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SOUTHERN COMPANY

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50-366 50-364 50-425

NL-14-0740

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Edwin I. Hatch Nuclear Plant
Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Annual Radiological Environmental Operating Reports for 2013

Ladies and Gentlemen:

In accordance with section 5.6.2 of the referenced plants' Technical Specifications, Southern Nuclear Operating Company hereby submits the Annual Radiological Environmental Operating Reports for 2013.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Respectfully submitted,

C. R. Pierce

C. R. Pierce
Regulatory Affairs Director

CRP/gls/lac

IE25
NRR

Enclosures: 1. Hatch Annual Radiological Environmental Operating Report for 2013
2. Farley Annual Radiological Environmental Operating Report for 2013
3. Vogtle Annual Radiological Environmental Operating Report for 2013

cc: Southern Nuclear Operating Company
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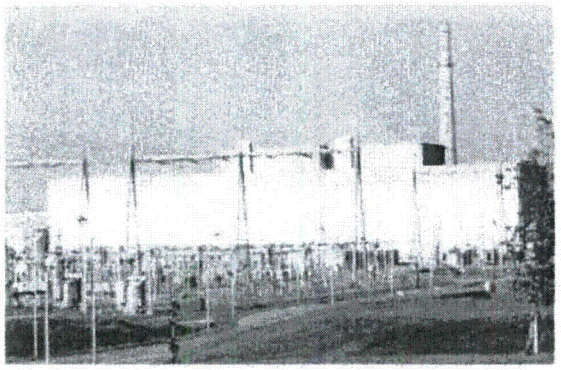
Edwin I. Hatch Nuclear Plant
Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Annual Radiological Environmental Operating Reports for 2013

Enclosure 1

Hatch Annual Radiological Environmental Operating Report for 2013

EDWIN I. HATCH NUCLEAR PLANT
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2013



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LIST OF ACRONYMS

Acronyms presented in alphabetical order.

Acronym	Definition
AREOR	Annual Radiological Environmental Operating Report
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Georgia Power Company Environmental Laboratory
EPA	Environmental Protection Agency
GPC	Georgia Power Company
HNP	Edwin I. Hatch Nuclear Plant
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
NA	Not Applicable
NDM	No Detectable Measurement(s)
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
OSL	Optically Stimulated Luminescence
Po	Preoperation
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
TLD	Thermoluminescent Dosimeter
TS	Technical Specification

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) is conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). REMP activities for 2012 are reported herein in accordance with Technical Specification (TS) 5.6.2 and ODCM 7.1.

The objectives of the REMP are to:

1) Determine the levels of radiation and the concentrations of radioactivity in the environs and:

2) Assess the radiological impact (if any) to the environment due to the operation of the Edwin I. Hatch Nuclear Plant (HNP).

The assessments include comparisons between the results of analyses of samples obtained at locations where radiological levels are not expected to be affected by plant operation (control stations), areas of higher population (community stations), and at locations where radiological levels are more likely to be affected by plant operation (indicator stations), as well as comparisons between preoperational and operational sample results.

The pre-operational stage of the REMP began with the establishment and activation of the environmental monitoring stations in January of 1972. The operational stage of the REMP began on September 12, 1974 with Unit 1 initial criticality.

A description of the REMP is provided in Section 2 of this report. An annual summary of the results of the analyses of REMP samples is provided in Section 3. A discussion of the results, including assessments of any radiological impacts upon the environment, and the results of the land use census and the river survey, are provided in Section 4. The results of the Interlaboratory Comparison Program (ICP) are provided in Section 5. Conclusions are provided in Section 6.

2.0 REMP DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table summarizes the program as it meets the requirements outlined in ODCM Table 4-1. It details the sample types to be collected and the analyses to be performed in order to monitor the airborne, direct radiation, waterborne and ingestion pathways, and also delineates the collection and analysis frequencies. The sampling locations (stations) specified by ODCM 4.2 are depicted on maps in Figures 2-1 and 2-2. These maps are keyed to Table 2-2 which delineates the direction and distance of each station from the main stack.

REMP samples are collected by Georgia Power Company's (GPC) Environmental Laboratory (EL) personnel. The same lab performs all the laboratory analyses at their headquarters in Smyrna, Georgia.

TABLE 2-1 (SHEET 1 of 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
1. Airborne Radioiodine and Particulates	6	Continuous operation of the sampler with sample collection weekly.	Radioiodine canister: I-131 analysis, weekly. Particulate sampler: analyze for gross beta radioactivity not less than 24 hours following filter change, weekly; perform gamma isotopic analysis on affected sample when gross beta activity is 10 times the yearly mean of control samples; and composite (by location) for gamma isotopic analysis, quarterly.
2. Direct Radiation	37	Quarterly	Gamma dose, quarterly.
3. Ingestion			
Milk (a)	1	Semimonthly	Gamma isotopic and I-131 analysis, semimonthly.
Fish or Clams (b)	2	Semiannually	Gamma isotopic analysis on edible portions, semiannually.
Grass or Leafy Vegetation	3	Monthly during growing season.	Gamma isotopic analysis, monthly. (c)
4. Waterborne			
Surface	2	Composite sample collected monthly. (d)	Gamma isotopic analysis, monthly. Composite (by location) for tritium analysis, quarterly.
Sediment	2	Semiannually.	Gamma isotopic analysis, semiannually.

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TABLE 2-1 (SHEET 2 of 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
Drinking Water (e & f)	One sample of river water near the intake and one sample of finished water from each of one to three of the nearest water supplies which could be affected by HNP discharges.	River water collected near the intake will be a composite sample; the finished water will be a grab sample. These samples will be collected monthly unless the calculated dose due to consumption of the water is greater than 1 mrem/year; then the collection will be biweekly. The collections may revert to monthly should the calculated doses become less than 1 mrem/year.	I-131 analysis on each sample when biweekly collections are required. Gross beta and gamma isotopic analysis on each sample; composite (by location) for tritium analysis, quarterly.
Groundwater	See Table 2-3, Figure 2-3, and Figure 2-4	Quarterly sample; pump used to sample GW wells; grab sample from yard drains and ponds	Tritium, gamma isotopic, and field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity) of each sample quarterly; Hard to detect radionuclides as necessary based on results of tritium and gamma

2-3

TABLE 2-1 (SHEET 3 of 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Notes:

a. Up to three sampling locations within 5 miles and in different sectors will be used as available. In addition, one or more control locations beyond 10 miles will be used.

b. Commercially or recreationally important fish may be sampled. Clams may be sampled if difficulties are encountered in obtaining sufficient fish samples.

c. If gamma isotopic analysis is not sensitive enough to meet the Minimum Detectable Concentration (MDC), a separate analysis for I-131 may be performed.

d. The composite samples shall be composed of a series of aliquots collected at intervals not exceeding a few hours.

e. If it is found that river water downstream of the plant is used for drinking, drinking water samples will be collected and analyzed as specified herein.

f. A survey shall be conducted annually at least 50 river miles downstream of the plant to identify those who use water from the Altamaha River for drinking.

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TABLE 2-2 (SHEET 1 of 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction (a)	Distance (a) (miles)	Sample Type
064	Other	Roadside Park	WNW	0.8	Direct Rad
101	Indicator	Inner Ring	N	1.9	Direct Rad
102	Indicator	Inner Ring	NNE	2.5	Direct Rad
103	Indicator	Inner Ring	NE	1.8	Airborne Rad Direct Rad
104	Indicator	Inner Ring	ENE	1.6	Direct Rad
105	Indicator	Inner Ring	E	3.7	Direct Rad
106	Indicator	Inner Ring	ESE	1.1	Direct Rad Vegetation
107	Indicator	Inner Ring	SE	1.2	Airborne Rad Direct Rad
108	Indicator	Inner Ring	SSE	1.6	Direct Rad
109	Indicator	Inner Ring	S	0.9	Direct Rad
110	Indicator	Inner Ring	SSW	1.0	Direct Rad
111	Indicator	Inner Ring	SW	0.9	Direct Rad
112	Indicator	Inner Ring	WSW	1.0	Airborne Rad Direct Rad Vegetation
113	Indicator	Inner Ring	W	1.1	Direct Rad
114	Indicator	Inner Ring	WNW	1.2	Direct Rad
115	Indicator	Inner Ring	NW	1.1	Direct Rad
116	Indicator	Inner Ring	NNW	1.6	Airborne Rad Direct Rad
170	Control	Upstream	WNW	(c)	River (b)
172	Indicator	Downstream	E	(c)	River (b)
201	Other	Outer Ring	N	5.0	Direct Rad
202	Other	Outer Ring	NNE	4.9	Direct Rad
203	Other	Outer Ring	NE	5.0	Direct Rad
204	Other	Outer Ring	ENE	5.0	Direct Rad
205	Other	Outer Ring	E	7.2	Direct Rad
206	Other	Outer Ring	ESE	4.8	Direct Rad
207	Other	Outer Ring	SE	4.3	Direct Rad
208	Other	Outer Ring	SSE	4.8	Direct Rad
209	Other	Outer Ring	S	4.4	Direct Rad
210	Other	Outer Ring	SSW	4.3	Direct Rad
211	Other	Outer Ring	SW	4.7	Direct Rad
212	Other	Outer Ring	WSW	4.4	Direct Rad
213	Other	Outer Ring	W	4.3	Direct Rad
214	Other	Outer Ring	WNW	5.4	Direct Rad
215	Other	Outer Ring	NW	4.4	Direct Rad
216	Other	Outer Ring	NNW	4.8	Direct Rad
301	Other	Toombs Central School	N	8.0	Direct Rad
304	Control	State Prison	ENE	11.2	Airborne Rad Direct Rad
304	Control	State Prison	ENE	10.3	Milk
309	Control	Baxley Substation	S	10.0	Airborne Rad Direct Rad
416	Control	Emergency News Center	NNW	21.0	Direct Rad Vegetation

TABLE 2-2 (SHEET 2 of 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Notes:

a. Direction and distance are determined from the main stack.

b. River (fish or clams, shoreline sediment, and surface water)

c. Station 170 is located approximately 0.6 river miles upstream of the intake structure for river water, 1.1 river miles for sediment and clams, and 1.5 river miles for fish.

   Station 172 is located approximately 3.0 river miles downstream of the discharge structure for river water, sediment and clams, and 1.7 river miles for fish.

   The locations from which river water and sediment may be taken can be sharply defined. However, the sampling locations for clams often have to be extended over a wide area to obtain a sufficient quantity. High water adds to the difficulty in obtaining clam samples and may also make an otherwise suitable location for sediment sampling unavailable. A stretch of the river of a few miles or so is generally needed to obtain adequate fish samples. The mile locations given above represent approximations of the locations where samples are collected.

TABLE 2-3

GROUNDWATER MONITORING LOCATIONS

WELL	DEPTH (ft)	MONITORING PURPOSE
R1	82.9	Confined Aquifer Upgradient
R2	82.7	Confined Aquifer Near Diesel Generator Bldg.
R3	89.2	Confined Aquifer Near CST-1
R4	41	Dilution Line Near River Water Discharge Structure
R5	33.6	Between Subsurface Drain Lines Downgradient
R6	38.2	Between Subsurface Drain Lines Downgradient
NW2A	27	Water Table Near CST-2 Inside of Subsurface Drain
NW2B	27	Water Table Outside of Subsurface Drain
NW3A	26.5	Water Table Inside of Subsurface Drain
NW3B	25.3	Water Table Outside of Subsurface Drain
NW4A	27	Water Table Upgradient Inside of Subsurface Drain
NW5A	26.7	Water Table Upgradient Inside of Subsurface Drain
NW5B	26.3	Water Table Upgradient Outside of Subsurface Drain
NW6	27	Water Table Near Diesel Generator Bldg.
NW8	23	Water Table Near Diesel Generator Bldg.
NW9	26.1	Water Table Downgradient Inside of Subsurface Drain
NW10	26.2	Water Table Near CST-2
T2	21.9	Water Table Near Recombiner Bldg.
T3	18	Water Table Near Turbine Bldg.
T7	21.4	Water Table Near Diesel Generator Bldg.
T10	18.8	Water Table Near CST-1
T12	23.2	Water Table Near CST-1
T15	27.4	Water Table Near CST-1
P15A*	74.5	Confined Aquifer Near Turbine Bldg.
P15B	18	Water Table Near Turbine Bldg.
P17A*	77	Confined Aquifer Near Diesel Generator Bldg.
P17B	14.8	Water Table Near Diesel Generator Bldg.
Deep Well 1	680	Backup Supply for Potable Water (infrequently used)
Deep Well 2	711	Plant Potable Water Supply
Deep Well 3	710	Potable Water Supply – Rec. Center, Firing Range, and Garage

*Used for water level only

3.0 RESULTS SUMMARY

In accordance with ODCM 7.1.2.1, the summarized and tabulated results for all of the regular samples collected for the year at the designated indicator and control stations are presented in Table 3-1. The format of Table 3-1 is similar to Table 3 of the Nuclear Regulatory Commission (NRC) Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program", Revision 1, November 1979. Since no naturally occurring radionuclides were found in the plant's effluent releases, only man-made radionuclides are reported as permitted by ODCM 7.1.2.1. Results for samples collected at locations other than control or indicator stations are discussed in Section 4 under the particular sample type.

TABLE 3-1 (SHEET 1 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Other Stations(g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Airborne Particulates (fCi/m3)	Gross Beta 312	10	21.3 5.3-47.7 (208/208)	Station 112 Inner Ring 1 mile WSW	22.1 7.3-47.7 (52/52)	NA	20.3 4.2-44.4 (104/104)
	Gamma Isotopic 24						
	Cs-134	50	NDM (c)		NDM		NDM
	Cs-137	60	NDM		NDM		NDM
Airborne Radioiodine (fCi/m3)	I-131 312	70	NDM		NDM	NA	NDM
Direct Radiation (mR/91 days)	Gamma Dose 148	NA (d)	12.7 9.5-17.7 (64/64)	Station 214 Outer Ring 5.4 miles WNW	16.5 15.8-18.3 (4/4)	12.4 8.8-18.3 (72/72)	10.2 1.3-14.4 (12/12)
Milk (pCi/l)	Gamma Isotopic 24						
	Cs-134	15	NA		NDM	NA	NDM
	Cs-137	18	NA		NDM		NDM
	Ba-140	60	NA		NDM		NDM
	La-140	15	NA		NDM		NDM
	I-131 24	1	NA		NDM		NDM

TABLE 3-1 (SHEET 2 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Control Locations Mean (b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)	
Vegetation (pCi/kg-wet)	Gamma Isotopic 36					
	I-131	60	NDM		NDM	NDM
	Cs-134	60	NDM		NDM	NDM
	Cs-137	80	95.0 20.7-455 (12/24)	Station 106 Inner Ring 1.1 miles ESE	120.9 20.7-455 (8/12)	NDM
River Water (pCi/l)	Gamma Isotopic 24					
	Mn-54	15	NDM		NDM	NDM
	Fe-59	30	NDM		NDM	NDM
	Co-58	15	NDM		NDM	NDM
	Co-60	15	NDM		NDM	NDM
	Zn-65	30	NDM		NDM	NDM
	Zr-95	30	NDM		NDM	NDM
	Nb-95	15	NDM		NDM	NDM
	I-131	15 (e)	NDM		NDM	NDM
	Cs-134	15	NDM		NDM	NDM
	Cs-137	18	NDM		NDM	NDM
	Ba-140	60	NDM		NDM	NDM
	La-140	15	NDM		NDM	NDM
	Tritium 8	3000 (f)	147 32-364 (4/4)	Station 170 Upstream 0.6 miles from intake	164 64-240 (4/4)	164 64-240 (4/4)

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TABLE 3-1 (SHEET 3 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Control Locations Mean (b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)	
Fish (pCi/kg-wet)	Gamma Isotopic 8					
	Mn-54	130	NDM		NDM	NDM
	Fe-59	260	NDM		NDM	NDM
	Co-58	130	NDM		NDM	NDM
	Co-60	130	NDM		NDM	NDM
	Zn-65	260	NDM		NDM	NDM
	Cs-134	130	NDM		NDM	NDM
	Cs-137	150	11.0 (1/4)	Station 170 Upstream WNW 1.5 miles from Intake	12.7 9.2-18.4 (3/4)	12.7 9.2-18.4 (3/4)
Sediment (pCi/kg-dry)	Gamma Isotopic 2					
	Cs-134	150	NDM		NDM	NDM
	Cs-137	180	55.9 46.8-65.0 (2/2)	Station 170 Upstream WNW 1.1 miles from Intake	91.7 (1/2)	56.2 (1/2)

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TABLE 3-1 (SHEET 4 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

NOTATIONS

a. The MDC is defined in ODCM 10.1. Except as noted otherwise, the values listed in this column are the detection capabilities required by ODCM Table 4-3. The values listed in this column are a priori (before the fact) MDCs. In practice, the a posteriori (after the fact) MDCs are generally lower than the values listed. Any a posteriori MDC greater than the value listed in this column is discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at specified locations that are detectable is placed in parenthesis.

c. No Detectable Measurement(s).

d. Not Applicable.

e. If a drinking water pathway were to exist, a MDC of 1 pCi/l would have been used (see Table 4-1 of this report).

f. If a drinking water pathway were to exist, a MDC of 2000 pCi/l would have been used (see Table 4-1 of this report).

g. "Other" stations, identified in the "station type" column of Table 2-2, include community and special stations.

4.0 DISCUSSION OF RESULTS

Included in this section are evaluations of the laboratory results for the various sample types. The Minimum Detectable Difference (MDD) compares the lowest significant difference between a control station and an indicator station, or the control station and the community station, that can be determined statistically at the 99% Confidence Level (CL). To calculate MDD an F-test was applied to determine the variability in the data. Once the data was determined to be paired or unpaired, the appropriate t-test (Student's or Welch's) and MDD formulas were applied. MDD as a tool can quantify plant Farley's impact on the surrounding environment, while the t-test adds greater statistical confidence in the data set. A difference in mean values which was less than the MDD was considered to be statistically indiscernible.

The 2013 results were compared with past results, including those obtained during pre-operation. As appropriate, results were compared with their Minimum Detectable Concentrations (MDC) and Reporting Levels (RL) which are listed in Tables 4-1 and 4-2 of this report, respectively. The required MDCs were achieved during laboratory sample analyses. Any anomalous results are explained within this report.

Results of interest are graphed to show historical trends. The data points are tabulated and included in this report. The points plotted and provided in the tables represent mean values of only detectable results. Periods for which no detectable measurements (NDM) were observed or periods for which values were not applicable (e.g., milk indicator, etc.) are plotted as 0's and listed in the tables as NDM.

Atmospheric nuclear weapons tests from the mid-1940s through 1980 distributed man-made nuclides around the world. The most recent atmospheric tests in the 1970s and in 1980 had a significant impact upon the radiological concentrations found in the environment prior to and during preoperation, and the earlier years of operation. Some long lived radionuclides, such as Cs-137, continue to be detectable.

Significant upward trends also followed the Chernobyl incident which began on April 26, 1986.

The most significant nuclear event since Chernobyl occurred at Fukushima Daiichi Nuclear Power Plant after the Tohoku earthquake and tsunami on March 11, 2011. Equipment failures and nuclear meltdowns resulted in radioactivity being released into the atmosphere. Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster.

In accordance with ODCM 4.1.1.2.1, deviations from the required sampling schedule are permitted, if samples are unobtainable due to hazardous conditions, unavailability, inclement weather, equipment malfunction or other just reasons. Deviations from conducting the REMP as described in Table 2-1 are summarized in Table 4-3 along with their causes and resolutions.

All results were tested for conformance to Chauvenet's criterion (G. D. Chase and J. L. Rabinowitz, Principles of Radioisotope Methodology, Burgess Publishing Company, 1962, pages 87-90) to identify values which differed from the mean of a set by a statistically significant amount. Identified outliers were investigated to

determine the reason(s) for the difference. If equipment malfunction or other valid physical reasons were identified as causing the variation, the anomalous result was excluded from the data set as non-representative. No data were excluded exclusively for failing Chauvenet's criterion. Data exclusions and deviations are discussed in table 4-3.

Table 4-1

Minimum Detectable Concentrations (MDC)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)	Sediment (pCi/kg-dry)
Gross Beta	4	10				
H-3	2000 (a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1 (b)	70		1	60	
Cs-134	15	50	130	15	60	150
Cs-137	18	60	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) If no drinking water pathway exists, a value of 3000 pCi/l may be used.

(b) If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 4-2

Reporting Levels (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)
H-3	20,000 (a)				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-95	400				
Nb-95	700				
I-131	2 (b)	900		3	100
Cs-134	30	10,000	1000	60	1000
Cs-137	50	20,000	2000	70	2000
Ba-140	200			300	
La-140	100			400	

(a) This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.

(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 4-3
ANOMALIES AND DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLES	ANOMALY (A)* OR DEVIATION (D)**	CAUSE	RESOLUTION
First Quarter 2013 CR 717669/TE 718816	GWPP Ground Water Monitoring wells T2, P15A, P17A	(D) Samples not obtained	Guidance stands that not all monitoring locations need to be sampled in ODCM	The guidance will be updated to require sampling of stated wells in the ODCM per NEI 07-07
Second Quarter 2013 CR 717669/TE 718816	GWPP Ground Water Monitoring wells T2, P15A	(D) Samples not obtained	Guidance stands that not all monitoring locations need to be sampled in ODCM	The guidance will be updated to require sampling of stated wells in the ODCM per NEI 07-07
April 2013 CR 729541/TE733127	172 - Surface Water	(A) Composite sampling was not continuous and did not cover the entire month.	Composite sampler intake screen was clogged and filled with sand	Composite sampler intake screen was cleaned and reset A grab sample was obtained per Georgia Power Sampling Procedure to fulfill sampling requirement
May 2013 CR 729541/TE733127	172 - Surface Water	(A) Composite sampling was not continuous and did not cover the entire month.	Composite sampler intake screen was clogged and filled with sand	Composite sampler intake screen was cleaned and reset A grab sample was obtained per Georgia Power Sampling Procedure to fulfill sampling requirement

* An anomaly is considered a non-standard sample that still meets sampling criteria outlined in Southern Nuclear and Georgia Power Labs procedures.
** A deviation is a sample result that is not recorded due to not meeting scheduling and/or procedural requirements as outlined by Southern Nuclear and Georgia Power Labs

4.1 Land Use Census and River Survey

In accordance with ODCM 4.1.2, a land use census was conducted on September 16, 2013, to determine the locations of the nearest permanent residence and milk animal in each of the 16 compass sectors within a distance of 5 miles, and the locations of all milk animals within a distance of 3 miles. A milk animal is defined as a cow or goat producing milk for human consumption. The locations of beef cattle and of gardens greater than 500 square feet producing broad leaf vegetation were also included in the census. The census results are tabulated in the Table 4.1-1.

Table 4.1-1

LAND USE CENSUS RESULTS

Distance in Miles to Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL	BEEF CATTLE	GARDEN
N	2.8	None	None	3.6
NNE	2.9	None	None	None
NE	3.3	None	3.4	4.8
ENE	4.2	None	4.1	None
E	3.0	None	None	None
ESE	3.8	None	None	None
SE	1.8	None	2.4	None
SSE	2.0	None	3.6	3.6
S	1.1	None	2.5	1.0
SSW	1.3	None	2.0	3.0
SW	1.1	None	4.7	1.6
WSW	1.0	None	3.6	None
W	1.1	None	2.7	None
WNW	1.1	None	None	None
NW	3.6	None	4.5	None
NNW	1.8	None	2.8	2.9

ODCM 4.1.2.2.1 requires a new controlling receptor to be identified if the land use census identifies a location that yields a calculated receptor dose greater than the one in current use. No change in the controlling receptor was required as a result of the 2013 land use census. The current controlling receptor as described in ODCM Table 3-7 is a child in the WSW Sector at 1.0 miles.

ODCM 4.1.2.2.2 requires that whenever the land use census identifies a location which would yield a calculated dose (via the same ingestion pathway) 20% greater than that of a current indicator station, the new location must become a REMP station (if samples are available). The 2013land use census did not identify a garden which yielded a calculated dose 20% greater than that for any of the current indicator stations for vegetation.

As required by Note f of Table 2-1, the annual survey of the Altamaha River for approximately 50 miles downstream of the plant was conducted on September 16, 2013 to identify any withdrawal of river water for drinking purposes. No sources of withdrawal for drinking water were identified. Information obtained from the Georgia Department of Natural Resources in September 2013 indicated that no surface water withdrawal permits for agricultural or drinking purposes had been issued for this stretch of the Altamaha River between the 2012 survey and the 2013 survey. Should it be determined that river water downstream of the plant is being used for drinking, the sampling and analysis requirements for drinking water found in Table 2-1 would be implemented. Irrigation equipment was identified at Clarke's Farm about ¾ mile downstream of Station #172 river water sampling station. The equipment is potentially used to irrigate peanuts. Mr. Clarke was contacted in September of 2013 and he stated that he has not irrigated his peanut crop from the river in 2013. Should it be determined that river water downstream of the plant is being used for irrigation, additional sampling and analysis of the crop would be implemented.

4.2 Airborne

As indicated in Table 2-2 and Figures 2-1 and 2-2, airborne particulates and airborne radioiodine are collected at 4 indicator stations (Nos. 103, 107, 112 and 116) which encircle the plant near the site periphery and at 2 control stations (Nos. 304 and 309) which are located approximately 10 miles from the main stack. At each location, air is continuously drawn through a glass fiber filter and a charcoal canister placed in series to collect airborne particulates and radioiodine. The filters and canisters are collected weekly and analyzed for gross beta and I-131, respectively. A gamma isotopic analysis is performed quarterly on a composite of the filters for each station.

The 2013 annual average weekly gross beta concentration of 21.3 fCi/m^3 for the indicator stations was 1.0 fCi/m^3 more than that for the control stations (20.3 fCi/m^3). This difference is not statistically discernible, since it is less than the calculated MDD of 2.8 fCi/m^3. Figure 4.2-1 and Table 4.2-1 provide the historical trending of the average weekly gross beta concentrations in air. In general, there is close agreement between the results for the indicator and control stations. This close agreement supports the position that the plant is not contributing significantly to the gross beta concentration in air.

Figure 4.2-1

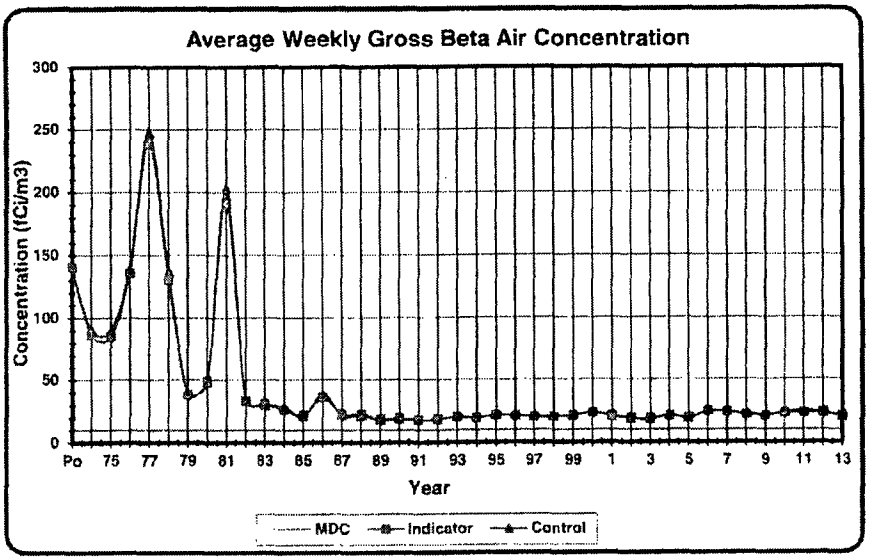


Table 4.2-1
Average Weekly Gross Beta Air Concentration

Year	Indicator (fCi/m3)	Control (fCi/m3)
Pre-op	140	140
1974	87	90
1975	85	90
1976	135	139
1977	239	247
1978	130	137
1979	38	39
1980	49	48
1981	191	203
1982	33	34
1983	31	30
1984	26	28
1985	22	21
1986	36	38
1987	23	22
1988	22.6	21.7
1989	18.4	17.8
1990	19.3	18.7
1991	18.1	18
1992	18.5	18.4
1993	20.4	20.7
1994	19.5	19.7
1995	21.7	21.7
1996	21.3	21.4
1997	20.3	20.7
1998	20.0	20.5
1999	21.3	21.3
2000	23.6	23.9
2001	21.5	21.0
2002	19.3	19.2
2003	18.8	18.2
2004	21.4	21.3
2005	19.7	19.4
2006	24.9	24.7
2007	24.4	24.3
2008	21.8	22.5
2009	21.2	21.4
2010	23.1	24.0
2011	23.5	25.1

Table 4.2-1 (continued)
Average Weekly Gross Beta Air Concentration

Year	Indicator (fCi/m3)	Control (fCi/m3)
2012	23.7	22.7
2013	21.3	20.3

During 2013, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the particulate air filters. During preoperation and during operation through 1986, a number of fission products and activation products were detected. These were generally attributed to the nuclear weapons tests and to the Chernobyl incident. On only one occasion since 1986, has a man-made radionuclide been detected in a quarterly composite. A small amount of Cs-137 (1.7 fCi/m3) was identified in the first quarter of 1991 at Station 304. The MDC and RL for Cs-137 in air are 60 and 20.000 fCi/m3, respectively. The historical trending of the average annual concentrations of detectable Cs-137 from quarterly air filter composites is provided in Figure 4.2-2 and Table 4.2-2.

Figure 4.2-2

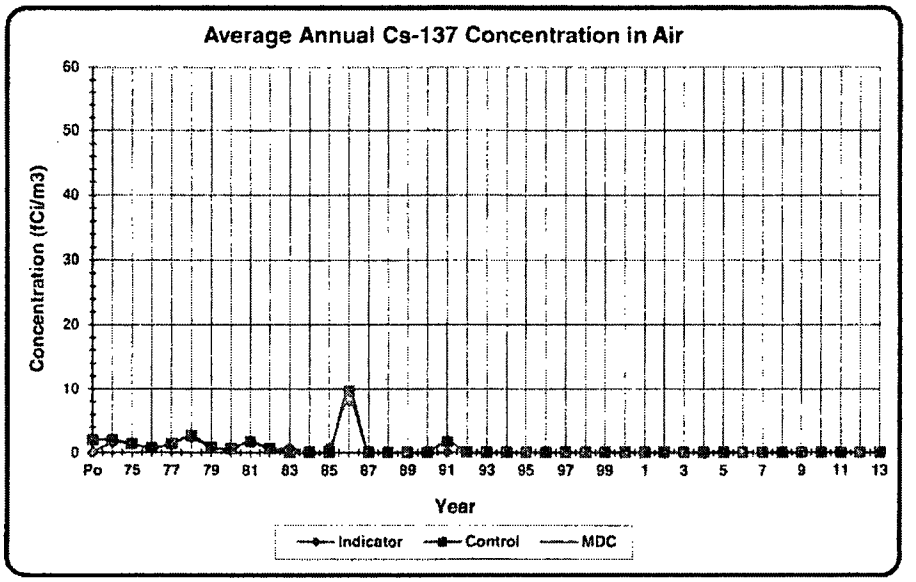


Table 4.2-2
Average Annual Cs-137 Concentration In Air

Year	Indicator (fCi/m3)	Control (fCi/m3)
Pre-op	NDM	2.0
1974	1.5	2.0
1975	1.4	1.4
1976	0.6	0.7
1977	1.5	1.4
1978	2.3	2.6
1979	0.8	0.8
1980	0.4	0.6
1981	1.8	1.7
1982	0.5	0.6
1983	0.7	NDM
1984	NDM	NDM
1985	0.7	NDM
1986	8.1	9.6
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	1.7
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM

Table 4.2-2 (continued)
Average Annual Cs-137 Concentration In Air

Year	Indicator (fCi/m3)	Control (fCi/m3)
2012	NDM	NDM
2013	NDM	NDM

During 1976, 1977, and 1978, positive levels of I-131 were found in nearly all of the samples collected for a period of a few weeks following atmospheric nuclear weapons tests. Some of the concentrations were approximately 70 fCi/m^3. In 1986, the same phenomenon occurred following the Chernobyl incident. The nuclear accident at Fukushima Daiichi Nuclear Power Plant which occurred after the Tohoku earthquake and tsunami on March 11, 2011 released radioactivity into the environment that was detected in Hatch air samples. Iodine-131 was detected in air cartridges after Fukushima but no changes in gross beta activity were seen during that same time period. Iodine-131 ranging from 16.9-106.9 fCi/m^3 was seen at Hatch for several weeks following the Fukushima accident. The highest airborne I-131 concentration found to date in an individual charcoal canister was 217 fCi/m^3 in 1977. The MDC and RL for airborne I-131 are 70 fCi/m^3 and 900 fCi/m^3, respectively.

There were no air sampling REMP deviations that occurred in 2013.

4.3 Direct Radiation

In 2013, direct (external) radiation was measured with Landauer InLight optically stimulated luminescent (OSL) dosimeters. The OSL dosimeters replaced Panasonic thermoluminescent dosimeters (TLDs). The Panasonic system was retired at the end of 2010 due to the inability to keep the aging badge readers operating reliably. Similar to the TLD protocol of the past, two OSL badges are placed at each station. Each badge contains two elements composed of aluminum oxide crystals with carbon impurity. The gamma dose at each station is based upon the average readings of the elements from the two badges. The two badges for each station are placed in thin plastic bags for protection from moisture while in the field. The badges are nominally exposed for periods of a quarter of a year (91 days). An inspection is performed near mid-quarter for offsite badges to assure that the badges are on-station and to replace any missing or damaged badges.

Two direct radiation stations are established in each of the 16 compass sectors around the plant to form 2 concentric rings, as seen in Figures 2-1 and 2-2. The two ring configuration of stations was established in 1980, in accordance with NRC Branch Technical Position "An Acceptable Radiological Environmental Monitoring Program", Revision 1, 1979. With the exception of the East sector, the inner ring stations (Nos. 101 through 116) are located near the site boundary and the outer ring stations (Nos. 201 through 216) are located at distances of 4 to 5 miles from the plant. The stations in the East sector are a few miles farther out than the other stations in their respective rings due to large swamps making normal access extremely difficult. The 16 stations forming the inner ring are designated as the indicator stations. The 3 control stations (Nos. 304, 309 and 416) are located 10 miles or more from the plant. Stations 064 and 301 monitor special interest areas. Station 064 is located at the onsite roadside park, while Station 301 is located near the Toombs Central School. Station 210, in the outer ring, is located near the Altamaha School (the only other nearby school).

As provided in Table 3-1, the average quarterly exposure measured at the indicator stations (inner ring) during 2013 was 12.7 mR. At the control stations, the average quarterly exposure was 10.2 mR. This difference (2.5 mR) is statistically discernible since it is more than the MDD of 1.4 mR. However the low concentrations, small difference, and historical trends do not indicate environmental impact.

The quarterly exposures acquired at the outer ring stations during 2013 ranged from 8.8 to 18.3 mR, with an average of 12.4 mR. The average for the outer ring stations was 2.2 mR more than the average for the control stations. Since the results for the outer ring stations and the control stations differ by more than the MDD of 1.4 mR, there is discernible difference between outer ring and control station results for 2013. However the low concentrations, small difference, and historical trends do not indicate environmental impact.

The historical trending of the average quarterly exposures for the indicator inner ring, outer ring, and the control stations are plotted in Figure 4.3-1 and listed in Table 4.3-1. The decrease between 1991 and 1992 values is attributed to a change in TLDs from Teledyne to Panasonic. It should be noted however that the differences between indicator and control and outer ring values did not change.

During 2010, OSL badges were co-located on station with the TLD badges. In 2011, only the OSL badges were placed at each station. Following the change to only OSL badges, the differences between indicator, control, and community locations has been consistent with previous years. An increase noted in 2010 reflects issues (especially during 2nd Qtr) with the aging Panasonic TLD reader. The close agreement between the station groups supports the position that the plant is not contributing significantly to direct radiation in the environment.

Figure 4.3-1

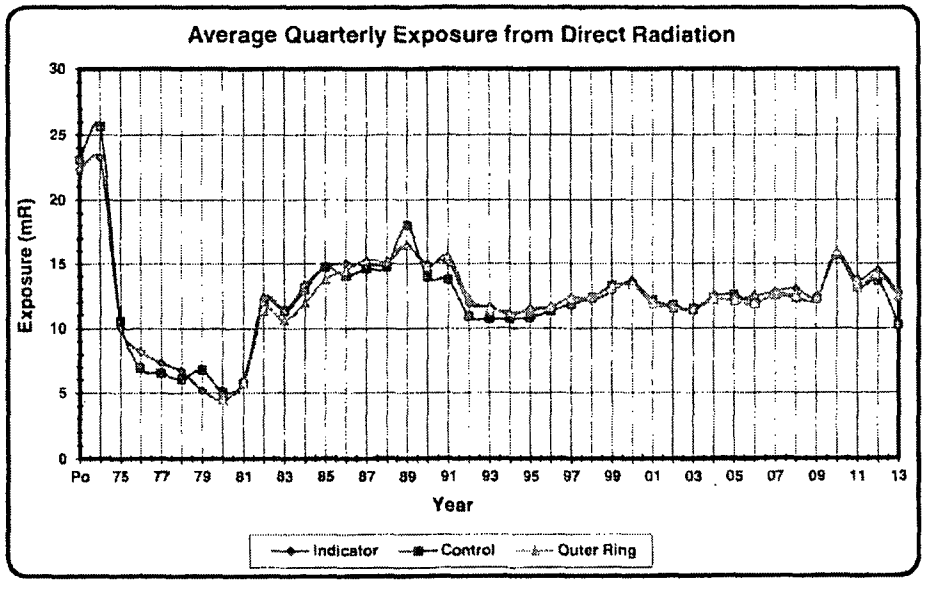


Table 4.3-1
Average Quarterly Exposure from Direct Radiation

Year	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	22.3	23	NA
1974	23.2	25.6	NA
1975	10.0	10.5	NA
1976	8.18	6.9	NA
1977	7.31	6.52	NA
1978	6.67	6.01	NA
1979	5.16	6.77	NA
1980	4.44	5.04	4.42
1981	5.9	5.7	5.7
1982	12.3	12	11.3
1983	11.4	11.3	10.6
1984	13.3	12.9	11.9
1985	14.7	14.7	13.7
1986	15	14	14.5
1987	14.9	14.6	15.3
1988	15.0	14.7	15.2
1989	16.4	18.0	16.5
1990	14.9	13.9	14.7
1991	15.1	13.7	15.6
1992	11.9	10.9	12.3
1993	11.6	10.7	11.5
1994	11	10.7	11.2
1995	11.5	10.8	11.3
1996	11.6	11.3	11.6
1997	12.3	11.8	12.3
1998	12.1	12.3	12.3
1999	12.8	13.2	13.0
2000	13.6	13.3	13.3
2001	12.0	12.1	11.8
2002	11.7	11.7	11.5
2003	11.4	11.4	11.4
2004	12.2	12.4	12.2
2005	12.1	12.5	12.0
2006	12.4	11.9	11.8
2007	12.8	12.5	12.6
2008	13.0	12.3	12.4
2009	12.4	12.2	12.2
2010	15.8	15.6	16.0
2011	13.7	13.1	13.1

Table 4.3-1 (continued)
Average Quarterly Exposure from Direct Radiation

Year	Indicator (mR)	Control (mR)	Outer Ring (mR)
2012	14.4	13.6	14.1
2013	12.7	10.2	12.4

The historical trending, since 1986, of the average quarterly exposures at the special interest areas is provided in Figure 4.3-2 and listed in Table 4.3-2. These exposures are within the range of those acquired at the other stations. They too, show that the plant is not contributing significantly to direct radiation at the special interest areas.

Figure 4.3-2

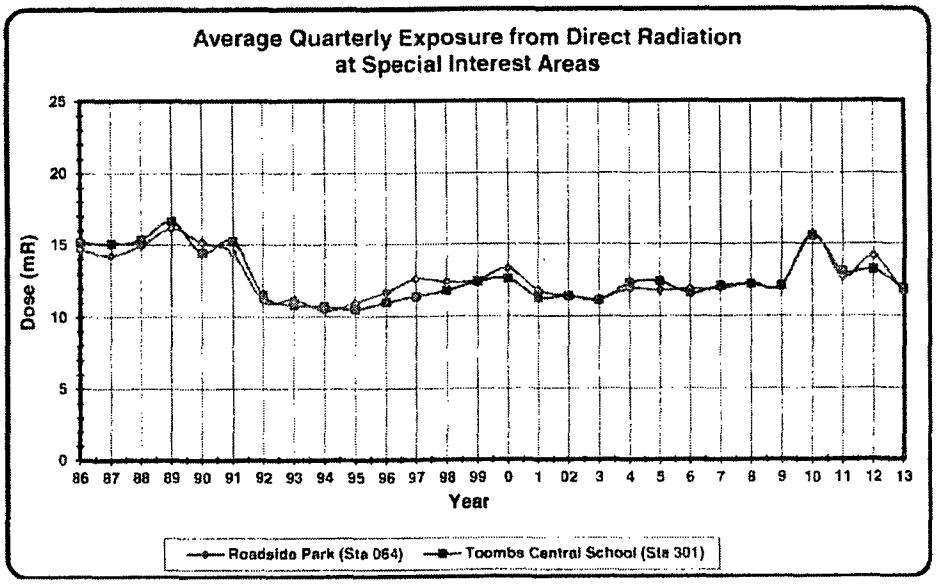


Table 4.3-2

Average Quarterly Exposure from Direct Radiation at Special Interest Areas

Period	Station 064 (mR)	Station 301 (mR)
1986	14.6	15.1
1987	14.2	15.0
1988	14.9	15.3
1989	16.1	16.6
1990	15.1	14.4
1991	14.4	15.2
1992	11.1	11.5
1993	11.2	10.8
1994	10.4	10.7
1995	11.0	10.5
1996	11.7	11.0
1997	12.6	11.4
1998	12.4	11.8
1999	12.5	12.4
2000	13.3	12.6
2001	11.8	11.3
2002	11.4	11.4
2003	11.2	11.1
2004	11.9	12.3
2005	11.8	12.4
2006	11.9	11.6
2007	11.9	12.1
2008	12.3	12.2
2009	12.1	12.1
2010	15.7	15.5
2011	12.7	13.1
2012	14.1	13.2
2013	11.6	11.9

Table 4-3 lists the REMP Program deviations that occurred in 2013. There were no deviations involving OSL dosimeters in 2013.

The standard deviation for the quarterly result for each Landauer OSL badge was subjected to a self imposed limit of 3.5. Previously with TLDs, this limit had been 1.4. However, the OSL readings varied more (between the two elements) than the TLD readings (between the three phosphors). This limit is calculated using a method developed by the American Society for Testing and Materials (ASTM) (ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976). The calculation is based upon the standard deviations obtained by the EL with the OSL badges during 2010. The limit serves as a flag to initiate an investigation. To be conservative, readings with a standard deviation greater or equal to 3.5 are excluded from the data set since the high standard deviation is interpreted as an indication of unacceptable variation in OSL dosimeter response. All of the dosimeters are read twice. The second read is not used unless the first read appears too variable. If both readings are above 3.5, an investigation is conducted to determine if there are true environmental differences in an OSL.

In 2013, the following OSL results were investigated because their standard deviations were greater than or equal to 3.5:

First Quarter	None
Second Quarter	None
Third Quarter	None
Fourth Quarter	None

No badges at any station were investigated for having a standard deviation greater than or equal to 3.5 in 2013

4.4 Milk

Milk samples are obtained twice each calendar month from Station 304 (the state prison dairy) which is a control station located more than 10 miles from the plant. Gamma isotopic and I-131 analyses are performed on each sample as specified in Tables 2-1 and 2-2. Since 1989, efforts to locate a reliable milk sample source within 5 miles of the plant have been unsuccessful.

During 2013, no man-made radionuclides were detected from the gamma isotopic analysis of the milk samples. Cesium-137 was found in most of the samples each year from 1978 (when this analysis became a requirement) through 1989. No other man-made radionuclides have been detected by this analysis.

The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively. The historical trending of the average annual detectable Cs-137 concentration in milk is provided in Figure 4.4-1 and Table 4.4-1.

Figure 4.4-1

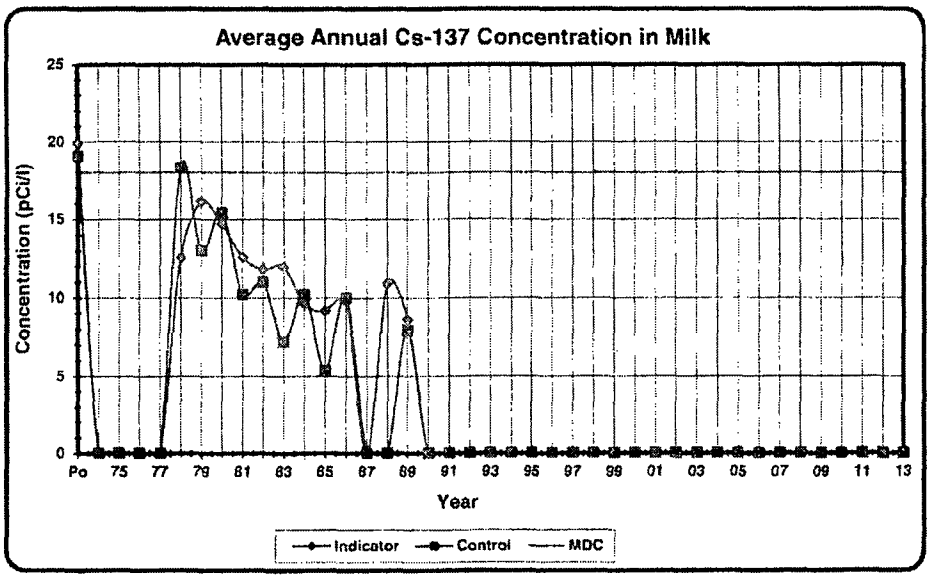


Table 4.4-1
Average Annual Cs-137 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	19.9	19.4
1974	NDM	NDM
1975	NDM	NDM
1976	NDM	NDM
1977	NDM	NDM
1978	12.1	18.3
1979	16.1	13
1980	14.7	15.4
1981	12.57	10.2
1982	11.8	11
1983	12	7.2
1984	9.6	10.2
1985	9.14	5.35
1986	9.8	10
1987	NDM	NDM
1988	10.9	NDM
1989	8.6	7.9
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM

Table 4.4-1 (continued)
Average Annual Cs-137 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
2012	NDM	NDM
2013	NDM	NDM

During 2013, I-131 was not detected in any of the milk samples. During preoperation, all readings were less than 2 pCi/l which was the allowed MDC at that time. Figure 4.4-2 and Table 4.4-2 provide the historical trending of the average annual detectable concentration of I-131 in milk. In 1988, a single reading of 0.32 pCi/l, which was believed to have resulted from a procedural deficiency, was reported. The MDC and RL for I-131 in milk are 1 and 3 pCi/l, respectively.

All the detectable results for Cs-137 and I-131 are attributed to fallout from the nuclear weapons tests and the Chernobyl incident.

Figure 4.4-2

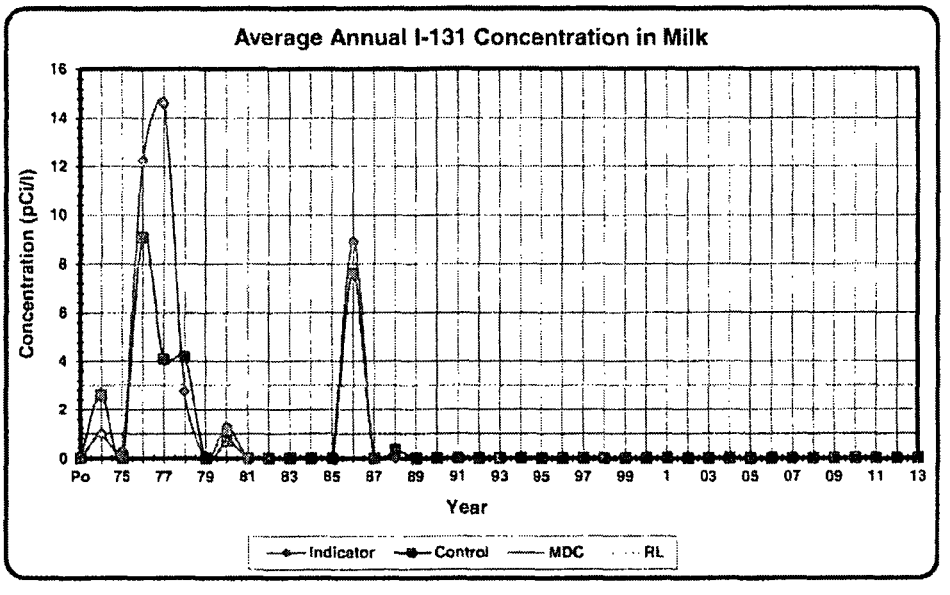


Table 4.4-2
Average Annual I-131 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	NDM	NDM
1974	0.98	2.6
1975	0.3	NDM
1976	12.23	9.1
1977	14.61	4.08
1978	2.72	4.18
1979	NDM	NDM
1980	1.26	0.69
1981	NDM	NDM
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	8.9	7.6
1987	NDM	NDM
1988	NDM	0.32
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM

Table 4.4-2 (continued)
Average Annual I-131 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
2012	NDM	NDM
2013	NDM	NDM

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly from two indicator stations near the site boundary (Nos. 106 and 112) and at one control station located about 21 miles from the plant (No. 416). Gamma isotopic analyses are performed on each sample. Gamma isotopic analysis on vegetation samples began in 1978 when the analysis became a TS requirement.

The results presented in Table 3-1 show that Cs-137 was the only man-made radionuclide detected in vegetation samples during 2013. Cesium-137 was detected in 12 samples of the 24 samples collected at the indicator stations. The average of the positive 12 samples was 95.0 pCi/kg-wet. Cesium-137 was detected in none of the 12 control station samples. Due to no positive results at the control station, MDD was not able to be used to evaluate the data. In 2011, the average Cs-137 seen at the indicator station was higher than it had been since the late 1980's. Fertilization of the area, resulting in soil disturbance could have accounted for the increase. However, the Cs-137 detected at indicator stations could potentially be attributed to plant effluents. In 2012, the Cs-137 values returned to historical range. Since 1986, Cs-137 has been the only man-made radionuclide found in vegetation samples. The MDC and RL for Cs-137 in vegetation samples are 80 pCi/kg-wet and 2000 pCi/kg-wet, respectively. The occasional presence of Cs-137 in vegetation samples is attributed primarily to fallout from nuclear weapons tests and the Chernobyl incident.

Figure 4.5-1 and Table 4.5-1 provide the historical trending of the average annual detectable Cs-137 concentration found in vegetation. Since 1978, the Cs-137 concentration has been on a decline, and since about 1989, generally occurring below the required MDC.

In March 2011, after the nuclear accident at Fukushima Daiichi Nuclear Power Plant, Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster. Iodine-131 was detected at Hatch in two of the three forage samples collected on 03/28/11 (after the Fukushima event), but not in any forage samples collected since that time. The range of I-131 values was 85.4 to 90.1 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively.

Figure 4.5-1

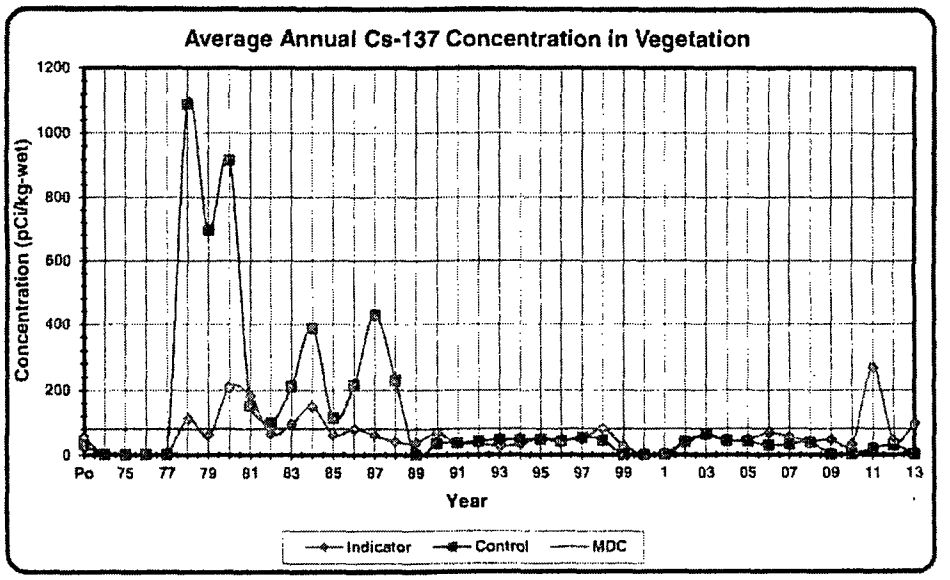

Average Annual Cs-137 Concentration in Vegetation
Concentration (pCi/kg-wet)
1200
1000
800
600
400
200
0
Pre-Op 75 77 79 81 83 85 87 89 91 93 95 97 99 1 03 05 07 09 11 13
Year
Indicator
Control
MDC

Table 4.5-1
Average Annual Cs-137 Concentration in Vegetation

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	55	30
1974	NDM	NDM
1975	NDM	NDM
1976	NDM	NDM
1977	NDM	NDM
1978	112	1089
1979	59	695
1980	208	916
1981	182	152
1982	65	99
1983	95	211
1984	149	388
1985	60.9	113.3
1986	80	215
1987	60	428
1988	40.1	228.8
1989	37	NDM
1990	66.7	34.5
1991	34.1	36.1
1992	35.2	41.3
1993	24.7	45.8
1994	32.2	46.6
1995	49.8	47.6
1996	47.2	41.1
1997	48.4	54.9
1998	81.4	44.1
1999	26.9	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	33.7	41.1
2003	61.0	62.8
2004	41.6	43.5
2005	47.7	39.8
2006	66.8	29.6
2007	55.7	31.1
2008	41.8	38.1
2009	46.8	NDM
2010	31.4	NDM
2011	267.5	19.1

Table 4.5-1 (continued)
Average Annual Cs-137 Concentration in Vegetation

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
2012	44.3	29.0
2013	95.0	NDM

4.6 River Water

Surface water from the Altamaha River is obtained at an upstream location (Station 170) and at a downstream location (Station 172) using automatic samplers. Small quantities are drawn at intervals not exceeding a few hours. The samples drawn are collected monthly and quarterly composites are produced from the monthly collections.

As specified in Table 2-1, a gamma isotopic analysis is conducted on each monthly sample. No man-made gamma emitting nuclides were detected during 2013. The only man-made gamma emitters previously detected are presented in the table below.

Year	Quarter	Station	Radionuclide	Level (pCi/l)
1975	4th	172	Ce-141	78.2
1986	2nd	170	La-140	18.0
1986	2nd	172	Cs-137	12.0
1988	2nd	170	Cs-137	6.8

A tritium analysis is performed on the quarterly composite. Prior to 1986, positive results were usually found in each quarterly composite at levels generally ranging from 150 and 350 pCi/l which is approximately background environmental levels. Subsequently, the number of positive results have diminished.

In 2013 quarterly samples, tritium was detected in all of the quarterly samples at the upstream (control) location with an average of 164 pCi/l. The downstream (indicator) location also had tritium results for all four quarters with an average of 147 pCi/l. The MDD of 162 pCi/l indicated no statistical difference between the indicator and control stations. The low levels detected at both are consistent with detectable values observed in past samples. The MDC and RL for tritium in river water are 3000 and 30,000 pCi/l, respectively. Figure 4.6-1 and Table 4.6-1 provide the historical trending of the annual average detectable tritium concentration in river water.

The annual downstream survey of the Altamaha River to determine if river water is being withdrawn for drinking purposes is discussed in Section 4.1.

Figure 4.6-1

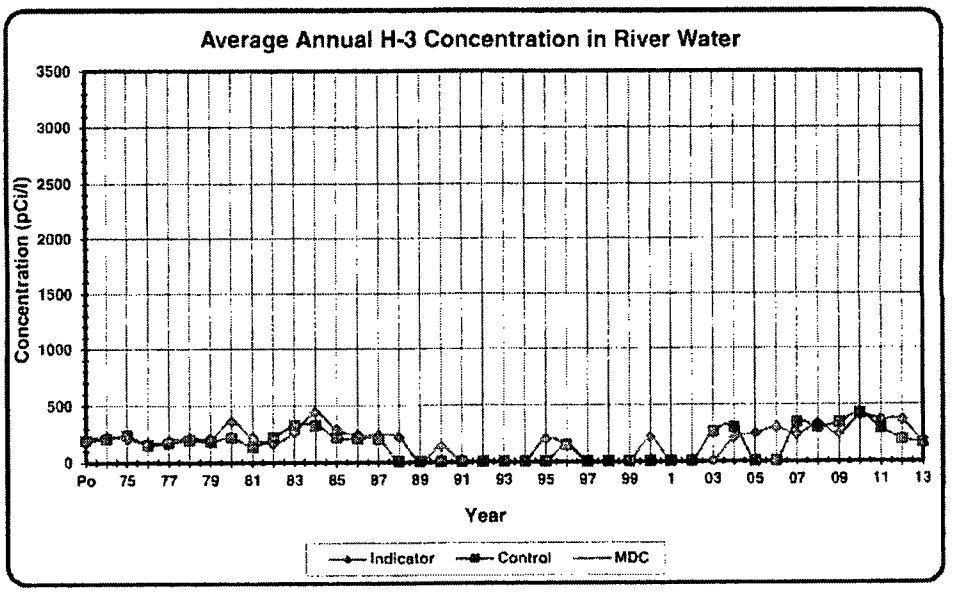

Average Annual H-3 Concentration in River Water
Concentration (pCi/l)
3500
3000
2500
2000
1500
1000
500
0
Po 75 77 79 81 83 85 87 89 91 93 95 97 99 1 03 05 07 09 11 13
Year
Indicator
Control
MDC

Table 4.6-1
Average Annual H-3 Concentration in River Water

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	210	191
1974	230	205
1975	205	238
1976	165	153
1977	189	170
1978	224	193
1979	210	180
1980	358	218
1981	220	135
1982	165	220
1983	265	328
1984	437	327
1985	288	220
1986	242	206
1987	241	204
1988	220	NDM
1989	NDM	NDM
1990	139	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	200	NDM
1996	144	147
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	209	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	261
2004	206	302
2005	245	NDM
2006	299	NDM
2007	235	338
2008	329	298
2009	242	343
2010	403	426
2011	366	293

Table 4.6-1 (continued)
Average Annual H-3 Concentration in River Water

Year	Indicator (pCi/l)	Control (pCi/l)
2012	364	195
2013	147	164

4.7 Fish

Gamma isotopic analyses were performed on the edible portion of the fish samples collected at the river stations on May 28, 2013 and October 14, 2013. The control station (No. 170) is located upstream of the plant while the indicator station (No. 172) is located downstream.

As shown in Table 3-1, only Cs-137 was detected in fish during 2013. Cs-137 in fish samples has been attributed primarily to weapons testing and the Chernobyl incident. However, the Cs-137 seen in past fish samples at the indicator station could potentially be attributed to plant effluents. One fish indicator sample yielded a positive result with a Cs-137 value of 11.0 pCi/kg-wet. Three control samples had an average value of 12.7 pCi/kg-wet. Due to the low number of samples, MDD was not used to evaluate the data. The low levels detected at both indicator and control stations are consistent with detectable values observed in past samples. The MDC and RL for Cs-137 in fish are 150 and 2000 pCi/kg-wet, respectively.

The historical trending of the average annual detectable Cs-137 concentration in fish is provided in Figure 4.7-1 and Table 4.7-1. Figure 4.7-1 indicates, in general, a decline in the Cs-137 levels after 1983. (Note: From 1979 through 1982, clams were collected rather than fish.)

Figure 4.7-1

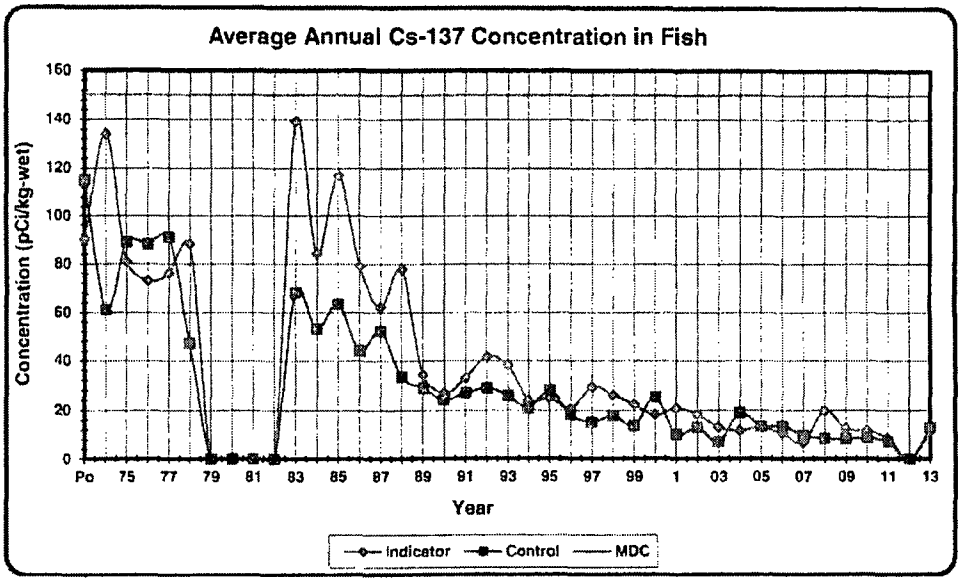

Average Annual Cs-137 Concentration in Fish
Concentration (pCi/kg-wet)
160
140
120
100
80
60
40
20
0
Pc
75
77
79
81
83
85
87
89
91
93
95
97
99
1
03
05
07
09
11
13
Year
Indicator
Control
MDC

Table 4.7-1
Average Annual Cs-137 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	90	115
1974	134	61
1975	80.6	89.4
1976	73	88
1977	76	91
1978	88	47
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	NDM
1982	NDM	NDM
1983	138.6	67.5
1984	84	53
1985	117	63.3
1986	79	44
1987	62	52
1988	77.8	33.3
1989	34.3	28.9
1990	26.7	24.2
1991	32.9	26.9
1992	41.6	28.8
1993	38.0	25.9
1994	23.8	20.7
1995	25.0	27.9
1996	20.4	18.0
1997	29.4	15.1
1998	26.1	17.7
1999	22.3	13.5
2000	17.9	25.3
2001	20.8	10.2
2002	18.2	13.0
2003	13.1	7.1
2004	11.6	18.8
2005	13.0	13.3
2006	10.4	13.5
2007	6.8	9.8
2008	19.9	8.4
2009	12.4	8.4
2010	11.6	8.6
2011	8.6	7.1

Table 4.7-1 (continued)
Average Annual Cs-137 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
2012	NDM	NDM
2013	11.0	12.7

In the past, the only other man-made radionuclides detected in fish samples were Co-60 and Cs-134. During pre-operation, Co-60 was detected in one fish sample at a very low concentration. During the period of 1983 through 1988, Cs-134 was found in about half of the samples at concentrations of the same order of magnitude as those found for Cs-137. The Co-60 and Cs-134 levels found in these samples are attributed to the nuclear weapons tests and the Chernobyl incident. Figure 4.7-2 and Table 4.7-2 show the historical trending of the annual average detectable concentration of Cs-134 in fish.

Figure 4.7-2

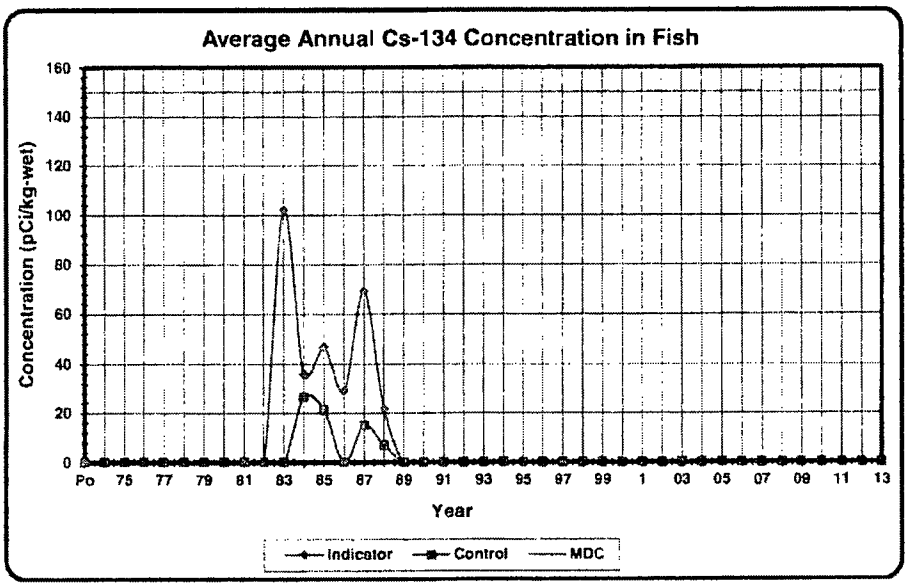


Table 4.7-2
Average Annual Cs-134 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	NDM	NDM
1974	NDM	NDM
1975	NDM	NDM
1976	NDM	NDM
1977	NDM	NDM
1978	NDM	NDM
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	NDM
1982	NDM	NDM
1983	101.8	NDM
1984	35.8	26.3
1985	46.7	21.1
1986	29	NDM
1987	69	15
1988	21.7	6.9
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM

Table 4.7-2 (continued)
Average Annual Cs-134 Concentration in Fish

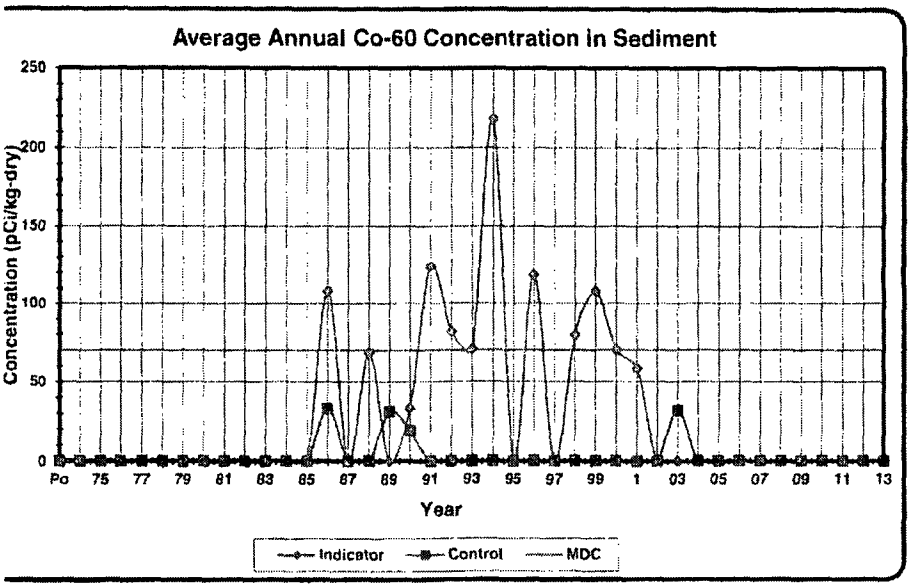
Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
2012	NDM	NDM
2013	NDM	NDM

4.8 Sediment

Sediment was collected along the shoreline of the Altamaha River on May 28 and November 4, 2013, at the upstream control station (No. 170) and the downstream indicator station (No. 172). A gamma isotopic analysis was performed on each sample.

Co-60 was detected in sediment samples near the plant from 1986, the year of the Chernobyl incident, through 2004. However, because Co-60 was detected in indicator station samples more often than in control station samples during the years 1986 through 2002, some contribution from plant effluents cannot be ruled out. Co-60 was not detected in 2013 and has not been detected in either control or indicator station samples since 2004. There is no RL or MDC assigned to Co-60 in sediment in ODCM Tables 4-2 and 4-3 (Tables 4-2 and 4-1 of this report). The MDC assigned by the EL for Co-60 in sediment is 70 pCi/kg-dry. The historical trending of the average annual detectable Co-60 concentration in sediment is provided in Figure 4.8-1 and Table 4.8-1.

Figure 4.8-1



4-38

Table 4.8-1
Average Annual Co-60 Concentration in Sediment

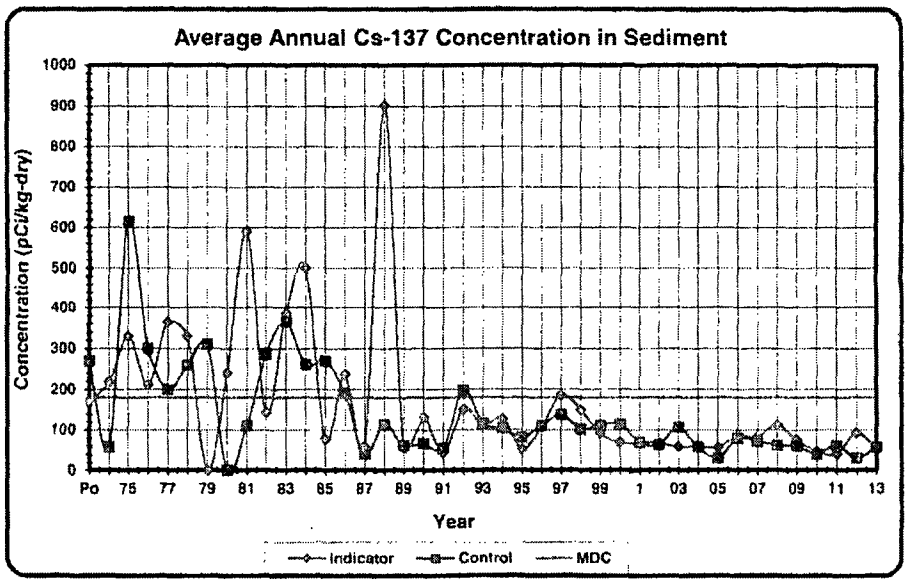
Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Pre-op	NDM	NDM
1974	NDM	NDM
1975	NDM	NDM
1976	NDM	NDM
1977	NDM	NDM
1978	NDM	NDM
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	NDM
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	108	33
1987	NDM	NDM
1988	67.8	NDM
1989	NDM	31
1990	33	19
1991	123.6	NDM
1992	81.4	NDM
1993	70.7	NDM
1994	218	NDM
1995	NDM	NDM
1996	118.5	NDM
1997	NDM	NDM
1998	79.4	NDM
1999	107.7	NDM
2000	70.0	NDM
2001	58.1	NDM
2002	NDM	NDM
2003	NDM	31.5
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM

Table 4.8-1 (continued)
Average Annual Co-60 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
2012	NDM	NDM
2013	NDM	NDM

In 2013, Cs-137 was detected in the spring and fall indicator sediment samples and control station samples from the spring collection. Cs-137 has been found in over 95% of all of the sediment samples collected back through preoperation, and is generally attributed to atmospheric nuclear weapons tests or to the Chernobyl incident. As shown in Table 3-1, the average concentration of Cs-137 detected in the indicator station samples was 55.9 pCi/kg-dry and the concentration of the positive control station sample was 56.2 pCi/kg-dry. Due to the low number of samples, MDD was not used to evaluate the data. The low levels detected at both indicator and control stations are consistent with detectable values observed in past samples. The MDC for Cs-137 in sediment is 180 pCi/kg-dry. The historical trending of the average annual detectable Cs-137 concentration in sediment is provided in Figure 4.8-2 and Table 4.8-2.

Figure 4.8-2



4-41

Table 4.8-2
Average Annual Cs-137 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Pre-op	170	270
1974	218	57
1975	330	615
1976	211	300
1977	364	200
1978	330	260
1979	NDM	310
1980	240	NDM
1981	590	110
1982	141	285
1983	384	365
1984	500	260
1985	76.5	269
1986	238	190
1987	59	39
1988	903	114
1989	56	62
1990	130.5	66
1991	43.1	54.5
1992	151	198.5
1993	113	115
1994	127	104
1995	52.3	80.6
1996	106	110
1997	186	137
1998	148.5	101.4
1999	92	111.8
2000	68.1	114.5
2001	68.7	69.6
2002	68.1	62.8
2003	57.3	106
2004	59.5	57.1
2005	57.2	30.3
2006	85.2	79.2
2007	82.1	71.6
2008	112.7	61.9
2009	74.9	60.5
2010	47.1	39.6
2011	40.2	61.2

Table 4.8-2 (continued)
Average Annual Cs-137 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
2012	91.7	30.3
2013	55.9	56.2

Other man-made nuclides, besides Co-60 and Cs-137, were occasionally found in past years. Their presence was generally attributed to the nuclear weapons tests or to the Chernobyl incident, although plant releases were not ruled out. Mn-54, Co-58, and Zn-65, which have relatively short half-lives, are most likely a result of plant releases and have been plotted in Figure 4.8-3 along with their MDCs. All the man-made nuclides detected in sediment except for Co-60 and Cs-137 have been listed in Table 4.8-3. The Cs-134 MDC (150 pCi/kg-dry) is defined in ODCM Table 4-3 (Table 4-1 of this report). The MDCs for Mn-54 (42 pCi/kg-dry) and Zn-65 (129 pCi/kg-dry) were determined by the EL since no values are provided in ODCM Table 4-3.

Figure 4.8-3

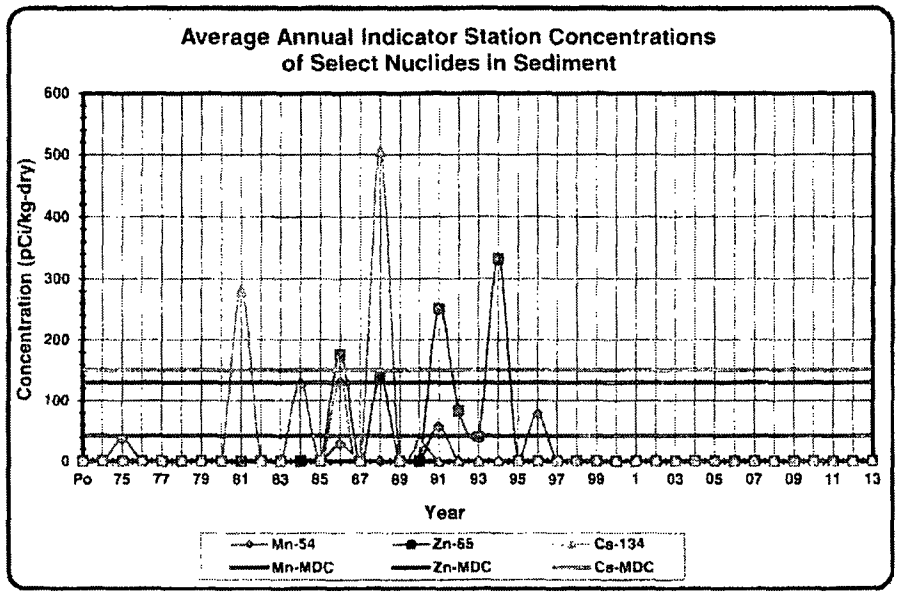


Table 4.8-3

Sediment Nuclide Concentrations Other Than Co-60 & Cs-137

Nuclide	YEAR	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Ce-141	1976	340	254
	1977	141	
Ce-144	Preop		720
	1974	363	
	1975	342	389
	1978	700	
	1981	1290	
Co-58	1994	22.2	
Cs-134	Preop		40
	1981	280	
	1984	130	40
	1986	132	
	1988	505	
	1990	31	
Mn-54	1975	36.1	
	1986	28	26
	1991	57.2	
	1996	77.7	
Ru-103	1974	81	
	1976	158	
	1977	195	
	1981	220	
Zn-65	1986	175	
	1988	136	
	1991	250.5	
	1992	83	
	1993	39.9	
	1994	332	
Zr-95	Preop		180
	1974	138	
	1976	427	170
	1977	349	294
	1978	220	230
	1981	860	280

4.9 Groundwater

As nuclear plants began to undergo decommissioning in the late 1990's to early 2000s, instances of subsurface and/or groundwater contamination were identified. In addition, several operating facilities also identified groundwater contamination resulting from spills and leaks or equipment failure. In one instance, low levels of licensed material were detected in a private well located on property adjacent to a nuclear power plant.

In 2006, NEI (Nuclear Energy Institute) formed a task force to address monitoring onsite groundwater for radionuclides at nuclear facilities. A Groundwater Protection Initiative was developed which was adopted by all U.S. commercial operating nuclear plants.

The NRC also formed a task force to study the groundwater issues and released Information Notice 2006-13, *Ground-water Contamination due to Undetected Leakage of Radioactive Water*, which summarized its review of radioactive contamination of ground water at multiple facilities as a result of undetected leakage from structures, systems, and components that contain or transport radioactive fluids. Licensees were instructed to review the information for applicability and to consider appropriate actions to avoid similar problems.

The NEI task force felt it was prudent for the industry to update site hydrology information and to develop radiological groundwater monitoring plans at each site. These groundwater protection plans would ensure that underground leaks and spills would be addressed promptly. Additionally, the task force recommended developing a communications protocol to report radioactive leaks or spills that entered groundwater (or might eventually enter groundwater) to the NRC and State and Local government officials as needed. NEI-07-07, *Industry Groundwater Protection Final Guidance Document*, was developed by the task force to document the guidelines recommended for the industry.

To ensure compliance with NEI-07-07, Southern Nuclear developed the Nuclear Management Procedure, *Radiological Groundwater Protection Program*. The procedure contains detailed site-specific monitoring plans, program technical bases, and communications protocol (to ensure that radioactive leaks and spills are addressed and communicated appropriately). The guidance in this procedure is used to informally update both the NRC and the State of Georgia regarding the changes in Hatch's groundwater tritium concentrations. In an effort to prevent future leaks of radioactive material to groundwater, SNC plants have established robust buried piping and tanks inspection programs.

Plant Hatch has monitored onsite groundwater since preoperation. Initially piezometers, which were installed prior to plant construction, were used to monitor groundwater. In the late 1970s to the early 1980s timeframe, a hydrological engineering consultant was hired to evaluate several areas where leaks had occurred and tritium had been detected in onsite wells. The consultant recommended drilling additional monitoring wells to study the groundwater movement, to determine the source of the leaks, and to track the tritium concentrations in groundwater. The monitoring program continued over the years and most of the data generated in the late 1970s through the mid 1980s, was reported to the NRC.

The reporting frequency decreased over time for several reasons – the areas where the groundwater showed tritium were all onsite and the movement of groundwater was extremely slow and in a direction (towards the river) that was not expected to impact the public. During that period of time, there was no regulatory requirement to provide the reports.

In 2006 as the nuclear industry was moving towards establishing groundwater protection programs, Plant Hatch hired a hydrological engineering consultant to re-evaluate the groundwater study which had been done previously. The key purpose of the new study was to evaluate the adequacy of the current monitoring program and to diagram the existing groundwater tritium plume to ensure that the plume had not migrated offsite. The consultant concluded that tritium was not leaving the site through the groundwater. The consultant recommended installing additional monitoring wells to better characterize the groundwater plume in areas of the site where there were no existing wells.

During the course of Plant Hatch's groundwater evaluation in 2006, some leaks were discovered which explained why the levels of tritium around CST-1 (Unit 1 Condensate Storage Tank) were not decreasing. Underground piping which carried radioactive liquids was evaluated over the plant site and replaced in some areas around CST-1. Both CST tank/pump moats (Unit 1 and Unit 2) were coated and sealed to ensure that the moats would not leak in the event of transfer pump or tank leaks.

In 2006, Plant Hatch's groundwater monitoring program included over 50 location points which were sampled on weekly, monthly, quarterly, or annual frequencies. Included in these sample points were the onsite drinking water wells (which did not contain detectable amounts of radioactivity above background). Surface drains or outfalls were also included as sample points. Tritium was detected in two of the outfalls which discharged to the river. These outfalls were initially added to the Hatch ODCM as radiological effluent release points. Permitted release point Y22N008A (by design) discharges groundwater from the site subsurface drainage system which includes the tritiated groundwater around the CST-1. The other release point, Y22N003A, discharges runoff from the roof drains. The source of tritium in this outfall has been determined to be from rain washout of the gaseous plant effluents and is no longer a permitted release point. Plant Hatch sampled rainfall during two rain events in 2006 and found tritium levels as high as 4.58E5 pCi/l on the reactor building roof. Two other outfalls, Y22N024A and Y22N025A, which discharge into the onsite swamp show sporadic levels of tritium. The source of tritium in these outfalls is also believed to be from rain washout.

In 2007, Hatch continued to aggressively monitor the groundwater tritium plume especially in two areas of higher activity around CST-1 and CST-2. The amount of seasonal rainfall during 2007 seems to have had some correlation with the tritium concentrations in the T-12 well near CST-1. During early spring and late fall rainy seasons, the concentrations of tritium were at their highest levels, whereas, during the summer and early fall drought season the tritium concentrations decreased significantly. This is indicative of water table level fluctuations.

However, this same seasonal affect was not observed in the newer NW10 monitoring well installed in 2006 near CST-2. The tritium concentration in NW10 increased from February 2007 through September 2007 by a factor of 2.5.

Events which could have contributed to the increase were a CST-2 transfer pump leak (in November 2006) which led to an accumulation of a couple feet of CST-2 water in the pump moat. Although the moat had been sealed earlier in 2006, there was a possibility that some of the contaminated water seeped through the concrete moat and gradually seeped through the ground to NW10. In addition, there was a deep hole dug (in January 2007) near the CST-2 (and NW10) to replace some CST-2 piping. The hole may have altered groundwater flow toward NW10 from the CST-1 groundwater plume and resulted in higher concentrations of tritium being drawn to NW10.

In 2008, Hatch made further enhancements to the groundwater tritium monitoring program. Three additional shallow wells and three additional deep wells were installed ("R" series wells). One of the deep wells was a replacement well for the deep well N7A. The integrity of N7A was questioned due to the high level of tritium (~211,000 pCi/l) seen in this well which should have been protected from contamination by a confining layer. The well was retired and a new well (R-3) was placed in the same vicinity. The newer well showed much smaller amounts of tritium activity (average of 1324 pCi/l in 2012).

In addition, several other groups within Southern Company are now utilized to conduct an improved sampling program and to provide additional expertise in characterizing groundwater quality and flow. The sampling frequency for radiological groundwater monitoring was officially changed to quarterly starting in second quarter of 2008 with SCS Civil Field Services performing the sampling and Georgia Power Environmental Laboratory continuing to analyze the samples.

Southern Nuclear Corporate Engineering and Hatch Site Engineering have developed a Buried Piping and Tanks Inspection Program. This program should help to prevent releases of radioactive material to groundwater. Underground piping and components are risked ranked using detailed procedures and EPRI's software, BPWorks, to ensure vulnerable areas are identified and repaired or replaced before problems occur.

In May of 2009, there was an increase in tritium concentration in well T-3 (located near the U-1 Turbine Building) from approximately 2600 pCi/l to approximately 37,000 pCi/l. Neighboring well N9B (not part of the formal GW sampling program) also showed an approximate 10X increase – going from 1300 pCi/l to over 10K pCi/l. Investigation found no process leaks and the non-rad constituents continued to match groundwater. The increase was attributed to migration of the plume. Increased rainfall and the fact that the wells are located near the subsurface drain could likely have facilitated the pathway of the plume towards the T3 well. A courtesy notification was made to the State of Georgia Dept. of Natural Resources, and a 10CFR50.72 formal report was made to the NRC – although only courtesy notifications were required per procedure.

In 2013, the tritium concentrations in T-3 ranged from 960 pCi/l to 2690 pCi/l during the year (average of 1833 pCi/l in 2012) but remained below the established Administative Control Limit (ACL) of 37,000 pCi/l. Administrative Control Limits (ACL) were established near the end of 2010 for the surficial and deep aquifers and for specific wells based on the presence of legacy tritium, the previous well results, and total measurement uncertainty. There are no reporting requirements associated with exceeding an ACL but additional actions would be taken to verify no new sources of tritium if an ACL was exceeded. The ACL for T-12 is 900,000 pCi/l and the average for T-12 in 2013 was 67,967 pCi/l of tritium with a range in values of 21,400 to 149,000 pCi/l (99,000 pCi/l was the

2012 average in T-12). The high of 149,000 pCi/l decreased slightly from a spike first noticed in the 4th quarter of 2012 of 212,000 pCi/l. These elevated results were due to a leaking buried transfer pipe for CST-1 located near well T-12 (wells T-10, T-11 and T-16 were also affected). The leak was repaired and additional tritium monitoring was initiated in response. The investigation (see CR736580) indicated no significant potential for off-site impact. For NW-10, the ACL is 160,000 pCi/l and the average tritium concentration in 2013 was 15,125 pCi/l with a range of 13,900 to 16,600 pCi/l (15,075 pCi/l was the average in 2012).

The ACL for T10 (25,000 pCi/l) was exceeded on 9/21/11. The result, which was determined on 9/28/11, was 4.61E6 pCi/l and the previous sample had been only 5000 pCi/l. Additional samples were taken to verify the high tritium level and hard to detect radionuclides, Sr-89/90 and Fe-55, were analyzed for but were determined to be at background levels. No gamma emitters were detected. Voluntary communications with state/local stakeholders were performed on 9/29/11. A formal 10CFR50.72b notification to NRC was also made. A response team was assembled (with 24 hour coverage) to identify the source of the tritium. Buried piping that supplied water from the CST-1 to the liquid radwaste processing system was identified as the source, and the section of piping was evacuated of water and abandoned in place. A design change was completed to replace it with aboveground piping. No drinking water sources were impacted by the leak, and the tritium was contained within the shallow perched aquifer located in the immediate vicinity of CST-1. Two new wells, NU-1 and NU-2, were drilled in the area near the leak to enhance monitoring and to facilitate remediation activities (pumping out wells to remove the contamination). By 4th quarter sampling (12/06/11), the tritium in T-10 had decreased to 2.3E6 pCi/l. Sample results for this location in 2012 averaged 61,766 pCi/l. However first quarter 2013 results spiked upwards with a measurement of 439,000 pCi/l. As mentioned above, this spike was due to a leaking buried transfer pipe for CST-1. The leak was repaired and additional tritium monitoring was initiated in response. The subsequent three quarters of data at well T-10 were closer to historical averages falling between 45,300 and 85,900 pCi/l.

No tritium activity above background has been detected in the Deep Wells 2 and 3 which are used for drinking water at the plant. The plant staff continues to sample and monitor strategically located wells on a more frequent basis than quarterly to ensure that radiological leaks have not occurred. In addition, outfalls, pull boxes, manholes, and the sewage treatment plant effluent are sampled by the plant staff on a periodic basis.

The latest groundwater tritium plume map (generated from the 2013 SCS 4th quarter sampling data) is shown as Figure 4.9-1 on the last page of this section. It is a representation of the current groundwater conditions at Plant Hatch. NW-10 continued to show an overall decreasing trend as discussed above. However the other well of interest around the CST's, well T-12, saw a spike that carried through to the first quarter of 2013. Repairs to this well and subsequent monitoring showed the well returning to levels consistent with an overall downward trend in tritium concentration in the area. The subsurface drain system and rainfall continue to influence groundwater movement around the site and contribute to the wide range of tritium values seen in the groundwater monitoring wells.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

5.0 INTERLABORATORY COMPARISON PROGRAM

In accordance with ODCM 4.1.3, the EL participates in an ICP that satisfies the requirements of Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979. The guide indicates the ICP is to be conducted with the Environmental Protection Agency (EPA) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and the ICP should include all of the determinations (sample medium/radionuclide combinations) that are offered by the EPA and included in the REMP.

The ICP is conducted by Analytics, Inc. of Atlanta, Georgia. Analytics has a documented Quality Assurance (QA) program and the capability to prepare Quality Control (QC) materials traceable to the National Institute of Standards and Technology. The ICP is a third party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. Analytics supplies the crosscheck samples to the EL which performs the laboratory analyses in a normal manner. Each of the specified analyses is performed three times. The results are then sent to Analytics who performs an evaluation which may be helpful to the EL in the identification of instrument or procedural problems.

The samples offered by Analytics and included in the EL analyses are gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples.

The accuracy of each result is measured by the normalized deviation, which is the ratio of the reported average less the known value to the total error. The total error is the square root of the sum of the squares of the uncertainties of the known value and of the reported average. The uncertainty of the known value includes all analytical uncertainties as reported by Analytics. The uncertainty of the reported average is the propagated error of the values in the reported average by the EL. The precision of each result is measured by the coefficient of variation, which is defined as the standard deviation of the reported result divided by the reported average. An investigation is undertaken whenever the absolute value of the normalized deviation is greater than three or whenever the coefficient of variation is greater than 15% for all radionuclides other than Cr-51 and Fe-59. For Cr-51 and Fe-59, an investigation is undertaken when the coefficient of variation exceeds the values shown as follows:

Nuclide	Concentration *	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
Cr-51	NA	>1000	25
Cr-51	>300	<1000	15
Fe-59	<80	NA	25
Fe-59	>80	NA	15

* For air filters, concentration units are pCi/filter. For all other media, concentration units are pCi/liter (pCi/l).

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

As required by ODCM 4.1.3.3 and 7.1.2.3, a summary of the results of the EL's participation in the ICP is provided in Table 5-1 for: the gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples. Delineated in this table for each of the media/analysis combinations, are: the specific radionuclides; Analytics' preparation dates; the known values with their uncertainties supplied by Analytics; the reported averages with their standard deviations; and the resultant normalized deviations and coefficients of variation expressed as a percentage.

The Environmental Radiochemistry laboratory participates in a performance evaluation (PE) sample program provided by Analytics Inc. The PE samples are received and analyzed routinely with environmental and effluent samples. The laboratory analyzed 9 samples for 34 parameters in 2013.

The 2013 analyses included tritium, gross beta and gamma emitting radionuclides in different matrices. The attached results for all analyses were within acceptable limits for accuracy.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
I-131	06/13/13	90.30	89.60	3.4	1.50	5.98	0.14

GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	06/13/13	78.90	80.80	3.59	1.35	6.52	-0.36
Co-58	06/13/13	87.00	84.00	7.74	1.40	10.20	0.33
Co-60	06/13/13	223.00	194.00	11.7	2.62	8.56	0.01
Cr-51	06/13/13	234.00	224.00	12.5	3.74	8.40	0.50
Cs-134	06/13/13	112.00	112.00	11.2	1.87	10.80	0.00
Cs-137	06/13/13	137.00	135.00	12.7	2.25	10.29	0.14
Fe-59	06/13/13	106.00	107.00	8.24	1.79	9.51	-0.12
Mn-54	06/13/13	164.00	154.00	13.8	2.57	9.52	0.61
Zn-65	06/13/13	223.00	194.00	17.4	3.25	9.14	1.41

GROSS BETA ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	09/12/13	58.30	58.70	0.79	0.98	5.08	-0.14

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Co-58	09/12/13	112.00	108.00	8.91	1.80	9.90	0.39
Co-60	09/12/13	209.00	196.00	10.8	3.27	6.67	0.94
Cr-51	09/12/13	301.00	277.00	30.1	4.63	14.32	0.55
Cs-134	09/12/13	184.00	172.00	4.02	2.88	4.56	1.42
Cs-137	09/12/13	141.00	131.00	5.49	2.19	6.62	1.02
Fe-59	09/12/13	133.00	130.00	6.29	2.18	8.32	0.27
I-131	09/12/13	108.00	98.30	9.13	1.64	10.86	0.80
Mn-54	09/12/13	151.00	139.00	4.98	2.32	6.21	1.31
Zn-65	09/12/13	289.00	266.00	9.27	4.45	6.44	1.23

GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	06/13/13	270.00	293.00	9.58	4.90	5.91	-1.42
	12/05/13	307.00	279.00	10.69	4.67	6.12	1.51

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	12/05/13	73.40	88.80	5.18	1.48	10.69	-1.95
Co-58	12/05/13	92.40	90.60	1.63	1.51	6.57	0.30
Co-60	12/05/13	118.00	119.00	1.5	1.98	5.03	-0.25

TABLE 5-1 (SHEET 3 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES CONT. (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Cr-51	12/05/13	245.00	240.00	14.2	4.01	12.37	0.16
Cs-134	12/05/13	113.00	115.00	7.53	1.92	8.17	-0.20
Cs-137	12/05/13	106.00	102.00	5.7	1.70	8.21	0.44
Fe-59	12/05/13	86.00	89.10	3.02	1.49	8.58	-0.42
I-131	12/05/13	98.20	92.40	4.93	1.54	6.16	0.96
Mn-54	12/05/13	145.00	136.00	1.85	2.27	5.53	1.09
Zn-65	12/05/13	658.00	600.00	44.5	10.00	8.01	1.09

TRITIUM ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
H-3	06/13/13	9870.00	9890.00	16.69	165.00	2.22	-0.10
	12/05/13	14100.00	14500.00	184.08	242.00	2.41	-1.21

5-5

6.0 CONCLUSIONS

This report confirms the licensee's conformance with the requirements of Chapter 4 of the ODCM. It provides a summary and discussion of the results of the laboratory analyses for each type of sample.

The REMP trends over the course of time from preoperation to the present are decreasing or have remained fairly constant. This supports the conclusion that there is no adverse radiological impact on the environment or to the public as a result of the operation of Hatch Nuclear Plant.

7.0 ERRATA

The following pages are corrections to the Edwin I. Hatch Nuclear Plant Annual Radiological Environmental Operating Report for 2012.

A discrepancy was identified regarding river water and sediment sample results in the 2012 AREOR. In the river water data table 4.6-1, Average Annual H-3 Concentration in River Water, the control and indicator values were transposed. The corrected version of page 4-28 follows in this section.

A similar discrepancy occurred with the sediment results reported in section 4.8 of the 2012 report. Values for Cs-137 were transposed or incorrect for the indicator and control stations. This error affected the text on page 4-36, as well as the associated graph and table on pages 4-37 and 4-39. Corrections to these pages follow in this section.

The correction resulted from an NRC review of Georgia Power Environmental Laboratory's 2012 Interlaboratory Comparison Program results, a calculation error was identified. This error was subsequently corrected by Georgia Power Environmental Lab and the corrected page is included in this errata section.. The error appeared on Table 5-1 of Section 5 Interlaboratory Comparison Program in the 2012 AREOR. . The normalized deviation had been calculated incorrectly at -11.99 for the March 15 gross beta water analysis. The correct normalized deviation value was calculated to be -1.46 which is under the normalized deviation acceptance level of 3. The affected page of table 5-1 has been updated with the correct result and is included in the following pages of this section. No change to the text of Section 5 was required.

Table 4.6-1 (continued)
Average Annual H-3 Concentration in River Water

Year	Indicator (pCi/l)	Control (pCi/l)
2012	364	195

4.7 Fish

Gamma isotopic analyses were performed on the edible portion of the fish samples collected at the river stations on April 9, 2012 and November 1, 2012. The control station (No. 170) is located upstream of the plant while the indicator station (No. 172) is located downstream.

As shown in Table 3-1, no man-made radionuclides were detected in fish during 2012. Cs-137 in past fish samples has been attributed primarily to weapons testing and the Chernobyl incident. However, the Cs-137 seen in past fish samples at the indicator station could potentially be attributed to plant effluents. The MDC and RL for Cs-137 in fish are 150 and 2000 pCi/kg-wet, respectively.

The historical trending of the average annual detectable Cs-137 concentration in fish is provided in Figure 4.7-1 and Table 4.7-1. Figure 4.7-1 indicates, in general, a decline in the Cs-137 levels after 1983. (Note: From 1979 through 1982, clams were collected rather than fish.)

Table 4.8-1 (continued)
Average Annual Co-60 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
2012	NDM	NDM

In 2012, Cs-137 was detected in both indicator and control station sediment samples from the spring collection. No radionuclides were detected in either the control or indicator station samples from the fall collection. Cs-137 has been found in over 95% of all of the sediment samples collected back through preoperation, and is generally attributed to atmospheric nuclear weapons tests or to the Chernobyl incident. As shown in Table 3-1, the concentration of Cs-137 detected in the indicator station sample from the spring collection was 91.7 pCi/kg-dry and the concentration at the control station was 30.3 pCi/kg-dry. Because the value at the control station was higher than the value at the indicator station, it can be concluded that effluents from plant Hatch did not contribute to environmental concentrations. Due to the low number of samples, MDD was not able to be used to evaluate the data. The MDC for Cs-137 in sediment is 180 pCi/kg-dry. The historical trending of the average annual detectable Cs-137 concentration in sediment is provided in Figure 4.8-2 and Table 4.8-2.

Figure 4.8-2

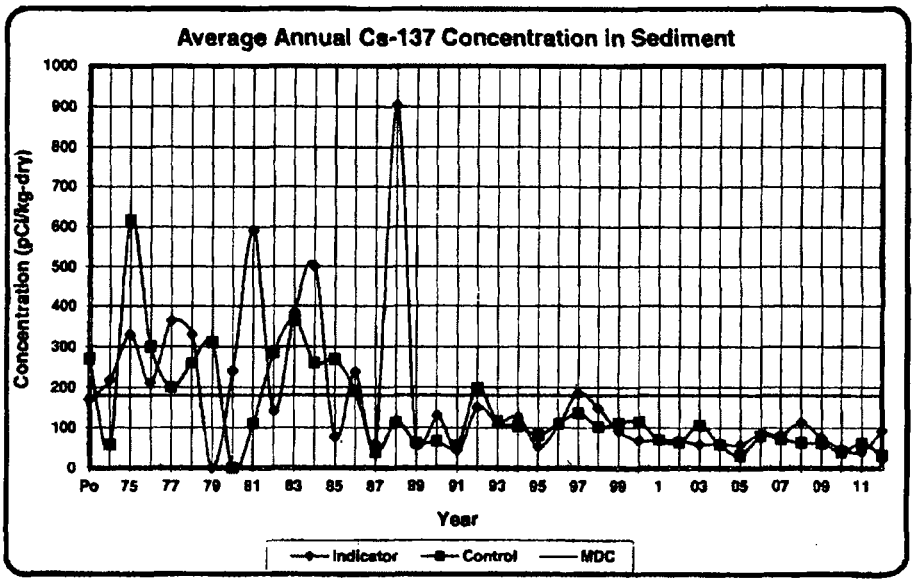
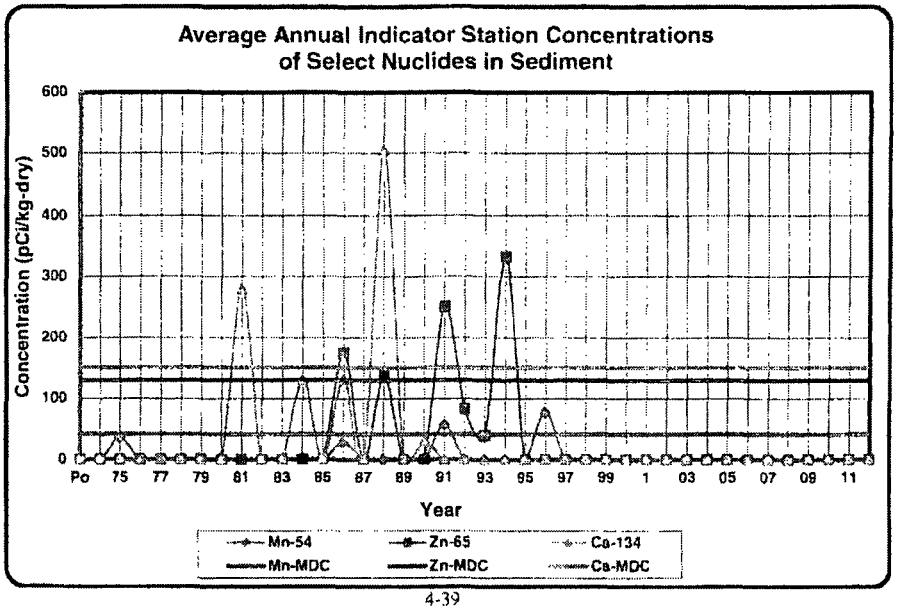

Average Annual Cs-137 Concentration in Sediment
Concentration (pCi/kg-dry)
1000
900
800
700
600
500
400
300
200
100
0
Pre-75 75 77 79 81 83 85 87 89 91 93 95 97 99 1 03 05 07 09 11
Year
Indicator
Control
MDC

Table 4.8-2 (continued)
Average Annual Cs-137 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
2012	91.7	30.3

Other man-made nuclides, besides Co-60 and Cs-137, were occasionally found in past years. Their presence was generally attributed to the nuclear weapons tests or to the Chernobyl incident, although plant releases were not ruled out. Mn-54, Co-58, and Zn-65, which have relatively short half-lives, are most likely a result of plant releases and have been plotted in Figure 4.8-3 along with their MDCs. All the man-made nuclides detected in sediment except for Co-60 and Cs-137 have been listed in Table 4.8-3. The Cs-134 MDC (150 pCi/kg-dry) is defined in ODCM Table 4-3 (Table 4-1 of this report). The MDCs for Mn-54 (42 pCi/kg-dry) and Zn-65 (129 pCi/kg-dry) were determined by the EL since no values are provided in ODCM Table 4-3.

Figure 4.8-3



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7-5

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	7/14/12	76.60	82.20	2.85	1.37	8.62	-0.84
Co-58	7/14/12	90.20	99.70	2.85	1.66	7.33	-0.32
Co-60	7/14/12	350.00	355.00	10.7	5.93	4.23	-0.35
Cr-51	7/14/12	433.00	402.00	21.1	6.71	8.51	0.85
Cs-134	7/14/12	180.00	174.00	6.26	2.91	4.68	0.69
Cs-137	7/14/12	216.00	212.00	9.26	3.54	5.63	0.34
Fe-59	7/14/12	126.00	128.00	6.53	2.13	8.21	-0.17
I-131	7/14/12	102.00	99.70	7	1.66	8.78	0.30
Mn-54	7/14/12	134.00	132.00	3.79	2.21	5.69	0.24
Zn-65	7/14/12	208.00	199.00	8.17	3.33	7.09	0.59

GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	03/15/12	263.00	297.00	18.93	4.96	1.10	-1.46
	07/14/12	166.00	148.00	10.28	2.47	10.85	0.98

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	03/15/12	190.00	184.00	5.65	3.07	5.25	0.64
Co-58	03/15/12	92.50	93.40	5.19	1.56	8.20	-0.11
Co-60	03/15/12	208.00	197.00	5.68	3.29	4.59	1.16

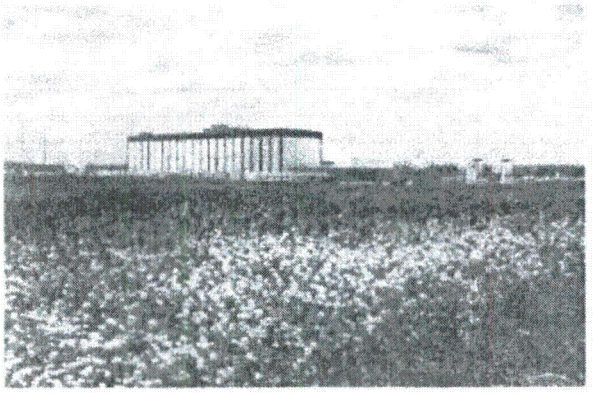
7-4

Edwin I. Hatch Nuclear Plant
Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Annual Radiological Environmental Operating Reports for 2013

Enclosure 2

Farley Annual Radiological Environmental Operating Reports for 2013

JOSEPH M. FARLEY NUCLEAR PLANT
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2013



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LIST OF ACRONYMS

Acronyms presented in alphabetical order

Acronym	Definition
AREOR	Annual Radiological Environmental Operating Report
APCo	Alabama Power Company
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Georgia Power Company Environmental Laboratory
EPA	Environmental Protection Agency
FNP	Joseph M. Farley Nuclear Plant
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
MWe	MegaWatts Electric
NA	Not Applicable
NDM	No Detectable Measurement(s)
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
OSL	Optically Stimulated Luminescence
Po	Preoperation
PWR	Pressurized Water Reactor
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
RM	River Mile
TLD	Thermoluminescent Dosimeter
TS	Technical Specification

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) for 2013 was conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM).. The REMP activities for 2013 are reported herein in accordance with Technical Specification (TS) 5.6.2 and ODCM 7.1.

The objectives of the REMP are to:

1) Determine the levels of radiation and the concentrations of radioactivity in the environs and;

2) Assess the radiological impact (if any) to the environment due to the operation of the Joseph M. Farley Nuclear Plant (FNP).

The assessments include comparisons between results of analyses of samples obtained at locations where radiological levels are not expected to be affected by plant operation (control stations), areas of higher population (community stations), and at locations where radiological levels are more likely to be affected by plant operation (indicator stations), as well as comparisons between preoperational and operational sample results.

FNP is owned by Alabama Power Company (APCo) and operated by Southern Nuclear Operating Company (SNOC). It is located in Houston County, Alabama approximately fifteen miles east of Dothan, Alabama on the west bank of the Chattahoochee River. Unit 1, a Westinghouse Electric Corporation Pressurized Water Reactor (PWR) with a licensed core thermal power output of 2775 MegaWatts thermal (MWt), achieved initial criticality on August 9, 1977 and was declared "commercial" on December 1, 1977. Unit 2, also a 2775 MWt Westinghouse PWR, achieved initial criticality on May 8, 1981 and was declared "commercial" on July 30, 1981.

The preoperational stage of the REMP began with initial sample collections in January of 1975. The transition from the preoperational to the operational stage of the REMP was marked by Unit 1 initial criticality.

A description of the REMP is provided in Section 2 of this report. An annual summary of the results of the analyses of REMP samples is provided in Section 3. A discussion of the results, including assessments of any radiological impacts upon the environment and the results of the land use census are provided in Section 4. The results of the Interlaboratory Comparison Program (ICP) are provided in Section 5. Conclusions are provided in Section 6.

2.0 REMP DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table summarizes the program as it meets the requirements outlined in ODCM Table 4-1. It details the sample types to be collected and the analyses to be performed in order to monitor the airborne, direct radiation, waterborne and ingestion pathways, and also delineates the collection and analysis frequencies. In addition, Table 2-1 describes the locations of the indicator, community and control stations as described in ODCM Table 4-4 and the identification of each sample according to station location and analysis type. The stations are also depicted on maps in Figures 2-1 through 2-4.

The location of each REMP station for gaseous releases is described by its direction and distance from a point midway between the Unit 1 and Unit 2 plant vent stacks. The surrounding area is divided into 16 azimuthal sectors which are centered on the major compass points; each sector is numbered sequentially clockwise and oriented so that the centerline of sector 16 is due north. Each sampling station is identified by a four digit number. The first two digits indicate the sector number, and the last two digits indicate the distance from the origin to the nearest mile. For example, air monitoring station 0215 is located approximately 15 miles northeast of the origin. The locations for the sampling stations along the river are identified by the nearest River Mile (RM) which is the distance along the navigable portion of the Chattahoochee River upstream of the Jim Woodruff Dam near Chattahoochee, Florida. The approximate locations of the plant discharge and intake structures are at RM 43.5 and 43.8, respectively.

The samples are collected by the plant's technical staff, except for fish and river sediment samples which are collected by APCo Environmental Field Services personnel.

All laboratory analyses were performed by Georgia Power Company's Environmental Laboratory (EL) in Smyrna, Georgia.

TABLE 2-1 (SHEET 1 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
AIRBORNE Particulates		Continuous sampler operation with sample collection weekly.	Particulate sampler: Analyze for gross beta radioactivity ≥ 24 hours following filter change. Perform gamma isotopic analysis on each sample when gross beta activity is > 10 times the yearly mean of control samples. Perform gamma isotopic analysis on composite sample (by location) quarterly.
Indicator Stations: River Intake Structure (ESE-0.8) South Perimeter (SSE-1.0) Plant Entrance (WSW-0.9) North Perimeter (N-0.8)	 PI-0501 PI-0701 PI-1101 PI-1601		
Control Stations: Blakely GA (NE-15) Neals Landing, FL (SSE-18) Dothan, AL (W-18)	 PB-0215 PB-0718 (spare station, not in service) PB-1218		
Community Stations: GA Pacific Paper Co. (SSE-3) Ashford, AL (WSW-8) Columbia, AL (N-5)	 PC-0703 PC-1108 PC-1605		

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TABLE 2-1 (SHEET 2 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
Iodine		Continuous sampler operation with sample collection weekly	Radioiodine canister: Analyze each sample for I-131 weekly.
Indicator Stations: River Intake Structure (ESE-0.8) South Perimeter (SSE-1.0) Plant Entrance (WSW-0.9) North Perimeter (N-0.8)	II-0501 II-0701 II-1101 II-1601		
Control Station: Blakely, GA (NE-15) Neals Landing, FL (SSE-18) Dothan, AL (W-18)	IB-0215 IB-0718 (spare station, not in service) IB-1218		
Community Station: GA Pacific Paper Co. (SSE-3)	IC-0703		
DIRECT RADIATION		Quarterly	Gamma dose: Read each badge quarterly
Indicator Stations: Plant Perimeter (NNE-0.9) (NE-1.0) (ENE-0.9) (E-0.8) (ESE-0.8)	 RI-0101 RI-0201 RI-0301 RI-0401 RI-0501		

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TABLE 2-1 (SHEET 3 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
(SE-1.1) (SSE-1.0) (S-1.0) (SSW-1.0) (SW-0.9) (WSW-0.9) (W-0.8) (WNW-0.8) (NW-1.1) (NNW-0.9) (N-0.8)	RI-0601 RI-0701 RI-0801 RI-0901 RI-1001 RI-1101 RI-1201 RI-1301 RI-1401 RI-1501 RI-1601		
Control Stations: Blakely, GA (NE-15) Neals Landing, FL (SSE-18) Dothan, AL (W-15) Dothan, AL (W-18) Webb, AL (WNW-11) Haleburg, AL (N-12)	 RB-0215 RB-0718 RB-1215 RB-1218 RB-1311 RB-1612		
Community Station By sector (NNE-4) (NE-4) (ENE-4) (E-5) (ESE-5) (SE-5) (SSE-3)	 RC-0104 RC-0204 RC-0304 RC-0405 RC-0505 RC-0605 RC-0703		

TABLE 2-1 (SHEET 4 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
(S-5) (SSW-4) (SW-5) (WSW-4) (W-4) (WNW-4) (NW-4) (NNW-4) (N-5) Of Special Interest: Nearest Residence (SW-1.2) City of Ashford, AL (WSW-8.0)	RC-0805 RC-0904 RC-1005 RC-1104 RC-1204 RC-1304 RC-1404 RC-1504 RC-1605 RC-1001 RC-1108		
WATERBORNE Surface Water		Aliquots taken with proportional semi-continuous sampler, having a minimum sampling frequency not exceeding two hours, collected weekly for 4 week composites and quarterly composites	Gamma isotopic analysis of each 4 week composite sample. Tritium analysis for each quarterly composite.
Indicator Station: Paper Mill, (~3 miles downstream of plant discharge, RM 40)	WRI		
Control Station: Upstream of Andrews Lock and dam (~3 miles upstream of the plant intake, RM 47)	WRB		

2-5

TABLE 2-1 (SHEET 5 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
Offsite Ground Water		Grab sample quarterly	Gamma isotopic, I-131, and tritium analyses of each sample quarterly
Indicator Station: Paper Mill Well (SSE-4)	WGI-07		
Control Station: Whatley Residence Well (SW-1.2)	WGB-10		
Onsite Ground Water	See Table 2-2	Quarterly sample; pump used to sample GW wells; grab sample from yard drains and ponds	Tritium, gamma isotopic, and field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity) of each sample quarterly; Hard to detect radionuclides as necessary based on results of tritium and gamma
River Sediment		Grab sample semiannually	Gamma isotopic analysis of each sample semiannually
Indicator Station: Downstream of plant discharge at Smith's Bend (RM 41)[a]	RSI		
Control Station: Upstream of plant discharge at Andrews Lock & Dam Reservoir (RM 48)[a]	RSB		

TABLE 2-1 (SHEET 6 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
INGESTION Milk		Grab sample semimonthly	Gamma isotopic and I-131 analyses of each sample semimonthly
Control Station: Robert Weir Dairy Donaldsonville, GA (SSE - 14)	MB-0714	NOTE: Samples were no longer available at this location in 2010. No replacement location has been identified.	
Fish		Grab sample semiannually for Game Fish and Bottom Feeding Fish	Gamma isotopic analysis on the edible portions of each sample semiannually
Indicator Stations: Downstream of plant discharge in vicinity of Smith's Bend (RM 41)[b]	FGI & FBI		
Control Station: Upstream of plant discharge in Andrews Lock & Dam Reservoir (RM 48)[b]	FGB & FBB		
Forage		Grab sample monthly.	Gamma isotopic analysis of each sample monthly.
Indicator Station: South Southeast Perimeter (SSE-1.0) North Perimeter (N-0.8)	FI-0701 FI-1601		
Control Station: Dothan, AL (W-18)	FB-1218		

2-7

TABLE 2-1 (SHEET 7 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

NOTATIONS

a. These collections are normally made at river mile 41.3 for the indicator station and river mile 47.8 for the control station; however, due to river bottom sediment shifting caused by high flows, dredging, etc., collections may be made from river mile 40 to 42 for the indicator station and from river mile 47 to 49 for the control station.

b. Since a few miles of river water may be needed to obtain adequate fish samples, these river mile positions represent the approximate locations about which the catches are taken. Collections for the indicator station should be from river mile 37.5 to 42.5 and for the control station from river mile 47 to 52.

TABLE 2-2
Onsite Groundwater Monitoring Locations

WELL	ACQUIFER	MONITORING PURPOSE
R1	Major Shallow aquifer	Dilution line
R2	Major Shallow aquifer	Dilution line
R3	Major Shallow aquifer	Unit 2 RWST
R4	Major Shallow aquifer	Unit 1 RWST
R5	Major Shallow aquifer	Dilution line
R6	Major Shallow aquifer	Dilution line
R7	Major Shallow aquifer	Dilution line
R8	Major Shallow aquifer	Dilution line
R9	Major Shallow aquifer	Dilution line
R10	Major Shallow aquifer	Dilution line
R11	Major Shallow aquifer	Background 1
R13	Major Shallow aquifer	Dilution line
R14	Major Shallow aquifer	Background 2
PW#2	Drinking water	Production Well #2 Supply
PW#3	Drinking water	Production Well #3 Supply
PW#4	Drinking water	Production Well #4 Supply
CW West	Drinking water	Construction Well West Supply
CW East	Drinking water	Construction Well East Supply
FRW	Drinking water	Firing Range Well Supply
SW-1	N/A	Background 3 Service Water Pond
East YD	N/A	Plant outfall East Yard Drain
SE YD	N/A	Plant outfall Southeast Yard Drain

3.0 RESULTS SUMMARY

In accordance with ODCM 7.1.2.1, the summarized and tabulated results for all of the regular samples collected for the year at the designated indicator, community and control stations are presented in Table 3-1. The format of Table 3-1 is similar to Table 3 of the Nuclear Regulatory Commission (NRC) Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program" Revision 1, November 1979. Results for samples collected at locations other than those listed in Table 2-1 are discussed in Section 4 under the particular sample type.

As indicated in ODCM 7.1.2.1, the results for naturally-occurring radionuclides that are also found in plant effluents must be reported along with man-made radionuclides. The radionuclide Be-7, which occurs abundantly in nature, is often detected in REMP samples. It is occasionally detected in the plant's liquid and gaseous effluents. When it is detected in effluents, it is also included in the REMP results. In 2013, Be-7 was not detected in liquid or gaseous effluents at Farley.

TABLE 3-1 (SHEET 1 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Airborne Particulates (fCi/m3)	Gross Beta 463	10	16.7 -0.5-45.5 (204/204)	PC-1101 Plant Entrance 0.9 miles WSW	20.1 -0.5-44.6 (52/52)	16.1 2.1-38.9 (156/156)	18.7 0-40.4 (103/103)
	Gamma Isotopic 36						
	Be-7	24	71.3 43.8-115.4 (16/16)	FB-1218 Dothan, AL 18 miles W	84.6 73.5-92.5 (4/4)	66.6 50.6-84.7 (12/12)	79.4 61.3-94.6 (8/8)
	I-131	70	NDM (0/16)	NA	NDM (0/16)	NDM (0/12)	NDM (0/8)
	Cs-134	50	NDM(c) (0/16)	NA(d)		NDM (0/12)	NDM (0/8)
	Cs-137	60	NDM (0/16)	NA		NDM (0/12)	NDM (0/8)
Airborne Radioiodine (fCi/m3)	I-131 359	70	NDM (0/204)	NA	NDM	NDM (0/52)	NDM (0/104)
Direct Radiation (mR/91 days)	Gamma Dose 160	NA	16.5 10.4-25.7 (64/64)	RI-0401 Plant Perimeter 0.8 miles E	25.3 24.7-25.7 (4/4)	13.8 10.4-17.4 (72/72)	15.1 12.3-20.2 (24/24)
Milk (pCi/l)	Gamma Isotopic 0						
	Cs-134	15	NA	NA		NA	NA
	Cs-137	18	NA	NA		NA	NA
	Ba-140	60	NA	NA		NA	NA
	La-140	15	NA	NA		NA	NA
	I-131	1	NA	NA		NA	NA

3-2

TABLE 3-1 (SHEET 2 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Forage (pCi/kg wet)	Gamma Isotopic 36						
	Be-7	729	1948 (365-4347) (24/24)	FI-1601 N. Perimeter 0.8 miles N	2227 (365-4347) (12/12)	NA	1347 (499-3343) (12/12)
	I-131	60	NDM (0/24)	NA		NA	NDM (0/12)
	Cs-134	60	NDM (0/24)	NA		NA	NDM ((0/12)
	Cs-137	80	NDM (0/24)	FB-1218 Dothan, AL	13.6 (1/12)	NA	13.6 (1/12)
Offsite Ground Water (pCi/l)	H-3 8	2000	81 -58-300 (4/4)	Whatley Residence Well 1.2 miles SW	162 80-251 (4/4)	NA	162 80-251 (4/4)
(g)	I-131 8	1	NDM (0/4)	NA		NA	NDM (0/4)
	Gamma Isotopic 8						
	Mn-54	15	NDM (0/4)	NA		NA	NDM (0/4)
	Fe-59	30	NDM ((0/4)	NA		NA	NDM (0/4)
	Co-58	15	NDM (0/4)	NA		NA	NDM (0/4)
	Co-60	15	NDM (0/4)	NA		NA	NDM (0/4)
	Zn-65	30	NDM (0/4)	NA		NA	NDM (0/4)
	Zr-95	30	NDM (0/4)	NA		NA	NDM (0/4)

TABLE 3-1 (SHEET 3 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Offsite Ground Water cont. (pCi/l)	Nb-95	15	NDM (0/4)	NA		NA	NDM (0/4)
	Cs-134	15	NDM (0/4)	NA		NA	NDM (0/4)
	Cs-137	18	NDM (0/4)	NA		NA	NDM (0/4)
	Ba-140	60	NDM (0/4)	NA		NA	NDM (0/4)
	La-140	15	NDM (0/4)	NA		NA	NDM (0/4)
Surface Water (pCi/l)	H-3 8	3000	203 104-315 (4/4)	Ga Pacific Paper Mill RM 40	202.8 104-315 (4/4)	NA	40 5-85 (4/4)
	Gamma Isotopic 26						
	Be-7	124 (e)	NDM (0/13)	NA		NA	NDM (0/13)
	Mn-54	15	NDM (0/13)	NA		NA	NDM (0/13)
	Fe-59	30	NDM (0/13)	NA		NA	NDM (0/13)
	Co-58	15	NDM (0/13)	NA		NA	NDM (0/13)
	Co-60	15	NDM (0/13)	NA		NA	NDM (0/13)
	Zn-65	30	NDM (0/13)	NA		NA	NDM (0/13)
	Zr-95	30	NDM (0/13)	NA		NA	NDM (0/13)
	Nb-95	15	NDM (0/13)	NA		NA	NDM (0/13)

3-4

TABLE 3-1 (SHEET 4 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Surface Water cont. (pCi/l)	I-131	15 (f)	NDM (0/13)	NA		NA	NDM (0/13)
	Cs-134	15	NDM (0/13)	NA		NA	NDM (0/13)
	Cs-137	18	NDM (0/13)	NA		NA	NDM (0/13)
	Ba-140	60	NDM (0/13)	NA		NA	NDM (0/13)
	La-140	15	NDM (0/13)	NA		NA	NDM (0/13)
Bottom Feeding Fish (pCi/kg wet)	Gamma Isotopic 4						
	Be-7	655 (e)	NDM (0/2)	NA		NA	NDM (0/2)
	Mn-54	130	NDM (0/2)	NA		NA	NDM (0/2)
	Fe-59	260	NDM (0/2)	NA		NA	NDM (0/2)
	Co-58	130	NDM (0/2)	NA		NA	NDM (0/2)
	Co-60	130	NDM (0/2)	NA		NA	NDM (0/2)
	Zn-65	260	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-134	130	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	150	9.4 (1/2)	Downstream, near Smith's Bend (RM 41)		NA	NDM (0/2)

TABLE 3-1 (SHEET 5 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Game Fish (pCi/kg wet)	Gamma Isotopic 4						
	Be-7	655 (e)	NDM (0/2)	NA		NA	NDM (0/2)
	Mn-54	130	NDM (0/2)	NA		NA	NDM (0/2)
	Fe-59	260	NDM (0/2)	NA		NA	NDM (0/2)
	Co-58	130	NDM (0/2)	NA		NA	NDM (0/2)
	Co-60	130	NDM (0/2)	NA		NA	NDM (0/2)
	Zn-65	260	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-134	130	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	150	17.8 16.7-19.0 (2/2)	Downstream, near Smith's Bend (RM 41)	17.8 16.7-19.0 (2/2)	NA	9.5 (1/2)
River Shoreline Sediment (pCi/kg dry)	Gamma Isotopic 4						
	Be-7	655 (e)	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-134	150	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	180	NDM (0/2)	NA		NA	NDM (0/2)

3-6

TABLE 3-1 (SHEET 6 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

NOTATIONS

a. The MDC is defined in ODCM 10.1. Except as noted otherwise, the values listed in this column are the detection capabilities required by ODCM Table 4-3 (Table 4-1 of this report). The values listed in this column are a priori (before the fact) MDCs. In practice, the a posteriori (after the fact) MDCs are generally lower than the values listed. Any a posteriori MDC greater than the value listed in this column is discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at a specified location that are detectable is placed in parentheses.

c. No Detectable Measurement(s).

d. Not Applicable.

e. The EL has determined that this value may be routinely attained under normal conditions. No value is provided in Table 4-1 of this report.

f. If a drinking water pathway exists, a value of 1 pCi/l would be used. See note b of Table 4-1 of this report.

g. Onsite groundwater results are discussed in Section 4.6.

3-7

4.0 DISCUSSION OF RESULTS

Included in this section are evaluations of the laboratory results for the various sample types. The Minimum Detectable Difference compares the lowest significant difference between a control station and an indicator station, or the control station and the community station, that can be determined statistically at the 99% Confidence Level (CL). To calculate MDD an F-test was applied to determine the variability in the data. Once the data was determined to be paired or unpaired, the appropriate t-test (Student's or Welch's) and MDD formulas were applied. MDD as a tool can quantify plant Farley's impact on the surrounding environment, while the t-test adds greater statistical confidence in the data set. A difference in mean values which was less than the MDD was considered to be statistically indiscernible.

The 2013 results were compared with past results, including those obtained during preoperation. As appropriate, results were compared with their Minimum Detectable Concentrations (MDC) and Reporting Levels (RL) which are listed in Tables 4-1 and 4-2 of this report, respectively. The required MDCs were achieved during laboratory sample analysis. Any anomalous results are explained within this report.

Results of interest are graphed to show historical trends. The data points are tabulated and included in this report. The points plotted and provided in the tables represent mean values of only detectable results. Periods for which no detectable measurements (NDM) were observed, or periods for which values were not applicable (e.g., milk indicator, etc.), are plotted as 0's and listed in the tables as NDM.

Atmospheric nuclear weapons tests from the mid 1940's through 1980 distributed man-made nuclides around the world. The most recent atmospheric tests in the 1970's and in 1980 had a significant impact upon the radiological concentrations found in the environment prior to and during preoperation, and the earlier years of operation. Some long-lived radionuclides, such as Cs-137, continue to have some impact.

Significant upward trends also followed the Chernobyl incident, which began on April 26, 1986.

The most significant nuclear event since Chernobyl occurred at Fukushima Daiichi Nuclear Power Plant after the Tohoku earthquake and tsunami on March 11, 2011. Equipment failures and nuclear meltdowns resulted in radioactivity being released into the atmosphere. Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster.

In accordance with ODCM 4.1.1.2.1, deviations from the required sampling schedule are permitted if samples are unobtainable due to hazardous conditions, unavailability, inclement weather, equipment malfunction or other just reasons. Deviations from conducting the REMP as described in Table 2-1 are summarized in Table 4-3 along with their causes and resolutions.

When appropriate, results were tested for conformance with Chauvenet's criterion (G. D. Chase and J. L. Rabinowitz, Principles of Radioisotope Methodology, Burgess Publishing Company, 1962, pages 87-90) to identify values which differed from the mean of a set by a statistically significant amount. Identified outliers were investigated to determine the reason(s) for the variation. If equipment malfunction or other valid physical reasons were identified as causing

the variation, the anomalous result was excluded from the data set as non-representative. No data were excluded exclusively for failing Chauvenet's criterion. Data exclusions are discussed in this section under the appropriate sample type.

Table 4-1

Minimum Detectable Concentrations (MDC)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg) wet	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg) wet	Sediment (pCi/kg) dry
Gross Beta	4	10				
H-3	2000 (a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1 (b)	70		1	60	
Cs-134	15	50	130	15	60	150
Cs-137	18	60	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) If no drinking water pathway exists, a value of 3000 pCi/l may be used.

(b) If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 4-2

Reporting Levels (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg) wet	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg) wet
H-3	20,000 (a)				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-95	400				
Nb-95	700				
I-131	2 (b)	900		3	100
Cs-134	30	10,000	1000	60	1000
Cs-137	50	20,000	2000	70	2000
Ba-140	200			300	
La-140	100			400	

(a) This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.

(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 4-3 (SHEET 4 of 2)

ANOMALIES AND DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLE(S)	ANOMALY (A)* OR DEVIATION (D)**	CAUSE	RESOLUTION
1/1/13 through 7/27/13 (continuation from 2012) CR 489640/TE 640024	Air I and Part. PI-1101/II-1101 0.9 miles WSW	(D) No flow measurement of totalizer display	Flow turbine not operating correctly; no flow indicated on totalizer	Sample flow verified adequate: 48 LPM used as estimating sample. Flow turbine repaired and returned to service on 7/27/13.
February 2013 CR 593347/TE 593697	WRB – Surface Water, Andrews Dam River mile 47	(A) Composite sampling was not continuous and did not cover the entire month.	Sampler out of service for 7.8 days due to flooding conditions	Sampler returned to service on 2/19/13 when river conditions allowed proper operation.
February 2013 CR 593347/ TE 593697	WRI – Surface Water, Georgia Pacific Paper Mill Intake River mile 40	(A) Composite sampling was not continuous and did not cover the entire month.	Sampler out of service for 3.8 days due to flooding conditions	Sampler returned to service on 2/15/13 when river conditions allowed proper operation.
March 2013 CR 609290/ TE 612487	WRI – Surface Water, Georgia Pacific Paper Mill Intake River mile 40	(A) Composite sampling was not continuous and did not cover the entire month.	Sampler out of service for 7.5 days due to a shutdown of the Georgia Pacific Paper Mill.	Sampler returned to service on 3/26/13 following the re-start of the paper mill.
6/18/13 – 6/25/13 CR 661373/TE 661759	Air I and Part. NSD23RM0001 PI-1601, II-1601	(D) Loss of sample due to low sample volume (63 cubic meters)	Loss of power at the sample station due to electrical storms during sample period	Power was restored to sampler on 6/26/13.
7/23/13 – 7/30/13 CR 679230/ TE 680240	Air I and Part. NSD23RM0003 PI-0701, II-0701	(D) Loss of sample due to low sample volume (7 cubic meters)	Loss of power at the sample station due to electrical storms during sample period	Power restored with portable generator on 7/31/13. Normal power supply returned to service on 8/28/13.
7/23/13 -7/30/13 CR 679569/ TE 680262	Air I and Part. NSD23RM0001 PI-1601, II-1601	(D) Loss of sample due to low sample volume (18 cubic meters)	Loss of power at the sample station due to electrical storms during sample period	Power restored on 8/7/13.
7/30/13 -8/6/13 CR 679569/ TE 680262	Air I and Part. NSD23RM0001 PI-1601, II-1601	(D) Sample not obtained	Loss of power at the sample station due to storms during sample period	Power restored by portable electric generator on 8/7/13. Normal power supply restored 8/28/13

4-4

TABLE 4-3 (SHEET 5 of 2)

ANOMALIES AND DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Third Quarter 2013 CR 710803	GWPP PW#3	(D) Sample not obtained	PW #3 was danger tagged as part no flow boundary for Filtered Water Storage Tank	Equipment was returned to service and sample obtained as required for the fourth quarter
Third Quarter and Fourth Quarter 2013 CR 710803	GWPP CW#1	(D) Sample not obtained	CW #1 was not sampled due to operational problems with Construction Well West Water Pump, which supplies motive force for sample flow.	The Construction Well West Water Pump is still inoperable, SNC514635.
9/25/13 – 10/1/13 CR 711412	Air I and Part. PB-0215, IB-0215	(D) Loss of sample due to low sample volume	Loss of power due to billing issues that led to power cut off by city of Blakely, GA.	Billing issues were resolved and power restored on 10/2/13.

* An anomaly is considered a non-standard sample that still meets sampling criteria outlined in Southern Nuclear and Georgia Power Labs procedures.

** A deviation is a sample result that is excluded due to not meeting scheduling and/or procedural requirements as outlined by Southern Nuclear and Georgia Power Labs

4-5

4.1 Land Use Census

In accordance with ODCM 4.1.2, a land use census was conducted during the month of November 2013. The land use census is used to determine the locations of the nearest permanent residence and milk animal in each of the 16 compass sectors within a distance of 5 miles. A milk animal is a cow or goat producing milk for human consumption. The 2013 survey revealed no significant changes from the 2012 survey. No milk animals were found within a 5 mile distance. The census results are tabulated in Table 4.1-1.

Table 4.1-1

LAND USE CENSUS RESULTS
Distance in Miles to the Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL
N	2.6	none
NNE	2.5	none
NE	2.4	none
ENE	2.4	none
E	2.8	none
ESE	3.0	none
SE	3.4	none
SSE	>5	none
S	4.3	none
SSW	2.9	none
SW	1.2	none
WSW	2.4	none
W	1.3	none
WNW	2.1	none
NW	1.5	none
NNW	3.4	none

The Houston County, Alabama and the Early County, Georgia Extension Agents were contacted for assistance in locating commercial dairy farms and privately owned milk animals within 5 miles of the plant. A list of commercial dairy farms in Houston County, AL and Seminole County, GA was provided; there are no commercial dairy farms in Early County, GA. Neither agent knew of privately owned milk animals within 5 miles of FNP. In addition, field surveys were conducted in the plant vicinity along the state and county highways and the interconnecting secondary roads. No milk animals were found within 5 miles of the plant.

A river survey performed for Plant Farley in early 2014 identified a potential use of water from the Chattahoochee River, downstream of the plant discharge at a distance of approximately 2 miles. In July 2013, the Georgia Department of Natural Resources issued a farm use permit to withdraw from the Chattahoochee River to the Nature Conservancy of Georgia. The Nature Conservancy of Georgia leases property along the river for agricultural and grazing purposes to a private farm family, and water from the river could potentially be used for crop irrigation

It is not known, at the time of this report, if the property lessee (farmer) has exercised permit rights to withdraw from the river. Plant Farley is pursuing this information from the farmer and will request future crop samples from the farmer if, and when, water is withdrawn from the river for irrigation of crops. Additionally CR 740059 was written to investigate adding a river use survey to the REMP program. A revision to procedure FNP-0-ENV0191 has since been approved and a river use survey will be a program requirement starting in late 2014.

ODCM 4.1.2.2.1 requires a new controlling receptor to be determined, if the land use census identifies a location that yields a calculated receptor dose greater than the one in current use. Neither current sampling locations nor the controlling receptor were affected by the 2013 land use census results. The current controlling receptor as described in ODCM Table 3-7 remains a child in the SW Sector at 1.2 miles.

4.2 Airborne

As specified in Table 2-1 and shown in Figures 4.2-1 and 4.2-2, airborne particulate filters and charcoal canisters are collected weekly at 4 indicator, 3 control, and 3 community stations. Particulate filters are collected at all of the stations while the charcoal canisters are collected at all but 2 of the community stations. At each location, air is continuously drawn through a glass fiber filter to retain airborne particulates and, as appropriate, an activated charcoal canister is placed in series to adsorb radioiodine. Each particulate filter is counted for gross beta activity. A quarterly gamma isotopic analysis is performed on a composite of the air particulate filters for each station. Each charcoal canister is analyzed for I-131.

As provided in Table 3-1, the 2013 annual average weekly gross beta activity was 16.7 fCi/m^3 at the indicator stations and 18.7 fCi/m^3 at the control stations. MDD was not calculated because the control station average was higher than the indicator location average. The 2013 annual average weekly gross beta concentration was 16.1 fCi/m^3 at the community stations. The community stations average was 2.6 fCi/m^3 less than the average for the control stations. MDD was not calculated because the control station average was higher than that of the community station average.

Due to the weapons tests during preoperation and the early years of operation, the average gross beta concentrations were 5 to 10 times greater than those currently being measured. By the mid 1980s, the readings had diminished to about half the current levels. These annual averages approximately doubled as a consequence of the Chernobyl incident in 1986; this impact faded away in approximately 2 years. The installation of new air monitoring equipment in 1992 yielded an approximate factor of 2 increase in the readings. Since then, the levels have not varied significantly.

The nuclear accident at Fukushima Daiichi Nuclear Power Plant which occurred after the Tohoku earthquake and tsunami on March 11, 2011 released radioactivity into the environment that was detected in Farley air samples. Iodine-131 was detected in air cartridges after Fukushima but no changes in gross beta activity were seen during that same time period.

The historical trending of the average weekly gross beta air concentrations for each year of operation and the preoperational period at the indicator, control and community stations is plotted in Figure 4.2-1 and listed in Table 4.2-1. Historical values for the mean gross beta and values for 2013 support the position that the plant's contribution to gross beta concentration in air is insignificant.

Figure 4.2-1

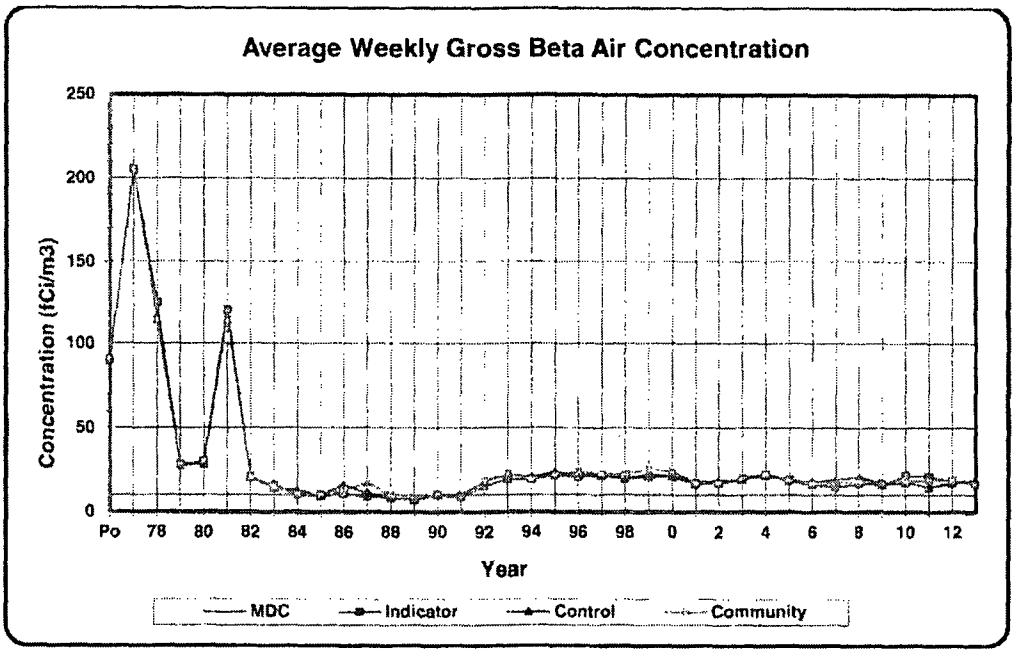

Average Weekly Gross Beta Air Concentration
Concentration (fCi/m3)
250
200
150
100
50
0
Po
78
80
82
84
86
88
90
92
94
96
98
0
2
4
6
8
10
12
Year
MDC
Indicator
Control
Community

Table 4.2-1

Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	90	92	91
1977	205	206	206
1978	125	115	115
1979	27.3	27.3	28.7
1980	29.7	28.1	29.2
1981	121	115	115
1982	20.0	20.4	21.0
1983	15.5	14.1	14.5
1984	10.2	12.6	10.5
1985	9.0	9.6	10.3
1986	10.5	15.8	12.5
1987	9.0	11.0	17.0
1988	8.0	8.0	10.0
1989	7.0	7.0	8.0
1990	10.0	10.0	10.0
1991	9.0	10.0	8.0
1992	15.0	17.9	18.5
1993	19.1	22.3	22.4
1994	19.0	20.0	19.0
1995	21.7	22.9	21.6
1996	20.3	22.3	23.5
1997	21.1	21.6	22.4
1998	20.6	19.3	22.0
1999	20.5	22.1	25.2
2000	20.9	20.8	23.6
2001	16.3	17.2	17.3
2002	16.8	18.0	16.8
2003	19.1	19.3	19.9
2004	22.0	21.3	22.4
2005	18.4	19.3	19.0
2006	16.1	17.5	16.8
2007	14.5	18.9	17.3
2008	16.7	20.6	18.0
2009	16.2	16.3	17.3
2010	21.2	17.5	18.2
2011	20.9	14.5	18.2
2012	18.0	17.3	18.9
2013	16.7	18.7	16.1

During 2013, Be-7 was the only radioisotope detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters. This has generally been the case since the impact of the weapons tests and the Chernobyl incident have faded.

Be-7 is naturally occurring and was not detected in Farley's gaseous effluents. The average Be-7 at the indicator stations was 71.3 fCi/m^3 and the average at the control stations was 79.4 fCi/m^3. MDD was not calculated because the control station average was higher than that of the indicator station average. The average Be-7 at the community stations was 66.6 fCi/m^3. MDD was not calculated because the control station average was higher than that of the community station average. There is no required MDC or Reporting Level for Be-7.

During preoperation and the early years of operation, a number of fission and activation products were detected. During preoperation, the average levels for Cs-134 and Cs-137 were 22 and 9 fCi/m^3, respectively. In 1986, as a consequence of the Chernobyl incident, Cs-134 and Cs-137 levels of 3 to 4 fCi/m^3 were found. The MDC and RL for Cs-134 are 50 and 10,000 fCi/m^3 and the MDC and RL for Cs-137 are 60 and 20,000 fCi/m^3 respectively.

The historical trending of the annual detectable Cs-137 concentrations for the indicator, control and community stations is provided in Figure 4.2-2 and Table 4.2-2. The trend has been generally downward since preoperation and no positive results have been observed since 1988.

Figure 4.2-2

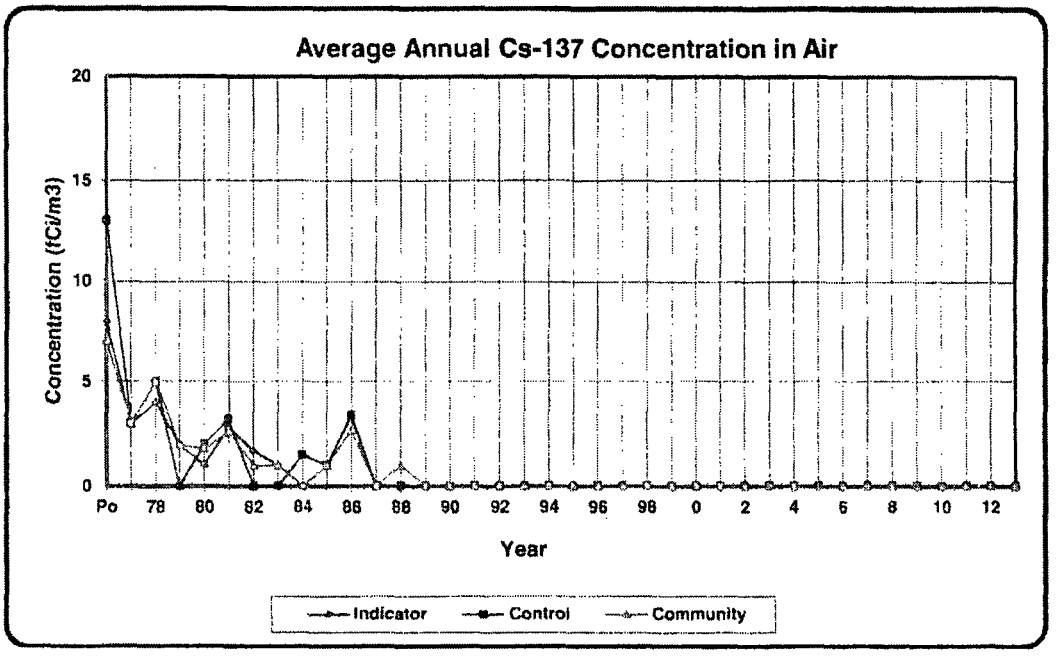

Average Annual Cs-137 Concentration in Air
Concentration (fCi/m3)
20
15
10
5
0
Po
78
80
82
84
86
88
90
92
94
96
98
0
2
4
6
8
10
12
Year
Indicator
Control
Community

Table 4.2-2

Average Annual Cs-137 Concentration in Air

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	8	13	7
1977	3.0	3.0	3.0
1978	4.0	5.0	5.0
1979	2.0	NDM	2.0
1980	1.0	2.0	1.8
1981	2.8	3.2	2.6
1982	1.7	NDM	1.0
1983	1.0	NDM	1.0
1984	NDM	1.5	NDM
1985	1.0	1.0	1.0
1986	3.3	3.4	2.7
1987	NDM	NDM	NDM
1988	NDM	NDM	1
1989	NDM	NDM	NDM
1990	NDM	NDM	NDM
1991	NDM	NDM	NDM
1992	NDM	NDM	NDM
1993	NDM	NDM	NDM
1994	NDM	NDM	NDM
1995	NDM	NDM	NDM
1996	NDM	NDM	NDM
1997	NDM	NDM	NDM
1998	NDM	NDM	NDM
1999	NDM	NDM	NDM
2000	NDM	NDM	NDM
2001	NDM	NDM	NDM
2002	NDM	NDM	NDM
2003	NDM	NDM	NDM
2004	NDM	NDM	NDM
2005	NDM	NDM	NDM
2006	NDM	NDM	NDM
2007	NDM	NDM	NDM
2008	NDM	NDM	NDM
2009	NDM	NDM	NDM
2010	NDM	NDM	NDM
2011	NDM	NDM	NDM
2012	NDM	NDM	NDM
2013	NDM	NDM	NDM

Airborne I-131 was not detected in charcoal canister samples in 2013. As discussed earlier in this section, I-131 activity was detected in 2011 (ranging from 32.5 to 115.0 fCi/m^3) and was attributed to the Fukushima nuclear accident. In 1978, levels between 40 and 50 fCi/m^3 were found in a few samples and attributed to the Chinese weapons tests; then after the Chernobyl incident, levels up to a few hundred fCi/m^3 were found in some samples. At no other times has airborne I-131 been detected in the environmental samples. The MDC and RL for airborne I-131 are 70 and 900 fCi/m^3 respectively.

Table 4-3 lists REMP deviations that occurred during 2013. There were six sampling deviations related to air sampling listed in Table 4-3. One issue was with the sampler flow totalizer display and resulted in estimated flow rates being used after adequate flow was verified. Five deviations were related to loss of power at the sampling stations. This resulted in non-representative samples that were not retained for use in the data for this report.

4.3 Direct Radiation

Direct (external) radiation was measured with Landauer InLight optically stimulated luminescent (OSL) dosimeters, which replaced the Panasonic thermoluminescent dosimeters (TLDs). Two OSL badges are placed at each station. Each badge contains two elements composed of aluminum oxide crystals with carbon impurity. The gamma dose at each station is based upon the average readings of the elements from the two badges. The two badges for each station are placed in thin plastic bags for protection from moisture while in the field. The badges are nominally exposed for periods of a quarter of a year (91 days). An inspection is performed near mid-quarter for offsite badges to assure that the badges are on-station and to replace any missing or damaged badges.

Direct radiation stations are established in each of the 16 sectors, to form 2 concentric rings. The inner ring stations are located near the plant perimeter, as shown in Figure 2-1, and the outer ring stations are located at distances of approximately 3 to 5 miles from the plant, as shown in Figure 2-2. The stations forming the inner ring are designated as the indicator stations. The 6 control stations are located at distances greater than 10 miles from the plant, as shown in Figure 2-3. Stations are also provided which monitor special interest areas: the nearest occupied residence (SW at 1.2 miles), as shown in Figure 2-1, and the city of Ashford (WSW at 8 miles), as shown in Figure 2-3. The 16 outer ring stations and the 2 special interest stations are designated as community stations.

As provided in Table 3-1, the average quarterly exposure measured at the indicator stations (inner ring) during 2013 was 16.5 mR which was 1.4 mR greater than the 15.1 mR measured at the control stations. This difference is statistically discernible since it is larger than the MDD of 1.2 mR. However results of the indicator and control stations are consistent in magnitude and historical trends indicating no environmental impact.

The average quarterly exposure measured at the community stations was 13.8 mR. The community station average was 1.3 mR less than the average for the control stations. MDD was not calculated because the control station average was higher than the community location average. The results of the community and control stations are consistent in magnitude and historical trends indicating no environmental impact.

The historical trending of the average quarterly exposures in units of mR at the indicator, control, and community locations are plotted in Figure 4.3-1 and listed in Table 4.3-1. During preoperation the average exposure at the indicator stations was 1.2 mR greater than that for the control stations, compared to the average over the entire period of operation which was 1.3 mR greater. During preoperation, the average exposure at the control stations was 1.3 mR greater than that at the community stations and the average over the period of operation was 1.3 mR greater. This supports the position that the plant is not contributing significantly to direct radiation in the environment.

During 2010, OSL badges were co-located on station with the TLD badges. In 2011, only the OSL badges were placed at each station. Following the change to only OSL badges, the differences between indicator, control, and community locations has been consistent with previous years. An increase noted in 2010 reflects issues (especially during 2nd Qtr) with the aging Panasonic TLD reader.

Figure 4.3-1

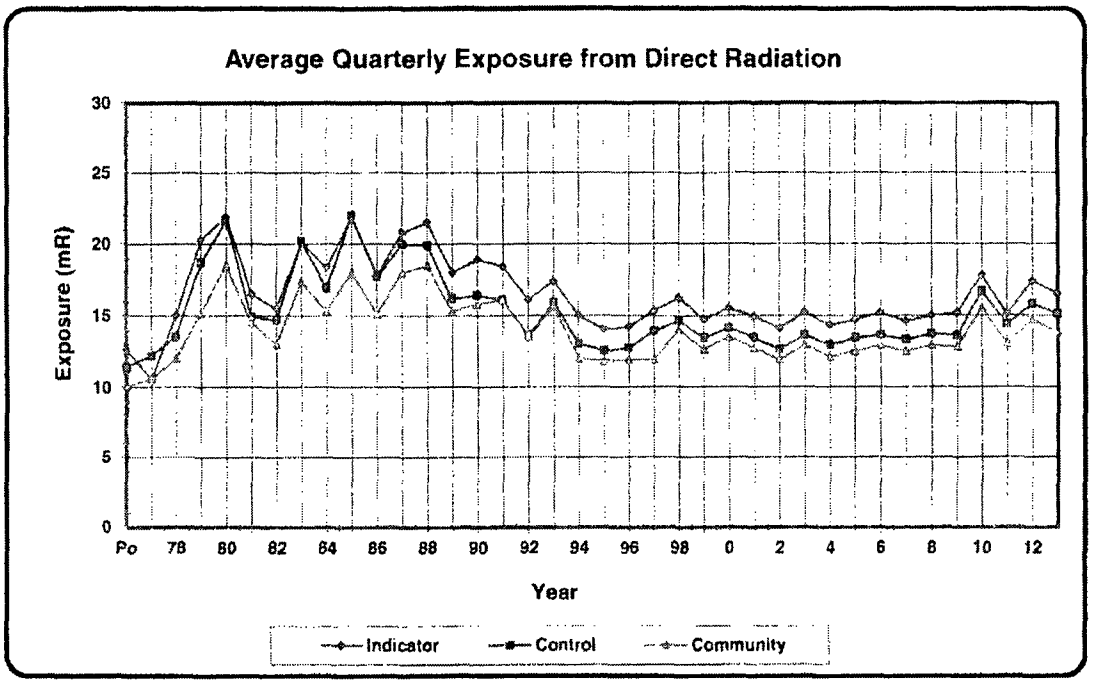


Table 4.3-1

Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Community (mR)
Pre-op	12.6	11.4	10.1
1977	10.6	12.2	10.6
1978	15.0	13.5	12.0
1979	20.3	18.7	15.2
1980	21.9	21.6	18.5
1981	16.5	14.9	14.5
1982	15.5	14.7	13.0
1983	20.2	20.2	17.4
1984	18.3	16.9	15.3
1985	21.9	22.0	18.0
1986	17.8	17.7	15.1
1987	20.8	20.0	18.0
1988	21.5	19.9	18.5
1989	18.0	16.2	15.3
1990	18.9	16.4	15.8
1991	18.4	16.1	16.1
1992	16.1	13.6	13.5
1993	17.4	15.9	15.6
1994	15.0	13.0	12.0
1995	14.0	12.5	11.8
1996	14.2	12.7	11.9
1997	15.3	13.9	11.9
1998	16.2	14.6	13.9
1999	14.7	13.4	12.6
2000	15.5	14.1	13.5
2001	14.9	13.4	12.7
2002	14.1	12.6	11.9
2003	15.2	13.6	12.9
2004	14.3	12.9	12.1
2005	14.7	13.4	12.5
2006	15.2	13.6	12.9
2007	14.6	13.3	12.5
2008	15.0	13.7	12.9
2009	15.2	13.6	12.8
2010	17.8	16.7	15.5
2011	15.1	14.4	13.0
2012	17.4	15.8	14.7
2013	16.5	15.1	13.8

The standard deviation for the quarterly result for each Landauer OSL badge was subjected to a self imposed limit of 3.5. Previously with TLDs, this limit had been 1.4. However, the OSL readings varied more (between the two elements) than the TLD readings (between the three phosphors). This limit is calculated using a method developed by the American Society for Testing and Materials (ASTM) (ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976). The calculation is based upon the standard deviations obtained by the EL with the OSL badges during 2010. All of the dosimeters are read twice. The second read is not used unless the first read appears too variable. If both readings are above 3.5, an investigation is conducted to determine if there are true environmental differences in an OSL.

In 2013, the following OSL results were investigated because their standard deviations were greater than or equal to 3.5:

First Quarter	None
Second Quarter	None
Third Quarter	None
Fourth Quarter	None

No badges at any station were investigated for having a standard deviation greater than or equal to 3.5 in 2013.

4.4 Milk

Milk samples had been collected biweekly from a control location until the end of 2009 when the dairy would no longer provide samples. No indicator station (a location within five miles of the plant) has been available for milk sampling since 1987. As discussed in Section 4.0, no milk animals were found within five miles of the plant during the 2012 land use census therefore no milk sampling was performed during 2013.

Per Table 2.1, gamma isotopic analyses were performed on milk samples when they were collected in previous years. Cs-137 and I-131 are the only man-made radionuclides that have been identified over the history of milk sampling. The historical trending of the average annual detectable Cs-137 concentration in milk samples is shown in Figure 4.4-1 and Table 4.4-1. Cs-137 has not been detected in milk since 1986. Its presence at that time is attributed to the Chernobyl incident. The earlier detectable results were attributed to weapons testing. The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively.

Figure 4.4-1

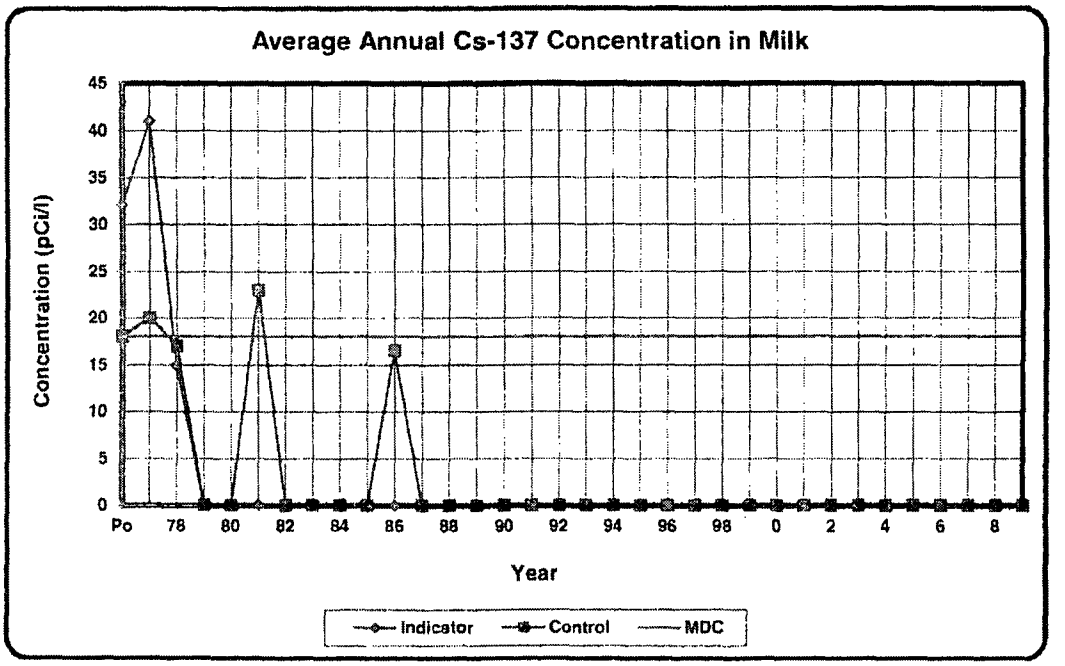


Table 4.4-1

Average Annual Cs-137 Concentration in Milk

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	32	18
1977	41	20
1978	15	17
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	23.0
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	16.5
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	No sample	No sample
2011	No sample	No sample
2012	No sample	No sample
2013	No sample	No sample

As specified in Table 2-1, milk samples were also analyzed for I-131, which has not been detected in milk since 1986. The presence of I-131 at that time is attributed to the Chernobyl incident. The earlier detectable results were attributed to weapons testing. The MDC and RL for I-131 are 1 and 3 pCi/l, respectively. Figure 4.4-2 and Table 4.4-2 show the historical trending of the average annual detectable I-131 concentration in milk samples.

Figure 4.4-2

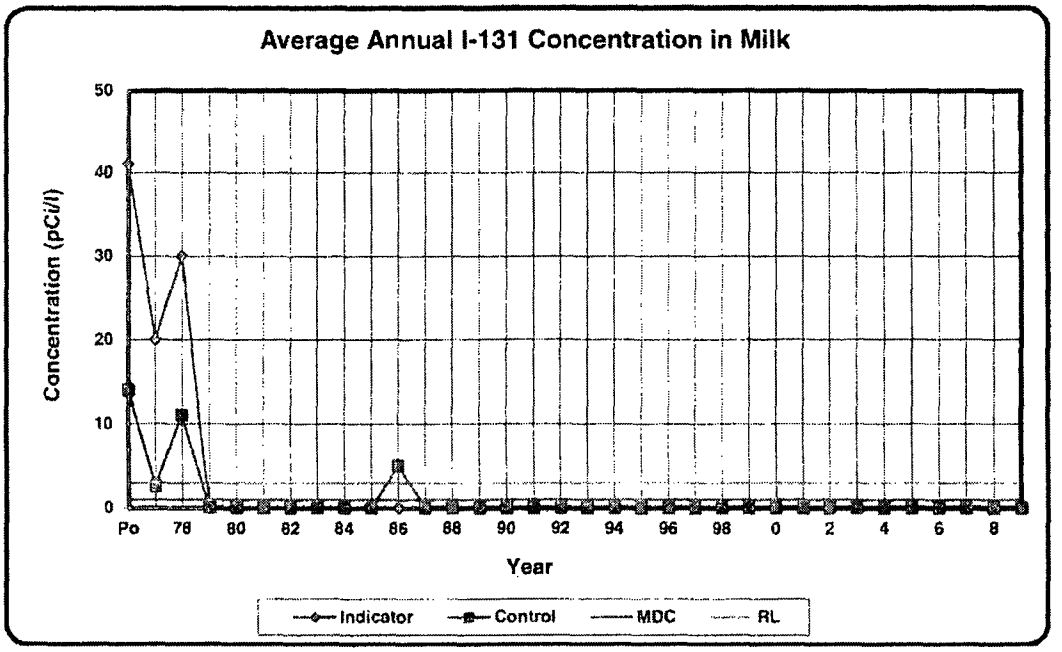


Table 4.4-2

Average Annual I-131 Concentration in Milk

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	41	14
1977	20	2.6
1978	30	11
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	NDM
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	5.0
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	No sample	No sample
2011	No sample	No sample
2012	No sample	No sample
2013	No sample	No sample

4.5 Forage

In accordance with Table 2-1, forage samples are collected monthly at two indicator stations on the plant perimeter, and at one control station located approximately 18 miles west of the plant, in Dothan. Gamma isotopic analyses are performed on each sample.

During preoperation and the years of operation through 1986 (the year of the Chernobyl incident), Cs-137 was typically found in about a third of the 35 to 40 forage samples collected per year. In 1987 and 1988 the number dropped to about a seventh of the total samples and from 1989 through 1994, it was only found in one or two samples every year. From 1994 to 2006, Cs-137 was detected in only a few samples, three indicator samples and three control samples.

In 2013, Cs-137 was detected in one of the 12 control samples, at 13.6 pCi/kg wet, and in none of the 24 indicator samples. The occasional presence of Cs-137 in vegetation samples is attributed primarily to fallout from nuclear weapons tests and from the Chernobyl incident. The MDC and RL for Cs-137 in forage are 80 and 2000 pCi/kg wet, respectively. Table 4.5-1 presents the average detectable results of Cs-137 found in forage over the life of the plant and Figure 4.5-1 shows the historical trending of this data.

Be-7 is naturally occurring and it was not detected in liquid or gaseous effluent samples in 2013. Because it has been detected in plant effluents in previous years, it was reported when detected in REMP samples in 2013. All forage indicator and control samples were positive for Be-7. The average Be-7 at the indicator stations was 1948 pCi/kg wet and the average at the control station was 1347 pCi/kg wet. The difference of 601 pCi/kg wet is more than the MDD of 546 pCi/kg wet and therefore is statistically discernible. The results from both the indicator and control stations are consistent with historical trends, and there were no Be-7 effluent releases from the plant in 2013 therefore it is unlikely these results prove environmental impact from Plant Farley. There is no Required MDC or Reporting Level for Be-7.

Figure 4.5-1

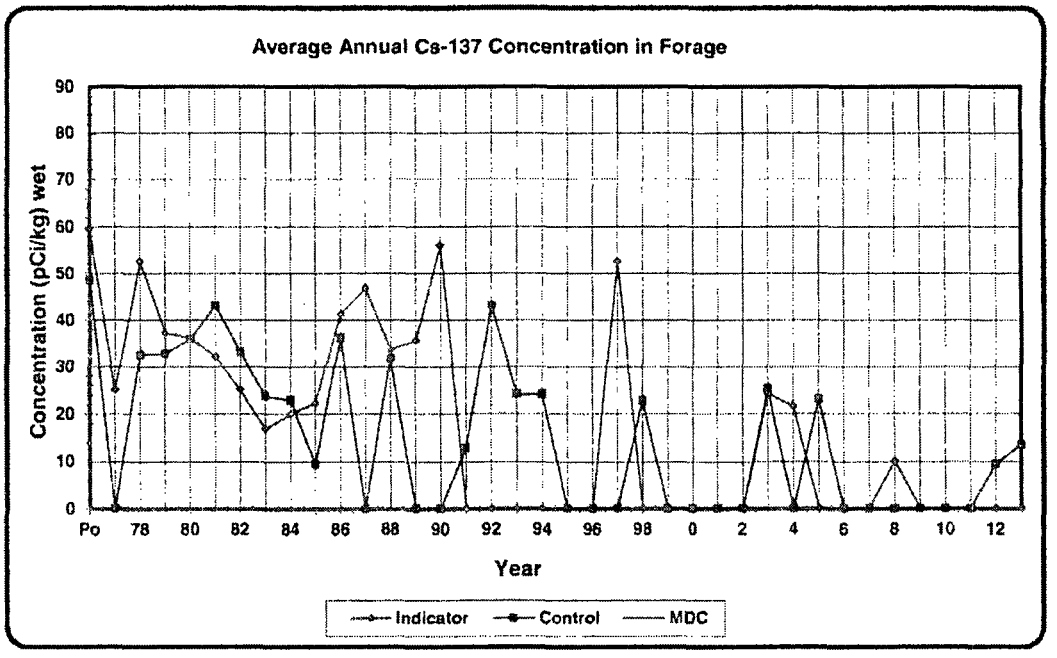

Average Annual Cs-137 Concentration in Forage
Concentration (pCi/kg) wet
90
80
70
60
50
40
30
20
10
0
Po
78
80
82
84
86
88
90
92
94
96
98
0
2
4
6
8
10
12
Year
Indicator
Control
MDC

Table 4.5-1

Average Annual Cs-137 Concentration in Forage

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	59.4	48.6
1977	25.0	NDM
1978	52.5	32.5
1979	37.2	32.8
1980	36.2	35.9
1981	32.1	43.1
1982	25.0	33.1
1983	16.8	23.6
1984	19.9	22.8
1985	22.2	9.5
1986	41.2	36.2
1987	46.8	NDM
1988	33.6	31.7
1989	35.7	NDM
1990	56.0	NDM
1991	NDM	12.9
1992	NDM	43.0
1993	NDM	24.0
1994	NDM	24
1995	NDM	NDM
1996	NDM	NDM
1997	52.6	NDM
1998	NDM	22.7
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	24.1	25.2
2004	21.6	NDM
2005	NDM	23.1
2006	NDM	NDM
2007	NDM	NDM
2008	10.1	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM
2012	NDM	9.4
2013	NDM	13.6

During preoperation and in the early years of operation, I-131 was found in 10% to 25% of the forage samples at very high levels which ranged from around 100 to 1,000 pCi/kg wet. In 1986 (Chernobyl incident), I-131 reappeared after not having been detected for 3 years. In March 2011, after the nuclear accident at Fukushima Daiichi Nuclear Power Plant, Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster. Iodine-131 was detected in one forage sample (20.4 pCi/kg wet) at Farley (the North Perimeter indicator station) after the Fukushima event.

In 2013, I-131 was not detected in any of the forage samples at the indicator or control locations. The MDC and RL for I-131 are 60 and 100 pCi/kg wet, respectively. Table 4.5-2 lists the average detectable results of I-131 found in forage over the life of the plant and Figure 4.5-2 plots the historical trending of this data.

Figure 4.5-2

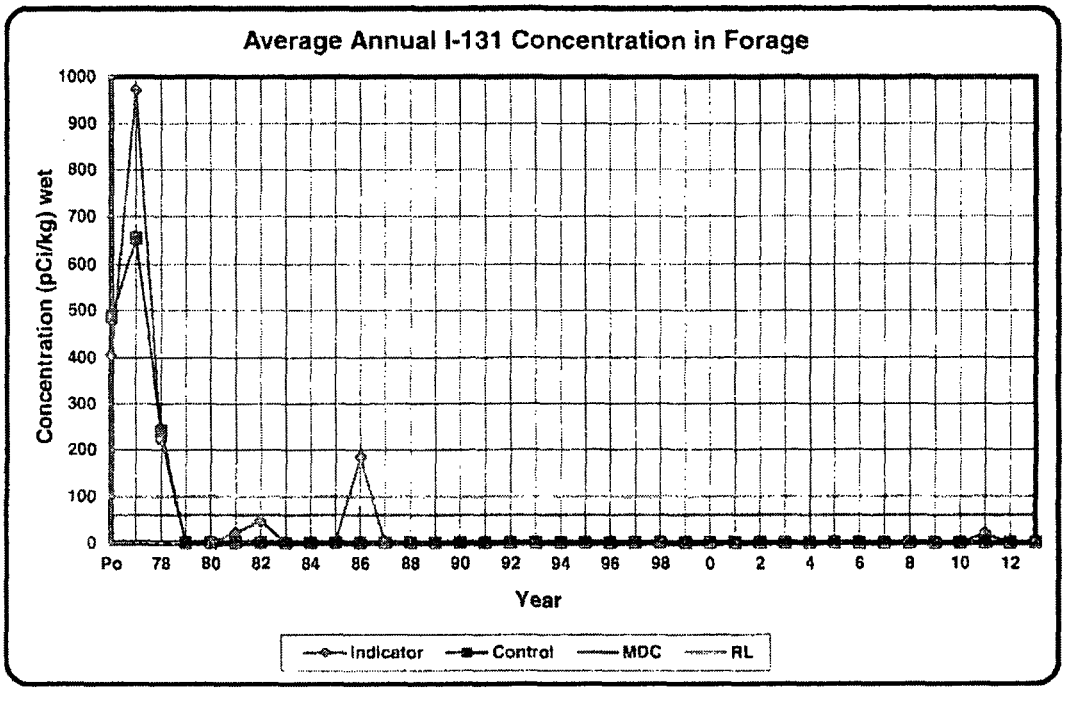


Table 4.5-2

Average Annual I-131 Concentration in Forage

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	405	486
1977	971	654
1978	220	240
1979	NDM	NDM
1980	NDM	NDM
1981	21.4	NDM
1982	46.4	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	184	NDM
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	20.4	NDM
2012	NDM	NDM
2013	NDM	NDM

These forage analyses results show the impact of the weapons tests during preoperation and the early years of operation and of the Chernobyl incident in 1986 and for a few years afterwards. The impact is reflected by the number of different radionuclides detected, the fraction of samples with detectable results, as well as the magnitude of the results. During preoperation and for the first few years of operation, 11 different radionuclides from fission and activation products were detected. By 1985, only 2 different radionuclides were detected and the fraction of samples with detectable results had diminished. In 1986, the same two nuclides as seen in 1985 appeared at a significantly higher magnitude and I-131 reappeared. In the years following 1986, only Cs-137 has been found in forage and it has been found in a decreasing fraction of the samples.

4.6 Ground Water

In the FNP offsite environs, there are no true indicator sources of ground water. A well, located about four miles south-southeast of the plant on the east bank of the Chattahoochee River, serves Georgia Pacific Paper Company as a source of potable water and is designated as the indicator station. A deep well located about 1.2 miles southwest of the plant, which supplies water to the Whatley residence, is designated as the control station. Samples are collected quarterly and analyzed for gamma isotopic, I-131 and tritium as specified in Table 2-1. In 2013, the only radionuclide detected in any of the ground water samples from either sample station was tritium. Tritium at the control stations averaged 162 pCi/l while the indicator station results had an average of 81 pCi/l. All positive detections at both stations were in the range of the environmental background of approximately 350 pCi/L (+/- 250 pCi/L). MDD was not calculated because the control station average was larger than the indicator average, and due to the low number of samples available to compare the data sets.

In 1983, 1985, and 1986, Cs-134 was detected in single samples at levels ranging from 3 to 13 pCi/l. The MDC and RL for Cs-134 in water are 15 and 30 pCi/l, respectively.

During preoperation, Cs-137 was detected in two of the samples at levels of 15 and 17 pCi/l. Then in 1984 and 1985, Cs-137 was again detected in a few samples with levels ranging from 4 to 5 pCi/l. The MDC and RL for Cs-137 in water are 18 and 50 pCi/l, respectively.

Iodine-131 has never been detected in ground water samples. From 1986-2003, no radionuclides were detected. Since 2004, tritium has been detected at very low concentrations (near the instrument detection level) and close to environmental background concentration which is approximately 350 pCi/l (+/- 250 pCi/l) in the area around Farley. The positive results seen in these years were less than 3% of the reporting level for tritium. The MDC and RL for tritium in drinking water are 2,000 and 20,000 pCi/l, respectively. Figure 4.6-1 and Table 4.6-1 show the historical trending of the average annual detectable tritium concentration in offsite ground water.

Figure 4.6-1

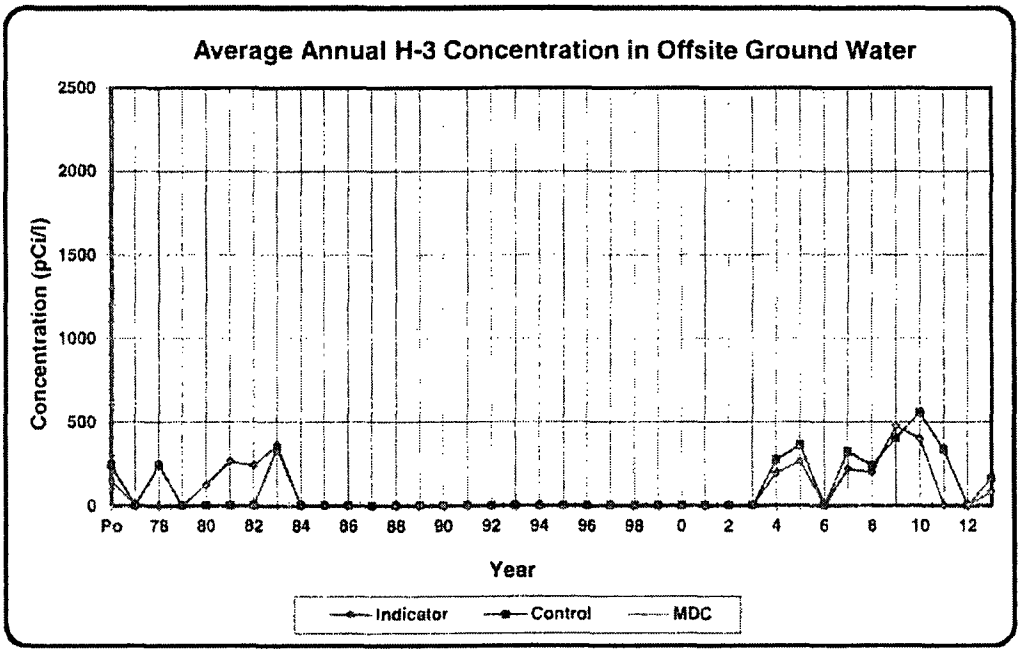

Average Annual H-3 Concentration in Offsite Ground Water
Concentration (pCi/l)
2500
2000
1500
1000
500
0
Po 78 80 82 84 86 88 90 92 94 96 98 0 2 4 6 8 10 12
Year
Indicator
Control
MDC

Table 4.6-1

Average Annual H-3 Concentration in Offsite Ground Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	150	240
1977	NDM	NDM
1978	NDM	240
1979	NDM	NDM
1980	124	NDM
1981	264	NDM
1982	240	NDM
1983	360	341
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	NDM
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	194	271
2005	264	360
2006	NDM	NDM
2007	218	321
2008	196	237
2009	474	401
2010	400	556
2011	NDM	333
2012	NDM	NDM
2013	81	162

As nuclear plants began to undergo decommissioning in the late 1990's to early 2000s, instances of subsurface and/or groundwater contamination were identified. In addition, several operating facilities also identified groundwater contamination resulting from spills, leaks, and equipment failure. In one instance, low levels of licensed material were detected in a private well located on property adjacent to a nuclear power plant.

In 2006, NEI (Nuclear Energy Institute) formed a task force to address monitoring onsite groundwater for radionuclides at nuclear facilities. A Groundwater Protection Initiative was developed which was adopted by all U.S. commercial operating nuclear plants.

The NRC also formed a task force to study the groundwater issues and released Information Notice 2006-13, *Ground-water Contamination due to Undetected Leakage of Radioactive Water*, which summarized its review of radioactive contamination of ground water at multiple facilities as a result of undetected leakage from structures, systems, and components that contain or transport radioactive fluids. Licensees were instructed to review the information for applicability and to consider appropriate actions to avoid similar problems.

The NEI task force felt it was prudent for the industry to update site hydrology information and to develop radiological groundwater monitoring plans at each site. These groundwater protection plans would ensure that underground leaks and spills would be addressed promptly. Additionally, the task force recommended developing a communications protocol to report radioactive leaks or spills that have or could enter groundwater to the NRC and State / Local government officials as needed. NEI-07-07, *Industry Groundwater Protection Final Guidance Document*, was developed by the task force to document the guidelines recommended for the industry.

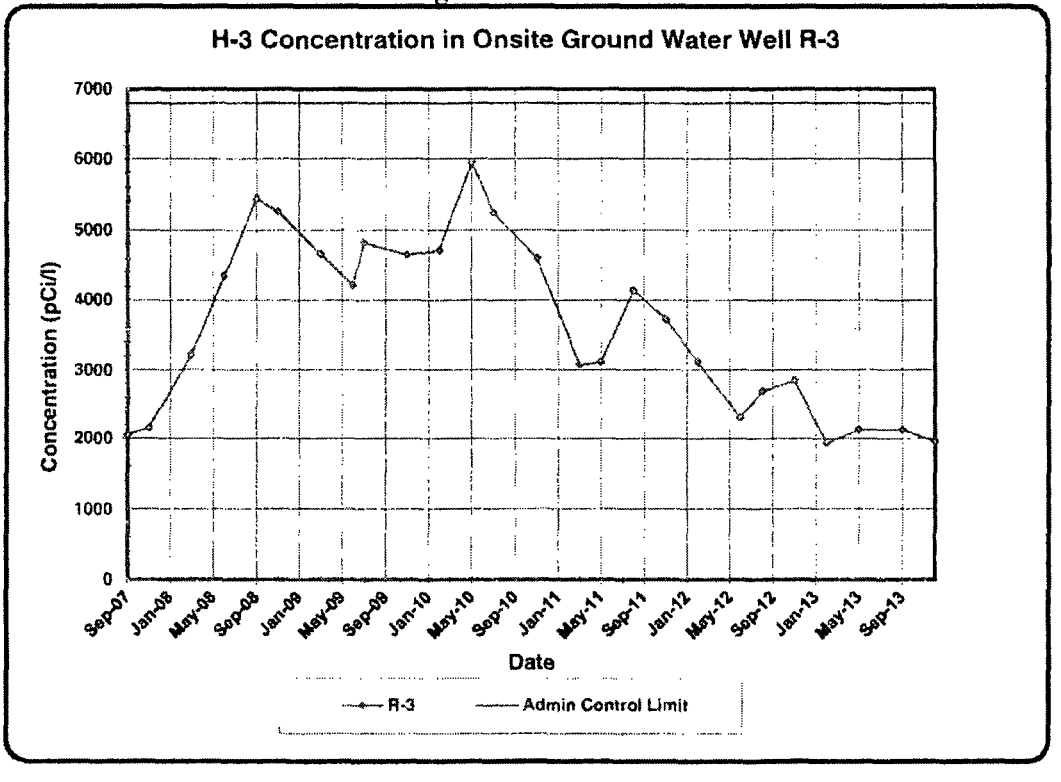
To ensure compliance with NEI-07-07, Southern Nuclear developed the Nuclear Management Procedure, *Radiological Groundwater Protection Program*. The procedure contains detailed site-specific monitoring plans, program technical bases, and communications protocol (to ensure that radioactive leaks and spills are addressed and communicated appropriately). In an effort to prevent future leaks of radioactive material to groundwater, SNOC plants have also established robust buried piping and tanks inspection programs.

In 2006, Farley located several old onsite piezometer wells and sampled these and the onsite drinking water wells for tritium and gamma isotopic activity. None of these wells contained detectable amounts of radioactivity. In 2007, after the site hydrology was evaluated, Farley implemented a more extensive radiological groundwater monitoring program which included drilling twelve new onsite monitoring wells (see Table 2-2). The twelve new wells along with one of the existing piezometer wells, the onsite drinking water wells, and several surface water / discharge locations comprise the monitoring program. These locations were sampled twice in the latter portion of 2007 and sampled quarterly in 2008. Of the numerous samples taken from 2007 through 2013 (from the locations described above), only one location (groundwater well R-3) has shown low levels of radiological contamination (see Figure 4.6-2). Tritium was the only nuclide identified. R-3 was also analyzed for gamma emitters (quarterly) and strontium (initially and after an increase was noted) and these were not detected. This well is located near the Protected Area and in the vicinity of the site where the Unit-2 radioactive effluent discharge line ruptured in 2002.

In 2010, an Administrative Control Limit (ACL) was established for the area near R-3 where legacy material has been the source of tritium. The quarterly results for R-3 were all below the ACL of 6800 pCi/L of tritium. The ACL was derived based on previous years' tritium results and total measurement uncertainty. There are no reporting requirements associated with exceeding an ACL but additional actions would be taken to verify no new sources of tritium if an ACL was exceeded.

In 2013, R-3 continued to be the only monitoring well with tritium concentrations consistently above the environmental background. The November 28, 2012 sample of R-8 was slightly above the environmental background at 573 p/Ci/l (+/- 213 pCi/l). The well returned to background level concentrations in 2013.

Figure 4.6-2



4.7 Surface Water

As specified in Table 2-1 and shown in Figure 2-2, water samples are collected from the Chattahoochee River at a control station approximately 3 miles upstream of the intake structure and at an indicator station approximately 4 miles downstream of the discharge structure. Small quantities are collected during the week at periodic intervals using automatic samplers. For each station, one liter from each of four consecutive weekly samples is combined into a composite sample which is analyzed for gamma emitters. In addition, 0.075 liters is collected from 13 consecutive weekly samples for each station to form composite quarterly samples which are analyzed for tritium.

No detectable results have been found from these gamma isotopic analyses since 1988. During preoperation and in every year of operation through 1988 (except 1979 and 1980), a few samples showed at least one of nine different activation or fission products at levels less than or on the order of their MDCs. During preoperation, Cs-137 was found in about 3% of the samples. From 1981 through 1988, it was found in about 15% of the samples. Cs-134 was found in about 15% of the samples from 1981 to 1986. All of these gamma emitters are attributed to the weapons tests and the Chernobyl incident.

In 2013, as shown in Table 3-1, tritium was detected in all quarterly composites at the indicator station with an average of 203 pCi/L, and in all quarterly composite samples collected at the control station with an average of 40 pCi/l. MDD was not calculated due to the low number of samples available to compare the data sets. All positive detections at both stations were in the range of the environmental background of approximately 350 pCi/L (+/- 250 pCi/L).

Historical trending of the detectable concentrations of tritium in surface water is provided in Figure 4.7-1 and Table 4.7-1. The slightly elevated plot of the indicator stations is indicative of plant tritium contributions to surface water from permitted plant effluent releases. However, it is noteworthy that the annual average levels are less than 10% of the MDC and less than 1% of the RL. The MDC and RL for tritium in surface water are 3,000 and 30,000, respectively.

Figure 4.7-1

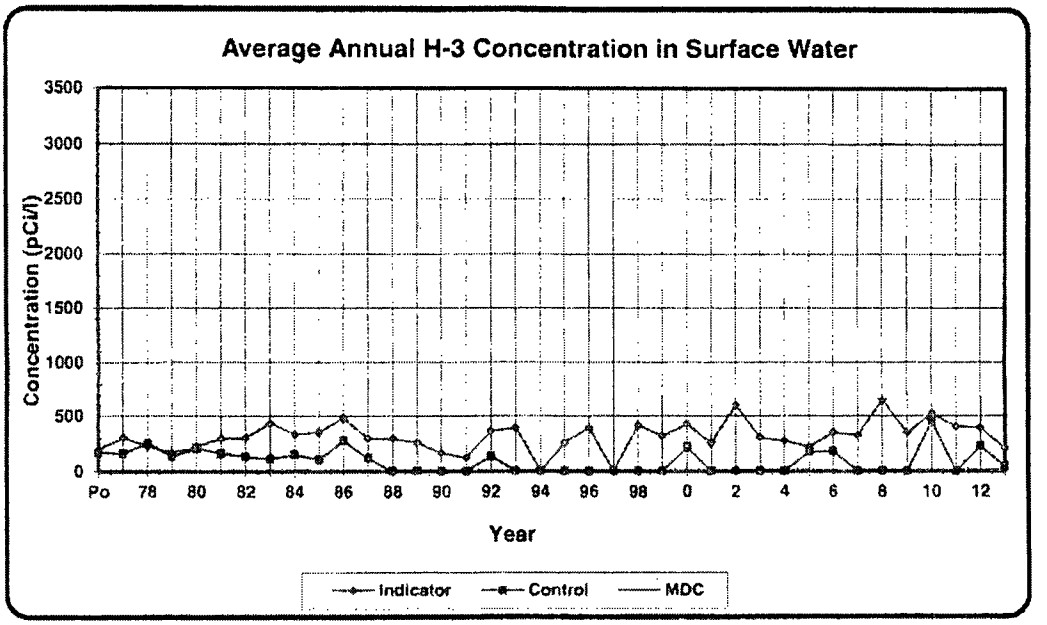

Average Annual H-3 Concentration in Surface Water
Concentration (pCi/l)
3500
3000
2500
2000
1500
1000
500
0
Po 78 80 82 84 86 88 90 92 94 96 98 0 2 4 6 8 10 12
Year
Indicator
Control
MDC

Table 4.7-1

Average Annual H-3 Concentration in Surface Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	200	170
1977	300	160
1978	230	250
1979	169	135
1980	221	206
1981	294	162
1982	300	132
1983	434	111
1984	333	152
1985	351	105
1986	478	272
1987	291.8	116.5
1988	293.3	NDM
1989	253.8	NDM
1990	166	NDM
1991	122	NDM
1992	360.5	134
1993	388.8	NDM
1994	NDM	NDM
1995	257	NDM
1996	386	NDM
1997	NDM	NDM
1998	415	NDM
1999	314	NDM
2000	424	212
2001	252	NDM
2002	598	NDM
2003	296	NDM
2004	270	NDM
2005	215	173
2006	348	179
2007	321	NDM
2008	644	NDM
2009	343	NDM
2010	518	446
2011	401	NDM
2012	390	223
2013	203	40

4.8 Fish

Two types of fish (bottom feeding and game) are collected semiannually from the Chattahoochee River at a control station several miles upstream of the plant intake structure and at an indicator station a few miles downstream of the plant discharge structure. These locations are shown in Figure 2-2. Gamma isotopic analysis is performed on the edible portions of each sample as specified in Table 2-1.

As shown in Table 3-1, Cs-137 was the only radionuclide of interest that was found from the gamma isotopic analysis of fish samples in 2013. Cesium-137 was detected in the spring collection of bottom feeding fish samples at the indicator station at a concentration of 9.4 pCi/kg-wet. Cesium-137 was not detected in either bottom feeding fish sample at the control station. The MDC for Cs-137 in fish is 150 pCi/kg wet and the RL is 2000 pCi/kg wet.

Cesium-137 was detected in the spring control station sample of game fish at a concentration of 9.5 pCi/kg-wet. Cs-137 was also detected in the spring and fall samples of the indicator station at an average concentration of 17.8 pCi/kg-wet. MDD was not calculated due to the low number of samples available to compare the data sets. The MDC for Cs-137 in fish is 150 pCi/kg wet and the RL is 2000 pCi/kg wet.

Figures 4.8-1 and 4.8-2 and Tables 4.8-1 and 4.8-2 provide the historical trending of the average annual detectable concentrations of Cs-137 in pCi/kg wet in bottom feeding and game fish, respectively. Since the early 1980s, values have generally decreased for both indicator and control groups, with the exception of the bottom feeding fish collected at the indicator station in 1993. While some contribution from the plant cannot be ruled out, most of the Cs-137 in these samples may be attributed to the nuclear weapons tests and the Chernobyl incident, as evidenced by the normally close agreement between the control and indicator station results.

Figure 4.8-1

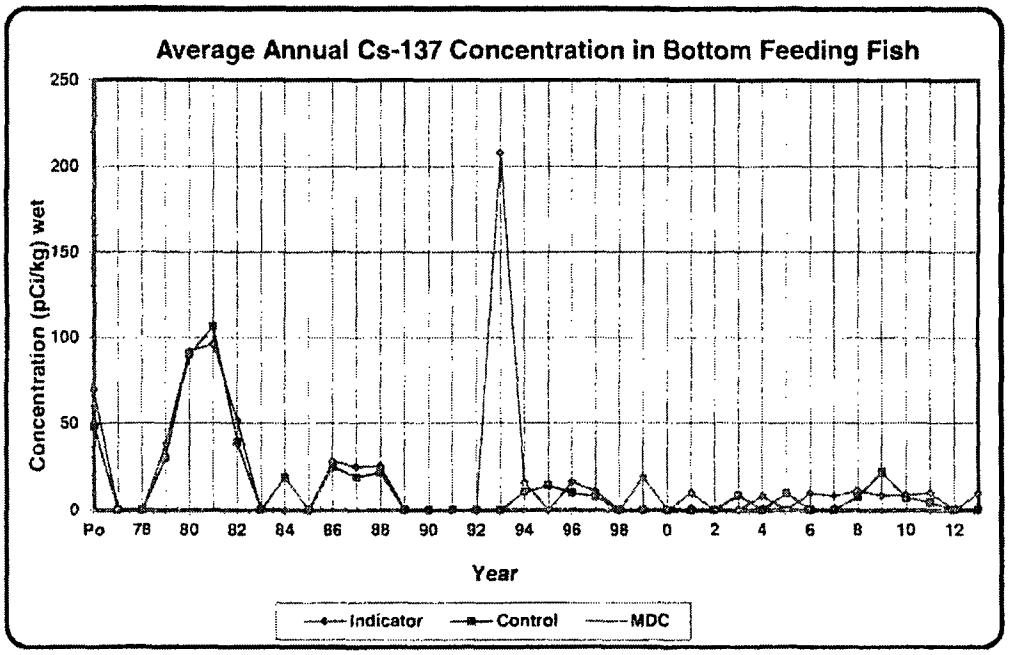

Average Annual Cs-137 Concentration in Bottom Feeding Fish
Concentration (pCi/kg) wet
250
200
150
100
50
0
Po
78
80
82
84
86
88
90
92
94
96
98
0
2
4
6
8
10
12
Year
Indicator
Control
MDC

Table 4.8-1

Average Annual Cs-137 Concentration in Bottom Feeding Fish

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	69	48
1977	NDM	NDM
1978	NDM	NDM
1979	38	30
1980	92	90
1981	96	106
1982	51.5	39.0
1983	NDM	NDM
1984	NDM	19
1985	NDM	NDM
1986	28	25
1987	25	19
1988	25.5	22.0
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	208	NDM
1994	15.9	10.3
1995	NDM	14.2
1996	16.4	9.9
1997	10.9	7.7
1998	NDM	NDM
1999	19.2	NDM
2000	NDM	NDM
2001	9.8	NDM
2002	NDM	NDM
2003	NDM	8.5
2004	8.1	NDM
2005	NDM	9.6
2006	9.7	NDM
2007	8.1	NDM
2008	11.4	7.7
2009	8.4	21.9
2010	8.5	7.1
2011	10.0	4.3
2012	NDM	NDM
2013	9.4	NDM

Figure 4.8-2

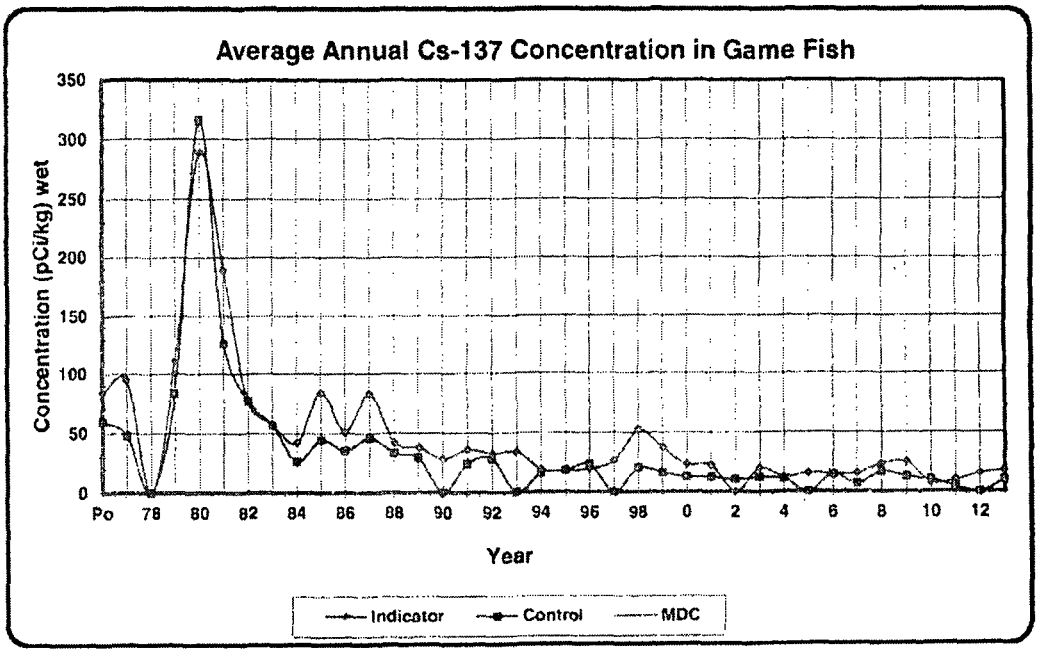

Average Annual Cs-137 Concentration in Game Fish
Concentration (pCi/kg) wet
350
300
250
200
150
100
50
0
Po 78 80 82 84 86 88 90 92 94 96 98 0 2 4 6 8 10 12
Year
Indicator
Control
MDC

Table 4.8-2

Average Annual Cs-137 Concentration in Game Fish

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	84	60
1977	95	48
1978	NDM	NDM
1979	111	83.5
1980	289	316
1981	189	126
1982	76	77
1983	57	56.5
1984	42	26
1985	84	44
1986	51	35
1987	83	46
1988	42	33
1989	38	29
1990	28	NDM
1991	36	24
1992	32.5	28
1993	34	NDM
1994	19	16
1995	17.9	18.2
1996	19.6	23.1
1997	25.9	NDM
1998	52	20
1999	36.9	15.9
2000	22.9	12.5
2001	22.4	12.3
2002	NDM	10.1
2003	19.3	12.0
2004	12.7	10.8
2005	15.7	NDM
2006	15.0	14.7
2007	15.4	6.5
2008	16.6	23.2
2009	24.9	12.5
2010	7.6	9.8
2011	9.0	15.9
2012	15.4	NDM
2013	17.8	9.5

Radionuclides of interest other than Cs-137 have been found in only a few samples in the past. The following table provides a summary of the results in pCi/kg wet compared with the applicable MDCs.

YEAR	Nuclide	Fish Type	Indicator (pCi/kg)	Control (pCi/kg)	MDC (pCi/kg)
1978	Ce-144	Bottom Feeding	NDM	200	
1981	Nb-95	Bottom Feeding	38	NDM	50 (a)
1982	Nb-95	Game	31	NDM	50 (a)
1986	Co-60	Game	25	NDM	130

(a) Determined by the EL. Not defined in ODCM Table 4-3 (Table 4-1 of this report)

4.9 Sediment

River sediment samples are collected semiannually on the Chattahoochee River at a control station which is approximately 4 miles upstream of the intake structure and at an indicator station which is approximately 2 miles downstream of the discharge structure as shown in Figure 2-2. A gamma isotopic analysis is performed on each sample as specified in Table 2-1. During 2013, no man-made radioisotopes (nor Be-7) were detected in sediment collections. Be-7 was not identified in the liquid effluents at Farley in 2013.

Historically, Be-7, Cs-134, Cs-137, and Nb-95 have been detected in some samples. These positive results were generally for samples collected at the control station. A summary of the positive historical results for these nuclides along with their applicable MDCs in units of pCi/kg dry is provided in Table 4.9. Cs-134 and Cs-137 data are plotted in Figures 4.9-1 and 4.9-2, respectively.

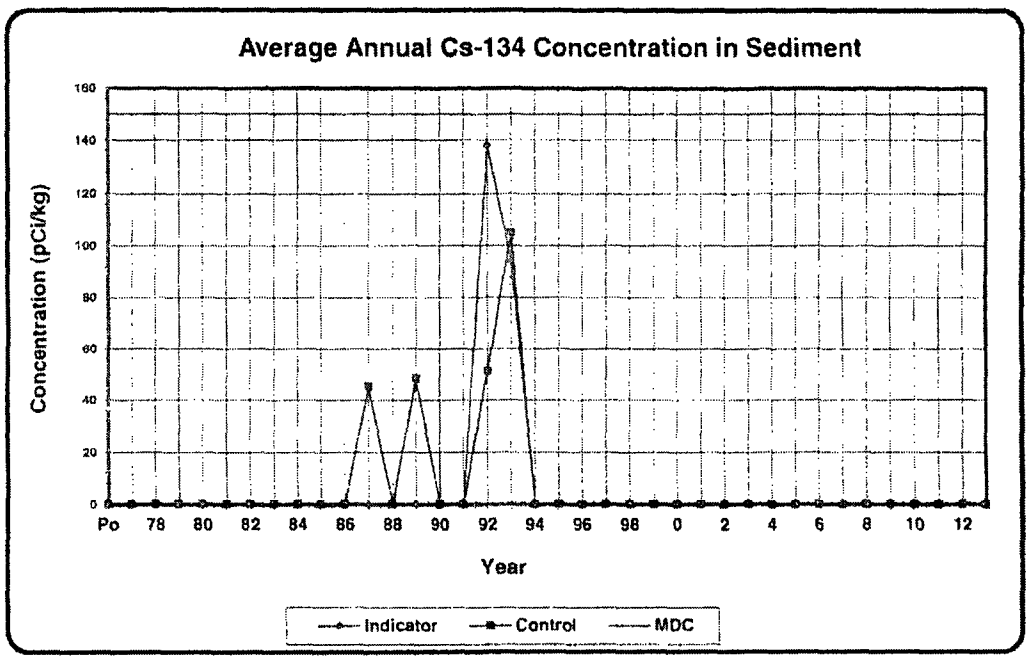
Table 4.9

Sediment Nuclide Concentrations

Nuclide	YEAR	Indicator (pCi/kg)	Control (pCi/kg)	MDC (pCi/kg)
Be-7	**1985**	535	945	655 (a)
	2003	199	NDM	
	2009	72.8	NDM	
	2011	58.4	63.1	
Cs-134	**1987**	NDM	45	150
	1989	NDM	48	
	1992	138	51	
	1993	94	105	
Cs-137	**1981**	NDM	185	180
	1985	NDM	97	
	1989	NDM	39	
	1994	29	11	
	1996	11.8	NDM	
	2005	14.5	NDM	
	2009	NDM	24.4	
	2011	NDM	8.1	
Nb-95	**1981**	52	113	50 (a)

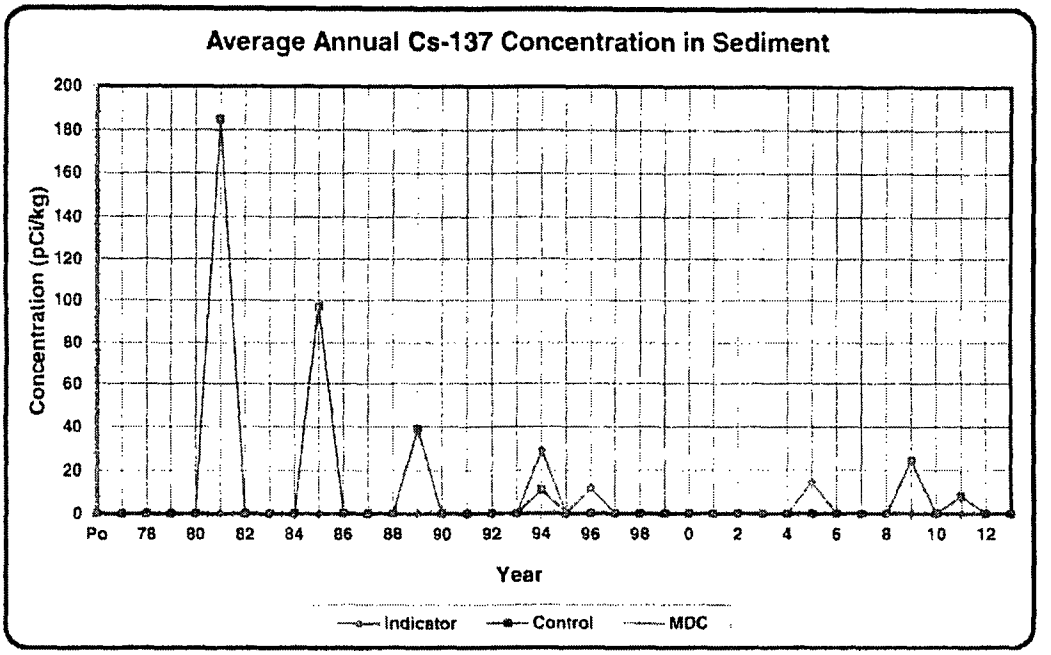
(a) Determined by the EL. Not defined in ODCM Table 4-3 (Table 4-1 of this report).

Figure 4.9-1



The positive results for Cs-134 from 1986-1994 appear mostly at the control station. Due to its relatively short half-life of approximately 2 years, the positive results may be attributed to the Chernobyl incident. The overall plotting of the positive results does not show any discernible trends.

Figure 4.9-2



Cs-137 trended down after above ground weapons testing was stopped and has remained fairly low with random detections occurring. The majority of the positive results over the years are at the control station. Therefore in general, the positive results can be attributed to the weapons tests and the Chernobyl incident.

5.0 INTERLABORATORY COMPARISON PROGRAM

In accordance with ODCM 4.1.3, the EL participates in an ICP that satisfies the requirements of Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979. The guide indicates the ICP is to be conducted with the Environmental Protection Agency (EPA) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and the ICP should include all of the determinations (sample medium/radionuclide combinations) that are offered by the EPA and included in the REMP.

The ICP is conducted by Analytics, Inc. of Atlanta, Georgia. Analytics has a documented Quality Assurance (QA) program and the capability to prepare Quality Control (QC) materials traceable to the National Institute of Standards and Technology. The ICP is a third party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. Analytics supplies the crosscheck samples to the EL which performs the laboratory analyses in a normal manner. Each of the specified analyses is performed three times. The results are then sent to Analytics who performs an evaluation which may be helpful to the EL in the identification of instrument or procedural problems.

The samples offered by Analytics and included in the EL analyses are gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples.

The accuracy of each result is measured by the normalized deviation, which is the ratio of the reported average less the known value to the total error. The total error is the square root of the sum of the squares of the uncertainties of the known value and of the reported average. The uncertainty of the known value includes all analytical uncertainties as reported by Analytics. The uncertainty of the reported average is the propagated error of the values in the reported average by the EL. The precision of each result is measured by the coefficient of variation, which is defined as the standard deviation of the reported result divided by the reported average. An investigation is undertaken whenever the absolute value of the normalized deviation is greater than three or whenever the coefficient of variation is greater than 15% for all radionuclides other than Cr-51 and Fe-59. For Cr-51 and Fe-59, an investigation is undertaken when the coefficient of variation exceeds the values shown as follows:

Nuclide	Concentration *	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
Cr-51	NA	>1000	25
Cr-51	>300	<1000	15
Fe-59	<80	NA	25
Fe-59	>80	NA	15

* For air filters, concentration units are pCi/filter. For all other media, concentration units are pCi/liter (pCi/l).

As required by ODCM 4.1.3.3 and 7.1.2.3, a summary of the results of the EL's participation in the ICP is provided in Table 5-1 for: the gross beta and gamma isotopic analyses of an air filter: gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples. Delineated in this table for each of the media/analysis combinations, are: the specific radionuclides; Analytics' preparation dates; the known values with their uncertainties supplied by Analytics; the reported averages with their standard deviations; and the resultant normalized deviations and coefficients of variation expressed as a percentage.

The Environmental Radiochemistry laboratory participates in a performance evaluation (PE) sample program provided by Analytics Inc. The PE samples are received and analyzed routinely with environmental and effluent samples. The laboratory analyzed 9 samples for 34 parameters in 2013.

The 2013 analyses included tritium, gross beta and gamma emitting radionuclides in different matrices. The attached results for all analyses were within acceptable limits for accuracy.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
I-131	06/13/13	90.30	89.60	3.4	1.50	5.98	0.14

GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	06/13/13	78.90	80.80	3.59	1.35	6.52	-0.36
Co-58	06/13/13	87.00	84.00	7.74	1.40	10.20	0.33
Co-60	06/13/13	223.00	194.00	11.7	2.62	8.56	0.01
Cr-51	06/13/13	234.00	224.00	12.5	3.74	8.40	0.50
Cs-134	06/13/13	112.00	112.00	11.2	1.87	10.80	0.00
Cs-137	06/13/13	137.00	135.00	12.7	2.25	10.29	0.14
Fe-59	06/13/13	106.00	107.00	8.24	1.79	9.51	-0.12
Mn-54	06/13/13	164.00	154.00	13.8	2.57	9.52	0.61
Zn-65	06/13/13	223.00	194.00	17.4	3.25	9.14	1.41

GROSS BETA ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	09/12/13	58.30	58.70	0.79	0.98	5.08	-0.14

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Co-58	09/12/13	112.00	108.00	8.91	1.80	9.90	0.39
Co-60	09/12/13	209.00	196.00	10.8	3.27	6.67	0.94
Cr-51	09/12/13	301.00	277.00	30.1	4.63	14.32	0.55
Cs-134	09/12/13	184.00	172.00	4.02	2.88	4.56	1.42
Cs-137	09/12/13	141.00	131.00	5.49	2.19	6.62	1.02
Fe-59	09/12/13	133.00	130.00	6.29	2.18	8.32	0.27
I-131	09/12/13	108.00	98.30	9.13	1.64	10.86	0.80
Mn-54	09/12/13	151.00	139.00	4.98	2.32	6.21	1.31
Zn-65	09/12/13	289.00	266.00	9.27	4.45	6.44	1.23

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GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	06/13/13	270.00	293.00	9.58	4.90	5.91	-1.42
	12/05/13	307.00	279.00	10.69	4.67	6.12	1.51

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	12/05/13	73.40	88.80	5.18	1.48	10.69	-1.95
Co-58	12/05/13	92.40	90.60	1.63	1.51	6.57	0.30
Co-60	12/05/13	118.00	119.00	1.5	1.98	5.03	-0.25

TABLE 5-1 (SHEET 3 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES CONT. (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Cr-51	12/05/13	245.00	240.00	14.2	4.01	12.37	0.16
Cs-134	12/05/13	113.00	115.00	7.53	1.92	8.17	-0.20
Cs-137	12/05/13	106.00	102.00	5.7	1.70	8.21	0.44
Fe-59	12/05/13	86.00	89.10	3.02	1.49	8.58	-0.42
I-131	12/05/13	98.20	92.40	4.93	1.54	6.16	0.96
Mn-54	12/05/13	145.00	136.00	1.85	2.27	5.53	1.09
Zn-65	12/05/13	658.00	600.00	44.5	10.00	8.01	1.09

TRITIUM ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
H-3	06/13/13	9870.00	9890.00	16.69	165.00	2.22	-0.10
	12/05/13	14100.00	14500.00	184.08	242.00	2.41	-1.21

6.0 CONCLUSIONS

This report confirms the licensee's conformance with the requirements of Chapter 4 of the ODCM. It provides a summary and discussion of the results of the laboratory analyses for each type of sample.

In 2013, there were two instances in which the indicator station results were statistically discernible from the control station results. One instance was the detection of Be-7 in forage and the other was the average of direct radiation indicator station results compared to average direct radiation control station results.

The difference in the average results of Be-7 in forage at the indicator stations and the control stations of 601 pCi/kg wet is more than the MDD of 546 pCi/kg wet and therefore is statistically discernible. Because Be-7 is naturally occurring and because the results from both the indicator and control stations are consistent with historical trends, these sample results do not indicate significant impact to the environment from Plant Farley effluents. There were no Be-7 effluent releases from the plant in 2013. Be-7 is naturally occurring but also was detected in Farley's gaseous effluents. therefore it is unlikely these results prove environmental impact from Plant Farley.

The average of the direct radiation sample results at the indicator stations was 16.5 mrem and the average result at the direct radiation control stations was 15.1. While this difference (1.4 mrem) compared to the MDD (1.2) was statistically discernable, these values are consistent with historical values and do not indicate significant environmental impact from the operation of Plant Farley.

Cesium-137 was detected, at a value of 9.4 (pCi/kg) wet, in bottom feeding fish samples collected in the spring of 2013. Regular consumption of bottom feeding fish containing this low level of Cs-137, would result in a potential dose of approximately 1.41×10^{-2} mrem in a year as calculated using NRC regulatory guide 1.109. This dose is about 0.7% of the regulatory limit of 3 mrem per year to the total body due to liquid effluents.

Cesium-137 was also detected in game fish samples in both the spring and fall sample collections at the indicator location, FGI-S5. The average Cs-137 of the two samples was 17.8 (pCi/kg) wet. Cesium-137 was also detected, at a value of 9.5 (pCi/kg) wet, in game fish samples at the control station in the spring collection Using the ingestion dose factors and consumption rate factors in Reg. Guide 1.109 it was calculated that the highest potential dose to a maximum exposed member of the public (an adult), due to regular consumption of game fish containing Cs-137 at the low level seen in the 2013 samples, would be approximately 2.67×10^{-2} mrem in a year. This dose is about 1.4% of the regulatory limit of 3 mrem per year to the total body due to liquid effluents. While the Cs-137 seen in the game fish could be attributed to plant effluents, low levels of Cs-137 in the environment are attributed primarily to fallout from nuclear weapons testing and from the Chernobyl incident.

No discernible radiological impact upon the environment or the public as a consequence of plant discharges to the atmosphere and to the river was established for any other REMP samples.

The radiological levels reported from 2013 sample results remained low. The REMP trends over the course of time from preoperation to the present are generally decreasing or have remained fairly constant at low levels. This supports the conclusion that there is no adverse radiological impact on the environment or to the public as a result of the operation of Farley Nuclear Plant.

7.0 ERRATA

The following page is a correction to the Joseph M. Farley Nuclear Plant Annual Radiological Environmental Operating Report for 2012.

The correction resulted from an NRC review of Georgia Power Environmental Laboratory's 2012 Interlaboratory Comparison Program results, a calculation error was identified. This error was subsequently corrected by Georgia Power Environmental Lab and the corrected page is included in this errata section.. The error appeared on Table 5-1 of Section 5 Interlaboratory Comparison Program in the 2012 AREOR. . The normalized deviation had been calculated incorrectly at -11.99 for the March 15 gross beta water analysis. The correct normalized deviation value was calculated to be -1.46 which is under the normalized deviation acceptance level of 3. The affected page of table 5-1 has been updated with the correct result and is included in the following pages of this section. No change to the text of Section 5 was required.

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	7/14/12	76.60	82.20	2.85	1.37	8.62	-0.84
Co-58	7/14/12	90.20	99.70	2.85	1.66	7.33	-0.32
Co-60	7/14/12	350.00	355.00	10.7	5.93	4.23	-0.35
Cr-51	7/14/12	433.00	402.00	21.1	6.71	8.51	0.85
Cs-134	7/14/12	180.00	174.00	6.26	2.91	4.68	0.69
Cs-137	7/14/12	216.00	212.00	9.26	3.54	5.63	0.34
Fe-59	7/14/12	126.00	128.00	6.53	2.13	8.21	-0.17
I-131	7/14/12	102.00	99.70	7	1.66	8.78	0.30
Mn-54	7/14/12	134.00	132.00	3.79	2.21	5.69	0.24
Zn-65	7/14/12	208.00	199.00	8.17	3.33	7.09	0.59

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GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	03/15/12	263.00	297.00	18.93	4.96	1.10	-1.46
	07/14/12	166.00	148.00	10.28	2.47	10.85	0.98

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

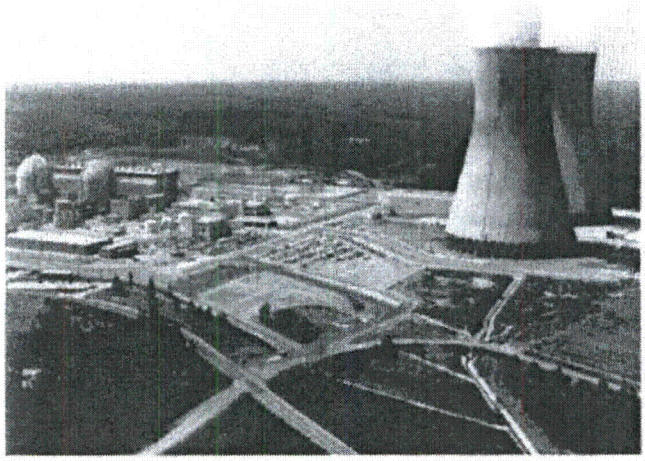
Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	03/15/12	190.00	184.00	5.65	3.07	5.25	0.64
Co-58	03/15/12	92.50	93.40	5.19	1.56	8.20	-0.11
Co-60	03/15/12	208.00	197.00	5.68	3.29	4.59	1.16

Edwin I. Hatch Nuclear Plant
Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Annual Radiological Environmental Operating Reports for 2013

Enclosure 3

Vogtle Annual Radiological Environmental Operating Report for 2013

VOGTLE ELECTRIC GENERATING PLANT ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2013



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LIST OF ACRONYMS

Acronyms presented in alphabetical order.

Acronym	Definition
AREOR	Annual Radiological Environmental Operating Report
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Georgia Power Company Environmental Laboratory
EPA	Environmental Protection Agency
GPC	Georgia Power Company
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
MWe	MegaWatts Electric
NA	Not Applicable
NDM	No Detectable Measurement(s)
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
OSL	Optically Stimulated Luminescence
Po	Preoperation
PWR	Pressurized Water Reactor
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
RM	River Mile
SRS	Savannah River Site
TLD	Thermoluminescent Dosimeter
TS	Technical Specification
VEGP	Alvin W. Vogtle Electric Generating Plant

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) is conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). The REMP activities for 2013 are reported herein in accordance with Technical Specification (TS) 5.6.2 and ODCM 7.1.

The objectives of the REMP are to:

1) Determine the levels of radiation and the concentrations of radioactivity in the environs and;

2) Assess the radiological impact (if any) to the environment due to the operation of the Alvin W. Vogtle Electric Generating Plant (VEGP).

The assessments include comparisons between results of analyses of samples obtained at locations where radiological levels are not expected to be affected by plant operation (control stations), areas of higher population (community stations), and at locations where radiological levels are more likely to be affected by plant operation (indicator stations), as well as comparisons between preoperational and operational sample results.

VEGP is owned by Georgia Power Company (GPC), Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia, and the City of Dalton, Georgia. It is located on the southwest side of the Savannah River approximately 23 river miles upstream from the intersection of the Savannah River and U.S. Highway 301. The site is in the eastern sector of Burke County, Georgia, and across the river from Barnwell County, South Carolina. The VEGP site is directly across the Savannah River from the Department of Energy Savannah River Site (SRS). Unit 1, a Westinghouse Electric Corporation Pressurized Water Reactor (PWR), with a licensed core thermal power of 3626 MegaWatts (MWt), received its operating license on January 16, 1987 and commercial operation started on May 31, 1987. Unit 2, also a Westinghouse PWR rated for 3626 MWt, received its operating license on February 9, 1989 and began commercial operation on May 19, 1989.

The pre-operational stage of the REMP began with initial sample collections in August of 1981. The transition from the pre-operational to the operational stage of the REMP occurred as Unit 1 reached initial criticality on March 9, 1987.

A description of the REMP is provided in Section 2 of this report. Maps showing the sampling stations are keyed to a table which indicates the direction and distance of each station from a point midway between the two reactors. Section 3 provides a summary of the results of the analyses of REMP samples for the year. The results are discussed, including an assessment of any radiological impacts upon the environment and the results of the land use census and the river survey, in Section 4. The results of the Interlaboratory Comparison Program (ICP) are provided in Section 5. Conclusions are provided in Section 6.

2.0 REMP DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table summarizes the program as it meets the requirements outlined in ODCM Table 4-1. It details the sample types to be collected and the analyses to be performed in order to monitor the airborne, direct radiation, waterborne and ingestion pathways, and also delineates the collection and analysis frequencies. In addition, Table 2-1 references the locations of stations as described in ODCM Section 4.2 and in Table 2-2 of this report. The stations are also depicted on maps in Figures 2-1 through 2-3. Figure 2-4 indicates the locations of onsite groundwater wells. These wells are not part of the REMP but are part of the VEGP Radiological Groundwater Protection Program describe in section 4.10.

REMP samples are collected by Georgia Power Company's (GPC) Environmental Laboratory (EL) personnel. The same lab performs all the laboratory analyses at their headquarters in Smyrna, Georgia.

TABLE 2-1 (SHEET 1 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Direct Radiation	forty routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations, one in each compass sector in the general area of the site boundary; An outer ring of stations, one in each compass sector at approximately 5 miles from the site; and Special interest areas, such as population centers, nearby recreation areas, and control stations.	Quarterly	Gamma dose, quarterly
2. Airborne Radioiodine and Particulates	Samples from seven locations: Five locations close to the site boundary in different sectors; A community having the highest calculated annual average ground level D/Q; A control location near a population center at a distance of about 14 miles.	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine canister: I-131 analysis, weekly. Particulate sampler; Gross beta analysis[1] following filter change and gamma isotopic analysis[2] of composite (by location), quarterly.

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TABLE 2-1 (SHEET 2 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
3. Waterborne			
a. Surface[3]	One sample upriver. Two samples downriver.	Composite sample over one month period[4].	Gamma isotopic analysis[2], monthly. Composite for tritium analysis, quarterly.
b. Drinking	Two samples at each of the three nearest water treatment plants that could be affected by plant discharges. Two samples at a control location.	Composite sample of river water near the intake of each water treatment plant over two week period[4] when I-131 analysis is required for each sample; monthly composite otherwise; and grab sample of finished water at each water treatment plant every two weeks or monthly, as appropriate.	I-131 analysis on each sample when the dose calculated for the consumption of the water is greater than 1 mrem per year[5]. Composite for gross beta and gamma isotopic analysis[2] on raw water, monthly. Gross beta, gamma isotopic and I-131 analyses on grab sample of finished water, monthly. Composite for tritium analysis on raw and finished water, quarterly.
c. Groundwater	See Table 2-3 and Figure 2-4 for well locations.	Quarterly sample; pump used to sample GW wells; grab sample from yard drains and ponds	Tritium, gamma isotopic, and field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity) of each sample quarterly; Hard to detect radionuclides as necessary based on results of tritium and gamma

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TABLE 2-1 (SHEET 3 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
d. Sediment from Shoreline	One sample from downriver area with existing or potential recreational value. One sample from upriver area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis[2], semiannually.
4. Ingestion			
a. Milk	Two samples from milking animals[6] at control locations at a distance of about 10 miles or more.	Bimonthly	Gamma isotopic analysis[2,7], bimonthly.
b. Fish	At least one sample of any commercially or recreationally important species near the plant discharge. At least one sample of any commercially or recreationally important species in an area not influenced by plant discharges. At least one sample of any anadromous species near the plant discharge.	Semiannually During the spring spawning season.	Gamma isotopic analysis[2] on edible portions, semiannually. Gamma isotopic analysis[2] on edible portions, annually.

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TABLE 2-1 (SHEET 4 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Grass or Leafy Vegetation	One sample from two onsite locations near the site boundary in different sectors. One sample from a control location at a distance of about 17 miles.	Monthly during growing season.	Gamma isotopic analysis[2,7], monthly.

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TABLE 2-1 (SHEET 5 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Notes:

(1) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

(2) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

(3) Upriver sample is taken at a distance beyond significant influence of the discharge. Downriver samples are taken beyond but near the mixing zone.

(4) Composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) to assure obtaining a representative sample.

(5) The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

(6) A milking animal is a cow or goat producing milk for human consumption.

(7) If the gamma isotopic analysis is not sensitive enough to meet the Minimum Detectable Concentration (MDC) for I-131, a separate analysis for I-131 may be performed.

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TABLE 2-2 (SHEET 1 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction[1]	Distance (miles)[1]	Sample Type
1	Indicator	River Bank	N	1.1	Direct Rad.
2	Indicator	River Bank	NNE	0.8	Direct Rad.
3	Indicator	Discharge Area	NE	0.6	Airborne Rad.
3	Indicator	River Bank	NE	0.7	Direct Rad
4	Indicator	River Bank	ENE	0.8	Direct Rad.
5	Indicator	River Bank	E	1.0	Direct Rad.
6	Indicator	Plant Wilson	ESE	1.1	Direct Rad.
7	Indicator	Simulator Building	SE	1.7	Airborne Rad. Direct Rad. Vegetation
8	Indicator	River Road	SSE	1.1	Direct Rad.
9	Indicator	River Road	S	1.1	Direct Rad.
10	Indicator	Met Tower	SSW	0.9	Airborne Rad.
10	Indicator	River Road	SSW	1.1	Direct Rad.
11	Indicator	River Road	SW	1.2	Direct Rad.
12	Indicator	River Road	WSW	1.2	Airborne Rad. Direct Rad.
13	Indicator	River Road	W	1.3	Direct Rad.
14	Indicator	River Road	WNW	1.8	Direct Rad.
15	Indicator	Hancock Landing Road	NW	1.5	Direct Rad. Vegetation
16	Indicator	Hancock Landing Road	NNW	1.4	Airborne Rad. Direct Rad.
17	Other	Sav. River Site (SRS), River Road	N	5.4	Direct Rad.
18	Other	SRS, D Area	NNE	5.0	Direct Rad.
19	Other	SRS, Road A.13	NE	4.6	Direct Rad.
20	Other	SRS, Road A.13.1	ENE	4.8	Direct Rad.
21	Other	SRS, Road A.17	E	5.3	Direct Rad.
22	Other	River Bank	ESE	5.2	Direct Rad.
23	Other	River Road	SE	4.6	Direct Rad.
24	Other	Chance Road	SSE	4.9	Direct Rad.
25	Other	Chance Road near Highway 23	S	5.2	Direct Rad.
26	Other	Highway 23 and Ebenezer Church Road	SSW	4.6	Direct Rad.
27	Other	Highway 23 opposite Boll Weevil Road	SW	4.7	Direct Rad.
28	Other	Thomas Road	WSW	5.0	Direct Rad.

TABLE 2-2 (SHEET 2 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction[1]	Distance (miles)[1]	Sample Type
29	Other	Claxton-Lively Road	W	5.1	Direct Rad.
30	Other	Nathaniel Howard Road	WNW	5.0	Direct Rad.
31	Other	River Road at Allen's Chapel Fork	NW	5.0	Direct Rad.
32	Other	River Bank	NNW	4.7	Direct Rad.
35	Other	Girard	SSE	6.6	Airborne Rad. Direct Rad.
36	Control	GPC Waynesboro Op. HQ	WSW	13.9	Airborne Rad. Direct Rad.
37	Control	Substation Waynesboro, GA	WSW	16.7	Direct Rad Vegetation
43	Other	Employee's Rec. Center	SW	2.2	Direct Rad.
47	Control	Oak Grove Church	SE	10.4	Direct Rad.
48	Control	McBean Cemetery	NW	10.2	Direct Rad.
51	Control	SGA School Sardis, GA	S	11.0	Direct Rad.
52	Control	Oglethorpe Substation; Alexander, GA	SW	10.7	Direct Rad.
80	Control	Augusta Water Treatment Plant	NNW	29.0	Drinking Water[2]
81	Control	Sav River	N	2.5	Fish[3] Sediment[4]
82	Control	Sav River (RM 151.2)	NNE	0.8	River Water
83	Indicator	Sav River (RM 150.4)	ENE	0.8	River Water Sediment[4]
84	Other	Sav River (RM 149.5)	ESE	1.6	River Water
85	Indicator	Sav River	ESE	4.3	Fish[3]
87	Indicator	Beaufort-Jasper County Water Treatment Plant	SE	76	Drinking Water[5]
88	Indicator	Cherokee Hill Water Treatment Plant, Port Wentworth, Ga	SSE	72	Drinking Water[6]

TABLE 2-2 (SHEET 3 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

89	Indicator	Purrysburg Water Treatment Plant: Purrysburg, SC	SSE	76	Drinking Water[7]
98	Control	W.C. Dixon Dairy	SE	9.8	Milk[8]
101	Indicator	Girard Dairy	S	5.5	Milk[8]
102	Control	Seven Oaks Dairy	W	7.5	Milk[8]

Notes:

(1) Direction and distance are determined from a point midway between the two reactors.

(2) The intake for the Augusta Water Treatment Plant is located on the Augusta Canal. The entrance to the canal is at River Mile (RM) 207 on the Savannah River. The canal effectively parallels the river. The intake to the pumping station is about 4 miles down the canal.

(3) A 5 mile stretch of the river is generally needed to obtain adequate fish samples. Samples are normally gathered between RM 153 and 158 for upriver collections and between RM 144 and 149.4 for downriver collections.

(4) Sediment is collected at locations with existing or potential recreational value. Because high water, shifting of the river bottom, or other reasons could cause a suitable location for sediment collections to become unavailable or unsuitable, a stretch of the river between RM 148.5 and 150.5 was designated for downriver collections while a stretch between RM 153 and 154 was designated for upriver collections. In practice, collections are normally made at RM 150.2 for downriver collections and RM 153.3 for upriver collections.

(5) The intake for the Beaufort-Jasper County Water Treatment Plant is located at the end of canal that begins at RM 39.3 on the Savannah River. This intake is about 16 miles by line of sight down the canal from its beginning on the Savannah River.

(6) The intake for the Cherokee Hill Water Treatment Plant is located on Abercorn Creek which is about one and a quarter creek miles from its mouth on the Savannah River at RM 29.

(7) The intake for the Purrysburg Water Treatment Plant is located on the same canal as the Beaufort-Jasper Water Treatment Plant. The Purrysburg intake is nearer to the Savannah River at the beginning of the canal.

(8) Girard Dairy is considered an indicator station since it is the closest dairy to the plant (@5.5 miles). Dixon Dairy went out of business in June 2009 and Seven Oaks Dairy (@7.5 miles) was added as a replacement and is considered a control station even though a control station is typically 10 miles or greater.

Groundwater Monitoring Locations

Table 2-3

WELL	AQUIFER	MONITORING PURPOSE
LT-1B	Water Table	NSCW related tank
LT-7A	Water Table	NSCW related tank
LT-12	Water Table	NSCW related tank
LT-13	Water Table	NSCW related tank
802A	Water Table	Southeastern potential leakage
803A#	Water Table	Up gradient to rad waste building
805A***	Water Table	Down gradient from rad waste bldg and NSCW related facilities
806B	Water Table	Dilution line
808	Water Table	Up gradient; along Pen Branch Fault
R1	Water Table	NSCW related tank; western potential leakage
R2	Water Table	Southern potential leakage
R3	Water Table	Eastern potential leakage
R4	Water Table	Dilution line
R5	Water Table	Dilution line
R6	Water Table	Dilution line
R7	Water Table	Dilution line
R8	Water Table within Sav. River sediments	Dilution line
1013*	Water Table	Low level rad waste storage
1014	Tertiary	Up gradient
1015	Water Table	Vertically up gradient
1003*	Tertiary	Up gradient
1004*	Water Table	Vertically up gradient
27**	Tertiary	Down gradient tertiary
29**	Tertiary	Down gradient tertiary
MU-1	Tertiary/Cretaceous	Facility water supply
River	N/A	Surface water

NSCW – Nuclear service cooling water
* Wells abandoned in Feb. 2009 due to construction activities with proposed new units
** Sampling discontinued in 2010 due to structural issues with the well
*** Well abandoned in 2009 due to structural issues
# Well was removed for construction activities after Q1 2013

3.0 RESULTS SUMMARY

In accordance with ODCM 7.1.2.1, the summarized and tabulated results for all of the regular samples collected for the year at the designated indicator and control stations are presented in Table 3-1. The format of Table 3-1 is similar to Table 3 of the Nuclear Regulatory Commission (NRC) Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program", Revision 1, November 1979. Results for samples collected at locations other than indicator or control stations are discussed in Section 4 under the particular sample type.

As indicated in ODCM 7.1.2.1, the results for naturally occurring radionuclides that are also found in plant effluents must be reported along with man-made radionuclides. The radionuclide Be-7, which occurs abundantly in nature, is often detected in REMP samples. It is occasionally detected in the plant's liquid and gaseous effluents. When it is detected in effluents or REMP samples, it is also included in the REMP results. In 2013, Be-7 was not detected in liquid effluents, but was detected in gasesous effluents at Vogtle.

TABLE 3-1 (SHEET 1 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Airborne Particulates (fCi/m3)	Gross Beta 364	10	22.9 2.2-47.5 (260/260)	GPC Waynesboro Op. HQ WSW 13.9 mi.	23.9 7.8-52.7 (52/52)	22.2 7.1-40 (52/52)	23.9 7.8-52.7(52/52)
	Gamma Isotopic 28			GPC Waynesboro Op.			
	Be-7	24	74.1 47.7-102 (20/20)	HQ WSW 13.9 mi.	87.5 65.4-103.9 (4/4)	74.9 60.5-85.5 (4/4)	87.5 65.4-103.9 (4/4)
	I-131	70	NDM (c)		NDM	NDM	NDM
	Cs-134	50	NDM		NDM	NDM	NDM
	Cs-137	60	NDM		NDM	NDM	NDM
Airborne Radioiodine (fCi/m3)	I-131 364	70	NDM	NA		NDM	NDM
Direct Radiation (mR/91 days)	Gamma Dose 160	NA (d)	13.1 8.1-18 (64/64)	SRS, Road A.13.1 ENE 4.8 mi.	17.3 16.3-19.6 (4/4)	13.6 10.8-16.8 (72/72)	13.2 8.4-19.6 (24/24)

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TABLE 3-1 (SHEET 2 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean Name Distance & Direction	Mean (b), Range (Fraction)	Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Milk (pCi/l)	Gamma Isotopic 46						
	I-131	1	NDM	NA	NDM	NA	NDM
	Cs-134	15	NDM		NDM	NA	NDM
	Cs-137	18	NDM		NDM	NA	NDM
	Ba-140	60	NDM		NDM	NA	NDM
	La-140	15	NDM		NDM	NA	NDM
	I-131 46	1	NDM	NA	NDM	NA	NDM
Vegetation (pCi/kg-wet)	Gamma Isotopic 36						
	Be-7	729	2705.0 494.2-10323 (24/24)	Simulator Building SE 1.7 mi.	3172 494.2-10323 (12/12)	NA	1940.2 354-4587.7 (12/12)
	I-131	60	NDM	NA	NDM	NA	NDM
	Cs-134	60	NDM	NA	NDM	NA	NDM
	Cs-137	80	16.6 9.4-23.8 (2/24)	Simulator Building SE 1.7 mi.	16.6 9.4-23.8 (2/24)	16.6 9.4-23.8 (2/24)	NDM

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TABLE 3-1 (SHEET 3 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
River Water (pCi/l)	Gamma Isotopic 36						
	Be-7	124(e)	NDM		NDM	NDM	NDM
	Mn-54	15	NDM		NDM	NDM	NDM
	Fe-59	30	NDM		NDM	NDM	NDM
	Co-58	15	NDM		NDM	NDM	NDM
	Co-60	15	NDM		NDM	NDM	NDM
	Zn-65	30	NDM		NDM	NDM	NDM
	Zr-95	30	NDM		NDM	NDM	NDM
	Nb-95	15	NDM		NDM	NDM	NDM
	I-131	15	NDM		NDM	NDM	NDM
	Cs-134	15	NDM		NDM	NDM	NDM
	Cs-137	18	NDM		NDM	NDM	NDM
	Ba-140	60	NDM		NDM	NDM	NDM
	La-140	15	NDM		NDM	NDM	NDM
	Tritium 12	2000	1655 440-3750 (4/4)	Sav River (RM 150.4) ENE 0.8 mi.	1655.0 440-3750 (4/4)	932 428-2230 (4/4)	266 159-485 (1/4)

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TABLE 3-1 (SHEET 4 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Water Near Intakes to Water Treatment Plants (pCi/l)	Gross Beta 48	4	3.5 1.05-12.11 (36/36)	Cherokee Hill Water Treatment Plant, Port Wentworth, Ga SSE 72 mi.	3.8 2.24-12.11 (12/12)	NA	3.33 1.84-9.69 (12/12)
	Gamma Isotopic 48						
	Be-7	124(e)	NDM		NDM	NA	NDM
	Mn-54	15	NDM		NDM	NA	NDM
	Fe-59	30	NDM		NDM	NA	NDM
	Co-58	15	NDM		NDM	NA	NDM
	Co-60	15	NDM		NDM	NA	NDM
	Zn-65	30	NDM		NDM	NA	NDM
	Zr-95	30	NDM		NDM	NA	NDM
	Nb-95	15	NDM		NDM	NA	NDM
	I-131(f)	15	NDM		NDM	NA	NDM
	Cs-134	15	NDM		NDM	NA	NDM
	Cs-137	18	NDM		NDM	NA	NDM
	Ba-140	60	NDM		NDM	NA	NDM
	La-140	15	NDM		NDM	NA	NDM
	Tritium 16	2000	427 45.9-898 (12/12)	Purrysburg Water Treatment Plant: Purrysburg, SC SSE 76 mi.	467.5 104-701 (4/4)	NA	190 170-210 (4/4)

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TABLE 3-1 (SHEET 5 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean Name Distance & Direction	Mean (b), Range (Fraction)	Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Finished Water at Water Treatment Plants (pCi/l)	Gross Beta 48	4	2.96 0.9-6.98 (36/36)	Beaufort-Jasper County Water Treatment Plant SE 76 mi.	4.0 2.26-6.98 (12/12)	NA	2.25 0.5-3.91 (12/12)
	Gamma Isotopic 48						
	Be-7	124(e)	NDM		NDM	NA	NDM
	Mn-54	15	NDM		NDM	NA	NDM
	Fe-59	30	NDM		NDM	NA	NDM
	Co-58	15	NDM		NDM	NA	NDM
	Co-60	15	NDM		NDM	NA	NDM
	Zn-65	30	NDM		NDM	NA	NDM
	Zr-95	30	NDM		NDM	NA	NDM
	Nb-95	15	NDM		NDM	NA	NDM
	I-131	1	NDM		NDM	NA	NDM
	Cs-134	15	NDM		NDM	NA	NDM
	Cs-137	18	NDM		NDM	NA	NDM
	Ba-140	60	NDM		NDM	NA	NDM
	La-140	15	NDM		NDM	NA	NDM
	Tritium 16	2000	432.4 91.5-840 (12/12)	Beaufort-Jasper County Water Treatment Plant SE 76 mi.	485.8 101-840 (4/4)	NA	221.3 46.2-476 (4/4)

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TABLE 3-1 (SHEET 6 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Anadromous Fish (pCi/kg-wet)	Gamma Isotopic 1						
	Be-7	655(e)	NA		NA	NA	NDM
	Mn-54	130	NA		NA	NA	NDM
	Fe-59	260	NA		NA	NA	NDM
	Co-58	130	NA		NA	NA	NDM
	Co-60	130	NA		NA	NA	NDM
	Zn-65	260	NA		NA	NA	NDM
	Cs-134	130	NA		NA	NA	NDM
	Cs-137	150	NA		NA	NA	NDM
Fish (pCi/kg-wet)	Gamma Isotopic 6						
	Be-7	655(e)	NDM		NDM	NA	NDM
	Mn-54	130	NDM		NDM	NA	NDM
	Fe-59	260	NDM		NDM	NA	NDM
	Co-58	130	NDM		NDM	NA	NDM
	Co-60	130	NDM		NDM	NA	NDM
	Zn-65	260	NDM		NDM	NA	NDM
	Cs-134	130	NDM		NDM	NA	NDM
	Cs-137	150	56.0 22.3-78.1 (3/3)	Sav River N 2.5 mi.	61.6 13.9-97.6 (3/3)	NA	61.6 13.9-97.6 (3/3)

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TABLE 3-1 (SHEET 7 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Other Stations (g) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance & Direction (Fraction)	Mean (b), Range		
Sediment (pCi/kg-dry)	Gamma Isotopic 4						
	Be-7	655(e)	1942.5 1377-2508 (2/2)	Sav River (RM 150.4) ENE 0.8 mi.	1942.5 1377-2508 (2/2)	NA	1490 1012-1967 (2/2)
	Co-60	70(e)	NDM	NA	NDM	NA	NDM
	Cs-134	150	NDM	NA	NDM	NA	NDM
	Cs-137	180	154.5 131.9-177.2 (2/2)	Sav River (RM 150.4) ENE 0.8 mi.	154.5 131.9-177.2 (2/2)	NA	91.5 88.5-94.5 (2/2)

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TABLE 3-1 (SHEET 8 of 8)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Notes:

a. The MDC is defined in ODCM 10.1. Except as noted otherwise, the values listed in this column are the detection capabilities required by ODCM Table 4-3. The values listed in this column are a priori (before the fact) MDCs. In practice, the a posteriori (after the fact) MDCs are generally lower than the values listed. Any a posteriori MDC greater than the value listed in this column is discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at a specified location that are detectable is placed in parenthesis.

c. No Detectable Measurement(s).

d. Not Applicable.

e. The EL has determined that this value may be routinely attained under normal conditions. No value is provided in ODCM Table 4-3.

f. Item 3 of ODCM Table 4-1 implies that an I-131 analysis is not required to be performed on water samples when the dose calculated from the consumption of water is less then 1 mrem per year. However, I-131 analyses have been performed on the finished drinking water samples.

g. "Other" stations, as identified in the "Station Type" column of Table 2-2, are "Community" and/or "Special" stations.

4.0 DISCUSSION OF RESULTS

Included in this section are evaluations of the laboratory results for the various sample types. The Minimum Detectable Difference (MDD) compares the lowest significant difference between the means of a control station and an indicator station, or the control station and the community station, that can be determined statistically at the 99% Confidence Level (CL). To calculate MDD, first an F-test was applied to determine the variability in the data. Once the data was determined to be paired or unpaired, the appropriate t-test (Student's or Welch's) and MDD formulas were applied. MDD as a tool can quantify plant Vogtle's impact on the surrounding environment, while the t-test adds greater statistical confidence in the data set. A difference in mean values which was less than the MDD was considered to be statistically indiscernible.

The 2013 results were compared with past results, including those obtained during preoperation. As appropriate, results were compared with their Minimum Detectable Concentrations (MDC) and Reporting Levels (RL) which are listed in Tables 4-1 and 4-2 of this report, respectively. The required MDCs were achieved during laboratory sample analysis. Any anomalous results are explained within this report.

Results of interest are graphed to show historical trends. The data points are tabulated and included in this report. The points plotted and provided in the tables represent mean values of only detectable results. Periods for which no detectable measurements (NDM) were observed or periods for which values were not applicable (e.g., milk indicator, etc.) are listed as NDM and are plotted in the tables as 0's.

Atmospheric nuclear weapons tests from the mid 1940s through 1980 distributed man-made nuclides around the world. The most recent atmospheric tests in the 1970s and in 1980 had a significant impact upon the radiological concentrations found in the environment prior to and during preoperation, and the earlier years of operation. Some long lived radionuclides, such as Cs-137, continue to have some impact. A significant component of the Cs-137 which has often been found in various samples over the years (and continues to be found) is attributed to the nuclear weapons tests.

Data in this section has been modified to remove any obvious non-plant short term impacts. The specific short term impact data that has been removed includes: the nuclear atmospheric weapon test in the fall of 1980; abnormal releases from the Savannah River Site (SRS) during 1987 and 1991; and the Chernobyl incident in the spring of 1986.

The most significant nuclear event since Chernobyl occurred at Fukushima Daiichi Nuclear Power Plant after the Tohoku earthquake and tsunami on March 11, 2011. Equipment failures and nuclear meltdowns resulted in radioactivity being released into the atmosphere. Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster.

In accordance with ODCM 4.1.1.2.1, deviations from the required sampling schedule are permitted, if samples are unobtainable due to hazardous conditions,

unavailability, inclement weather, equipment malfunction or other just reasons. Deviations from conducting the REMP as described in Table 2-1 are summarized in Table 4-3 along with their causes and resolutions.

All results were tested for conformance with Chauvenet's criterion (G. D. Chase and J. L. Rabinowitz, Principles of Radioisotope Methodology. Burgess Publishing Company, 1962, pages 87-90) to identify values which differed from the mean of a set by a statistically significant amount. Identified outliers were investigated to determine the reason(s) for the difference. If equipment malfunction or other valid physical reasons were identified as causing the variation, the anomalous result was excluded from the data set as non-representative. No data points were excluded for violating Chauvenet's criterion.

Table 4-1

Minimum Detectable Concentrations (MDC)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)	Sediment (pCi/kg)
Gross Beta	4	10				
H-3	2000 (a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1 (b)	70		1	60	
Cs-134	15	50	130	15	60	150
Cs-137	18	60	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) If no drinking water pathway exists, a value of 3000 pCi/l may be used.

(b) If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 4-2
Reporting Levels (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)
H-3	20,000 (a)				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-95	400				
Nb-95	700				
I-131	2 (b)	900		3	100
Cs-134	30	10,000	1000	60	1000
Cs-137	50	20,000	2000	70	2000
Ba-140	200			300	
La-140	100			400	

(a) This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.

(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 4-3

ANOMALIES AND DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLES	ANOMALY (A)* OR DEVIATION (D)**	CAUSE	RESOLUTION
6/11/13-6/18/13 CR 699053/TE 699816	Air I, Air Part. 35 – Girard Air Sampling Station	(A) Low sample volume	Loss of power for 8.2 hours due to installation of new power pole.	Power restored following installation of new power pole. Sample volume was low but acceptable per GPL sampling procedure.
1/29/13 – 2/5/13 CR 726664/TE 730682	Air I, Air Part. 10A – Met Tower	(A) Low sample volume	Filter media heavy loading	Filter media changed at weekly interval – no further issues. Sample volume was low but acceptable per GPL sampling procedure.
Second quarter 2013 CR 672396	R-8	(A) Sample not obtained	High water level in the access near the river	Sample was not obtained
October 2013 CR 717685/TE 719785	84 - River Water	(A) Composite sampling was not continuous and did not cover the entire month.	The field sampling team observed that recent high river levels had likely caused ants to take refuge in the sample box and that they had shorted the battery terminals on the sampler.	A grab sample was taken to supplement the sample, per GPL sampling procedure. The ants were removed and the battery replaced. Continuous sampling was resumed.
October 2013 CR 717679/TE 719788	83 - River Water	(A) Insufficient sample volume	The field sampling team observed that the intake sampling line had collapsed in on itself, restricting sample flow.	The intake line was replaced and proper operation verified. October indicator station sample obtained downstream at station 84

* An anomaly is considered a non-standard sample that still meets sampling criteria outlined in Southern Nuclear and Georgia Power Labs procedures.

** A deviation is a sample result that is not recorded due to not meeting scheduling and/or procedural requirements as outlined by Southern Nuclear and Georgia Power Labs

4-4

4.1 Land Use Census and River Survey

In accordance with ODCM 4.1.2, a land use census was conducted on November 12, 2013 to determine the locations of the nearest permanent residence, milk animal, and garden of greater than 500 square feet producing broad leaf vegetation, in each of the 16 compass sectors within a distance of 5 miles; the locations of the nearest beef cattle in each sector were also determined. A milk animal is a cow or goat producing milk for human consumption. Land within SRS was excluded from the census. The census results are tabulated in Table 4.1-1. The 2013 census indicated that there were no changes to the nearest location for any of the categories in any of the sectors when compared to the 2012 census.

Table 4.1-1

LAND USE CENSUS RESULTS

Distance in Miles to the Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL	BEEF CATTLE	GARDEN
N	1.4	None	None	None
NNE	None	None	None	None
NE	None	None	None	None
ENE	None	None	None	None
E	None	None	None	None
ESE	4.2	None	None	None
SE	4.3	None	4.9	None
SSE	4.7	None	4.7	None
S	4.4	None	4.3	None
SSW	4.7	None	4.6	None
SW	3.1	None	None	None
WSW	2.6	None	2.7	None
W	3.4	None	4.4	None
WNW	1.9	None	None	None
NW	1.5	None	None	None
NNW	1.5	None	None	None

ODCM 4.1.2.2.1 requires a new controlling receptor to be identified, if the land use census identifies a location that yields a calculated receptor dose greater than the one in current use. In 2008, the controlling receptor was moved to a more conservative location at 1.2 miles WSW. This property was acquired by Georgia Power in 2008. The residents were relocated but this property will potentially be used for contract labor in the future.

ODCM 4.1.2.2.2 requires that whenever the land use census identifies a location which yields a calculated dose (via the same ingestion pathway) 20% greater than that of a current indicator station, the new location must become a REMP station (if samples are available). None of the identified locations yielded a calculated dose 20% greater than that for any of the current indicator stations because there were no changes to indicator stations in any of the sectors.. No milk animals were identified within five miles of the plant. A new dairy was started at Girard in 2008 and was added to the REMP. Since control stations are approximately 10 miles or greater, this dairy is considered an indicator station.

Neither current sampling locations nor the controlling receptor were affected by the 2013 land use census results.

A survey of the Savannah River downstream of the plant for approximately 100 miles was conducted on September 17, 2013 to identify any new withdrawal of water from the river for drinking, irrigation, or construction purposes. No new usage was identified. These results were corroborated by checking with the Georgia Department of Natural Resources on September 20, 2013 and the South Carolina Department of Health and Environmental Control on September 30, 2013. Each of these agencies confirmed that no water withdrawal permits for drinking, irrigation, or construction purposes had been issued for this stretch of the Savannah River. The three water treatment plants used as indicator stations for drinking water are located further downriver.

4.2 Airborne

As specified in Table 2-1 and shown in Figures 2-1 through 2-3, airborne particulate filters and charcoal canisters are collected weekly at 5 indicator stations (Stations 3, 7, 10, 12 and 16) which encircle the plant at the site periphery, at a nearby community station (Station 35) approximately 7 miles from the plant, and at a control station (Station 36) which is approximately 14 miles from the plant. At each location, air is continuously drawn through a glass fiber filter to retain airborne particulate and an activated charcoal canister is placed in series with the filter to adsorb radioiodine.

Each particulate filter is counted for gross beta activity. A quarterly gamma isotopic analysis is performed on a composite of the air particulate filters for each station. Each charcoal canister is analyzed for I-131.

As provided in Table 3-1, the 2013 annual average weekly gross beta activity was 22.9 fCi/m^3 for the indicator stations. It was 1.0 fCi/m^3 less than the control station average of 23.9 fCi/m^3 for the year. This difference is not statistically discernible, since it is less than the calculated MDD of 2.2 fCi/m^3.

The 2013 annual average weekly gross beta activity at the Girard community station was 22.2 fCi/m^3 which was 1.7 fCi/m^3 less than the control station average. This difference is not statistically discernible since it is less than the calculated MDD of 2.8 fCi/m^3.

The historical trending of the average weekly gross beta air concentrations for each year of operation and the preoperational period (September, 1981 to January, 1987) at the indicator, control and community stations is plotted in Figure 4.2-1 and listed in Table 4.2-1. In general, there is close agreement between the results for the indicator, control and community stations. This close agreement supports the position that the plant is not contributing significantly to the gross beta concentrations in air.

Figure 4.2-1

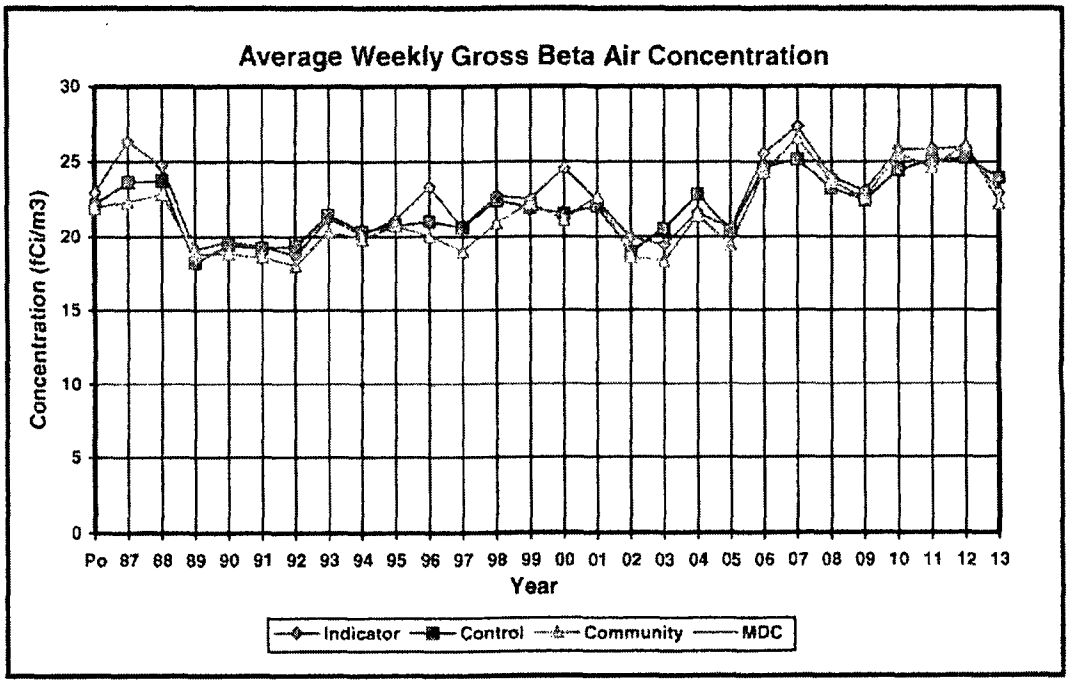
Average Weekly Gross Beta Air Concentration
Concentration (fCi/m3)
30
25
20
15
10
5
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
Community
MDC

Table 4.2-1

Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	22.9	22.1	21.9
1987	26.3	23.6	22.3
1988	24.7	23.7	22.8
1989	19.1	18.2	18.8
1990	19.6	19.4	18.8
1991	19.3	19.2	18.6
1992	18.7	19.3	18.0
1993	21.2	21.4	20.3
1994	20.1	20.3	19.8
1995	21.1	20.7	20.7
1996	23.3	21.0	20.0
1997	20.6	20.6	19.0
1998	22.7	22.4	20.9
1999	22.5	21.9	22.2
2000	24.5	21.5	21.1
2001	22.4	22.0	22.7
2002	19.9	18.9	18.6
2003	19.4	20.5	18.3
2004	21.6	22.8	21.4
2005	20.5	20.4	19.4
2006	25.5	24.6	24.3
2007	27.3	25.1	26.5
2008	24.0	23.2	23.7
2009	23.0	22.4	22.5
2010	25.8	24.4	25.5
2011	25.8	25.1	24.6
2012	25.9	25.2	26.1
2013	22.9	23.9	22.2

During 2013, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters. In 1987. Cs-137 was found in one indicator composite at a concentration of 1.7 fCi/m^3. During pre-operation, Cs-137 was found in approximately 12% of the indicator composites and 14% of the control composites with average concentrations of 1.7 and 1.0 fCi/m^3, respectively. The MDC for airborne Cs-137 is 60 fCi/m^3. Also, during pre-operation, Cs-134 was found in about 8% of the indicator composites at an average concentration of 1.2 fCi/m3. The MDC for Cs-134 is 50 fCi/m3.

The naturally occurring radionuclide Be-7 is typically detected in all indicator and control station gamma isotopic analyses of the quarterly composites of the air particulate filters. In 2013, Be-7 was identified in plant gaseous effluents and in REMP air samples and is, therefore, included in the REMP summary table of the airborne pathway samples. The average Be-7 concentration at the indicator stations was 74.1 fCi/m^3 which was 13.4 fCi/m^3 less than the average at the control station (87.5 fCi/m^3). The difference is statistically discernible since it is more than the MDD of 12.3 fCi/m^3however because the indicator is less than the control station the result does not indicate an adverse environmental impact. The average at the community station was 74.9 fCi/m^3 which was 12.6 fCi/m^3 less than the average at the control station. The difference is statistically indiscernible since it is less than the MDD of 17.8 fCi/m^3. Be-7 has been detected in gaseous effluents in nine of the years of plant operation prior to 2013.

Airborne I-131 was not detected in air samples during 2013. During pre-operation, positive results were obtained only during the Chernobyl incident when concentrations as high as 182 fCi/m^3 were observed. The nuclear accident at Fukushima Daiichi Nuclear Power Plant which occurred after the Tohoku earthquake and tsunami on March 11, 2011 released radioactivity into the environment that was detected in Vogtle air samples. Iodine-131 was detected in air cartridges after Fukushima but no changes in gross beta activity were seen during that same time period. Iodine-131 ranging from 24.7-93.8 fCi/m^3 was seen at Vogtle for several weeks following the Fukushima accident. The MDC and RL for airborne I-131 are 70 and 900 fCi/m^3, respectively.

4.3 Direct Radiation

In 2013, direct (external) radiation was measured with Landauer InLight optically stimulated luminescent (OSL) dosimeters which replaced the Panasonic thermoluminescent dosimeters (TLDs). The Panasonic system was retired at the end of 2010 due to the inability to keep the aging badge readers operating reliably. Similar to the TLD protocol of the past, two OSL badges are placed at each station. Each badge contains two elements composed of aluminum oxide crystals with carbon impurity. The gamma dose at each station is based upon the average readings of the elements from the two badges. The two badges for each station are placed in thin plastic bags for protection from moisture while in the field. The badges are nominally exposed for periods of a quarter of a year (91 days). An inspection is performed near mid-quarter for offsite badges to assure that the badges are on-station and to replace any missing or damaged badges.

Two direct radiation stations are established in each of the 16 compass sectors, to form 2 concentric rings. The inner ring (Stations 1 through 16) is located near the plant perimeter as shown in Figure 2-1 and the outer ring (Stations 17 through 32) is located at a distance of approximately 5 miles from the plant as shown in Figure 2-2. The 16 stations forming the inner ring are designated as the indicator stations. The two ring configuration of stations was established in accordance with NRC Branch Technical Position "An Acceptable Radiological Environmental Monitoring Program", Revision 1, November 1979. The 6 control stations (Stations 36, 37, 47, 48, 51 and 52) are located at distances greater than 10 miles from the plant as shown in Figure 2-2. Monitored special interest areas consist of the following: Station 35 at the town of Girard, and Station 43 at the employee recreational area. The mean and range values presented in the "Other" column in Table 3-1 (page 1 of 8) includes the outer ring stations (stations 17 through 32) as well as stations 35 and 43.

As provided in Table 3-1 the average quarterly exposure measured at the indicator stations in 2013 was 13.1 mR with a range of 8.1 to 18.0 mR. The average was 0.1 mR less than the average quarterly exposure measured at the control stations (13.2). This difference is not statistically discernible since it is less than the MDD of 0.7 mR. Over the operational history of the site, the annual average quarterly exposures shows a variation of no more than 0.7 mR difference between the indicator and control stations. The overall average quarterly exposure for the control stations during preoperation was 1.2 mR greater than that for the indicator stations.

The quarterly exposures acquired at the outer ring stations during 2013 ranged from 10.8 to 16.8 mR with an average of 13.6 mR which was 0.4 mR more than that for the control stations. However, this difference is not discernible since it is less than the MDD of 0.8 mR. For the entire period of operation, the annual average quarterly exposures at the outer ring stations vary by no more than 1.2 mR from those at the control stations. The overall average quarterly exposure for the outer ring stations during preoperation was 1.8 mR less than that for the control stations.

Third quarter 1997, TLDs were placed on a trial basis at SGA School in Sardis (S 11 miles) and Oglethorpe substation SW 10.7 miles. The results were within the range of the existing control stations, so these were added as controls in 1999.

The historical trending of the average quarterly exposures for the indicator inner ring, outer ring, and the control stations are plotted in Figure 4.3-1 and listed in Table 4.3-1. The decrease between 1991 and 1992 values is attributed to a change in TLDs from Teledyne to Panasonic. It should be noted however that the differences between indicator and control and outer ring values did not change.

During 2010, OSL badges were co-located on station with the TLD badges. In 2011, only the OSL badges were placed at each station. Following the change to only OSL badges, the differences between indicator, control, and community locations has been consistent with previous years. An increase noted in 2010 reflects issues (especially during 2nd Qtr) with the aging Panasonic TLD reader. The close agreement between the station groups supports the position that the plant is not contributing significantly to direct radiation in the environment.

Figure 4.3-1

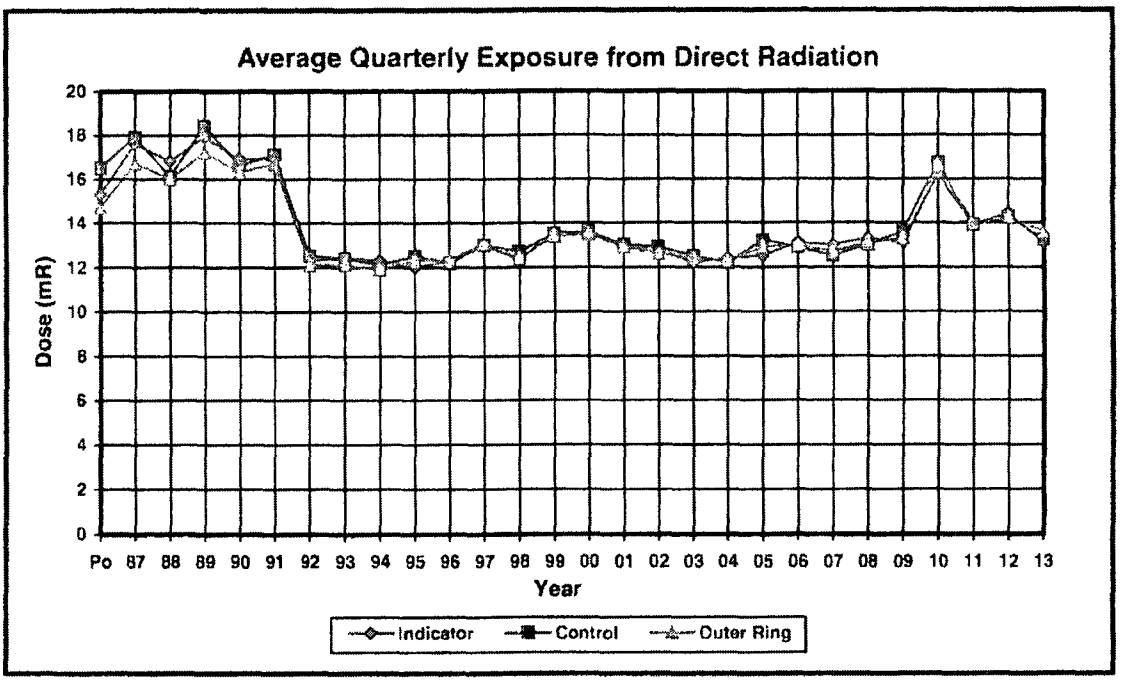

Table 4.3-1

Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	15.3	16.5	14.7
1987	17.6	17.9	16.7
1988	16.8	16.1	16.0
1989	17.9	18.4	17.2
1990	16.9	16.6	16.3
1991	16.9	17.1	16.7
1992	12.3	12.5	12.1
1993	12.4	12.4	12.1
1994	12.3	12.1	11.9
1995	12.0	12.5	12.3
1996	12.3	12.2	12.3
1997	13.0	13.0	13.1
1998	12.3	12.7	12.4
1999	13.6	13.5	13.4
2000	13.5	13.6	13.5
2001	12.9	13.0	12.9
2002	12.8	12.9	12.6
2003	12.2	12.5	12.4
2004	12.4	12.2	12.3
2005	12.5	13.2	12.9
2006	13.1	12.9	13.0
2007	13.0	12.5	12.7
2008	13.3	13.0	13.1
2009	13.1	13.6	13.3
2010	16.2	16.7	16.6
2011	13.9	13.9	14.0
2012	14.4	14.3	14.2
2013	13.1	13.2	13.6

The historical trending of the average quarterly exposures at the special interest areas for the same periods are provided in Figure 4.3-2 and listed in Table 4.3-2. These exposures are within the range of those acquired at the other stations. They too, show that the plant is not contributing significantly to direct radiation at the special interest areas.

Figure 4.3-2

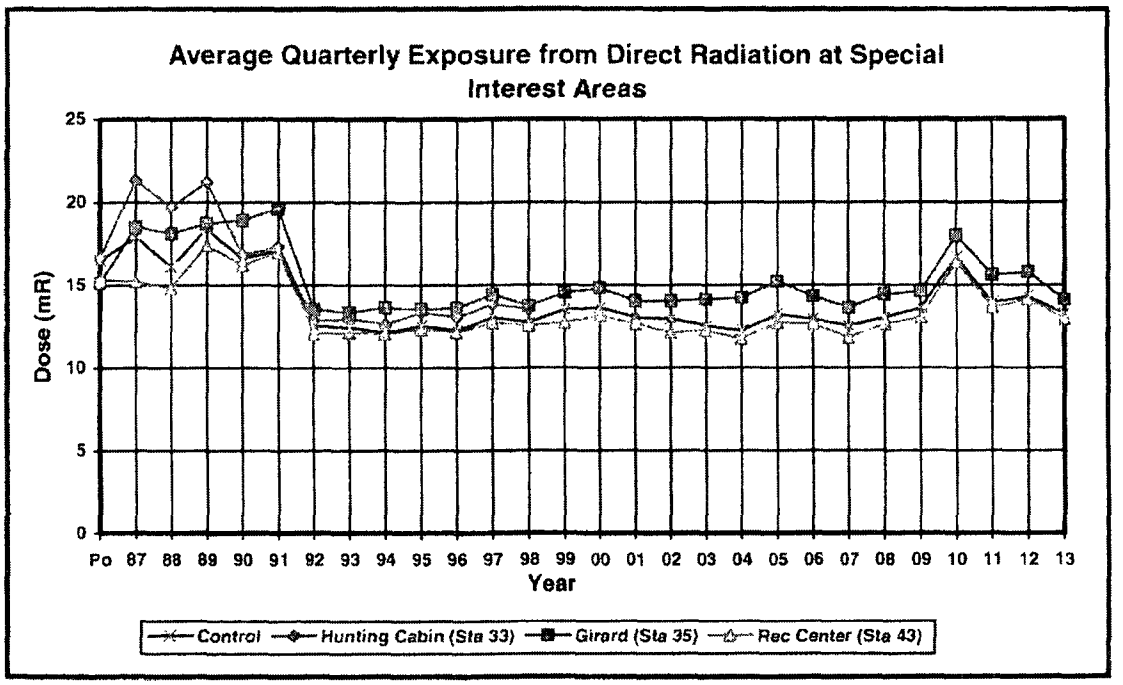

Table 4.3-2

Average Quarterly Exposure from Direct Radiation at Special Interest Areas

Period	Control (mR)	Station 33 (mR)	Station 35 (mR)	Station 43 (mR)
Pre-op	16.5	16.6	15.1	15.3
1987	17.9	21.3	18.5	15.2
1988	16.1	19.7	18.1	14.8
1989	18.4	21.2	18.7	17.4
1990	16.6	16.8	18.9	16.2
1991	17.1	17.3	19.6	17.0
1992	12.5	12.8	13.5	12.0
1993	12.4	12.9	13.3	12.1
1994	12.1	12.6	13.6	12.0
1995	12.5	13.3	13.5	12.3
1996	12.2	13.0	13.6	12.1
1997	13.0	13.8	14.4	12.7
1998	12.7	13.5	13.7	12.5
1999	13.5	NA	14.5	12.7
2000	13.6	NA	14.8	13.1
2001	13.0	NA	14.0	12.6
2002	12.9	NA	14.0	12.1
2003	12.5	NA	14.1	12.2
2004	12.2	NA	14.2	11.7
2005	13.2	NA	15.2	12.7
2006	12.9	NA	14.3	12.6
2007	12.5	NA	13.6	11.8
2008	13.0	NA	14.4	12.6
2009	13.6	NA	14.6	13.0
2010	16.7	NA	18.0	16.4
2011	13.9	NA	15.6	13.6
2012	14.3	NA	15.8	14.1
2013	13.2	NA	14.1	12.9

The hunting cabin activities at Station 33 have been discontinued and, consequently, this location is no longer considered as an area of special interest. Monitoring at this location was discontinued at the end of 1998.

The standard deviation for the quarterly result for each Landauer OSL badge was subjected to a self-imposed limit of 3.5 standard deviations. Previously with TLDs, this limit had been 1.4. However, the OSL readings varied more (between the two elements) than the TLD readings (between the three phosphors). This limit is calculated using a method developed by the American Society for Testing and Materials (ASTM) (ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976). The calculation is based upon the standard deviations obtained by the EL with the OSL badges during 2010. All of the dosimeters are read twice. The second read is not used unless the first read appears too variable. If both readings are above 3.5, an investigation is conducted to determine if there are true environmental differences in an OSL.
In 2013, the OSL results from the following stations were investigated because their standard deviations were greater than or equal to 3.5:

First Quarter:	None
Second Quarter:	None
Third Quarter:	None
Fourth Quarter:	None

No badges at any station were investigated for having a standard deviation greater than or equal to 3.5 in 2013

4.4 Milk

In accordance with Tables 2-1 and 2-2, milk samples are collected bimonthly from two locations, the Girard Dairy (Station 101) which is considered an indicator station because it is approximately 5.5 miles from Vogtle (ideally a milk indicator station is less than 5 miles from the plant), and the Seven Oaks Dairy (Station 102) at 7.5 miles from Vogtle is the control location (ideally control locations are greater than 10 miles from the plant). TE 770030 identified Milky Way Dairy as a replacement control location. The Milky Way Dairy will be added to the ODCM and be used for sampling starting in 2014.

As discussed in Section 4.1, no milk animal was found within 5 miles of plant Vogtle during the 2013 land use census. There were no milk sampling deviations in 2013.

Gamma isotopic and I-131 analyses are performed on each milk sample when samples are available. In 2013 there were no detectable results for I-131 or gamma isotopes including Cs-137. The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively. During preoperation and each year of operation through 1991, Cs-137 was found in 2 to 6% of the samples at concentrations ranging from 5 to 27 pCi/l. During preoperation, Cs-134 was detected in one sample and in the first year of operation, Zn-65 was detected in one sample. Figure 4.4-1 and Table 4.4-1 provide the historical trending of the Cs-137 concentration in milk.

Figure 4.4-1

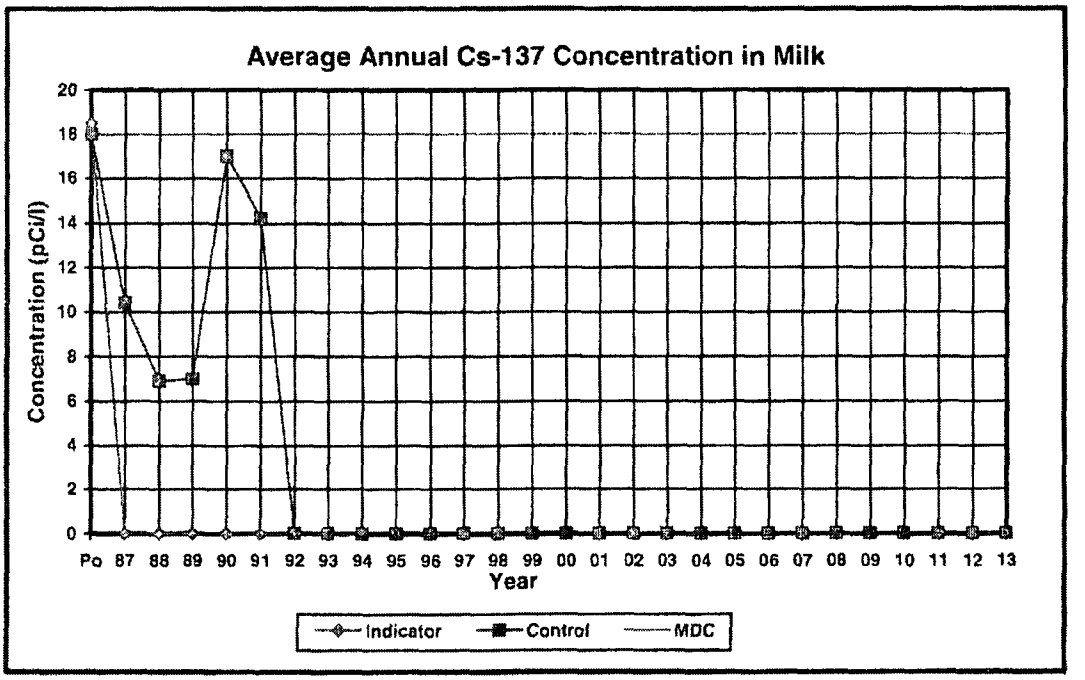

Table 4.4-1

Average Annual Cs-137 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	18.5	18
1987	NDM	10.4
1988	NDM	6.9
1989	NDM	7
1990	NDM	17
1991	NDM	14.2
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM
2012	NDM	NDM
2013	NDM	NDM

Following the Fukushima accident which began on March 11, 2011, I-131 was detected in milk samples collected from both dairy locations. Positive I-131, ranging from 1.63 to 12.5 pCi/l, was seen in the late March samples and in the samples from both collection dates in April. No other samples from 2011 contained I-131. Since plant operations began in 1987, I-131 may have been detected in one sample in 1996 and two during 1990; however, its presence in these cases was questionable, due to large counting uncertainties. During preoperation, positive I-131 results were found only during the Chernobyl incident with concentrations ranging from 0.53 to 5.07 pCi/l. The MDC and RL for I-131 in milk are 1 and 3 pCi/l, respectively.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles WSW from the plant (Station 37). Gamma isotopic analyses are performed on the samples. The man-made radionuclide Cs-137 has been found in vegetation samples in the past, however, there was no Cs-137 detected in any of the 2013 vegetation samples. Cesium-137 is often detected in environmental samples as a result of atmospheric weapons testing and the Chernobyl incident.

The naturally occurring radionuclide Be-7 is typically detected in indicator and control station vegetation samples. Be-7 was detected in gaseous effluents in 2013 and was detected in REMP vegetation samples. The results have been included in the REMP summary table of the airborne pathway samples. The average at the indicator stations was 2705 pCi/kg-wet which is 765 pCi/kg-wet higher than the average at the control station (1940 pCi/kg-wet). The difference between the averages at the indicator and control stations is not statistically discernible since it is less than the MDD of 1305 pCi/kg-wet. Be-7 has been detected in gaseous effluents in previous years of plant operation and is therefore of interest in the REMP program. However, the levels of Be-7 found in the REMP make no significant contribution to dose. There is no required MDC or Reporting Level for Be-7.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in this data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Two positive results averaging 16.6 pCi/kg-wet were measured in 2013. Cs-137 is the only man-made radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

In 2006, one sample at the control station was positive for Cs-137 at a higher concentration, 491.8 pCi/kg-wet, than typically seen over the years in Vogtle vegetation samples. A duplicate sample (which is taken periodically) happened to be taken at the same collection time and also revealed a similar activity. The higher concentration more than likely resulted from plowing and seeding activities (to maintain the vegetation plot) which took place a couple of weeks prior to the sample collection.

In 2011, following the nuclear accident at Fukushima Daiichi Nuclear Power Plant, I-131 was detected in REMP vegetation samples. Iodine-131 was detected at Vogtle in all three forage samples collected on 03/29/11 (after the Fukushima event), but not in any other monthly forage samples collected in 2011. The range of I-131 values was 58.3 to 81.8 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively.

During 2013, I-131 was not detected in any Vogtle REMP vegetation samples.

Figure 4.5-1

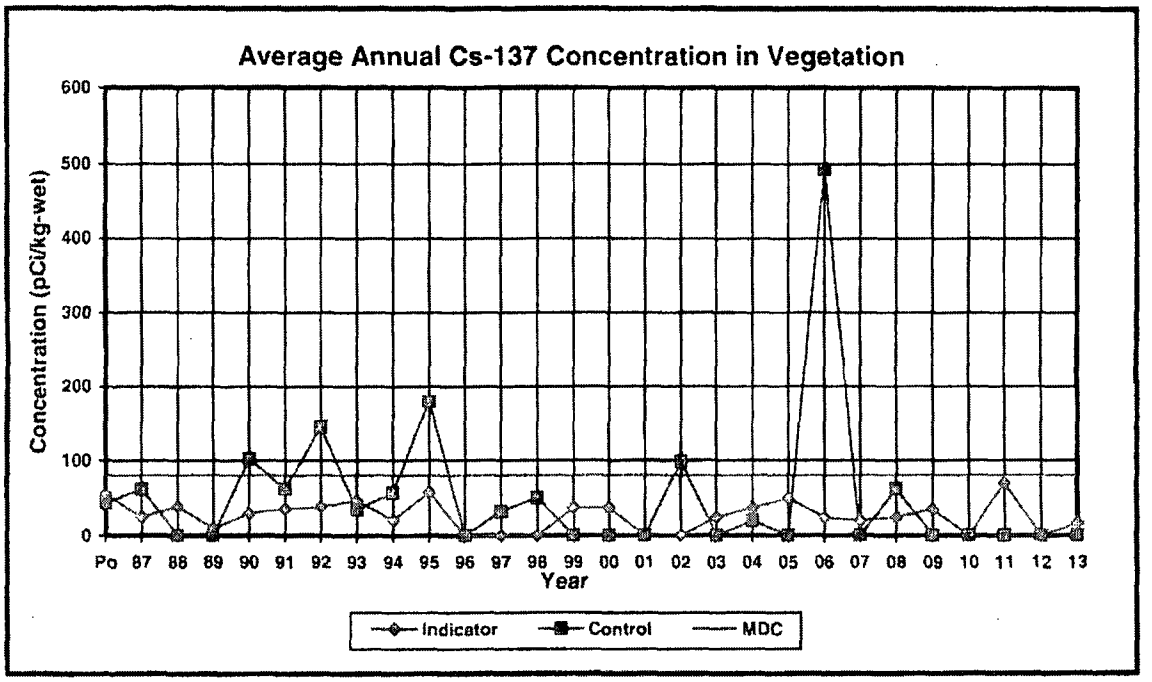
Average Annual Cs-137 Concentration in Vegetation
Concentration (pCi/kg-wet)
600
500
400
300
200
100
0
Pre 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.5-1

Average Annual Cs-137 Concentration in Vegetation

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	54.6	43.7
1987	24.4	61.5
1988	38.7	NDM
1989	9.7	NDM
1990	30.0	102.0
1991	35.3	62.4
1992	38.1	144.0
1993	46.4	34.1
1994	20.7	57.4
1995	57.8	179.0
1996	NDM	NDM
1997	NDM	32.6
1998	NDM	50.1
1999	37.2	NDM
2000	36.6	NDM
2001	NDM	NDM
2002	NDM	98.3
2003	24.5	NDM
2004	36.8	19.7
2005	49.5	NDM
2006	23.9	491.8
2007	20.2	NDM
2008	24.6	62.1
2009	34.6	NDM
2010	NDM	NDM
2011	69.6	NDM
2012	NDM	NDM
2013	16.6	NDM

4.6 River Water

Surface water from the Savannah River is obtained at three locations using automatic samplers. Small quantities are drawn at intervals not exceeding a few hours. The samples drawn are collected monthly; quarterly composites are produced from the monthly collections.

The collection points consist of a control location (Station 82) which is located about 0.4 miles upriver of the plant intake structure, an indicator location (Station 83) which is located about 0.4 miles downriver of the plant discharge structure, and a special location (Station 84) which is located approximately 1.3 miles downriver of the plant discharge structure. A statistically significant increase in the concentrations found in samples collected at the indicator station compared to those collected at the control station could be indicative of plant releases. Concentrations found at the special station are more likely to represent the activity in the river as a whole, which might include plant releases combined with those from other sources along the river.

A gamma isotopic analysis is conducted on each monthly sample. As in all previous years, there were no gamma emitting radionuclides of interest detected in the 2013 river water samples.

Each quarterly composite is analyzed for tritium. As indicated in Table 3-1, the average concentration found at the indicator station was 1655 pCi/l which was 1389 pCi/l greater than the average at the control station (266 pCi/l).
The MDD was calculated to be 1888 pCi/l, providing evidence the difference was statistically insignificant The MDC for tritium in river water used to supply drinking water is 2000 pCi/l and the RL is 20,000 pCi/l.

At the special river water sampling station, the results ranged from 428 pCi/l to 2230 pCi/l with an average of 932 pCi/l. The difference between the special station and the control station was 667 pCi/l. This difference was determined to be statistically insignificant with an MDD of 1149.

The historical trending of the average tritium concentrations found at the special, indicator, and control stations along with the MDC for tritium is plotted on Figure 4.6-1. The data for the plot is listed in Table 4.6-1. Also included in the table are data from the calculated difference between the indicator and control stations; the MDD between the indicator and control stations; and the total curies of tritium released from the plant in liquid effluents.

The annual downriver survey of the Savannah River, as discussed in Section 4.1, indicated that river water is not being used for purposes of drinking or irrigation for at least 100 miles downriver.

Figure 4.6-1

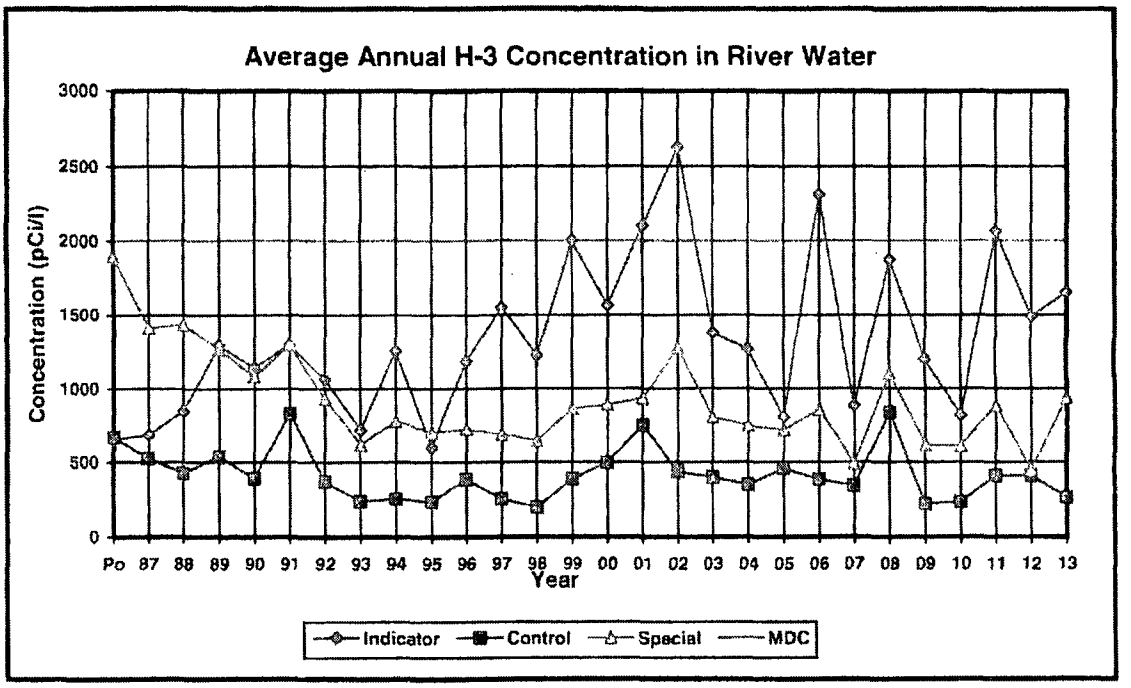
Average Annual H-3 Concentration in River Water
Concentration (pCi/l)
3000
2500
2000
1500
1000
500
0
Pre 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
Special
MDC

Table 4.6-1

Average Annual H-3 Concentration in River Water

Year	Special (pCi/l)	Indicator (pCi/l)	Control (pCi/l)	Difference Between Indicator and Control (pCi/l)	MDD (pCi/l)	Annual Site Tritium Released (Ci)
Pre-op	1900	650	665	-15	145	NA
1987	1411	680	524	156	416	321
1988	1430	843	427	416	271	390
1989	1268	1293	538	755	518	918
1990	1081	1142	392	750	766	1172
1991	1298	1299	828	471	626	1094
1992	929	1064	371	693	714	1481
1993	616	712	238	474	1526	761
1994	774	1258	257	1001	2009	1052
1995	699	597	236	361	766	968
1996	719	1187	387	800	2147	1637
1997	686	1547	254	1293	1566	1449
1998	640	1226	196	1030	1313	1669
1999	859	2005	389	1616	1079	1674
2000	885	1564	496	1068	1786	869
2001	931	2101	743	1358	1696	1492
2002	1280	2628	437	2190	1211	1566
2003	800	1376	399	977	1706	1932
2004	743	1269	351	918	1061	1212
2005	713	800	458	342	1333	1860
2006	852	2307	384	1882	2688	2005
2007	489	879	344	535	1189	757
2008	1105	1874	832	1042	4838	1364
2009	614	1203	221	982	3551	1224
2010	607	814	235	579	2094	903
2011	880	2068	409	1659	2522	1361
2012	446	1488	412	1076	NA	1810
2013	932	1655	266	1389	1888	1902

4.7 Drinking Water

Samples are collected at a control location (Station 80 - the Augusta Water Treatment Plant in Augusta, Georgia located about 56 river miles upriver), and at three indicator locations (Station 87 - the Beaufort-Jasper County Water Treatment Plant near Beaufort, South Carolina, 112 river miles downriver; Station 88 - the Cherokee Hill Water Treatment Plant near Port Wentworth, Georgia, 122 river miles downriver; and Station 89 – the Purrysburg Water Treatment Plant near Purrysburg, South Carolina, located about 112 miles downriver. The Purrysburg Station was added to the REMP in January 2006.) Stations 87 and 89 are located on the same canal with the Purrysburg location at the beginning of the canal (nearer the Savannah River) and the Beaufort-Jasper location near the end of the canal. These upriver and downriver distances in river miles are the distances from the plant to the point on the river where water is diverted to the intake for each of these water treatment plants.

Water samples are taken near the intake of each water treatment plant (raw drinking water) using automatic samplers that take periodic small aliquots from the stream. These composite samples are collected monthly along with a grab sample of the processed water coming from the treatment plants (finished drinking water). Quarterly composites are made from these monthly collections for both raw and processed river water. Gross beta and gamma isotopic analyses are performed on each of the monthly samples while tritium analysis is conducted on the quarterly composites. An I-131 analysis is not required to be conducted on these samples, since the dose calculated from the consumption of water is less than 1 mrem per year (see ODCM Table 4-1). However, an I-131 analysis is conducted on each of the monthly finished water grab samples, since a drinking water pathway exists.

Provided in Figures 4.7-1 and 4.7-2 and Tables 4.7-1 and 4.7-2, are the historical trends of the average gross beta concentrations found in the monthly collections of raw and finished drinking water.

For 2013, the indicator station average gross beta concentration in the raw drinking water was 3.51 pCi/l which was 0.18 pCi/l greater than the average gross beta concentration at the control station (3.33 pCi/l). This difference is not statistically discernible since it is less than the calculated MDD of 1.09 pCi/l. Through the years, there has been close agreement between the gross beta values at the indicator stations and the control station which supports that there is no significant gross beta contribution from the plant effluents. The required MDC for gross beta in water is 4.0 pCi/l. There is no RL for gross beta in water.

For 2013, the indicator station average gross beta concentration in the finished drinking water was 2.96 pCi/l which was 0.71 pCi/l more than the average gross beta concentration at the control station (2.25 pCi/l). This difference is statistically discernible since it is more than the MDD of 0.66 pCi/l. However the small difference and historical trends do not indicate environmental impact. The gross beta concentrations at the indicator stations ranged from 0.90 to 6.98 pCi/l while the concentrations at the control station ranged from 0.50 to 3.91 pCi/l. The required MDC for gross beta in water is 4.0 pCi/l. There is no RL for gross beta in water.

Figure 4.7-1

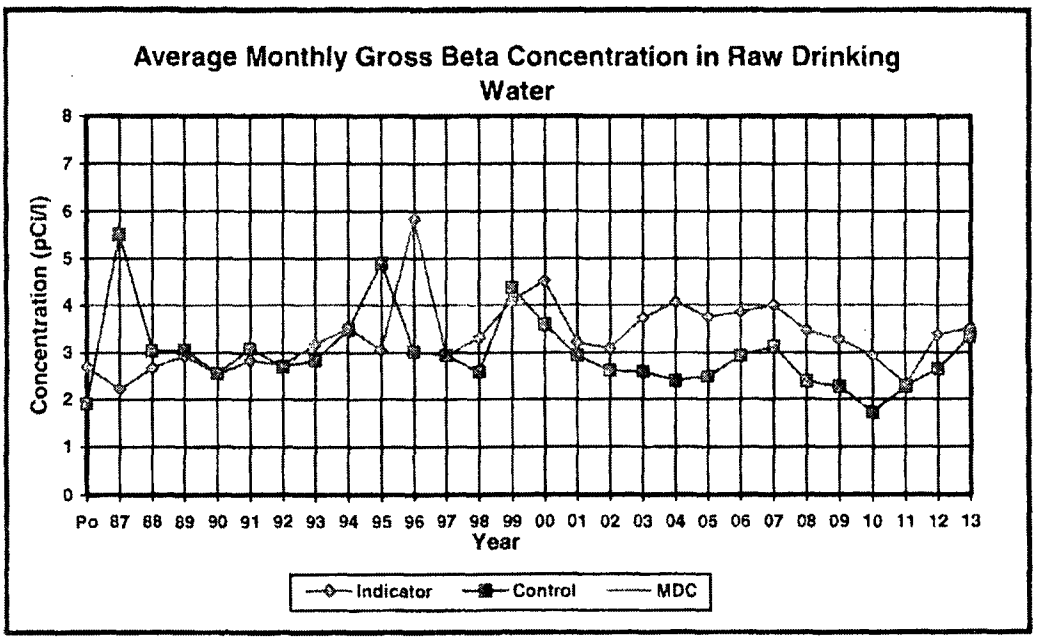
Average Monthly Gross Beta Concentration in Raw Drinking Water
Concentration (pCi/l)
0
1
2
3
4
5
6
7
8
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.7-1

Average Monthly Gross Beta Concentration in Raw Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	2.70	1.90
1987	2.20	5.50
1988	2.67	3.04
1989	2.93	3.05
1990	2.53	2.55
1991	2.83	3.08
1992	2.73	2.70
1993	3.17	2.83
1994	3.51	3.47
1995	3.06	4.90
1996	5.83	3.02
1997	2.93	2.94
1998	3.31	2.58
1999	4.10	4.37
2000	4.52	3.59
2001	3.21	2.94
2002	3.09	2.61
2003	3.73	2.59
2004	4.06	2.39
2005	3.75	2.48
2006	3.85	2.93
2007	4.00	3.13
2008	3.46	2.37
2009	3.28	2.26
2010	2.95	1.71
2011	2.31	2.26
2012	3.38	2.65
2013	3.51	3.33

Figure 4.7-2

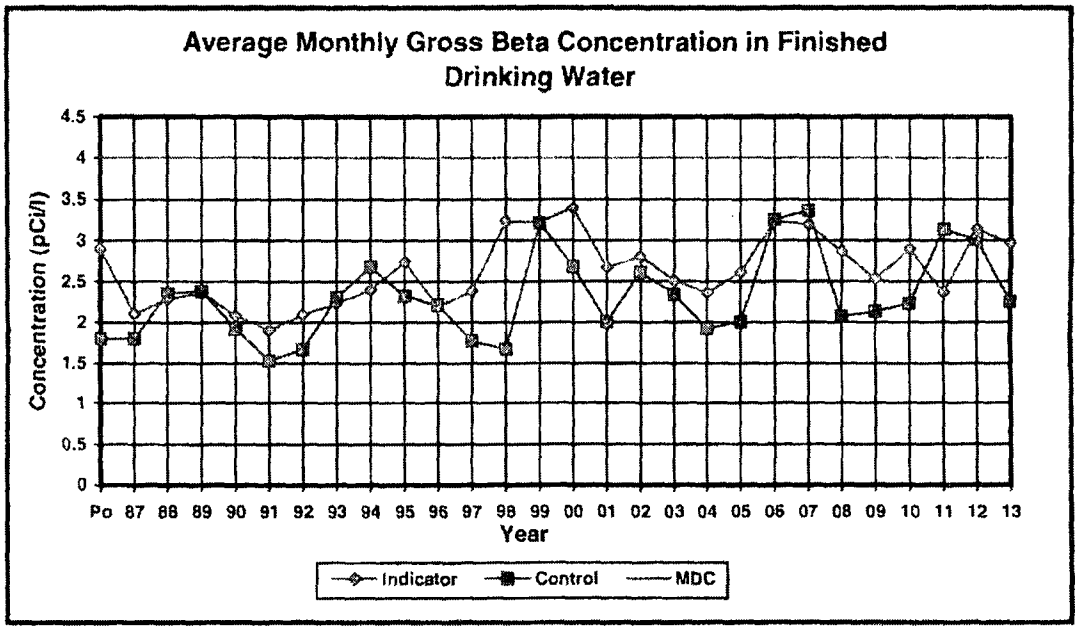
Average Monthly Gross Beta Concentration in Finished Drinking Water
Concentration (pCi/l)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.7-2

Average Monthly Gross Beta Concentration in Finished Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	2.90	1.80
1987	2.10	1.80
1988	2.28	2.35
1989	2.36	2.38
1990	2.08	1.92
1991	1.90	1.53
1992	2.09	1.67
1993	2.23	2.30
1994	2.40	2.68
1995	2.74	2.32
1996	2.19	2.21
1997	2.38	1.77
1998	3.23	1.67
1999	3.23	3.21
2000	3.39	2.68
2001	2.67	2.00
2002	2.80	2.61
2003	2.51	2.34
2004	2.36	1.92
2005	2.61	2.00
2006	3.23	3.25
2007	3.19	3.36
2008	2.86	2.07
2009	2.53	2.13
2010	2.89	2.23
2011	2.36	3.13
2012	3.13	3.00
2013	2.96	2.25

As provided in Table 3-1, there were no positive results during 2013 for the radionuclides of interest from the gamma isotopic analysis of the monthly collections for both raw and finished drinking water. Only one positive result has been found since operation began. Be-7 was found at a concentration of 68.2 pCi/l in the sample collected for September 1987 at Station 87. During preoperation Be-7 was found in about 5% of the samples at concentrations ranging from 50 to 80 pCi/l. The MDC assigned for Be-7 in water is 124 pCi/l. Also during preoperation, Cs-134 and Cs-137 were detected in about 7% of the samples at concentrations on the order of their MDCs which are 15 and 18 pCi/l, respectively.

I-131 was detected in finished drinking water in 1997 at levels near the MDC. This was the first occurrence for detecting I-131 in finished drinking water since operation began. During preoperation, it was detected in only one of 73 samples at a concentration of 0.77 pCi/l at Port Wentworth. The MDC and RL for I-131 in drinking water are 1 and 2 pCi/l, respectively.

Figures 4.7-3 and 4.7-4 and Tables 4.7-3 and 4.7-4 provide historical trending for the average tritium concentrations found in the quarterly composites of raw and finished drinking water collected at the indicator and control stations. The tables also list the calculated differences between the indicator and control stations, and list the MDDs (when applicable) between these two station groups.

The graphs and tables show that the tritium concentrations in the drinking water samples, both raw and finished, have been gradually trending downward since 1988. The small increase in average concentrations at the indicator stations for 1991 and 1992 reflect the impact of the inadvertent release from SRS of 7,500 Ci of tritium to the Savannah River about 10 miles downriver of VEGP, in December 1991 (SRS release data was obtained from "Release of 7,500 Curies of Tritium to the Savannah River from the Savannah River Site", Georgia Department of National Resources, Environmental Protection Division, Environmental Radiation Program, January 1992).

The 2013 raw drinking water indicator stations average tritium concentration was 427 pCi/l which was 237 pCi/l greater than the average concentration found at the control station (190 pCi/l). MDD was calculated as 134 pCi/l between the indicator and control stations, indicating a statistically significant difference. However the small difference and historical trends do not indicate environmental impact. The MDC and RL for tritium in drinking water are 2000 pCi/l and 20,000 pCi/l, respectively.

The finished drinking water average tritium concentration at the indicator stations during 2013 was 432 pCi/l which was 211 pCi/l greater than the average concentration found at the control station (221 pCi/l). This difference is not statistically discernible since it is less than the calculated MDD of 232 pCi/l. The MDC and RL for tritium in drinking water are 2000 pCi/l and 20,000 pCi/l, respectively.

Figure 4.7-3

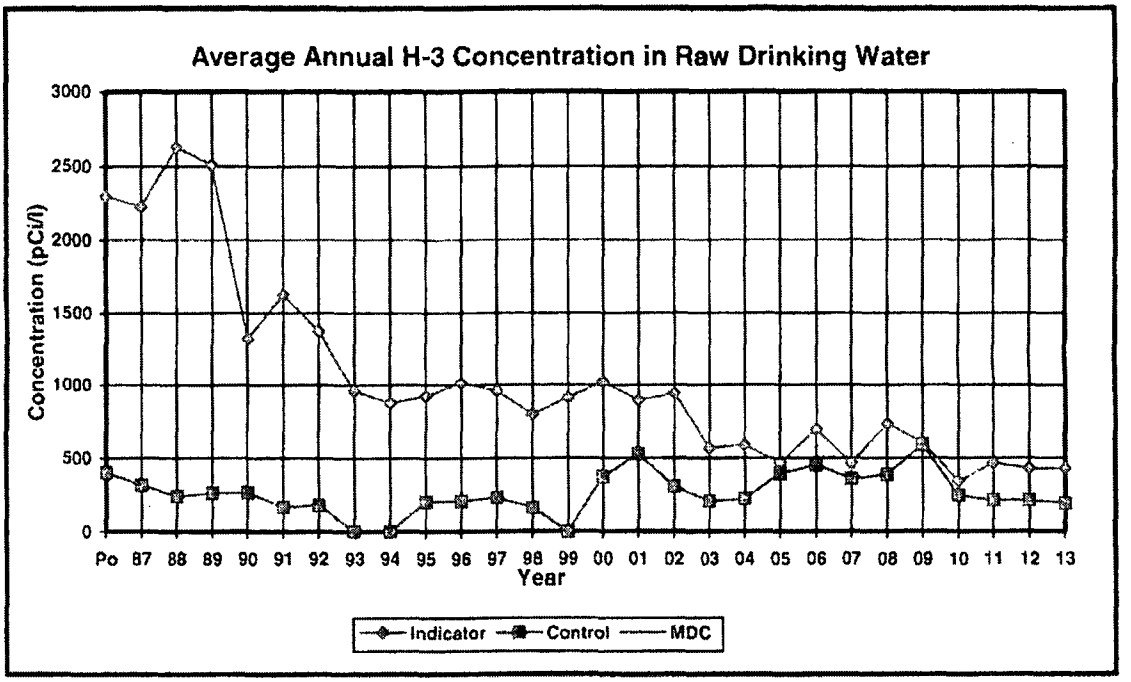
Average Annual H-3 Concentration in Raw Drinking Water
Concentration (pCi/l)
3000
2500
2000
1500
1000
500
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.7-3

Average Annual H-3 Concentration in Raw Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)	Difference Between Ind. & Control (pCi/l)	MDD (pCi/l)
Pre-op	2300	400	1900	
1987	2229	316	1913	793
1988	2630	240	2390	580
1989	2508	259	2249	1000
1990	1320	266	1054	572
1991	1626	165	1461	834
1992	1373	179	1194	353
1993	955	NDM	955	NA
1994	871	NDM	871	NA
1995	917	201	716	NA
1996	1014	207	807	151
1997	956	230	726	61
1998	791	160	631	NA
1999	908	NDM	908	NA
2000	1020	373	647	704
2001	889	525	364	NA
2002	938	304	634	284
2003	563	203	360	NA
2004	585	220	365	204
2005	463	393	70	301
2006	690	451	239	394
2007	462	357	105	NA
2008	726	386	340	269
2009	602	587	15	NA
2010	343	244	99	205
2011	464	211	253	NA
2012	428	210	218	NA
2013	427	190	237	134

Figure 4.7-4

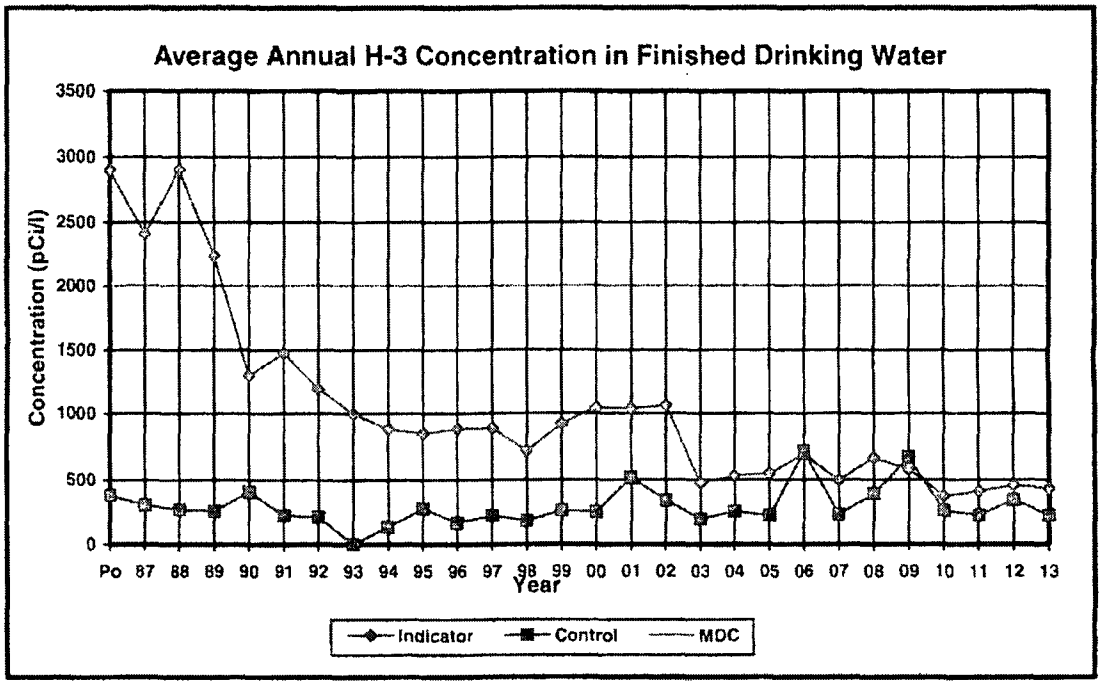
Average Annual H-3 Concentration in Finished Drinking Water
Concentration (pCi/l)
3500
3000
2500
2000
1500
1000
500
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.7-4

Average Annual H-3 Concentration in Finished Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)	Difference Between Ind. & Control (pCi/l)	MDD (pCi/l)
Pre-op	2900	380	2520	
1987	2406	305	2101	1007
1988	2900	270	2630	830
1989	2236	259	1977	627
1990	1299	404	895	1131
1991	1471	225	1246	647
1992	1195	211	984	427
1993	993	NDM	993	NA
1994	880	131	749	270
1995	847	279	568	NA
1996	884	168	716	NA
1997	887	221	666	383
1998	713	180	533	NA
1999	920	263	657	NA
2000	1043	251	792	833
2001	1037	516	521	NA
2002	1060	340	720	416
2003	473	196	277	NA
2004	531	255	276	314
2005	546	223	323	NA
2006	688	710	22	NA
2007	494	229	265	NA
2008	661	391	270	468
2009	579	667	88	NA
2010	374	262	112	NA
2011	410	226	184	NA
2012	454	344	110	357
2013	432	221	211	232

4.8 Fish

Table 2-1 requires the collection of at least one sample of any anadromous species of fish in the vicinity of the plant discharge during the spring spawning season, and for the semi-annual collection of at least one sample of any commercially or recreationally important species in the vicinity of the plant discharge area and in an area not influenced by plant discharges. Table 2-1 specifies that a gamma isotopic analysis be performed on the edible portions of each sample collected.

As provided in Table 2-2, a 5-mile stretch of the river is generally needed to obtain adequate fish samples. For the semiannual collections, the control location (Station 81) extends from approximately 2 to 7 miles upriver of the plant intake structure, and the indicator location (Station 85) extends from about 1.4 to 7 miles downriver of the plant discharge structure. For anadromous species, all collection points can be considered as indicator stations.

Anadromous fish was sampled in once on May 29, 2013. No radionuclides were detected in the 2013 analysis. In all but three previous years of operation, no radionuclides were detected in anadromous fish samples. In 2005, Cs-137 was detected in the anadromous fish sample at a low level of 28.8 pCi/kg-wet. In 1987, as well as in 1991, Cs-137 was found in a single sample of American Shad at concentrations of 10 and 12 pCi/kg-wet, respectively.

The dates and compositions of the semi-annual catches at the indicator and control stations during 2013 are shown below. As indicated in Table 4-3, Channel catfish were not observed during the fall sample collection and, therefore, no sample of this species was collected.

Date	Indicator	Control
May 29	Largemouth Bass	Largemouth Bass
May 29	Channel Catfish	Channel Catfish
October 15	Largemouth Bass	Largemouth Bass

As indicated in Table 3-1, Cs-137 was found in the semiannual collections of commercially or recreationally important species of fish and in fish at the control station. It has been found in all but 6 samples collected during operation and in all but 5 of the 32 samples collected during preoperation. As provided in Table 3-1, 56.0 pCi/kg-wet was the average Cs-137 detected in the 3 samples from the indicator station, and 61.6 pCi/kg-wet was the average Cs-137 detected at the control station. The difference of 5.6 pCi/kg-wet between the indicator and control stations is not statistically significant since it is less than the MDD of 50.8 pCi/kg-wet. No discernible difference between the indicator and control stations has occurred for any year of operation or during pre-operation.

Figure 4.8-1 and Table 4.8-1 provide the historical trending of the average concentrations of Cs-137 in units of pCi/kg-wet found in fish samples at the indicator and control stations. The indicator station fish sample concentration of Cs-137 in 1999 was greatly influenced by a largemouth bass collected in October with a concentration of 2500 pCi/kg-wet. Other than the fact that largemouth bass are predators that concentrate Cs-137, no specific cause for the elevated concentration in this sample is known. No trend is recognized in this data. The MDC and RL for Cs-137 in fish are 150 and 2000 pCi/kg-wet, respectively.

Figure 4.8-1

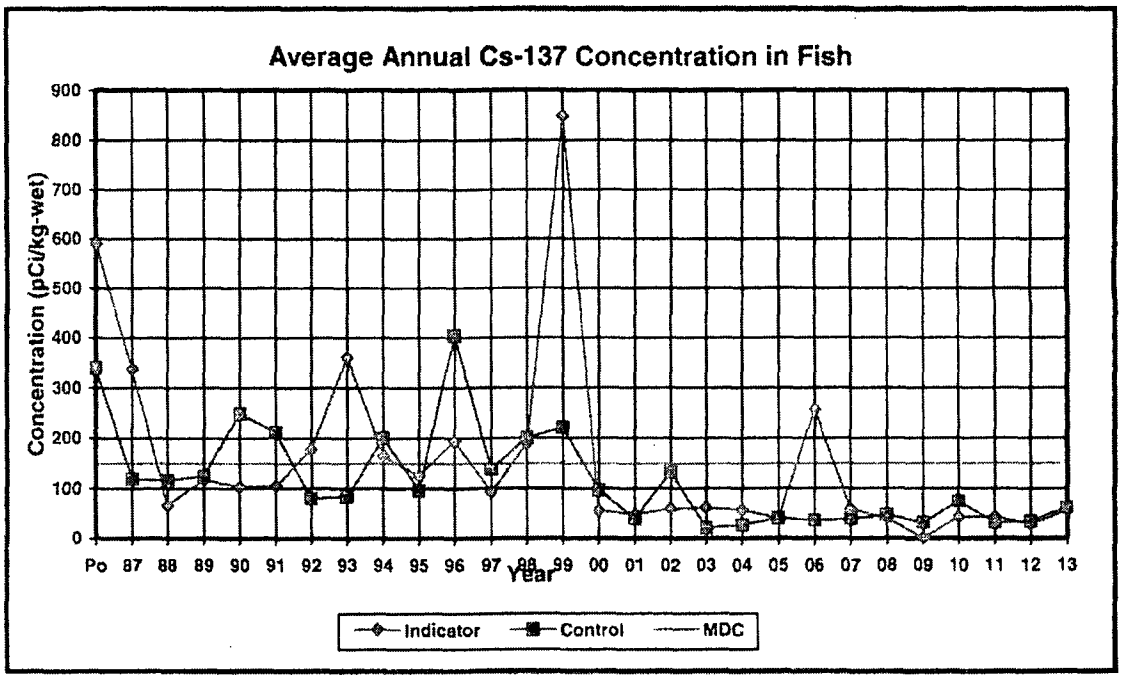
Average Annual Cs-137 Concentration in Fish
Concentration (pCi/kg-wet)
900
800
700
600
500
400
300
200
100
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.8-1

Average Annual Cs-137 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	590	340
1987	337	119
1988	66	116
1989	117	125
1990	103	249
1991	105	211
1992	178	80
1993	360	84
1994	165	200
1995	125	96
1996	194	404
1997	93	139
1998	190	200
1999	848	221
2000	55	96
2001	48	39
2002	59	133
2003	62	21
2004	56.4	26.0
2005	39.3	40.2
2006	257	35.7
2007	58.7	37.7
2008	39.4	47.0
2009	NDM	30.4
2010	42.8	74.4
2011	42.6	30.5
2012	27.5	34.0
2013	56.0	61.6

The only other radionuclide found in fish samples during operation is I-131. In 1989, it was found in one sample at the indicator station at a concentration of 18 pCi/kg-wet. In 1990, it was found in one sample at the indicator station and in one sample at the control station, at concentrations of 13 and 12 pCi/kg-wet, respectively. The MDC assigned to I-131 in fish is 53 pCi/kg-wet. In the November 2008 collection, the Largemouth Bass sample from the control location showed 90 pCi/kg-wet of I-131. The specific source of the I-131 is unknown but is likely due to medical waste.

During preoperation, Cs-134 was found in two of the 17 samples collected at the control station at concentrations of 23 and 190 pCi/kg-wet. The MDC and RL for Cs-134 are 130 and 1000 pCi/kg-wet, respectively. Nb-95 was also found in one of the control station samples at a concentration of 34 pCi/kg-wet. The assigned MDC and calculated RL for Nb-95 are 50 and 70,000 pCi/kg-wet, respectively.

4.9 Sediment

Sediment was collected along the shoreline of the Savannah River in the spring and fall at Stations 81 and 83. Station 81 is a control station located about 2.5 miles upriver of the plant intake structure while Station 83 is an indicator station located about 0.6 miles downriver of the plant discharge structure. A gamma isotopic analysis was performed on each sample. The radionuclides of interest identified in 2013 samples were Be-7 and Cs-137.

Be-7, which is abundant in nature, was not identified in plant liquid effluents during 2013. It continues to be trended in river sediment in the REMP report even when not identified in plant effluents. In 2013, the average Be-7 concentration at the indicator station was 1943 pCi/kg-dry and at the control station the average concentration was 1490 pCi/kg-dry. This difference (453 pCi/kg-dry is less than the MDD (2160.5 pCi/kg-dry) and is therefore not statistically discernible.

For Cs-137, the average concentration at the indicator station during 2013 was 154.5 pCi/kg-dry which was 63.0 pCi/kg-dry greater than that at the control station (91.5 pCi/kg-dry). The difference between the average value at the indicator station and the average value at the control station is not statistically discernible since it is less than the calculated MDD of 66.6 pCi/kg-dry. However, the concentration of Cs-137 found at the indicator station could be attributed to plant effluents or to other facilities that release radioactive effluents in the vicinity of the plant. The Cs-137 level at the indicator station has averaged nearly 100 pCi/kg-dry greater than that at the control station over the entire period of operation. During preoperation, the Cs-137 was 170 pCi/kg-dry greater at the indicator station than at the control station.

During 2013, Co-60 was not detected in any of the four sediment samples. Cobalt-60 has been detected in sediment collected at the indicator station every year of plant operation but four. The concentrations of Co-60 often found at the indicator station could be attributed to plant releases or, potentially, to other facilities that release radioactive effluents in the vicinity of the plant.

The historical average concentrations of Be-7, Co-58, Co-60, and Cs-137 in sediment are plotted in Figures 4.9-1 through 4.9-4 along with listings of their concentrations in Tables 4.9-1 through 4.9-4. The concentrations of the solely man-made nuclides (Co-58, Co-60, & Cs-137) are consistent with past average concentrations. No pattern has been detected. Be-7, produced by man and nature, is also within the range that is typically seen.

During preoperation, Zr-95, Nb-95, Cs-134, and Ce-141 were detected in at least one of the control station samples and Nb-95 was detected in one of the indicator station samples. Be-7 and Cs-137 were found in several of the samples. The concentrations of these preoperational nuclides were on the order of their respective MDC values. The presence of these preoperational nuclides could be attributed to atmospheric weapons testing and the Chernobyl incident.

Mn-54, I-131, and Cs-134 have been found sporadically during the years of operation. A summary of the positive results for these nuclides along with their applicable MDCs is provided in Table 4.9-5.

Figure 4.9-1

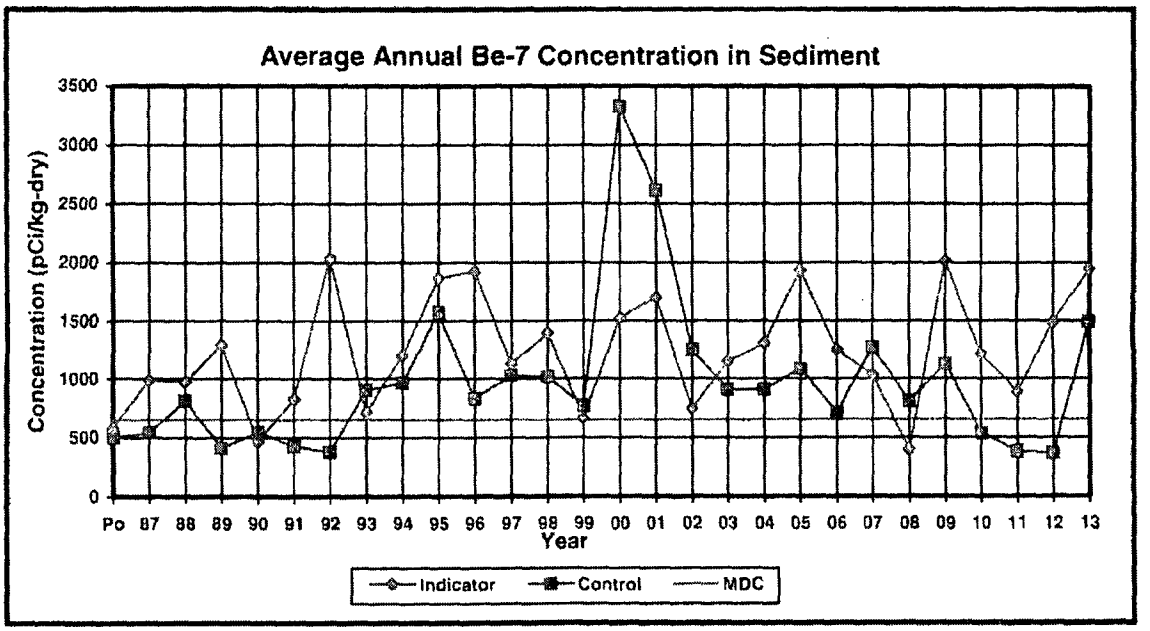
Average Annual Be-7 Concentration in Sediment
Concentration (pCi/kg-dry)
3500
3000
2500
2000
1500
1000
500
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.9-1

Average Annual Be-7 Concentration in Sediment

MDC=655 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	580	500
1987	987	543
1988	970	810
1989	1300	415
1990	465	545
1991	826	427
1992	2038	380
1993	711	902
1994	1203	964
1995	1865	1575
1996	1925	831
1997	1130	1028
1998	1396	1016
1999	662	769
2000	1526	3324
2001	1697	2614
2002	742	1254
2003	1150	903
2004	1309	905
2005	1931	1086
2006	1254	704
2007	1034	1274
2008	394	805
2009	2011	1131
2010	1217	533
2011	885	380
2012	363	296
2013	1943	1790

Figure 4.9-2

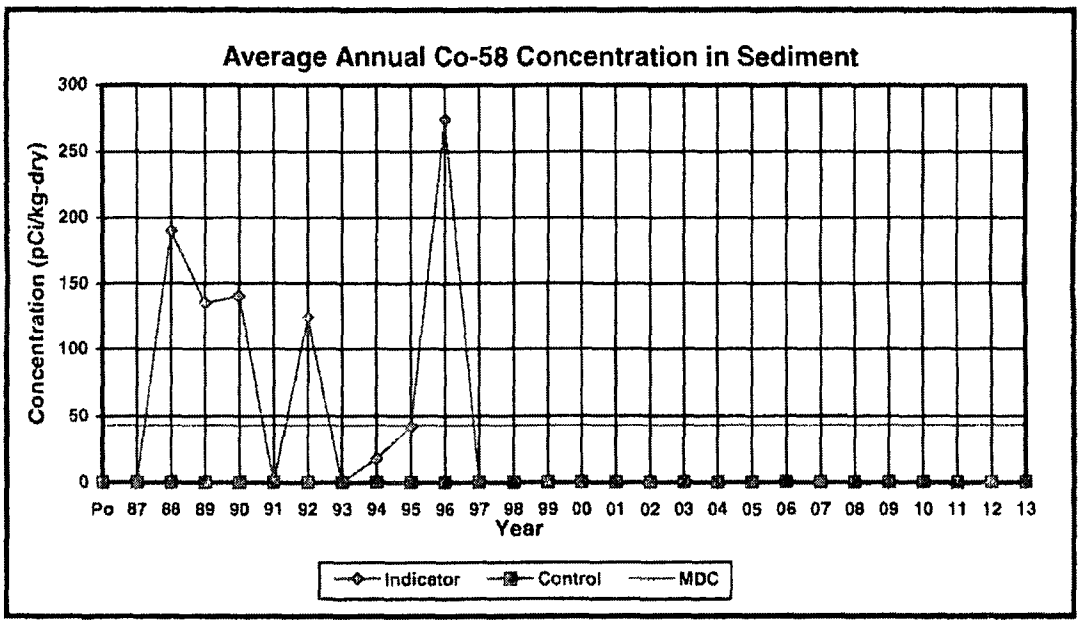
Average Annual Co-58 Concentration in Sediment
Concentration (pCi/kg-dry)
300
250
200
150
100
50
0
Pre 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.9-2

Average Annual Co-58 Concentration in Sediment

MDC=43 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	NDM	NDM
1987	NDM	NDM
1988	190	NDM
1989	135	NDM
1990	140	NDM
1991	NDM	NDM
1992	124	NDM
1993	NDM	NDM
1994	18.4	NDM
1995	42.4	NDM
1996	274	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM
2012	NDM	NDM
2013	NDM	NDM

Figure 4.9-3

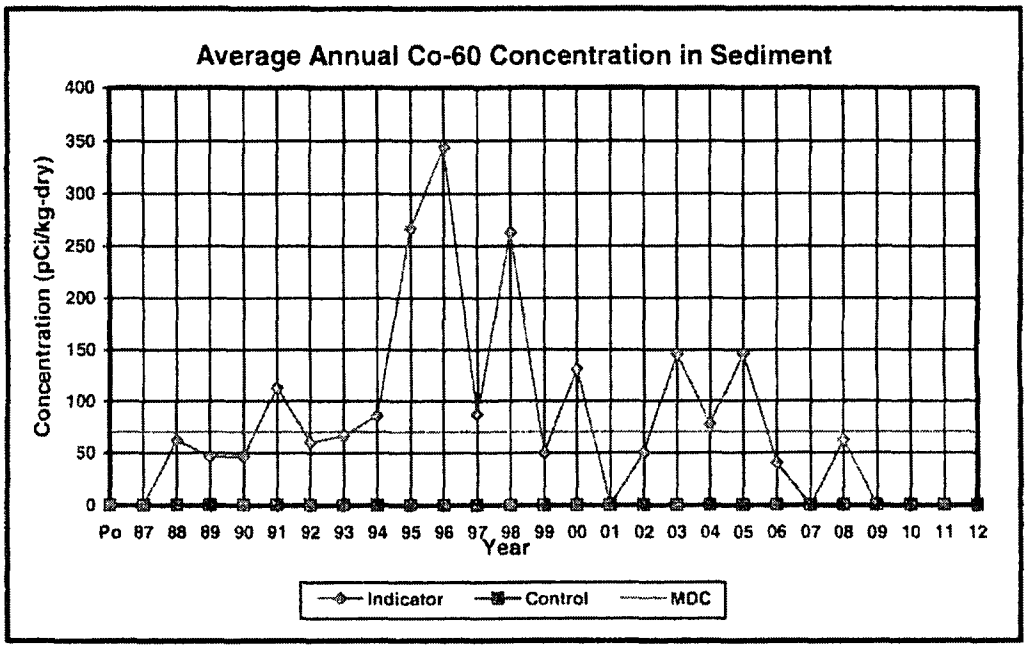
Average Annual Co-60 Concentration in Sediment
Concentration (pCi/kg-dry)
400
350
300
250
200
150
100
50
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12
Year
Indicator
Control
MDC

Table 4.9-3

Average Annual Co-60 Concentration in Sediment

MDC=70 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	NDM	NDM
1987	NDM	NDM
1988	62	NDM
1989	46	NDM
1990	46	NDM
1991	113	NDM
1992	59.5	NDM
1993	65.9	NDM
1994	85.2	NDM
1995	267	NDM
1996	344	NDM
1997	86	NDM
1998	263	NDM
1999	49.5	NDM
2000	131.3	NDM
2001	NDM	NDM
2002	49.7	NDM
2003	146	NDM
2004	77	NDM
2005	146	NDM
2006	40	NDM
2007	NDM	NDM
2008	61.9	NDM
2009	NDM	NDM
2010	NDM	NDM
2011	NDM	NDM
2012	NDM	NDM
2013	NDM	NDM

Figure 4.9-4

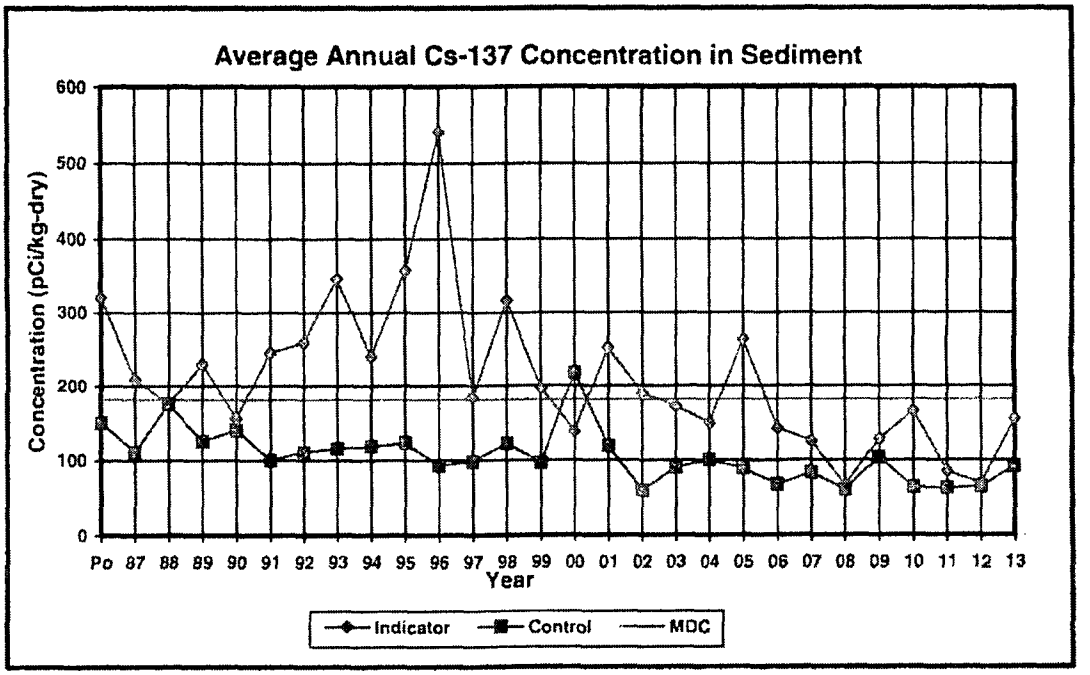
Average Annual Cs-137 Concentration in Sediment
Concentration (pCi/kg-dry)
600
500
400
300
200
100
0
Po 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13
Year
Indicator
Control
MDC

Table 4.9-4

Average Annual Cs-137 Concentration in Sediment

MDC=180 pCi/kg		
Year	**Indicator (pCi/kg)**	**Control (pCi/kg)**
Pre-op	320	150
1987	209	111
1988	175	175
1989	230	125
1990	155	140
1991	246	100
1992	259	111
1993	345	115
1994	240	118
1995	357	123
1996	541	93
1997	184	98
1998	316	122
1999	197	97
2000	138	218
2001	252	118
2002	189	60
2003	171	90
2004	149	100
2005	263	89
2006	142	68
2007	125	83
2008	66.2	60.9
2009	127.7	103.2
2010	164.6	64.1
2011	85.1	63.1
2012	69.1	65.0
2013	154.5	91.5

Table 4.9-5

Additional Sediment Nuclide Concentrations

Nuclide	YEAR	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)	MDC (pCi/kg-dry)
Mn-54	1988	22	NDM	42
	1989	18	NDM	
	1994	32	NDM	
I-131	1992	194	20	53
	1994	51	41	
Cs-134	2011	18	NDM	150

4.10 Groundwater

As nuclear plants began to undergo decommissioning in the late 1990's to early 2000s, instances of subsurface and/or groundwater contamination were identified. In addition, several operating facilities also identified groundwater contamination resulting from spills and leaks or equipment failure. In one instance, low levels of licensed material were detected in a private well located on property adjacent to a nuclear power plant.

In 2006, NEI (Nuclear Energy Institute) formed a task force to address monitoring onsite groundwater for radionuclides at nuclear facilities. A Groundwater Protection Initiative was developed which was adopted by all U.S. commercial operating nuclear plants.

The NRC also formed a task force to study the groundwater issues and released Information Notice 2006-13, *Ground-water Contamination due to Undetected Leakage of Radioactive Water,* which summarized its review of radioactive contamination of ground water at multiple facilities as a result of undetected leakage from structures, systems, and components that contain or transport radioactive fluids. Licensees were instructed to review the information for applicability and to consider appropriate actions to avoid similar problems.

The NEI task force felt it was prudent for the industry to update site hydrology information and to develop radiological groundwater monitoring plans at each site. These groundwater protection plans would ensure that underground leaks and spills would be addressed promptly. Additionally, the task force recommended developing a communications protocol to report radioactive leaks or spills that entered groundwater (or might eventually enter groundwater) to the NRC and State / Local government officials as needed. NEI-07-07, *Industry Groundwater Protection Final Guidance Document*, was developed by the task force to document the guidelines recommended for the industry.

To ensure compliance with NEI-07-07, Southern Nuclear developed the Nuclear Management Procedure, *Radiological Groundwater Protection Program.* The procedure contains detailed site-specific monitoring plans, program technical bases, and communications protocol (to ensure that radioactive leaks and spills are addressed and communicated appropriately). In an effort to prevent future leaks of radioactive material to groundwater, SNC plants have established robust buried piping and tanks inspection programs.

In 2006, Vogtle sampled onsite drinking water deep wells and onsite makeup water deep wells for tritium and gamma isotopic activity. These wells did not contain detectable amounts of radioactivity. In 2007, Vogtle implemented a more extensive radiological groundwater monitoring program. A qualified hydrologist made recommendations for drilling additional onsite monitoring wells and updated the site hydrology information. Eight new wells and 17 existing wells comprise the current VEGP groundwater monitoring program (see Table 2-3). These locations were sampled twice in the latter portion of 2007. Several wells were positive for tritium but no gamma emitters were detected. The highest activity sample showed approximately 900 pCi/l of tritium. This level of tritium is typical background for the area around Plant Vogtle based on historical information from Georgia Department of Natural Resources and Savannah River Site. Drinking water wells, sewage treatment plant effluent, and several surface water locations supplement the monitoring program and were also sampled in 2007. None of these locations showed activity above typical environmental levels in this area. This is also true of the 2008 supplemental sampling.

The tritium levels in the water table since the radiological groundwater sampling program started in mid-2007 through 2013 are graphed in Figures 4.10-1, 4.10-2, and 4.10-3. The February 2008 sampling event appears to be an outlier, however, more data is needed to determine seasonal changes and typical fluctuations in tritium concentration due to rain washout and recharge of the aquifer. None of the tertiary aquifer wells have shown tritium concentrations above background.

In 2008, three of the monitoring wells (1013, 1003, and 1004) used for groundwater monitoring (but not newly drilled for the program) were retired due to preliminary construction activities of two potential new operating reactors. These wells were not critical to the radiological groundwater monitoring program as they were upgradient and used primarily to obtain background data for site characterization.

In 2009, upgradient well 805-A had "silted in" and is now only being used for groundwater level data. In 2010, tertiary aquifer wells 27 and 29 were no longer sampled due to structural issues with the wells that made sampling extremely labor intensive. It was determined that enough background data had been gathered from these wells.

In 2013, tritium concentrations observed in the Vogtle groundwater monitoring wells fluctuated but did not exceed the established Administrative Control Limits (ACLs). The ACLs were derived based on historical tritium results and total measurement uncertainty and are site specific by plant and aquifer. There are no reporting requirements associated with exceeding an ACL but additional actions would be taken to verify no new sources of tritium were contributing to the increase. For the deeper aquifer sampled at Vogtle, the ACL is 1600 pCi/L and for the surficial aquifer, the ACL is 2100 pCi/L.

5.0 INTERLABORATORY COMPARISON PROGRAM

In accordance with ODCM 4.1.3, the EL participates in an ICP that satisfies the requirements of Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979. The guide indicates the ICP is to be conducted with the Environmental Protection Agency (EPA) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and the ICP should include all of the determinations (sample medium/radionuclide combinations) that are offered by the EPA and included in the REMP.

The ICP is conducted by Analytics, Inc. of Atlanta, Georgia. Analytics has a documented Quality Assurance (QA) program and the capability to prepare Quality Control (QC) materials traceable to the National Institute of Standards and Technology. The ICP is a third party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. Analytics supplies the crosscheck samples to the EL which performs the laboratory analyses in a normal manner. Each of the specified analyses is performed three times. The results are then sent to Analytics who performs an evaluation which may be helpful to the EL in the identification of instrument or procedural problems.

The samples offered by Analytics and included in the EL analyses are gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples.

The accuracy of each result is measured by the normalized deviation, which is the ratio of the reported average less the known value to the total error. The total error is the square root of the sum of the squares of the uncertainties of the known value and of the reported average. The uncertainty of the known value includes all analytical uncertainties as reported by Analytics. The uncertainty of the reported average is the propagated error of the values in the reported average by the EL. The precision of each result is measured by the coefficient of variation, which is defined as the standard deviation of the reported result divided by the reported average. An investigation is undertaken whenever the absolute value of the normalized deviation is greater than three or whenever the coefficient of variation is greater than 15% for all radionuclides other than Cr-51 and Fe-59. For Cr-51 and Fe-59, an investigation is undertaken when the coefficient of variation exceeds the values shown as follows:

Nuclide	Concentration *	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
Cr-51	NA	>1000	25
Cr-51	>300	<1000	15
Fe-59	<80	NA	25
Fe-59	>80	NA	15

* For air filters, concentration units are pCi/filter. For all other media, concentration units are pCi/liter (pCi/l).

As required by ODCM 4.1.3.3 and 7.1.2.3, a summary of the results of the EL's participation in the ICP is provided in Table 5-1 for: the gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples. Delineated in this table for each of the media/analysis combinations, are: the specific radionuclides; Analytics' preparation dates; the known values with their uncertainties supplied by Analytics; the reported averages with their standard deviations; and the resultant normalized deviations and coefficients of variation expressed as a percentage.

The Environmental Radiochemistry laboratory participates in a performance evaluation (PE) sample program provided by Analytics Inc. The PE samples are received and analyzed routinely with environmental and effluent samples. The laboratory analyzed 9 samples for 34 parameters in 2013.

The 2013 analyses included tritium, gross beta and gamma emitting radio-nuclides in different matrices. The attached results for all analyses were within acceptable limits for accuracy.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
I-131	06/13/13	90.30	89.60	3.4	1.50	5.98	0.14

GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	06/13/13	78.90	80.80	3.59	1.35	6.52	-0.36
Co-58	06/13/13	87.00	84.00	7.74	1.40	10.20	0.33
Co-60	06/13/13	223.00	194.00	11.7	2.62	8.56	0.01
Cr-51	06/13/13	234.00	224.00	12.5	3.74	8.40	0.50
Cs-134	06/13/13	112.00	112.00	11.2	1.87	10.80	0.00
Cs-137	06/13/13	137.00	135.00	12.7	2.25	10.29	0.14
Fe-59	06/13/13	106.00	107.00	8.24	1.79	9.51	-0.12
Mn-54	06/13/13	164.00	154.00	13.8	2.57	9.52	0.61
Zn-65	06/13/13	223.00	194.00	17.4	3.25	9.14	1.41

GROSS BETA ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	09/12/13	58.30	58.70	0.79	0.98	5.08	-0.14

5-1

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Co-58	09/12/13	112.00	108.00	8.91	1.80	9.90	0.39
Co-60	09/12/13	209.00	196.00	10.8	3.27	6.67	0.94
Cr-51	09/12/13	301.00	277.00	30.1	4.63	14.32	0.55
Cs-134	09/12/13	184.00	172.00	4.02	2.88	4.56	1.42
Cs-137	09/12/13	141.00	131.00	5.49	2.19	6.62	1.02
Fe-59	09/12/13	133.00	130.00	6.29	2.18	8.32	0.27
I-131	09/12/13	108.00	98.30	9.13	1.64	10.86	0.80
Mn-54	09/12/13	151.00	139.00	4.98	2.32	6.21	1.31
Zn-65	09/12/13	289.00	266.00	9.27	4.45	6.44	1.23

GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	06/13/13	270.00	293.00	9.58	4.90	5.91	-1.42
	12/05/13	307.00	279.00	10.69	4.67	6.12	1.51

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	12/05/13	73.40	88.80	5.18	1.48	10.69	-1.95
Co-58	12/05/13	92.40	90.60	1.63	1.51	6.57	0.30
Co-60	12/05/13	118.00	119.00	1.5	1.98	5.03	-0.25

5-2

TABLE 5-1 (SHEET 3 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES CONT. (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Cr-51	12/05/13	245.00	240.00	14.2	4.01	12.37	0.16
Cs-134	12/05/13	113.00	115.00	7.53	1.92	8.17	-0.20
Cs-137	12/05/13	106.00	102.00	5.7	1.70	8.21	0.44
Fe-59	12/05/13	86.00	89.10	3.02	1.49	8.58	-0.42
I-131	12/05/13	98.20	92.40	4.93	1.54	6.16	0.96
Mn-54	12/05/13	145.00	136.00	1.85	2.27	5.53	1.09
Zn-65	12/05/13	658.00	600.00	44.5	10.00	8.01	1.09

TRITIUM ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
H-3	06/13/13	9870.00	9890.00	16.69	165.00	2.22	-0.10
	12/05/13	14100.00	14500.00	184.08	242.00	2.41	-1.21

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6.0 CONCLUSIONS

This report confirms the licensee's conformance with the requirements of Chapter 4 of the ODCM. It provides a summary and discussion of the results of the laboratory analyses for each type of sample.

In 2013 tritium was detected in finished drinking water samples. Using the ingestion dose factors and consumption rate factors in Reg. Guide 1.109 it was calculated that the highest potential dose to a maximum exposed member of the public (an adult), due to regular consumption of drinking water containing tritium at the low level seen in the 2013 samples (using indicator station average concentration of 432.4 pCi/l), would be approximately 3.33E-2 mrem in a year. This dose is about 1.1% of the regulatory limit of 3 mrem per year due to liquid effluents. While the tritium seen in the drinking water samples could be attributed to plant effluents, tritium is a radioisotope that occurs naturally in the environment.

The REMP trends over the course of time from preoperation to the present are decreasing or have remained fairly constant. This supports the conclusion that there is no adverse radiological impact on the environment or to the public as a result of the operation of Plant Vogtle.

7.0 ERRATA

This section contains corrections to the Vogtle Electric Generating Plant Annual Radiological Environmental Operating Reports for calendar years 2009 through 2012.

One of the corrections was a result of a discovery by the SNOC Corporate Environmental staff while preparing the Vogtle AREOR for calendar year 2013.

A discrepancy was identified regarding the vegetation sample results for Cs-137 concentration in the text of Section 4.5 Vegetation. In the 2009 report, the paragraph describing "control" station sample results was incorrectly changed to "indicator". This error was carried through in the AREORs for 2010, 2011, and 2012. The text has been corrected in the 2013 report.

Section 4.5 Vegetation includes an historical graph and an historical table of the Cs-137 results. In each of the affected annual reports, the table and graph were verified as correct. Only the text of Section 4.5 was incorrect.

Another correction resulted from an NRC review of Georgia Power Environmental Laboratory's 2012 Interlaboratory Comparison Program results, a calculation error was identified. This error was subsequently corrected by Georgia Power Environmental Lab and the corrected page is included in this errata section.. The error appeared on Table 5-1 of Section 5 Interlaboratory Comparison Program in the 2012 AREOR. . The normalized deviation had been calculated incorrectly at -11.99 for the March 15 gross beta water analysis. The correct normalized deviation value was calculated to be -1.46 which is under the normalized deviation acceptance level of 3. The affected page of table 5-1 has been updated with the correct result and is included in the following pages of this section. No change to the text of Section 5 was required.

The following page is corrected page 4-19 of the 2009 Vogtle AREOR.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles WSW from the plant (Station 37). Gamma isotopic analyses are performed on the samples. During 2009, one sample (34.6 pCi/kg-wet) out of the 24 samples collected at the indicator stations was positive for the man-made radionuclide, Cs-137. No Cs-137 was identified in the twelve control station samples. Cs-137 is often detected in environmental samples as a result of atmospheric weapons testing and the Chernobyl incident.

In 2006, one sample at the control station was positive for Cs-137 at a higher concentration, 491.8 pCi/kg-wet, than typically seen over the years in Vogtle vegetation samples. A duplicate sample (which is taken periodically) happened to be taken at the same collection time and also revealed a similar activity. The higher concentration more than likely resulted from plowing and seeding activities (to maintain the vegetation plot) which took place a couple of weeks prior to the sample collection.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in this data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Cs-137 is the only man-made radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

The naturally occurring radionuclide Be-7 is typically detected in indicator and control station vegetation samples. Be-7 was not detected in gaseous effluents in 2009, therefore it is not included in the REMP summary table for the airborne pathway samples. Be-7 has been detected in gaseous effluents eight of the twenty years of plant operation and is therefore of interest in the REMP program. However, the levels of Be-7 found in the REMP make no significant contribution to dose.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

The following page is corrected page 4-19 of the 2010 Vogtle AREOR.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles WSW from the plant (Station 37). Gamma isotopic analyses are performed on the samples. During 2010, none of the 24 samples collected at the indicator stations were positive for the man-made radionuclide, Cs-137. Cesium-137 was not identified in the twelve control station samples. Cs-137 is often detected in environmental samples as a result of atmospheric weapons testing and the Chernobyl incident.

In 2006, one sample at the control station was positive for Cs-137 at a higher concentration, 491.8 pCi/kg-wet, than typically seen over the years in Vogtle vegetation samples. A duplicate sample (which is taken periodically) happened to be taken at the same collection time and also revealed a similar activity. The higher concentration more than likely resulted from plowing and seeding activities (to maintain the vegetation plot) which took place a couple of weeks prior to the sample collection.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in this data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Cs-137 is the only man-made radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

The naturally occurring radionuclide Be-7 is typically detected in indicator and control station vegetation samples. Be-7 was not detected in gaseous effluents in 2010, therefore it is not included in the REMP summary table for the airborne pathway samples. Be-7 has been detected in gaseous effluents eight of the twenty years of plant operation and is therefore of interest in the REMP program. However, the levels of Be-7 found in the REMP make no significant contribution to dose.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

The following page is corrected page 4-19 of the 2011 Vogtle AREOR.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles WSW from the plant (Station 37). Gamma isotopic analyses are performed on the samples. During 2011, three of the 24 samples collected at the indicator stations were positive for the man-made radionuclide, Cs-137. The average of the positive results was 69.6 pCi/kg-wet. Cesium-137 was not identified in any of the twelve control station samples. Cesium-137 is often detected in environmental samples as a result of atmospheric weapons testing and the Chernobyl incident.

In 2006, one sample at the indicator station was positive for Cs-137 at a higher concentration, 491.8 pCi/kg-wet, than typically seen over the years in Vogtle vegetation samples. A duplicate sample (which is taken periodically) happened to be taken at the same collection time and also revealed a similar activity. The higher concentration more than likely resulted from plowing and seeding activities (to maintain the vegetation plot) which took place a couple of weeks prior to the sample collection.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in this data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Cs-137 is the only man-made radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

The naturally occurring radionuclide Be-7 is typically detected in indicator and control station vegetation samples. Be-7 was detected in gaseous effluents in 2011, therefore it is included in the REMP summary table for the airborne pathway samples. The average at the indicator stations was 3384.5 pCi/kg-wet which is 1320.7 pCi/kg-wet higher than the average at the control station (2063.8 pCi/kg-wet). The difference between the averages at the indicator and control stations is not statistically discernible since it is less than the MDD of 2130 pCi/kg-wet. Be-7 has been detected in gaseous effluents nine of the twenty years of plant operation and is therefore of interest in the REMP program. However, the levels of Be-7 found in the REMP make no significant contribution to dose. There is no Required MDC or Reporting Level for Be-7.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

In March 2011, after the nuclear accident at Fukushima Daiichi Nuclear Power Plant, Southern Nuclear's three sites (Farley, Hatch, and Vogtle) detected I-131 in REMP samples for several weeks following the disaster. Iodine-131 was detected at Vogtle in all three forage samples collected on 03/29/11 (after the Fukushima event), but not in any other monthly forage samples collected in 2011. The range of I-131 values was 58.3 to 81.8 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively.

The following pages are corrected pages 4-19 and 4-20 of the 2012 Vogtle AREOR.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles WSW from the plant (Station 37). Gamma isotopic analyses are performed on the samples. The man-made radionuclide Cs-137 has been found in vegetation samples in the past, however, there was no Cs-137 detected in any of the 2012 vegetation samples. Cesium-137 is often detected in environmental samples as a result of atmospheric weapons testing and the Chernobyl incident.

The naturally occurring radionuclide Be-7 is typically detected in indicator and control station vegetation samples. Be-7 was not detected in gaseous effluents in 2012, but it was detected in REMP vegetation samples and is, therefore, included in the REMP summary table of the airborne pathway samples. The average at the indicator stations was 2724.6 pCi/kg-wet which is 1025.5 pCi/kg-wet higher than the average at the control station (1699.1 pCi/kg-wet). The difference between the averages at the indicator and control stations is not statistically discernible since it is less than the MDD of 2679 pCi/kg-wet. Be-7 has been detected in gaseous effluents in nine of the previous years of plant operation and is therefore of interest in the REMP program. However, the levels of Be-7 found in the REMP make no significant contribution to dose. There is no Required MDC or Reporting Level for Be-7.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in this data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Cs-137 is the only man-made radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

In 2006, one sample at the indicator station was positive for Cs-137 at a higher concentration, 491.8 pCi/kg-wet, than typically seen over the years in Vogtle vegetation samples. A duplicate sample (which is taken periodically) happened to be taken at the same collection time and also revealed a similar activity. The higher concentration more than likely resulted from plowing and seeding activities (to maintain the vegetation plot) which took place a couple of weeks prior to the sample collection.

In 2011, following the nuclear accident at Fukushima Daiichi Nuclear Power Plant, I-131 was detected in REMP vegetation samples. Iodine-131 was detected at Vogtle in all three forage samples collected on 03/29/11 (after the Fukushima event), but not in any other monthly forage samples collected in 2011. The range

of I-131 values was 58.3 to 81.8 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively.

During 2012, I-131 was not detected in any Vogtle REMP vegetation samples.

The following page is corrected page 5-11 of the 2012 Vogtle AREOR.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	7/14/12	76.60	82.20	2.85	1.37	8.62	-0.84
Co-58	7/14/12	90.20	99.70	2.85	1.66	7.33	-0.32
Co-60	7/14/12	350.00	355.00	10.7	5.93	4.23	-0.35
Cr-51	7/14/12	433.00	402.00	21.1	6.71	8.51	0.85
Cs-134	7/14/12	180.00	174.00	6.26	2.91	4.68	0.69
Cs-137	7/14/12	216.00	212.00	9.26	3.54	5.63	0.34
Fe-59	7/14/12	126.00	128.00	6.53	2.13	8.21	-0.17
I-131	7/14/12	102.00	99.70	7	1.66	8.78	0.30
Mn-54	7/14/12	134.00	132.00	3.79	2.21	5.69	0.24
Zn-65	7/14/12	208.00	199.00	8.17	3.33	7.09	0.59

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GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	03/15/12	263.00	297.00	18.93	4.96	1.10	-1.46
	07/14/12	166.00	148.00	10.28	2.47	10.85	0.98

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	03/15/12	190.00	184.00	5.65	3.07	5.25	0.64
Co-58	03/15/12	92.50	93.40	5.19	1.56	8.20	-0.11
Co-60	03/15/12	208.00	197.00	5.68	3.29	4.59	1.16