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Edwin I. Hatch Nuclear Plant – Units 1 & 2  
Joseph M. Farley Nuclear Plant– Units 1 & 2  
Vogtle Electric Generating Plant– Units 1 & 2  
Annual Radiological Environmental Operating Reports for 2015

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 2015.

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

Respectfully submitted,

C. R. Pierce  
Regulatory Affairs Director

CRP/RMJ

IE25  
NRR

- Enclosures: 1. Hatch Annual Radiological Environmental Operating Report for 2015  
2. Farley Annual Radiological Environmental Operating Report for 2015  
3. Vogtle Annual Radiological Environmental Operating Report for 2015

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**Edwin I. Hatch Nuclear Plant – Units 1 & 2  
Joseph M. Farley Nuclear Plant– Units 1 & 2  
Vogtle Electric Generating Plant– Units 1 & 2  
Annual Radiological Environmental Operating Reports for 2015**

**Enclosure 1**

**Hatch Annual Radiological Environmental Operating Reports for 2015**



**EDWIN I. HATCH NUCLEAR PLANT**  
**2015 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING**  
**REPORT**



**SOUTHERN**   
**NUCLEAR**  
A SOUTHERN COMPANY



# EDWIN I. HATCH NUCLEAR PLANT

## 2015 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

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Groundwater Protection Results from 2014 Report





**LIST OF ACRONYMS**

AREOR	Annual Radiological Environmental Operating Report
ASTM	American Society for Testing and Materials
BWR	Boiling Water Reactor
CL	Confidence Level
EPA	Environmental Protection Agency
GA EPD	State of Georgia Environmental Protection Division
GPC	Georgia Power Company
GPCEL	Georgia Power Company Environmental Laboratory
HNP	Edwin I. Hatch 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
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
RM	River Mile
SNC	Southern Nuclear Operating Company
TLD	Thermoluminescent Dosimeter
TS	Technical Specification





## 1 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) is conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). REMP activities for 2015 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
- Section 3 provides a summary of the results and an assessment of any radiological impacts to the environment as well as the results from the interlaboratory comparison
- A summary of the land use census and the river survey are included in Section 4
- Conclusions are included in Section 5



## 2 REMP DESCRIPTION

The following section provides a description of the sampling and laboratory protocols associated with the REMP. Table 2-1 provides a summary of 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 summarizes the collection and analysis frequencies (in accordance with ODCM Section 4.2). Table 2-2 provides specific information regarding the station locations, their proximity to the plant, and exposure pathways. Additionally, the locations of the sampling stations are depicted on Maps A-1 through A-3 of the georeferenced data included in Appendix A of this report.

Georgia Power Company's Environmental Laboratory (GPCEL), located in Smyrna, Georgia collects and analyzes REMP samples.





Table 2-1. Summary Description of Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling/Collection Frequency	Type/Frequency of Analysis
Direct Radiation	37 routine monitoring stations	Quarterly	Gamma dose, quarterly
Airborne Radioiodine and Particulates	Samples from six locations:	Continuous sampler operation 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.
<b>Waterborne</b>			
Surface	One sample upriver One sample downriver	Composite sample over one month period <sup>1</sup>	Gamma isotopic analysis <sup>2</sup> , monthly Composite for tritium analysis, quarterly
Drinking <sup>3,4</sup>	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.





Table 2-1. Summary Description of Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling/Collection Frequency	Type/Frequency of Analysis
Groundwater	See Table 3-8 and Map A-3 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.
Shoreline Sediment	Two	Semiannually	Gamma isotopic analysis <sup>2</sup> , semiannually
<b>Ingestion</b>			
Milk <sup>5</sup>	One	Bimonthly	Gamma isotopic analysis <sup>2,7</sup> , bimonthly
Fish or Clams <sup>6</sup>	Two	Semiannually	Gamma isotopic analysis <sup>2</sup> on edible portions, semiannually
Grass or Leafy Vegetation	Three	Monthly during growing season	Gamma isotopic analysis <sup>2,7</sup> , monthly
<p>Notes:</p> <p><sup>1</sup> 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.</p> <p><sup>2</sup> Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.</p> <p><sup>3</sup> 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.</p> <p><sup>4</sup> 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.</p> <p><sup>5</sup> Up to three sampling locations within five miles and in different sectors will be used as available. In addition, one or more control locations beyond 10 miles will be used.</p> <p><sup>6</sup> Commercially or recreationally important fish may be sampled. Clams may be sampled if difficulties are encountered in obtaining sufficient fish samples.</p> <p><sup>7</sup> 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.</p>			



Table 2-2. Radiological Environmental Sampling Locations

Station Number	Station Type	Descriptive Location	Direction <sup>1</sup>	Distance (miles) <sup>1</sup>	Radiation Sample Type
064	Other	Roadside Park	WNW	0.8	Direct
101	Indicator	Inner Ring	N	1.9	Direct
102	Indicator	Inner Ring	NNE	2.5	Direct
103	Indicator	Inner Ring	NE	1.8	Airborne, Direct
104	Indicator	Inner Ring	ENE	1.6	Direct
105	Indicator	Inner Ring	E	3.7	Direct
106	Indicator	Inner Ring	ESE	1.1	Direct, Vegetation
107	Indicator	Inner Ring	SE	1.2	Airborne, Direct
108	Indicator	Inner Ring	SSE	1.6	Direct
109	Indicator	Inner Ring	S	0.9	Direct
110	Indicator	Inner Ring	SSW	1.0	Direct
111	Indicator	Inner Ring	SW	0.9	Direct
112	Indicator	Inner Ring	WSW	1.0	Airborne, Direct, Vegetation
113	Indicator	Inner Ring	W	1.1	Direct
114	Indicator	Inner Ring	WNW	1.2	Direct
115	Indicator	Inner Ring	NW	1.1	Direct
116	Indicator	Inner Ring	NNW	1.6	Airborne, Direct
170	Control	Upstream	WNW	<sup>2</sup>	River <sup>3</sup>
172	Indicator	Downstream	E	<sup>2</sup>	River <sup>3</sup>
201	Other	Outer Ring	N	5.0	Direct
202	Other	Outer Ring	NNE	4.9	Direct
203	Other	Outer Ring	NE	5.0	Direct
204	Other	Outer Ring	ENE	5.0	Direct
205	Other	Outer Ring	E	7.2	Direct
206	Other	Outer Ring	ESE	4.8	Direct
207	Other	Outer Ring	SE	4.3	Direct
208	Other	Outer Ring	SSE	4.8	Direct
209	Other	Outer Ring	S	4.4	Direct
210	Other	Outer Ring	SSW	4.3	Direct
211	Other	Outer Ring	SW	4.7	Direct
212	Other	Outer Ring	WSW	4.4	Direct
213	Other	Outer Ring	W	4.3	Direct
214	Other	Outer Ring	WNW	5.4	Direct
215	Other	Outer Ring	NW	4.4	Direct
216	Other	Outer Ring	NNW	4.8	Direct





Table 2-2. Radiological Environmental Sampling Locations

Station Number	Station Type	Descriptive Location	Direction <sup>1</sup>	Distance (miles) <sup>1</sup>	Radiation Sample Type
301	Other	Toombs Central School	N	8.0	Direct
304	Control	State Prison	ENE	11.2	Airborne, Direct
304	Control	State Prison	ENE	10.3	Milk
309	Control	Baxley Substation	S	10.0	Airborne, Direct
416	Control	Emergency News Center	NNW	21.0	Direct, Vegetation

## Notes:

<sup>1</sup>Direction and distance are determined from the main stack.

<sup>2</sup>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.

<sup>3</sup>River (fish or clams, shoreline sediment, and surface water)





### 3 RESULTS SUMMARY

Included in this section are statistical evaluations of the laboratory results, comparison of the results by media, and a summary of the anomalies and deviations. Overall, 885 analyses were performed across nine exposure pathways. Tables and figures are provided throughout this section to provide an enhanced presentation of the information.

In recent history, man-made nuclides have been released into the environment and have resulted in wide spread distribution of radionuclides across the globe. For example, 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 pre-operation, and through early operation. Some long-lived radionuclides, such as Cs-137, continue to be detected and a portion of these detections are believed to be attributed to the nuclear weapons tests.

Additionally, data associated with certain radiological effects created by off-site events have been removed from the historical evaluation, this includes: the nuclear atmospheric weapon test in the fall of 1980 and the Chernobyl incident in the spring of 1986.

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. Historically, the radionuclide Be-7, which occurs abundantly in nature, is often detected in REMP samples, and occasionally detected in the plant's liquid and gaseous effluents. When it is detected in effluents and REMP samples, it is also included in the REMP results. In 2015, Be-7 was not detected in any plant effluents and is therefore not included in this report. The Be-7 detected in select REMP samples likely represents naturally occurring and/or background conditions.

As part of the data evaluation process, SNC considered the impact of the non-plant associated nuclides along with a statistical evaluation of the REMP data. The statistical evaluations included within this report include the Minimum Detectable Concentration (MDC), the Minimum Detectable Difference (MDD), and Chauvenet's Criterion as described below.

#### **Minimum Detectable Concentration**

The minimum detectable concentration is defined as an estimate of the true concentration of an analyte required to give a specified high probability that the measured response will be greater than the critical value.



**Minimum Detectable Difference**

The Minimum Detectable Difference (MDD) compares the lowest significant difference (between the means) of a control station, versus an indicator station or a community station, that can be determined statistically at the 99% Confidence Level (CL). A difference in mean values which was less than the MDD was considered to be statistically indiscernible.

**Chauvenet's Criterion**

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.

The 2015 results were compared with past results, including those obtained during pre-operation. As appropriate, results were compared with their MDC (listed in Table 3-1) and RL which is listed in Table 3-2. The required MDCs were achieved during laboratory sample analysis. No data points were excluded for violating Chauvenet's criterion.





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
Airborne Particulates (fCi/m3)	Gross Beta 312	10	19.1 4-40.4 (208/208)	State Prison ENE 11.2 Miles	20 2.3-35.9 (52/52)		19.6 2.3-35.9 (104/104)
	Gamma Isotopic 24						
	I-131	70	NDM(c)		NDM		NDM
	Cs-134	50	NDM		NDM		NDM
	Cs-137	60	NDM		NDM		NDM
Airborne Radioiodine (fCi/m3)	I-131 312	70	NDM		NDM	NDM	NDM
Direct Radiation (mR/91 days)	Gamma Dose 148		12.1 9.4-17.4 (64/64)	Outer Ring WNW 5.4 mi.	16.4 14.3-16.2 (4/4)	12.1 8.6-16.9 (72/72)	11.7 9.8-14.2 (12/12)
Milk (pCi/l)	Gamma Isotopic 24						
	I-131	1			NDM		NDM
	Cs-134	15			NDM		NDM
	Cs-137	18		State Prison ENE 10.3 Miles	0.78-0.78 (1/24)		0.78-0.78 (1/24)
	Ba-140	60			NDM		NDM
	La-140	15			NDM		NDM
Vegetation (pCi/kg-wet)	Gamma Isotopic 36						
	I-131	60	NDM				NDM





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
	Cs-134	60	NDM				NDM
	Cs-137	80	135.2 16.2-376.2 (9/24)	Inner Ring ESE 1.1 mi.	149.7 16.2-376.2 (8/12)		NDM
River Water (pCi/l)	Gamma Isotopic 13						
	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(d)	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 (e)	200 200-200 (1/4)	Downstream E 3.0 RM from intake	200 200-200 (1/4)		17.5 17.5-17.5 (1/4)
Fish (pCi/kg-wet)	Gamma Isotopic 4						





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
	Be-7	655(d)	NDM				NDM
	Mn-54	130	NDM				NDM
	Fe-59	260	NDM				NDM
	Co-58	130	NDM				NDM
	Co-60	130	NDM				NDM
	Zn-65	260	NDM				NDM
	Cs-134	130	NDM				NDM
	Cs-137	150	NDM				NDM
Sediment (pCi/kg-dry)	Gamma Isotopic 4						
	Cs-134	150	NDM				NDM
	Cs-137	180	40.5 28.9-52.0 (2/2)	Upstream WNW 1.1 RM from intake	84.0 79.6-88.5 (2/2)		84.0 79.6-88.5 (2/2)
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. (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) (NDM). (d) If a drinking water pathway were to exist, a MDC of 1pCi/L would have been used. (e) If a drinking water pathway were to exist, a MDC of 2000pCi/L would have been used.							
Not Applicable (sample not required)							



Table 3-2. 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 <sup>a</sup>				
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 <sup>b</sup>	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	

<sup>a</sup> 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.

<sup>b</sup> If no drinking water pathway exists, a value of 20 pCi/l may be used.

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 sampling (as described in Table 2-1) are summarized in Table 3-3 along with their causes and resolution.





**Table 3-3. Anomalies and Deviations from Radiological Environmental Monitoring Program**

Collection Period	Affected Samples	Anomaly (A)* or Deviation (D)**	Cause	Resolution
No program deviations were identified in the Hatch Radiological Environmental Monitoring Program during 2015.				
<p>* An anomaly is considered a non-standard sample that still meets sampling criteria outlined in SNC and Georgia Power Lab procedures.</p> <p>** A deviation is a sample result that is not recorded due to not meeting scheduling and/or procedural requirements as outlined by SNC and Georgia Power Lab</p>				



### 3.1 Airborne Particulates

As specified in Table 2-1, airborne particulate filters and charcoal canisters are collected weekly at four indicator stations (Stations 103, 107, 112 and 116) which encircle the plant at the site periphery, and at two control stations (Station 304 and 309) which is approximately 10 miles from the main stack. At sampling locations containing a filter and cartridge series, 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.

#### 3.1.1 Gross Beta

As provided in Table 3-1, the 2015 annual average weekly gross beta activity was 19.1 fCi/m<sup>3</sup> for the indicator stations. It was 0.5 fCi/m<sup>3</sup> less than the control station average of 19.6 fCi/m<sup>3</sup> for the year. This difference is not statistically discernible, since it is less than the calculated MDD of 4.1 fCi/m<sup>3</sup>.

Average Air Gross Beta historical data (Table 3-4) is graphed to show trends associated with a prevalent exposure pathway (Figure 3-1). 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.

**Table 3-4. Average Weekly Gross Beta Air Concentration**

Period	Indicator (fCi/m <sup>3</sup> )	Control (fCi/m <sup>3</sup> )
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



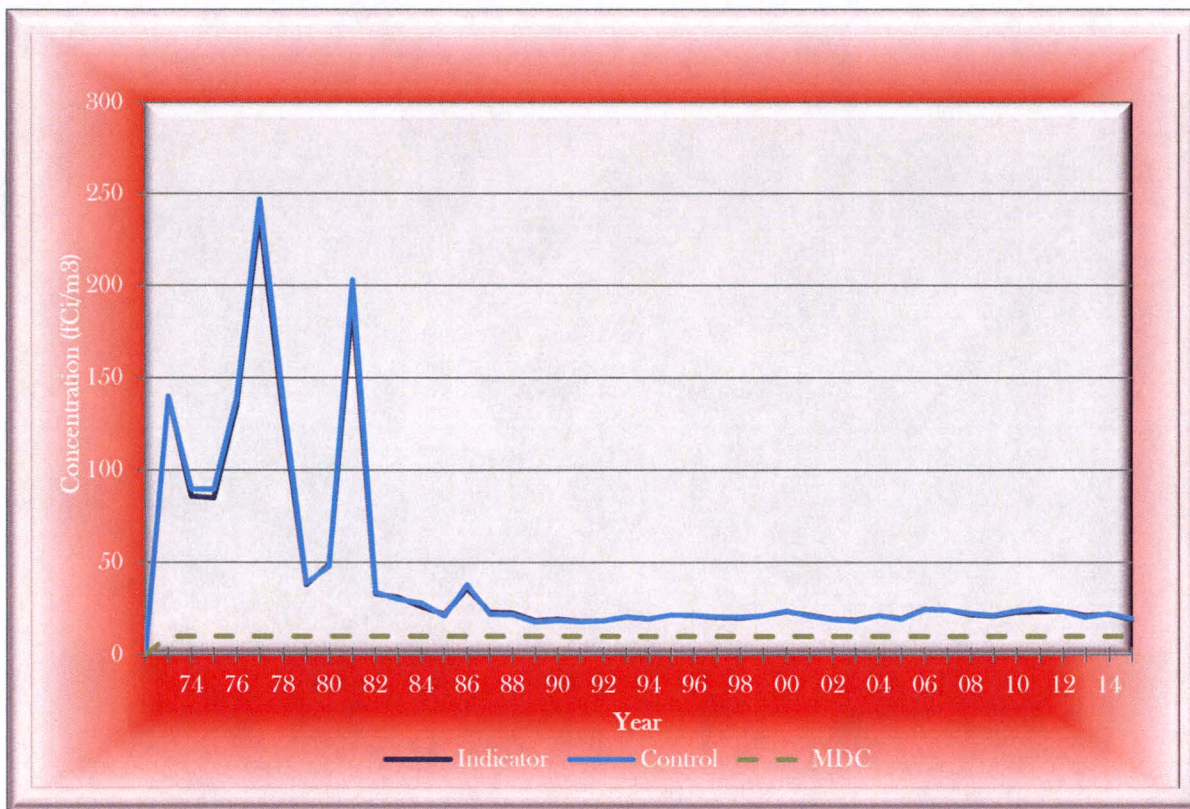


Table 3-4. Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)
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
2012	23.7	22.7
2013	21.3	20.3
2014	22.0	22.3
2015	19.1	19.6



Figure 3-1. Average Weekly Gross Beta Air Concentration



### 3.1.2 Gamma Particulates

During 2015, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters.

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/m<sup>3</sup>) 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/m<sup>3</sup>, respectively.

### 3.2 Direct Radiation

In 2015, direct (external) radiation was measured with Optically Stimulated Luminescent (OSL) dosimeters by placing two OSL badges at each station. The gamma dose at each station is reported as the average reading of the two badges. The badges are analyzed on a quarterly basis. 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 two concentric rings. The inner ring stations (Nos. 101 through 116) are located near the plant perimeter as shown in Map A-1 in Appendix A and the outer ring stations (Nos. 201 through 216) are located at distances of four to five miles from the plant as shown in Map A-2 in Appendix A. The stations in the East sector are a few additional miles away with regard to 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 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 three control stations (Nos. 304, 309 and 416) are located at distances greater than 10 miles from the plant as shown in Map A-2. The mean and range values presented in the "Other" column in Table 3-1 includes the outer ring stations (stations 201 through 216) as well as stations 064 and 301, which 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 2015 average quarterly exposure at the indicator stations (inner ring) was 12.1 mR with a range of 9.4-17.4 mR. The indicator station average was 0.4 mR more than the control station average (11.7 mR). This difference is not considered statistically discernible since it is less than the MDD of 1.1 mR.

The quarterly exposures acquired at the community/other (outer ring) stations during 2015 ranged from 8.6 to 16.2 mR with an average of 12.1 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 0.6 mR.

Average Direct Radiation historical data (Table 3-5) is graphed to show trends associated with a prevalent exposure pathway (Figure 3-2). 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.

**Table 3-5. Average Quarterly Exposure from Direct Radiation**

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	22.3	23.0	NA
1974	23.2	25.6	NA
1975	10.0	10.5	NA
1976	8.18	6.90	NA
1977	7.31	6.52	NA
1978	6.67	6.01	NA
1979	5.16	6.77	NA



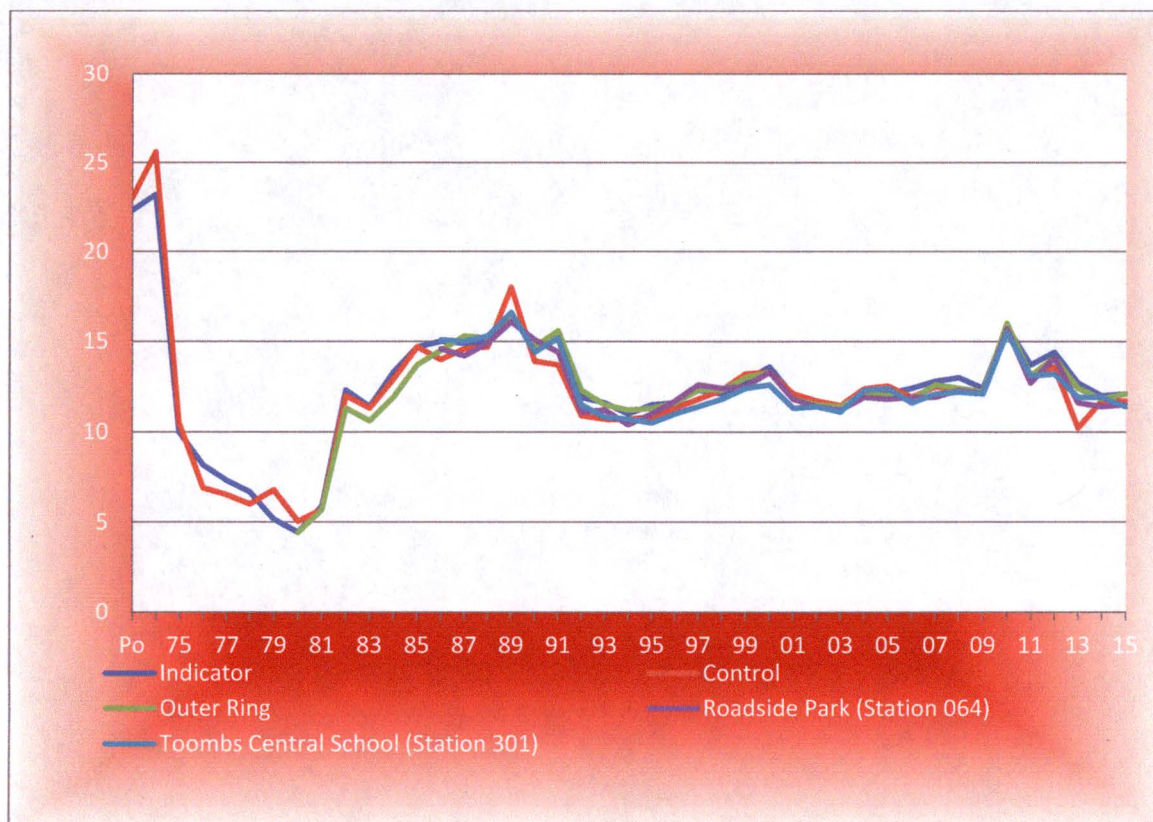
Table 3-5. Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
1980	4.44	5.04	4.42
1981	5.90	5.70	5.70
1982	12.3	12.0	11.3
1983	11.4	11.3	10.6
1984	13.3	12.9	11.9
1985	14.7	14.7	13.7
1986	15.0	14.0	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	11.0	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	19.7	19.1	19.2
2012	14.4	13.6	14.1
2013	12.7	10.2	12.4
2014	12.0	11.7	11.8
2015	12.1	11.7	12.1





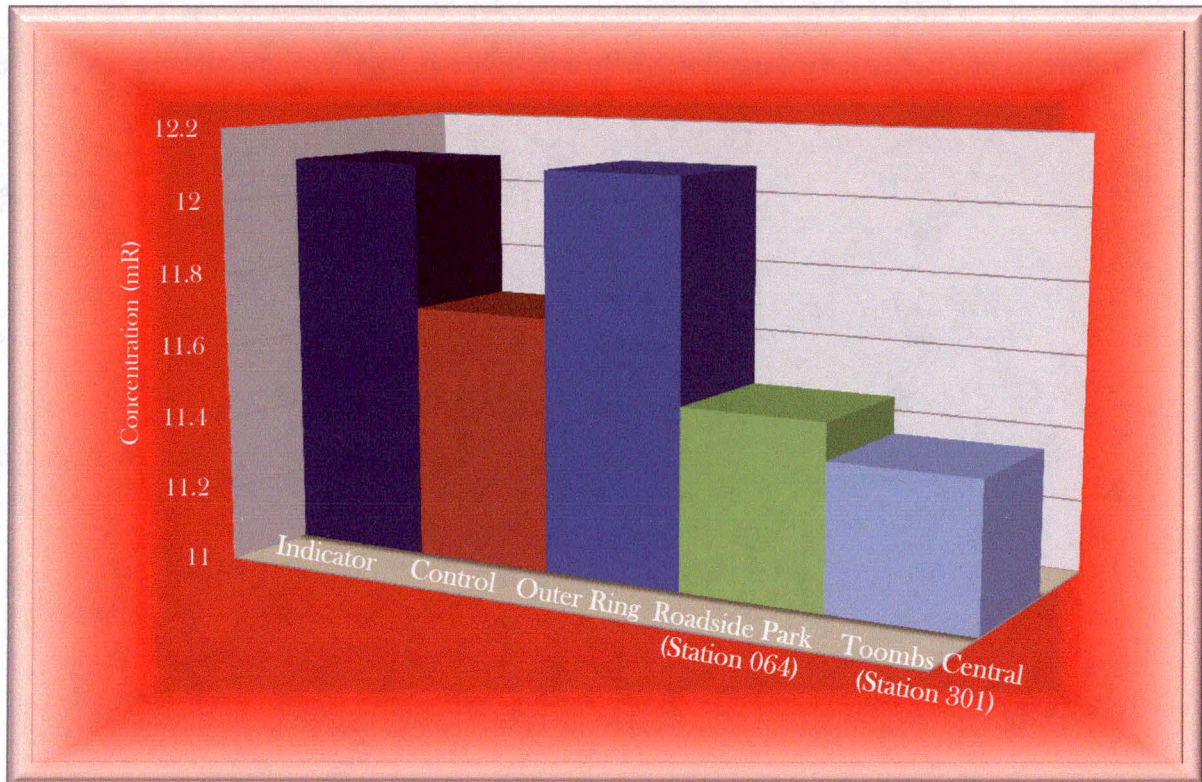
Figure 3-2. Average Quarterly Exposure from Direct Radiation



The increase shown in 2010 reflects issues 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 3-3 below provides a more detailed view of the 2015 values. The values for the special interest areas detailed below, indicate that Plant Hatch did not significantly contribute to direct radiation at those areas.



Figure 3-3. 2015 Average Exposure from Direct Radiation



### 3.3 Biological Media

Cs-137 was the only radionuclide analyzed across all three biological mediums. As indicated in Figure 3-4, the Cs-137 activity levels are below the respective MDCs and well below that of the respective RLs for each sample media for both the indicator and control stations.

#### 3.3.1 Milk

In accordance with Tables 2-1 and 2-2, milk samples are collected bimonthly from Station 304 (the state prison dairy) which is a control station located more than 10 miles from the plant. Since 1989, efforts to locate a reliable milk sample source within five miles of the plant have been unsuccessful and the 2015 land census did not identify a milk animal within five miles of the plant.



Gamma isotopic (including I-131 and Cs-137) analyses were performed on each collected milk sample and there were no detectable results for gamma isotopes, with the exception of a single detection of Cs-137 (0.78 pCi/L) in November 2015. Figure 3-4 provides the 2015 Cs-137 concentration in milk.

### 3.3.2 Vegetation

In accordance with Tables 2-1 and 2-2, vegetation samples are collected monthly for gamma isotopic analyses at two indicator locations near the site boundary (Stations 106 and 112) and at one control station located about 21 miles from the plant (Station 416). Cesium-137 was detected in nine of the 24 samples collected at the indicator stations. The average of the samples was 135.2 pCi/kg-wet. Cesium-137 was not detected in any control station samples. Due to the low number of samples, MDD was not able to be used to evaluate the data. The man-made radionuclide Cs-137 is periodically identified in vegetation samples, and is generally attributed to offsite sources (such as weapons testing, Chernobyl, and Fukushima).

While Cs-137 and I-131 were periodically found in vegetation samples during pre-operation, the historical trends and the relationship between the indicator and control stations demonstrate that plant operations are having no adverse impact to the environment. The sample results have consistently been below the MDC and the RL for Cs-137 (80 and 2000 pCi/kg-wet, respectively).

During 2015, no other man-made gamma isotopes were detected in any Hatch REMP vegetation samples.

### 3.3.3 Fish

Fish samples were collected in accordance with the ODCM (as indicated in Table 2-1). For the semiannual collections, the control location (Station 170) is located upriver of the plant intake structure, and the indicator location (Station 172) is located downriver of the plant discharge structure.

Cs-137 was not detected in the indicator and control locations, which is consistent with historical results.

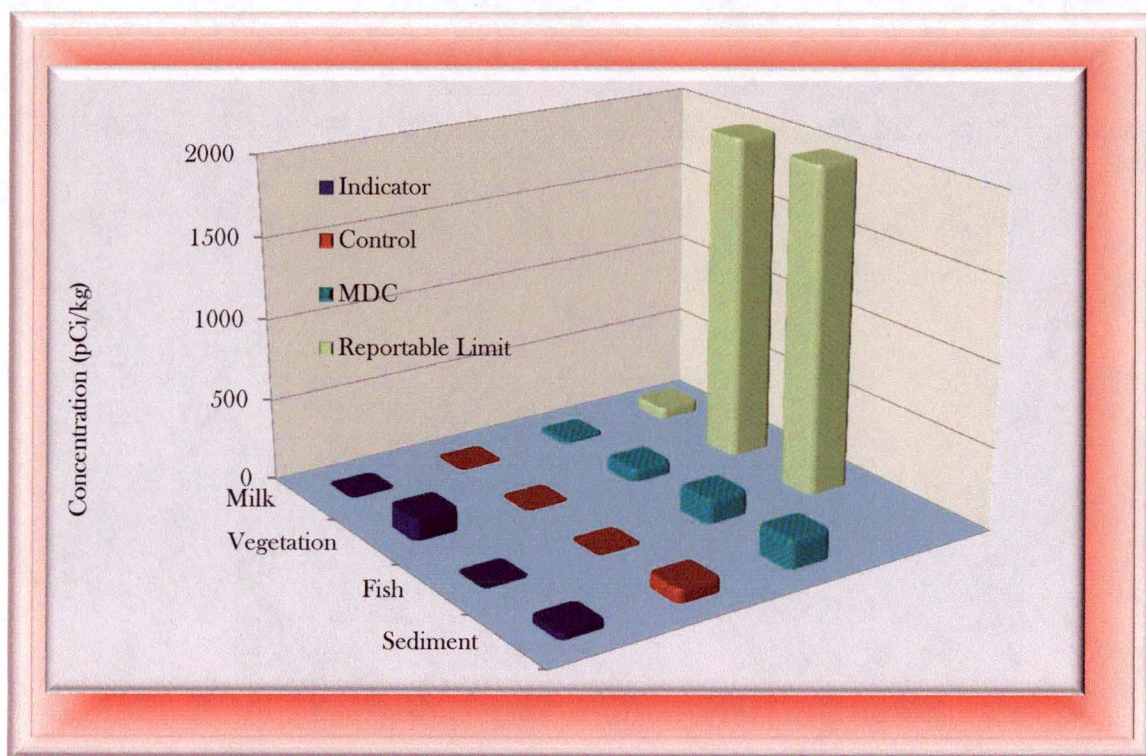
### 3.3.4 Biological Media Summary

There were no statistical differences, trends, or anomalies associated with the 2015 biological media samples when compared to historical data. Figure 3-4 below, details the 2015 Cs-137 concentration compared to the Reportable Limits.





Figure 3-4. 2015 Biological Media Average Cs-137 Concentrations



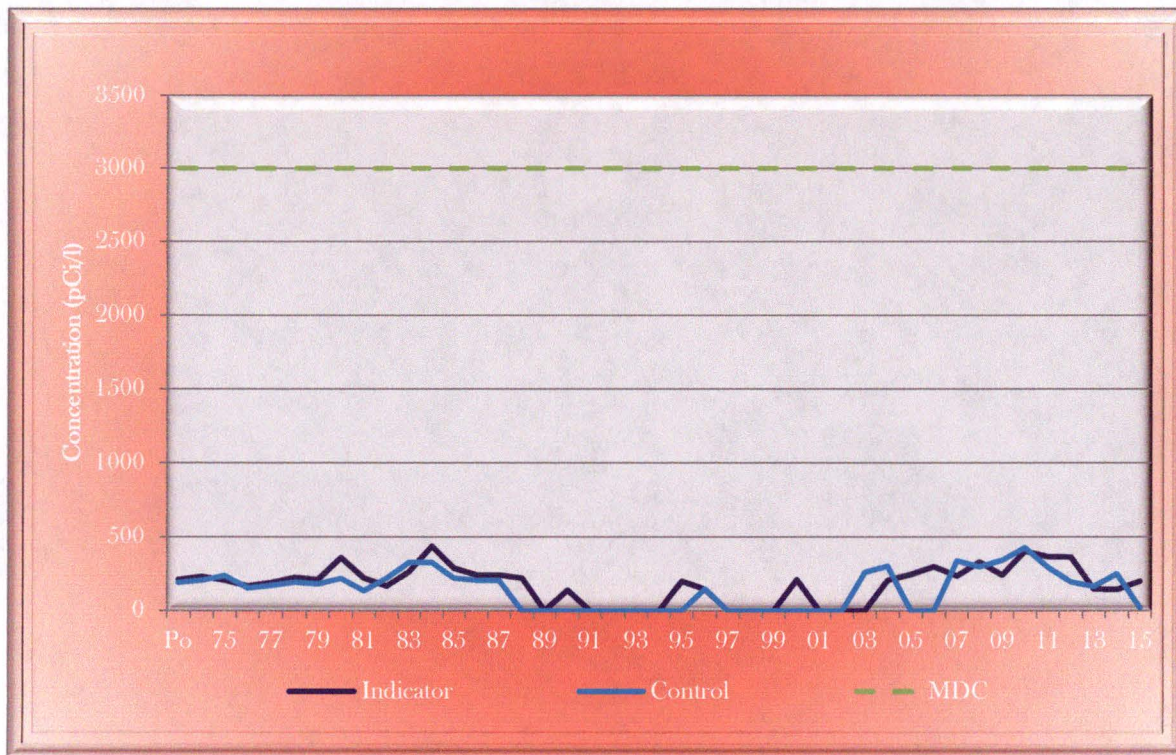
### 3.4 Surface Water

Composite river water samples are collected monthly at an upstream control location and at a downstream indicator location (shown on Map A-3 in Appendix A). The details of the sampling protocols are outlined in Tables 2-1 and Table 2-2. A gamma isotopic analysis is conducted on each monthly sample and the monthly aliquots are combined to form quarterly composite samples, which are analyzed for tritium.

As provided in Table 3-1, there were no positive results during 2015 from the gamma isotopic analysis of the river water samples. Also indicated in Table 3-1, the average tritium concentration found at the indicator station was 200 pCi/l which was 182.5 pCi/l more than the average at the control station (17.5 pCi/l). No MDD was calculated because only one of the four samples for both the indicator and control stations indicated any concentration. Historically, the relationship between the indicator and control stations has remained consistent. Figure 3-5 below details the 2015 historical average tritium concentrations in river water.



Figure 3-5. Average Annual Tritium Concentrations in River Water



### 3.5 Sediment

Sediment was collected along the shoreline of the Altamaha River in the spring and fall, at the upstream control station (No. 170) and the downstream indicator station (No. 172). A gamma isotopic analysis was performed on each sample. There were no man-made radionuclides detected in sediment samples, with the exception of Cs-137 (slightly above the control average), which is previously plotted along with biological media (Cs-137 across all detected mediums) in Section 3.3.4, and Figure 3-4.

### 3.6 Interlaboratory Comparison Program

In accordance with ODCM 4.1.3, GPCEL participates in an Interlaboratory Comparison Program (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 ICP includes the required determinations (sample medium/radionuclide combinations) included in the REMP.



The ICP was conducted by Eckert & Ziegler Analytics, Inc. (EZA) of Atlanta, Georgia. EZA 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. EZA supplies the crosscheck samples to GPCEL which performs routine laboratory analyses. Each of the specified analyses is performed three times.

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. 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 on Table 3-6 below:

**Table 3-6. Interlaboratory Comparison Limits**

Nuclide	Concentration *	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
	NA	>1000	25
	>300	<1000	15
Fe-59	<80	NA	25
	>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 GPCEL's participation in the ICP is provided in Table 3-7 for:

- gross beta and gamma isotopic analyses of an air filter
- gamma isotopic analyses of milk samples
- gross beta, tritium and gamma isotopic analyses of water samples

The 2015 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 (less than 15% coefficient of variation and less than 3.0 normalized deviations, except for Cr-51 and Fe-59, which are outlined in Table 3-6).





Table 3-7. Interlaboratory Comparison Summary

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
<b>I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)</b>							
I-131	9/10/2015	85.4	82.0	1.37	1.37	5.79	0.69
<b>GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)</b>							
Ce-141	9/10/2015	92.7	85.5	4.36	1.43	7.5	1.03
Co-58	9/10/2015	114	106	5.28	1.76	5.6	0.9
Co-60	9/10/2015	139	132	5.38	2.21	5	0.37
Cr-51	9/10/2015	226	216	16.66	3.61	9.6	0.45
Cs-134	9/10/2015	85.3	84.9	3.37	1.42	5.4	0.08
Cs-137	9/10/2015	111	102	5	1.71	6.5	1.2
Fe-59	9/10/2015	96.7	90.5	5.5	1.51	6.2	0.91
Mn-54	9/10/2015	133	116	5.82	1.94	6	2.09
Zn-65	9/10/2015	164	142	8.46	2.37	7.3	1.85
<b>GROSS BETA ANALYSIS OF AN AIR FILTER (PCI/FILTER)</b>							
Gross Beta	9/10/2015	103	96.3	3.66	1.61	5.9	1.44
<b>GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (PCI/LITER)</b>							
Co-58	6/11/2015	77.7	68.4	5.92	1.14	10.92	1.1
Co-60	6/11/2015	203	193	8.29	1.06	4.52	1.12
Cr-51	6/11/2015	295	276	33.19	4.61	12.3	0.53
Cs-134	6/11/2015	184	163	6.93	2.72	5.02	2.28
Cs-137	6/11/2015	144	125	7.77	2.09	7.38	1.75
Fe-59	6/11/2015	163	151	10.07	2.53	6.94	1.03
I-131	6/11/2015	105	95.9	6.91	1.6	8	1.04
Mn-54	6/11/2015	115	101	6.9	1.68	7.31	1.62
Zn-65	6/11/2015	282	248	15.62	4.15	7.3	1.64





Table 3-7. Interlaboratory Comparison Summary

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
GROSS BETA ANALYSIS OF WATER SAMPLE (PCI/LITER)							
Gross Beta	3/19/2015	319	281	10.5	4.69	4.56	2.59
	6/11/2015	290	248	10.2	4.15	4.68	3.1
GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (PCI/LITER)							
Ce-141	3/19/2015	135.7	139.2	8.44	2.32	7.97	-0.3
Co-58	3/19/2015	183	180	9.32	3	6.76	0.24
Co-60	3/19/2015	325.3	328	12.73	5.48	5.61	-0.15
Cr-51	3/19/2015	399.1	366	38.04	6.11	17.12	0.48
Cs-134	3/19/2015	131.1	126	5.81	2.1	9.49	0.41
Cs-137	3/19/2015	175	167	9	2.78	7.49	0.6
Fe-59	3/19/2015	203	195	11.63	3.25	7.01	0.56
I-131	3/19/2015	100.5	96.7	7.16	1.61	9.24	0.41
Mn-54	3/19/2015	170	159	8.97	2.65	7.78	0.8
Zn-65	3/19/2015	328	299	17.26	4.99	7.61	1.15
TRITIUM ANALYSIS OF WATER SAMPLES (PCI/LITER)							
H-3	3/19/2015	12104	12600	140	210	3.14	-1.31
	6/11/2015	12700	13000	148	217	2.11	-0.95





### 3.7 Groundwater

To ensure compliance with NEI 07-07 (Industry Ground Water Protection Initiative – Final Guidance Document), 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. No changes were made to the Groundwater Protection Program in 2015.

Plant Hatch maintains the following wells (Table 3-8), which are sampled at a frequency that satisfies the requirements of NEI 07-07. The analytical results for 2015 were all within regulatory limits specified within this report. Table 3-9 contains the results of the Groundwater Protection Program tritium results (in pCi/L). See Map A-4 in Appendix A for well locations.

**Table 3-8. Groundwater Monitoring Locations**

Well	Depth (Feet)	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
T3	18	Water Table Near Turbine Bldg.
T7	21.4	Water Table Near Diesel Generator Bldg.
T10	18.8	Water Table Near CST-1





Table 3-8. Groundwater Monitoring Locations

Well	Depth (Feet)	Monitoring Purpose
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

Table 3-9. Groundwater Protection Program Tritium Results (pCi/L)

Well	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
R1	12.6	NDM	220	286
R2	NDM	NDM 8	66.1	370
R3	1040	961	1320	1430
R4	NDM	120	12.3	NDM
R5	17400	18600	12600	8400
R6	88.5	324	161	326
NW2A	153	491	500	272
NW2B	154	199	NDM	NDM
NW3A	17.4	NDM	NDM	52.7
NW3B	105	327	NDM	101
NW4A	111	135	41.3	325
NW5A	159	218	83.1	288
NW5B	125	89.1	75.8	NDM
NW6	100	297	285	184
NW8	NS	NS	NS	298
NW9	57.5	484	477	NDM
NW10	9540	8620	10000	6140
T3	7260	3200	1370	1720
T7	19.9	235	224	273
T10	14100	18600	23300	19900
T12	18300	18300	7290	8190
T15	911	2810	941	1910
P15A	NDM	91.6	45.2	195





**Table 3-9. Groundwater Protection Program Tritium Results (pCi/L)**

Well	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
P15B	NS – Not enough water to sample	2440	3270	1900
P17A	135	106	NDM	NDM
P17B	132	173	545	423
Deep Well 1	NS – Out of Service	NS – Out of Service	NS – Out of Service	NS – Out of Service
Deep Well 2	NDM	NDM	NDM	NDM
Deep Well 3	81.2	NDM	NDM	113

Plant Hatch has had historic tritium leaks into the perched aquifer from around the Unit 1 Condensate Storage Tank (CST), documented on 10 CFR 50.75(g) records. The tritium values in the wells that were found to be elevated above MDC were from previous CST and related piping leaks and are not considered present issues. Historic leaks and spills are reported in accordance with NEI 07-07.



## 4 SURVEY SUMMARIES

### 4.1 Land Use Census

In accordance with ODCM 4.1.2, a land use census was conducted on November 9, 2015 to verify the locations of the nearest radiological receptor within five miles. The census results, shown in Table 4-1, indicated no major changes from 2014; therefore, no changes to the ODCM are required. Residents were located in each sector as identified below; no resident was identified closer than the current closest resident.

**Table 4-1. Land Use Census Results**

Sector	Residence	Milk Animal	Beef Cattle	Fruit/Nut Tree	Garden
Distance in Miles to the Nearest Location in Each Sector					
N	2.0	None	None	4.2	3.8
NNE	2.9	None	None	4.7	None
NE	3.3	None	None	None	None
ENE	4.2	None	4.1	None	None
E	3.0	None	None	None	None
ESE	3.8	None	None	None	None
SE	1.8	None	2.4	None	2.4
SSE	2.0	None	3.6	None	2.2
S	1.0	None	2.5	None	1.0
SSW	1.1	None	2.8	1.4	2.5
SW	1.1	None	4.0	1.6	1.6
WSW	1.0	None	3.6	1.5	2.0
W	1.1	None	2.7	2.8	None
WNW	1.1	None	None	None	None
NW	3.6	None	4.5	None	None
NNW	1.8	None	2.8	None	2.9

### 4.2 Altamaha River Survey

A survey of the Altamaha River downstream of the plant for approximately 50 miles (approximately river miles 66.5 to 117.0) was conducted on September 21, 2015 to identify any new withdrawal of water from the river for drinking, irrigation, or construction purposes.





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 crops. Mr. Clarke was contacted on September 3, 2015, and he stated that he had used river water to irrigate peanuts this year. A sample of peanuts was collected and analyzed for gamma isotopes. The data is indicated in Table 4-2 below.

Correspondence from the Georgia Environmental Protection Division (EPD) on September 29, 2015, and November 12, 2015, indicated that no new agricultural or drinking water withdrawal permits had been issued at those respective times.

**Table 4-2. Special Sample Results (Peanuts)**

Nuclide	Sample	Units	Activity	MDA
Cs-134	Peanuts	pCi/Kg	NDM	8.07E+01
Cs-137	Peanuts	pCi/Kg	NDM	7.56E+00
I-131	Peanuts	pCi/Kg	NDM	1.11E+01

NDM – No Detectable Measurement



## 5 CONCLUSIONS

This report confirms SNCs conformance with the requirements of Chapter 4 of the ODCM and the objectives were 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 HNP.

Based on the 2015 activities associated with the REMP, SNC offers the following conclusions:

- Samples were collected and there were no deviations or anomalies that negatively affected the quality of the REMP
- Land use census and river survey did not reveal any changes
- Analytical results were below reporting levels
- These values are consistent with historical results, indicating no adverse radiological environmental impacts associated with the operation of HNP



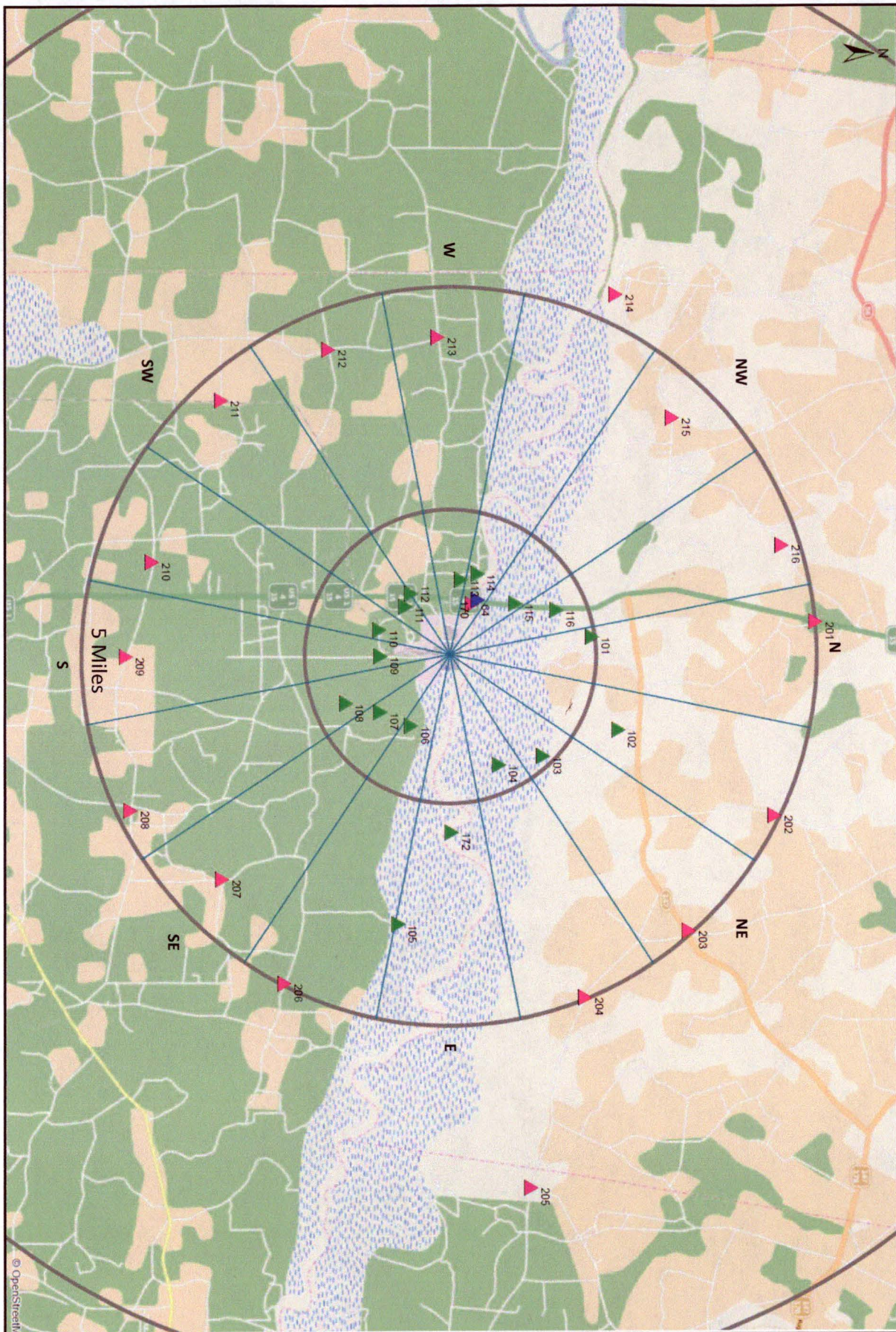


## **APPENDIX A**

### **Maps**







**Legend:**

- Indicator Stations -
- Control Stations -
- Other Stations -

Edwin I. Hatch Nuclear Plant  
2015 Annual Radiological Environmental Report  
REMP Stations in Plant Vicinity

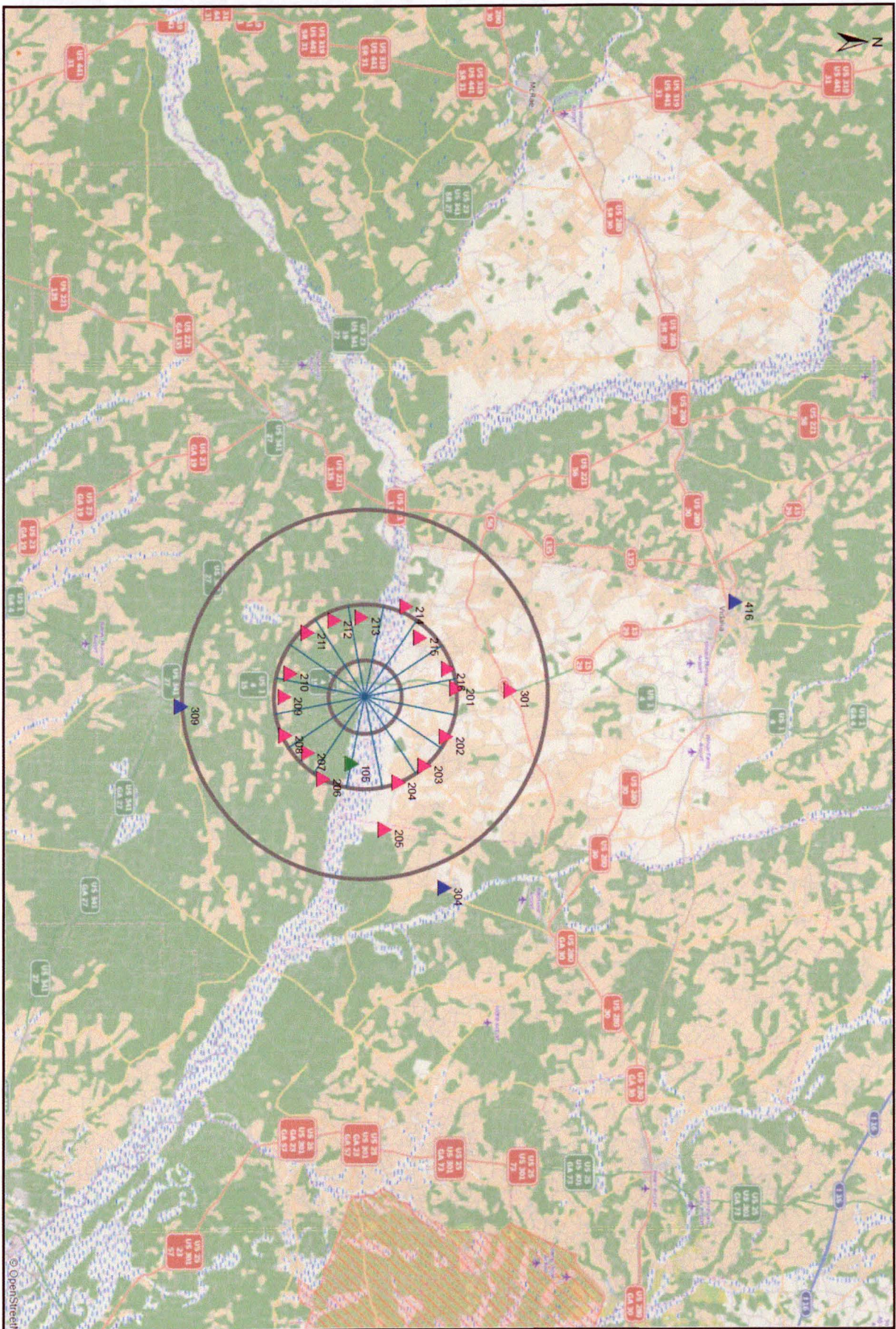


Drawn by: C. Groce

April 30, 2016

Appendix A  
Map A-1





**Legend:**

- Indicator Stations - 
- Control Stations - 
- Other Stations - 

Edwin I. Hatch Nuclear Plant  
 2015 Annual Radiological Environmental Report  
 REMP Stations within 10 miles



Drawn by: C. Groce

April 30, 2016

Appendix A  
 Map A-2





Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**Legend:**

- Upper Perched Aquifer - ●
- Minor Confined Aquifer - ●

Edwin I. Hatch Nuclear Plant  
2015 Annual Radiological Environmental Report  
Facility Groundwater Wells



Drawn by: C. Groce

April 30, 2016

Appendix A  
Map A-3



## **APPENDIX B**

### **Errata**



### 3.8 Groundwater

To ensure compliance with NEI 07-07 (Industry Ground Water Protection Initiative – Final Guidance Document), 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. No changes were made to the Groundwater Protection Program in 2014.

Plant Hatch maintains the following wells (Table 3-8), which are sampled at a frequency that satisfies the requirements of NEI 07-07. The analytical results for 2014 were all within regulatory limits specified within this report. Table 3-9 contains the results of the Groundwater Protection Program results. See Map A-4 in appendix for well locations.

**Table 3-8. Groundwater Monitoring Locations**

Well	Depth (Feet)	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
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





Table 3-8. Groundwater Monitoring Locations

Well	Depth (Feet)	Monitoring Purpose
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

Table 3-9. Groundwater Protection Program Tritium Results (pCi/L)

Well	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
R1	259	NDM	NDM	NDM
R2	NDM	130	173	NDM
R3	941	792	1040	887
R4	295	NDM	NDM	NDM
R5	12500	22500	30300	24200
R6	194	NDM	195	NDM
NW2A	440	1420	829	188
NW2B	NDM	NDM	NDM	NDM
NW3A	208	NDM	185	NDM
NW3B	NDM	NDM	303	197
NW4A	NDM	NDM	NDM	NDM
NW5A	NDM	160	NDM	NDM
NW5B	966	NDM	NDM	NDM
NW6	1050	NDM	NDM	NDM
NW8	215	NDM	NS – insufficient water	NS – insufficient water
NW9	NDM	NDM	162	161
NW10	15500	11800	9920	10800
T3	2290	1970	1240	3440
T7	NDM	NDM	NDM	NDM
T10	11100	38500	55900	16500
T12	10500	59700	43400	17600
T15	NDM	4190	4130	1520
P15A	NS – not assigned	NS – not assigned	NDM	NDM
P15B	6007	4300	2180	NS – insufficient water
P17A	NDM	NDM	NDM	NDM
P17B	519	474	547	361



**Table 3-9. Groundwater Protection Program Tritium Results (pCi/L)**

Well	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Deep Well 1	NS – not assigned	NS – not assigned	143	NS – not assigned
Deep Well 2	NDM	NDM	NS – not assigned	208
Deep Well 3	NDM	NDM	NDM	NDM

NDM – No Detectable Measurement

NS – Not Sampled

Plant Hatch has had historic tritium leaks into the perched aquifer from around the Unit 1 Condensate Storage Tank (CST), documented on 10 CFR 50.75(g) records. The tritium values in the wells that were found to be elevated above MDC were from previous CST and related piping leaks and are not considered present issues. Historic leaks and spills are reported in accordance with NEI 07-07.





**Edwin I. Hatch Nuclear Plant – Units 1 & 2  
Joseph M. Farley Nuclear Plant– Units 1 & 2  
Vogtle Electric Generating Plant– Units 1 & 2  
Annual Radiological Environmental Operating Reports for 2015**

**Enclosure 2**

**Farley Annual Radiological Environmental Operating Reports for 2015**

**JOSEPH M. FARLEY NUCLEAR PLANT**  
**2015 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING**  
**REPORT**



**SOUTHERN**   
**NUCLEAR**  
A SOUTHERN COMPANY



# JOSEPH M. FARLEY NUCLEAR PLANT

## 2015 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

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**Appendix A – Maps**

- A-1 – REMP Stations in Plant Vicinity
- A-2 – REMP Stations within 5 Miles
- A-3 – Extended REMP Stations
- A-4 – Facility Groundwater Wells

**Appendix B – Errata**

Groundwater Protection Results from 2014 Report





**LIST OF ACRONYMS**

ADEM	Alabama Department of Environmental Management
APC	Alabama Power Company
AREOR	Annual Radiological Environmental Operating Report
ASTM	American Society for Testing and Materials
CL	Confidence Level
EPA	Environmental Protection Agency
GA EPD	State of Georgia Environmental Protection Division
FNP	Joseph M. Farley Nuclear Plant
GPCEL	Georgia Power Company Environmental Laboratory
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
SNC	Southern Nuclear Operating Company
TLD	Thermoluminescent Dosimeter
TS	Technical Specification





## 1 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 2015 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 (APC) 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
- Section 3 provides a summary of the results and an assessment of any radiological impacts to the environment as well as the results from the Interlaboratory Comparison
- A summary of the land use census and the river survey are included in Section 4
- Conclusions are included in Section 5





## 2 REMP DESCRIPTION

The following section provides a description of the sampling and laboratory protocols associated with the REMP. Table 2-1 provides a summary of 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 summarizes the collection and analysis frequencies (in accordance with ODCM Section 4.2). Table 2-2 provides specific information regarding the station locations, their proximity to the plant, and exposure pathways. Additionally, the locations of the sampling stations are depicted on Maps A-1 through A-3 of the station locations included in the Appendix A of this report.

Plant personnel collect some samples, while others are collected by Georgia Power Company's Environmental Laboratory (GPCEL), located in Smyrna, Georgia. The lab analyzes all REMP samples.



Table 2-1. Summary Description of Radiological Environmental Monitoring Program

Exposure Pathway and/or	Number of Representative Samples and Sample Locations	Sampling/Collection Frequency	Type/Frequency of Analysis
<b>Direct Radiation</b>	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
<b>Airborne Radioiodine and Particulates</b>	Samples from nine locations:  Four locations close to the site boundary in different sectors;  Three community stations; within 8 miles  Two control locations near population centers, approximately 15 and 18 miles away	Continuous sampler operation with sample collection weekly	Particulate sampler: Analyze for gross beta radioactivity $\geq 24$ 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.  Radioiodine canister: I-131 analysis, weekly (One community station)
<b>Waterborne</b>			
Surface <sup>3</sup>	One sample upriver One sample downriver	Composite sample over one month period <sup>4</sup>	Gamma isotopic analysis <sup>2</sup> , monthly Composite for tritium analysis, quarterly





Table 2-1. Summary Description of Radiological Environmental Monitoring Program

Exposure Pathway and/or	Number of Representative Samples and Sample Locations	Sampling/Collection Frequency	Type/Frequency of Analysis
Groundwater	See Table 3-8 and Map A-4 in Appendix A for well locations Off-site monitoring includes one indicator station and one control station	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 (Off-site wells are analyzed only for Gamma Isotopic, I-131, & tritium)
Shoreline Sediment <sup>7</sup>	<ul style="list-style-type: none"> <li>One sample from downriver area with existing or potential recreational value</li> <li>One sample from upriver area with existing or potential recreational value</li> </ul>	Semiannually	Gamma isotopic analysis <sup>2</sup> , semiannually
<b>Ingestion</b>			
Milk	Two samples from milking animals <sup>5</sup> at control locations at a distance of about 10 miles or more	Bimonthly	Gamma isotopic analysis <sup>2,6</sup> , bimonthly
Fish <sup>8</sup>	<ul style="list-style-type: none"> <li>One bottom feeding fish and one game fish both upstream and downstream</li> </ul>	Semiannually  During spring spawning season	Gamma isotopic analysis <sup>2</sup> on edible portions, semiannually  Gamma isotopic analysis <sup>2</sup> on edible portions, annually.
Grass or Leafy Vegetation	<ul style="list-style-type: none"> <li>One sample from two onsite locations near the site boundary in different sectors</li> <li>One sample from a control location at a distance of about 18 miles</li> </ul>	Monthly during growing season	Gamma isotopic analysis <sup>2,6</sup> , monthly



Table 2-1. Summary Description of Radiological Environmental Monitoring Program

Exposure Pathway and/or	Number of Representative Samples and Sample Locations	Sampling/Collection Frequency	Type/Frequency of Analysis
<p>Notes:</p> <p><sup>1</sup> 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.</p> <p><sup>2</sup> Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.</p> <p><sup>3</sup> Upstream sample is taken at a distance beyond significant influence of the discharge. Downriver samples are taken beyond but near the mixing zone.</p> <p><sup>4</sup> 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.</p> <p><sup>5</sup> A milking animal is a cow or goat producing milk for human consumption, no milk animals were found within five miles of the plant.</p> <p><sup>6</sup> 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.</p> <p><sup>7</sup> 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.</p> <p><sup>8</sup> Since several miles of river water may be needed to obtain adequate fish samples, these river mile positions represent the approximate locations from which the fish 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.</p>			





Table 2-2. Radiological Environmental Sampling Locations

Station Number	Station Type	Descriptive Location	Direction <sup>1</sup>	Distance (miles) <sup>1</sup>	Radiation Sample Type
0501	Indicator	River Intake Structure	ESE	0.8	Airborne
0701	Indicator	South Perimeter	SSE	1.0	Airborne
1101	Indicator	Plant Entrance	WSW	0.9	Airborne
1601	Indicator	North Perimeter	N	0.8	Airborne
0215	Control	Blakely GA	NE	15	Airborne, Direct
0718 <sup>3</sup>	Control	Neals Landing, FL	SSE	18	Airborne, Direct
1218	Control	Dothan, AL	W	18	Airborne, Direct, Vegetation
0703	Community	GA Pacific Paper Co.	SSE	3	Airborne, Direct
1108	Community	Ashford, AL	WSW	8	Airborne
1605	Community	Columbia, AL	N	5	Airborne, Direct
0101	Indicator	Plant Perimeter	NNE	0.9	Direct
0201	Indicator	Plant Perimeter	NE	1.0	Direct
0301	Indicator	Plant Perimeter	ENE	0.9	Direct
0401	Indicator	Plant Perimeter	E	0.8	Direct
0501	Indicator	Plant Perimeter	ESE	0.8	Direct
0601	Indicator	Plant Perimeter	SE	1.1	Direct
0701	Indicator	Plant Perimeter	SSE	1.0	Direct, Vegetation
0801	Indicator	Plant Perimeter	S	1.0	Direct
0901	Indicator	Plant Perimeter	SSW	1.0	Direct
1001	Indicator	Plant Perimeter	SW	0.9	Direct
1101	Indicator	Plant Perimeter	WSW	0.9	Direct
1201	Indicator	Plant Perimeter	W	0.8	Direct
1301	Indicator	Plant Perimeter	WNW	0.8	Direct
1401	Indicator	Plant Perimeter	NW	1.1	Direct
1501	Indicator	Plant Perimeter	NNW	0.9	Direct
1601	Indicator	Plant Perimeter	N	0.8	Direct, Vegetation
1215	Control	Dothan, AL	W	15	Direct
1311	Control	Webb, AL	W	11	Direct
1612	Control	Haleburg, AL	WNW	12	Direct
1001	Community	Whatley Residence	SW	12	Direct
1108	Community	Ashford, AL	WSW	8.0	Direct
WRI	Indicator	Downstream of plant discharge, approximately RM 40	S	3.0	River Water
WRB	Control	Upstream of plant intake, approximately RM 47	NNE	3.0	River Water
WGI-07	Indicator	Paper Mill Well	SSE	4.0	Groundwater





Table 2-2. Radiological Environmental Sampling Locations

Station Number	Station Type	Descriptive Location	Direction <sup>1</sup>	Distance (miles) <sup>1</sup>	Radiation Sample Type
WGB-10	Control	Whatley Residence	SW	1.2	Groundwater
RSI	Indicator	Downstream of plant discharge at Smith's Bend (RM 41)	S	4.0	Sediment
RSB	Control	Upstream of plant intake at Andrews Lock and Dam (RM 48)	N	4.0	Sediment
MB-0714	Control <sup>2</sup>	Robert Weir Dairy, Donaldsonville, GA	SSE	14	Milk
FGI & FGB	Indicator	Downstream of plant discharge at Smith's Bend (RM 41)	S	4.0	Fish
FGB & FBB	Control	Upstream of plant intake at Andrews Lock and Dam (RM 48)	N	4.0	Fish
0104	Community	Early Co., GA	NNE	4.0	Direct
0204	Community	Early Co., GA	NE	4.0	Direct
0304	Community	Early Co., GA	ENE	4.0	Direct
0405	Community	Early Co., GA	E	5.0	Direct
0505	Community	Early Co., GA	ESE	5.0	Direct
0605	Community	Early Co., GA	SE	5.0	Direct
0805	Community	Houston Co., AL	SSE	5.0	Direct
0904	Community	Houston Co., AL	SSW	4.0	Direct
1005	Community	Houston Co., AL	SW	5.0	Direct
1104	Community	Houston Co., AL	WSW	4.0	Direct
1204	Community	Houston Co., AL	W	4.0	Direct
1304	Community	Houston Co., AL	WNW	4.0	Direct
1404	Community	Houston Co., AL	NW	4.0	Direct
1504	Community	Houston Co., AL	NNW	4.0	Direct

Notes:

<sup>1</sup> Direction and distance are determined as the mid-point between the Unit 1 and Unit 2 vent stacks.

<sup>2</sup> No milk animals were found within five miles of the plant, control sample not collected since 2009.

<sup>3</sup> Spare, per the ODCM





### 3 RESULTS SUMMARY

Included in this section are statistical evaluations of the laboratory results, comparison of the results by media, and a summary of the anomalies and deviations. Overall, 1,120 analyses were performed across nine exposure pathways. Tables and figures are provided throughout this section to provide an enhanced presentation of the information.

In recent history, man-made nuclides have been released into the environment and have resulted in wide spread distribution of radionuclides across the globe. For example, 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 pre-operation, and through early operation. Some long-lived radionuclides, such as Cs-137, continue to be detected and a portion of these detections are believed to be attributed to the nuclear weapons tests.

Additionally, data associated with certain radiological effects created by off-site events have been removed from the historical evaluation, this includes: the nuclear atmospheric weapon test in the fall of 1980 and the Chernobyl incident in the spring of 1986.

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. Historically, the radionuclide Be-7, which occurs abundantly in nature, is often detected in REMP samples, and occasionally detected in the plant's liquid and gaseous effluents. When it is detected in effluents and REMP samples, it is also included in the REMP results. In 2015, Be-7 was not detected in any plant effluents and therefore is not included in this report. The Be-7 detected in select REMP samples likely represents naturally occurring and/or background conditions.

As part of the data evaluation process, SNC considered the impact of the non-plant associated nuclides along with a statistical evaluation of the REMP data. The statistical evaluations included within this report include the Minimum Detectable Concentration (MDC), the Minimum Detectable Difference (MDD), and Chauvenet's Criterion as described below.

#### **Minimum Detectable Concentration**

The minimum detectable concentration is defined as an estimate of the true concentration of an analyte required to give a specified high probability that the measured response will be greater than the critical value.



**Minimum Detectable Difference**

The Minimum Detectable Difference (MDD) compares the lowest significant difference (between the means) of a control station, versus an indicator station or a community station, that can be determined statistically at the 99% Confidence Level (CL). A difference in mean values which was less than the MDD was considered to be statistically indiscernible.

**Chauvenet's Criterion**

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.

The 2015 results were compared with past results, including those obtained during pre-operation. As appropriate, results were compared with their MDC (listed in Table 3-1) and RL which is listed in Table 3-2. The required MDCs were achieved during laboratory sample analysis. No data points were excluded for violating Chauvenet's criterion.





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
Airborne Particulates (fCi/m3)	Gross Beta 466	10	13.4 0.8-35.6 (206/207)	Columbia, AL N 5 mi. Community	21.5 2.6-42.2 (52/52)	16.8 1.1-42.2 (155/155)	15.9 2.3-33.6 (104/104)
	Gamma Isotopic 36						
	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-131 363	70	NDM		NDM	NDM	NDM
Direct Radiation (mR/91 days)	Gamma Dose 157		17.1 11.4-27.7 (63/63)	Plant Perimeter, E 0.8 Indicator	25.4 23.7-26.1 (4/4)	14.4 10.9-18.3 (70/70)	15.6 12.3-19 (24/24)
Milk (pCi/l)	Gamma Isotopic 0						
	I-131	1					
	Cs-134	15					
	Cs-137	18					
	Ba-140	60					
	La-140	15					
Vegetation (pCi/kg-wet)	Gamma Isotopic 36						
	I-131	60	NDM				NDM
	Cs-134	60	NDM				NDM





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
	Cs-137	80	7.9 4.5-11.3 (2/12)	Dothan, AL W 18 mi. Control	12.3 (12.3-12.3) (1/12)		12.3 (12.3-12.3) (1/12)
River Water (pCi/l)	Gamma Isotopic 26						
	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		
	Ba-140	60	NDM		NDM		
	La-140	15	NDM		NDM		
	Tritium 8	3000	203.3 156-248 (3/4)	Paper Mill (RM 40) Indicator	203.3 156-248 (3/4)		NDM
Off-site Groundwater	Gamma Isotopic 8						
	Mn-54	15	NDM		NDM		NDM
	Fe-59	30	NDM		NDM		NDM
	Co-58	15	NDM		NDM		NDM





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
	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 8	15	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	2000	NDM		NDM		NDM
Bottom Feeding Fish (pCi/kg-wet)	Gamma Isotopic 4						
	Mn-54	130			NDM		NDM
	Fe-59	260			NDM		NDM
	Co-58	130			NDM		NDM
	Co-60	130			NDM		NDM
	Zn-65	260			NDM		NDM
	Cs-134	130			NDM		NDM
	Cs-137	150			NDM		NDM
Game Fish (pCi/kg-wet)	Gamma Isotopic 4						
	Mn-54	130	NDM		NDM		NDM
	Fe-59	260	NDM		NDM		NDM





Table 3-1. Radiological Environmental Monitoring Program Annual Summary

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 (f) Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
				Name Distance and Direction	Mean (b), Range (Fraction)		
	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	13.5 (13.1-14.0) (2/2)	Downstream of plant discharge in vicinity of Smith's Bend (RM 41)	13.5 (13.1-14.0) (2/2)		NDM
Sediment (pCi/kg-dry)	Gamma Isotopic 4						
	Co-60	70(e)	NDM		NDM		NDM
	Cs-134	150	NDM		NDM		NDM
	Cs-137	180	NDM		NDM		NDM

## 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.

(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) (NDM).

(d) The Georgia Power Company Environmental Laboratory has determined that this value may be routinely attained under normal conditions. No value is provided in ODCM Table 4-3.

(e) 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 than 1 mrem per year. However, I-131 analyses have been performed on the finished drinking water samples.

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

Not Applicable (sample not required)





Table 3-2. 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 <sup>a</sup>				
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 <sup>b</sup>	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	

<sup>a</sup> 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.

<sup>b</sup> If no drinking water pathway exists, a value of 20 pCi/l may be used.

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 sampling (as described in Table 2-1) are summarized in Table 3-3 along with their causes and resolution.



Table 3-3. Anomalies and Deviations from Radiological Environmental Monitoring Program

Collection Period	Affected Samples	Anomaly (A)* or Deviation (D)**	Cause	Resolution
04/07/15 – 04/14/15 CR10053095	PI-1101/II-1101 0.9 mile - WSW	Non-representative sample of airborne particulates.	Lost 102 hours of sample time when portable generator used to supply power during outage tripped off.	Station operation satisfactory after normal power restored.
2 <sup>nd</sup> Quarter 2015 04/07/15 to 04/28/15 CR 10062765	OSLD Station RI-0701A&B 1.0 mile - SSE	Non-representative direct radiation data	In-service OSLD badge set missing and presumed lost following severe weather event in area.	Spare OSLD badge set installed at station during remainder of 2 <sup>nd</sup> Quarter period.
04/21/15 – 04/28/15 CR 10062765	PI-1601/II-1601 0.8 mile - North	Non-representative sample of airborne particulates	Lost 6.25 hours of sample time due to power interruption during severe weather event in area.	Station operation satisfactory after normal power restored.
05/12/15 - 05/19/15 CR 10069726	PI-0701/II-0701 1.0 mile - SSE	Non-representative sample of airborne particulates	Lost 3.5 hours of sample time due to unexpected loss of the 12KV South Feeder power supply.	Station operation satisfactory after normal power restored.
2 <sup>nd</sup> Quarter 2015 04/08/15 – 07/10/15 CR 10095289	OSLD Station RC-0204A&B (4 miles - NE)	OSLD missing from station	In-service OSLD badge set missing and presumed lost following severe weather event in area.	New OSLD badge set installed at start of 3 <sup>rd</sup> Quarter period.
09/29/15 – 10/06/15 CR 10131957	PC-0703/IC-0703 3 miles - SSE	Non-representative sample of airborne particulates. Inadequate sample volume collected (less than 250 m <sup>3</sup> )	Lost 171 hours of sample time after local breaker on sampler tripped off during electrical storm.	Station operation satisfactory after normal power restored.
12/24/15 - EOY CR 10162085	WRB (Andrews Dam) ~3 miles - upstream	Non-representative monthly and quarterly river water composites	Water sampler out of service for 7.5 days due to high river levels and resulting flood conditions	Station operability satisfactory after access to facility restored and sampling equipment returned to service.
12/21/15 – EOY CR 10162781	PI-0701/II-0701 1.0 mile - SSE	Air samples not obtained	In-service air samples and sampling equipment ruined during river flooding event.	Station operation satisfactory following power restoration and replacement of sampling equipment.





4 <sup>th</sup> Quarter 2015 10/08/15 – EOY CR 10167965	OSLD Station RC-0405A &B 5 miles - East	OSLD collection delayed	OSLD station is inaccessible due to closed roads in surrounding area.	4 <sup>th</sup> Quarter OSLD badge set will be changed-out when normal access is restored.
1 <sup>st</sup> through 3 <sup>rd</sup> Quarter 2015 TE 921084	Groundwater Sample Point PW#3 (onsite Production Well #3 supply)	Samples not obtained for tritium and gamma isotopic analyses	PW#3 pump was Danger-Tagged 'off' for an underground piping leak (1-DT-14-Y36-00041).	PW#3 pump was untagged and samples collected during 4 <sup>th</sup> Quarter 2015.
3 <sup>rd</sup> Quarter 2015 TE 921084	Groundwater Sample Point CW#2 (onsite Construction East Well supply)	Samples not obtained for tritium and gamma isotopic analyses	CW#2 pump was inoperable (SNC677410)	CW#2 pump was repaired and samples collected during 4 <sup>th</sup> Quarter 2015.
<p>* An anomaly is considered a non-standard sample that still meets sampling criteria outlined in SNC and Georgia Power Labs procedures.</p> <p>** A deviation is a sample result that is not recorded due to not meeting scheduling and/or procedural requirements as outlined by SNC and Georgia Power Labs</p>				



### 3.1 Airborne Particulates

As specified in Table 2-1, airborne particulate filters and charcoal canisters are collected weekly at four indicator stations (Stations 0501, 0701, 1101, and 1601) which encircle the plant at the site periphery, at three community station (0703, 1108, and 1605) approximately three to eight miles from the plant, and at three control stations (0215 and 1218) which range from approximately 15 to 18 miles from the plant. At each location, air is continuously drawn through a glass fiber filter to retain airborne particulate. An activated charcoal canister is also placed in series with the particulate filter to adsorb radioiodine at each indicator and control station and at community station 0703 in Cedar Springs, GA for comparison purposes with GA EPD.

#### 3.1.1 Gross Beta

As provided in Table 3-1, the 2015 annual average weekly gross beta activity was 13.4 fCi/m<sup>3</sup> for the indicator stations. It was 2.5 fCi/m<sup>3</sup> less than the control station average of 15.9 fCi/m<sup>3</sup> for the year. The MDD is not applicable as the indicator stations produced a lower average than the control stations.

The 2015 annual average weekly gross beta activity at the community stations was 16.8 fCi/m<sup>3</sup> which was 0.9 fCi/m<sup>3</sup> more than the control station average. This difference is not statistically discernible since it is less than the calculated MDD of 3.0 fCi/m<sup>3</sup>.

Average Air Gross Beta historical data (Table 3-4) is graphed to show trends associated with a prevalent exposure pathway (Figure 3-1). 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.

**Table 3-4. Average Weekly Gross Beta Air Concentration**

Period	Indicator (fCi/m <sup>3</sup> )	Control (fCi/m <sup>3</sup> )	Community (fCi/m <sup>3</sup> )
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



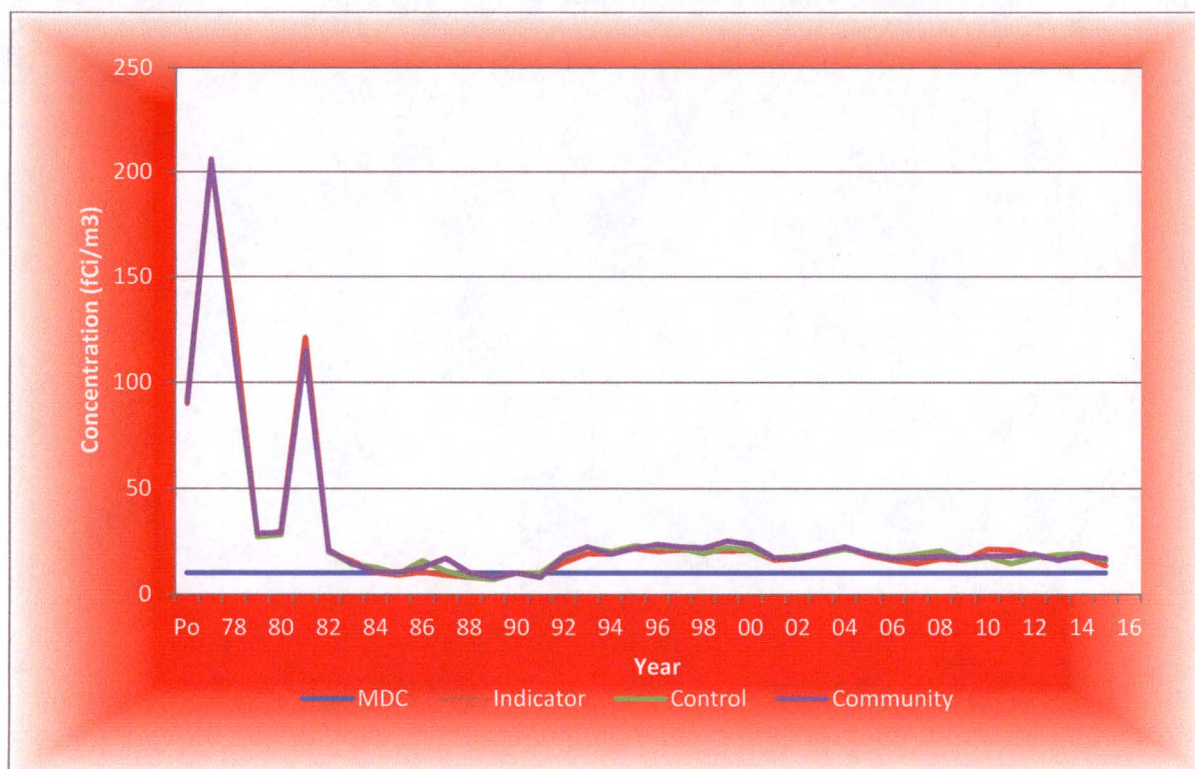


Table 3-4. Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
1986	10.5	15.8	12.5
1987	9.0	11.0	17.0
1988	8	8	10
1989	7	7	8
1990	10	10	10
1991	9	10	8
1992	15	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	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
2014	17.7	19.1	18.5
2015	13.4	15.9	16.8



Figure 3-1. Average Weekly Gross Beta Air Concentration



### 3.1.2 Gamma Particulates

During 2015, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters.

Historically, gamma isotopes have been detected as a result of offsite events. During pre-operation Cs-137 was occasionally detected.

## 3.2 Direct Radiation

In 2015, direct (external) radiation was measured with Optically Stimulated Luminescent (OSL) dosimeters by placing two OSL badges at each station. The gamma dose at each station is reported as the average reading of the two badges. The badges are analyzed on a quarterly basis. 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 two concentric rings. The inner ring (Stations 0101 through 1601) is located near the plant perimeter as shown in Map A-1 in Appendix A and the outer ring (Stations 0104 through 1605) is located at a distance of approximately 5 miles from the plant as shown in Map A-2 in Appendix A. 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 six control stations (Stations 0215, 0718, 1215, 1218, 1311 and 1612) are located at distances greater than 10 miles from the plant as shown in Map A-3 in Appendix A. Monitored special interest areas consist of the following: Station 1001 which is the nearest residence to the plant, and Station 1108 in the town of Ashford, Alabama. The mean and range values presented in the "Other" column in Table 3-1 includes the outer ring stations (stations 0104 through 1605) as well as stations 1001 and 1108.

As provided in Table 3-1, the 2015 average quarterly exposure at the indicator stations (inner ring) was 17.1 mR with a range of 11.4 to 27.7 mR. The indicator station average was 1.5 mR more than the control station average (15.6 mR). This difference is considered statistically discernible since it is more than the MDD of 1.1 mR. However, the average is consistent with historical readings and is only slightly above the control value and therefore no environmental concerns were identified.

The quarterly exposures acquired at the community/other (outer ring) stations during 2015 ranged from 10.9 to 18.3 mR with an average of 14.4 mR which was 1.2 mR less than that of the control stations.

Average Direct Radiation historical data (Table 3-5) is graphed to show trends associated with a prevalent exposure pathway (Figure 3-2). 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.

**Table 3-5. Average Quarterly Exposure from Direct Radiation**

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	12.6	11.4	10.1
1977	10.6	12.2	10.6
1978	15	13.5	12
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
1983	20.2	20.2	17.4
1984	18.3	16.9	15.3



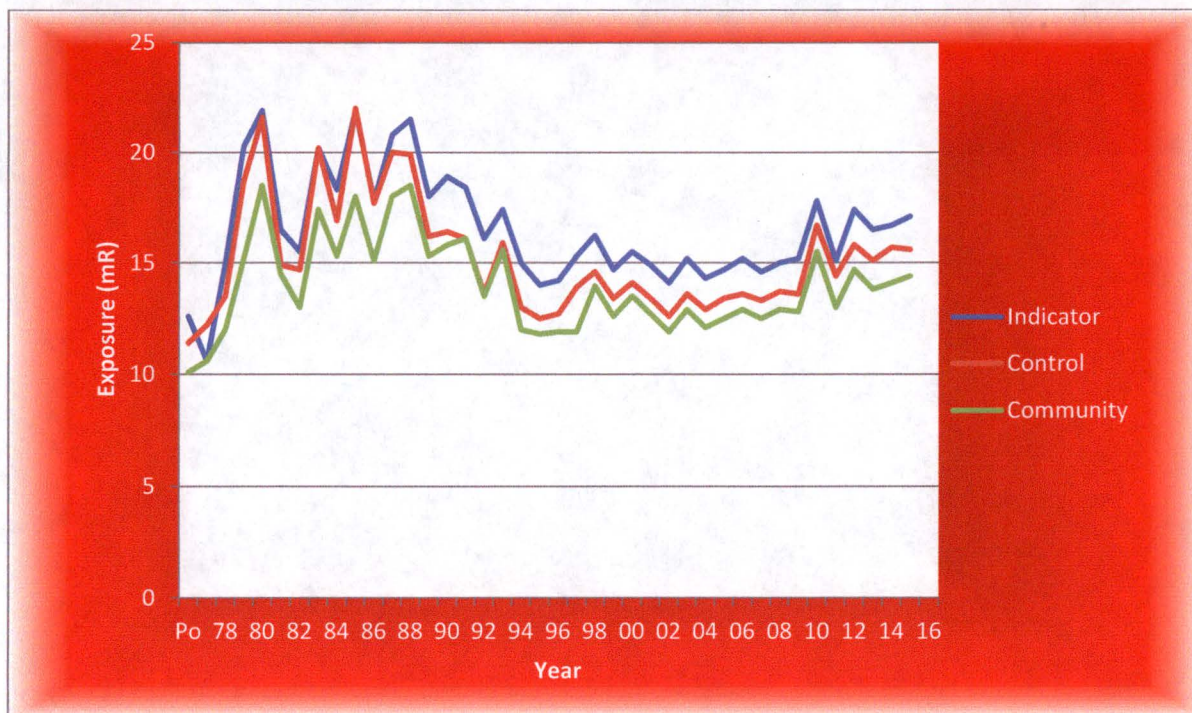


Table 3-5. Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
1985	21.9	22	18
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	21.0	19.9	18.4
2012	17.4	15.8	14.7
2013	16.5	15.1	13.8
2014	16.7	15.7	14.1
2015	17.1	15.6	14.4



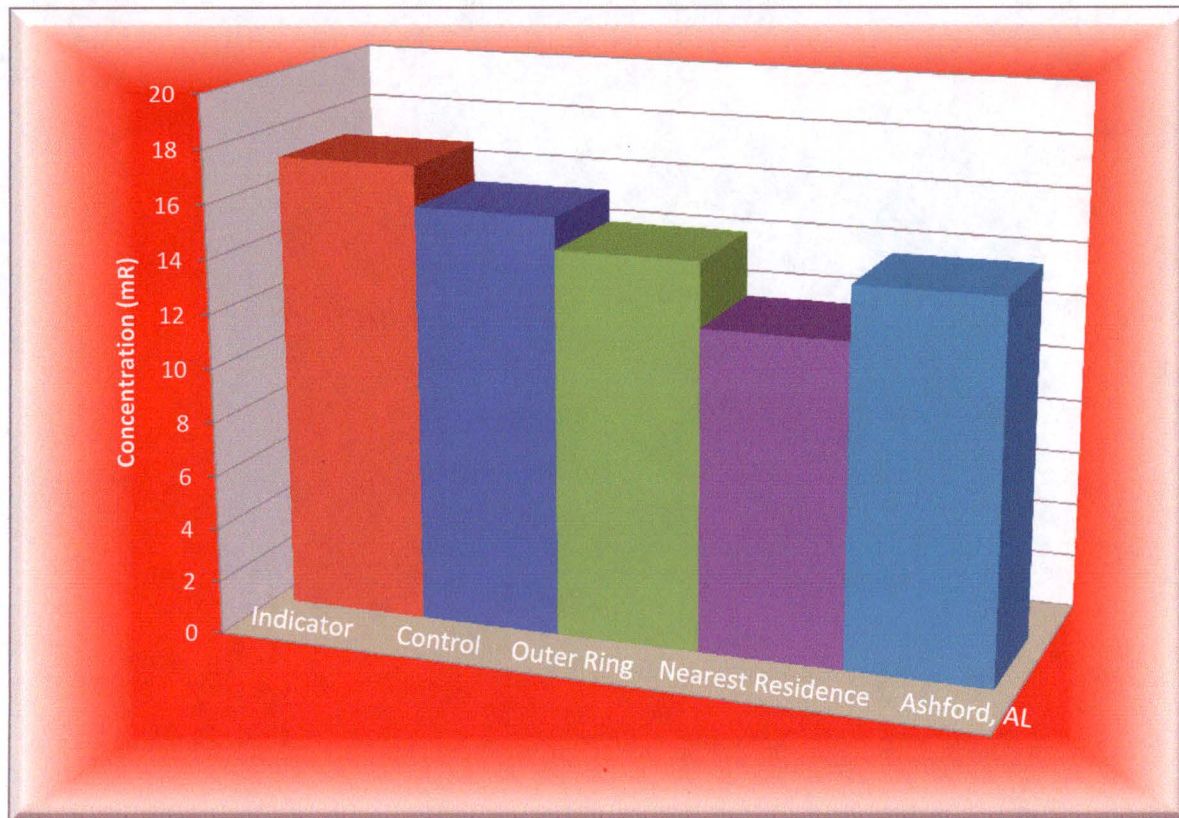
Figure 3-2. Average Quarterly Exposure from Direct Radiation



The increase shown in 2010 reflects issues 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 3-3 provides a more detailed view of the 2015 values. The values for the special interest areas detailed below indicate that Plant Farley did not significantly contribute to direct radiation at those areas.



Figure 3-3. 2015 Average Exposure from Direct Radiation



### 3.3 Biological Media

Cs-137 was the only radionuclide detected in two of the three biological media. As indicated in Figure 3-4, the Cs-137 activity levels are below the respective MDCs and well below that of the respective RLs for each sample media for both the indicator and control stations.

#### 3.3.1 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 2015 land use census and therefore no milk sampling was performed during the reporting year.



### 3.3.2 Vegetation

In accordance with Table 2-1 and 2-2, forage samples are collected every four weeks at two indicator stations on the plant perimeter, and at one control station located approximately 18 miles west of the plant, in Dothan. The man-made radionuclide Cs-137 is periodically identified in vegetation samples, and is generally attributed to offsite sources (such as weapons testing, Chernobyl, and Fukushima).

During 2015, one gamma isotope (Cs-137) was identified twice at Station 1601 (Plant Perimeter) and once at a control station (Dothan, Alabama). The average for the indicator station (7.9 pCi/L) was below the average for the control station (12.3 pCi/L). No environmental concerns are noted as these values are below the MDC and RL.

### 3.3.3 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 Map A-3 in Appendix A.

#### 3.3.3.1 Bottom Feeding Species

For bottom-feeding species, all fish sampled are considered indicator stations. No radionuclides were detected in the 2015 analyses, which is consistent with historical data.

#### 3.3.3.2 Game Species

For game species, all fish sampled are considered indicator stations. One sample location identified Cs-137 on two occasions with an average value of 13.5 pCi/kg. While the control samples did not contain Cs-137, the indicator value is below the MDC (50 pCi/kg) and the RL (2,000 pCi/kg) and this value is not considered attributable to Plant activity.

### 3.3.4 Biological Media Summary

There were no statistical differences, trends, or anomalies associated with the 2015 biological media samples when compared to historical data. As shown in Table 3-1, Cs-137 was identified in vegetation and game species fish; no other radionuclides were found from the gamma isotopic analysis of biological media samples in 2015.



### 3.4 Off-site Groundwater

There are no true indicator sources of ground water offsite of Plant Farley. A well, located approximately 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 2015, there were no radionuclides detected in any of the ground water samples from either sample station, with the exception of tritium.

Since 2004, tritium has been detected at very low concentrations (near the instrument detection level) and close to environmental background levels in off-site groundwater. In 2015, tritium was not detected. Typically the positive results are at concentrations well below the MDC and RL for tritium (2,000 and 20,000 pCi/l, respectively).

### 3.5 River Water

Composite river water samples are collected monthly at an upstream control location and at two downstream indicator locations (shown on Figure 2). The details of the sampling protocols are outlined in Tables 2-1 and Table 2-2. A gamma isotopic analysis is conducted on each monthly sample and the monthly aliquots are combined to form quarterly composite samples, which are analyzed for tritium.

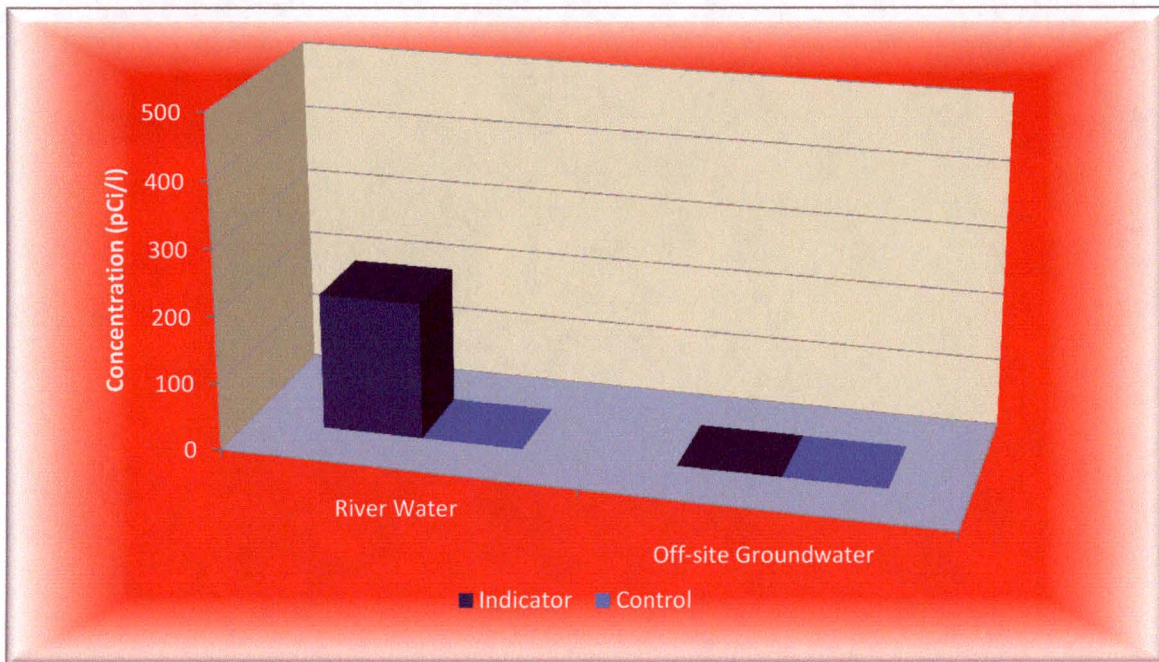
As provided in Table 3-1, there were no positive results during 2015 from the gamma isotopic analysis of the river water samples. Also indicated in Table 3-1, the average tritium concentration (three samples) found at the indicator station was 203.3 pCi/l, the control station did not indicate any positive concentrations (four samples). The MDC for tritium in river water used to supply drinking water is 2000 pCi/l and the RL is 20000 pCi/l.

Figure 3-4 below details the 2015 average tritium concentrations across both water mediums.





Figure 3-4. 2015 Average Tritium Concentrations in River and Off-site Groundwater



### 3.6 Sediment

Sediment was collected along the shoreline of the Chattahoochee River in the spring and fall at a control station which is approximately four miles upstream of the intake structure and at an indicator station which is approximately two miles downstream of the discharge structure as shown in Map A-3. A gamma isotopic analysis was performed on each sample. There were no radionuclides detected in sediment samples in 2015.

### 3.7 Interlaboratory Comparison Program

In accordance with ODCM 4.1.3, GPCEL participates in an Interlaboratory Comparison Program (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 ICP includes the required determinations (sample medium/radionuclide combinations) included in the REMP.

The ICP was conducted by Eckert & Ziegler Analytics, Inc. (EZA) of Atlanta, Georgia. EZA 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. EZA supplies the crosscheck samples to GPCEL which performs routine laboratory analyses. Each of the specified analyses is performed three times.

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. 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 on Table 3-6 below:

**Table 3-6. Interlaboratory Comparison Limits**

Nuclide	Concentration *	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
	NA	>1000	25
	>300	<1000	15
Fe-59	<80	NA	25
	>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 GPCEL's participation in the ICP is provided in Table 3-7 for:

- gross beta and gamma isotopic analyses of an air filter
- gamma isotopic analyses of milk samples
- gross beta, tritium and gamma isotopic analyses of water samples

The 2015 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 (less than 15% coefficient of variation and less than 3.0 normalized deviations, except for Cr-51 and Fe-59, which are outlined in Table 3-6).

The 2015 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 3-7. Interlaboratory Comparison Summary

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
<b>I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)</b>							
I-131	9/10/2015	85.4	82.0	1.37	1.37	5.79	0.69
<b>GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)</b>							
Ce-141	9/10/2015	92.7	85.5	4.36	1.43	7.5	1.03
Co-58	9/10/2015	114	106	5.28	1.76	5.6	0.9
Co-60	9/10/2015	139	132	5.38	2.21	5	0.37
Cr-51	9/10/2015	226	216	16.66	3.61	9.6	0.45
Cs-134	9/10/2015	85.3	84.9	3.37	1.42	5.4	0.08
Cs-137	9/10/2015	111	102	5	1.71	6.5	1.2
Fe-59	9/10/2015	96.7	90.5	5.5	1.51	6.2	0.91
Mn-54	9/10/2015	133	116	5.82	1.94	6	2.09
Zn-65	9/10/2015	164	142	8.46	2.37	7.3	1.85
<b>GROSS BETA ANALYSIS OF AN AIR FILTER (PCI/FILTER)</b>							
Gross Beta	9/10/2015	103	96.3	3.66	1.61	5.9	1.44
<b>GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (PCI/LITER)</b>							
Co-58	6/11/2015	77.7	68.4	5.92	1.14	10.92	1.1
Co-60	6/11/2015	203	193	8.29	1.06	4.52	1.12
Cr-51	6/11/2015	295	276	33.19	4.61	12.3	0.53
Cs-134	6/11/2015	184	163	6.93	2.72	5.02	2.28
Cs-137	6/11/2015	144	125	7.77	2.09	7.38	1.75
Fe-59	6/11/2015	163	151	10.07	2.53	6.94	1.03
I-131	6/11/2015	105	95.9	6.91	1.6	8	1.04
Mn-54	6/11/2015	115	101	6.9	1.68	7.31	1.62
Zn-65	6/11/2015	282	248	15.62	4.15	7.3	1.64





Table 3-7. Interlaboratory Comparison Summary

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
GROSS BETA ANALYSIS OF WATER SAMPLE (PCI/LITER)							
Gross Beta	3/19/2015	319	281	10.5	4.69	4.56	2.59
	6/11/2015	290	248	10.2	4.15	4.68	3.1
GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (PCI/LITER)							
Ce-141	3/19/2015	135.7	139.2	8.44	2.32	7.97	-0.3
Co-58	3/19/2015	183	180	9.32	3	6.76	0.24
Co-60	3/19/2015	325.3	328	12.73	5.48	5.61	-0.15
Cr-51	3/19/2015	399.1	366	38.04	6.11	17.12	0.48
Cs-134	3/19/2015	131.1	126	5.81	2.1	9.49	0.41
Cs-137	3/19/2015	175	167	9	2.78	7.49	0.6
Fe-59	3/19/2015	203	195	11.63	3.25	7.01	0.56
I-131	3/19/2015	100.5	96.7	7.16	1.61	9.24	0.41
Mn-54	3/19/2015	170	159	8.97	2.65	7.78	0.8
Zn-65	3/19/2015	328	299	17.26	4.99	7.61	1.15
TRITIUM ANALYSIS OF WATER SAMPLES (PCI/LITER)							
H-3	3/19/2015	12104	12600	140	210	3.14	-1.31
	6/11/2015	12700	13000	148	217	2.11	-0.95





### 3.8 Groundwater

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. No changes were made to the Groundwater Protection Program in 2015.

Plant Farley maintains the following wells (Table 3-8), which are sampled at a frequency that satisfies the requirements of NEI 07-07. The analytical results for 2015 were all within regulatory limits specified within this report. Table 3-9 contains the results of the Groundwater Protection Program results for tritium (in pCi/L).

**Table 3-8. Groundwater Protection Program Locations**

Well	Aquifer	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



Table 3-9. Groundwater Protection Program Tritium Results (pCi/L)

Well	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
R1	27.6	NDM	NDM	87.2
R2	45.1	53.7	6.87	96.9
R3	1690	1870	1660	1650
R4	NDM	145	NDM	NDM
R5	45.4	NDM	143	NDM
R6	182	NDM	78.4	NDM
R7	90.5	16.3	123	NDM
R8	50.6	57.9	NDM	28.9
R9	60.3	NDM	76.1	NDM
R10	60.5	NDM	41.6	NDM
R11	NDM	9.33	110	NDM
R13	NDM	NDM	27.1	NDM
R14	131	NDM	NDM	NDM
PW#2	173	NDM	NDM	NDM
PW#3	NS – Out of Service	NS – Out of Service	NS – Out of Service	173
PW#4	NDM	NDM	NDM	209
CW West	NDM	NDM	NDM	NDM
CW East	NDM	74.5	NS – Out of Service	179
FRW	NDM	NDM	NDM	248
SW-1	NDM	53.6	NDM	NDM

NDM – No Detectable Measurements

NS – Not Sampled





## 4 SURVEY SUMMARIES

### 4.1 Land Use Census

In accordance with ODCM 4.1.2, a land use census was conducted on November 25, 2015 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 five 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. The census results are tabulated in Table 4.1-1. The 2015 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 2014 census, nor were any milk animals located within a five-mile radius.

In accordance with ODCM 4.1.2, a land use census was conducted on November 25, 2015 to verify the locations of the nearest radiological receptor within five miles. The census results, shown in Table 4-1 indicated one change from 2013; a new permanent resident was identified in the western sector (12); now located 1.0 mile from the plant (a change of 0.2 miles). This location was evaluated under CAR 249563 in accordance with ODCM 4.1.2.2.1. There were no significant differences in X/Q or D/Q values or radiological doses between the new location and the previous location.

**Table 4-1. Land Use Census Results**

Sector	Residence	Milk Animal
Distance in Miles to the Nearest Location in Each Sector		
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	None	None
S	4.3	None
SSW	2.9	None
SW	1.2	None
WSW	2.4	None
W	1.0	None
WNW	2.1	None
NW	1.5	None
NNW	3.4	None



## 4.2 Chattahoochee River Survey

A previous river survey performed for Plant Farley 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.

In June 2015, a survey was sent to the Alabama Department of Environmental Management (ADEM) and Alabama Department of Economic and Community Affairs (ADECA) to request any information about river use permits that had been issued in the area near the plant. No additional withdrawal permits or intake locations had been added at the time of the survey.





## 5 CONCLUSIONS

This report confirms SNCs conformance with the requirements of Chapter 4 of the ODCM and the objectives were 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 FNP.

Based on the 2015 activities associated with the REMP, SNC offers the following conclusions:

- Samples were collected and there were no deviations or anomalies that negatively affected the quality of the REMP
- Land use census and river survey did not reveal any changes
- Analytical results were below reporting levels
- These values are consistent with historical results, indicating no adverse radiological environmental impacts associated with the operation of FNP

