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SOUTHERN NUCLEAR
A SOUTHERN COMPANY

MAY 16 2016

Docket Nos.: 50-321 50-348 50-424 NL-16-0741
50-366 50-364 50-425

U. S. Nuclear Regulatory Commission
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Washington, D. C. 20555-0001

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

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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**Tables**

## Figures



## Appendix A – Maps



## Appendix B – Errata

# 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<br><br>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. |
| **Waterborne** | | | |
| Surface | One sample upriver<br>One sample downriver | Composite sample over one month period[1] | Gamma isotopic analysis[2], monthly<br>Composite for tritium analysis, quarterly |
| Drinking[3,4] | 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[2], semiannually |
| **Ingestion** | | | |
| Milk[5] | One | Bimonthly | Gamma isotopic analysis[2,7], bimonthly |
| Fish or Clams[6] | Two | Semiannually | Gamma isotopic analysis[2] on edible portions, semiannually |
| Grass or Leafy Vegetation | Three | Monthly during growing season | Gamma isotopic analysis[2,7], monthly |

Notes:
[1]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.
[2]Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
[3]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.
[4]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.
[5]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.
[6]Commercially or recreationally important fish may be sampled. Clams may be sampled if difficulties are encountered in obtaining sufficient fish samples.
[7]If the gamma isotopic analysis is not sensitive enough to meet the Minimum Detectable Concentration (MDC) for I-131, a separate analysis for I-131 may be performed.

Table 2-2. Radiological Environmental Sampling Locations

| Station Number | Station Type | Descriptive Location | Direction[1] | Distance (miles)[1] | 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 | [2] | River[3] |
| 172 | Indicator | Downstream | E | [2] | River[3] |
| 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[1] | Distance (miles)[1] | 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:
[1]Direction and distance are determined from the main stack.

[2]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.

[3]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<br>16.2-376.2<br>(9/24) | Inner Ring ESE 1.1 mi. | 149.7<br>16.2-376.2<br>(8/12) | | NDM |
| River Water (pCi/l) | Gamma Isotopic<br>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<br>8 | 3000 (e) | 200<br>200-200<br>(1/4) | Downstream E 3.0 RM from intake | 200<br>200-200<br>(1/4) | | 17.5<br>17.5-17.5<br>(1/4) |
| Fish (pCi/kg-wet) | Gamma Isotopic<br>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.

[grey box] 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[a] | | | | |
| Mn-54 | 1000 | | 30,000 | | |
| Fe-59 | 400 | | 10,000 | | |
| Co-58 | 1000 | | 30,000 | | |
| Co-60 | 300 | | 10,000 | | |
| Zn-65 | 300 | | 20,000 | | |
| Zr-95 | 400 | | | | |
| Nb-95 | 700 | | | | |
| I-131 | 2[b] | 900 | | 3 | 100 |
| Cs-134 | 30 | 10,000 | 1000 | 60 | 1000 |
| Cs-137 | 50 | 20,000 | 2000 | 70 | 2000 |
| Ba-140 | 200 | | | 300 | |
| La-140 | 100 | | | 400 | |

[a] This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.
[b] If no drinking water pathway exists, a value of 20 pCi/l may be used.

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

## 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/m3 for the indicator stations. It was 0.5 fCi/m3 less than the control station average of 19.6 fCi/m3 for the year. This difference is not statistically discernible, since it is less than the calculated MDD of 4.1 fCi/m3.

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.

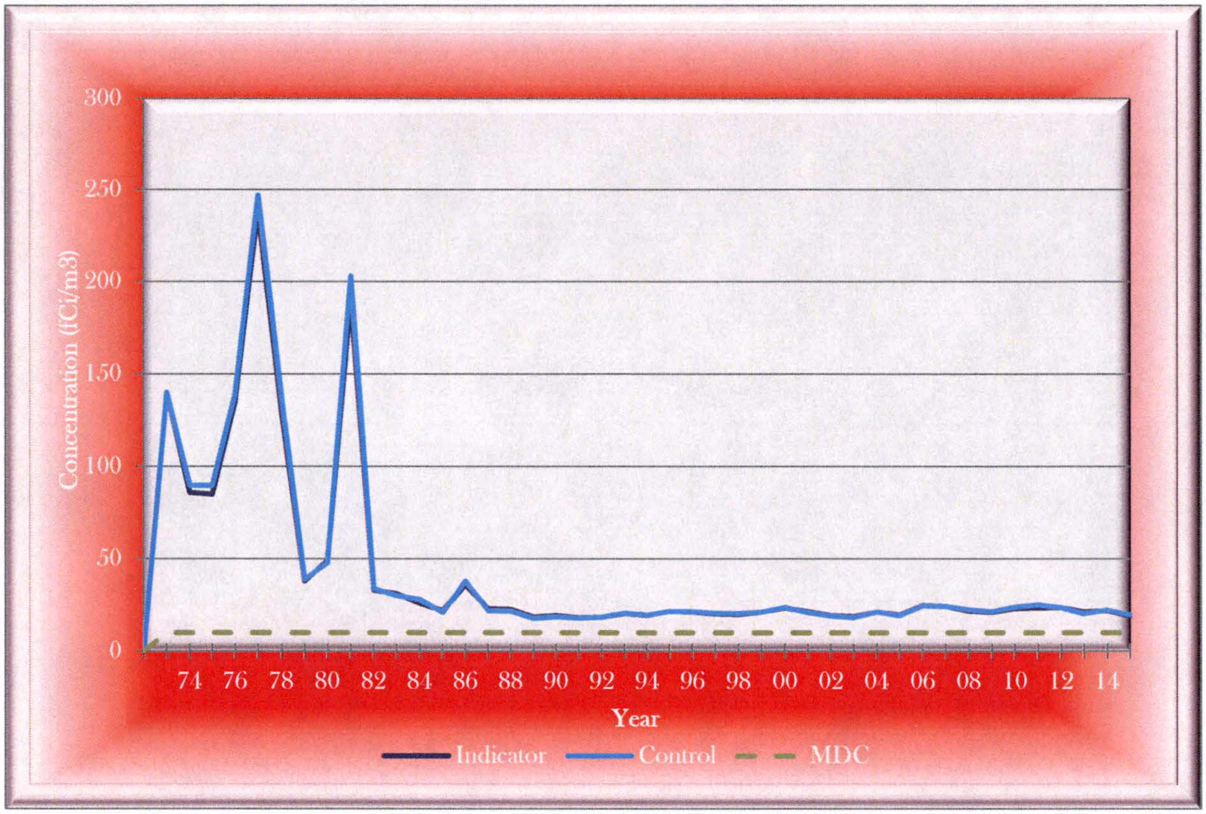
**Table 3-4. Average Weekly Gross Beta Air Concentration**

| Period | Indicator (fCi/m3) | Control (fCi/m3) |
|---|---|---|
| Pre-op | 140 | 140 |
| 1974 | 87 | 90 |
| 1975 | 85 | 90 |
| 1976 | 135 | 139 |
| 1977 | 239 | 247 |
| 1978 | 130 | 137 |
| 1979 | 38 | 39 |
| 1980 | 49 | 48 |
| 1981 | 191 | 203 |
| 1982 | 33 | 34 |
| 1983 | 31 | 30 |
| 1984 | 26 | 28 |
| 1985 | 22 | 21 |
| 1986 | 36 | 38 |
| 1987 | 23 | 22 |
| 1988 | 22.6 | 21.7 |
| 1989 | 18.4 | 17.8 |
| 1990 | 19.3 | 18.7 |
| 1991 | 18.1 | 18 |

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/m3) was identified in the first quarter of 1991 at Station 304. The MDC and RL for Cs-137 in air are 60 and 20,000 fCi/m3, respectively.

## 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.

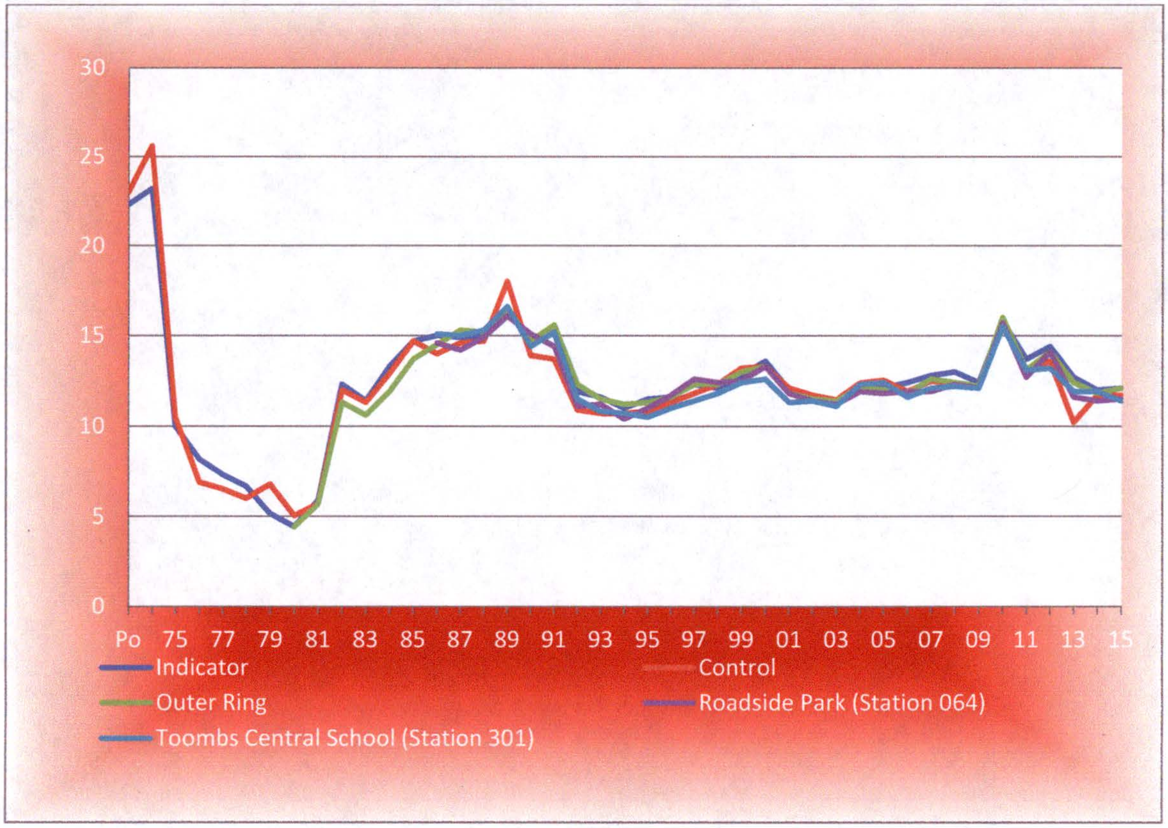
**Table 3-5. Average Quarterly Exposure from Direct Radiation**

| 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**

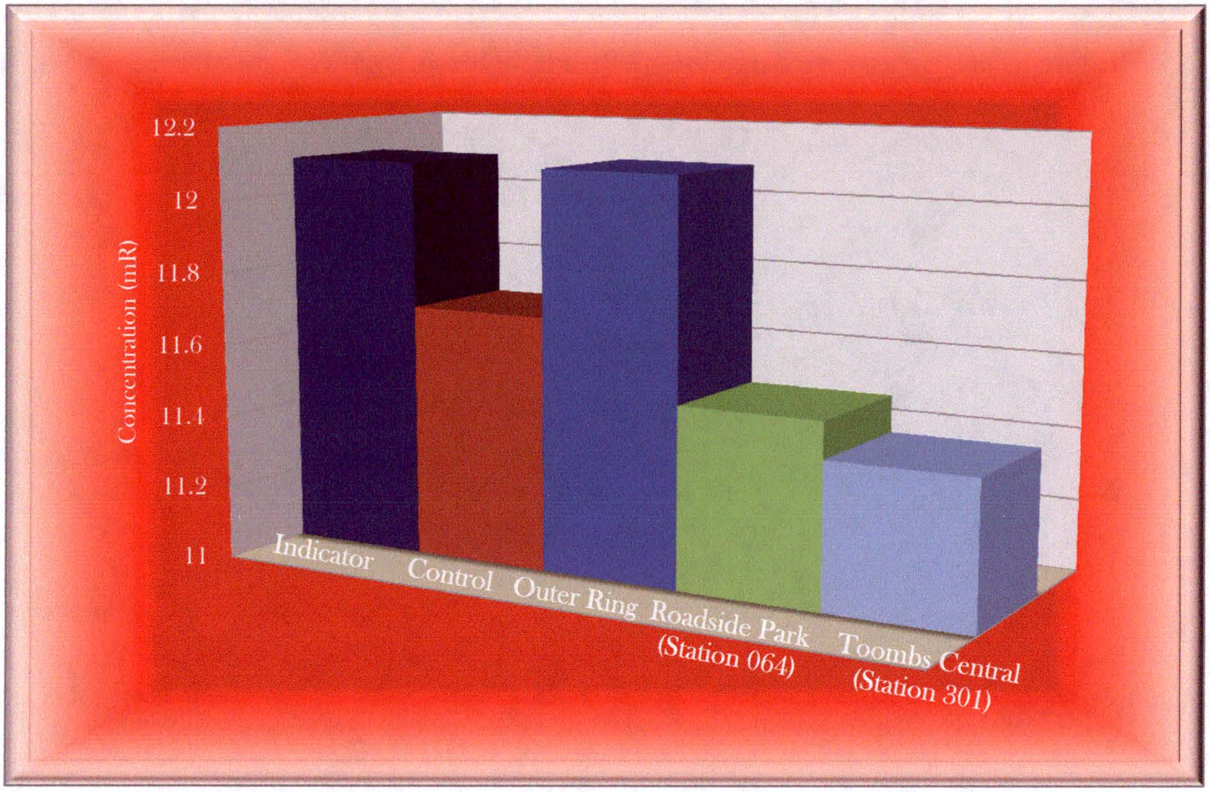
| Period | Indicator (mR) | Control (mR) | Outer Ring (mR) |
|---|---|---|---|
| 1980 | 4.44 | 5.04 | 4.42 |
| 1981 | 5.90 | 5.70 | 5.70 |
| 1982 | 12.3 | 12.0 | 11.3 |
| 1983 | 11.4 | 11.3 | 10.6 |
| 1984 | 13.3 | 12.9 | 11.9 |
| 1985 | 14.7 | 14.7 | 13.7 |
| 1986 | 15.0 | 14.0 | 14.5 |
| 1987 | 14.9 | 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

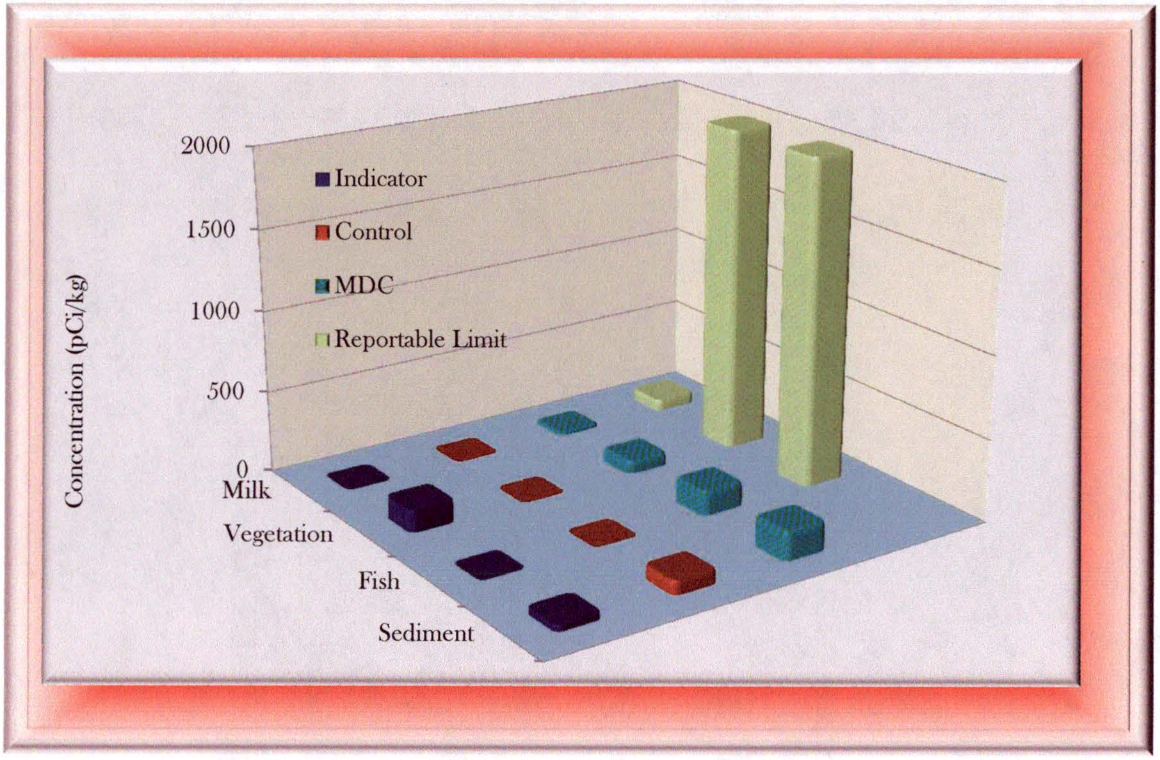
Fish samples were collected in accordance with the ODCM (as indicated in Table 2-1). For the semiannual collections, the control location (Station 170) is located upriver of the plant intake structure, and the indicator location (Station 172) is located downriver of the plant discharge structure.

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**

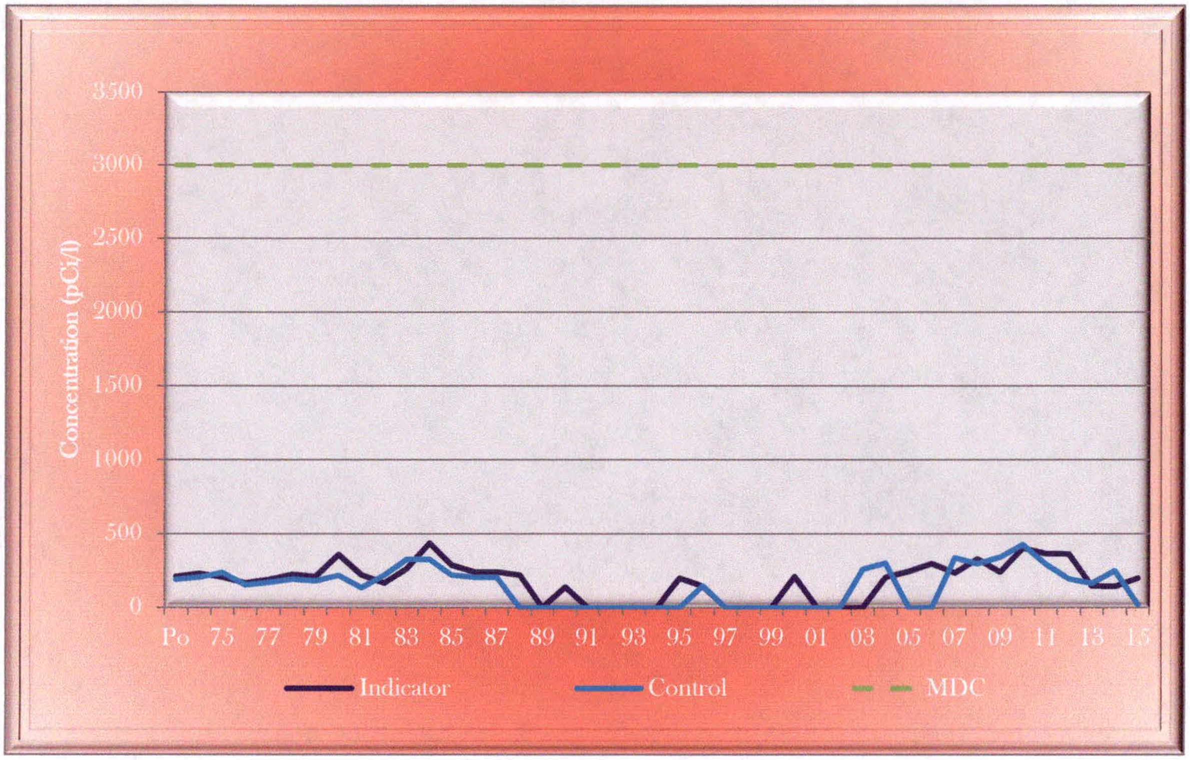



## 3.4 Surface Water

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 |
|---|---|---|---|---|---|---|---|
| I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge) | | | | | | | |
| I-131 | 9/10/2015 | 85.4 | 82.0 | 1.37 | 1.37 | 5.79 | 0.69 |
| GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter) | | | | | | | |
| 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 |
| GROSS BETA ANALYSIS OF AN AIR FILTER (PCI/FILTER) | | | | | | | |
| Gross Beta | 9/10/2015 | 103 | 96.3 | 3.66 | 1.61 | 5.9 | 1.44 |
| GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (PCI/LITER) | | | | | | | |
| 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. Table3-9 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;

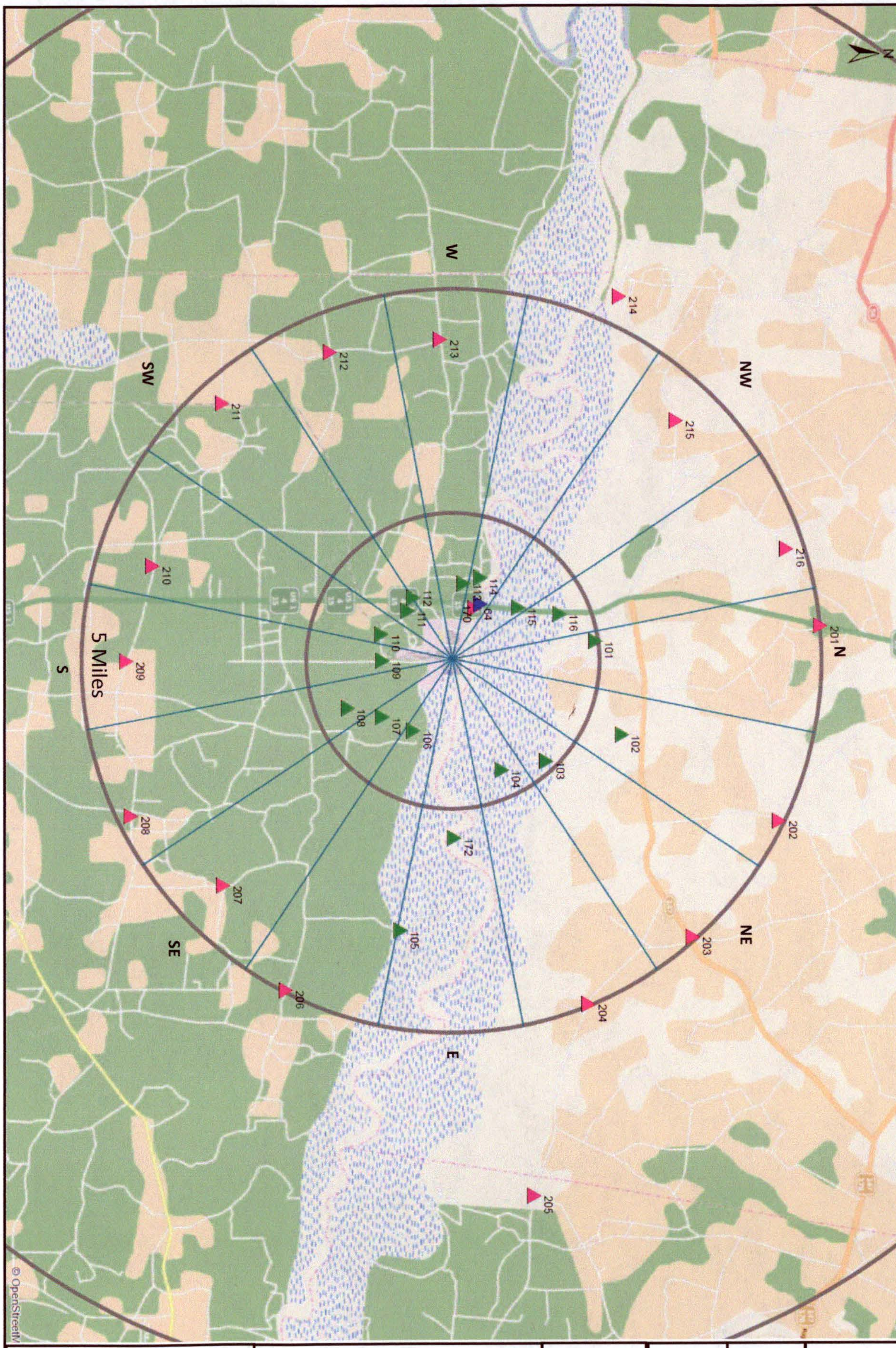
2) Assess the radiological impact (if any) to the environment due to the operation of the HNP.

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

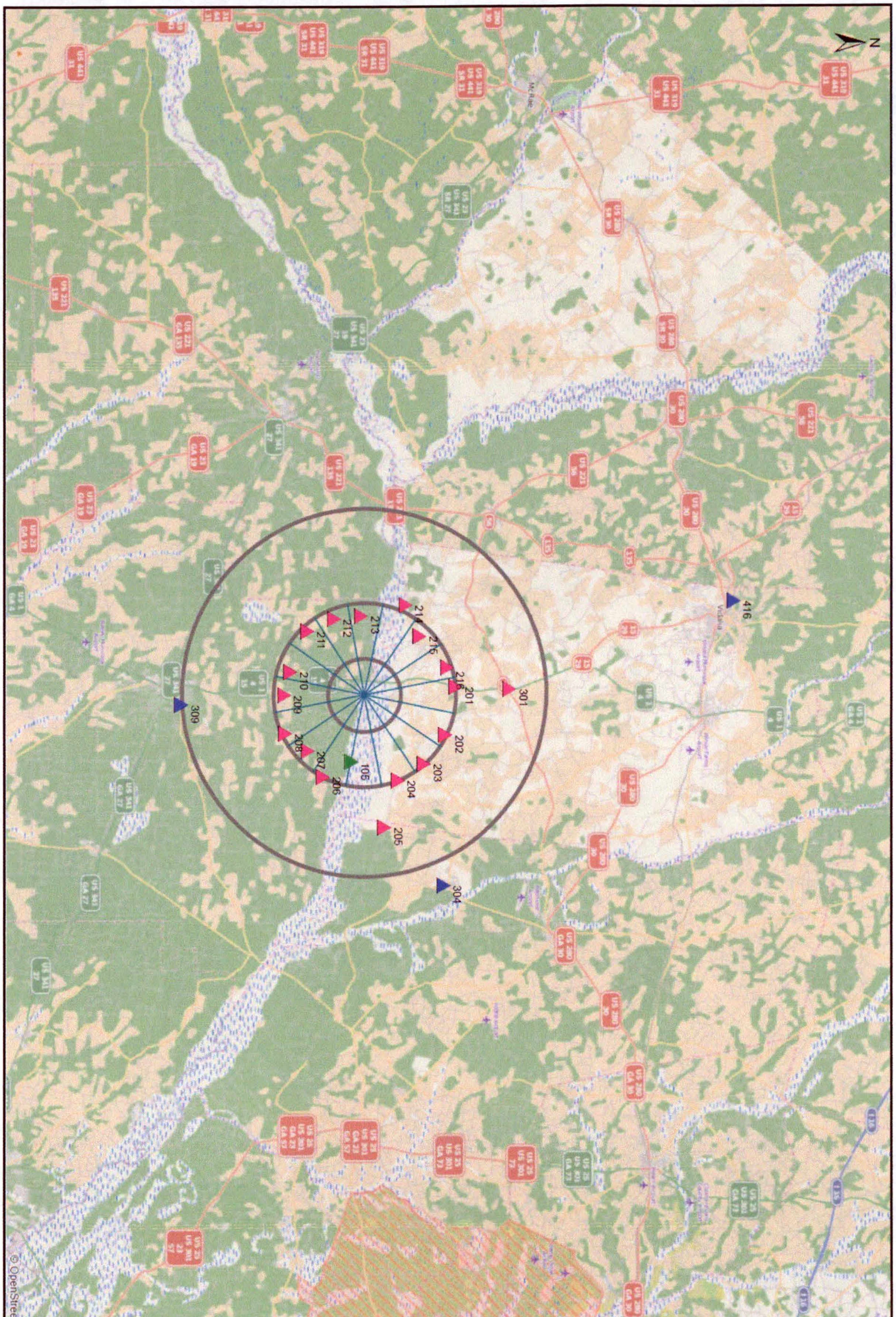
- Samples were collected and there were no deviations or anomalies that negatively affected the quality of the REMP
- Land use census and river survey did not reveal any changes
- Analytical results were below reporting levels
- These values are consistent with historical results, indicating no adverse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

# APPENDIX A

**Maps**




| Legend: | Edwin I. Hatch Nuclear Plant | | Drawn by: | C. Groce | Appendix A |
|---|---|---|---|---|---|
| Indicator Stations - ▲ (green) | 2015 Annual Radiological Environmental Report | | | | Map A-1 |
| Control Stations - ▲ (blue) | REMP Stations in Plant Vicinity | | April 30, 2016 | | |
| Other Stations - ▲ (pink) | | | | | |




**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 | Appendix A<br>Map A-2 |
| April 30, 2016 | | |


| Legend: | Edwin I. Hatch Nuclear Plant | | Drawn by: | C. Groce | Appendix A |
|---|---|---|---|---|---|
| Upper Perched Aquifer - ⊗ (blue) | 2015 Annual Radiological Environmental Report | | | | Map A-3 |
| Minor Confined Aquifer - ⊗ (green) | Facility Groundwater Wells | | April 30, 2016 | | |

# 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. Table3-9 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

## TABLE OF CONTENTS



**Tables**

**Figures**



**Appendix A – Maps**



**Appendix B – Errata**

# 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 |
|---|---|---|---|
| **Direct Radiation** | Forty routine monitoring stations with two or more dosimeters placed as follows:<br>An inner ring of stations, one in each compass sector in the general area of the site boundary;<br>An outer ring of stations, one in each compass sector at approximately 5 miles from the site; and<br>Special interest areas, such as population centers, nearby recreation areas, and control stations | Quarterly | Gamma dose, quarterly |
| **Airborne Radioiodine and Particulates** | Samples from nine locations:<br>Four locations close to the site boundary in different sectors;<br>Three community stations; within 8 miles<br>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 ≥ 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.<br>Radioiodine canister: I-131 analysis, weekly (One community station) |
| **Waterborne** | | | |
| Surface[3] | One sample upriver<br>One sample downriver | Composite sample over one month period[4] | Gamma isotopic analysis[2], monthly<br>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<br>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[7] | • One sample from downriver area with existing or potential recreational value<br>• One sample from upriver area with existing or potential recreational value | Semiannually | Gamma isotopic analysis[2], semiannually |
| **Ingestion** | | | |
| Milk | Two samples from milking animals[5] at control locations at a distance of about 10 miles or more | Bimonthly | Gamma isotopic analysis[2,6], bimonthly |
| Fish[8] | • One bottom feeding fish and one game fish both upstream and downstream | Semiannually<br><br>During spring spawning season | Gamma isotopic analysis[2] on edible portions, semiannually<br><br>Gamma isotopic analysis[2] on edible portions, annually. |
| Grass or Leafy Vegetation | • One sample from two onsite locations near the site boundary in different sectors<br>• One sample from a control location at a distance of about 18 miles | Monthly during growing season | Gamma isotopic analysis[2,6], 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 |
|---|---|---|---|

Notes:
[1]Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.
[2]Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
[3]Upriver sample is taken at a distance beyond significant influence of the discharge. Downriver samples are taken beyond but near the mixing zone.
[4]Composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) to assure obtaining a representative sample.
[5]A milking animal is a cow or goat producing milk for human consumption, no milk animals were found within five miles of the plant.
[6]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.
[7]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.
[8] 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.

**Table 2-2. Radiological Environmental Sampling Locations**

| Station Number | Station Type | Descriptive Location | Direction[1] | Distance (miles)[1] | 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[3] | 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[1] | Distance (miles)[1] | 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[2] | 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:
[1]Direction and distance are determined as the mid-point between the Unit 1 and Unit 2 vent stacks.
[2] No milk animals were found within five miles of the plant, control sample not collected since 2009.
[3] 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<br>0.8-35.6<br>(206/207) | Columbia, AL<br>N 5 mi.<br>Community | 21.5<br>2.6-42.2<br>(52/52) | 16.8<br>1.1-42.2<br>(155/155) | 15.9<br>2.3-33.6<br>(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<br>11.4-27.7<br>(63/63) | Plant Perimeter, E<br>0.8<br>Indicator | 25.4<br>23.7-26.1<br>(4/4) | 14.4<br>10.9-18.3<br>(70/70) | 15.6<br>12.3-19<br>(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<br>4.5-11.3<br>(2/12) | Dothan, AL<br>W 18 mi.<br>Control | 12.3<br>(12.3-12.3)<br>(1/12) | | 12.3<br>(12.3-12.3)<br>(1/12) |
| River Water<br>(pCi/l) | Gamma Isotopic<br>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<br>8 | 3000 | 203.3<br>156-248<br>(3/4) | Paper Mill (RM 40)<br>Indicator | 203.3<br>156-248<br>(3/4) | | NDM |
| Off-site Groundwater | Gamma Isotopic<br>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 then 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.

(shaded) 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[a] | | | | |
| Mn-54 | 1000 | | 30,000 | | |
| Fe-59 | 400 | | 10,000 | | |
| Co-58 | 1000 | | 30,000 | | |
| Co-60 | 300 | | 10,000 | | |
| Zn-65 | 300 | | 20,000 | | |
| Zr-95 | 400 | | | | |
| Nb-95 | 700 | | | | |
| I-131 | 2[b] | 900 | | 3 | 100 |
| Cs-134 | 30 | 10,000 | 1000 | 60 | 1000 |
| Cs-137 | 50 | 20,000 | 2000 | 70 | 2000 |
| Ba-140 | 200 | | | 300 | |
| La-140 | 100 | | | 400 | |

[a] This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.
[b] If no drinking water pathway exists, a value of 20 pCi/l may be used.

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<br>CR10053095 | PI-1101/II-1101<br>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. |
| 2nd Quarter 2015<br>04/07/15 to 04/28/15<br>CR 10062765 | OSLD Station<br>RI-0701A&B<br>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 2nd Quarter period. |
| 04/21/15 – 04/28/15<br>CR 10062765 | PI-1601/II-1601<br>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<br>CR 10069726 | PI-0701/II-0701<br>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. |
| 2nd Quarter 2015<br>04/08/15 – 07/10/15<br>CR 10095289 | OSLD Station<br>RC-0204A&B<br>(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 3rd Quarter period. |
| 09/29/15 – 10/06/15<br>CR 10131957 | PC-0703/IC-0703<br>3 miles - SSE | Non-representative sample of airborne particulates. Inadequate sample volume collected (less than 250 $m^3$) | 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<br>CR 10162085 | WRB<br>(Andrews Dam)<br>~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<br>CR 10162781 | PI-0701/II-0701<br>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. |

| | | | | |
|---|---|---|---|---|
| 4th Quarter 2015<br>10/08/15 – EOY<br>CR 10167965 | OSLD Station<br>RC-0405A &B<br>5 miles - East | OSLD collection delayed | OSLD station is inaccessible due to closed roads in surrounding area. | 4th Quarter OSLD badge set will be changed-out when normal access is restored. |
| 1st through 3rd Quarter 2015<br>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 4th Quarter 2015. |
| 3rd Quarter 2015<br>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 4th Quarter 2015. |
| * An anomaly is considered a non-standard sample that still meets sampling criteria outlined in SNC and Georgia Power Labs procedures.<br>** 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 | | | | |

## 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/m3 for the indicator stations. It was 2.5 fCi/m3 less than the control station average of 15.9 fCi/m3 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/m3 which was 0.9 fCi/m3 more than the control station average. This difference is not statistically discernible since it is less than the calculated MDD of 3.0 fCi/m3.

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.

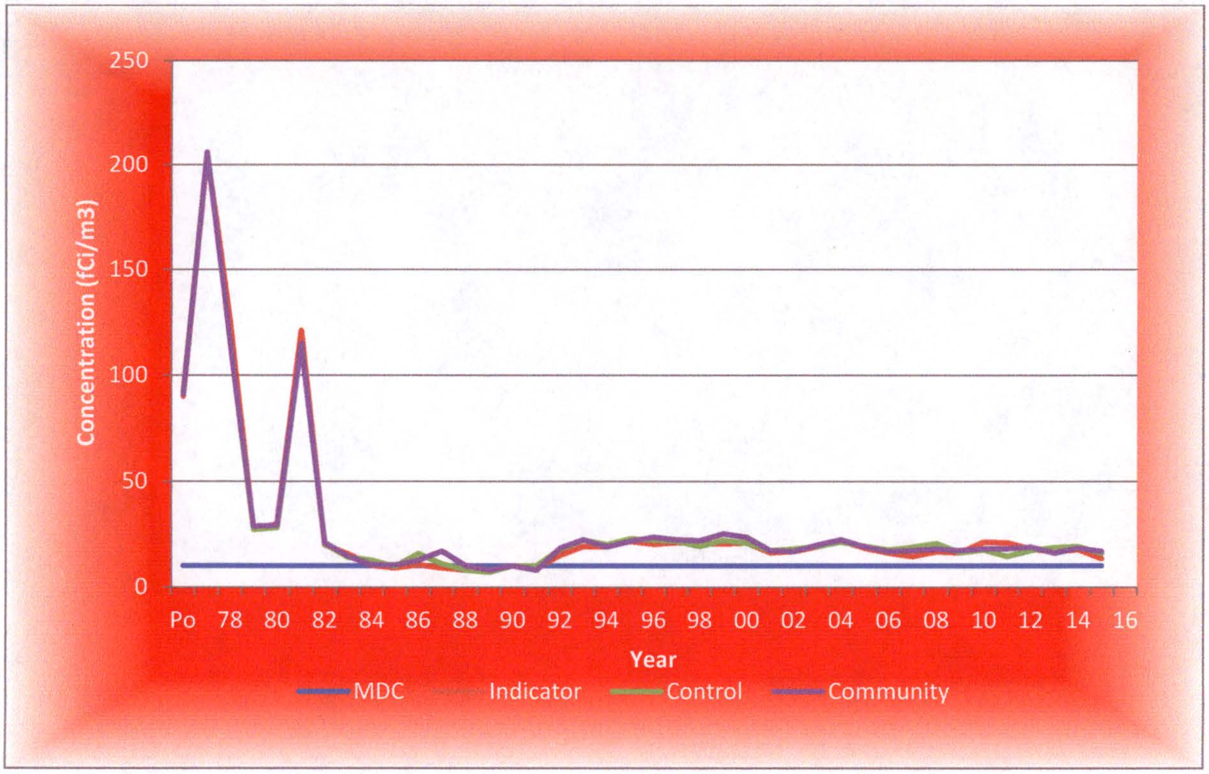
**Table 3-4. Average Weekly Gross Beta Air Concentration**

| Period | Indicator (fCi/m3) | Control (fCi/m3) | Community (fCi/m3) |
|---|---|---|---|
| Pre-op | 90 | 92 | 91 |
| 1977 | 205 | 206 | 206 |
| 1978 | 125 | 115 | 115 |
| 1979 | 27.3 | 27.3 | 28.7 |
| 1980 | 29.7 | 28.1 | 29.2 |
| 1981 | 121 | 115 | 115 |
| 1982 | 20.0 | 20.4 | 21.0 |
| 1983 | 15.5 | 14.1 | 14.5 |
| 1984 | 10.2 | 12.6 | 10.5 |
| 1985 | 9.0 | 9.6 | 10.3 |

**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.

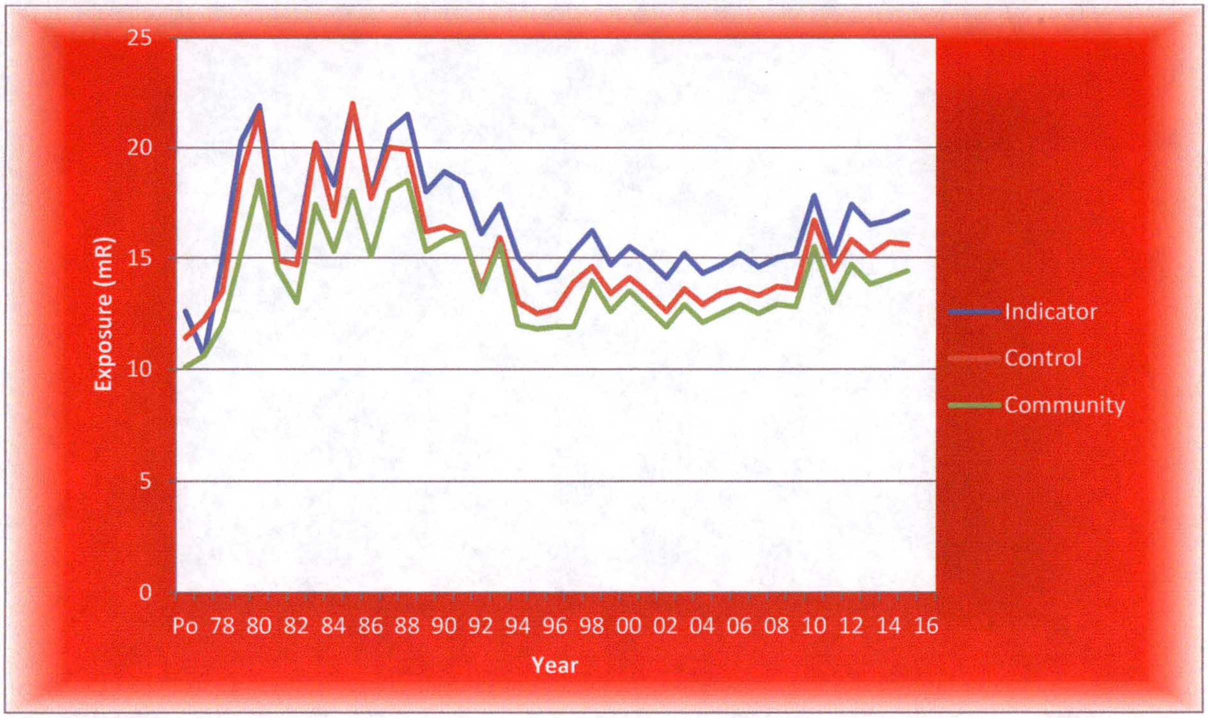
**Table 3-5. Average Quarterly Exposure from Direct Radiation**

| 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**

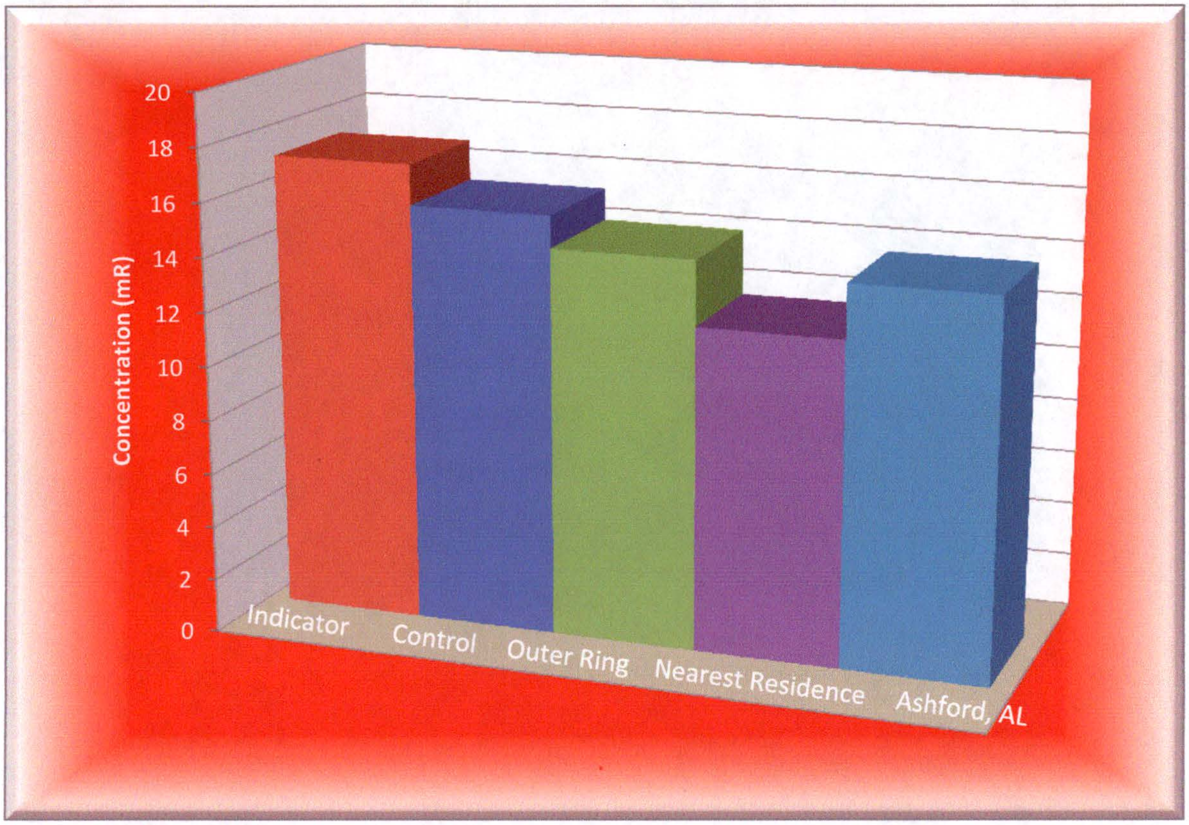
| Period | Indicator (mR) | Control (mR) | Outer Ring (mR) |
|---|---|---|---|
| 1985 | 21.9 | 22 | 18 |
| 1986 | 17.8 | 17.7 | 15.1 |
| 1987 | 20.8 | 20.0 | 18.0 |
| 1988 | 21.5 | 19.9 | 18.5 |
| 1989 | 18.0 | 16.2 | 15.3 |
| 1990 | 18.9 | 16.4 | 15.8 |
| 1991 | 18.4 | 16.1 | 16.1 |
| 1992 | 16.1 | 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).

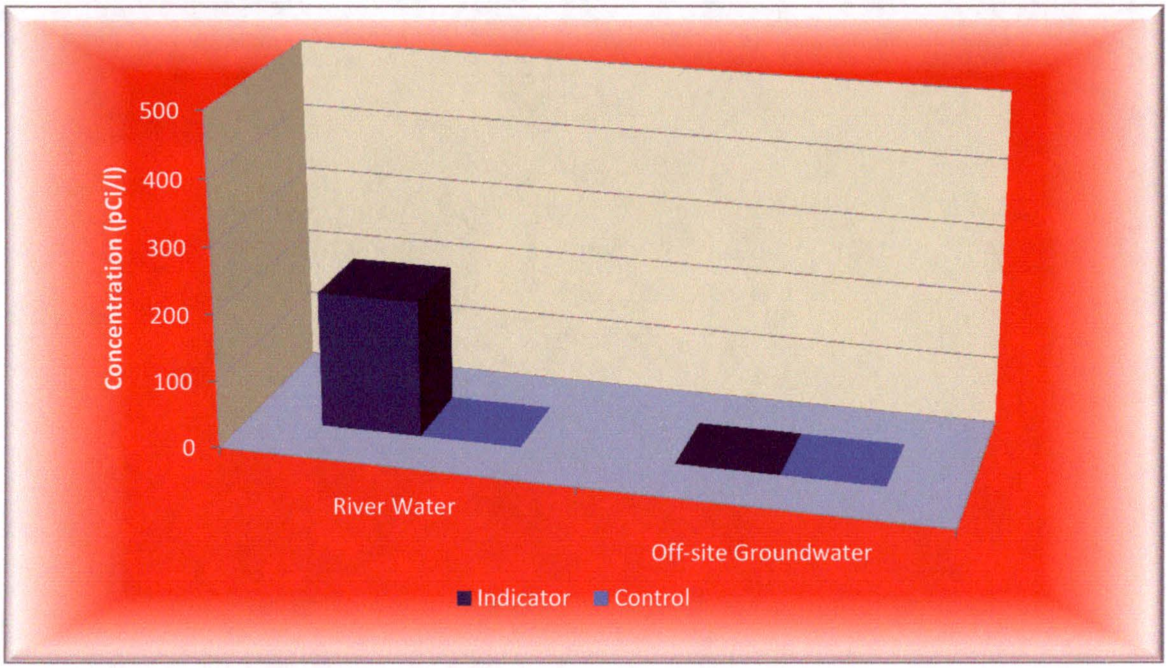
## 3.5 River Water

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 |
|---|---|---|---|---|---|---|---|
| I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge) | | | | | | | |
| I-131 | 9/10/2015 | 85.4 | 82.0 | 1.37 | 1.37 | 5.79 | 0.69 |
| GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter) | | | | | | | |
| 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 |
| GROSS BETA ANALYSIS OF AN AIR FILTER (PCI/FILTER) | | | | | | | |
| Gross Beta | 9/10/2015 | 103 | 96.3 | 3.66 | 1.61 | 5.9 | 1.44 |
| GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (PCI/LITER) | | | | | | | |
| 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