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United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261 / RENEWED LICENSE NO. DPR-23

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT - 2011

Ladies and Gentlemen:

In accordance with the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, Technical Specifications, Section 5.6.2, "Annual Radiological Environmental Operating Report," enclosed is the Radiological Environmental Operating Report for the period January 1, 2011, through December 31, 2011.

If you have any questions concerning this report, please contact me at (843) 857-1329.

Sincerely,

A handwritten signature in blue ink that reads 'W. Richard Hightower'.

W. Richard Hightower
Supervisor - Licensing/Regulatory Programs

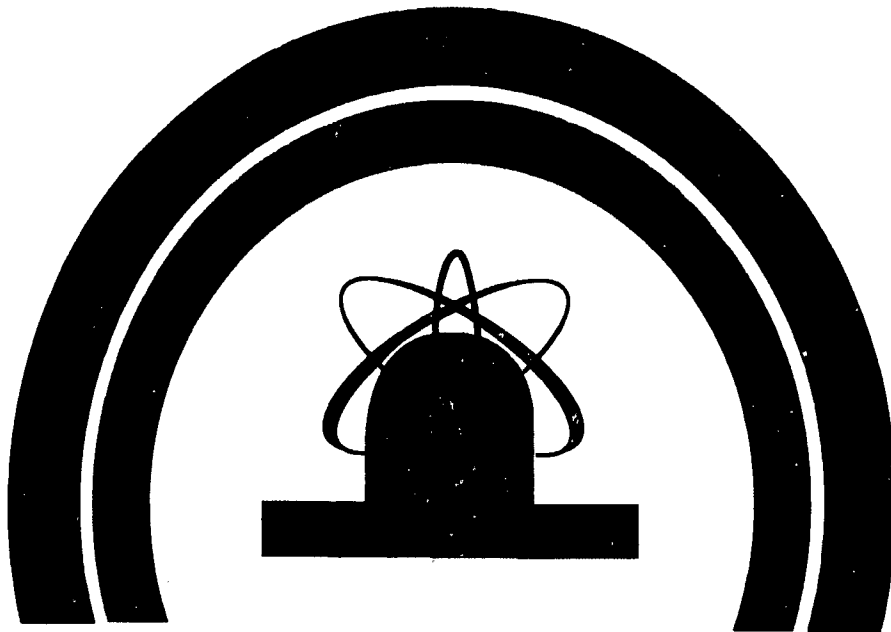
WRH/mjp

Enclosure

c: V. M. McCree, NRC, Region II
A. T. Billoch Colón, NRC, NRR (w/o Enclosure)
NRC Resident Inspector

**RADIOLOGICAL
ENVIRONMENTAL OPERATING
REPORT**

2011



**H. B. ROBINSON STEAM ELECTRIC PLANT,
UNIT NO. 2**

CAROLINA POWER & LIGHT COMPANY

ALSO KNOWN AS

PROGRESS ENERGY CAROLINAS, INC.

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

FOR THE

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

FACILITY OPERATING LICENSE NO. DPR-23

DOCKET NO. 50-261

JANUARY 1 THROUGH DECEMBER 31, 2011

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EXECUTIVE SUMMARY

The H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP) is operated by Carolina Power & Light Company; also known as Progress Energy Carolinas, Inc.; under a license granted by the Nuclear Regulatory Commission (NRC). The HBRSEP Technical Specifications and the HBRSEP Off-Site Dose Calculation Manual establish the requirements of the Radiological Environmental Monitoring Program. This report provides the results of the Radiological Environmental Monitoring program from January 1, 2011, through December 31, 2011.

The Radiological Environmental Monitoring program was established in 1973. Radiation and radioactivity in various environmental media have been monitored for more than 38 years. Monitoring is also provided for control locations that would not be impacted by operation of the HBRSEP. Using these control locations and data collected prior to operation allows comparison of data collected at locations near HBRSEP that could potentially be impacted by its operation. The pre-operational monitoring program began in December 1968.

Monitoring results for environmental media are summarized as follows:

- During 2011, REMP samples obtained from air monitoring (air cartridge and air particulate), and surface water locations identified the presence of low levels of radioactive iodine-131. The detectable concentrations were not a result of RNP operations given the following facts:
 - The REMP sample results detected the presence of Iodine-131 in the specific environmental media samples from March 14, 2011, to April 25, 2011.
 - The concentrations detected at the indicator samples were also identified at RNP control samples and throughout the region.

As such, the atypical detection of these radionuclides in both indicator and control samples is credibly attributed to the trans-Pacific transport of airborne releases from the Fukushima Dai-ichi nuclear power plant following the March 11, 2011, Tohoku earthquake and tsunami and is not related to the operation of RNP.

- Air-monitoring results are similar or less than the concentrations of radioactivity from pre-operation monitoring. These observations are also consistent with past operational data other than during the timeframe of fallout from the Fukushima Dai-ichi nuclear power plant.
- Milk monitoring has not been conducted due to the unavailability of milk samples in the area since July 17, 1998, when the dairy ceased operation. Milk sampling will resume if a new sample location is identified. Broadleaf sampling is conducted, since no milk animals are located within five miles of the plant in any sector.

- Terrestrial vegetation includes broadleaf vegetation and food products. Results indicate detectable concentrations of Cs-137 in both the indicator and control locations for broadleaf vegetation with comparable results. The Cesium-137 concentrations were also comparable to previous years. No other gamma by-product/plant-related activity was detected in any samples, except for K-40 and other naturally occurring gamma activity. Sampling of miscellaneous food products (non-leafy) in the vicinity of the site is conducted when leafy vegetables are not being grown. The concentrations identified were comparable to previous years' data.
- Aquatic organism surveillances include fish and aquatic vegetation. Fish samples revealed detectable concentrations of Cs-137 activity in both indicator and control locations. No other gamma by-product/plant-related activity was detected in any fish sample, except for K-40 and other naturally occurring gamma activity. The concentrations observed are consistent with previous years' data. The aquatic vegetation is used for long term trending and there is no dose contribution to the public. Cesium-137 activity was detected in two indicator and one control sample at concentrations consistent with previous years' data.
- Surface water results indicate no by-product/plant-related gamma activity, except for the I-131 activity identified in one indicator sample in 2011, which was during the Fukushima Dai-ichi nuclear power plant incident. Surface water (non-drinking water) results indicate that the surface water from Lake Robinson shows the presence of tritium, which is attributed to plant operation; but is well below the EPA reportable non-drinking water limit (30,000 pCi/Liter) and drinking water limit (20,000 pCi/Liter). The tritium concentrations observed are not irreversible to the environment due to plant operations (See Figure 13) and are consistent with previous years' data. Refer to the Interpretations and Conclusions Section / Surface Water.
- Ground water results show the presence of tritium; however, the results are well below the EPA reportable non-drinking water limit (30,000 pCi/Liter) and drinking water limit (20,000 pCi/Liter). Refer to the Interpretations and Conclusions Section / Ground Water.
- Sediment surveillance includes both shoreline and bottom sediment. The shoreline sediment gamma analyses identified naturally occurring gamma activity and no gamma by-product/plant-related activity was detected in any shoreline sediment sample collected in 2011. These samples are used to calculate groundplane dose to the public. During 2011, bottom sediment results indicated the presence of Cs-137 at concentrations consistent with previous years. Bottom sediment is used for long term trending and there is no public dose associated with these samples.
- External radiation dose showed no measurable change from pre-operational data

The continued operation of HBRSEP has not significantly contributed radiation or the presence of radioactivity in the environmental media monitored. The measured concentrations of radioactivity are well within applicable regulatory limits.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

PURPOSE AND REQUIREMENTS FOR THE RADIOLOGICAL MONITORING PROGRAM

The purpose of the radiological monitoring program is to measure accumulation of radioactivity in the environment, to determine whether this radioactivity is the result of operation of the HBRSEP, and to assess the potential dose to the off-site population based on the cumulative measurements of radioactivity of plant origin. Radiological environmental monitoring programs provide an additional verification of the containment and radiological controls of nuclear generating stations.

Requirements are established for the radiological monitoring program in the Technical Specifications and the Off-Site Dose Calculation Manual (ODCM).

Additional guidance regarding the radiological monitoring program may be found in the following:

- NRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, October 1977
- NRC Regulatory Guide 4.13, Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications, Revision 1, July 1977
- NRC Regulatory Guide 4.15 revision 1, Quality Assurance for Radiological Monitoring Programs (Normal Operation) - Effluent Streams and the Environment, Revision 1, February 1979
- NRC Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants, Revision 1, April 1975
- NRC Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants, For comment, December 1975
- Radiological Assessment Branch Technical Position, An Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979

General Site Description

The HBRSEP (Unit No. 2) consists of a pressurized water reactor with a design rating of 800 MWe (Megawatts electric). The site is shared with a pulverized coal unit (Unit No.1), which established commercial operation in 1960. Commercial production was initiated by Unit No. 2 on March 7, 1971. The HBRSEP is located in Darlington County, South Carolina. The site is along state route 151 approximately five (5) miles northwest of Hartsville, South Carolina and is displayed on the map of northeastern South Carolina (Figure 1). The site is also approximately twenty five (25) miles northwest of Florence, South Carolina.

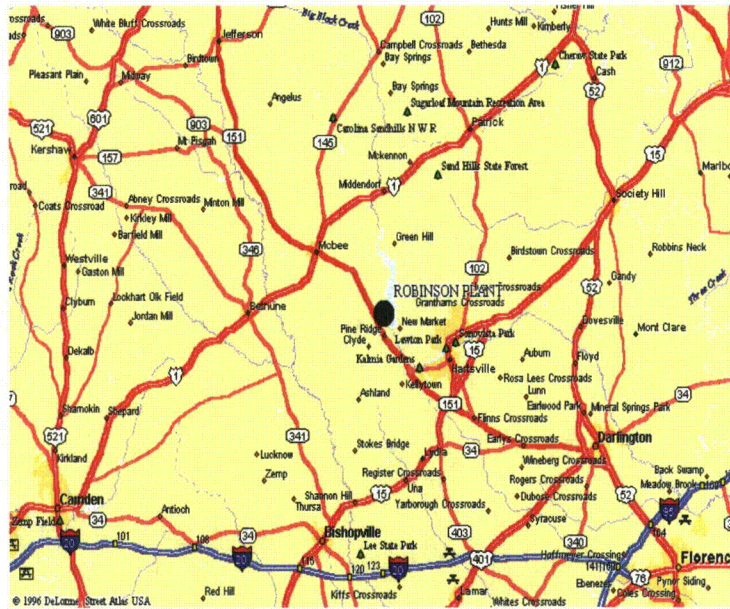


Figure 1: Location of HBRSEP

Lake Robinson is adjacent to the plant and is the source of cooling water. The lake was impounded during the construction of Robinson Unit No.1 (coal fired). The lake is fed by Black Creek and is approximately 2,250 acres in area. The plant intake is at the southern portion of the lake near the dam. The discharge is to a canal which conveys the cooling water to a point 4.2 miles north of the plant, where it returns to Lake Robinson.

The local economy supports primarily industrial and agricultural contributions. Fishing, boating, and swimming are popular activities on Lake Robinson and other nearby lakes. These activities contribute to the radiological pathways by consumption of fish and immersion related to swimming and boating. Consumption of milk and food products contributes to the ingestion pathway. No milk animals are located within five miles of the plant in any sector at this time, so broadleaf sampling is conducted to simulate the milk ingestion pathway.

RADIOLOGICAL MONITORING PROGRAM QUALITY ASSURANCE

A required component of the environmental radiological monitoring program is the Quality Assurance Program. The standards for the Quality Assurance Program are established in the NRC Regulatory Guide (R.G.) 4.15 revision 1, "Quality Assurance for Radiological Monitoring Programs. According to R.G. 4.15 revision 1, the purpose of the Quality Assurance Program is to "(1) to identify deficiencies in the sampling and measurement processes to those responsible for these operations so that corrective action can be taken, and (2) to obtain some measure of confidence in the results of the monitoring programs in order to assure the regulatory agencies and the public that the results are valid." NRC Regulatory Guide 4.15 B, Pg. 4.15-2 revision 1. This provides the opportunity to implement corrective actions that address possible deficiencies. Examples of the activities of the Quality Assurance Program include:

- regular review of sample collection and records
- regular review of laboratory procedures and methods
- participation in an Environmental Interlaboratory Comparison Program, which provides an independent assessment of the quality of laboratory results.
- the use of known concentrations of radioactivity in test samples by the laboratory to ensure consistent quality results on an ongoing basis.

RADIOLOGICAL MONITORING PROGRAM GENERAL DESCRIPTION

Although the contribution to background radiation is small, Carolina Power & Light Company; also known as Progress Energy Carolinas, Inc.; has established this program to measure the exposure pathways to man. An exposure pathway describes the source of the radiological exposure. The primary forms of potential radiological emissions from the plant are airborne and liquid discharge. The pathways monitored are external dose, ingestion of radioactive materials, and the inhalation of radioactive material. Specific methods and different environmental media are required to assess each pathway. Table 1 provides a list of the media used to assess each of these pathways.

Table 1

Media Used to Assess Exposure Pathways to Man

<u>Purpose of Samples</u>	<u>Sample Media</u>
External Dose	Shoreline Sediment Thermoluminescent Dosimetry (TLD)
Ingestion	Milk (Broadleaf Vegetation) Food Products Fish (Surface Water) Ground Water
Inhalation	Air Samples (Particulate & Radioiodine)
Trending	Aquatic Vegetation Bottom Sediment Surface Water (Tritium)

Sampling Locations

Sampling locations are chosen based upon meteorological factors, pre-operational monitoring, and results of the land use surveys. A number of locations are selected as controls. Control stations are selected because they are very unlikely to be affected by operation of the plant. Sample locations may be seen in Figures 2 and 3. A description of each sample location may be found in Table 2.

Radiological Sampling Locations

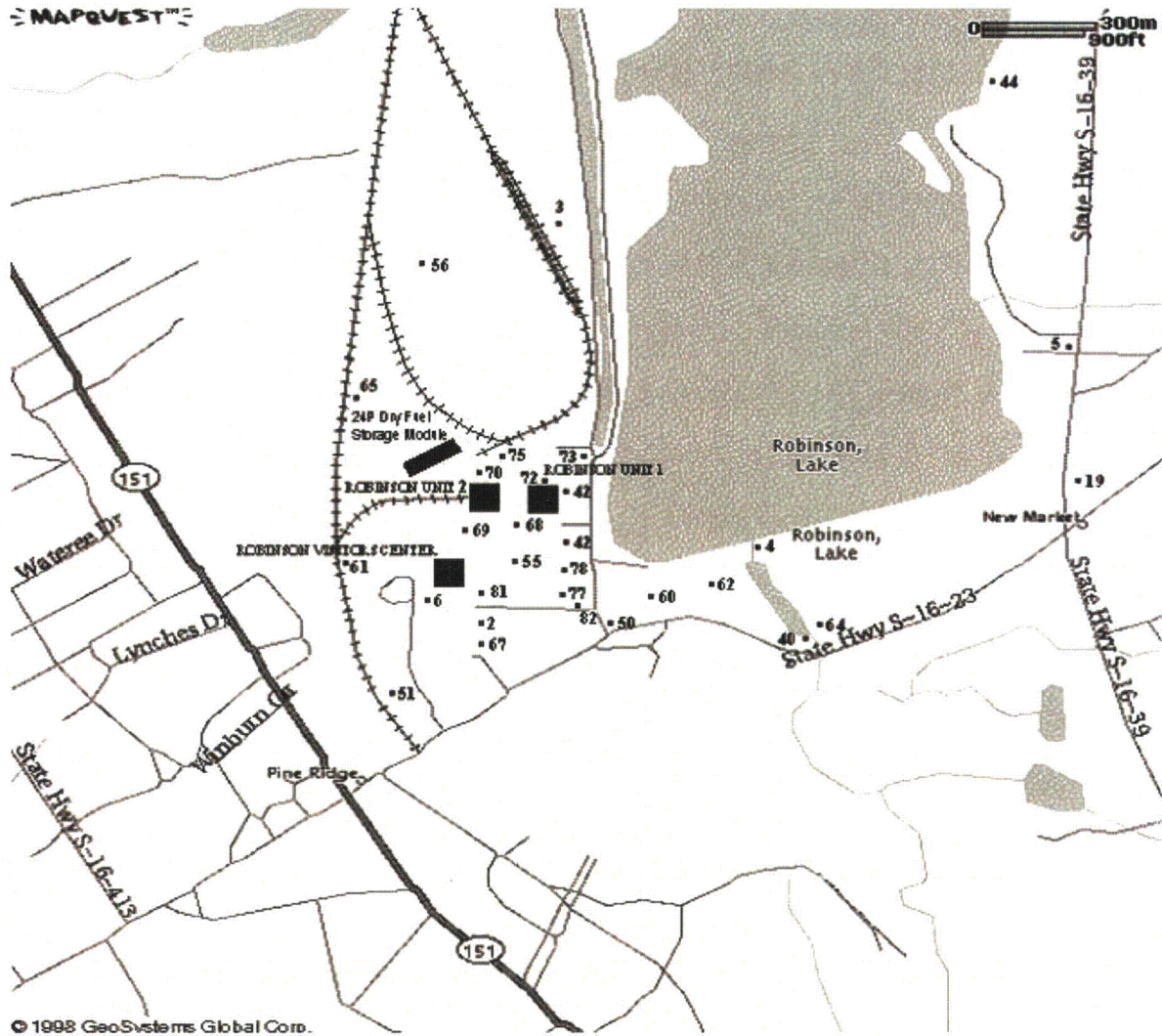


Figure 2: Radiological Sampling Locations (Near Plant)

Stations not shown include 1, 7-18, 20-39, 41, 45, 46, 47, 49, 52, 54, 57, 58, 66, 71, 76, and 79.

Sample Types

Air Cartridge & Particulate
 Shoreline Sediment
 Ground Water
 Broadleaf Vegetation
 Surface Water
 Thermoluminescent Dosimeter
 Fish
 Food Products
 Aquatic Vegetation & Bottom Sediment

Sample Locations

1-7, 55, 60, 61
 44, 57
 42, 64, 68 - 73, 75 - 79, 81 - 82
 50, 51, 52, 62, 67
 40, 41, 57, 66
 1-39, 55, 56, 61, 65
 45-47
 49, 54, 58
 41, 45, 46, 66

Radiological Sampling Locations

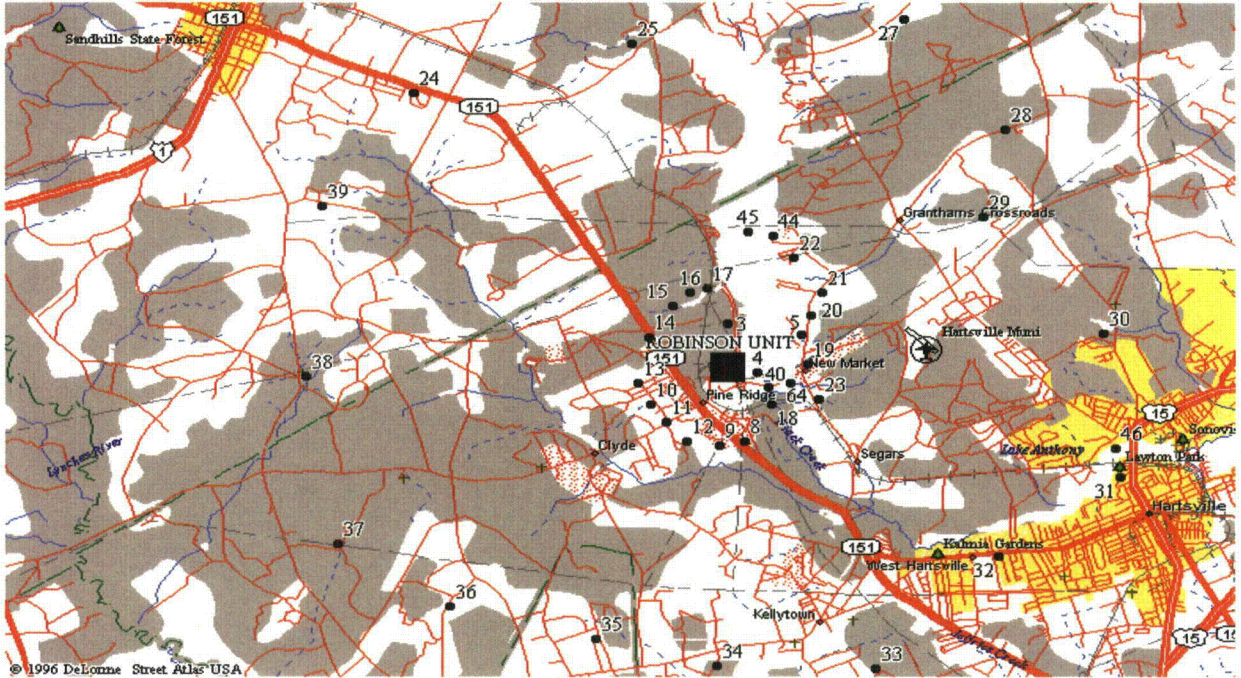


Figure 3: Radiological Sampling Locations (Distant from Plant)

Stations not shown include 1, 2, 6, 7, 26, 41, 42, 47 (varies), 49 (varies), 50 - 52, 54 - 58 (varies), 60 - 62, 65 - 73, 75 - 79, and 81 - 82.

Sample Types

Air Cartridge & Particulate
 Shoreline Sediment
 Ground Water
 Broadleaf Vegetation
 Surface Water
 Thermoluminescent Dosimeter
 Fish
 Food Products
 Aquatic Vegetation & Bottom Sediment

Sample Locations

1-7, 55, 60, 61
 44, 57
 42, 64, 68 - 73, 75 - 79, 81 - 82
 50, 51, 52, 62, 67
 40, 41, 57, 66
 1-39, 55, 56, 61, 65
 45-47
 49, 54, 58
 41, 45, 46, 66

Table 2
Radiological Monitoring Sampling Locations
for
H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP)

Sample Type	Location & Description	Frequency	Sample Size	Analysis
Air Cartridge (AC)	1--24.4 miles ESE Florence, S.C.* 2--0.2 miles S Information Center 3--0.5 miles N Microwave Tower 4--0.4 miles ESE Spillway 5--0.9 miles ENE East shore of lake near Johnson's Landing 6--0.2 miles SSW Information Center 7--6.4 miles ESE CP&L facility on RR Ave., Hartsville 55--0.2 miles SSE South of West Settling Pond 60--0.2 miles SE Robinson Picnic Area 61--0.3 miles WSW West Parking lot near RR tracks	Weekly	510 m ³	Iodine
Air Particulate (AP)	1--24.4 miles ESE Florence, S.C.* 2--0.2 miles S Information Center 3--0.5 miles N Microwave Tower 4--0.4 miles ESE Spillway 5--0.9 miles ENE East shore of lake near Johnson's Landing 6--0.2 miles SSW Information Center 7--6.4 miles ESE CP&L facility on RR Ave., Hartsville 55--0.2 miles SSE South of West Settling Pond 60--0.2 miles SE Robinson Picnic Area 61--0.3 miles WSW West Parking lot near RR tracks	Weekly	510 m ³	Gross Beta (Weekly) Composite Gamma (Quarterly)
Fish (FI) (Bottom Feeders & Free Swimmers)	45--Site varies within Lake Robinson 46--Site varies within Prestwood Lake 47--Control station, Any lake not influenced by plant discharge*	Semiannual	495 grams (wet)	Gamma (edible portions)
Broadleaf Vegetation (BL)	50--SSE Close to Site Boundary 51--SSW Close to Site Boundary 52--10 miles W near Bethune* 62--SE Close to Site Boundary 67--S Close to Site Boundary	Monthly (As available)	350 grams (wet)	Gamma Iodine
Shoreline Sediment (SS)	44--1.6 miles NNE East shore of lake, Shady Rest Club 57--Ash Pond Shore	Semiannual	575 grams	Gamma
Aquatic Veg. (AV) & Bottom Sediments (SD)	41--7.2 miles NNW Black Creek (upstream)* 45--Site varies within Lake Robinson 46--Site varies within Prestwood Lake 66--Black Creek between Prestwood Lake discharge & upstream of Sonoco Spray Farm (downstream)	Annual	420 grams and 575 grams	Gamma
Ground Water (GW)	42--Unit 1 Deep Wells 64--0.6 miles SE Artesian Well 69--Well B Behind the Training Building 70--Well C Btwn the O&M Building & Fab Shop 71--0.87miles NNW (MW-03A) Btwn Ash Pond & RR tracks 72--0.10 miles E (MW-06) 20 ft from FP/FH 7 fire hydrant & Unit 1 North Deep Well Pump 73--0.11 miles ENE (MW-13) Btwn Discharge Canal & Unit 1 Stand Alone Fuel Oil Tanks	Quarterly Grab	1.5 liters	Gamma Tritium

* Control Stations

Table 2 (Continued)

**Radiological Monitoring Sampling Locations
for
H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP)**

Sample Type	Location & Description	Frequency	Sample Size	Analysis
Ground Water (GW) Continued	75--0.05 miles NE (PSW-02) By Unit 1 boundary Fence to Unit 2 across paved rd. from Hydrogen Gas Tanks 76--0.49 miles N (PSW-03) NE corner of the MET Tower Station 77--0.25 miles SSE (TS-01B) By entrance rd. to Unit 1 78--0.17 miles SSE (TS-02C) NE corner by East Settling Pond influent by fence 79--1.0 miles N (TS-07C) S corner by cove & Discharge Canal 81--0.19 miles SSE (TS-17B) W of West Settling Pond across paved rd.	Quarterly Grab	1.5 liters	Gamma Tritium
Ground Water (GW) Continued	68--Well A Btwn Unit 1 Switchyard & breakroom	Quarterly Grab	6.5 liters	Gamma, Tritium, Iodine
Ground Water (GW) Continued	82--0.3 miles SSE (PDW-01) By entrance rd. to Unit 1	Quarterly Grab	6.5 liters	Gamma, Tritium, Iodine, Gross Beta
Surface Water (SW)	40--0.6 miles ESE Black Creek at Old Camden Road (S-16-23) 41--8.0 miles N Black Creek at US Hwy 1* 57--Ash Pond 66--Black Creek between Prestwood Lake discharge & upstream of Sonoco Spray Farm (downstream)	Monthly Composite	4 liters	Gamma Tritium
Food Products (FP)	58--Site varies from plant 49--10.0 miles W or greater than 5 miles from plant * 54--10.1 miles E Auburndale Plantation (if irrigating from Black Creek)	Annual at Harvest	350 grams	Gamma (edible portions)

* Control Stations

Table 2 (Continued)

**Radiological Monitoring Sampling Locations
for
H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP)**

Sample Type	Location & Description	Frequency	Sample Size	Analysis
Thermoluminescent Dosimetry (TLD)	1--24.4 miles ESE Florence, S.C. * 2--0.2 mile S Information Center ^{1,2} 3--0.5 mile N Microwave Tower 4--0.4 mile ESE Spillway 5--0.9 mile ENE East shore of lake near Johnson's Landing 6--0.2 mile SSW Information Center ^{1,2} 7--6.4 miles ESE CP&L Facility on RR Ave., Hartsville 8--0.8 mile SSE Transmission right-of-way 9--1.0 mile S Transmission right-of-way 10--1.0 mile WSW Clyde Church of God 11--1.0 mile SW Old Camden Road 12--1.2 miles SSW off of Old Camden Road 13--0.7 miles W Corner of Saluda and Sandpit Roads 14--0.8 mile WNW First Baptist Church of Pine Ridge 15--0.7 miles NW Transmission right-of-way 16--1.0 mile NNW South side of Darlington Co. I.C. Turbine Plant 17--1.2 miles N Darlington Co. Plant emergency fire pump 18--0.7 mile SE Near Old Black Creek RR trestle 19--1.0 mile E Old Camden Road (#S-16-23) 20--1.0 mile ENE New Market Road (#S-16-39) 21--1.4 miles NE New Market Road (#S-16-39) 22--1.7 miles NNE Shady Rest entrance off of Cloverdale Drive 23--1.0 miles ESE New Market Road (#S-16-39) 24--4.6 miles NW Sowell Road (#S-13-711) 25--4.0 miles NNW Lake Robinson Road (#S-13-346) 26--5.0 miles N Lake Robinson Road (#S-13-346) 27--5.4 miles NNE Prospect Church Road (#S-13-763) 28--4.3 miles NE New Market Road (#S-13-39) 29--4.0 miles ENE Ruby Road (#S-16-20) 30--4.4 miles E Ruby Road (#S-16-20) 31--4.6 miles ESE on Lakeshore Drive 32--4.0 miles SE Transmission right-of-way 33--4.5 miles SSE on Bay Road (#S-16-493) 34--4.7 miles S on Kellybell Road (#S-16-772) 35--4.5 miles SSW Kelly Bridge Road (#S-31-51) 36--5.0 miles SW on Kingston Drive 37--5.0 miles WSW Pine Cone Road 38--4.9 miles W at Union Church Road 39--5.1 miles WNW King's Pond Road 55--0.2 miles SSE South of the West Settling Pond 56--0.4 miles NNW North of the center of the 7P-ISFSI ^{1,2} 61--0.3 miles WSW West parking lot near RR tracks ² 65--0.3 miles WNW Northwest of the 24P-ISFSI ²	Quarterly	Not Applicable	TLD Reading Gamma Dose

*Control Station

1 Required for monitoring of the 7P-ISFSI

2 Required for monitoring of the 24P-ISFSI

SUMMARY OF RADIOLOGICAL MONITORING PROGRAM

The Radiological Environmental Monitoring Program (REMP) was conducted in accordance with the HBRSEP Off-Site Dose Calculation Manual (ODCM) and approved procedures.

The purpose of the REMP is to measure accumulation of radioactivity in the environment, to determine whether this radioactivity is the result of the operation of the HBRSEP, Unit No. 2, and to assess the potential dose to the off-site population based on the cumulative measurements of radioactivity of plant origin. Approximately 1,487 samples were collected from indicator and control locations and 1,607 analyses and measurements were made during 2011. Detectable radioactivity resulting from plant operation was found in 31 out of 36 indicator samples of surface water (Table 3). Only the tritium activity measured in the surface water of Lake Robinson and in fish samples constituted a source of public exposure. The highest concentration of any plant related radionuclide releases to the environment was tritium in Lake Robinson at an average concentration of $2.29E+3$ pCi/Liter. Using the methodology of Regulatory Guide 1.109 "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, dated October 1977," via fish consumption, is listed below. The maximum possible exposure to an individual from the evaporation of tritium in Lake Robinson is 0.163 mrem/yr. to a child.

<u>Age Group</u>	<u>2011 Dose (mrem)</u>
Adult	0.005
Teenager	0.004
Child	0.003

1. A statistical summary of all the data gathered in 2011 has been compiled in Table 3.
2. Radioactivity in environmental samples attributed to plant operations in 2011, for which there is a potential dose pathway to the public, is summarized in Table 4.
3. All detectable radionuclides in the environmental samples for 2011 were less than reporting levels as defined in HBRSEP ODCM. Table 5 summarizes the reporting levels.
4. Environmental sampling and analyses performed during 2011 demonstrated that the HBRSEP, Unit No. 2 continues to operate with minimum impact on the environment and minimal dose to the general public.

5. The following locations are used as control locations and are intended to indicate conditions away from the HBRSEP influence:

Thermoluminescent Dosimeters, Airborne and Particulate Samples	24.4 miles ESE, Florence, S.C. (Location 1)
Surface Water	8.0 miles N, Black Creek at US Highway 1 (Location 41)
Bottom Sediment and Aquatic Vegetation	7.2 miles NNW, Black Creek (upstream,) (Location 41)
Fish	Any lake not influenced by plant discharge (Location 47)
Broadleaf Vegetation	10 Miles W, near Bethune (Location 52)
Food Products	10.0 miles W or greater than 5 Miles from plant (Location 49 - Bethune - site varies)

TABLE 3
H. B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY

H. B. Robinson Steam Electric Plant, Unit No. 2
 Darlington County, South Carolina

Docket Number - 50-261
 Calendar Year 2011

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Lower Limit of Detection (LLD) ⁽¹⁾	All Indicator Locations Mean Range ⁽²⁾	Location w/Highest Annual Mean		Control Locations Mean Range ⁽²⁾	Number of Nonroutine Reported Measurements
				Name, Distance, and Direction	Mean Range ⁽²⁾		
Air Cartridge (pCi/m ³)	I-131 520 ⁽³⁾	5.1E-2	7.07E-2 (37/468) 1.85E-2 - 1.36E-1	East shore of Lake near Johnson's Landing 0.9 miles ENE	8.23E-2 (4/52) 3.37E-2 - 1.36E-1	8.10E-2 (4/52) 2.21E-2 - 1.22E-1	0
Air Particulate (pCi/m ³)	Gross Beta 520 ⁽³⁾	2.6E-3	2.44E-2 (468/468) 9.46E-3 - 3.88E-2	Microwave Tower 0.5 miles N	2.68E-2 (52/52) 1.42E-2 - 3.88E-2	2.51E-2 (52/52) 9.10E-3 - 3.70E-2	0
	Gamma 81 I-131 ⁽⁸⁾	3.1E-2	1.61E-2 (16/73) 9.67E-3 - 2.44E-2	Microwave Tower 0.5 miles N	1.91E-2 (1/8) Single value	1.67E-2 (3/8) 1.27E-2 - 2.05E-2	0
	Cs-137 ⁽⁹⁾	2.2E-3	1.68E-3 (1/73) Single value	Information Center 0.2 miles S	1.68E-3 (1/8) Single value	All less than LLD	0
Aquatic Vegetation ⁽⁵⁾ (pCi/g, wet)	Gamma 4 Cs-137	2.0E-2	2.57E-2 (2/3) 1.21E-2 - 3.92E-2	Site varies within Lake Robinson	3.92E-2 (1/1) Single value	2.46E-2 (1/1) Single value	0
Broadleaf Vegetation (pCi/g, wet)	Gamma 60 ⁽³⁾⁽⁴⁾ Cs-137	3.2E-2	5.05E-2 (17/48) 1.20E-2 - 9.40E-2	Close to Site Boundary (BL-62) SE	5.84E-2 (4/12) 5.55E-2 - 6.18E-2	3.41E-2 (9/12) 2.12E-2 - 7.90E-2	0
Fish Free-Swimmer (pCi/g, wet)	Gamma 6 K-40	5.9E-1	4.33E+0 (4/4) 3.67E+0 - 5.05E+0	Site varies within Lake Robinson	4.94E+0 (2/2) 4.84E+0 - 5.05E+0	4.42E+0 (2/2) 4.30E+0 - 4.53E+0	0
	Cs-137	7.4E-2	5.51E-2 (4/4) 3.87E-2 - 7.18E-2	Site varies within Lake Robinson	5.52E-2 (2/2) 3.87E-2 - 7.18E-2	7.48E-2 (2/2) 7.20E-2 - 7.76E-2	0

**TABLE 3 (Cont.)
HBRSEP
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY**

H. B. Robinson Steam Electric Plant, Unit No. 2
Darlington County, South Carolina

Docket Number - 50-261
Calendar Year 2011

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Lower Limit of Detection (LLD) ⁽¹⁾	All Indicator Locations Mean Range ⁽²⁾	Location w/Highest Annual Mean		Control Locations Mean Range ⁽¹⁾	Number of Nonroutine Reported Measurements
				Name, Distance, and Direction	Mean Range ⁽²⁾		
Fish Bottom-Feeder (pCi/g, wet)	Gamma 6 K-40	5.9E-1	3.72E+0 (4/4) 3.24E+0 – 4.61E+0	Site varies within Prestwood Lake	3.92E+0 (2/2) 3.24E+0 – 4.61E+0	3.80E+0 (2/2) 3.42E+0 – 4.17E+0	0
	Cs-137	7.4E-2	4.57E-2 (4/4) 2.70E-2 – 6.07E-2	Site varies within Prestwood Lake	5.51E-2 (2/2) 4.96E-2 – 6.07E-2	5.73E-2 (2/2) 5.68E-2 – 5.79E-2	0
Food Products (pCi/g, wet)	Gamma 6 ⁽³⁾ K-40	3.2E-1	2.71E+0 (3/3) 1.63E+0 – 3.86E+0	Site varies from Plant (FP-58)	2.71E+0 (3/3) 1.63E+0 – 3.86E+0	3.96E+0 (3/3) 2.59E+0 – 6.28E+0	0
	Cs-137	3.2E-2	All less than LLD	-----	-----	All less than LLD	0
Ground Water (pCi/l)	Gamma 60 ⁽³⁾	Sec Table 6	All less than LLD	-----	-----	No control	0
	Gross Beta 4	9.0E-1 ⁽⁷⁾	1.28E+0 (4/4) 8.01E-1 – 2.38E+0	GW-82 (PDW-01) by Entrance Rd. to U/I 0.3 miles SSE	1.28E+0 (4/4) 8.01E-1 – 2.38E+0	No control	0
	I-131 8	Sec Table 6	All less than LLD	-----	-----	No control	0
	Tritium 60 ⁽³⁾	2.2E+2 ⁽⁷⁾	6.19E+2 (42/60) 2.41E+2 – 2.35E+3	GW-79 (TS-07C) S corner by cove & Discharge Canal 1.0 mile N	2.11E+3 (4/4) 1.80E+3 – 2.35E+3	No control	0

**TABLE 3 (Cont.)
HBRSEP
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY**

H. B. Robinson Steam Electric Plant, Unit No. 2
Darlington County, South Carolina

Docket Number - 50-261
Calendar Year 2011

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Lower Limit of Detection (LLD) ⁽¹⁾	All Indicator Locations Mean Range ⁽²⁾	Location w/ Highest Annual Mean		Control Locations Mean Range ⁽²⁾	Number of Nonroutine Reported Measurements
				Name, Distance, and Direction	Mean Range ⁽³⁾		
Shoreline Sediment (pCi/g, dry)	Gamma 4	See Table 6	All less than LLD	-----	-----	No Control	0
Bottom Sediment ⁽⁴⁾ (pCi/g, dry)	Gamma 4 Co-60	1.1E-1	1.46E-1 (1/3) Single value	Site varies within Lake Robinson	1.46E-1 (1/1) Single value	All less than LLD	0
	Cs-137	9.5E-2	4.01E-1 (2/3) 3.93E-1 - 4.09E-1	Site varies within Prestwood Lake	4.09E-1 (1/1) Single value	1.41E-1 (1/1) Single value	0

**TABLE 3 (Cont.)
HBRSEP
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY**

H. B. Robinson Steam Electric Plant, Unit No. 2
Darlington County, South Carolina

Docket Number - 50-261
Calendar Year 2011

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Lower Limit of Detection (LLD) ⁽¹⁾	All Indicator Locations' Mean Range ⁽²⁾	Location w/Highest Annual Mean		Control Locations' Mean Range ⁽³⁾	Number of Nonroutine Reported Measurements
				Name, Distance, and Direction	Mean Range ⁽⁴⁾		
Surface Water (pCi/l)	Gamma 48 1-131 ⁽⁶⁾	1.4E+1	1.78E+1 (1/36) Single value	Ash Pond	1.78E+1 (1/12) Single value	All less than LLD	0
	Tritium 48	2.2E+2 ⁽⁷⁾	1.66E+3 (31/36) 3.11E+2 - 6.77E+3	Black Creek at Old Camden Rd. 0.6 miles ESE	2.29E+3 (12/12) 6.14E+2 - 6.77E+3	All less than LLD	0
TLD (mR/qr) ⁽⁶⁾	TLD 168 ⁽³⁾	N/A	1.40E+1 (164/164) 9.00E+0 - 2.06E+1	Pine Cone Rd. 5.0 miles WSW	1.94E+1 (4/4) 1.87E+1 - 2.06E+1	1.27E+1 (4/4) 1.20E+1 - 1.32E+1	0

FOOTNOTES TO TABLE 3

1. Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will yield a net count above system background that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal. Due to counting statistics and varying volumes, occasionally lower LLDs are achieved. Refer to Analytical Procedures Section/Gamma Spectrometry for an explanation of how LLD values were derived.
2. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parentheses.
3. Missing samples are discussed in Missed Surveillances.
4. Three types of broadleaf vegetation samples are collected monthly when available from four locations for a possible total of 144 samples.
5. Bottom sediment and aquatic vegetation sampling are not required by plant Offsite Dose Calculation Manual (ODCM). Sampling and analysis is performed to monitor any radionuclide accumulation in the lake.
6. TLD exposure is reported in milliroentgen (mR) per 90-day period (quarter) beginning in 1995. This is the exposure standard (mR/std. qtr.) used to compare data to the Nuclear Regulatory commission (NRC).
7. The tritium LLD was lowered to approximately $2.20E+2$ pCi/L for samples that typically demonstrate activity less than the LLD (groundwater and surface water control). The LLD was lowered to be consistent with the LLD used by the state laboratory. Other samples that typically exhibit activity greater than the LLD have a tritium Lower Limit of Detection (LLD) of $1.0E+3$ pCi/L.
8. During 2011, REMP samples obtained from air monitoring (air cartridge and air particulate), and surface water locations identified the presence of low levels of radioactive iodine-131. The detectable concentrations were not a result of RNP operations given the following facts:

- The REMP sample results detected the presence of Iodine-131 in the specific environmental media samples from March 14, 2011, to April 25, 2011.
- The concentrations detected at the indicator samples were also identified at RNP control samples and throughout the region.

As such, the atypical detection of these radionuclides in both indicator and control samples is credibly attributed to the trans-Pacific transport of airborne releases from the Fukushima Dai-ichi nuclear power plant following the March 11, 2011, Tohoku earthquake and tsunami and is not related to the operation of RNP.

TABLE 4

Potential Dose Pathways

Sample Media	Radionuclide	Highest Annual Mean (Average) Concentration and Occurrence	Maximum Individual Dose
Surface Water	H-3	2.29E+3 (pCi/L) (12/12)	0.005 millirem/yr - child (from fish)
Surface Water	H-3	2.29E+3 (pCi/L) (12/12)	0.163 millirem/yr - child (Evaporation from Lake Robinson using RNP 2011 Meteorology Data)

TABLE 5

Reporting Levels for Radioactivity Concentrations
in Environmental Samples

Radionuclide	Water (pCi/l)	Airborne (pCi/m³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	2E+04 ^a	----	----	----	----
Mn-54	1E+03	----	3E+04	----	----
Fe-59	4E+02	----	1E+04	----	----
Co-58	1E+03	----	3E+04	----	----
Co-60	3E+02	----	1E+04	----	----
Zn-65	3E+02	----	2E+04	----	----
Zr-Nb-95	4E+02	----	----	----	----
I-131	2E+00 ^b	9E-01	----	3E+00	1E+02
Cs-134	3E+01	1E+01	1E+03	6E+01	1E+03
Cs-137	5E+01	2E+01	2E+03	7E+01	2E+03
Ba-La-140	2E+02	----	----	3E+02	----

^aFor drinking water samples. This is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

^bIf no drinking water pathway exists, a value of 20 pCi/L may be used.

INTERPRETATIONS AND CONCLUSIONS

Air Sampling

The majority (>92%) of the 520 air cartridge (AC) samples from indicator and control stations had I-131 concentrations less than the typical/worst case LLD of $5.1\text{E-}2$ pCi/m³. The air samplers operated for a total of 99.95% availability for the 2011 year. I-131 was detected in air samples for a four week period following the Fukushima Dai-ichi nuclear power plant incident after the March 11, 2011, earthquake and tsunami (CR # 455413 and 456837).

For the period of January 1, 2011, to December 31, 2011, the gross beta activity was detectable in all airborne particulate (AP) samples, with acceptable runtime, from the nine indicator locations. The 468 indicator samples had an average concentration of $2.44\text{E-}2$ pCi/m³. Similar gross beta activities were observed at the control location in Florence, which had an average concentration of $2.51\text{E-}2$ pCi/m³ in 52 control samples. Figures 4 through 12 provide a graphic representation of the gross beta activity at the indicator locations compared to the control location for the year 2011. AP weekly samples that exhibit an elevated gross beta activity above the set administrative limits typically have a gamma isotopic analysis done and the results indicate all natural gamma activity. No plant-related gamma activity was observed for any air particulates during 2011, except for the I-131 activity that was detected in 16 individual AP weekly indicator samples and three individual AP weekly control samples (CR # 455413 and 456837). The natural gamma concentrations are typical of the natural environment and are not attributed to plant operations and the I-131 activity was not attributed to the plant operations, but to the Fukushima Dai-ichi nuclear power plant incident of March 11, 2011. Refer to the Missed Surveillance Section on the AC and AP Missed Surveillances in the 2011 collection year (CR # 465832, 465851, 469880, and 486916).

No plant-related gamma activity was detected in the quarterly composite filter samples from either the indicator or control locations; however, Cs-137 was detected in one set of quarterly composite samples (2nd Qtr. 2011 AP-2 [CR # 479195]). Typical/worst case LLDs for air particulates are contained in Table 6.

Broadleaf Vegetation

Broadleaf vegetation sampling is accomplished by collecting cherry, sassafras, and wax myrtle leaves in 2011. Three species of samples, when available, are collected monthly at five locations (one control and four indicator locations at the site boundary selected using historical meteorology with the highest calculated annual average ground level deposition). Broadleaf sampling is conducted since no milk animals are located within a radius of approximately five miles of the plant and is used to simulate dose to an individual via the milk pathway for compliance purposes.

During 2011, 17 of 48 samples taken from the indicator sites demonstrated detectable concentrations of Cs-137 for an average value of $5.05E-2$ pCi/g (wet). The control samples had detectable concentrations of Cs-137 in 9 of 12 samples with a mean concentration of $3.41E-2$ pCi/g (wet). Upon comparing these results, it is concluded that the indicator values reflect fallout Cs-137 contamination. Past sampling experience further supports this interpretation. Refer to the Missed Surveillance Section for missed (unavailable) surveillances (CR # 443720, 449839, 455768, 489662, 490435, 497027, 501430, and 506243).

Fish

Samples of free-swimming and bottom-feeding fish were taken from Lake Robinson and Prestwood Lake (the first downstream lake) and compared to similar fish from a control lake, which is unaffected by plant operation. During 2011, 4 out of 4 bottom-feeding fish and 4 out of 4 free-swimming fish (indicator sites) demonstrated detectable concentrations of Cs-137 for an average value of $4.57E-2$ pCi/g (wet) and $5.51E-2$ pCi/g (wet), respectively. The control samples had detectable concentrations of Cs-137 for 2 out of 2 bottom-feeding fish and 2 out of 2 free-swimming fish for an average concentration of $5.73E-2$ pCi/g (wet) and $7.48E-2$ pCi/g (wet), respectively. Upon comparing these results, it is concluded that the indicator values reflect fallout Cs-137 contamination. Past sampling experience further supports this interpretation.

Ground Water

No by-product/plant-related gamma activity associated with plant operations was detected in the sixty (60) samples of ground water collected in 2011. The ground water samples had detectable concentrations of tritium activity in forty-two (42) out of sixty (60) samples, for an average concentration of $6.19\text{E}+2$ pCi/L; with a range of $2.41\text{E}+2$ pCi/L to $2.35\text{E}+3$ pCi/L. During 2011, eight (8) ground water samples were analyzed for I-131 to the Drinking water levels (<1 pCi/L). No detectable concentrations of I-131 activity were detected in the eight samples.

Milk

Milk monitoring has not been conducted due to the unavailability of milk samples in the area since July 17, 1998, when the dairy ceased operation. Milk sampling will resume if a new sample location is identified. Broadleaf sampling is conducted since no milk animals are located within a radius of approximately five miles of the plant in any sector and is used to calculate dose to an individual via the vegetation-milk-man pathway. Refer to Broadleaf Vegetation Section for additional information.

Food Products

During 2011, food product (FP) samples (collards, cucumbers, and squash) were obtained from the control location (FP-49) and from the indicator location (FP-58). No gamma activity associated with plant operation was detected in any control or indicator samples.

Shoreline Sediment

In 2011, no gamma activity associated with plant operation was detected in any sample in the semiannual shoreline sediment samples. Only naturally occurring gamma activity was detected. No Cs-137 activity was detected in 2011; however, Cs-137 activity seen in past years was attributed to worldwide fallout and not the plant operation.

Bottom Sediment

The bottom sediment samples are used as indicators of buildup of radioactivity in the environment and do not constitute a dose pathway. Cs-137 activity was detectable in two of the three indicator bottom sediment samples in 2011, with an average concentration of 4.01E-1 pCi/g (dry). The control sample indicated detectable Cs-137 activity with a concentration of 1.41E-1 pCi/g (dry). Cobalt-60 (Co-60) activity was detectable in one of the three indicator samples with an average concentration of 1.46E-1 pCi/g (dry). The Co-60 in the bottom sediment is attributed to plant operation. This concentration is similar to previous years and does not indicate a buildup in the environment. No other gamma activity, except for naturally occurring gamma activity, was detected in the annual bottom sediment samples in 2011.

Aquatic Vegetation

The aquatic vegetation samples are considered to be sensitive environmental indicators used as long term trending and do not constitute a dose pathway. In 2011, there were three aquatic vegetation indicator samples collected and one aquatic vegetation control sample collected. The aquatic vegetation samples collected pose no dose consequence since this is not a dose pathway to the public. Cesium (Cs)-137 activity was also detected in two out of three indicator samples and the control sample with an average indicator value of 2.57E-2 pCi/g (wet) and the control value of 2.46E-2 pCi/g (wet). The Cs-137 in both the control and indicator samples appears to be fallout Cs-137 contamination. This concentration is similar to previous years and does not indicate unexpected levels in the environment.

Surface Water

Surface waters of Lake Robinson indicated the presence of tritium which is attributed to plant operation. This tritium activity is cyclic and follows the Robinson Plant fuel cycle. Figure 13 displays the tritium activity throughout 2011. These surface waters do not supply drinking water at any downstream location and are not used for irrigation. Therefore, radiological dose via this pathway is limited to the consumption of fish (0.005 mrem/yr.) and evaporation of tritium (0.163 mrem/yr. using RNP 2011 Meteorology Data) from Lake Robinson and its subsequent inhalation and ingestion from vegetable gardens and meat producing animals. Using the methodology of Regulatory Guide 1.109, a dose of 0.168 millirem/year to the maximum exposed individual could be assigned to this pathway.

The monthly composite gamma analyses for surface water samples revealed no radionuclides typical of plant effluents. The RNP environmental monthly Ash Pond Surface Water (SW-57) composite sample from March 7, 2011, to April 5, 2011, (midpoint date March 21, 2011) indicated iodine-131 (I-131) activity ($1.78E+1$ pCi/Liter). Other than the detected I-131 activity, the gamma analysis of the composite surface water only detected natural occurring nuclides. None of the other RNP composite surface water samples during this timeframe identified any detectable I-131 activity, only natural occurring nuclides. Iodine-131 was not identified in any monthly composite sample from this location prior to or after this stated collection period. The identification of the I-131 activity is indicative of the Fukushima Dai-ichi nuclear power plant incident due to the March 11, 2011, earthquake and tsunami that hit Japan (CR # 459285).

External Radiation

Direct radiation exposure in the HBRSEP environs was measured by the placement of thermoluminescent dosimeters (TLDs) around the plant forming an inner ring at approximately 1 mile and an outer ring at approximately 5 miles. The average of inner versus outer ring dose measurements is shown on Figure 14.

Asiatic Clams

Benthic samples from Lake Robinson during 2011 continue to confirm the absence of any substantial populations of Asiatic clams (*Corbicula fluminea*). The natural chemistry of the lake (i.e., low alkalinity and hardness) inhibits their proliferation.

MISSED SURVEILLANCES

Air Cartridge and Air Particulates

Any REMP weekly air samples (Air Cartridge – AC or Air Particulate – AP (APAC)) that exceed 30 hours of down time in a surveillance period will be reported as a “missed surveillance”. However, this sample will still be counted and the data reported; whereas a “missed sample” indicates that no sample was available and no data was reported.

All AP and AC samples were available for counting in 2011.

Missed Samples:

- None for 2011

Missed Surveillances:

- APAC-07, May 16 – Total down time was 41.0 hours. The air sampler was found not running as a result of a lighting hit (CR # 465832 and 465851).

Other down time in June of 2011 was identified that did not meet the definition of “missed surveillances” and the information pertaining to this event can be found in the corrective action program (CR # 469880). Damaged Petri dishes for two AP weekly samples (AP-1 and AP-7) collected August 29, 2011, through September 5, 2011, were documented. These samples were determined to be valid samples (CR # 486916).

Broadleaf Vegetation

Broadleaf vegetation (BL) samples were not available during the months of January, February, March, April, September, October, November, and December of 2011 due to the seasonal nature of broadleaf vegetation (CR # 443720, 449839, 455768, 489662, 490435, 497027, 501430, and 506243).

The BL samples received in August of 2011 were opened and scattered within the sample shipment box. The plant personnel were contacted and the integrity of the August BL samples was discussed. It was decided that August BL samples would be resampled (CR # 485033).

Thermoluminescent Dosimeters (TLDs)

Four out of the possible 172 TLD samples were missing during 2011.

First Quarter – TLD # 26 was missing in the field (CR # 459892).

First Quarter – TLD # 31 was not changed out in early January 2011 when the TLD change out occurred. There was not a valid TLD in the field; therefore, the period during January 2011 until the deployment of the new TLD, the area was not monitored as required by the ODCM (CR # 445416).

First Quarter – TLD # 39 was not noted as missing on the sample shipment paperwork from RNP, but was not received at HEEC for processing; therefore, it is missing (CR # 465172).

Second Quarter – TLD # 12 was missing in the field where it was attached to a tree. The area had been cleared of trees. The area was searched, but the TLD was not found (CR # 478138).

Second Quarter – Incorrect RNP transit environmental TLDs were returned to HEEC for processing. The 3rd Qtr. 2011 RNP transit TLDs were returned to HEEC for processing when the 2nd Qtr. 2011 transit TLDs should have been sent. TLD results had to be recalculated using the correct RNP transit TLDs (CR # 481938).

Fourth Quarter – TLD # 38 was missing in the field. The tree that the TLD was located had been removed from the area and a search of the area did not locate the missing TLD (CR # 507298).

ANALYTICAL PROCEDURES

Gross Beta

Gross beta radioactivity measurements are made utilizing a Tennelec Low-Background Alpha/Beta Counting System. The LLD for air particulates is approximately $2.6\text{E-}3$ pCi/m³ for RNP samples. Air particulate samples are mounted in 2-inch stainless steel planchets and typically counted directly for 50 minutes.

Gross beta activity in ground water is determined by evaporating 1.0 Liter of the sample, transferring it to a weighed planchet, and counting the planchet on a Tennelec Low-Background Alpha/Beta Counting System for 50 minutes. Typical/worst case LLD for gross beta is $9.0\text{E-}1$ pCi/L.

Tritium

Liquid samples requiring tritium analysis are treated with a small amount of sodium hydroxide, potassium permanganate crystals, and then distilled. Five milliliters of the distillate are mixed with thirteen milliliters of liquid scintillation cocktail and counted in a liquid scintillation counter typically for 400 minutes. The lower LLD (approximately $2.20\text{E+}2$ pCi/L) was established for consistency with the state laboratory for valid comparisons.

Iodine-131

Iodine-131 airborne concentrations are analyzed by the high-purity germanium (Ge) gamma spectrometry systems. The cartridges are placed on the detector and each charcoal cartridge is typically counted for 900 seconds individually with an approximate LLD of $5.1\text{E-}2$ pCi/m³.

Iodine-131 in ground water and surface water is determined by an instrumental method. Analysis involves passing 4 liters of sample over an anion exchange resin and direct gamma analysis of the resin with a high-purity Ge detector. The LLD using the Ge detector is approximately $1.0\text{E+}0$ pCi/L using 40,000-second count time. Refer to Table 6 for Typical/Worst Case LLDs.

Gamma Spectrometry

Gamma spectrum analysis uses high-purity germanium detectors with thin aluminum windows housed in steel and lead shields. The analyzer system is the Canberra APEX Gamma Spectroscopy System. Table 6 summarizes worst case LLD values derived from using the instrument with the worst sensitivity, typical sample volumes, typical count times, typical worst background count, and worst case on decay (from collection to counting).

Air particulate quarterly composite filters are placed in a Petri dish and analyzed directly for a typical count time of 900 seconds.

Liquid samples are transferred to Marinelli beakers and analyzed by gamma counting. One-liter ground water samples are gamma scanned directly in a 1-Liter Marinelli beaker for 14,000 seconds and the surface water samples for 73,000 seconds.

Shoreline and bottom sediments are dried, ground, weighed, and then analyzed in a 1-liter Marinelli beaker for 840 seconds (>1000 grams, dry) or 1,380 seconds (\leq 1000 grams, dry).

Broadleaf and aquatic vegetation and food product samples are weighed as sampled (wet) and analyzed in a Marinelli beaker for typically 7,500 seconds.

Fish samples are prepared by placing small raw, edible portions of the fish in a 1-liter Marinelli beaker for gamma analysis and are typically counted for 1,500 seconds.

Thermoluminescent Dosimetry

Each area monitoring station includes a TLD packet, which is a polyethylene bag containing three calcium sulfate phosphors contained in a Panasonic UD-814 badge. The TLD is light tight and the bag is weather-resistant.

Dosimeters are machine annealed before field placement. Following exposure in the field, each dosimeter is read utilizing a Panasonic TLD reader. This instrument integrates the light photons emitted from traps as the dosimeter is heated. Calibration is calculated using dosimeters irradiated to known doses for each set of dosimeters measured. Prior to the measurement of each dosimeter, the instrument is checked through use of an internal constant light source as a

secondary standard. The exposure reported is corrected for exposure received in transit and during storage through the use of control dosimeters.

Interlaboratory Comparison Program

The Radiochemistry Laboratory at the Harris Energy & Environmental Center in New Hill, North Carolina, provides radioanalytical services for Progress Energy Carolinas, Inc.'s nuclear plant radiological environmental surveillance programs. In fulfillment of ODCM Operational Requirements, the laboratory is a participant in the Eckert & Ziegler Analytics Environmental Cross Check Program and uses its performance in this program as a major determinant of the accuracy and precision of its analytical results.

The Interlaboratory Comparison Program entails measurements on each instrument that is used to determine concentrations of radioactive material in the various media that are analyzed as part of the REMP. From these individual measurements, average results are calculated for each sample medium. During 2011, 82 average results were reported for the year on 17 samples representing seven major environmental media (i.e., water, milk, air filters, air filters composite, soil, air cartridges, and simulated vegetation). Data on the known activities, the uncertainties, and the ratios to the known for the 82 average results have been received from Eckert & Ziegler Analytics. The results were compared to the criteria established in the NRC Inspection Manual (Procedure 84750) for Radioactive Waste Treatment, Effluent, and Environmental Monitoring (see below results).

All of the 82 average results were within the acceptance criteria. During 2011, there were 401 individual measurements of which 398 (99.3%) were passing. The individual measurements were evaluated and results falling outside the acceptable ratio criteria had an evaluation performed to identify any recommended remedial actions and to reduce anomalous errors (CR # 485925). Complete documentation of any evaluation will be available and provided to the NRC upon request.

Environmental Cross Check Performance Summary for 2011

Sample	Nuclide	Quarter	Units	HEEC Value	EZA Value	HEEC/EZA Ratio	Evaluation
Gross beta water 1 st Qtr E7457-668 3 rd Qtr E8110-668 4 th Qtr E8237-668	Gross beta	1 st	pCi/L	260	247	1.05	Agreement
		3 rd	pCi/L	257	249	1.03	Agreement
		4 th	pCi/L	259	252	1.03	Agreement
Gross beta filter 2 nd Qtr E7850-668 4 th Qtr E8236-668	Gross beta	2 nd	pCi	80.8	74.6	1.08	Agreement
		4 th	pCi	66.2	65.5	1.01	Agreement
Tritium in water 1 st Qtr E7456-668 4 th Qtr E8235-668	H-3	1 st	pCi/L	4250	4530	0.94	Agreement
		4 th	pCi/L	10600	10900	0.97	Agreement
Iodine Cartridge 2 nd Qtr E7849-668 4 th Qtr E8238-668	I-131	2 nd	pCi	86.0	85.9	1.00	Agreement
		4 th	pCi	91.8	89.6	1.03	Agreement
Gamma Milk E7458-668	I-131	1 st	pCi/L	97.0	96.9	1.00	Agreement
	Cr-51	1 st	pCi/L	309	298	1.04	Agreement
	Cs-134	1 st	pCi/L	124	130	0.95	Agreement
	Cs-137	1 st	pCi/L	224	205	1.09	Agreement
	Co-58	1 st	pCi/L	116	113	1.02	Agreement
	Mn-54	1 st	pCi/L	286	266	1.07	Agreement
	Fe-59	1 st	pCi/L	193	175	1.11	Agreement
	Zn-65	1 st	pCi/L	281	261	1.08	Agreement
Co-60	1 st	pCi/L	179	172	1.04	Agreement	
Gamma Soil E7459-668	Cr-51	1 st	pCi/g	0.526	0.489	1.08	Agreement
	Cs-134	1 st	pCi/g	0.223	0.214	1.04	Agreement
	Cs-137	1 st	pCi/g	0.480	0.425	1.13	Agreement
	Co-58	1 st	pCi/g	0.192	0.186	1.03	Agreement
	Mn-54	1 st	pCi/g	0.475	0.436	1.09	Agreement
	Fe-59	1 st	pCi/g	0.325	0.286	1.14	Agreement
	Zn-65	1 st	pCi/g	0.472	0.428	1.10	Agreement
	Co-60	1 st	pCi/g	0.298	0.281	1.06	Agreement
Gamma Vegetation E8111-668	Ce-141	3 rd	pCi/g	0.156	0.169	0.92	Agreement
	Cr-51	3 rd	pCi/g	0.546	0.573	0.95	Agreement
	Cs-134	3 rd	pCi/g	0.289	0.325	0.89	Agreement
	Cs-137	3 rd	pCi/g	0.280	0.288	0.97	Agreement
	Co-58	3 rd	pCi/g	0.236	0.247	0.96	Agreement
	Mn-54	3 rd	pCi/g	0.378	0.382	0.99	Agreement
	Fe-59	3 rd	pCi/g	0.145	0.139	1.04	Agreement
	Zn-65	3 rd	pCi/g	0.456	0.457	1.00	Agreement
Co-60	3 rd	pCi/g	0.383	0.397	0.96	Agreement	

Environmental Cross Check Performance Summary for 2011

Sample	Nuclide	Quarter	Units	HEEC Value	EZA Value	HEEC/EZA Ratio	Evaluation
Gamma Filter 2 nd Qtr E7847-668 3 rd Qtr E8112-668	Ce-141	2 nd	pCi	52.0	52.3	0.99	Agreement
		3 rd	pCi	66.0	69.0	0.96	Agreement
	Cr-51	2 nd	pCi	137	135	1.02	Agreement
		3 rd	pCi	226	234	0.96	Agreement
	Cs-134	2 nd	pCi	132	124	1.06	Agreement
		3 rd	pCi	136	133	1.02	Agreement
	Cs-137	2 nd	pCi	99.0	90.2	1.10	Agreement
		3 rd	pCi	118	118	1.00	Agreement
	Co-58	2 nd	pCi	101	99.1	1.02	Agreement
		3 rd	pCi	97.0	101	0.96	Agreement
	Mn-54	2 nd	pCi	98.0	90.1	1.09	Agreement
		3 rd	pCi	165	156	1.06	Agreement
	Fe-59	2 nd	pCi	98.0	80.6	1.22	Agreement
		3 rd	pCi	67.0	56.8	1.18	Agreement
	Zn-65	2 nd	pCi	203	170	1.19	Agreement
		3 rd	pCi	209	187	1.12	Agreement
Co-60	2 nd	pCi	135	127	1.06	Agreement	
	3 rd	pCi	158	163	0.97	Agreement	
Gamma 13 Filter Composite E7848-668	Ce-141	2 nd	pCi	62.0	64.7	0.96	Agreement
	Cr-51	2 nd	pCi	166	167	1.00	Agreement
	Cs-134	2 nd	pCi	159	154	1.04	Agreement
	Cs-137	2 nd	pCi	117	112	1.05	Agreement
	Co-58	2 nd	pCi	122	123	0.99	Agreement
	Mn-54	2 nd	pCi	115	112	1.03	Agreement
	Fe-59	2 nd	pCi	113	99.8	1.13	Agreement
	Zn-65	2 nd	pCi	237	211	1.12	Agreement
	Co-60	2 nd	pCi	161	157	1.02	Agreement

Environmental Cross Check Performance Summary for 2011

Sample	Nuclide	Quarter	Units	HEEC Value	EZA Value	HEEC/EZA Ratio	Evaluation
Gamma Water 2 nd Qtr E7846-668 3 rd Qtr E8109-668	I-131	2 nd	pCi/L	102	101	1.01	Agreement
		3 rd	pCi/L	82.0	80.1	1.02	Agreement
	Ce-141	2 nd	pCi/L	94	93.5	1.01	Agreement
		3 rd	pCi/L	93.0	91.5	1.02	Agreement
	Cr-51	2 nd	pCi/L	251	241	1.04	Agreement
		3 rd	pCi/L	329	310	1.06	Agreement
	Cs-134	2 nd	pCi/L	210	222	0.95	Agreement
		3 rd	pCi/L	166	176	0.94	Agreement
	Cs-137	2 nd	pCi/L	174	161	1.08	Agreement
		3 rd	pCi/L	166	156	1.06	Agreement
	Co-58	2 nd	pCi/L	179	177	1.01	Agreement
		3 rd	pCi/L	140	134	1.05	Agreement
	Mn-54	2 nd	pCi/L	169	161	1.05	Agreement
		3 rd	pCi/L	220	207	1.06	Agreement
	Fe-59	2 nd	pCi/L	159	144	1.10	Agreement
		3 rd	pCi/L	87.0	75.2	1.16	Agreement
	Zn-65	2 nd	pCi/L	334	305	1.10	Agreement
		3 rd	pCi/L	270	247	1.09	Agreement
Co-60	2 nd	pCi/L	239	228	1.05	Agreement	
	3 rd	pCi/L	218	215	1.01	Agreement	

Lower Limits of Detection

The samples analyzed met the “a priori” LLD required by the ODCM. Typical/Worst Case “a priori” LLD values for the samples analyzed are listed in Table 6.

Table 6

Typical/Worst Case Lower Limits of Detection (a priori)

Gamma Spectrometry

<u>Surface Water/Groundwater Samples</u>	
Isotope	LLD (pCi/L)
Mn-54	3 / 6
Co-58	3 / 6
Fe-59	6 / 12
Co-60	2 / 7
Zn-65	5 / 12
Zr-Nb-95	5 - 4 / 11 - 10
I-131	14 / 13
Cs-134	3 / 7
Cs-137	3 / 6
Ba-La-140	23 - 8 / 31 - 12
I-131 (Separation)	0.86 / 0.63
<u>Air Cartridges</u> (Weekly)	
Isotope	LLD (pCi/m³)
I-131	0.051
<u>Air Particulates</u> (Quarterly Composite)	
Isotope	LLD (pCi/m³)
Cs-134	3.1E-3
Cs-137	2.2E-3

Table 6 (cont.)

Sediments (Shoreline or Bottom)	
Isotope	LLD (pCi/kg, dry)
Cs-134	127
Cs-137	95
Fish	
Isotope	LLD (pCi/kg, wet)
Mn-54	60
Co-58	70
Fe-59	141
Co-60	66
Zn-65	127
Cs-134	73
Cs-137	74
Food/Products and Vegetation/Aquatic	
Isotope	LLD (pCi/kg, wet)
I-131	45 / 41
Cs-134	34 / 29
Cs-137	32 / 20

LAND USE CENSUS

PURPOSE OF THE LAND USE CENSUS

The land use census identifies the pathways (or routes) that radioactive material may reach the general populations near commercial nuclear generating stations. This is accomplished by completing studies that identify how the surrounding lands are used by the population. A comprehensive census of the use of the land within a five-mile distance of the plant is completed during the growing season. This information is used for dose assessment and to identify changes to the stations sampled and the type of samples. These results ensure that the Radiological Environmental Monitoring Program (REMP) is based upon current data regarding human activity in the vicinity of the plant. Therefore, the purpose of the land use census is to ensure the monitoring program is current, as well as to provide data for the calculation of estimated radiation exposure.

The pathways that are evaluated are:

- **Ingestion Pathway -** Results from eating food products that may have radioactive materials deposited on them, incorporated radioactive materials from the soil or atmosphere. Another pathway is through drinking milk from local cows or goats if present. The grass used to feed these animals may have incorporated or had deposited on it radioactive materials that can be transferred to the milk.
- **Direct Radiation Exposure Pathway-** Results from deposition of radioactive materials on the ground or from passage of these radioactive materials in the air.
- **Inhalation Pathway-** Results from breathing radioactive materials transported in the air.

Methodology

The following must be identified within the five (5) mile radius of the plant for each of the sixteen meteorological sectors (compass direction the winds may blow, for example NNE [North North East]):

- The nearest resident
- The nearest garden of greater than 500 square feet, producing broadleaf vegetables
- The nearest milk animal
- The nearest meat/egg producing animal

The primary methods are visual inspection from the roadside within the five (5) mile radius and personal contact with the individuals.

Land Use Census Results

The HBRSEP (RNP) Land Use Census was performed July 2011 to meet the requirements of the HBRSEP's ODCM. The last HBRSEP land use census was performed in June 2010. The 2011 and 2010 results of the survey for the nearest resident, garden, milk producing animal, and meat/egg producing animal for each meteorological sector are compared in Table 7.

No milk producing animals were identified within the five-mile radius of the site in any sector. Also, no garden (at the time of the census) is currently growing leafy vegetables. Vegetables like tomatoes, squash, okra, cucumbers, etc. are examples of the vegetables of choice for this area and are what is typically grown and sampled in the past. Sampling of these vegetables (non-leafy) will continue until leafy vegetables can be identified. Milk sampling will resume if a new sample location is identified. The results of the 2011 Land Use Census and 10 year average meteorological data were reviewed. No changes that require an ODCM change, additional dose calculations, or procedure changes were identified.

TABLE 7

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

**LAND USE CENSUS COMPARISONS (2010-2011)
NEAREST PATHWAY (MILES)**

SECTOR	RESIDENT		GARDEN		MEAT/ EGG		MILK	
	2010	2011	2010	2011	2010	2011	2010	2011
N	2.81	2.81	3.31	3.29*	----	4.75*	---	---
NNE	1.51	1.51	2.64	2.08*	2.59	2.59	---	---
NE	1.03	1.03	2.74	1.10*	----	----	---	---
ENE	0.83	0.83	3.80	1.07*	2.44	2.44	---	---
E	0.90	0.90	1.05	1.05	2.98	2.98	---	---
ESE	0.62	0.62	1.28	1.28	0.70	0.70	---	---
SE	0.38	0.38	1.20	1.20	2.00	2.00	---	---
SSE	0.33	0.33	2.37	2.37	2.37	2.37	---	---
S	0.40	0.40	2.25	2.25	2.62	2.62	---	---
SSW	0.37	0.37	0.84	0.84	0.84	0.84	---	---
SW	0.46	0.46	0.79	0.79	3.54	3.54	---	---
WSW	0.45	0.45	0.60	0.88*	3.46	0.88*	---	---
W	0.54	0.54	0.70	0.70	0.84	0.84	---	---
WNW	0.60	0.60	0.70	0.83*	4.27	4.27	---	---
NW	1.59	1.59	2.43	2.43	2.09	2.07*	---	---
NNW	2.04	2.04	3.80	3.80	2.36	----*	---	---

*Changes or new locations from 2010.

**Changes in mileage due to GPS readings.

Figure 4 For HBRSEP from 1/1/2011 To 12/31/2011
AIR PARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

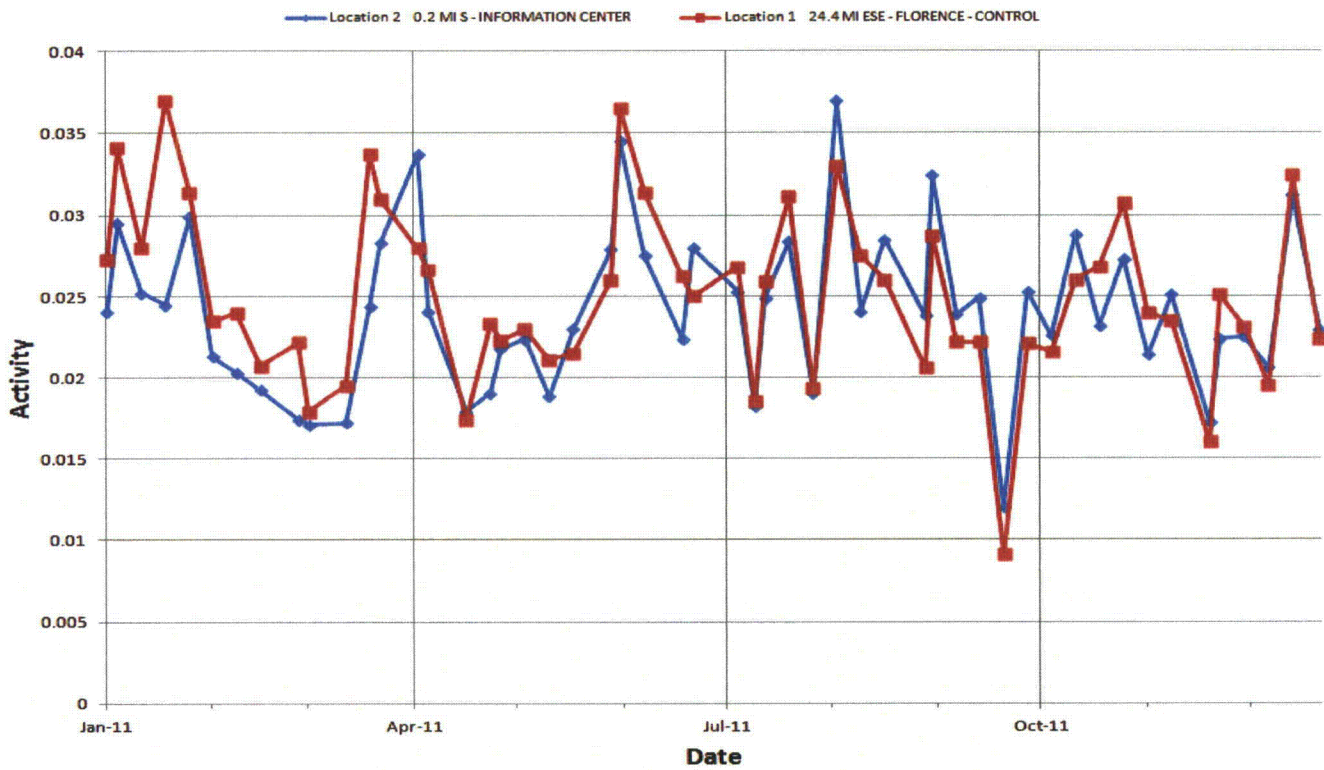


Figure 5 For HBRSEP from 1/1/2011 To 12/31/2011

AIR PARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

Location 3 0.5 MI N - MICROWAVE TOWER Location 1 24.4 MI ESE - FLORENCE - CONTROL

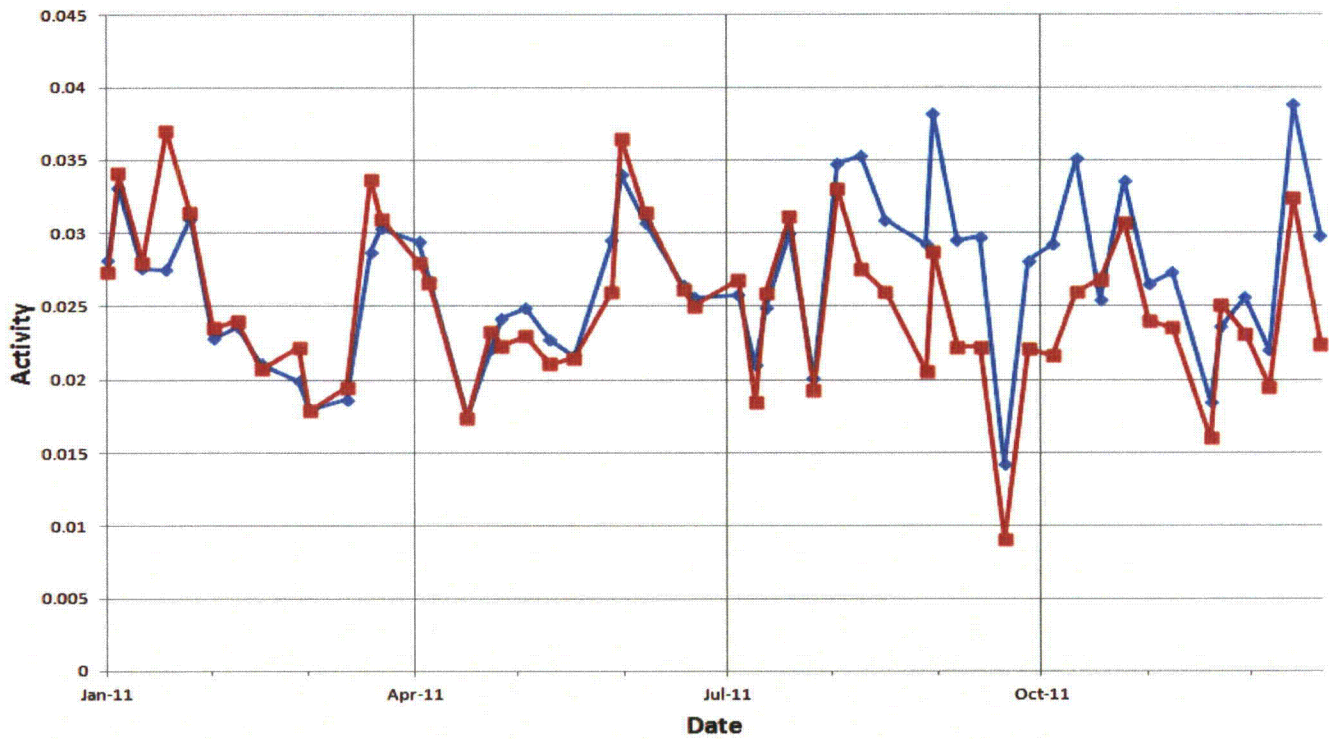


Figure 6 For HBRSEP from 1/1/2011 To 12/31/2011
AIR PARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

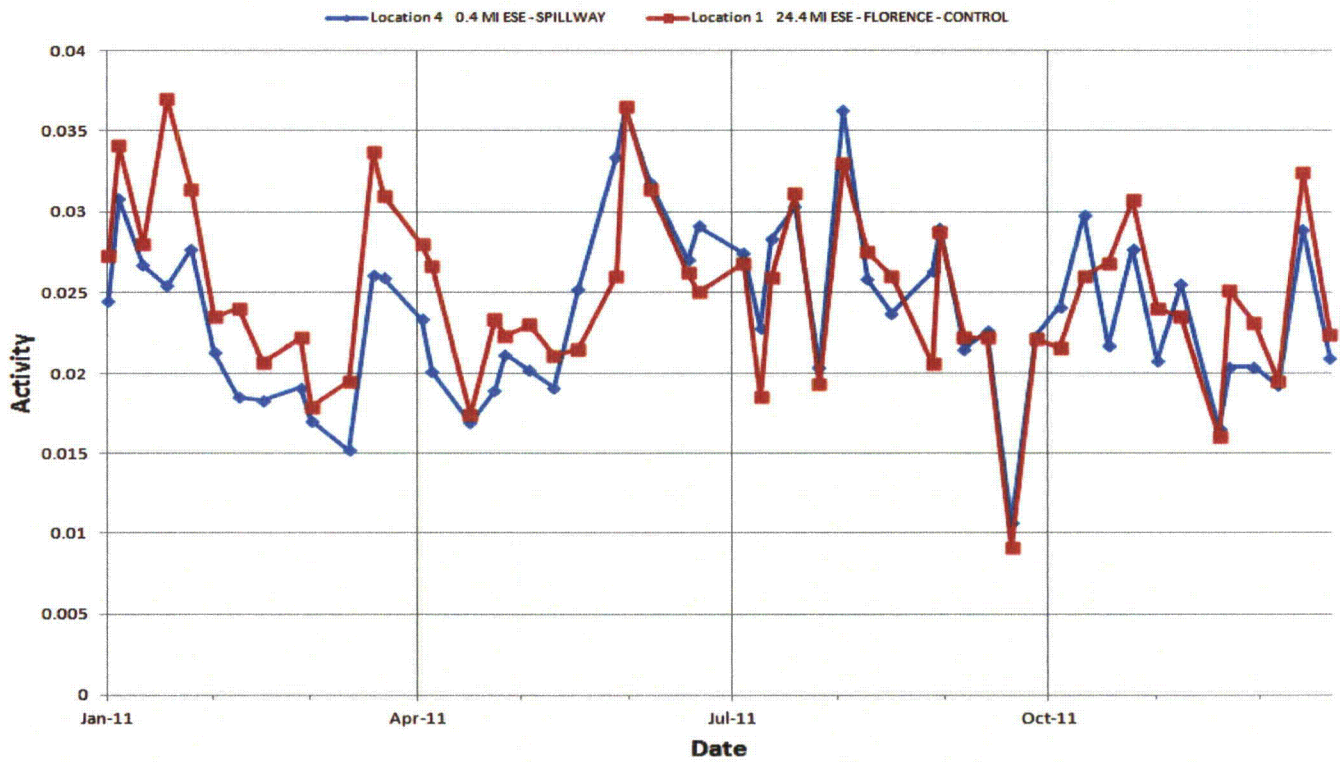


Figure 8 For HBRSEP from 1/1/2011 To 12/31/2011

AIRPARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

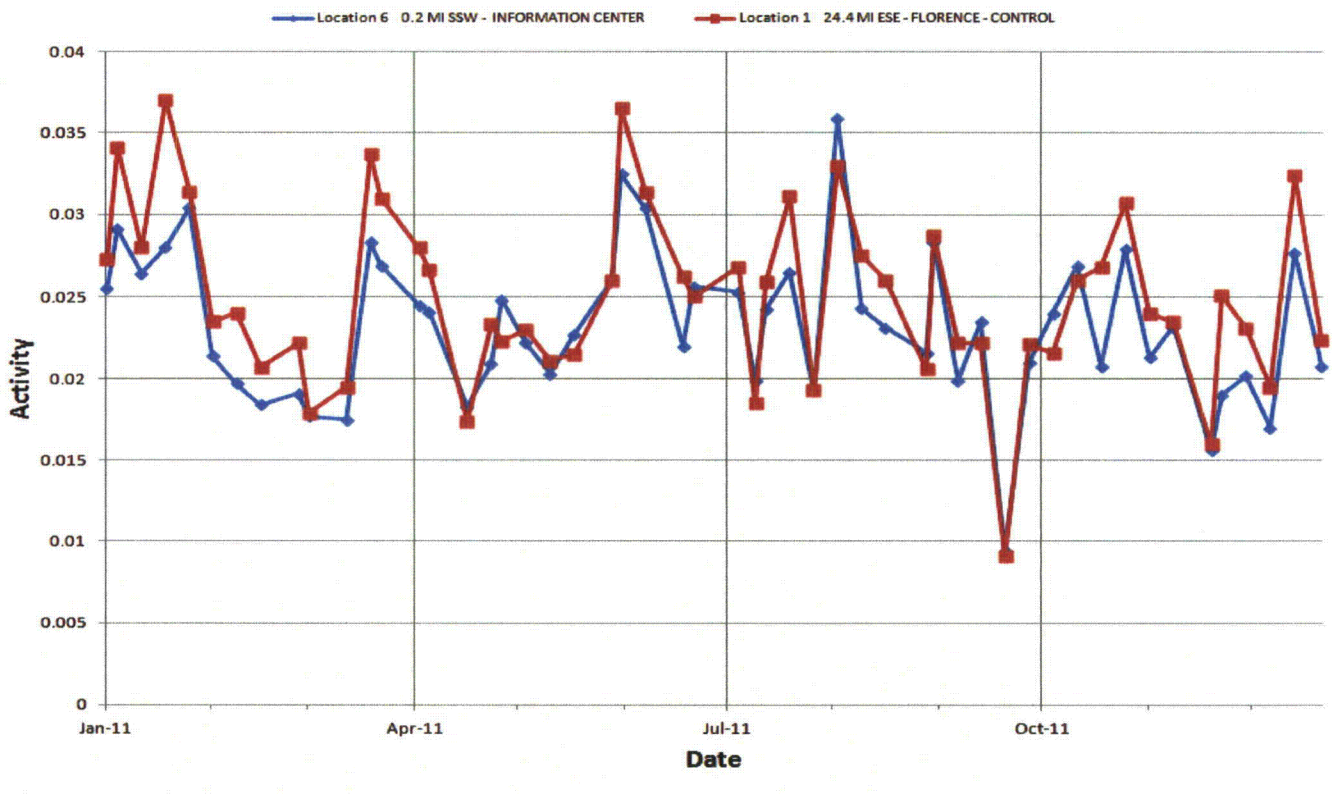


Figure 9 For HBRSEP from 1/1/2011 To 12/31/2011
AIR PARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

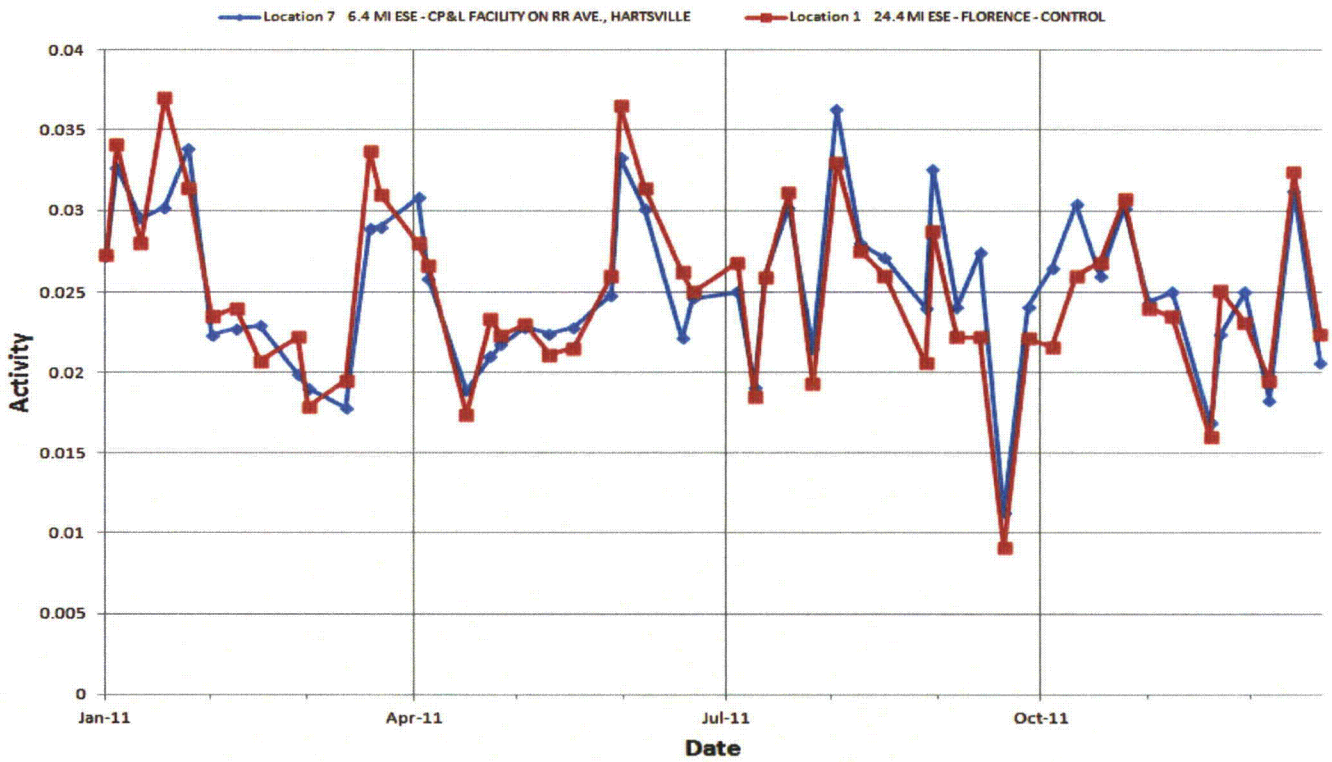


Figure 11 For HBRSEP from 1/1/2011 To 12/31/2011
AIR PARTICULATE for GROSS BETA - Activity (pCi/cubic meter)

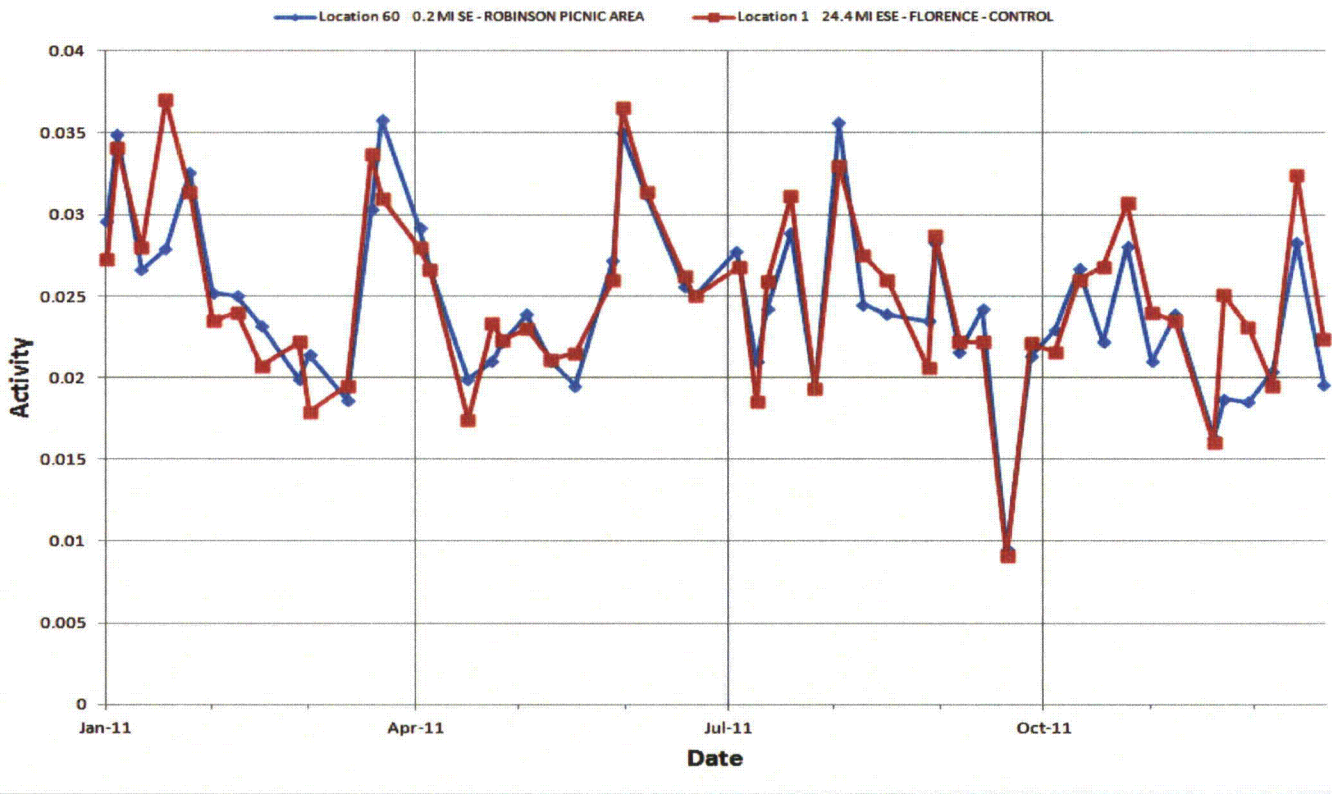


Figure 13 RNP 2011 Surface Water Tritium

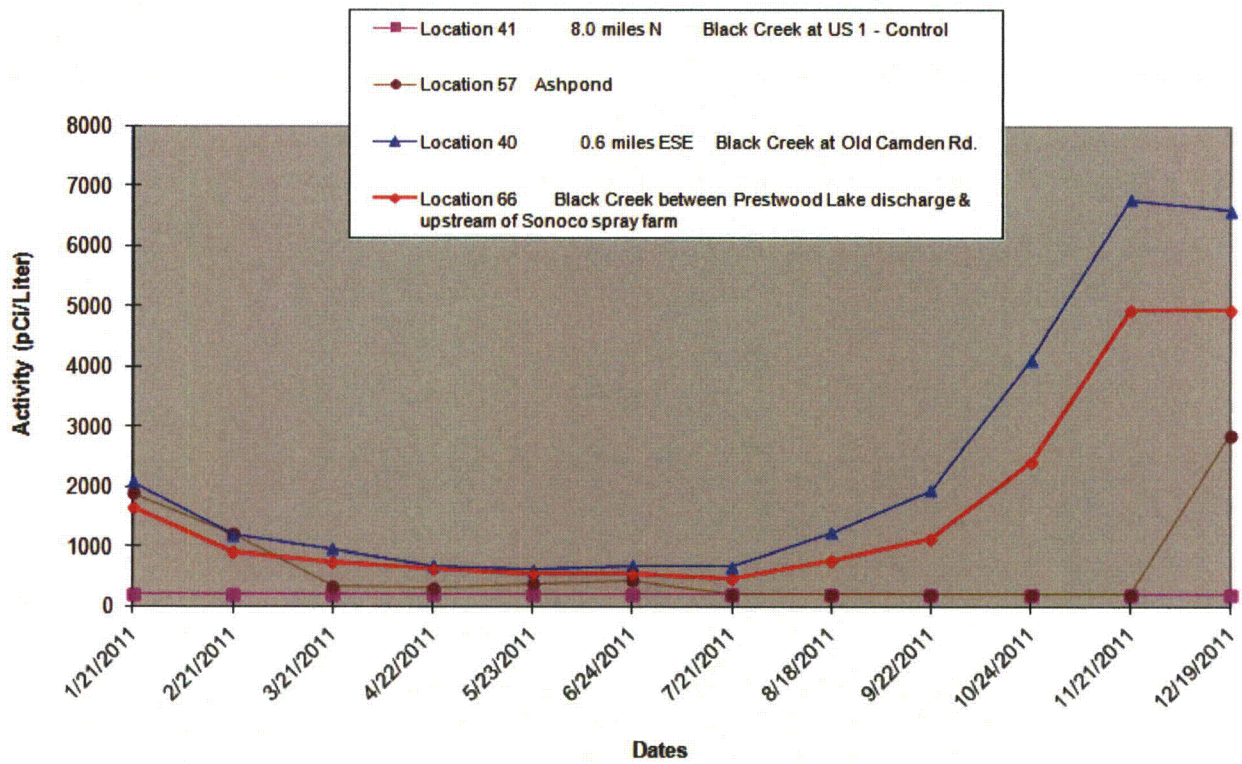
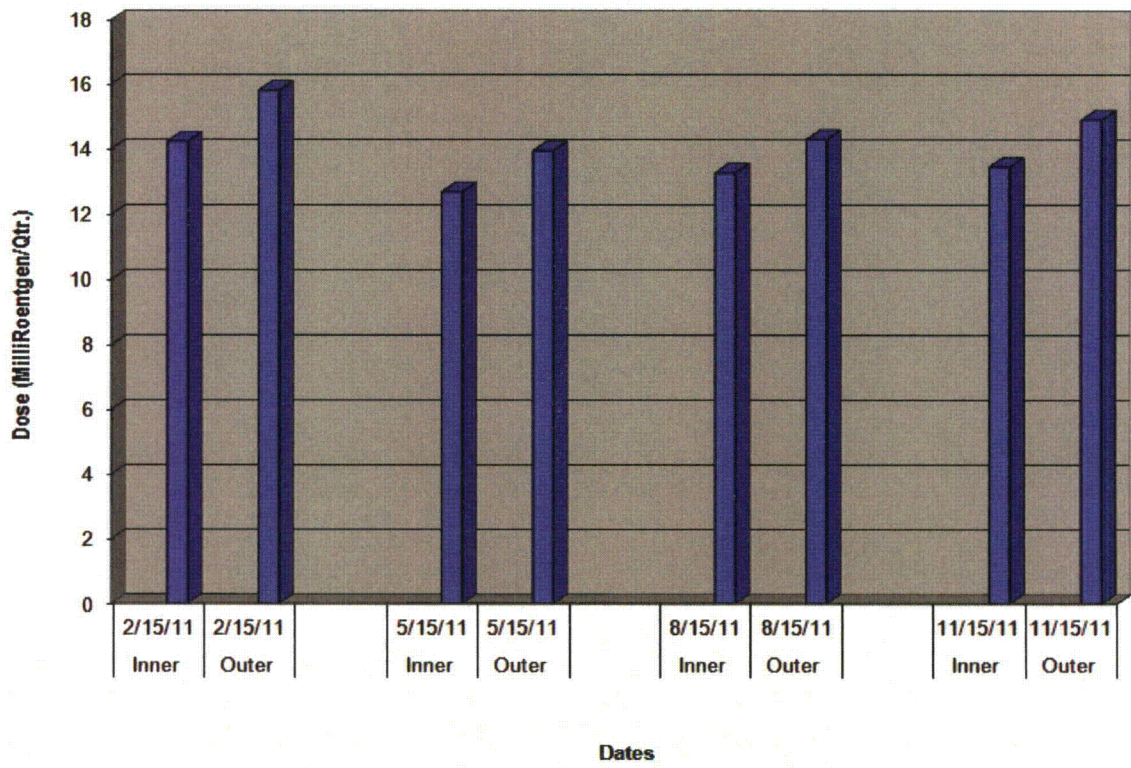


Figure 14 RNP 2011 TLD Averages for Inner and Outer Ring Locations



HBRSEP (RNP)

TLD Report

- 9 pages

Analysis Report

- 49 pages

Gamma Isotopic Report

- 87 pages