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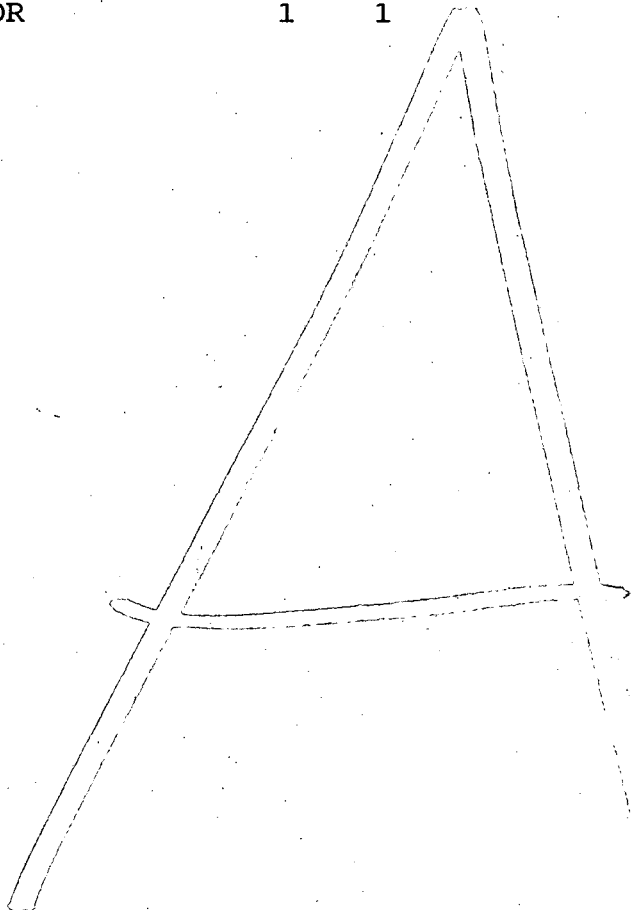
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2  
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1987 ANNUAL ENVIRONMENTAL MONITORING REPORT

Dear Sir:

Carolina Power & Light Company (CP&L) hereby submits the 1987 Annual Environmental Monitoring Report as required by Technical Specification 6.9.1.d.7.

Please contact my staff if you need additional information.

Very truly yours,

R. E. Morgan  
General Manager

H. B. Robinson S. E. Plant

SAG:as

Enclosure

cc: L. W. Garner  
J. N. Grace

TEAS  
11

# Environmental Surveillance Report

January 1, 1987 — December 31, 1987

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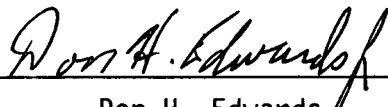
ENVIRONMENTAL RADIOLOGICAL MONITORING REPORT

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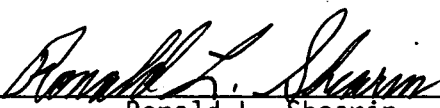
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JANUARY 1, 1987, THROUGH DECEMBER 31, 1987

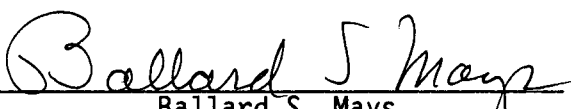
Prepared By:

  
Don H. Edwards  
Senior Specialist - Environmental

Reviewed By:

  
Ronald L. Shearin  
Project Specialist - Environmental

Approved By:

  
Ballard S. Mays  
Principal Specialist - Environmental

1548  
1/1

## TABLE OF CONTENTS

	<u>Page</u>
<b>1.0 INTRODUCTION.....</b>	<b>1-1</b>
1.1 Plant and Location.....	1-1
1.2 Radiological Impact Considerations.....	1-1
1.3 Environmental Monitoring Program.....	1-2
<b>2.0 PROGRAM SUMMARY.....</b>	<b>2-1</b>
<b>3.0 INTERPRETATIONS AND CONCLUSIONS.....</b>	<b>3-1</b>
3.1 Air Samples.....	3-1
3.2 Broadleaf Vegetation.....	3-2
3.3 Fish.....	3-5
3.4 Food Products.....	3-6
3.5 Groundwater.....	3-6
3.6 Milk Samples.....	3-6
3.7 Shoreline Sediment.....	3-7
3.8 Surface Water.....	3-7
3.9 Thermoluminescent Dosimetry Area Monitors.....	3-8
3.10 Summary.....	3-8
<b>4.0 MISSED SAMPLES AND ANALYSES.....</b>	<b>4-1</b>
4.1 Air Cartridge and Air Particulate.....	4-1
4.2 Broadleaf Vegetation.....	4-1
4.3 Milk.....	4-2
4.4 Environmental TLDs.....	4-2
<b>5.0 LAND-USE CENSUS.....</b>	<b>5-1</b>
<b>6.0 ANALYTICAL PROCEDURES.....</b>	<b>6-1</b>
6.1 Gross Beta.....	6-1
6.2 Tritium.....	6-1
6.3 Iodine-131.....	6-1
6.4 Gamma Spectrometry Ge(Li).....	6-1
6.5 Thermoluminescent Dosimetry.....	6-2
6.6 EPA Laboratory Intercomparison Program.....	6-3
6.7 Lower Limits of Detection (LLD).....	6-4

## LIST OF TABLES

<u>Table</u>		<u>Page</u>
1-1	Environmental Radiological Monitoring Program.....	1-5
2-1	Environmental Radiological Monitoring Program Summary.....	2-2
3-1	Cesium-137 in Broadleaf Vegetation.....	3-3
3-2	Cesium-137 Concentration in Fish Samples.....	3-5
5-1	Land-Use Census Distances to Locations of Interest.....	5-1
6-1	Typical Lower Limits of Detection (LLD) Ge(Li) Gamma Spectrometry.....	6-5

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1-1 H.B. Robinson Unit No. 2 Environmental Radiological Sampling Points.....	1-3
1-2 H.B. Robinson Unit No. 2 Environmental Radiological Sampling Points on Site.....	1-4
3-1 Plot of Air Particulate Gross Beta Activity by Date at Station 02 Versus Control Station Activity.....	3-10
3-2 Plot of Air Particulate Gross Beta Activity by Date at Station 03 Versus Control Station Activity.....	3-11
3-3 Plot of Air Particulate Gross Beta Activity by Date at Station 04 Versus Control Station Activity.....	3-12
3-4 Plot of Air Particulate Gross Beta Activity by Date at Station 05 Versus Control Station Activity.....	3-13
3-5 Plot of Air Particulate Gross Beta Activity by Date at Station 06 Versus Control Station Activity.....	3-14
3-6 Plot of Air Particulate Gross Beta Activity by Date at Station 07 Versus Control Station Activity.....	3-15

## 1.0 INTRODUCTION

The following report summarizes the radiological environmental data for the H.B. Robinson Steam Electric Plant during the calendar year 1987. The surveillance requirements for this report were performed by the requirements of the Radiological Effluent Technical Specifications (RETS) which were implemented on January 1, 1985. This is the eleventh year in which the program's sample analyses and data interpretations have been entirely performed by Carolina Power & Light Company.

### 1.1 Plant and Location

The H.B. Robinson Steam Electric Plant is located in northeastern South Carolina near Hartsville and approximately 25 miles northwest of Florence. This site includes a fossil-fueled plant, Unit 1, which was placed in service in 1960 and a pressurized water nuclear power reactor, Unit 2, which entered commercial operation on March 7, 1971. The Robinson Impoundment (hereafter referred to as Lake Robinson) on the plant site was created for Unit 1 and is also a cooling reservoir for Unit 2. Lake Robinson has an area of 2250 acres with plant intake at the south end adjacent to the dam. Following condenser use, the water is returned by a 4.2-mile canal to the north end of Lake Robinson near the mouth of Black Creek which flows into the lake from the north.

### 1.2 Radiological Impact Considerations

Potential population exposure due to plant operations is most significant in the liquid release fish-man pathway. Two additional pathways are also potentially important. These are the airborne radioiodine-pasture-milk pathway and the direct external radiation exposure to individuals on the ground from plumes of noble gases. Contact with Lake Robinson, including boating and immersion (swimming), constitutes an insignificant dose to man.



### 1.3 Environmental Monitoring Program

The required environmental sampling is defined by technical specifications. The program, as implemented by the plant, is described in the ODCM. The objectives of the program are to monitor the specific elements of exposure pathways. The sampling media and release pathways are listed below.

#### Sampling Media

#### Release Pathway

Glass Fiber Filter	Gaseous
Iodine Collection Cartridge	Gaseous
TLDS	Gaseous
Surface Water	Liquid
Groundwater	Liquid
Shoreline Sediment	Liquid
Milk	Gaseous
Fish	Liquid
Food Crops	Gaseous
Broadleaf Vegetation	Gaseous

SYMBOL	SAMPLE TYPE	
AC	AIR CARTRIDGE	1 7
AP	AIR PARTICULATE	1-7
SS	SHORELINE SEDIMENT	44 57
GW	GROUNDWATER	40 42 43
BL	BROADLEAF VEGETATION	50 51 52
SW	SURFACE WATER	40 41
TL	TLD	1-39
MK	MILK	53 54
FI	FISH	45 46 47
FC	FOOD PRODUCTS	49 54 58

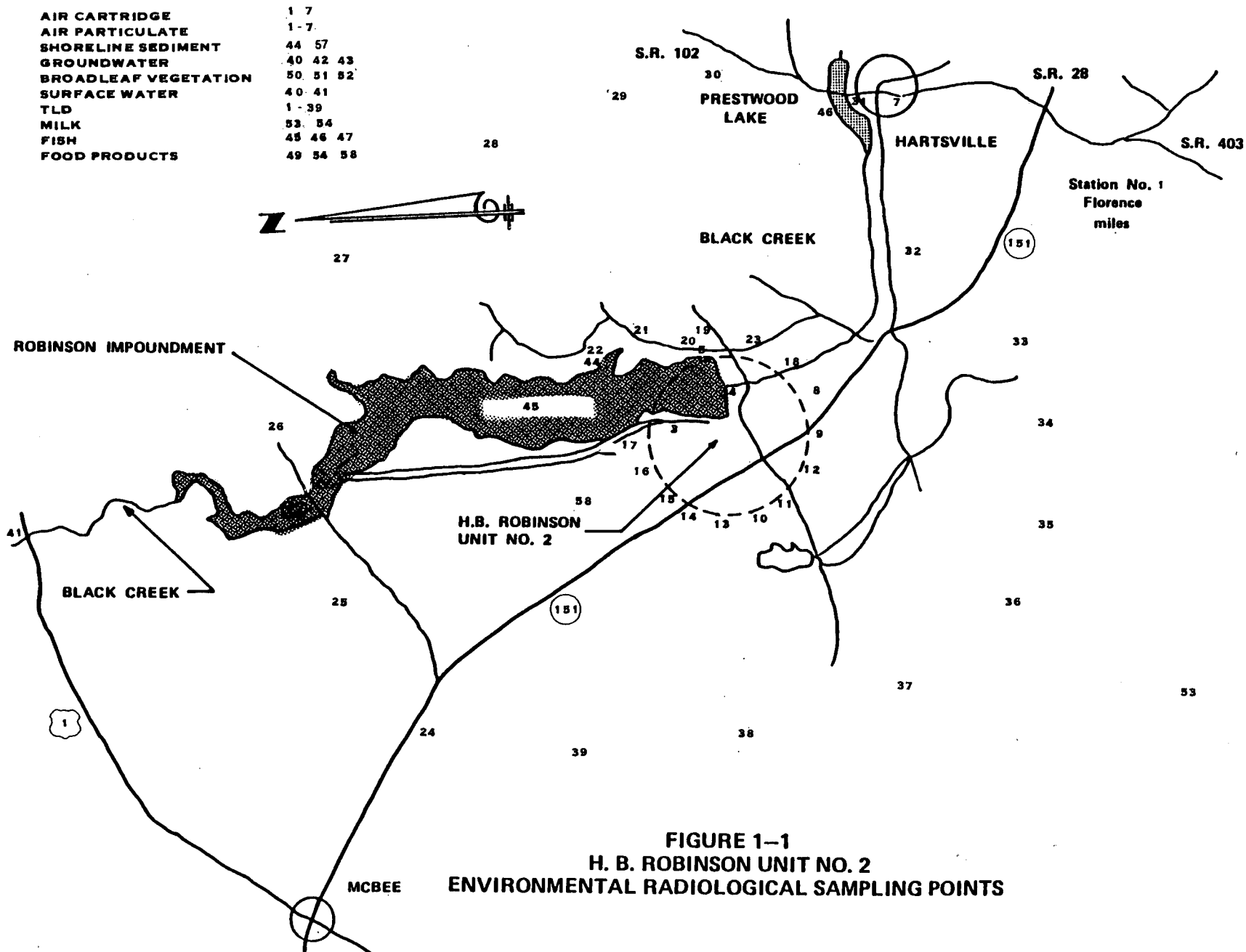


FIGURE 1-1  
H. B. ROBINSON UNIT NO. 2  
ENVIRONMENTAL RADIOLOGICAL SAMPLING POINTS

SYMBOL	SAMPLE TYPE	
AC	AIR CARTRIDGE	1-7
AP	AIR PARTICULATE	1-7
SS	SHORELINE SEDIMENT	44 57
GW	GROUNDWATER	40 42 43
BL	BROADLEAF VEGETATION	50 51 52
SW	SURFACE WATER	40 41
TL	TLD	1-39
MK	MILK	53 54
FI	FISH	45 46 47
FC	FOOD PRODUCTS	49 54 58

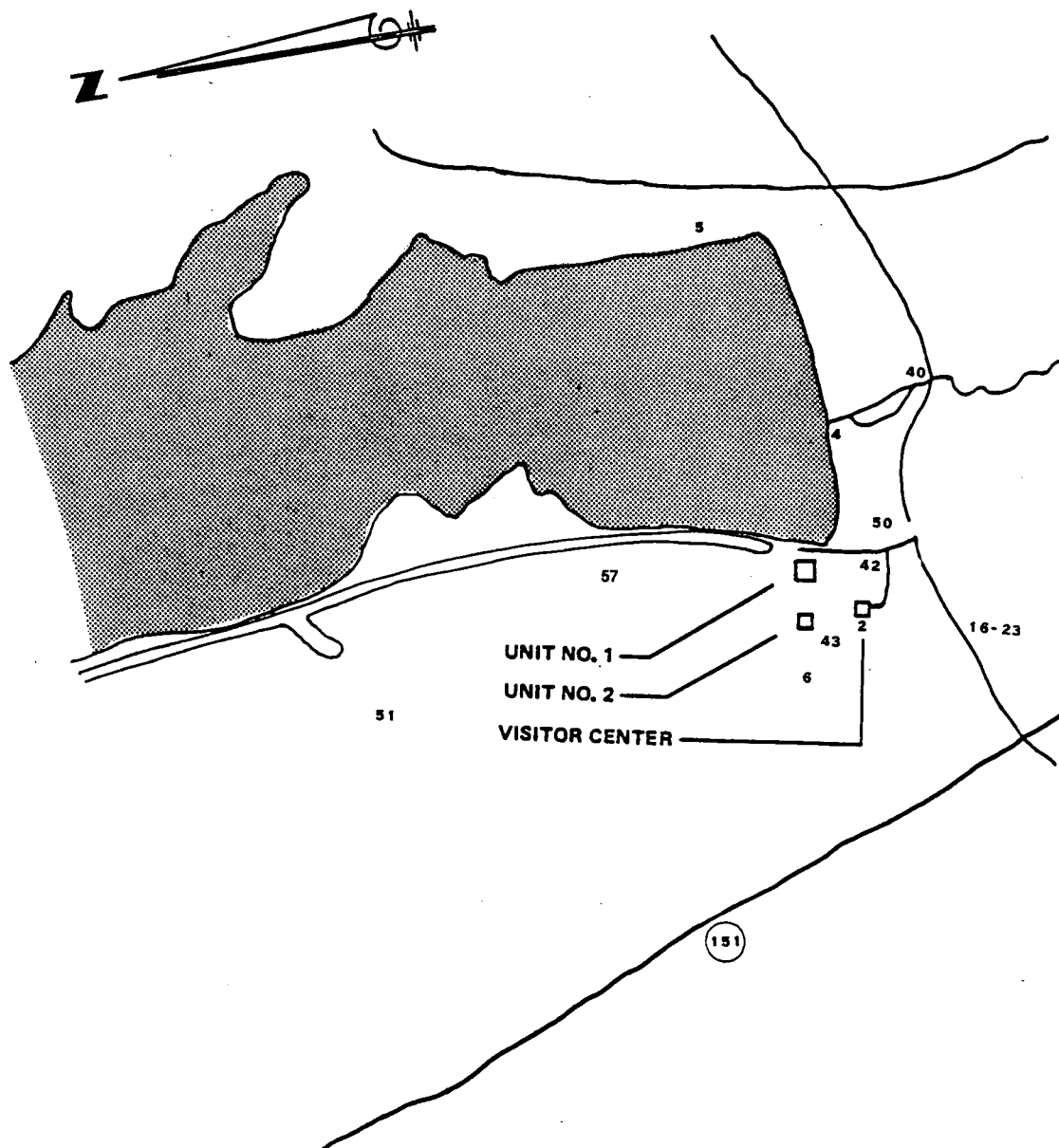


FIGURE 1-2  
H. B. ROBINSON UNIT NO. 2  
ENVIRONMENTAL RADIOLOGICAL SAMPLING POINTS  
ON SITE

TABLE 1-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM  
H.B. ROBINSON STEAM ELECTRIC PLANT

<u>Sample Type</u>	<u>Sampling Point and Description</u>	<u>Sampling Frequency</u>	<u>Approximate Sample Size</u>	<u>Sample Analysis</u>
Air Cartridge (AC)	1--26 miles ESE Florence--Control	Weekly	800 cu m	Iodine
	2--0.2 mile S Information Center			
	3--0.7 mile N Microwave Tower			
	4--0.4 mile ESE Spillway			
	5--0.9 mile ENE Johnson's Landing			
	6--0.3 mile SW Information Center			
	7--6.3 miles ESE Hartsville			
Air Particulate (AP)	1--26 miles ESE Florence--Control	Weekly	800 cu m	Weekly--Gross Beta Quarterly--Composite- Gamma
	2--0.2 mile S Information Center			
	3--0.7 mile N Microwave Tower			
	4--0.4 mile ESE Spillway			
	5--0.9 mile ENE Johnson's Landing			
	6--0.3 mile SW Information Center			
	7--6.3 miles ESE Hartsville			

TABLE 1-1 (cont.)

<u>Sample Type</u>	<u>Sampling Point and Description</u>	<u>Sampling Frequency</u>	<u>Approximate Sample Size</u>	<u>Sample Analysis</u>
External Radiation Dose (TL)	1--26 miles ESE Florence--Control	Quarterly	Not Applicable	TLD Readout
	2--0.2 mile S Information Center			
	3--0.7 mile N Microwave Tower			
	4--0.4 mile ESE Spillway			
	5--0.9 mile ENE Johnson's Landing			
	6--0.3 mile SW Information Center			
	7--6.3 miles ESE Hartsville			
	8--0.8 mile SSE Oak Tree Near Trans- mission Lines			
	9--1.0 mile S Second Pole From SC-151			
	10--1.0 mile WSW on Power Pole at Church of God Cemetery			
	11--1.0 mile SW 4th Pole From Old Camden Road			
	12--1.2 miles SSW Tree at 2nd Inter- section of Dirt Road			
	13--1.0 mile W Pine Tree on Corner Where Road Splits			
	14--0.9 mile WNW Power Pole at Pine Ridge Church			
	15--1.0 mile NW Pine Tree Adjacent to CP&L Ash Pond			
	16--1.0 mile NNW Darlington Co. IC Turbine Plant			
	17--1.1 miles N Pine Tree Beside Dis- charge Canal Road			
	18--0.7 mile SE Near Old Railroad Trestle at Black Creek			
	19--1.0 mile E Power Pole on Road 16-23			
	20--1.3 miles ENE Power Pole 47 on Road 16-39			
	21--1.4 miles NE Near Atkinson's Boat Landing Sign			

TABLE 1-1 (cont.)

<u>Sample Type</u>	<u>Sampling Point and Description</u>	<u>Sampling Frequency</u>	<u>Approximate Sample Size</u>	<u>Sample Analysis</u>
External Radiation Dose (TL) (cont.)	22--1.9 miles NNE Shady Rest Club on Light Pole	Quarterly	Not Applicable	TLD Readout
	23--1.2 miles ESE Power Pole 41E-5 on Road 16-39			
	24--5.0 miles NW 5th Pole from SR 151 on Road 13-711			
	25--4.6 miles NNW Fence Line off Road 13-346			
	26--5.0 miles N Power Pole 32J-6 on Road 13-346			
	27--5.0 miles NNE Road 13-763			
	28--4.8 miles NE Power Pole 30-4-A on Road 13-39			
	29--4.1 miles Transmission Pole Near Road 16-20			
	30--4.6 miles E Pole at Johnson's Fence and Awning Co.			
	31--4.6 miles ESE Pole 1122 on Lake-shore Drive			
	32--4.5 miles SE Transmission Tower at End of Kalber Drive			
	33--4.6 miles SSE Power Pole 25-4 on Road 16-493			
	34--4.6 miles S Transmission Pole Nearest Road 16-772			
	35--4.4 miles SSW Intersection of Roads 31-51 and 16-12			
	36--4.7 miles SW Pole on Dirt Road 3/4 mile From 16-85			
	37--5.0 miles WSW Transmission Tower Nearest Clay Road			
	38--4.9 miles W Pole Beside Union Church			
	39--5.0 miles WNW Pole in Middle of Field			

TABLE 1-1 (cont.)

<u>Sample Type</u>	<u>Sampling Point and Description</u>	<u>Sampling Frequency</u>	<u>Approximate Sample Size</u>	<u>Sample Analysis</u>
Surface Water (SW)	40--0.6 mile ESE Black Creek at Road 16-23 41--7.2 miles NNW Black Creek--Control	Monthly Composite	4 liters	Gamma Tritium
Groundwater (GW)	40--0.6 mile ESE Artesian Well 42--Unit 1 Deep Well 43--Unit 2 Deep Well	Monthly	4 liters	Gamma Tritium
Milk (MK)	53--9.0 miles SW Lyndale Farm--Control 54--10.1 miles E Auburndale Plantation*	Semimonthly when animals are on pasture; monthly at other times	8 liters	Iodine Gamma
Fish (FI)	45--Site Varies Within Lake Robinson 46--4.9 miles ESE Prestwood Lake 47--13.0 miles NNW Bee Lake or 12.5 miles NW May Lake--Control	Semiannually	500 grams	Flesh--Gamma
Shoreline Sediment (SS)	44--1.9 miles NNE Shady Rest Club 57--Ash Pond**	Semiannually	500 grams	Gamma

\*Auburndale Plantation had no milking operations between January 1, 1987, and November 9, 1987.

\*\*This location was added in 1981.

TABLE 1-1 (cont.)

<u>Sample Type</u>	<u>Sampling Point and Description</u>	<u>Sampling Frequency</u>	<u>Approximate Sample Size</u>	<u>Sample Analysis</u>
Food Products (FC)	58--< 3 miles in Highest D/Q Sector	Annual at Harvest	500 grams	Gamma
	49--> 5 miles in Least D/Q Sector			
	Control			
	54--10.1 miles E Auburndale Plantation			
Broadleaf Vegetation (BL)	50--0.25 mile SSE CP&L Property	Monthly when Available	500 grams	Gamma--I-131
	51--0.25 mile NNE CP&L Property			
	52--10 miles W Bethune--Control			



## 2.0 PROGRAM SUMMARY

The purpose of the Environmental Radiological Monitoring Program is to measure any accumulation of radioactivity in the environment, to determine whether this radioactivity is the result of the operation of the H.B. Robinson Plant, and to interpret the potential dose to off-site populations based on the cumulative measurement of radiation of plant origin.

The following locations are used as the control locations for the respective measurements and are intended to indicate conditions away from the H.B. Robinson Plant influence.

**Florence**  
**(Sample Location 1)**

Thermoluminescent Dosimetry Area Monitors  
Airborne Iodine and Particulate Samples

**Black Creek Above Lake Robinson at US 1**  
**(Sample Location 41)**

Surface Water

**Lake Bee or May Lake**  
**(Sample Location 47)**

Fish

**Lyndale's Farm**  
**(Sample Location 53)**

Milk

**10 miles W. Bethune**  
**(Sample Location 52)**

Broadleaf Vegetation

**> 5 miles from plant with**  
**lowest deposition rate (D/Q)**  
**(Sample Location 49)**

Food Crop

Table 2-1 summarizes the environmental monitoring data for 1987.

TABLE 2-1

## ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

H.B. Robinson Steam Electric Plant  
Darlington County, South Carolina

Docket Numbers - 50-261  
Calendar Year 1987

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Typical Lower Limit of Detection (LLD) (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean		Control Location Mean Range (2)
				Name, Distance, and Direction	Mean Range (2)	
Air Cartridge (pCi/m <sup>3</sup> )	1-131 359 <sup>(3)</sup>	1.0E-2	1.13E-2 (1/311) Single value	Information Center 0.3 mile SW	1.13E-2 (1/52) Single value	All less than LLD
Air Particulate (pCi/m <sup>3</sup> )	Gross Beta 359 <sup>(3)</sup>	1.3E-3	1.65E-2 (311/311) 4.27E-3 - 2.86E-2	Hartsville substation 6.3 miles ESE	1.71E-2 (52/52) 7.17E-3 - 2.84E-2	1.63E-2 (48/48) 7.94E-3 - 2.90E-2
	Gamma 28	N/A	All less than LLD		All less than LLD	All less than LLD
Broadleaf Vegetation (pCi/g) wet	Gamma 53 <sup>(4)</sup>	1.5E-2	8.50E-2 (24/36) 1.43E-2 - 3.37E-1	CP&L Property 0.25 mile SSE	1.13E-1 (11/18) 1.81E-2 - 3.37E-1	4.93E-1 (10/17) 2.03E-2 - 1.37E+0
	Cs-137					
Fish (pCi/g) wet Bottom-Feeder	Gamma 9	1.7E-2	5.14E-2 (6/6) 2.82E-2 - 6.89E-2	Lake Robinson site varies	5.30E-2 (3/3) 2.82E-2 - 6.89E-2	All less than LLD
	Cs-137	1.8E-2	1.78E-1 (6/6) 1.40E-1 - 1.89E-1	Lake Robinson site varies	1.87E-1 (3/3) 1.86E-1 - 1.89E-1	1.58E-1 (3/3) 2.11E-1 - 1.32E-1
	K-40	5.0E-1	3.29E+0 (6/6) 2.21E+0 - 4.01E+0	Lake Robinson site varies	3.35E+0 (3/3) 2.21E+0 - 4.01E+0	2.56E+0 (3/3) 2.11E+0 - 2.87E+0
Fish (pCi/g) wet Free-Swimmer	Gamma 9	1.7E-2	9.88E-2 (6/6) 7.96E-2 - 1.26E-1	Lake Robinson site varies	1.14E-1 (3/3) 9.74E-2 - 1.26E-1	3.10E-2 (1/3) Single value
	Cs-137	1.8E-2	2.98E-1 (6/6) 2.69E-1 - 3.41E-1	Lake Robinson site varies	3.00E-1 (3/3) 2.90E-1 - 3.08E-1	3.06E-1 (3/3) 2.46E-1 - 3.59E-1
	K-40	5.0E-1	3.20E+0 (6/6) 2.71E+0 - 3.66 E+0	Lake Robinson site varies	3.40E+0 (3/3) 3.01E+0 - 3.66+0	2.72E+0 (3/3) 2.60E+0 - 2.85E+0
Food Products (pCi/g) wet	Gamma 3 Cs-137	1.60E-2	All less than LLD		All less than LLD	1.14E-2 (1/1) Single value

TABLE 2-1 (continued)

## ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

H.B. Robinson Steam Electric Plant  
Darlington County, South Carolina

Docket Numbers - 50-261  
Calendar Year 1987

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	Typical Lower Limit of Detection (LLD) (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean		Control Location Mean Range (2)
				Name, Distance, and Direction	Mean Range (2)	
Groundwater (pCi/l)	Gamma 36	N/A	All less than LLD		All less than LLD	No control
	Tritium 36	1.2E+3	All less than LLD		All less than LLD	No control
Milk (pCi/l)	I-131 30 (5)	3.0E-1	All less than LLD		All less than LLD	All less than LLD
	Gamma 30	4.7E+0	All less than LLD		All less than LLD	4.62E+0 (3/26)
	Cs-137					2.90E+0 - 6.16E+0
	Hg-203	5.0E+0	All less than LLD		All less than LLD	6.08E+0 (1/26) Single value
Shoreline Sediment (pCi/g) dry	Gamma 4	3.6E-2	3.59E-2 (2/4) 1.48E-2 - 5.71E-2	Ash Pond 0.9 mile NNW	5.71E-2 (1/2) Single value	No control
	Cs-137					
Surface Water (pCi/l)	Gamma 36	N/A	All less than LLD		All less than LLD	All less than LLD
	Tritium 36	1.2E+3	1.54E+3 (9/24) 1.30E+3 - 1.77E+3	SC-23 at Black Creek 0.6 mile ESE	1.58E+3 (5/12) 1.48E+3 - 1.77E+3	All less than LLD
TLD (mrem/wk)	TLD 152 (6)	1 mR	1.13E+0 (148/148) 7.00E-1 - 1.90E+0	Intersection of SR 13-51 and 16-12 4.4 miles SSW	1.80E+0 (4/4) 1.70E+0 - 1.90E+0	1.17E+0 (4/4) 1.10E+0 - 1.30E+0

#### FOOTNOTES:

1. The Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will yield a net count above system background which will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a "real" signal.
2. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parentheses.
3. Air particulate and charcoal cartridges are collected weekly for a possible total of 364 (7 locations x 52 weeks) samples. Missing samples are discussed in Section 4.1.
4. Broadleaf vegetation samples are collected monthly when available from three locations for a possible total of 108 samples. The 24 missing samples are discussed in Section 4.2.
5. Milk samples are collected every two weeks from two commercial dairies. The Auburndale Plantation had no dairy operations between January 1, 1987, and November 9, 1987. See Section 4.3.
6. TLDs are collected quarterly from 39 locations for a possible total of 156 analyses. The missing TLDs are discussed in Section 4.4.

### 3.0 INTERPRETATIONS AND CONCLUSIONS

#### 3.1 Air Sampling

Air samples collected during 1987 have measurable gross beta activity in 311 of 311 samples, at an average concentration of  $1.65\text{E-}2$  pCi/m<sup>3</sup> and  $1.63\text{E-}2$  pCi/m<sup>3</sup> for the indicator and control locations, respectively. These are consistent with preoperational data obtained for the H.B. Robinson Plant and are typical of naturally occurring radionuclides. Figures 3-1 through 3-6 compare indicator and control location gross beta activity. The figures demonstrate that there were no significant deviations between indicator and control locations.

The quarterly composite gamma analyses for air particulate samples for all quarters revealed no anthropogenic radionuclides.

Weekly air cartridge samples are analyzed for iodine-131 (I-131) by gamma spectrometry. Iodine-131 activity was detected only once during 1987. For collection period ending January 5, 1987, at indicator location AC-6 (0.6 mile SSW from plant site), iodine-131 activity was detected at a concentration of  $1.13\text{E-}2$  pCi/m<sup>3</sup>. During this collection period, plant operations released  $9.10\text{E-}3$  Ci of iodine-131, and the weekly average dispersion factor from the concurrent meteorology for this location was  $2.20\text{E-}06$  sec/m<sup>3</sup> undecayed and undepleted. Using Regulatory Guide 1.109 methodology, this would represent an average concentration of  $3.31\text{E-}2$  pCi/m<sup>3</sup> which is a factor of 3 more conservative than the environmental sampling and analysis results. The inhalation dose to a child's thyroid using the environmental sample results ( $1.13\text{E-}2$  pCi/m<sup>3</sup>) for one week ( $6.05\text{E-}05$  sec.), dose conversion factor of  $4.39\text{E-}03$  mrem/pCi, and inhalation rate of  $1.17\text{E-}04$  m<sup>3</sup>/sec from Regulatory Guide 1.109 would only be  $3.51\text{E-}03$  mrem which is insignificant in comparison to the 10CFR50 Appendix I limit (15 mrem).

### 3.2 Broadleaf Vegetation

Broadleaf vegetation sampling is accomplished by collecting oak, persimmon, magnolia, cherry, dogwood, maple, chinaberry, and sweetgum leaves. Three species of samples, when available, are collected monthly at three locations (one control and two locations at site boundary with the highest calculated annual average ground level deposition). Broadleaf sampling is conducted since no milk animals are located within the area influenced by the plant, a radius approximately five miles, and is used to simulate dose to an individual via the milk pathway.

Cesium-137 was the only radionuclide detected during 1987 at an average concentration of 493 pCi/kg (10 of 14 analysis) for the control location and 85 pCi/kg (24 of 36 analysis) for the indicator locations. These activities are not attributed to plant operations and reflect the accumulation of debris from old nuclear testing. In addition, Table 3.1 shows that the cesium-137 activity appears to be more dependent on species at higher concentrations of the control location than the indicator locations.

Table 3-1

Cesium-137 (pCi/kg  $\pm$  2 Sigma Error)  
in Broadleaf Vegetation

Wild Cherry

<u>DATE</u>	<u>Control Location</u>	<u>0.25 mi. SSE</u>	<u>0.25 mi. NNE</u>
4/28	$\leq 22.5$	$\leq 23.2$	$72.6 \pm 23.2$
5/22	$20.3 \pm 10.5$	$\leq 26.0$	$26.6 \pm 14.8$
6/29	$\leq 25.7$	$40.2 \pm 15.6$	
7/21	$\leq 20.6$	$\leq 22.5$	
8/11	$\leq 23.2$	$25.3 \pm 14.6$	$\leq 27.1$
9/15		$49.2 \pm 19.8$	

Oak

4/28	$89.6 \pm 32$	$\leq 23.5$	$59.9 \pm 17.7$
5/22	$101 \pm 32$	$18.2 \pm 5.1$	$83.0 \pm 29.9$
6/29	$1,373 \pm 62$	$186 \pm 29.9$	$93.4 \pm 30.2$
7/21	$885 \pm 44$	$147 \pm 37.2$	$93.2 \pm 34.8$
8/11	$615 \pm 50$	$129 \pm 29.5$	$98.5 \pm 28.9$
9/15	$749 \pm 60$	$257 \pm 31.0$	$80.8 \pm 19.8$

Maple

4/28			$53.6 \pm 20.4$
8/11	$\leq 18.7$		
9/15	$\leq 24.7$		$78.0 \pm 29.4$

Dogwood

5/22	$\leq 28.4$
------	-------------

Table 3-1 (cont.)

<u>Persimmons</u>			
<u>DATE</u>	<u>Control Location</u>	<u>0.25 mi. SSE</u>	<u>0.25 mi. NNE</u>
4/28		$\leq 17.6$	
5/22		$\leq 20.8$	$\leq 26.7$
6/29		$\leq 19.6$	$\leq 23.5$
7/21	$36.4 \pm 16.6$	$336 \pm 36$	$19.5 \pm 15.9$
8/11		$28.8 \pm 13.9$	
9/15		$28.4 \pm 15.1$	$\leq 22.8$

<u>Magnolia</u>			
6/29			$\leq 29.2$
7/21			$25.3 \pm 23.0$
8/11			$14.3 \pm 17.9$

<u>Sweetgum</u>			
9/15	$200 \pm 35.8$		

<u>Chinaberry</u>			
6/29	$51.0 \pm 13.2$		



### 3.3 Fish

Samples of free-swimming and bottom-feeding fish were collected from Lake Robinson, Prestwood Lake, and Bee Lake (control) during May, June, and November. Gamma isotopic analysis was performed on the edible portions and cesium-137 (Cs-137) and cesium-134 (Cs-134) activity was detected. Using a T-test at 99.5 percent confidence level for comparing the Cs-137 concentrations in Robinson Lake and Prestwood Lake (indicator locations) to Bee Lake (control location) reveals no influence from plant operations is indicated (see Table 3.2).

Table 3-2

Cesium-137 Concentrations  $\pm$  2 Sigma Error  
in Fish Samples

#### Free Swimmers

	<u>Bee Lake</u>	<u>Robinson</u>	<u>Prestwood</u>
May	359.2 $\pm$ 53.7	304.2 $\pm$ 77.6	268.8 $\pm$ 41.2
June	312.9 $\pm$ 46.7	307.5 $\pm$ 33.7	277.8 $\pm$ 40.6
November	246.1 $\pm$ 31.7	289.6 $\pm$ 47.1	341.0 $\pm$ 46.2

#### Bottom Feeders

May	210.8 $\pm$ 39.1	186.2 $\pm$ 43.9	181.2 $\pm$ 25.4
June	130.0 $\pm$ 29.0	189.0 $\pm$ 32.8	140.3 $\pm$ 24.3
November	132.2 $\pm$ 33.9	185.6 $\pm$ 33.5	182.8 $\pm$ 37.3

Cesium-134 was detected in fish samples for both Lake Robinson and Prestwood Lake in six of six analyses at an average concentration of 83.3 pCi/kg and 66.3 pCi/kg, respectively. These average concentrations include free-swimmers and bottom-feeders. Fish samples from Bee Lake (control location) had Cs-134 activity in one of six analyses at a concentration of 31.0 pCi/kg. The average Cs-134 concentration at the control location including the low limit detection (LLD) for the nondetectable analysis is 34.6

pCi/kg. Using 34.6 pCi/kg as a background from other source terms would leave a net concentration of 48.7 pCi/kg in fish samples for Lake Robinson. Using 21 kg/yr consumption rate for an adult, dose conversion factor of  $1.48\text{E-}4\text{pCi/pCi}$ , and the methodology in Regulatory Guide 1.109 would yield a dose to the liver (most critical organ) of 0.151 mrem/yr. Plant operations during 1984 released  $7.59\text{E-}03\text{ Ci}$  of Cs-134 at a liquid flow rate of 971  $\text{ft}^3/\text{sec}$  with a mixing ratio of 0.817 for Lake Robinson. Using the bioaccumulation factor of 2000 pCi/kg/pCi/l, dose conversion factor of  $1.48\text{E-}4\text{ mrem/pCi}$ , consumption rate of 21 kg/yr, and the methodology from Regulatory Guide 1.109 the dose to the most critical organ (adults liver) is 0.0437 mrem. This compares reasonably well with the dose to the most critical organ (liver) of 0.151 mrem/yr derived from environmental sample results and is well within the 10CFR50 appendix limit of 10.0 mrem/yr.

### 3.4 Food Crops

Locally grown food products are sampled annually at harvest and analyzed for gamma-emitting radionuclides. Tomatoes and corn were collected from the two indicator locations and corn from the control location. Cesium-137 was detected at the control location (not influenced by plant operations) at a concentration of 11.4 pCi/kg which is attributed from debris of old nuclear testing.

### 3.5 Groundwater

Groundwater is sampled monthly and analyzed for tritium and gamma-emitting radionuclides at three locations. All analyses were less than the lower limit of detection.

### 3.6 Milk Samples

After being closed since May 1986, milk samples from the Auburndale Plantation [(MK-54), 10.1 miles east] were collected beginning November 9, 1987. The purpose of this location is to evaluate the

potential dose via irrigating-grass-cow-milk-man pathway. All analyses at this location were less than the lower limit of detection. Milk samples were also collected from Lyndale Dairy [(Mk-53) control location] which is located 9.0 miles southwest of site and is not under the influence of plant operations. Milk samples at this location had Cs-137 activity in 3 of 26 samples at an average concentration of 4.62 pCi/l ranging from 2.9 pCi/l to 6.16 pCi/l. These concentrations are representative of data obtained over the last several years and reflect the accumulation of debris from old nuclear testing.

### 3.7 Shoreline Sediment

Shoreline sediment samples are collected semiannually from a downstream area with existing recreational value. This location is at the Shady Rest Club on Lake Robinson, 1.9 miles NNE. Cesium-134 was detected in one of two samples at a concentration of  $1.48\text{E-}02$  pCi/kg which is equivalent to approximately 515.7 pCi/m<sup>2</sup>. The maximum individual (teenager) exposure from this ground plane source would only be  $1.45\text{E-}4$  mrem/yr. This is fairly good agreement with the dose results derived from effluent releases of  $6.97\text{E-}5$  mrem/yr (a factor of 2) using the methodology in Regulatory Guide 1.109.

An additional shoreline sediment sample is collected from the ash pond. This sample is not for evaluating routine releases but for trending long-term impact from burial of slightly contaminated fly ash/soil from the settling ponds. The only radionuclide detected was Cs-137 at a concentration of 57.1 pCi/kg which has insignificant consequences.

### 3.8 Surface Water

Surface water samples are analyzed monthly for gamma-emitting radionuclides and tritium. All gamma-emitting radionuclide activities were less than the lower limit of detection (< LLD). Tritium

was detected in 9 of 24 indicator samples with an average concentration of  $1.54\text{E}+3$  pCi/liter. The location with the highest concentration was at Secondary Road S-16-23 with an average concentration of  $1.58\text{E}+3$  pCi/liter. This average concentration is consistent with concentrations detected in previous years, and the dose to an individual is insignificant. All control activities were less than the lower limit of detection.

### 3.9 Thermoluminescent Dosimetry (TLD) Area Monitors

The average dose rate of all indicator locations was 1.13 mrem/wk which is comparable to the control location average of 1.17 mrem/wk. The location with the highest reading was near the intersection of Secondary Roads S-13-51 and S-16-12, 4.4 miles SSW. This location had an average dose rate of 1.80 mrem/wk with a range of 1.6 to 1.9 mrem/wk. This location has a history of being approximately 60 percent higher than the average of all indicator locations and its value is attributed to local geologic anomalies and not to plant operations.

The TLDs are located in two concentric rings of which one is approximately a one-mile radius of the plant and the other is approximately a five-mile radius of the plant. To assess direct radiation from the Robinson Plant to members of the public, a one-sided t-test was performed. The test was to determine if the average dose rate of the one-mile radius TLDs exceeded that of the five-mile radius TLDs. The results of the test showed statistically that the inner ring did not represent a higher dose than the outer ring. Therefore, no measurable effect from plant operations was detected.

### 3.10 Summary

The radiological environmental monitoring program was conducted in accordance with the technical specifications and procedures for the H.B. Robinson Steam Electric Plant.

1. All detectable radioactivities have been within the guidance set forth in the technical specifications.
2. The environmental analyses performed during 1987 demonstrate that the H.B. Robinson Steam Electric Plant continues to operate in harmony with the environment and the general public.

CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR POINT SAMPLE COLLECTED FROM=0002

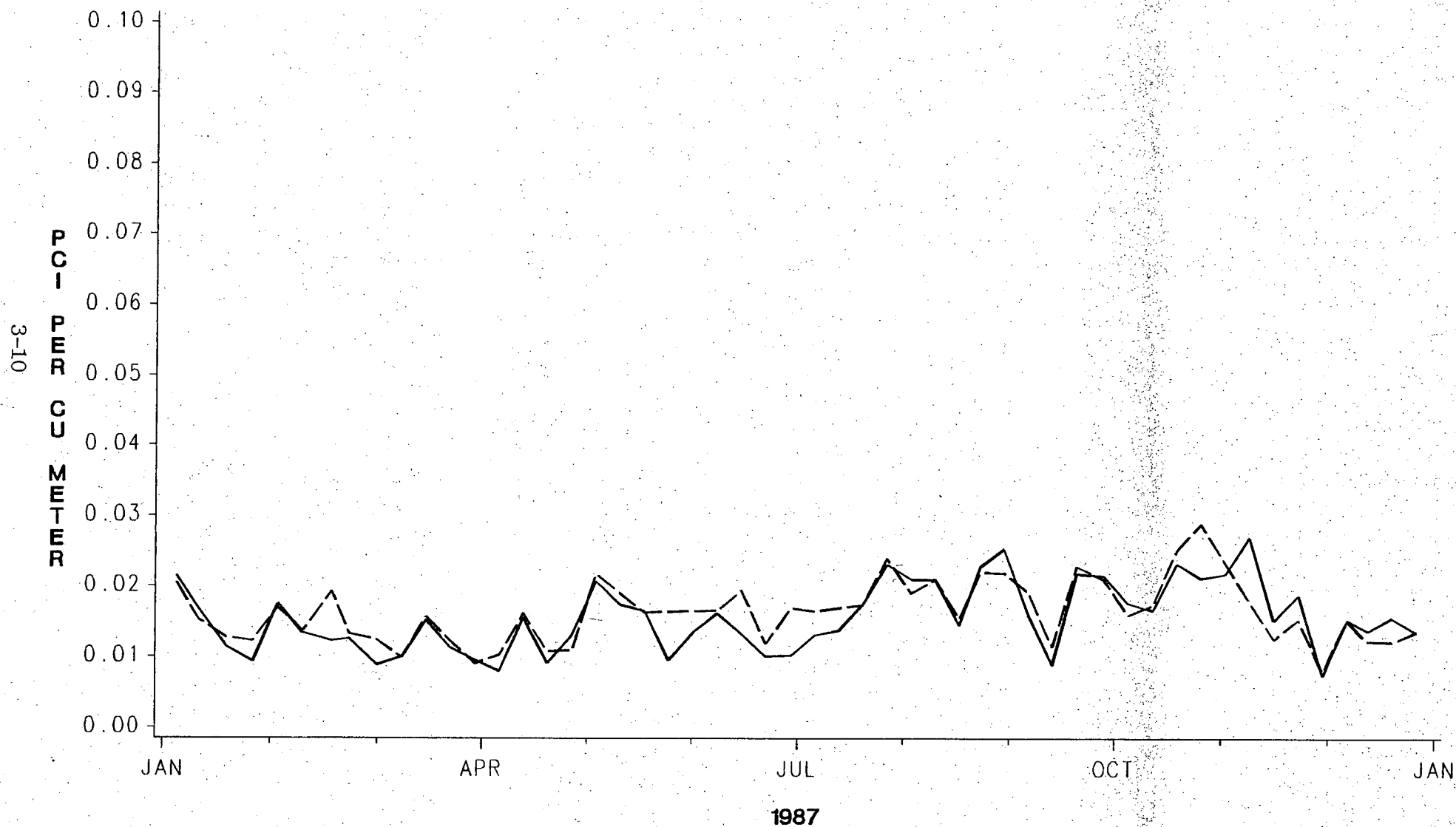


Figure 3-1

CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR POINT SAMPLE COLLECTED FROM=0003

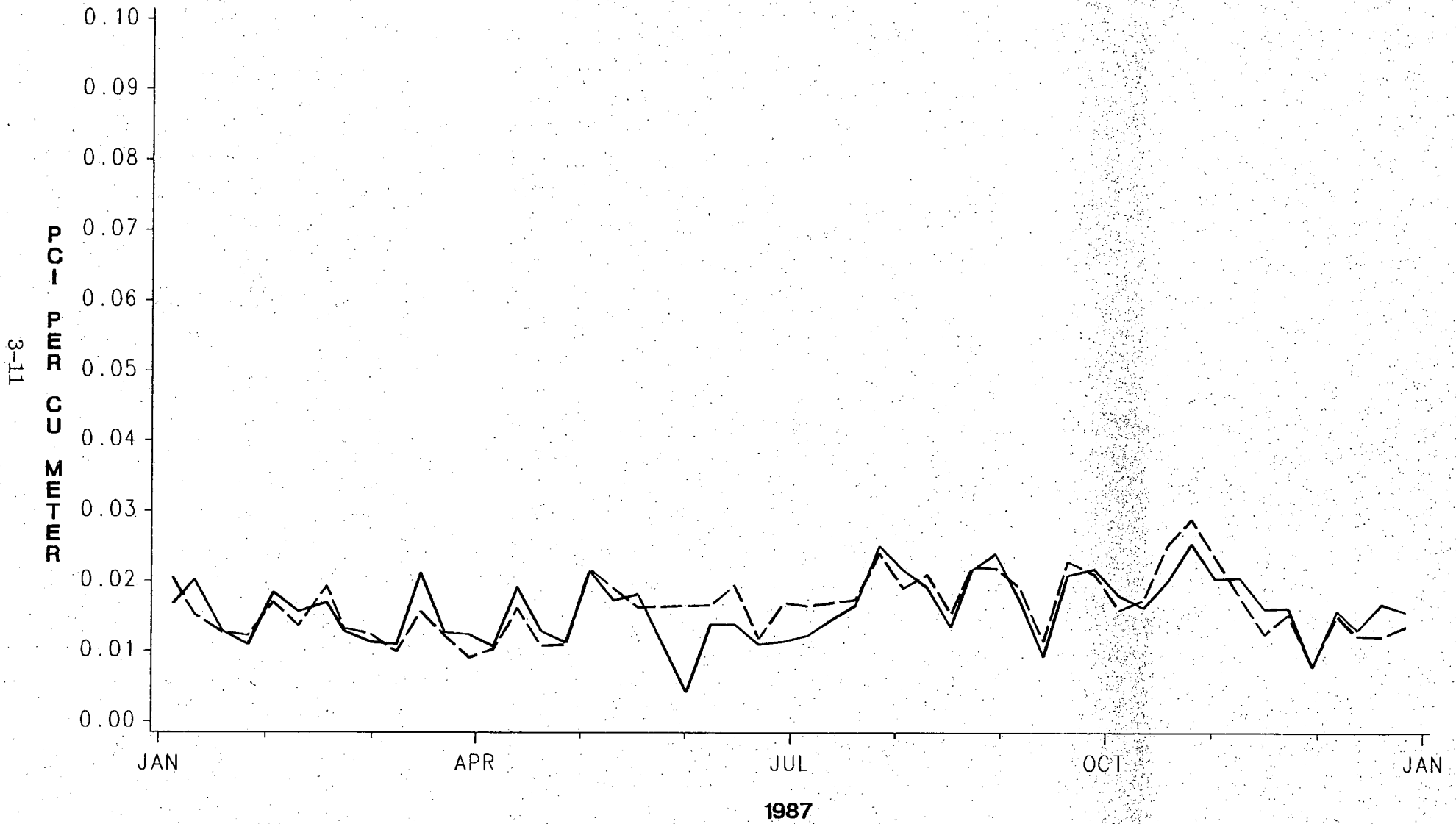


Figure 3-2

CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR POINT SAMPLE COLLECTED FROM=0004

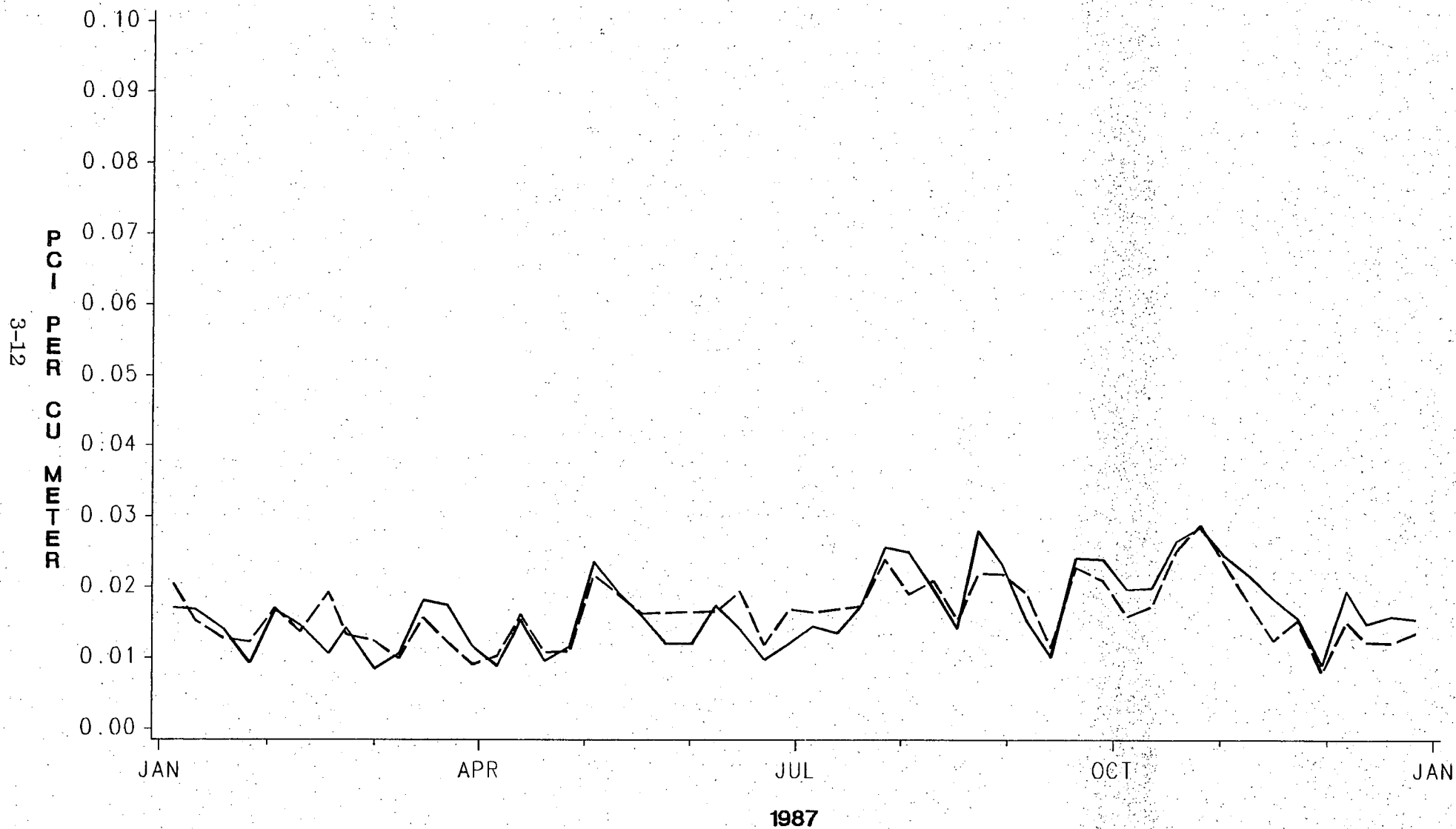


Figure 3-3



CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR POINT SAMPLE COLLECTED FROM=0005

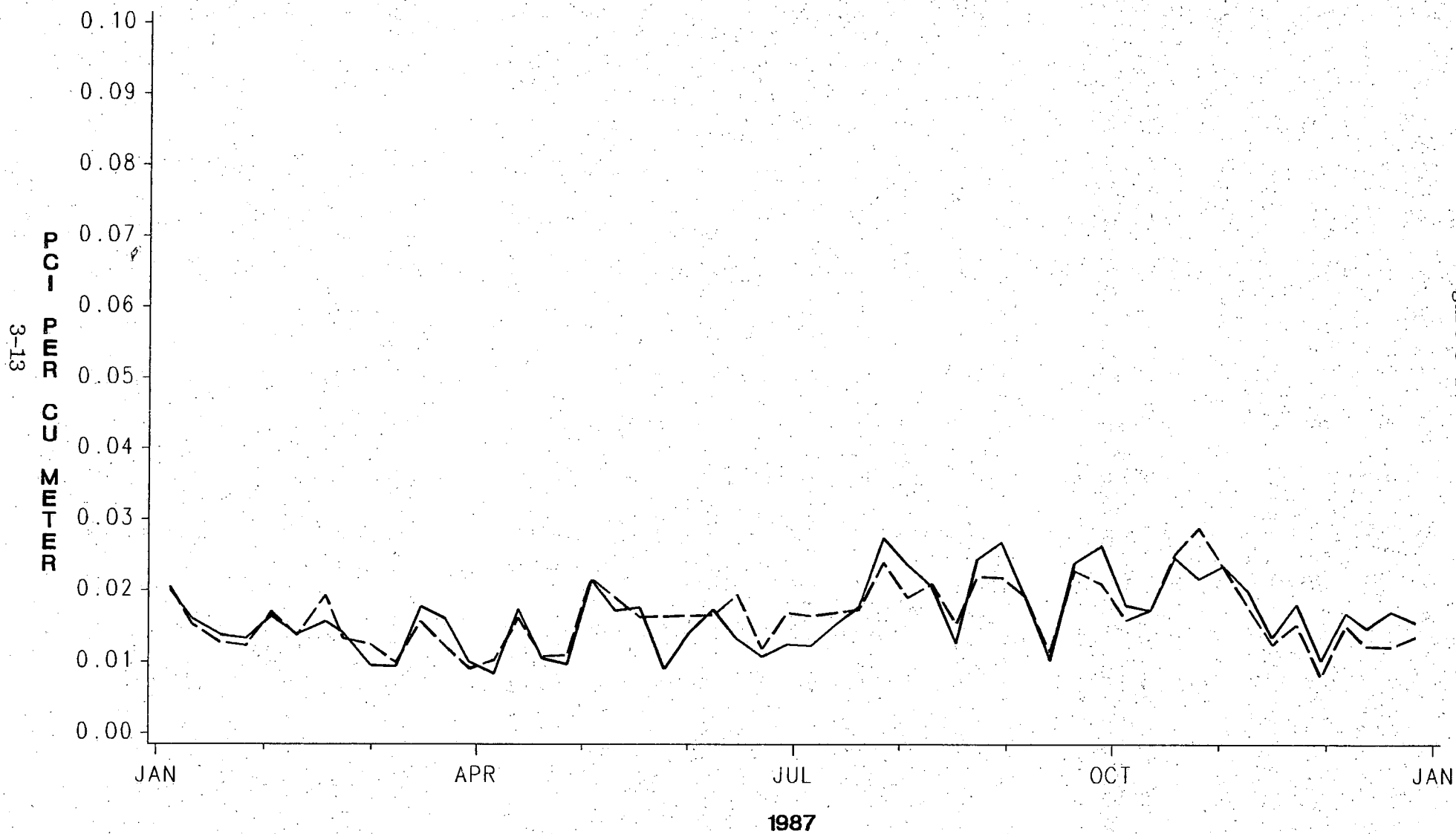


Figure 3-4

CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR POINT SAMPLE COLLECTED FROM=0006

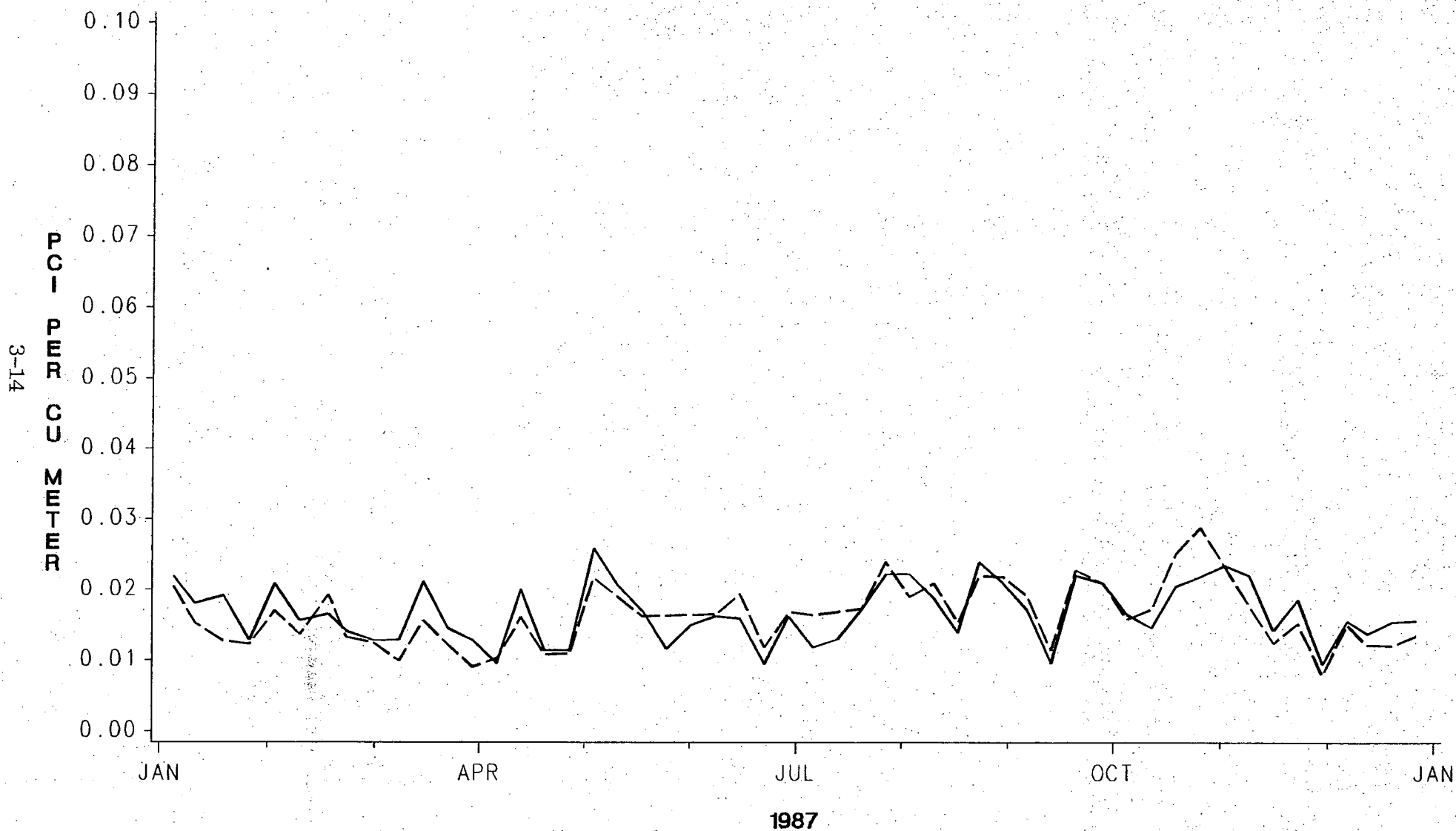


Figure 3-5

CP&L ENVIRONMENTAL SURVEILLANCE  
GROSS BETA ACTIVITY FOR  
AIR PARTICULATE SAMPLES  
PLANT=HBR. POINT SAMPLE COLLECTED FROM=0007

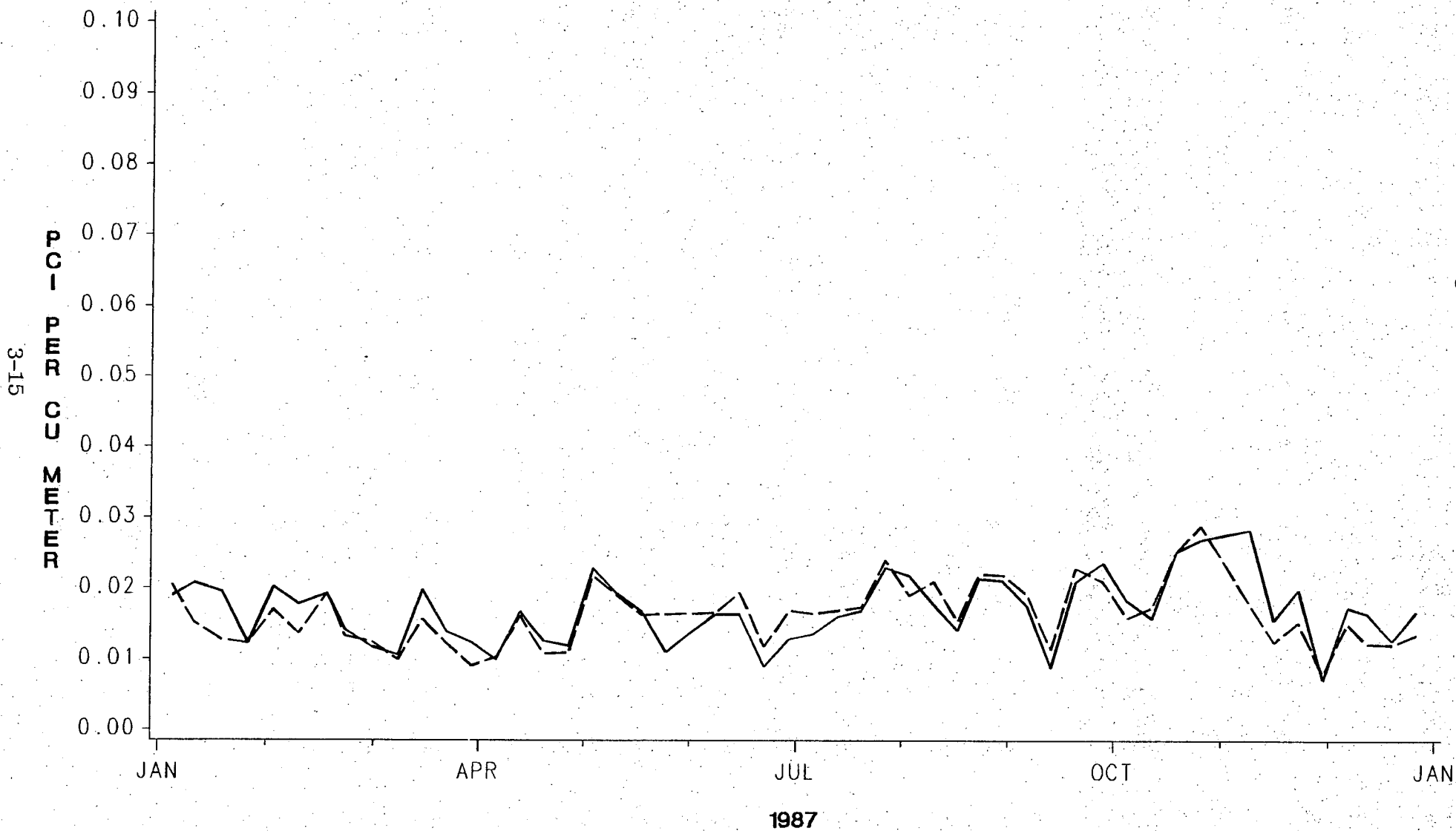


Figure 3-6

SOLID LINE FOR SAMPLE STATION  
BROKEN LINE FOR CONTROL STATION

#### 4.0 MISSED SAMPLES AND ANALYSES

##### 4.1 Air Cartridge and Air Particulate (Weekly)

Air particulate and charcoal cartridges are collected weekly. There were 52 weeks in 1987 times 7 air-monitoring locations for a possible total of 364 samples. Listed below are the missing samples.

<u>Location</u>	<u>Date</u>	<u>Reason</u>
Location 1 Ctrl	May 25, 1987	Low volume due to faulty circuit breaker.
Location 3	May 25, 1987	Low volume due to mechanical malfunction. Replaced sampler.
Location 1 Ctrl	June 1, 1987	Low volume due to faulty circuit breaker.
Location 1 Ctrl	July 13, 1987	Low volume due to faulty circuit breaker.
Location 1 Ctrl	November 2, 1987	Low volume due to mechanical malfunction.

##### 4.2 Broadleaf Vegetation Samples (Monthly)

Broadleaf vegetation samples are collected monthly when available from three locations. Three different kinds of broadleaf vegetation should be collected from each location for a possible total of 108 samples. These samples were not collected due to seasonal availability:

January	March	November
February	October	December

#### April

BL-52 Ctrl                      1 of 3 samples not available at this location.

#### **4.3 Milk**

Milk samples are typically collected every two weeks from two commercial dairies. The Auburndale Plantation had no dairy operations between January 1, 1987, and November 9, 1987. A total of 4 samples were collected from the Auburndale Plantation and 26 samples were collected from the Lyndale Farm (control) for a total of 30 milk samples.

#### **4.4 Thermoluminescent Dosimeters (TLDs)**

The following list identifies all missing TLDs.

<u>Location</u>	<u>Reason</u>	<u>Date</u>
Location 18	Missing in field at time of collection	Second quarter
Location 22	Missing in field at time of collection	Second quarter
Location 32	Missing in field at time of collection	Second quarter
Location 33	Missing in field at time of collection	Third quarter

## 5.0 LAND-USE CENSUS

The 1987 land-use census was performed on May 7, 1987, in accordance with Technical Specification 3.17.2. The purpose of the survey was to identify the location of the nearest milk animal, the nearest resident, and the nearest garden of greater than 500 square feet producing fresh, leafy vegetables in each of the 16 meteorological sectors within a distance of 5 miles.

Table 5-1 summarizes the locations of the nearest resident and garden within a five-mile radius of the site in each of the 16 meteorological sectors.

Table 5-1  
Distances to Locations of Interest (miles)

Sector	Distance to Nearest Resident	Distance to Nearest Garden
N	2.9	2.9
NNE	1.3	1.8
NE	1.1	1.1
ENE	0.85	1.1
E	0.8	0.9
ESE	0.6	0.8
SE	0.3	1.0
SSE	0.30	1.5
S	0.3	0.3
SSW	0.30	0.8
SW	0.40	0.9
WSW	0.4	0.4
W	0.5	0.5
WNW	0.6	0.6
NW	1.2	1.2
NNW	2.9	2.9

---

No milk-producing animals are located within a five-mile radius of the plant.

## 6.0 ANALYTICAL PROCEDURES

### 6.1 Gross Beta

Gross beta radioactivity measurements are made utilizing a Tennelec Low-Background Alpha/Beta Counting System. The LLD for air particulates is approximately  $0.0013 \text{ pCi/m}^3$  for Robinson site.

Air particulate samples are mounted in 2-inch stainless steel planchets and counted directly.

### 6.2 Tritium

Liquid samples requiring tritium analysis are distilled. Five milliliters of the distillate are mixed with ten milliliters of liquid scintillation cocktail and counted on a liquid scintillation counter for 50 minutes. The LLD is approximately 1200 pCi/l.

### 6.3 Iodine-131

Iodine-131 airborne concentrations are quantified by the Ge(Li) gamma spectrometry systems. The cartridges are placed on the detector, and each charcoal cartridge is counted individually with an approximate LLD of  $1\text{E}-2$  to  $3\text{E}-2 \text{ pCi/m}^3$ .

Iodine-131 in milk is analyzed by use of anion-exchange resin, sodium hypochlorite leach, and organic extraction. Iodine is precipitated as silver iodide, collected on a tared filter, dried, and counted on a beta-gamma coincidence system or by low-background beta counter. The LLD is approximately 0.3 pCi/liter.

### 6.4 Gamma Spectrometry Ge(Li)

Gamma spectrum analysis utilizes germanium or Ge(Li) detectors with thin aluminum windows housed in steel and lead shields. The analyzer systems are Nuclear Data 4420 and 6685. Table 6-1 summarizes

LLD values derived from instrument sensitivity based upon a blank sample background.

Air particulate composites are placed in a Petri dish and analyzed directly.

Liquid samples, except milk, are boiled down to a small volume, transferred to a 250-ml polypropylene beaker with lid, and analyzed directly.

Shoreline sediments are dried, weighed, and then analyzed in a Marinelli beaker.

Food products and broadleaf vegetation samples are weighed as sampled and analyzed in a Marinelli beaker.

Fish samples are cleaned and dressed and the edible portions are placed in a Marinelli beaker for analysis.

## **6.5 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 lighttight 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 deexcited above 150°C. The lower-energy traps are automatically eliminated through a preheat cycle. Calibration is checked regularly using dosimeters irradiated to known doses. Prior to the measurement of each dosimeter, the instrument is checked through use of an internal constant light source as a secondary standard. The minimum sensitivity of the dosimeters used is approximately 1 mR.



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

#### 6.6 EPA Laboratory Intercomparison Program

The Radiological Environmental Laboratory at the Harris Energy & Environmental Center in New Hill, North Carolina, provides radio-analytical services for CP&L's nuclear plant environmental surveillance programs. The laboratory is a participant in the EPA cross-check program and uses its performance in this program as a major determinant of the accuracy and precision of its analytical results.

During 1987, 21 samples representing 3 major environmental media (water, milk, and air filters) were analyzed. Data on the known activities and the normalized standard deviations using the known value for these 50 analyses have been received from EPA. A comparison of the average of our reported values with the EPA known activity and its normalized standard deviation is provided below:

<u>Standard Deviation From Known Activity</u>	<u>Percent of Analyses</u>
≤ 1 standard deviation	58
≤ 2 standard deviation	86
≤ 3 standard deviation	94

Of the 50 determinations, 3 (~6 percent) fell outside the 3 standard deviation control limit.

In June 1987, an analysis for gross alpha in water was 3.10 standard deviations above the known value. The self-absorption curve was redone, and the analysis then yielded a value of 34 pCi/l as compared with the known value of 30 pCi/l. This is equivalent to a value of 0.79 standard deviation above the known value. There appeared to have been a shift in the curve developed in January 1987 for the higher solid contents.

In July 1987, Cr-51 in a gamma analysis of water was 4.15 standard deviations above the known value. The values for the other 5 nuclides were all equal to or less than 1.5 standard deviations from the known values. Cr-51 is determined using the 9.83 percent abundance peak at 320.08 keV. Subsequent analyses for Cr-51 were within limits.

In October 1987, a gross beta analysis of water was 5.54 standard deviations above the known value. An EPA sample run after this sample with the same parameters was 0.38 standard deviations below the known value. The difference in the reported value is probably due to technician error during the preparation of the sample. Sr-89 and Cs-137 were among the beta emitters in the sample. It is interesting to note that 44 percent of the participating laboratories were outside the 3 standard deviations for this parameter.

#### **6.7 Lower Limits of Detection (LLD)**

All samples analyzed met the LLD required by Technical Specification. Typical "a priori" LLD values for the samples analyzed are listed in Table 6-1.

Table 6-1

**Typical Lower Limits of Detection (a priori LLD)  
Ge(Li) Gamma Spectrometry**

Surface and Groundwater Samples\*  
(Freshwater)

Isotope	(LLD)
Cr-51	18 pCi/l
Mn-54	3
Co-58	3
Co-60	4
Zn-65	9
Zr-Nb-95	4
I-131	7
Cs-134	4
Cs-137	4
Ba-La-140	12
Other Expected	2 to
Gamma Emitters	56

Air Particulates\*  
(Quarterly Composite)

Isotope	(LLD)
Cs-134	0.001 pCi/m <sup>3</sup>
Cs-137	0.001
Ba-140	0.001
La-140	0.001
Other Expected	0.001 to
Gamma Emitters	0.015

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\*The sample activities were decayed from the middle of the sampling period rather than from the end of the sampling period. This resulted in LLD values that appear higher than values calculated from the end of the period.

Table 6-1 (continued)

Milk  
(gamma scan)

Isotope	(LLD)
Cr-51	33 pCi/l
Mn-54	5
Co-58	6
Co-60	7
I-131	4
Cs-134	6
Cs-137	5
Ba-La-140	7
Other Expected	2 to
Gamma Emitters	43

Sediments

Isotope	(LLD)
Cr-51	201 pCi/kg
Mn-54	33
Co-58	33
Co-60	55
Cs-134	50
Cs-137	31
Other Expected	16 to
Gamma Emitters	592

Table 6-1 (continued)

Fish

Isotope	(LLD)
Cr-51	248 pCi/kg
Mn-54	46
Co-58	36
Co-60	20
Zn-65	83
I-131	24
Cs-134	54
Cs-137	41
Other Expected	19 to
Gamma Emitters	690

Food Products and Vegetation

Isotope	(LLD)
Cr-51	110 pCi/kg
Mn-54	18
Co-58	19
Co-60	19
I-131	14
Cs-134	19
Cs-137	16
Other Expected	8 to
Gamma Emitters	299