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Dr. J. N. Grace
Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Dear Dr. Grace:

The Annual Environmental Radiological Monitoring Report for 1985 is enclosed for your review. If you have any questions concerning this report, please contact Mr. J. M. Curley at extension 2367.

Very truly yours,

R. E. Morgan
General Manager
H. B. Robinson S. E. Plant

KWE/JCS:sdm

Enclosure

cc: Harold Denton (23)

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Environmental Surveillance Report

January 1, 1985 — December 31, 1985

H.B. ROBINSON
STEAM ELECTRIC PLANT
Unit No. 2

CAROLINA POWER & LIGHT COMPANY

Shearon Harris Energy & Environmental Center

Carolina Power & Light Company

New Hill, North Carolina

ENVIRONMENTAL RADIOLOGICAL MONITORING REPORT

FOR

H.B. ROBINSON STEAM ELECTRIC PLANT

JANUARY 1, 1985, THROUGH DECEMBER 31, 1985

Prepared By:

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TABLE OF CONTENTS

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

LIST OF TABLES

Table		Page
1-1	Environmental Radiological Monitoring Program	1-5
2-1	Environmental Radiological Monitoring Program Summary	2-2
3-1	Dose Commitments from Free-Swimming Fish	3-3
5-1	Typical Lower Limits of Detection (LLD) Ge(Li) Gamma Spectrometry	5-5
6-1	Land-Use Census Distances to Locations of Interest	6-1

LIST OF FIGURES

Figure		Page
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	3-8
3-2	Plot of Air Particulate Gross Beta Activity by Date at Station 03 Versus Control Station Activity	3-9
3-3	Plot of Air Particulate Gross Beta Activity by Date at Station 04 Versus Control Station Activity	3-10
3-4	Plot of Air Particulate Gross Beta Activity by Date at Station 05 Versus Control Station Activity	3-11
3-5	Plot of Air Particulate Gross Beta Activity by Date at Station 06 Versus Control Station Activity	3-12
3-6	Plot of Air Particulate Gross Beta Activity by Date at Station 07 Versus Control Station Activity	3-13

1.0 INTRODUCTION

The following report summarizes the radiological environmental data for the H.B. Robinson Steam Electric Plant during the calendar year 1985. The surveillance requirements for this report were performed by the requirements of the new Radiological Effluent Technical Specifications (RETS) which were implemented on January 1, 1985. This is the ninth 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

The most significant population exposure due to plant operations is from the liquid release pathway through the fish-man pathway. Two additional pathways are also potentially important. They are the airborne radioiodine-pasture-milk pathway and the direct external radiation exposure to ground 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
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

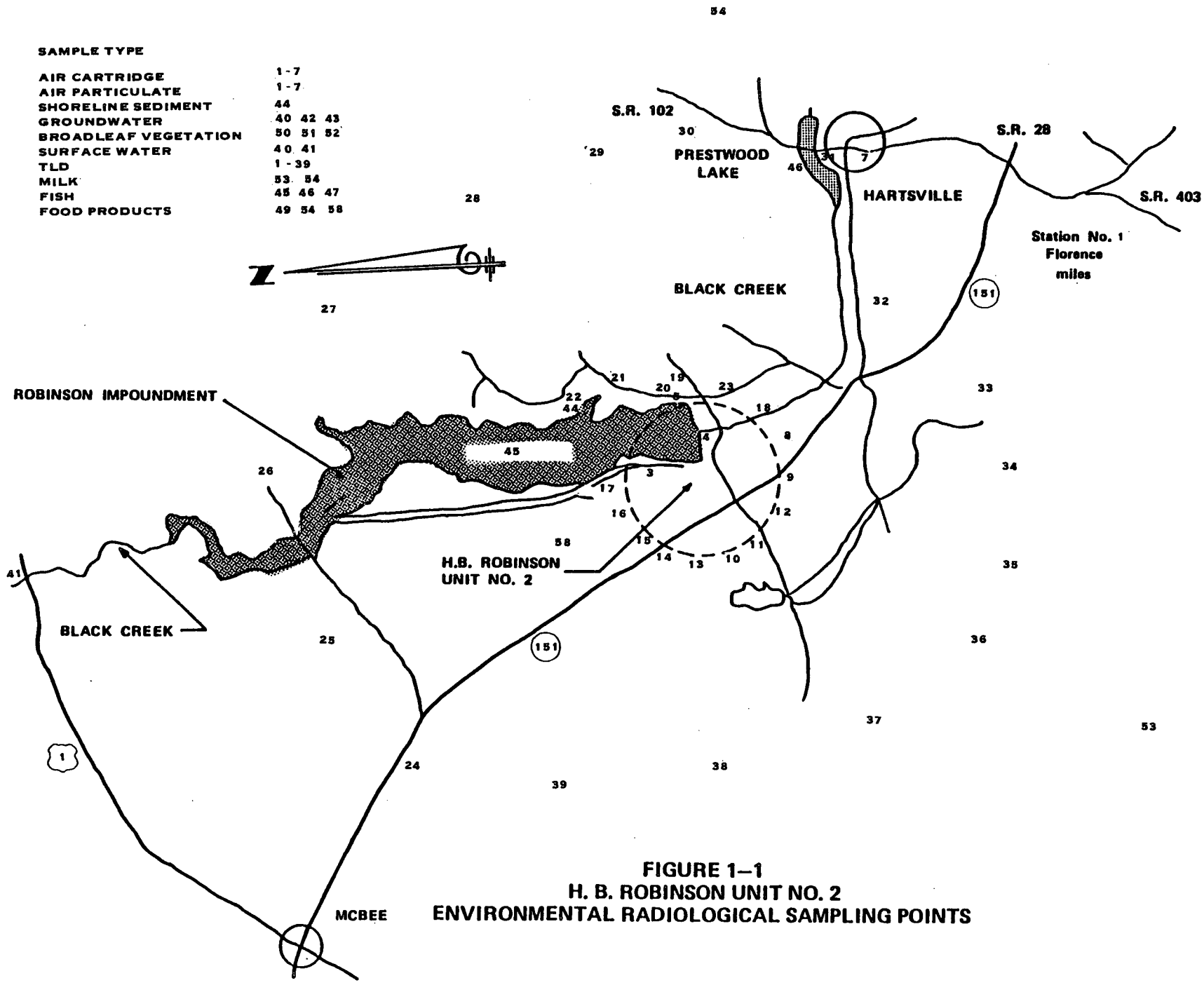


FIGURE 1–1
H. B. ROBINSON UNIT NO. 2
ENVIRONMENTAL RADIOLOGICAL SAMPLING POINTS

SYMBOL	SAMPLE TYPE	
AC	AIR CARTRIDGE	1 - 7
AP	AIR PARTICULATE	1 - 7
SS	SHORELINE SEDIMENT	44
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

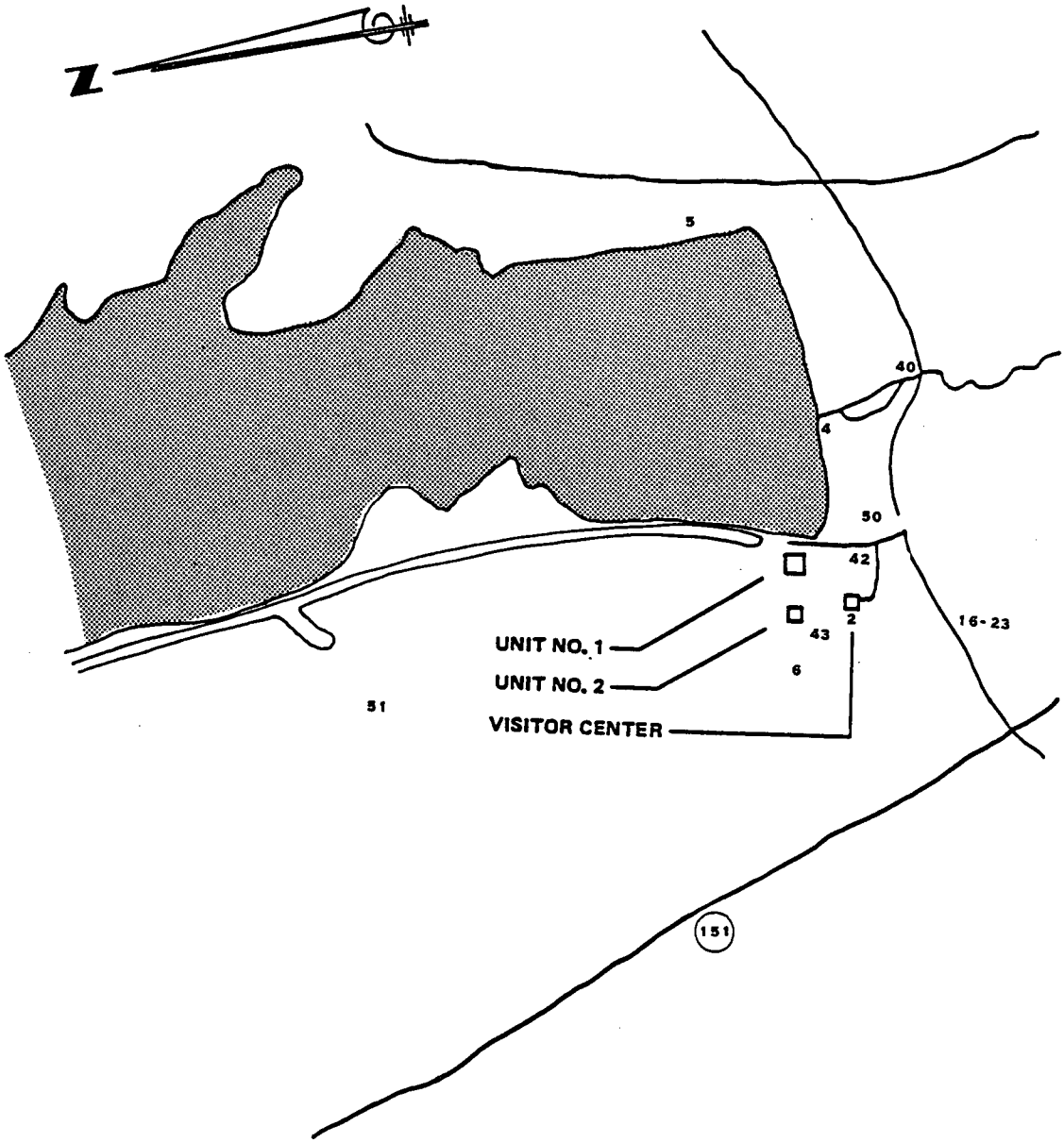


FIGURE 1–2
H. B. ROBINSON UNIT NO. 2
ENVIRONMENTAL RADIOLOGICAL SAMPLING POINTS
ON SITE

TABLE 1-1

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

Sample Type	Sampling Point and Description	Sampling Frequency	Approximate Sample Size	Sample Analysis
Air Cartridge (AC)	1--26 miles ESE Florence--Control 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 End of Construction Road 7--6.3 miles ESE Hartsville*	Weekly	800 cu m	Iodine
Air Particulate (AP)	1--26 miles ESE Florence--Control 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 End of Construction Road 7--6.3 miles ESE Hartsville*	Weekly	800 cu m	Weekly--Gross Beta Quarterly-Composite-Gamma

*Air sample Location 7 is currently at the CP&L substation, Hartsville, 6.3 miles ESE. Prior to November 18, 1985, this sampler was located at the CP&L area office in Hartsville, 5.3 miles ESE. Data for AC/AP-7 is an average of both locations for 1985.

TABLE 1-1 (cont.)

Sample Type	Sampling Point and Description	Sampling Frequency	Approximate Sample Size	Sample Analysis
External Radiation Dose (TL)	1--26 miles ESE Florence--Control 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 End of Construction Road 7--6.3 miles ESE Hartsville 8--0.8 mile SSE Oak Tree Near Transmission Lines 9--1.0 mile S Second Pole From SC-151 10--1.0 mile WSW On Power Pole at Church of God 11--1.0 mile SW 4th Pole From Old Camden Road 12--1.2 miles SSW Tree at 2nd Intersection 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 mile N Pine Tree Beside Discharge 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 Atkinson's Boat Landing	Quarterly	Not Applicable	TLD Readout

TABLE 1-1 (cont.)

Sample Type	Sampling Point and Description	Sampling Frequency	Approximate Sample Size	Sample Analysis
External Radiation Dose (TL) (cont.)	22--1.9 miles NNE Shady Rest Club on Light Pole 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 Lakeshore 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	Quarterly	Not Applicable	TLD Readout

TABLE 1-1 (cont.)

Sample Type	Sampling Point and Description	Sampling Frequency	Approximate Sample Size	Sample Analysis
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	Semiannually	500 grams	Gamma

TABLE 1-1 (cont.)

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

2.0 PROGRAM SUMMARY

The purpose of the Environmental Radiological Monitoring Program is to measure any release and 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 were used as the control locations for the respective measurements and were 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 the entire year of 1985.

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

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

Docket Numbers - 50-261
Calendar Year 1985

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 (2) Mean Range	Location w/Highest Annual Mean: Name, Distance, and Direction	Location w/Highest Annual Mean: Mean Range (2)	Control Locations Mean Range (2)
Air Cartridge (pCi/m^3)	I-131 362(3)	2.00E-2	All less than LLD	All less than LLD		All less than LLD
Air Particulate (pCi/m^3)	Gross Beta 362(3)	7.00E-4	1.66E-2 (310/310) 4.90E-3 - 3.21E-2	Hartsville-(5) 6.3 miles ESE	1.74E-2 (52/52) 8.99E-3 - 3.21E-2	1.60E-2 (52/52) 6.21E-3 - 2.76E-2
	Gamma 28	N/A	All less than LLD	All less than LLD		All less than LLD
Broadleaf Vegetation (pCi/g) wet	Gamma 95 Cs-137	3.20E-2	1.49E-1 (34/63) 1.35E-2 - 7.35E-1	CP&L Property 0.25 mile NNE	1.94E-1 (18/32) 1.35E-2 - 6.60E-1	3.27E-1(17/32) 1.57E-2 - 1.05E+0
Food Products (pCi/g) wet	Gamma 9 Cs-137	3.20E-2	7.37E-2 (3/8) 6.30E-2 - 9.22E-2	1.0 mile W	7.91E-2 (2/3) 6.59E-2 - 9.22E-2	All less than LLD
Fish (pCi/g) dry Bottom Feeder	Gamma 12 Cs-134	1.30E-2	3.18E-1 (7/8) 2.49E-1 - 3.71E-1	Site varies within Lake Robinson	3.27E-1 (3/4) 2.56E-1 - 3.71E-1	All less than LLD
	Cs-137	1.60E-2	1.10E+0 (8/8) 8.83E-1 - 1.43E+0	Site varies within Lake Robinson	1.10E+0 (4/4) 9.70E-1 - 1.25E+0	9.15E-1 (4/4) 6.55E-1 - 1.22E+0
	K-40	2.00E-1	1.59E+1 (7/8) 1.40E+1 - 2.02E+1	Prestwood Lake 4.9 miles ESE	1.67E+1 (4/4) 1.40E+1 - 2.02E+1	1.55E+1 (4/4) 1.37E+1 - 1.77E+1

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 1985

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 (2) Mean Range	Location w/Highest Annual Mean: Name, Distance, and Direction	Location w/Highest Annual Mean: Mean Range (2)	Control Locations Mean Range (2)
Fish (pCi/g) dry Free Swimmer	Gamma 12 Cs-134	1.30E-2	4.52E-1 (8/8) 2.69E-1 - 7.23E-1	Site varies within Lake Robinson	6.09E-1(4/4) 3.89E-1 - 7.23E-1	All less than LLD
	Cs-137	1.60E-2	1.63E+0 (8/8) 1.00E+0 - 2.53E+0	Site varies within Lake Robinson	2.06E+0 (4/4) 1.19E+0 - 2.53E+0	1.69E+0 (4/4) 6.03E-1 - 2.63E+0
	K-40	2.00E-1	1.54E+1 (8/8) 1.21E+1 - 1.83E+1	Prestwood Lake 4.9 miles ESE	1.55E+1 (4/4) 1.40E+1 - 1.83E+1	1.72E+1 (4/4) 1.47E+1 - 1.95E+1
Groundwater (pCi/l)	Gamma 36	N/A	All less than LLD	All less than LLD		No control
	Tritium 36	1.20E+3	All less than LLD	All less than LLD		No control
Milk (pCi/l)	I-131 26	N/A	All less than LLD	All less than LLD		All less than LLD
	Gamma 26 Cs-137	6.40E+0	7.47E+0 (6/12) 3.88E+0 - 1.26E+1	Auburndale Plantation 10.1 miles E	7.47E+0 (6/12) 3.88E+0 - 1.26E+1	3.65E+0 (1/12) (single value)
Shoreline Sediment (pCi/g) dry	Gamma 2	N/A	All less than LLD	All less than LLD		All less than LLD
Surface Water (pCi/l)	Gamma 24	N/A	All less than LLD	All less than LLD		All less than LLD
	Tritium 24	1.20E+3	1.88E+3 (7/12) 1.15E+3 - 2.49E+3	SC23 at Black Creek and Artesian Well 0.6 mile ESE	1.88E+3 (7/12) 1.15E+3 - 2.49E+3	All less than LLD
TLD millirem per week	TLD 152(4)	1 mR	1.36E+0 (148/152) 7.00E-1 - 2.50E+0	Intersection Roads 31-51 and 16-12 4.4 miles SSW	2.05E+0 (4/4) 1.80E+0 - 2.50E+0	1.35E+0 (4/4) 1.30E+0 - 1.40 E+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 parenthesis.

3. Air particulate and charcoal cartridges are collected weekly for a possible total of 364 (7 locations x 52 weeks) samples. As shown in Table 2-1, 362 samples were collected. The two missing samples are discussed in Section 4.

4. TLDs are collected monthly from 39 locations for a possible total of 156 analyses. The four missing TLDs are discussed in Section 4.3.

5. Air Sample Location 7 is currently at the CP&L substation, Hartsville, 6.3 miles ESE. Prior to November 18, 1985, this sampler was located at the CP&L area office in Hartsville, 5.3 miles ESE. Data for AC/AP-7 is an average of both locations for 1985.

3.0 INTERPRETATIONS AND CONCLUSIONS

3.1 Air Samples

Air samples collected during 1985 contained no unusual concentrations of radioactivity. Measurable gross beta concentrations were observed in 310 of 310 samples, averaging 1.66E-2 pCi/m^3, compared to the control location average of 1.60E-2 pCi/m^3. These levels are consistent with preoperational data obtained for the H.B. Robinson Plant. Graphs of the individual air sampling location (gross beta activity) compared to control location gross beta activity are included as Figures 3-1 through 3-6 to demonstrate that all locations were comparable to the control location with no large deviation at any single location.

The quarterly composite gamma analyses for air particulate samples revealed no man-made radionuclides during 1985.

Determination of iodine-131 in air via charcoal was made using gamma spectrometry. No iodine was detected for the entire year.

3.2 Broadleaf Vegetation

The sampling media for broadleaf vegetation includes inedible vegetation such as holly, magnolia, cherry, oak, and other leaves as well as grass samples. Cesium-137 was detected in 34 of 63 samples with an average concentration of 0.149 pCi/g, wet, which is comparable to the control location average concentration of 0.327 pCi/g, wet, in 17 of 32 samples. The location with the highest concentration was on the CP&L property, 0.25 mile N, with an average value of 0.194 pCi/g, wet. The low-level Cs-137 activity detected is attributed to old debris from nuclear testing.

3.3 Fish

Fish samples are normally collected and analyzed quarterly for gamma-emitting radionuclides. The technical specification minimum sampling and analysis frequency is semiannually. The fish are classified into two categories: free-swimming and bottom-feeders. The sample locations for fish are Lake Robinson, Prestwood Lake, and Lake Bee or May Lake (control).

Cesium-134 was observed in fish flesh of the free-swimmers with a mean concentration of 9.13E-2 pCi/gram, wet (4.52E-1 pCi/gram, dry). Calculations were performed for Cs-134 dose assignments for the maximum exposed individual as per Regulatory Guide 1.109 as listed in Table 3-2.

Cesium-137 was observed in fish flesh of free-swimming species from Lake Robinson with a mean of 2.06 pCi/g, dry, in 4 of 4 samples and from Prestwood Lake with a mean of 1.20 pCi/g, dry, in 4 of 4 samples. Using a "t-test," these concentrations are comparable to the mean of 1.69 pCi/g, dry, in 4 of 4 samples collected from the control locations of Lake Bee or May Lake.

TABLE 3-1

DOSE COMMITMENTS FROM FREE-SWIMMING FISH

Assumptions are based on the maximum exposed individual. Calculations are modeled from Regulatory Guide 1.109. The Cs-134 and Cs-137 concentrations are 9.13E-2 pCi/g, wet, and 3.29E-1 pCi/g, wet, respectively.

	Child	Teen	Adult
Consumption (kg/yr)	6.9	16	21
Ingestion factors (mrem/pCi)			
Cs-134 Liver	3.84E-4	1.97E-4	1.48E-4
Cs-134 Total Body	8.10E-5	9.14E-5	1.21E-4
Cs-137 Liver	3.13E-4	1.49E-4	1.09E-4
Cs-137 Total Body	4.62E-5	5.19E-5	7.14E-5
Dose (mrem/yr)			
Cs-134 Liver	0.24	0.29	0.28
Cs-134 Total Body	0.05	0.13	0.23
Cs-137 Liver	0.71	0.78	0.75
Cs-137 Total Body	0.11	0.27	0.49
Total Dose (mrem/yr)			
Liver	0.95	1.07	1.03
Total Body	0.16	0.40	0.72

3.4 Food Products

Locally grown food crops were sampled and analyzed for gamma-emitting radionuclides. Food crops included turnip greens, mustard greens, peaches, squash, corn, persimmons, tomatoes, and soybeans. Cesium-137 was detected in turnip greens mixed with the turnips, mustard greens, and persimmons at concentrations of 92.2 pCi/kg, 65.9 pCi/kg, and 63.0 pCi/kg, respectively. The sporadic appearances and the low concentrations of Cs-137 does not clearly suggest H.B. Robinson Plant as the source and appears to be a recycling process from nuclear testing fallout. No other gamma-emitting radionuclides were detected in the food crop samples.

3.5 Groundwater

Groundwater is sampled quarterly and analyzed for tritium and gamma-emitting radionuclides. The values from all three locations were less than the lower limit of detection (LLD).

3.6 Milk Samples

Milk samples were collected from Lyndale's Farm, 9.0 miles SW, Control, and from the Auburndale Plantation, 10.1 miles E. The iodine-131 (I-131) analyses indicated all activities were less than the lower limit of detection (LLD). Cesium-137 was detected in 6 of 12 indicator location samples with an average concentration of 7.47 pCi/liter. The analyses from the control location revealed Cs-137 in 1 of 12 samples with a value of 3.65 pCi/liter. The higher frequency of detection and concentrations at Auburndale Plantation appear to be attributable to farming practices related to pasture fertilization and the sandy soil conditions as compared to the control location samples. If the source term was attributed totally to the operation of the Robinson Plant, using an average concentration of 6.24 pCi/liter (six typical LLD values used with the six

actual values), the maximum dose to an individual would be as follows:

	Infant	Child	Teen	Adult
Consumption (liters/yr)	330	330	400	310
Ingestion factors (mrem/pCi)				
Cs-137 Bone	5.22E-4	3.27E-4	1.12E-4	7.97E-5
Cs-137 Liver	6.11E-4	3.13E-4	1.49E-4	1.09E-4
Cs-137 Total Body	4.33E-5	4.62E-5	5.19E-5	7.14E-5
Cs-137 Kidney	1.64E-4	1.02E-4	5.07E-5	3.70E-5
Cs-137 Lung	6.64E-5	3.67E-5	1.97E-5	1.23E-5
Cs-137 GI-LLI	1.91E-6	1.96E-6	2.12E-6	2.11E-6
Total Dose (mrem/yr)				
Bone	1.07	0.67	0.28	0.15
Liver	1.26	0.65	0.37	0.21
Total Body	0.09	0.10	0.13	0.14
Kidney	0.34	0.21	0.13	0.07
Lung	0.14	0.08	0.05	0.02
GI-LLI	0.01	0.01	0.01	0.01

3.7 Shoreline Sediment

A shoreline sediment sample is required to be collected semi-annually from a downstream area with existing recreational value. This location is at the Shady Rest Club on Lake Robinson, 1.9 miles NNE. The two samples indicated all gamma-emitting radionuclides were less than the lower limit of detection (LLD).

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 7 of 12 samples with an average concentration of 1880 pCi/liter just downstream of Lake Robinson's spillway (Black Creek). 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 1210 pCi/liter.

3.9 Thermoluminescent Dosimetry Area Monitors

The average dose rate of all indicator locations is 1.36 mrem/wk which is comparable to the control location average of 1.35 mrem/wk. The location with the highest reading was near the intersection of Roads S-31-51 and 16-12, 4.4 miles SSW. This location had an average dose rate of 2.05 mrem/wk with a range of 1.8 to 2.5 mrem/wk. This location's higher dose rate is attributed to local geologic anomalies and not to plant operations. This is supported by data from TLDs 1 mile from the plant in this and adjacent sectors which averaged 1.4 mrem/wk.

3.10 Summary

In summary, the following statements can be made in regard to all radioactive effluents (air particulate, gaseous, and liquid) from the H.B. Robinson Steam Electric Plant:

1. All detectable radioactivities have been below the levels set forth in the technical specifications.

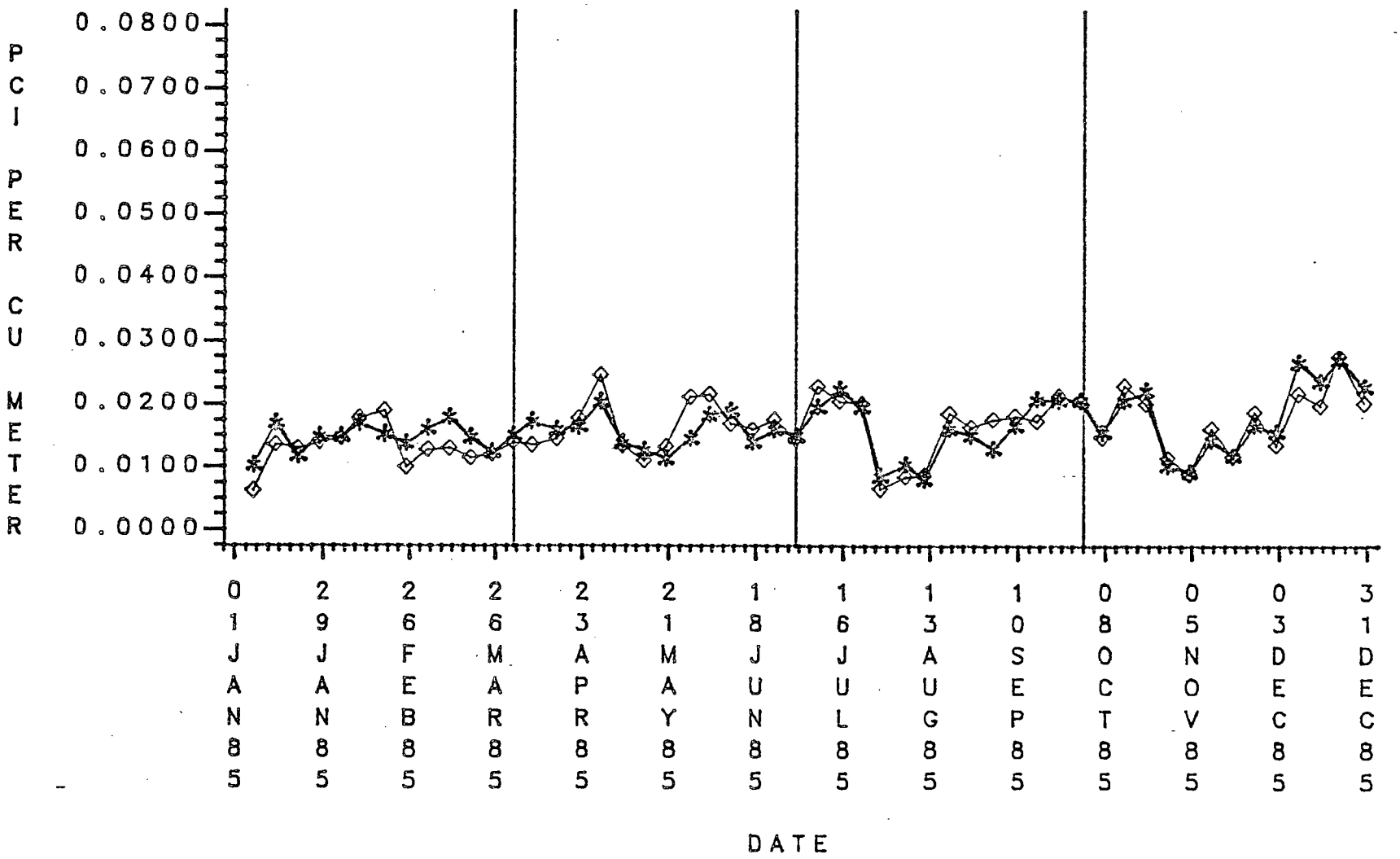
2. The radioactivity released from the H.B. Robinson Steam Electric Plant has not significantly increased the amount

of radioactivity detected in the environs surrounding the plant.

3. The environmental analyses performed during 1985 demonstrate that the H.B. Robinson Steam Electric Plant and the environment can exist in harmony and produce electricity safely while ensuring the safety of the general public.

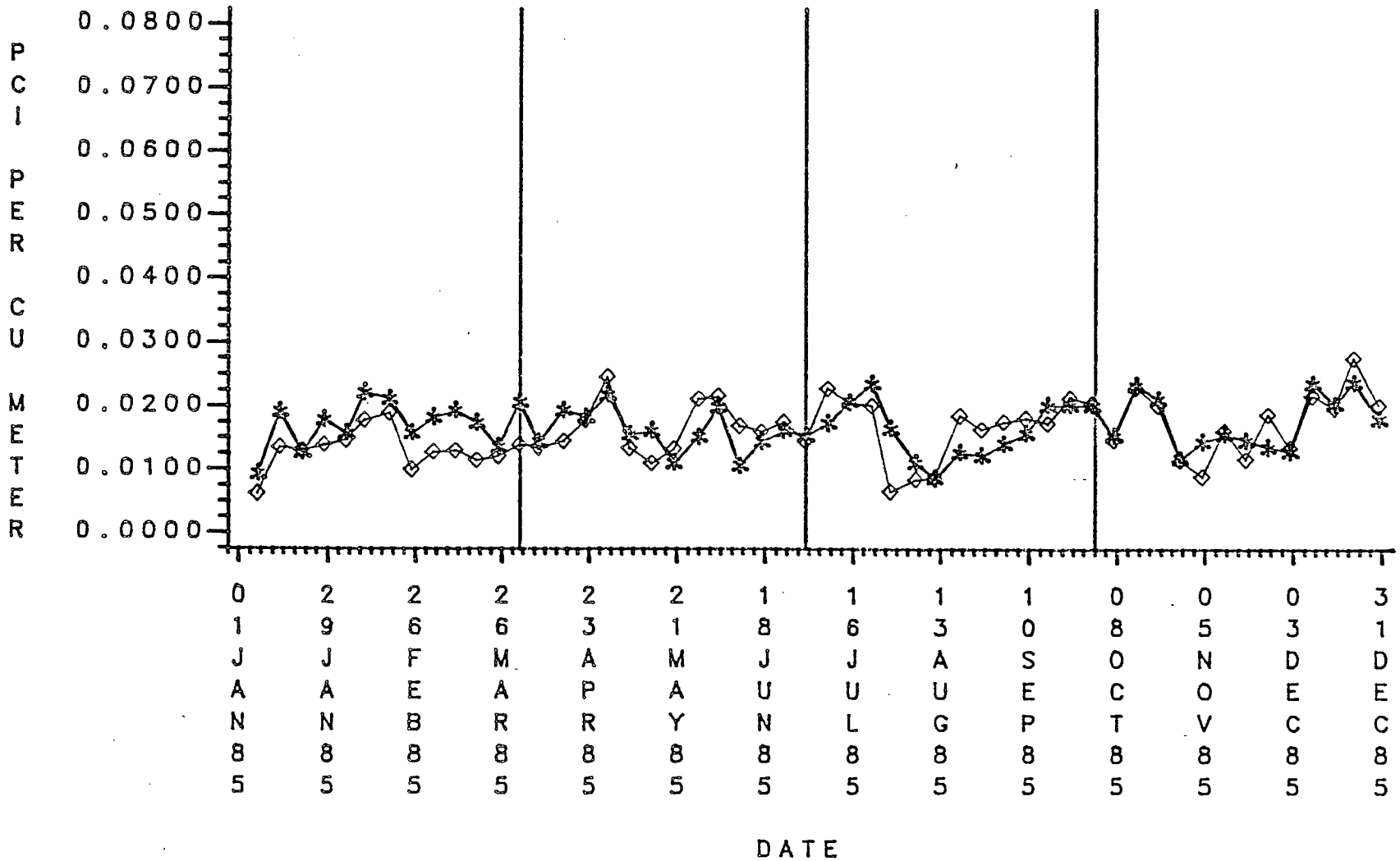
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0002



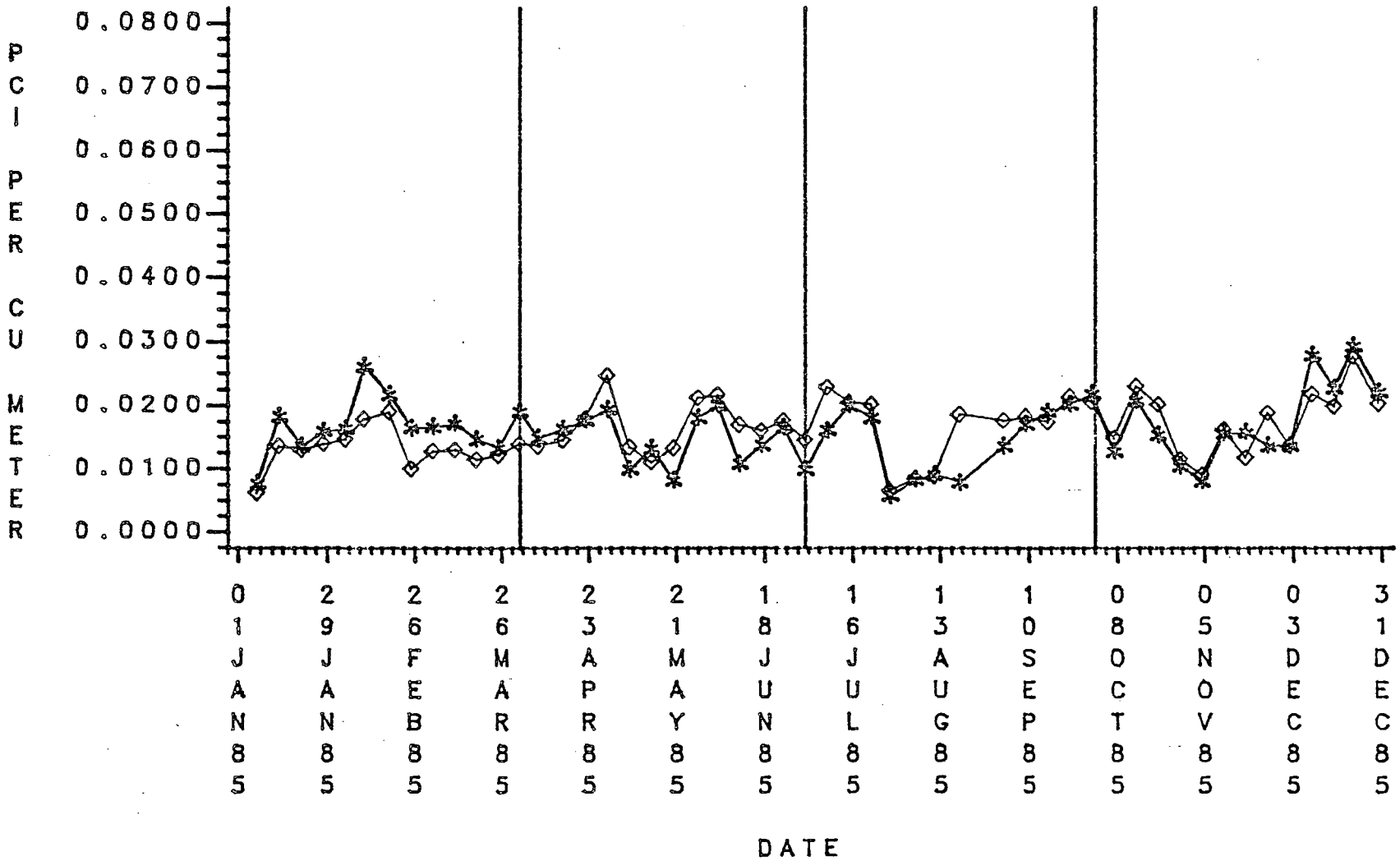
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0003



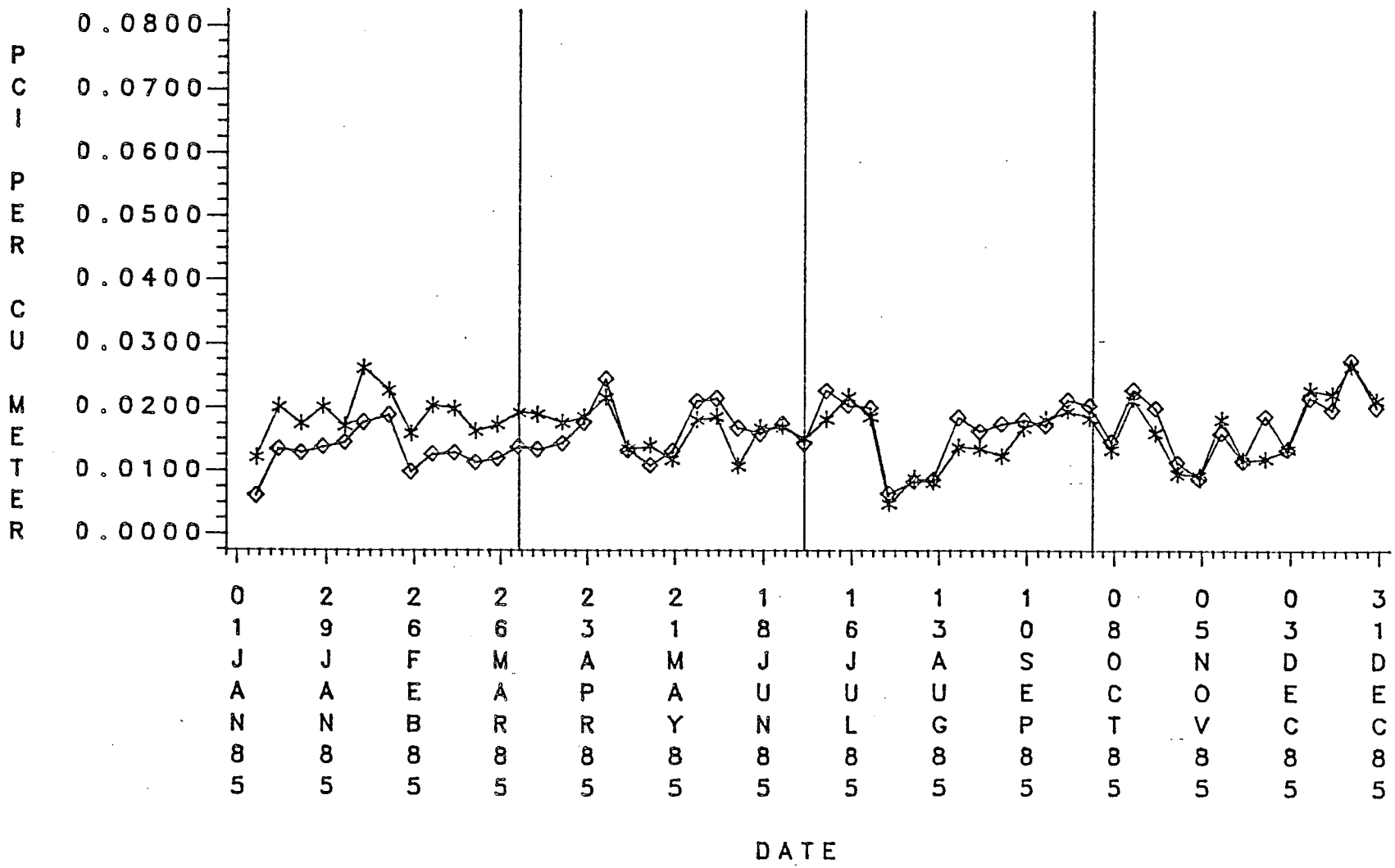
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0004



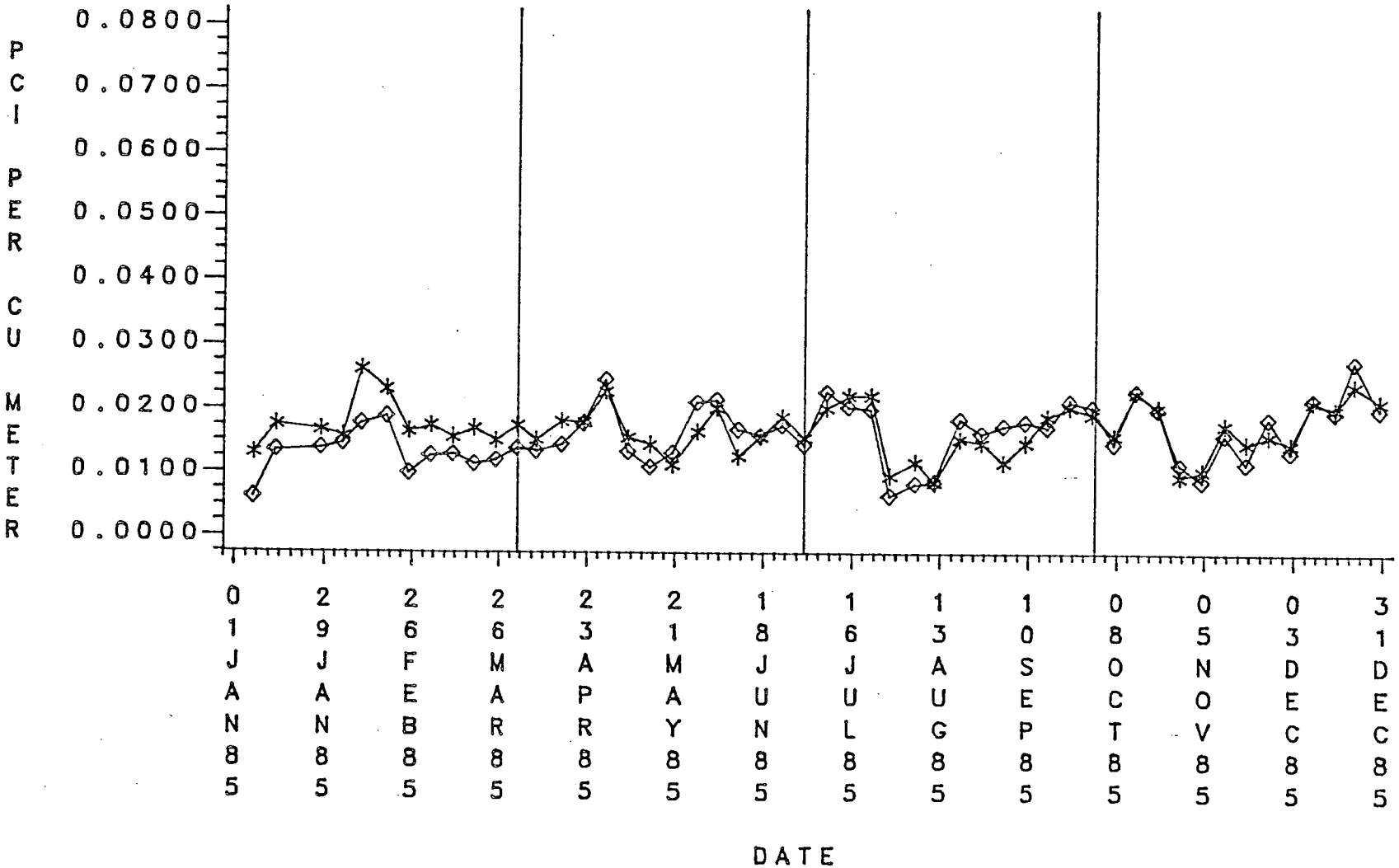
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0005



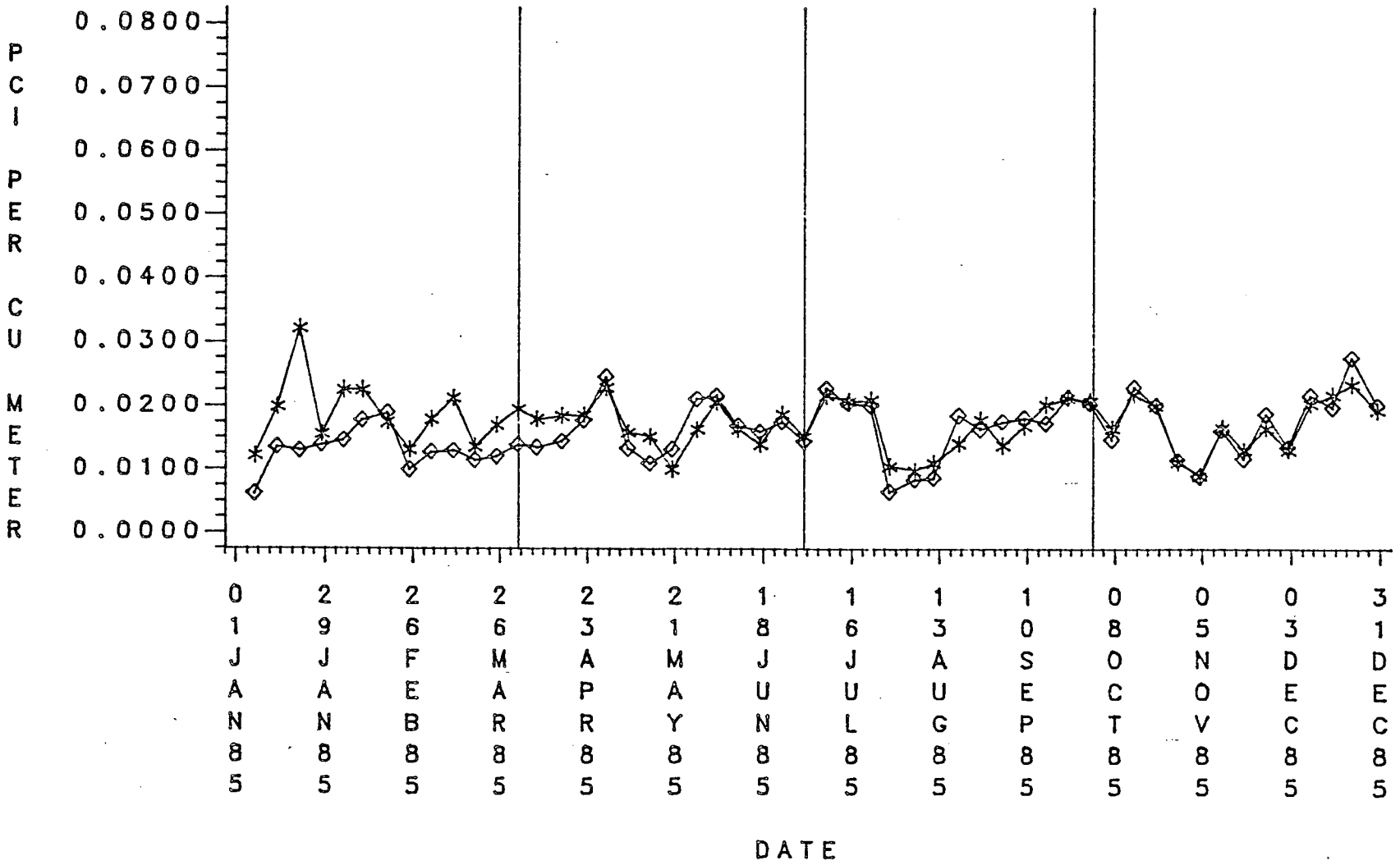
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0006



CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
* FOR SAMPLE STATION
◇ FOR CONTROL STATION

PLANT SAMPLE COLLECTED FOR=HBR POINT SAMPLE COLLECTED FROM=0007



4.0 MISSED SAMPLES AND ANALYSES

4.1 Air Particulate and Air Cartridge (Weekly)

Analyses not included in Table 2-1 are summarized below:

Location	Date	Reason
Location 6	January 21, 1985	Low volume--electrical malfunction.
Location 4	August 26, 1985	Low volume--sampler out of service.

4.2 Broadleaf Vegetation

Location	Date	Reason
Location 50	March 14, 1985	Lost during analytical processing.

4.3 Thermoluminescent Dosimeters TLDs

Location	Reason	Date
Location 8	Missing in field	First quarter
Location 27	Missing in field	First quarter
Location 8	Missing in field	Third quarter
Location 19	Missing in field	Fourth quarter

5.0 ANALYTICAL PROCEDURES

5.1 Gross Beta

Gross beta radioactivity measurements are made utilizing a Tennelec Low-Background Alpha/Beta Counting System. The LLD is approximately 0.002 pCi/m^3 for air particulates.

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

5.2 Tritium

Liquid samples requiring tritium analysis are first distilled. Five milliliters of the distillate are mixed with ten milliliters of liquid scintillation cocktail and counted on a liquid scintillation counter for up to 300 minutes. The LLD is approximately 1200 pCi/l.

5.3 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 1.1E-2 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.

5.4 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 5-1 summarizes LLD values derived from instrument sensitivity based upon a blank sample background.

Air particulate composites are fitted into a Petri dish and analyzed directly.

Liquid samples, except milk, are boiled down to a small volume, transferred to a polyethylene beaker, and analyzed directly.

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

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

Fish samples are cleaned and dressed similar to meal preparation. These samples are then dried at 100°C and ground to produce a homogeneous mixture. These are placed in a polyethylene beaker and analyzed.

5.5 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.

5.6 EPA Laboratory Intercomparison Program

The Radiological Environmental Laboratory at the Harris Energy & Environmental Center in New Hill, North Carolina, provides radioanalytical 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 1985, 22 samples representing three major environmental media (water, milk, and air filters) were analyzed. Data on the known activities and the 3σ control limits for all of the samples have been received from EPA. These 22 samples required triplicate determinations of the activity of 46 radionuclides. A comparison of the average of our reported values with the EPA known activity and its standard deviation can be summarized as follows:

Standard Deviation (σ) From Known Activity	Percent of Analyses
$< 1\sigma$	59
$< 2\sigma$	80
$< 3\sigma$	91

Of the 46 determinations, 4 (9 percent) fell outside the 3σ control limit.

The results which were beyond the control limits were randomly distributed in time and among nuclides. No trend developed and no corrective actions were deemed necessary. For example:

- The Zn-65 and Cr-51 values in the June mixed gamma samples were 16 percent and 18 percent high, respectively, while the other 4 components of the mixture (Co-60, Ru-106, Cs-134, and Cs-137) were within 1-2σ of the known values.

- A single Cr-51 value in the February mixed gamma was 19 percent low. Cr-51 analyses are difficult because of the low gamma abundance (9.8 percent), low energy (320 keV), and the short half-life (27.8 days). The June and October sample activities were within limits.

- A single I-131 result in a May water sample was lower than the known activity by 37 percent. Analyses in June, August, and October were within limits.

5.7 Lower Limits of Detection (LLD)

All samples analyzed met the LLD required by Technical Specification 3.17-3 with the exception of three leaf samples obtained in December 1985. One cherry leaf sample and two oak leaf samples from Locations 50 and 51 consisted of dried leaves still remaining on the trees after frost. Such leaf material is not considered representative of broadleaf vegetation samples and are not routinely collected.

Table 5-1

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

Air Particulates*
(Quarterly Composite)

Isotope	(LLD)
Cs-134	0.0068 pCi/cubic meter
Cs-137	0.0057
Ba-140	0.039
La-140	0.015
Other Expected Gamma Emitters	0.0035 to 0.063

Surface Water Samples*

Isotope	(LLD)
Cr-51	56 pCi/l
Mn-54	4
Co-58	4.9
Co-60	4.3
Cs-134	4.4
Cs-137	3.6
La-140	21
Other Expected Gamma Emitters	0.22 to 116

*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.

Groundwater Samples

Isotope	(LLD)
Cr-51	19 pCi/l
Mn-54	3.4
Co-58	3.0
Co-60	4.0
Cs-134	4.0
Cs-137	3.4
La-140	4.5
Other Expected Gamma Emitters	0.21 to 116

Milk

Isotope	(LLD)
Cr-51	51 pCi/l
Mn-54	6
Co-58	6.1
Co-60	6.7
I-131	7.2
Cs-134	7.0
Cs-137	6.4
Other Expected Gamma Emitters	8.7 to 11

Shoreline Sediments

Isotope	(LLD)
Cr-51	220 pCi/kg
Mn-54	26
Co-58	23
Co-60	26
Cs-134	38
Cs-137	26
Other Expected Gamma Emitters	19 to 2300

Fish

Isotope	(LLD)
Cr-51	110 pCi/kg
Mn-54	14
Co-58	13
Co-60	18
I-131	24
Cs-134	13
Other Expected Gamma Emitters	11 to 960

Food Products and Vegetation

Isotope	(LLD)
Cr-51	280 pCi/kg
Mn-54	38
Co-58	40
Co-60	39
I-131	43
Cs-134	34
Cs-137	32
Other Expected Gamma Emitters	26 to 800

6.0 LAND-USE CENSUS

The 1985 land-use census was performed on May 6-7, 1985, 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, 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 6-1 summarizes the locations of the nearest meat animal and resident within a five-mile radius of the site in each of the 16 meteorological sectors.

Table 6-1
Distances to Locations of Interest (miles)

Sector	Distance to Nearest Resident	Distance to Nearest Garden
N	2.9	4.1
NNE	1.3	1.3
NE	1.1	1.1
ENE	0.86	1.15
E	0.82	0.82
ESE	0.62	0.62
SE	0.3	0.63
SSE	0.33	0.33
S	0.3	0.3
SSW	0.29	0.29
SW	0.57	0.55
WSW	0.38	0.38
W	0.5	0.6
WNW	0.7	0.7
NW	1.2	1.2
NNW	2.9	2.9

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