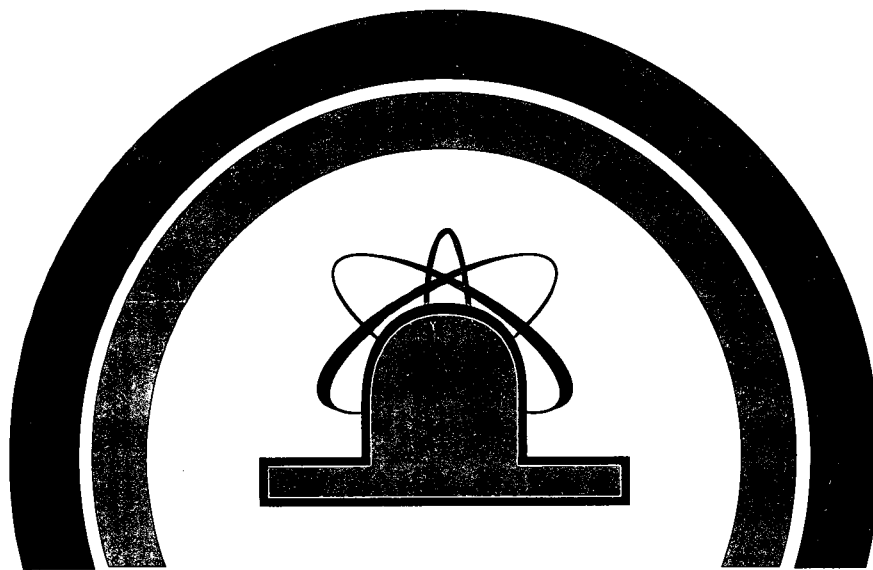


Radiological Environmental Operating Report

1992



ROBINSON NUCLEAR PROJECT
CAROLINA POWER & LIGHT

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Harris Energy & Environmental Center

Carolina Power & Light Company

New Hill, North Carolina

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

FOR THE

H. B. ROBINSON STEAM ELECTRIC GENERATING PLANT

JANUARY 1 THROUGH DECEMBER 31, 1992

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1.0 SUMMARY

The Radiological Environmental Surveillance Program was conducted in accordance with the H.B. Robinson Steam Electric Generating Plant Technical Specifications, Off-Site Dose Calculation Manual, and approved procedures.

The purpose of the Radiological Environmental Surveillance Program is to measure accumulation of radioactivity in the environment, to determine whether this radioactivity is the result of the operations of the H.B. Robinson Steam Electric Generating Plant, and to assess the potential dose to the off-site population based on the cumulative measurements of radioactivity of plant origin. Approximately 1,000 samples were collected from indicator locations and 1,125 analyses and measurements were made during the year. Detectable radioactivity resulting from plant operations was found in only 22 samples (Table 1-1) of surface water, bottom sediment, and aquatic vegetation. Only the tritium activity in fish samples constituted a potential source of public exposure. Using the methodology of Regulatory Guide 1.109, the potential dose to a member of the public from fish consumption is 0.004 mrem per year.

1. Radioactivity in environmental samples which could be attributed to the plant operations in 1992 is summarized in Table 1-1.
2. All detectable radionuclides in the environmental samples for 1992 were less than reportable levels as defined in HBR Technical Specifications.
3. Environmental sampling and analyses performed during 1992 demonstrated that the H.B. Robinson Unit 2 Steam Electric Plant continues to operate with minimum impact on the environment and little dose to the general public.
4. A statistical summary of all the data gathered in 1992 has been compiled in Table 1-2.

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

Thermoluminescent Dosimeters, Airborne and Particulate Samples	<u>Florence, S.C.</u> (Sample Location 1)
Surface Water, Bottom Sediment, and Aquatic Vegetation	<u>Black Creek at US 1</u> (Sample Location 41)
Fish	<u>Lake Bee or May Lake</u> (Sample Location 47)
Milk	<u>Cunningham Dairy</u> (Sample Location 63)
Broadleaf Vegetation	<u>10 Miles W. Bethune</u> (Sample Location 52)
Food Products	<u>> 5 Miles from plant--Lowest D/Q</u> (Sample Location 49)

TABLE 1-1

Radioactivity in Environmental Samples
Attributed to Plant Operations

Sample Media	Radionuclide	Average Concentration and Occurrence	Maximum Individual Dose (mrem/yr.)
Bottom Sediment (pCi/g)	Co-60	1.36 E+0 (1/3)	*
Aquatic Vegetation (pCi/g)	Co-58	5.63 E-1 (3/3)	*
	Co-60	5.39 E-1 (3/3)	*
	Mn-54	4.12E-2 (1/3)	*
Surface Water (pCi/l)	H-3	2.29 E+3 (18/23)	0.004 (from fish)

*No dose calculated since no general population exposure pathway exists.

TABLE 1-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY

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

Docket Number - 50-261
Calendar Year 1992

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⁾
				Name, Distance, and Direction	Mean Range ⁽²⁾	
Air Cartridge (pCi/m ³)	I-131 410 ⁽³⁾	8.0E-3	All less than LLD		All less than LLD	All less than LLD
Air Particulate (pCi/m ³)	Gross Beta 410 ⁽³⁾	1.1E-3	1.81E-2 (358/358) 7.18E-3 - 3.46E-2	Johnson's Landing 0.9 mile ENE	2.00E-2 (51/51) 9.34E-3 - 3.25E-2	1.59E-2 (52/52) 9.51E-3 - 2.81E-2
	Gamma 32	See Table 6-1	All less than LLD		All less than LLD	All less than LLD
Broadleaf Vege- tation (pCi/g, wet)	Gamma 45 ⁽³⁾⁽⁴⁾		3.42E-1 (25/30)	CP&L Property	3.98E-1 (12/15)	2.17E-1 (12/15)
	Cs-137	1.9E-2	1.61E-2 - 2.39E+0	0.25 mile SSE	2.81E-2 - 2.39E+0	2.06E-2 - 6.13E-1
Fish (pCi/g, wet) Bottom-Feeder	Gamma 6		8.78E-2 (4/4)	Lake Robinson	1.09E-1 (2/2)	1.70E-1 (2/2)
	Cs-137	2.4E-2	5.60E-2 - 1.34E-1	Site varies	8.31E-2 - 1.34E-1	9.57E-2 - 2.45E-1
	K-40	7.4E-2	3.76E+0 (4/4) 1.90E+0 - 4.98E+0	Prestwood Lake 4.9 miles ESE	4.08E+0 (2/2) 3.56E+0 - 4.61E+0	4.12E+0 (2/2) 3.39E+0 - 4.85E+0
Fish (pCi/g, wet) Free-Swimmer	Gamma 6		1.18E-1 (4/4)	Prestwood Lake	1.39E-1 (2/2)	1.92E-1 (2/2)
	Cs-137	2.4E-2	8.97E-2 - 1.61E-1	4.9 miles ESE	1.17E-1 1.61E-1	1.76E-1 - 2.08E-1
	K-40	7.4E-2	3.60E+0 (4/4) 2.82E+0 - 4.10E+0	Prestwood Lake 4.9 miles ESE	4.00E+0 (2/2) 3.91E+0 - 4.10E+0	2.71E+0 (2/2) 2.32E+0 - 3.10E+0
Food Products (pCi/g, wet)	Gamma 5 ⁽³⁾	See Table 6-1	All less than LLD		All less than LLD	All less than LLD
Groundwater (pCi/l)	Gamma 35 ⁽³⁾	See Table 6-1	All less than LLD		All less than LLD	No control
	Tritium 35 ⁽³⁾	1.2E+3	All less than LLD		All less than LLD	No control
Milk (pCi/l)	I-131 51 ⁽³⁾	5.0E-1	All less than LLD		All less than LLD	All less than LLD
	Gamma 52	See Table 6-1	All less than LLD		All less than LLD	All less than LLD

TABLE 1-2 (continued)

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⁾
				Name, Distance, and Direction	Mean Range ⁽²⁾	
Shoreline Sediment (pCi/g, dry)	Gamma 4 Cs-137	3.1E-2	4.79E-2 (1/4) Single value	Ash Pond	4.79E-2 (1/2) Single value	No Control
Bottom Sediment ⁽⁶⁾ (pCi/g, dry)	Gamma 4 Co-60	2.4E-2	1.36E+0 (1/3) Single value	Lake Robinson Site varies	1.36E+0 (1/1) Single value	All less than LLD
	Cs-137	3.1E-2	1.24E+0 (3/3) 4.42E-1 - 2.00E+0	Prestwood Lake 4.9 miles ESE	2.00E+0 (1/1) Single value	4.94E-1 (1/1) Single value
Aquatic Vegetation ⁽⁶⁾ (pCi/g, wet)	Gamma 4 Co-58	1.7E-2	5.63E-1 (3/3) 4.54E-1 - 1.37E+0	Lake Robinson site varies	1.37E+0 (1/1) Single value	All less than LLD
	Co-60	2.0E-2	5.39E-1 (3/3) 3.84E-2 - 1.52E+0	Lake Robinson site varies	1.52E+0 (1/1) Single value	All less than LLD
	Cs-137	1.9E-2	4.48E-2 (1/3) Single value	Prestwood Lake 4.9 miles ESE	4.48E-2 (1/1) Single value	1.85E-2 (1/1) Single value
	Mn-54	1.5E-2	4.12E-2 (1/3) Single value	Lake Robinson site varies	4.12E-2 (1/1) Single value	All less than LLD
Surface Water (pCi/l)	Gamma 35 ³	See Table 6-1	All less than LLD		All less than LLD	All less than LLD
	Tritium 35 ⁽³⁾	1.2E+3	2.29E+3 (18/23) 1.26E+3 - 3.62E+3	Black Creek @ SC 23 0.6 miles ESE	2.47E+3 (10/12) 1.38E+3 - 3.49E+3	All less than LLD
TLD (mR/wk)	TLD 161 ⁽³⁾	1 mR	1.10E+0 (157/157) 8.00E-1 - 2.30E+0	4.4 miles SSW Intersection of SR 31-51 and 16-12	1.67E+0 (4/4) 1.50E+0 - 1.90E+0	1.08E+0 (4/4) 9.00E-1 - 1.20E+0

FOOTNOTES TO TABLE 1-2

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 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. Missing samples are discussed in Section 4.
4. Three types of broadleaf vegetation samples are collected monthly when available from three locations for a possible total of 108 samples.
5. Food products are required to be sampled at locations where plant effluents are used to irrigate food crops. The farm previously sampled has ceased its irrigation operations. However, food products were collected for split sampling with the state of South Carolina.
6. Bottom sediment and aquatic vegetation sampling are not required by plant technical specifications. Sampling and analysis is performed to monitor any radionuclide buildup in the lake.

2.0 GENERAL INFORMATION

The following report summarizes the radiological environmental data for the H.B. Robinson Steam Electric Generating Plant during the calendar year 1992. 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.

2.1 Plant and Location

The H.B. Robinson Steam Electric Generating 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 2,250 acres with plant intake at the south end adjacent to the dam. Following condenser use, the water is returned by a canal to a point in Lake Robinson 4.2 miles to the north.

2.2 Radiological Impact Considerations

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

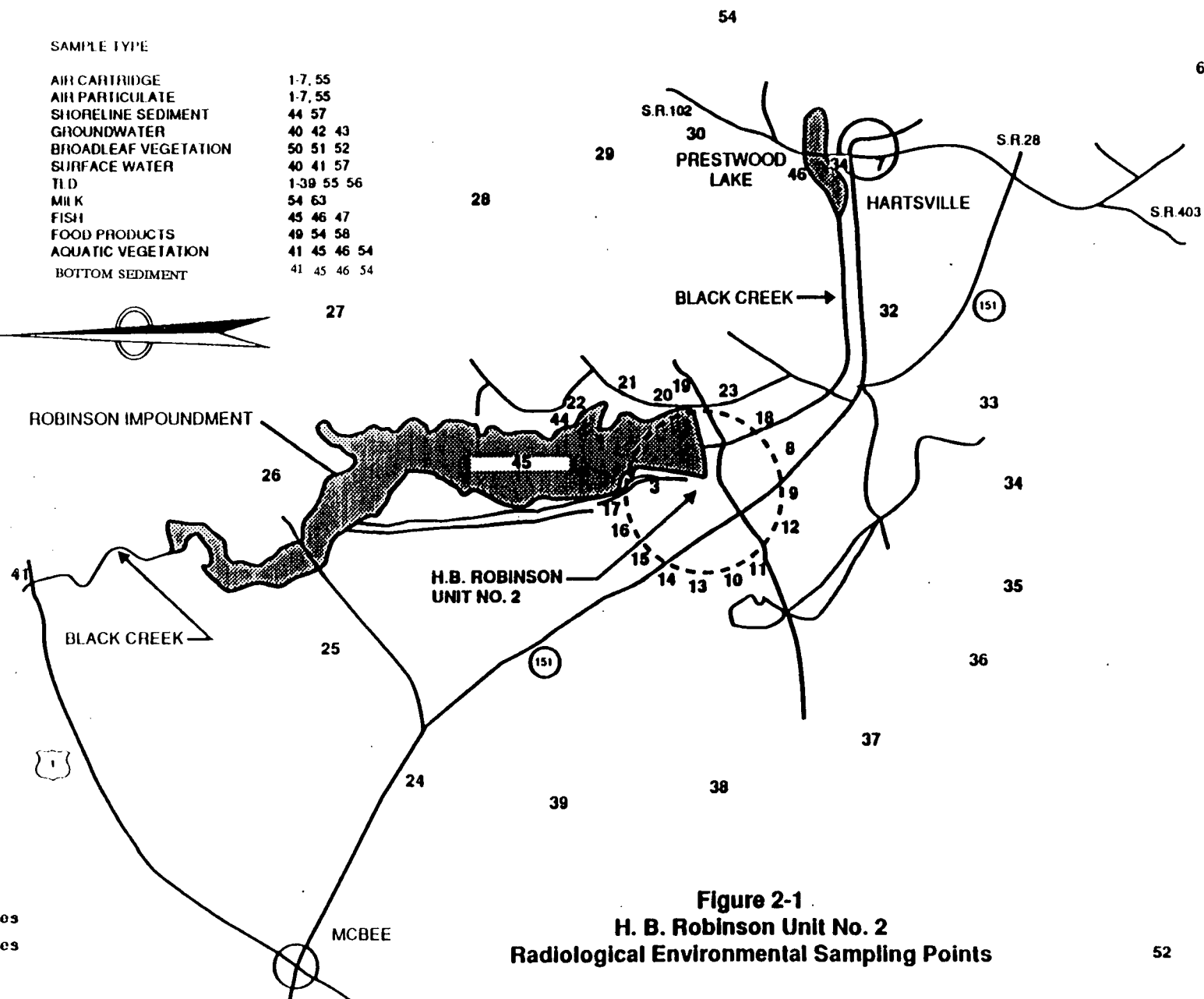
2.3 Radiological Environmental Monitoring Program

The required radiological environmental sampling is defined by technical specifications. The program, as implemented by the plant, is described in the Off-Site Dose Calculation Manual. The program objective is to monitor specific elements of exposure pathways. The sampling media and release pathways are listed below.

Sampling Media	Release Pathway
Glass Fiber Filter	Airborne particulates
Iodine Collection Cartridge	Gaseous
TLDs	Gaseous
Surface Water	Liquid
Groundwater	Liquid
Shoreline Sediment	Liquid
Milk	Gaseous, airborne particulates and liquid (when irrigating)
Fish	Liquid
Food Crops	Gaseous, airborne particulates and liquid (when irrigating)
Broadleaf Vegetation (when there are no milk locations within five miles of plant site)	Gaseous and airborne particulates
Aquatic Vegetation	Liquid
Bottom Sediment	Liquid

Figures 2-1 and 2-2 provide map locations for the program's sampling locations and sample types. Table 2-1 provides the sampling point descriptions.

SYMBOL	SAMPLE TYPE	
AC	AIR CARTRIDGE	1-7, 55
AP	AIR PARTICULATE	1-7, 55
SS	SHORELINE SEDIMENT	44 57
GW	GROUNDWATER	40 42 43
BL	BROADLEAF VEGETATION	50 51 52
SW	SURFACE WATER	40 41 57
TL	TLD	1-39 55 56
MK	MILK	54 63
FI	FISH	45 46 47
FC	FOOD PRODUCTS	49 54 58
AV	AQUATIC VEGETATION	41 45 46 54
SD	BOTTOM SEDIMENT	41 45 46 54



FLORENCE
63 1

SYMBOL	SAMPLE TYPE	
AC	AIR CARTRIDGE	1-7, 55
AP	AIR PARTICULATE	1-7, 55
SS	SHORELINE SEDIMENT	44 57
GW	GROUNDWATER	40 42 43
SL	BROADLEAF VEGETATION	50 51 52
SW	SURFACE WATER	40 41 57
TL	TLD	1-39 55 56
MK	MILK	54 63
FI	FISH	45 46 47
FC	FOOD PRODUCTS	49 54 58
AV	AQUATIC VEGETATION	41 45 46 54
SD	BOTTOM SEDIMENT	41 45 46 54

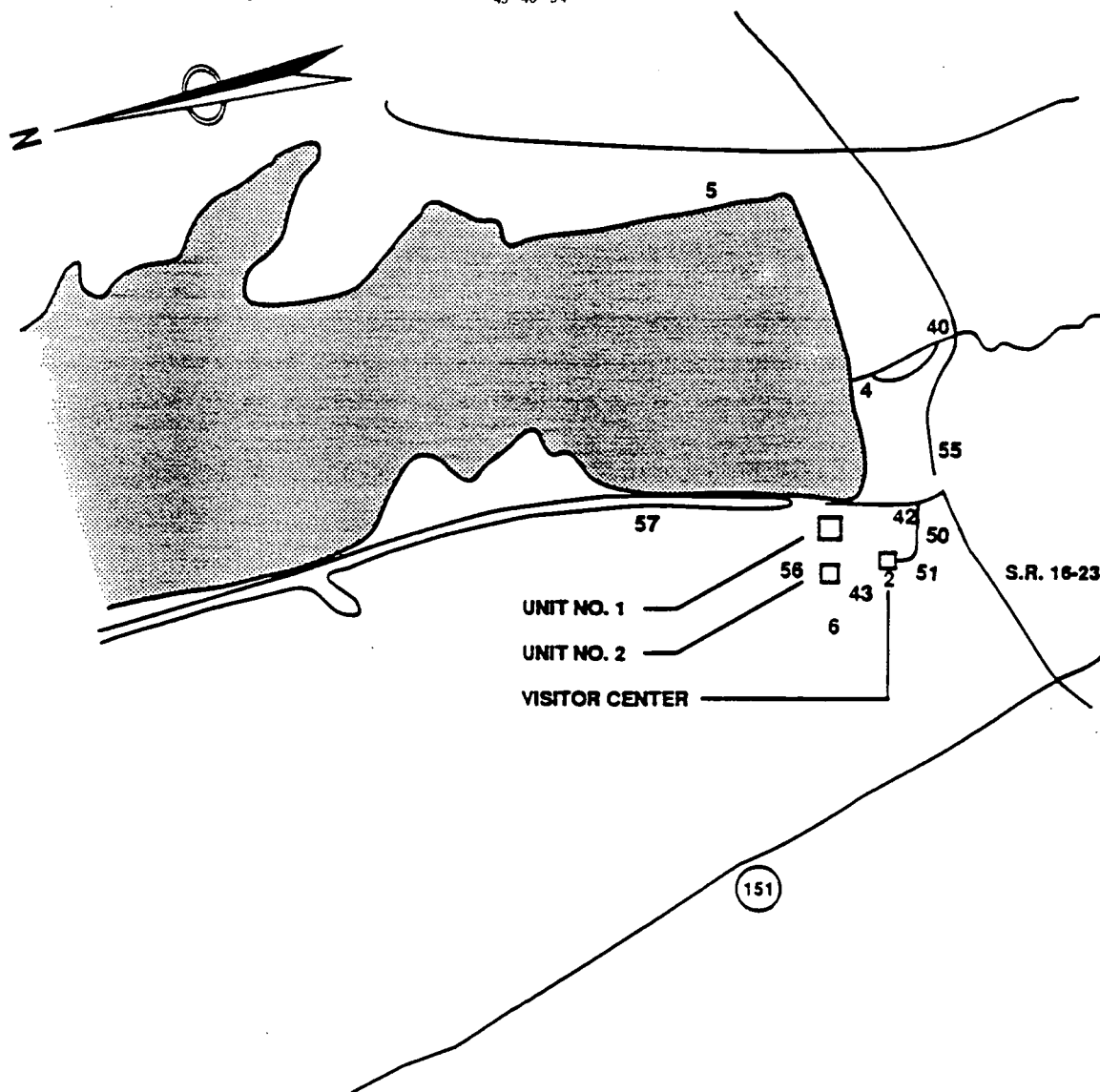


FIGURE 2-2
H. B. ROBINSON UNIT NO. 2
RADIOLOGICAL ENVIRONMENTAL SAMPLING POINTS
ON SITE

TABLE 11
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
H.B. ROBINSON STEAM ELECTRIC PLANT

Sample Type	Sampling Point and Description ¹	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 Near Information Center 7--6.3 miles ESE Hartsville Substation 55--0.3 mile SSE Site Boundary	Weekly	800 m ³	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 Near Information Center 7--6.3 miles ESE Hartsville Substation 55--0.3 mile SSE Site Boundary	Weekly	800 m ³	Weekly--Gross Beta Quarterly--Composite- Gamma
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 Near Information Center 7--6.3 miles ESE Hartsville Substation 8--0.8 mile SSE Near Transmission Tower 9--1.0 mile S on Transmission Tower 10--1.0 mile WSW at Church of God Cemetery	Quarterly	Not Applicable	TLD Readout

TABLE 2-1 (continued)

Sample Type	Sampling Point and Description ¹	Sampling Frequency	Approximate Sample Size	Sample Analysis
External Radiation Dose (TL) (cont.)	11--1.0 mile SW on Old Camden Road 12--1.2 miles SSW Intersection of Dirt Road Near Roads 16-23 and 16-413 13--1.0 mile; 0.5 mile Down Extension of Road 16-846 14--0.9 mile WNW at Pine Ridge Church 15--1.0 mile NW at Ash Pond 16--1.0 mile NNW Darlington Co. IC Turbine Plant 17--1.1 miles N Discharge Canal Road @ Unit 1 Weir 18--0.7 mile SE Near Old Railroad Trestle at Black Creek 19--1.0 mile E; 0.1 mile from Intersection of Road 16-23 and Road 16-39 20--1.3 miles ENE; 0.5 mile N of Intersection of Roads 16-23 and 16-39 21--1.4 miles NE Near Atkinson's Boat Landing 22--1.9 miles NNE Shady Rest Club 23--1.2 miles ESE on Road 16-39; 0.5 mile S of Intersection of Roads 16-23 and 16-39 24--5.0 miles NW; 1.5 miles from Intersection of SR 151, 13-711, 13-172 25--4.6 miles NNW on Road 13-346 26--5.0 miles N, on Road 13-346 27--5.0 miles NNE Road 13-763 28--4.8 miles NE on Road 13-39 29--4.1 miles ENE on Road 16-20 at Transmission Tower 30--4.6 miles E, Near Intersection of Roads 16-20 and 16-492	Quarterly	Not Applicable	TLD Readout

TABLE 2-1 (continued)

Sample Type	Sampling Point and Description ¹	Sampling Frequency	Approximate Sample Size	Sample Analysis
External Radiation Dose (TL) (cont.)	31--4.6 miles ESE on Lakeshore Drive 32--4.5 miles SE Transmission Tower at End of Kalber Drive 33--4.6 miles SSE on Road 16-493 34--4.6 miles S on Road 16-772 35--4.4 miles SSW Near Intersection of Roads 31-51 and 16-12 36--4.7 miles SW on Road 16-1127 37--5.0 miles WSW Transmission Tower Nearest Clay Road 38--4.9 miles W at Union Church Cemetery 39--5.0 miles WNW, .15 mile from Intersection of Road 16-231 and 13-172 55--0.3 mile SSE Site Boundary 56--300 feet N of ISFSI	Quarterly	Not Applicable	TLD Readout
Surface Water (SW)	40--0.6 mile ESE Black Creek at Road 16-23 41--7.2 miles NNW Black Creek @ US 1--Control 57--Ash Pond	Monthly Composite	4 liters	Gamma Tritium
Groundwater (GW)	40--0.6 mile ESE Artesian Well on Road 16-23 42--Unit 1 Deep Well 43--Unit 2 Deep Well	Monthly	4 liters	Gamma Tritium
Milk (MK)	54--10.1 miles E Auburndale Plantation 63--18.4 miles ESE Cunningham Dairy--Control	Semimonthly when animals are on pasture; monthly at other times	8 liters	Iodine Gamma

TABLE 2-1 (continued)

Sample Type	Sampling Point and Description ¹	Sampling Frequency	Approximate Sample Size	Sample Analysis
Fish (FI)	45--Site Varies Within Lake Robinson 46--4.9 miles ESE Prestwood Lake 47--13.0 miles NW Bee Lake or 12.5 miles NNW May Lake--Control	Semiannually	500 grams	(Edible Portion) Gamma
Shoreline Sediment (SS)	44--1.9 miles NNE Shady Rest Club 57--Ash Pond	Semiannually	500 grams	Gamma
Food Products (FC)	49-- > 5 miles in Least D/Q Sector--Control 58--Site varies from plant	Annual at Harvest	500 grams	Gamma
Broadleaf Vegetation (BL)	50--0.25 mile SSE CP&L Property 51--0.25 mile SSW CP&L Property 52--10 miles W Bethune--Control	Monthly when available	500 grams	Gamma
Aquatic Vegetation (AV) and Bottom Sediment (SD)	46--4.9 miles ESE--Prestwood Lake 41--7.2 miles NNW Black Creek at US 1--Control 45--Site varies within Lake Robinson 54--10.1 miles E Auburndale Plantation	Annual	500 grams	Gamma

3.0 INTERPRETATIONS AND CONCLUSIONS

3.1 Air Sampling

Air samples collected during 1992 had a mean gross beta activity of 1.81 E-2 pCi/m^3 for the indicator stations versus an average concentration of 1.59 E-2 pCi/m^3 for the control stations. This data is essentially unchanged from 1991 and is consistent with preoperational data obtained for the H.B. Robinson Steam Electric Generating Plant (1.40 E-1 pCi/m^3) and are typical of the naturally occurring radionuclides of the region. Figures 3-1 through 3-7 depict the gross beta activity in air versus the control location and the preoperational average. The lower current value is primarily due to the reduction of worldwide fallout over that which was occurring during the preoperational years. These figures confirm that the indicator stations show no significant increase over the control samples and hence no discernible impact from the plant operations is apparent in the data.

The quarterly composite gamma analyses for air particulate samples for all quarters revealed no radionuclides typical of plant effluents.

All 358 air cartridge samples from the indicator stations and 52 air cartridges from the control locations had iodine-131 (I-131) activities which were less than the LLD.

3.2 Broadleaf Vegetation

Broadleaf vegetation sampling is accomplished by collecting oak, wild cherry, and sassafras leaves. Three species of samples, when available, are collected monthly at three locations (one control and two 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 1992, 25 of 30 samples taken from the indicator site demonstrated detectable concentrations of Cs-137 for an average value of $3.42 \text{ E-1 pCi/g (wet)}$. The control samples had detectable concentrations of Cs-137 in 12 of 15 samples with a mean concentration of $2.17 \text{ E-1 pCi/g (wet)}$. Upon comparing these results, we conclude

that the indicator values reflect fallout Cs-137 contamination. Past sampling experience further supports this interpretation.

3.3 Fish

Samples of free-swimmer 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 unaffected by plant operations. All 12 fish samples from the indicator and control locations contained traces of Cs-137. The activity levels of fish from the indicator locations were lower than the control samples; therefore, no plant-related dose was assigned to the presence of this radionuclide. These data are very similar to the results on 1991 samples.

3.4 Groundwater

No gamma or tritium activity was detected in the 35 samples of groundwater collected in 1992 which is consistent with the observations in previous years.

3.5 Milk

Twenty-six samples from an indicator location and 26 from the control location were collected. Iodine-131 and gamma activities were all less than LLD.

3.6 Food Products

In support of the NRC/State of South Carolina Environmental Radiological Verification Monitoring program, food products consisting of collards, turnips, tomatoes, and peaches were sampled and analyzed primarily for interlaboratory comparisons. No gamma activity associated with plant operations was detected in any samples.

3.7 Shoreline Sediment

No radionuclides of plant origin were detected in four samples collected semi-annually in 1992 as was the case in 1991. However, fallout Cs-137 was detected in a single sample in 1992.

3.8 Bottom Sediment

The 1992 data suggests a slight increase over 1991 in the Co-60 activity in Lake Robinson (from 1.0 to 1.4 pCi/g). However, this could also be related to the variability of bottom sediment sampling.

Cs-137 activities also increased in the sediments of the indicator locations over 1991 values, but the control station at Lake Bee had a greater percentage increase.

3.9 Aquatic Vegetation

The Co-58, 60 activities in the annual samples of aquatic vegetation were higher in both Lake Robinson and Prestwood Lake than the 1991 activities. These nuclides were also observed further downstream at Auburndale Plantation than noted in 1991. Mn-54 was detected in samples from Lake Robinson in 1992 but had not been seen in 1991. Cs-137 levels in Lake Robinson were similar to those in 1991.

3.10 Surface Water

Surface waters of Lake Robinson indicated a presence of tritium which is attributed to plant operations but was essentially unchanged from 1991. These surface waters do not supply drinking water at any downstream location and irrigation practices downstream have not been used since 1989; therefore, radiological dose via this pathway is limited to the consumption of fish from Lake Robinson. Using the methodology of Nuclear Regulatory Guide 1.109, a dose of 0.004 mrem/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.

3.11 Direct Radiation

Direct radiation exposure in the H.B. Robinson environs was measured by the placement of thermoluminescent dosimeters about the plant forming an inner ring at approximately 1 mile and an outer ring at 5 miles. The expectation would be that if a plant effect existed, the inner ring dose measurements would exceed those made in the outer ring. This condition was not observed since the outer ring was slightly

higher than the inner. Therefore, any direct radiation dose to the off-site population was determined to be insignificant.

3.12 Asiatic Clams

Benthic samples from Lake Robinson during 1992 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.

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

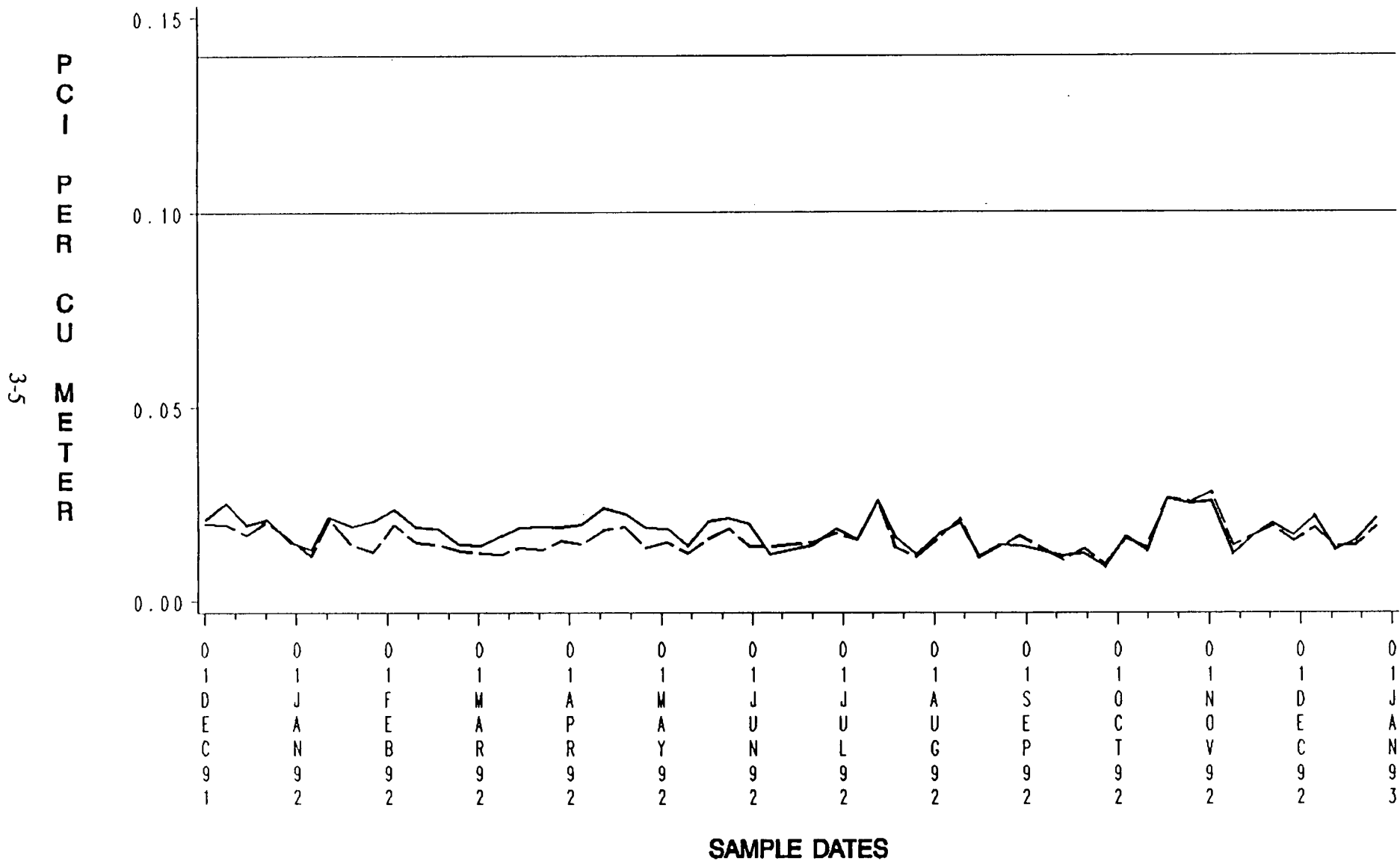


FIGURE 3-1

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
 ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

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

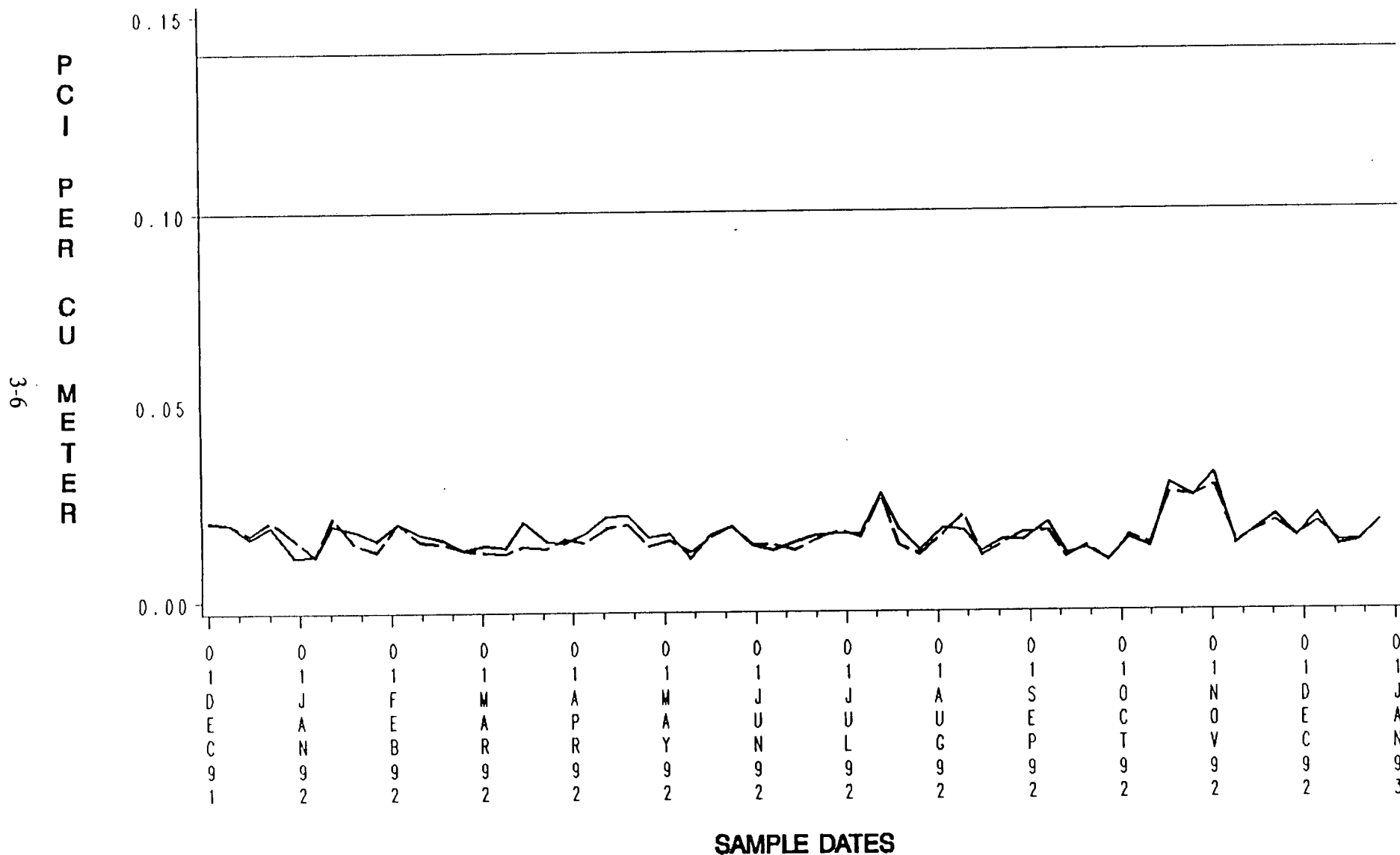


FIGURE 3-2

SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

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

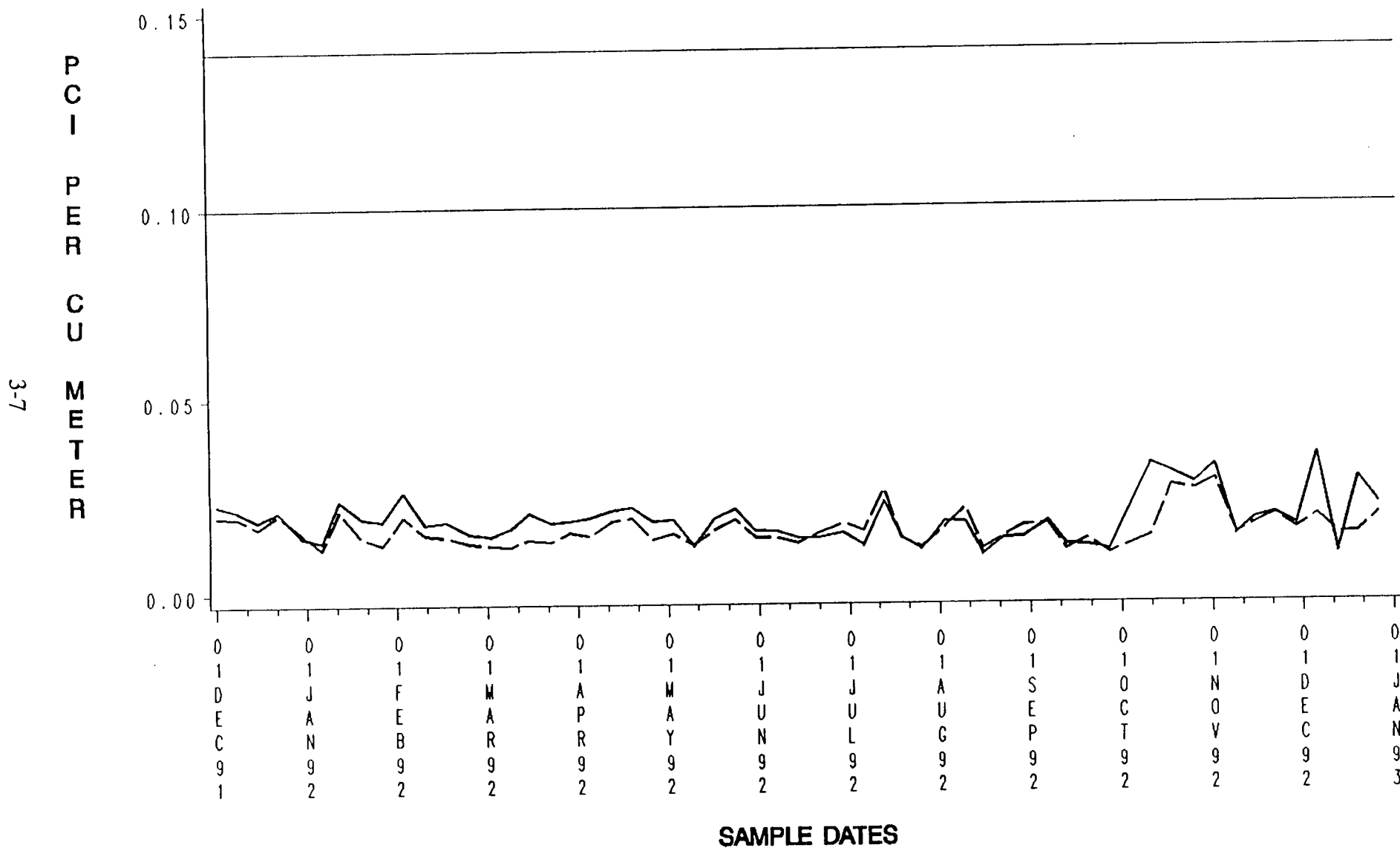


FIGURE 3-3

SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

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

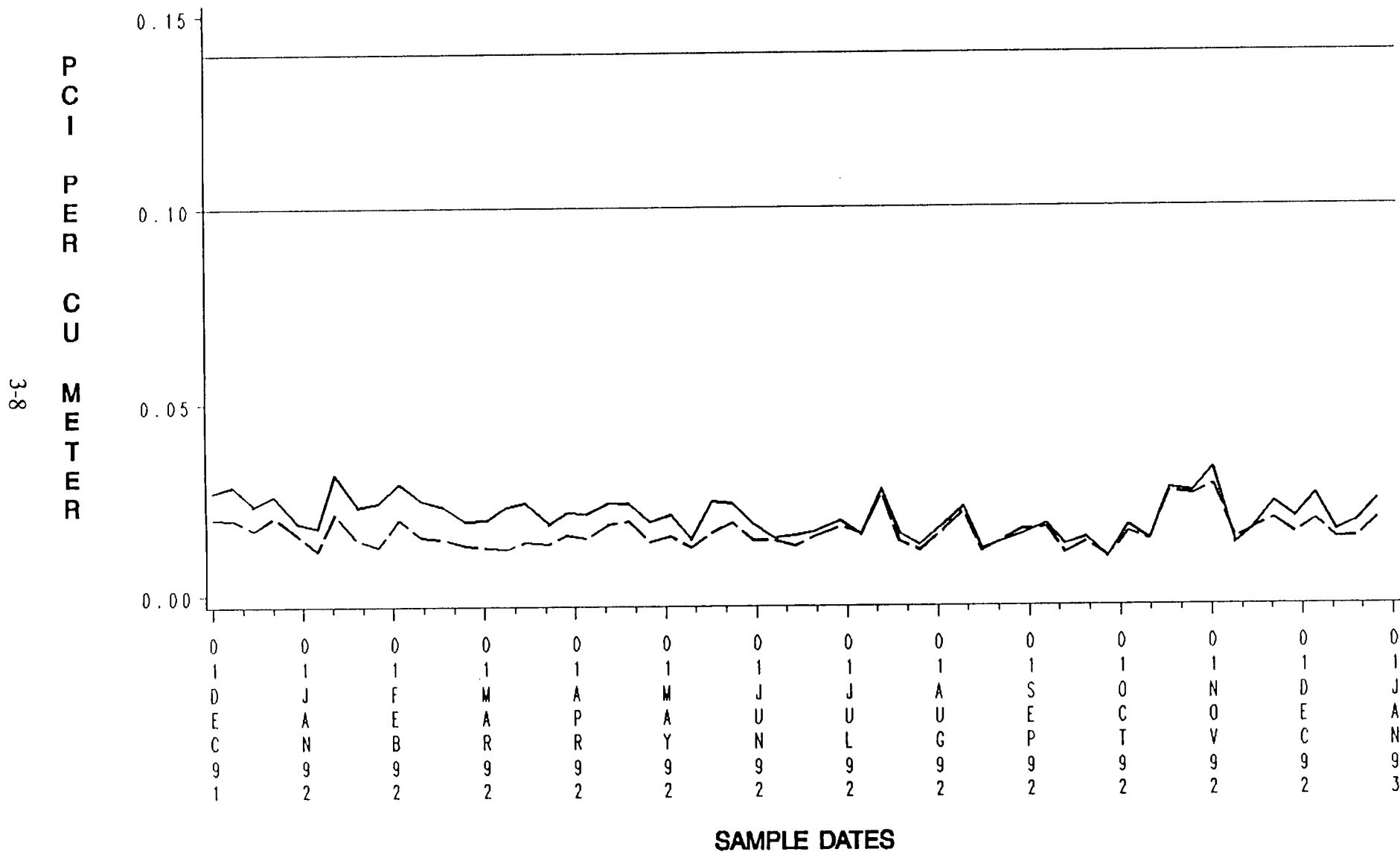


FIGURE 3-4

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
 ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

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

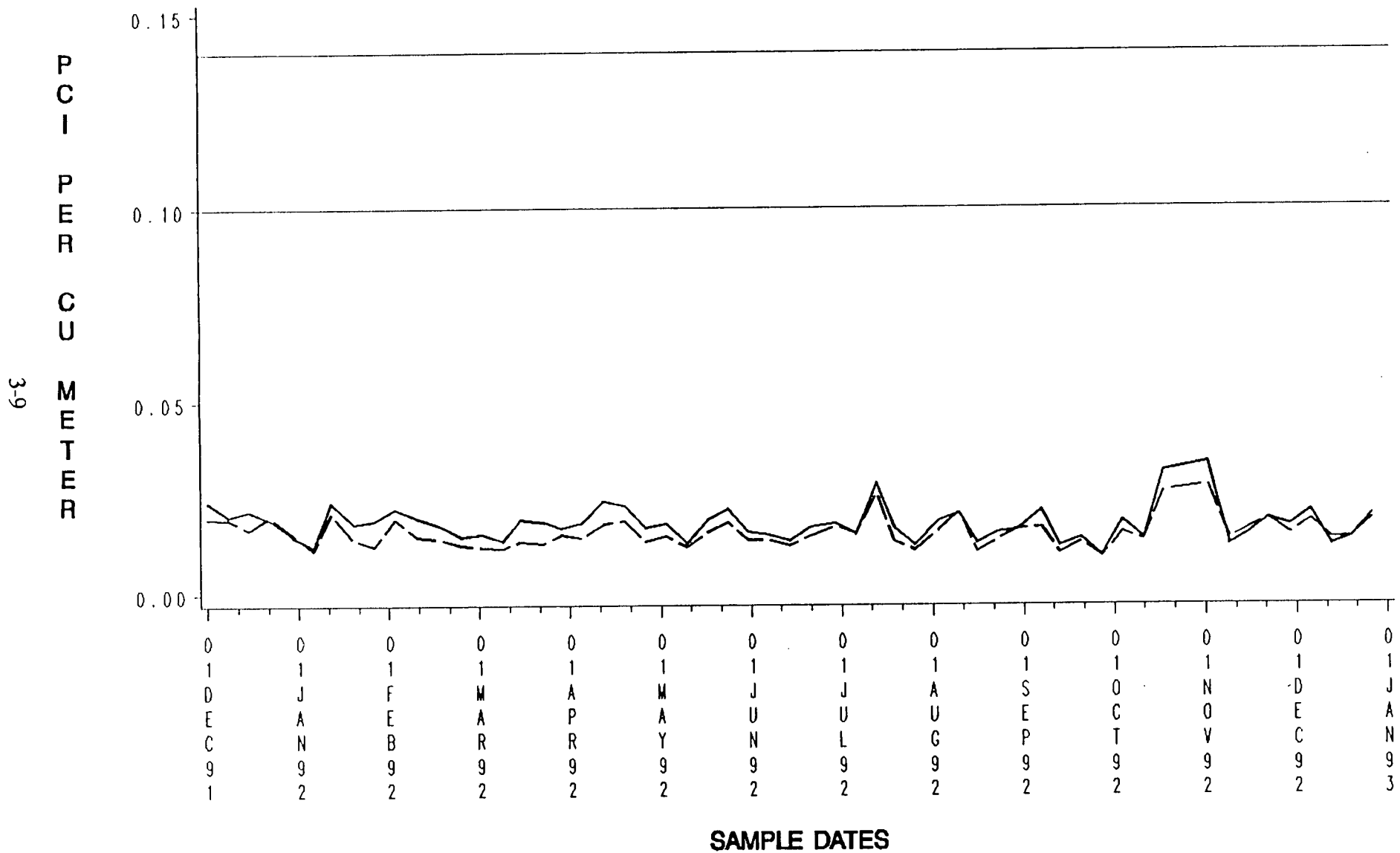


FIGURE 3-5

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
 ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

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

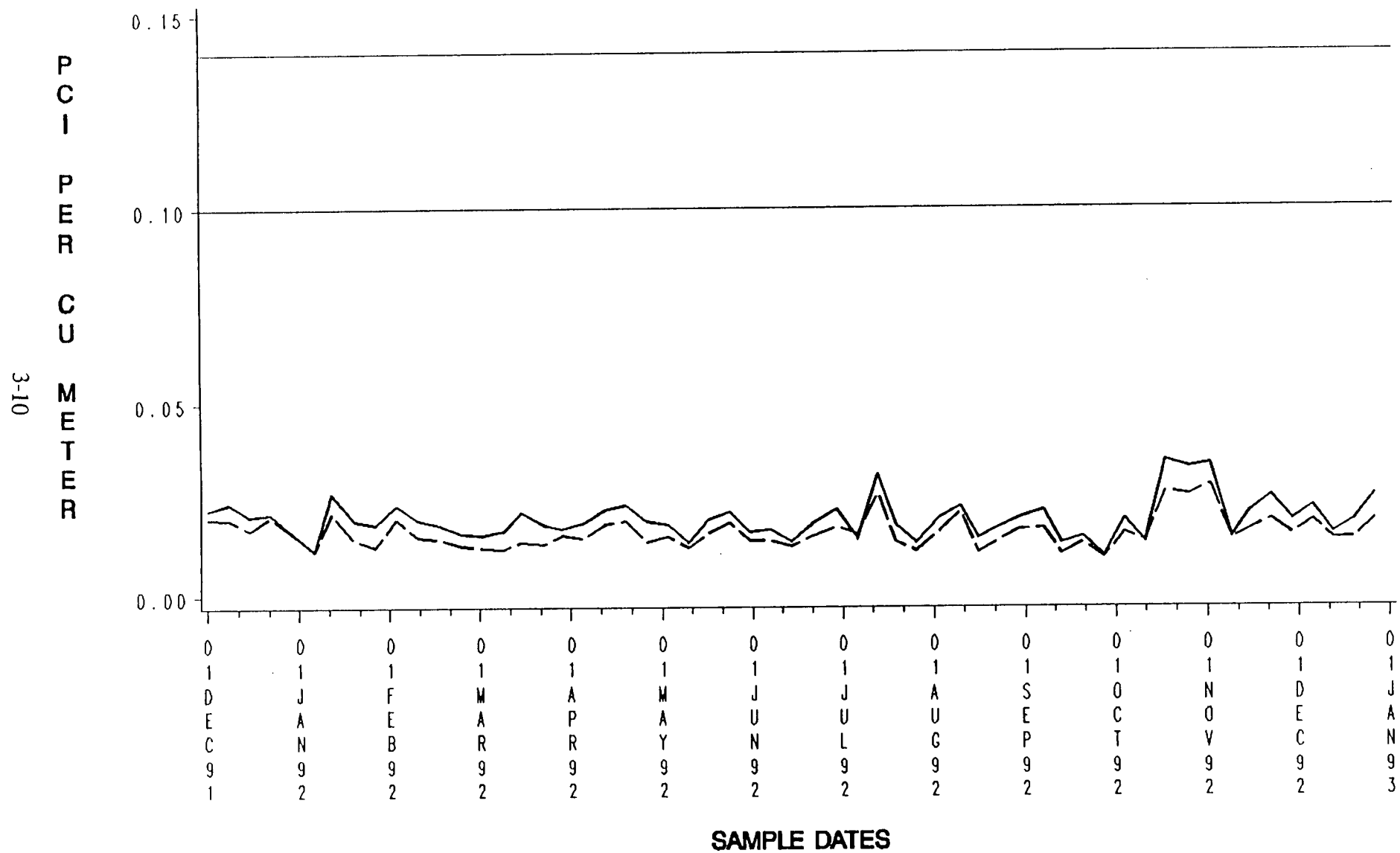


FIGURE 3-6

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
 ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 PLANT=HBR SAMPLE POINT=0055

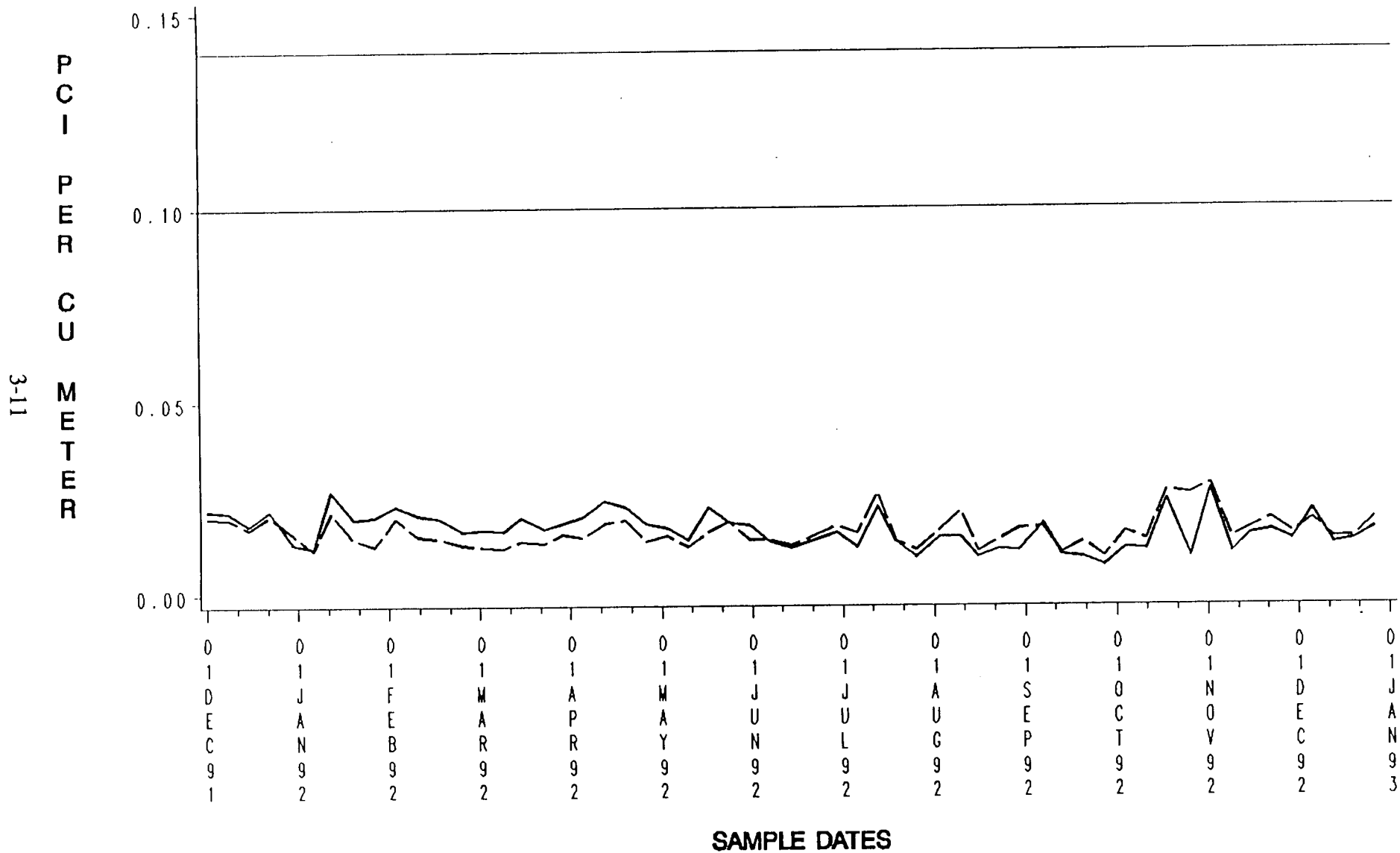


FIGURE 3-7

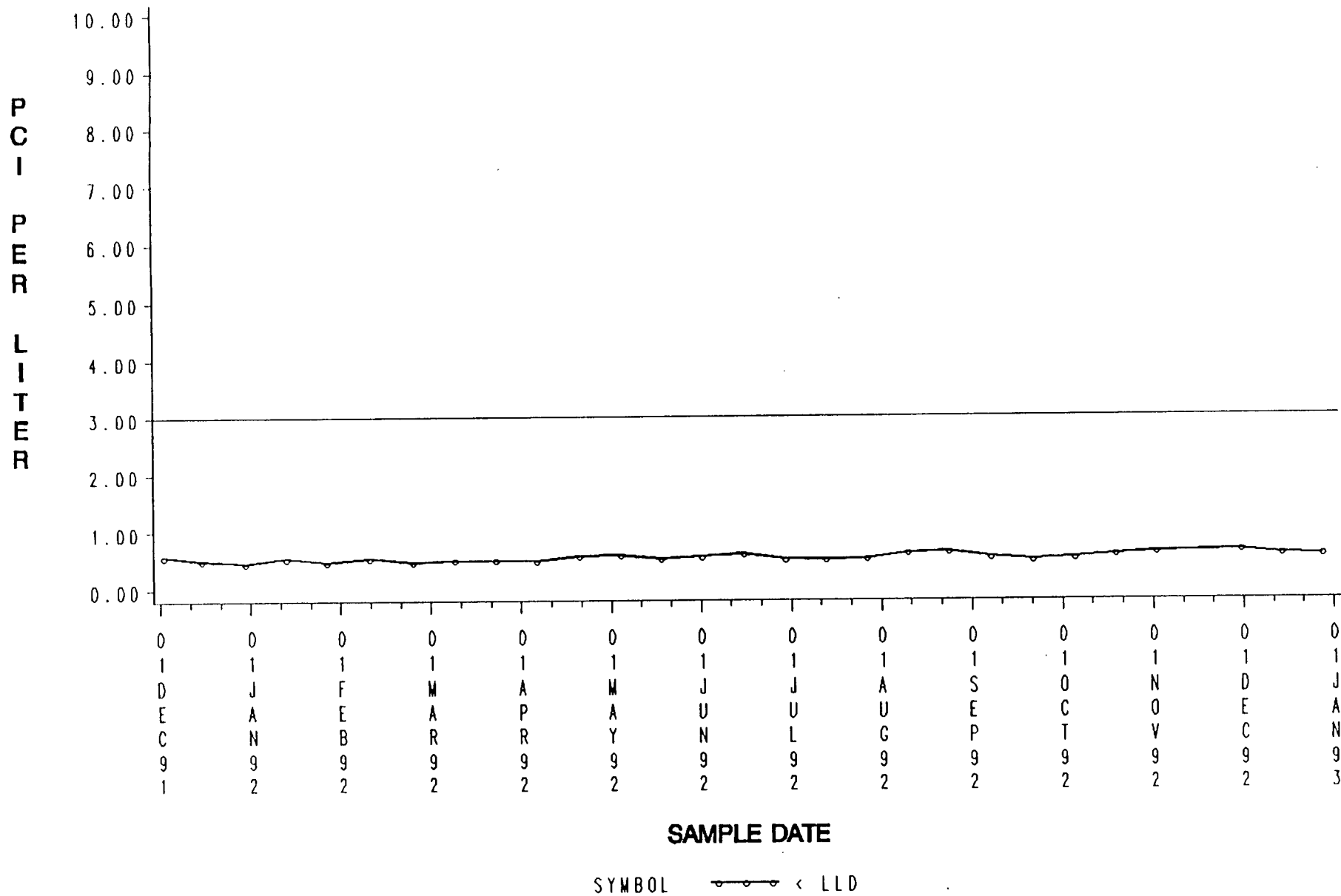
SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.14
 ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

CP&L ENVIRONMENTAL SURVEILLANCE

IODINE-131 ACTIVITY FOR
MILK SAMPLES

PLANT=HBR POINT=0054



STATION '0063' IS THE CONTROL POINT

REPORTING LEVEL IS 3.0

CP&L ENVIRONMENTAL SURVEILLANCE
 IODINE-131 ACTIVITY FOR
 MILK SAMPLES
 PLANT=HBR POINT=0063

3-13
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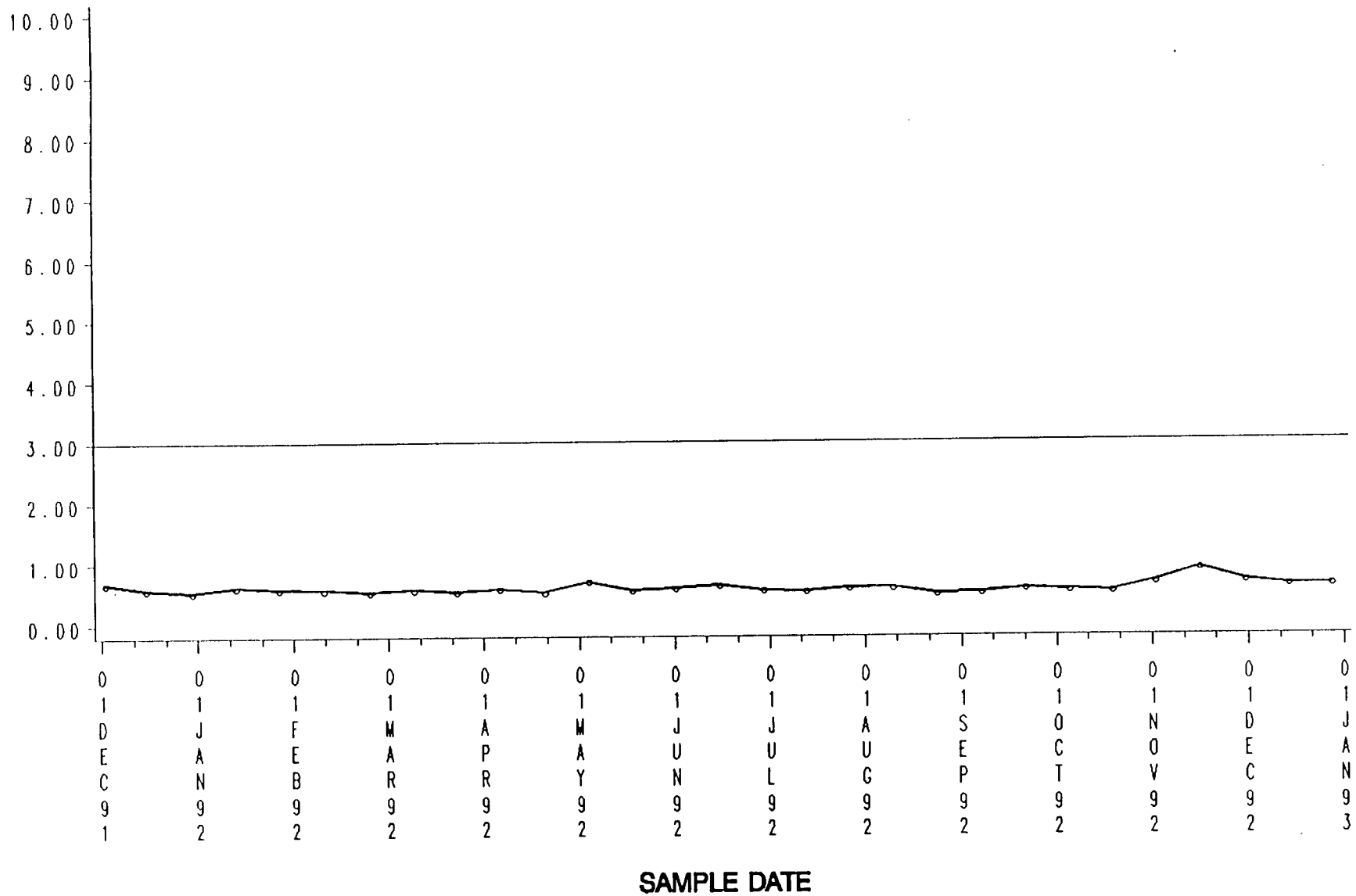


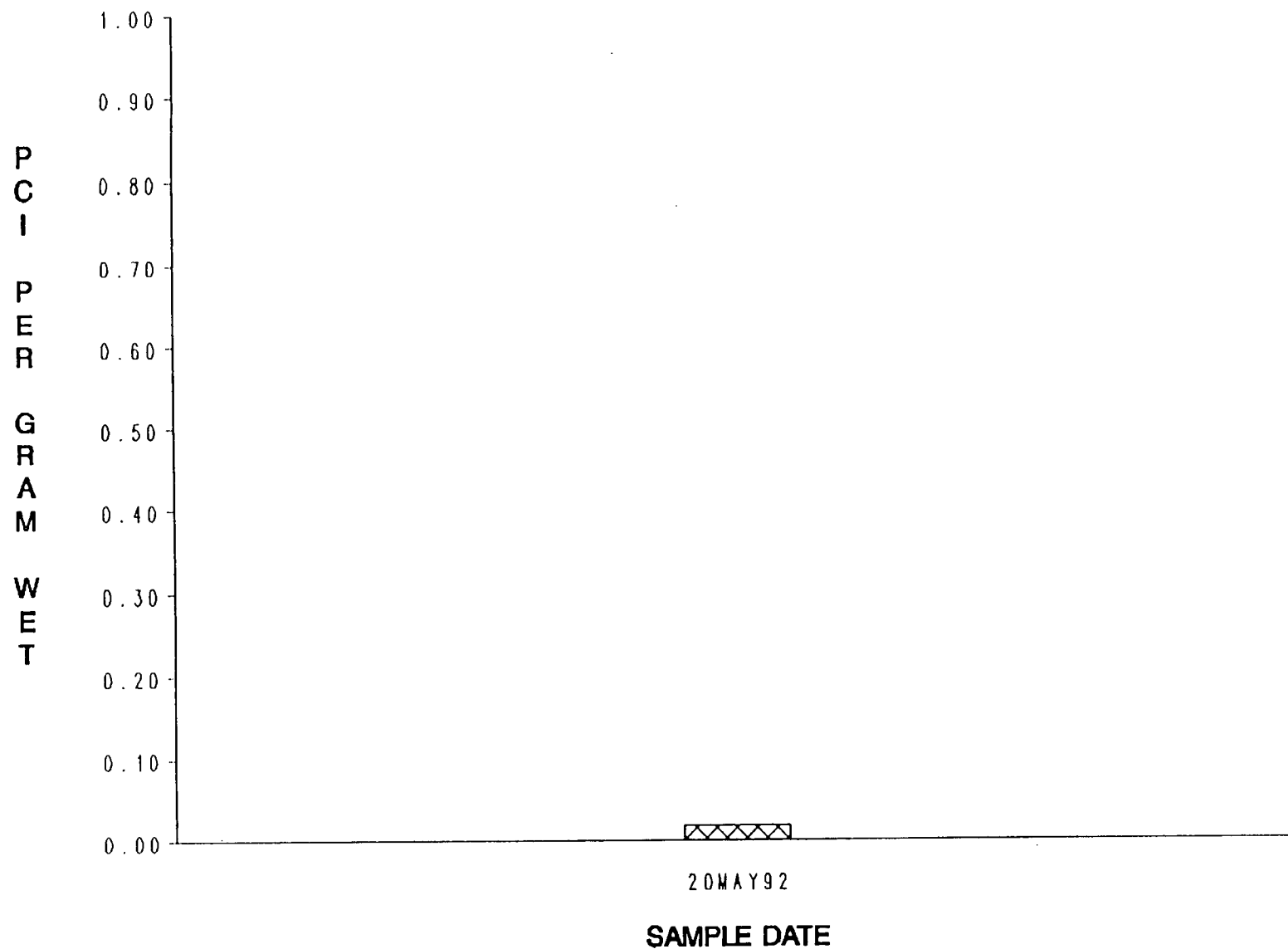
FIGURE 3-9

SYMBOL < LLD

STATION '0063' IS THE CONTROL POINT

REPORTING LEVEL IS 3.0

CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
AQUATIC VEGETATION SAMPLES
PLANT=HBR SAMPLE POINT=0041



ISOTOPE  CS-137

FIGURE 3-10

CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
AQUATIC VEGETATION SAMPLES
PLANT=HBR SAMPLE POINT=0045

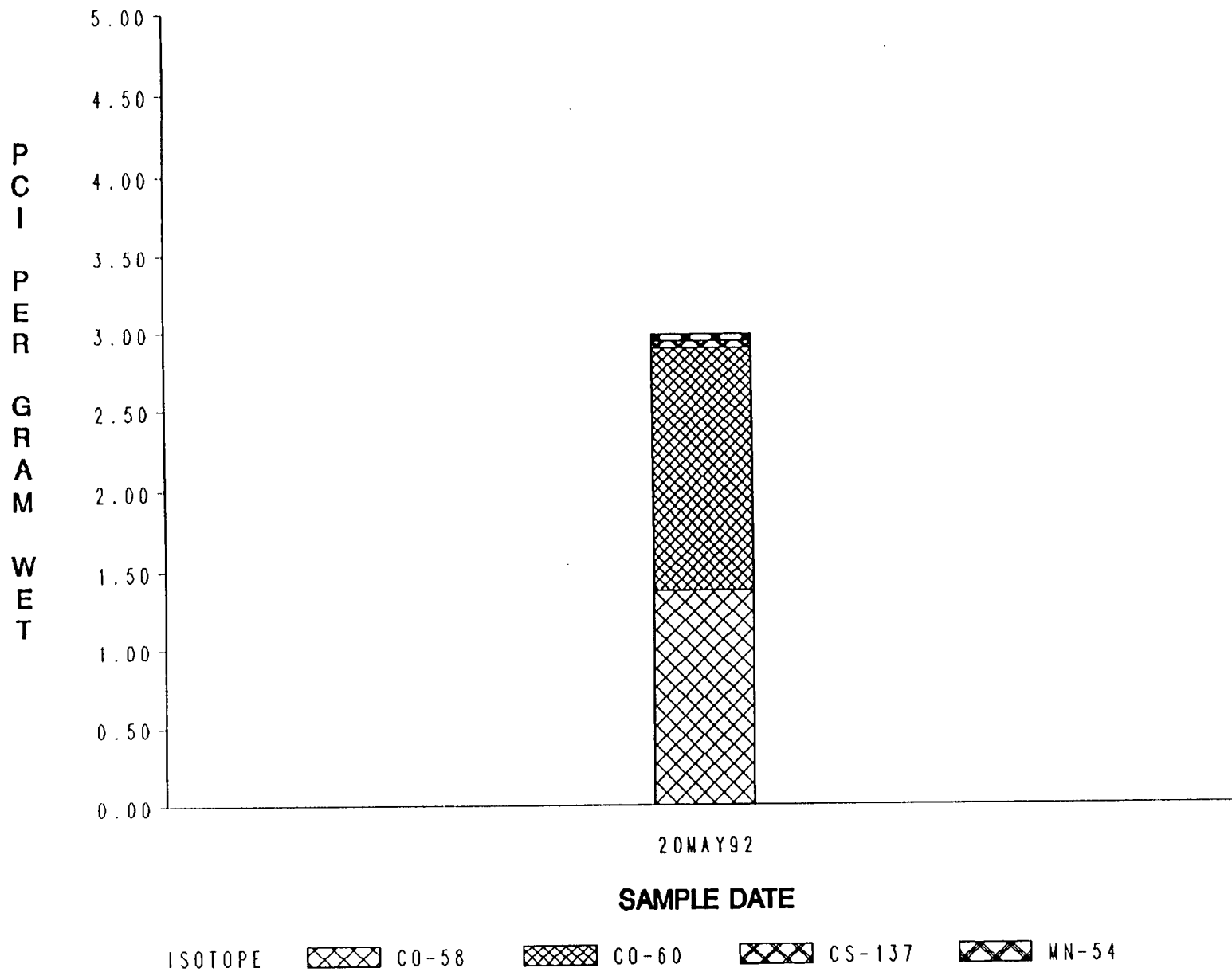
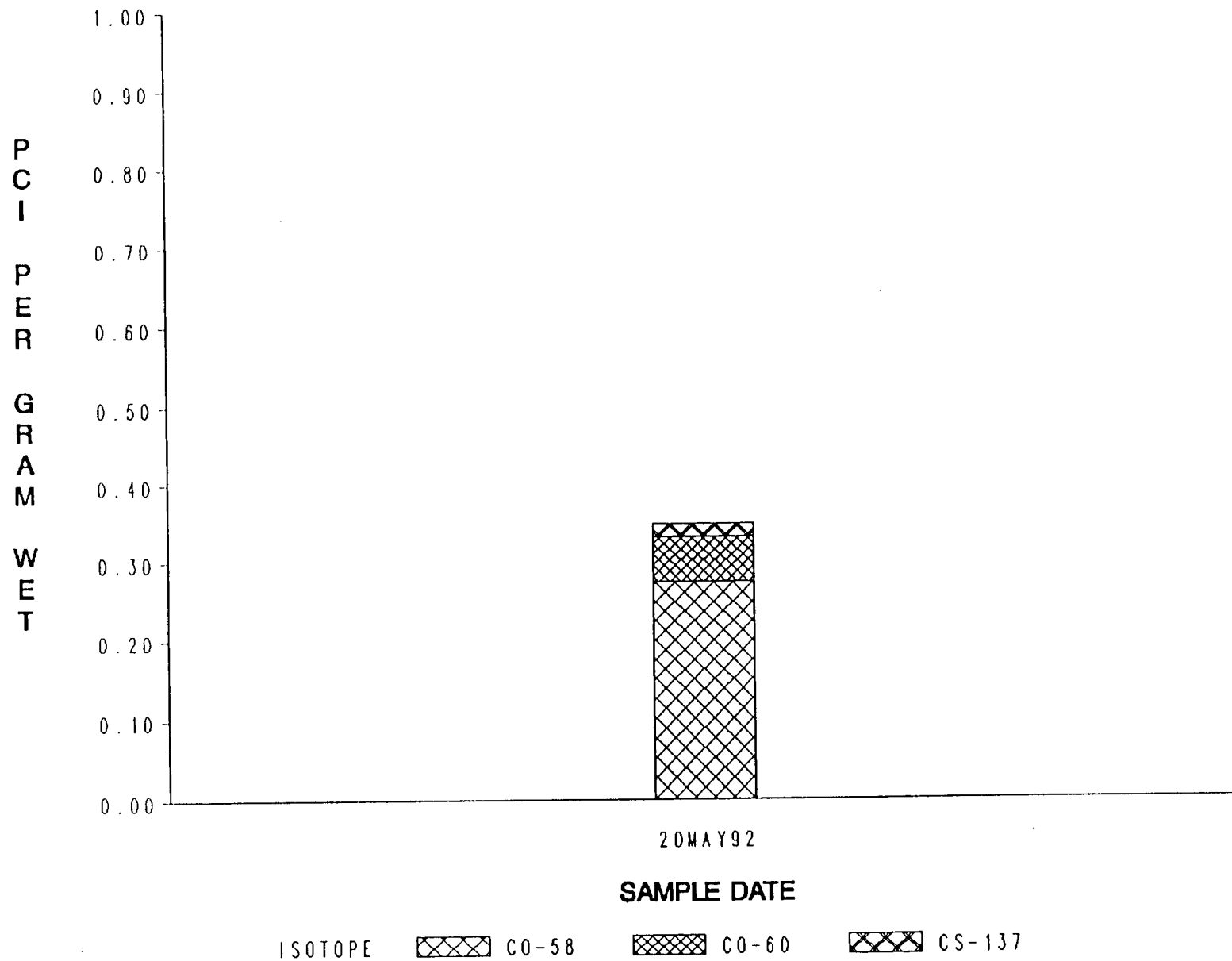
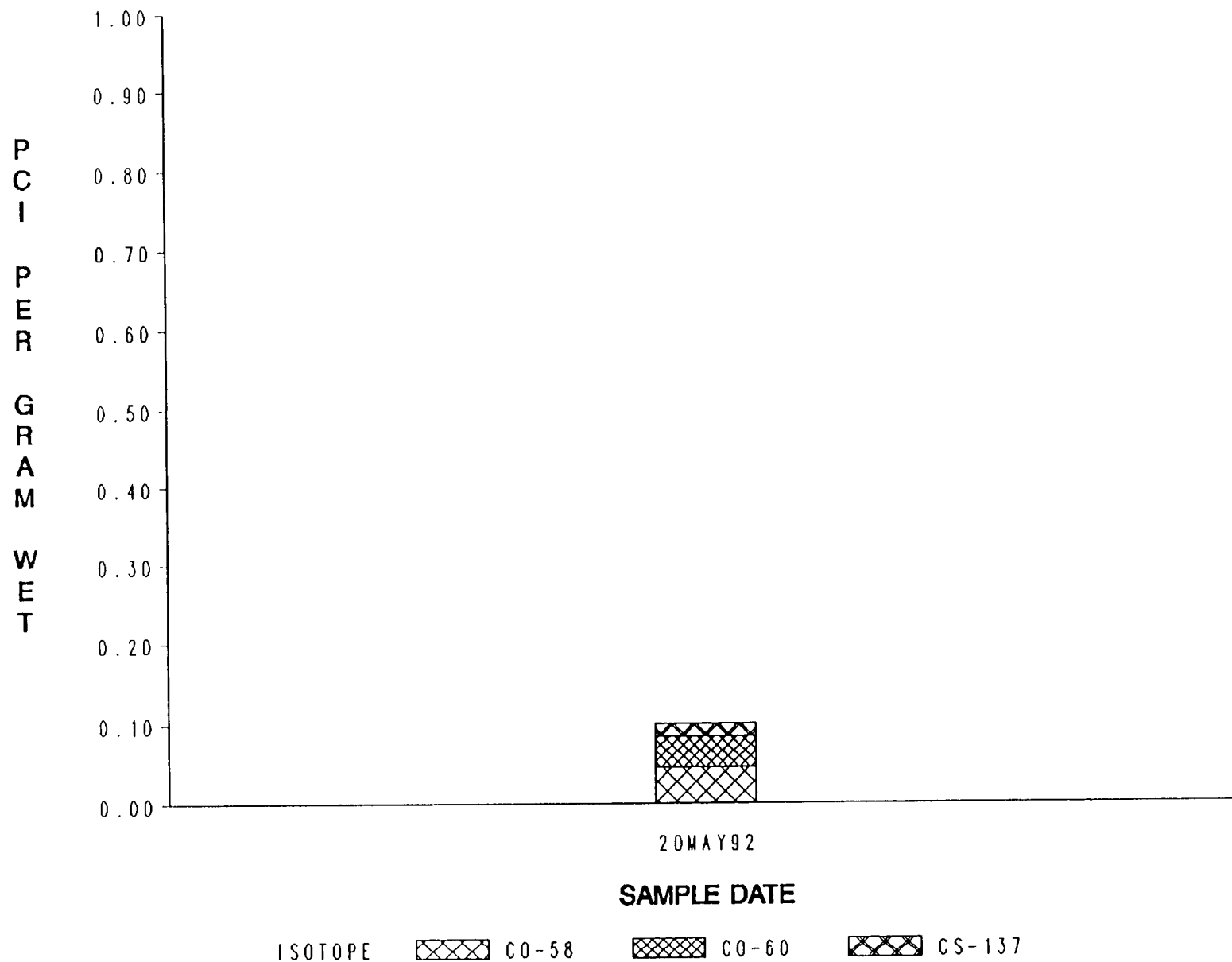


FIGURE 3-11

CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
AQUATIC VEGETATION SAMPLES
PLANT=HBR SAMPLE POINT=0046



CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
AQUATIC VEGETATION SAMPLES
PLANT=HBR SAMPLE POINT=0054



CP&L ENVIRONMENTAL SURVEILLANCE
 TRITIUM ACTIVITY FOR
 SURFACE WATER SAMPLES
 PLANT=HBR SAMPLE POINT=0040

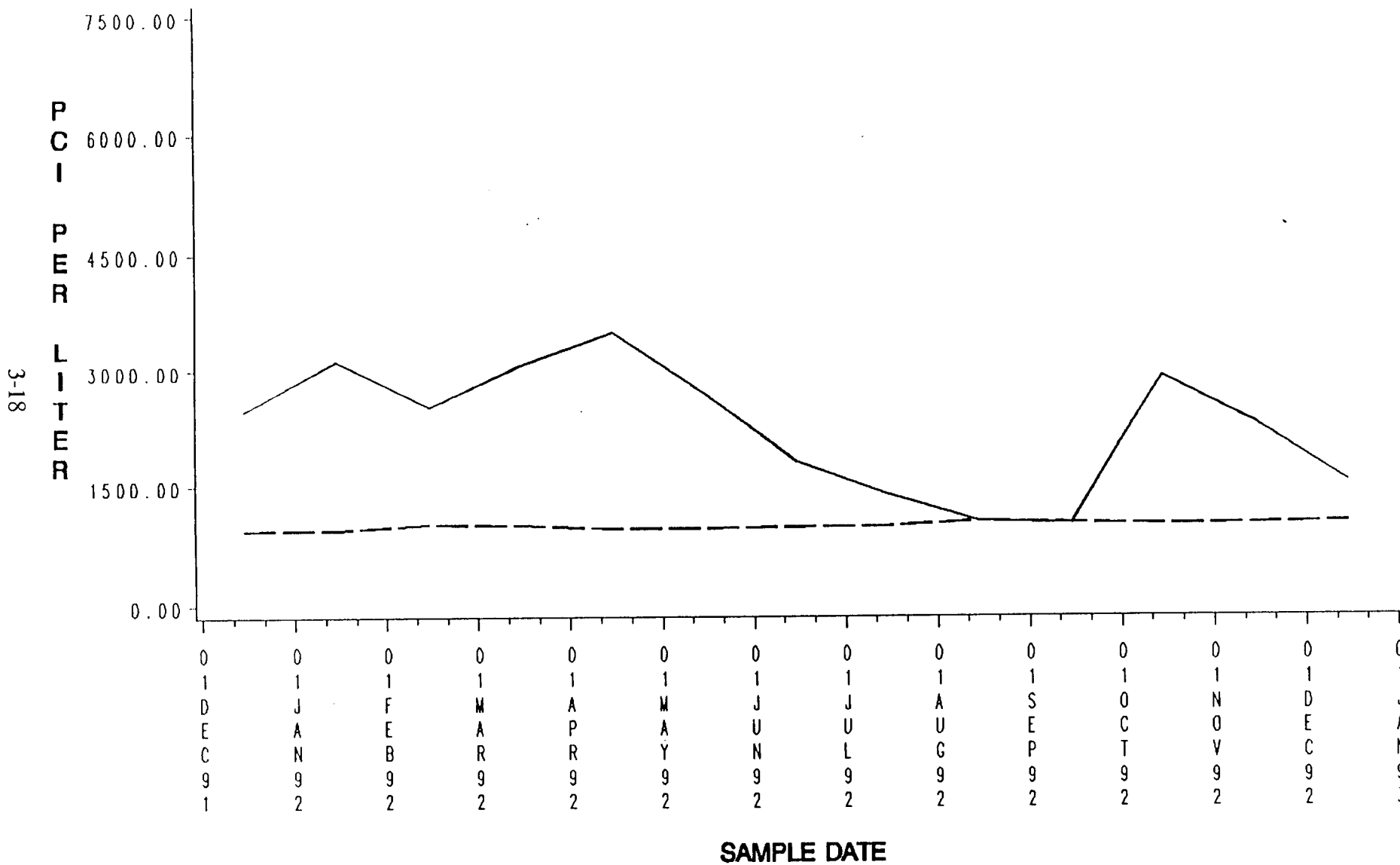


FIGURE 3-14

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

CP&L ENVIRONMENTAL SURVEILLANCE
 TRITIUM ACTIVITY FOR
 SURFACE WATER SAMPLES
 PLANT=HBR SAMPLE POINT=0057

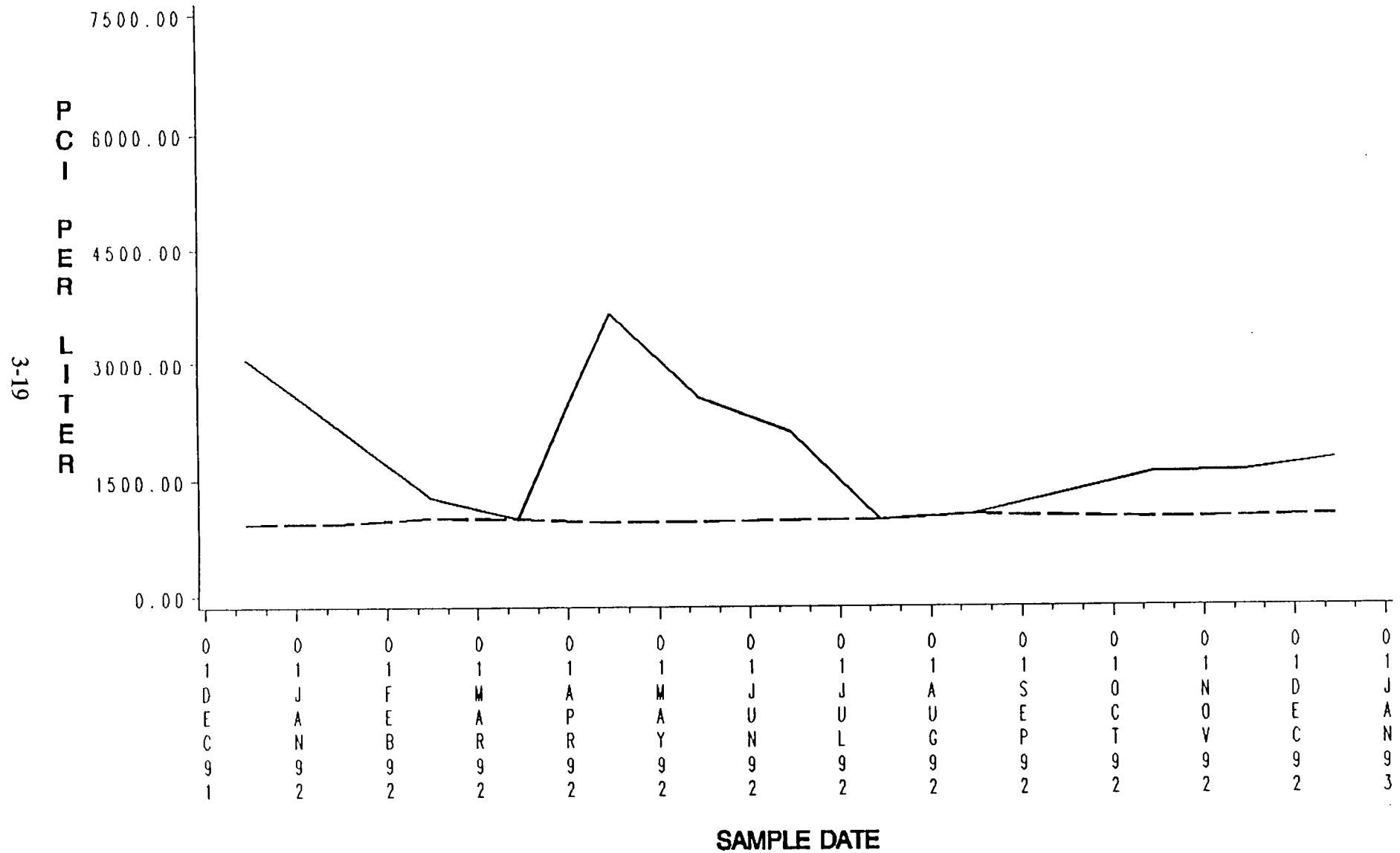


FIGURE 3-15

SOLID LINE FOR SAMPLE STATION
 BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
SHORELINE SEDIMENT SAMPLES
PLANT=HBR SAMPLE POINT=0057

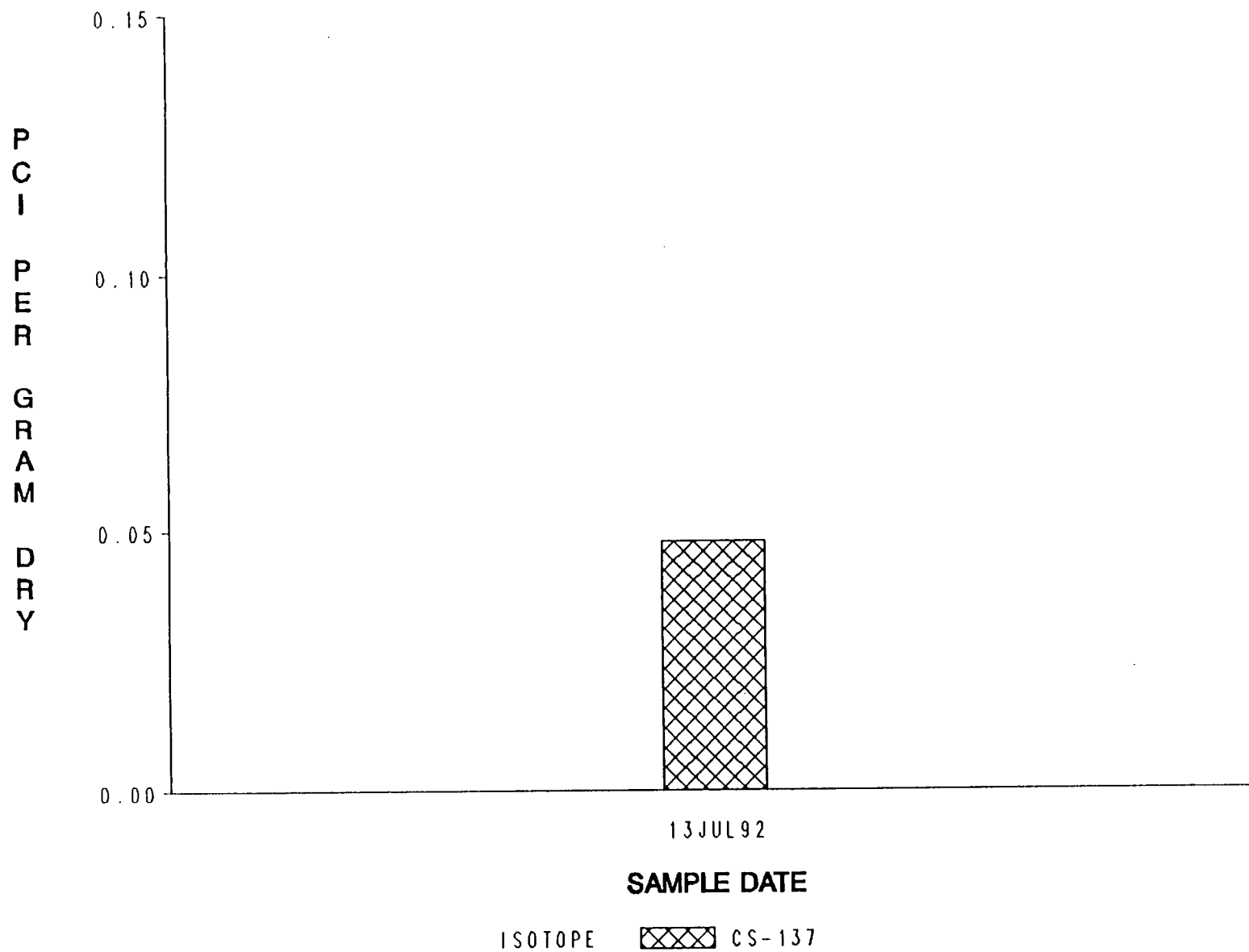


FIGURE 3-16

SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

CP&L ENVIRONMENTAL SURVEILLANCE
 TLD AVERAGES FOR
 INNER AND OUTER RING LOCATIONS
 PLANT=HBR

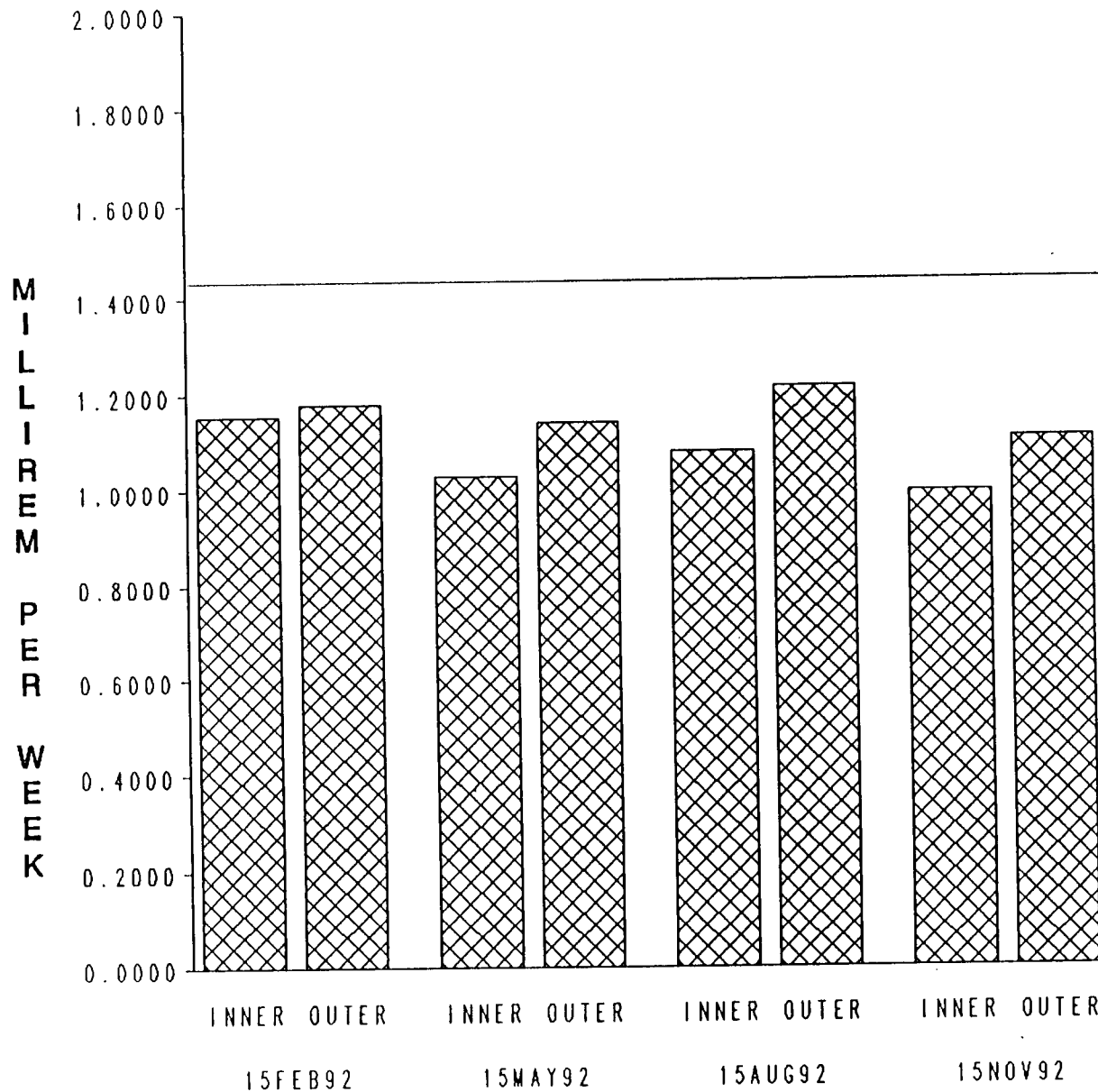


FIGURE 3-17

AVERAGE(1983-1987)=1.4358

4.0 MISSED SAMPLES

4.1 Air Cartridges and Air Particulates

No samples were available for:

- AC/AP-2 on June 14 and September 7 due to breaker trips.
- AC/AP-55 on June 23 due to a breaker trip.
- AC/AP-5 on August 23 due to a motor burnout.
- AC/AP-4 on October 6 due to a motor burnout.
- AC/AP-6 on October 26 due to a motor burnout.

4.2 Broadleaf Vegetation

No broadleaf vegetation samples were available for the months of January, February, March, April, October, November, and December.

4.3 Groundwater

No sample was available in February from GW-43 due to pump and well repairs in progress.

4.4 Milk

Iodine-131 analysis data on MK-54 for November 16 was lost due to repeated equipment failures. A recount was not attempted since the eight-day counting criteria for I-131 analyses would have been exceeded.

4.5 Surface Water

No sample was collected from the ash pond (SW-57) in September 1992. The ash pond was dry for the month.

4.6 Thermoluminescent Dosimeters (TLDs)

TLDs 27 and 36 were missing in the field for the third quarter. TLD 27 was collected in the fourth quarter but was too damaged to read.

5.0 LAND-USE CENSUS

The 1992 land-use census was performed on May 28, 1992, in accordance with Technical Specification 3.17.2 and 4.21.2. The purpose of the survey is to identify the location of the nearest resident, the nearest meat and/or milk animal, 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 5-mile radius of the site in each of the 16 meteorological sectors. No milk-producing animals are located within a 5-mile radius of the plant. No significant changes in the land-use census occurred from the previous year.

Table 5-1
Land-Use Census
Distance to Locations of Interest (miles)

Sector	Distance to Nearest Resident	Distance to Nearest Garden
N	2.90	2.90
NNE	1.60	1.90
NE	1.30	1.50
ENE	0.85	3.00
E	0.90	0.90
ESE	0.60	0.60
SE	0.60	1.90
SSE	0.30	> 5.00
S	0.30	2.50
SSW	0.40	0.40
SW	0.70	0.80
WSW	0.40	1.00
W	0.50	0.80
WNW	0.90	0.90
NW	1.20	1.20
NNW	3.50	3.50

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 $1.1\text{E-}3$ pCi/m³.

Air particulate samples are mounted in 2-inch stainless steel planchets and counted directly for 50 minutes.

6.2 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 in a liquid scintillation counter for 50 minutes. The LLD is approximately 1200 pCi/l.

6.3 Iodine-131

Iodine-131 airborne concentrations are analyzed by the intrinsic germanium (Ge) gamma spectrometry systems. The cartridges are placed on the detector and each charcoal cartridge is counted individually with an approximate LLD of $8.0\text{ E-}3$ pCi/m³.

Iodine-131 in milk is determined either by radiochemical or instrumental methods. Analysis involves use of anion-exchange resin and either direct gamma analysis of the resin with a sodium iodide (NaI) well-detector or sodium hypochlorite elution of the resin and organic extraction of the iodine followed by precipitation as silver iodide. The precipitate is collected on a tared filter, dried, and counted on a low-background beta counter. The LLD using the NaI detector is approximately 0.4 pCi/l for milk using a 25,000 second count time. The LLD using the radiochemical separation and beta counting is also approximately 0.4 pCi/l.

6.4 Gamma Spectrometry

Gamma spectrum analysis utilizes intrinsic germanium detectors with thin aluminum windows housed in steel and lead shields. The analyzer system is the Nuclear

Data 6685. Table 6-1 summarizes LLD values derived from instrument sensitivity based upon a blank sample background.

Air particulate filter quarterly composites are placed in a Petri dish and analyzed directly for 3,000 seconds.

Liquid samples are boiled down to reduce the volume, transferred to a PB-50 beaker, and analyzed directly for 20,000 seconds.

Shoreline and bottom sediments are dried, ground, weighed, and then analyzed in a Marinelli beaker for 5,000 seconds.

Broadleaf and aquatic vegetation and food product samples are weighed wet and analyzed in a Marinelli beaker for 20,000 seconds.

Fish samples are cleaned, dressed, and placed in a Marinelli beaker for analysis for 5,000 seconds.

6.5 Thermoluminescent Dosimetry (TLD)

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 as the dosimeter is heated above 150°C. The photons from 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 Radiochemistry Laboratory at the Harris Energy & Environmental Center in New Hill, North Carolina, provides radioanalytical services for CP&L's nuclear plant radiological 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 1992, 60 analyses were completed on 21 samples representing three major environmental media (water, milk, and air filters). Data on the known activities and the normalized standard deviations for the 60 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	65
≤ 2 standard deviation	93
≤ 3 standard deviation	98

One of 60 analyses exceeded the 3 sigma action level. A gross beta analysis of a water sample received in January 1992 fell outside the 3σ limit. The self-absorption curve was redone and the sample reanalyzed. The results were $< 1\sigma$ from the known activity.

6.7 Lower Limits of Detection

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 Gamma Spectrometry**

<u>Surface Water/Groundwater Samples</u> (Freshwater)	
Isotope	(LLD)
Mn-54	3 pCi/ℓ
Fe-59	6
Co-58	4
Co-60	4
Zn-65	7
Zr-95	7
Nb-95	3
I-131	0.4*
Cs-134	4
Cs-137	4
Ba-140	12
La-140	4
Other Expected Gamma Emitters	2 to 65
<u>Air Particulates</u> (Quarterly Composite)	
Isotope	(LLD)
I-131	0.020 pci/m ³
Cs-134	0.001
Cs-137	0.001
Other Expected Gamma Emitters	0.001 to .022
<u>Milk</u> (Gamma Scan)	
Isotope	(LLD)
I-131	0.4* pCi/ℓ
Cs-134	4
Cs-137	4
Other Expected Gamma Emitters	1 to 86

*Nai well crystal analysis of resin concentrates of samples.

Table 6-1 (continued)

Sediments (Shoreline or Bottom)	
Isotope	(LLD)
Cr-51	248 pCi/kg (dry weight)
Mn-54	31
Co-58	27
Co-60	23
Cs-134	35
Cs-137	31
Other Expected Gamma Emitters	23 to 1751
Fish	
Isotope	(LLD)
Mn-54	23 pCi/kg (wet weight)
Fe-59	51
Co-58	23
Co-60	29
Zn-65	47
I-131	31
Cs-134	30
Cs-137	24
Other Expected Gamma Emitters	9 to 572
Food Products and Vegetation	
Isotope	(LLD)
I-131	21 pCi/kg (wet weight)
Cs-134	18
Cs-137	19
Other Expected Gamma Emitters	14 to 308