Radiological Environmental Operating Report

1991

HARRIS NUCLEAR PROJECT

CAROLINA POWER & LIGHT COMPANY

Harris Energy & Environmental Center

Carolina Power & Light Company

New Hill, North Carolina

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

FOR THE

SHEARON HARRIS NUCLEAR POWER PLANT

JANUARY 1 THROUGH DECEMBER 31, 1991

Prepared by:

Katherine C Minard

Reviewed by:

Daniel F. Cahill

TABLE OF CONTENTS

Table of Contents i
List of Figures iii
List of Tables v

1.0 SUMMARY 1-1

2.0 GENERAL INFORMATION 2-1
2.1 Plant and Location 2-1
2.2 Radiological Environmental Monitoring Program 2-2

3.0 INTERPRETATIONS AND CONCLUSIONS 3-1
3.1 Air 3-1
3.2 Drinking Water 3-1
3.3 Fish 3-2
3.4 Surface Water 3-2
3.5 Groundwater 3-3
3.6 Milk 3-3
3.7 Bottom Sediment 3-3
3.8 Shoreline Sediment 3-3
3.9 Food Crops 3-4
3.10 External Radiation Exposure 3-4
3.11 Comparison with Preoperational and 1990 Operational Data 3-4

4.0 MISSED SAMPLES AND ANALYSES 4-1
4.1 Air Cartridge and Air Particulates 4-1
4.2 Food Crops 4-1
4.3 TLDs 4-1

5.0 LAND-USE CENSUS 5-1
5.1 Introduction 5-1
5.2 Requirements 5-1

TABLE OF CONTENTS (continued)

5.3 Methods 5-1
5.4 Results 5-2

6.0 ANALYTICAL PROCEDURES 6-1
6.1 Gross Beta 6-1
6.2 Tritium 6-1
6.3 Iodine-131 6-1
6.4 Gamma Spectrometry 6-2
6.5 Thermoluminescent Dosimetry 6-2
6.6 EPA Laboratory Intercomparison Program 6-3
6.7 Lower Limits of Detection 6-4

LIST OF FIGURES

Figure		Page
2-1	Shearon Harris Nuclear Power Plant--Radiological Environmental Sampling Points	2-7
2-2	Shearon Harris Nuclear Power Plant-- Radiological Environmental Sampling Points	2-8
2-3	Shearon Harris Nuclear Power Plant--Radiological Environmental Sampling Points	2-9
2-4	Legend for Figures 2-1, 2-2, 2-3	2-10
3-1	Gross Beta Activity for Air Particulate Samples (Sample Point 0001)	3-8
3-2	Gross Beta Activity for Air Particulate Samples (Sample Point 0002)	3-9
3-3	Gross Beta Activity for Air Particulate Samples (Sample Point 0004)	3-10
3-4	Gross Beta Activity for Air Particulate Samples (Sample Point 0026)	3-11
3-5	Gross Beta Activity for Air Particulate Samples (Sample Point 0047)	3-12
3-6	Gross Beta Activity for Drinking Water Samples (Sample Point 0040)	3-13
3-7	Gross Beta Activity for Drinking Water Samples (Sample Point 0051)	3-14
3-8	Tritium Activity for Drinking Water Samples (Sample Point 0040)	3-15
3-9	Tritium Activity for Drinking Water Samples (Sample Point 0051)	3-16
3-10	Gross Beta Activity for Surface Water Samples (Sample Point 0026)	3-17
3-11	Gross Beta Activity for Surface Water Samples (Sample Point 0040)	3-18
3-12	Tritium Activity for Surface Water Samples (Sample Point 0026)	3-19

LIST OF FIGURES (Continued)

Figure		Page
3-13	Tritium Activity for Surface Water Samples (Sample Point 0040)	3-20
3-14	Tritium Activity for Surface Water Samples (Sample Point 026S)	3-21
3-15	Tritium Activity for Surface Water Samples (Sample Point 041S)	3-22
3-16	Tritium Activity for Surface Water Samples (Sample Point 052S)	3-23
3-17	Iodine-131 Activity for Milk Samples (Sample Point 0005)	3-24
3-18	Iodine-131 Activity for Milk Samples (Sample Point 0042)	3-25
3-19	Iodine-131 Activity for Milk Samples (Sample Point 0043)	3-26
3-20	Gamma Activity for Bottom Sediment Samples (Sample Point 0052)	3-27
3-21	TLD Averages for Inner and Outer Ring Locations	3-28

LIST OF TABLES

Table		Page
1-1	Radiological Environmental Monitoring Program Data Summary	1-3
2-1	Radiological Environmental Monitoring Program	2-4
5-1	Distance to the Nearest Special Locations from the Shearon Harris Nuclear Power Plant (miles)	5-4
5-2	Meat Animal Type at Nearest Location to the Shearon Harris Nuclear Power Plant by Sector	5-5
6-1	Typical Lower Limits of Detection (a priori) Gamma Spectrometry	6-4

1.0 SUMMARY

This report presents the results of the Radiological Environmental Monitoring Program conducted during 1991 for the Shearon Harris Nuclear Power Plant (SHNPP) and fulfills the reporting requirements of Technical Specifications 6.9.1.3. The program was conducted in accordance with Technical Specification 4.12.1, the Off-Site Dose Calculation Manual, and applicable procedures.

Approximately 900 samples of 11 different media types from indicator stations were compared to approximately 200 control samples. No detectable activity or activities not differing from the corresponding control samples occurred in 96 percent of the indicator samples.

Radioactivity in environmental samples which could be attributed to plant operations in 1991 is as follows:

Environmental Media	Radionuclide	Highest Average Activity and Occurrence	Maximum Individual Dose mrem/yr
Harris Lake Surface Water	H-3	7.81 E+3 pCi/ℓ (24/24)	No ingestion pathway. No dose calculated.
Fish	H-3	See above	.01 (T.B.)
SHNPP Drinking Water	H-3	5.27 E+3 pCi/ℓ (11/12)	.10 (T.B)
Harris Lake Shoreline Sediment	Co-58	6.85E-2pCi/g (5/8)	1.8E-4
	Cs-137	4.79E-2pCi/g (1/8)	1.3E-4
Harris Lake Bottom Sediment	Mn-54	2.52E+0 pCi/g (3/3)	No dose calculated as water shielding eliminates dose at surface.
	Co-57	2.54E-1 pCi/g (3/3)	
	Co-58	1.12E+1 pCi/g (3/3)	
	Co-60	4.13E+1 pCi/g (3/3)	
	Cs-137	3.70E-1 pCi/g (3/3)	
	Sb-125	3.25E+0 pCi/g (1/3)	

Overall, the radiological environmental data indicates that SHNPP operations in 1991 had no significant impact on the environment or public health and safety.

A statistical summary of all the data for 1991 has been compiled and summarized in Table 1-1.

The only impact of the plant on the environment in its five year's of operation has been (1) a slow but steady increase in the annual average tritium activity in Harris Lake from 3.4E+3 pCi/ℓ in 1987 to 7.8E+3 pCi/ℓ in 1991 and (2) the accumulation of activation products (primarily cobalt and manganese) in bottom sediment near the cooling tower discharge point.

TABLE
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM DATA SUMMARY

Shearon Harris Nuclear Power Plant
Wake County, North Carolina

Docket Number: STN 50-400
Calendar Year: 1991

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 Mean (2) Range	Location w/Highest Annual Mean: Name, Distance, and Direction	Location w/Highest Annual Mean: Mean (2) Range	Control Locations Mean (2) Range
Air Cartridge (pCi/m^3)	I-131 310(3)	1.4E-2	All less than LLD		All less than LLD	All less than LLD
Air Particulate (pCi/m^3)	Gross Beta 310(3)	1.2E-3	1.33E-2 (259/259) 4.22E-3 - 3.60E-2	SR 1912 3.4 miles SSW	1.51E-2 (52/52) 7.58E-3 - 3.60E-2	1.26E-2 (51/51) 5.80E-3 - 1.99E-2
	Gamma 24	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD
Drinking Water (pCi/l)	I-131 156	4.0E-1	All less than LLD		All less than LLD	All less than LLD
	Gross Beta 36	2.0E+0	4.34E+0 (24/24) 2.32E+0 - 8.16E+0	Lillington Cape Fear River 17 miles SSE	5.55E+0 (12/12) 2.94E+0 - 8.16E+0	6.18E+0 (12/12) 2.59E+0 - 1.17E+1
	Gamma 36	Refer to Table 6-1	All less than LLD	All less than LLD		All less than LLD
	Tritium 36(5)	1.2E+3	5.27E+3 (11/24) 3.77E+3 - 6.96E+3	SHNPP site 0.1 mile SSW	5.27E+3 (11/12) 3.77E+3 - 6.96E+3	All less than LLD
Fish Bottom-Feeders (pCi/g, wet)	Gamma 4	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD
Free-Swimmers (pCi/g, wet)	Gamma 8	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD

TABLE 1-[illegible]nt.)
RADIOLOGICAL ENVIRONMENTAL MON[illegible]RING PROGRAM DATA SUMMARY

Shearon Harris Nuclear Power Plant
Wake County, North Carolina

Docket Number: STN 50-400
Calendar Year: 1991

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 Mean (2) Range	Location w/Highest Annual Mean: Name, Distance, and Direction	Location w/Highest Annual Mean: Mean (2) Range	Control Locations Mean (2) Range
Food Crop (pCi/g, wet)	Gamma 49(3)		4.86E-2 (3/26)	SR 1167	4.86E-2 (3/14)	1.79E-2 (1/23)
	Cs-137	1.7E-2	4.61E-2 - 5.35E-2	1.7 miles NNW	4.61E-2 - 5.35E-2	Single Value
Groundwater (pCi/1)	Gamma 20	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD
	Tritium 20	1.2E+3	All less than LLD		All less than LLD	All less than LLD
Milk (pCi/1)	I-131 72	4.0E-1	All less than LLD		All less than LLD	All less than LLD
	Gamma 72	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD
Bottom Sediments(4) (pCi/g, dry)	Gamma 3		2.52E+0 (3/3)	Harris Lake	2.52E+0 (3/3)	No control
	Mn-54	4.4E-2	2.07E+0 - 3.13E+0	3.8 miles S	2.07E+0 - 3.13E+0	
	Co-57	3.1E-2	2.54E-1 (3/3)	Harris Lake	2.54E-1 (3/3)	No control
			1.31E-1 - 4.31E-1	3.8 miles S	1.31E-1 - 4.31E-1	
	Co-58	3.7E-2	1.12E+1 (3/3)	Harris Lake	1.12E+1 (3/3)	No control
			3.10E+0 - 2.07E+1	3.8 miles S	3.10E+0 - 2.07E+1	
	Co-60	3.7E-2	4.13E+1 (3/3)	Harris Lake	4.13E+1 (3/3)	No control
			1.52E+1 - 8.26E+1	3.8 miles S	1.52E+1 - 8.26E+1	
	Cs-137	5.3E-2	3.70E-1 (3/3)	Harris Lake	3.70E-1 (2/3)	No control
			2.29E-1 - 5.61E-1	3.8 miles S	2.29E-1 - 5.61E-1	
	Sb-125	1.2E-1	3.25E+0 (1/3)	Harris Lake	3.25E+0 (1/3)	No control
			Single Value	3.8 miles S	Single Value	

TABLE 1-[illegible]nt.)

RADIOLOGICAL ENVIRONMENTAL MON[illegible]RING PROGRAM DATA SUMMARY

Shearon Harris Nuclear Power Plant
Wake County, North Carolina

Docket Number: STN 50-400
Calendar Year: 1991

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 Mean (2) Range	Location w/Highest Annual Mean: Name, Distance, and Direction	Location w/Highest Annual Mean: Mean (2) Range	Control Locations Mean (2) Range
Shoreline Sediments (pCi/g, dry)	Gamma 8					
	Co-58	3.7E-2	6.85E-2 (5/8) 2.04E-2 - 1.20E-1	Harris Lake 3.8 miles S	8.99E-2 (2/4) 5.98E-2 - 1.20E-1	No control
	Cs-137	5.3E-2	4.79E-2 (1/8) Single Value	Harris Lake 3.8 miles S	4.79E-2 (1/4) Single Value	No control
Surface Water(5)(6) (pCi/1)	I-131 104	4.0E-1	All less than LLD		All less than LLD	All less than LLD
	Gross Beta 36	2.0E+0	4.58E+0 (24/24) 2.70E+0 - 8.16E+0	Lillington Cape Fear River 17 miles SSE	5.55E+0 (12/12) 2.94E+0 - 8.16E+0	6.18E+0 (12/12) 2.59E+0 - 1.17E+1
	Gamma 36	Refer to Table 6-1	All less than LLD		All less than LLD	All less than LLD
	Tritium 48	1.2E+3	7.81E+3 (24/36) 5.48E+3 - 1.16E+4	Harris Lake 3.8 miles S	8.09E+3 (4/4) 6.25E+3 - 1.16E+4	All less than LLD
Direct Radiation (mR/week)	TLD 162(3)	1 mR	9.60E-1 (158/158) 7.00E-1 - 1.40E+0	Int SR1149 and US 1 4.7 miles NE	1.33E+0 (4/4) 1.20E+0 - 1.40E+0	9.00E-1 (4/4) 9.00E-1 - 9.00E-1

U:\OSU\REP\LFS\91HNPREO

FOOTNOTES TO TABLE 1-1

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 and 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 all samples with detectable activities at specific locations are indicated in parentheses.

3. Refer to Section 4, Missing Samples and Analyses.

4. Bottom sediment sampling is not required by the technical specifications.

5. Although quarterly composite samples are required, monthly composite samples are used to provide more frequent and sensitive analyses.

6. Lake surface waters are only required to be analyzed for tritium quarterly, but additional sampling and analyses were performed monthly. These additional analyses were intended to better characterize the impact of plant operations on Harris Lake.

2.0 GENERAL INFORMATION

This section (1) describes the pertinent characteristics of the plant and its environs; (2) provides the details of the monitoring program including sample locations, types, frequencies, and analyses; and (3) presents maps showing the distribution of sampling sites around the plant.

2.1 Plant and Location

The Shearon Harris Nuclear Power Plant (SHNPP) is a pressurized water reactor designed to produce 860 MWe (net). Criticality was initially achieved on January 3, 1987.

The SHNPP site is located in the extreme southwest corner of Wake County, North Carolina. The plant is approximately 16 miles southwest of Raleigh and approximately 15 miles northeast of Sanford. This location is on the northwest shore of Harris Lake which is a 4,000-acre reservoir created by the impoundment of Buckhorn Creek. The reservoir provides process and cooling tower makeup water for the plant and also serves as the receiving body for liquid effluents such as yard runoff, cooling tower blowdown, and radioactive waste processing system. The main dam for the reservoir is approximately 4.6 miles south of the plant. The spillway at the dam flows into Buckhorn Creek which, after flowing south for approximately two miles, enters the Cape Fear River.

There are no industrial or residential structures on CP&L property. Carolina Power & Light cooperates with various state agencies to provide public access for boating, fishing, hunting, and other recreational uses on the property such as boat ramps and access areas.

The majority of the land within five miles of the site is wooded with a scattering of fields and residential properties. Much of the land is used for timber and pulpwood production. Agricultural activities occur on a limited basis within this area including an operating commercial dairy.

The population within ten miles of the plant is, for the most part, considered rural. Towns in this area with notable populations include Apex, Holly Springs, and Fuquay-Varina (see Figure 2-2).

Within a 50-mile radius of the plant, much of the land is devoted to agricultural activity. Major crops include tobacco, soybeans, and corn for grain. Livestock production includes hogs, beef, poultry, and dairy products. Commercial fish and shellfish catches from waters within 50 miles of the station discharge are negligible. Recreational fishing is popular in the area. Since there are no estuarine or saltwater bodies, sportfishing is confined to freshwater streams, rivers, private ponds, and impoundments such as Harris Lake and Jordan Lake.

2.2 Radiological Environmental Monitoring Program

The purposes of the SHNPP Radiological Environmental Monitoring Program are to:

- Provide an evaluation of the environmental impact of releases of radioactive materials from the plant.
- Measure any accumulation of radioactivity in the environment and to assess trends.
- Detect unanticipated pathways for the transport of radionuclides through the environment.

The following locations are designated as control locations for the respective measurements and are intended to indicate conditions away from SHNPP influence:

Pittsboro > 12 miles NW

(Sample Station 5)

Airborne Particulate (filter) Samples
Charcoal Cartridge Samples--Airborne I-131
Thermoluminescent Dosimeter Area Monitors
Milk Samples
Food Products

Cape Fear Steam Electric Plant 6.1 Miles WSW

(Sample Station 38)

Surface Water Samples
Drinking Water Samples

Upstream of the Buckhorn Dam on the Cape Fear River

Site Varies in this Locale

(Sample Station 45)

Fish Samples

The current radiological environmental monitoring program is detailed in Table 2-1 and has been based on plant Technical Specification 4.12.1. Harris Lake bottom sediment sampling, although not a requirement, is a component of the program. Figures 2-1, 2-2, and 2-3 show the environmental monitoring locations. Figure 2-4 provides a legend for Figures 2-1 through 2-3.

TABLE 2.1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SHEARON HARRIS NUCLEAR POWER PLANT

Exposure Pathway[1]	Sampling Point and Description[1]	Sampling Frequency		Typical Sample Size	Sample Analysis
Air Cartridge (AC)	1–2.5 miles N 2–1.5 miles NNE 4–3.2 miles NNE 5–> 12 miles NW–Pittsboro (Control)[3] 26–4.6 miles S 47–3.4 miles SSW	Continuous operating sampling with sample collection at least once per seven days or as required by dust loading	Weekly	30,000 cu. ft. (900 cu m)	I-131 (charcoal cartridge)
Air Particulate (AP)	1–2.5 miles N 2–1.5 miles NNE 4–3.2 miles NNE 5–> 12 miles NW–Pittsboro (Control)[3] 26–4.6 miles S 47–3.4 miles SSW	Continuous operating sampling with sample collection at least once per seven days or as required by dust loading	Weekly Quarterly Composite	30,000 cu. ft. (900 cu m)	Gross Beta[2] Gamma Isotopic[4]
Sediment from Shoreline (SS)	26–4.6 miles S 41–3.8 miles S		Semiannually	500g	Gamma Isotopic[4]
Bottom Sediment[7] (SD)	52–3.8 miles S		Semiannually	500g	Gamma Isotopic[4]
Drinking Water (DW)	38–6.1 miles WSW (Control)[3] 40–17 miles SSE–Lillington 51–0.1 mile SSW–SHNPP Site		Weekly Monthly Composite[5]	8 liters	I-131 Gamma Isotopic[4] Tritium Gross Beta
Groundwater (GW)[6]	39–0.7 mile SSW 57–0.4 mile SSW 58–0.5 mile WSW 59–0.5 mile NNE 60–0.5 mile ESE		Quarterly	8 liters	Tritium Gamma Isotopic[4]
Fish (FH)	44–Site varies within Harris Lake 45–Site varies in Cape Fear River above Buckhorn Dam (Control)[3]		Semiannually	1 kg each Free-Swimmers Bottom-Feeders	Gamma Isotopic[4] on edible portion for each
Food Products (FC)	54–1.7 miles NNE–Wilkins or Morris 55–1.7 miles NNW–L. L. Goodwin 5–>12 miles WNW, NW< or NNW–Pittsboro (Control)[3]	During growing season when milk sampling is not performed	Monthly	500g	Gamma Isotopic[4]
Milk (MK)	42–7.5 miles SSE–Maple Knoll Dairy 43–2.2 miles N–Goodwin's Dairy 5–>12 miles NW–Strowd's Dairy (Control)[3]	When animals on pasture	Semimonthly	8 liters	I-131 Gamma Isotopic[4]
Surface Water (SW)[8]	26–4.6 miles S 38–6.1 miles WSW (Control)[3] 40–17 miles SSE–Lillington		Weekly Monthly Composite[5]	8 liters	I-131 Gamma Isotopic[4] Tritium Gross Beta

U:\OSU\REP\LFS\91HNPREO.REP

TABLE
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SHEARON HARRIS NUCLEAR POWER PLANT

Exposure Pathway[6]	Sampling Point and Description[1]	Sampling Frequency		Typical Sample Size	Sample Analysis
Direct Radiation Monitors (TLD)	TLDs 1–2.5 miles N 2–1.5 miles NNE 3–2.6 miles ENE 4–3.2 miles NNE 5–>12 miles NW–Pittsboro (Control)[3] 6–0.9 mile ENE 7–0.8 mile E 8–0.7 mile ESE 9–2.3 miles SE 10–2.2 miles SSE 11–0.7 mile S 12–0.8 mile SSW 13–0.7 mile SW 14–1.4 miles W 15–1.8 miles W 16–1.7 miles WNW 17–1.4 miles NW 18–1.3 miles NNW 19–4.9 miles NNE 20–4.7 miles NE 21–4.8 miles ENE 22–4.6 miles E 23–5.0 miles ESE 24–4.7 miles SE 25–4.8 miles SSE 26–4.6 miles S 27–4.8 miles SSW 28–4.8 miles SW 29–5.6 miles WSW 30–5.1 miles W 31–4.5 miles WNW 32–6.4 miles NW 33–4.4 miles NNW 34–8.6 miles NE–Apex 35–6.9 miles E–Holly Springs 36–11.2 miles E 37–9.7 miles ESE–Fuquay-Varina 48–4.5 miles N 49–2.6 miles NE 50–2.8 miles ESE 53–5.5 miles NW 56–2.8 miles WSW	Continuous measurement with an integrated readout at least once per quarter		Not applicable	Gamma Dose

NOTES TO TABLE 2-1

1. Sample locations are shown on Figures 2-1, 2-2, and 2-3. Figure 2-4 provides a legend explaining Figures 2-1 through 2-3.

2. Particulate samples will be analyzed for gross beta radioactivity 24 hours or more following filter change to allow for radon and radon-daughter decay. If gross beta activity is greater than ten times the yearly mean of the control sample station activity, a gamma isotopic analysis will be performed on the individual samples.

3. Control sample stations (or background stations) are located in areas that are unaffected by plant operations. All other sample stations that have the potential to be affected by radioactive emissions from plant operations are considered indicator stations.

4. Gamma isotopic analysis means the identification and quantitation of gamma-emitting radionuclides that may be attributable to the effluents from the plant operations.

5. Composite samples will be collected with equipment which is capable of collecting an aliquot at time intervals which are very short (e.g., every two hours) relative to the compositing period (e.g., monthly).

6. The dose will be calculated for the maximum organ and age group using the methodology contained in Regulatory Guide 1.109, Rev. 1, and the actual parameters particular to the site.

7. Bottom sediment sampling and analysis is not required by RETS. Samples are collected to provide additional environmental characterization.

8. Weekly I-131 analyses are not required for surface water samples. However, water samples collected at Locations 38 and 40 serve also as drinking water samples. I-131 analyses are performed on samples from these two locations.

9. Groundwater Sampling Locations 57-60 provide additional environmental characterization.

Figure 2-1
Shearon Harris Nuclear Power Plant
RADIOLOGICAL ENVIRONMENTAL SAMPLING POINTS

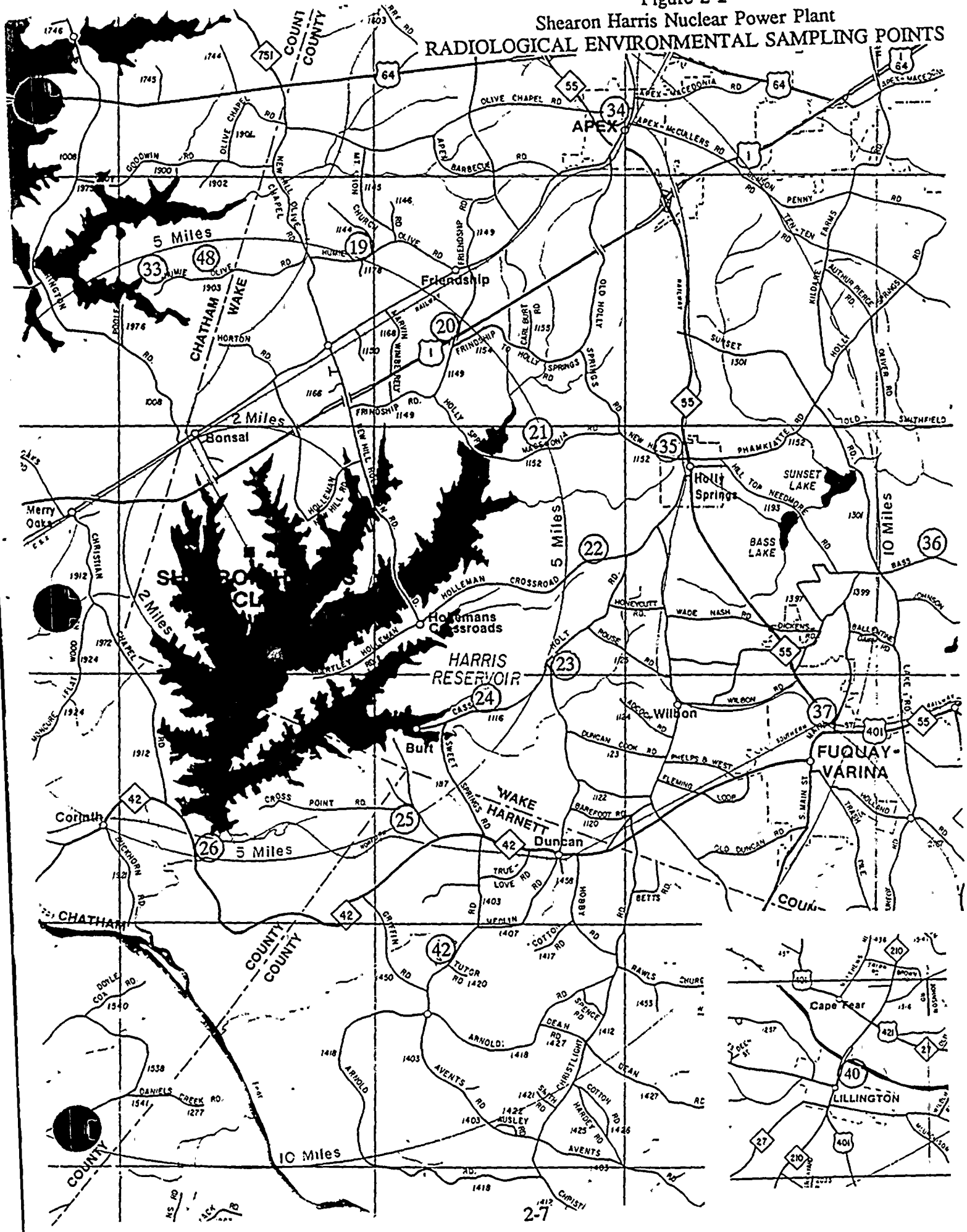


Figure 2-2
Shearon Harris Nuclear Power Plant
RADIOLOGICAL ENVIRONMENTAL SAMPLING POINTS

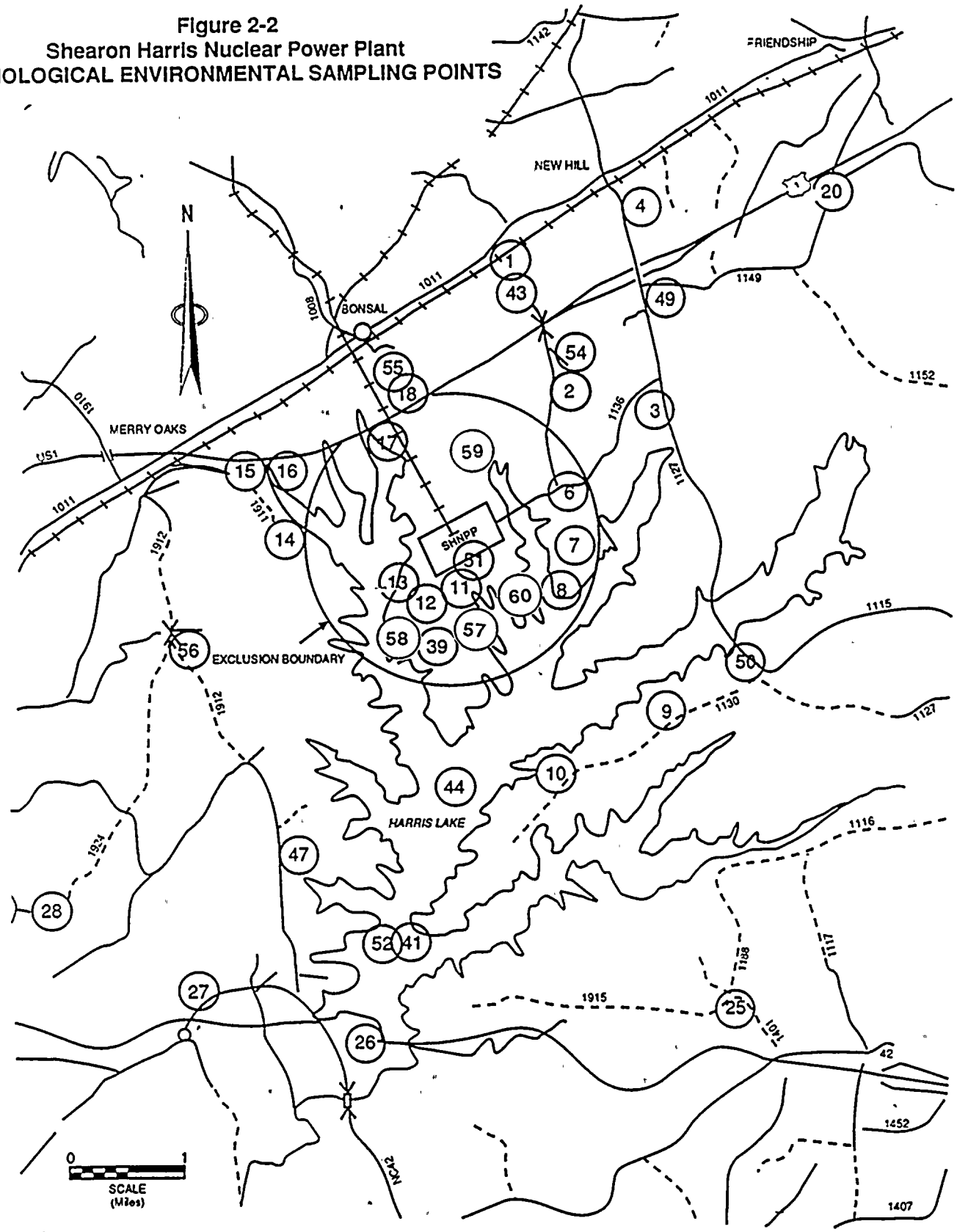


Figure 2-3

Shearon Harris Nuclear Power Plant

RADIOLOGICAL ENVIRONMENTAL SAMPLING POINTS

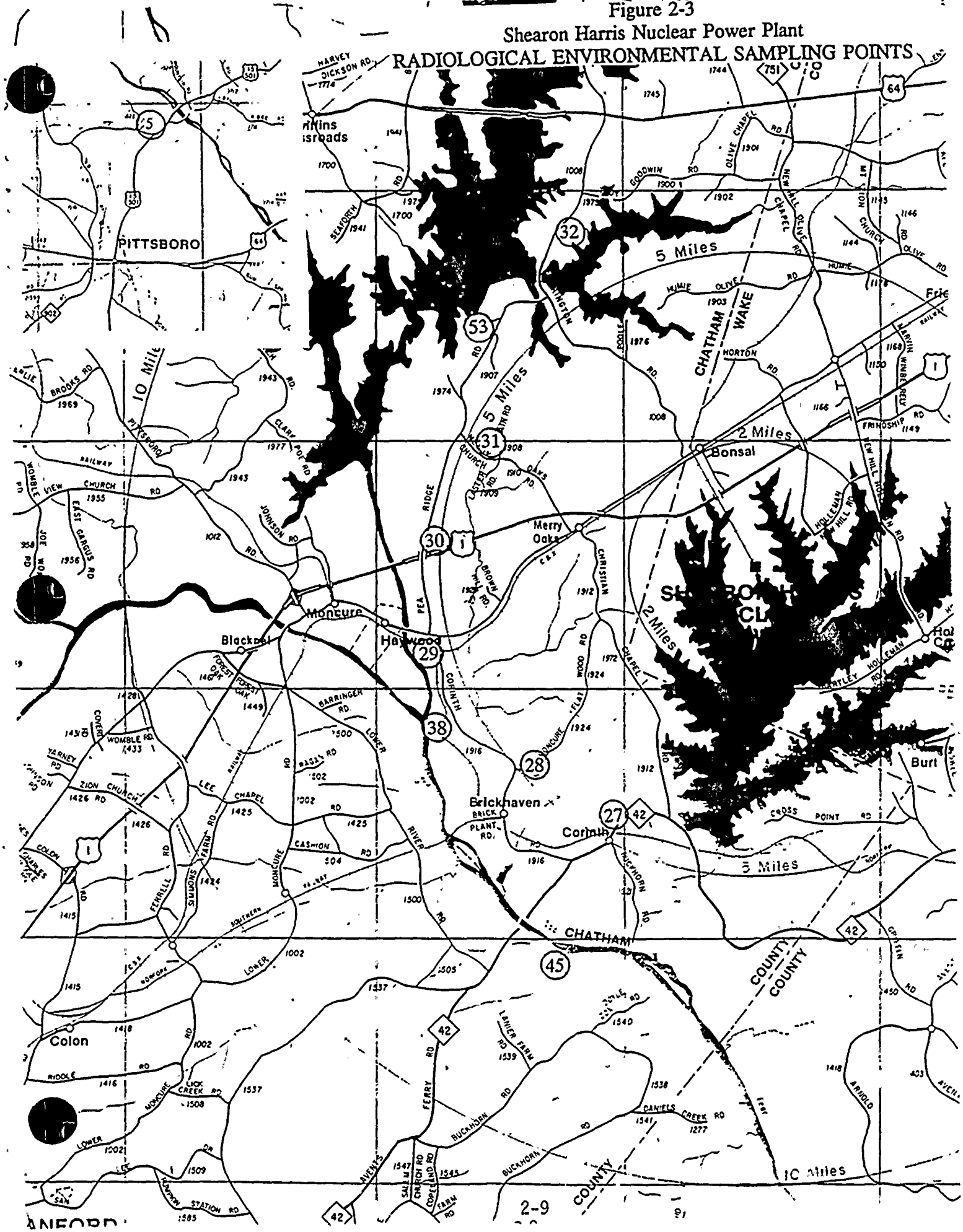


Figure 2-4

LEGEND FOR FIGURES 2-1, 2-2, 2-3					
Station No.	Refer to Figure	Sample Type	Station No.	Refer to Figure	Sample Type
1	2-2	AP, AC, TL	29	2-3	TL
2	2-2	AP, AC, TL	30	2-3	TL
3	2-2	TL	31	2-3	TL
4	2-2	AP, AC, TL	32	2-3	TL
5	2-3	AP, AC, MK, FC, TL	33	2-1	TL
6	2-2	TL	34	2-1	TL
7	2-2	TL	35	2-1	TL
8	2-2	TL	36	2-1	TL
9	2-2	TL	37	2-1	TL
10	2-2	TL	38	2-3	SW, DW
11	2-2	TL	39	2-2	GW
12	2-2	TL	40	2-1	SW, DW
13	2-2	TL	41	2-2	SS
14	2-2	TL	42	2-1	MK
15	2-2	TL	43	2-2	MK
16	2-2	TL	44	2-2	FH
17	2-2	TL	45	2-3	FH
18	2-2	TL	47	2-2	AP, AC
19	2-1	TL	48	2-1	TL
20	2-1, 2-2	TL	49	2-2	TL
21	2-1	TL	50	2-2	TL
22	2-1	TL	51	2-2	DW
23	2-1	TL	52	2-2	SD
24	2-1	TL	53	2-3	TL
25	2-1, 2-2	TL	54	2-2	FC
26	2-1, 2-2	AP, AC, SW, SS, TL	55	2-2	FC
27	2-2, 2-3	TL	56	2-2	TL
28	2-2, 2-3	TL	57-60	2-2	GW

AC Air Cartridge
AP Air Particulate
SD Bottom Sediment
FC Food Crop
FH Fish
GW Groundwater
MK Milk
SW Surface Water
DW Drinking Water
TL TLD
SS Shoreline Sediment

3.0 INTERPRETATIONS AND CONCLUSIONS

3.1 Air

All 310 air cartridge samples from indicator and control stations had I-131 activities which were less than the LLD (see Table 6-1).

Gross beta activity was detectable in all airborne particulate samples from the five indicator locations. The 259 samples had an average concentration of 1.33E-2 pCi/m^3. Similar gross beta activities were observed at the control location in Pittsboro which had an average concentration of 1.26E-2 pCi/m^3 in 51 samples. No gamma activity was detected in quarterly composite filter samples from either the indicator or control locations.

Figures 3-1 through 3-5 provide a graphic representation of the gross beta activity at the indicator locations compared to the control location for the period January through December 1991.

3.2 Drinking Water

None of the 104 drinking water samples collected at the SHNPP and the Lillington Municipal water supply nor the 52 control samples collected from the Cape Fear River above the Buckhorn Dam contained detectable I-131 activity during 1991.

Figures 3-6 and 3-7 provide graphic representation of the gross beta activity during 1991 for Locations 40 (Lillington) and 51 (SHNPP site). The solid line is the indicator location, while the broken line is the control location at the Cape Fear Plant.

The average monthly gross beta concentrations at the indicator and control locations were similar with activities of 4.34 and 6.18 pCi/l, respectively.

Analyses for gamma-emitting radionuclides indicated all concentrations were less than the lower limit of detection for drinking water. Table 6-1 contains typical LLD values for gamma-emitting radionuclides in drinking water.

Tritium activities in drinking water at the SHNPP, which is drawn from the Harris Lake, ranged from 3.8E+3 to 7.0E+3 pCi/l. The average activity in 1991 was

5.3E+3 pCi/l. No tritium was detected in the Lillington municipal water supply or the control station samples.

The total body dose to occupationally exposed personnel at SHNPP from the ingestion of 5.3E+3 pCi/l of tritium in drinking water during the year was calculated using the USNRC Regulatory Guide 1.109, Equation A-1. This dose was estimated at 0.1 mrem for the year of 1991.

Figures 3-8 and 3-9 present the tritium activities at the sample locations versus the control values.

3.3 Fish

Analyses for gamma-emitting radionuclides in two samples of bottom-feeding fish and in four samples of free-swimming species (sunfish and largemouth bass) from the indicator location, Harris Lake, revealed no detectable activity for 1991.

3.4 Surface Water

Surface water samples were collected and analyzed weekly for I-131. Water samples collected during 1991 contained no detectable I-131 (LLD < 4E-01 pCi/l).

Average gross beta concentrations at the indicator and control locations were 4.6 pCi/l and 6.2 pCi/l, respectively.

Figures 3-10 and 3-11 provide a graphic representation of the gross beta activity in surface water during 1991 for Locations 26 (Harris Lake) and 40 (Lillington). The solid line is the indicator location, while the broken line is the control location.

Surface water samples were analyzed for gamma-emitting radionuclides and tritium. All concentrations of man-made gamma-emitters were less than their respective lower limits of detection (see Table 6-1). Tritium activity was detectable in the Harris Lake surface water at an annual average concentration of 7.8E+3 pCi/l. This value included an additional six samples taken in the Harris Lake. No tritium activity above the LLD of 1.2E+3 pCi/l was detected in the surface water downstream at Lillington or in the Cape Fear at the control location.

Figures 3-12 through 3-16 present the tritium activities in surface water during 1991.

3.5 Groundwater

Groundwater samples are collected on site at SHNPP and analyzed for gamma-emitting radionuclides and tritium. Concentrations of these radionuclides were all less than their respective lower limits of detection during 1991.

3.6 Milk

Of the 72 indicator and control milk samples taken and analyzed for 1991, none contained detectable concentrations of I-131 or other gamma-emitting radionuclides of plant effluent origin.

Figures 3-17 to 3-19 present graphical information on the I-131.

3.7 Bottom Sediment

Sampling of bottom sediment is not a requirement of the plant technical specifications; however, samples are collected near the discharge of the cooling tower blowdown pipe to serve as an indicator of plant liquid discharges. In 1991, three samples were collected. Activation products of cobalt and manganese were detected in each sample and fallout Cs-137 was also observed. Sb-125 was detected in a single sample at a concentration of 3.2 pCi/g. Co-60, Co-58, and Mn-54 were the predominate nuclides with average concentrations of 41.3, 11.2, and 2.5 pCi/g, respectively.

Figure 3-20 presents the results of these analyses.

3.8 Shoreline Sediment

Shoreline sediment samples were collected (1) opposite the discharge structure and (2) near the main dam on three occasions in 1991. Detectable concentrations of Co-58 were observed in five of eight samples collected with an average concentration of 6.8E-2 pCi/g. Cs-137 occurred as a single value in one of eight samples at a concentration of 4.8E-2 pCi/g. These activities are only slightly

above their respective LLDs (see Table 6-1), and dose attributed to their presence was less than 0.001 mrem to the maximum exposed individual.

3.9 Food Crops

In addition to milk sampling, a food product sampling program was maintained. Six crop species were collected during a growing season which occurred in eight months of the year. The species selected were primarily broad-leaf vegetables most sensitive to direct fallout of airborne radionuclides. Crops sampled in 1991 included mustard greens, turnip greens, lettuce, cabbage, collards, and tomatoes.

Gamma spectrometry analyses of the food crops from indicator locations detected Cs-137 in 3 of 26 samples at an average concentration of 4.8E-2 pCi/g (wet). Cs-137 was detected in 1 of 23 control samples. Since Cs-137 is frequently found in this environment from worldwide fallout and the observed concentrations were only slightly above the LLD of 1.3E-2 pCi/g, these concentrations are not considered to be the result of plant effluents.

3.10 External Radiation Exposure

Thermoluminescent dosimeters were used to monitor ambient radiation exposures in the plant environs. The average weekly dose rate from the indicator locations was 1 mrem/wk and 0.9 mrem/wk from the control station. The highest indicator location was 4.7 miles northeast of the plant and averaged 1.3 mrem/wk. This is the same location identified in 1989 and 1990 as having the highest value. The differences among these locations is attributed to variations in soils and local geology and are not the result of plant operations.

Comparison of the weekly dose rates for TLDs within three miles (inner ring) of the plant with those at approximately five miles (outer ring) is presented in Figure 3-21 and shows that the outer ring, if anything, demonstrates a greater dose rate than does the inner ring. This presentation supports the interpretation that elevated dose rates are mostly a product of the local geology.

3.11 Comparison with Preoperational and 1990 Operational Data

Comparison of the 1991 environmental data with preoperational and 1990 operational data shows that, in most cases, the analyses involves activities < LLD

which does not allow statistical treatment. Conclusions and comparative statements are based on inspection and judgment.

Air Samples

With this exception, no I-131 has been detected in air samples collected from 1986 through 1991. I-131 was detected for a six-week period following the Chernobyl incident in April 1986.

Gross beta activities in air remained at 1.3E-2 pCi/m^3, a value similar to preoperational data and to the 1989-90 values.

Drinking Water

As in previous years, no I-131 was detected in any of the 1991 drinking water samples. This has been the experience for the preoperational and operational period with the exception of 1986 when the fallout from Chernobyl was detected.

In 1991 as in previous years, no tritium was detected in the Lillington water supply. Tritium again was detectable in the SHNPP drinking water. Since this water supply is not a primary source of water for members of the general public, it is not considered a public water supply. The water is consumed by employees during working hours. During 1991, 11 of 12 monthly samples of the SHNPP drinking water contained measurable tritium at an average concentration of 5.3E+3 pCi/ℓ--an increase over the 2.8E+3 pCi/ℓ seen in 1990. The maximum radiological exposure from this pathway is estimated at 0.1 mrem/yr.

Fish

During 1991 as in 1989-90, no gamma-emitting radionuclides from plant operations were detected in any of the fish samples. Data from previous years has occasionally indicated the presence of Cs-137 and Mn-54.

Surface Water

I-131 activities in samples of surface waters taken from the Harris Lake and the Cape Fear River, including a downstream location at Lillington, remained less than detectable as they have been since plant operations began in 1987.

The average gross beta activities were slightly higher than the levels observed in 1985-90 (4.6 vs. 3.4 pCi/ℓ) but less than the activity in the control samples.

Tritium activity in Harris Lake has increased measurably from the preoperational concentrations of less than 1.2E+3 pCi/l to a 1991 average of 7.81E+3 pCi/l. This is an increase over the 1990 value of 6.3E+3 pCi/l. Since the surface water tritium activity affects the activity in fish, it is estimated that the dose to the maximum exposed individual from consuming 21 kg of fish would be 0.01 mrem.

Groundwater

No tritium or gamma-emitter activity has been observed over the period from 1985-1991.

Milk

During 1991 as in all past years with the exception of the Chernobyl period, no I-131 concentrations were detected in milk samples throughout the entire year. There were also no other gamma-emitting radionuclides from plant operations detected in the milk.

Bottom Sediment

In the preoperational period of 1985-1986, sediment samples collected from the lake bottom in the vicinity of the liquid discharge structure had shown low concentrations (0.3 pCi/g) of Cs-137. During 1987 additional activation products, likely from plant operations, were detected beginning in July. As in 1990, Co-57; Co-58; Co-60; Mn-54; Cs-137; and Sb-125 were detected in bottom sediment samples in 1991. Inconsistent changes in nuclide activity occurred from 1990, i.e., Mn-54, Co-60, and Sb-125 increased; Co-58 decreased; Co-57 and Cs-137 were unchanged. These results are likely due to the difficulties of sampling bottom sediments. Due to the lake water shielding of radiation from these depositions, no radiological exposure to the public can be attributed to these radionuclides.

Shoreline Sediment

Previous years' sampling indicated that in 1987 three radionuclides of possible plant origin--Co-58, Cs-137, and Mn-54--were detected in shoreline sediment samples. In 1988 the concentrations of these radionuclides diminished. In 1989 none of the radionuclides were detected. During 1990, Co-58 and Cs-137 were detected in three of six samples at concentrations only slightly above their respective LLDs. In 1991, Co-58 was detected in five of eight samples at levels ranging from 2.0E-2 to 1.2E-1 pCi/g.

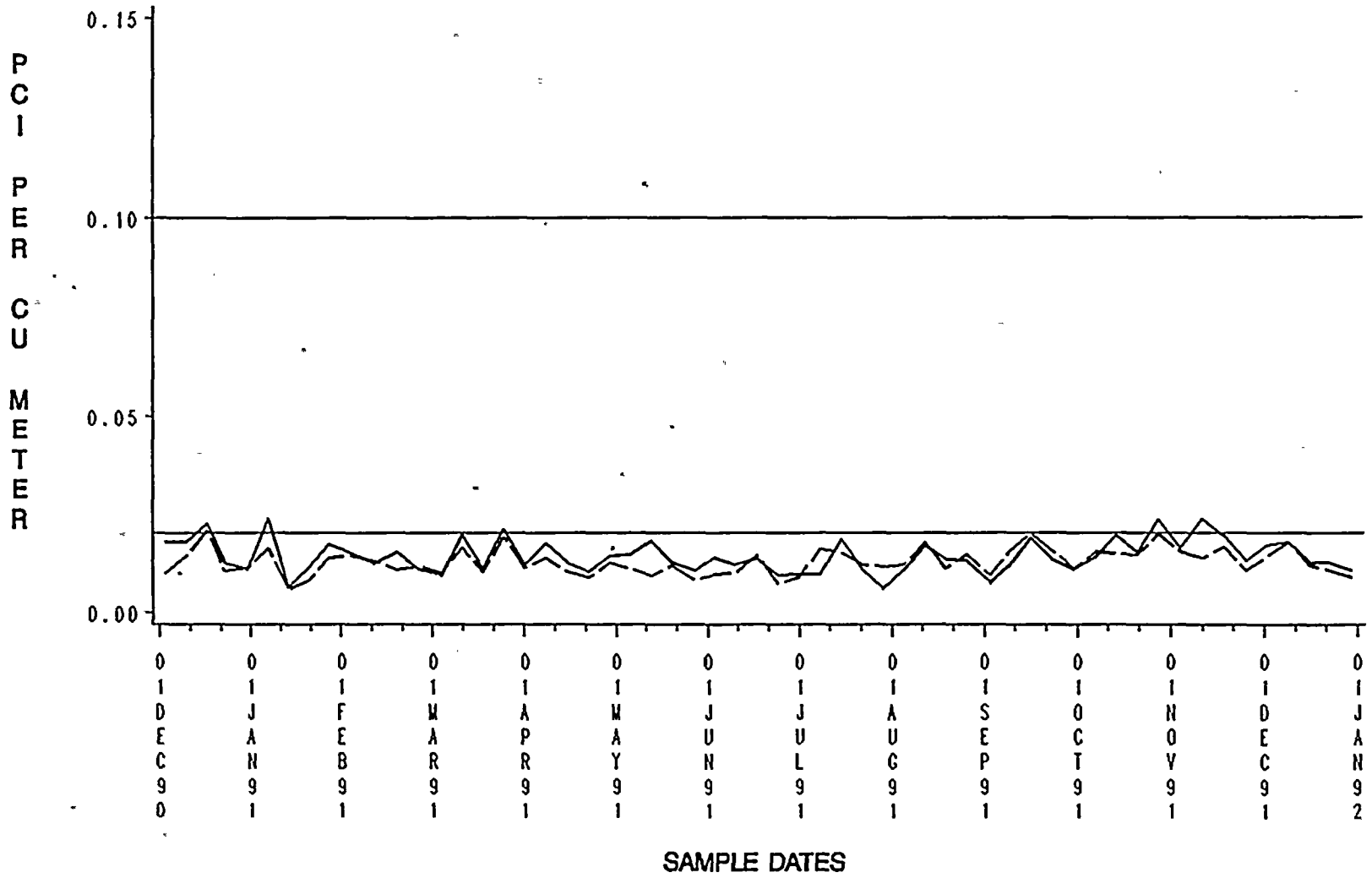
Food Crops

Cs-137 was detected in 3 of 26 indicator samples at an average concentration of 4.9E-2 pCi/g in 1991. This value is somewhat above the Lower Limit of Detection of 1.9E-2 pCi/gm for this radionuclide and is slightly higher than values randomly observed in past years both at the indicator locations and at the control locations. In 1988, Cs-137 was detected at the control location at similar concentrations, but no gamma-emitting radionuclides occurred in the control samples for the years 1989 and 1990. The results for 1991 in food crops are considered consistent with normal fluctuations indigenous to the area and not indicative of adverse trends.

TLD

The 41 TLD locations surrounding the plant showed virtually no change in the average weekly ambient beta-gamma environment from 1985 through 1991. The location with the maximum average recorded exposure was the same as for 1989 and 1990 and is located 4.7 miles northeast of the plant. Inspection of Figure 3-21 indicates that no plant effluent effect is demonstrated in the measurements especially since the average of the inner ring of TLDs (closest to the plant) are less than the outer measurements.

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
PLANT=HNPP SAMPLE POINT=0001

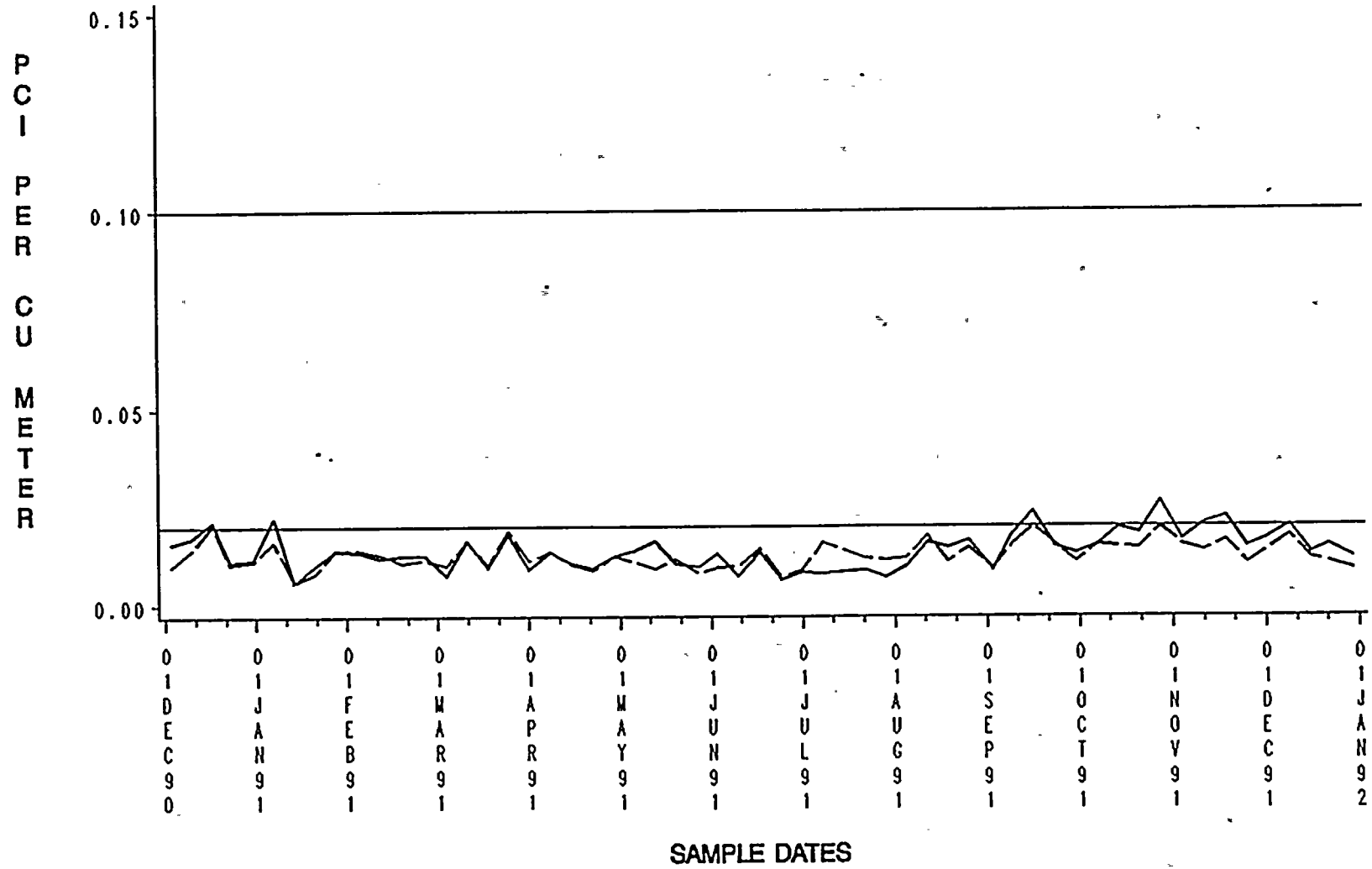


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

Figure 3-1

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

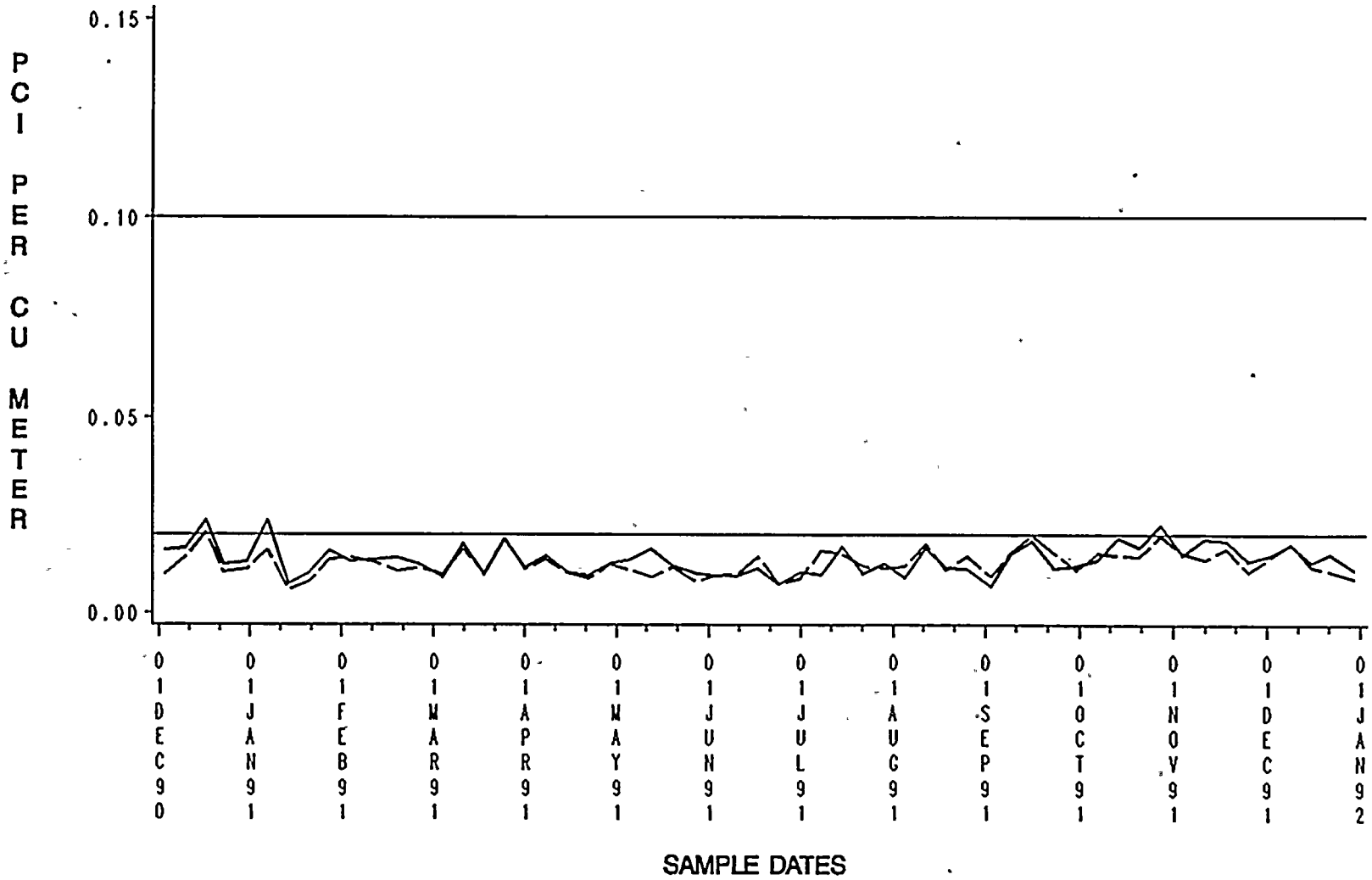


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

Figure 3-2

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

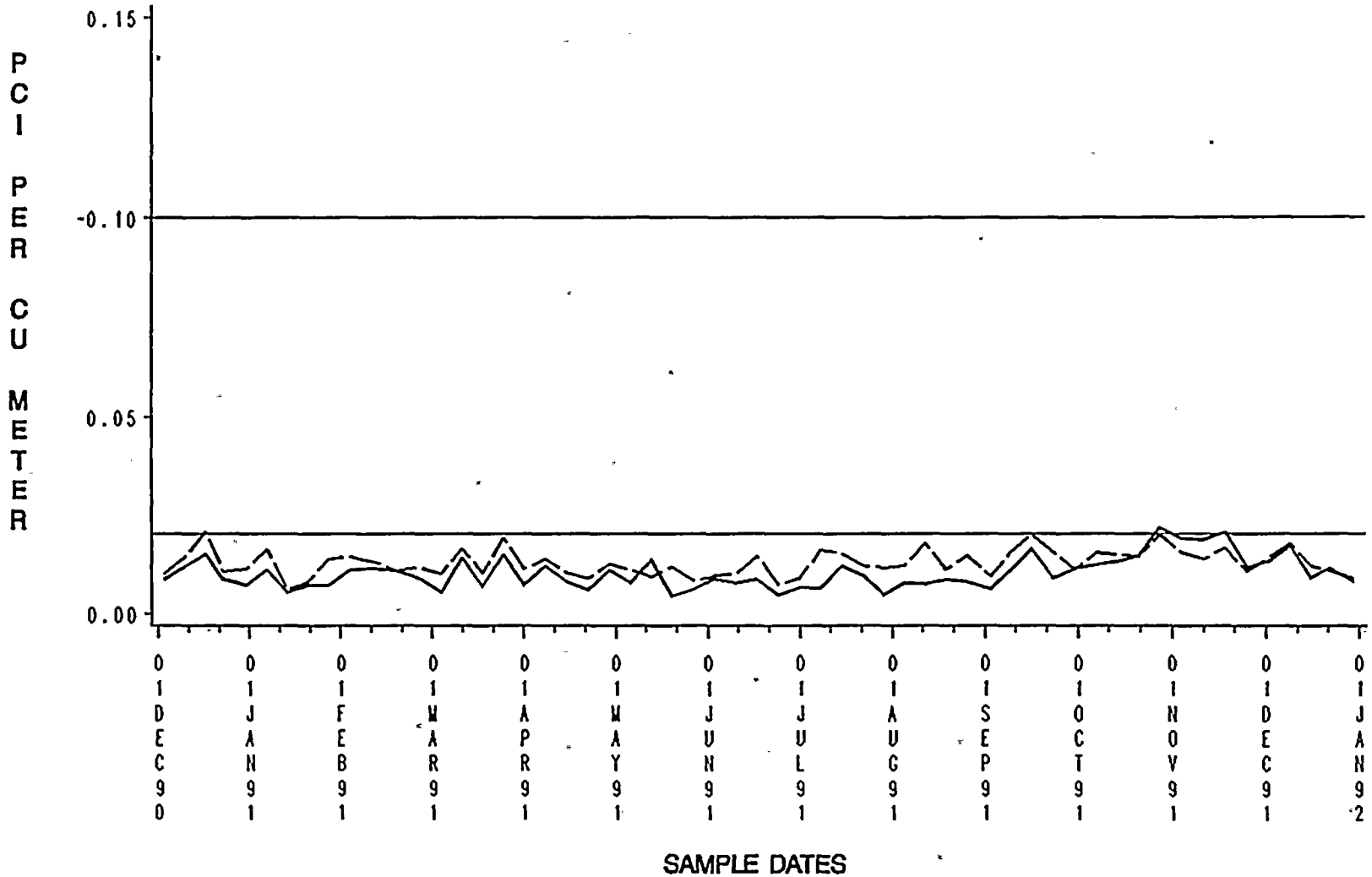


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

Figure 3-3

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
PLANT=HNPP SAMPLE POINT=0026

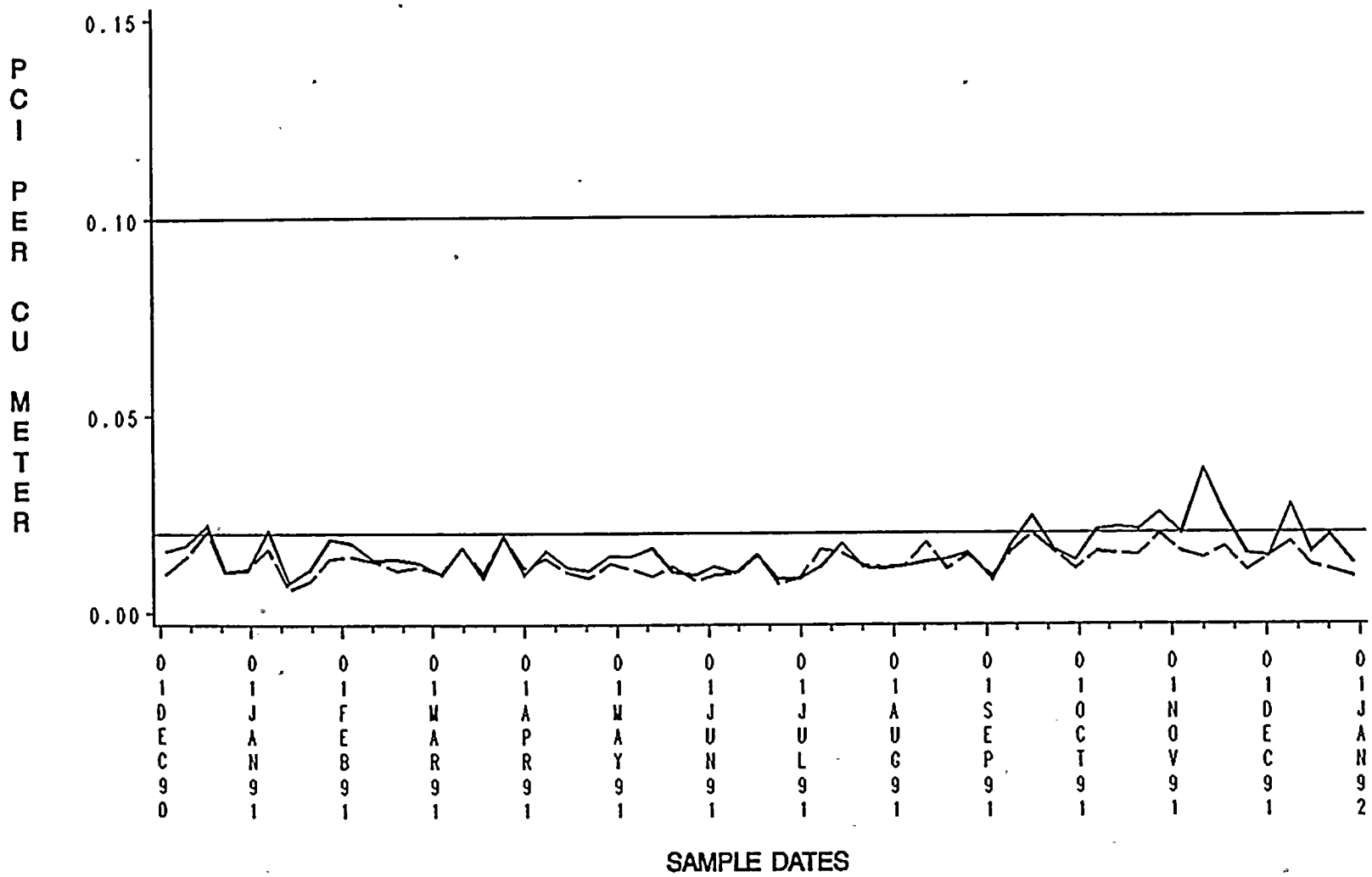


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

Figure 3-4

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
AIR PARTICULATE SAMPLES
PLANT=HNPP SAMPLE POINT=0047

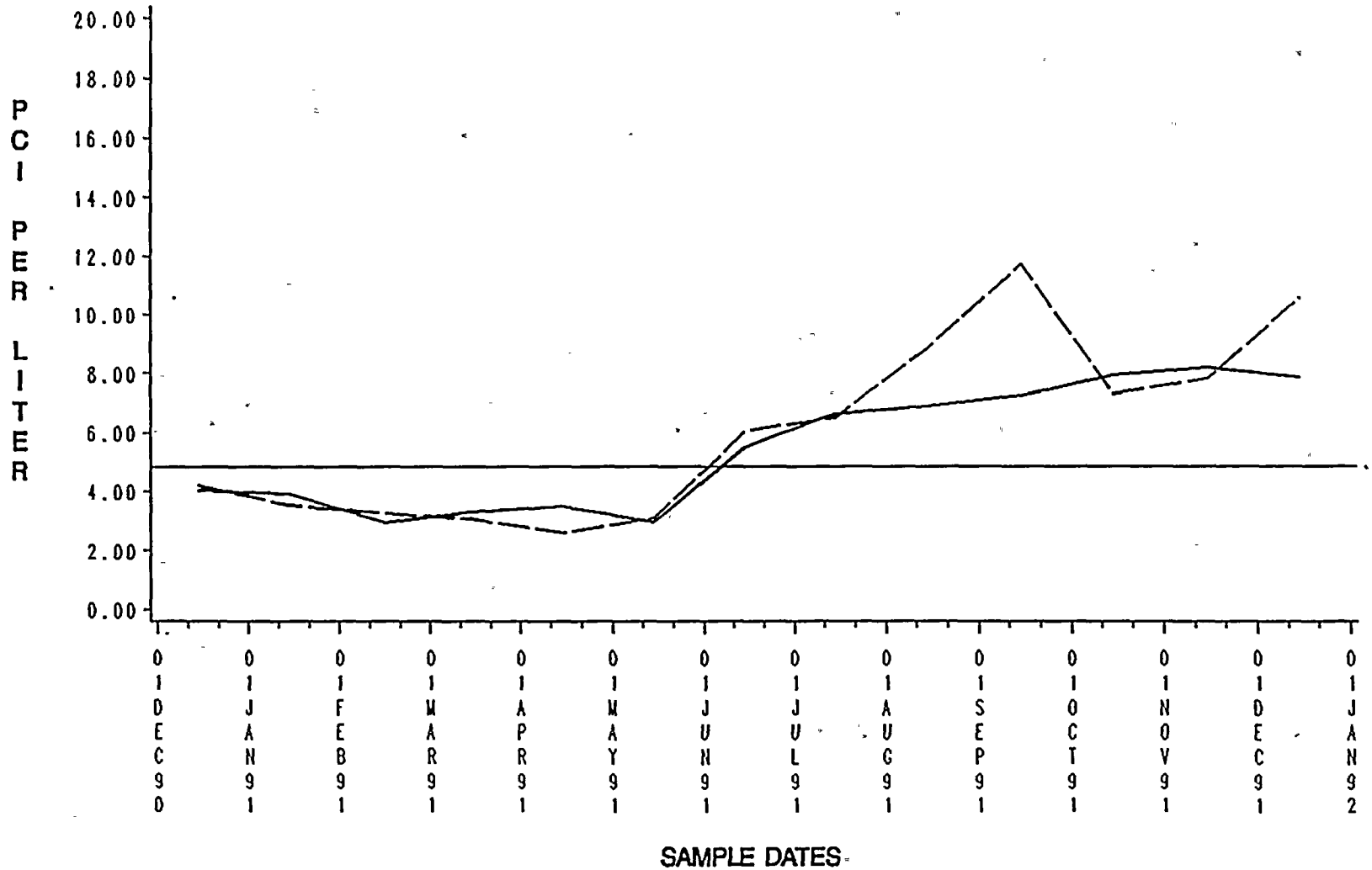


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=0.02
ISOTOPIC ANALYSIS REQUIRED ABOVE 0.10

Figure 3-5

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
DRINKING WATER SAMPLES
PLANT=HNPP SAMPLE POINT=0040

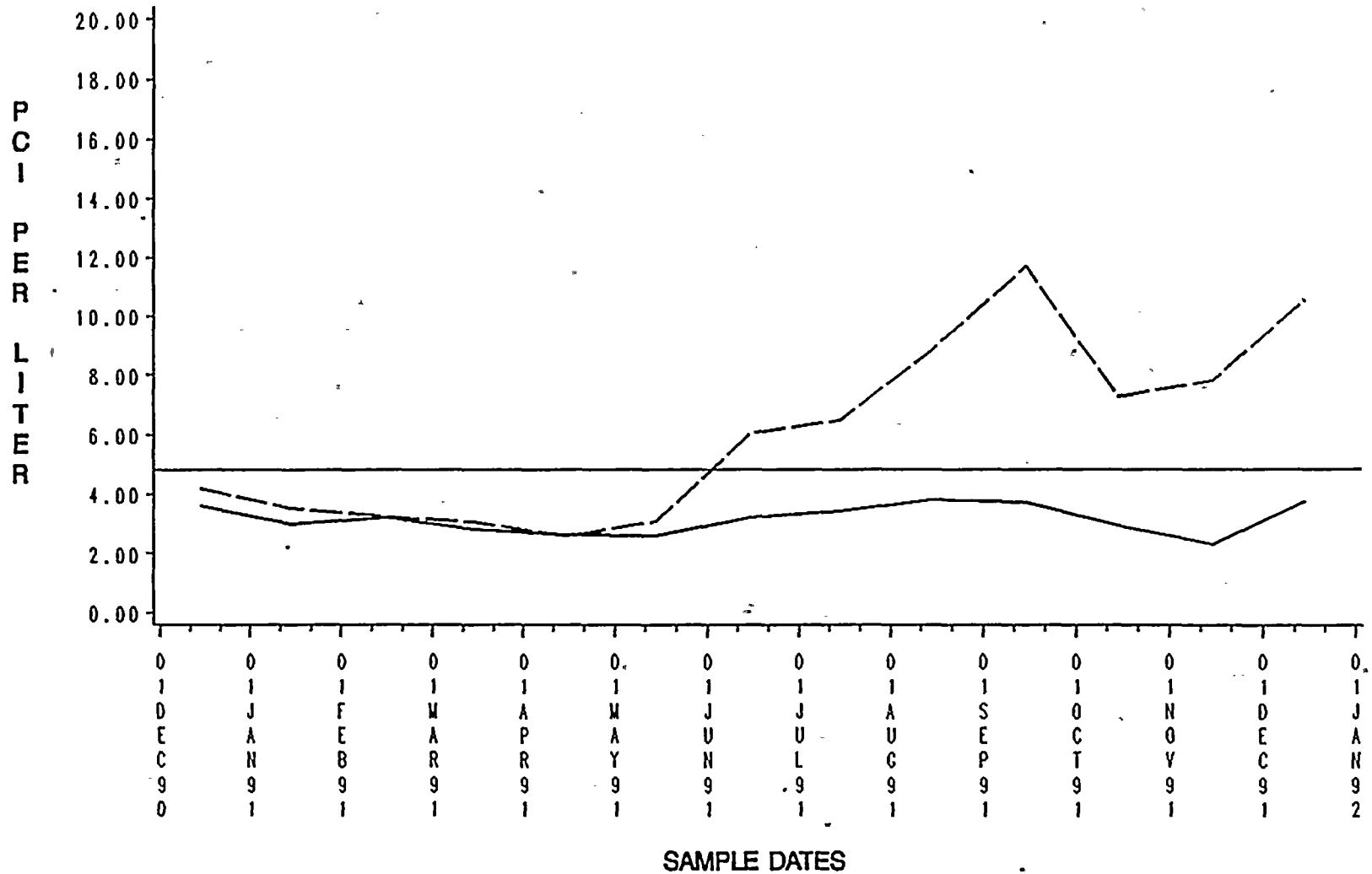


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=4.84

Figure 3-6

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
DRINKING WATER SAMPLES
PLANT=HNPP SAMPLE POINT=0051

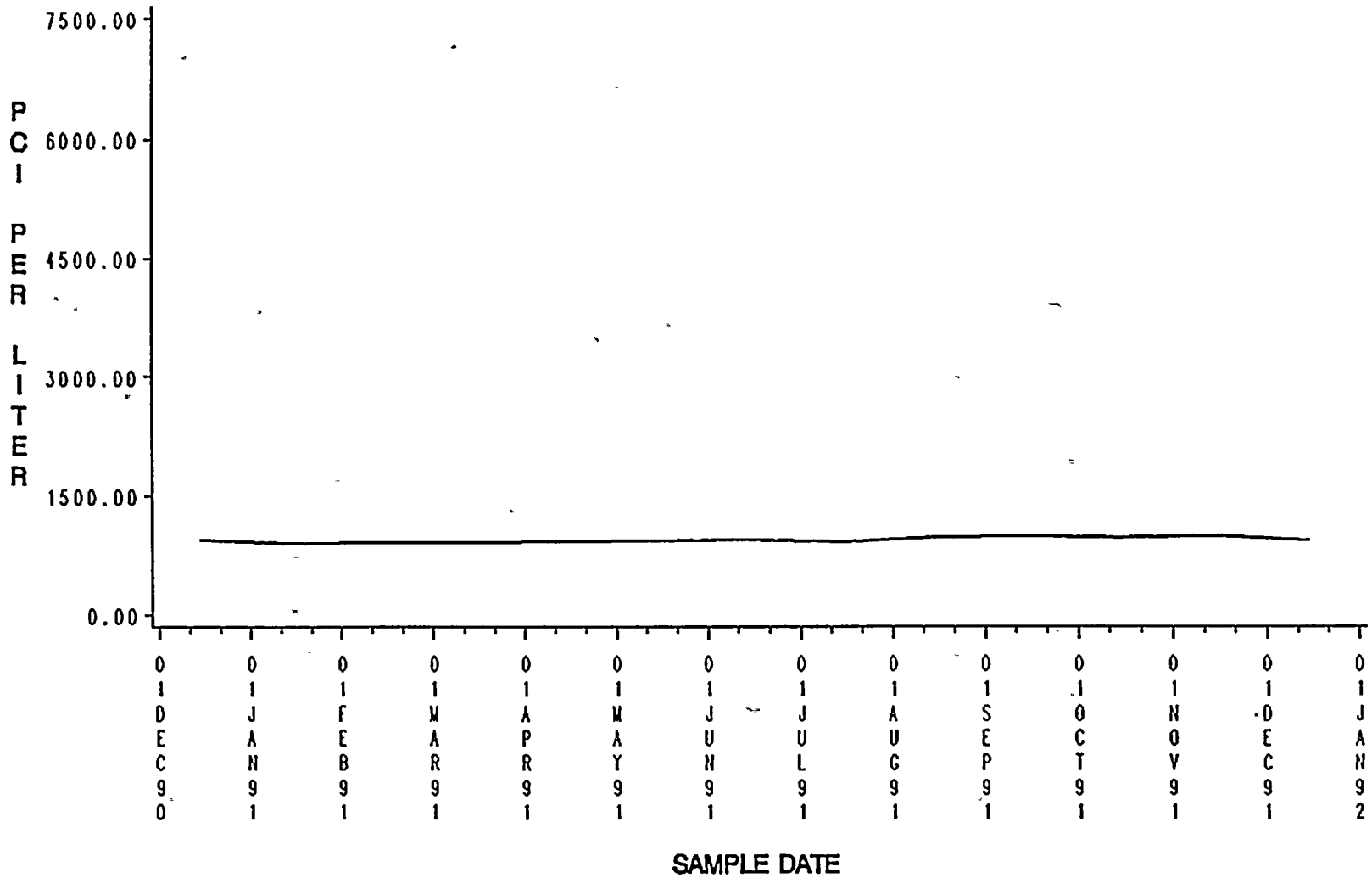


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=4.84

Figure 3-7

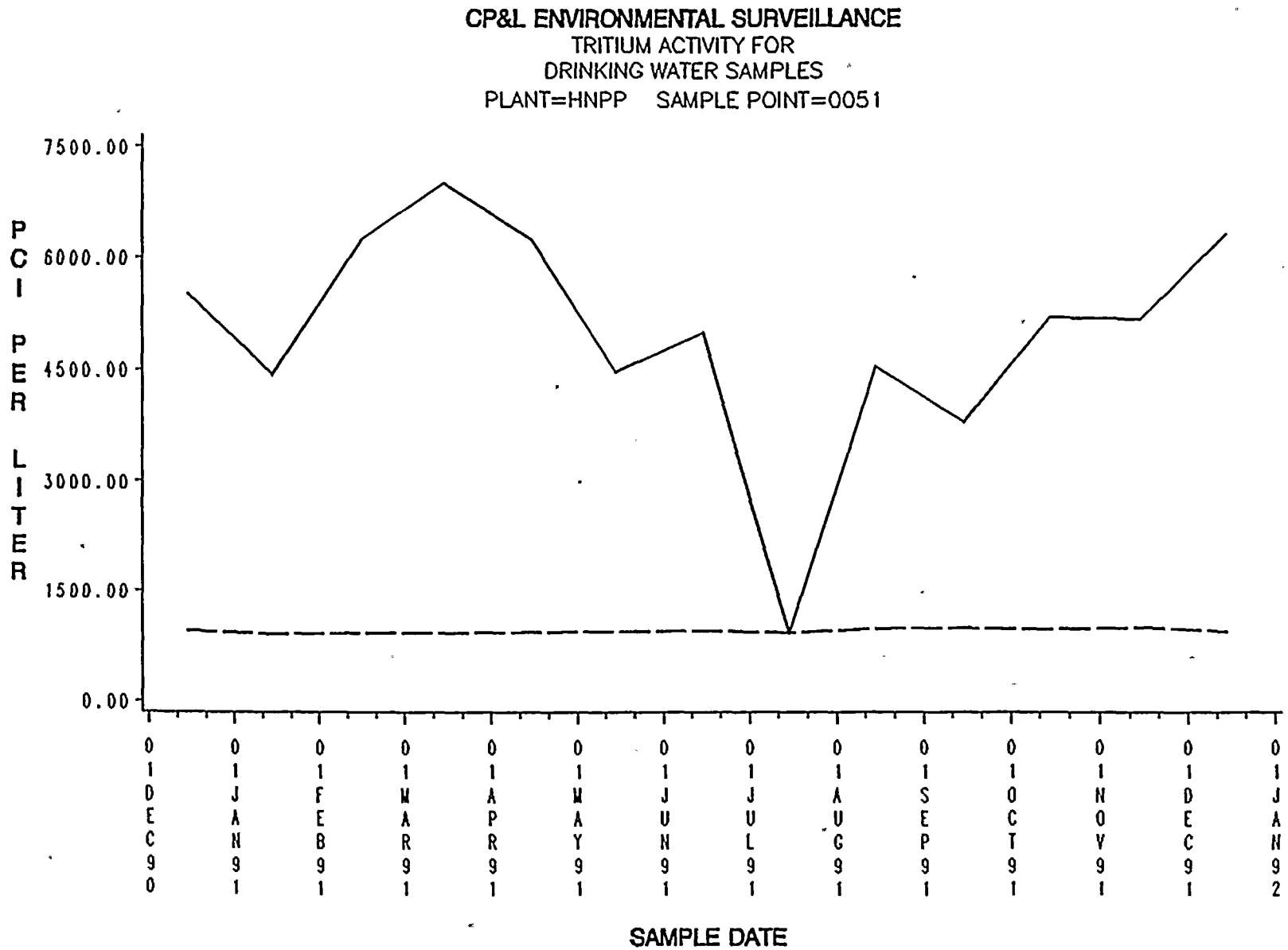
CP&L ENVIRONMENTAL SURVEILLANCE
TRITIUM ACTIVITY FOR
DRINKING WATER SAMPLES
PLANT=HNPP SAMPLE POINT=0040



SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-8

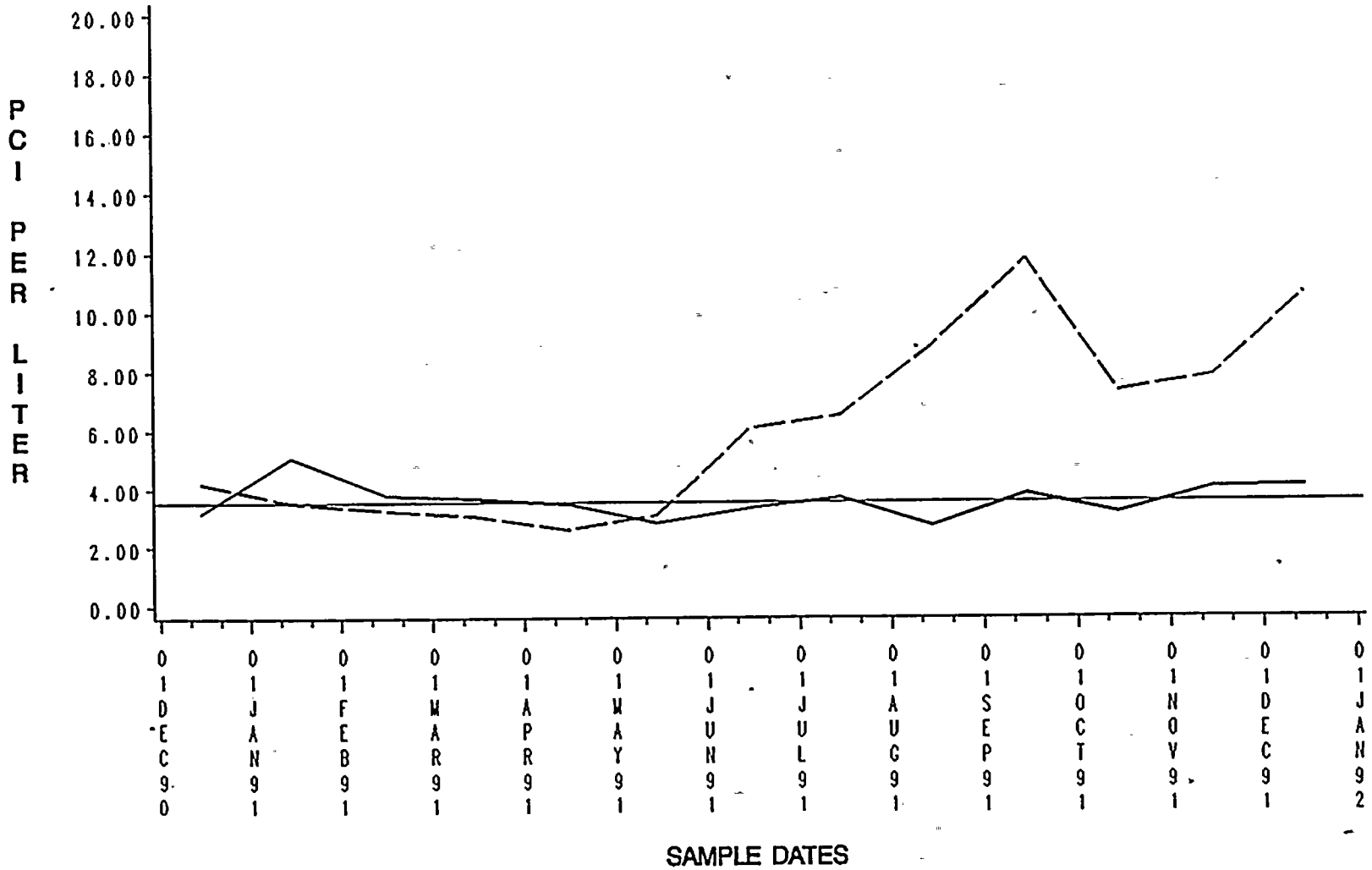


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-9

CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
SURFACE WATER SAMPLES
PLANT=HNPP SAMPLE POINT=0026

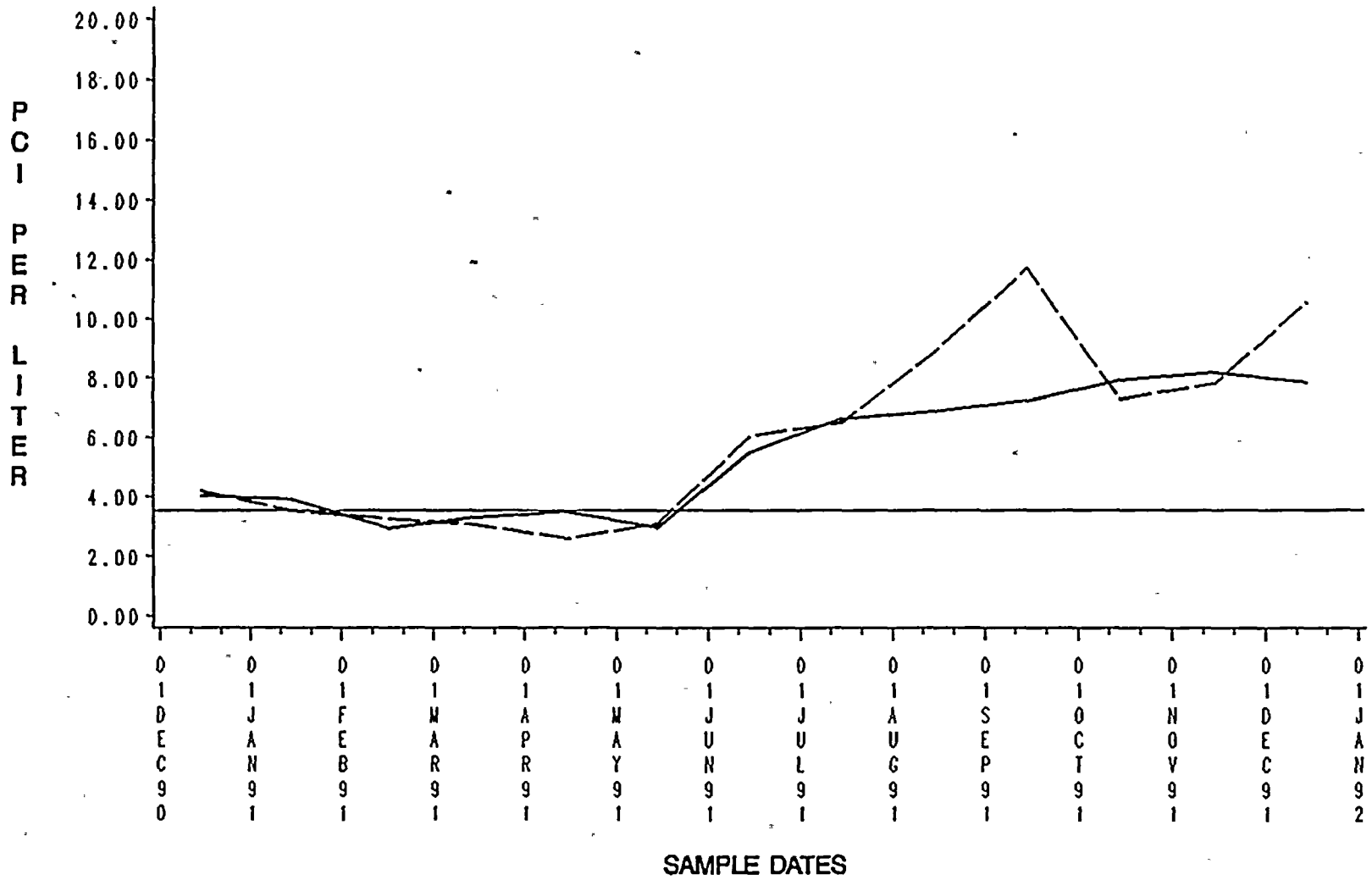


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=3.55

Figure 3-10

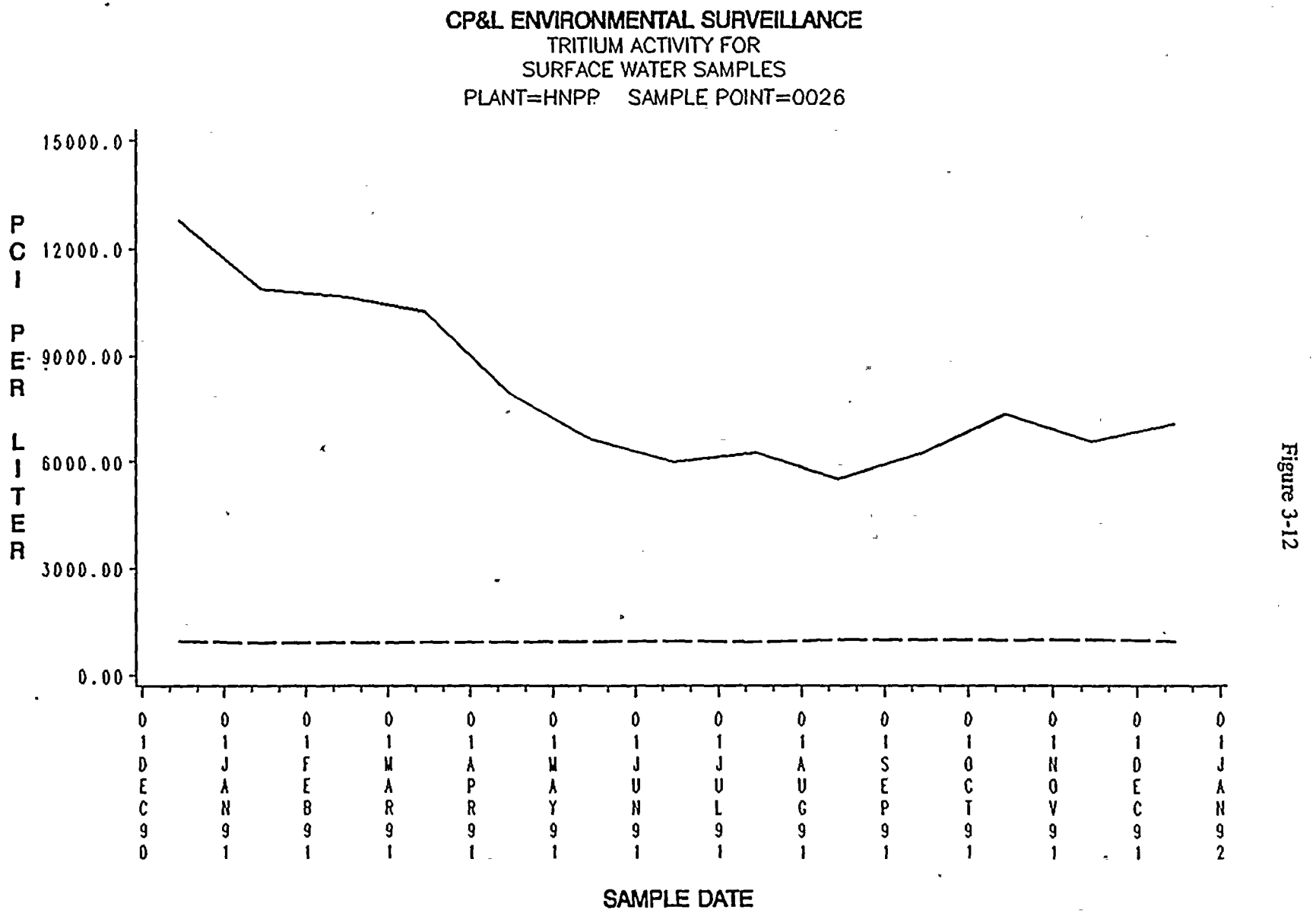
CP&L ENVIRONMENTAL SURVEILLANCE
GROSS BETA ACTIVITY FOR
SURFACE WATER SAMPLES
PLANT=HNPP SAMPLE POINT=0040



SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

PRE-OP AVERAGE=3.55

Figure 3-11

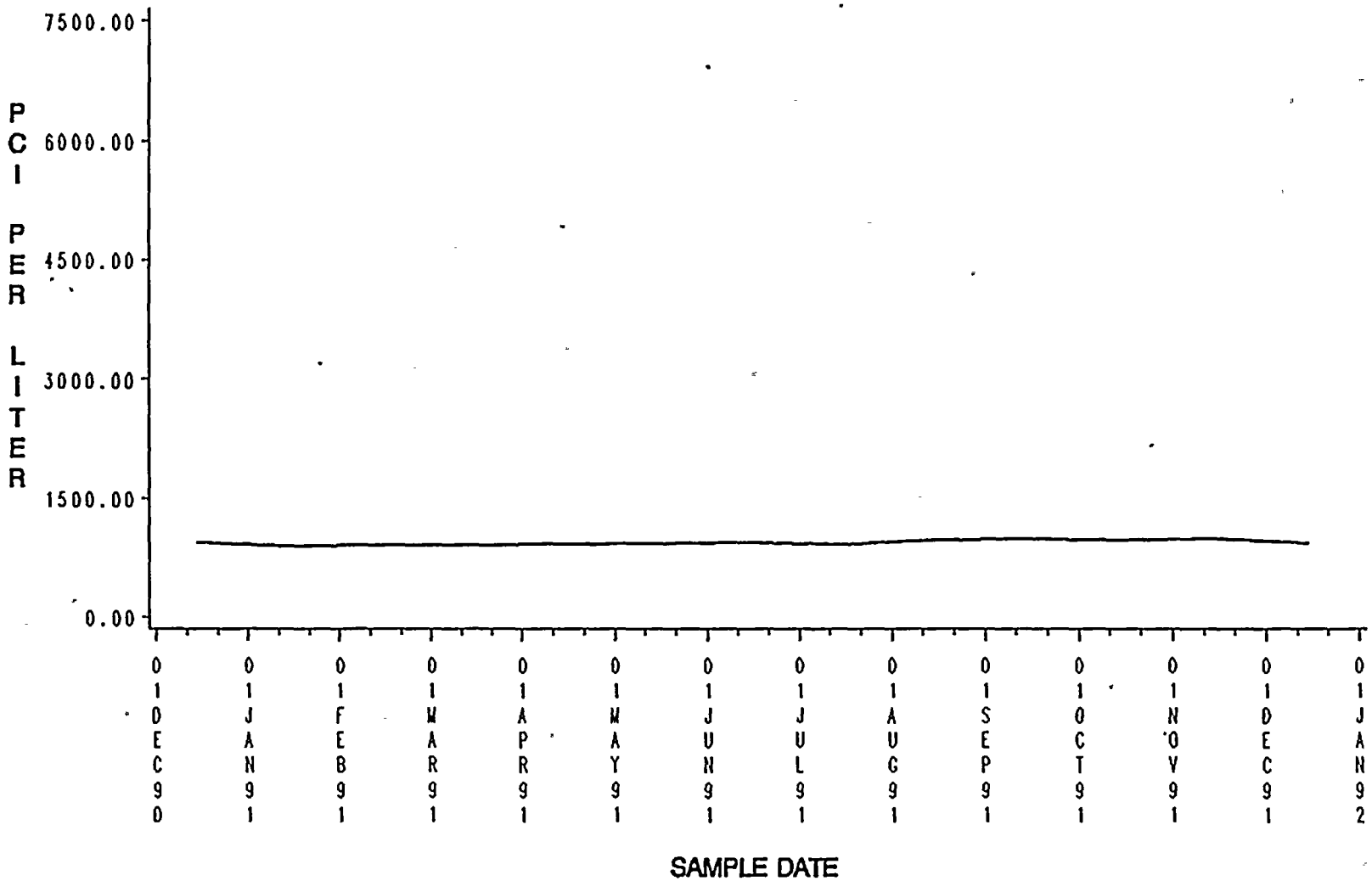


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-12

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

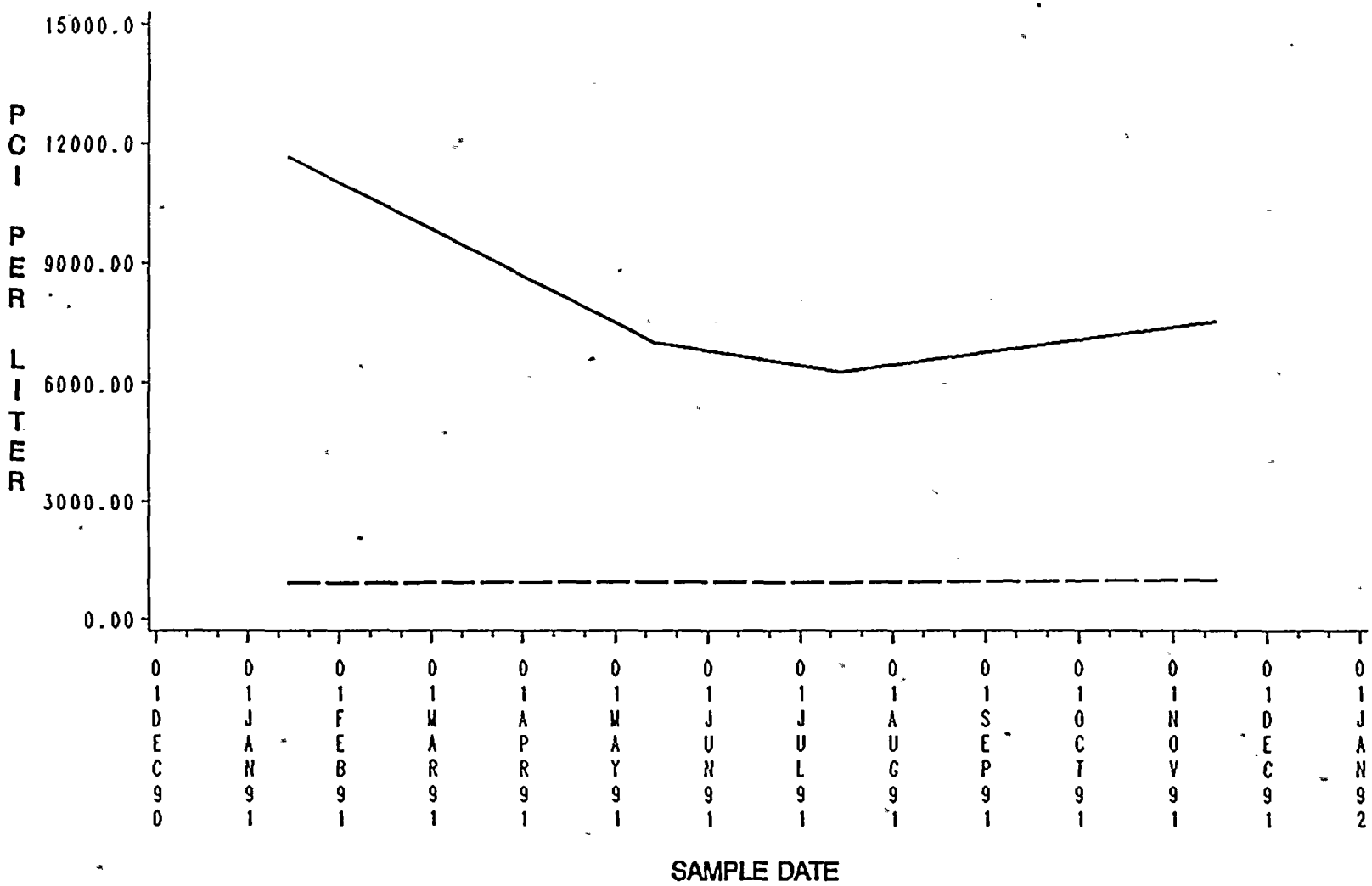


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-13

CP&L ENVIRONMENTAL SURVEILLANCE
TRITIUM ACTIVITY FOR
SURFACE WATER SAMPLES
PLANT=HNPP SAMPLE POINT=026S

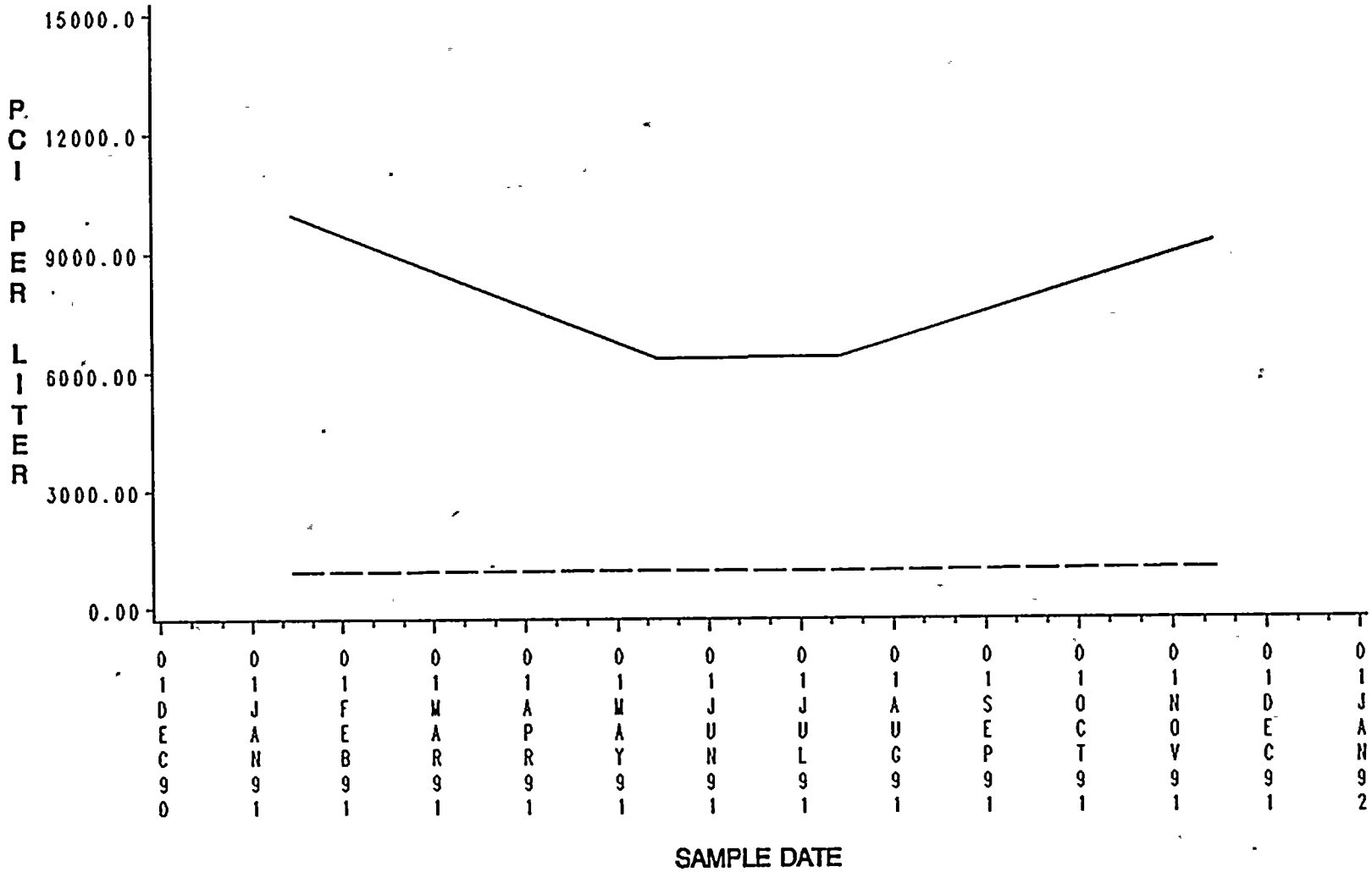


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-14

CP&L ENVIRONMENTAL SURVEILLANCE
TRITIUM ACTIVITY FOR
SURFACE WATER SAMPLES
PLANT=HNPP SAMPLE POINT=041S

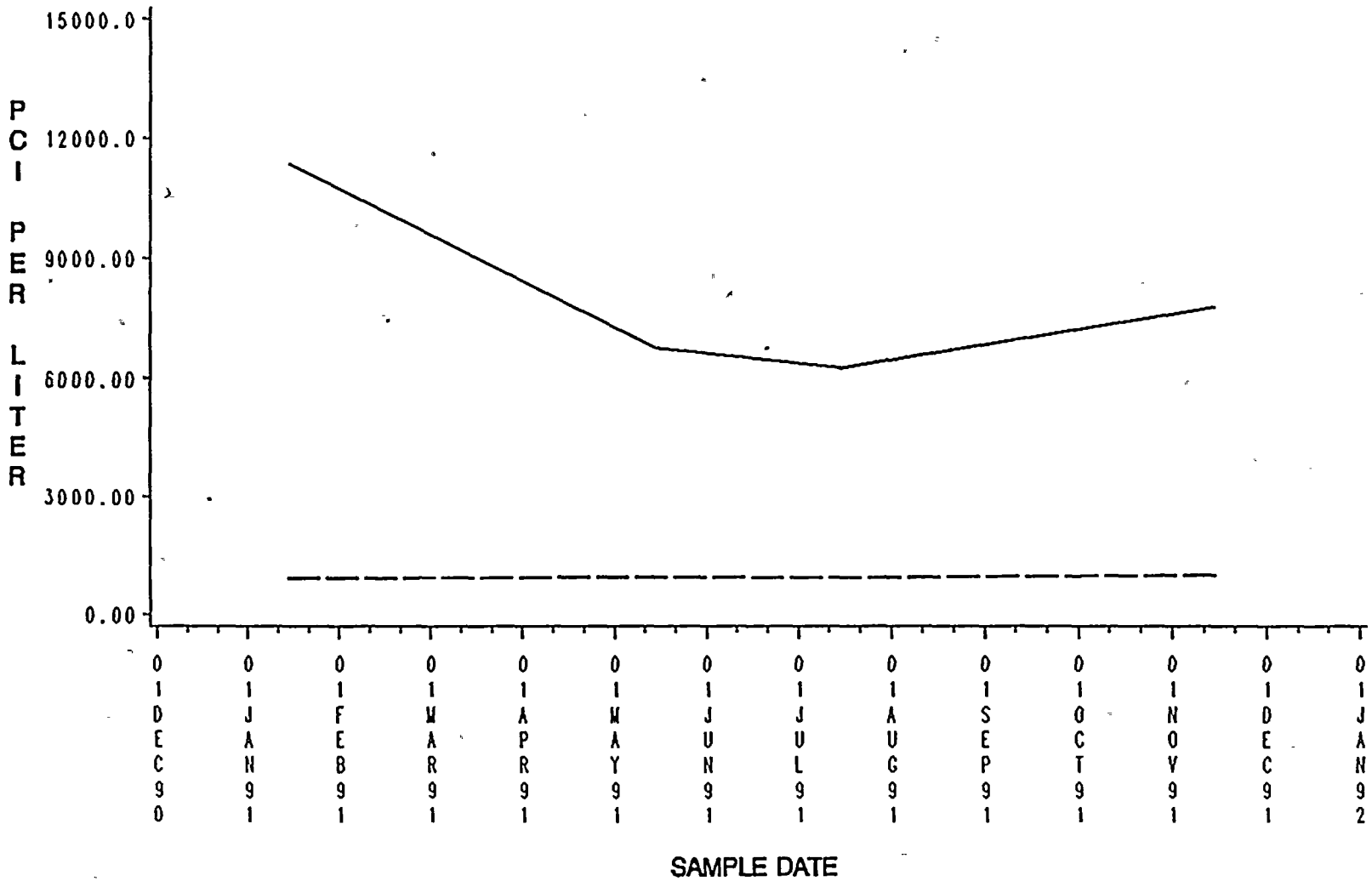


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-15

CP&L ENVIRONMENTAL SURVEILLANCE
TRITIUM ACTIVITY FOR
SURFACE WATER SAMPLES
PLANT=HNPP SAMPLE POINT=052S

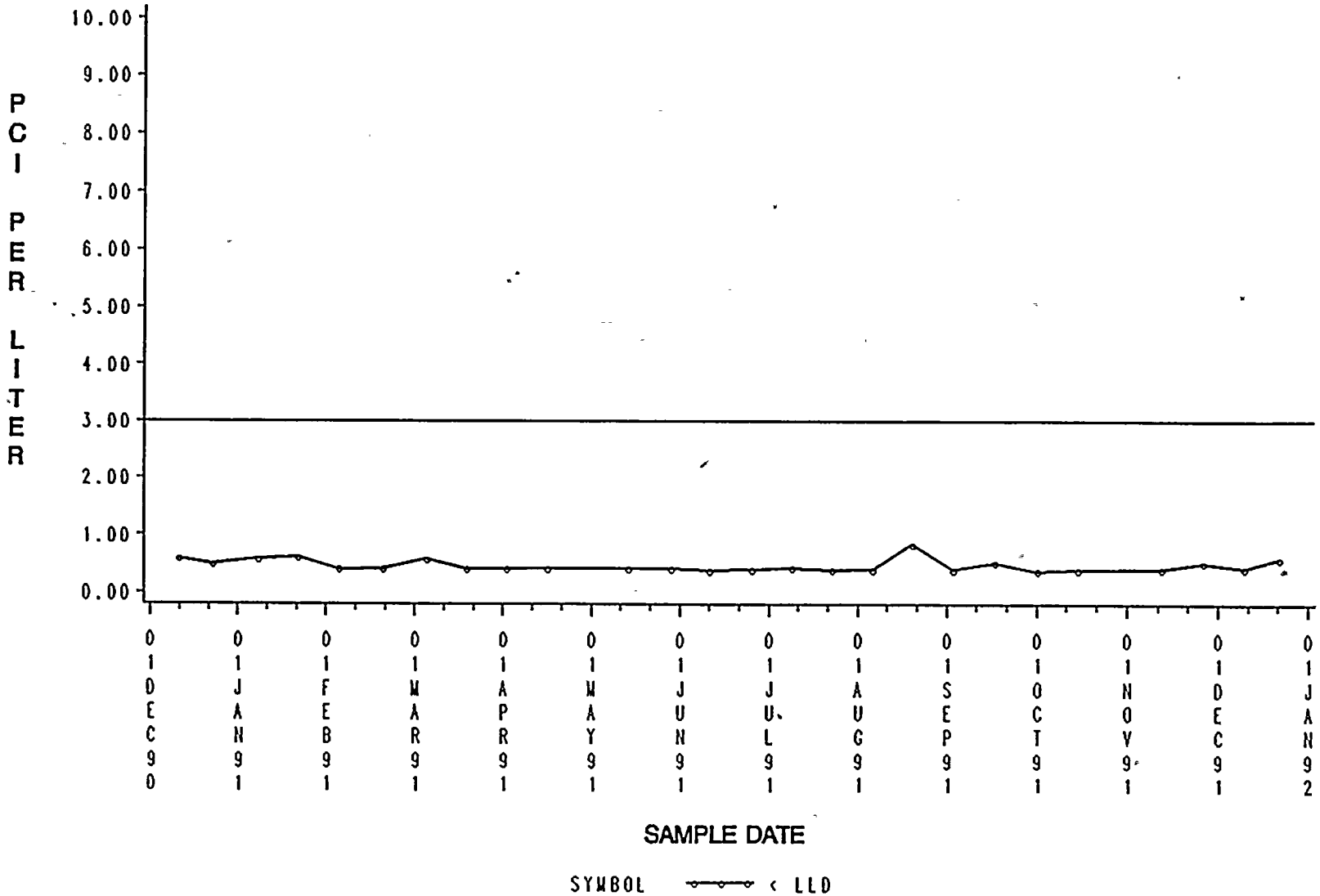


SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION

SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-16

CP&L ENVIRONMENTAL SURVEILLANCE
IODINE-131 ACTIVITY FOR
MILK SAMPLES
PLANT=HNPP POINT=0005

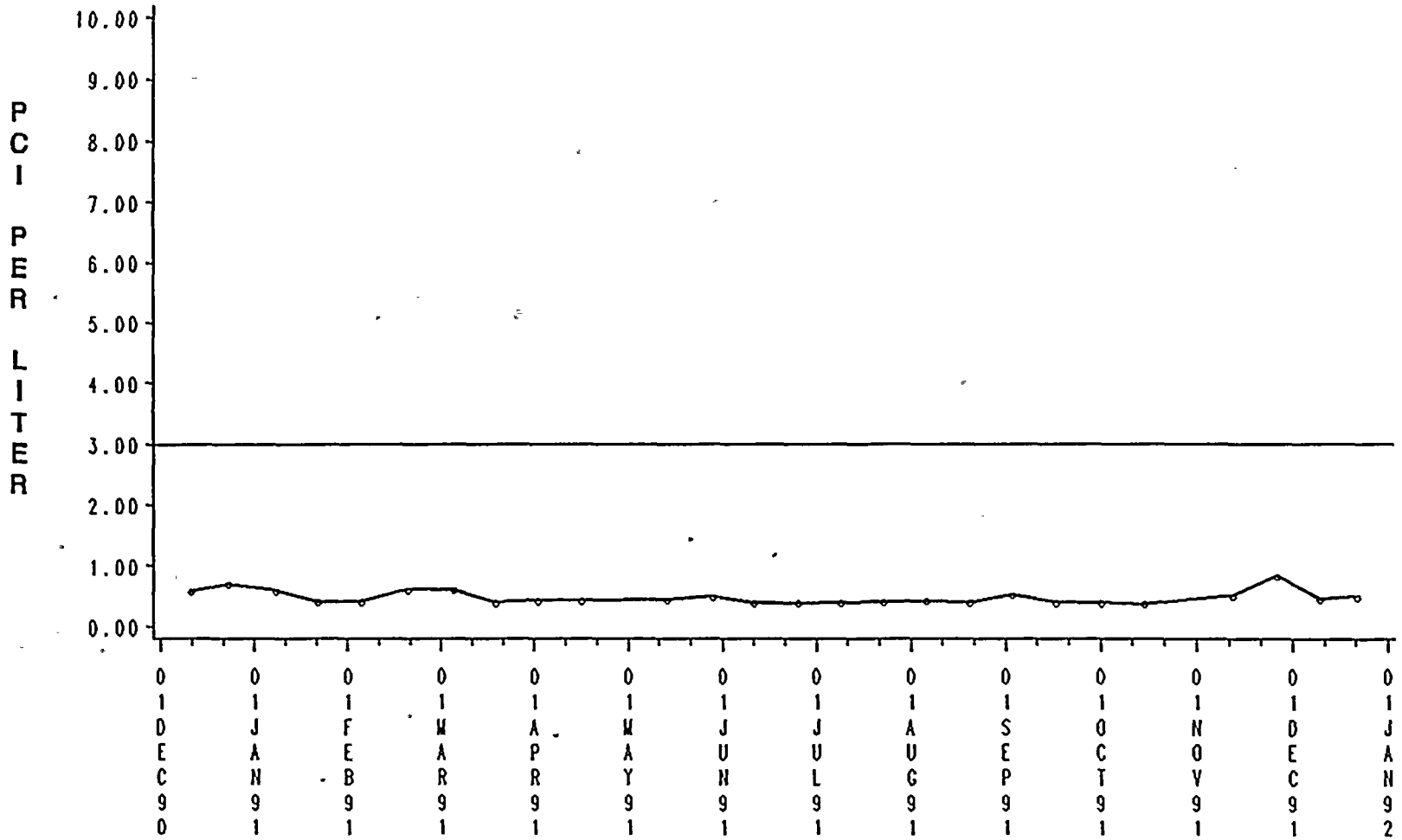


STATION '0005' IS THE CONTROL POINT

REPORTING LEVEL IS 3.0

Figure 3-17

CP&L ENVIRONMENTAL SURVEILLANCE
IODINE-131 ACTIVITY FOR
MILK SAMPLES
PLANT=HNPP POINT=0042

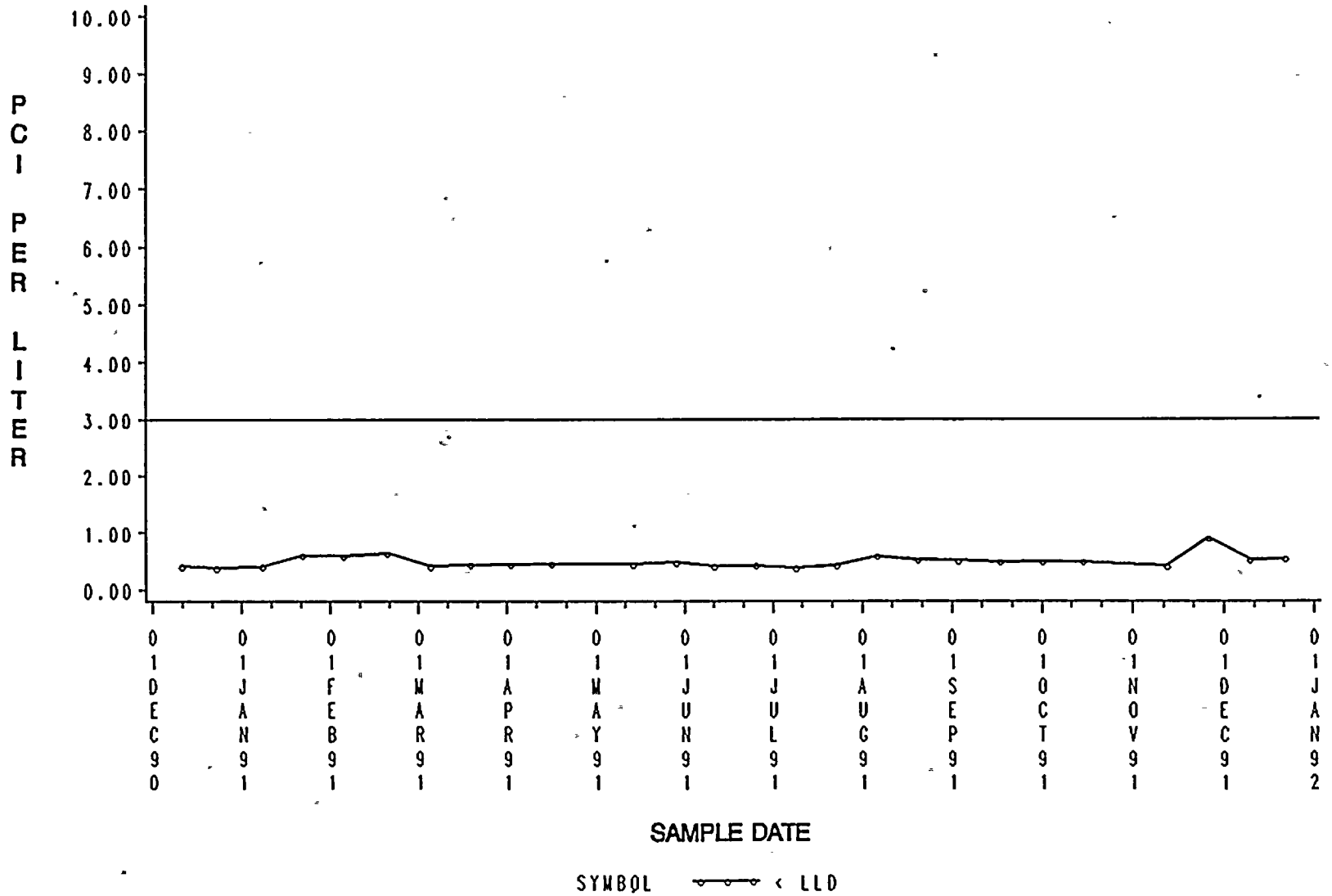


STATION '0005' IS THE CONTROL POINT

REPORTING LEVEL IS 3.0

Figure 3-18

CP&L ENVIRONMENTAL SURVEILLANCE
IODINE–131 ACTIVITY FOR
MILK SAMPLES
PLANT=HNPP POINT=0043



STATION '0005' IS THE CONTROL POINT

REPORTING LEVEL IS 3.0

Figure 3-19

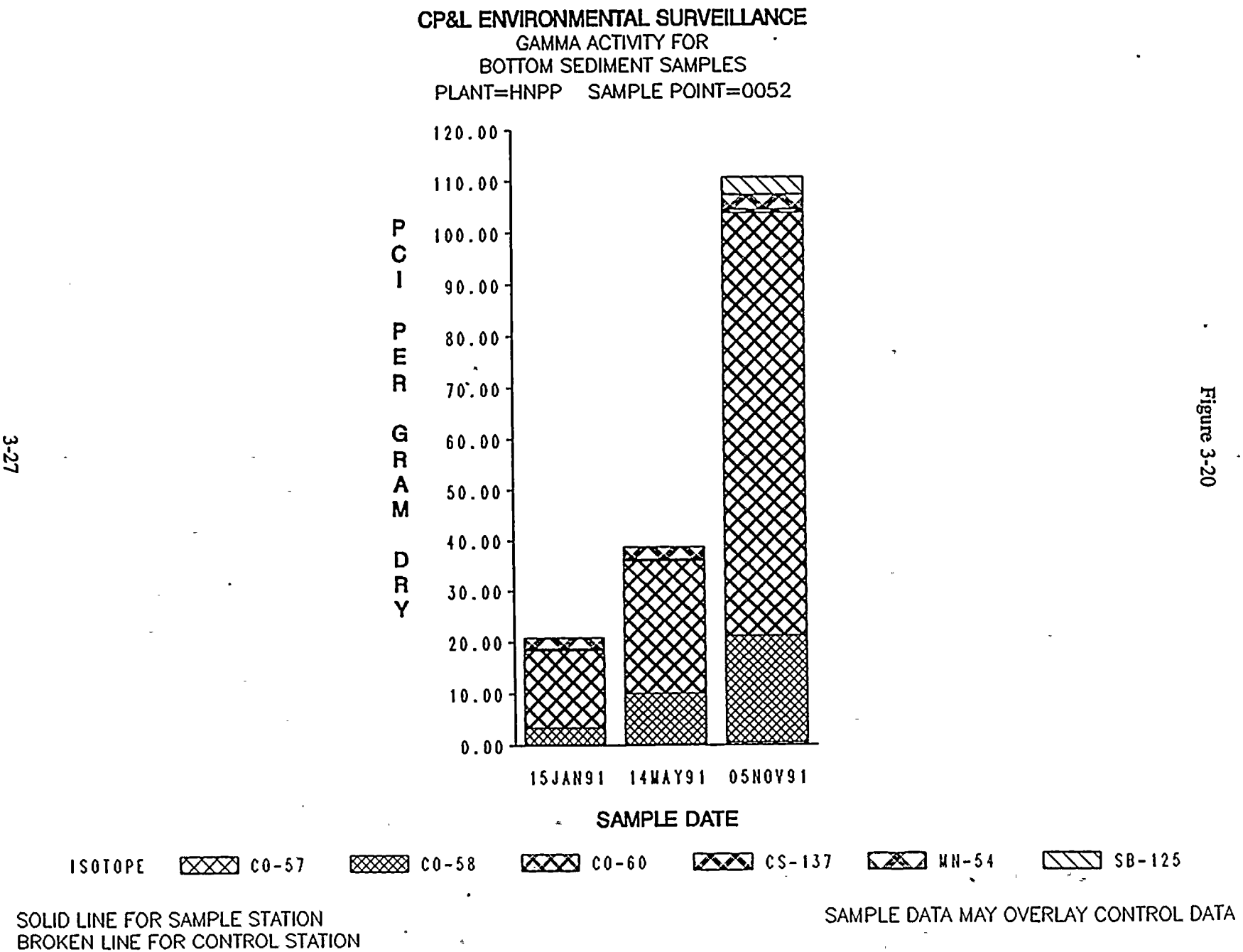
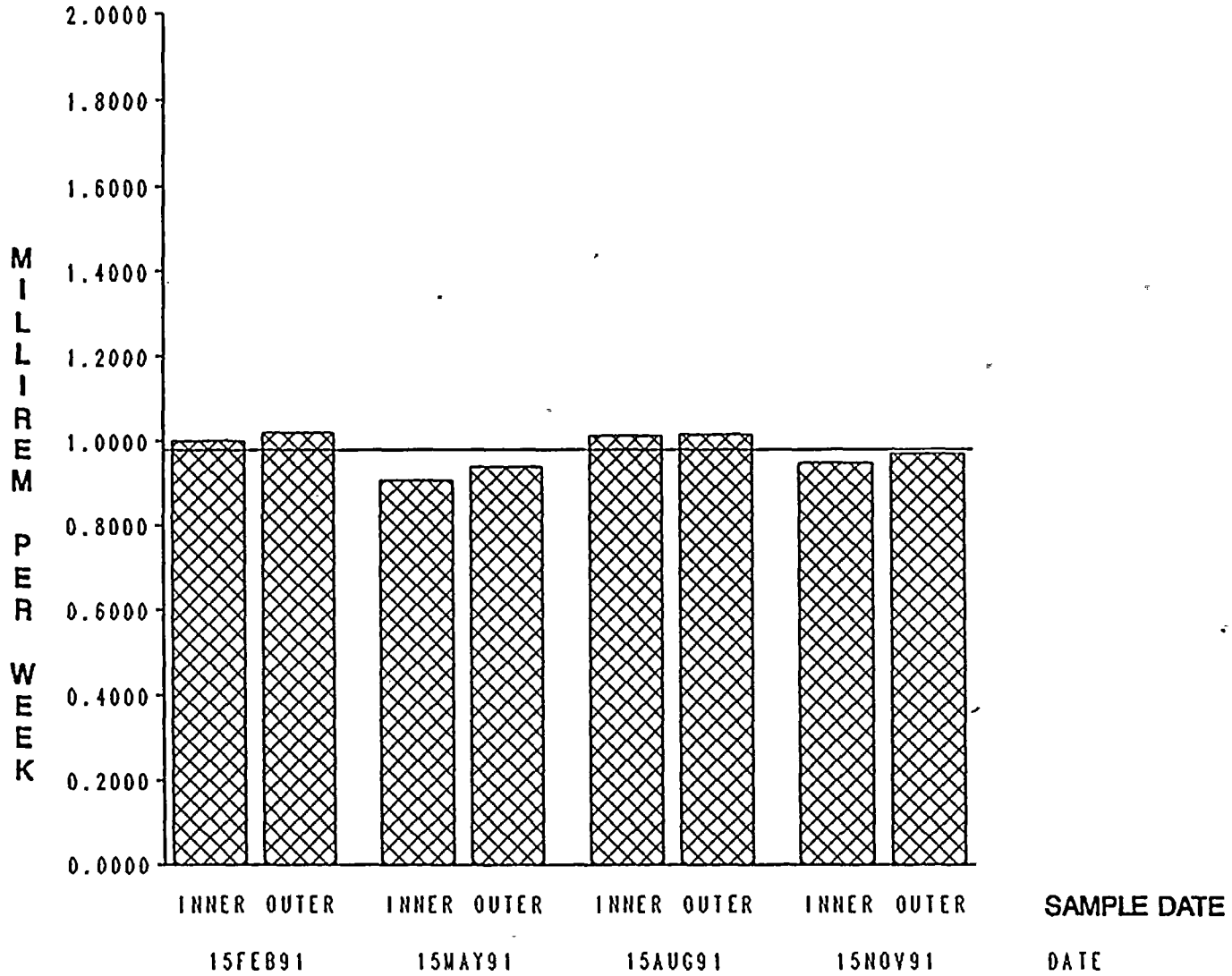

CP&L ENVIRONMENTAL SURVEILLANCE
GAMMA ACTIVITY FOR
BOTTOM SEDIMENT SAMPLES
PLANT=HNPP SAMPLE POINT=0052
PCI PER GRAM DRY
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
15JAN91
14MAY91
05NOV91
SAMPLE DATE
ISOTOPE
CO-57
CO-58
CO-60
CS-137
MN-54
SB-125
SOLID LINE FOR SAMPLE STATION
BROKEN LINE FOR CONTROL STATION
SAMPLE DATA MAY OVERLAY CONTROL DATA

Figure 3-20

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



AVERAGE(1983–1987)=0.9786

Figure 3-21

4.0 MISSED SAMPLES AND ANALYSES

4.1 Air Cartridge and Air Particulates

No sample at Location AC/AP-2 on July 15, 1991, due to tripped breaker.

No sample at Location AC/AP-5 on September 23, 1991, due to tripped breaker.

4.2 Food Crops

Food crops were not available at Location 54 in April, October, and November.
Food crops were not available at Location 55 in April and August.

4.3 TLDs

TLD 25 was missing in the field due to vandalism for the first quarter.
TLD 34 was missing the field due to vandalism for the fourth quarter.

5.0 LAND-USE CENSUS

5.1 Introduction

Technical Specification 3/4.12.2 for the Shearon Harris Nuclear Power Plant requires that a land-use census be conducted annually around the site. The objective is to evaluate any changes in the use of land which could impact on the radiological health of members of the public. The census employs whatever approach provides the best results, i.e., door-to-door survey, aerial survey, or by consulting local agricultural authorities. The 1991 land-use census was conducted during June.

5.2 Requirements

Technical Specifications 3/4.12.2 requires that the survey be conducted:

1. Within a five-mile radius of the plant.

2. Annually during the growing season.

3. In each of the 16 compass sectors to identify the nearest:

   a. Milk animal.

   b. Residence.

   c. Garden of greater than 500 square feet producing broad-leaf vegetation.

These requirements were supplemented with identification of the nearest meat animals in each of the 16 compass sectors.

5.3 Methods

In accordance with this guidance, the 1991 land-use census was conducted using a door-to-door survey method. A standard questionnaire was used during an interview to record pertinent data.

Resident and road locations were identified within a five-mile radius zone surrounding SHNPP using U.S. Geological Survey topographic quadrangle maps (7.5-minute series). These maps were revised in 1981, based on aerial photographs, and represent recent locations of structures and roads in this locale. Moncure, Cokesbury, Fuquay-Varina, Merry Oaks, New Hill, and Apex quadrangle maps were used. The maps were combined, and five concentric circles at one-mile increments were drawn with the plant at the center. Sixteen compass sectors were created in 22.5-degree increments on the map. Each sector was centered on the compass direction.

The combined map was used to identify the nearest residences which were confirmed by field observation. The nearest garden, milk animal (cow or goat), and meat animal (beef, hogs, or fowl) were located by inspection of fields and residential lots and by interviews with residents within the five-mile radius.

The survey was performed by CP&L in June during fair weather and good visibility. The survey started close to the plant in each sector and extended out to the five-mile perimeter. All roads within the five-mile zone were traveled. Barns, small sheds, and pasture-like fields were observed as indicators of grazing livestock. These indicators were followed up with an interview of the property owner. In some cases when the owner was not home, a neighbor was interviewed to obtain the desired information. If this was not possible, the property was either revisited at a later time or information was determined by visual inspection.

5.4 Results

Table 5-1 summarizes the locations of the nearest residence, milk cow, milk goat, garden, and meat animal in each of the 16 compass sectors. The data gathered during the observation and the 35 recorded visitations resulted in the following observations:

1. Milk goats are not located within the five-mile radius.

2. Milk cows are located in the N sector. This location is a commercial dairy that is currently part of the SHNPP Radiological Environmental Monitoring Program. Refer to Table 5-1.

3. All changes in garden locations resulted in increased distances from the plant.

4. Meat animals are found in 9 of the 16 compass sectors and are summarized in Table 5-2.

TABLE 5-1
DISTANCE TO THE NEAREST SPECIAL LOCATIONS FROM THE SHEARON HARRIS NUCLEAR POWER PLANT (MILES)

Sector	Exclusion Boundary	Residence		Milk Animal		Garden		Meat Animal	
		1990	1991	1990	1991	1990	1991	1990	1991
N	1.32	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
NNE	1.33	1.8	1.8	4.6	---	1.7	1.7	3.5	3.5
NE	1.33	2.3	2.3	---	---	2.3	2.3	2.3	2.3
ENE	1.33	2.0	3.6	---	---	3.6	3.8	---	---
E	1.33	1.9	1.9	---	---	4.7	4.7	2.2	2.2
ESE	1.33	2.7	2.7	---	---	2.7	4.4	4.4	4.4
SE	1.33	4.3	4.3	---	---	4.3	4.4	4.3	4.3
SSE	1.33	4.4	4.4	---	---	---	4.6	---	---
S	1.36	---	---	---	---	---	---	---	---
SSW	1.33	3.9	3.9	---	---	3.9	3.9	---	---
SW	1.33	2.8	2.8	---	---	2.8	2.8	---	---
WSW	1.33	4.3	4.3	---	---	4.3	4.3	4.3	---
W	1.33	2.8	2.8	---	---	2.9	2.9	2.9	2.9
WNW	1.33	2.1	2.1	---	---	2.1	2.9	3.6	---
NW	1.26	2.1	2.1	---	---	3.8	3.8	3.8	3.8
NNW	1.26	1.5	1.5	---	---	1.7	1.7	1.7	1.7

Distance estimates are ± 0.1 mile except at exclusion boundary.

TABLE 5-2
MEAT ANIMAL TYPE AT NEAREST LOCATION TO SHNPP BY SECTOR (1991)

Sector	Distance (Miles)	Meat Type
N	2.2	Beef, Hogs, Chickens
NNE	3.5	Chickens
NE	2.3	Beef
ENE	---	---
E	2.2	Chickens
ESE	4.4	Chickens
SE	4.3	Chickens
SSE	---	---
S	---	---
SSW	---	---
SW	---	---
WSW	---	---
W	2.9	Chickens
WNW	---	---
NW	3.8	Hogs, Chickens
NNW	1.7	Beef

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 1.2E-3 pCi/m^3 for SHNPP samples. Air particulate samples are mounted in 2-inch stainless steel planchets and counted directly.

Gross beta activity in drinking and surface waters is determined by evaporating 1 liter of the sample and counting a planchet on a Tennelec Low-Background Alpha/Beta Counting System for 50 minutes. Typical LLD for gross beta is 2.0E+0 pCi/ℓ.

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 1.2E+3 pCi/ℓ.

6.3 Iodine-131

Iodine-131 airborne concentrations are analyzed by the intrinsic germanium spectrometry systems. The cartridges are placed on the detector, and each charcoal cartridge is counted individually with an approximate LLD of 1.4E-2 pCi/m^3.

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

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.

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

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

Food crop samples are weighed wet and analyzed in a Marinelli beaker.

Fish samples are cleaned, dressed, and 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 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 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 1991, 54 analyses were completed on 20 samples representing three major environmental media (i.e., water, milk, air filters). Data on the known activities and the normalized standard deviations for the 54 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:

Standard Deviation From Known Activity	Percent of Analyses
≤ 1 Standard Deviation	63
≤ 2 Standard Deviation	93
≤ 3 Standard Deviation	97

One of 54 samples exceeded the three sigma action level. A gross beta analysis of a water sample received in May 1991 fell outside the 3σ limit. Independent verification of the sample analyses was accomplished by reanalysis. This result was well within the known activity limits and indicated a contamination problem from the beakers or planchets used in the initial sample analysis. The potential sources of contamination were discarded.

6.7 Lower Limits of Detection

All samples analyzed met the LLD required by Technical Specification 4.12.1 and Table 4.12.1-1.

TABLE 6-1
TYPICAL LOWER LIMITS OF DETECTION (A PRIORI)
GAMMA SPECTROMETRY

Surface Water/Groundwater Samples	
Isotope	**(LLD)**
Cr-51	18 pCi/ℓ
Mn-54	3
Co-58	3
Fe-59	7
Co-60	4
Zn-65	8
Nb-95	3
Zr-95	7
I-131	0.4*
Cs-134	4
Cs-137	3
Ba-La-140	6
Other Expected Gamma Emitters	1 to 111
Air Particulates (Quarterly Composite)	
Isotope	**(LLD)**
Cs-134	0.001 pCi/m³
Cs-137	0.001
Ba-La-140	0.001
Other Expected Gamma Emitters	0.001 to 0.012
Milk	
Isotope	**(LLD)**
Cr-51	31 pCi/ℓ
Mn-54	5
Co-58	5
Co-60	7
I-131	0.4*
Cs-134	6
Cs-137	5
Ba-La-140	11
Other Expected Gamma Emitters	3 to 44

*NaI well crystal analysis of resin concentrates of samples.

TABLE 6-1
TYPICAL LOWER LIMITS OF DETECTION (A PRIORI)
GAMMA SPECTROMETRY

Sediment	
Isotope	**(LLD)**
Cr-51	269 pCi/kg
Mn-54	44
Co-57	31
Co-58	37
Fe-59	79
Co-60	37
Nb-95	55
Zr-95	107
Cs-134	74
Cs-137	53
Other Expected Gamma Emitters	38 to 2804
Fish	
Isotope	**(LLD)**
Cr-51	180 pCi/kg
Mn-54	34
Co-58	37
Fe-59	87
Co-60	44
Zn-65	52
I-131	23
Cs-134	38
Cs-137	34
Other Expected Gamma Emitters	16 to 1064
Food Products and Vegetation	
Isotope	**(LLD)**
Cr-51	121 pCi/kg
Mn-54	16
Co-58	15
Co-60	19
I-131	15
Cs-134	17
Cs-137	17
Other Expected Gamma Emitters	13 to 450