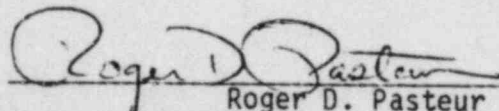


Shearon Harris Energy & Environmental Center
Carolina Power & Light Company
New Hill, North Carolina

ENVIRONMENTAL RADIOLOGICAL MONITORING REPORT
FOR
BRUNSWICK STEAM ELECTRIC PLANT
JANUARY 1, 1983, THROUGH DECEMBER 31, 1983

Prepared by:



Roger D. Pasteur
Senior Specialist - Environmental

Reviewed By:



Ronald L. Shearin
Project Specialist - Environmental

Approved By:

Original Signed By

G. H. WARRINER

George H. Warriner
Principal Specialist - Environmental

8504100574 831231
PDR ADOCK 05000324
R PDR

IE25 1/1

TABLE OF CONTENTS

	<u>Page</u>
LIST OF FIGURES.....	ii
LIST OF TABLES.....	iii
1.0 INTRODUCTION.....	1-1
1.1 Plant and Location.....	1-1
1.2 Environmental Monitoring Program.....	1-2
2.0 PROGRAM SUMMARY.....	2-1
3.0 INTERPRETATIONS AND CONCLUSIONS.....	3-1
3.1 Air Samples.....	3-1
3.2 Milk Samples.....	3-11
3.3 Vegetation.....	3-13
3.4 Soil.....	3-14
3.5 Surface Water.....	3-14
3.6 Fish.....	3-16
3.7 Shrimp, Benthic Organisms, and Oysters.....	3-17
3.8 Bottom Sediment and Aquatic Vegetation.....	3-18
3.9 Groundwater.....	3-18
3.10 Zooplankton.....	3-19
3.11 External Radiation Dose.....	3-19
3.12 Summary.....	3-19
4.0 MISSED SAMPLES AND ANALYSES.....	4-1
4.1 Air Cartridge and Air Particulate.....	4-1
4.2 Aquatic Vegetation.....	4-1
4.3 Fish.....	4-1
4.4 Fodder and Feed.....	4-1
4.5 Milk.....	4-2
4.6 External Radiation (TLD).....	4-2
5.0 ANALYTICAL PROCEDURES.....	5-1
5.1 Gross Beta.....	5-1
5.2 Tritium.....	5-1
5.3 Iodine-131.....	5-1
5.4 Strontium-89, 90.....	5-2
5.5 Gamma Spectrometry Ge(Li).....	5-2
5.6 Thermoluminescent Dosimetry.....	5-3
5.7 EPA Laboratory Intercomparison Program.....	5-3

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Locations of BSEP Radiological Environmental Monitoring Stations.....	1-8
1-2	Locations of BSEP Radiological Environmental Monitoring Stations.....	1-9
1-3	Sketch Map of Landfill Area Showing Locations of Monitor Well Sites.....	1-10
1-4	Detailed Section - Monitor Well Site.....	1-11
3-1	Plot of Sample Station 02 Activity Versus Date and Control Station Activity Versus Date.....	3-3
3-2	Plot of Sample Station 05 Activity Versus Date and Control Station Activity Versus Date.....	3-4
3-3	Plot of Sample Station 18 Activity Versus Date and Control Station Activity Versus Date.....	3-5
3-4	Plot of Sample Station 23 Activity Versus Date and Control Station Activity Versus Date.....	3-6
3-5	Plot of Sample Station 24 Activity Versus Date and Control Station Activity Versus Date.....	3-7
3-6	Plot of Sample Station 45 Activity Versus Date and Control Station Activity Versus Date.....	3-8
3-7	Plot of Sample Station 74 Activity Versus Date and Control Station Activity Versus Date.....	3-9
3-8	Plot of Sample Station 75 Activity Versus Date and Control Station Activity Versus Date.....	3-10
3-9	History of Cs-137 at Milk Station 35.....	3-12
3-10	Plot of Sample Station 32 Activity (Discharge Canal) Versus Date and Control Station Activity (Intake Canal) Versus Date.....	3-15

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1-1	Environmental Radiological Monitoring Program Brunswick Steam Electric Plant.....	1-3
2-1	Environmental Radiological Monitoring Program Summary.....	2-3
3-1	Gross Beta Air Particulate Six-Month Averages for Comparison of Preoperational Data to 1983 Data.....	3-2
3-2	Dose Available to Man Via Fish-Man Pathway.....	3-16
5-1	Typical Minimum Detectable Activities Ge(Li) Gamma Spectrometry.....	5-4

1.0 INTRODUCTION

The following report summarizes the Environmental Radiological Monitoring conducted for the Brunswick Steam Electric Plant during the calendar year 1983. This is the seventh year in which the program's sample analyses and data interpretation have been entirely performed by Carolina Power & Light Company.

1.1 Plant and Location

The Brunswick Steam Electric Plant (BSEP) consists of two boiling water reactors which are designed to generate a total of 1,642 MW (net). Unit 2 first achieved criticality on March 21, 1975, and went into commercial production on November 3, 1975. Unit 1 achieved criticality on November 22, 1976, and went into commercial production on March 18, 1977.

The BSEP is located in the southeastern corner of North Carolina in Brunswick County approximately 2.5 miles north of Southport. This location is near the mouth of the Cape Fear River, which is the source of condenser cooling water. The intake canal extends approximately three miles east of the plant to the Cape Fear River, and the discharge canal proceeds southwest and south for approximately six miles to the Atlantic Ocean. The discharge canal passes under the Intracoastal Waterway by inverted siphon, proceeds to a pumping basin at the shoreline, and is carried out into the ocean by a 2,000-foot pipeline.

Elevation of the plant areas ranges from sea level to 30 feet (MSL), and extensive swamps and marshes occur in the area. Beaches within 20 miles of the plant are a source of recreation. Fishing and boating are popular. Within 50 miles of the plant, less than half the land is used for agriculture, as small truck, dairy, and poultry farms, producing crops, including corn, soybeans, and tobacco. Most of the industrial

activity is in the Wilmington area (approximately 16 miles north of BSEP). Sunny Point Military Ocean Terminal is located approximately 4.5 miles north of BSEP and primarily transfers munitions, received by truck and rail, to ships. Pfizer Chemical Company is located 1.5 miles southeast of BSEP and is a manufacturer of citric acid. It employs approximately 250-300 people. A ship channel in the Cape Fear River allows traffic to Wilmington, and the Atlantic Intracoastal Waterway intercepts the ship channel at Southport.

1.2 Environmental Monitoring Program

The significant elements of the preoperational dose estimates were used to establish both the preoperational and operational surveillance programs. The program that evolved during preoperational surveillance and was subsequently incorporated into the Brunswick Environmental Technical Specifications is detailed in Table 1-1. Figures 1-1 and 1-2 show the environmental monitoring locations.

Figures 1-3 and 1-4 relate to environmental monitoring requirements implemented in June 1980 that were commitments to the state of North Carolina in assessing the effect of an unplanned transfer of radioactivity to the Brunswick County Southport Landfill. The environmental monitoring program associated with these locations is a special program of limited duration and is not a part of the environmental surveillance designed to support the Brunswick Environmental Technical Specifications (Appendix B).

TABLE 1-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM
BRUNSWICK STEAM ELECTRIC PLANT

Sample Type	Sampling Point and Description	Sampling Frequency	Sample Size	Sample Analysis
Air Cartridge (AC)	2-Information Center	Weekly	10,000 cu ft (300 cu m)	Iodine
	5-Caswell Beach at Pump Station			
	18-Southport Near CP&L Substation			
	22-Sutton Plant*			
	23-Projected Maximum Annual Concentration Point - NE			
	24-CP&L Substation on Construction Access Road			
	45-On Site			
	74-Bethel Church Road			
	75-Stevens' Farm Vector	Weekly	10,000 cu ft (300 cu m)	Weekly--Gross Beta Quarterly--Composite- Gamma and Sr-89, 90
	2-Information Center			
	5-Caswell Beach at Pump Station			
	18-Southport near CP&L Substation			
	22-Sutton*			
	23-Projected Maximum Annual Concentration Point - NE			
	24-CP&L Substation on Construction Access Road			
	45-On Site			
Aquatic Vegetation (AV)	29-Ocean - 0.5 Mile East of Discharge Outfall	Semiannual	500 grams	Gamma and Sr-89, 90
	30-Ocean Near Discharge Outfall			
	31-Ocean - 0.5 Mile West of Discharge Outfall			
	42-Lower Cape Fear River Away From Plant Discharge*			

*Control Station

TABLE 1-1 (Continued)

Sample Type	Sampling Point and Description	Sampling Frequency	Sample Size	Sample Analysis
Benthic Organism (BO)	29-Ocean - 0.5 Mile East of Discharge Outfall	Semiannual	10 cc wet	Gamma and Sr-89, 90
	30-Ocean Near Discharge Outfall			
	31-Ocean - 0.5 Mile West of Discharge Outfall			
	42-Lower Cape Fear River Away From Plant Discharge*			
Bottom Sediment (SD)	13-River Road at Intake Canal*	Semiannual	500 grams	Gamma and Sr-89, 90
	29-Ocean - 0.5 Mile East of Discharge Outfall			
	30-Ocean Near Discharge Outfall			
	31-Ocean - 0.5 Mile West of Discharge Outfall			
	33-Discharge Canal at Stilling Pond			
	34-Discharge Canal Near the Plant			
Fish (FI)	30-Ocean Near Discharge Outfall	Quarterly	500 grams	Gamma
	43-Discharge Canal			
Fodder and Feed (FO)	35-Stevens' Farm	Monthly (during growing season)	500 grams	Gamma
	37-Johnson's Farm*			

*Control Station

TABLE 1-1 (Continued)

Sample Type	Sampling Point and Description	Sampling Frequency	Sample Size	Sample Analysis
Food Crop (FC)	41-Hwy. 211 - 0.25 Mile East of Hwy. 133 47-Location Varies*	Three Per Growing Season	500 grams	Gamma
Groundwater (GW)	5-Caswell Beach at Pump Station 25-Southport* 26-Hwy. 87 - West side of Discharge Canal 27-Hwy. 211 - West side of Discharge Canal 28-BSEP - On Site - Well No. 1 35-Stevens' Farm 53-69-Brunswick County Landfill** 70-73-BSEP Landfill***	Quarterly	2 liters	Gamma and Tritium Gamma
Milk (MS)	35-Stevens' Farm 37-Johnson's Farm*	Weekly	2 liters	Weekly--Iodine Monthly--Composite - Gamma and Sr-89, 90
Oyster (OY)	44-Lower Cape Fear River	Semiannual	500 grams	Gamma
Shrimp (SH)	46-Ocean Near Discharge	Semiannual	500 grams	Gamma and Sr-89, 90

*Control Station

**Added as a commitment to the state of North Carolina (started 2nd quarter 1980)

***Added as a commitment to the on-site landfill permit (started 1st quarter 1981)

TABLE 1-1 (Continued)

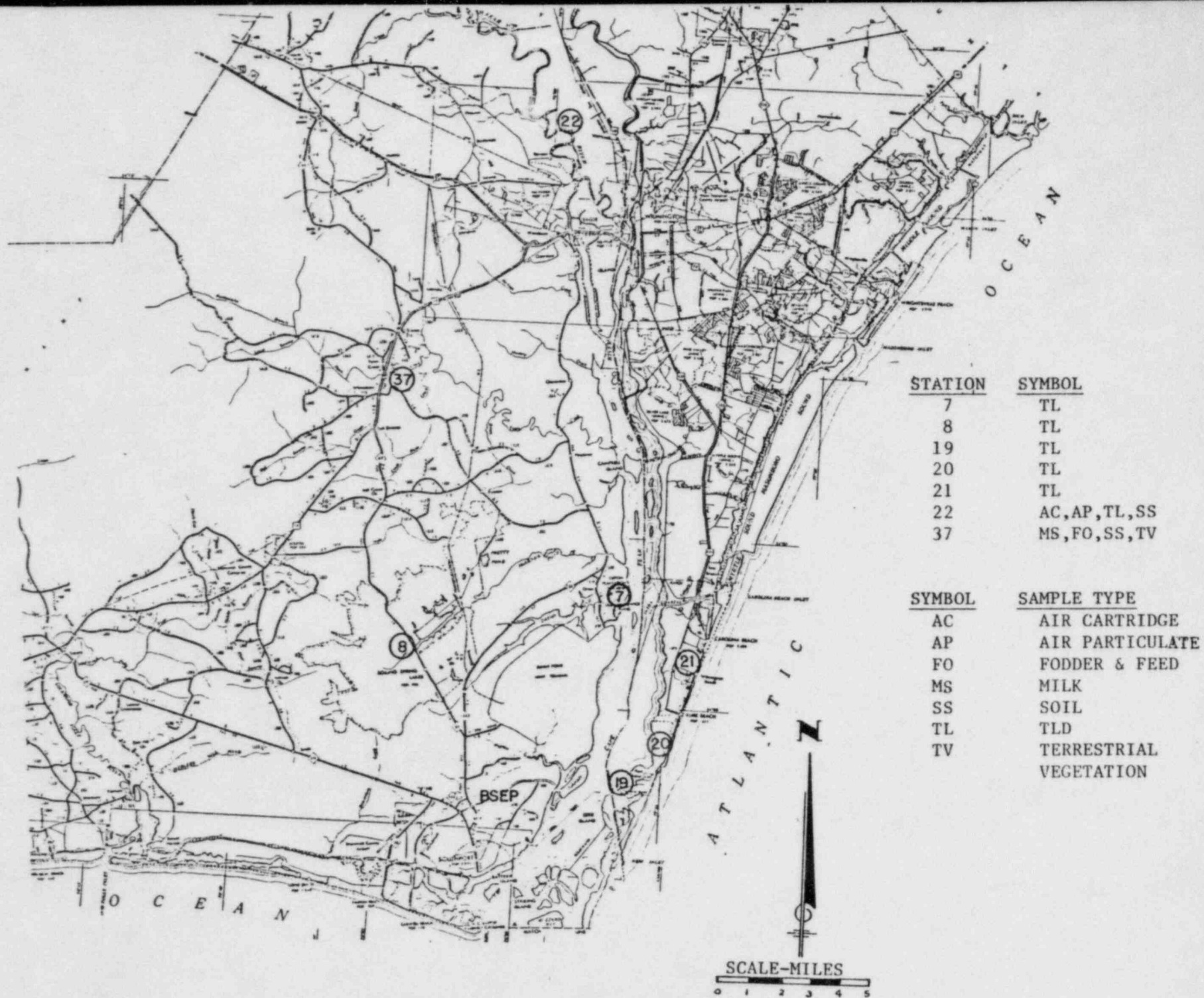
Sample Type	Sampling Point and Description	Sampling Frequency	Sample Size	Sample Analysis
Soil (SS)	2-Information Center	Every Three Years	500 grams	Gamma and Sr-89, 90
	10-State Road 1525 at RR Crossing			
	18-Southport Near CP&L Substation			
	22-Sutton Plant			
	23-Projected Maximum Annual Concentration Point - NE			
	24-CP&L Substation on Construction Access Road			
	27-Hwy. 211 - West Side of Discharge Canal			
	35-Stevens' Farm			
	37-Johnson's Farm*			
	41-Hwy. 211 - 0.25 Mile East of Hwy. 133			
	38-Caswell Beach - 0.5 Mile East Discharge Pipe	Semiannual	500 grams	Gamma and Sr-89, 90
	39-Caswell Beach - at Discharge Pipe			
	40-Caswell Beach - 0.5 Mile West of Discharge Pipe			
Surface Water (SW)	29-Ocean - 0.5 Mile East of Discharge Outfall	Monthly	2 liters	Monthly--Gross Beta, Tritium and Gamma Quarterly Composite - Sr-89, 90
	30-Ocean Near Discharge Outfall			
	31-Ocean - 0.5 Mile West of Discharge Outfall			
	32-Discharge Canal			
	48-Intake Canal*			
Terrestrial Vegetation (TV)	2-Information Center	Quarterly	500 grams	Gamma
	13-River Road at Intake Canal			
	27-Hwy. 211 - West Side of Discharge Canal			
	37-Johnson's Farm*			

*Control Station

TABLE 1-1 (Continued)

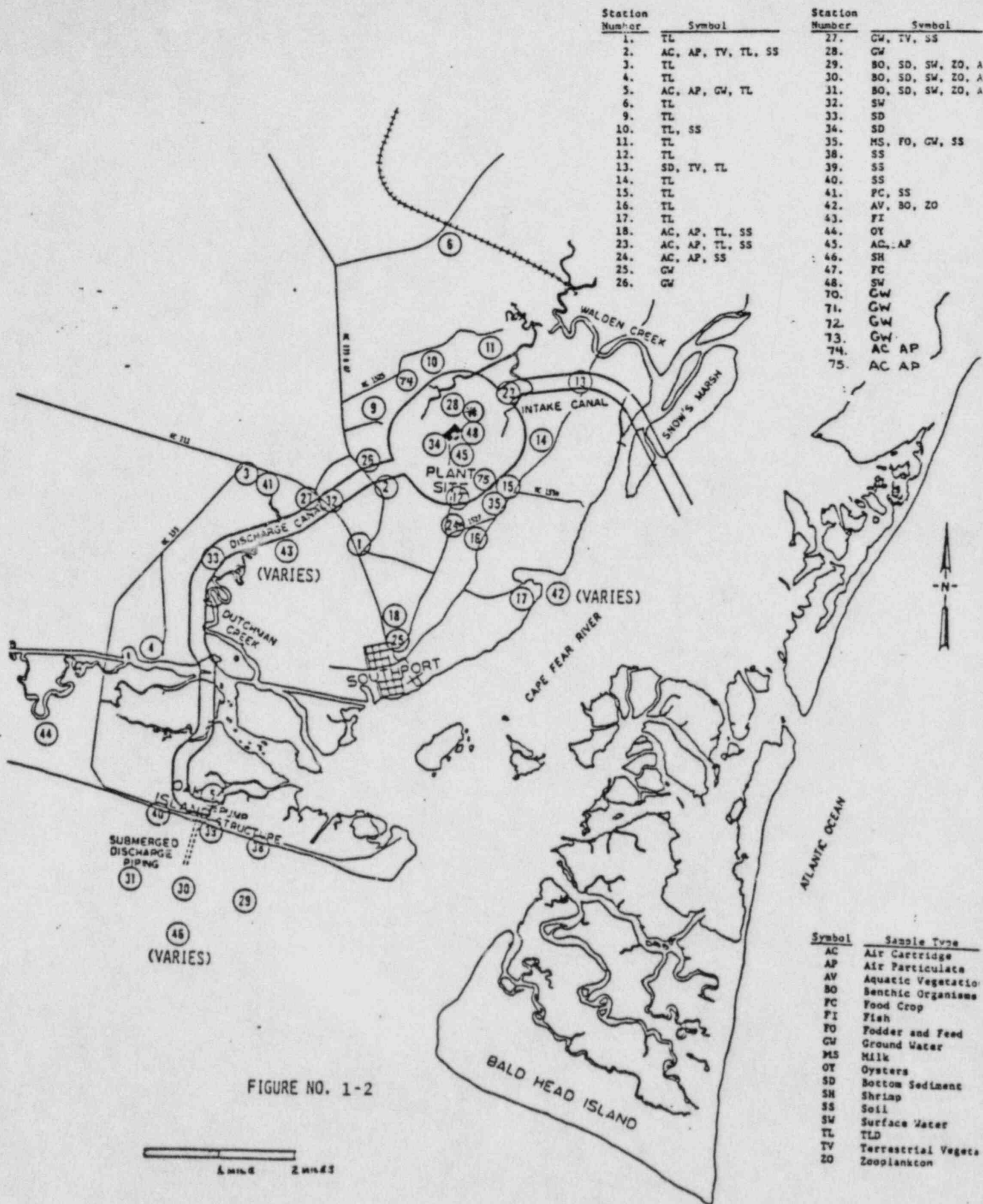
Sample Type	Sampling Point and Description	Sampling Frequency	Sample Size	Sample Analysis
External Radiaton (TL)	1-Junction of Hwys. 87 and 211	Quarterly	Not Applicable	TLD Readout
	2-Information Center			
	3-Junction of Hwys. 211 and 133			
	4-Standard Products Access Road Off Hwy. 133 Near Intercoastal Waterway			
	5-Caswell Beach at Pump Station			
	6-Sunny Point Access Road and RR Crossing			
	7-Entrance to Old Brunswick Town			
	8-Highway 87 at Boiling Springs Lake			
	9-Exclusion Boundary, Dirt Road Which Intersects Hwys. 87 and 133			
	10-SR 1525 at RR Crossing			
	11-Eastern End of SR 1525			
	12-Exclusion Boundary on Construction Access Road			
	13-River Road at Intake Canal			
	14-River Road Opposite I. D. Smith Residence			
	15-River Road and SR 1534			
	16-River Road and Site of Old Brown & Root Construction Office			
	17-Southport - Fort Fisher Ferry Slip			
	18-Southport Near CP&L Substation			
	19-Fort Fisher Ferry Slip			
	20-Kure Beach - Across From AFB Housing			
	21-Carolina Beach			
	22-Sutton Plant*			
	23-Projected Maximum Annual Concentration Point - NE			
Zooplankton (ZO)	29-Ocean - 0.5 Mile East of Discharge Outfall	Semiannual	10 cc wet	Gamma and Sr-89, 90
	30-Ocean Near Discharge Outfall			
	31-Ocean - 0.5 Mile West of Discharge Outfall			
	42-Lower Cape Fear River Away From Plant Discharge*			

*Control Station

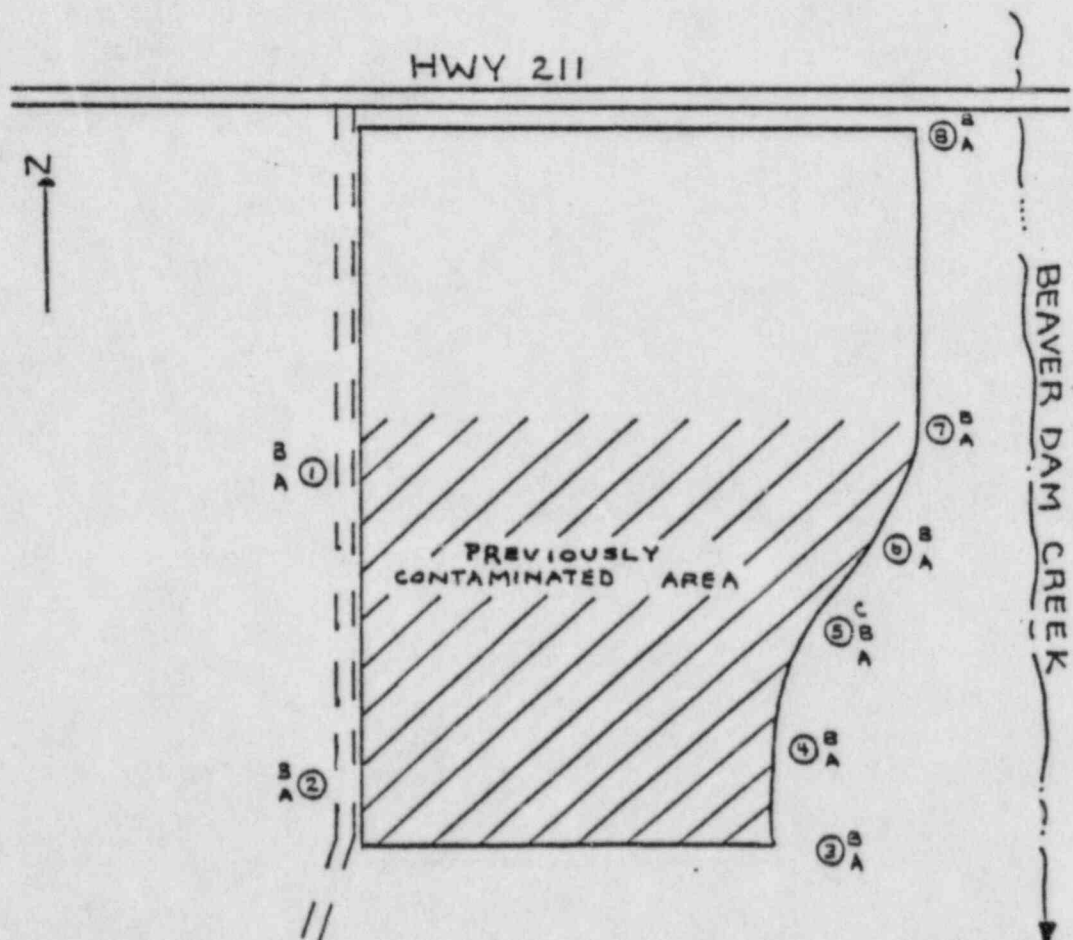


Locations of BSEP Radiological
Monitoring Stations

FIGURE 1-1



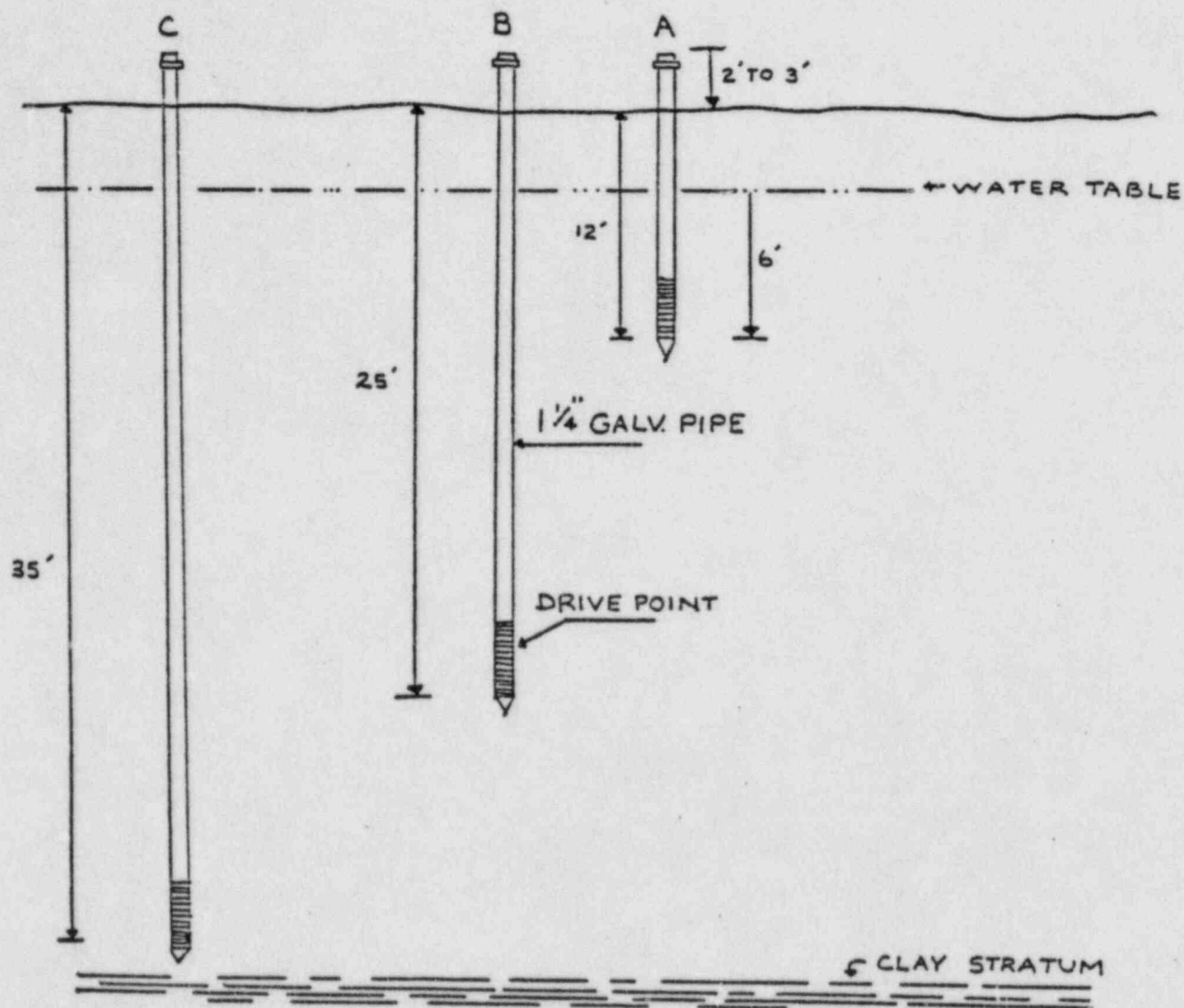
WELL NUMBER	LOCATION
1 A	GW-53
1 B	GW-54
2 A	GW-55
2 B	GW-56
3 A	GW-57
3 B	GW-58
4 A	GW-59
4 B	GW-60
5 A	GW-61
5 B	GW-62
5 C	GW-63
6 A	GW-64
6 B	GW-65
7 A	GW-66
7 B	GW-67
8 A	GW-68
8 B	GW-69



SKETCH MAP OF LANDFILL* AREA SHOWING LOCATIONS OF MONITOR WELL SITES. FOR DETAILED SECTION, SEE FIGURE 1.4.

*BRUNSWICK COUNTY LANDFILL

FIGURE 1-3
1-10



DETAIL SECTION - MONITOR WELL SITE

FIGURE 1-4

Following is a tabulation of the specific methods used in monitoring the various pathways of exposure to man.

Gaseous Effluent Path

Submersion Dose and Other External Dose	Thermoluminescent Dosimetry Area Monitors
Vegetation Path Soil Samples Air Samples	Vegetation Samples
Milk Path Vegetation and Cattle Feed Samples Air Samples	Milk Samples
Inhalation Path	Air Samples

Liquid Effluent Path

Fish and Shellfish Path Bottom Sediment Samples Aquatic Vegetation Samples Zooplankton Samples Benthic Organisms Fish Samples Oyster Samples Shrimp Samples	Water Samples
Water and Shoreline Exposure Area Monitors Water Samples Bottom Sediment Samples Soil and Beach Sand	Thermoluminescent Dosimetry
Drinking Water Path	Groundwater Samples

2.0 PROGRAM SUMMARY

The purposes of the Environmental Radiological Monitoring Program are:

- To measure any accumulation of radioactivity in the environment and to assess whether this radioactivity is the result of the operation of the Brunswick Plant.
- To provide an evaluation of the environmental impact of operating releases of radioactive materials from the Brunswick Plant.
- To compare population doses from environmental sample data with corresponding doses predicted in the Final Environmental Statement.

The Brunswick Plant's preoperational radiological monitoring was conducted from July 24, 1972, until plant start-up in March 1975, and data therefrom were reported to the Nuclear Regulatory Commission in June 1975.

The following locations are designated as the Control Locations for the respective measurements and are intended to indicate conditions away from Brunswick Plant influence:

L. V. SUTTON PLANT - 23 Mi. NNE (Sample Station 22)

Thermoluminescent Dosimetry Area Monitors
Air Particulate Samples
Charcoal Cartridge Samples - Airborne I-131

INTAKE CANAL (Sample Stations 48 and 13)

Surface Water Samples (48) at Plant
Bottom Sediment Samples (13) at River Road

SOUTHPORT WATER SUPPLY

(Sample Station 25)

Groundwater Samples

JOHNSON'S FARM - 14.5 Mi. NNW

(Sample Station 37)

Terrestrial Vegetation Samples

Cattle Fodder and Feed Samples

Soil Samples

Milk Samples

VARIABLE LOCATION AWAY FROM PLANT

(Sample Station 42)

Plankton Samples

Benthos Samples

Aquatic Vegetation Samples

VARIABLE LOCATION AWAY FROM PLANT

(Sample Station 47)

Food Crop Samples

No control locations are designated for shrimp, oysters, or fish. Table 2-1 summarizes the results of the environmental radiological monitoring program for calendar year of 1983.

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Brunswick Steam Electric Plant
Brunswick County, North Carolina

Docket Numbers - 50-324 and 325
Calendar Year 1983

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	MDA (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean		Control Locations Mean Range (2)	No. of Nonroutine Reported Measurements (3)
				Name, Distance, and Direction	Mean Range (2)		
Air Cartridge (pCi/m ³)	1-131 463 (4)	2.58E-2	All less than MDA	All less than MDA		All less than MDA	0
Air Particulate (pCi/m ³)	Gross Beta 463 (4)	1.29E-3	1.86E-2 (411/416) 2.76E-3 - 7.74E-2	Information Center 1.0 mile SW	2.06E-2 (51/52) 7.40E-3 - 7.74E-2	1.75E-2 (52/52) 4.28E-3 - 3.59E-2	0
	Sr-89 36	1.29E-3	3.32E-3 (2/32) 2.38E-3 - 4.27E-3	Bethel Church Rd. 0.9 mile NW	4.27E-3 (1/32) (Single value)	All less than MDA	0
	Sr-90 36	3.55E-4	5.87E-4 (3/32) 4.35E-4 - 6.92E-4	Information Center 1.0 mile SW	6.92E-4 (1/32) (Single value)	All less than MDA	0
	Gamma (14) 36	N/A	All less than MDA	All less than MDA		All less than MDA	0
Aquatic Vegetation (pCi/g, wet)	Sr-89 2 (5)	3.22E-2 (wet)	No sample available	No sample available		All less than MDA	0
	Sr-90 2 (5)	1.29E-2 (wet)	No sample available	No sample available		All less than MDA	0
	Gamma (14) 2 (5)	N/A	No sample available	No sample available		All less than MDA	0
Benthic Organisms (pCi/g, wet)	Sr-89 8	3.22E-2 (wet)	5.62E-2 (1/6) (Single value)	Atlantic Ocean 0.5 miles west of Discharge Outfall 5.7 miles SSW	5.62E-2 (1/2) (Single value)	All less than MDA	0
	Sr-90 8	2.17E-2 (wet)	4.60E-2 (2/6) 2.15E-2 - 7.05E-2	Atlantic Ocean 0.5 miles west of Discharge Outfall 5.7 miles SSW	7.05E-2 (1/2) (Single value)	3.05E-2 (1/2) (Single value)	0
	Gamma (14) 8	Ref. Table 5.1	All less than MDA	All less than MDA		All less than MDA	0

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Brunswick Steam Electric Plant
Brunswick County, North Carolina

Docket Numbers - 50-324 and 325
Calendar Year 1983

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	MDA (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean Name, Distance, and Direction	Mean Range (2)	Control Locations Mean Range (2)	No. of Nonroutine Reported Measurements (3)
Bottom Sediment (pCi/g, dry)	Sr-89 12	1.94E-1	All less than MDA	All less than MDA		All less than MDA	0
	Sr-90 12	1.29E-1	All less than MDA	All less than MDA		All less than MDA	0
	Gamma (14) 72 (6)		7.30E-1 (22/60)	Discharge Canal at Stilling Pond	1.24E+0 (12/12)	4.41E-2 (2/12)	
	Mn-54	1.16E-2	3.51E-2 - 2.66E+0	4.9 miles SSW	8.27E-2 - 2.66E+0	4.40E-2 - 4.42E-2	0
	Co-60	2.13E-2	3.25E+0 (24/60) 2.42E-1 1.14E+1	Discharge Canal at Stilling Pond 4.9 miles SSW	5.82E+0 (12/12) 1.17E+0 - 1.14E+1	1.01E-1 (4/12) 6.51E-2 - 1.40E-1	12
	Cs-137	1.35E-2	2.49E-1 (29/60) 1.73E-2 - 1.14E+0	Discharge Canal at Stilling Pond 4.9 miles SSW	4.96E-1 (12/12) 7.73E-2 - 1.14E+0	3.10E-1 (12/12) 2.14E-1 4.55E-1	0
Fish (pCi/g, dry)	Gamma (14) 7 (15)	1.29E-2	2.46E-1 (3/7)	Discharge Canal	2.46E-1 (3/3)		
	Co-60 (dry)	(dry)	1.44E-1 - 3.37E-1	1.5 miles WSW	1.44E-1 - 3.37E-1	No control	0
	Ag-110m (wet)	5.16E-3	6.31E-1 (1/7) (Single value)	Discharge Canal 1.5 miles WSW	6.31E-1 (1/3) (Single value)	No control	0
Fodder and Feed (pCi/g, dry)	Cs-137 (dry)	1.29E-2	4.21E-2 (2/7) 2.82E-2 - 5.60E-2	Discharge Canal 1.5 miles WSW	4.21E-2 (2/3) 2.82E-2 - 5.60E-2	No control	0
	Gamma (14) 15 (7)	2.58E-2	1.11E-1 (1/5)	Stevens' Farm	1.11E-1 (1/5)		
	Co-60 (dry)	(dry)	(Single value)	0.9 mile SE	(Single value)	All less than MDA	0
	Cs-137 (dry)	1.93E-2	2.81E-1 (5/5) 9.16E-2 - 5.23E-1	Stevens' Farm 0.9 mile SE	2.81E-1 (5/5) 9.16E-2 - 5.23E-1	All less than MDA	0

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Brunswick Steam Electric Plant
Brunswick County, North Carolina

Docket Numbers - 50-324 and 325
Calendar Year 1983

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	MDA (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean Name, Distance, and Direction	Mean Range (2)	Control Locations Mean Range (2)	No. of Nonroutine Reported Measurements (3)
Food Crop (pCi/g, dry)	Gamma (14) Cs-137 6	1.93E-2 (dry)	7.37E-1 (1/3) (Single value)	Hwy. 211 - 0.25 mile E of Hwy. 133 1.9 miles W	7.37E-1 (1/3) (Single value)	2.22E-1 (2/3) 1.80E-1 - 2.63E-1	0
Groundwater (pCi/l)	Tritium 24 (8)	3.23E+2	All less than MDA	All less than MDA		All less than MDA	0
	Gamma (14) 107 (8)	N/A	All less than MDA	All less than MDA		All less than MDA	0
Milk (pCi/l)	I-131 52 (9)	2.58E-1	Not sampled	Not sampled		All less than MDA	0
	Sr-89 12 (9)	1.29E+0	Not sampled	Not sampled		All less than MDA	0
	Sr-90 12 (9)	5.81E-1	Not sampled	Not sampled		2.85E+0 (2/12) 1.77E+0 - 4.21E+0	0
	Gamma (14) 12 (9) Cs-137	3.87E+0	Not sampled	Not sampled		5.20E+0 (2/12) 4.95E+0 - 5.45E+0	0
Oyster (pCi/g dry)	Gamma (14) 2	Ref Table 5-1	All less than MDA	All less than MDA		No control	0
Shrimp (pCi/g wet)	Sr-89 2	3.22E-2	All less than MDA	All less than MDA		No control	0
	Sr-90 2	1.29E-2	All less than MDA	All less than MDA		No control	0
	Gamma (14) 2	Ref. Table 5-1	All less than MDA	All less than MDA		No control	0

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Docket Numbers - 50-324 and 325
Calendar Year 1983

Brunswick Steam Electric Plant
Brunswick County, North Carolina

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	MDA (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean Name, Distance, and Direction	Mean Range (2)	Control Locations Mean Range (2)	No. of Nonroutine Reported Measurements (3)
Soil (pCi/g, dry)	Sr-89 6 (10)	1.94E-1	All less than MDA	All less than MDA		No control	0
	Sr-90 6 (10)	1.29E-1	All less than MDA	All less than MDA		No control	0
	Gamma (14) 6 (10)	Ref. Table 5-1	All less than MDA	All less than MDA		No control	0
Surface Water (pCi/l)	Gross Beta 60	5.16E-1	3.42E+2 (45/48) 7.65E+1 - 6.17E+2	Ocean Near Discharge Outfall 5.7 miles SSW	3.58E+2 (12/12) 1.64E+2 - 6.17E+2	3.29E+2 (9/12) 7.27E+1 - 6.26E+2	0
	Sr-89 20	1.29E+0	All less than MDA	All less than MDA		All less than MDA	0
	Sr-90 20	8.90E-1	1.56E+0 (1/16) (Single value)	Ocean Near Discharge Outfall 5.7 miles SSW	1.56E+0 (1/4) (Single value)	All less than MDA	0
Terrestrial Vegetation (pCi/g, dry)	Gamma (14) 60	Ref. Table 5-1	All less than MDA	All less than MDA		All less than MDA	0
	Tritium 60	3.23E+2	8.48E+2 (2/48) 5.97E+2 - 1.10E+3	Discharge Canal 1.5 miles WSW	8.48E+2 (2/12) 5.97E+2 - 1.10E+3	5.93E+2 (1/12) (Single value)	0
	Gamma (14) 16 Cs-137	1.94E-2	8.70E-2 (3/12) 7.64E-2 - 9.94E-2	River Road at Intake Canal 1.5 miles ENE	8.70E-2 (3/4) 7.64E-2 - 9.94E-2	3.23E-1 (2/4) 1.60E-2 - 6.30E-1	0
TLD (millirem per week)	TLD Readout 88 (11)	1mr (12)(13)	1.21E+0 (84/84) 8.00E-1 - 2.30E+0	PMAC - Intake Canal 0.6 mile NE	1.80E+0 (4/4) 1.20E+0 - 2.30E+0	1.17E+0 (4/4) 9.00E-1 - 1.70E+0	0

TABLE 2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Brunswick Steam Electric Plant
Brunswick County, North Carolina

Docket Numbers - 50-324 and 325
Calendar Year 1983

Medium or Pathway Sampled or Measured (Unit of Measurement)	Type and Total No. of Measurements Performed	MDA (1)	All Indicator Locations (2) Mean Range	Location w/Highest Annual Mean Name, Distance, and Direction	Mean Range (2)	Control Locations Mean Range (2)	No. of Nonroutine Reported Measurements (3)
Zooplankton (pCi/g, wet)	Sr-89 8	3.23E-2	All less than MDA	All less than MDA		All less than MDA	0
	Sr-90 8	1.94E-2	4.35E-1 (2/6) 3.73E-2 - 8.33E-1	Ocean Near Discharge Outfall 5.7 miles SSW	8.33E-1 (1/2) (Single value)	All less than MDA	0
	Gamma (14) 8	Ref. Table 5-1		All less than MDA	All less than MDA	All less than MDA	0
(pCi/g, dry)							

FOOTNOTES

1. Minimum Detectable Activity (MDA) is calculated based on three standard deviations above background using typical sample size in a given counting time. Due to counting statistics and varying volumes, occasionally lower MDAs are achieved. See Table 5-1.
2. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parenthesis.
3. Measurements are in excess at 99.5 percent confidence level of ten times the control station value or ten times the minimum detectable activity (MDA), whichever is larger, and have passed a positive "t" test for significance.
4. Air particulate and charcoal cartridge samples were collected weekly. There were 52 weeks in 1983 times 9 air monitor stations for a total of 468 samples. Listed are the samples that were collected but not used for this report due to low volumes.
 - a. Station 2 (May 2, 1983): low volume due to blown fuse.
 - b. Station 18 (May 2, 1983): low volume due to blown fuse.
 - c. Station 75 (July 4, 1983): low volume due to damaged power cord.
 - d. Station 74 (November 28, 1983): low volume due to blown fuse.
 - e. Station 74 (December 12, 1983): low volume due to blown fuse.Therefore, a total of 463 samples were analyzed.

5. Collection of aquatic vegetation samples at Station 29 (ocean 0.5 mile east of discharge outfall), Station 30 (ocean near discharge outfall), and Station 31 (ocean 0.5 mile west of discharge outfall) was attempted during 1983. These attempts were unsuccessful since no permanent beds of vegetation were located at the required sampling stations. Only the two control location samples were analyzed in 1983.
6. Bottom sediment samples are required semiannually at six locations for a total of 12 samples. Strontium and gamma analyses were performed on the 12 routine samples. However, due to increased concentrations of radionuclides, additional monthly sampling was performed for a total of 60 samples. Gamma analyses were performed on the additional monthly samples. Twelve 30-day nonroutine reports were submitted to the NRC in 1983.
7. Fodder samples were not available at Station 35 (Stevens' Farm) in January, February, March, April, May, November, and December 1983. Therefore, 5 samples were obtained from Station 35 in 1983. Fodder samples were not available at Station 37 (Johnsons' Farm) in November and December; therefore, 10 samples were obtained from Station 37 in 1983.

8. Six groundwater sample stations require tritium and gamma analysis once per quarter, as per technical specifications, for a total of 24 samples. Seventeen additional groundwater stations at the Brunswick County landfill require only quarterly gamma analysis for a total of 68 samples. Four stations at the Brunswick Steam Electric Plant landfill require gamma analysis quarterly for a total of 16 samples. However, Station 73 was not collected in the fourth quarter.
9. Milk samples were not available in 1983 from Station 35 (Stevens' Farm) because the cow was dry. All required samples were collected from Station 37 (Johnsons' Farm).
10. Ten soil samples are collected once per three years. This was performed in 1981. Collection from three sample stations is required semiannually.
11. Twenty-three stations are sampled quarterly; however, four TLDs were missing during 1983. They are TLDs 01 and 13 in Quarter 1, TLD 18 in Quarter 3, and TLD 04 in Quarter 4. This yields a total of 88 total samples.
12. Dependent on ambient background conditions.
13. Minimum sensitivity is approximately one mR. Refer to Section 5.6 for additional information.
14. Summary of gamma analysis results in this report does not include the following naturally occurring isotopes since most environmental samples contained some or all of these: Be-7, K-40, Tl-208, Pb-212, Bi-212, Bi-214, Pb-214, Ra-226, Ac-228, and Th-234.
15. Fish samples are collected quarterly from two locations. No sample was available at Station 43 during the fourth quarter for a total of 7 samples in 1983.
16. The MDA for surface water is listed as $5.16\text{E-}1$ pCi/l. This value is based upon a volume of 1000 mls of freshwater. A review of the data for SW-32 reveals the MDA values for March, April, and May 1983 were approximately < 47, < 45, and < 78, respectively. Location SW-32, the discharge canal, has very high solids due to the brackish nature of the water and the turbulence created by pumping. Only 10 mls can be evaporated due to high solids content. Therefore, a realistic MDA for surface water is 51.6 pCi/l.

$$\left[\frac{1000 \text{ mls}}{10 \text{ mls}} \times .516 \text{ pCi/l} = 51.6 \text{ pCi/l} \right]$$

3.0 INTERPRETATIONS AND CONCLUSIONS

3.1 Air Samples

The gross beta results for air particulate samples collected during the year of 1983 are below the preoperational levels. All indicator station activities averaged $1.86\text{E-}2$ pCi/m³ compared to $9.83\text{E-}2$ pCi/m³ over the entire preoperational monitoring period. The 1983 average activity of control station samples was $1.75\text{E-}2$ pCi/m³ which is a more meaningful comparison to the indicator stations due to yearly weather conditions (amount of rainfall) and other sources of activity (fallout from nuclear testing 1976, 1977, 1978). The gross beta plots in Figures 3-1 through 3-8 show each indicator station in comparison to the control station. They verify no significant increase in the indicator location activities in comparison to the control station with the exceptions of Stations 2 (Visitors Center), 23 (PMAC), and 45 (on site). The gamma isotopic and strontium analyses for all locations during this time period revealed Sr-89 and Sr-90 activities with average concentrations of $3.32\text{E-}3$ pCi/m³ and $5.87\text{E-}4$ pCi/m³, respectively.

The following are doses and assumptions from Reg. Guide 1.109 for inhalation of Sr-89 and Sr-90 in air by the maximum exposed individual.

	Infant	Child	Teen	Adult	10CFR50 App I
Inhalation m ³ /yr	1400	3700	8000	8000	--
Dose factors Sr-89 mrem/pCi	$1.5\text{E-}3$	$5.8\text{E-}4$	$3.0\text{E-}4$	$1.8\text{E-}4$	--
Dose factors Sr-90 mrem/pCi	$8.0\text{E-}3$	$4.0\text{E-}3$	$2.1\text{E-}3$	$1.2\text{E-}3$	--
Dose to lungs mrem/qtr	$3.3\text{E-}3$	$4.0\text{E-}3$	$4.4\text{E-}3$	$2.6\text{E-}3$	--
Dose to lungs mrem/yr	$1.3\text{E-}2$	$1.6\text{E-}2$	$1.8\text{E-}2$	$1.0\text{E-}2$	15.0

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

TABLE 3-1

GROSS BETA AIR PARTICULATE SIX-MONTH AVERAGES FOR COMPARISON OF PREOPERATIONAL DATA TO 1983 DATA

Stations	1st Half '73 pCi/m ³	2nd Half '73 pCi/m ³	1st Half '74 pCi/m ³	2nd Half '74 pCi/m ³	1st Half '83 pCi/m ³	2nd Half '83 pCi/m ³
AP-2 Information Center	1.5E-2	2.9E-2	1.7E-1	1.1E-1	1.9E-2	2.2E-2
AP-5 Caswell Beach at Pumping Station	1.5E-2	2.8E-2	1.6E-1	1.1E-1	1.2E-2	1.8E-2
AP-18 Southport near CP&L Substation	1.6E-2	3.2E-2	1.5E-1	1.1E-1	1.7E-2	2.3E-2
AP-22 Sutton Plant (Control Station)	1.7E-2	3.2E-2	1.6E-1	1.0E-1	1.6E-2	1.9E-2
AP-23 PMAC	--	3.1E-2	1.6E-1	1.2E-1	1.8E-2	2.2E-2
AP-24 CP&L Substation on Construction Access Road	--	3.4E-2	1.7E-1	1.1E-1	1.7E-2	2.0E-2
AP-45 On Site	1.6E-2 (2 Samples Only)	3.1E-2	1.8E-1	1.1E-1	1.9E-2	1.9E-2
AP-74 Bethel Church Road	--	--	--	--	1.7E-2	1.8E-2
AP-75 Stevens' Farm Vector	--	--	--	--	1.7E-2	1.9E-2

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=02

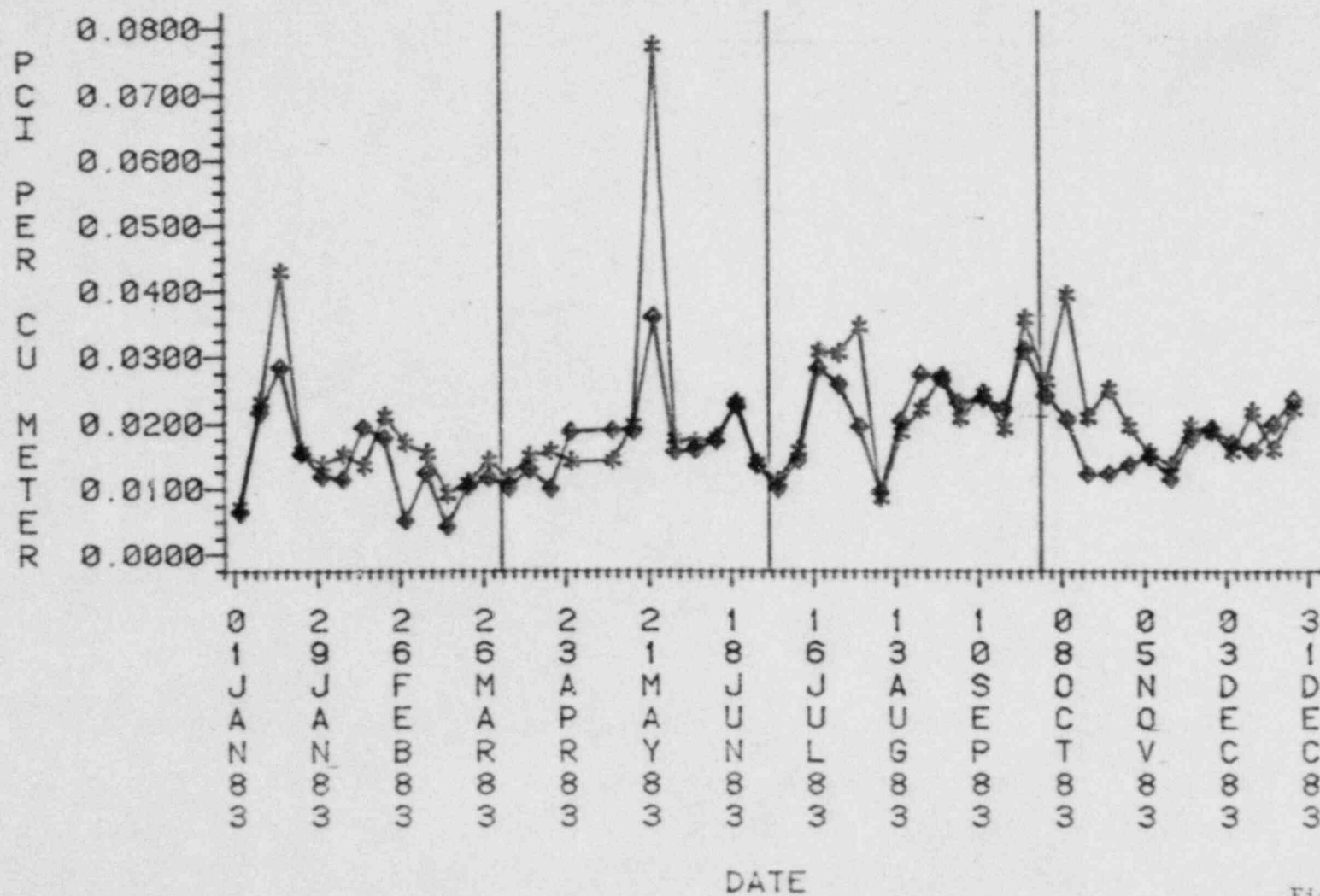


Figure 3-1

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=05

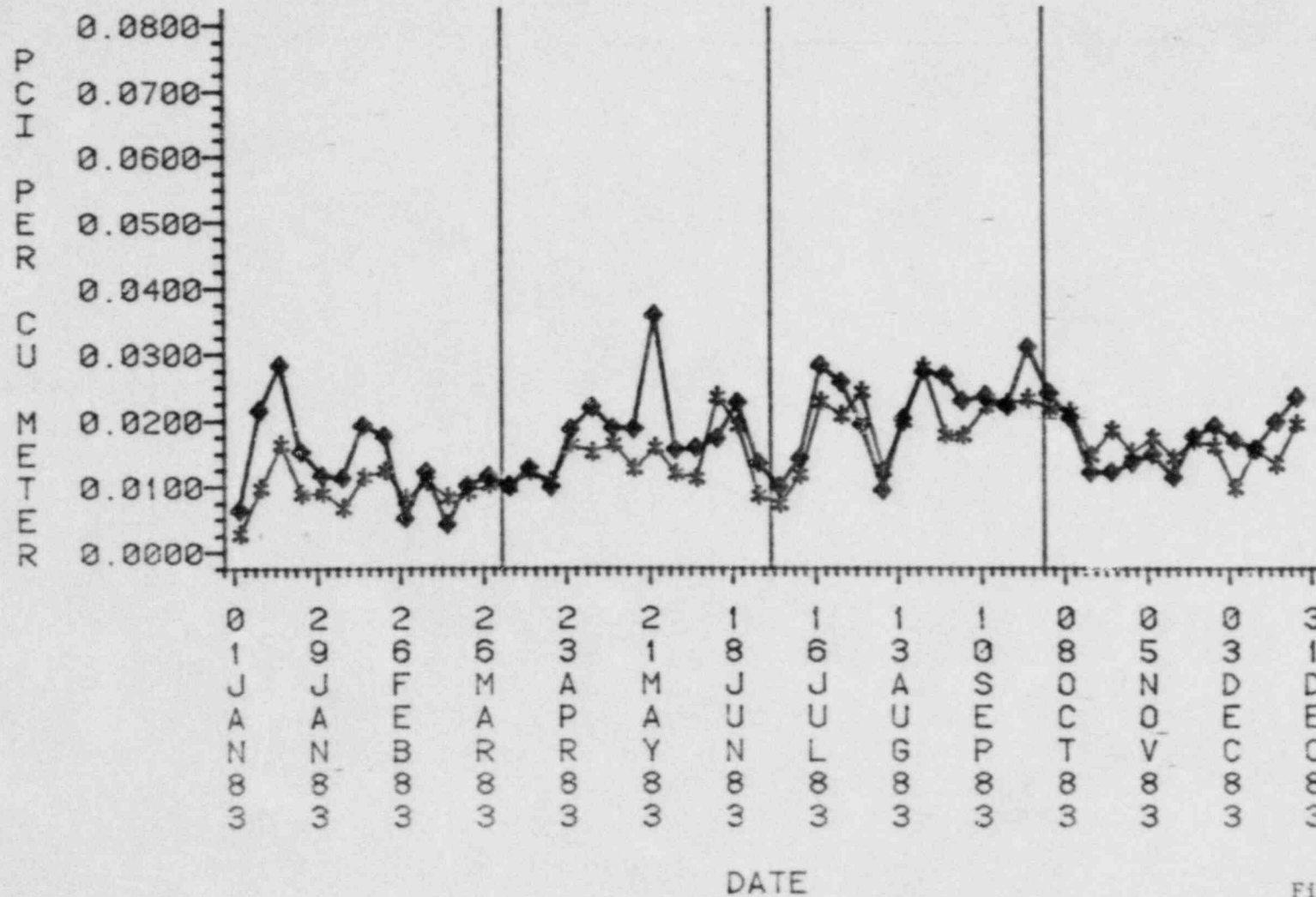


Figure 3-2

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=18

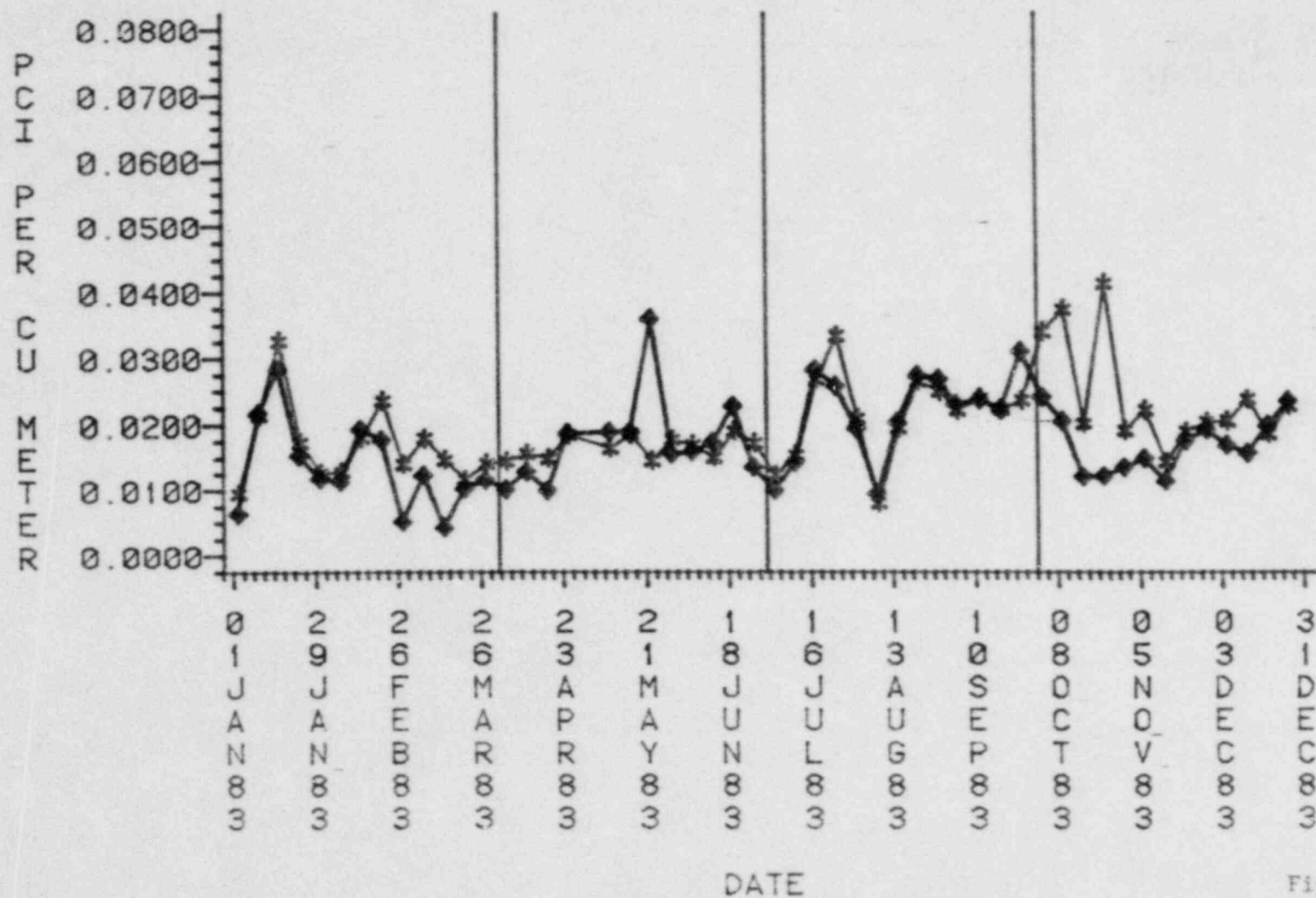


Figure 3-3

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=23

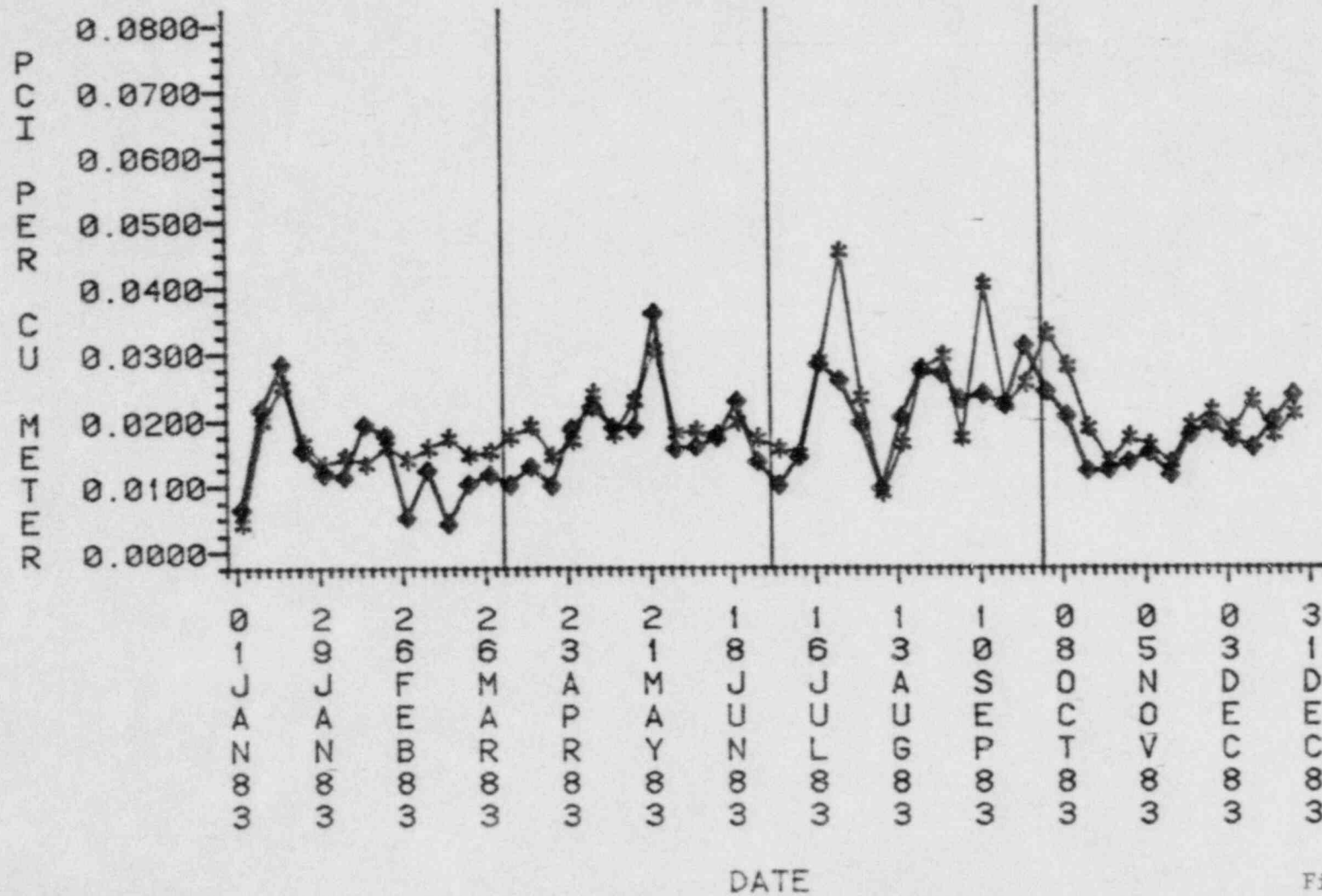


Figure 3-4

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=24

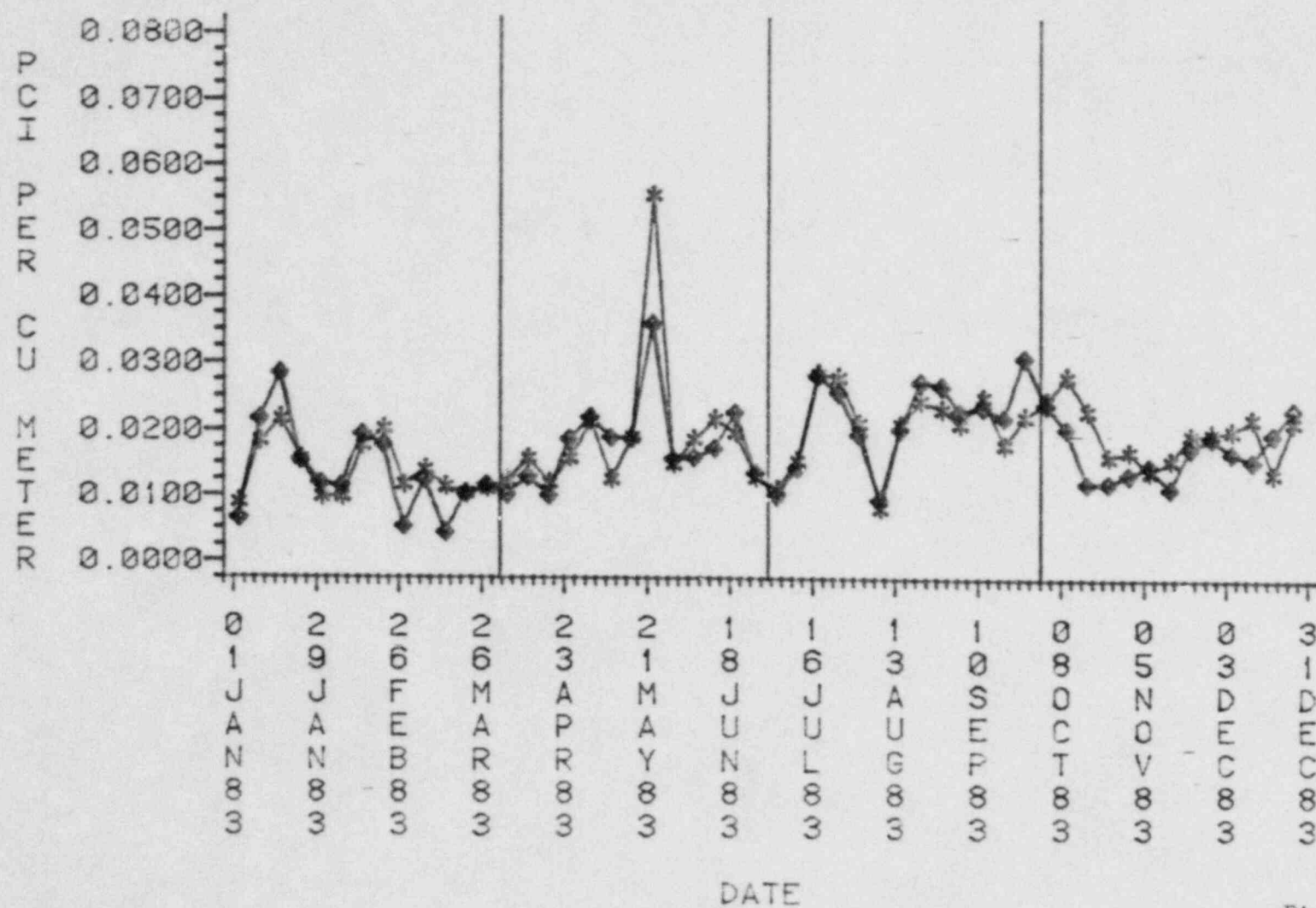


Figure 3-5

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=45

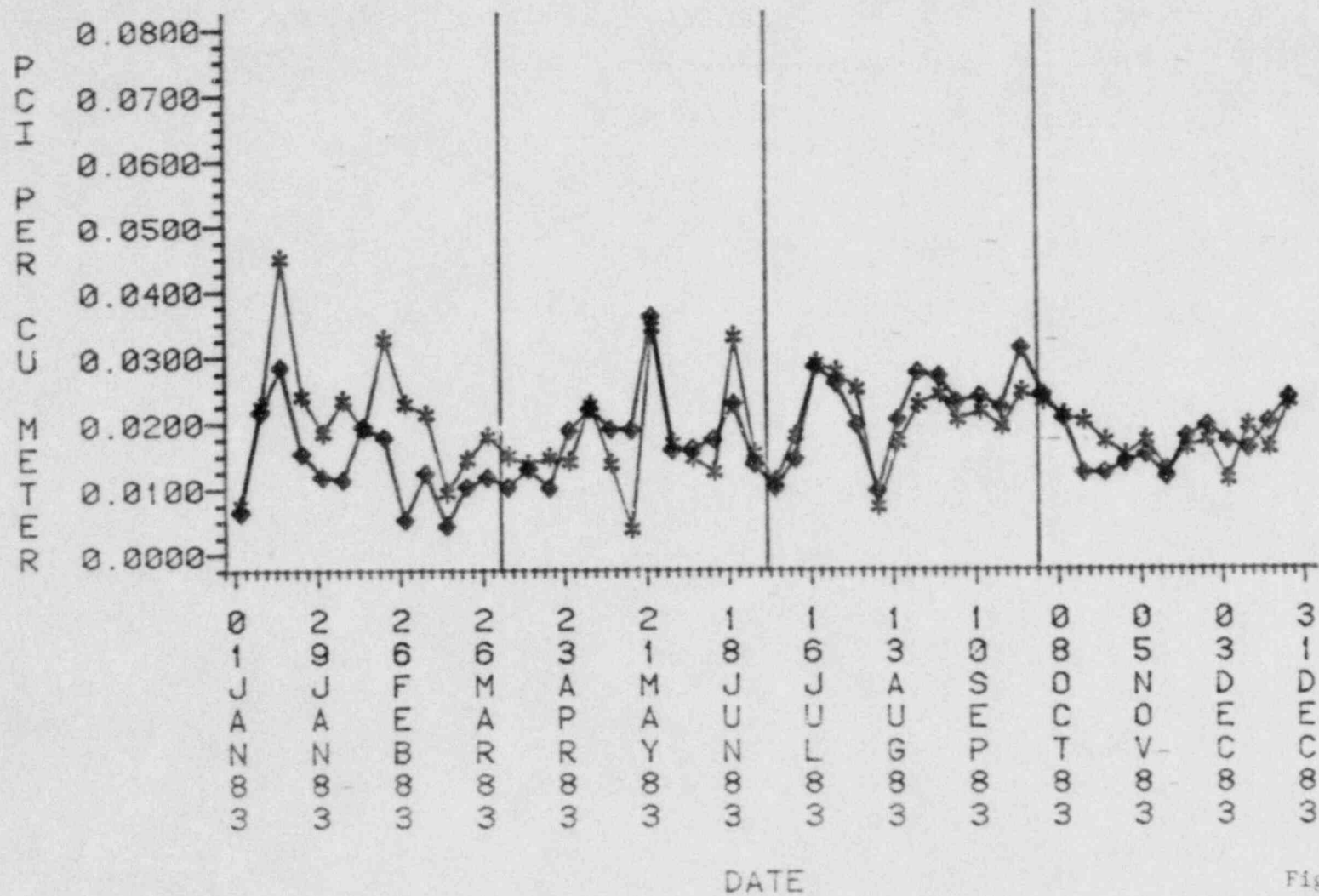


Figure 3-6

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 AIR PARTICULATE SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=74

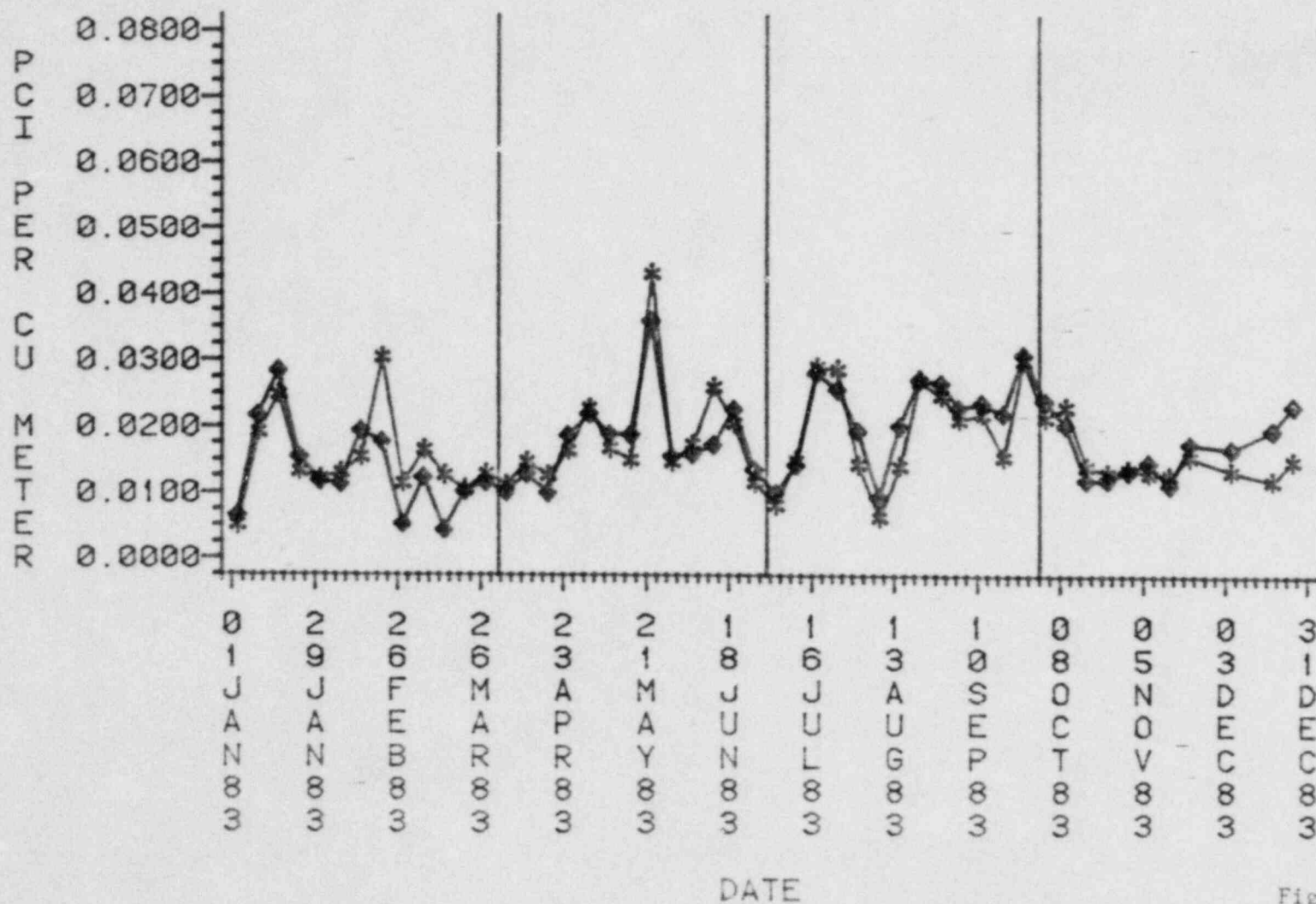
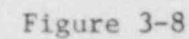


Figure 3-7



3.2 Milk Samples

The milk sampling program requires weekly samples to be collected from two locations--the Stevens' family cow and Johnson's Farm. The single cow at the Stevens' farm was dry during the entire year of 1983, so no samples were collected.

Station 37 (control), the Johnson's Farm, revealed no iodine-131 or strontium-89 activity. Strontium-90 was revealed in 2 out of 12 samples with an average concentration of 2.85 pCi/l. This may be compared to the corresponding preoperational levels of 9.0 pCi/l. Gamma analysis indicated cesium-137 activity in 2 out of 12 samples with an average concentration of 5.20 pCi/l.

CS-137 ACTIVITIES LESS THAN MDA WERE OMITTED
AVERAGE MDA=9.0 PCI PER LITER

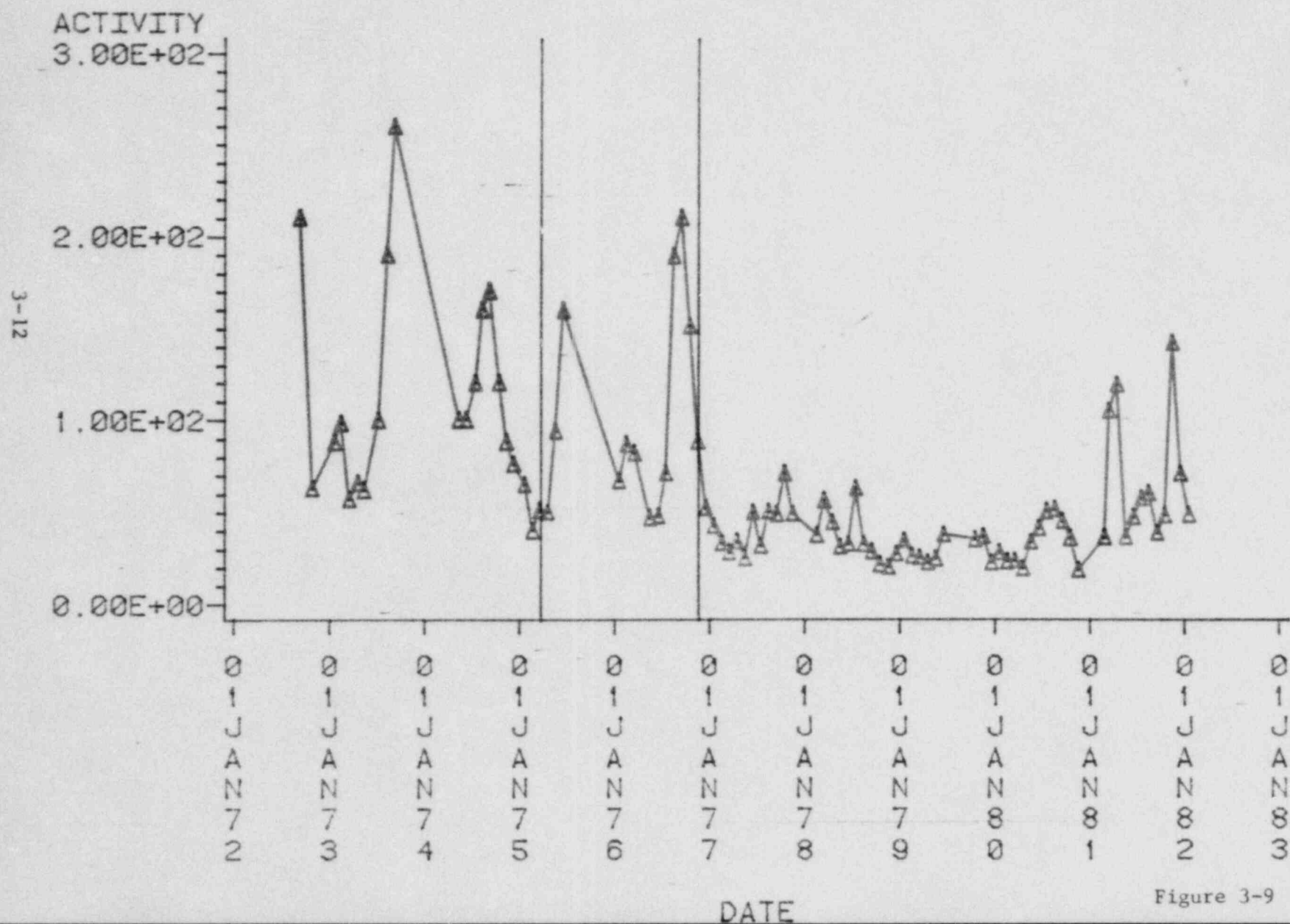


Figure 3-9

3.3 Vegetation (Terrestrial Vegetation, Fodder and Feed, Food Crop)

Terrestrial vegetation is sampled quarterly at four locations. Pine needles are used as the sample media because of its availability at any location during any season. The high surface area on pine needles enables this particular sample type to collect air particulates rather efficiently and makes it one of the most sensitive indicators for detecting fallout.

Gamma isotopic analyses revealed the presence of cesium-137 with an average concentration of $8.70\text{E-}2$ pCi/g, dry. The cesium-137 concentration was compared to the control station cesium-137 concentration of $3.23\text{E-}1$ pCi/g, dry. Therefore, this measurable activity was not attributed to BSEP plant operations.

Cattle fodder and feed (pasture grass) sampled monthly revealed a single incidence of cobalt-60 with a concentration of $1.11\text{E-}1$ pCi/g, dry, at the Stevens' farm. Cesium-137 was also detected in 5 out of 5 samples with an average concentration of $2.81\text{E-}1$ pCi/g, dry. Both radionuclides were below the minimum detectable activity (MDA) at the control station, Johnson's Farm.

Although the typical MDA value for a fodder sample is approximately $1.9\text{E-}2$ pCi/g, dry, the MDA will vary with each specific sample. Listed are the dates, sample concentrations, and calculated MDAs for the five Cs-137 values detected.

Date	Activity pCi/g, dry	MDA pCi/g, dry
June 1983	$1.59\text{E-}1$	$7.55\text{E-}2$
July 1983	$9.16\text{E-}2$	$9.48\text{E-}2$
August 1983	$5.23\text{E-}1$	$7.55\text{E-}2$
September 1983	$1.57\text{E-}1$	$8.65\text{E-}2$
October 1983	$4.75\text{E-}1$	$5.48\text{E-}2$

Based on this data, the sample activity did not exceed ten times MDA in any case. Hence, no reports were required for Cs-137 for food and fodder crops.

The high frequency of detection of cesium-137 at the Stevens' farm is attributable to farming practices as related to pasture fertilization. For example, the owner has not enhanced pasture growth. The last known major fertilization was performed in 1977. Thus, recycling of cesium in the pasture is occurring.

Food crops sampled during the growing season revealed cesium-137 activity with a concentration of $3.98\text{E-}2$ pCi/g, wet ($7.37\text{E-}1$ pCi/g, dry) in a single sample of squash. Ingestion by the maximum individual (teenager) for the most critical organ (liver) would yield a dose of 3.74 mrem per year. This assumes consumption of 630 Kg (1389 pounds) of squash and uses the ingestion dose factor $1.49\text{E-}04$ mrem per picocurie, ingested, as given in Reg. Guide 1.109. This dose is well below 10CFR50, Appendix I, design objectives of 15 mrem per year for the most critical organ.

3.4 Soil

Soil (beach sand) samples collected semiannually and analyzed for radiostrontium and gamma emitters revealed no measurable radioactivity.

3.5 Surface Water

Surface water is sampled monthly at five locations and analyzed for gross beta, radiostrontium, tritium, and gamma-emitting radionuclides. Gross beta activity was measurable in 45 of 48 samples analyzed averaging 342 pCi/l. This average is comparable to the control station average of 329 pCi/l which was measurable in 9 of 12 samples. Refer to Figure 3-10 for a comparison of intake canal (control station) versus discharge canal.

CP&L ENVIRONMENTAL SURVEILLANCE
 GROSS BETA ACTIVITY FOR
 SURFACE WATER SAMPLES
 * FOR SAMPLE STATION
 ◇ FOR CONTROL STATION
 PLANT=BSEP POINT=32

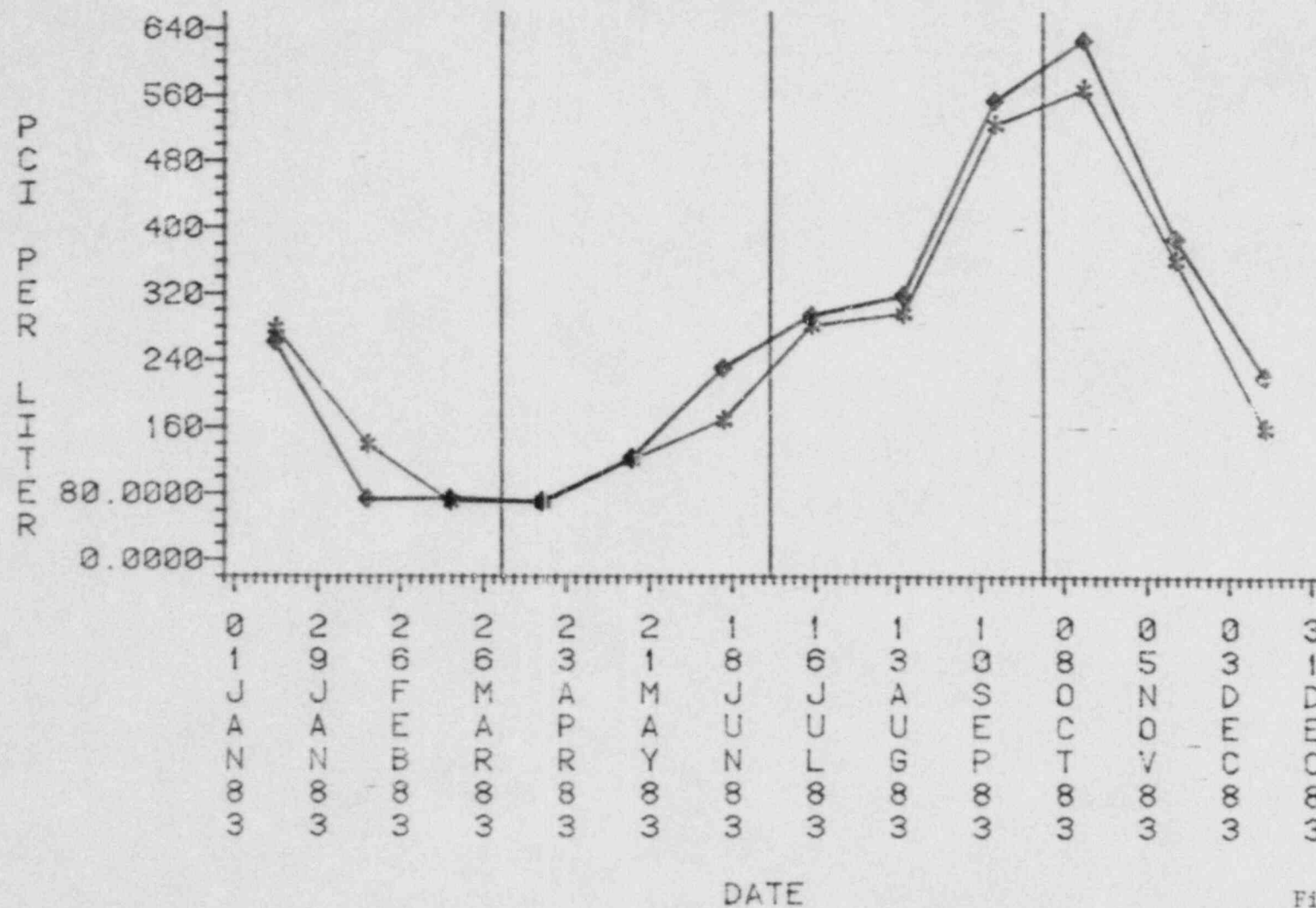


Figure 3-10

Strontium-89 activities were all less than the minimum detectable activity. Strontium-90 analyses revealed a single sample with a concentration of 1.56 pCi/l. This value is near the typical MDA value of 0.89 pCi/l.

Tritium was revealed in 2 of 48 samples with an average concentration of 848 pCi/l. This may be compared to the single control value of 593 pCi/l.

All gamma isotopic analyses were less than MDA values.

3.6 Fish

Fish samples collected quarterly and analyzed for gamma emitters at Station 30 (ocean near discharge outfall) revealed no man-made activities. During preoperational testing, cesium-137 was detected in 5 of 23 samples with an average concentration of 0.17 pCi/g.

The gamma analyses for fish samples collected at Station 43 (discharge canal) revealed cobalt-60 (3 of 3), silver-110m (1 of 3), and cesium-137 (2 of 3) with average concentrations of $5.16\text{E-}2$ pCi/g, wet; $1.32\text{E-}1$ pCi/g, wet; and $8.84\text{E-}3$ pCi/g, wet, respectively. The maximum potential dose available to man via the fish-man pathway is summarized in Table 3-2.

Table 3-2

Organ	Dose (mrem/yr)	10CFR50 APP I (mrem/yr)
Liver	0.0230	20
Kidney	0.0077	20
GI-LLI	0.2120	20
Total Body	0.0186	6

These doses are based on an individual eating 21 Kg (46.3 pounds) of minnow-sized fish in one year harvested from the discharge canal. These doses are well within plant design objectives.

A review of Table 2-1 indicates a typical MDA for Ag-110m in fish as $5.16\text{E-}3$ pCi/g, wet. The actual calculated MDA for the single detection of Ag-110m is $3.9\text{E-}2$ pCi/g, dry. This can be compared to the Ag-110m activity of $6.31\text{E-}1$ pCi/g, dry. The "t-test" was performed and proved that the activity was not a significant occurrence; therefore, a nonroutine report was not required.

Cobalt-60 was detected in 3 of 7 samples at Location 43. Shown below are the cobalt-60 concentrations and associated MDA values.

Date	Activity pCi/g, dry	MDA pCi/g, dry
January 1983	$1.44\text{E-}1$	$4.1\text{E-}2$
April 1983	$3.37\text{E-}1$	$3.1\text{E-}2$
July 1983	$2.56\text{E-}1$	$3.5\text{E-}2$

The sample activities are less than ten times MDA or did not pass the "t-test" and do not require reporting.

3.7 Shrimp, Benthic Organisms, and Oysters

Shrimp samples collected semiannually and analyzed for radiostrontium and gamma emitters revealed no measurable radioactivity.

Oyster samples collected semiannually and analyzed for gamma emitters revealed no measurable radioactivity.

Benthic samples (crabs) collected semiannually and analyzed for radiostrontium and gamma emitters revealed strontium-89 at Station 31 (ocean--0.5 miles west of discharge outfall) in a single sample with a concentration of $5.62\text{E-}2$ pCi/g, wet. Strontium-90 was found in samples collected January 5, 1983, from Station 29 (ocean--0.5 miles east of discharge outfall) and Station 31 (ocean--0.5

miles west of discharge outfall) with an average concentration of $4.60\text{E-}2$ pCi/g, wet. The control station revealed a single sample and was collected with a concentration of $3.05\text{E-}2$ pCi/g, wet.

Assuming the maximum adult consumes 5 Kg of crabs collected from Stations 29 and 31, the whole body dose would be 0.43 mrem (1.03 mrem--bone). This should be compared to the control station's whole body dose of 0.28 mrem (1.16 mrem--bone) and is not attributable to BSEP operations.

3.8 Bottom Sediment and Aquatic Vegetation

Bottom sediment samples collected semiannually and analyzed for radiostrontium and gamma emitters revealed manganese-54, cobalt-60, and cesium-137 as shown in Table 2-1. There were 12 nonroutine reports submitted to the NRC because of the cobalt-60 concentrations. The manganese-54 did not pass the "t-test" in any sample. However, since bottom sediments are not consumed by man, no dose commitment estimates are given. These radionuclides are attributable to Brunswick effluents.

Aquatic vegetation samples are attempted to be collected semiannually and analyzed for radiostrontium and gamma emitters. Three locations in the vicinity of the discharge outfall have no active beds of vegetation therefore providing no sample. The aquatic vegetation collected from the control station indicated all concentrations of radionuclides were less than minimum detectable activity (MDA).

3.9 Groundwater

Groundwater samples are collected and analyzed quarterly for tritium and gamma emitters. Both were found to be less than minimum detectable activity (MDA).

3.10 Zooplankton

Zooplankton collected semiannually and analyzed for radiostrontium and gamma emitters revealed no detectable activity in 1983. Strontium-90 was seen in two samples. The sample with the concentration of $8.33\text{E-}1$ pCi/g, wet, had an MDA value of $4.61\text{E-}1$ pCi/g, wet. The sample with the concentration of $3.73\text{E-}2$ pCi/g, wet, had an MDA value of $2.16\text{E-}2$ pCi/g, wet. All samples consisted of a large water fraction. Attempts have been made to separate water from the residue by filtration. It was apparent that the significant water fraction and relative amount of plankton per sample was highly variable. Consultation with aquatic ecologists who perform plankton inventories showed that the measures represent the state of the art. Classification was performed by microscopic examination of slides; the "biomass" inventories of plankton rely upon simple mechanical separation. These inventories represent plankton plus other organisms such as algae and other dissolved and suspended materials. Since radiostrontium concentrations are normally several orders of magnitude lower than other fission and activation products, and in the absence of these gamma emitting fission and activation products in these samples, it is probable that these results are statistical anomalies.

3.11 External Radiation Dose

Environmental dosimetry data did not show any significant changes from the corresponding data of previous years. Station 23 (PMAC) continued to show the highest average dose as indicated in Table 2-1.

3.12 Summary

In summary, the following statements can be made in regard to all radioactive effluents (air particulate, gaseous, and liquid) by the Brunswick Steam Electric Plant:

1. All detectable radioactivities have been below the levels set forth in the Code of Federal Regulations, Title 10, Part 20.
2. The radioactivity released from the Brunswick Steam Electric Plant has not significantly increased the amount of radioactivity detected in the environs surrounding the plant.
3. A total of 1,781 environmental analyses were performed during 1983.

4.0 MISSED SAMPLES AND ANALYSES

4.1 Air Cartridge and Air Particulate

The samples collected from the stations listed below with their respective dates were collected but not analyzed due to low volumes caused by blown fuses.

Station 2	May 2, 1983
Station 18	May 2, 1983
Station 74	November 28, 1983
Station 74	December 12, 1983

The sample from Station 75 for July 4, 1983, had a low volume due to a cut power cable and was not analyzed.

4.2 Aquatic Vegetation

Collection of aquatic vegetation samples from Station 29 (0.5 miles east of discharge outfall), Station 30 (ocean at discharge outfall), and Station 31 (0.5 miles west of discharge outfall) was not successful during 1983 since no beds of vegetation were available.

4.3 Fish

Attempts were made in October, November, and December 1983 to collect a fish sample from Station 43 (discharge canal) but were unsuccessful due to the inability to locate fish.

4.4 Fodder and Feed

Fodder samples were not available from Station 35 (Stevens' Farm) in January, February, March, April, May, November, and December 1983. They were also not available from Station 37 (Johnson's Farm) in November and December 1983.

4.5 Milk

Milk samples have not been available from Station 35 (Stevens' Farm) since January 4, 1982. The single cow at this location has been dry during the entire period.

4.6 External Radiation (TLD)

The TLDs from Stations 1 and 13 in the first quarter, Station 18 in the third quarter, and Station 4 in the fourth quarter were declared as missing in the field. For 1983, 88 of 92 samples were collected.

5.0 ANALYTICAL PROCEDURES

5.1 Gross Beta

Gross beta radioactivity measurements are made utilizing a Tennelec Low-Background Alpha/Beta Counting System. The MDA is approximately 0.65 pCi per sample.

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

Acidified water samples are evaporated to a low volume, transferred onto a 2-inch tared stainless steel planchet, evaporated to total dryness, then counted on the Tennelec with appropriate self-absorption correction, based upon sample weight.

5.2 Tritium

Liquid samples requiring tritium analysis are first distilled. Five milliliters of the distillate are mixed with 10 milliliters of liquid scintillation cocktail and counted on a liquid scintillation counter for up to 300 minutes. The MDA is approximately 320 pCi/l.

5.3 Iodine-131

Iodine-131 airborne concentrations are quantified by the Ge(Li) gamma spectrometry systems. The cartridges are placed on the detector and each charcoal cartridge is counted individually.

Iodine-131 in milk is analyzed by use of anion exchange resin, sodium hypochlorite leach, and organic extraction. Iodine is precipitated as silver iodide, collected on a tared filter, dried, and counted on a beta-gamma coincidence system or by low-background beta counter. The MDA is approximately 0.325 pCi/sample.

5.4 Strontium-89, 90

Strontium is removed from environmental samples by the following methods: (1) leached with dilute acid from air filters, sediment, and soil; (2) direct precipitation from both fresh and saline water; and (3) adsorption as Sr^{+2} from milk, aquatic organisms, and vegetation onto a cation exchange resin column.

In all cases strontium is precipitated as strontium carbonate, collected on a tared filter, dried, and counted on a Tennelec system. After an ingrowth period of 10-14 days to establish secular equilibrium between strontium-90 and yttrium-90, the yttrium is isolated as the oxalate and counted.

5.5 Gamma Spectrometry Ge(Li)

Gamma spectrum analysis utilizes germanium or Ge(Li) detectors with thin aluminum windows housed in steel and lead shields. The analyzer system are Nuclear Data 4420 and 6685. Table 5-1 summarizes MDA values derived from instrument sensitivity, based upon a blank sample background.

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

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

Bottom sediment, vegetation, and soil are dried, weighed, and then analyzed in a marinelli beaker.

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

Zooplankton, benthic organisms, terrestrial, and aquatic vegetation are dried at 100°C, ground, and placed in containers to be analyzed.

5.6 Thermoluminescent Dosimetry

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

Dosimeters are machine annealed before field placement. Following receipt from the field, each dosimeter is read utilizing Panasonic TLD readers. This instrument integrates the light photons emitted from traps deexcited above 150°C. The lower-energy traps are automatically eliminated through a preheat cycle. Calibration is checked regularly using dosimeters irradiated to known doses. Prior to the measurement of each dosimeter, the instrument is checked through use of an internal constant light source as a secondary standard. The minimum sensitivity of the dosimeters used is approximately 1 mR.

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

5.7 EPA Laboratory Intercomparison Program

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

During 1983, 28 samples comprising the four major types of environmental media (milk, water, food, and air filters) were received. A total of 83 individual radionuclide analyses were performed on these samples. A summary of the analytical results is as follows:

<u>Normalized Deviation</u> <u>From Known Value (σ)</u>	<u>Percent of Analyses</u>
≤ 0.5	40
≤ 1.0	59
≤ 1.5	75
≤ 2.0	82
≤ 2.5	89
≤ 3.0	90

Eight of eighty-three analyses exceeded three standard deviations from the known values. These results required investigative and corrective actions as follows:

- In February 1983, a Sr-89 value for milk was reported which was 32 percent lower than the known activity. The beta counter was recalibrated for Sr-89 and Y-90 efficiencies. Two subsequent Sr-89 analyses of milk were within acceptable limits.
- In June 1983, two gross beta analyses performed within three days of one another were low by 13 and 19 percent, respectively. Recalibration of the beta detector resulted in subsequent gross beta values within acceptable limits.
- In February and May 1983, Ru-106 analysis of two mixed gamma samples were low in one case and high in another. At the same time, the activities reported for the five other nuclides in the mixture were very close to the known values. The erratic results are primarily due to the need to rely on a low-abundance (9.9 percent) Ru-106 peak at 621.8 keV to calculate sample activity. The most abundant energy line is too close to the positron annihilation peak for accurate quantitative analyses.

- In May and June 1983, low Sr-90 activities were reported for a water and a milk sample. The levels were approximately 30 percent low and were traced to the use of a two-year-old yttrium carrier solution which was no longer at its stated concentration. A monthly standardization program for all carrier solutions used in radiochemical analyses was initiated.
- In December 1983, the Sr-90 activity reported for a milk sample was low by a factor of four. The Sr-89 activity was correct, and other possible sources of error were eliminated. Technician error at a critical step in the yttrium analyses was suspected.

Table 5-1

Typical Minimum Detectable Activities (MDA)
Ge(Li) Gamma Spectrometry

Air Samples

(MDA)

Cs-134	1.3E-3 pCi/m ³
Cs-137	6.5E-4
Ba-140	2.6E-3
La-140	6.5E-4
Other Expected	6.5E-4 to
Gamma Emitters	1.3E-2

Water Samples

(MDA)

Cr-51	10 pCi/l
Co-58	1.9
Co-60	2.6
Mn-54	1.3
Cs-134	1.9
Cs-137	1.9
Ba-140	4.5
La-140	1.9
Other Expected	1.9 to
Gamma Emitters	32

Soil and Bottom Sediments

(MDA)

Cs-134	1.5E-2 pCi/g (dry)
Cs-137	1.4E-2
Cr-51	5.9E-2
Co-58	1.2E-2
Co-60	2.1E-2
Mn-54	1.2E-2
Other Expected	6.5E-3 to
Gamma Emitters	1.0E-1

Fish and Vegetation

(MDA)

I-131	4.5E-3 pCi/g (wet)
Cs-134	5.2E-3
Cs-137	5.2E-3
Cr-51	3.2E-2
Co-58	4.5E-3
Co-60	6.4E-3
Mn-54	4.5E-3
Other Expected	4.5E-3 to
Gamma Emitters	4.5E-2

Shrimp, Benthos, and Oysters

(MDA)

I-131	5.8E-3
Cs-134	6.4E-3
Cs-137	6.4E-3
Cr-51	3.9E-3
Co-58	6.4E-3
Co-60	6.4E-3
Mn-54	6.4E-3
Other Expected	5.2E-3 to
Gamma Emitters	6.4E-2

CP&L

Carolina Power & Light Company

Brunswick Steam Electric Plant

P. O. Box 10429

Southport, NC 28461-0429

March 26, 1984

FILE: B10-11296

SERIAL: BSEP/84-0872

Mr. James P. O'Reilly, Administrator
U. S. Nuclear Regulatory Commission
Region II, Suite 3100
101 Marietta Street N.W.
Atlanta, GA 30303

BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2
DOCKET NO. 50-325 AND 50-324
LICENSE NO. DPR-71 AND DPR-62
ANNUAL ENVIRONMENTAL RADIOLOGICAL MONITORING REPORT

Dear Mr. O'Reilly:

Enclosed are two copies of the Environmental Radiological Monitoring Report for Brunswick Steam Electric Plant covering the period from January 1, 1983, through December 31, 1983.

This report fulfills the reporting requirements of Section 5.4.1.2 of Appendix B of the Brunswick Technical Specifications. Section 5.4.1.2, Appendix B, of the Brunswick Technical Specifications was deleted with the incorporation of the Radiological Effluent Technical Specifications which were approved on December 27, 1983. Future Annual Environmental Radiological Monitoring Reports will be submitted in accordance with Technical Specifications 6.9.1.6 and 6.9.1.7.

Very truly yours,

C. R. Dietz

C. R. Dietz, General Manager
Brunswick Steam Electric Plant

SLW/dr/LETH1

Enclosure

cc: Mr. R. C. DeYoung
NRC Document Control Desk

IE25
OFFICIAL COPY

84-43