PILGRIM NUCLEAR POWER STATION

ENVIRONMENTAL RADIATION MONITORING PROGRAM
REPORT NO. 17

JANUARY 1 THROUGH DECEMBER 31, 1984

ISSUED: APRIL 1985

BY: NUCLEAR MANAGEMENT SERVICES DEPARTMENT
ENVIRONMENTAL AND RADIOLOGICAL
HEALTH AND SAFETY GROUP

BOSTON EDISON COMPANY

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BOSTON EDISON COMPAMY

PILGRIM NUCLEAR POWER STATION

Environmental Radiation Monitoring Program

REPORT NO. 17

January 1, 1984 through December 31, 1984

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I. Introduction and Summary

This report presents a summary of the results of measurement of direct radiation and radioactivity in environmental media in the vicinity of the Pilgrim Nuclear Power Station - Unit 1 (PNPS-1) and at selected control locations for the period January 1 - December 31, 1984. The results of this Program indicate that PNPS-1 has had a negligible and most often immeasurably small impact on the environment in the vicinity of the plant. Conservatively, estimated doses resulting from the measured highest station mean concentrations are typically less than 1% of the doses resulting from naturally occurring radionuclides and residual fallout from previous atmospheric nuclear weapons testing.

Estimates of concentrations of radionuclides in vegetation and milk and estimates of dose to man, as quoted in this report, were made using methods similar to those described in Regulatory Guide 1.109 and 1.111.

PNPS-1 was in an outage during 1984. PNPS-1 shutdown on December 10, 1983 for a refueling and recirculation pipe replacement, outage and startup commenced on December 30, 1984.

In general, there were a greater number of positive measurements of nuclides specific to reactor operation observed during 1984 versus 1983, due to the extensive outage.

A tabulation of radioactive effluents from the PNPS-1 is provided in Appendix B for the 1984 calendar year.

There were no Anomalous Measurement Reports made for the calendar year of 1984.

Essentially, all samples required by the PNPS-1 Technical Specifications were collected on schedule. The only exceptions were the unavailability of one milk sample location, two milk samples, one air particulate sample, one charcoal filter sample, plus occasional failures of the air samplers, one bay sample due to unavailability, and three fish samples and one lobster sample due to unavailability. In addition, a total of three TLDs were found to be missing from their field locations during 1984.

These incidents affected only about 2% of the total number of samples scheduled for collection.

The Plimoth Plantation was not available as a milk sampling location during 1984. Plimoth Plantation informed Boston Edison in January 1981 that milk producing animals would no longer be available as they disposed of their cow. This situation had not changed for 1984. During 1984, two milk samples were not collected from the Plymouth County Farm and the Whitman Farm during week number 32 (early August) due to the fault of Boston Edison.

II. Description of the Monitoring Program

The Radiological Monitoring Program conducted in accordance with the PNPS-1 Technical Specification is included as Appendix D. The program is essentially identical to that conducted during 1982 and incorporates a supplemental provision as specified in the Settlement Agreement between the Massachusetts Wildlife Federation and Boston Edison Company, June 9, 1977.[2] The exceptions to the program are as follows:

1) There is no TLD station at Saquish Neck since the Mass Wildlife Federation has not yet provided a means for placement and retrievel of the TLD as prescribed by the agreement noted above.
2) There is no longer a milk producing cow at Plimoth Plantation. The Plimoth Plantation location has been unavailable since 1981. The nearest dependable cow location is at the Plymouth County Farm, which is 3.5 miles from PNPS in the West sector.
3) There is no longer a Karbott Farm. Vegetable samples are now collected at the two nearest gardens near the W and ESE site boundaries.

The 1984 site Census conducted according to Technical Specification requirements determined that there are several vegetable gardens near the site boundary in the W-WNW and SE-ESE sectors (see Appendix E). In the ESE sector, the nearest garden is at the J. B. Work residence (0.6 miles ESE). A sample of cabbage was collected on 9/26/84. In the west direction, the location of the nearest observed garden of approximately 500 square feet was at the Malmagren residence (1.0 miles W). During the nearest observed garden in the west direction was the Evan's residence (0.7 miles W). This location did not have a garden in 1984. Another sample of rhubbarb was collected on 9/26/84 from the Jenkins residence (1 mile SE).

A sample of rhubbarb was collected from this location on 9/26/84. In addition to the above, a sample of beet leaves was obtained from the Whipple Farm (1.5 miles SSW) on 9/26/84.

In perspective, cows and goat locations within a 5 mile radius of PNPS-1 are rare and transitory at best. It is extremely unlikely that the cow-milk pathway could be responsible for even small doses to any member of the general public.

III. Results and Analyses

This section summarizes the results of the analyses of environmental media samples in compliance with the monitoring program described in Appendix D. The section is divided into sub-sections, each of which describes a particular media or potential exposure pathway.

The results of analyses conducted on environmental media are maintained in a computerized data file which constitutes a data base used for statistical analyses by a computer code entitled ERMAP[3].

ERMAP calculates a set of statistical parameters for each radionuclide whose concentration is reported in a given environmental medium. This set of statistical parameters includes separate analyses for (1) the indicator stations, (2) the control stations, and (3) the station having the highest annual mean concentration. For each of these three groups of data, ERMAP calculates:

1) the mean value of all measured concentrations;
2) the square root of the mean square deviation (this is an estimate of the sample variance);
3) the lowest and highest calculated concentrations;
4) the number of positive measurements divided by the total number of measurements.

Entries listed under the heading LLD* are the required LLDs that are to be met per PNPS-1 Technical Specification requirements.

The results of ERMAP are provided in each subsection for the appropriate media.

In addition, plots of measured concentration as a function of sampling time are included for certain isotopes in certain media in an effort to simplify interpretation of the results.

Sample station identification numbers used by the ERMAP program are provided in Table III-A-1.

*Lower Limit of Detection

TABLE III-A-1
Sample Station Identification Codes

Media	Station Code Number	Station Location
Air Particulate and Iodine Filters	00	Warehouse (0.03 mi-SSE)
	01	Rocky Hill Road (0.8 mi-SE)
	03	Rocky Hill Road (0.3 mi-WNW)
	06	Property Line (0.34 mi-NW)
	07	Pedestrian Bridge (0.14 mi-N)
	08	Overlook Area (0.03 mi-W)
	09	East Breakwater (0.35 mi-ESE)
	10	Cleft Roak (0.9 mi-S)
	15	Plymouth Center (4.0 mi-W-WNW)
	17	Manomet Substation (2.5 mi-SSE)
	21	East Weymouth (control-21 mi-NW)
Waterborne	11	Discharge Canal
	17	Bartlett Pond (1.7 mi-SE)
	23	Power Point (control 7.8 mi-NNW)
Shellfish	11	Discharge Canal Outfall
	12	Warren Cove
	13	Duxbury Bay
	15	Manomet Point
	24	Marshfield (Control)
Algae (Irish Moss)	11	Discharge Canal Outfall
	15	Manomet Point
	22	Ellisville (Control, 8 mi-SSE))
	34	Brant Rock (Control, 12 mi-NWN)
Lobster (Arthropods)	11	Vicinity of Discharge Canal Off-shore
	15/19	Offshore (Control)
	25	Scituate (Control)
Fish	2	Round Hill Point-Offshore-(Control)
	11	Vicinity of Discharge Canal
	12	Warren Cove
	13	Duxbury Bay (Control)
	14	Vicinity of Plymouth Beach
	19	White Horse Beach
	21	Auto Trawl Station-Offshore-(Control)
	22	Offshore-(Control)
	28	Cataumet, Bourne-(Control)
	29	Priest Cove-Offshore-(Control)
	96	Mouth of North River-Hanover (Control)
	97	Nantucket Sound (Control)
	99	Provincetown-Offshore (Control)
Sediment	11	Rocky Point
	12	Warren Cove
	13	Duxbury Bay
	14	Plymouth Beach
	15	Manomet Point
	24	Marshfield (Control)

TABLE III-A-1
Sample Station Identification Codes

Media	Station Code Number	Station Location
Milk	11	Plymouth County Farm (3.5 mi-W)
	21	Whitman Farm (Control-21 mi NW)
Cranberries	13	Manomet Point Bog (2.5 mi-SE)
	14	Bartlett Road Bog (2.8 mi-SSE/S)
	23	Pine St. Bog (Control-17 mi-WNW)
Vegetation	11	Plymouth County Farm (3.5 mi-W)
	16	Work Residence (0.6 mi-ESE)
	17	Evans Garden (0.7 mi-W)
	27	Bridgewater Farm (Control-20 mi-W)
	43	Whipple Farm (1.5 mi-SSW)
	75	Malmgren Residence (1.0 mi-W)
	76	Jenkins Residence (1.0 mi-SE)
Beef Forage	11	Plymouth County Farm (3.5 mi-W)
	21	Whitman Farm (Control-21 mi-W)
	27*	Bridgewater Farm (Control-20 mi-W)

*Unavailable during 1984.

III.A. Air Particulate Filters

Sample collection systems consisting of a cellulose particulate filter and a charcoal filter cartridge are used to collect particulate matter and iodine nuclides respectively. Analyses of the particulate filters for beta radiation is performed weekly. In addition, quarterly composite particulate samples are analyzed for gamma emitting nuclides. Table III-A-2 presents the results of the ERMAP for air particulate analyses. (The station identification numbers correspond to the locations identified in Table III-A-1).

For ease of interpretation of these measurements, a plot of gross beta activity vs. time for all indicator stations is provided in Figure III-A-1 and for the control station in Figure III-A-2.

The air particulate filter at Station #00 (Warehouse) for week number 51 was not analyzed as the filter was lost by Boston Edison during sample preparation.

During 1984, there were several instances of low sample volume due to a variety of causes, such as power failures, motor failures, broken fittings, and crimped sample lines. Of these, there were two instances which resulted in the MDC not being met. The MDC was not met for Station #07 (Pedestrian Bridge) collected on 5/29/84 due to a low sample volume which was the result of a motor failure of the air sampler. In addition, the MDC was not met for Station #00 (Warehouse) collected on 10/1/84 due to a low sample volume which was the result of lumber leaning on the line, thus blocking the flow.

Positive measurements of a specific nuclide characteristic of reactor operation (CO-60) were observed in five quarterly composite samples. The following stations had positive measurements of Co-60: Warehouse (Station #00-0.03 mi-SSE), second and third quarter composites; Pedestrian Bridge (Station #07-0.14 mi-N), third and fourth quarter composites; and, Overlook (Station #08-0.03 mi-W), third quarter composite. These three stations are the closest stations to PNPS. The highest mean concentration of Co-60 was observed in the Overlook third quarter composite sample. The positive indications of Co-60 were due to the effluents of PNPS-1. The only other positive measurements observed in the quarterly composite samples were due to naturally occurring nuclides (Be-7, AcTh-228 and K-40).

However, even if an individual were to breathe air with the Co-60 concentration (589+-53)E-5 pCi/m^3, the maximum exposed individual would receive an annual dose of about 0.00008 mrem to the total body and about 0.031 mrem to the maximum exposed organ (Teen-Lung).

In consideration of the natural background dose rate of 80 to 100 mrem-year, there was clearly no significant environmental effect observed in the air particulate media as a result of the operation of PNPS-1.

TABLE III-A-2
ERMAP RESULTS-AIR PARTICULATE FILTERS

MEDIUM: AIR PARTICULATE UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
GR-B (570)	.01	(2.3 ± .1)E -2	07	(2.7 ± .3)E -2	(2.4 ± .2)E -2
(0)		(4.7 - 1490.0)E -4		(5.6 - 1490.0)E -4	(5.5 - 65.1)E -3
		(510/518)		*(50/ 52)*	*(51/ 52)*
BE-7 (44)		(3.6 ± .1)E -2	06	(3.8 ± .1)E -2	(3.7 ± .4)E -2
(0)		(2.7 - 4.9)E -2		(3.6 - 4.2)E -2	(2.7 - 4.6)E -2
		(40/ 40)		*(4/ 4)*	*(4/ 4)*
K-40 (44)		(6.3 ± .7)E -3	06	(9.2 ± 1.6)E -3	(4.9 ± 1.2)E -3
(0)		(-1.9 - 14.0)E -3		(6.9 - 14.0)E -3	(2.0 - 8.0)E -3
		(5/ 40)		*(0/ 4)*	*(1/ 4)*
CR-51 (44)		(4.2 ± 3.4)E -4	01	(1.9 ± 1.1)E -3	(1.7 ± .7)E -3
(0)		(-4.8 - 4.8)E -3		(-5.5 - 45.4)E -4	(4.2 - 35.0)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
MN-54 (44)		(4.9 ± 3.0)E -5	00	(2.1 ± 1.0)E -4	(4.8 ± 11.1)E -5
(0)		(-4.5 - 4.4)E -4		(2.0 - 42.1)E -5	(-2.0 - 3.2)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CO-58 (44)	.02	(-3.3 ± 3.4)E -5	08	(9.2 ± 13.9)E -5	(-1.1 ± 100.5)E -6
(0)		(-4.2 - 3.5)E -4		(-2.9 - 3.5)E -4	(-2.3 - 2.4)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
FE-59 (44)		(1.5 ± .9)E -4	17	(7.0 ± 3.3)E -4	(6.0 ± 12.3)E -5
(0)		(-1.1 - 1.4)E -3		(-1.6 - 13.9)E -4	(-1.5 - 4.1)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CO-60 (44)	.02	(4.1 ± 1.6)E -4	08	(1.7 ± 1.4)E -3	(-1.4 ± 53.5)E -6
(0)		(-5.3 - 58.9)E -4		(8.4 - 589.0)E -5	(-1.2 - 1.3)E -4
		(5/ 40)		*(1/ 4)*	*(0/ 4)*
ZN-65 (44)		(2.1 ± 7.4)E -5	07	(4.9 ± 3.2)E -4	(-1.4 ± 2.9)E -4
(0)		(-1.0 - 1.4)E -3		(-1.3 - 13.9)E -4	(-6.2 - 7.2)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-A-2
(CONTINUED)

MEDIUM: AIR PARTICULATE UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
ZR-95 (44)		(-1.0 ± .8)E -4	15	(4.4 ± 2.1)E -4	(-5.4 ± 37.6)E -5
(0)		(-1.5 - .9)E -3		(-1.1 - 8.7)E -4	(-1.1 - .5)E -3
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
NB-95 (44)		(-9.0 ± 40.3)E -6	08	(2.5 ± 2.1)E -4	(1.1 ± .8)E -4
(0)		(-4.4 - 7.3)E -4		(-2.7 - 7.3)E -4	(-6.6 - 31.0)E -5
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
RU-103 (44)		(-1.4 ± 4.1)E -5	15	(1.2 ± .9)E -4	(1.1 ± .5)E -4
(0)		(-5.6 - 6.7)E -4		(-8.2 - 33.6)E -5	(2.1 - 23.9)E -5
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
RU-106 (44)		(1.9 ± 2.6)E -4	06	(1.2 ± 1.1)E -3	(-7.6 ± 7.9)E -4
(0)		(-4.2 - 3.5)E -3		(-1.5 - 3.5)E -3	(-2.6 - .7)E -3
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
I-131 (44)		(1.7 ± 2.0)E -4	10	(1.7 ± .5)E -3	(-8.0 ± 25.2)E -5
(0)		(-2.8 - 3.0)E -3		(1.0 - 3.0)E -3	(-6.7 - 3.9)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CS-134 (44)	.01	(-9.0 ± 3.4)E -5	10	(1.6 ± 1.3)E -4	(-1.2 ± 1.4)E -4
(0)		(-7.5 - 4.9)E -4		(-1.7 - 4.9)E -4	(-3.5 - 2.8)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CS-137 (44)	.01	(1.5 ± 3.1)E -5	00	(1.8 ± .7)E -4	(-1.3 ± 6.0)E -5
(0)		(-5.1 - 3.5)E -4		(2.8 - 34.9)E -5	(-1.4 - 1.3)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
BA-140 (44)		(-1.9 ± 1.3)E -4	21	(7.0 ± 4.4)E -4	(7.0 ± 4.4)E -4
(0)		(-1.9 - 2.2)E -3		(-3.6 - 14.3)E -4	(-3.6 - 14.3)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CE-141 (44)		(5.3 ± 3.7)E -5	03	(2.3 ± 1.7)E -4	(1.4 ± 1.1)E -4
(0)		(-3.6 - 6.6)E -4		(-7.1 - 66.3)E -5	(-7.1 - 36.7)E -5
		(0/ 40)		*(0/ 4)*	*(0/ 4)*
CE-144 (44)		(-9.6 ± 12.0)E -5	07	(6.2 ± 2.3)E -4	(4.9 ± 34.7)E -5
(0)		(-1.7 - 1.5)E -3		(-5.1 - 96.4)E -5	(-6.1 - 10.1)E -4
		(0/ 40)		*(0/ 4)*	*(0/ 4)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-A-2
(CONTINUED)

MEDIUM: AIR PARTICULATE UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
AC-228 (44)		(2.4 ± 1.3)E -4	09	(7.8 ± 8.5)E -4	(4.5 ± 2.3)E -4
(0)		(-1.0 - 3.2)E -3		(-6.2 - 32.2)E -4	(5.8 - 111.0)E -5
		(1/ 40)		*(1/ 4)*	*(0/ 4)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

FIGURE III-A-1
GROSS BETA ACTIVITY
AIR PARTICULATES
INDICATOR STATIONS

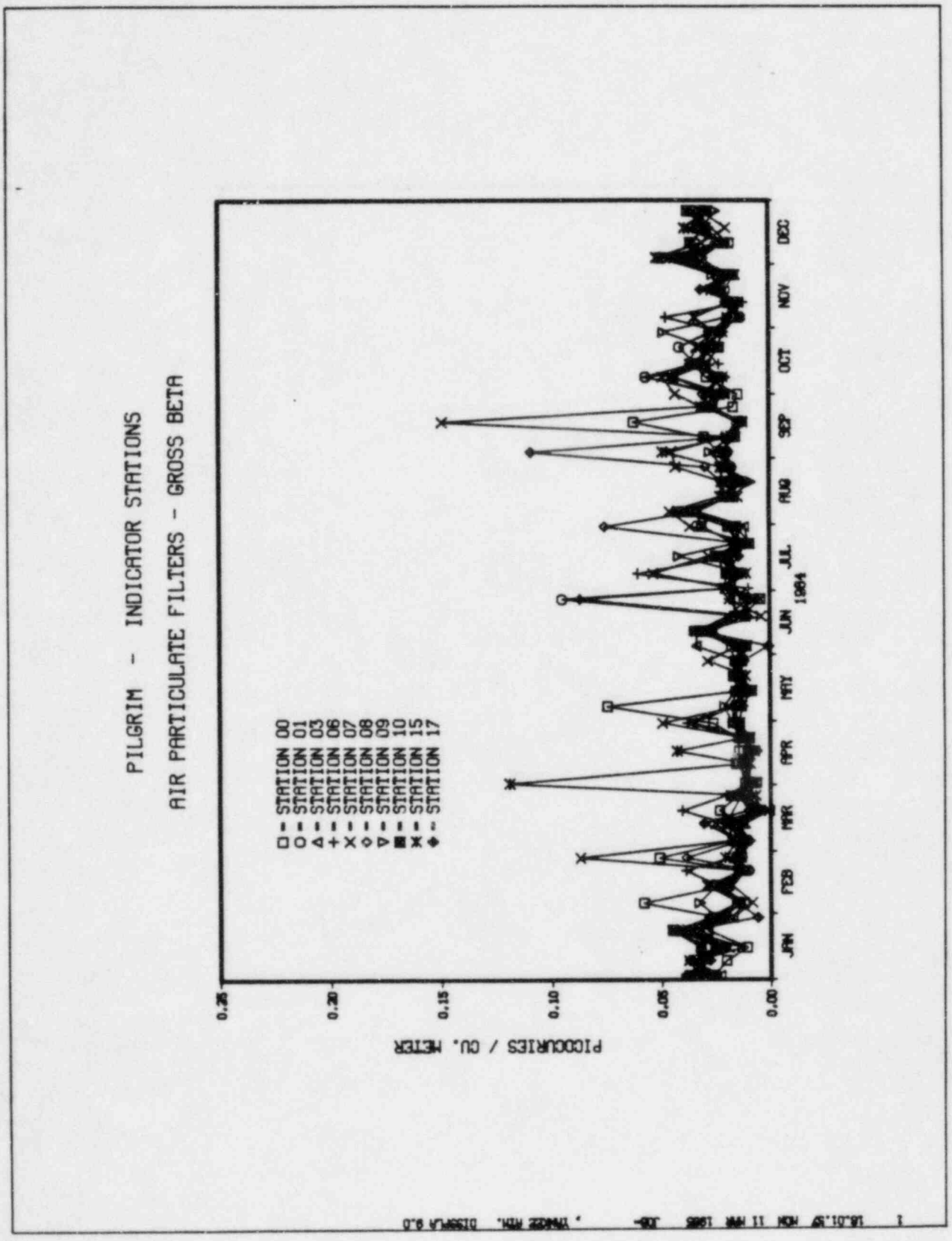
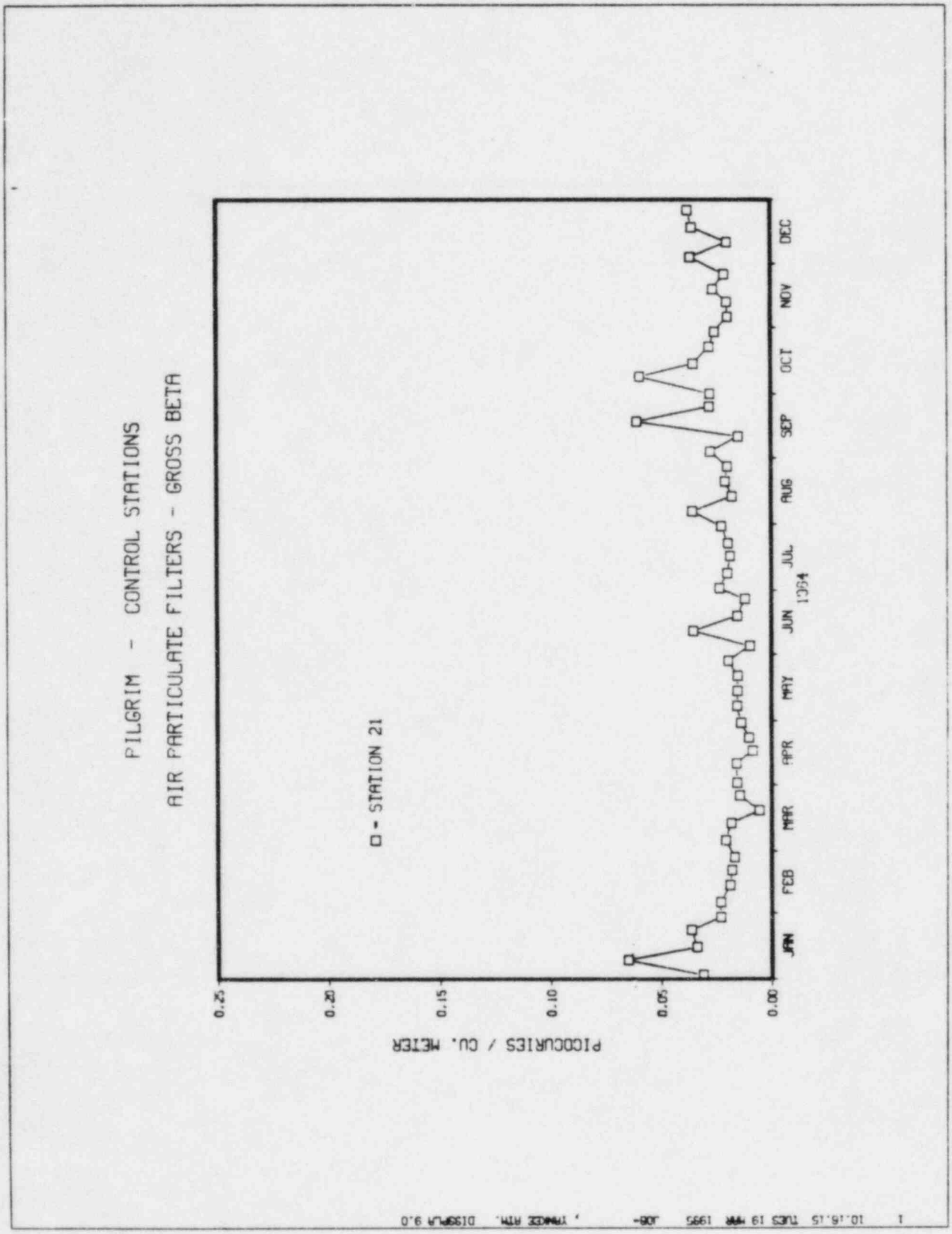


FIGURE III-A-2
GROSS BETA ACTIVITY
AIR PARTICULATES
CONTROL STATION



III.B. Iodine

The same sample collection systems used to collect airborne particulates are used to collect gaseous iodine on a charcoal filter cartridge. The cartridge is removed and analyzed for I-131 weekly. The results of the ERMAP program for this media are provided in Table III-B-1. It is not apparent from this table that the mean value of the calculated concentrations for the indicator stations is greater than the mean value for the control station. The results of these analyses are presented graphically in Figure III-B-1 for the indicator stations and Figure III-B-2 for the control station.

One charcoal filter sample was not analyzed due to the fault of Boston Edison. The charcoal filter sample for Station #17 (Manomet) was not analyzed for week number 18 as a blank filter was mistakenly submitted for analysis. In addition, the charcoal filter was then placed in the field at Station #17 for week #20.

The MDC for iodine analysis was not met for two samples at two different stations. The MDC was not met for Station #07 (Pedestrian Bridge) collected on 5/29/84 due to a low sample volume which was the result of a motor failure of the air sampler. In addition, the MDC was not met for Station #00 (Warehouse) collected on 10/1/84 due to a low sample volume which was the result of lumber leaning on the sample line, thus blocking the flow.

There was clearly no significant environmental effect observed in the airborne gaseous iodine collection media as a result of the operation of PNPS-1.

TABLE III-B-1
ERMAP RESULTS-CHARCOAL FILTERS

MEDIUM: CHARCOAL FILTER UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
I-131 (572)	.07	(-3.0 ± .5)E -3	06	(-3.4 ± 12.2)E -4	(-2.6 ± 1.3)E -3
(0)		(-9.4 - 2.8)E -2		(-2.8 - 1.4)E -2	(-3.4 - 1.5)E -2
		(0/520)		*(0/ 52)*	*(0/ 52)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

FIGURE III-B-1
CONCENTRATIONS OF I-131
CHARCOAL FILTERS
INDICATOR STATIONS

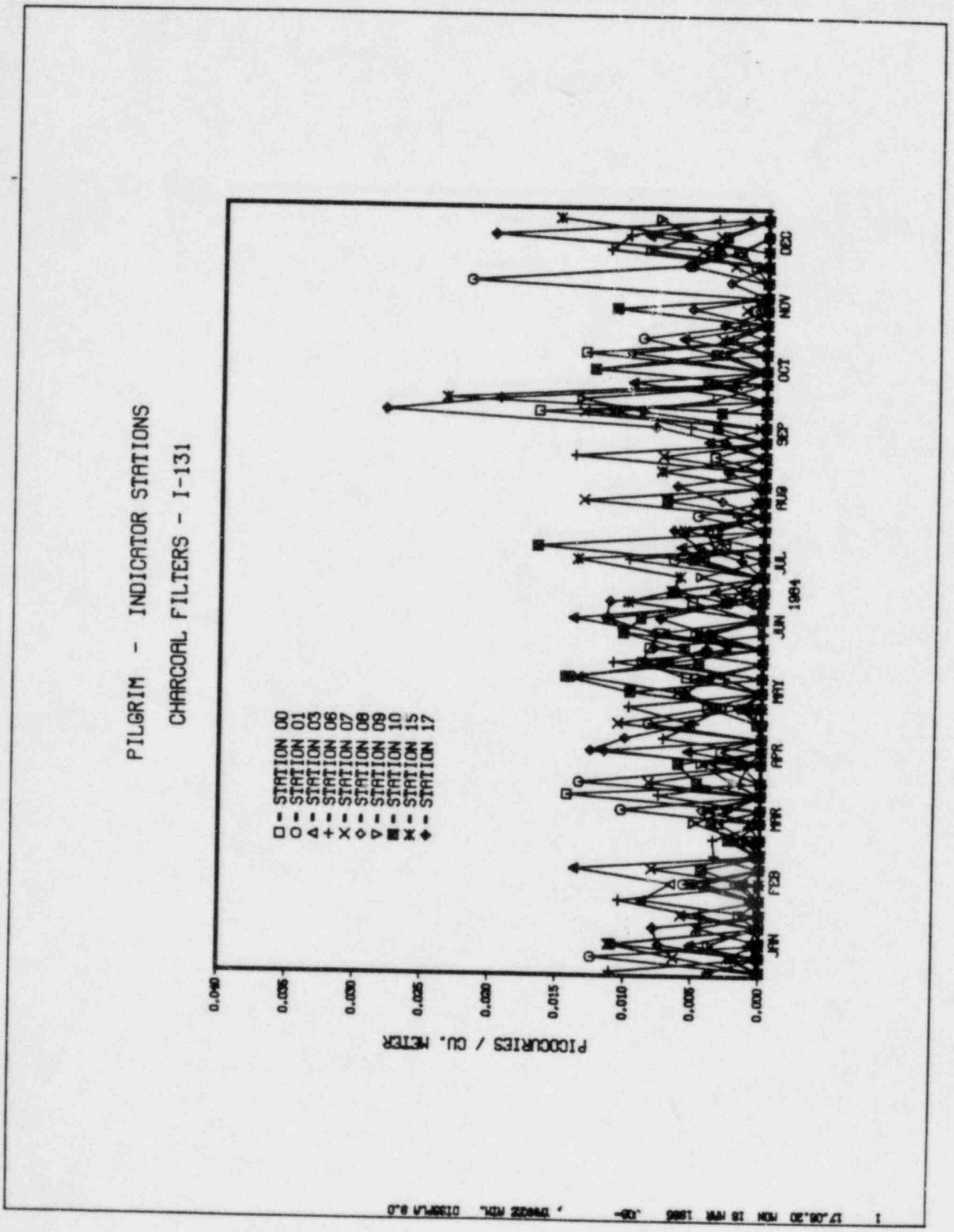
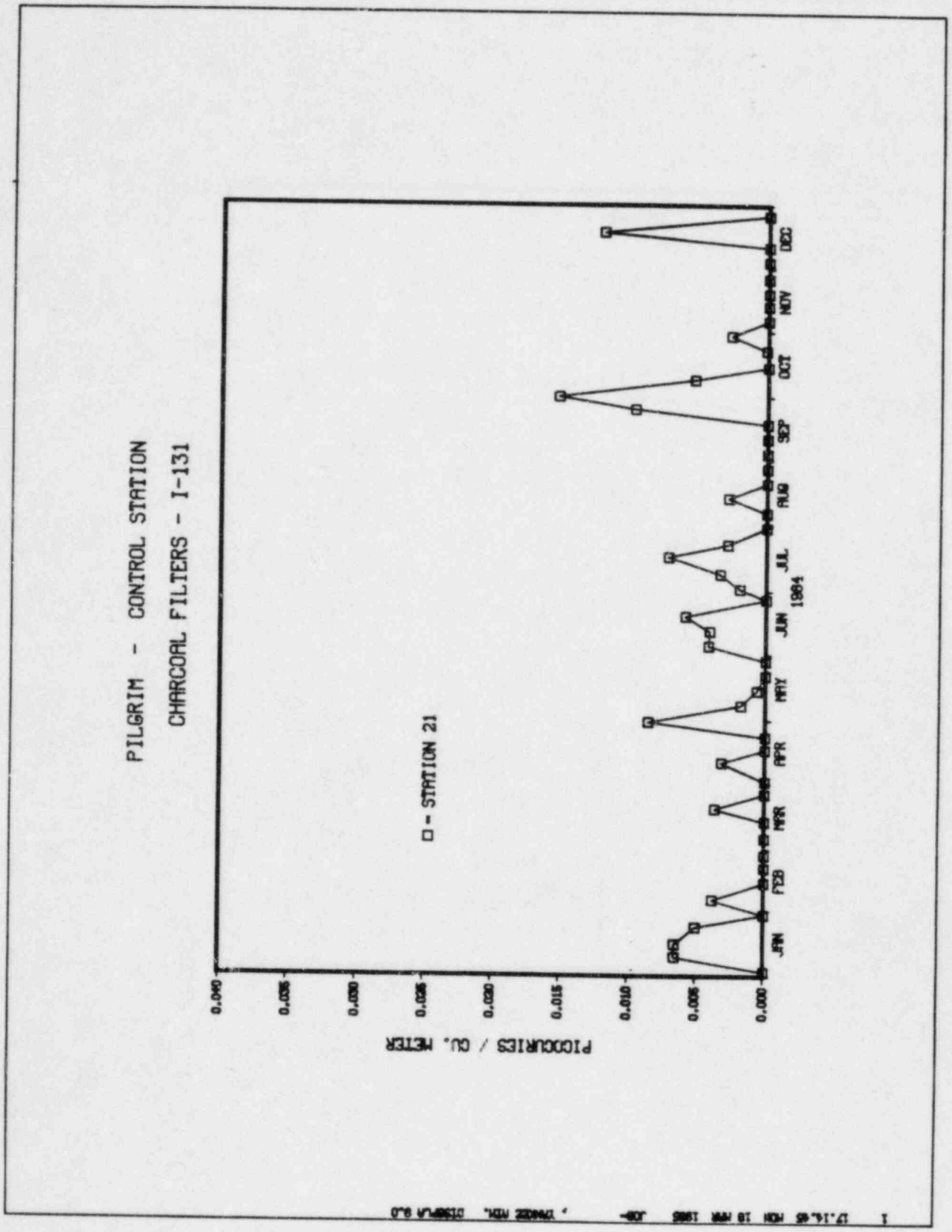


FIGURE III-B-2
CONCENTRATIONS OF I-131
CHARCOAL FILTERS
CONTROL STATION



III.C. Soil

Soil surveys at eleven locations are required once every three years in compliance with the revised Technical Specifications which went into effect on April 19, 1977. These in-situ surveys were conducted during May, October and December of 1982. The results of these surveys are included in Appendix C of this report.

1. Continuous Thermoluminescent Dosimetry

Thermoluminescent dosimeters (TLD) of the $CaSO_4(Dy)$ type are used to record direct gamma radiation from all sources including direct and scattered radiation from Nitrogen-16 in the turbine building, and cosmic and other natural and artificial gamma radiation. TLD's are installed at the locations identified in Table III-D-1.

Tables III-D-2 through III-D-5 show quarterly average doses from direct gamma radiation in uR/hr at these stations.

In addition to average doses for each TLD for each readout period, geographic regional average doses for sectors of different nearness are computed; viz, in immediate proximity to PNPS, more distant but near the site boundary, up to several miles away - "neighborhood", and far away (background). Each set of data show consistent trends; the near plant dosimeters (primarily OA, PB, and WS) stand out among all readings and have an average above the dose rates further away. The next region has a lower average dose rate, and beyond 0.7 miles (distant neighborhood and background) the dose rates are statistically consistent. In all cases, the near plant levels are distinctly higher than those off-site and off-site dose rates are not significantly sensitive to distance variations beyond the site itself. Thus, beyond the "exclusion area" (for this purpose, the 0.25-0.7 mile region), dose rates show no significant plant

effect; populated areas are therefore beyond the limits of elevated dose rates.

2. Field Survey

A gamma exposure survey of Plymouth Beach and Priscilla/White Horse Beach was conducted during July of 1984. The results of this most recent survey are in agreement with the last seven beach surveys conducted for 1977 through 1983. In addition, a comprehensive soil survey of 11 locations was conducted during the spring and fall of 1982. This study included both gamma exposure rate measurements and in-situ gamma spectrometry analysis for each location. Laboratory soil analyses were also conducted for selected locations. The results of this study are presented in Appendix C. The latest gamma exposure survey was conducted using a Reuter Stokes RS-111 high pressure ion chamber (HPIC), Serial Number 4-1656. The design and calibration of this instrument were described in the above report.[4]

The present survey was designed to detect differences in the external exposure rate encountered at beaches near the plant (Plymouth and Priscilla/White Horse) and a control location (Duxbury). The detector's calibration was checked before each measurement. The data (Table III-D-7) indicate that the exposure rates at Plymouth Beach (behind Berts Restaurant) and Priscilla/White Horse Beach are not significantly greater than the exposure rates measured at the control station in Duxbury.

The small differences are likely due to the presence of granite beach stones which are essentially absent at the Duxbury location. Plymouth Beach (Outer) showed a slightly elevated exposure rate most likely due to a different beach sand composition at the 1984 measurement site of course sand and small stones. It has been demonstrated that proximity to beach stones results in higher exposure rates than in sandy areas (see Annual Report No. 10).

This survey indicates that the natural background exposure rate at beaches near Pilgrim Station is probably 6-11 uR/hr. These results are in complete agreement with similar measurements performed in Maine[5], where the natural background exposure rate at shoreline locations was found to vary between 6.6 and 14.5 uR/hr. These exposure rates were also found to vary directly with the size and proximity of granite outcroppings[5].

These latest measurements are also in agreement with the soil survey mentioned earlier. The results of that survey indicate that off-site dose rates have a range of 9.3 to 10.5 uR/hr with an average of 9.7 uR/hr.

The survey results are within the expected natural background exposure rates in the northeastern part of the United States.

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TABLE III-D-1

THERMOLUMINESCENT DOSIMETER LOCATIONS

Surveillance Stations				Station Specification				
Near Plant (0-0.15 miles)	Exclusion Area (0.25-0.7)	Distant Neighborhood (0.96-4.5 miles)	Background (8-23 miles)	Station Code	See Fig.	Item No.	† Distance (miles)	Direction
Overlook Area				OA	II-2	9	0.09	W-WNW
*Warehouse				WH	II-2	23	0.18	S-SSE
*Pedestrian Bridge				PB	II-2	8	0.15	NNW
Public Parking Area				PA	II-2	7	0.16	NW-NNW
	*Property Line			A	II-2	5	0.25	W-WSW
	*Property Line			F	II-2	2	0.27	WNW-NW
	*East Breakwater			EB	II-2	10	0.31	ESE
	Property Line			B	II-2	13	0.33	SSE
	Property Line (SW)			H	II-2	6	0.33	SW
	Property Line			I	II-2	3	0.33	W-WNW
	*Property Line			PL	II-2	24	0.34	WNW-NW
	*Property Line			D	II-2	1	0.37	NW-NNW
	*Property Line			L	II-2	22	0.40	ESE-SE
	*Property Line			NB	II-2	12	0.43	SE
	*Property Line			C	II-2	11	0.44	ESE-SE
	*Property Line (West)			G	II-2	4	0.44	N
	Rocky Hill Road (West)			WR	II-2	18	0.51	WNW
	Microwave Tower			MT	II-2	14	0.55	S-SSW
	Cleft Rock Area			CR	II-2	9	0.61	S-SSW
	Rocky Hill Road (East)			ER	II-2	21	0.68	SE
	*Bay Shore Drive			BD	II-1	6	0.70	W-WNW
		*Emerson Road		EM	II-2	15	0.97	SSE
		*Property Line		J	II-2	19	1.21	S-SSE
		*Property Line (South)		K	II-2	17	1.23	S
		*White Horse Road		WH	II-2	16	1.31	SSE
		*Property Line		E	II-2	20	1.32	S-SSE
		Manomet Point		MP	II-1	8	2.25	E-ESE
		Manomet Elem. School		ME	II-1	9	2.50	SE
		Manomet Substation		MS	II-1	10	2.50	SSE
		South Plymouth		SP	II-1	5	3.00	WSW
		*Manomet Beach		MB	II-1	11	3.50	SE-SSE
		Plymouth Center		PC	II-1	4	4.50	W-WNW
		North Plymouth		NP	II-1	3	5.50	NNW
		*Standish Shores (Duxs)		SS	II-1	1	6.25	NW
		*Cullays Pond		CP	II-1	12	6.50	SW
			Sherman Airport (Ply)	SA	II-1	14	8.00	WSW
			Cedarville Sub. (Sag)	CS	II-1	13	10.00	S-SSE
			Kingston Substation	KS	II-1	2	10.00	WNW
			East Weymouth	EW	II-1	15	23.00	NW

*Not required by operating license.
† Distances measured from Unit 1 reactor building.

TABLE II.-D-2
GAMMA EXPOSURE (TLD) DATA FOR QUARTER #1 1984

Station	Micor/ Hour	+-	2 Sigma
CP	5.87	+-	1.36
CR	7.92	+-	1.62
CS	1.77	+-	0.28
ER	5.60	+-	2.30
EW	6.95	+-	1.10
KS	7.27	+-	3.11
MB	8.58	+-	2.66
ME	1.35	+-	0.51
MP	9.57	+-	3.04
MS	10.95	+-	2.56
NP	6.36	+-	1.73
PC	5.43	+-	2.24
SA	14.50	+-	3.05
SP	7.31	+-	1.50
SS	7.07	+-	2.49
WR	9.01	+-	1.64
BD	5.66	+-	0.98
EB	8.07	+-	1.53
EM	9.10	+-	2.45
MT	5.78	+-	1.42
OA	18.44	+-	3.95
PA	7.68	+-	2.04
PB	17.47	+-	2.86
WH	5.37	+-	1.21
A	6.02	+-	2.33
B	9.15	+-	2.88
C	7.67	+-	2.77
D	6.15	+-	2.37
E	6.62	+-	2.20
F	5.00	+-	1.11
G	8.21	+-	1.97
H	10.78	+-	1.65
I	5.30	+-	1.49
J	4.43	+-	1.54
K	6.73	+-	1.02
L	11.87	+-	3.20
PL	7.95	+-	1.74
WS	20.48	+-	2.96
HB	7.78	+-	1.81
RL	0.90	+-	0.40
RL	9.73	+-	2.19

Geographical Regional Averages for this period are:

Near Plant (0-.16 mi.)	16.02	+-	3.50
Exclusion Area (.25-.68 mi.)	7.36	+-	2.04
Distant Nbrhood (.7-6.5 mi.)	6.90	+-	2.16
Background (8-21 mi.)	7.62	+-	2.60

TABLE III-D-3
GAMMA EXPOSURE (TLD) DATA FOR QUARTER #2 1984

Station	Micror/ Hour	+-	2 Sigma
CP	15.20	+-	6.08
CR	3.52	+-	1.26
CS	2.34	+-	0.84
ER	1.78	+-	0.67
EW	2.08	+-	0.69
KS	16.17	+-	3.45
MB	2.12	+-	0.72
ME	6.50	+-	3.26
MP	3.87	+-	2.35
MS	4.04	+-	2.44
NP	3.97	+-	1.95
PC	0.16	+-	0.06
SA	2.86	+-	1.86
SP	2.22	+-	0.74
SS	1.32	+-	0.66
WR	3.29	+-	1.08
BD	2.09	+-	0.67
EB	3.84	+-	2.11
EM	1.52	+-	0.48
MT	1.73	+-	0.78
OA	18.55	+-	3.90
PA	10.60	+-	5.61
PB	18.59	+-	2.13
WH	2.57	+-	1.19
A	1.77	+-	0.74
B	2.75	+-	0.38
C	3.65	+-	0.65
D	1.81	+-	0.82
E	2.86	+-	1.15
F	3.27	+-	0.29
G	2.83	+-	0.56
H	4.74	+-	0.64
I	8.28	+-	7.58
J	14.13	+-	3.68
K	21.63	+-	2.17
L	17.31	+-	4.41
PL	5.05	+-	1.81
WS	12.24	+-	3.94
HB	4.08	+-	1.77
RL	2.61	+-	1.19
RL	3.94	+-	0.47

Geographical Regional Averages for this period are:

Near Plant (0-.16 mi.)	14.99	+-	4.72
Exclusion Area (.25-.68 mi.).	3.49-	+-	2.31
Distant Nbrhood (.7-6.5 mi.)	6.69	+-	3.36
Background (8-21 mi.)	5.86	+-	2.35

TABLE III-D-4
GAMMA EXPOSURE (TLD) DATA FOR QUARTER #3 1984

Station	Micror/ Hour	+-	2 Sigma
CP	6.24	+-	1.55
CR	7.71	+-	2.15
CS	1.84	+-	.38
ER	7.16	+-	1.83
EW	9.37	+-	2.21
KS	8.89	+-	4.00
MB	8.54	+-	3.01
ME	1.77	+-	.62
MP	9.83	+-	3.35
MS	14.67	+-	6.12
NP	6.16	+-	1.44
PC	6.90	+-	2.27
SA	15.52	+-	3.44
SP	7.92	+-	1.80
SS	7.47	+-	2.50
WR	9.82	+-	1.56
BD	6.98	+-	1.54
EB	9.25	+-	3.05
EM	7.85	+-	4.22
MT	6.46	+-	1.72
OA	19.70	+-	5.08
PA	11.08	+-	2.01
PB	20.47	+-	4.94
WH	7.81	+-	2.55
A	8.88	+-	3.31
B	9.22	+-	4.60
C	8.39	+-	2.51
D	7.58	+-	2.43
E	7.70	+-	2.24
F	6.49	+-	2.51
G	10.93	+-	2.52
H	10.35	+-	4.22
I	6.77	+-	3.43
J	5.77	+-	1.97
K	7.28	+-	1.58
L	11.69	+-	4.21
PL	7.84	+-	2.42
WS	20.85	+-	7.67
HB	8.24	+-	2.64
RL	1.39	+-	.11
RL	1.79	+-	.68

Geographical Regional Averages for this period are:

Near Plant (0-.16 mi.)	18.03	+-	6.14
Exclusion Area (.25- 68 mi.)	8.34	+-	2.95
Distant Nbrhood (.7-6.5 mi.)	7.58	+-	3.01
Background (8-21 mi.)	8.90	+-	3.31

TABLE III-D-5
GAMMA EXPOSURE (TLD) DATA FOR QUARTER #4 1984

Station	Micror/ Hour	+-	2 Sigma
CP	13.08	+-	3.17
CR	2.27	+-	1.01
CS	1.84	+-	1.04
ER	3.96	+-	1.67
EW	3.68	+-	1.14
KS	10.53	+-	5.39
MB	3.20	+-	1.08
ME	3.78	+-	1.42
MP	3.71	+-	1.52
MS	2.66	+-	.97
NP	3.42	+-	1.19
PC	1.55	+-	.67
SA	2.64	+-	1.08
SP	5.82	+-	1.02
SS	3.26	+-	.67
WR	1.44	+-	.53
BD	.64	+-	.37
EB	ND*	+-	ND
EM	1.80	+-	.58
MT	2.12	+-	1.23
OA	6.28	+-	1.75
PA	.98	+-	.69
PB	10.38	+-	3.39
WH	4.75	+-	1.81
A	2.12	+-	.68
B	4.08	+-	1.00
C	2.25	+-	.68
D	ND	+-	ND
E	2.40	+-	.44
F	2.83	+-	.50
G	3.63	+-	.83
H	2.70	+-	1.02
I	8.97	+-	4.46
J	ND	+-	ND
K	9.77	+-	4.79
L	5.33	+-	1.98
PL	3.13	+-	2.03
WS	6.76	+-	3.59
HB	3.78	+-	1.21
RL	2.01	+-	.97
RL	1.93	+-	.95

*ND - No data due to missing TLD.Geographical Regional Averages for this period are:

Near Plant (0-.16 mi.)	6.10	+-	3.05
Exclusion Area (.25-.68 mi.)	3.46	+-	1.64
Distant Nbrhood (.7-6.5 mi.)	4.82	+-	2.57
Background (8-21 mi.)	4.67	+-	3.30

QUARTERLY AVERAGES FOR GAMMA EXPOSURE RATES

STATION	1ST QUARTER MICROR/HR			2ND QUARTER MICROR/HR			3RD QUARTER MICROR/HR			4TH QUARTER MICROR/HR		
CP	5.87	+-	1.36	15.20	+-	6.08	6.24	+-	1.55	13.08	+-	3.17
CR	7.92	+-	1.62	3.52	+-	1.26	7.71	+-	2.15	2.27	+-	1.01
CS	1.77	+-	0.28	2.34	+-	0.84	1.84	+-	.38	1.84	+-	1.04
ER	5.60	+-	2.30	1.78	+-	0.67	7.16	+-	1.83	3.96	+-	1.67
EW	6.95	+-	1.10	2.08	+-	0.69	9.37	+-	2.21	3.66	+-	1.14
KS	7.27	+-	3.11	16.17	+-	3.45	8.89	+-	4.00	10.53	+-	5.39
MB	8.58	+-	2.66	2.12	+-	0.72	8.54	+-	3.01	3.20	+-	1.08
ME	1.35	+-	0.51	6.50	+	3.26	1.77	+-	.62	3.78	+-	1.42
MP	9.57	+-	3.04	3.87	+-	2.35	9.83	+-	3.35	3.71	+-	1.52
MS	10.95	+-	2.56	4.04	+-	2.44	14.67	+-	6.12	2.66	+-	.97
NP	6.36	+-	1.73	3.97	+-	1.95	6.16	+-	1.44	3.42	+-	1.19
PC	5.43	+-	2.24	0.16	+-	0.06	6.90	+-	2.27	1.55	+-	.67
SA	14.50	+-	3.05	2.86	+-	1.86	15.52	+-	3.44	2.64	+-	1.08
SP	7.31	+-	1.50	2.22	+-	0.74	7.92	+-	1.80	5.82	+-	1.02
SS	7.07	+-	2.49	1.32	+-	0.66	7.47	+-	2.50	3.26	+-	.67
WR	9.01	+-	1.64	3.29	+-	1.08	9.82	+-	1.56	1.44	+-	.53
BD	5.66	+-	0.98	2.09	+-	0.67	6.98	+-	1.54	.64	+-	.37
EB	8.07	+-	1.53	3.84	+-	2.11	9.25	+-	3.05	ND*	+-	ND
EM	9.10	+-	2.45	1.52	+-	0.48	7.85	+-	4.22	1.80	+-	.58
MT	5.78	+-	1.42	1.73	+-	0.78	6.46	+-	1.72	2.12	+-	1.23
OA	18.44	+-	3.95	18.55	+-	3.90	19.70	+-	5.08	6.28	+-	1.75
PA	7.68	+-	2.04	10.60	+-	5.61	11.08	+-	2.01	.98	+-	.69
PB	17.47	+-	2.86	18.59	+-	2.13	20.47	+-	4.94	10.38	+-	3.39
WH	5.37	+-	1.21	2.57	+-	1.19	7.81	+-	2.55	4.75	+-	1.81
A	6.02	+-	2.33	1.77	+-	0.74	8.88	+-	3.31	2.12	+-	.68
B	9.15	+-	2.88	2.75	+-	0.38	9.22	+-	4.60	4.08	+-	1.00
C	7.67	+-	2.77	3.65	+-	0.65	8.39	+-	2.51	2.25	+-	.68
D	6.15	+-	2.37	1.81	+-	0.82	7.58	+-	2.43	ND	+-	ND
E	6.62	+-	2.20	2.86	+-	1.15	7.70	+-	2.24	2.40	+-	.44
F	5.00	+-	1.11	3.27	+-	0.29	6.49	+-	2.51	2.83	+-	.50
G	8.21	+-	1.97	2.83	+-	0.56	10.93	+-	2.52	3.63	+-	.83
H	10.78	+-	1.65	4.74	+-	0.64	10.35	+-	4.22	2.70	+-	1.02
I	5.30	+-	1.49	8.28	+-	7.58	6.77	+-	3.43	8.97	+-	4.46
J	4.43	+-	1.54	14.13	+-	3.68	5.77	+-	1.97	ND	+-	ND
K	6.73	+-	1.02	21.63	+-	2.17	7.28	+-	1.58	9.77	+-	4.79
L	11.87	+-	3.20	17.31	+-	4.41	11.69	+-	4.21	5.33	+-	1.98
PL	7.95	+-	1.74	5.05	+-	1.81	7.84	+-	2.42	3.13	+-	2.03
WS	20.48	+-	2.96	12.24	+-	3.94	20.85	+-	7.67	6.76	+-	3.59
HB	7.78	+-	1.81	4.08	+-	1.77	8.24	+-	2.64	3.78	+-	1.21
RL	0.90	+-	0.40	2.61	+-	1.19	1.39	+-	.11	2.01	+-	.97
RL	9.73	+-	2.19	3.94	+-	0.47	1.79	+-	.68	1.93	+-	.95

TABLE III-D-6
QUARTERLY AVERAGE
EXPOSURE RATES
1984

*ND - No data due to missing TLD.

TABLE III-D-7

1983 DIRECT RADIATION SURVEY RESULTS

Location	Exposure Rate (uR/hr+-1 sigma)	Beach Terrain
White Horse Beach (near Hill P. Avenue)	6.8+-0.5	Sand with large amount of course gravel, granite boulders near beach area (within thirty feet).
White Horse Beach (in back of Blue Sail Bar)	7.2+-0.4	Sandy with small amounts of gravel.
Plymouth Beach (outer beach)	10.2+-0.4	Sandy with small amounts of gravel.
Plymouth Beach (inner beach)	7.4+-0.6	Sandy.
Plymouth Beach (behind Berts Restaurant)	6.8+-0.4	Sandy.
Duxbury Beach (Control) (ocean side)	7.4+-0.4	Sandy with course gravel.

III.E. Waterborne

Samples of seawater are collected at three locations, the Discharge Canal (Station 11), Bartlett Pond (Station 17 - 1.7 mi - SE) and Powder Point (Station 23 - 7.8 mi - NNW). The Discharge Canal sample is collected by a continuously compositing sampler which extracts a sample of about 20 ml of water from the Discharge Canal every one-half hour. Grab samples are taken weekly from each of the other two locations. The results of the ERMAP program for seawater samples are presented in Table III-E-1.

There were positive measurements of nuclides characteristic of reactor operation observed at the Discharge Canal in five samples during the second and third quarters of 1984. There were positive measurements of Cs-137, Co-60 and K-40 in these five samples from the Discharge Canal. The other samples from the Discharge Canal, and the majority of samples from Bartlett Pond and Powder Point resulted in positive measurements of only K-40.

The observed concentrations of Cs-137 and Co-60 were the result of PNPS-1 liquid releases. However, the observed concentrations of K-40 were due to the natural occurrence of this nuclide.

In addition, there were indications of the presence of H-3 (activity greater than three times the standard deviation) in the second quarter composite sample for the Discharge Canal and Bartlett Pond. The highest mean concentration occurred at the Discharge Canal.

It is important to note that since seawater is not potable, the presence of the Cs-137 and Co-60 concentrations do not represent a significant potential source of dose to the general public.

Therefore, there was clearly no significant environmental effect observed in the seawater media as a result of the operation of PNPS-1.

TABLE III-E-1
ERMAP RESULTS-WATERBORNE

MEDIUM: SEAWATER UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (36)		(1.5 ± 1.8)E 0	11	(5.2 ± 2.0)E 0	(1.3 ± 1.4)E 0
(0)		(-1.8 - 1.8)E 1		(-6.4 - 15.5)E 0	(-8.4 - 7.3)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
K-40 (36)		(1.6 ± .3)E 2	11	(3.0 ± .1)E 2	(2.7 ± .3)E 2
(0)		(-1.3 - 32.5)E 1		(2.5 - 3.3)E 2	(6.9 - 359.0)E 0
		(13/ 24)		*(12/ 12)*	*(11/ 12)*
CR-51 (36)		(6.4 ± 16.9)E -1	17	(1.2 ± 2.2)E 0	(-1.4 ± 1.7)E 0
(0)		(-1.3 - 1.8)E 1		(-7.0 - 18.0)E 0	(-1.1 - .5)E 1
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
MN-54 (36)	15.	(9.6 ± 15.2)E -2	17	(2.7 ± 2.1)E -1	(2.2 ± 16.5)E -2
(0)		(-1.6 - 1.2)E 0		(-1.1 - 1.2)E 0	(-1.1 - .7)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CO-58 (36)	15.	(-6.1 ± 15.6)E -2	17	(5.7 ± 16.3)E -2	(-8.7 ± 3.3)E -1
(0)		(-1.5 - 2.4)E 0		(-6.6 - 11.1)E -1	(-2.5 - 1.0)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
FE-59 (36)	30.	(2.4 ± 4.6)E -1	17	(7.3 ± 6.4)E -1	(6.4 ± 6.8)E -1
(0)		(-2.7 - 5.5)E 0		(-2.2 - 5.0)E 0	(-2.1 - 6.6)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CO-60 (36)	15.	(2.6 ± 1.2)E 0	11	(5.2 ± 2.1)E 0	(-8.4 ± 3.6)E -1
(0)		(-1.5 - 23.3)E 0		(-5.3 - 233.0)E -1	(-4.0 - .5)E 0
		(5/ 24)		*(5/ 12)*	*(0/ 12)*
ZN-65 (36)	30.	(-2.3 ± 4.5)E -1	17	(-1.5 ± 6.6)E -1	(-4.6 ± 5.3)E -1
(0)		(-3.9 - 3.3)E 0		(-3.4 - 3.0)E 0	(-4.1 - 1.8)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
ZR-95 (36)	10.	(3.7 ± 3.1)E -1	17	(4.9 ± 4.4)E -1	(-2.5 ± 5.8)E -1
(0)		(-2.3 - 3.7)E 0		(-1.6 - 3.7)E 0	(-4.2 - 3.7)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-E-1
(CONTINUED)

MEDIUM: SEAWATER UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (36)		(2.0 ± 2.1)E -1	17	(3.6 ± 2.6)E -1	(1.5 ± 2.7)E -1
(0)		(-2.0 - 1.6)E 0		(-9.5 - 16.4)E -1	(-7.5 - 19.3)E -1
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
RU-103 (36)		(-7.8 ± 2.0)E -1	17	(-5.5 ± 3.2)E -1	(-8.0 ± 2.7)E -1
(0)		(-2.5 - 2.1)E 0		(-2.3 - 2.1)E 0	(-2.2 - .4)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
RU-106 (36)		(-2.8 ± 1.4)E 0	23	(3.5 ± 2.1)E 0	(3.5 ± 2.1)E 0
(0)		(-2.7 - .5)E 1		(-5.4 - 14.7)E 0	(-5.4 - 14.7)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
I-131 (36)		(-3.0 ± 5.6)E -1	23	(2.8 ± 5.4)E -1	(2.8 ± 5.4)E -1
(0)		(-5.6 - 7.5)E 0		(-3.8 - 3.5)E 0	(-3.8 - 3.5)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CS-134 (36)	15.	(-5.7 ± 2.1)E -1	11	(-2.0 ± 3.4)E -1	(-9.5 ± 1.9)E -1
(0)		(-2.6 - 2.3)E 0		(-1.9 - 2.3)E 0	(-2.0 - -.0)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CS-137 (36)	15.	(8.1 ± 4.1)E -1	11	(1.7 ± .7)E 0	(-2.5 ± 2.2)E -1
(0)		(-1.3 - 7.1)E 0		(-2.0 - 70.7)E -1	(-1.8 - .6)E 0
		(4/ 24)		*(4/ 12)*	*(0/ 12)*
BA-140 (36)	15.	(-5.7 ± 2.2)E -1	17	(-5.2 ± 1.8)E -1	(-7.9 ± 4.2)E -1
(0)		(-3.3 - 1.3)E 0		(-1.5 - .4)E 0	(-3.0 - 1.5)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CE-141 (36)		(1.4 ± 3.7)E -1	17	(4.2 ± 5.5)E -1	(-2.0 ± 4.2)E -1
(0)		(-3.8 - 3.8)E 0		(-2.9 - 3.8)E 0	(-2.3 - 3.2)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
CE-144 (36)		(-5.0 ± 9.9)E -1	23	(1.5 ± 1.7)E 0	(1.5 ± 1.7)E 0
(0)		(-8.2 - 9.0)E 0		(-7.0 - 9.4)E 0	(-7.0 - 9.4)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*
AC-228 (36)		(1.7 ± .6)E 0	11	(2.8 ± 1.1)E 0	(8.5 ± 9.1)E -1
(0)		(-3.5 - 10.4)E 0		(-3.5 - 10.4)E 0	(-3.3 - 5.8)E 0
		(0/ 24)		*(0/ 12)*	*(0/ 12)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-E-1
(CONTINUED)

MEDIUM: SEAWATER UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
H-3 (12)	330.	(8.9 ± 5.5)E 1	11	(1.3 ± .8)E 2	(1.4 ± 32.9)E 0
(0)		(-1.2 - 3.6)E 2		(1.0 - 35.5)E 1	(-8.0 - 7.0)E 1
		(2/ 8)		*(1/ 4)*	*(0/ 4)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.F. Shellfish

Shellfish are normally sampled quarterly from 5 locations: the Station Discharge Canal, Duxbury Bay, Manomet Point, Warren Cove and Marshfield. The results of the ERMAP program for shellfish are presented in Table III-F-1. It is clear from this table that there have been positive measurements of Be-7, Ce-141, Co-58, Mn-54 (peak), Zn-65, Co-60, AcTh-228 and K-40 in samples from the Discharge Canal. In addition there have been positive measurements of Be-7, Mn-54, Co-60, AcTh-228 (peak) and K-40 at Manomet Point; Be-7, AcTh-228 (peak) and K-40 at Warren Cove; AcTh-228 and K-40 at Duxbury Bay; and, Be-7, AcTh-228 and K-40 at the control station in Marshfield.

The observed concentrations of Ce-141, Mn-54 (peak) Co-58, Co-60, and Zn-65 were the result of PNPS-1 liquid releases. However, the observed concentrations of Be-7, AcTh-228 and K-40 are due to the natural occurrence of these nuclides.

However, even if a person were to consume the maximum annual quantity of seafood (5 kilograms/year) with the highest mean concentrations of the above nuclides, they would receive a dose of less than 0.003 mrem to the total body and less than 0.02 mrem to the most restrictive organ (Adult, GI-LLI).

When compared to the natural background dose rate of 80-100 mrem/year, there was clearly no significant environmental impact observed in shellfish as a result of the operations of PNPS-1.

TABLE III-F-1
ERMAP RESULTS-SHELLFISH

MEDIUM: SHELLFISH UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (40)		(2.1 ± .9)E 1	15	(3.3 ± .8)E 1	(3.3 ± .7)E 1
(0)		(-8.0 - 15.9)E 1		(1.7 - 5.4)E 1	(5.8 - 61.2)E 0
		(10/ 32)		*(3/ 4)*	*(5/ 8)*
K-40 (40)		(1.0 ± .1)E 3	15	(1.5 ± .2)E 3	(7.7 ± 2.1)E 2
(0)		(1.2 - 21.1)E 2		(1.2 - 1.9)E 3	(1.9 - 15.7)E 2
		(29/ 32)		*(4/ 4)*	*(8/ 8)*
CR-51 (40)		(2.8 ± 7.9)E 0	11	(7.5 ± 8.1)E 0	(-1.3 ± .7)E 1
(0)		(-1.3 - 1.1)E 2		(-1.1 - 6.2)E 1	(-5.8 - .0)E 1
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
MN-54 (40)	130.	(2.2 ± 1.4)E 0	11	(9.1 ± 1.8)E 0	(1.6 ± 4.5)E -1
(0)		(-1.8 - 1.6)E 1		(3.2 - 16.0)E 0	(-1.7 - 2.6)E 0
		(8/ 32)		*(7/ 8)*	*(0/ 8)*
CO-58 (40)	130.	(-9.0 ± 83.0)E -2	11	(2.9 ± 1.1)E 0	(4.6 ± 463.0)E -3
(0)		(-1.3 - .8)E 1		(-1.4 - 8.0)E 0	(-2.2 - 1.8)E 0
		(2/ 32)		*(2/ 8)*	*(0/ 8)*
FE-59 (40)	260.	(-3.0 ± 2.3)E 0	15	(3.3 ± 1.0)E 0	(9.2 ± 9.3)E -1
(0)		(-5.3 - 2.0)E 1		(8.3 - 54.6)E -1	(-3.0 - 4.7)E 0
		(0/ 32)		*(0/ 4)*	*(0/ 8)*
CO-60 (40)	130.	(9.2 ± 3.6)E 1	11	(3.6 ± .9)E 2	(-3.6 ± 4.3)E -1
(8)		(-9.0 - 851.0)E 0		(8.9 - 85.1)E 1	(-2.7 - 1.0)E 0
		(12/ 32)		*(8/ 8)*	*(0/ 8)*
ZN-65 (40)	260.	(4.3 ± 3.1)E 0	11	(1.8 ± .7)E 1	(3.7 ± 1.8)E 0
(2)		(-5.7 - 5.2)E 1		(-2.5 - 52.0)E 0	(-1.2 - 14.5)E 0
		(5/ 32)		*(5/ 8)*	*(0/ 8)*
ZR-95 (40)		(2.3 ± 1.3)E 0	13	(7.2 ± 2.0)E 0	(3.5 ± 9.3)E -1
(0)		(-1.9 - 1.8)E 1		(1.1 - 16.2)E 0	(-4.1 - 3.4)E 0
		(0/ 32)		*(0/ 8)*	*(0/ 8)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-F-1
(CONTINUED)

MEDIUM: SHELLFISH UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (40)		(5.8 ± 9.6)E -1	24	(1.6 ± .8)E 0	(1.6 ± .8)E 0
(0)		(-1.1 - 2.0)E 1		(6.3 - 713.0)E -2	(6.3 - 713.0)E -2
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
RU-103 (40)		(6.6 ± 10.3)E -1	13	(3.3 ± 1.5)E 0	(1.4 ± 25.3)E -2
(0)		(-1.3 - 2.0)E 1		(-1.1 - 9.4)E 0	(-1.4 - .8)E 0
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
RU-106 (40)		(9.7 ± 12.5)E 0	13	(4.1 ± 2.6)E 1	(-1.2 ± 4.1)E 0
(0)		(-2.4 - 1.7)E 2		(-2.8 - 16.9)E 1	(-2.8 - 1.0)E 1
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
I-131 (40)	80.	(-1.3 ± 3.5)E 0	11	(2.6 ± 6.5)E 0	(-1.9 ± 1.4)E 1
(0)		(-6.8 - 4.6)E 1		(-1.3 - 4.6)E 1	(-1.1 - .0)E 2
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
CS-134 (40)	80.	(-1.3 ± .9)E 0	11	(1.1 ± .6)E 0	(-5.4 ± 5.1)E -1
(0)		(-1.5 - .8)E 1		(-1.4 - 4.2)E 0	(-2.2 - 1.3)E 0
		(1/ 32)		*(1/ 8)*	*(0/ 8)*
CS-137 (40)	80.	(3.2 ± 1.1)E 0	11	(6.6 ± 2.6)E 0	(-2.8 ± 8.0)E -1
(0)		(-1.2 - 2.4)E 1		(2.6 - 235.0)E -1	(-5.2 - 2.4)E 0
		(4/ 32)		*(4/ 8)*	*(0/ 8)*
BA-140 (40)		(-7.6 ± 1.6)E 0	13	(-7.0 ± 2.8)E 0	(-8.4 ± 2.5)E 0
(0)		(-2.4 - 1.6)E 1		(-1.9 - .4)E 1	(-2.0 - -.1)E 1
		(0/ 32)		*(0/ 8)*	*(0/ 8)*
CE-141 (40)		(3.3 ± 2.1)E 0	12	(5.5 ± 4.0)E 0	(1.0 ± 1.6)E 0
(0)		(-3.3 - 2.6)E 1		(-2.1 - 2.6)E 1	(-7.2 - 8.4)E 0
		(2/ 32)		*(0/ 12)*	*(0/ 8)*
CE-144 (40)		(3.8 ± 4.0)E 0	12	(1.2 ± .9)E 1	(-2.6 ± 2.3)E 0
(0)		(-3.4 - 6.5)E 1		(-3.4 - 6.5)E 1	(-1.8 - .3)E 1
		(0/ 32)		*(0/ 12)*	*(0/ 8)*
AC-228 (40)		(3.9 ± .8)E 1	13	(7.4 ± 1.4)E 1	(1.1 ± .4)E 1
(0)		(-1.7 - 12.3)E 1		(7.3 - 117.0)E 0	(4.2 - 287.0)E -1
		(7/ 32)		*(4/ 8)*	*(3/ 8)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.G. Algae (Irish Moss)

Algae, referred to as Irish Moss or Chondrus Chrispus, is sampled quarterly at three locations, the PNPS Discharge Canal, Manomet Point and Ellisville. The results of the ERMAP program for Algae are presented in Table III-G-1.

It is clear from this table that there have been positive measurements of Be-7, Mn-54, Co-58, Co-60, Zn-65, Cs-137, AcTh-228 and K-40 at the Discharge Canal. In addition, there have been positive measurements of Be-7, Mn-54, Co-60, AcTh-228 and K-40 at Manomet Point (Station 15 - 3 miles - SE); and Be-7, Mn-54, Co-60, AcTh-228 and K-40 at the control station of Ellisville (Station 22 - 8 mi - SSE). Due to the positive measurements of reactor related nuclides at Station #22, samples were collected from another control station for the second, third and fourth quarters of 1984. This control station was established at Brant Rock (Station 34-12 mi-NNW). The only observed positive measurements of Brant Rock samples were Be-7, AcTh-228 (peak) and K-40.

The measured concentrations of Co-58 Mn-54, Zn-65, Cs-137, and Co-60 at the Discharge Canal are certainly due to liquid effluents from PNPS-1. The observed concentrations of Mn-54 and Co-60 at Manomet Point and Ellisville were the result of PNPS-1 liquid releases. The prevailing surface currents along the shoreline in the Plymouth area is in the southerly direction. There were no positive measurements of reactor related nuclides at the control station in Brant Rock, approximately twelve miles away the NNW sector.

It is important to note that due to processing and market dilution, the presence of the Mn-54, Cs-137, Zn-65, Co-58 and Co-60 concentrations do not represent a significant potential source of dose to the general public. In fact, even direct human consumption of Algae (which to our knowledge, does not occur) with the highest mean concentrations would result in a dose rate of about 0.05 mrem/yr to the total body and less than 0.03 mrem/yr to the most sensitive organ (Adult-GI-LLI, using the models presented in Regulatory Guide 1.109) and assuming consumption of 5 kg/year of unprocessed material. When compared with the natural background dose rate of 80-100 mrem/yr, there was clearly no significant environmental impact observed in Algae as a result of the operation of PNPS-1.

TABLE III-G-1
ERMAP RESULTS-ALGAE

MEDIUM: IRISH MOSS UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (16)		(1.4 ± .2)E 2	22	(2.1 ± .7)E 2	(1.6 ± .5)E 2
(0)		(6.4 - 25.2)E 1		(8.3 - 45.4)E 1	(8.2 - 454.0)E 0
		(7/ 8)		*(5/ 5)*	*(6/ 8)*
K-40 (16)		(6.3 ± .7)E 3	11	(7.9 ± .7)E 3	(6.4 ± 1.8)E 3
(0)		(4.3 - 9.3)E 3		(6.1 - 9.3)E 3	(4.0 - 19.1)E 3
		(8/ 8)		*(4/ 4)*	*(8/ 8)*
CR-51 (16)		(1.4 ± 2.1)E 1	22	(5.7 ± 4.6)E 1	(3.3 ± 3.0)E 1
(0)		(-7.3 - 13.1)E 1		(2.8 - 242.0)E 0	(-2.0 - 24.2)E 1
		(0/ 8)		*(0/ 5)*	*(0/ 8)*
MN-54 (16)	130.	(9.1 ± 3.4)E 1	11	(1.7 ± .3)E 2	(3.4 ± 1.6)E 0
(4)		(1.1 - 208.0)E 0		(9.9 - 20.8)E 1	(-1.7 - 12.0)E 0
		(5/ 8)		*(4/ 4)*	*(1/ 8)*
CO-58 (16)	130.	(9.6 ± 3.7)E 0	11	(1.8 ± .3)E 1	(4.4 ± 13.4)E -1
(2)		(-2.8 - 27.5)E 0		(1.2 - 2.8)E 1	(-4.6 - 7.2)E 0
		(2/ 8)		*(2/ 4)*	*(0/ 8)*
FE-59 (16)	260.	(1.4 ± 6.1)E 0	11	(8.1 ± 11.3)E 0	(-5.8 ± 42.1)E -1
(0)		(-2.3 - 2.7)E 1		(-2.3 - 2.7)E 1	(-2.0 - 1.8)E 1
		(0/ 8)		*(0/ 4)*	*(0/ 8)*
CO-60 (16)	130.	(7.2 ± 3.0)E 2	11	(1.4 ± .4)E 3	(3.6 ± 2.4)E 1
(4)		(2.2 - 212.0)E 1		(4.8 - 21.2)E 2	(-1.5 - 202.0)E 0
		(8/ 8)		*(4/ 4)*	*(4/ 8)*
ZN-65 (16)	260.	(3.4 ± 1.6)E 1	11	(6.7 ± 1.9)E 1	(-3.7 ± 6.7)E 0
(2)		(-1.1 - 11.0)E 1		(1.6 - 11.0)E 1	(-4.6 - 2.1)E 1
		(2/ 8)		*(2/ 4)*	*(0/ 8)*
ZR-95 (16)		(4.9 ± 2.7)E 0	11	(6.7 ± 3.2)E 0	(-1.5 ± 24.9)E -1
(0)		(-7.3 - 16.2)E 0		(2.5 - 16.2)E 0	(-8.0 - 14.0)E 0
		(0/ 8)		*(0/ 4)*	*(0/ 8)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-G-1
(CONTINUED)

MEDIUM: IRISH MOSS

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (16)		(2.2 ± 2.7)E 0	15	(5.2 ± 3.7)E 0	(-6.6 ± 157.6)E -2
(0)		(-8.1 - 11.7)E 0		(-2.8 - 11.7)E 0	(-6.1 - 4.8)E 0
		(0/ 8)		*(0/ 4)*	*(0/ 8)*
RU-103 (16)		(-1.8 ± 1.1)E 0	34	(3.6 ± 2.8)E 0	(2.2 ± 2.6)E 0
(0)		(-7.4 - 2.7)E 0		(-3.5 - 89.6)E -1	(-5.6 - 17.0)E 0
		(0/ 8)		*(0/ 3)*	*(0/ 8)*
RU-106 (16)		(1.4 ± .8)E 1	15	(2.0 ± 1.5)E 1	(-8.3 ± 7.4)E 0
(0)		(-2.3 - 4.3)E 1		(-2.3 - 4.3)E 1	(-4.8 - 2.3)E 1
		(0/ 8)		*(0/ 4)*	*(0/ 8)*
I-131 (16)	80.	(9.3 ± 5.3)E 0	22	(1.1 ± 1.0)E 1	(2.5 ± 9.0)E 0
(0)		(-1.2 - 2.6)E 1		(-6.0 - 50.3)E 0	(-3.8 - 5.0)E 1
		(0/ 8)		*(0/ 5)*	*(0/ 8)*
CS-134 (16)	80.	(-6.0 ± 15.7)E -1	11	(3.3 ± 22.4)E -1	(-2.0 ± 1.7)E 0
(0)		(-7.3 - 4.8)E 0		(-3.6 - 4.8)E 0	(-8.7 - 5.7)E 0
		(0/ 8)		*(0/ 4)*	*(0/ 8)*
CS-137 (16)	80.	(1.0 ± .4)E 1	11	(1.6 ± .7)E 1	(2.9 ± 1.1)E 0
(2)		(1.6 - 31.2)E 0		(4.6 - 31.2)E 0	(-1.5 - 8.9)E 0
		(2/ 8)		*(2/ 4)*	*(0/ 8)*
BA-140 (16)		(-3.7 ± 1.7)E 0	11	(-4.9 ± 20.7)E -1	(-7.0 ± 2.4)E 0
(0)		(-1.0 - .4)E 1		(-5.9 - 3.8)E 0	(-1.5 - .2)E 1
		(0/ 8)		*(0/ 4)*	*(0/ 8)*
CE-141 (16)		(3.6 ± 18.4)E -1	22	(7.1 ± 7.0)E 0	(5.0 ± 4.3)E 0
(0)		(-1.0 - .5)E 1		(-6.4 - 33.8)E 0	(-6.4 - 33.8)E 0
		(0/ 8)		*(0/ 5)*	*(0/ 8)*
CE-144 (16)		(1.6 ± 5.8)E 0	34	(6.1 ± 7.2)E 0	(-3.1 ± 7.8)E 0
(0)		(-2.4 - 2.9)E 1		(-8.2 - 14.2)E 0	(-4.3 - 1.8)E 1
		(0/ 8)		*(0/ 3)*	*(0/ 8)*
AC-228 (16)		(9.8 ± 10.5)E 0	22	(4.5 ± 1.0)E 1	(3.3 ± .8)E 1
(0)		(-2.9 - 5.5)E 1		(1.7 - 7.8)E 1	(5.2 - 77.7)E 0
		(1/ 8)		*(2/ 5)*	*(2/ 8)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.H. Lobster (Arthropods)

Lobster samples are collected four times per season in the vicinity of the Discharge Canal Outfall area and annually at a distant point offshore. Only one of the required samples from the Discharge Canal Outfall area was not obtained due to unavailability in the first quarter of the year. The results of the ERMAP program for Lobsters are presented in Table III-H-1. These results are unremarkable in that there were no positive measurements of any isotopes other than K-40 in either the indicator or the control samples (K-40 is a naturally occurring nuclide). Therefore, there is no evidence of any environmental impact on this media as a result of the operation of PNPS-1.

TABLE III-H-1
ERMAP RESULTS-LOBSTER

MEDIUM: LOBSTER UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (4)		(-2.4 ± 4.6)E 1	19	(4.3 ± 6.4)E 1	(4.3 ± 6.4)E 1
(0)		(-1.1 - .4)E 2			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
K-40 (4)		(2.2 ± .2)E 3	19	(2.7 ± .2)E 3	(2.7 ± .2)E 3
(0)		(1.7 - 2.5)E 3			
		(3/ 3)		*(1/ 1)*	*(1/ 1)*
CR-51 (4)		(-4.0 ± 3.9)E 1	19	(4.0 ± 8.3)E 1	(4.0 ± 8.3)E 1
(0)		(-1.2 - .1)E 2			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
MN-54 (4)	130.	(-1.3 ± 3.6)E 0	19	(4.9 ± 7.9)E 0	(4.9 ± 7.9)E 0
(0)		(-8.5 - 2.6)E 0			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
CO-58 (4)	130.	(1.3 ± 37.1)E -1	11	(1.3 ± 37.1)E -1	(-8.3 ± 8.9)E 0
(0)		(-7.1 - 5.2)E 0		(-7.1 - 5.2)E 0	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
FE-59 (4)	260.	(1.7 ± 1.0)E 1	11	(1.7 ± 1.0)E 1	(-5.1 ± 2.1)E 1
(0)		(-2.7 - 28.1)E 0		(-2.7 - 28.1)E 0	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
CO-60 (4)	130.	(-4.3 ± 57.0)E -1	11	(-4.3 ± 57.0)E -1	(-1.4 ± 1.1)E 1
(0)		(-1.2 - .6)E 1		(-1.2 - .6)E 1	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
ZN-65 (4)	260.	(-1.1 ± 1.7)E 1	19	(8.6 ± 18.2)E 0	(8.6 ± 18.2)E 0
(0)		(-4.2 - 1.5)E 1			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
ZR-95 (4)		(-5.9 ± 125.0)E -1	19	(-4.1 ± 158.0)E -1	(-4.1 ± 158.0)E -1
(0)		(-2.1 - 2.2)E 1			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-H-1
(CONTINUED)

MEDIUM: LOBSTER UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (4)		(8.8 ± 4.3)E 0	11	(8.8 ± 4.3)E 0	(-2.3 ± 82.1)E -1
(0)		(9.1 - 157.0)E -1		(9.1 - 157.0)E -1	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
RU-103 (4)		(5.5 ± 1.5)E 0	11	(5.5 ± 1.5)E 0	(1.6 ± 8.7)E 0
(0)		(3.6 - 8.3)E 0		(3.6 - 8.3)E 0	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
RU-106 (4)		(-7.3 ± 2.7)E 1	11	(-7.3 ± 2.7)E 1	(-9.4 ± 6.7)E 1
(0)		(-1.2 - -.3)E 2		(-1.2 - -.3)E 2	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
I-131 (4)	80.	(2.8 ± 1.5)E 1	11	(2.8 ± 1.5)E 1	(1.5 ± 2.7)E 1
(0)		(-1.5 - 50.7)E 0		(-1.5 - 50.7)E 0	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
CS-134 (4)	80.	(-1.1 ± .6)E 1	19	(-3.6 ± 7.1)E 0	(-3.6 ± 7.1)E 0
(0)		(-2.3 - -.3)E 1			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
CS-137 (4)	80.	(8.4 ± 2.8)E 0	11	(8.4 ± 2.8)E 0	(1.2 ± 8.6)E 0
(0)		(3.5 - 13.2)E 0		(3.5 - 13.2)E 0	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
BA-140 (4)		(5.7 ± 17.5)E 0	11	(5.7 ± 17.5)E 0	(-1.1 ± 2.1)E 1
(0)		(-2.9 - 2.7)E 1		(-2.9 - 2.7)E 1	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
CE-141 (4)		(-1.8 ± 8.3)E 0	19	(-7.1 ± 139.0)E -1	(-7.1 ± 139.0)E -1
(0)		(-1.8 - .8)E 1			
		(0/ 3)		*(0/ 1)*	*(0/ 1)*
CE-144 (4)		(6.2 ± 2.1)E 1	11	(6.2 ± 2.1)E 1	(-8.9 ± 44.3)E 0
(0)		(2.9 - 10.2)E 1		(2.9 - 10.2)E 1	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*
AC-228 (4)		(3.6 ± 1.5)E 1	11	(3.6 ± 1.5)E 1	(3.5 ± 3.4)E 1
(0)		(1.2 - 6.4)E 1		(1.2 - 6.4)E 1	
		(0/ 3)		*(0/ 3)*	*(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.I. Fish

Fish samples of Bottom Oriented (Group I) and Near Bottom (Group II) species are collected quarterly in the vicintiy of the Discharge Canal Outfall. In addition, samples of Anadromous (Group III) and Coastal Migratory (Group IV) species are collected when in season, in this same area. Lastly, a sample from each group is collected once per year at a distant location offshore. During 1984, one Group II sample was unavailable in the first quarter, and two Group III samples were unavailable in the third and fourth quarters respectively.

The result of the ERMAP program of fish are presented in Table III-I-1. There was a positive measurement of Cs-137 at the indicator station (Discharge Canal - Station 11) during the fourth quarter.

An Atlantic cod sample collected on 11/15/84 at the Discharge Canal Outfall Area indicated a positive measurement of Cs-137. The Atlantic cod is in the Group II category (Near Bottom). Although the collection of salmon is not required per Technical Specifications, salmon is collected and analyzed when available. A salmon sample collected on 11/21/84 at the Mouth of the North River (Hanover) indicated a positive measurement of Cs-137. The salmon is in the Group III category (Anadromous). The highest mean concentration of Cs-137 was observed in the Atlantic cod sample. Even if an individual were to consume the maximum annual quantity of fish (21 kilograms/year) with the highest mean concentration of Cs-137, they would receive a dose of less than 0.03 mrem to the total body and less than 0.04 mrem to the most restrictive organ (Adult - Liver). Therefore, there is little evidence of any environmental impact on this media as a result of the operation of PNPS-1.

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TABLE III-I-1
ERMAP RESULTS-FISH

MEDIUM: FINFISH

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (28)		(1.2 ± 1.4)E 1	97	(1.0 ± 1.0)E 2	(3.7 ± 2.5)E 1
(0)		(-1.2 - 1.0)E 2			(-2.6 - 10.4)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
K-40 (28)		(3.3 ± .1)E 3	97	(3.8 ± .3)E 3	(3.1 ± .2)E 3
(0)		(2.2 - 4.9)E 3			(2.5 - 3.8)E 3
		(22/ 22)		*(1/ 1)*	*(6/ 6)*
CR-51 (28)		(4.4 ± 1.9)E 1	13	(2.4 ± 1.7)E 2	(3.0 ± 5.6)E 1
(0)		(-1.2 - 2.0)E 2			(-1.8 - 2.5)E 2
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
MN-54 (28)	130.	(5.4 ± 18.2)E -1	14	(1.3 ± 1.0)E 1	(-6.0 ± 35.1)E -1
(0)		(-1.2 - 1.6)E 1			(-1.3 - 1.3)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CO-58 (28)	130.	(-8.1 ± 13.6)E -1	96	(1.1 ± .5)E 1	(9.8 ± 32.8)E -1
(0)		(-1.7 - .9)E 1			(-1.3 - 1.1)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
FE-59 (28)	260.	(4.9 ± 4.4)E 0	12	(2.3 ± 2.6)E 1	(-1.1 ± 1.1)E 1
(0)		(-3.9 - 4.1)E 1			(-5.9 - 1.8)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CO-60 (28)	130.	(1.5 ± 2.0)E 0	29	(8.3 ± 11.4)E 0	(-4.5 ± 4.7)E 0
(0)		(-1.7 - 1.5)E 1			(-2.5 - .8)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
ZN-65 (28)	260.	(-5.0 ± 6.2)E 0	19	(1.5 ± 2.3)E 1	(-3.5 ± 7.2)E 0
(0)		(-7.3 - 5.9)E 1			(-3.0 - 1.2)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
ZR-95 (28)		(-2.1 ± 4.5)E 0	29	(1.3 ± 1.8)E 1	(-1.2 ± .7)E 1
(0)		(-5.0 - 3.0)E 1			(-3.4 - 1.3)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-I-1
(CONTINUED)

MEDIUM: FINFISH

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (28)		(6.2 ± 17.9)E -1	14	(1.5 ± 1.0)E 1	(5.3 ± 3.9)E 0
(0)		(-1.6 - 1.8)E 1			(-8.7 - 15.2)E 0
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
RU-103 (28)		(2.1 ± 31.1)E -1	12	(1.1 ± 1.1)E 1	(-7.3 ± 2.6)E 0
(0)		(-3.2 - 2.7)E 1			(-1.4 - .3)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
RU-106 (28)		(2.9 ± 1.8)E 1	19	(8.9 ± 6.7)E 1	(-6.2 ± 21.4)E 0
(0)		(-1.1 - 2.1)E 2			(-7.5 - 4.3)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
I-131 (28)	80.	(1.5 ± .9)E 1	19	(1.2 ± .8)E 2	(-7.0 ± 22.6)E 0
(0)		(-5.5 - 12.3)E 1			(-7.7 - 9.2)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CS-134 (28)	80.	(-5.1 ± 1.9)E 0	12	(1.4 ± 1.2)E 1	(-7.1 ± 4.2)E 0
(0)		(-2.3 - 1.4)E 1			(-2.2 - .7)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CS-137 (28)	80.	(4.4 ± 1.8)E 0	13	(2.6 ± 1.2)E 1	(1.2 ± .4)E 1
(0)		(-8.7 - 18.7)E 0			(2.1 - 25.8)E 0
		(1/ 22)		*(0/ 1)*	*(1/ 6)*
BA-140 (28)		(-1.4 ± .7)E 1	13	(4.2 ± 5.6)E 1	(-1.3 ± 14.0)E 0
(0)		(-7.8 - 3.6)E 1			(-5.0 - 4.2)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CE-141 (28)		(7.5 ± 3.5)E 0	19	(2.3 ± 2.1)E 1	(-3.2 ± 6.3)E 0
(0)		(-2.2 - 3.8)E 1			(-2.1 - 1.5)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
CE-144 (28)		(9.9 ± 91.8)E -1	99	(4.6 ± 3.7)E 1	(3.0 ± 14.6)E 0
(0)		(-7.9 - 8.7)E 1			(-5.7 - 4.6)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*
AC-228 (28)		(9.6 ± 5.9)E 0	97	(1.1 ± .5)E 2	(2.9 ± 2.3)E 1
(0)		(-5.0 - 5.4)E 1			(-3.5 - 11.5)E 1
		(0/ 22)		*(0/ 1)*	*(0/ 6)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.J. Sediments

Sediment samples are taken semi-annually at five indicator stations including Rocky Point, Plymouth Harbor, Duxbury Bay, Plymouth Beach and Manomet Point and a control sample is taken from Marshfield. There is a detailed subdivision of individual sample cores in which samples are sectioned into 2 cm increments during the first half of the year (this applies to all locations except Plymouth Beach), and samples are sectioned into 5 cm increments during the second half of the year.

The surface and alternate sections are analyzed for gamma emitting nuclides. In addition, the surface section from each core and a mid-depth section from Rocky Point and Plymouth Harbor are analyzed for Pu-238 and Pu-239, 240.

One sediment sample segment was not analyzed during 1984 due to the fault of Boston Edison. This was the 5-10 cm segment collected at Plymouth Beach on 5/17/84.

The results of the ERMAP program for sediments are presented in Table III-J-1. It is clear from this table that the highest mean concentration of Cs-137 was observed in the sediment samples taken from Duxbury Bay (Station 13). The highest value of Cs-137 was observed in the 12-14 cm segment. This sample was collected on 5/16/84. In addition, Cs-137 was observed in the majority of the sediment segments (0-26 cm) obtained from Duxbury Bay on 5/16/84, and was observed in all of the sediment segments (0-15 cm) collected on 10/19/84. The observation of Cs-137 was also made in the majority of the sediment segments (0-18 cm) at Warren Cove and in all of the sediment segments (0-15 cm) collected

on 10/15/84. There was one observation of Cs-137 at Plymouth Beach in the 10-15 cm sediment segment collected on 5/17/84. The majority of sediment segments (4-30 cm) collected on 5/17/84 for the control station at Marshfield had positive measurements of Cs-137, and there was only one observation of Cs-137 in the sediment samples collected on 10/16/84 at the 10-15cm segment. The concentrations of Cs-137 at Duxbury Bay may be explained by the fact that the sediment samples have a silty character not common to the other samples. The Warren Cove sediment is very similar to Duxbury Bay. It may be that the nature of the Duxbury sediment is such that certain materials are retained more strongly than others. This theory is supported by the fact that the Duxbury station also had the highest mean concentration of K-40, an isotope which is chemically similar to Cs-137. The measured concentrations of Be-7, and to some extent Cs-137, at Duxbury Bay, Warren Cove and Marshfield, are attributable to the fission products related to fallout from previous weapons testing.

In addition to the above, there were four positive measurements of Co-60 observed. The highest mean concentration of Co-60 was observed at Rocky Point. All three sediment segments (0-15 cm) collected at Rocky Point on 10/11/84 indicated the presence of Co-60. One sediment segment (5-10 cm) collected at Manomet Point on 10/18/84 also indicated the presence of Co-60. The measured concentrations of Co-60 are due to the liquid effluents of PNPS-1.

Analyses for plutonium isotopes in sediment samples are performed by the EAL Corporation (formally LFE Environmental Analyses Laboratories) in Richmond, California. The results of these analyses are unavailable at

this writing, but are usually presented in Table III-J-2. In the past, and as is expected for the 1984 analysis results, there was no apparent trend in these data to indicate that the PNPS-1 is contributing measurably to levels of Pu-238 or 239, 240 in the environment since levels of plutonium at Rocky Point are among the lowest measured at any location.

TABLE III-J-1
ERMAP RESULTS SEDIMENT

MEDIUM: SEDIMENT UNITS: PCI/KG DRY

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (60)		(4.7 ± 2.0)E 1	13	(1.1 ± .6)E 2	(4.5 ± 4.8)E 1
(2)		(-1.7 - 6.8)E 2		(-5.5 - 67.5)E 1	(-1.5 - 4.7)E 2
		(3/ 49)		*(2/ 11)*	*(1/ 11)*
K-40 (60)		(1.0 ± .0)E 4	13	(1.4 ± .0)E 4	(1.0 ± .0)E 4
(0)		(6.3 - 15.9)E 3		(1.0 - 1.6)E 4	(9.1 - 11.6)E 3
		(49/ 49)		*(11/ 11)*	*(11/ 11)*
CR-51 (60)		(-1.1 ± 13.1)E 0	11	(3.8 ± 1.8)E 1	(-2.2 ± 2.5)E 1
(0)		(-3.3 - 1.7)E 2		(-6.3 - 17.3)E 1	(-1.6 - .8)E 2
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
MN-54 (60)	60.	(-8.3 ± 1.4)E 0	11	(-3.2 ± 2.1)E 0	(-1.0 ± .3)E 1
(0)		(-3.1 - .9)E 1		(-1.9 - .8)E 1	(-2.4 - 1.1)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
CO-58 (60)	60.	(-1.6 ± 1.2)E 0	12	(6.8 ± 23.7)E -1	(-6.6 ± 2.4)E 0
(0)		(-2.2 - 1.9)E 1		(-9.2 - 15.3)E 0	(-2.4 - .5)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
FE-59 (60)	120.	(-7.0 ± 3.2)E 0	13	(3.5 ± 8.9)E 0	(-1.1 ± 7.7)E 0
(0)		(-4.8 - 5.4)E 1		(-3.3 - 5.4)E 1	(-5.0 - 3.4)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
CO-60 (60)	50.	(5.9 ± 3.1)E 0	11	(2.1 ± 1.2)E 1	(-1.6 ± 2.3)E 0
(4)		(-1.9 - 10.3)E 1		(-1.8 - 10.3)E 1	(-1.3 - 1.0)E 1
		(4/ 49)		*(3/ 11)*	*(0/ 11)*
ZN-65 (60)	50.	(3.9 ± 29.6)E -1	11	(5.4 ± 4.7)E 0	(-1.3 ± .6)E 1
(0)		(-5.6 - 4.6)E 1		(-2.6 - 3.0)E 1	(-4.1 - 1.4)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
ZR-95 (60)	50.	(9.5 ± 2.7)E 0	13	(2.7 ± .5)E 1	(1.1 ± .5)E 1
(0)		(-2.7 - 5.8)E 1		(3.6 - 58.4)E 0	(-1.6 - 3.1)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-J-1
(CONTINUED)

MEDIUM: SEDIMENT UNITS: PCI/KG DRY

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (60)		(4.6 ± 1.5)E 0	11	(7.0 ± 1.8)E 0	(4.5 ± 3.8)E 0
(0)		(-1.9 - 2.9)E 1		(-5.5 - 15.5)E 0	(-1.5 - 2.4)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
RU-103 (60)		(1.8 ± 1.2)E 0	15	(3.8 ± 3.0)E 0	(1.4 ± 1.5)E 0
(0)		(-1.8 - 2.3)E 1		(-1.1 - 2.3)E 1	(-8.4 - 8.3)E 0
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
RU-106 (60)		(-1.8 ± .9)E 1	24	(5.2 ± 1.8)E 1	(5.2 ± 1.8)E 1
(0)		(-2.0 - 1.5)E 2		(-4.5 - 12.9)E 1	(-4.5 - 12.9)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
I-131 (60)		(-2.0 ± 6.6)E 0	15	(1.4 ± 1.3)E 1	(-1.1 ± 18.7)E 0
(0)		(-1.3 - 1.1)E 2		(-5.2 - 9.7)E 1	(-1.0 - .9)E 2
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
CS-134 (60)	50.	(-2.2 ± 1.0)E 0	14	(2.4 ± 4.4)E 0	(-1.1 ± 2.5)E 0
(0)		(-1.5 - 1.9)E 1		(-5.5 - 18.7)E 0	(-2.0 - .9)E 1
		(0/ 49)		*(0/ 5)*	*(0/ 11)*
CS-137 (60)	50.	(2.1 ± .4)E 1	13	(6.7 ± .9)E 1	(2.4 ± .6)E 1
(0)		(-1.1 - 11.4)E 1		(1.9 - 11.4)E 1	(1.1 - 736.0)E -1
		(19/ 49)		*(10/ 11)*	*(6/ 11)*
BA-140 (60)		(-2.7 ± .5)E 1	11	(-1.4 ± .9)E 1	(-2.6 ± .8)E 1
(0)		(-1.2 - .3)E 2		(-5.6 - 3.3)E 1	(-7.3 - .2)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
CE-141 (60)		(1.1 ± .2)E 1	13	(2.3 ± .7)E 1	(7.4 ± 5.0)E 0
(0)		(-2.3 - 5.6)E 1		(-2.3 - 5.6)E 1	(-1.9 - 3.5)E 1
		(0/ 49)		*(0/ 11)*	*(0/ 11)*
CE-144 (60)	150.	(-2.7 ± .6)E 1	14	(-1.2 ± 1.7)E 1	(-1.6 ± 1.5)E 1
(0)		(-1.2 - .6)E 2		(-5.1 - 2.9)E 1	(-1.1 - .4)E 2
		(0/ 49)		*(0/ 5)*	*(0/ 11)*
AC-228 (60)		(3.9 ± .2)E 2	13	(6.4 ± .3)E 2	(3.5 ± .2)E 2
(0)		(1.6 - 7.4)E 2		(3.8 - 7.4)E 2	(2.8 - 4.9)E 2
		(49/ 49)		*(11/ 11)*	*(11/ 11)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-J-2
RESULTS OF SEDIMENT ANALYSES
FOR PLUTONIUM

Location	Depth (cm)	Results pCi/Kg (dry) +- % Error (1) (a)	
		238 Pu	239,240 Pu
Duxbury	0-2		
Plymouth Harbor	0-2		
Plymouth Harbor	16-18		
Rocky Point	0-2	Unavailable at this time	
Rocky Point	12-14		
Manomet Point	0-2		
Marshfield-Control	0-2		

(a) If the result is zero, the error is in pCi/Kg

III.K. Milk

Milk samples were collected primarily at two locations during 1984, the Plymouth County Farm (Station 11 - 3.5 mi - W) and the Whitman Farm (Station 21 - 21 mi - NW). As stated in Section II, Boston Edison is aware of a milk-producing cow located at Beaver Dam Road (Station 28 - 2.5 mi - S). Unfortunately, samples were unavailable from Beaver Dam Road during 1984. This, the only dependable indicator station (within 5 miles) for milk near PNPS-1 during 1984 was from the Plymouth Country Farm. This was confirmed in the 1984 Census (see Appendix E). When available, samples were collected semi-monthly when animals are on pasture (generally May through October) and monthly at other times. During 1984, milk samples were not collected from either station during week number 32 in early August due to the fault of Boston Edison.

The results of ERMAP program for the milk media are presented in Table III-K-1. The results of analyses for Cs-137 and Sr-90 are presented graphically in Figures III-K-1 and III-K-2 respectively. There were no positive measurements or indications of I-131 in any of the samples.

The highest mean concentration of Sr-90 occurred at Plymouth County Farm (collected on 5/17/84) and the highest mean concentration of Sr-89 occurred at the Plymouth County Farm (collected on 4/19/84). However, there were no positive measurements made of either Sr-89 or Sr-90, there were only indications of the presence of Sr-90 (activity greater than three times the standard deviation). Station releases for this

period exhibited a Sr-89/Sr-90 ratio of about 1/80 and therefore it is unlikely that PNPS-1 is the major source of the indicator station activity since the measured Sr-89/Sr-90 was about 2/5.

In the case of Cs-137, the highest mean value of concentration occurred at Plymouth County Farm (3.5 mi - W). The Cs-137 highest mean concentration for Plymouth County Farm occurred in mid-April (collected on 4/19/84). The absence of Cs-134 at this location would indicate that the primary source of Cs-137 is other than PNPS-1, and was most likely due to fallout from previous atmospheric weapons testing.

Therefore, it is extremely unlikely that there was any environmental impact on milk due to the operation of PNPS.

TABLE III-K-1
ERMAP RESULTS-MILK

MEDIUM: MILK UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
SR-89 (34)	10.	(3.2 ± 1.8)E -1	11	(3.2 ± 1.8)E -1	(-2.8 ± 1.4)E -1
(0)		(-5.8 - 20.6)E -1		(-5.8 - 20.6)E -1	(-1.1 - 1.7)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
SR-90 (34)	2.	(3.8 ± .2)E 0	11	(3.8 ± .2)E 0	(2.1 ± .2)E 0
(0)		(2.7 - 5.3)E 0		(2.7 - 5.3)E 0	(9.5 - 36.4)E -1
		(17/ 17)		*(17/ 17)*	*(15/ 17)*
BE-7 (34)		(1.4 ± 16.6)E -1	21	(9.5 ± 17.7)E -1	(9.5 ± 17.7)E -1
(0)		(-1.4 - 1.3)E 1		(-1.2 - 1.4)E 1	(-1.2 - 1.4)E 1
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
K-40 (34)		(1.4 ± .0)E 3	11	(1.4 ± .0)E 3	(1.4 ± .0)E 3
(0)		(1.4 - 1.5)E 3		(1.4 - 1.5)E 3	(1.3 - 1.5)E 3
		(17/ 17)		*(17/ 17)*	*(17/ 17)*
CR-51 (34)		(-1.8 ± 1.8)E 0	21	(-1.7 ± 2.8)E 0	(-1.7 ± 2.8)E 0
(0)		(-1.6 - 2.0)E 1		(-2.9 - 1.5)E 1	(-2.9 - 1.5)E 1
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
MN-54 (34)		(5.6 ± 33.5)E -2	21	(1.6 ± 2.4)E -1	(1.6 ± 2.4)E -1
(0)		(-1.9 - 3.2)E 0		(-1.8 - 1.7)E 0	(-1.8 - 1.7)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
CO-58 (34)		(-3.7 ± 1.8)E -1	21	(-3.5 ± 2.3)E -1	(-3.5 ± 2.3)E -1
(0)		(-1.8 - 1.1)E 0		(-1.9 - 1.6)E 0	(-1.9 - 1.6)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
FE-59 (34)		(8.9 ± 5.8)E -1	11	(8.9 ± 5.8)E -1	(5.8 ± 5.8)E -1
(0)		(-2.5 - 6.1)E 0		(-2.5 - 6.1)E 0	(-3.9 - 4.4)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
CO-60 (34)		(-7.8 ± 39.7)E -2	11	(-7.8 ± 39.7)E -2	(-6.9 ± 3.3)E -1
(0)		(-4.4 - 2.2)E 0		(-4.4 - 2.2)E 0	(-3.3 - 2.5)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-K-1
(CONTINUED)

MEDIUM: MILK UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
ZN-65 (34)		(-9.5 ± 6.8)E -1	21	(-3.5 ± 6.7)E -1	(-3.5 ± 6.7)E -1
(0)		(-6.6 - 5.6)E 0		(-6.5 - 3.7)E 0	(-6.5 - 3.7)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
ZR-95 (34)		(2.5 ± 3.2)E -1	11	(2.5 ± 3.2)E -1	(-5.2 ± 5.1)E -1
(0)		(-3.2 - 1.7)E 0		(-3.2 - 1.7)E 0	(-4.3 - 3.5)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
NB-95 (34)		(3.1 ± 2.9)E -1	11	(3.1 ± 2.9)E -1	(-3.6 ± 21.2)E -2
(0)		(-2.0 - 2.2)E 0		(-2.0 - 2.2)E 0	(-1.1 - 1.8)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
RU-103 (34)		(-1.0 ± .3)E 0	21	(-1.0 ± .3)E 0	(-1.0 ± .3)E 0
(0)		(-2.5 - 1.5)E 0		(-3.1 - .8)E 0	(-3.1 - .8)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
RU-106 (34)		(-1.9 ± 2.2)E 0	21	(-5.8 ± 22.1)E -1	(-5.8 ± 22.1)E -1
(0)		(-1.4 - 2.1)E 1		(-1.3 - 1.6)E 1	(-1.3 - 1.6)E 1
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
I-131 (34)	2.	(4.6 ± 6.4)E -3	11	(4.6 ± 6.4)E -3	(-2.4 ± 7.4)E -3
(0)		(-2.7 - 5.2)E -2		(-2.7 - 5.2)E -2	(-7.0 - 4.5)E -2
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
CS-134 (34)	15.	(-5.2 ± 2.1)E -1	11	(-5.2 ± 2.1)E -1	(-6.3 ± 2.2)E -1
(0)		(-2.1 - .9)E 0		(-2.1 - .9)E 0	(-2.2 - .6)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
CS-137 (34)	15.	(4.1 ± .5)E 0	11	(4.1 ± .5)E 0	(2.5 ± .5)E 0
(0)		(-1.2 - 8.9)E 0		(-1.2 - 8.9)E 0	(-9.1 - 658.0)E -2
		(13/ 17)		*(13/ 17)*	*(6/ 17)*
BA-140 (34)	15.	(-3.7 ± 3.7)E -1	11	(-3.7 ± 3.7)E -1	(-4.9 ± 3.6)E -1
(0)		(-3.5 - 2.2)E 0		(-3.5 - 2.2)E 0	(-2.3 - 4.1)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
CE-141 (34)		(1.1 ± .4)E 0	11	(1.1 ± .4)E 0	(1.0 ± .5)E 0
(0)		(-2.7 - 4.6)E 0		(-2.7 - 4.6)E 0	(-3.1 - 4.3)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-K-1
(CONTINUED)

MEDIUM: MILK UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
CE-144 (34)		(-1.2 ± 1.6)E 0	21	(9.7 ± 12.5)E -1	(9.7 ± 12.5)E -1
(0)		(-1.6 - 1.2)E 1		(-9.6 - 8.4)E 0	(-9.6 - 8.4)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*
AC-228 (34)		(-6.7 ± 10.3)E -1	21	(2.3 ± 10.7)E -1	(2.3 ± 10.7)E -1
(0)		(-9.4 - 5.6)E 0		(-7.2 - 7.5)E 0	(-7.2 - 7.5)E 0
		(0/ 17)		*(0/ 17)*	*(0/ 17)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

FIGURE III-K-1
CONCENTRATIONS OF Cs-137 IN MILK

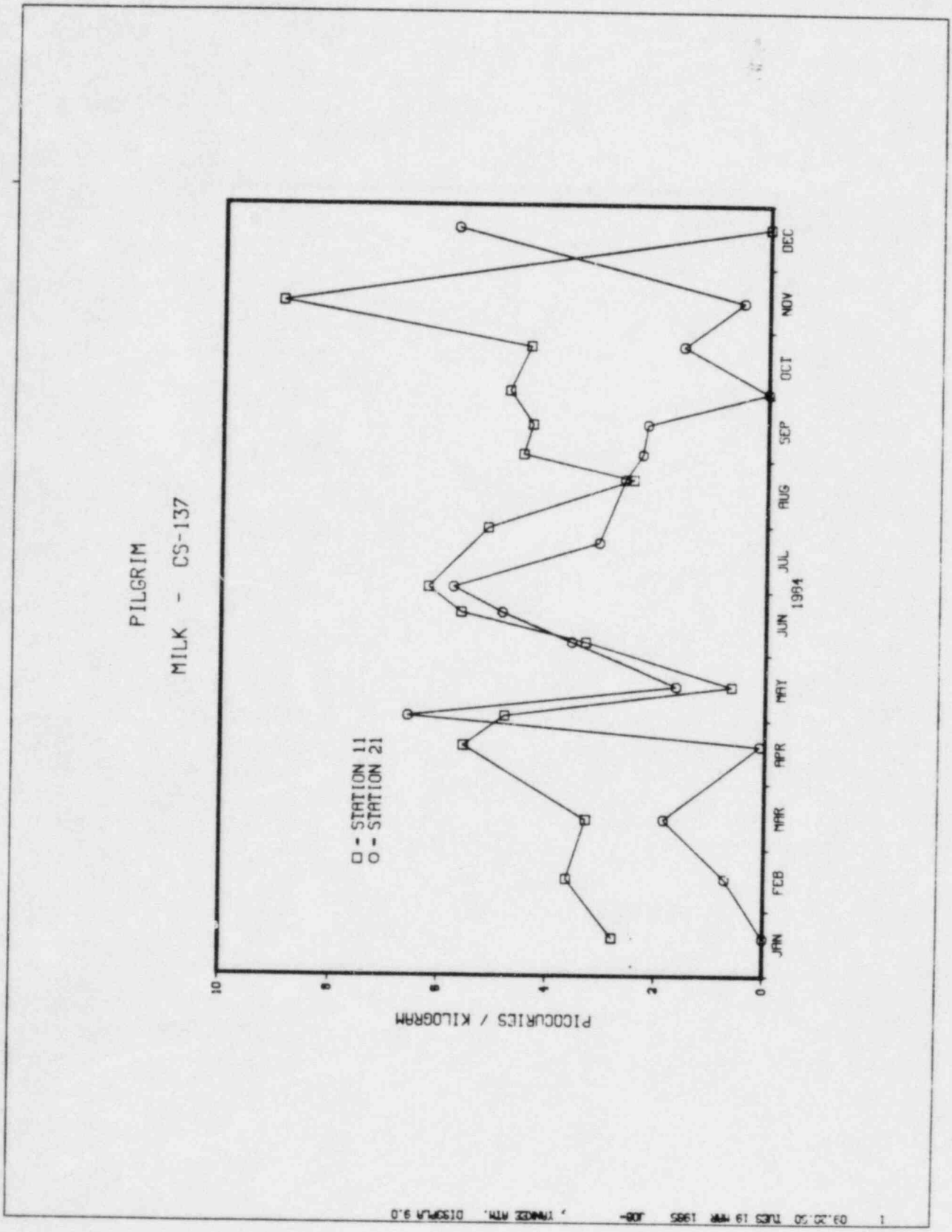
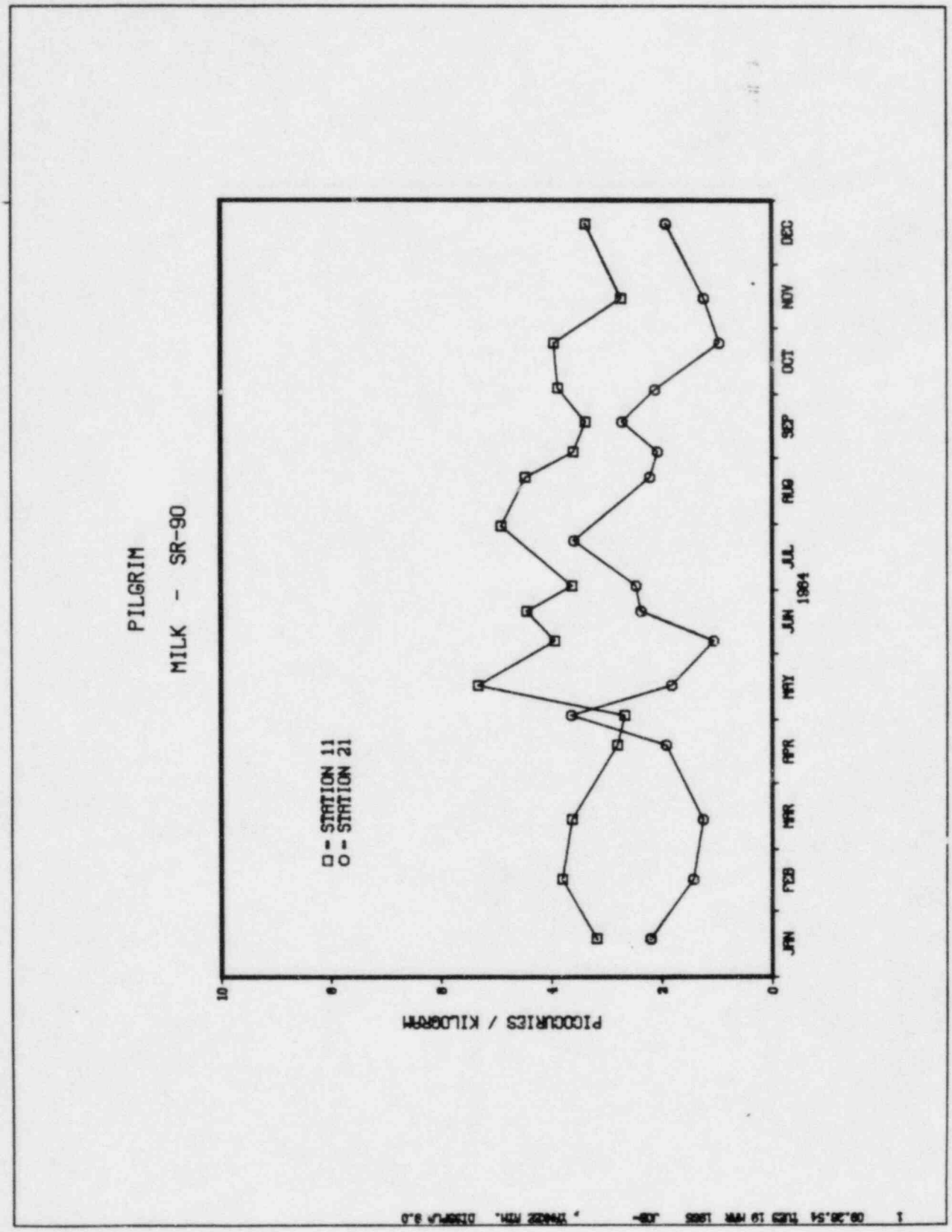


FIGURE III-K-2
CONCENTRATIONS OF Sr-90 IN MILK



III.L. Cranberries

Cranberries are collected from three locations: the Manomet Point Bog (2.5 mi - SE - Station 13), the Bartlett Road Bog (2.8 mi - SSE/S - Station 14) and the Pine Street Bog (17 mi - WNW - Station 23) at the time of harvest. The results of the ERMAP program for this media are presented in Table III-L-1. The only man-made radionuclide detected was Cs-137 which appeared in the Manomet Point Bog sample (collected on 9/18/84). A comprehensive study of cesium uptake in cranberries was performed during 1978. The results of this study are published in the 1978 Environmental Radiation Monitoring Program Report No. 11. This report identified fallout from previous nuclear weapons testing as the primary source of cesium in cranberries. In addition, this report indicated that cesium uptake in cranberries can be increased when conditions of low soil potassium occur, as cesium is a chemical congener of potassium. The results of this study and the fact that no other reactor related nuclides were measured above LLD in cranberry samples makes it extremely unlikely that there was any environmental impact on cranberries due to operation of PNPS-1, but rather that the measured concentration was due to fallout from previous weapons testing and a lack of adequate potassium in the soil.

TABLE III-L-1
ERMAP RESULTS-CRANBERRIES

MEDIUM: CRANBERRIES UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (3)		(5.5 ± 1.3)E 1	13	(6.8 ± 9.1)E 1	(3.0 ± 6.0)E 1
(0)		(4.2 - 6.8)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
K-40 (3)		(6.7 ± 1.1)E 2	14	(7.8 ± 1.5)E 2	(4.9 ± 1.5)E 2
(0)		(5.6 - 7.8)E 2			
		(2/ 2)		*(1/ 1)*	*(1/ 1)*
CR-51 (3)		(2.6 ± 11.6)E 1	14	(1.4 ± .8)E 2	(-3.5 ± 7.1)E 1
(0)		(-8.9 - 14.2)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
MN-54 (3)		(-9.3 ± 11.7)E 0	23	(5.7 ± 8.2)E 0	(5.7 ± 8.2)E 0
(0)		(-2.1 - .2)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CO-58 (3)		(-7.0 ± 5.8)E 0	23	(-9.5 ± 70.8)E -1	(-9.5 ± 70.8)E -1
(0)		(-1.3 - -.1)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
FE-59 (3)		(1.5 ± .0)E 1	14	(1.5 ± 1.6)E 1	(1.0 ± 1.5)E 1
(0)		(1.5 - 1.5)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CO-60 (3)		(-1.1 ± .6)E 1	23	(1.4 ± 1.1)E 1	(1.4 ± 1.1)E 1
(0)		(-1.8 - -.5)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
ZN-65 (3)		(-1.6 ± .3)E 1	23	(2.9 ± 15.1)E 0	(2.9 ± 15.1)E 0
(0)		(-1.9 - -1.3)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
ZR-95 (3)		(9.3 ± 6.1)E 0	13	(1.5 ± 1.7)E 1	(-1.7 ± 1.4)E 1
(0)		(3.3 - 15.4)E 0			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-L-1
(CONTINUED)

MEDIUM: CRANBERRIES

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (3)		(9.5 ± 1.9)E 0	13	(1.1 ± 1.1)E 1	(6.6 ± 7.7)E 0
(0)		(7.6 - 11.4)E 0			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
RU-103 (3)		(-1.6 ± .1)E 1	23	(-7.8 ± 75.8)E -1	(-7.8 ± 75.8)E -1
(0)		(-1.7 - -1.6)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
RU-106 (3)		(-2.4 ± 8.6)E 1	13	(6.2 ± 8.4)E 1	(1.4 ± 5.5)E 1
(0)		(-1.1 - .6)E 2			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
I-131 (3)		(2.0 ± 3.1)E 1	14	(5.1 ± 2.2)E 1	(4.8 ± 13.6)E 0
(0)		(-1.1 - 5.1)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CS-134 (3)		(-1.5 ± .3)E 1	23	(3.7 ± 7.2)E 0	(3.7 ± 7.2)E 0
(0)		(-1.8 - -1.2)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CS-137 (3)		(1.2 ± 1.2)E 2	13	(2.5 ± .2)E 2	(7.7 ± 6.9)E 0
(1)		(-1.8 - 248.0)E 0			
		(1/ 2)		*(1/ 1)*	*(0/ 1)*
BA-140 (3)		(-1.6 ± 2.2)E 1	13	(6.1 ± 18.1)E 0	(-1.1 ± 11.6)E 0
(0)		(-3.7 - .6)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CE-141 (3)		(1.6 ± .3)E 1	13	(1.9 ± 1.9)E 1	(8.9 ± 11.7)E 0
(0)		(1.3 - 1.9)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
CE-144 (3)		(-1.3 ± 5.9)E 1	13	(4.6 ± 5.9)E 1	(-6.4 ± 41.4)E 0
(0)		(-7.2 - 4.6)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*
AC-228 (3)		(-5.1 ± 21.2)E 0	13	(1.6 ± 5.0)E 1	(-1.3 ± 35.9)E 0
(0)		(-2.6 - 1.6)E 1			
		(0/ 2)		*(0/ 1)*	*(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

Samples of tuberous and green leafy vegetables were collected at the time of harvest at five locations: Plymouth County Farm (3.5 mi - W), Bridgewater Farm (20 mi - W), the Malmgren Residence (1.0 mi - W), the Work Residence (0.6 mi - ESE), the Jenkins Residence (1.0 mi-SE), and the Whipple Farm (1.5 mi - SSW).

The only nuclides observed (other than naturally occurring Be-7, AcTh-228 (peak) and K-40) was Cs-137. A positive measurement of Cs-137 was detected in a vegetation sample from the Jenkins Residence (rhubarb, collected 9/26/84). The absence of Cs-134 at this location and the fact that measured Cs-137 concentration is greater than 10,000 times what would be expected at this location based on releases from PNPS-1, strongly indicates that fallout, not PNPS-1, is the primary source of this Cs-137. Therefore, it is extremely unlikely that there was any environmental impact on vegetation due to the operation of PNPS-1.

TABLE III-M-1
ERMAP RESULTS-VEGETATION

MEDIUM: FOOD CROP UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (10)		(4.5 ± 1.7)E 2	16	(1.3 ± .1)E 3	(2.9 ± 2.0)E 1
(5)		(-8.8 - 1300.0)E 0			(-1.1 - 5.5)E 1
		(5/ 7)		*(1/ 1)*	*(0/ 3)*
K-40 (10)		(2.7 ± .3)E 3	43	(3.7 ± .2)E 3	(2.0 ± .3)E 3
(0)		(1.3 - 3.7)E 3			(1.4 - 2.4)E 3
		(7/ 7)		*(1/ 1)*	*(3/ 3)*
CR-51 (10)		(-1.9 ± 2.5)E 1	16	(9.1 ± 8.9)E 1	(-2.1 ± 3.4)E 1
(0)		(-9.3 - 9.1)E 1			(-7.1 - 4.5)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
MN-54 (10)	130.	(-3.0 ± 1.7)E 0	16	(4.9 ± 83.5)E -1	(-3.8 ± 2.9)E 0
(0)		(-1.2 - .2)E 1			(-9.4 - .2)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CO-58 (10)	130.	(-4.1 ± 1.4)E 0	76	(-1.9 ± 6.4)E 0	(-4.9 ± 6.3)E 0
(0)		(-1.3 - -.2)E 1			(-1.7 - .4)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
FE-59 (10)	260.	(-1.1 ± 4.4)E 0	76	(6.6 ± 13.4)E 0	(5.2 ± 8.5)E 0
(0)		(-2.0 - .8)E 1			(-7.2 - 21.4)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CO-60 (10)	130.	(3.5 ± 4.4)E 0	16	(1.2 ± 1.3)E 1	(-8.1 ± 4.5)E 0
(0)		(-6.9 - 26.5)E 0			(-1.6 - -.0)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
ZN-65 (10)	260.	(8.7 ± 47.5)E -1	43	(2.0 ± 2.4)E 1	(9.4 ± 6.3)E 0
(0)		(-1.3 - 2.0)E 1			(-3.1 - 16.7)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
ZR-95 (10)		(-7.7 ± 58.4)E -1	27	(1.9 ± .5)E 1	(1.9 ± .5)E 1
(0)		(-2.6 - 1.4)E 1		(1.2 - 2.8)E 1	(1.2 - 2.8)E 1
		(0/ 7)		*(0/ 3)*	*(0/ 3)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-M-1
(CONTINUED)

MEDIUM: FOOD CROP — UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (10)		(2.0 ± 2.7)E 0	76	(9.7 ± 6.3)E 0	(2.2 ± 4.4)E 0
(0)		(-8.2 - 11.2)E 0			(-3.4 - 11.0)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
RU-103 (10)		(-3.8 ± 2.0)E 0	43	(1.5 ± 12.1)E 0	(6.1 ± 42.1)E -1
(0)		(-9.6 - 1.5)E 0			(-5.2 - 8.8)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
RU-106 (10)		(-3.5 ± 2.2)E 1	75	(3.4 ± 41.0)E 0	(-3.3 ± 6.5)E 1
(0)		(-1.3 - .3)E 2			(-9.9 - 9.7)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
I-131 (10)	80.	(2.1 ± 72.8)E -1	75	(1.1 ± 1.6)E 1	(-9.2 ± 113.1)E -1
(0)		(-3.5 - 2.7)E 1			(-2.3 - 1.4)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CS-134 (10)	80.	(-2.1 ± 4.3)E 0	75	(9.2 ± 6.8)E 0	(-1.1 ± .1)E 1
(0)		(-1.8 - 1.3)E 1			(-1.3 - -1.0)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CS-137 (10)	80.	(1.6 ± .8)E 1	76	(6.0 ± .8)E 1	(6.6 ± 4.2)E 0
(1)		(-3.3 - 60.4)E 0			(-1.8 - 11.7)E 0
		(1/ 7)		*(1/ 1)*	*(0/ 3)*
BA-140 (10)		(-3.2 ± 2.8)E 0	43	(7.0 ± 17.5)E 0	(-1.1 ± 4.5)E 0
(0)		(-1.4 - .7)E 1			(-9.0 - 6.5)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CE-141 (10)		(5.2 ± 4.7)E 0	16	(2.6 ± 1.4)E 1	(3.5 ± 6.8)E 0
(0)		(-1.2 - 2.6)E 1			(-7.3 - 16.1)E 0
		(0/ 7)		*(0/ 1)*	*(0/ 3)*
CE-144 (10)		(2.9 ± 1.7)E 1	11	(5.3 ± 3.1)E 1	(7.1 ± 9.8)E 0
(0)		(-2.1 - 11.5)E 1		(1.6 - 11.5)E 1	(-1.2 - 2.1)E 1
		(0/ 7)		*(0/ 3)*	*(0/ 3)*
AC-228 (10)		(2.3 ± .9)E 1	75	(4.2 ± 2.6)E 1	(2.9 ± 2.9)E 1
(0)		(-4.1 - 59.9)E 0			(-2.3 - 7.8)E 1
		(0/ 7)		*(0/ 1)*	*(0/ 3)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

III.N. Forage

Beef forage is collected from three locations annually: the Plymouth County Farm (3.5 mi - W - Station Number 11), Whitman Farm (21 mi - NW - Station 21) and Bridgewater Farm (20 mi - W - Station 27). The beef forage sample from Station #27 was unavailable during 1984. The results of the ERMAP program for the media are presented in Table III-N-1. The following positive measurements were made: Be-7 and Cs-137 at the Plymouth County Farm; and, Be-7 at the Whitman Farm. In addition, all stations had a positive measurement of K-40.

The only positive measurement of Cs-137 occurred at the Plymouth County Farm. The Plymouth County Farm is an indicator station and is located 3.5 miles - W from PNPS-1. The absence of Cs-134 at this location and the fact that the measured Cs-137 concentration is about 10,000 times what would be expected at this location based on releases from PNPS-1. This strongly indicates that fallout from previous atmospheric weapons testing, not PNPS-1, is the primary source of this Cs-137.

Therefore, it is extremely unlikely that there was any environmental impact on forage due to the operation of PNPS-1.

TABLE III-N-1
ERMAP RESULTS-FORAGE

MEDIUM: CATTLE FEED UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
BE-7 (2) (0)		(4.7 ± .3)E 3 *(1/ 1)*	11	(4.7 ± .3)E 3 *(1/ 1)*	(2.6 ± .2)E 3 *(1/ 1)*
K-40 (2) (0)		(4.8 ± .4)E 3 *(1/ 1)*	21	(1.6 ± .1)E 4 *(1/ 1)*	(1.6 ± .1)E 4 *(1/ 1)*
CR-51 (2) (0)		(3.3 ± 24.2)E 1 *(0/ 1)*	11	(3.3 ± 24.2)E 1 *(0/ 1)*	(-8.7 ± 17.7)E 1 *(0/ 1)*
MN-54 (2) (0)	130.	(3.6 ± 1.9)E 1 *(0/ 1)*	11	(3.6 ± 1.9)E 1 *(0/ 1)*	(-3.7 ± 13.7)E 0 *(0/ 1)*
CO-58 (2) (0)	130.	(7.0 ± 19.5)E 0 *(0/ 1)*	21	(1.9 ± 1.5)E 1 *(0/ 1)*	(1.9 ± 1.5)E 1 *(0/ 1)*
FE-59 (2) (0)	260.	(6.6 ± 50.3)E 0 *(0/ 1)*	11	(6.6 ± 50.3)E 0 *(0/ 1)*	(-6.8 ± 46.5)E 0 *(0/ 1)*
CO-60 (2) (0)	130.	(3.4 ± 258.0)E -1 *(0/ 1)*	11	(3.4 ± 258.0)E -1 *(0/ 1)*	(-1.3 ± 1.9)E 1 *(0/ 1)*
ZN-65 (2) (0)	260.	(3.0 ± 4.2)E 1 *(0/ 1)*	11	(3.0 ± 4.2)E 1 *(0/ 1)*	(-6.6 ± 4.1)E 1 *(0/ 1)*
ZR-95 (2) (0)		(-3.8 ± 3.8)E 1 *(0/ 1)*	21	(1.7 ± 2.8)E 1 *(0/ 1)*	(1.7 ± 2.8)E 1 *(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

TABLE III-N-1
(CONTINUED)

MEDIUM: CATTLE FEED

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS MEAN RANGE NO. DETECTED**	STATION WITH HIGHEST MEAN STA. NO.	MEAN RANGE NO. DETECTED**	CONTROL STATIONS MEAN RANGE NO. DETECTED**
NB-95 (2)		(1.4 ± 2.3)E 1	21	(1.5 ± 1.9)E 1	(1.5 ± 1.9)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
RU-103 (2)		(-4.4 ± 23.4)E 0	11	(-4.4 ± 23.4)E 0	(-2.4 ± 2.0)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
RU-106 (2)		(-1.3 ± 1.2)E 2	11	(-1.3 ± 1.2)E 2	(-1.6 ± 1.3)E 2
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
I-131 (2)	80.	(-1.9 ± 2.2)E 2	21	(-1.1 ± 1.6)E 2	(-1.1 ± 1.6)E 2
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
CS-134 (2)	80.	(3.8 ± 2.0)E 1	11	(3.8 ± 2.0)E 1	(-1.7 ± 1.5)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
CS-137 (2)	80.	(9.1 ± 1.9)E 1	11	(9.1 ± 1.9)E 1	(3.4 ± 137.0)E -1
(1)		*(1/ 1)*		*(1/ 1)*	*(0/ 1)*
BA-140 (2)		(-1.6 ± .9)E 2	21	(-5.9 ± 8.5)E 1	(-5.9 ± 8.5)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
CE-141 (2)		(1.2 ± 3.6)E 1	11	(1.2 ± 3.6)E 1	(-2.0 ± 2.7)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
CE-144 (2)		(7.8 ± 78.8)E 0	11	(7.8 ± 78.8)E 0	(-5.8 ± 6.1)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*
AC-228 (2)		(-8.6 ± 7.0)E 1	21	(-7.6 ± 6.6)E 1	(-7.6 ± 6.6)E 1
(0)		*(0/ 1)*		*(0/ 1)*	*(0/ 1)*

* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

** THE FRACTION OF SAMPLE ANALYSES YIELDING DETECTABLE MEASUREMENTS (I.E. >3 STD DEVIATIONS) IS INDICATED WITH *( )*.

IV. References

1. Regulatory Guide 1.109 - CALCULATION OF ANNUAL DOSES TO MAN FROM ROUTINE RELEASES OF REACTOR EFFLUENTS FOR THE PURPOSE OF EVALUATING COMPLIANCE WITH 10 CFR PART 50, APPENDIX I - Revision 1, October 1977.

2. SETTLEMENT AGREEMENT BETWEEN MASSACHUSETTS WILDLIFE FEDERATION AND BOSTON EDISON COMPANY RELATING TO OFFSITE RADIOLOGICAL MONITORING - June 9, 1977.

3. Yankee Atomic Electric Company - Program "ERMAP", Version 3.1 -January 9, 1979, Author - J. E. Vossahlik.

4. Memorandum, Yankee Atomic Electric Company, 1984 Annual Direct Radiation Survey, REG 136/84, July 1984, E. R. Cumming.

5. Memorandum, Yankee Atomic Electric Company, REG. 211/76, A. E. Desrosiers.

6. Report on Accumulation of Cesium - 137 in Cranberries, March 1979, Yankee Atomic Electric Company, M. Strum.

APPENDIX A - ANOMALOUS MEASUREMENT REPORTS

There were no Anomalous Measurement Reports for the year of 1984.

APPENDIX B - Radioactive Effluents

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information

January - June, 1984

Facility Pilgrim Nuclear Power Station License DPR-35

1. Regulatory Limits

   a. Fission and activation gases $\frac{Q_S}{0.25/\bar{E}} + \frac{Q}{0.10/\bar{E}} \leq 1$

   b. Iodines 2Ci/Quarter

   c. Particulates, half-lives >8 days $13(1.8E4Q_S+1.8E5Q_V) \leq 1$

   d. Liquid effluents 10Ci/Quarter

2. Maximum Permissible Concentration

   Provide the MPC's used in determining allowable release rates or concentrations

   a. Fission and activation gases } 10 CFR 20
   b. Iodines } Appendix B
   c. Particulates, half-lives >8 days } Table II

   d. Liquid effluents $H-3 = 1 \times 10^{-5}$ μCi/ml; all rest, 10 CFR 20, Appendix B, Table II

3. Average Energy

   Provide the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases, if applicable $\bar{E}$ = N/

4. Measurements and Approximations of Total Radioactivity

   Provide the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.

   a. Fission and activation gases } GeLi
   b. Iodines } Istopic
   c. Particulates } Analysis
   d. Liquid effluents }

5. Batch Releases

   Provide the following information relating to batch releases of radioactive materials in liquid and gaseous effluents.

   a. Liquid

      1. Number of batch releases 324
      2. Total time period for batch releases 1425.55 hours
      3. Maximum time period for a batch release - 76.50 hours
      4. Average time period for batch releases 4.40 hours
      5. Minimum time period for a batch release - 10 minutes
      6. Average stream flow during periods of release of effluent into a flowing stream 5.27E4GPM

   b. Gaseous (Not Applicable)

6. Abnormal Releases

   a. None
   b. None

TABLE 1A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

JANUARY - JUNE 1984

	Unit	Quarter 1	Quarter 2	Est. Total Error, %
A. Fission and activation gases				
1. Total release	Ci	*	*	
2. Average release rate for period	μCi/sec			
3. Percent of Technical Specification limit	%			
B. Iodines				
1. Total iodine-131	Ci	<4.74E-5	*	25
2. Average release rate for period	μCi/sec	<9.14E-6		
3. Percent of Technical Specification limit	%	<2.37E-3		
C. Particulates				
1. Particulates with half-lives > 8 days	Ci	<1.18E-3	1.37E-3	30
2. Average release rate for period	μCi/sec	<2.28E-4	5.29E-4	
3. Percent of Technical Specification limit	%	<0.05	<0.05	
4. Gross alpha radioactivity	Ci	7.15E-7	<1.19E-6	
D. Tritium				
1. Total release	Ci	1.28E0	1.89E-1	40
2. Average release rate for period	μCi/sec	1.63E-1	2.40E-2	
3. Percent of Technical Specification limit	%	-	-	

*Plant shutdown on 12/10/83 - no releases

TABLE 1B

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)

GASEOUS EFFLUENTS – ELEVATED RELEASE

JANUARY - JUNE 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter	Quarter
1. Fission gases					
krypton-85	Ci	*	*		
krypton-85m	Ci	*	*		
krypton-87	Ci	*	*		
krypton-88	Ci	*	*		
xenon-133	Ci	*	*		
xenon-135	Ci	*	*		
xenon-135m	Ci	*	*		
xenon-138	Ci	*	*		
xenon-131m	Ci	*	*		
xenon-137	Ci	*	*		
xenon-133m	Ci	*	*		
Total for period	Ci	*	*		
2. Iodines					
iodine-131	Ci	< 6.19E-6	*		
iodine-133	Ci	*	*		
iodine-135	Ci	*	*		
Total for period	Ci	< 6.19E-6	*		
3. Particulates					
strontium-89	Ci	< 1.52E-4	*		
strontium-90	Ci	< 1.80E-6	*		
cesium-134	Ci	< 3.98E-6	*		
cesium-137	Ci	3.04E-6	*		
barium-lanthanum-140	Ci	< 9.60E-6	*		
chromium-51	Ci	-	*		
manganese-54	Ci	1.24E-6	*		
cobalt-58	Ci	-	*		
iron-59	Ci	-	*		
cobalt-60	Ci	8.13E-6	*		
zinc-65	Ci	-	*		
zirconium-niobium-95	Ci	-	*		
cerium-141	Ci	-	*		
cerium-144	Ci	-	*		
ruthenium-103	Ci	-	*		
ruthenium-106	Ci	-	*		

*Plant shutdown on 12/10/83 - no releases

TABLE 1C
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)
GASEOUS EFFLUENTS - GROUND LEVEL RELEASE

JANUARY - JUNE 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter	Quarter
1. Fission gases					
krypton-85	Ci	*	*		
krypton-85m	Ci	*	*		
krypton-87	Ci	*	*		
krypton-88	Ci	*	*		
xenon-133	Ci	*	*		
xenon-135	Ci	*	*		
xenon-135m	Ci	*	*		
xenon-138	Ci	*	*		
Total for period	Ci	*	*		
2. Iodines					
iodine-131	Ci	<4.12E-5	*		
iodine-133	Ci	*	*		
iodine-135	Ci	*	*		
Total for period	Ci	<4.12E-5	*		
3. Particulates					
strontium-89	Ci	<1.28E-6	<6.90E-7		
strontium-90	Ci	<1.94E-7	1.23E-6		
cesium-134	Ci	1.24E-5	1.02E-5		
cesium-137	Ci	1.46E-4	1.17E-4		
barium-lanthanum-140	Ci	<5.07E-5	-		
manganese-54	Ci	2.11E-4	1.73E-4		
cobalt-58	Ci	2.84E-5	9.39E-6		
iron-59	Ci	-	-		
cobalt-60	Ci	5.54E-4	8.29E-4		
zinc-65	Ci	-	2.26E-4		
zirconium-niobium-95	Ci	-	-		
cerium-141	Ci	-	-		
ruthenium-103	Ci	-	-		
ruthenium-106	Ci	-	-		

*Plant Shutdown on 12/10/83 - no releases

TABLE 2A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter 1	Quarter 2	Est. Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, noble gases, or alpha)	Ci	1.61E0	7.01E-2	30
2. Average diluted concentration during period	µCi/ml	1.05E-7	4.01E-8	
3. Percent of applicable limit	%	16.10	0.70	
B. Tritium				
1. Total release	Ci	1.00E1	4.57E-1	30
2. Average diluted concentration during period	µCi/ml	6.54E-7	2.61E-7	
3. Percent of applicable limit	%	6.54	2.61	
C. Dissolved and entrained gases				
1. Total release	Ci	(a)	(a)	
2. Average diluted concentration during period	µCi/ml	-	-	
3. Percent of applicable limit	%			
D. Gross alpha radioactivity				
1. Total release	Ci	< 3.60E-4	< 7.54E-5	40
E. Volume of waste released (prior to dilution)	liters	7.26E6	9.99E5	20
F. Volume of dilution water used during period	liters	1.53E10	1.75E9	20

(a) No measurable releases.

TABLE 2B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)

LIQUID EFFLUENTS
JANUARY - JUNE 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter	Quarter	Quarter 1	Quarter 2
strontium-89	Ci			< 3.08E-4	< 4.50E-5
strontium-90	Ci			1.83E-3	< 9.63E-5
cesium-131	Ci			2.80E-3	1.80E-4
cesium-137	Ci			7.89E-2	7.02E-3
iodine-131	Ci			8.20E-7	-
cobalt-58	Ci			2.78E-2	7.07E-4
cobalt-60	Ci			8.41E-1	4.19E-2
iron-59	Ci			5.57E-3	-
zinc-65	Ci			1.61E-3	3.77E-4
manganese-54	Ci			8.33E-2	3.13E-3
chromium-51	Ci			2.62E-5	1.61E-5
zirconimum-niobium-95	Ci			-	-
molybdenum 99-technetium 99m	Ci			-	-
barium-lanthanum-140	Ci			1.29E-6	-
cerium-141	Ci			2.23E-3	-
iodine-133	Ci			-	-
cerium-144	Ci			2.08E-3	-
silver-110m	Ci			-	-
iron-55	Ci			4.55E-1	1.24E-2
unidentified	Ci			1.09E-1	4.22E-3
Total for period (above)	Ci			1.61E0	7.01E-2
xenon-133	Ci			-	-
xenon-135	Ci			-	-

TABLE 3

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT (1984)
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
JANUARY - JUNE 1984

A. SOLID WASTE SHIPPED OFF SITE FOR BURIAL OR DISPOSAL. (not irradiated fuel)

1. TYPE OF WASTE	UNIT	6 MONTH PERIOD	EST. TOTAL ERROR %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3	82.12	
	Ci	311.39830	N/A
b. Dry compressible waste, contaminated equipment, etc.	m^3	1241.55	
	Ci	29.16550	N/A
c. Irradiated components, control rods, etc.	m^3		
	Ci	N/A	N/A
d. Other (Describe) miscellaneous low-level waste	m^3		
	Ci	N/A	N/A

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION. (by type of waste)		%	E(Curies)
a. Spent Resin, Filter Sludges, Evaporator Bottoms, etc.	Co-60	44.505	138.58645
	Co-58	2.716	8.4579
	H-3	0.046	0.14254
	Cs-137	32.869	102.35222
	Cs-134	2.549	7.93936
	C-14	0.026	0.08098
	Fe-59	0.196	0.60939
	I-131	0.004	0.01180
	I-129	0.010	0.03110
	La-140	0.064	0.20060
	Nb-95	0.010	0.03181
	Zr-95	0.007	0.02066
	Sr-90	7.441	23.17074
	Ni-63	1.403	4.37051
	Tc-99m	0.010	0.03110
	Mo-99	-	-
	Zn-65	1.698	5.28686
	Mn-54	3.874	12.06298
	Cr-51	2.148	6.68872
	Np-239	0.004	0.01180
	Pu-241	0.372	1.15971
	Ru-103	0.008	0.02609
	Cm-242	0.017	0.05187
	Sb-124	0.023	0.07307
	TOTAL	100.000	311.39830

TABLE 3 (continued)

		%	E(Curies)
b. Dry Compressible Waste Contaminated Equipment	Co-60	43.719	12.73023
	Co-58	7.620	2.21876
	Cs-137	7.882	2.29517
	Cs-134	0.499	0.14529
	Fe-59	1.315	0.38298
	I-131	0.021	0.00626
	Ba-140	0.506	0.14720
	Sr-90	0.167	0.04859
	Tc-99m	0.012	0.00357
	Zn-65	4.564	1.32893
	Mn-54	5.032	1.46510
	Nb-95	0.058	0.01692
	Zr-95	0.027	0.00788
	Cr-51	25.950	7.55626
	Ce-141	0.149	0.04338
	Ru-103	0.036	0.01061
	Ni-63	0.744	0.21663
	Pu-241	0.374	0.10874
	Cm-242	0.010	0.00286
	I-129	0.010	0.00296
	*C-14	0.018	0.00532
	*H-3	1.068	0.35797
	Cs-136	.009	0.00275
	Sb-124	.128	0.03724
	Ag-110	.082	0.02390
	TOTAL	100.000	*29.16550

c. N/A

d. N/A

3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
52	Tractor - Trailer	Barnwell, S.C.

4 IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/a

*C-14 and H-3 activities were not considered as part of the total percent for the first several shipments of 1984, but were listed separately on shipping documents. These separate totals have been added to the Curie column for this report.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information

July - December, 1984

Facility Pilgrim Nuclear Power Station **Licensee** DPR-35

1. **Regulatory Limits**

   a. Fission and activation gases: $\frac{Qs}{0.25/\bar{E}} + \frac{Qv}{0.10/\bar{E}} \leq 1$

   b. Iodines: 2Ci/Quarter

   c. Particulates, half-lives >8 days: 13 (1.8E4Qs + 1.8E5Qv) $\leq$ 1

   d. Liquid effluents: 10Ci/Quarter

2. **Maximum Permissible Concentration**

   Provide the MPC's used in determining allowable release rates or concentrations.

   a. Fission and activation gases: } 10 CFR 20
   b. Iodines: } Appendix B
   c. Particulates, half-lives >8 days: } Table II

   d. Liquid effluents: H - 3 = 1 X 10^{-5} μCi/ml; all rest, 10 CFR 20, Appendix B, Table II

3. **Average Energy**

   Provide the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases, if applicable. ~~XXXXXXXX~~

   $\bar{E}$ for Qs = 0.795 ; $\bar{E}$ for Qv = 0.434

4. **Measurements and Approximations of Total Radioactivity**

   Provide the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.

   a. Fission and activation gases: } GeLi
   b. Iodines: } Istopic
   c. Particulates: } Analysis
   d. Liquid effluents: }

5. **Batch Releases**

   Provide the following information relating to batch releases of radioactive materials in liquid and gaseous effluents.

   a. **Liquid**

      1. Number of batch releases: 343
      2. Total time period for batch releases: 1464.73 hours
      3. Maximum time period for a batch release: - 67.33 hours
      4. Average time period for batch releases: 4.20 hours
      5. Minimum time period for a batch release: - 0.25 hour
      6. Average stream flow during periods of release of effluent into a flowing stream: 9.53E + 4 GPM

   b. **Gaseous** **(Not Applicable)**

6. **Abnormal Releases**

   a. NONE
   b.

TABLE 1A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

July - December, 1984

	Unit	Quarter (3)	Quarter (4)	Est. Total Error, %
A. Fission and activation gases				
1. Total release	Ci	N/A*	<1.84E+1	4.30E+1
2. Average release rate for period	μCi/sec		<2.31E0	
3. Percent of Technical Specification limit	%		<7.33E-4	
B. Iodines				
1. Total iodine-131	Ci	N/A*	<3.09E-5	3.50E+1
2. Average release rate for period	μCi/sec		<3.89E-6	
3. Percent of Technical Specification limit	%		<1.55E-3	
C. Particulates				
1. Particulates with half-lives > 8 days	Ci	1.74E-3	<8.03E-4	3.50E+1
2. Average release rate for period	μCi/sec	2.19E-4	<1.01E-4	
3. Percent of Technical Specification limit	%	5.12E-2	<1.75E-2	
4. Gross alpha radioactivity	Ci	3.81E-7	<5.14E-7	
D. Tritium				
1. Total release	Ci	2.16E-1	8.28E-2	5.25E+1
2. Average release rate for period	μCi/sec	2.72E-2	1.04E-2	
3. Percent of Technical Specification limit	%	N/A	N/A	

* Plant shut down since 12-10-83

TABLE 1B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)
GASEOUS EFFLUENTS – ELEVATED RELEASE

July - December, 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter (3)	Quarter (4)	Quarter	Quarter
1. Fission gases					
krypton-85	Ci		<1.00E-5		
krypton-85m	Ci		1.67E0		
krypton-87	Ci		3.10E0		
krypton-88	Ci		4.27E0		
xenon-133	Ci		9.30E-1		
xenon-135	Ci		7.18E0		
xenon-135m	Ci		7.00E-2		
xenon-138	Ci		2.90E-1		
xenon-131m	Ci		-		
xenon-137	Ci		-		
xenon-133m	Ci		-		
Total for period	Ci		1.75E+1		
2. Iodines					
iodine-131	Ci		2.39E-5		
iodine-133	Ci		1.85E-3		
iodine-135	Ci		2.84E-3		
Total for period	Ci		4.71E-3		
3. Particulates					
strontium-89	Ci		1.58E-4		
strontium-90	Ci		1.29E-6		
cesium-134	Ci		-		
cesium-137	Ci		<1.35E-5		
barium-lanthanum-140	Ci		2.21E-5		
chromium-51	Ci		-		
manganese-54	Ci		-		
cobalt-58	Ci		-		
iron-59	Ci		-		
cobalt-60	Ci		<3.55E-5		
zinc-65	Ci		-		
zirconium-niobium-95	Ci		-		
cerium-141	Ci		-		
cerium-144	Ci		-		
ruthenium-103	Ci		-		
ruthenium-106	Ci		-		

TABLE 1C
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)
GASEOUS EFFLUENTS - GROUND LEVEL RELEASE

July - December, 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter(3)	Quarter (4)	Quarter	Quarter
1. Fission gases					
krypton-85	Ci		< 1.00E-6		
krypton-85m	Ci		< 2.00E-2		
krypton-87	Ci		< 6.00E-2		
krypton-88	Ci		< 8.00E-2		
xenon-133	Ci		< 6.00E-2		
xenon-135	Ci		6.80E-1		
xenon-135m	Ci		-		
xenon-138	Ci		-		
Total for period	Ci		9.00E-1		
2. Iodines					
iodine-131	Ci		< 7.03E-6		
iodine-133	Ci		< 4.32E-5		
iodine-135	Ci		< 5.59E-4		
Total for period	Ci		< 6.09E-4		
3. Particulates					
strontium-89	Ci	< 5.79E-7	1.52E-4		
strontium-90	Ci	< 1.94E-7	< 4.44E-7		
cesium-134	Ci	-			
cesium-137	Ci	6.53E-5	< 6.43E-5		
barium-lanthanum-140	Ci	-	< 9.00E-6		
manganese-54	Ci	1.19E-4			
cobalt-58	Ci	-			
iron-59	Ci	-			
cobalt-60	Ci	1.55E-3	< 3.47E-4		
zinc-65	Ci	-			
zirconium-niobium-95	Ci	-			
cerium-141	Ci	-			
ruthenium-103	Ci	-			
ruthenium-106	Ci	-			

TABLE 2A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES
July - December, 1984

	Unit	Quarter (3)	Quarter (4)	Est. Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, noble gases, or alpha)	Ci	9.80E-1	2.09E0	3.54E+1
2. Average diluted concentration during period	μCi/ml	7.42E-8	1.13E-7	
3. Percent of applicable limit	%	9.80E0	2.09E+1	
B. Tritium				
1. Total release	Ci	1.48E0	2.77E0	3.55E+1
2. Average diluted concentration during period	μCi/ml	1.12E-7	1.50E-7	
3. Percent of applicable limit	%	1.12E0	1.50E0	
C. Dissolved and entrained gases				
1. Total release	Ci	-	1.72E-3	4.24E+1
2. Average diluted concentration during period	μCi/ml	-	9.30E-11	
3. Percent of applicable limit	%	-	-	
D. Gross alpha radioactivity				
1. Total release	Ci	< 1.95E-4	< 4.09E-4	5.00E+1
E. Volume of waste released (prior to dilution)	liters	2.92E+6	8.86E+6	2.00E+1
F. Volume of dilution water used during period	liters	1.32E+10	1.85E+10	2.00E+1

TABLE 2B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1984)

LIQUID EFFLUENTS

July - December, 1984

		CONTINUOUS MODE		BATCH MODE	
Nuclides Released	Unit	Quarter	Quarter	Quarter (3)	Quarter (4)
strontium-89	Ci			<1.13E-4	<3.62E-4
strontium-90	Ci			<4.60E-4	5.36E-4
cesium-134	Ci			6.33E-3	9.46E-2
cesium-137	Ci			1.19E-1	1.08E0
iodine-131	Ci			-	-
cobalt-58	Ci			6.23E-5	4.46E-5
cobalt-60	Ci			5.23E-1	6.62E-1
iron-59	Ci			7.57E-7	-
zinc-65	Ci			2.15E-3	8.91E-3
manganese-54	Ci			1.09E-2	1.04E-2
chromium-51	Ci			5.85E-4	-
zirconimum-niobium-95	Ci			9.69E-5	3.96E-6
molybdenum 99-technetium 99m	Ci			-	-
barium-lanthanum-140	Ci			-	-
cerium-141	Ci			-	-
iodine-133	Ci			-	1.28E-3
cerium-144	Ci			1.27E-4	-
silver-110m	Ci			-	-
iron-55	Ci			1.63E-1	1.61E-1
unidentified	Ci			1.54E-1	7.11E-2
Total for period (above)	Ci			9.80E-1	2.09E0
xenon-133	Ci			-	-
xenon-135	Ci			-	1.72E-3

TABLE 3

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT (1984)
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
JULY - DECEMBER 1984

A. SOLID WASTE SHIPPED OFF SITE FOR BURIAL OR DISPOSAL. (not irradiated fuel)

1. TYPE OF WASTE	UNIT	6 MONTH PERIOD	EST. TOTAL ERROR %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3	191.54	
	Ci	1163.75420	N/A
b. Dry compressible waste, contaminated equipment, etc.	m^3	1601.72	
	Ci	35.28364	N/A
c. Irradiated components, control rods, etc.	m^3		
	Ci	N/A	N/A
d. Other (Describe) miscellaneous low-level waste	m^3		
	Ci	N/A	N/A

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION. (by type of waste)		%	E(Curies)
a. Spent Resin, Filter Sludges, Evaporator Bottoms, etc.	Co-60	52.009	605.25724
	Co-58	.273	3.17331
	Cs-137	22.001	256.03506
	Cs-134	2.910	33.86401
	Fe-55	15.231	177.24940
	Fe-59	.005	.06036
	Sr-90	.213	2.48022
	Tc-99m	.004	.04499
	Zn-65	.460	5.35956
	Mn-54	2.253	26.22129
	Nb-95	.004	.04438
	Ce-141	.004	.04438
	Ce-144	.056	.65540
	Ru-103	.044	.04438
	Pu-241	.489	5.69442
	Cm-242	.010	.11635
	C-14	.023	.26446
	I-129	.002	.02123
	H-3	.012	.13868
	Ni-63	4.024	46.83004
	Sb-124	.006	.06776
	Co-57	.007	.08727
TOTALS		100.000	1163.75420

TABLE 3 (continued)

		%	E(Curies)
b. Dry Compressible Waste Contaminated Equipment	Co-60	67.566	23.83968
	Co-58	.071	.02520
	Cs-137	25.020	8.82796
	Cs-134	1.375	.48508
	Sr-90	.373	.13155
	Tc-99m	.016	.00563
	Mn-54	2.099	.74050
	Pu-241	1.151	.40593
	Cm-242	.010	.00352
	C-14	.019	.00683
	I-129	.011	.00404
	H-3	1.345	.47461
	Ni-63	.944	.33311
	TOTAL	100.00	35.28364

c. N/A

d. N/A

3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
78	Tractor - Trailer	Barnwell, S.C.
2	Tractor - Trailer	Richland, WA.

4. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/a

APPENDIX C - 1982 Soil Survey

Results of Boston Edison *In Situ* Gamma Spectrometry Soil Analysis for 1982

Introduction

In compliance with Boston Edison's Technical Specifications for radiological monitoring of the environment, *in situ* gamma spectrometry analyses were performed at eleven sites during May, October and December of 1982. In addition to the gamma spectrometry, which employs a Ge(Li) "downlooker" detector in accordance with Reference 1, measurements were taken with a pressurized ion chamber (PIC) to assess the total exposure rates, and soil core samples were taken at five of the stations to confirm the *in situ* results.

At all eleven stations, by far the major contributors to the exposure rate due to soil were naturally occurring radionuclides and Cs-137, which is a result of fallout from weapons testing. A small amount of Co-60 was present in the soil at one site. These results are summarized in Tables 1-12, and the original data is on permanent file at the Environmental Laboratory.

Methodology

In situ gamma spectrometry was performed at each of the eleven locations, along with PIC measurements for comparison. When possible, a soil sample was also taken for laboratory gamma analysis.

In situ gamma spectrometry is a convenient and efficient technique used to evaluate the radioactive constituents of the soil. Using assumptions concerning the soil composition and distribution of the radionuclide of interest, the exposure rate and activity concentration of that radionuclide can be calculated. This is done using the spectrum obtained with an unshielded Ge(Li) detector placed above the ground, together with detector specific parameters such as efficiency. The radionuclides of interest are fallout and plant related fission and activation products, as well as those which occur naturally. In evaluating the activity concentration and exposure rate for a given radionuclide, a parameter describing depth distribution, α/ρ, must be evaluated. For naturally occurring radionuclides a value of zero is assumed, implying no increase or decrease in the concentration with soil depth. For radionuclides present only on the surface, such as those from fresh fallout, a value of infinity is used. (This value is also used for calculations of apparent activity concentrations and exposure rates for those radionuclides not found during the peak search.) For man-made radionuclides found in the soil and not believed to be recently deposited, an expotential distribution is assumed with $\alpha/\rho = .206$. This value is a good compromise between deep distribution and surface deposition; and laboratory analysis usually confirms that these radionuclides are present througout the first six inches of soil implying a period of migration. This procedure of *in situ* gamma spectrometry is explained in detail in Reference 2.

The PIC measurement, which includes all components of the exposure rate, not just terrestrial, is used to evaluate how much of the total exposure rate can be explained by the in situ results together with the cosmic contribution. At control stations, away from the plant's influence, the PIC measurement is used to check the in situ results, as one would expect the terrestrial exposure rate, calculated using the in-situ methodology, together with the cosmic contribution to closely approximate the PIC results.

When possible soil core samples are also taken and analyzed at the laboratory to confirm the presence or absence of radionuclides in the soil which have been identified in the in situ analysis. In this way, the source term is identified as soil or unknown. In the latter case, the in situ calculations are not valid and results are not reported. In addition, analysis of the different core sections aids in defining the depth distribution of the radionuclide.

Results

Tables 1-11 contain the results from the in situ gamma analysis for the eleven sites. (It should be noted that in August the Ge(Li) detector was repaired to remedy increasingly poor resolution. The poor resolution was not a problem in the measurements conducted during May; and prior to analysis of the remaining three sites, the operating characteristics of the detector were carefully checked with the result that recalibration following the repair was deemed unnecessary for in situ analysis (Reference 3).) Each table lists the apparent exposure rate and activity concentration for each of thirteen fission and activation products, as well as for three naturally occurring radionuclides. LLD values were not calculated for nuclides with more than one peak, as in these cases all of the peaks found were used to calculate the total exposure rate and activity concentration for that nuclide (or series). Table 12 contains all positive in situ results as well as PIC measurements for comparison.

With two exceptions, all exposure rates due to activity within the soil are more than 95 percent resulting from natural radiation. The remainder is almost entirely due to Cs-137 which is considered to be a result of weapons testing and is found throughout the environment. The first exception is high Cs-137 concentration at site 10, resulting in 17 percent of the total exposure rate due to soil. The activity concentration for Cs-137 at this site is greater than five times the average value for the other stations. The most probable explanation for this is that the detector may have been placed over a local accumulation point of debris, and therefore the fallout related Cs-137 was present in a higher than average concentration. It should be noted that sites considerably closer to the plant showed only typical environmental levels of Cs-137, and the high concentration is therefore not likely to be plant related. The second case in which the exposure rate due to soil was more than 5 percent related to fission or activation products, was at station 7 where Co-60 was identified during in situ analysis, and confirmed by Laboratory soil analysis. The activity concentration was calculated to be 305±7 pCi/kg, assuming a value for α/ρ equal to .206, while Laboratory analysis resulted in a value of 224±13 pCi/kg. The value for α/ρ is likely to be greater than .206, i.e. the distribution of Co-60 was more planar, as it was not found in the 2"-4" core section. This increase in α/ρ would result in a lower value for activity concentration more in line with the Laboratory results. In any case, the exposure rate due to Co-60 was calculated to be less than 1 μR/hr.

Cobolt-60 was identified at three additional sites, but could not be confirmed by Laboratory soil analysis (there was no core sample submitted for site 00). As the source term was therefore unknown for these sites, the exposure rates which were calculated assuming soil to be the source term, are not valid and were not listed in Table 12. It should also be noted that Zr-95 was detected at two sites at levels at or below LLD, but these results could not be confirmed by soil analysis at the Laboratory.

The PIC measurements agreed well with the in situ results, when a cosmic component of 3.6 μR/hr (Reference 4) was added, with a few notable exceptions. Sites 00, 07 and 08 showed relatively high PIC measurements which could not be explained with the Ge(Li) results. These sites are all within 0.15 miles of the plant so that the higher than background exposure rates were most likely a result of some source term other than soil.

References

(1) YAEL Procedure Number 510, Rev. 1, "Identification and Quantitative Determination of Radionuclides in Soil by Gamma-Ray In-Situ Spectrometry."

(2) HASL-258, "In-Situ Ge(Li) and NaI(Tl) Gamma-Ray Spectrometry," September 1972.

(3) YAEL Memo ELG 265/82 "Intrinsic Efficiency Check on Ge(Li) Detector No. 1."

(4) "Cosmic-Ray Ionization in the Lower Atmosphere," Wayne M. Londer and Harold Beck, Journal of Geophysical Research, Vol. 17, No. 19, October 1, 1966.

TABLE 1

LOCATION: WAREHOUSE

LOCATION#: 00

COUNT TIME: 6000sec

COUNT DATE: 05/27/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(-22+- 15) E-4	53E-4	(-100+- 68) E 0	240E 0
	Ce-141	(3+- 13) E-4	47E-4	(3+- 14) E 0	50E 0
	I-131	(9+- 34) E-4	120E-4	(12+- 46) E-1	160E-1
	Sb-125	(1+- 11) E-3	42E-3	(1+- 13) E 0	47E 0
	Ru-103	(47+- 40) E-4	140E-4	(45+- 38) E-1	140E-1
	Ba-140	(28+- 57) E-4	200E-4	(7+- 13) E 0	48E 0
	Ru-106	(-2+- 13) E-3	47E-3	(-5+- 28) E 0	100E 0
*+	Cs-137	(1565+- 94) E-4	310E-4	(285+- 17) E 0	56E 0
	Zr-95	(74+- 85) E-4	300E-4	(40+- 46) E-1	160E-1
	Nb-95	(-22+- 50) E-4	180E-4	(-11+- 26) E-1	94E-1
	Mn-54	(118+- 53) E-4	190E-4	(54+- 24) E-1	85E-1
*+	Co-60	(707+- 21) E-3	93E-3	(2182+- 64) E-1	300E-1
	La-140	(21+- 11) E-3	39E-3	(27+- 14) E-1	49E-1
*+	K-40	(2714+- 33) E-3	61E-3	(1516+- 21) E 1	34E 1
*+	Th-232	(2138+- 63) E-3	------	(758+- 22) E 0	------
*+	U-238	(1385+- 48) E-3	------	(761+- 26) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 2

LOCATION: ROCKY HILL RD.

LOCATION#: 01

COUNT TIME: 6000sec

COUNT DATE: 05/27/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(-284+- 96) E-5	230E-5	(-134+- 43) E 0	150E 0
	Ce-141	(-324+- 86) E-5	300E-5	(35+- 92) E-1	320E-1
	I-131	(-134+- 25) E-4	88E-4	(-174+- 34) E-1	120E-1
	Sb-125	(164+- 89) E-4	320E-4	(19+- 10) E 0	36E 0
	Ru-103	(154- 31) E-4	110E-4	(14+- 29) E-1	110E-1
	Ba-140	(314- 46) E-4	170E-4	(7+- 11) E 0	39E 0
	Ru-106	(64- 10) E-3	38E-3	(12+- 23) E 0	92E 0
x:	Cs-137	(16304- 76) E-4	230E-4	(296+- 14) E 0	41E 0
	Zr-95	(1214+- 71) E-4	250E-4	(65+- 38) E-1	130E-1
	Nb-95	(-314- 42) E-4	150E-4	(-164- 22) E-1	77E-1
	Mn-54	(784- 43) E-4	150E-4	(364- 19) E-1	69E-1
	Co-60	(304- 11) E-3	40E-3	(394- 15) E-1	52E-1
	La-140	(54- 10) E-3	38E-3	(74- 13) E-1	48E-1
x:	K-40	(22124+- 34) E-3	42E-3	(1236+- 19) E 1	27E 1
x:	Th-232	(2252+- 58) E-3	------	(799+- 21) E 0	------
x:	U-238	(1346+- 41) E-3	------	(740+- 23) E 0	------

Notes:

x Activity greater than 3*standard deviation

: Peak is found

------ LLD is not calculated

TABLE 3

LOCATION: ROCKY HILL RD. (W)

LOCATION#: 03

COUNT TIME: 6000sec

COUNT DATE: 12/15/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(-10+- 12) E-4	43E-4	(-43+- 53) E 0	190E 0
	Ce-141	(3+- 11) E-4	38E-4	(8+- 11) E 0	41E 0
	I-131	(-24+- 31) E-4	110E-4	(-33+- 42) E-1	150E-1
	Sb-125	(27+- 94) E-4	340E-4	(3+- 11) E 0	39E 0
	Ru-103	(-55+- 33) E-4	120E-4	(-52+- 32) E-1	120E-1
	Ba-140	(-42+- 42) E-4	180E-4	(-11+- 11) E 0	41E 0
	Ru-106	(-2+- 11) E-3	40E-3	(-4+- 24) E 0	89E 0
**	Cs-137	(618+- 55) E-4	160E-4	(1123+- 100) E-1	270E-1
	Zr-95	(42+- 73) E-4	260E-4	(23+- 40) E-1	140E-1
	Nb-95	(-7+- 42) E-4	120E-4	(-12+- 53) E-1	150E-1
	Mn-54	(100+- 45) E-4	160E-4	(45+- 20) E-1	71E-1
	Co-60	(24+- 12) E-3	44E-3	(31+- 16) E-1	56E-1
	La-140	(19+- 11) E-3	30E-3	(25+- 14) E-1	49E-1
*+	K-40	(2494+- 35) E-3	44E-3	(1393+- 20) E 1	24E 1
*+	Th-232	(2470+- 57) E-3	------	(876+- 20) E 0	------
*+	U-238	(1170+- 35) E-3	------	(643+- 19) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 4

LOCATION: PLY. CENTER

LOCATION#: 04

COUNT TIME: 6000sec

COUNT DATE: 10/07/82

InSitu COUNTING RESULTS

NUCLIDE ID	EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
Ce-144	(-54+- 12) E-4	43E-4	(-22+- 53) E 0	170E 0
Ce-141	(17+- 10) E-4	37E-4	(18+- 11) E 0	40E 0
I-131	(-56+- 31) E-4	110E-4	(-76+- 43) E-1	160E-1
Sb-125	(5+- 96) E-4	350E-4	(1+- 11) E 0	39E 0
Ru-103	(-22+- 34) E-4	120E-4	(-21+- 32) E-1	120E-1
Ba-140	(-19+- 49) E-4	180E-4	(-4+- 11) E 0	41E 0
Ru-106	(-6+- 11) E-3	40E-3	(-14+- 24) E 0	89E 0
** Cs-137	(2763+- 74) E-4	160E-4	(502+- 14) E 0	30E 0
Zr-95	(10+- 75) E-4	270E-4	(5+- 40) E-1	150E-1
Nb-95	(-164+- 46) E-4	170E-4	(-84+- 23) E-1	88E-1
Mn-54	(-45+- 60) E-4	210E-4	(-50+- 67) E-1	240E-1
Co-60	(-3+- 12) E-3	45E-3	(-4+- 15) E-1	58E-1
La-140	(-13+- 14) E-3	52E-3	(-41+- 43) E-1	160E-1
** K-40	(2382+- 34) E-3	43E-3	(1331+- 19) E 1	24E 1
** Th-232	(2414+- 55) E-3	------	(856+- 19) E 0	------
** U-238	(1571+- 37) E-3	------	(863+- 21) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 5

LOCATION: PROPERTY LINE

LOCATION#: 06

COUNT TIME: 6000sec

COUNT DATE: 05/26/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(4+- 12) E-4	43E-4	(16+- 54) E 0	190E 0
	Ce-141	(-8+- 11) E-4	39E-4	(-8+- 11) E 0	42E 0
	I-131	(25+- 31) E-4	110E-4	(34+- 42) E-1	150E-1
	Sb-125	(218+- 95) E-4	340E-4	(25+- 11) E 0	38E 0
	Ru-103	(38+- 32) E-4	120E-4	(36+- 31) E-1	110E-1
	Ba-140	(-34+- 47) E-4	170E-4	(-8+- 11) E 0	40E 0
	Ru-106	(15+- 11) E-3	39E-3	(33+- 24) E 0	85E 0
**	Cs-137	(1392+- 82) E-4	250E-4	(344+- 15) E 0	46E 0
	Zr-95	(140+- 72) E-4	250E-4	(76+- 39) E-1	140E-1
	Nb-95	(33+- 41) E-4	150E-4	(17+- 21) E-1	76E-1
	Mn-54	(116+- 60) E-4	210E-4	(129+- 67) E-1	230E-1
*	Co-60	(39+- 12) E-3	44E-3	(50+- 16) E-1	56E-1
	La-140	(3+- 11) E-3	41E-3	(3+- 14) E-1	52E-1
**	K-40	(2103+- 34) E-3	54E-3	(1178+- 19) E 1	30E 1
**	Th-232	(2320+- 60) E-3	------	(823+- 21) E 0	------
**	U-238	(1295+- 42) E-3	------	(712+- 23) E 0	------

Notes:
* Activity greater than 3*standard deviation
+ Peak is found
------ LLD is not calculated

TABLE 6

LOCATION: PEDESTRIAN BRIDGE

LOCATION#: 07

COUNT TIME: 6000sec

COUNT DATE: 05/26/92

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(5+- 15) E-4	52E-4	(23+- 67) E 0	230E 0
	Ce-141	(-10+- 13) E-4	46E-4	(-11+- 14) E 0	50E 0
	I-131	(48+- 35) E-4	120E-4	(65+- 47) E-1	160E-1
	Sb-125	(28+- 12) E-3	42E-3	(32+- 13) E 0	48E 0
	Ru-103	(37+- 40) E-4	140E-4	(35+- 38) E-1	140E-1
	Ba-140	(40+- 57) E-4	210E-4	(9+- 14) E 0	50E 0
	Ru-106	(14+- 13) E-3	47E-3	(31+- 29) E 0	100E 0
x+	Cs-137	(1134+- 30) E-4	250E-4	(206+- 14) E 0	46E 0
x	Zr-95	(280+- 88) E-4	314E-4	(151+- 48) E-1	170E-1
	Nb-95	(78+- 52) E-4	180E-4	(40+- 27) E-1	95E-1
	Mn-54	(61+- 55) E-4	200E-4	(23+- 25) E-1	90E-1
x+	Co-60	(982+- 23) E-3	97E-3	(3051+- 70) E-1	300E-1
	La-140	(-17+- 11) E-3	41E-3	(-21+- 14) E-1	52E-1
x+	K-40	(2143+- 34) E-3	55E-3	(1197+- 19) E 1	31E 1
x+	Th-232	(2211+- 61) E-3	------	(784+- 22) E 0	------
x+	U-238	(1267+- 46) E-3	------	(696+- 25) E 0	------

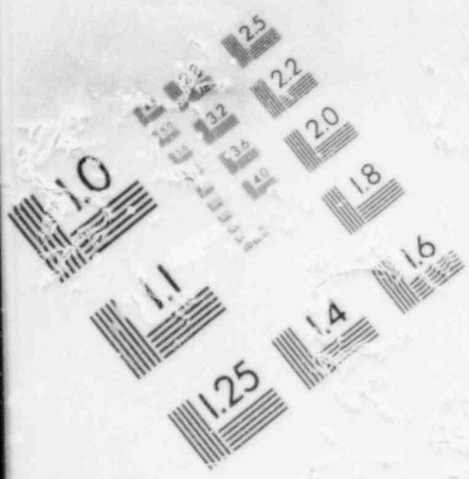
Notes:

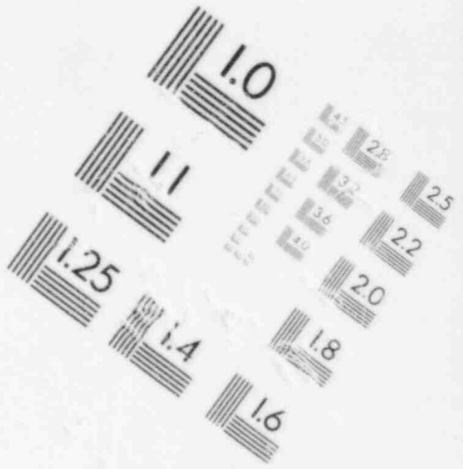
x Activity greater than 3x standard deviation

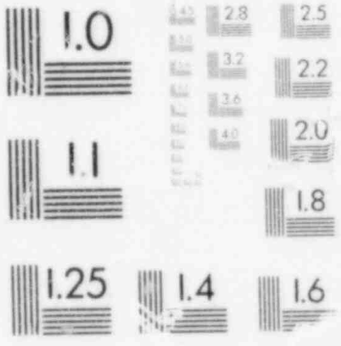
\+ Peak is found

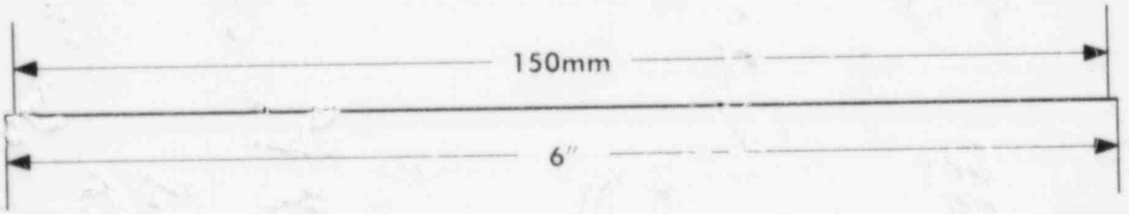
------ LLD is not calculated

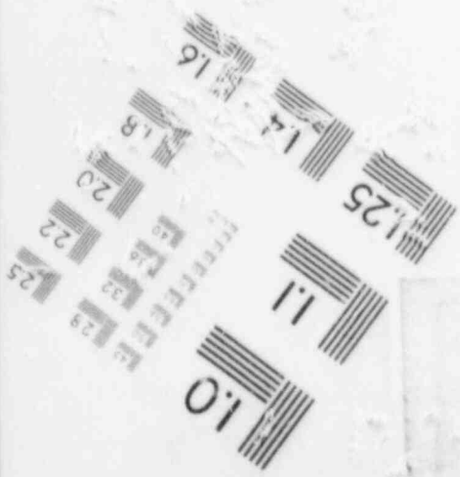
IMAGE EVALUATION
TEST TARGET (MT-3)











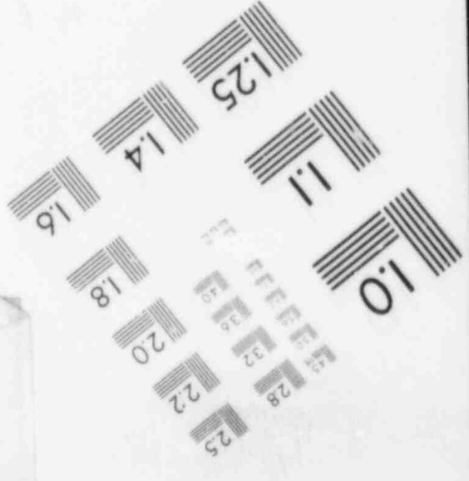


TABLE 7

LOCATION: OVERLOOK

LOCATION#: 08

COUNT TIME: 6000sec

COUNT DATE: 05/26/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
NAME		EXPOSURE RATE +- 1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
Ce-144		(-25+- 21) E-4	78E-4	(-111+- 96) E 0	350E 0
Ce-141		(-13+- 19) E-4	69E-4	(-20+- 20) E 0	74E 0
I-131		(-46+- 51) E-4	180E-4	(-64+- 70) E-1	250E-1
Sb-125		(11+- 15) E-3	54E-3	(12+- 17) E 0	61E 0
Ru-103		(-56+- 54) E-4	190E-4	(-53+- 51) E-1	190E-1
Ba-140		(-6+- 75) E-4	270E-4	(-1+- 17) E 0	63E 0
Ru-106		(-25+- 17) E-3	63E-3	(-55+- 38) E 0	140E 0
*+ Cs-137		(1081+- 89) E-4	280E-4	(197+- 16) E 0	51E 0
Zr-95		(8+- 11) E-3	41E-3	(43+- 61) E-1	220E-1
Nb-95		(-65+- 67) E-4	240E-4	(-34+- 35) E-1	130E-1
Mn-54		(80+- 99) E-4	350E-4	(9+- 11) E 0	39E 0
*+ Co-60		(959+- 27) E-3	110E-3	(2959+- 82) E-1	350E-1
La-140		(-29+- 18) E-3	69E-3	(-37+- 23) E-1	88E-1
*+ K-40		(2609+- 41) E-3	91E-3	(1458+- 23) E 1	51E 1
*+ Th-232		(2052+- 73) E-3	------	(728+- 26) E 0	------
*+ U-238		(1210+- 55) E-3	------	(665+- 30) E 0	------

Notes:
* Activity greater than 3*standard deviation
+ Peak is found
------ LLD is not calculated

TABLE 8

LOCATION: EAST BREAKWATER

LOCATION#: 09

COUNT TIME: 6000sec

COUNT DATE: 05/27/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
NAME		EXPOSURE RATE +-1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
Ce-144		(6+- 12) E-4	43E-4	(27+- 54) E 0	190E 0
Ce-141		(12+- 11) E-4	38E-4	(13+- 11) E 0	41E 0
I-131		(-17+- 31) E-4	110E-4	(-23+- 42) E-1	150E-1
Sb-125		(-31+- 95) E-4	350E-4	(-3+- 11) E 0	39E 0
Ru-103		(39+- 34) E-4	120E-4	(37+- 32) E-1	110E-1
Ba-140		(50+- 49) E-4	180E-4	(12+- 11) E 0	41E 0
Ru-106		(1+- 11) E-3	41E-3	(3+- 25) E 0	89E 0
*+ Cs-137		(1000+- 69) E-4	210E-4	(182+- 13) E 0	39E 0
* Zr-95		(269+- 72) E-4	250E-4	(145+- 39) E-1	130E-1
Nb-95		(7+- 44) E-4	160E-4	(4+- 23) E-1	82E-1
Mn-54		(-14+- 46) E-4	170E-4	(-7+- 21) E-1	76E-1
Co-60		(33+- 13) E-3	47E-3	(43+- 17) E-1	61E-1
La-140		(0+- 11) E-3	40E-3	(-1+- 14) E-1	51E-1
*+ K-40		(2766+- 38) E-3	57E-3	(1345+- 21) E 1	32E 1
*+ Th-232		(2467+- 63) E-3	-----	(875+- 22) E 0	------
*+ U-238		(1357+- 44) E-3	-----	(746+- 24) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

----- LLD is not calculated

TABLE 9

LOCATION: CLEFT ROCK

LOCATION#: 10

COUNT TIME: 6000sec

COUNT DATE: 05/28/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +-1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(95+- 99) E-5	340E-5	(43+- 44) E 0	150E 0
	Ce-141	(86+- 88) E-5	310E-5	(92+- 95) E-1	330E-1
	I-131	(23+- 27) E-4	92E-4	(31+- 36) E-1	130E-1
	Sb-125	(108+- 96) E-4	350E-4	(12+- 11) E 0	37E 0
	Ru-103	(26+- 33) E-4	120E-4	(25+- 31) E-1	110E-1
	Ba-140	(-5+- 47) E-4	170E-4	(-1+- 11) E 0	40E 0
	Ru-106	(28+- 11) E-3	37E-3	(61+- 23) E 0	82E 0
*+	Cs-137	(942+- 12) E-3	25E-3	(1713+- 22) E 0	45E 0
	Zr-95	(110+- 65) E-4	230E-4	(59+- 35) E-1	120E-1
	Nb-95	(25+- 38) E-4	140E-4	(13+- 20) E-1	70E-1
	Mn-54	(-27+- 41) E-4	150E-4	(-12+- 19) E-1	69E-1
	Co-60	(19+- 11) E-3	41E-3	(24+- 15) E-1	53E-1
	La-140	(-56+- 96) E-4	360E-4	(-7+- 12) E-1	46E-1
*+	K-40	(1677+- 30) E-3	48E-3	(937+- 17) E 1	27E 1
*+	Th-232	(1952+- 55) E-3	------	(692+- 20) E 0	------
*+	U-238	(919+- 37) E-3	------	(505+- 21) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 10

LOCATION: EAST WEYMOUTH

LOCATION#: 15

COUNT TIME: 6000sec

COUNT DATE: 10/07/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +-1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(-94+- 12) E-4	43E-4	(-39+- 54) E 0	190E 0
	Ce-141	(0+- 11) E-4	38E-4	(0+- 11) E 0	41E 0
	I-131	(-52+- 32) E-4	120E-4	(-71+- 43) E-1	160E-1
	Sb-125	(27+- 96) E-4	340E-4	(31+- 11) E 0	39E 0
	Ru-103	(-4+- 34) E-4	120E-4	(-4+- 33) E-1	120E-1
	Ba-140	(-18+- 42) E-4	180E-4	(-4+- 12) E 0	42E 0
	Ru-106	(0+- 12) E-3	42E-3	(1+- 25) E 0	92E 0
*+	Cs-137	(2726+- 82) E-4	220E-4	(496+- 15) E 0	39E 0
	Zr-95	(170+- 74) E-4	260E-4	(92+- 40) E-1	140E-1
	Nb-95	(-38+- 47) E-4	170E-4	(-19+- 24) E-1	87E-1
	Mn-54	(129+- 46) E-4	160E-4	(59+- 21) E-1	73E-1
	Co-60	(-8+- 13) E-3	47E-3	(-10+- 17) E-1	63E-1
	La-140	(25+- 10) E-3	36E-3	(32+- 13) E-1	46E-1
*+	K-40	(3007+- 39) E-3	43E-3	(1680+- 22) E 1	27E 1
*+	Th-232	(2570+- 60) E-3	------	(911+- 21) E 0	------
*+	U-238	(1435+- 33) E-3	------	(708+- 21) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 11

LOCATION: MANOMET SUB STA.

LOCATION#: 17

COUNT TIME: 6000sec

COUNT DATE: 05/28/82

InSitu COUNTING RESULTS

NUCLIDE ID		EXPOSURE RATE microR/hr		CONCENTRATION picoCi/Kgram	
	NAME	EXPOSURE RATE +-1-SIGMA	LLD	CONC +- 1-SIGMA	LLD
	Ce-144	(62+- 93) E-5	320E-5	(28+- 42) E 0	150E 0
	Ce-141	(136+- 84) E-5	290E-5	(146+- 90) E-1	310E-1
	I-131	(14+- 24) E-4	85E-4	(19+- 33) E-1	120E-1
	Sb-125	(-102+- 89) E-4	320E-4	(-12+- 10) E 0	37E 0
	Ru-103	(10+- 31) E-4	110E-4	(10+- 29) E-1	110E-1
	Ba-140	(-51+- 45) E-4	170E-4	(-12+- 11) E 0	39E 0
	Ru-106	(21+- 10) E-3	36E-3	(454+- 22) E 0	79E 0
*+	Cs-137	(2128+- 64) E-4	43E-4	(387+- 12) E 0	7.8E 0
	Zr-95	(111+- 67) E-4	240E-4	(60+- 36) E-1	130E-1
	Nb-95	(-38+- 40) E-4	140E-4	(-20+- 20) E-1	74E-1
	Mn-54	(11+- 41) E-4	150E-4	(5+- 19) E-1	67E-1
	Co-60	(8+- 11) E-3	39E-3	(10+- 14) E-1	51E-1
	La-140	(70+- 97) E-4	360E-4	(9+- 12) E-1	45E-1
*+	K-40	(2033+- 32) E-3	47E-3	(1136+- 18) E 1	26E 1
*+	Th-232	(2210+- 58) E-3	------	(784+- 20) E 0	------
*+	U-238	(1280+- 39) E-3	------	(703+- 21) E 0	------

Notes:

* Activity greater than 3*standard deviation

\+ Peak is found

------ LLD is not calculated

TABLE 12

1982 In Situ Results
Comparison of Ge(Li) In Situ and Ion Chamber Results

Location Site No.	(Distance in Miles from Plant)	Positive Ge(Li) In Situ Results (μR/Hr) U-238	Th-232	K-40	Cs-137	Other	Total*	Ion Chamber (μR/Hr)
00	Warehouse (0.03 SSE)	1.38	2.14	2.71	0.156	(a)	10.7	13.8
01	Rockyhill Rd. (E) (0.8 SE)	1.35	2.25	2.21	0.163	-	9.6	9.4
03	Rockyhill Rd. (W) (0.3 WNW)	1.17	2.47	2.49	0.062	-	9.8	9.8
04	Plymoth Center (4.5 WNW)	1.57	2.41	2.38	0.276	-	10.2	9.9
06	Property Line (0.34 NW)	1.30	2.32	2.11	0.189	(a)	9.5	10.5
07	Pedestrial Bridge (0.14 N)	1.27	2.21	2.14	0.113	.989 (bc)	10.3	13.8
08	Overlook (0.03 W)	1.21	2.05	2.61	0.108	(a)	9.6	37.8
09	East Breakwater (0.35 ESE)	1.36	2.47	2.77	0.100	(c)	10.3	10.4
10	Cleft Rock (0.9 S)	0.92	1.95	1.68	0.942	-	9.1	9.4
15	East Weymoth (23 NW)	1.44	2.57	3.01	0.273	-	10.9	10.5
17	Manomet Substation (2.5 SE)	1.28	2.21	2.03	0.213	-	9.3	9.3

* Total Includes 3.6 μR/Hr cosmic contribution.
(a) Co-60 found in in situ but not confirmed by lab soil analysis and therefore not included in total.
(b) Co-60 found in in situ and confirmed by lab soil analysis.
(c) Zr-95 found in in situ but not confirmed by lab soil analysis and therefore not included in total.

APPENDIX D - Radiological Environmental Monitoring Program

APPENDIX D

4.8.D Environmental Monitoring Program

An environmental monitoring program shall be conducted as follows:

1. Environmental samples shall be selected and analyzed according to Table 4.8.1 at the locations described in Tables 4.8.2 and 4.8.3 and shown in Figures 4.8.1, 4.8.2 and 4.8.3.

2. Analytical techniques used shall be such that the detection capabilities in Table 4.8.4 are achieved.

3. A census of gardens producing fresh leafy vegetables for human consumption (e.g., lettuce, spinach, etc.) shall be conducted near the end of the growing season to determine or verify the location of the garden (available for sampling) yielding the highest calculated thyroid dose. This census is limited to gardens having an area of 500 square feet or more and shall be conducted under the following conditions as necessary to meet the above requirement:

   a. Within a 1-mile radius of the plant site, enumeration by a door-to-door, or equivalent counting technique.

   b. If no milk-producing animals are located in the vicinity of the site, as determined by item 4 below, the census described in item 3a above shall be extended to a distance of 5 miles from the site.

   If the census indicates the existence of a garden at a location yielding a calculated thyroid dose greater than that from the previously sampled garden, the new location shall replace the garden previously having the maximum calculated iodine concentration. Also, any location from which fresh leafy vegetables can no longer be obtained may be dropped from the surveillance program as long as the NRC is notified in writing, as soon as possible that such vegetables are no longer grown or no longer available at that location.

4. A census of animals producing milk for human consumption shall be conducted at or near the middle of the grazing season to determine or verify the location yielding the highest calculated annual average thyroid dose. The census shall be conducted under the following conditions as necessary to meet the above requirement:

   a. Within a 1-mile radius from the plant site or within the 15 mrem/yr isodose line, whichever is larger, enumeration by a door-to-door or equivalent, counting technique.

   b. Within a 5-mile radius for cows and for goats, enumeration derived from referenced information from county agricultural agents or other reliable sources.

   If it is learned from this census that animals are present at a location which yields a calculated thyroid dose greater than from previously sampled animals, the new location shall be added to the surveillance program as soon as practicable. The sampling location having the lowest calculated dose may then be dropped from the surveillance program at the end of the grazing season during which the census was conducted. Also, any location from which milk can no longer be obtained may be dropped from the surveil-

lance program as long as the NRC is notified in writing, as soon as practicable, that milk-producing animals are no longer present, or milk samples are no longer available at that location.

5. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability or to malfunction of automatic sampling equipment. In the event of equipment malfunction, every reasonable effort shall be made to complete corrective action prior to the end of the next sampling period. Any significant deviations from the sampling schedule shall be explained in the annual report.

6. Detailed written procedures, including applicable check lists and instructions, shall be prepared and followed for all activities involved in carrying out the environmental monitoring program. Procedures shall include sampling, data recording and storage, instrument calibration, measurements and analyses, and actions to be taken when anomalous measurements are discovered.

Procedures shall be prepared for insuring the quality of program results, including analytical measurements. These procedures will identify the responsible organizations, include purchased services (e.g., contractual lab), include independent audits, and include systems (such as participation in IAEA and/or NBS intercalibration exercises and submission of "blind" quality control samples for analyses by the contractors) to identify and correct deficiencies, investigate anomalous or suspect results, and review and evaluate program results and reports. **

3.8.D and 4.8.D Environmental Monitoring Program

An Environmental radiological monitoring program is conducted to verify the adequacy of in-plant controls on the release of radioactive materials. The program is designed to detect radioactivity concentrations which could result in radiation doses to individuals not exceeding the levels set forth in 10CFR50 Appendix I.

An example of this is the detection of I-131 in milk. Calculational Models (Regulatory Guide 1.109 March 1976) have shown that a constant concentration of 3.5 pCi I-131 per liter milk would result in a dose of 15 millirem to the thyroid of an infant consuming that milk for a year. Allowing for an open grazing season of six months, and a maximum of two half-lives between event and sampling, the lower limit of detection at time of sampling must be 2 pCi/l (3.5 x 12/6 x 1/4 = 1.8).

A supplemental monitoring program for sediments and mussels has been incorporated into the basic program (see notes f and g to Table 4.8.1) as a result of an agreement with the Massachusetts Wildlife Federation. This supplemental program is designed to provide information on radioactivity levels at substantially higher sensitivity levels in selected samples to verify the adequacy (or, alternatively, to provide a basis for later modifications) of the long-term marine sampling schedules. As part of the supplemental program, analysis of mussels for isotopes of plutonium will be performed if radiocesium activity should exceed 200 pCi/Kgm in the edible portions. **

**supplemental provision

The 200 pCi/Kgm radiocesium "action level" is based on calculations which showed that if radiocesium from plant releases reached this level, plutonium could possibly appear at levels of potential interest.* The calculations also showed that the dose delivered from these levels of plutonium would not be a significant portion of the total dose attributable to liquid effluents.

The program was also designed to be consistent, wherever applicable with Regulatory Guide 4.8 (Issued for comment December 1975). The following exceptions to the generic recommendations stated in Regulatory Guide 4.8 are justified due to site specific considerations:

1. The required detection capability for I-131 in milk is about twice the value suggested in Regulatory Guide 4.8. The justification for the higher value is presented in the second paragraph of this section. This is a conservative estimate of the capability of the milk surveillance program to detect concentrations at the appropriate annual dose level since the annual dose is proportional to the annual average concentration in milk. The detection limit for a group of samples is less than that for a single sample and is inversely proportional to the square root of the number of samples. The conservatism in this case is approximately $\sqrt{12}$, or about a factor of 3.

2. Air particulates are not analyzed for radiostrontium. The program instead calls for this analysis in milk samples. This is justified because the air-cow-milk exposure pathway can be better monitored at Pilgrim after the very low level releases of radiostrontium are reconcentrated in cow's milk (Ref. 1).

3. Soils and sediments are not routinely analyzed for Sr-90, but rather the analysis is done on a contingency basis. The rationale behind this is that Sr-90 will not contribute to long-term radionuclide buildup until the more abundant gamma emitting nuclides appear in relatively large concentrations. Both Items 2 and 3 reflect the fact that in 3½ years of operation, Pilgrim Station liquid releases of Sr-90 have amounted to only 1/1000 of the Sr-90 inventory in Cape Cod Bay water (from weapons testing fallout) and about 4/1000,000 of the direct deposition on the Bay. Also, gaseous releases of Sr-90 have been only 1/100,000 of the terrestrial Sr-90 inventory within five miles of the station (Ref. 1).

4. Surveys are conducted annually, if necessary, to determine appropriate locations for sampling of leafy vegetables and milk. The objective of these surveys is to ensure that the environmental samples are representative of realistic food chain pathways, considering local conditions. Results of the monitoring program will be used as "benchmarks" to verify calculational models used to predict the consequences of effluent releases from the station. The models can then be employed to predict doses attributable to radiation deposition at any other location of interest. The combination of monitoring results and calculational model predictions is a practical method of demonstrating compliance with 10CFR50 Appendix I. This approach does not require (nor is it always practical) that environmental media always be sampled from the "worst case" locations: although sensitivity of the monitoring results might be improved by sampling from locations which are reasonably close to "worst case" conditions.

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* in measurable quantities having a potential dose (human food chain) significance comparable to other nuclides if present at their detection limits.

Verification of the appropriate milk sampling locations on an annual basis is satisfactory as there are very few locations suitable for the grazing of dairy herds in the vicinity of the plant (Ref. 2). This situation makes it unlikely the location of the nearest dairy herd (3.5 miles-W) will change.

5. Annual sampling of beef forage (in place of beef) is adequate because beef cattle are not raised commercially in the vicinity of the site. However, dairy cows from the Plymouth County Farm are periodically sold for beef. Feed (hay) from this location will be sampled to monitor this potential pathway for ingestion of radioactivity. If beef cattle feeding on local forage are found at locations closer to the site, forage samples from the closer location will replace the sample from the County Farm.

6. Goundwater flow at the plant site is into Cape Cod Bay: therefore, terrestrial monitoring of groundwater is not included in this program.

7. Poultry sampling is not performed because poultry in Plymouth County feed almost exclusively on imported grain and are usually raised under shelter.

8. Field gamma isotopic surveys are conducted to monitor radioactivity in soil in lieu of laboratory analysis of soil samples. The technique has several advantages over laboratory analysis. First, analysis can be performed on the same plot of land from survey to survey, and radioactivity build-up at the location can be accurately determined. Secondly, gamma exposure rate is determined directly from this technique: hence compliance with 10CFR50 Appendix I levels can be investigated directly rather than indirectly through soil sampling.

References:

1. Wrenn, M.E., "Review of Sr-90 Releases from Pilgrim 1 Nuclear Plant and a Comparison with Extant Environmental Levels", 1976.

2. Pilgrim Station Unit #2 PSAR, Appendix 11F, pp. 11FC-11 and 11A, amended June 15, 1976.

TABLE 4.8.1

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway or Sample Type	Locations (Direction-Distance) from Reactor	Sampling and Collection Frequency	Type and Frequency of Analysis
AIRBORNE			
Particulates	11 (see Table 4.8.2)	Continuous sampling over one week	Gross beta radioactivity at least 24 hours after filter change. (a) Quarterly composite (by location) for gamma isotopic. (b)
Radioiodine	11 (see Table 4.8.2)	Continuous sampling with canister collection weekly	Analyze weekly for I-131
Soil	11 (see Table 4.8.2)	Once per three years	Field gamma isotopic. (c)
DIRECT	20 (see Table 4,8.3)	Quarterly	Gamma exposure quarterly.
	Plymouth Beach and Priscilla/White Horse Beach	Annually (Spring)	Gamma exposure survey *
WATERBORNE	Discharge Canal	Continuous Composit Sample	Gamma isotopic (b) monthly; and composite for H-3 analysis quarterly, (c).
	Bartlett Pond (SE-1.7 mi.)	Weekly grab sample	
	Powder Point (NNW-7.8 mi.)(d)	Weekly grab sample	
AQUATIC			
Shellfish	Discharge outfall Duxbury Bay Manomet Pt. Plymouth or Kingston Harbor Marshfield (d)	Quarterly (at approximate 3-month intervals)	Gamma isotopic (b); also see note (f). *

* Note (f) and beach surveys are supplemental provision.

TABLE 4.8.1
(Cont'd)

Exposure Pathway or Sample Type	Locations (Direction-Distance) from Reactor	Sampling and Collection Frequency	Type and Frequency of Analysis
Irish Moss	Discharge outfall Manomet Pt. Ellisville (d)	Semi-annually	Gamma isotopic (b)
Lobster	Vicinity of discharge point offshore(d)	Four times per season Once per season	Gamma isotopic (b) on edible portions.
Fish	Vicinity of discharge point offshore(d)	Quarterly, Groups I and II (e) In season, Groups III and IV (e) Annually, each group	Gamma isotopic (b) on edible portions(e)
Sediments	Rocky Point Plymouth Harbor Duxbury Bay Plymouth Beach Manomet Pt. Marshfield (d)	Semi-annually	Gamma isotopic (b) (c), see also note (g) *
INGESTION (Terrestrial)			
Milk	Plymouth County Farm (W-3.5 mi.)(h); Whitman Farm (NW-21 mi.) (d)	Semi-monthly during periods when animals are on pasture, otherwise monthly	Gamma isotopic (b) Sr-89, 90 monthly; radioiodine analysis all samples.
Cranberries	Manomet Pt. Bog (SE-2.6 mi.) Bartlett Rd. Bog (SSE/S-2.8 mi.) Pine St. Bog (WNW-17 mi.) (d)	At time of harvest	Gamma isotopic (b) on edible portions.

*Note (g) is supplemental provision

TABLE 4.8.1
(Cont'd)

Exposure Pathway or Sample Type	Locations (Direction-Distance) from Reactor	Sampling and Collection Frequency	Type and Frequency of Analysis
Tuberous and green leafy vegetables	Karbott Farm (SSE-2.0 mi.)(h) Bridgewater Farm (W-20 mi.) (d)	At time of harvest	Gamma isotopic (b) on edible portions.
Beef Forage	Plymouth County Farm (W-3.5 mi.) (h)	Annually	Gamma isotopic (b)

Notes

(a) If gross beta radioactivity is greater than 10 times the control value, gamma isotopic will be performed on the sample.

(b) Gamma isotopic means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

(c) If integrated gamma activity (less K-40) is greater than 10 times the control value (less K-40), strontium-90 analysis will be performed on the sample.

(d) Indicates control location.

(e) Fish analyses will be performed on a minimum of 2 sub-samples, consisting of approximately 400 grams each from each of the following groups:

I. Bottom Oriented	II. NearBottom Distribution	III. Anadromous	IV. Coastal Migratory
Winter flounder	Tautog	Alewife	Bluefish
Yellowtail flounder	Cunner	Rainbow smelt	Atlantic herring
	Atlantic cod	Striped bass	Atlantic menhaden
	Pollock		Atlantic mackerel
	Hakes		

(f)* Mussel samples from four locations (immediate vicinity of discharge outfall, Manomet Pt., Plymouth or Kingston Harbor, and Green Harbor in Marshfield) will be analyzed quarterly as follows:

One kilogram wet weight of mussel bodies, including fluid within shells will be collected. Bodies will be reduced in volume by drying at about 100°C. Sample will be compacted and analyzed by GE(Li) gamma spectrometry or alternate technique, if necessary, to achieve a sensitivity** of 5 pCi/kg for Cs-134, Cs-137, Co-60, Zn-65 and Zr-95 and 15 pCi/kg for Ce-144.

The mussel shell sample from one location (the location nearest the discharge canal unless otherwise specified pursuant to licensee's agreement with Mass. Wildlife Federation) will be analyzed each quarter. One additional mussel shell sample (from the Green Harbor location, unless otherwise specified pursuant to Licensee's agreement with Mass Wildlife Federation) will be analyzed semi-annually. Unscrubbed shells to be analyzed will be dried, processed, and analyzed similarly to the mussel bodies.

Because of the small volume reduction in pre-processing of shells, sensitivities attained will be less than that for mussel bodies. The equipment and counting times to be employed for analyses of shells will be the same or comparable to that employed for mussel bodies so that the reduction in sensitivities (relative to those for mussel bodies) will be strictly limited to the effects of poorer geometry related to lower sample volume reduction. Shell samples not scheduled for analysis will be reserved (unscrubbed) for possible later analysis, depending upon recommendations of the review committee.

* Supplemental provision.

**All sensitivity values to be determined in accordance with footnote (a) to Table 4.8.4., viz., LLD at 95% confidence level on K_{sa} ; 50% confidence level on K_{sa} (See HASL-300 for definitions).

Notes (Cont'd)

If radiocesium (Cs-134 and Cs-137) activity exceeds 200 pCi/kg (wet) in mussel bodies, these samples will be analyzed by radiochemical spearation, electrodeposition, and alpha spectrometry for radioisotopes of plutonium, with a sensitivity of 0.4 pCi/kg.

(g)* Sediment samples from four locations (Manomet Pt., Rocky Pt., Plymouth Harbor, and head of Duxbury Bay) will be analyzed once per year (preferably early summer) as follows:

Cores will be taken to depths of 30-cm, minimum depth wherever sediment conditions permit by a hand-coring sampling device. If sediment conditions do not permit 30-cm deep cores, the deepest cores achievable with a hand-coring device will be taken. In any case, core depths will not be less than 14-cm. Core samples will be sectioned into 2-cm increments, and surface and alternate increments analyzed, others reserved. Sediment sample volumes (determined by core diameter and/or number of individual cores taken from any single location) and counting technique will be sufficient to achieve sensitivities of 50 pCi/kg dry sediment for Cs-134, Cs-137, Co-60, Zn-65, and Zr-95 and 150 pCi/kg for Ce-144. In any case individual core diameters will not be less than 2 inches.

The top 2-cm section from each core will be analyzed for Pu isotopes (Pu-238, Pu-239, 240) using radiochemical separations, electrodeposition, and alpha spectrometry with target sensitivity of 25 pCi/kg dry sediment. Two additional core slices per year (mid-depth slice from core samples taken at Rocky Point and Plymouth Harbor, unless otherwise specified pursuant to licensee's agreement with Mass Wildlife Federation) will be similarly analyzed.

(h) These locations may be altered in accordance with results of surveys discussed in paragraphs 4.8.D-3 and 4.8.D-4.

* Supplemental provision

TABLE 4.8.2

AIR PARTICULATES, GASEOUS RADIOIODINE AND SOIL SURVEILLANCE STATIONS

Sampling Location (Sample Designation)	Distance and Direction from Reactor
Offsite Stations	
East Weymouth (EW) *	23 miles NW *
Plymouth Center (PC)	4.5 miles W-WNW
Manomet Substation (MS)	2.5 miles SE
Cleft Rock Area (CR)	0.9 miles S
Onsite Stations	
Rocky Hill Road (ER)	0.8 miles SE
Rocky Hill Road (WR)	0.3 miles W-WNW
Overlook Area (OA)	0.03 miles W
Property Line (PL)	0.34 miles NW
Pedestrian Bridge (PB)	0.14 miles N
East Breakwater (EB)	0.15 miles ESE
Warehouse (WS)	0.03 miles SSE

* Control Station

TABLE 4.8.3

EXTERNAL GAMMA EXPOSURE SURVEILLANCE STATIONS (TLD)

Dosimeter Location (Designation)	Distance and Direction from Station
Offsite Stations	
East Weymouth (EW)*	23 miles NW *
Kingston (KS)	10 miles WNW
Sagamore (CS)	10 miles SSE-S
Plymouth Airport (SA)	8 miles WSW
North Plymouth (NP)	5.5 miles WNW
Plymouth Center (PC)	4.5 miles W-WNW
South Plymouth (SP)	3 miles WSW
Manomet (MS)	2.5 miles SSE
Manomet (ME)	2.5 miles SE
Manomet (MP)	2.25 miles ESE-S
Cleft Rock Area (CR)	0.9 miles S
Saquish Neck (SN)**	4.6 miles WNW ***
Onsite Stations	
Rocky Hill Road (ER)	0.8 miles SE
Microwave Tower (MT)	0.38 miles S
Rocky Hill Road (WR)	0.3 miles W-WNW
Rocky Hill Road (B)	0.26 miles SSE
Property Line (H)	0.21 miles SSW
Property Line (I)	0.14 miles W
Public Parking Area (PA)	0.07 miles N-NNE
Overlook Area (OA)	0.03 miles W

* Control Station

** Data from this surveillance station is subject to detector maintenance and retrieval by a private party not subject to control by the licensee. Therefore, the requirement to maintain this station is contingent on station availability and maintenance by the outside party.

*** Supplemental provision

TABLE 4.8.4

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (d)

Analysis	Lower Limit of Detection (a) Water pCi/l	Airborne particulate or gas - pCi/m^3	Wet solids pCi/Kg	Dry solids pCi/Kg	Milk pCi/l
Gross beta	2	1×10^{-2}			
H-3	330				
Mn-54	15		130	60	
Fe-59	30		260	120	
Co-58,60	15	2×10^{-2}	130	60	
Zn-65	30		260	120	
Sr-89	10		40		10
Sr-90	2		8	150	2
Zr/Nb-95	10				
I-131		7×10^{-2}	80(b)		2 (c)
Cs-134,137	15	1×10^{-2}	80	150	15
Ba/La-140	15				15

(a) The nominal lower limits of detection at the 95% confidence level (defined in the ERDA Health and Safety Laboratory procedures manual, HASL-300).

(b) Applies only to analysis of green leafy vegetables.

(c) Sensitivity with 25% error at the 95% confidence level.

(d) This table applies to all analyses other than those for which higher sensitivities appl in accordance with Notes (f) and (g) to Table 4.8.1.

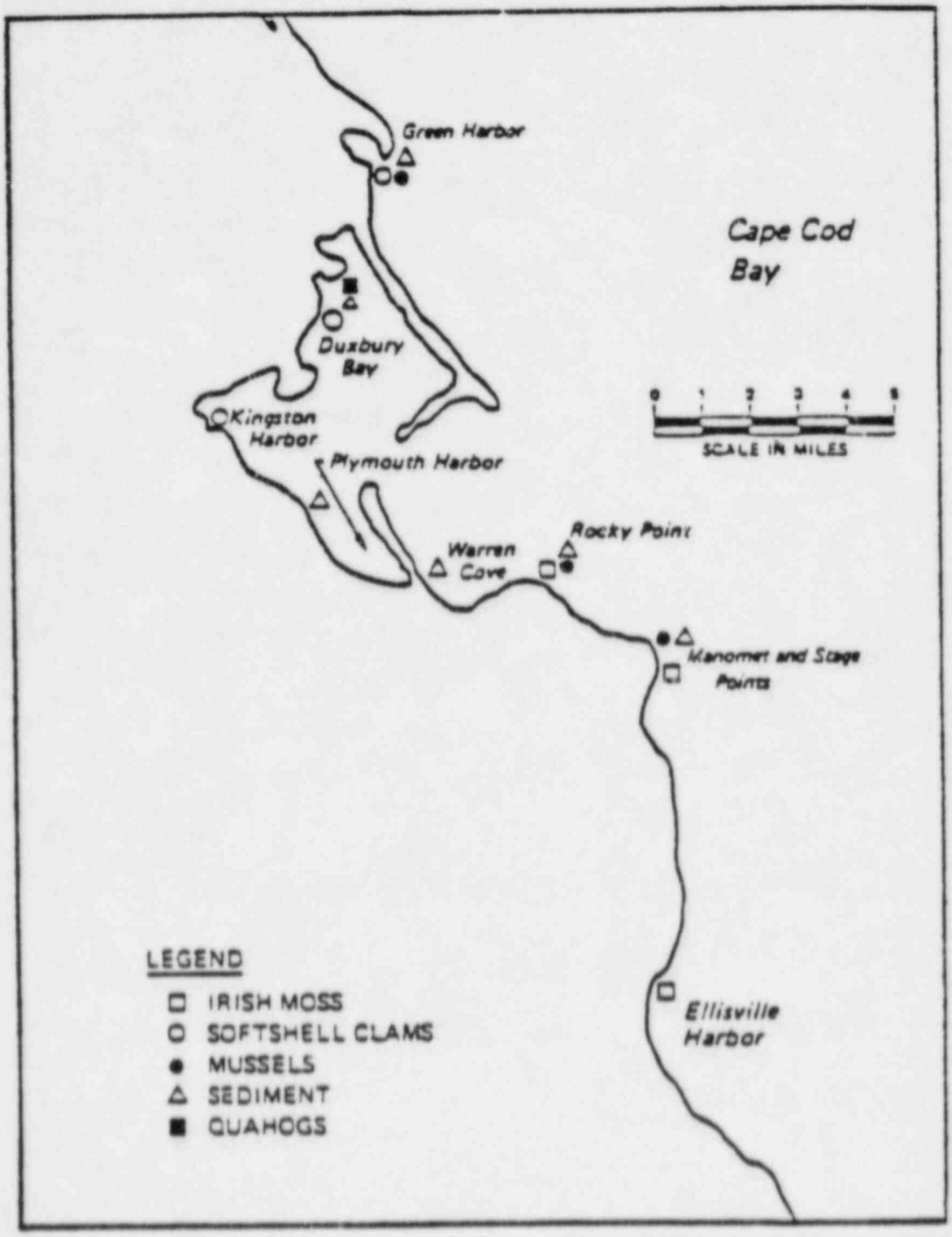


Figure 4.8-1 Typical Mollusc, Algae and Sediment Sampling Stations

6.9.C Unique Reporting Requirements

***

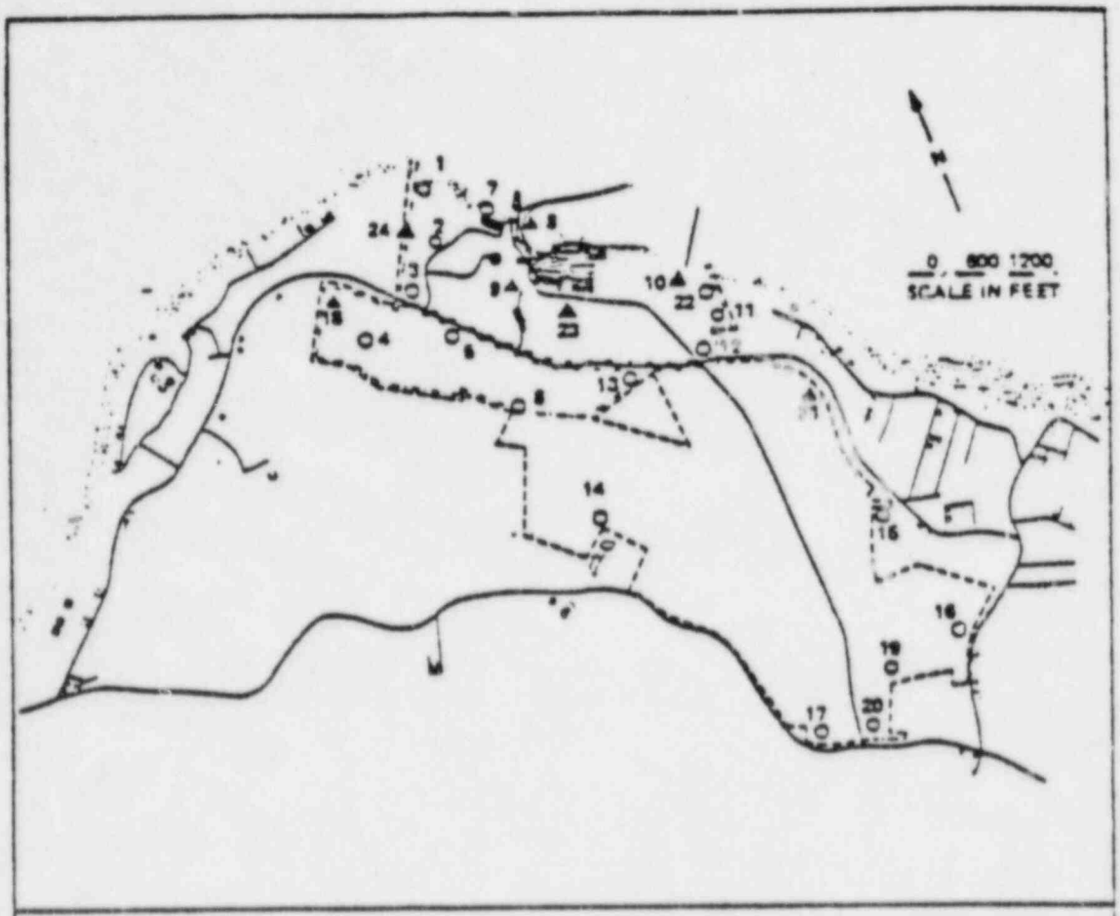
2. Environmental Program Data

a. Annual Report. A report on the radiological environmental surveillance program for the previous 12 months of operation shall be submitted to the Director of the NRC Regional Office (with a copy to the Director, Office of Nuclear Reactor Regulation) as a separate document within 90 days after January 1 of each year. The reports shall include summaries, interpretations, and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of any land use surveys which affect the choice of sample locations. If harmful effects or evidence of irreversible damage are detected by the monitoring, the licensee shall provide an analysis of the problem and a proposed course of action to alleviate the problem.

Results of all radiological environmental samples shall be summarized and tabulated on an annual basis. In the event that some results are not available within the 90-day period, the report shall be submitted, noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

b. Anomalous measurement report. If radioactivity in an indicator medium from an off-site location is found and confirmed at a level exceeding ten times the control station value, a written report shall be submitted to the Director of the NRC Regional Office (with a copy to the Director, Office of Nuclear Reactor Regulation) within 10 days after confirmation.** This report shall include an evaluation of any release conditions, environmental factors, or other aspects necessary to explain the anomalous result.

** A confirmatory reanalysis of the original, a duplicate, or a new sample may be desirable, as appropriate. The results of the confirmatory analysis shall be completed at the earliest time consistent with the analysis, but in any case within 30 days of receipt of the anomalous result.



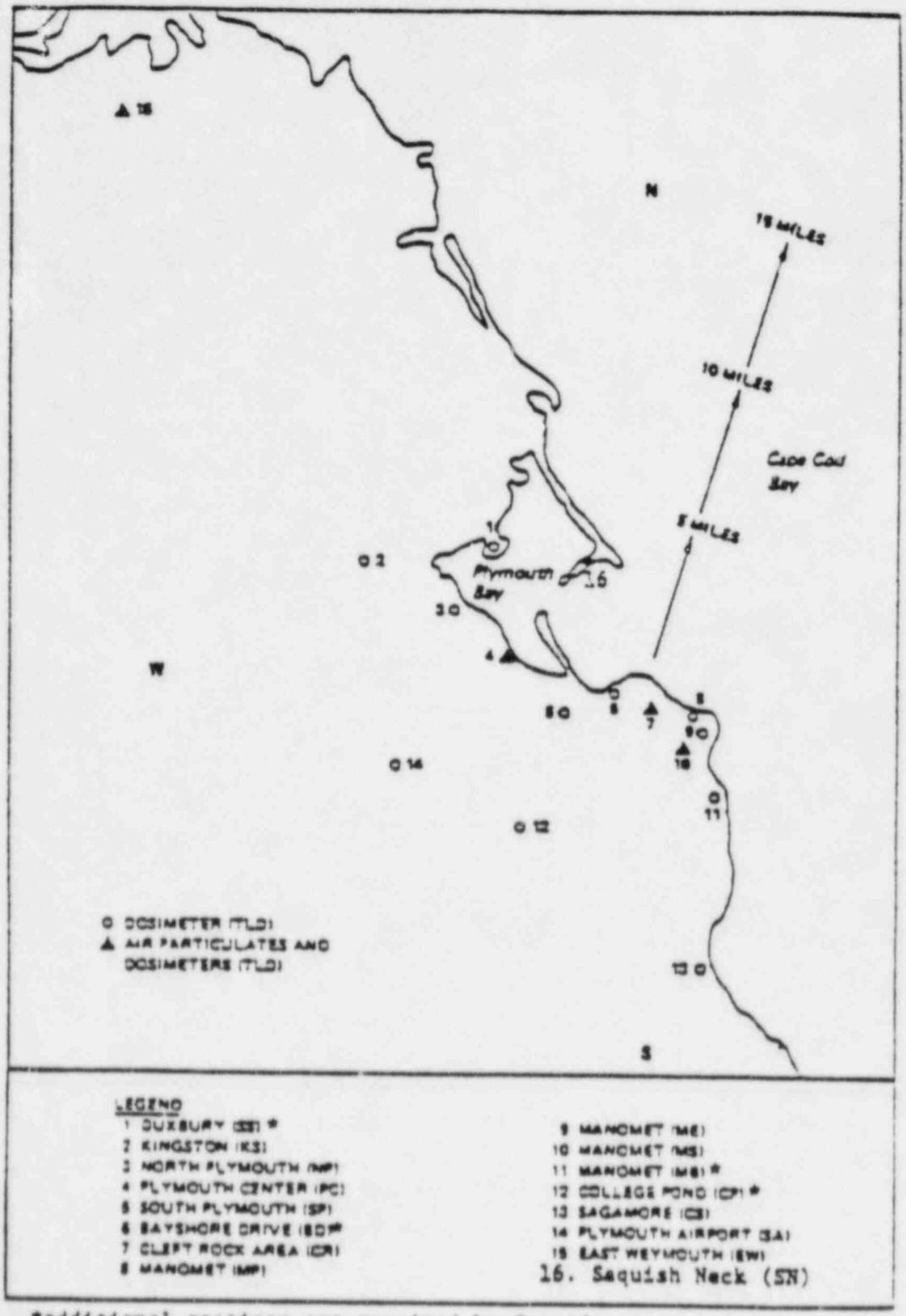
LEGEND

1 PROPERTY LINE (D) *
2 PROPERTY LINE (F) *
3 PROPERTY LINE (I)
4 PROPERTY LINE (G) *
5 ROCKY HILL ROAD (A) *
6 PROPERTY LINE (H)
7 PUBLIC PARKING AREA (PA)
8 PEDESTRIAN BRIDGE (PB)
9 OVERLOOK AREA (OA)
10 EAST BREAKWATER (EB)
11 PROPERTY LINE (C) *
12 PROPERTY LINE (HB) *
13 ROCKY HILL ROAD (B)
14 MICROWAVE TOWER (MT)
15 EMERSON ROAD (EM) *
16 WHITE HORSE ROAD (WH)*
17 PROPERTY LINE (E)*
18 ROCKY HILL ROAD (WR)
19 PROPERTY LINE (J)*
20 PROPERTY LINE (K)*
21 ROCKY HILL ROAD (ER)
22 PROPERTY LINE (L)*
23 WAREHOUSE (WS)
24 PROPERTY LINE (PL)

○ DOSIMETER (TLD)
▲ AIR PARTICULATES AND DOSIMETERS (TLD)

*additional station not required by Specification 4.8.D.1

Figure 4.8.2 Location of Onsite Monitoring Stations



*additional stations not required by Specification 4.8.D.1

Figure 4.8.3 Location of Offsite Monitoring Stations

TABLE 6.9.C-1

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/M^3)	Fish, Mussels (pCi/Kg, wet)	Milk (pCi/l)	Vegetables (pCi/kg, wet)
H-3	2×10^4				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-95	4×10^2				
I-131	2	0.9		3	1×10^2
L -134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-140	2×10^2			3×10^2	

APPENDIX E - 1984 Garden & Milk-Producing Animal Survey

B. E. Co. Form X6346

BOSTON EDISON

OFFICE MEMORANDUM

RMG Control No.
Dept. Doc. No. ERHS #85-30
Record Type A4.08
☐ Safety-Related
☐ Non Safety-Related

To Mr. A. V. Morisi From Ms. C. E. Bowman

Date March 29, 1985

Subject: 1984 GARDEN & MILK-PRODUCING ANIMAL CENSUS

As required by PNPS Environmental Technical Specifications, the 1984 Garden and Milk-Producing Census was conducted in September in a street-by-street search of the area within one mile of PNPS.

The existence of a garden near the site boundary of 0.6 miles ESE was confirmed. The garden near the site boundary of 0.7 miles W no longer exists; however, a garden 1.0 miles W of the site boundary was identified. These gardens are the closest and largest in the near vicinity (1 mile) of PNPS, and are less than 500 square feet. They do represent conservative garden locations for sampling analysis and dose calculation. With the assistance of Mr. Robert Tis, vegetation samples were collected from four locations on 9/26/84. Only one location was greater than one mile from PNPS. A sample of cabbage was collected from the J. Work Residence (0.6 miles ESE) on John Alden Road; rhubbarb was obtained from the Malmgren Residence (1.0 miles W) on Rocky Hill Road, and from the Jenkins Residence (1.0 miles SE) on Rocky Hill Road; and, a sample of beet leaves was collected from the Whipple Farm (1.5 miles SSW) off Doten Road.

In addition, no cows or goats or structures which would indicate the presence of such animals within one mile of PNPS were observed. The Plymouth Animal Inspector forwarded a letter (attached) to Boston Edison indicating that the only milk-producing animals within five miles of PNPS are located at the Plymouth County Farm. The Plymouth County Farm is a participant in the Environmental Monitoring Program. During the 1982 Census, a milk-producing cow was located on Beaver Dam Road (2.5 miles S). This animal is still located on Beaver Dam Road. The owner did not participate in the 1984 Environmental Monitoring Program, but has indicated a renewed interest for participating in the 1985 Environmental Monitoring Program.

In conclusion, the 1984 Census indicates that there are no additional indicator stations available for milk sampling.

:lsd
attachment

Distribution:

TOWN OF PLYMOUTH

OFFICE OF

BOARD OF HEALTH

March 14, 1985

Boston Edison Company
800 Boylston Street
Boston, MA 02199

Attention: Brian P. Lunn

Dear Mr. Lunn:

Please be advised that the only milk producing animals that I am aware of within the five mile radius of the Pilgrim Nuclear Power Plant are those housed at the Plymouth County farm. As you may know, this is located at the Plymouth County House of Correction, Obery Street, Plymouth.

If you have any further questions regarding this matter please contact me.

Sincerely,

Milton D. Wood /Sc

Milton D. Wood
Plymouth Animal Inspector

11 LINCOLN STREET
PLYMOUTH, MASSACHUSETTS 02360

Tel. 747-1620 Ext. 33

BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

WILLIAM D. HARRINGTON
SENIOR VICE PRESIDENT
NUCLEAR

April 1, 1985
BECo 85-65

Dr. Thomas E. Murley
Regional Administrator
Office of Inspection and Enforcement
Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

License DPR-35
Docket 50-293

Environmental Radiological Monitoring Report No. 17
January 1 - December 31, 1984

Dear Sir:

In accordance with the Pilgrim Nuclear Power Station Technical Specification 6.9.C.2, Boston Edison Company hereby submits Environmental Radiological Monitoring Report No. 17. This report applies to the period from January 1, 1984 through December 31, 1984.

Very truly yours,

W D Harrington

MTL/ns

Attachments: (2 copies)

cc: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
(18 copies)

1/1
IE 25