

YANKEE ATOMIC ELECTRIC COMPANY
ANNUAL RADIOLOGICAL
ENVIRONMENTAL MONITORING REPORT

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1.0 INTRODUCTION

The radiological environmental surveillance program at Yankee Atomic has been designed and carried out with specific objectives in mind. They are as follows:

- To provide an early indication of the appearance or accumulation of any radioactive material in the environment caused by the operation of the nuclear power station.
- To provide assurance to regulatory agencies and the public that the station's environmental impact is known and within anticipated limits.
- To verify the adequacy and proper functioning of station effluent controls and monitoring systems.
- To provide an estimate of actual radiation exposure to the surrounding population.
- To provide standby monitoring capability for rapid assessment of risk to the general public in the event of unanticipated or accidental releases of radioactive material.

During 1984, as in the past, the plant staff collected the bulk of the environmental samples and processed all environmental thermoluminescent dosimeters (TLDs) for direct radiation measurements. After the initial processing, all non-TLD samples were sent to the Yankee Atomic Environmental Laboratory in Westboro, Massachusetts for further processing and radionuclide analysis.

This report is a summary of the findings of the Radiological Environmental Surveillance Program for 1984. It is being provided in compliance with plant Technical Specification 6.9.5.a.

2.0 ENVIRONMENTAL MONITORING PROGRAM

In this section, Table 2.1 outlines the monitoring program as required by the plant Technical Specifications. Table 2.2 lists the sampling stations and their specific locations (distances are measured from the center of the containment building). The sampling locations are shown on maps in Figures 2.1 through 2.7.

Below are listed the two-letter media codes and what they represent:

AP	Air Particulate
CF	Charcoal Filter
TM	Milk
WG	Ground Water
WR	River Water
TF	Food Crop
TV	Broad Leaf Vegetation
MS	Maple Syrup
SE	Sediment
FH	Finfish
GM	Direct Radiation (TLD)
TS	Soil

Table 2.1

Yankee Atomic
Radiological Environmental Monitoring Program

<u>Media</u>	<u>Sampling Frequency</u>	<u>Required Analyses</u>
Air Particulate (AP)	- Weekly - Quarterly Composite	Gross beta Gamma spectroscopy
Charcoal Filter (CF)	- Weekly	I-131
Milk (TM)	- Monthly; once per 2 weeks from June 1 to Nov. 1	Gamma spectroscopy, I-131
Food Crop (TF)	- Annually (Harvest)	Gamma spectroscopy
Broad Leaf Vegetation (TV)	- Annually (Harvest)	I-131
Ground Water (WG)	- Quarterly	Gamma spectroscopy, H-3
River Water (WR)	- Monthly (Composite) - Quarterly Composite	Gross beta, Gamma spectroscopy, I-131 H-3
Sediment (SE)	- Semiannually	Gamma spectroscopy
Finfish (FH)	- Seasonal or Semiannually	Gamma spectroscopy
Direct Radiation (GM)	- Quarterly (Outer ring TLDs) - Quarterly (All other TLDs)	De-dose only Intergrated gamma dose

Table 2.2

Yankee Atomic
Radiological Environmental Monitoring Locations

<u>Station Code</u> (Media - Sta. No.)	<u>Station</u> <u>Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From</u> <u>Plant</u> <u>(km)</u>	<u>Direction</u> <u>From</u> <u>Plant</u>
AP/CF-11	Observation Stand	1	0.5	NW
AP/CF-12	Monroe Bridge	1	1.1	SW
AP/CF-13	Rowe School	1	4.2	SE
AP/CF-14	Harriman Station	1	3.2	N
AP/CF-21	Williamstown, MA	2	22.2	W
AP/CF-31**	Furlon House	1	0.8	SW
AP/CF-32**	Heartwellville, VT	2	12.6	NNW
TM-11	Heath, MA	1	5.8	E
TM-12	Readsboro, VT	1	6.1	N
TM-21	Williamstown, MA	2	21.0	WSW
TF-11	Monroe Bridge	1	1.3	SW
TF-12	Rowe, MA	1	3.5	E
TF-21	Williamstown, MA	2	21.0	WSW
TF-32**	Harriman Station	1	3.2	N
TV-11	Monroe Bridge	1	1.3	SW
MS-31**	Readsboro, VT	1	6.1	N
MS-41**	Heath, MA	1	5.3	E
MS-42**	Williamstown, MA	2	28.3	WSW
WG-11	Plant Potable	1	On-Site	--
WG-12	Sherman Spring	1	0.2	NW
WR-11	Bear Swamp Lower Res.	1	6.3	Downriver
WR-12	Harriman Reservoir	2	10.1	Upriver
SE-11	No. 4 Station	1	36.2	Downriver
SE-21	Harriman Reservoir	2	10.1	Upriver

Table 2.2
(continued)

Yankee Atomic
Radiological Environmental Monitoring Locations

<u>Station Code</u> (Media - Sta. No.)	<u>Station</u> <u>Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From</u> <u>Plant</u> <u>(km)</u>	<u>Direction</u> <u>From</u> <u>Plant</u>
FH-11	Sherman Pond	1	1.5	N
FH-21	Harriman Reservoir	2	10.1	Upriver
GM-1	Furlon House	NA	0.8	SW
GM-2	Observation Stand	NA	0.5	NW
GM-3	Rowe School	NA	4.2	SE
GM-4	Harriman Station	NA	3.2	N
GM-5	Monroe Bridge	NA	1.1	SW
GM-6	Readsboro Road Barrier	NA	1.3	N
GM-7	Whitingham Line	NA	3.5	NE
GM-8	Monroe Hill Barrier	NA	1.8	S
GM-9	Dunbar Brook	NA	3.2	SW
GM-10	Cross Road	NA	3.5	E
GM-11	Adams High Line	NA	2.1	WNW
GM-12	Readsboro, VT	NA	5.5	NNW
GM-13	Restricted Area Fence	NA	0.08	WSW
GM-14	Restricted Area Fence	NA	0.11	WNW
GM-15	Restricted Area Fence	NA	0.08	NNW
GM-16	Restricted Area Fence	NA	0.13	ENE
GM-17	Restricted Area Fence	NA	0.14	ENE
GM-18	Restricted Area Fence	NA	0.14	ESE
GM-19	Restricted Area Fence	NA	0.16	SE
GM-20	Restricted Area Fence	NA	0.16	SSE
GM-21	Restricted Area Fence	NA	0.11	SSW
GM-22	Heartwellville, VT	2	12.6	NNW
GM-23	Williamstown Substation	2	22.2	W
GM-24	Harriman Dam	0	7.3	N
GM-25	Whitingham, VT	0	7.7	NNE
GM-26	Sadoga Road	0	7.6	NE
GM-27	Number 9 Road	0	7.6	ENE
GM-28	Number 9 Road	0	6.0	E
GM-29	Route 8A	0	8.2	ESE

Table 2.2
(continued)

Yankee Atomic
Radiological Environmental Monitoring Locations

<u>Station Code</u> <u>(Media - Sta. No.)</u>	<u>Station</u> <u>Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From</u> <u>Plant</u> <u>(km)</u>	<u>Direction</u> <u>From</u> <u>Plant</u>
GM-30	Route 8A	0	9.4	SE
GM-31	Legate Hill Road	0	7.6	SSE
GM-32	Rowe Road	0	7.9	S
GM-33	Zoar Road	0	6.9	SSW
GM-34	Fife Brook Road	0	6.4	SW
GM-35	Whitcomb Summit	0	8.6	WSW
GM-36	Tilda Road	0	6.6	W
GM-37	Turner Hill Road	0	6.7	WNW
GM-38	West Hill Road	0	6.6	NW
GM-39	Route 100	0	6.8	NNW
GM-40	Readsboro	NA	0.5	W
TS-01**	Furlon House	1	0.8	SW
TS-02**	Monroe Bridge, MA	1	1.1	SW
TS-03**	Observation Stand	1	0.5	NW
TS-04**	Williamstown, MA	2	22.2	W
TS-05**	Heartwellville, VT	2	12.6	NNW
TS-06**	Harriman Station	1	3.2	N
TS-07**	Rowe School	1	4.2	SE

*1 = Indicator Stations; 2 = Control Stations; 0 = Outer Ring Incident Response TLD; NA = Not Applicable.

** Not required by Radiological Effluent Technical Specifications.

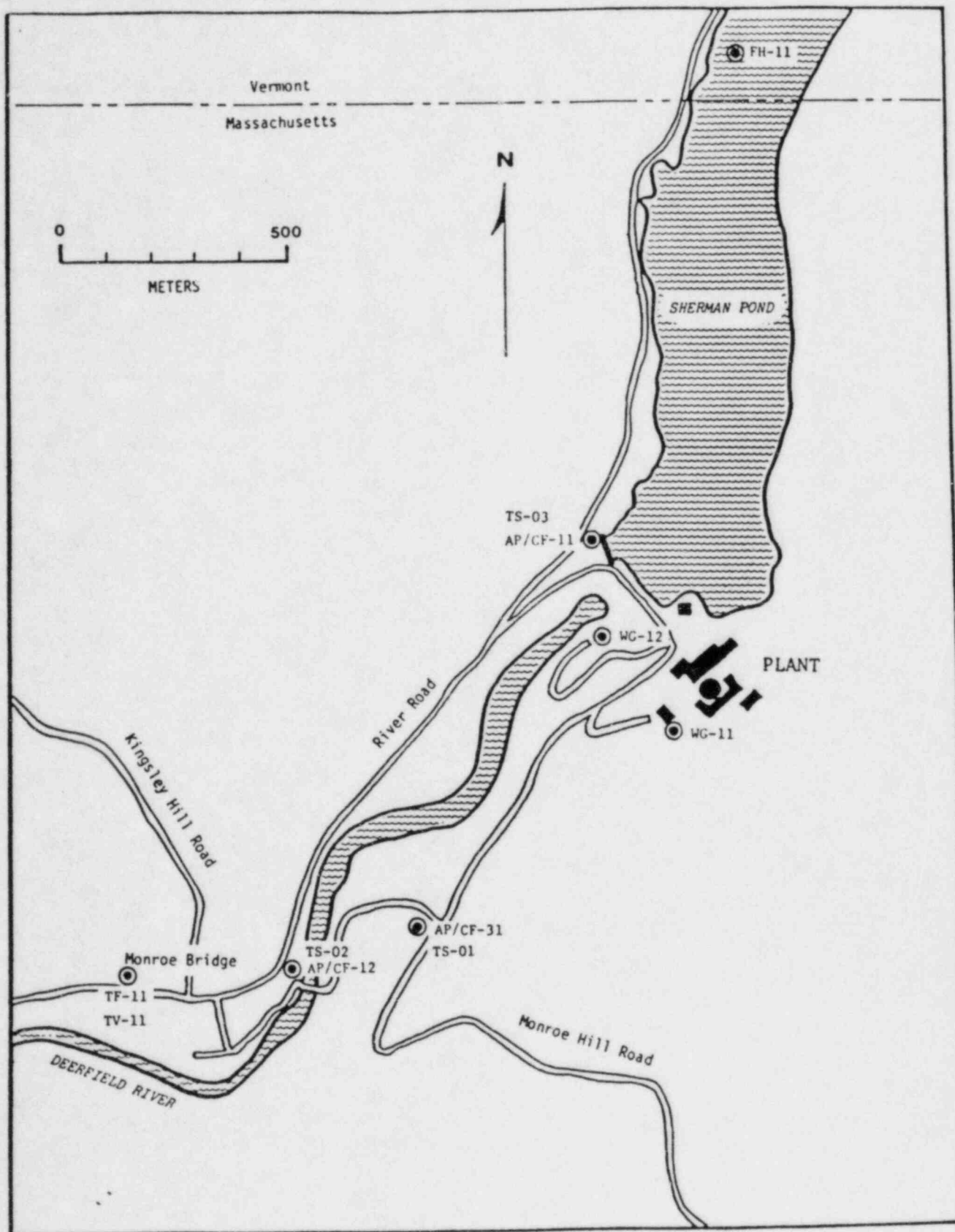


Figure 2.1 Yankee Plant Radiological Environmental Monitoring Locations Within 1 Mile (Airborne, Waterborne and Ingestion Pathways)

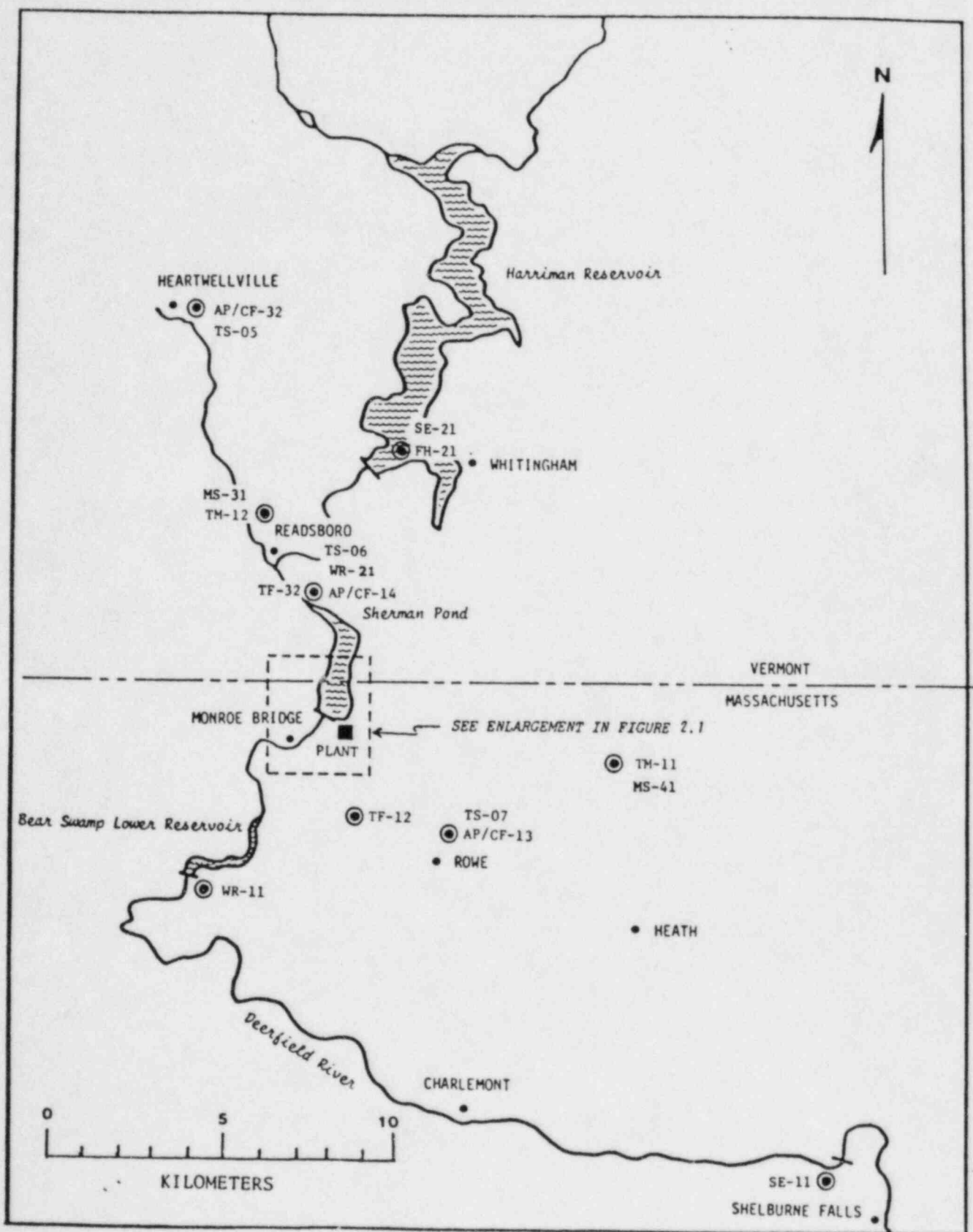


Figure 2.2 Yankee Plant Radiological Environmental Monitoring Locations Within 12 Miles (Airborne, Waterborne and Ingestion Pathways)

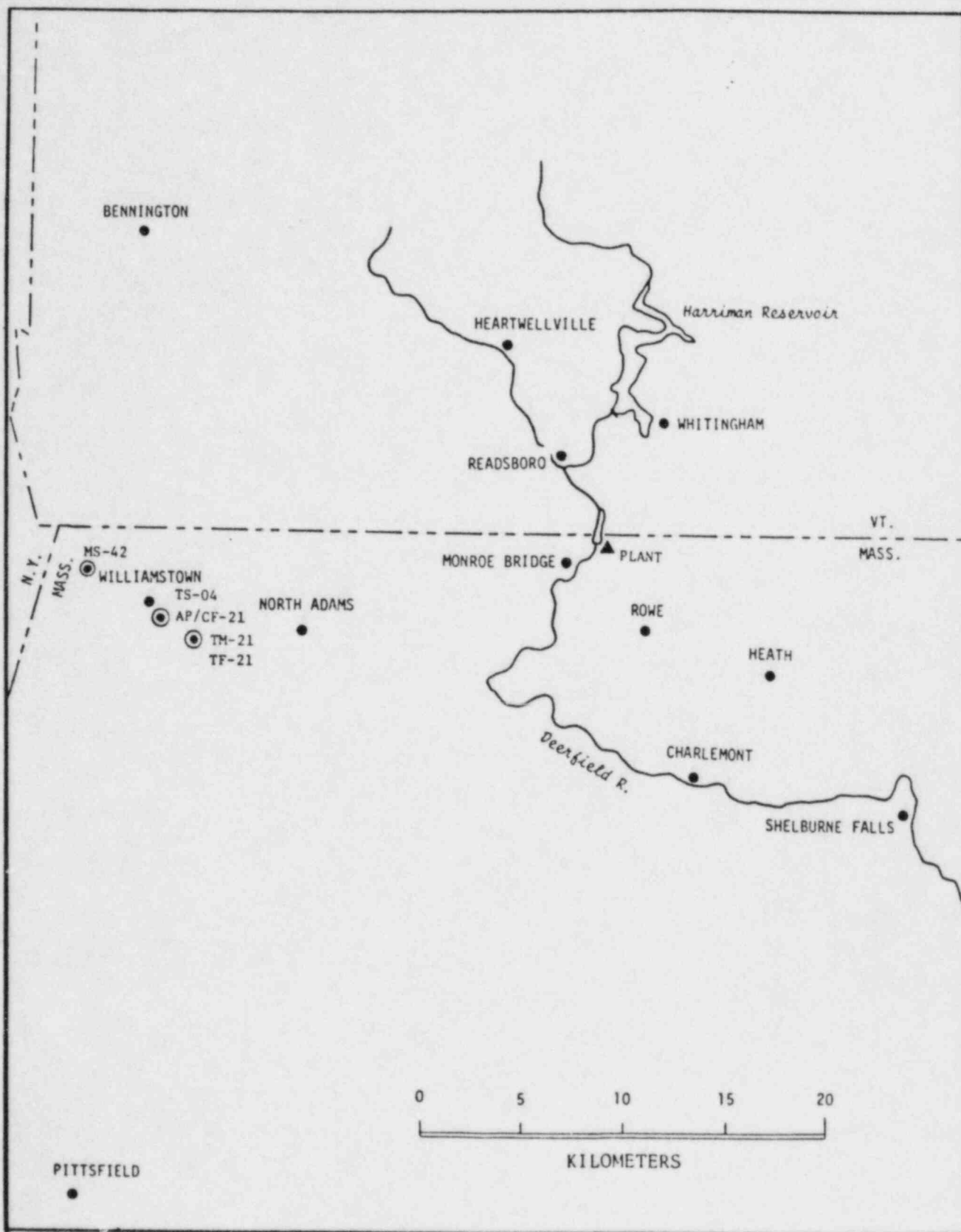


Figure 2.3 Yankee Plant Radiological Environmental Monitoring Locations Outside 12 Miles (Airborne, Waterborne and Ingestion Pathways)

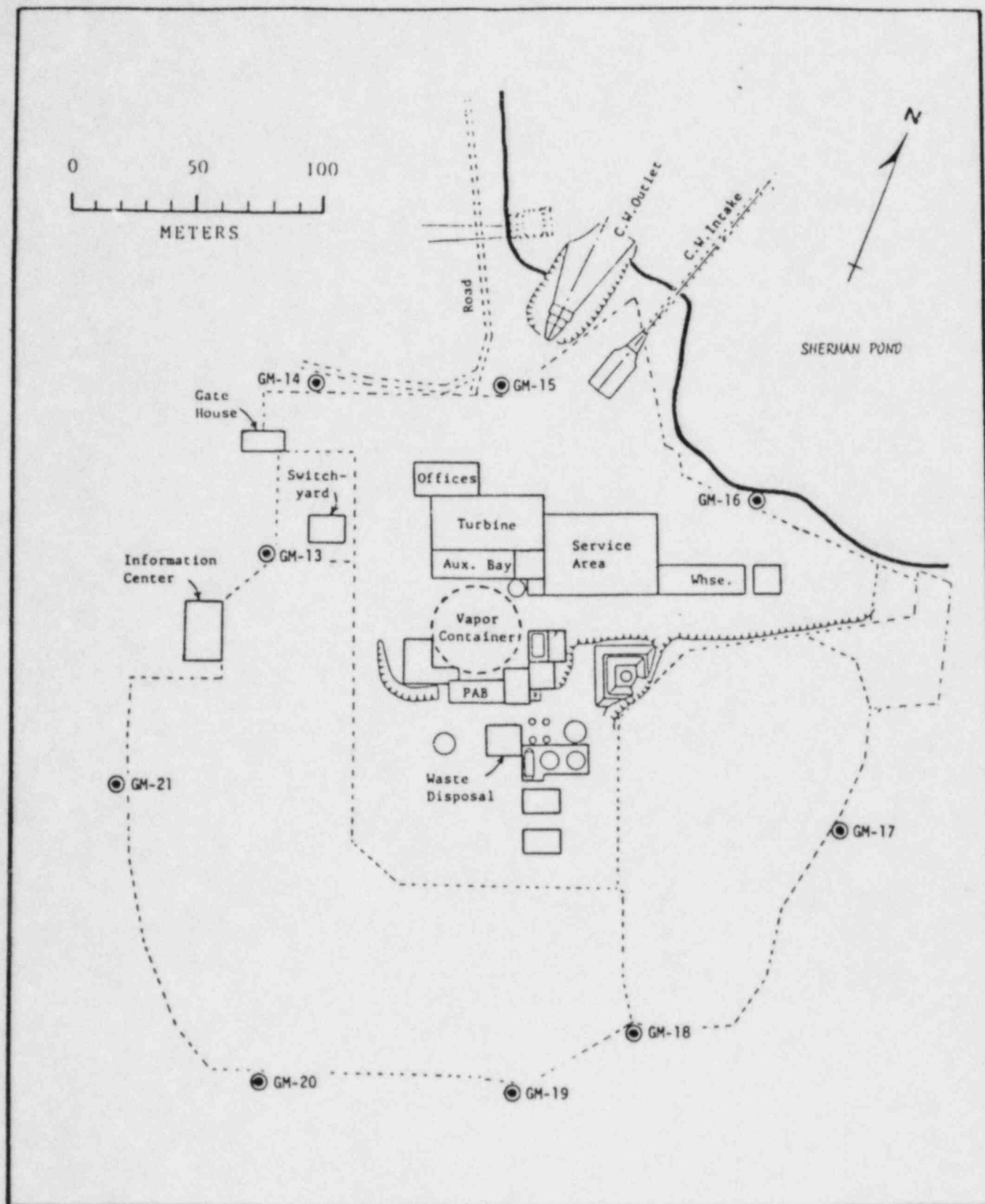


Figure 2.4 Yankee Plant Radiological Environmental Monitoring Locations at the Restricted Area Fence (Direct Radiation Pathway)

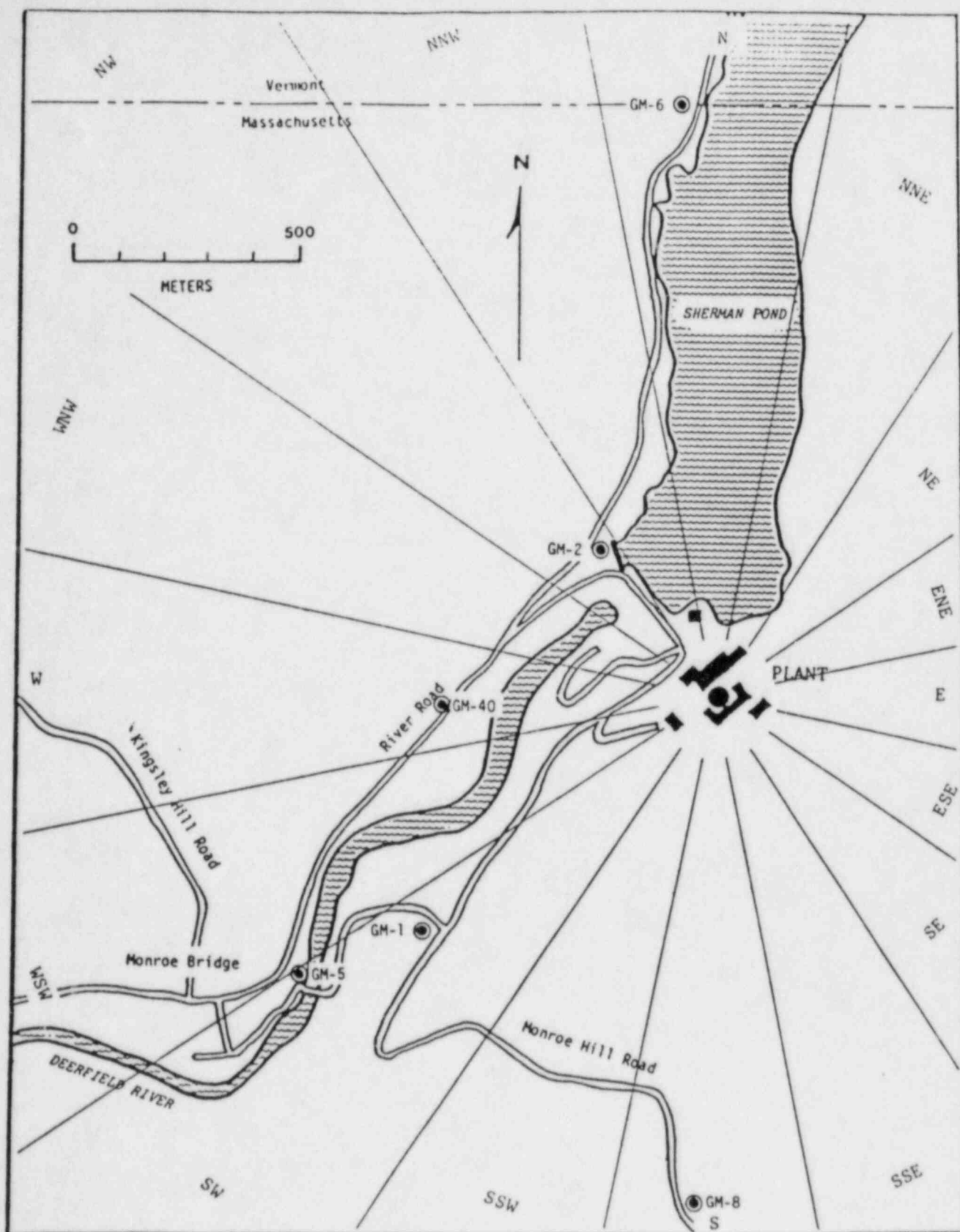


Figure 2.5 Yankee Plant Radiological Environmental Monitoring Locations Within 1 Mile (Direct Radiation Pathway)

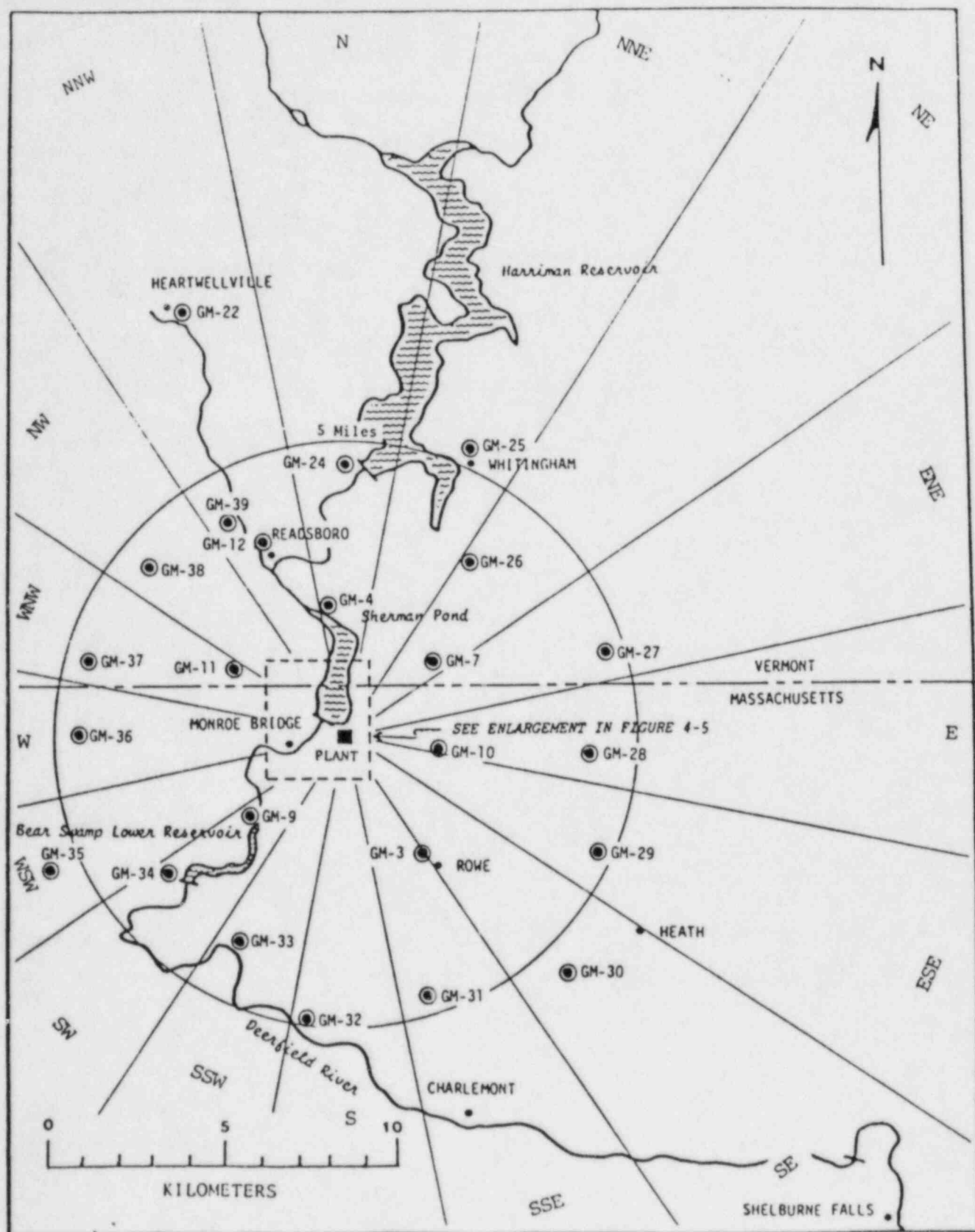


Figure 2.6 Yankee Plant Radiological Environmental Monitoring Locations Within 12 Miles (Direct Radiation Pathway)

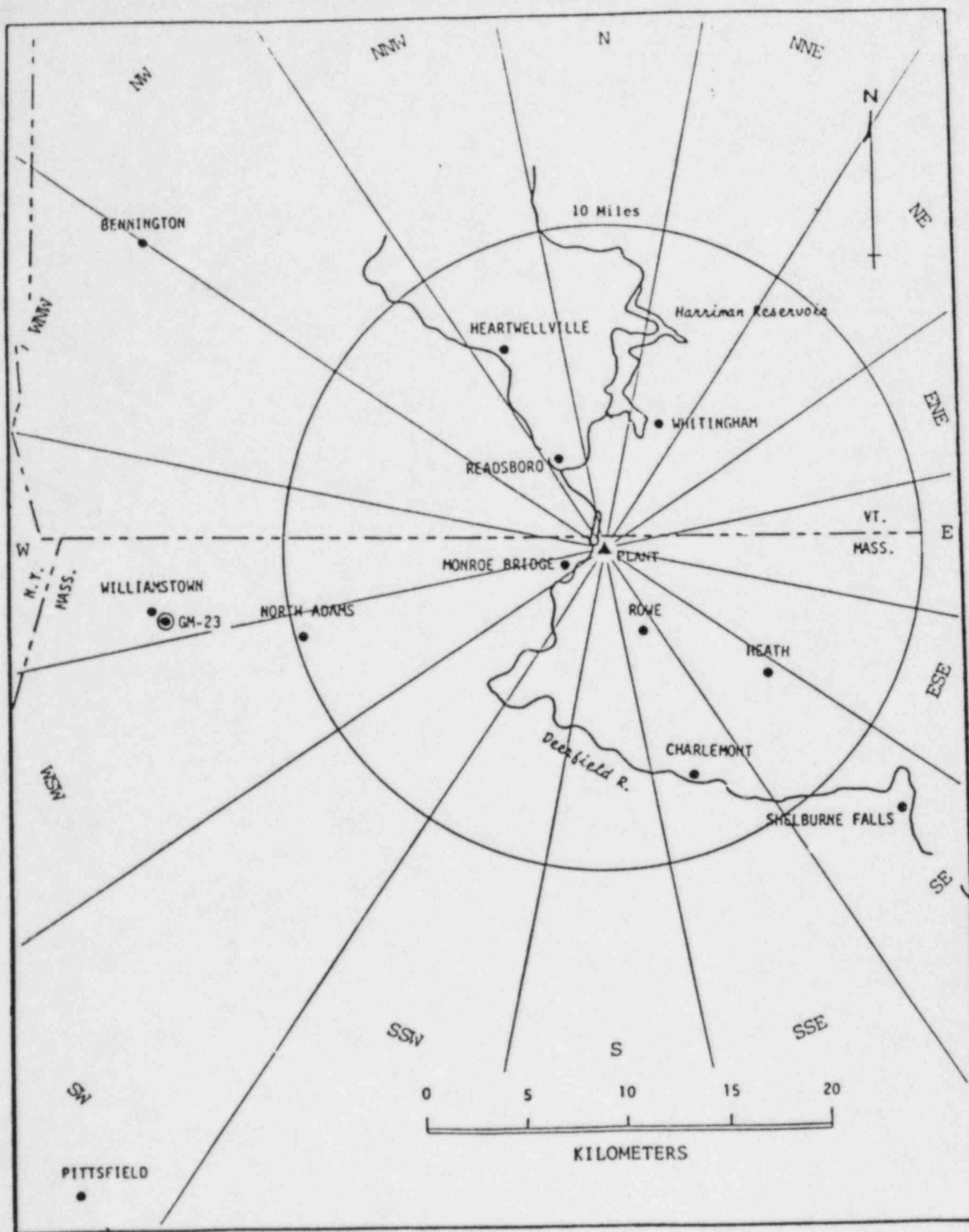


Figure 2.7 Yankee Plant Radiological Environmental Monitoring Locations Outside 12 Miles (Direct Radiation Pathway)

3.0 SUMMARY OF 1984 ENVIRONMENTAL DATA

The following pages summarize the analytical results of all the environmental samples which were collected during 1984. Each environmental media category is presented as a separate subsection. A discussion of the sampling program and results is followed by a table which summarizes the year's data for each category. The tables were generated by the computer program, ERMAP. At the top of each table, ERMAP lists the units of measurement for each medium. The left hand column contains the radionuclide which is being reported, total number of analyses of that radionuclide, and the number of measurements which exceeds ten times the yearly average background value. The latter are classified as "non-routine" measurements. The next column lists the Lower Limit of Detection (LLD) for those radionuclides which have detection capability requirements as specified in the plant's Radiological Effluent Technical Specifications. (Requirements are not given for many of the radionuclides routinely measured and reported herein.)

Those sampling stations which are within the range of influence of the plant and which could conceivably be affected by its operation are called "Indicator" or "Zone I" stations. Distant stations, which are beyond plant influence are called "Control" or "Zone II" stations.

ERMAP calculates a set of statistical parameters for each radionuclide. 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:

- o The mean value of all concentrations including negative values and values below LLD.
- o The square root of the mean square deviation. This is an estimate of the sample variance.
- o The lowest and highest calculated concentration.

- o The number of positive measurements (activity which is three times greater than the standard deviation) divided by the total number of measurements.

Each single radioactivity measurement datum in this report is based on a single measurement and is reported as a concentration plus or minus a one standard deviation uncertainty. The quoted uncertainty term represents only the random uncertainty associated with the radioactive decay process (counting statistics), and not the propagation of all possible uncertainties in the analytical procedure. Radioactivity is considered to be present in a sample when the concentration exceeds three times its associated standard deviation. Expressed in another way, the measurement is considered to be statistically different than normal instrument background when the plus or minus three standard deviation range surrounding the measurement does not include zero.

Direct radiation measurements from thermoluminescent dosimeters are discussed in Section 3.M.

During 1984, two environmental analyses did not meet their required LLDs. A burned out motor on an air sampling pump at Control Station AP/CF-21 during the week ending August 14, 1984 resulted in a total week's sample volume of 22 cubic meters. The low volume prevented the required LLDs for the air particulate filter (gross beta analysis) and its companion charcoal filter (I-131 analysis) from being reached.

A circuit breaker trip at Control Station AP/CF-21 resulted in a low sample volume of 197 cubic meters during the week ending May 1, 1984. The required LLDs for the air particulate and charcoal filters were achieved, however.

The required LLD for one non-environmental sample was not met as follows. On November 27, 1984, the Yankee plant initiated a load reduction to affect boiler feed pump repairs. The rate of load reduction exceeded 15% of rated thermal power in one hour. Required sampling of plant systems was initiated in accordance with Technical Specifications 4.4.7 and 4.11.2.1.2 (Table 4.11-2, Notes c and d). The results of the analysis required under 4.4.7 indicated that sampling and analysis under 4.11.2.1.2 were not

required. However, the completed sampling produced a charcoal sample for I-131 of one-hour duration resulting in a lower limit of detection of $3\text{E-}11$ uCi/mL versus the required $1\text{E-}11$ uCi/mL.

The small sample size obtained was a function of using the PVS back-up sampling system to obtain the samples. At that point in time, the back-up system was in use as the primary sample system due to changes to the PVS monitoring system under EDCR 84-314. Thus, the I-131 charcoal sample was a portion of the continuous sampling required under Table 4.11-2 and subject to the LLD requirement. The short duration of the sampling (approximately one hour) resulted in a low sample volume (mLs) and thus an increased LLD. Please note that, this LLD was achieved only for that one-hour span of time. The required LLDs were achieved for the sampling periods before and after the one-hour period.

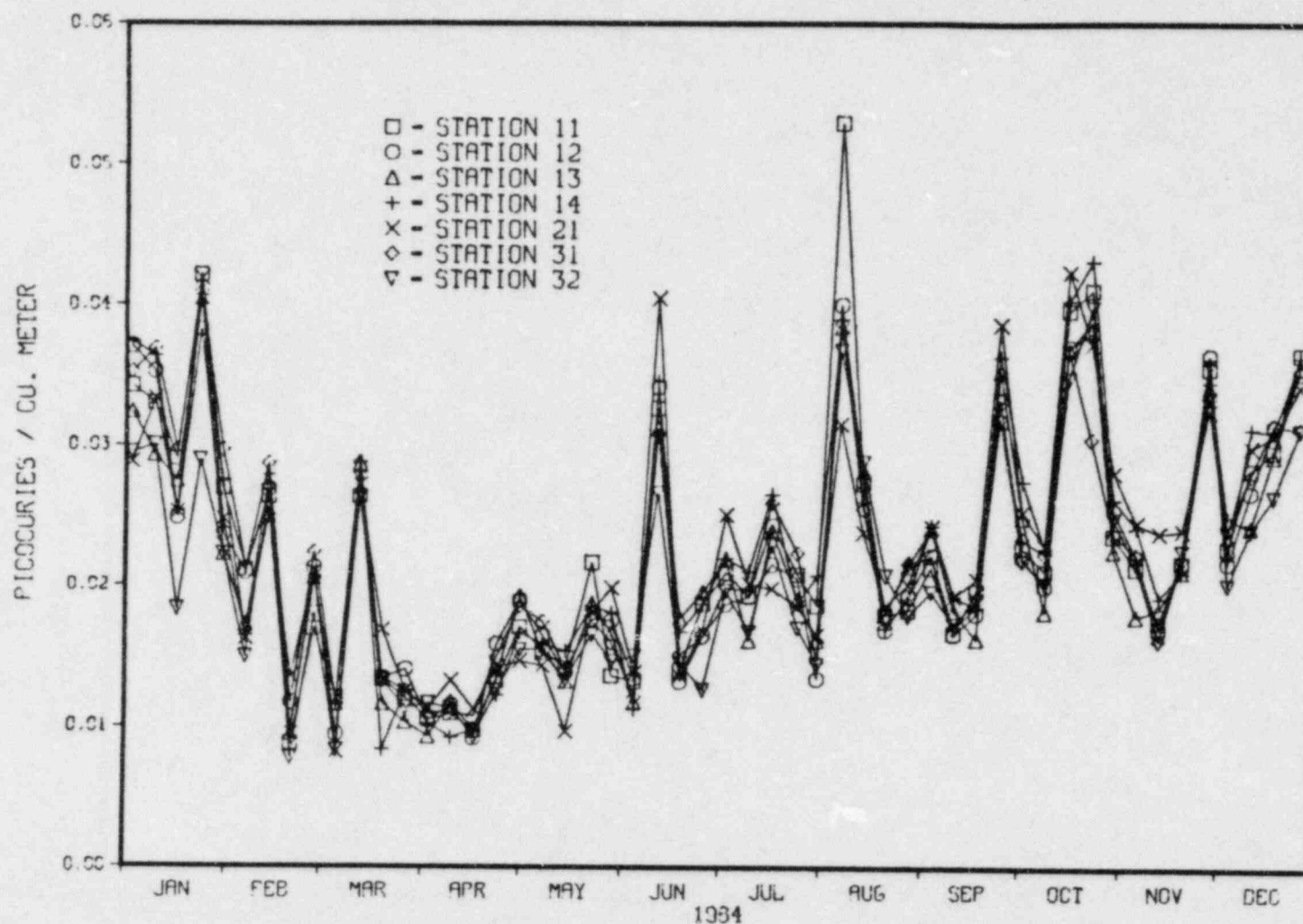
During the fourth quarter, the TLD badge at Station GM-9, Dunbar Brook, was apparently stolen. The annual average exposure rate, as reported in Table 3-1, is based on data from the first three calendar quarters only.

A) Air Particulate

Air monitoring stations are established at a total of seven locations, five of which are required by the Radiological Effluent Technical Specifications. The air pumps at these locations operate continuously at a flow rate of approximately one cubic foot per minute. Airborne particulates are collected by passing the air through a fiber filter. These filters are collected weekly and held for at least 100 hours before being analyzed for gross-beta activity (indicated as GR-B in tables) to allow for the decay of radon and thoron daughter products. Weekly composite air filters from each location are analyzed quarterly for gamma-emitting radionuclides.

Gross-beta analyses (Figure 3.1) show random fluctuations at all sampling locations including controls, thereby indicating that any plant contribution is negligible. For the gamma analyses, no activity was detected at either the indicator or control locations, with the exception of naturally occurring K-40 and Be-7.

FIGURE 3.1
GROSS BETA MEASUREMENTS OF AIR PARTICULATE FILTERS
YANKEE ATOMIC ELECTRIC COMPANY, ROWE, MA



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: AIR PARTICULATE

UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
GR-B (364) (0)	.01	(2.2 ± .1)E -2 (8.4 - 52.9)E -3 *(260/260)*	14	(2.3 ± .1)E -2 (8.4 - 43.1)E -3 *(52/ 52)*	(2.2 ± .1)E -2 (7.7 - 42.3)E -3 *(103/104)*
BE-7 (28) (0)		(4.2 ± .2)E -2 (2.8 - 5.7)E -2 *(20/ 20)*	14	(4.6 ± .4)E -2 (4.1 - 5.7)E -2 *(4/ 4)*	(4.4 ± .3)E -2 (3.3 - 5.8)E -2 *(8/ 8)*
K-40 (28) (0)		(4.2 ± .4)E -3 (-5.0 - 81.8)E -4 *(6/ 20)*	11	(5.3 ± 1.0)E -3 (3.8 - 8.2)E -3 *(3/ 4)*	(3.5 ± .7)E -3 (1.1 - 6.1)E -3 *(2/ 8)*
MN-54 (28) (0)		(-5.9 ± 26.7)E -6 (-2.4 - 2.1)E -4 *(0/ 20)*	11	(6.0 ± 7.8)E -5 (-1.5 - 2.1)E -4 *(0/ 4)*	(-2.9 ± 21.1)E -6 (-1.2 - .7)E -4 *(0/ 8)*
CO-58 (28) (0)		(-2.6 ± 2.7)E -5 (-1.9 - 3.0)E -4 *(0/ 20)*	14	(2.5 ± 9.5)E -5 (-1.4 - 3.0)E -4 *(0/ 4)*	(-3.8 ± 4.8)E -5 (-1.5 - 2.6)E -4 *(0/ 8)*
FE-59 (28) (0)		(-7.6 ± 6.6)E -5 (-7.3 - 3.7)E -4 *(0/ 20)*	32	(1.6 ± .6)E -4 (7.5 - 32.0)E -5 *(0/ 4)*	(3.1 ± 12.3)E -5 (-7.8 - 3.2)E -4 *(0/ 8)*
CO-60 (28) (0)		(-3.7 ± 2.8)E -5 (-3.4 - 1.5)E -4 *(0/ 20)*	14	(1.4 ± 2.2)E -5 (-1.8 - 7.7)E -5 *(0/ 4)*	(-2.3 ± 4.4)E -5 (-2.5 - 1.1)E -4 *(0/ 8)*
ZN-65 (28) (0)		(-1.8 ± 6.8)E -5 (-5.1 - 6.4)E -4 *(0/ 20)*	31	(2.4 ± 1.4)E -4 (6.0 - 64.1)E -5 *(0/ 4)*	(-9.2 ± 7.8)E -5 (-3.6 - 3.0)E -4 *(0/ 8)*
ZR-95 (28) (0)		(1.1 ± 6.0)E -5 (-4.0 - 6.0)E -4 *(0/ 20)*	11	(2.3 ± 1.4)E -4 (-5.0 - 59.6)E -5 *(0/ 4)*	(1.0 ± .9)E -4 (-4.3 - 3.4)E -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 *()%.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: AIR PARTICULATE

UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		
			MEAN STA. RANGE NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-103 (28) (0)		(-1.3 ± 2.6)E -5 (-3.0 - 2.0)E -4 *(0/ 20)*	32 (7.2 ± 3.8)E -5 (-8.9 - 170.0)E -6 *(0/ 4)*	(5.8 ± 38.9)E -6 (-2.0 - 1.7)E -4 *(0/ 8)*
RU-106 (28) (0)		(-3.4 ± 2.1)E -4 (-2.4 - 1.4)E -3 *(0/ 20)*	13 (3.5 ± 2.9)E -4 (-3.7 - 10.0)E -4 *(0/ 4)*	(-7.5 ± 4.3)E -4 (-3.0 - .9)E -3 *(0/ 8)*
CS-134 (28) (0)	.05	(-4.6 ± 2.6)E -5 (-2.7 - 2.3)E -4 *(0/ 20)*	12 (-1.3 ± 8.4)E -5 (-1.2 - 2.3)E -4 *(0/ 4)*	(-8.4 ± 5.1)E -5 (-2.6 - 2.0)E -4 *(0/ 8)*
CS-137 (28) (0)	.06	(5.3 ± 2.6)E -5 (-2.1 - 2.4)E -4 *(0/ 20)*	14 (1.4 ± .5)E -4 (3.0 - 23.6)E -5 *(0/ 4)*	(-3.5 ± 2.7)E -5 (-1.2 - .8)E -4 *(0/ 8)*
BA-140 (28) (0)		(-1.4 ± 1.0)E -4 (-8.0 - 12.5)E -4 *(0/ 20)*	13 (-1.6 ± 8.1)E -5 (-2.0 - 1.5)E -4 *(0/ 4)*	(-3.2 ± 1.3)E -4 (-8.2 - 2.1)E -4 *(0/ 8)*
CE-141 (28) (0)		(6.0 ± 4.4)E -5 (-2.7 - 4.9)E -4 *(0/ 20)*	12 (1.5 ± 1.3)E -4 (-1.2 - 4.9)E -4 *(0/ 4)*	(2.4 ± 8.8)E -5 (-3.1 - 5.1)E -4 *(0/ 8)*
CE-144 (28) (0)		(6.1 ± 10.5)E -5 (-8.2 - 8.5)E -4 *(0/ 20)*	31 (4.8 ± 1.7)E -4 (1.4 - 8.5)E -4 *(0/ 4)*	(1.8 ± 1.5)E -4 (-2.7 - 9.1)E -4 *(0/ 8)*
TH-232 (28) (0)		(6.9 ± 8.0)E -5 (-7.3 - 9.5)E -4 *(0/ 20)*	21 (6.4 ± 1.9)E -4 (2.0 - 10.4)E -4 *(0/ 4)*	(4.1 ± 1.4)E -4 (-1.2 - 10.4)E -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 *()*.

B) Charcoal Filters

Charcoal filter cartridges are situated in series with the air particulate fiber filters. Monitoring stations were located at a total of seven stations, five of which were required by the Radiological Effluent Technical Specifications. The air pumps at these locations operate continuously at a flow rate of approximately one cubic foot per minute.

Charcoal filters were collected and analyzed weekly for I-131 activity. Concentrations of I-131 activity in both indicator and control station samples during 1984 were below minimum detectable levels.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROME, MA
JANUARY - DECEMBER 1984

MEDIUM: CHARCOAL FILTER

UNITS: PCI/CU. M

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	MEAN RANGE STA. NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
I-131 (364) (0)	.07	(-1.5 ± .3)E -3 (-4.4 - 1.2)E -2 *(0/260)*	14 (-1.0 ± .9)E -3 (-2.7 - .9)E -2 *(0/ 52)*	(-2.8 ± 1.6)E -3 (-1.6 - .1)E -1 *(0/104)*

* 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 *()*.

C) Milk

Milk samples were collected and analyzed by the schedule shown in Table 2.1.

Detectable concentrations of Cs-137 and Sr-90 were measured in milk samples submitted from the indicator and control locations. The mean concentration of Cs-137 and Sr-90 in milk samples from the indicator location was greater by a factor of 12.0 and 3.1, respectively, than from the control location (see Figures 3.2 and 3.3). The higher concentration in indicator station samples has been noted for several years. It has been shown in previous reports that the radionuclides in the cows' food, particularly pasture grass, are a result of atmospheric nuclear weapons testing fallout, and that farming practices (amount of vegetation and type of vegetation that the cows are allowed to feed on) can cause large variations of Cs-137 and Sr-90 concentrations in milk. Mean concentrations and ranges for the control station and indicator station, for Cs-137 and Sr-90, were similar to those measured for 1983 (Reference 1).

FIGURE 3.2
CESIUM-137 IN COW MILK
YANKEE ATOMIC ELECTRIC COMPANY, ROWE, MA

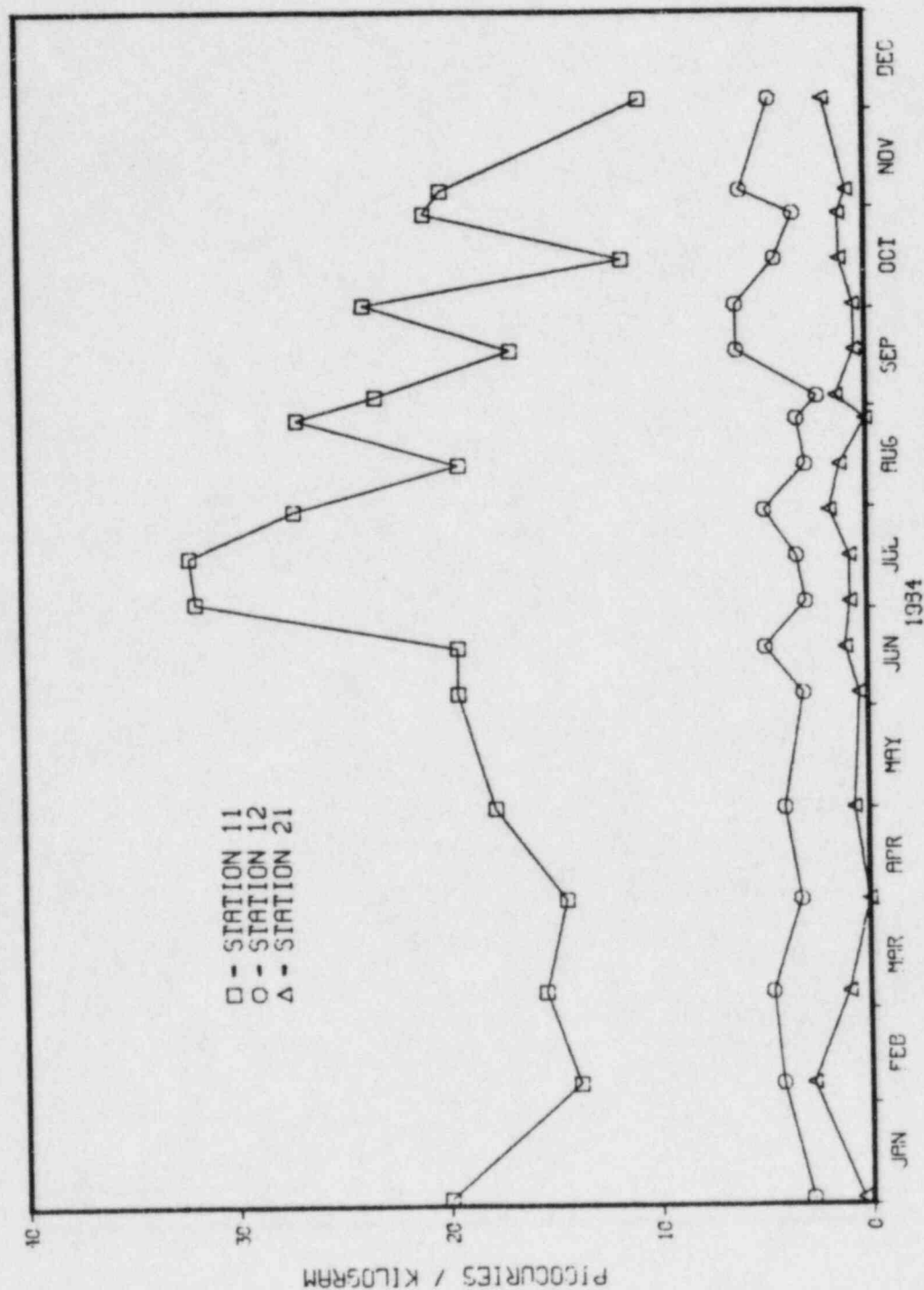
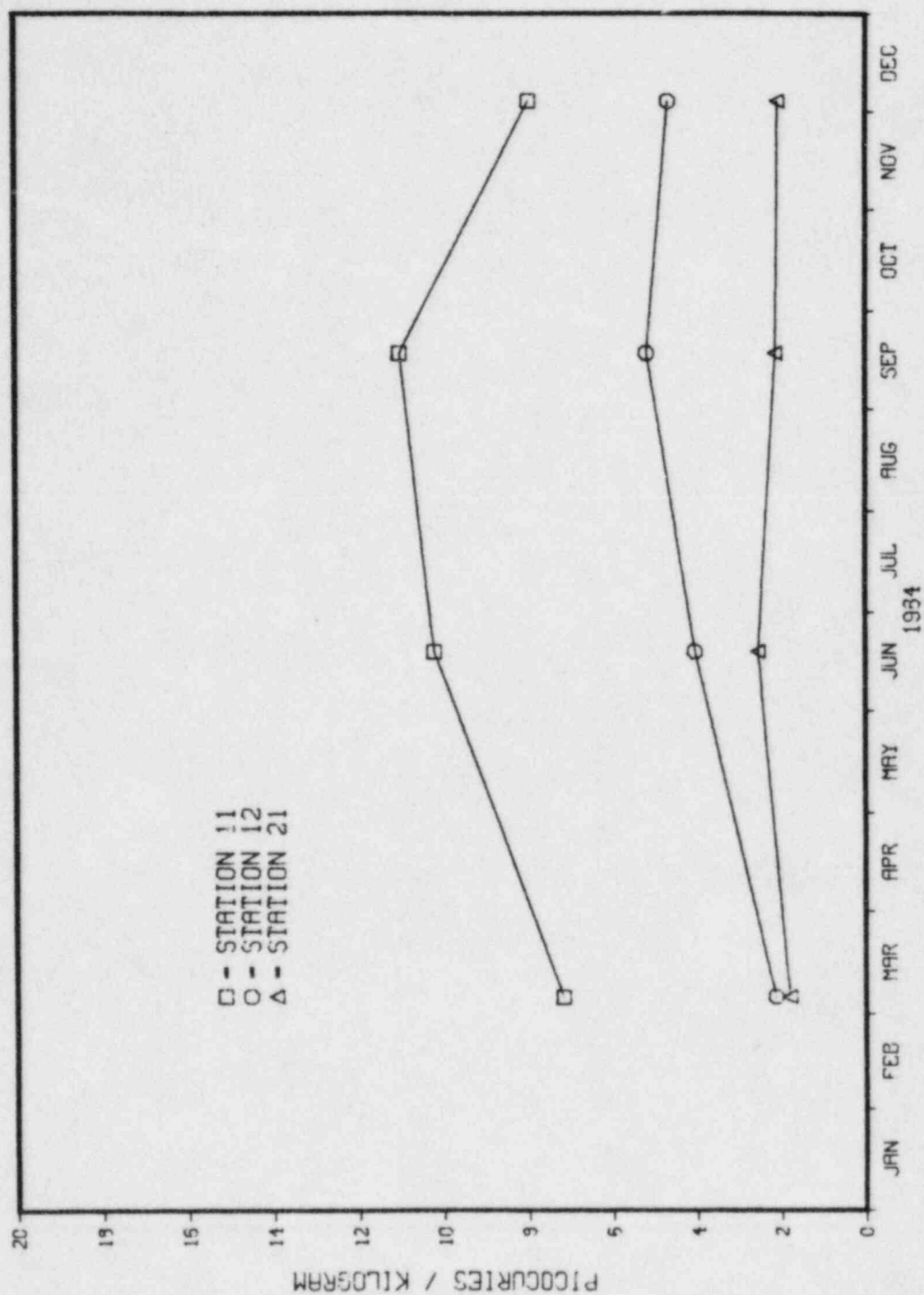


FIGURE 3.3
STRONTIUM-90 IN COW MILK
YANKEE ATOMIC ELECTRIC COMPANY, ROWE, MA



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: MILK

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
SR-89 (12) (0)		(1.2 ± 3.0)E -1 (-1.3 - 1.4)E 0 *(0/8)*	11	(4.3 ± .8)E -1 (2.1 - 5.9)E -1 *(0/4)*	(1.8 ± .4)E -1 (9.6 - 27.4)E -2 *(0/4)*
SR-90 (12) (0)		(6.5 ± 1.1)E 0 (2.1 - 11.0)E 0 *(8/8)*	11	(9.1 ± .9)E 0 (7.2 - 11.0)E 0 *(4/4)*	(2.1 ± .2)E 0 (1.8 - 2.5)E 0 *(4/4)*
BE-7 (57) (0)		(-1.6 ± 9.4)E -1 (-1.0 - 2.1)E 1 *(0/38)*	11	(3.8 ± 15.3)E -1 (-1.0 - 2.1)E 1 *(0/19)*	(-1.6 ± 1.3)E 0 (-1.4 - .8)E 1 *(0/19)*
K-40 (57) (0)		(1.3 ± .0)E 3 (1.1 - 1.5)E 3 *(38/38)*	21	(1.4 ± .0)E 3 (1.1 - 1.5)E 3 *(19/19)*	(1.4 ± .0)E 3 (1.1 - 1.5)E 3 *(19/19)*
MN-54 (57) (0)		(-8.1 ± 11.1)E -2 (-1.5 - 1.5)E 0 *(0/38)*	12	(2.7 ± 16.7)E -2 (-1.5 - 1.5)E 0 *(0/19)*	(2.0 ± 14.5)E -2 (-1.1 - 1.0)E 0 *(0/19)*
CO-58 (57) (0)		(-1.1 ± 1.5)E -1 (-2.0 - 1.9)E 0 *(0/38)*	12	(-3.7 ± 24.2)E -2 (-1.7 - 1.9)E 0 *(0/19)*	(-3.0 ± 1.7)E -1 (-2.0 - .8)E 0 *(0/19)*
FE-59 (57) (0)		(2.7 ± 2.9)E -1 (-3.0 - 4.7)E 0 *(0/38)*	11	(4.4 ± 4.0)E -1 (-2.2 - 3.6)E 0 *(0/19)*	(-2.3 ± 5.3)E -1 (-4.1 - 5.2)E 0 *(0/19)*
CO-60 (57) (0)		(-1.5 ± 1.4)E -1 (-2.2 - 1.4)E 0 *(0/38)*	21	(4.1 ± 1.7)E -1 (-8.0 - 21.4)E -1 *(0/19)*	(4.1 ± 1.7)E -1 (-8.0 - 21.4)E -1 *(0/19)*
ZN-65 (57) (0)		(-3.6 ± 3.7)E -1 (-9.1 - 3.3)E 0 *(0/38)*	12	(1.2 ± 47.7)E -2 (-4.4 - 3.3)E 0 *(0/19)*	(-3.9 ± 6.0)E -1 (-3.5 - 6.6)E 0 *(0/19)*

- * 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: MILK

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS ***** MEAN RANGE NO. DETECTED**	STA. NO.	STATION WITH HIGHEST MEAN ***** MEAN RANGE NO. DETECTED**	CONTROL STATIONS ***** MEAN RANGE NO. DETECTED**
ZR-95 (57) (0)		(2.5 ± 21.4)E -2 (-2.4 - 3.3)E 0 *(0/ 38)*	21	(8.2 ± 2.6)E -1 (-1.2 - 3.5)E 0 *(0/ 19)*	(8.2 ± 2.6)E -1 (-1.2 - 3.5)E 0 *(0/ 19)*
RU-103 (57) (0)		(-8.6 ± 1.3)E -1 (-2.2 - 1.9)E 0 *(0/ 38)*	11	(-7.9 ± 2.3)E -1 (-2.2 - 1.9)E 0 *(0/ 19)*	(-1.1 ± .2)E 0 (-2.3 - .1)E 0 *(0/ 19)*
RU-106 (57) (0)		(7.9 ± 12.6)E -1 (-1.3 - 1.9)E 1 *(0/ 38)*	11	(1.5 ± 1.6)E 0 (-9.1 - 16.9)E 0 *(0/ 19)*	(-3.6 ± 16.4)E -1 (-1.1 - 1.0)E 1 *(0/ 19)*
I-131 (57) (0)	1.	(5.5 ± 5.3)E -3 (-4.8 - 9.4)E -2 *(0/ 38)*	21	(1.1 ± .6)E -2 (-2.2 - 8.2)E -2 *(0/ 19)*	(1.1 ± .6)E -2 (-2.2 - 8.2)E -2 *(0/ 19)*
CS-134 (57) (0)	15.	(-4.0 ± 1.1)E -1 (-2.4 - .8)E 0 *(0/ 38)*	11	(-3.4 ± 1.1)E -1 (-1.1 - .6)E 0 *(0/ 19)*	(-5.3 ± 1.1)E -1 (-1.3 - .5)E 0 *(0/ 19)*
CS-137 (57) (19)	18.	(1.2 ± .2)E 1 (2.3 - 32.1)E 0 *(38/ 38)*	11	(2.0 ± .1)E 1 (1.1 - 3.2)E 1 *(19/ 19)*	(9.7 ± 1.6)E -1 (-2.7 - 27.7)E -1 *(2/ 19)*
BA-140 (57) (0)	15.	(-5.6 ± 2.5)E -1 (-4.4 - 4.2)E 0 *(0/ 38)*	21	(-2.6 ± 27.5)E -2 (-2.1 - 2.7)E 0 *(0/ 19)*	(-2.6 ± 27.5)E -2 (-2.1 - 2.7)E 0 *(0/ 19)*
CE-141 (57) (0)		(1.2 ± 2.7)E -1 (-4.2 - 2.8)E 0 *(0/ 38)*	21	(3.6 ± 2.6)E -1 (-1.4 - 2.2)E 0 *(0/ 19)*	(3.6 ± 2.6)E -1 (-1.4 - 2.2)E 0 *(0/ 19)*
CE-144 (57) (0)		(8.9 ± 6.0)E -1 (-5.4 - 9.2)E 0 *(0/ 38)*	11	(1.3 ± 1.0)E 0 (-5.4 - 9.2)E 0 *(0/ 19)*	(4.5 ± 85.4)E -2 (-6.9 - 6.8)E 0 *(0/ 19)*
TH-232 (57) (0)		(1.6 ± .5)E 0 (-3.0 - 8.2)E 0 *(0/ 38)*	11	(1.7 ± .6)E 0 (-2.7 - 7.1)E 0 *(0/ 19)*	(2.4 ± 7.2)E -1 (-6.0 - 5.7)E 0 *(0/ 19)*

* 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 *()*.

D) Food Crop

Samples of tomatoes were collected at harvest time and analyzed for gamma-emitting nuclides. These crops were both sampled from three indicator and one control station. Other than naturally occurring K-40 and Be-7, no radionuclides were detected in the samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: FOOD CROP

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
BE-7 (4) (1)		(1.4 ± 1.7)E 2 (-7.3 - 46.6)E 1 *(1/ 3)*	32	(4.7 ± 1.3)E 2 *(1/ 1)*	(-2.4 ± 6.7)E 1 *(0/ 1)*
K-40 (4) (0)		(2.4 ± .1)E 3 (2.3 - 2.6)E 3 *(3/ 3)*	11	(2.6 ± .2)E 3 *(1/ 1)*	(1.7 ± .2)E 3 *(1/ 1)*
MN-54 (4) (0)		(-3.6 ± 5.5)E 0 (-9.4 - 7.4)E 0 *(0/ 3)*	11	(7.4 ± 8.4)E 0 *(0/ 1)*	(-5.2 ± 9.9)E 0 *(0/ 1)*
CO-58 (4) (0)		(7.8 ± 6.3)E 0 (-4.7 - 14.8)E 0 *(0/ 3)*	32	(1.5 ± 1.1)E 1 *(0/ 1)*	(1.5 ± 8.5)E 0 *(0/ 1)*
FE-59 (4) (0)		(5.1 ± 14.6)E 0 (-2.4 - 2.1)E 1 *(0/ 3)*	11	(2.0 ± 1.5)E 1 *(0/ 1)*	(-4.7 ± 15.2)E 0 *(0/ 1)*
CO-60 (4) (0)		(-4.7 ± 11.4)E 0 (-2.3 - 1.6)E 1 *(0/ 3)*	11	(1.6 ± 1.0)E 1 *(0/ 1)*	(1.3 ± 1.5)E 1 *(0/ 1)*
ZN-65 (4) (0)		(5.4 ± 11.0)E 0 (-1.6 - 2.1)E 1 *(0/ 3)*	11	(2.1 ± 1.5)E 1 *(0/ 1)*	(1.6 ± 1.8)E 1 *(0/ 1)*
ZR-95 (4) (0)		(3.8 ± 98.9)E -1 (-1.1 - 2.0)E 1 *(0/ 3)*	12	(2.0 ± 1.5)E 1 *(0/ 1)*	(-2.2 ± 1.7)E 1 *(0/ 1)*
RU-103 (4) (0)		(6.7 ± 4.2)E 0 (2.0 - 15.2)E 0 *(0/ 3)*	12	(1.5 ± .9)E 1 *(0/ 1)*	(7.5 ± 80.4)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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROME, MA
JANUARY - DECEMBER 1984

MEDIUM: FOOD CROP

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-106 (4) (0)		(1.6 ± 3.7)E 1 (-4.7 - 8.3)E 1 *(0/ 3)*	11	(8.3 ± 6.8)E 1 *(0/ 1)*	(-1.1 ± .9)E 2 *(0/ 1)*
I-131 (4) (0)		(-2.8 ± 2.2)E 1 (-7.2 - -.3)E 1 *(0/ 3)*	21	(1.4 ± 9.7)E 0 *(0/ 1)*	(1.4 ± 9.7)E 0 *(0/ 1)*
CS-134 (4) (0)	60.	(-2.6 ± 9.9)E 0 (-1.5 - 1.7)E 1 *(0/ 3)*	21	(1.7 ± 1.0)E 1 *(0/ 1)*	(1.7 ± 1.0)E 1 *(0/ 1)*
CS-137 (4) (0)	80.	(-3.8 ± 70.0)E -1 (-9.0 - 13.5)E 0 *(0/ 3)*	12	(1.3 ± .8)E 1 *(0/ 1)*	(-1.4 ± 1.1)E 1 *(0/ 1)*
BA-140 (4) (0)		(-4.6 ± 5.8)E 0 (-1.6 - .1)E 1 *(0/ 3)*	21	(1.9 ± 1.9)E 1 *(0/ 1)*	(1.9 ± 1.9)E 1 *(0/ 1)*
CE-141 (4) (0)		(-1.3 ± 4439.6)E -3 (-7.9 - 7.4)E 0 *(0/ 3)*	21	(1.0 ± 1.2)E 1 *(0/ 1)*	(1.0 ± 1.2)E 1 *(0/ 1)*
CE-144 (4) (0)		(-1.4 ± 2.5)E 1 (-6.2 - 2.4)E 1 *(0/ 3)*	21	(4.0 ± 5.5)E 1 *(0/ 1)*	(4.0 ± 5.5)E 1 *(0/ 1)*
TH-232 (4) (0)		(2.2 ± 2.1)E 1 (-6.4 - 62.6)E 0 *(0/ 3)*	32	(6.3 ± 4.6)E 1 *(0/ 1)*	(-2.8 ± 4.5)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 *()*.

E) Broad Leaf Vegetation

The Radiological Effluent Technical Specifications require that one sample of broad leaf vegetation be sampled at harvest time. In 1984, a Swiss chard sample was collected from Station TV-11 (Monroe Bridge). The required I-131 analysis showed no detectable radioactivity.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: GREEN LEAFY VEGETABLE

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
I-131 (1) (0)	60.	(1.6 ± 1.0)E 0 *(0/ 1)*	11	(1.6 ± 1.0)E 0 *(0/ 1)*	NO DATA

* 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 *()%.

F) Maple Syrup

Maple syrup grab samples (not required by Technical Specifications) were collected during April at one indicator and two control locations. In addition to naturally occurring K-40, Cs-137 was detected in each sample. Attributed to nuclear weapons testing fallout, this Cs-137 has been detected in most samples since collection was started in 1972. Both control stations in 1984 had a higher Cs-137 level than detected at the indicator station.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: MAPLE SYRUP

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		
BE-7 (3) (0)		(2.7 ± 7.8)E 0 *(0/ 1)*	31 (2.7 ± 7.8)E 0 *(0/ 1)*	(-9.2 ± .0)E 0 (-9.2 - -9.2)E 0 *(0/ 2)*
K-40 (3) (0)		(2.0 ± .0)E 3 *(1/ 1)*	31 (2.0 ± .0)E 3 *(1/ 1)*	(1.9 ± .1)E 3 (1.7 - 2.0)E 3 *(2/ 2)*
MN-54 (3) (0)		(1.1 ± .8)E 0 *(0/ 1)*	41 (1.5 ± 1.0)E 0 *(0/ 1)*	(6.2 ± 8.7)E -1 (-2.6 - 14.9)E -1 *(0/ 2)*
CO-58 (3) (0)		(-1.5 ± .9)E 0 *(0/ 1)*	41 (-4.8 ± 10.2)E -1 *(0/ 1)*	(-7.9 ± 3.1)E -1 (-1.1 - -.5)E 0 *(0/ 2)*
FE-59 (3) (0)		(4.9 ± 2.6)E 0 *(0/ 1)*	31 (4.9 ± 2.6)E 0 *(0/ 1)*	(3.9 ± .3)E 0 (3.7 - 4.2)E 0 *(0/ 2)*
CO-60 (3) (0)		(4.0 ± 11.6)E -1 *(0/ 1)*	42 (5.1 ± 11.8)E -1 *(0/ 1)*	(-1.1 ± 1.6)E 0 (-2.7 - .5)E 0 *(0/ 2)*
ZN-65 (3) (0)		(-1.3 ± 2.7)E 0 *(0/ 1)*	41 (5.1 ± 2.5)E 0 *(0/ 1)*	(1.5 ± 3.6)E 0 (-2.1 - 5.1)E 0 *(0/ 2)*
ZR-95 (3) (0)		(-1.1 ± 1.6)E 0 *(0/ 1)*	42 (3.0 ± 1.6)E 0 *(0/ 1)*	(2.1 ± 1.0)E 0 (1.1 - 3.0)E 0 *(0/ 2)*
RU-103 (3) (0)		(-1.4 ± 1.0)E 0 *(0/ 1)*	31 (-1.4 ± 1.0)E 0 *(0/ 1)*	(-2.5 ± .4)E 0 (-2.9 - -2.1)E 0 *(0/ 2)*

* 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROME, MA
JANUARY - DECEMBER 1984

MEDIUM: MAPLE SYRUP

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-106 (3) (0)		(-3.9 ± 8.1)E 0 *(0/ 1)*	42	(9.4 ± 6.0)E 0 *(0/ 1)*	(1.3 ± 8.1)E 0 (-6.7 - 9.4)E 0 *(0/ 2)*
I-131 (3) (0)		(3.2 ± 20.3)E -1 *(0/ 1)*	31	(3.2 ± 20.3)E -1 *(0/ 1)*	(-1.8 ± 1.0)E 0 (-2.8 - -.7)E 0 *(0/ 2)*
CS-134 (3) (0)		(-1.4 ± .9)E 0 *(0/ 1)*	42	(1.7 ± 8.9)E -1 *(0/ 1)*	(-1.4 ± 1.6)E 0 (-3.0 - .2)E 0 *(0/ 2)*
CS-137 (3) (0)		(2.1 ± .1)E 1 *(1/ 1)*	41	(8.9 ± .3)E 1 *(1/ 1)*	(5.8 ± 3.1)E 1 (2.8 - 8.9)E 1 *(2/ 2)*
BA-140 (3) (0)		(-9.8 ± 14.0)E -1 *(0/ 1)*	41	(-1.7 ± 15.1)E -1 *(0/ 1)*	(-5.9 ± 4.2)E -1 (-1.0 - -.2)E 0 *(0/ 2)*
CE-141 (3) (0)		(1.3 ± 1.6)E 0 *(0/ 1)*	31	(1.3 ± 1.6)E 0 *(0/ 1)*	(1.7 ± 2.4)E -1 (-7.0 - 41.6)E -2 *(0/ 2)*
CE-144 (3) (0)		(-2.3 ± 5.7)E 0 *(0/ 1)*	42	(8.8 ± 5.5)E 0 *(0/ 1)*	(8.4 ± .4)E 0 (8.1 - 8.8)E 0 *(0/ 2)*
TH-232 (3) (0)		(4.4 ± 2.9)E 0 *(0/ 1)*	31	(4.4 ± 2.9)E 0 *(0/ 1)*	(1.3 ± 21.3)E -1 (-2.0 - 2.3)E 0 *(0/ 2)*

- * 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 *()*.

G) Ground Water

Ground water grab samples were collected from two indicator stations on a monthly basis. (Technical Specifications require a quarterly collection.) Each of these samples was analyzed for gross-beta and gamma-emitting radionuclides. Each sample from Station WG-11 was analyzed for H-3, and the monthly samples from Station WG-12 were composited for a quarterly H-3 analysis.

Tritium (H-3) was detected in all of the Station WG-12 samples and none of those from Station WG-11. Since the water from WG-12 (Sherman Spring) is not used for drinking water, and since the Deerfield River into which it empties is also not used for drinking, there would be no impact on man from the low levels detected. In any case, the calculated total body dose to an average adult who is assumed to ingest 370 kilograms per year of this water (undiluted) at the average 1984 concentration of 1600 pCi/kilogram, would be approximately 0.06 mrem, using USNRC Regulatory Guide 1.109 methodology (Reference 2). The annual mean H-3 concentration has decreased steadily for most of the past ten years.

Gross-beta radioactivity was detected in all ground water samples. Caused primarily by naturally occurring radionuclides in ground water, the gross-beta levels were similar to those of the past several years.

No gamma-emitting radionuclides were detected in the ground water samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: GROUND WATER

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	MEAN RANGE STA. NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
GR-B (24) (0)	4.	(3.8 ± .2)E 0 (2.1 - 5.9)E 0 *(24/24)*	11 (4.4 ± .2)E 0 (3.5 - 5.9)E 0 *(12/12)*	NO DATA
BE-7 (24) (0)		(-1.1 ± 1.6)E 0 (-1.4 - 1.7)E 1 *(0/24)*	12 (9.7 ± 23.6)E -1 (-1.0 - 1.7)E 1 *(0/12)*	NO DATA
K-40 (24) (0)		(-2.6 ± 3.2)E 0 (-3.6 - 2.4)E 1 *(0/24)*	12 (2.2 ± 4.0)E 0 (-1.8 - 2.4)E 1 *(0/12)*	NO DATA
MN-54 (24) (0)	15.	(-2.9 ± 2.2)E -1 (-1.8 - 2.8)E 0 *(0/24)*	11 (-2.0 ± 3.9)E -1 (-1.8 - 2.8)E 0 *(0/12)*	NO DATA
CO-58 (24) (0)	15.	(-6.0 ± 2.3)E -1 (-3.2 - 1.2)E 0 *(0/24)*	12 (1.8 ± 1.7)E -1 (-4.5 - 12.3)E -1 *(0/12)*	NO DATA
FE-59 (24) (0)	30.	(1.6 ± 3.8)E -1 (-4.0 - 4.0)E 0 *(0/24)*	12 (4.6 ± 6.0)E -1 (-4.0 - 4.0)E 0 *(0/12)*	NO DATA
CO-60 (24) (0)	15.	(-3.2 ± 1.7)E -1 (-2.0 - .8)E 0 *(0/24)*	12 (-2.9 ± 2.4)E -1 (-2.0 - .7)E 0 *(0/12)*	NO DATA
ZN-65 (24) (0)	30.	(5.1 ± 4.4)E -1 (-4.0 - 3.8)E 0 *(0/24)*	11 (1.1 ± .8)E 0 (-4.0 - 3.8)E 0 *(0/12)*	NO DATA
ZR-95 (24) (0)	15.	(-6.0 ± 3.7)E -1 (-4.2 - 3.6)E 0 *(0/24)*	12 (-6.7 ± 41.1)E -2 (-3.8 - 1.6)E 0 *(0/12)*	NO DATA

* 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: GROUND WATER

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
RJ-103 (24) (0)		(-7.9 ± 1.7)E -1 (-2.2 - 1.3)E 0 *(0/ 24)*	12	(-5.8 ± 2.8)E -1 (-2.1 - 1.3)E 0 *(0/ 12)*	NO DATA
RJ-106 (24) (0)		(1.2 ± 1.5)E 0 (-1.6 - 1.4)E 1 *(0/ 24)*	12	(2.0 ± 2.0)E 0 (-8.1 - 14.2)E 0 *(0/ 12)*	NO DATA
I-131 (24) (0)	1.	(6.5 ± 5.6)E -1 (-7.7 - 8.0)E 0 *(0/ 24)*	12	(9.6 ± 3.7)E -1 (-1.1 - 2.6)E 0 *(0/ 12)*	NO DATA
CS-134 (24) (0)	15.	(-2.6 ± 1.5)E -1 (-2.3 - .8)E 0 *(0/ 24)*	11	(-1.9 ± 2.1)E -1 (-1.4 - .8)E 0 *(0/ 12)*	NO DATA
CS-137 (24) (0)	18.	(-4.1 ± 2.4)E -1 (-2.8 - 1.1)E 0 *(0/ 24)*	12	(3.4 ± 1.9)E -1 (-6.8 - 11.3)E -1 *(0/ 12)*	NO DATA
BA-140 (24) (0)	15.	(-1.5 ± 3.7)E -1 (-4.2 - 3.2)E 0 *(0/ 24)*	11	(6.4 ± 4.9)E -1 (-1.7 - 3.2)E 0 *(0/ 12)*	NO DATA
CE-141 (24) (0)		(-4.2 ± 4.5)E -1 (-3.4 - 4.6)E 0 *(0/ 24)*	11	(-3.2 ± 6.6)E -1 (-3.4 - 2.9)E 0 *(0/ 12)*	NO DATA
CE-144 (24) (0)		(-5.0 ± 12.0)E -1 (-1.4 - 1.0)E 1 *(0/ 24)*	11	(6.4 ± 206.0)E -2 (-1.4 - 1.0)E 1 *(0/ 12)*	NO DATA
TH-232 (24) (0)		(1.6 ± .6)E 0 (-4.8 - 8.2)E 0 *(0/ 24)*	12	(2.1 ± .9)E 0 (-1.3 - 8.2)E 0 *(0/ 12)*	NO DATA
H-3 (21) (12)	2000.	(9.3 ± 1.8)E 2 (-1.5 - 20.8)E 2 *(12/ 21)*	12	(1.6 ± .1)E 3 (1.1 - 2.1)E 3 *(12/ 12)*	NO DATA

* 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 *()*.

H) River Water

Composite samplers were used at the two required sampling locations and samples from each of these were collected monthly and analyzed for gross-beta, gamma-emitting radionuclides, and I-131. Quarterly composites were analyzed for H-3.

The third quarter composite sample showed detectable levels of H-3 at Station WR-11 (Bear Swamp Lower Reservoir). Since the Deerfield River is not used for drinking water, the low levels of H-3 found will have no impact on man. If one was to calculate, however, the dose to an adult who consumed his entire yearly intake of water (370 kilograms per year) from the Deerfield River at the above sampling location, with the average concentration of 390 pCi/kilogram, it would be shown that the dose would be approximately .009 mrem per year, using USNRC Regulatory Guide 1.109 methodology (Reference 2).

Gross beta radioactivity, primarily from naturally occurring radionuclides in river water, was detected in most samples. The mean and range were similar to those measured in previous years. The control and indicator station mean concentrations were also equal in 1984.

Other than naturally occurring Th-232, no gamma-emitting radionuclides were detected in the 1984 river water samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: RIVER WATER

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	MEAN RANGE STA. NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
GR-B (26) (0)	4.	(1.9 ± .1)E 0 (8.7 - 25.1)E -1 *(12/13)*	21 (1.9 ± .1)E 0 (1.2 - 2.7)E 0 *(13/13)*	(1.9 ± .1)E 0 (1.2 - 2.7)E 0 *(13/13)*
K-40 (26) (0)		(6.2 ± 29.0)E -1 (-1.7 - 1.8)E 1 *(0/13)*	11 (6.2 ± 29.0)E -1 (-1.7 - 1.8)E 1 *(0/13)*	(-3.9 ± 4.5)E 0 (-3.4 - 3.1)E 1 *(0/13)*
MN-54 (26) (0)	15.	(-3.7 ± 1.7)E -1 (-1.3 - .9)E 0 *(0/13)*	11 (-3.7 ± 1.7)E -1 (-1.3 - .9)E 0 *(0/13)*	(-6.7 ± 2.8)E -1 (-2.8 - 1.1)E 0 *(0/13)*
CO-58 (26) (0)	15.	(1.0 ± 3.0)E -1 (-1.9 - 2.0)E 0 *(0/13)*	11 (1.0 ± 3.0)E -1 (-1.9 - 2.0)E 0 *(0/13)*	(-2.1 ± 3.6)E -1 (-2.2 - 2.4)E 0 *(0/13)*
FE-59 (26) (0)	30.	(1.2 ± .5)E 0 (-3.2 - 3.4)E 0 *(0/13)*	11 (1.2 ± .5)E 0 (-3.2 - 3.4)E 0 *(0/13)*	(7.8 ± 6.6)E -1 (-2.8 - 4.5)E 0 *(0/13)*
CO-60 (26) (0)	15.	(2.5 ± 2.7)E -1 (-7.4 - 19.1)E -1 *(0/13)*	11 (2.5 ± 2.7)E -1 (-7.4 - 19.1)E -1 *(0/13)*	(1.9 ± 3.7)E -1 (-2.3 - 2.5)E 0 *(0/13)*
ZN-65 (26) (0)	30.	(-5.7 ± 4.3)E -1 (-3.5 - 1.3)E 0 *(0/13)*	11 (-5.7 ± 4.3)E -1 (-3.5 - 1.3)E 0 *(0/13)*	(-6.1 ± 5.9)E -1 (-3.7 - 4.5)E 0 *(0/13)*
ZR-95 (26) (0)	15.	(-1.1 ± 4.5)E -1 (-2.3 - 3.1)E 0 *(0/13)*	11 (-1.1 ± 4.5)E -1 (-2.3 - 3.1)E 0 *(0/13)*	(-2.0 ± 4.4)E -1 (-2.7 - 2.9)E 0 *(0/13)*
RU-103 (26) (0)		(-9.1 ± 3.5)E -1 (-3.1 - 1.1)E 0 *(0/13)*	21 (-5.5 ± 2.9)E -1 (-2.1 - 1.3)E 0 *(0/13)*	(-5.5 ± 2.9)E -1 (-2.1 - 1.3)E 0 *(0/13)*

* 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: RIVER WATER

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-106 (26) (0)		(9.6 ± 216.6)E -2 (-1.5 - 1.9)E 1 *(0/ 13)*	11	(9.6 ± 216.6)E -2 (-1.5 - 1.9)E 1 *(0/ 13)*	(-7.0 ± 22.7)E -1 (-1.4 - 1.0)E 1 *(0/ 13)*
I-131 (26) (0)		(2.2 ± 1.1)E -2 (-3.1 - 12.3)E -2 *(0/ 13)*	11	(2.2 ± 1.1)E -2 (-3.1 - 12.3)E -2 *(0/ 13)*	(6.7 ± 8.0)E -3 (-5.8 - 3.8)E -2 *(0/ 13)*
CS-134 (26) (0)	15.	(-6.9 ± 2.2)E -1 (-2.6 - .3)E 0 *(0/ 13)*	11	(-6.9 ± 2.2)E -1 (-2.6 - .3)E 0 *(0/ 13)*	(-1.2 ± .2)E 0 (-2.5 - .1)E 0 *(0/ 13)*
CS-137 (26) (0)	18.	(-2.0 ± 1.4)E -1 (-1.1 - .5)E 0 *(0/ 13)*	11	(-2.0 ± 1.4)E -1 (-1.1 - .5)E 0 *(0/ 13)*	(-4.5 ± 2.2)E -1 (-2.0 - .8)E 0 *(0/ 13)*
BA-140 (26) (0)	15.	(-3.6 ± 5.5)E -1 (-3.5 - 4.2)E 0 *(0/ 13)*	11	(-3.6 ± 5.5)E -1 (-3.5 - 4.2)E 0 *(0/ 13)*	(-1.0 ± .5)E 0 (-6.0 - .6)E 0 *(0/ 13)*
CE-141 (26) (0)		(7.9 ± 4.2)E -1 (-2.5 - 3.1)E 0 *(0/ 13)*	21	(9.4 ± 4.8)E -1 (-1.8 - 4.0)E 0 *(0/ 13)*	(9.4 ± 4.8)E -1 (-1.8 - 4.0)E 0 *(0/ 13)*
CE-144 (26) (0)		(-8.4 ± 18.3)E -1 (-1.1 - 1.4)E 1 *(0/ 13)*	21	(2.5 ± 1.6)E 0 (-6.7 - 12.9)E 0 *(0/ 13)*	(2.5 ± 1.6)E 0 (-6.7 - 12.9)E 0 *(0/ 13)*
TH-232 (26) (1)		(2.4 ± 1.3)E 0 (-7.4 - 11.4)E 0 *(1/ 13)*	11	(2.4 ± 1.3)E 0 (-7.4 - 11.4)E 0 *(1/ 13)*	(2.8 ± 9.2)E -1 (-5.7 - 5.2)E 0 *(0/ 13)*
H-3 (8) (1)	2000.	(2.4 ± 1.2)E 2 (9.6 - 58.4)E 1 *(1/ 4)*	11	(2.4 ± 1.2)E 2 (9.6 - 58.4)E 1 *(1/ 4)*	(-1.2 ± 15.1)E 1 (-3.9 - 3.5)E 2 *(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 *()*.

I) Sediment

Sediment cores were collected semiannually from two locations. Each core was separated into 5 cm segments, which were analyzed for gamma-emitting radionuclides. Cesium-137 was detected in most samples. The levels measured at the indicator location were consistent with what has been measured in the previous several years and are attributed to nuclear weapons testing fallout. Station SE-21 at Harriman Reservoir (control) has in the past had levels of Cs-137 that are comparable to those at Station SE-11 on the Deerfield River. During 1984, however, several cores were taken in May and then again in August at Harriman Reservoir, but at a location a short distance away from the traditional one at the Whitingham boat launch. (Cores were also collected at the traditional location during August and October.) The cores at the new location showed a much higher level of Cs-137 (up to 4609 pCi/kg in the 5-10 cm segment), consequently elevating the annual mean as compared to previous years. The higher levels are apparently due to the very high organic matter content in the soil, which was collected from near the high water mark under a stand of trees.

Other than naturally occurring K-40 and Th-232, no other gamma-emitting radionuclides were detected in 1984 sediment samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROME, MA
JANUARY - DECEMBER 1984

MEDIUM: SEDIMENT

UNITS: PCI/KG DRY

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		
			STA. NO.	MEAN RANGE NO. DETECTED**
BE-7 (21) (0)		(6.5 ± 6.5)E 1 (-1.5 - 4.1)E 2 *(0/ 7)*	11	(6.5 ± 6.5)E 1 (-1.5 - 4.1)E 2 *(0/ 7)*
K-40 (21) (0)		(1.5 ± .1)E 4 (1.0 - 1.8)E 4 *(7/ 7)*	11	(1.5 ± .1)E 4 (1.0 - 1.8)E 4 *(7/ 7)*
MN-54 (21) (0)		(-1.2 ± .4)E 1 (-2.0 - 1.1)E 1 *(0/ 7)*	11	(-1.2 ± .4)E 1 (-2.0 - 1.1)E 1 *(0/ 7)*
CO-58 (21) (0)		(-1.6 ± .5)E 1 (-3.8 - -.2)E 1 *(0/ 7)*	21	(-6.4 ± 2.3)E 0 (-1.9 - 1.2)E 1 *(0/ 14)*
FE-59 (21) (0)		(-1.7 ± 1.9)E 1 (-9.5 - 4.4)E 1 *(0/ 7)*	21	(-7.3 ± 10.7)E 0 (-8.8 - 8.3)E 1 *(0/ 14)*
CO-60 (21) (0)		(-2.3 ± 55.4)E -1 (-1.7 - 2.0)E 1 *(0/ 7)*	11	(-2.3 ± 55.4)E -1 (-1.7 - 2.0)E 1 *(0/ 7)*
ZN-65 (21) (0)		(7.1 ± 9.7)E 0 (-2.7 - 5.7)E 1 *(0/ 7)*	11	(7.1 ± 9.7)E 0 (-2.7 - 5.7)E 1 *(0/ 7)*
ZR-95 (21) (0)		(1.6 ± 1.0)E 1 (-1.1 - 6.2)E 1 *(0/ 7)*	11	(1.6 ± 1.0)E 1 (-1.1 - 6.2)E 1 *(0/ 7)*
RU-103 (21) (0)		(-4.6 ± 5.8)E 0 (-3.7 - .7)E 1 *(0/ 7)*	21	(-1.4 ± 4.0)E 0 (-2.6 - 2.4)E 1 *(0/ 14)*

* 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROME, MA
JANUARY - DECEMBER 1984

MEDIUM: SEDIMENT

UNITS: PCI/KG DRY

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	MEAN RANGE STA. NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-106 (21) (0)		(2.7 ± 3.8)E 1 (-1.1 - 2.2)E 2 *(0/ 7)*	11 (2.7 ± 3.8)E 1 (-1.1 - 2.2)E 2 *(0/ 7)*	(-3.1 ± 2.2)E 1 (-1.7 - 1.3)E 2 *(0/ 14)*
CS-134 (21) (0)	150.	(-4.1 ± 6.0)E 0 (-3.3 - 1.8)E 1 *(0/ 7)*	21 (-3.4 ± 2.4)E 0 (-2.3 - 1.5)E 1 *(0/ 14)*	(-3.4 ± 2.4)E 0 (-2.3 - 1.5)E 1 *(0/ 14)*
CS-137 (21) (0)	180.	(3.2 ± .5)E 2 (2.2 - 5.7)E 2 *(7/ 7)*	21 (1.4 ± .4)E 3 (7.6 - 4610.0)E 0 *(13/ 14)*	(1.4 ± .4)E 3 (7.6 - 4610.0)E 0 *(13/ 14)*
BA-140 (21) (0)		(-1.1 ± .7)E 2 (-4.2 - .6)E 2 *(0/ 7)*	21 (-9.9 ± 3.1)E 1 (-4.0 - .3)E 2 *(0/ 14)*	(-9.9 ± 3.1)E 1 (-4.0 - .3)E 2 *(0/ 14)*
CE-141 (21) (0)		(1.3 ± 1.2)E 1 (-1.3 - 7.5)E 1 *(0/ 7)*	21 (1.7 ± .5)E 1 (-2.5 - 5.2)E 1 *(0/ 14)*	(1.7 ± .5)E 1 (-2.5 - 5.2)E 1 *(0/ 14)*
CE-144 (21) (0)		(-3.7 ± 2.9)E 1 (-1.6 - .5)E 2 *(0/ 7)*	11 (-3.7 ± 2.9)E 1 (-1.6 - .5)E 2 *(0/ 7)*	(-3.8 ± 1.4)E 1 (-1.2 - .4)E 2 *(0/ 14)*
TH-232 (21) (0)		(8.8 ± .3)E 2 (7.5 - 10.5)E 2 *(7/ 7)*	11 (8.8 ± .3)E 2 (7.5 - 10.5)E 2 *(7/ 7)*	(4.3 ± .2)E 2 (2.7 - 5.8)E 2 *(14/ 14)*

* 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 *()*.

J) Finfish

Fish samples were collected semiannually from two locations. Each was analyzed for gamma-emitting radionuclides.

Cesium-137 was detected in all samples. Over the past several years, the levels have been comparable between Station FH-11 and Station FH-21, fish. The measured levels have also decreased slightly over the past three years at both stations. Consequently, we can conclude that the detected Cs-137 is due to nuclear weapons testing fallout.

Other than Cs-137 and naturally occurring K-40, no gamma-emitting radionuclides were detected in 1984 fish samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: FINFISH

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****		CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	STA. NO.	MEAN RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
BE-7 (4) (0)		(2.3 ± 7.1)E 1 (-4.8 - 9.4)E 1 *(0/ 2)*	21	(2.6 ± 9.1)E 1 (-6.5 - 11.7)E 1 *(0/ 2)*	(2.6 ± 9.1)E 1 (-6.5 - 11.7)E 1 *(0/ 2)*
K-40 (4) (0)		(2.9 ± .1)E 3 (2.8 - 3.0)E 3 *(2/ 2)*	11	(2.9 ± .1)E 3 (2.8 - 3.0)E 3 *(2/ 2)*	(2.7 ± .1)E 3 (2.6 - 2.8)E 3 *(2/ 2)*
MN-54 (4) (0)	130.	(4.5 ± 3.8)E 0 (7.1 - 82.3)E -1 *(0/ 2)*	21	(1.9 ± .7)E 1 (1.2 - 2.6)E 1 *(0/ 2)*	(1.9 ± .7)E 1 (1.2 - 2.6)E 1 *(0/ 2)*
CO-58 (4) (0)	130.	(-1.2 ± 83.8)E -1 (-8.5 - 8.3)E 0 *(0/ 2)*	21	(4.1 ± 2.2)E 0 (1.9 - 6.2)E 0 *(0/ 2)*	(4.1 ± 2.2)E 0 (1.9 - 6.2)E 0 *(0/ 2)*
FE-59 (4) (0)	260.	(4.3 ± 9.4)E -1 (-5.2 - 13.7)E -1 *(0/ 2)*	11	(4.3 ± 9.4)E -1 (-5.2 - 13.7)E -1 *(0/ 2)*	(-3.6 ± 1.0)E 1 (-4.6 - -2.6)E 1 *(0/ 2)*
CO-60 (4) (0)	130.	(3.0 ± 6.9)E 0 (-3.9 - 9.9)E 0 *(0/ 2)*	11	(3.0 ± 6.9)E 0 (-3.9 - 9.9)E 0 *(0/ 2)*	(-3.7 ± 6.8)E 0 (-1.0 - .3)E 1 *(0/ 2)*
ZN-65 (4) (0)	260.	(7.9 ± 1.6)E 0 (6.3 - 9.5)E 0 *(0/ 2)*	11	(7.9 ± 1.6)E 0 (6.3 - 9.5)E 0 *(0/ 2)*	(-1.7 ± 2.3)E 1 (-4.0 - .6)E 1 *(0/ 2)*
ZR-95 (4) (0)		(-2.2 ± 40.1)E -1 (-4.2 - 3.8)E 0 *(0/ 2)*	11	(-2.2 ± 40.1)E -1 (-4.2 - 3.8)E 0 *(0/ 2)*	(-3.0 ± .2)E 1 (-3.2 - -2.7)E 1 *(0/ 2)*
RU-103 (4) (0)		(-8.0 ± 3.0)E 0 (-1.1 - -.5)E 1 *(0/ 2)*	11	(-8.0 ± 3.0)E 0 (-1.1 - -.5)E 1 *(0/ 2)*	(-1.3 ± .3)E 1 (-1.5 - -1.0)E 1 *(0/ 2)*

* 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 *()*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
JANUARY - DECEMBER 1984

MEDIUM: FINFISH

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		
RU-106 (4) (0)		(2.2 ± .0)E 1 (2.2 - 2.2)E 1 *(0/ 2)*	21 (4.9 ± 5.9)E 1 (-1.1 - 10.8)E 1 *(0/ 2)*	(4.9 ± 5.9)E 1 (-1.1 - 10.8)E 1 *(0/ 2)*
I-131 (4) (0)		(-1.6 ± 1.5)E 2 (-3.1 - -.1)E 2 *(0/ 2)*	21 (-5.1 ± .4)E 1 (-5.6 - -4.7)E 1 *(0/ 2)*	(-5.1 ± .4)E 1 (-5.6 - -4.7)E 1 *(0/ 2)*
CS-134 (4) (0)	130.	(-2.9 ± 14.9)E 0 (-1.8 - 1.2)E 1 *(0/ 2)*	11 (-2.9 ± 14.9)E 0 (-1.8 - 1.2)E 1 *(0/ 2)*	(-3.6 ± 13.2)E 0 (-1.7 - 1.0)E 1 *(0/ 2)*
CS-137 (4) (0)	150.	(5.1 ± .1)E 1 (4.9 - 5.2)E 1 *(2/ 2)*	11 (5.1 ± .1)E 1 (4.9 - 5.2)E 1 *(2/ 2)*	(4.3 ± 1.7)E 1 (2.6 - 6.1)E 1 *(2/ 2)*
BA-140 (4) (0)		(-1.4 ± 2.3)E 1 (-3.7 - .9)E 1 *(0/ 2)*	21 (3.3 ± 8.1)E 1 (-4.9 - 11.4)E 1 *(0/ 2)*	(3.3 ± 8.1)E 1 (-4.9 - 11.4)E 1 *(0/ 2)*
CE-141 (4) (0)		(1.8 ± 1.2)E 1 (6.3 - 29.3)E 0 *(0/ 2)*	11 (1.8 ± 1.2)E 1 (6.3 - 29.3)E 0 *(0/ 2)*	(-1.9 ± 1.7)E 1 (-3.7 - -.2)E 1 *(0/ 2)*
CE-144 (4) (0)		(-1.6 ± 1.8)E 1 (-3.4 - .2)E 1 *(0/ 2)*	11 (-1.6 ± 1.8)E 1 (-3.4 - .2)E 1 *(0/ 2)*	(-1.6 ± 3.2)E 1 (-4.8 - 1.7)E 1 *(0/ 2)*
TH-232 (4) (0)		(2.6 ± .4)E 1 (2.3 - 3.0)E 1 *(0/ 2)*	11 (2.6 ± .4)E 1 (2.3 - 3.0)E 1 *(0/ 2)*	(2.5 ± .5)E 1 (2.0 - 3.0)E 1 *(0/ 2)*

* 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 *()*.

K) Direct Radiation

Direct gamma radiation exposure was determined from the use of thermoluminescent dosimeters (TLDs). One $\text{CaSO}_4:\text{Dy}$ TLD dosimeter was placed at each of the monitoring stations. (Each dosimeter has four readout areas.) A total of thirty-eight stations is required by the Radiological Effluent Technical Specifications. TLDs from twenty-two must be read out quarterly, while those from the remaining sixteen incident response (outer ring) stations need only be de-dosed quarterly, unless a gaseous release LCO was exceeded during the period. During 1984, all TLDs were routinely readout on a quarterly schedule. Table 3.1 provides a summary of the results.

The results for 1984 are similar to those from 1983 indicating no significant change in direct radiation levels. As in 1983, the mean of the indicator stations is slightly below that of the control stations.

Station GM-5 had a significantly higher exposure rate than other non-site boundary stations, as can be seen in Table 3.1. This is consistent with the results of the in situ analysis at the station, performed in October of 1984 (see Table 3.2).

Environmental Radiological Program Summary
Yankee Nuclear Power Station, Rowe, Massachusetts
January - December 1984

Medium: Direct Radiation Measurements (TLD)

Units: Micro-R per Hour

<u>Indicator Stations</u>	<u>Restricted Area Fence</u>	<u>Control Stations</u>
<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
<u>Range</u>	<u>Range</u>	<u>Range</u>
<u>(No. Meas.)*</u>	<u>(No. Meas.)*</u>	<u>(No. Meas.)*</u>
7.9	17.8	8.4
5.7 - 10.6	12.4 - 28.1	7.1 - 9.4
(52)	(36)	(8)

*All measurements based on the average of four determinations per dosimeter.

Table 3.1

Yankee Atomic
Summary of Direct Radiation Measurements, 1984

<u>Station</u>	<u>Micro-R</u> <u>Per Hour*</u>	<u>Station</u>	<u>Micro-R</u> <u>Per Hour*</u>
1	8.1	13	18.6
2	7.9	14	12.9
3	6.6	15	14.0
4	7.0	16	15.4
5	10.0	17	15.3
6	7.7	18	24.0
7	7.3	19	22.7
8	7.9	20	17.9
9	7.7**	21	19.5
10	6.6	22	8.0
11	8.3	23	8.8
12	9.3	40	8.2

* Annual average

** Fourth quarter TLD stolen. Annual average based on data from first three quarters only.

L) Soil

During October 1984, soil at seven locations was analyzed for gamma emitting radionuclides using in situ measurements involving both a high purity germanium (HPGe) detector and a high pressure ionization chamber (PIC). Core samples were taken at one of the sites for analysis at the Environmental Laboratory for comparison with the in situ results. The only man-made radionuclide detected in the soil analyzed was Cs-137, which is associated with fallout from atmospheric weapons testing and was detected at levels consistent with well documented environmental levels. The results of these analyses are summarized in Tables 3.2 and 3.3.

Soil analysis is not required by the Radiological Effluent Technical Specifications.

Table 3.2

Yankee Nuclear Power Station, Rowe, MA
Summary of In Situ Soil Analyses
October 1984

Exposure Rate (Micro-R Per Hour)

Location	Cs-137	K-40	Th-232	U-238	Total*
01 Furlon House	0.23 \pm 0.01	2.2 \pm 0.05	1.6 \pm 0.10	1.0 \pm 0.05	8.4 \pm 0.12
02 Monroe Bridge	0.25 \pm 0.01	2.7 \pm 0.06	2.5 \pm 0.09	1.6 \pm 0.06	10.7 \pm 0.13
03 Observation Stand	0.27 \pm 0.01	2.7 \pm 0.06	1.9 \pm 0.08	1.2 \pm 0.05	9.4 \pm 0.11
04 Williamstown	0.15 \pm 0.01	2.7 \pm 0.06	2.4 \pm 0.09	1.2 \pm 0.05	10.1 \pm 0.12
05 Heartwellville	0.24 \pm 0.01	2.2 \pm 0.04	2.5 \pm 0.09	1.0 \pm 0.05	9.5 \pm 0.11
06 Harriman Station	0.19 \pm 0.01	2.9 \pm 0.06	2.5 \pm 0.10	1.2 \pm 0.05	10.4 \pm 0.13
07 Rowe School	0.17 \pm 0.01	2.1 \pm 0.05	1.9 \pm 0.08	0.93 \pm 0.05	8.7 \pm 0.11

* Includes 3.6 uR/hr cosmic component.

Table 3.3

Yankee Nuclear Power Station, Rowe, MA
Summary of In Situ Soil Analyses
October 1984

Concentration (pCi Per Kilogram)

<u>Location</u>	<u>Cs-137</u>	<u>K-40</u>	<u>Th-232</u>	<u>U-238</u>
01 Furlon House	430 \pm 19	12100 \pm 300	590 \pm 87	550 \pm 26
02 Monroe Bridge	460 \pm 20	15000 \pm 340	900 \pm 33	890 \pm 33
03 Observation Stand	490 \pm 22	15000 \pm 340	670 \pm 28	660 \pm 29
04 Williamstown	270 \pm 18	15000 \pm 340	850 \pm 31	650 \pm 28
05 Hearwellville	440 \pm 19	12000 \pm 300	900 \pm 31	540 \pm 26
06 Harriman Station	340 \pm 19	16000 \pm 350	890 \pm 36	670 \pm 27
07 Rowe School	320 \pm 16	12000 \pm 300	680 \pm 28	510 \pm 25

4.0 QUALITY ASSURANCE PROGRAM

Three separate Quality Assurance programs were performed during 1984 to demonstrate the validity of laboratory analyses by the Yankee Atomic Environmental Laboratory (YAEL).

YAEL participates in the EPA Interlaboratory Comparison (cross-check) program for those species and matrices routinely analyzed by the laboratory. This provides an independent check of accuracy and precision of the laboratory analysis. When the results of the cross-check analysis fall outside of the control limit, an investigation is made to determine the cause of the problem and corrective measures are taken.

YAEL maintains an intralaboratory quality control program to assure the validity and reliability of the data. This program includes quality control of laboratory equipment, use of reference standards for calibration, and analysis of blank and spiked samples. The records of the quality control program are reviewed by the responsible cognizant individual, and corrective measures are taken whenever applicable.

A blind duplicate/replicate program is maintained in which samples are prepared from split or homogenous media and sent to the laboratory for analysis. The results from this blind duplicate program are used to check for precision in laboratory analyses.

EPA Interlaboratory and Intralaboratory Results

The Quality Assurance Program implemented at the analytical laboratory indicated good precision and accuracy in reported values. Table 4.1 shows the results of accuracy and precision for laboratory analyses in 1984 for EPA samples, intralaboratory analyses, and interlaboratory cross-check analyses. For accuracy, 55.2 and 84.4 percent of the results were within 5 and 10 percent of the known values, respectively, with 96.4 percent of all results falling within the laboratory criteria of 15 percent. For precision, 82.2 and 97.2 percent of the results were within 5 and 10 percent of the mean, respectively, with 100 percent of all results meeting the laboratory criteria of 15 percent.

Table 4.1

EPA Interlaboratory and Intralaboratory Results - 1984

<u>Total Number of Samples</u>	<u>Accuracy</u>		
	<u>0 to 5%</u>	<u>0 to 10%</u>	<u>0 to 15%*</u>
868	479 (55.2%)	733 (84.4%)	837 (96.4%)
<u>Total Number of Samples</u>	<u>Precision</u>		
	<u>0 to 5%</u>	<u>0 to 10%</u>	<u>0 to 15%*</u>
850	699 (82.2%)	826 (97.2%)	850 (100%)

*This category also contains those samples having a verified zero concentration which were analyzed and found not to contain the isotope of interest.

The results of the EPA Interlaboratory Comparison program, when considered apart from the remainder of the Quality Assurance program, were satisfactory with respect to accuracy and precision in 1984. One-hundred seventeen samples were analyzed (air particulate filters, food, milk, and water). A total of 294 analyses were performed (beta, Sr-89, Sr-90, I-131, Ba-140, K, Cs-137, Cr-51, Co-60, Zn-65, Ru-106, Cs-134, Ra-226, Ra-228, and H-3).

Of the 294 analyses, 3 (1.0 percent) did not meet the EPA acceptance criteria for accuracy. The first two of these were beta analyses of air filters. The use of an artificially prepared matrix by EPA, for which no reference nuclide has been quoted and no background air filters have been supplied, has caused the YAEL to question the EPA's results. The problem has been well documented in the past (Reference 3). The third of these was a Sr-90 analysis of a milk sample. After reprocessing of the originally-analyzed precipitate, the results were acceptable. All of the analyses met the EPA acceptance criteria for precision. Details on all of the above cases may be found in References 4 and 5.

Blind Duplicate-Replicate Program

A total of 57 paired samples were submitted by the five participating plants for analysis during 1984. The data base used for the duplicate-replicate analysis consisted of paired measurements of 26 gamma-emitting nuclides, H-3, Sr-89, Sr-90, low level I-131 and gross beta. A dual level criteria for agreement was established. If the paired measurements fall within ± 15 percent of their average value, then agreement between the measurements has been met. If the value falls outside of the ± 15 percent, then a two standard deviation range (95 percent confidence level) for duplicates and a three standard deviation range (99 percent confidence level) for replicates is established for each of the analyses. If the ranges overlap, agreement is obtained. One thousand four hundred and fifty-nine paired duplicate and replicate measurements were analyzed for 1984. A total of 99.5 percent of all measurements fell within the established criteria discussed above. The seven measurements that did not meet the criteria were measurements of TeI-132 in river water, Fe-59 in milk, Cr-51 in ground water, Cr-51 in mussel bodies, Ce-141 in milk, Co-58 in seawater, and I-131 in seawater. Each was a single measurement in a 26-radionuclide gamma spectrometry analysis. The seven duplicate measurements represent 0.5 percent of all the blind duplicate-replicate measurements made during 1984. In all the above cases, the radionuclide in question was not present at a detectable level in the sample, and three-standard deviation acceptance criteria was met. No trend was evident with respect to repeated failings of measurements for the above radionuclides.

5.0 LAND USE CENSUS

Specification 3/4.12.2 of the Radiological Effluent Technical specifications requires that a land use census be conducted after June 1 and before October 1 of each year. The census is used to identify the location of the nearest milk animal, the nearest residence, and the nearest garden of greater than 500 square feet producing fresh leafy vegetables in each of the sixteen meteorological sectors within a distance of five miles. The 1984 census was completed on August 8. The distance from the plant for each of the above locations is shown in Table 5.1.

Based on the dosimetric comparisons required by the plant Radiological Effluent Technical Specifications, no changes were found to be necessary in the radiological environmental sampling locations.

Table 5.1

1984 Land Use Census Results

<u>Sector</u>	<u>Nearest Residence (km)</u>	<u>Nearest Milk Animal (km)</u>	<u>Nearest Garden (km)</u>
N	2.4	6.3	3.5
NNE	4.5	7.4	4.8
NE	3.7	3.7	3.7
ENE	3.1	-	7.7
E	3.1	6.0	3.1
ESE	3.4	6.0	3.4
SE	2.3	-	2.3
SSE	2.1	-	2.1
S	2.3	-	2.3
SSW	-	-	-
SW	1.3	-	1.3
WSW	1.3	-	1.3
W	1.9	-	1.9
WNW	1.9	1.9	1.9
NW	0.45	-	0.45
NNW	2.9	3.9	3.9

6.0 SUMMARY

During 1984, as in 1983, samples collected as part of the radiological environmental monitoring program at Yankee Atomic showed detectable levels of man-made radionuclides in cow milk, ground water, river water, sediment, soil, finfish, and maple syrup. The H-3 detected in ground water (sta. WG-12, Sherman Spring) and river water (Station WR-11, Bear Swamp Lower Reservoir) were the only radionuclides possibly related to plant operations. Since water from the spring or the Deerfield River is not consumed by man, there would be no impact on man from the low levels detected. The dose to an imaginary person who consumed large quantities of the above water was calculated, however, to set an upper bound to the possible consequences of the measured environmental levels of H-3. In both cases (river and ground waters), the dose to man was negligible when compared to natural background radiation and its yearly fluctuations.

The Cs-137 detected in cow milk, sediment, soil, finfish, and maple syrup, as well as the Sr-90 detected in cow milk, originated from atmospheric nuclear weapons testing fallout and not from plant operations.

REFERENCES

1. Radiological Environmental Monitoring Report, 1983, Yankee Atomic Electric Company.
2. USNRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I", 1977.
3. YAEL Quarterly Status Report, October-December 1983, Environmental Laboratory Group, Yankee Atomic Electric Company.
4. YAEL Quarterly Status Report, April-June 1984, Environmental Laboratory Group, Yankee Atomic Electric Company.
5. YAEL Quarterly Status Report, October-December 1984, Environmental Laboratory Group, Yankee Atomic Electric Company.

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2.C.2.1
FYR 85-50

May 1, 1985

United States Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

Attention: Dr. Thomas E. Murley, Regional Administrator
Reference: (a) License No. DPR-3 (Docket No. 50-29)
Subject: Annual Radiological Environmental Report

Dear Sir:

Enclosed herewith please find three (3) copies of the Annual Radiological Environmental Monitoring Report for the Yankee Nuclear Power Station. This report contains a summary and analysis of the radiological environmental data collected for the year 1984, and is submitted as required by Technical Specification 6.9.5(a).

Please contact us if you have any questions in regard to this material.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

J. A. Kay
J. A. Kay

Senior Project Engineer - Licensing

JAK/jbm

Enclosures

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