

VERMONT YANKEE NUCLEAR POWER STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL  
SURVEILLANCE REPORT

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## 1.0 INTRODUCTION

The radiological environmental surveillance program at the Vermont Yankee Nuclear Power Station 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 standby monitoring capability for rapid assessment of risk to the general public in the event of unanticipated or accidental releases of radioactive material.

During 1989, as in the past, Aquatec, Inc., collected all of the aquatic environmental samples, while the plant Chemistry staff collected the bulk of the terrestrial environmental samples (including ground water) and the environmental thermoluminescent dosimeters (TLDs) for direct radiation measurements. After the initial processing, all samples were sent to the Yankee Atomic Environmental Laboratory in Westborough, Massachusetts for further processing and radionuclide analysis. TLDs were also sent to this laboratory for processing.

This report is a summary of the findings of the Radiological Environmental Surveillance Program for 1989. It is being provided in compliance with plant Technical Specification 6.7.C.3.

## 2.0 RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE PROGRAM

In this section, Table 2.1 summarizes the surveillance program as required by plant Technical Specification 3.9.C. Table 2.2 lists the sampling stations and their specific locations with distances measured from the plant stack. Given in Table 2.3 are distances and directions relative to the center of the Turbine Building for all TLD locations. The sampling locations are shown on maps in Figures 2.1 through 2.3 and the TLD locations are shown on the maps in Figures 2.4 through 2.6.

Table 2.1

Radiological Environmental Surveillance Program  
Vermont Yankee Nuclear Power Station

<u>Media</u>	<u>Sampling Frequency</u>	<u>Required Analyses</u>
Air Particulate (AP)	- Semimonthly (2) - Quarterly Composite	Gross beta Gamma spectroscopy
Charcoal Filter (CF)	- Semimonthly (2)	Iodine-131
Milk (TM)	- Monthly (6)	Gamma spectroscopy, Iodine-131
Mixed Vegetation (TG)	- Quarterly (1)	Gamma spectroscopy
Silage (TC)	- Annually (3)	Gamma spectroscopy
Groundwater (WG)	- Quarterly	Gamma spectroscopy, H-3
River Water (WR)	- Monthly (5) - Quarterly Composite	Gamma spectroscopy H-3
Sediment (SE)	- Semiannually	Gamma spectroscopy
Fish (FH)	- Semiannually	Gamma spectroscopy
Direct Radiation (DR)	- Quarterly	Integrated gamma dose(4)

- 
- (1) Collection frequency dependent upon availability of samples during winter.
  - (2) Weekly, when main plant stack effluent release rate of Iodine-131 is equal to or greater than 0.1 uCi/sec.
  - (3) Collected at harvest time in reasonable proximity to specified location; subject to availability.
  - (4) Outer ring TLDs - De-dose quarterly unless gaseous release LCO was exceeded in period.
  - (5) Composite sample collected over month at downstream location.
  - (6) Semimonthly when milk animals are identified as being on pasture.



Table 2.2

Radiological Environmental Surveillance Locations  
Vermont Yankee Nuclear Power Station

<u>Station Code</u> (Media - Sta. No.)	<u>Station Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From Plant</u> <u>Stack</u> (km)	<u>Direction</u> <u>From Plant</u> <u>Stack</u>
AP/CF/TG-11	River Station No. 3.3	1	1.9	SSE
AP/CF/TG-12	N. Hinsdale, NH	1	3.6	NNW
AP/CF/TG-13	Hinsdale Substation	1	3.1	E
AP/CF/TG-14	Northfield, MA	1	11.3	SSE
AP/CF/TG-15	Tyler Hill Road	1	3.2	WNW
AP/CF/TG-21	Spofford Lake, NH	2	16.1	NNE
TM-11	Miller Farm	1	0.8	WNW
TM-12	Dominick	1	5.2	E
TM-13	Newton Farm	1	5.1	SSE
TM-14	Brown Farm	1	2.6	S
TM-16	Tall Oaks Farm	1	4.7	WNW
TM-20	Rauney Farm	2	17.0	N
WG-11	VY Plant Well	1	--	On-Site
WG-12	Vernon Nursing Well	1	2.0	SSE
WG-21	Brattleboro C. C.	2	12.1	NNW
WR-11	River Station No. 3.3	1	1.9	Downriver
WR-21	Rt. 9 Bridge	2	12.8	Upriver
FH-11	Vernon Pond	1	--	On-Site
FH-21	Rt. 9 Bridge	2	12.8	Upriver
SE-11	Shoreline Downriver	1	0.8	On-Site
SE-12	N. Storm Drain Outfall	1	0.15	On-Site
TC-11	Miller Farm	1	0.8	WNW
TC-12	Dominick	1	5.2	E
TC-13	Newton Farm	1	5.1	SSE
TC-14	Brown Farm	1	2.6	S
TC-16	Tall Oaks Farm	1	4.7	WNW
TC-20	Ranney Farm	2	17.0	N

\* 1 = Indicator Station; 2 = Control Station.

Table 2.3

Environmental Direction Radiation Monitoring Locations  
Vermont Yankee Nuclear Power Station

<u>Station Code</u> (Media - Sta. No.)	<u>Station Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From Center</u> <u>of Turbine</u> <u>Building</u> <u>(km)</u>	<u>Direction</u> <u>From</u> <u>Center</u> <u>of Turbine</u> <u>Building</u>
DR-1	River Station No. 3.3	I	1.6	SSE
DR-2	N. Hinsdale, NH	I	3.9	NNW
DR-3	Hinsdale Substation	I	3.0	E
DR-4	Northfield, MA	I	11.0	SSE
DR-5	Spofford Lake, NH	O	16.3	NNE
DR-6	Vernon School	I	0.46	WSW
DR-7	Site Boundary	SB	0.27	W
DR-8	Site Boundary	SB	0.25	SW
DR-9	Inner Ring	I	2.1	N
DR-10	Outer Ring	O	4.6	N
DR-11	Inner Ring	I	2.0	NNE
DR-12	Outer Ring	O	3.6	NNE
DR-13	Inner Ring	I	1.4	NE
DR-14	Outer Ring	O	4.3	NE
DR-15	Inner Ring	I	1.4	ENE
DR-16	Outer Ring	O	2.9	ENE
DR-17	Inner Ring	I	1.2	E
DR-18	Outer Ring	O	3.0	E
DR-19	Inner Ring	I	3.5	ESE
DR-20	Outer Ring	O	5.3	ESE
DR-21	Inner Ring	I	1.8	SE
DR-22	Outer Ring	O	3.2	SE
DR-23	Inner Ring	I	1.8	SSE
DR-24	Outer Ring	O	3.9	SSE
DR-25	Inner Ring	I	2.0	S
DR-26	Outer Ring	O	3.7	S
DR-27	Inner Ring	I	1.0	SSW
DR-28	Outer Ring	O	2.2	SSW
DR-29	Inner Ring	I	0.7	WSW
DR-30	Outer Ring	O	2.3	SW
DR-31	Inner Ring	I	0.8	W
DR-32	Outer Ring	O	5.0	WSW
DR-33	Inner Ring	I	0.9	WNW
DR-34	Outer Ring	O	4.9	W
DR-35	Inner Ring	I	1.4	WNW
DR-36	Outer Ring	O	4.7	WNW

Table 2.3  
(Continued)

Environmental Direction Radiation Monitoring Locations  
Vermont Yankee Nuclear Power Station

<u>Station Code</u> <u>(Media - Sta. No.)</u>	<u>Station Description</u>	<u>Zone*</u>	<u>Distance</u> <u>From Center</u> <u>of Turbine</u> <u>Building</u> <u>(km)</u>	<u>Direction</u> <u>From</u> <u>Center</u> <u>of Turbine</u> <u>Building</u>
DR-37	Inner Ring	I	3.0	NW
DR-38	Outer Ring	O	7.7	NW
DR-39	Inner Ring	I	3.2	NNW
DR-40	Outer Ring	O	5.8	NNW
DR-41	Site Boundary	SB	0.38	SSW
DR-42	Site Boundary	SB	0.60	S
DR-43	Site Boundary	SB	0.42	SSE
DR-44	Site Boundary	SB	0.21	SE
DR-45	Site Boundary	SB	0.12	NE
DR-46	Site Boundary	SB	0.29	NNW
DR-47	Site Boundary	SB	0.51	NNW
DR-48	Site Boundary	SB	0.82	NW
DR-49	Site Boundary	SB	0.27	WNW
DR-50	Governor Hunt House	I	0.34	SSW
DR-51	Site Boundary	SB	0.27	W

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I = Inner Ring; O = Outer Ring; SB = Site Boundary.



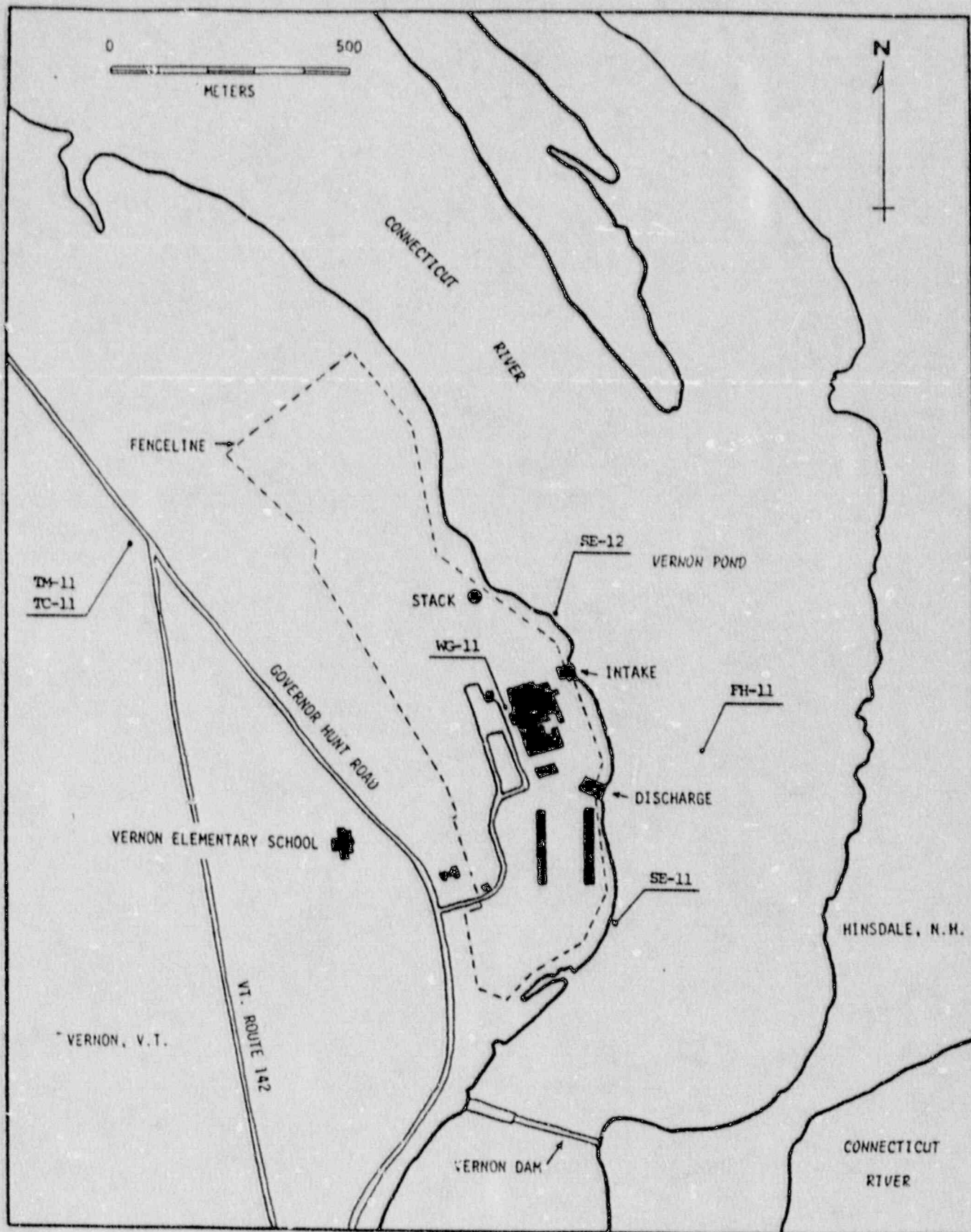


Figure 2.1 Environmental Radiological Monitoring Locations in Close Proximity to Plant

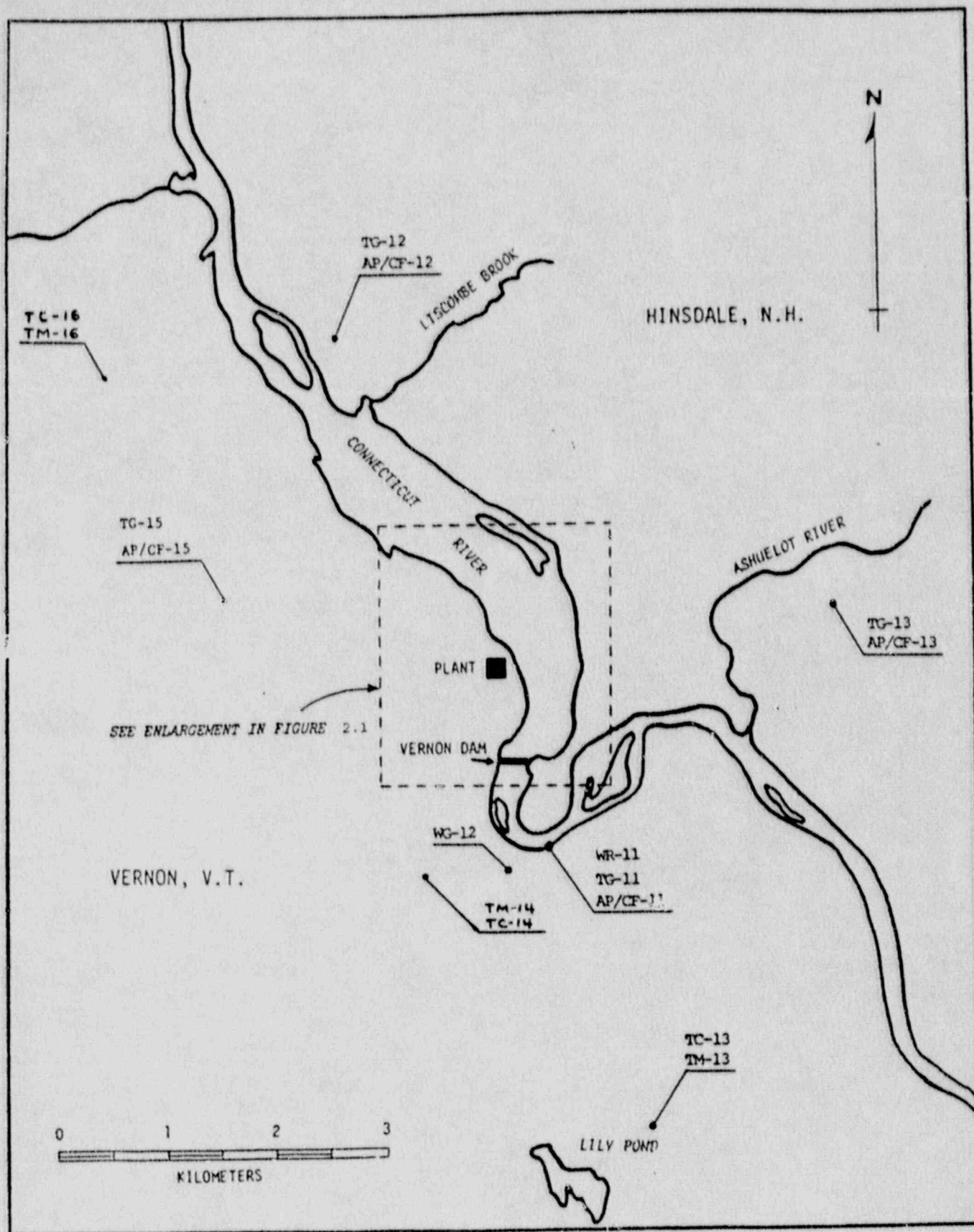


Figure 2.2 Environmental Radiological Monitoring Locations Within 5 Kilometers of Plant

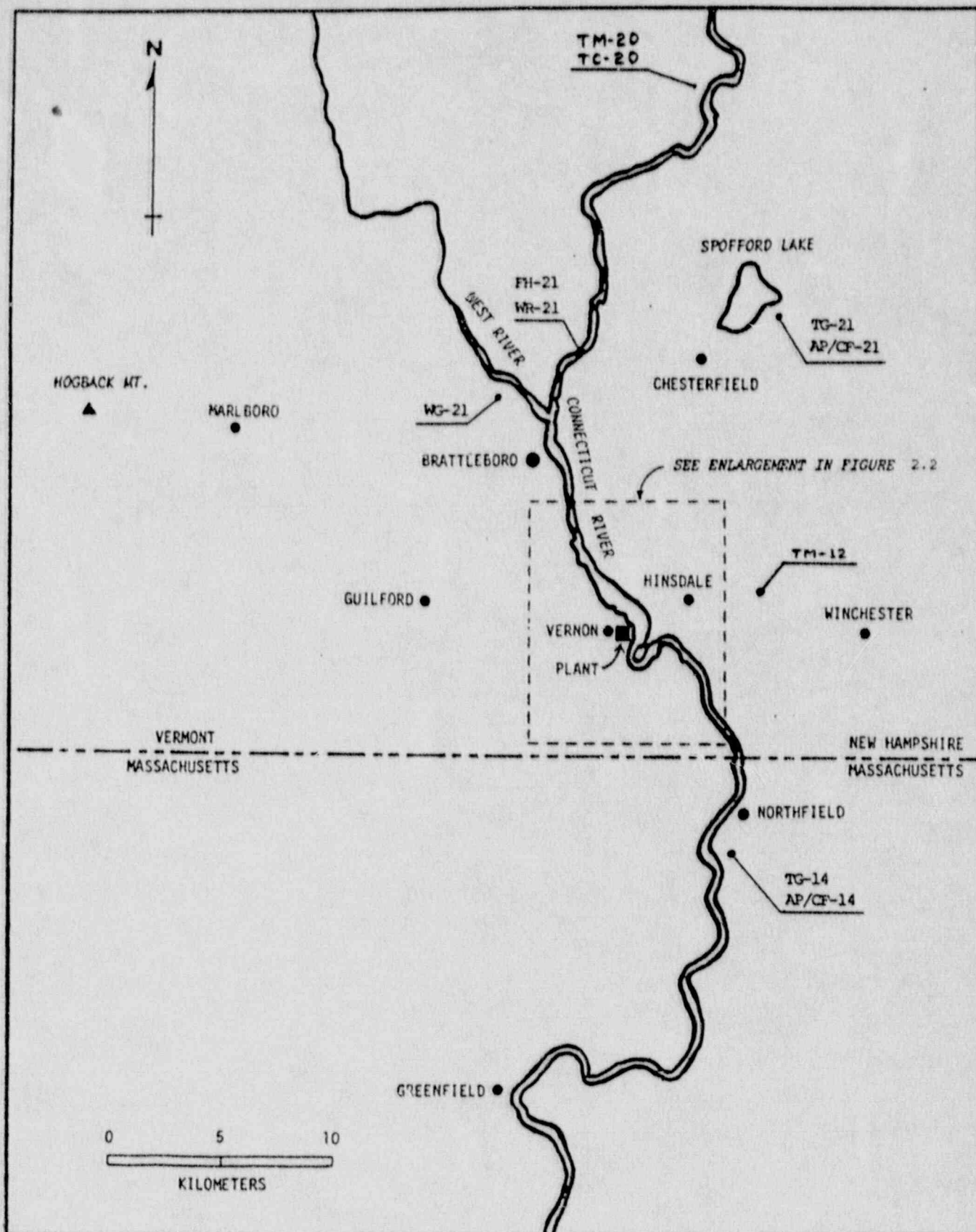


Figure 2.3 Environmental Radiological Monitoring Locations  
Greater Than 5 Kilometers from Plant



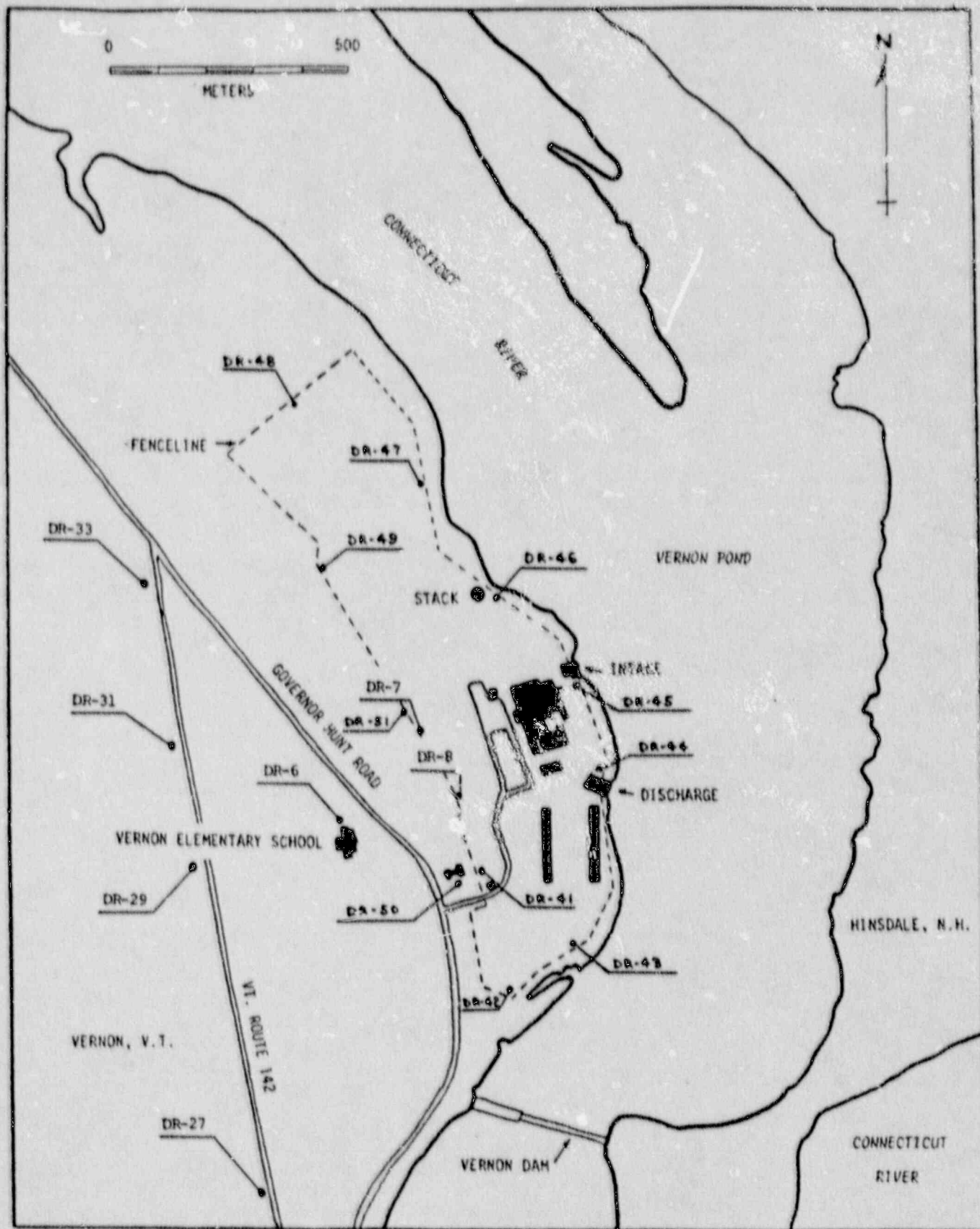


Figure 2.4 TLD Locations in Close Proximity to Plant

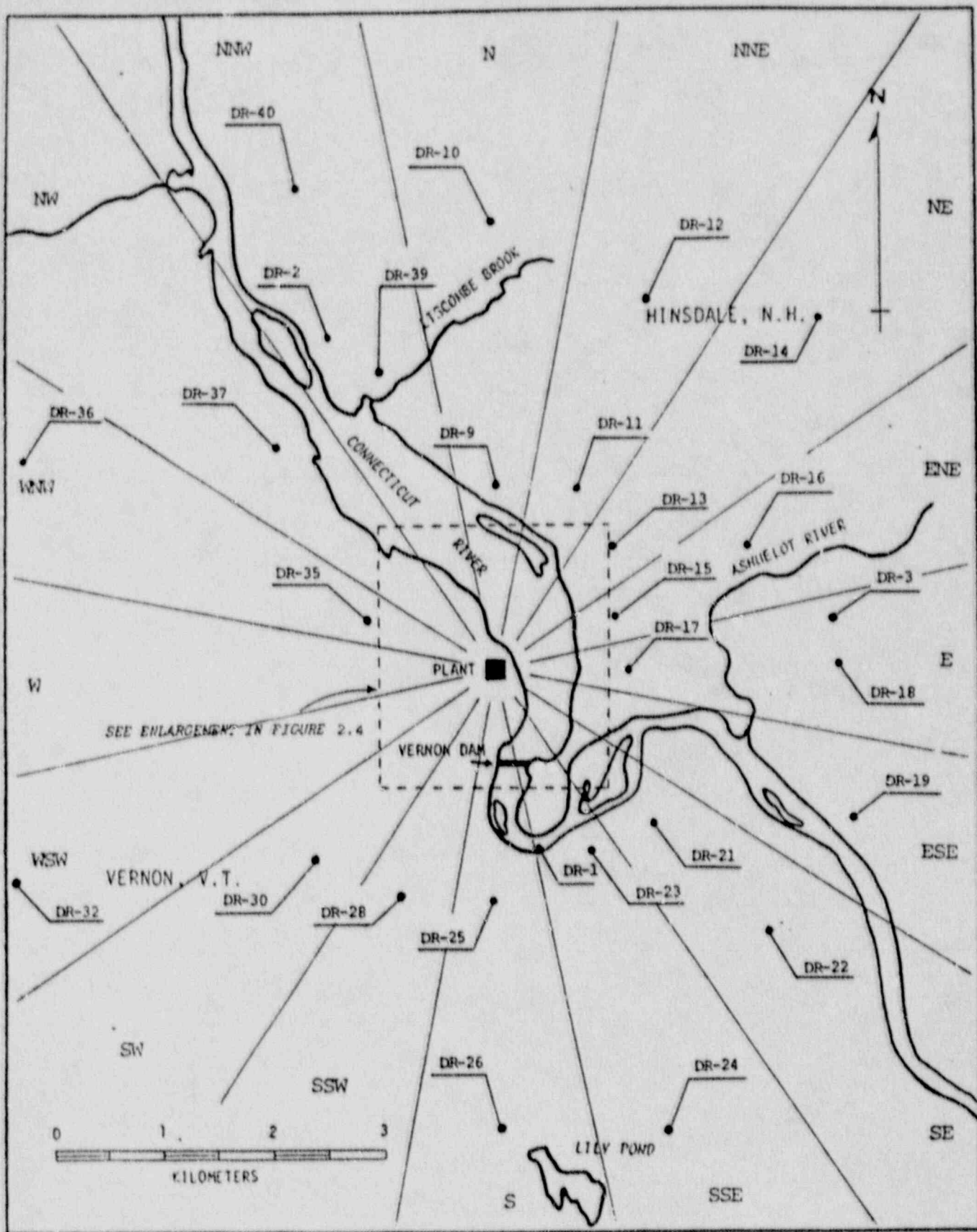


Figure 2.5 TLD Locations Within 5 Kilometers of Plant

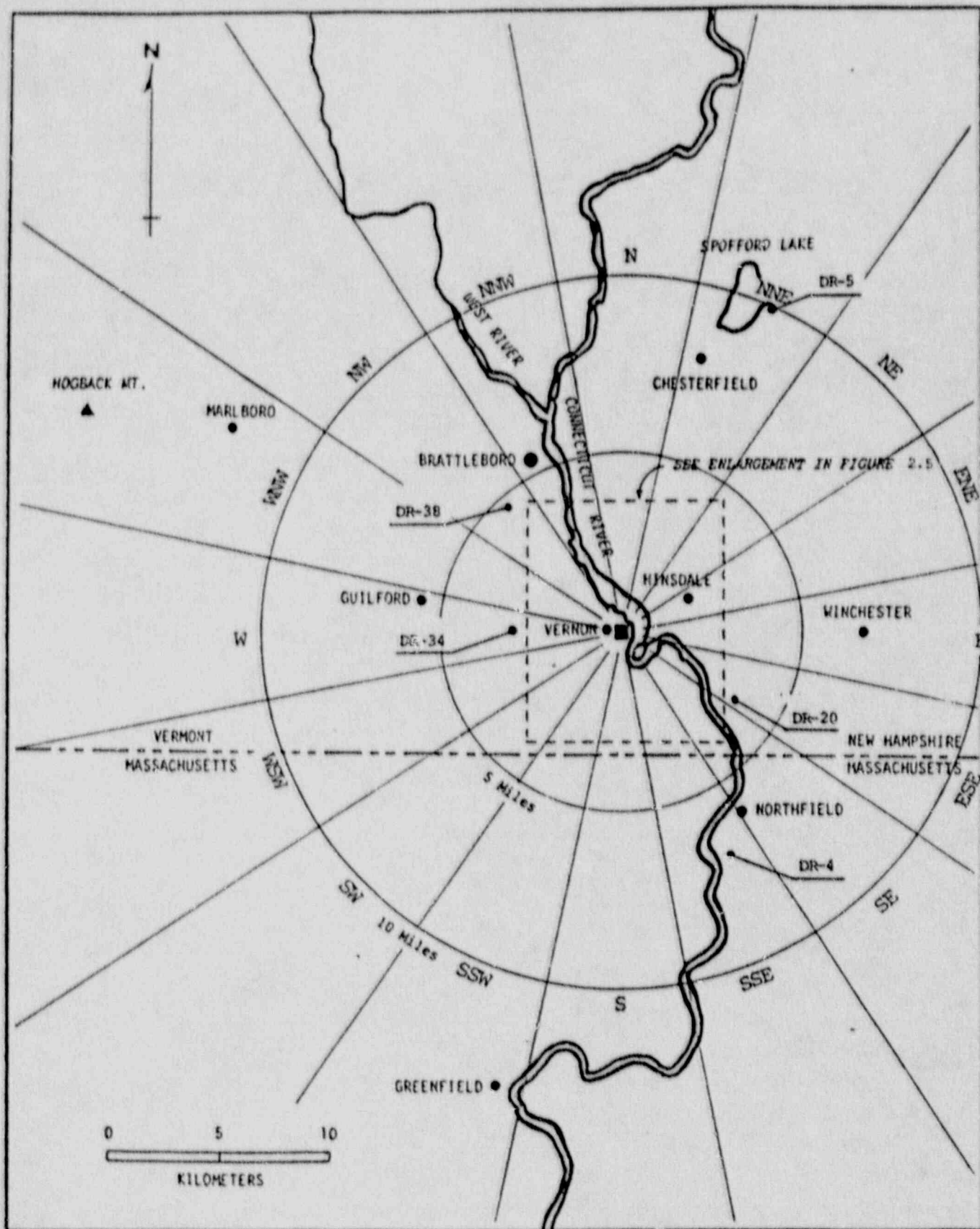


Figure 2.6 TLD Locations Greater Than 5 Kilometers from Plant



### 3.0 SUMMARY OF 1989 RADIOLOGICAL ENVIRONMENTAL DATA

The following pages summarize the analytical results of the environmental samples which were collected during 1989. 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. At the top of each table are listed 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 of control measurements. 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 specified in Technical Specification Table 4.9.3.

Those sampling stations which are adjacent to the plant and which could conceivably be affected by the operation of Vermont Yankee are called "indicator" or "Zone 1" stations. Distant stations, which are beyond plant influence are called "Control" or "Zone 2" stations. Direct radiation (TLD) monitoring locations are subdivided into site boundary, inner ring, and outer ring (emergency response) stations.

A set of statistical parameters is calculated 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 that radionuclide. For each of these three groups of data, these parameters are as follows:

- o The mean value of all concentrations.
- o The standard error of the mean.
- o The lowest and highest concentration.

- o The number of positive measurements (a concentration which is greater than the a posteriori LLD for that analysis) 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.

Pursuant to Technical Specification Table 4.9.3 (Footnote f), any concentration below the LLD for its analysis is reported as "not detected." These values are set to zero for averaging purposes. Where a range of values is reported in the tables of this section, values less than the a posteriori LLD for the analysis are reported as zero.

#### A) Air Particulate

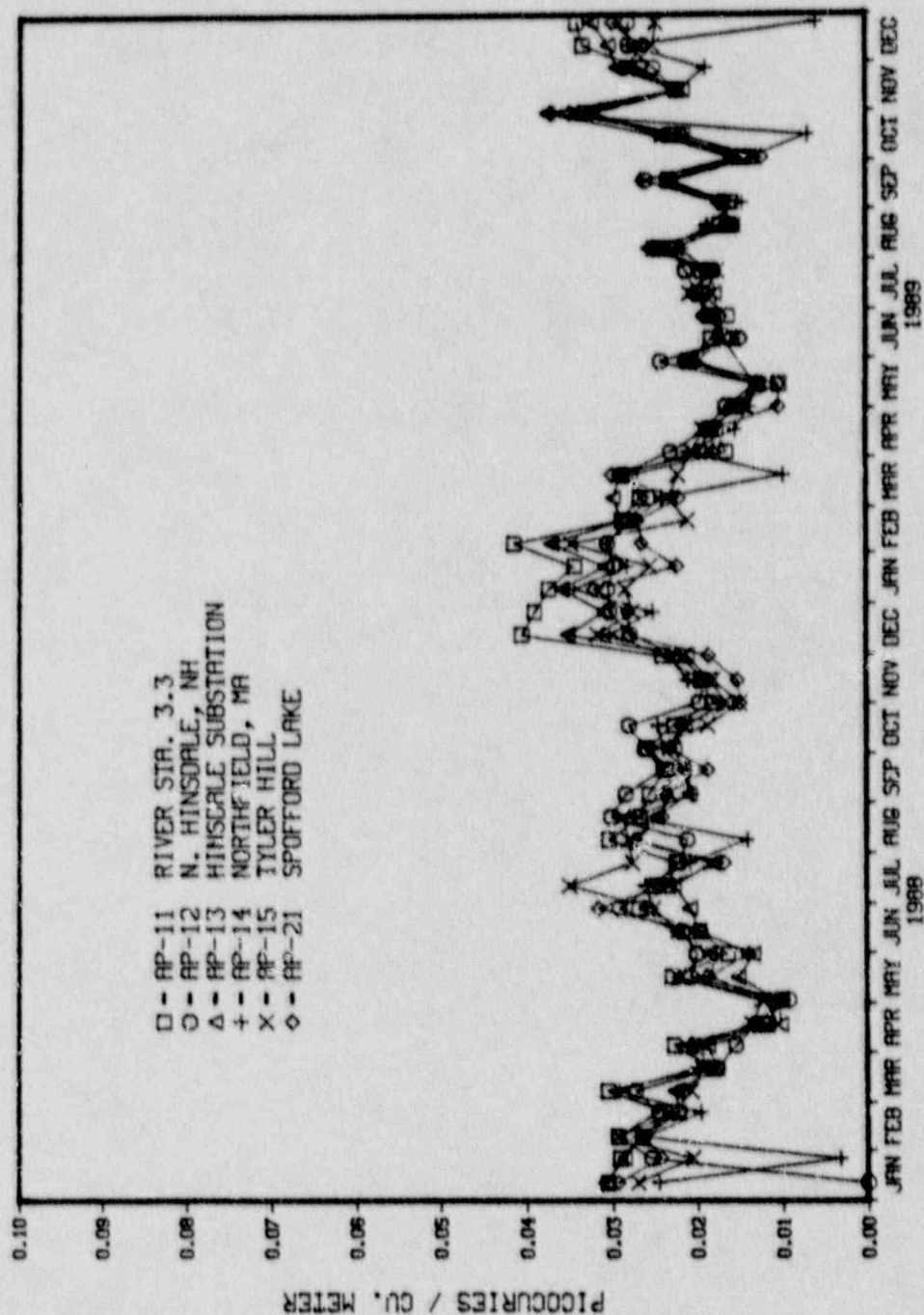
Air monitoring stations were established at a total of six locations (five are required by Technical Specifications). Five of these locations are indicators, while the remaining one is a control station. Airborne particulates are collected by passing the air through a glass-fiber filter. These filters are collected bi-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 daughter products. Quarterly composite air filters from each location are analyzed for gamma emitting radionuclides.

Gross-beta counts (Figure 3.1) showed random fluctuation throughout 1989 at indicator stations and controls, thereby indicating that any plant contribution was negligible. Several unusually low concentrations in 1989, as shown in Figure 3.1, were due to unknown causes. Each of the low measurements was confirmed with a recount. Naturally occurring Be-7 was also detected on all quarterly composite samples.

There were two interruptions in the air particulate sampling program during 1989. During the period from December 27, 1988 to January 10, 1989, the pump at Station AP-14 ran only the first 11.5 days out of a 14-day period. The pump was replaced. On May 30, 1989, it was discovered that the sample at Station AP-15 had not been put back into service after sample collection on May 16, 1989. Consequently, no sample existed for the period May 16, 1989 to May 30, 1989 at that location.



FIGURE 3.1  
GROSS BETA ON AIR PARTICULATE FILTERS  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

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**
GR-B (161) ( 0)	.01	( 2.3 ± 0.1)E -2 ( 6.1 - 41.5)E -3 *(134/134)*	11 ( 2.4 ± 0.2)E -2 ( 1.0 - 4.2)E -2 *( 27/ 27)*	( 2.2 ± 0.1)E -2 ( 1.0 - 3.5)E -2 *( 27/ 27)*
BE-7 ( 24) ( 0)		( 4.7 ± 0.2)E -2 ( 3.2 - 6.1)E -2 *( 20/ 20)*	13 ( 5.2 ± 0.3)E -2 ( 4.4 - 6.0)E -2 *( 4/ 4)*	( 4.8 ± 0.4)E -2 ( 4.1 - 5.8)E -2 *( 4/ 4)*
MN-54 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
CO-58 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
FE-59 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
CO-60 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
ZN-65 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
ZR-95 ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 0/ 4)*
AG-110M ( 24) ( 0)		( 0.0 ± 0.0)E 0  *( 0/ 20)*	ALL EQUAL	( 0.0 ± 0.0)E 0  *( 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 \*(    )\*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

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. DETECTED**	MEAN RANGE NO. DETECTED**
RU-103 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
RU-106 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
SB-124 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
CS-134 ( 24 ) ( 0 )	.05	( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
CS-137 ( 24 ) ( 0 )	.06	( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
BA-140 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
CE-141 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
CE-144 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 0/ 4 )*
TH-232 ( 24 ) ( 0 )		( 0.0 ± 0.0 )E 0 *( 0/ 20 )*	ALL EQUAL	( 0.0 ± 0.0 )E 0 *( 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 \*(     )\*.



## B) Charcoal Filters

Charcoal filter cartridges are situated in series with the air particulate glass-fiber filters. Monitoring stations were established at a total of six locations (five are required by Technical Specifications). Five of these are indicators and one is a control. Charcoal filters from the air sampling stations were collected and analyzed bi-weekly for I-131 activity.

During 1989, no I-131 was detected on charcoal filters.

There were two interruptions in the charcoal filter sampling program during 1989. During the period from December 27, 1988 to January 10, 1989, the pump at Station CF-14 ran only the first 11.5 days out of a 14-day period. The pump was replaced. On May 30, 1989, it was discovered that the samples at Station CF-15 had not been put back into service after sample collection on May 16, 1989. Consequently, no sample existed for the period May 16, 1989 to May 30, 1989 at that location.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: CHARCOAL FILTER

UNITS: PCI/QU. 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**
I-131 (161) ( 0)	.07	( 0.0 ± 0.0)E 0 *( 0/134)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 27)*

\* 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 monthly for low level I-131 and gamma-emitting radionuclides. Monthly samples were composited quarterly and analyzed for Sr-89 and Sr-90 (not a Technical Specification requirement). Semi-monthly sampling was done at Stations TM-14 and TM-20 when the cows were on pasture.

In January of 1989, the Coombs Farm (TM-15) was sold at auction, leaving no dairy animals to provide samples. It was replaced by the Newton Farm (TM-13), where samples had previously been collected on a regular basis. As a result of the Land Use Census in 1989, the Dominick location was added to the milk sampling program (for goat milk). Due to limited availability, samples will only be collected there as available.

Detectable concentrations of Cs-137 and Sr-90 were measured in milk samples submitted from the indicator and control locations. As shown in Figures 3.2 and 3.3, concentrations were similar to those detected in previous years. The detected levels are consistent with those measured in cow milk at other New England locations. Such levels have been well documented and are attributed to fallout from nuclear weapons tests, although Cs-137 levels after May 1986 were elevated somewhat due to Chernobyl-related fallout. Differences between dairy farms can be attributed to differences in feeding practices between farms.

In addition to these radionuclides, naturally occurring K-40 was detected in all samples. No I-131 was detected in any of the samples.



FIGURE 3.2  
CESIUM-137 IN MILK  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

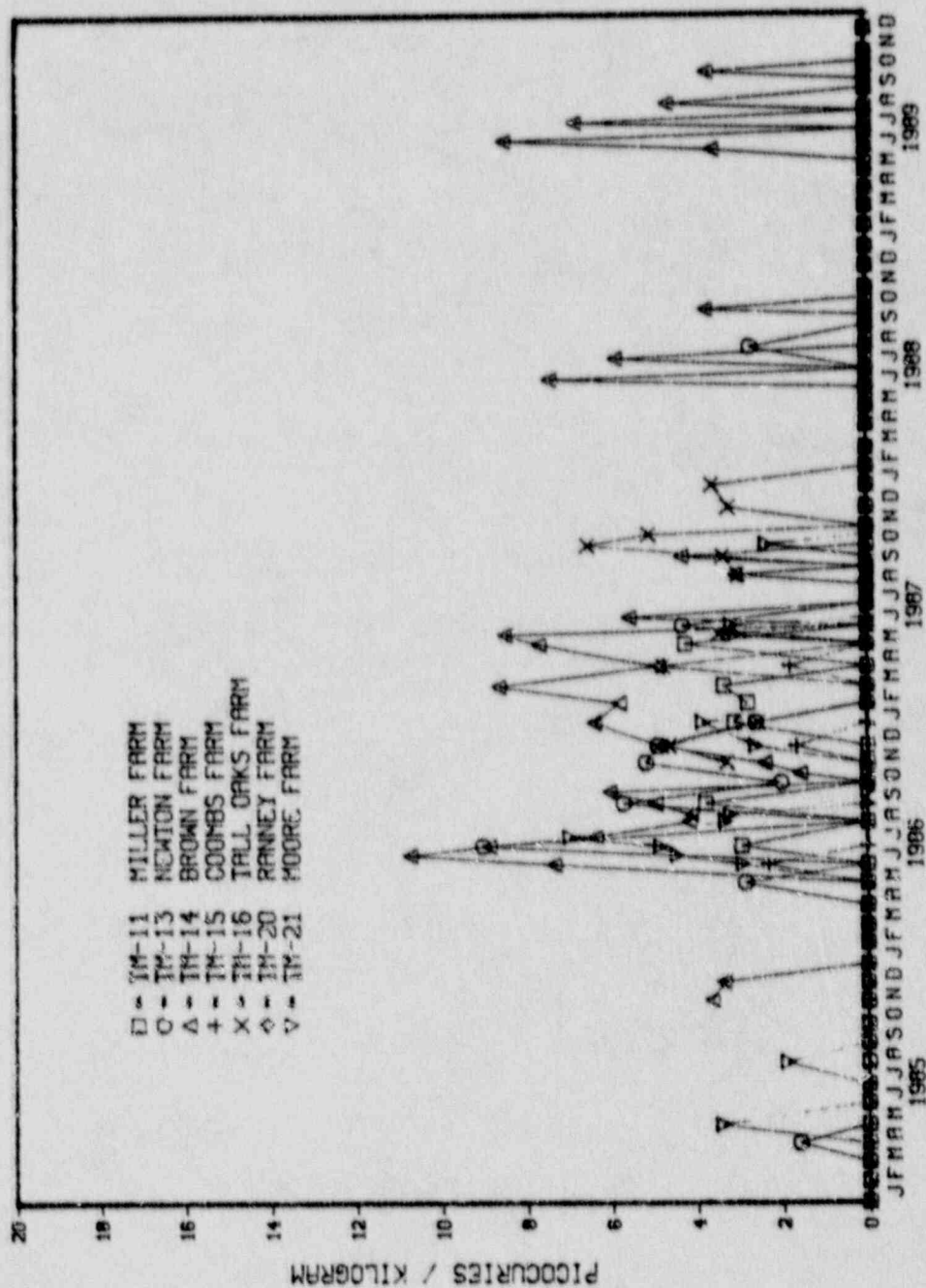
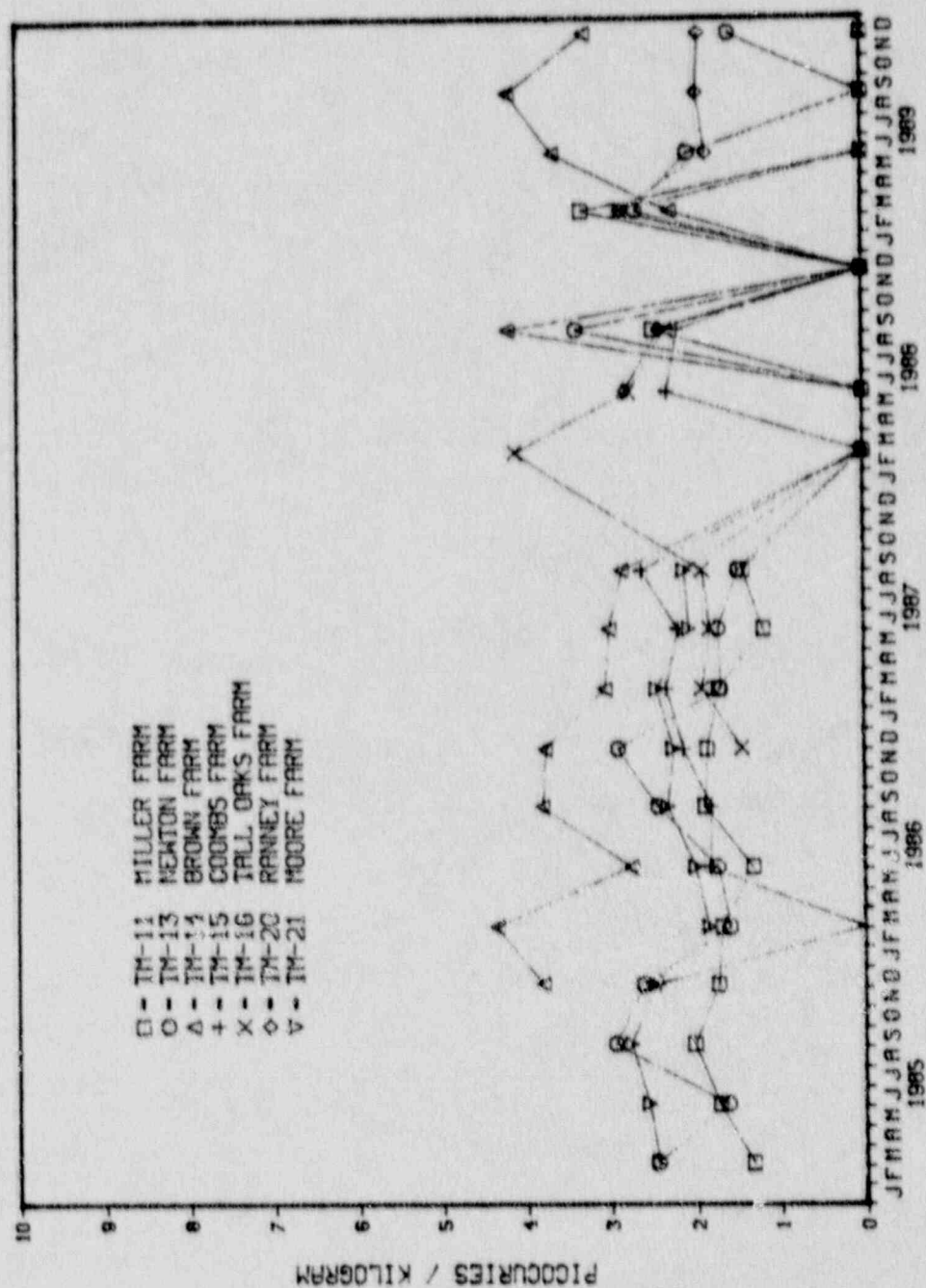


FIGURE 3.3  
STRONTIUM-90 IN MILK  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: MILK

UNITS: PCI/KG

RADIOISOTOPES (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 ( 21) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 17)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
SR-90 ( 21) ( 0)		( 1.8 ± 0.4)E 0 ( 0.0 - 4.2)E 0 *( 10/ 17)*	12	( 4.1 ± 0.5)E 0 *( 1/ 1)*	( 2.1 ± 0.2)E 0 ( 1.9 - 2.8)E 0 *( 4/ 4)*
BE-7 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
K-40 ( 74) ( 0)		( 1.3 ± 0.0)E 3 ( 1.0 - 1.9)E 3 *( 56/ 56)*	12	( 1.9 ± 0.0)E 3 ( 1.9 - 1.9)E 3 *( 2/ 2)*	( 1.3 ± 0.0)E 3 ( 1.2 - 1.4)E 3 *( 18/ 18)*
MN-54 ( 7) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CO-58 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
FE-59 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CO-60 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
ZN-65 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*		ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*

\* 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  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: MILK

UNITS: PCI/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
ZR-95 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
RU-103 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
RU-106 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
I-131 ( 74) ( 0)	1.	( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CS-134 ( 74) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CS-137 ( 74) ( 0)	18.	( 7.5 ± 2.9)E -1 ( 0.0 ± 1.0)E 1 *( 7/ 56)*	12 ( 7.3 ± 2.8)E 0 ( 4.5 ± 10.1)E 0 *( 2/ 2)*	( 0.0 ± 0.0)E 0 *( 0/ 18)*
BA-140 ( 74) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CE-141 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*
CE-144 ( 74) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 56)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 18)*

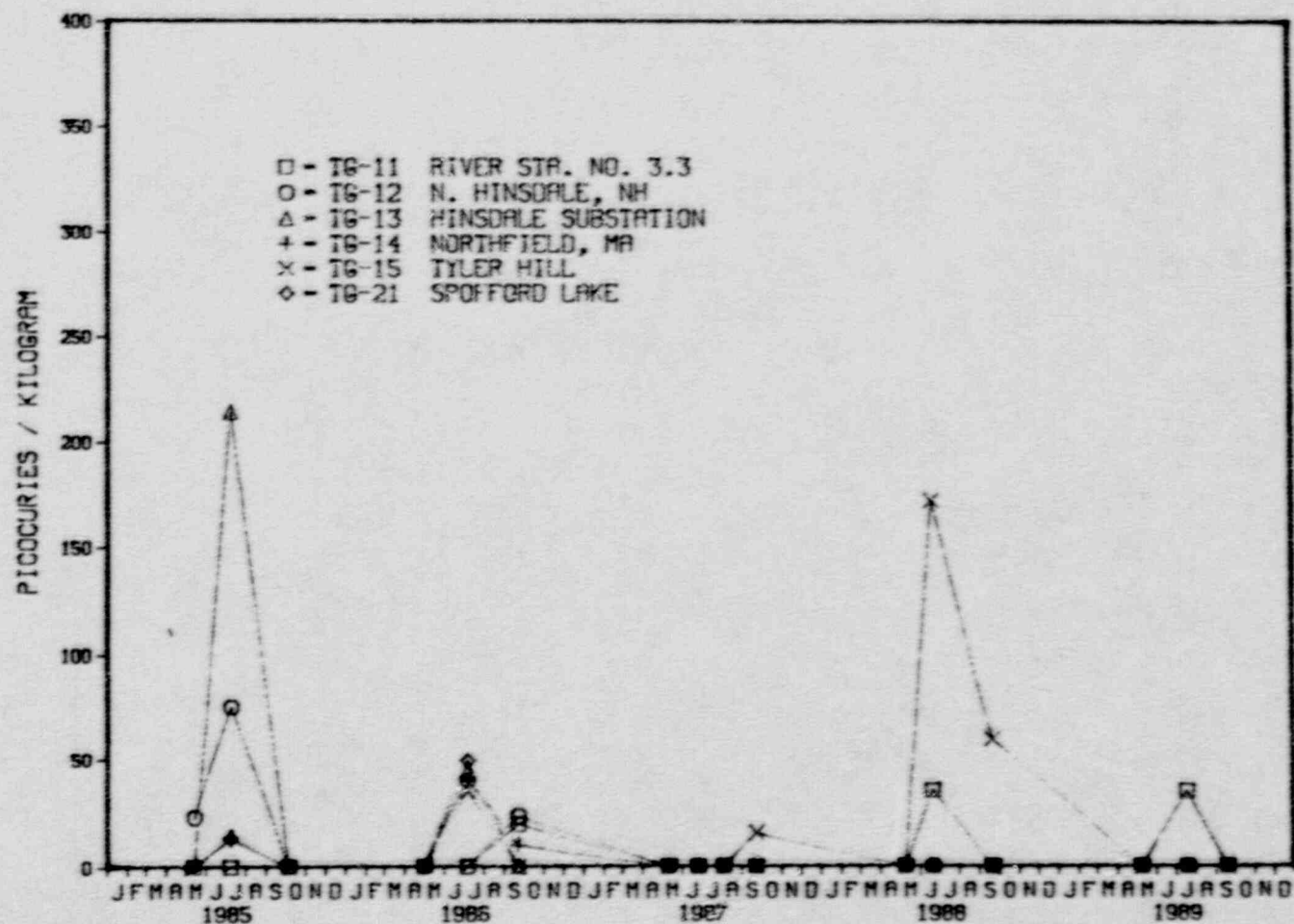
\* NON-ROUTINE REFERS TO THE NUMBER OF SEPARATE MEASUREMENTS WHICH WERE GREATER THAN TEN (10) TIMES THE AVERAGE BACKGROUND FOR THE PERIOD OF THE REPORT.

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D) Mixed Vegetation

Mixed vegetation samples were collected during May, July, and September from the six air sampling locations. Samples were not available during the winter months. The vegetation consisted of various types of grasses and were analyzed for gamma emitting nuclides. The results of the gamma spectroscopy analysis on each sample showed that, in addition to naturally occurring Be-7 and K-40 on all samples, Cs-137 was detected on one sample. The level detected in 1989 is consistent with those measured in previous years, as shown in Figure 3.4, and are believed to be caused by nuclear weapons testing fallout that has persisted in the environment. The highest measured value at Station TG-11 is less than two percent of the reporting level for Cs-137 in vegetation given in Technical Specification Table 3.9.4.

FIGURE 3.4  
CESIUM-137 IN MIXED GRASSES  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT





ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: MIXED VEGETATION

UNITS: PC1/KG WET

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**
BE-7 (18) (0)		( 1.3 ± 0.2)E 3 ( 3.5 - 38.8)E 2 *( 15/ 15)*	12 ( 2.4 ± 0.7)E 3 ( 1.6 - 3.9)E 3 *( 3/ 3)*	( 1.5 ± 0.9)E 3 ( 5.7 - 32.7)E 2 *( 3/ 3)*
K-40 (18) (0)		( 5.3 ± 0.4)E 3 ( 3.1 - 7.2)E 3 *( 15/ 15)*	14 ( 5.8 ± 1.3)E 3 ( 3.3 - 7.2)E 3 *( 3/ 3)*	( 5.5 ± 0.7)E 3 ( 4.3 - 6.8)E 3 *( 3/ 3)*
MN-54 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CO-58 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
FE-59 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CO-60 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
ZN-65 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
ZR-95 (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
AG-110M (18) (0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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 \*(     )\*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: MIXED VEGETATION

UNITS: PCI/KG WET

RADIOISOTOPES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
RU-103 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
RU-106 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
I-131 ( 18) ( 0)	60.	( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CS-134 ( 18) ( 0)	60.	( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CS-137 ( 18) ( 1)	80.	( 2.3 ± 2.3)E 0 ( 0.0 - 3.5)E 1 *( 1/ 15)*	11 ( 1.1 ± 1.2)E 1 ( 0.0 - 3.5)E 1 *( 1/ 3)*	( 0.0 ± 0.0)E 0 *( 0/ 3)*
BA-140 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CE-141 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
CE-144 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*
TH-232 ( 18) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 15)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 3)*

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E) Silage

Silage samples were collected at the milk sampling stations during October of 1989. Each sample was analyzed for gamma-emitting radionuclides and I-131.

In January of 1989, the Coombs Farm (TC-15) was sold at auction, thereby removing itself from the milk and silage sampling program. It was replaced by the Newton Farm (TC-13), where samples had previously been collected.

Naturally occurring Be-7 and K-40 were detected in all silage samples. No man-made radionuclides were detected in any of them.



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: SILAGE

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
BE-7 ( 5) ( 0)		( 1.2 ± 1.2)E 2 ( 0.0 - 4.8)E 2 *( 1/ 4)*	20 ( 9.0 ± 1.2)E 2 *( 1/ 1)*	( 9.0 ± 1.2)E 2 *( 1/ 1)*
K-40 ( 5) ( 0)		( 1.3 ± 0.1)E 3 ( 1.1 - 1.4)E 3 *( 4/ 4)*	20 ( 2.3 ± 0.2)E 3 *( 1/ 1)*	( 2.3 ± 0.2)E 3 *( 1/ 1)*
MN-54 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CO-58 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
FE-59 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CO-60 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
ZN-65 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
ZR-95 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
AG-110M ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: SILAGE

UNITS: PCI/KG WET

RADIOISOTOPES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
RU-103 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
RU-106 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
I-131 ( 5) ( 0)	60.	( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CS-134 ( 5) ( 0)	60.	( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CS-137 ( 5) ( 0)	80.	( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
BA-140 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CE-141 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
CE-144 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 1)*
YH-232 ( 5) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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.

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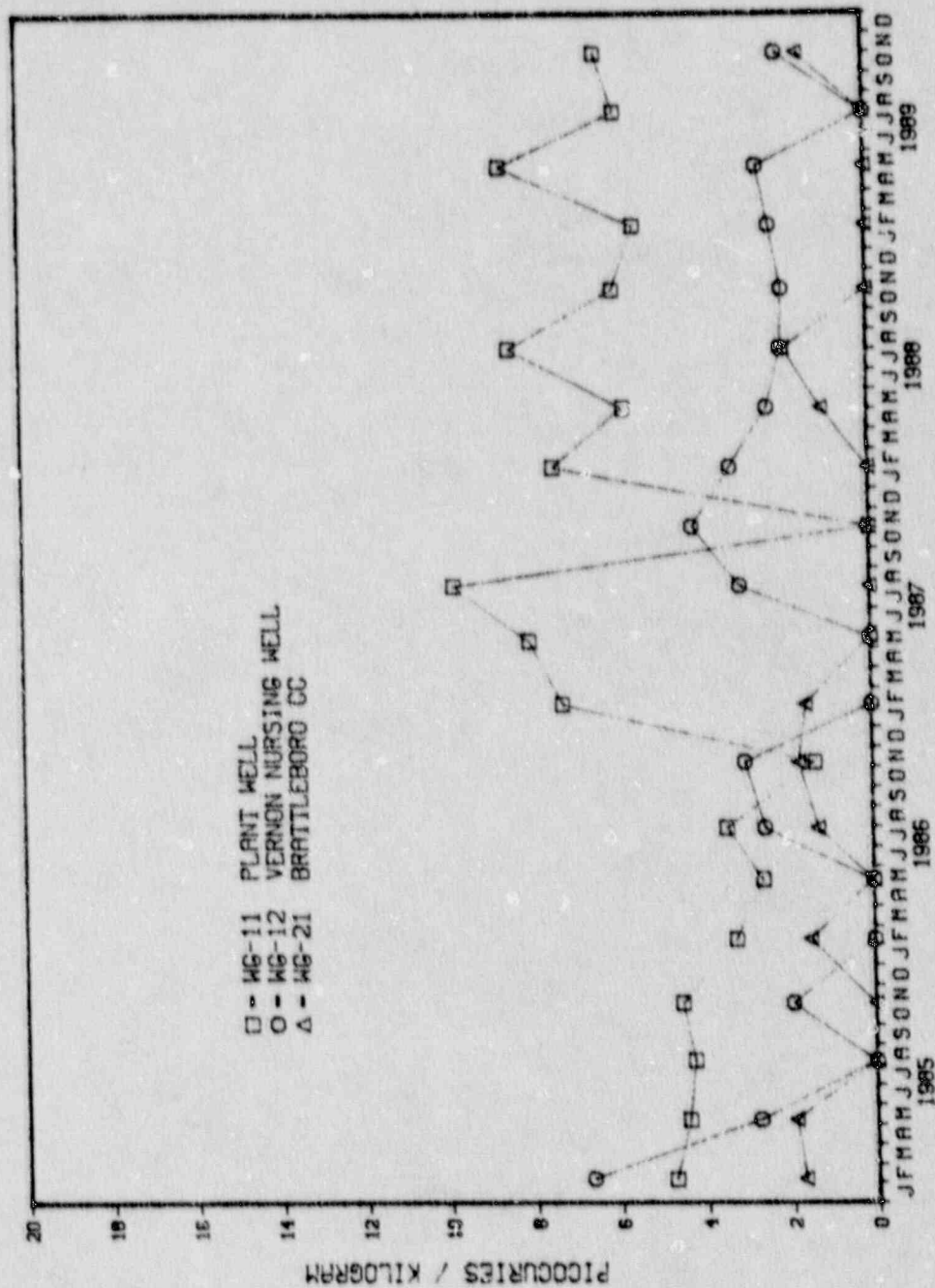
F) Groundwater

Groundwater grab samples were collected from two indicator (only one is required by Technical Specifications) and one control station on a quarterly basis. These samples were analyzed for H-3 and gamma-emitting radionuclides. Additionally, gross-beta analyses were performed, although they are not required.

The gross-beta concentrations at WG-11 have been elevated since 1987. No explanation for these levels has been found, although a problem with low well-water levels and moving to a new well may have caused a change in naturally-occurring radioactivity. Elevated radium levels are suspected, as confirmed by a sample collected in August of 1988. No other gamma-emitting radionuclides or H-3 were detected in groundwater during this time, however.



FIGURE 3.5  
GROSS-BETA MEASUREMENTS OF GROUND WATER  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: GROUND WATER

UNITS: PCI/KG

RADIOISOTOPES (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**
GR-8 (12) ( 6)	4.	( 4.4 ± 0.9)E 0 ( 1.9 - 8.6)E 0 *( 8/ 6)*	11 ( 6.5 ± 0.7)E 0 ( 5.4 - 8.6)E 0 *( 4/ 4)*	( 3.9 ± 3.9)E -1 ( 0.0 - 1.6)E 0 *( 1/ 4)*
BE-7 (12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
MN-54 (12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CO-58 (12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
FE-59 (12) ( 0)	30.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CO-60 (12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
ZR-65 (12) ( 0)	30.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
ZR-95 (12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
AC-110M (12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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 \*(     )\*.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: GROUND WATER

UNITS: PC1/KG

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**	MEAN STA. RANGE NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-103 ( 12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
RU-106 ( 12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
I-131 ( 12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CS-134 ( 12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CS-137 ( 12) ( 0)	18.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
BA-140 ( 12) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CE-141 ( 12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
CE-144 ( 12) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 4)*
H-3 ( 12) ( 0)	3000.	( 0.0 ± 0.0)E 0 *( 0/ 8)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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.

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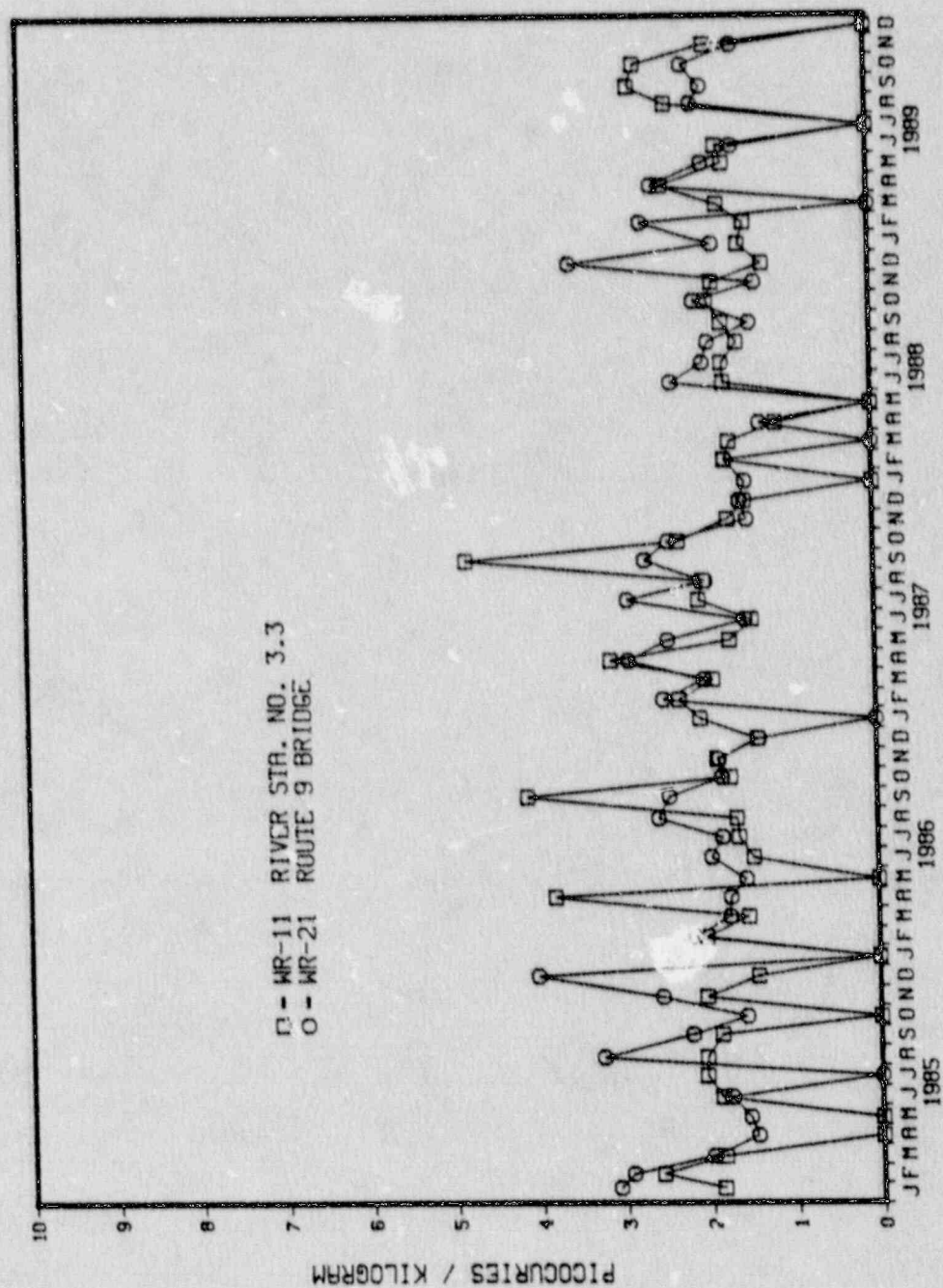
G) River Water

River water is analyzed monthly for gamma-emitting radionuclides and gross-beta (not required by Technical Specifications). The monthly samples are composited and analyzed for H-3 on a quarterly basis. A composite sampler is used at Station WR-11 and grab samples are taken at Station WR-21.

Gross-beta radioactivity was detected in most samples during 1989. Considerable fluctuation in gross-beta levels at both the indicator and control locations over the past nine years is evident in Figure 3.6. The mean value, however, for the indicator stations was similar to that of the control station and to that of previous years, indicating that those radionuclides detected are not due to plant operations, but are due to naturally occurring radioactivity.

On three occasions during 1989, the automatic composite sampling system did not function properly. On April 25, 1989 the sample was discovered to be out of order. It was repaired and put back in service on May 22, 1989. Daily grab samples were collected during that period. On October 18, 1989, the sample was again found to be out of order. It was repaired and put back into service on October 20, 1989. Again, daily grab samples were collected during that period. On December 12, 1989, the sampling lines were found to be frozen, with no sample being collected. This was caused by a tripped circuit breaker in the sampling shed, which shut off the heat. The breaker was reset and the sample was put back in operation on December 14, 1989. There were no liquid discharges from the plant during any of the above time periods.

FIGURE 3.6  
GROSS-BETA MEASUREMENTS OF RIVER WATER  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

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 STA. RANGE NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
GR-B ( 25) ( 0)	4.	( 1.7 ± 0.2)E 0 ( 0.0 - 2.8)E 0 *( 11/ 13)*	11 ( 1.7 ± 0.3)E 0 ( 0.0 - 2.8)E 0 *( 10/ 12)*	( 1.5 ± 0.3)E 0 ( 0.0 - 2.7)E 0 *( 9/ 12)*
BE-7 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
MN-54 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CO-58 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
FE-59 ( 25) ( 0)	30.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CO-60 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
ZN-65 ( 25) ( 0)	30.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
ZR-95 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
AG-110M( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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.

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ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

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 STA. RANGE NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-103 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
RU-106 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
I-131 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CS-134 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CS-137 ( 25) ( 0)	18.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
BA-140 ( 25) ( 0)	15.	( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CE-141 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
CE-144 ( 25) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 13)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 12)*
H-3 ( 8) ( 0)	3000.	( 0.0 ± 0.0)E 0 *( 0/ 4)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 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 \*(     )\*.



## H) Sediment

During 1989, sediment samples were collected from two locations in May and October. Each sample was analyzed for gamma-emitting radionuclides. One grab sample was collected at Station SE-11 and 23 grab samples at Station SE-12 during May. During October, one was again collected at SE-11 and 18 at SE-12.

Cesium-137 was detected in all samples. Since there were no liquid releases during 1982 through 1989, it can be concluded that the levels of Cs-137 in 1989 sediment samples were due to nuclear weapons testing fallout, as has been discussed in previous Vermont Yankee Radiological Environmental Surveillance Reports. This is further supported by the fact that similar levels have in the past been detected at Station SE-21, a control station, and at control locations at other power plants. Low levels of Co-60 have been detected in many samples collected at Station SE-12 (N. Storm Drain Outfall) during 1989 and in previous years. The activity is localized to a small area and is due to plant operations. This subject has been discussed in previous reports.

It should be noted here that the statistics given in the following table are heavily weighed toward Station SE-12, since 41 of the 43 samples were collected there. No Co-60 was detected at Station SE-11.

Naturally occurring Be-7, K-40, and Th-232 were also detected in most samples.

ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: SEDIMENT

UNITS: PCI/KG DRY

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STA. NO.	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**	
BE-7 (43) (10)		( 1.8 ± 0.5)E 2 ( 0.0 - 1.2)E 3 *( 10/ 43)*	12	( 1.9 ± 0.6)E 2 ( 0.0 - 1.2)E 3 *( 10/ 41)*	NO DATA
K-40 (43) (0)		( 1.3 ± 0.0)E 4 ( 1.0 - 1.6)E 4 *( 43/ 43)*	12	( 1.4 ± 0.0)E 4 ( 1.0 - 1.6)E 4 *( 41/ 41)*	NO DATA
MN-54 (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	NO DATA
CO-58 (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	NO DATA
FE-59 (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	NO DATA
CO-60 (43) (24)		( 5.5 ± 0.9)E 1 ( 0.0 - 2.1)E 2 *( 24/ 43)*	12	( 5.8 ± 1.0)E 1 ( 0.0 - 2.1)E 2 *( 24/ 41)*	NO DATA
ZN-65 (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	NO DATA
ZR-95 (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	NO DATA
AG-110M (43) (0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*		ALL EQUAL	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  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

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 STA. RANGE NO. NO. DETECTED**	MEAN RANGE NO. DETECTED**
RU-103 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
RU-106 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
I-131 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
CS-134 ( 43) ( 0)	150.	( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
CS-137 ( 43) ( 42)	180.	( 2.3 ± 0.1)E 2 ( 0.0 - 3.9)E 2 *( 42/ 43)*	12 ( 2.3 ± 0.1)E 2 ( 1.0 - 3.9)E 2 *( 41/ 41)*	NO DATA
BA-140 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
CE-141 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
CE-144 ( 43) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 43)*	ALL EQUAL	NO DATA
TH-232 ( 43) ( 0)		( 9.4 ± 0.3)E 2 ( 6.0 - 13.8)E 2 *( 43/ 43)*	11 ( 1.0 ± 0.0)E 3 ( 10.0 - 10.5)E 2 *( 2/ 2)*	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 \*( )\*.

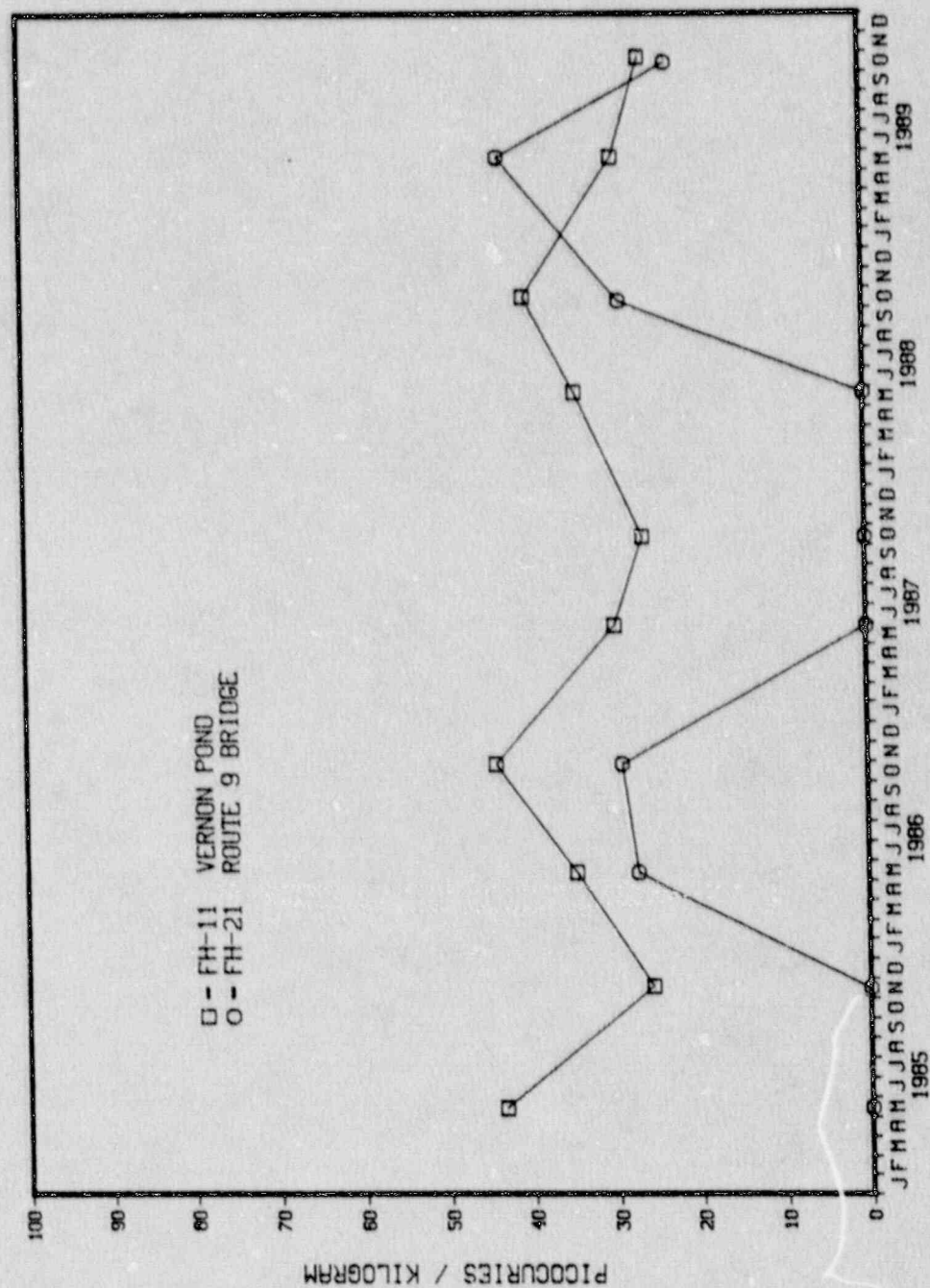


# 1) Fish

Fish samples were collected from two locations during May and again in October of 1989. Each sample consisted of mixed fresh water species, generally perch and bass. All were analyzed for gamma-emitting radionuclides. Cesium-137 was detected in roughly equal concentrations at both indicator and control location. The levels are similar to those in past years (see Figure 3.7) and are consistent with well-documented environmental levels caused by nuclear weapons testing fallout. No other radionuclides were detected except for naturally-occurring K-40.



FIGURE 3.7  
CESIUM-137 IN FISH  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



ENVIRONMENTAL RADIOLOGICAL PROGRAM SUMMARY  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: FISH

UNITS: PCI/KG WET

RADIOISOTOPES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
BE-7 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
K-40 ( 4) ( 0)		( 2.5 ± 0.3)E 3 ( 2.2 - 2.8)E 3 *( 2/ 2)*	11 ( 2.5 ± 0.3)E 3 ( 2.2 - 2.8)E 3 *( 2/ 2)*	( 2.4 ± 0.1)E 3 ( 2.3 - 2.5)E 3 *( 2/ 2)*
MN-54 ( 4) ( 0)	130.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CO-58 ( 4) ( 0)	130.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
FE-59 ( 4) ( 0)	260.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CO-60 ( 4) ( 0)	130.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
ZN-65 ( 4) ( 0)	260.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
ZR-95 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
AG-110M( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)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  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT  
(JANUARY - DECEMBER 1989)

MEDIUM: FISH

UNITS: PCI/KG WET

RADIONUCLIDES (NO. ANALYSES) (NON-ROUTINE)*	REQUIRED LLD	INDICATOR STATIONS *****	STATION WITH HIGHEST MEAN *****	CONTROL STATIONS *****
		MEAN RANGE NO. DETECTED**		MEAN RANGE NO. DETECTED**
RU-103 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
RU-106 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
SB-124 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
I-131 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CS-134 ( 4) ( 0)	130.	( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CS-137 ( 4) ( 0)	150.	( 2.8 ± 0.2)E 1 ( 2.6 - 3.0)E 1 *( 2/ 2)*	21 ( 3.3 ± 1.0)E 1 ( 2.3 - 4.3)E 1 *( 2/ 2)*	( 3.3 ± 1.0)E 1 ( 2.3 - 4.3)E 1 *( 2/ 2)*
BA-140 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CE-141 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)E 0 *( 0/ 2)*
CE-144 ( 4) ( 0)		( 0.0 ± 0.0)E 0 *( 0/ 2)*	ALL EQUAL	( 0.0 ± 0.0)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 \*(     )\*.



### 3) Direct Radiation

Direct gamma radiation exposure was determined from the use of thermoluminescent dosimeters (TLDs). Beginning in 1988, Panasonic UD-801AS1 and UD-814AS1 calcium sulfate dosimeters were used, replacing the previous Victoreen  $\text{CaF}_2\text{:Mn}$  dosimeters. A total of five elements were in place at each monitoring location. Fifty-one sets of TLDs were read out on a quarterly schedule. Sixteen of these were located at inner ring stations and 16 at outer ring stations. Twelve were located at the site boundary, six were at special interest locations, and one was a control.

Summaries of the results for 1989 can be seen in the table below. A complete station-by-station summary is given in Table 3.1. In this table, the quarterly averages for inner ring stations (i.e., those locations that could possibly be influenced by plant operations) can be compared with those for the outer ring stations (i.e., those locations outside of the range of influence of the plant). Upon examining the quarterly exposure rates in the table, it is also evident that the inner ring exposure rates are not statistically different from those of the outer ring.

Upon examining Figure 3.10, it is evident that Station DR-45 has a higher average exposure rate than any other station. Station DR-46 also had a higher exposure during most of 1989. Both locations are on-site, and the higher exposure rates are due to plant operations in the immediate vicinity of the TLDs. As can be seen on the map in Figure 2.4, there is no significant dose potential to the surrounding population or any real individual from these sources.

As can be seen in Figure 3.8, Station DR-6 had a high reading during the third quarter of 1987. Over-response of the TLDs is suspected. Panasonic TLDs from the Yankee Environmental Laboratory were co-located with the standard Victoreen during 1987. The Panasonic TLD at DR-6 during the third quarter gave a reading of



7.2 micro-R per hour. Additionally, two TLD stations (DR-7 and DR-8) located between the plant and DR-6 had readings of 11.36 and 10.81 micro-R per hour, which is substantially lower than the 24.04 micro-R per hour at DR-6.

Environmental Radiological Program Summary  
 Vermont Yankee Nuclear Power Station  
January - December 1989

Medium: Direct Radiation  
 Measurements (TLD)

Units: Micro-R per  
 Hour

<u>Inner Ring</u> Mean Range (No. Meas.)*	<u>Station</u> No.	<u>Station With</u> <u>Highest Mean</u> Mean Range (No. Meas.)*	<u>Outer Ring</u> Mean Range (No. Meas.)*
6.9 $\pm$ 0.6		18.8 $\pm$ 2.4	6.9 $\pm$ 0.8
5.8 - 8.9	45	16.5 - 22.2	5.2 - 9.0
(88)		(4)	(68)

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\* Most measurements based on five readings per station.

Table 3.1

Summary of Direct Radiation Measurements - 1989  
Vermont Yankee Nuclear Power Station  
 (Micro-R Per Hour)

<u>Location</u>	<u>Type*</u>	<u>QTR 1</u>	<u>QTR 2</u>	<u>QTR 3</u>	<u>QTR 4</u>	<u>Yearly Mean</u>
DR-1	I	6.3	5.9	6.9	6.4	6.4
DR-2	I	6.2	6.1	7.2	6.4	6.5
DR-3	I	7.7	7.6	8.9	7.7	8.0
DR-4	I	6.2	6.1	7.2	6.1	6.4
DR-5	O	6.3	6.2	7.2	6.2	6.4
DR-6	I	6.6	6.5	7.3	6.6	6.8
DR-7	SB	7.3	8.2	10.0	8.7	8.6
DR-8	SB	7.7	8.3	9.7	8.9	8.7
DR-9	I	6.1	6.3	7.4	6.6	6.6
DR-10	O	5.3	5.2	6.3	5.6	5.6
DR-11	I	5.8	5.9	6.9	6.2	6.2
DR-12	O	5.9	5.8	6.7	6.1	6.1
DR-13	I	6.0	6.4	7.1	6.6	6.5
DR-14	O	7.3	7.2	8.4	7.6	7.6
DR-15	I	7.0	7.0	7.3	7.0	7.0
DR-16	O	7.2	7.0	7.6	7.3	7.3
DR-17	I	6.5	6.4	7.3	6.7	6.7
DR-18	O	6.8	6.6	7.7	7.0	7.1
DR-19	I	7.0	6.7	7.7	7.2	7.2
DR-20	O	7.3	7.4	8.3	7.7	7.7
DR-21	I	6.8	6.9	7.7	7.2	7.1
DR-22	O	7.0	6.9	7.5	7.0	7.1
DR-23	I	6.4	6.4	7.5	6.9	6.8
DR-24	O	5.8	5.7	6.5	6.0	6.0
DR-25	I	6.5	6.5	7.3	6.6	6.7
DR-26	O	6.5	6.8	7.7	6.9	7.0
DR-27	I	6.4	6.7	7.8	8.4	7.3
DR-28	O	6.5	6.9	8.0	7.3	7.2
DR-29	I	6.5	6.7	7.8	7.1	7.0
DR-30	O	6.2	6.4	7.8	6.8	6.8
DR-31	I	6.7	6.7	7.8	7.1	7.1
DR-32	O	6.3	6.4	7.6	7.2	6.9
DR-33	I	6.5	6.5	7.7	7.4	7.0
DR-34	O	6.8	6.9	8.1	7.4	7.3
DR-35	I	6.5	6.5	7.4	7.0	6.9
DR-36	O	7.4	7.7	9.0	8.4	8.1
DR-37	I	6.2	6.9	7.8	7.3	7.0
DR-38	O	6.7	6.7	8.0	7.4	7.2
DR-39	I	6.4	6.7	7.5	7.1	7.0
DR-40	O	6.5	6.3	7.3	6.9	6.8
DR-41	SB	7.8	7.8	8.6	7.6	7.9
DR-42	SB	6.1	6.7	7.8	7.4	7.0
DR-43	SB	6.8	7.3	8.5	7.7	7.6
DR-44	SB	7.9	7.7	8.9	8.7	8.3



Table 3.1  
(Continued)

Summary of Direct Radiation Measurements - 1989  
Vermont Yankee Nuclear Power Station

<u>Location</u>	<u>Type*</u>	<u>QTR 1</u>	<u>QTR 2</u>	<u>QTR 3</u>	<u>QTR 4</u>	<u>Yearly Mean*</u>
DR-45	SB	22.2	16.5	18.4	18.0	18.8
DR-46	SB	8.5	11.1	22.7	30.2	18.1
DR-47	SB	7.5	7.4	9.3	8.6	8.2
DR-48	SB	7.1	6.5	8.0	7.2	7.2
DR-49	SB	6.6	6.3	7.8	7.1	6.9
DR-50	I	6.8	6.8	8.1	7.4	7.3
DR-51	SB	7.7	8.1	9.9	9.0	8.7
QTR Mean		6.5	6.6	7.5	7.0	
Inner Ring		±0.4	±0.4	±0.4	±0.5	
QTR Mean		6.6	6.6	7.6	7.0	
Outer Ring		±0.5	±0.6	±0.7	±0.7	
QTR Mean		8.6	8.5	10.8	10.8	
Site		±4.3	±2.8	±4.7	±6.8	
Boundary						

---

\*I = Inner Ring; O = Outer Ring; SB = Site Boundary.



FIGURE 3.8  
EXPOSURE RATE AT INDICATOR TLDS, DR 01-04, 06, 50  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

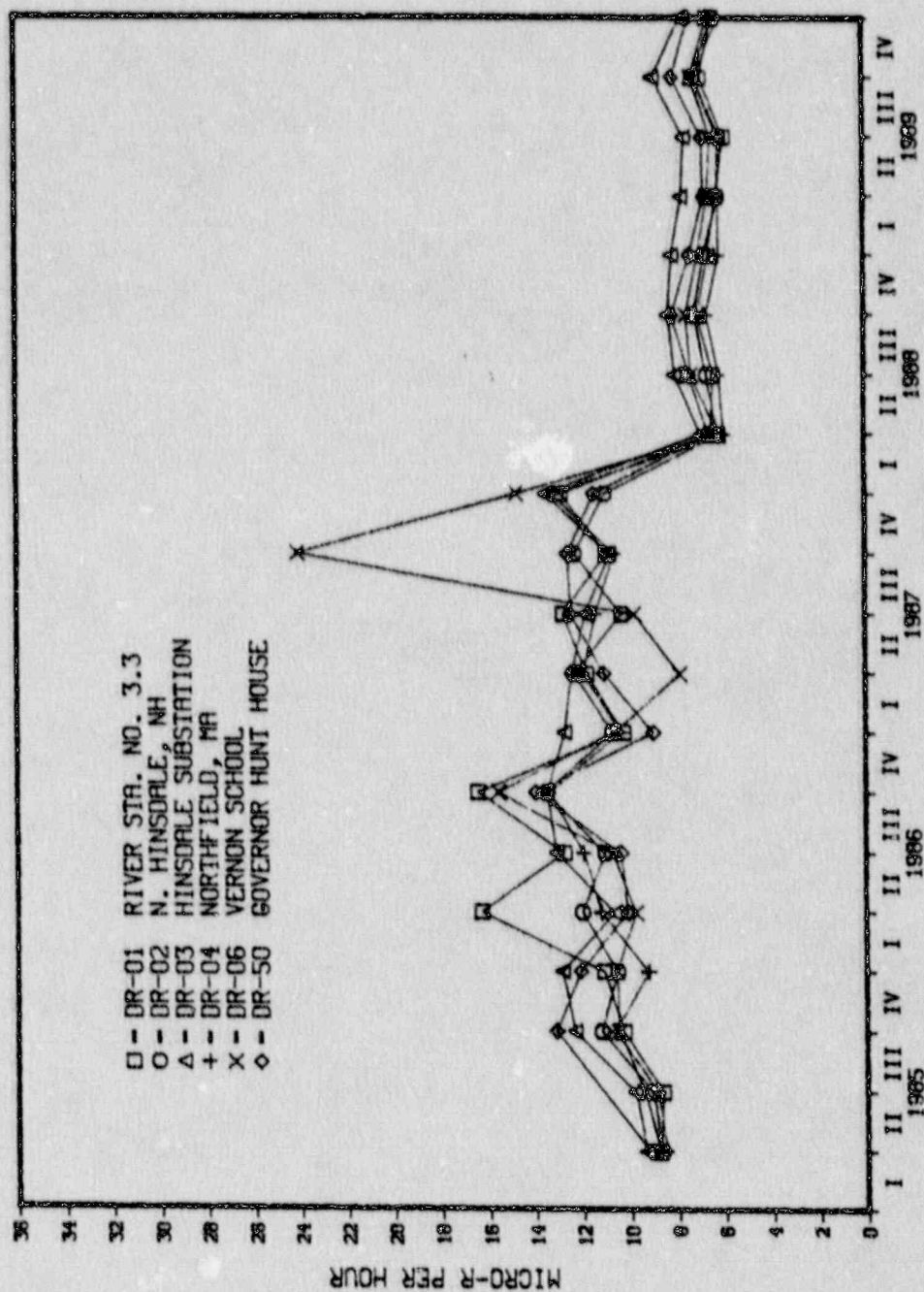


FIGURE 3.3  
EXPOSURE RATE AT SITE BOUNDARY TLDS, DR 07-08, 41-44  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

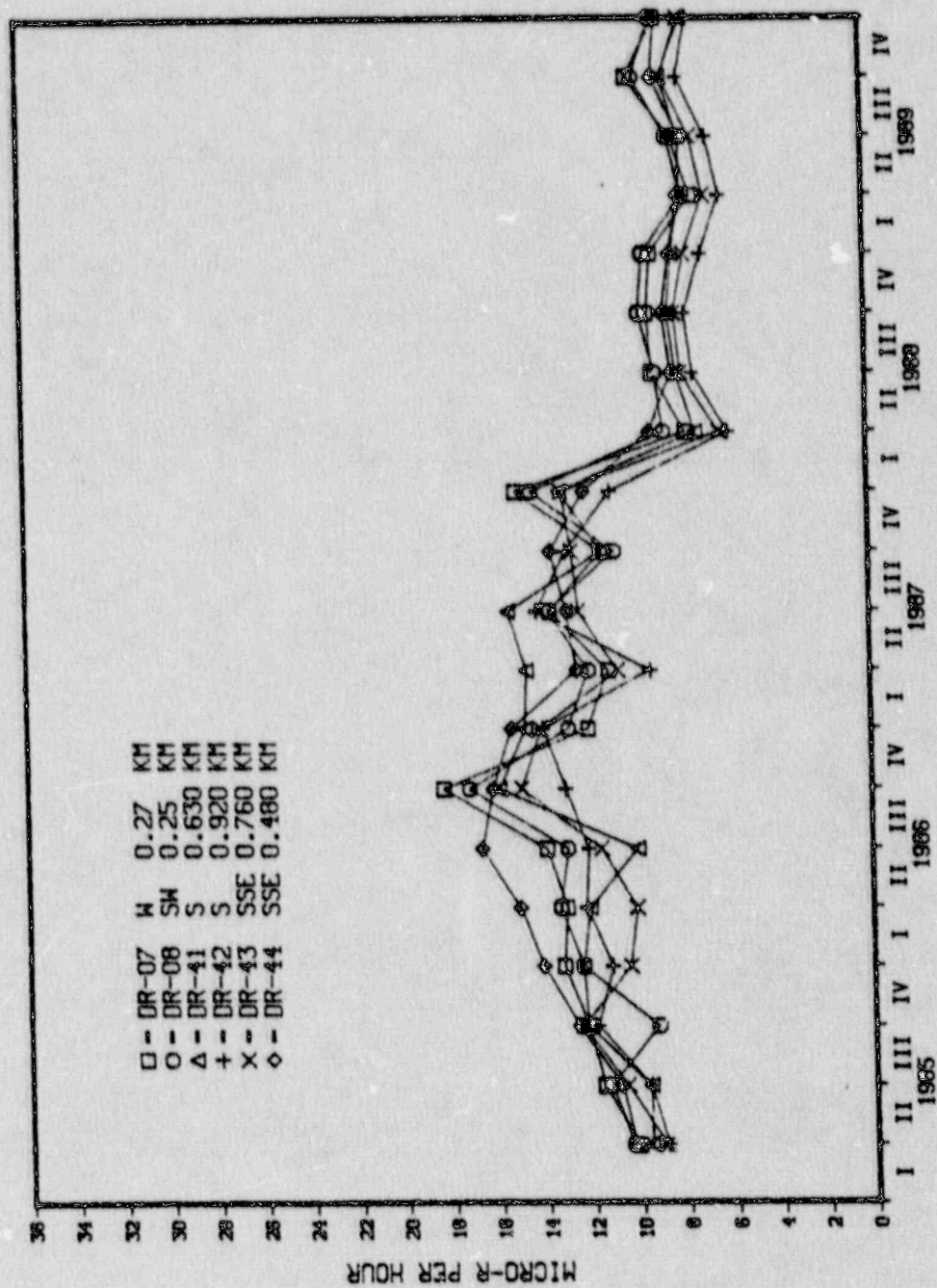


FIGURE 3.10  
EXPOSURE RATE AT SITE BOUNDARY TLDS, DR 45-49,51  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

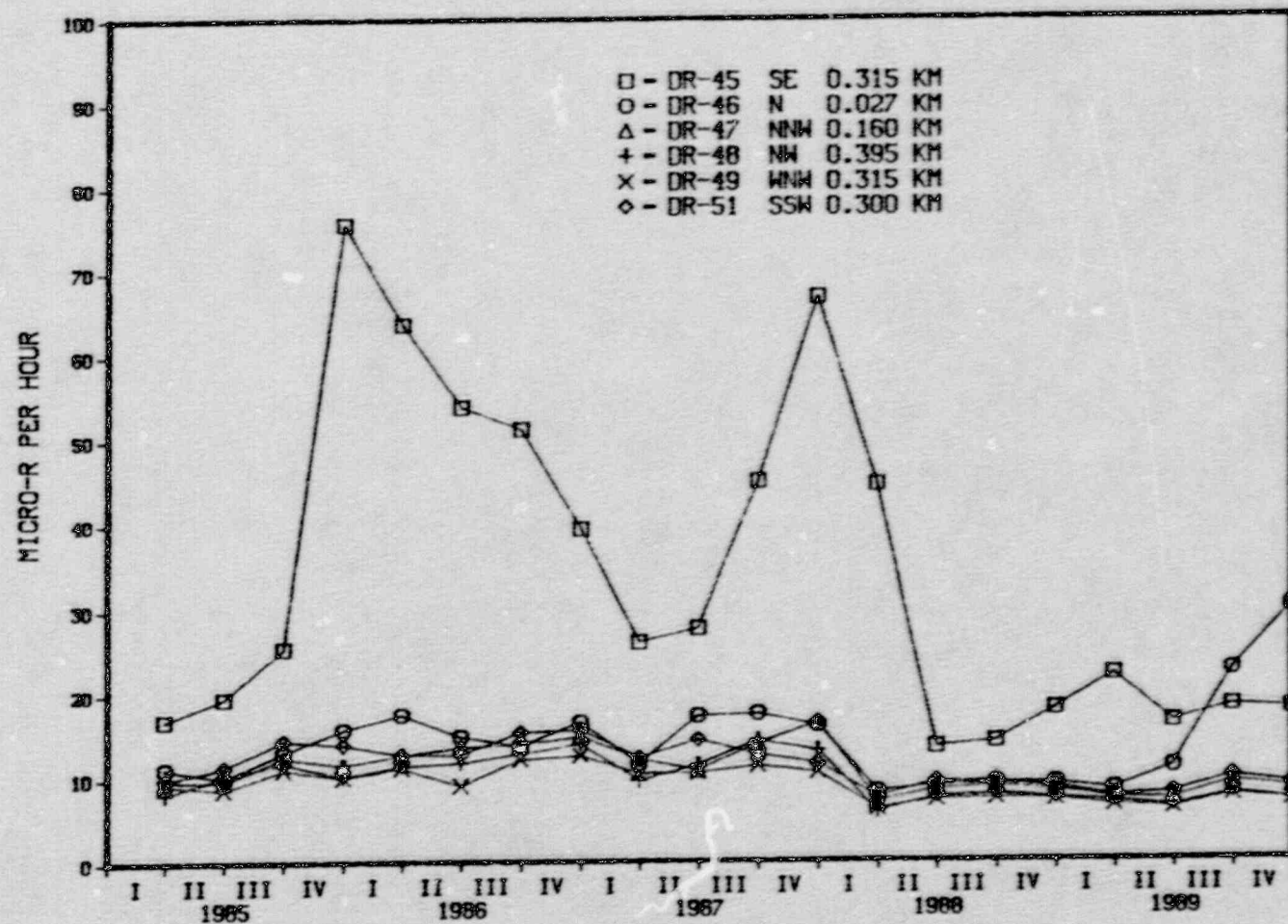




FIGURE 3.11  
EXPOSURE RATE AT INNER RING TLDS, DR 09-23 (ODD NUMBERS)  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

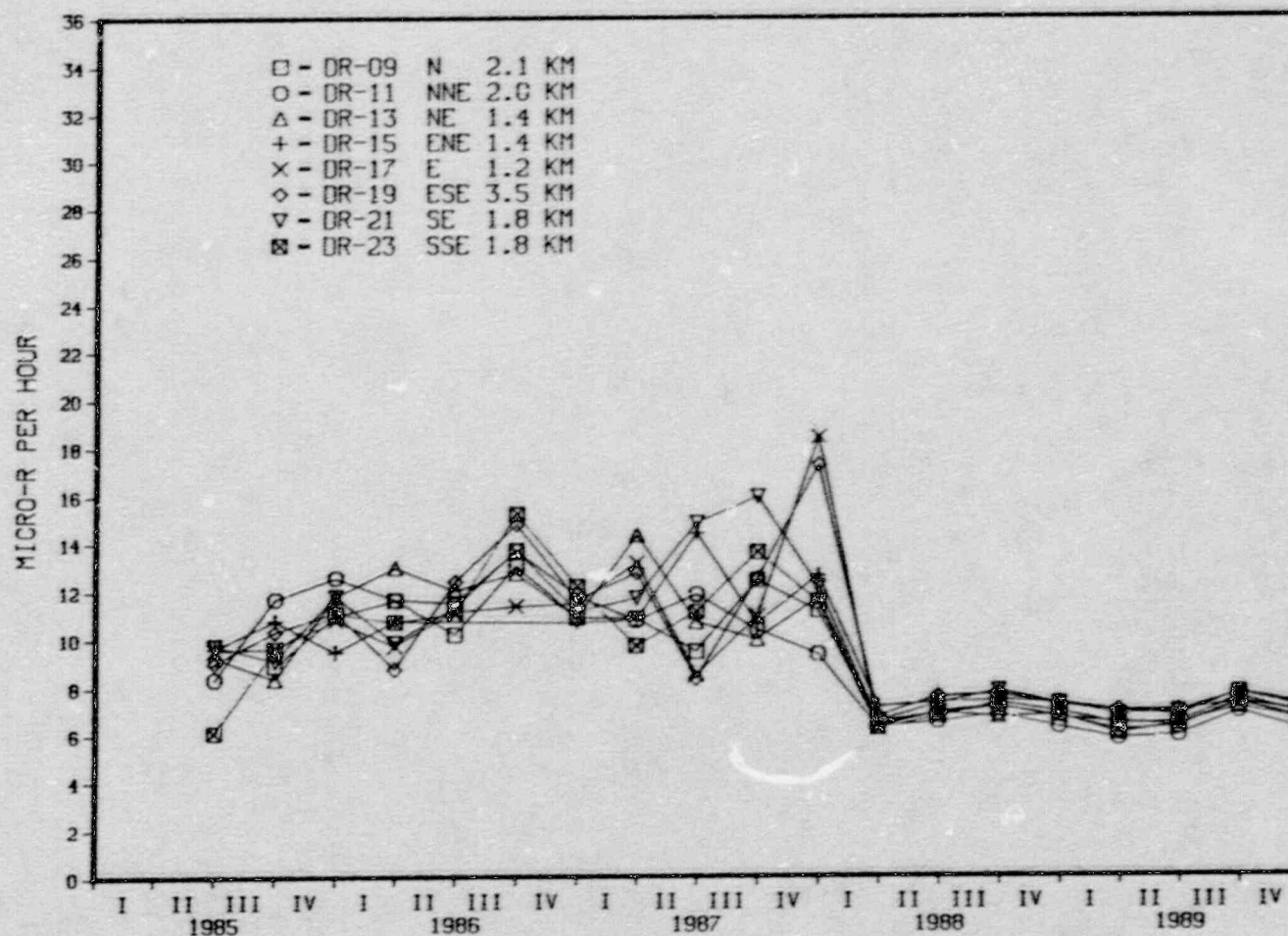


FIGURE 3.12  
EXPOSURE RATE AT INNER RING TLDs, DR 25-39 (ODD NUMBERS)  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

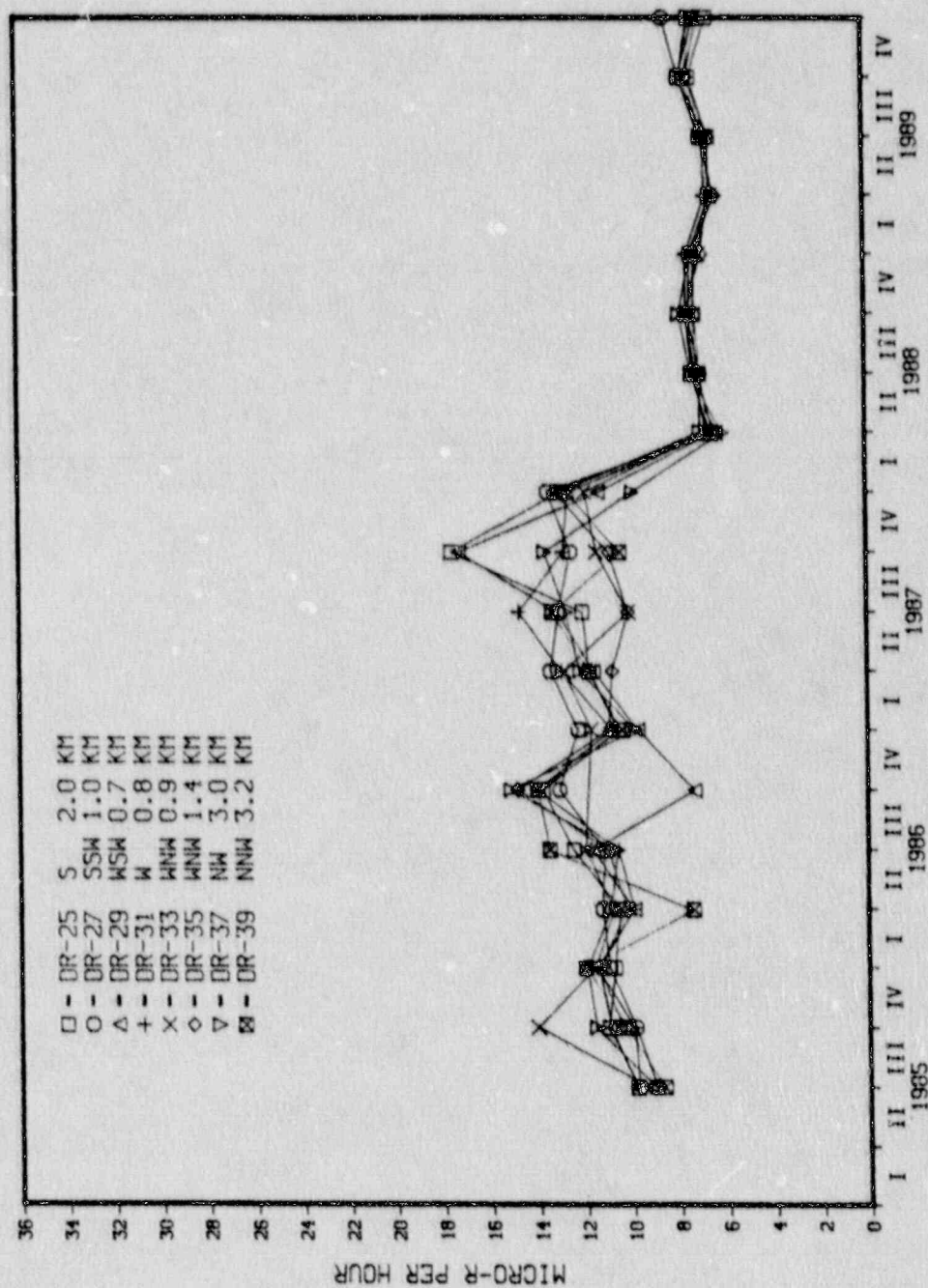


FIGURE 3.13  
EXPOSURE RATE AT OUTER RING TLDS, DR 10-24 (EVEN NUMBERS)  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

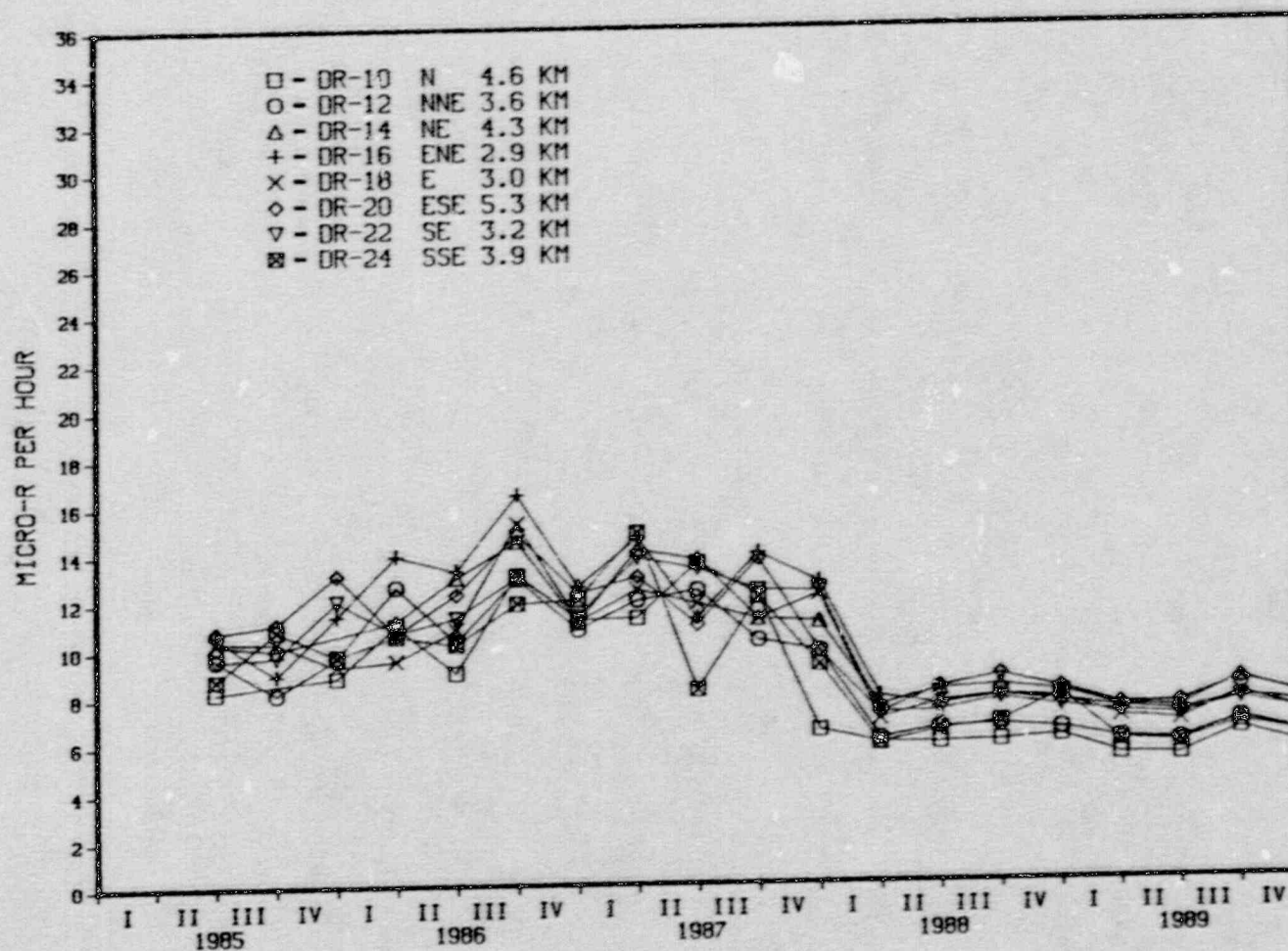




FIGURE 3.14  
EXPOSURE RATE AT OUTER RING TLDS, DR 26-40 (EVEN NUMBERS)  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT

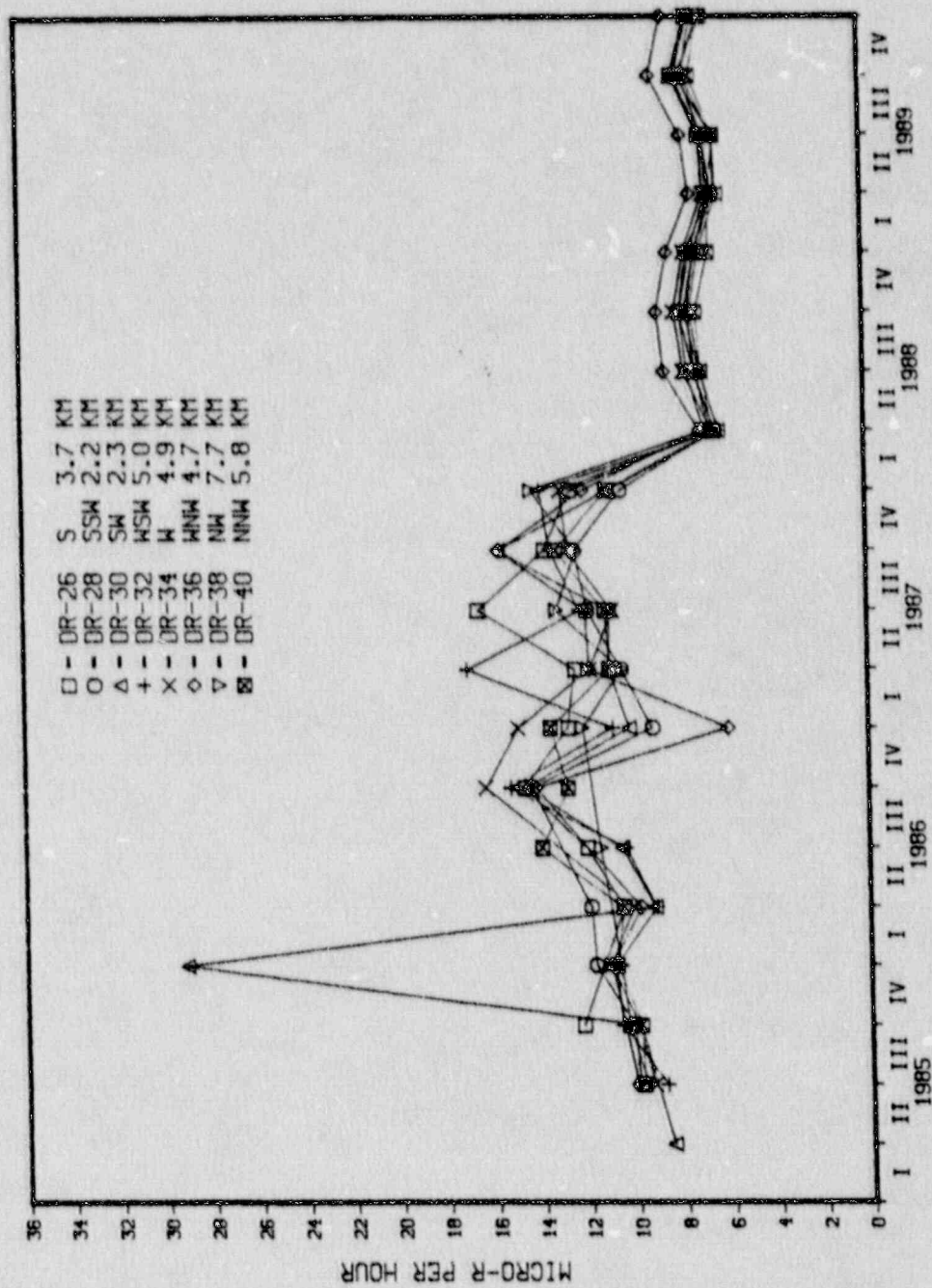
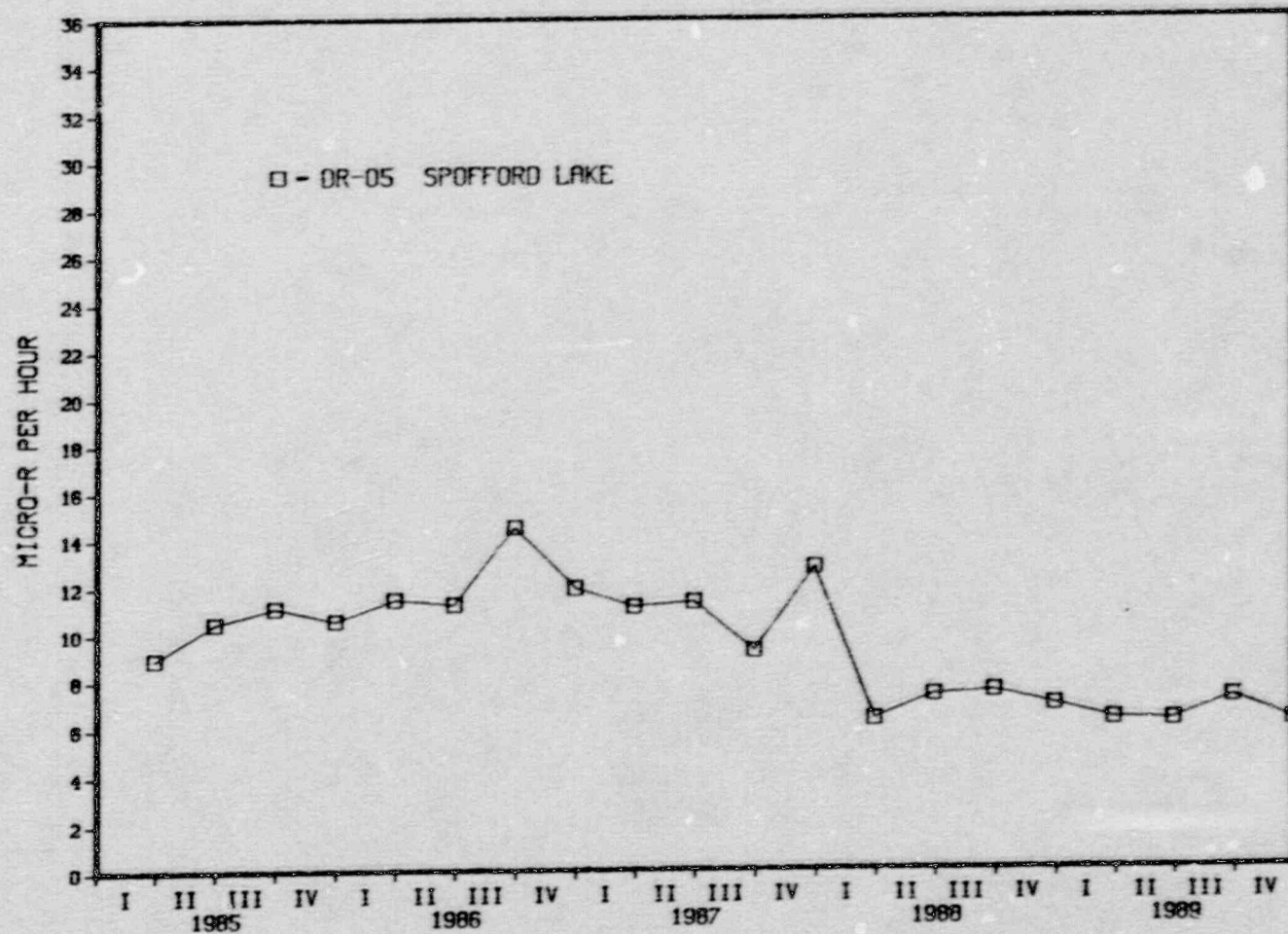


FIGURE 3.15  
EXPOSURE RATE AT CONTROL TLD DR-05  
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT



#### 4.0 QUALITY ASSURANCE PROGRAM

Three separate Quality Assurance programs were performed during 1989 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 program is maintained in which paired samples from five nuclear plants, including Vermont Yankee, are prepared from 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 1989 for intralaboratory analyses, and EPA interlaboratory cross-check analyses.

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 1989. One hundred and fifty-nine analyses were performed on air particulate filters, milk, and water. The sample analyses that did not meet the mean value criteria were a



Sr-89 and a Sr-90 analysis on a milk sample set. (Details of this may be found in References 1 and 2.) The mounted samples were reanalyzed for Sr-90, and the new mean values fell within the EPA control limits.

The above EPA Interlaboratory Comparison Program results are provided in compliance with Technical Specification 4.9.E.

#### Blind Duplicate Program

A total of 51 paired samples were submitted by the five participating plants for analysis during 1989. The data base used for the duplicate analyses 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  $\pm 15$  percent of their average value, then agreement between the measurements has been met. If the value falls outside of the  $\pm 15$  percent, then a two standard deviation range (95 percent confidence level) is established for each of the analyses. If the ranges overlap, agreement is obtained.

One thousand three hundred and fourteen paired duplicate measurements were analyzed for 1989. A total of 99.2 percent of all measurements fell within the established criteria discussed above. The eleven measurements that did not meet the criteria were measurements of Mo-99 in milk, Be-7 in milk, Np-239 in milk, Ba-140 in milk, Sr-89 in milk, Co-57 in milk, Ba-140 in groundwater, Co-60 in estuary water, Zn-65 in milk, Ce-144 in seawater, and Np-239 in estuary water. In all of the above cases, the radionuclide in question was not detected in the sample (i.e., the concentration was less than three standard deviations) and the three standard deviation ranges of the paired samples overlapped. The eleven duplicate measurements represent 0.8 percent of all the blind duplicate paired measurements made during 1989. No trend was evident with respect to reported failings of measurements for the above radionuclides.

Table 4.1

Intralaboratory and EPA Interlaboratory Results - 1989

<u>Total Number of Measurements</u>	<u>Accuracy</u>		
	<u>0 to 5%</u>	<u>0 to 10%</u>	<u>0 to 15%*</u>
717	448 (62.5%)	619 (86.3%)	689 (96.1%)
<u>Total Number of Measurements</u>	<u>Precision</u>		
	<u>0 to 5%</u>	<u>0 to 10%</u>	<u>0 to 15%*</u>
714	599 (83.9%)	675 (94.5%)	710 (99.4%)

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

## 5.0 LAND USE CENSUS

Vermont Yankee Technical Specification 3/4.9.D requires that a Land Use Census be conducted annually between June 1 and October 1 of each year. The census identifies the location of the nearest milk animal and the nearest residence in each of the 16 meteorological sectors within 5 miles of the plant. It also identifies the nearest milk animal (within 3 miles of the plant) to the point of predicted highest annual average D/Q value in each of the three major meteorological sectors due to elevated releases from the plant stack. Dosimetric analyses are then carried out to determine whether any identified milk animal represents a significantly better milk sampling location than those currently being used.

The 1989 Land Use Census at Vermont Yankee was carried out between the dates of June 1 and October 1, as required by Technical Specifications. The identified locations can be found in Table 5.1. As a result of the dosimetric comparisons and an assessment of sample availability at specific farms, one change was made in the milk sampling program. The goat location at F, 5.2 km was added to the program as TM-12 (as well as TC-12 for silage sampling). Due to limited sample availability at this location, the ODCM states that samples will be collected as available.



Table 5.1

1989 Land Use Census Results  
Vermont Yankee Nuclear Power Station

Sector	Nearest Residence (km)	Milk Animals*	
		km	Cow or Goat
N	1.6	**	--
NNE	1.6	**	--
NE	1.3	**	--
ENE	1.0	**	--
E	1.0	5.2	Goats
ESE	2.8	**	--
SE	1.8	3.4	Cows
SSE	2.0	5.1	Cows
S	0.5	**	--
SSW	0.5	2.1	Cows
SW	0.5	7.2	Cows
WSW	0.5	**	--
W	0.5	7.2	Goats
WNW	0.6	0.8	Cows
WNW	--	4.7	Cows
NW	1.2	**	--
NNW	2.1	**	--

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\* Identified in accordance with Technical Specification 3.9.D.1

\*\* No milk animals found within 5 miles.

## 6.0 SUMMARY

During 1989, samples collected as a part of the radiological environmental monitoring program at Vermont Yankee showed detectable levels of man-made radionuclides in cow milk, mixed vegetation, fish, and sediment. As reported in the past for sediment, low levels of Co-60 were detected in the immediate vicinity of the North Storm Drain Outfall. The radioactivity from this drain has been detected only at this location. In all other cases, the low levels detected were shown to originate from fallout from atmospheric nuclear weapons tests conducted during the 1970s and 1980, or from fallout from the Chernobyl nuclear plant accident in 1986. The radiological environmental monitoring program has therefore demonstrated that plant operations have had no significant radiological impact on the environment.

## 7.0 REFERENCES

1. Yankee Atomic Environmental Laboratory, Semi-Annual Quality Assurance Status Report, January to June 1989, Yankee Atomic Electric Company.
2. Yankee Atomic Environmental Laboratory, Semi-Annual Quality Assurance Status Report, July to December 1989, Yankee Atomic Electric Company.