YANKEE ATOMIC ELECTRIC COMPANY

Telephone (508) 721-7736
Facsimile (508) 721-7743

YANKEE

Suite 200, 19 Midstate Drive, Auburn, Massachusetts 01501

April 30, 2001
BYR 2001-041

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

References: (a) License No. DPR-3 (Docket No. 50-29)

Subject: 2000 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Enclosed is the 2000 Annual Radiological Environmental Operating Report. This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Yankee Atomic Electric Company (YAEC) in the vicinity of the Yankee Nuclear Power Station (YNPS) in Rowe, Massachusetts. This information is submitted in accordance with YNPS Defueled Technical Specification 6.8.2.a.

We trust this information is satisfactory; however, if you have any questions, please contact Mr. James A. Kay (978) 568-2302.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

J. A. Kay

James A. Kay
Manager of Regulatory affairs

Enclosure

c: J. Hickman, USNRC, Project Manager
R. B. Bellamy, USNRC, Region I

IE25

YANKEE NUCLEAR POWER STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

January - December 2000

April 2001

Prepared by:
Duke Engineering and Services
Radiological Engineering Group
Solomon Pond Park
400 Donald Lynch Boulevard
Marlborough, Massachusetts 01752

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF FIGURES
(Continued)

1. INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Yankee Atomic Electric Company in the vicinity of the Yankee Nuclear Power Station (YNPS) in Rowe, Massachusetts during the calendar year 2000. It is submitted annually in compliance with plant Technical Specification 6.8.2.a. and is organized as follows.

Section 2:	Provides an introductory explanation to the background radioactivity and radiation that is detected in the YNPS environs.
Section 3:	Provides a brief description of the YNPS site and its environs.
Section 4:	Provides a description of the overall REMP program design. Included is a summary of the Offsite Dose Calculation Manual (ODCM) Requirements for REMP sampling, tables listing all locations sampled or monitored in 2000, with compass sectors and distances from the plant, and maps showing each REMP location. Tables listing Lower Limit of Detection requirements and Reporting Levels are also included.
Section 5:	Consists of the summarized data as required by the ODCM. The tables are in the format specified by the NRC Branch Technical Position on Environmental Monitoring (Reference 1). Also included is a summary of environmental TLD measurements for 2000.
Section 6:	Provides the results of the 2000 monitoring program. The performance of the program in meeting regulatory requirements as given in the Technical Specifications and ODCM is discussed, and the data acquired during the year are analyzed.
Section 7:	Provides an overview of the Quality Assurance programs used at the Duke Engineering and Services Environmental Laboratory (DESEL). As required by the ODCM, the results of the Intercomparison Programs are given.
Section 8:	Summarizes the requirements and the results of the 2000 Land Use Census.
Section 9:	Gives an overall summary of the results of the 2000 Radiological Environmental Monitoring Program.

2. NATURALLY-OCCURRING AND MAN-MADE BACKGROUND RADIOACTIVITY

Radiation or radioactivity potentially detected in the YNPS environment can be grouped into three categories. The first is "naturally-occurring" radiation and radioactivity. The second is "man-made" radioactivity from sources other than YNPS. The third potential source of radioactivity is due to emissions from YNPS. For the purposes of the YNPS REMP, the first two categories are classified as "background" radiation, and are the subject of discussion in this section of the report. The third category, radioactivity from plant emissions, is the one that the REMP is primarily designed to detect and evaluate.

2.1 Naturally-occurring Background Radioactivity

Natural radiation and radioactivity in the environment, which provide the major source of human radiation exposure, may be subdivided into three separate sub-categories: "primordial radioactivity," "cosmogenic radioactivity," and "cosmic radiation." "Primordial radioactivity" is made up of those radionuclides that were created with the universe and that have a sufficiently long half-life to be still present on the earth. Included in this category are the radionuclides that these elements have decayed into. A few of the more important radionuclides in this category are Uranium-238 (U-238), Thorium-232 (Th-232), Potassium-40 (K-40), Radium-226 (Ra-226), and Radon-222 (Rn-222). Uranium-238 and Thorium-232 are readily detected in soil and rock, whether through direct field measurements or through laboratory analysis of samples. Radium-226 in the earth can find its way from the soil into ground water, and is often detectable there. Radon-222 is one of the components of natural background in the air we breath, and its daughter products are detectable on air sampling filters. Potassium-40 comprises about 0.01 percent of all natural potassium in the earth, and is consequently detectable in most biological substances, including the human body. There are many more primordial radionuclides found in the environment in addition to the major ones discussed above (Reference 2).

The second sub-category of naturally-occurring radiation and radioactivity is "cosmogenic radioactivity." This is produced through the nuclear interaction of high energy cosmic radiation with elements in the earth's atmosphere, and to a much lesser degree in the earth's crust. These radioactive elements are then incorporated into the entire geosphere and atmosphere, including the earth's soil, surface rock, biosphere, sediments, ocean floors, polar ice and atmosphere. The major radionuclides in this category are Carbon-14 (C-14), Hydrogen-3 (H-3 or Tritium), Sodium-22 (Na-22), and Beryllium-7 (Be-7). Beryllium-7 is the one most readily detected, and is found on air sampling filters and occasionally in biological media (Reference 2).

The third sub-category of naturally-occurring radiation and radioactivity is "cosmic radiation." This consists of high energy atomic and sub-atomic particles of extra-terrestrial origin and the secondary particles and radiation that are produced through their interaction in the earth's

atmosphere. The primary radiation comes mostly from outside of our solar system, and to a lesser degree from the sun. We are protected from most of this radiation by the earth's atmosphere, which absorbs the radiation. Consequently, one can see that with increasing elevation one would be exposed to more cosmic radiation as a direct result of a thinner layer of air for protection. This "direct radiation" is best detected in the field with high pressure ion chambers.

2.2 Man-Made Background Radioactivity

The second source of "background" radioactivity in the YNPS environment is from "man-made" sources not related to the power plant. The most recent contributor to this category was the fallout from the Chernobyl accident in April of 1986, which was detected in the YNPS environment and other parts of the world. A much greater contributor to this category, however, has been fallout from atmospheric nuclear weapons tests. Tests were conducted from 1945 through 1980 by the United States, the Soviet Union, the United Kingdom, China and France, with the large majority of testing occurring during the periods 1954-1958 and 1961-1962. A test ban treaty was signed in 1963 by the United States, Soviet Union and United Kingdom, but not by France and China. Atmospheric testing, was conducted by the People's Republic of China last in October 1980. Much of the fallout detected today is due to this explosion and the last large scale one, done in November of 1976 (Reference 3).

The radioactivity produced by these detonations was deposited worldwide. The amount of fallout deposited in any given area is dependent on many factors, such as the explosive yield of the device, the latitude and altitude of the detonation, the season in which it occurred, and the timing of subsequent rainfall which washes fallout from the troposphere (Reference 4). Most of this fallout has decayed into stable elements, but the residual radioactivity is still readily detectable in environmental samples worldwide. The two predominant radionuclides are Cesium-137 (Cs-137) and Strontium-90 (Sr-90). They are found in soil and in vegetation, and since cows and goats graze large areas of vegetation, these radionuclides are also readily detected in milk.

Other potential "man-made" sources of environmental "background" radioactivity include other nuclear power plants, coal-fired power plants, national defense installations, hospitals, research laboratories and industry. These collectively are insignificant on a global scale when compared to the sources discussed above (natural and fallout).

3. GENERAL PLANT AND SITE INFORMATION

The Yankee Nuclear Power Station (YNPS) is located on a 2200 acre site in a predominantly rural area of northwestern Massachusetts, three-quarters of a mile south of the Vermont border. The plant resides in the town of Rowe, Massachusetts, approximately 9 air miles east-northeast of North Adams, Massachusetts. The surrounding area is heavily forested and lightly populated. Hills bounding the river valley rise 500 to 1000 feet above the site, reaching elevations of 2100 feet.

The Deerfield River is used extensively for hydroelectric power generation both upstream and downstream of YNPS. Sherman Dam, immediately adjacent to YNPS, operates as a hydroelectric generating station. Sherman Pond, the impoundment behind this dam, has been used as a source of cooling water for YNPS.

YNPS was voluntarily shut down on October 1, 1991 and ceased power operation on February 26, 1992 after 32 years of operation. The plant is involved in the process of decommissioning which involves the disassembly and removal of the plant components and structures. This process is taking place in strict conformance with USNRC regulations. Oversight will also continue from the U.S. Environmental Protection Agency, the Massachusetts Department of Environmental Protection, Massachusetts Department of Public Health, and Massachusetts Emergency Management Administration.

The radiological environmental monitoring program for YNPS continued during 2000 at a reduced scale subsequent to an ODCM change made to reflect the change in the physical configurations at the plant and the removal of radionuclide source terms and production. The radiological environmental monitoring program will continue throughout the decommissioning period.

4. PROGRAM DESIGN

The Radiological Environmental Monitoring Program for the YNPS was designed with specific objectives in mind. These were:

- To provide an early indication of the appearance or accumulation of any radioactive material in the environment caused by YNPS activities.

- To provide assurance to regulatory agencies and the public that the environmental impact from YNPS 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.

These objectives will continue to be in force, to varying degrees, throughout decommissioning activities at the YNPS site. Due to the shutdown status of the plant and due to the relatively low quantities of radioactive material now on the site, some of the objectives have a different degree of importance than in the past.

The radiological environmental monitoring program was initiated in 1958, approximately two years before the plant began operation in 1960. It has been in operation continuously since that time, with improvements made periodically over those years. The program continued without modification following the shutdown of the plant in 1991 and was reduced in scope beginning in 1997 primarily to reflect the absence of short lived radionuclides in various pathways resulting from the plant shutdown (no source of production) and the individual radionuclides short half-life (long decay time since the shutdown).

The program was designed to meet the intent of NRC Regulatory Guide 4.1, *Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants*; NRC Regulatory Guide 4.8, *Environmental Technical Specifications for Nuclear Power Plants*; the NRC Branch Technical Position of November 1979 entitled, *An Acceptable Radiological Environmental Monitoring Program*; and NRC NUREG-0472, *Radiological Effluent Technical Specifications for PWR's*.

The environmental TLD program was designed and tested around NRC Regulatory Guide 4.13, *Performance, Testing and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications*. The quality assurance program was designed around the guidance given in NRC Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment*.

Prior to August 1992, the requirements for the Radiological Environmental Monitoring Program (REMP) were given in the YNPS Technical Specifications. In August 1992, the REMP requirements were removed from the Technical Specifications and placed in the Offsite Dose Calculation Manual (ODCM) (Reference 5) pursuant to NRC Generic Letter 89-01 (Reference 6). ODCM controls are cited in this report when specific REMP requirements are discussed.

The sampling requirements of the REMP are given in Table 4.1 of the ODCM and in Table 4.1 of this report. The identification of the required sampling locations is given in Table 4.4 of the ODCM and in Tables 4.2 and 4.3 of this report. The sampling and monitoring locations are shown graphically on the maps in Figures 4.1 through 4.7.

4.1 Monitoring Zones

The REMP is designed to allow comparison of levels of radioactivity in samples from the area possibly influenced by the plant to levels found in areas not influenced by the plant. The first area is called Zone 1, and its monitoring locations are called "indicators." The second area is called Zone 2, and its monitoring locations are called "controls." The distinction between the two zones, depending on the type of sample or sample pathway, is based on one or more of several factors, such as site meteorological history, meteorological dispersion calculations, relative direction from the plant, river flow, and distance. Analysis of survey data from the two zones aids in determining if there is a significant difference between the two areas. It can also help in differentiating between radioactivity or radiation due to plant activities and that due to other fluctuations in the environment, such as atmospheric nuclear weapons test fallout or seasonal variations in the natural background.

4.2 Pathways Monitored

Four pathway categories are monitored by the REMP. They are the direct radiation, airborne, waterborne, and ingestion pathways. Each of these four categories is monitored by the collection of one or more sample media, which are listed below, and are described in more detail in this section:

Airborne Pathway
- Air Particulate Sampling

Waterborne Pathways
- River Water Sampling
- Ground Water Sampling
- Storm Drain Water Sampling
- Sediment Sampling

Ingestion Pathways
- Milk Sampling
- Fish Sampling
- Food Product and Maple Syrup Sampling

Direct Radiation Pathway
- TLD Monitoring

4.3 Descriptions of Monitoring Programs

4.3.1 Air Sampling

Continuous air samplers are installed at six locations, five of which are required by the YNPS ODCM. The sampling pumps at these locations operate continuously at a flow rate of approximately one cubic foot per minute. Airborne particulates are collected by passing air through a 47 mm glass-fiber filter. A dry gas meter is incorporated into the sampling stream to measure the total volume of air sampled in a given interval. The entire system is housed in a weatherproof structure. The filters are collected biweekly, and to allow for the decay of radon daughter products, they are held for at least 100 hours at the DESEL before being analyzed for gross-beta radioactivity (indicated as GR-B in the data tables). The biweekly filters are composited by location at the DESEL for a quarterly gamma spectroscopy analysis.

4.3.2 River Water Sampling

An automatic compositing sampler is located at one downstream sampling location. The sampler is controlled by timers that collect an aliquot of river water at least every two hours over a period of one month. Grab samples are collected monthly at Sherman Pond and at one upstream location. All river water samples are preserved with HCl and $NaHSO_3$, or HNO_3, to prevent the plate out of potentially present radionuclides on the container walls. Each sample is analyzed for gross-beta and gamma-emitting radionuclides. The monthly samples are composited quarterly by location at the DESEL for a H-3 analysis. The monthly H-3 samples are also analyzed as a non ODCM requirement.

4.3.3 Ground Water Sampling

Grab samples are collected monthly from two on-site locations. The ODCM requires samples to be collected at least once per quarter. All ground water samples are preserved with HCl and $NaHSO_3$ or HNO_3 to prevent the plate out of potentially-present radionuclides on the container walls. Each sample is required by the ODCM to be analyzed for gamma-emitting radionuclides and H-3. Samples are also analyzed for gross beta activity, which is not an ODCM requirement.

4.3.4 Storm Drain Water Sampling

Grab samples are collected monthly from the East and West Storm Drain. These are not ODCM required sampling locations. This water is comprised of a network of storm drains connected to parking areas, associated facility, and administration building, as well as groundwater and precipitation (including snowmelt) draining from the east side and west side of the plant facility. Neither storm drain network is directly connected to any plant operation. All storm drain water samples are preserved with HCl and $NaHSO_3$, or HNO_3, to prevent the plate out of potentially present radionuclides on the container walls. Each sample is analyzed for gross-beta and gamma-emitting radionuclides and H-3.

4.3.5 Sediment Sampling

Shoreline sediment cores are collected semiannually from two locations, one upstream and one downstream of the plant. At each location, six two-inch inner diameter plastic coring tubes are driven into the sediment at least six inches deep. The cores are carefully extracted and kept in an upright position and frozen prior to delivery to the DESEL. At the DESEL, the frozen cores are cut into 5 cm (two-inch) segments. For each location, the 0-5 cm segments are blended into a single sample, as are the 5-10 cm and 10-15 cm segments. These composite samples are then analyzed for gamma-emitting radionuclides.

An additional bottom sediment core is collected semiannually in Sherman Pond near the plant discharge. A Wildco K. B. Core Sampler, fitted with a plastic coring tube, is dropped from a boat. Six cores are collected here, and are processed and analyzed as described above.

4.3.6 Milk Sampling

Milk samples are collected monthly from one control location. Immediately after collection, the milk sample is preserved with an appropriate amount of formaldehyde. The sample is analyzed for gamma-emitting radionuclides. Although not required by the ODCM, Sr-89 and Sr-90 analyses are also performed on quarterly composite samples.

4.3.7 Fish Sampling

Fish samples are collected semiannually at two locations (upstream of the plant and in Sherman Pond). A gill net is set overnight from a boat, and mixed species of fish are removed the following day. The species typically collected are yellow perch, smelt, pickerel, trout, bullheads or suckers. The fish samples are frozen and delivered to the DESEL where the edible portions are analyzed for gamma-emitting radionuclides.

4.3.8 Food Product Sampling

Food products are collected annually (at harvest) at three locations. The samples are either tuberous vegetables, above-ground vegetables, or fruit. Two indicator locations are chosen as a result of the annual Land Use Census, based on meteorological dispersion calculations. The third location is a control, which is located sufficiently far away from the plant to be outside any potential influence from it. The edible portions of the samples are then analyzed at the DESEL for gamma-emitting radionuclides.

4.3.9 Maple Syrup Sampling

Maple syrup is an important commercial product in northern New England, including the YNPS plant environs. Consequently, samples are collected annually from two or three locations although there is no ODCM requirement. These samples are collected from the syrup manufacturer as a finished product, that is, following the boiling down of the maple sap. Since the samples have already been boiled down as part of the syrup production process, no preservatives are needed in the samples. Following collection, the samples are analyzed at the DESEL for gamma-emitting radionuclides. It should be noted that because of the boiling down and filtering of the sap, the resulting radionuclide measurements do not represent actual environmental concentrations. It is estimated that the resulting syrup has been concentrated by a factor of from 15 to 120 times the original sap, depending mostly on the time of the season that the sap was collected.

4.3.10 TLD Monitoring

Direct gamma radiation exposure was continuously monitored with the use of thermoluminescent dosimeters (TLDs). Specifically, Panasonic UD-801AS1 and UD-814AS1 calcium sulfate dosimeters were used, with a total of five elements in place at each monitoring location. Each pair of dosimeters is sealed in a plastic bag, which is in turn housed in a plastic-screened container. This container is attached to an object such as a tree, fence or utility pole. TLDs are posted at 33 locations, with 24 of these stations required by the ODCM. All the TLDs are read out quarterly. The plant staff posts and retrieves all TLDs, while the DESEL processes them.

TABLE 4.1

Radiological Environmental Monitoring Program
(as required by ODCM Table 4.1)

Exposure Pathway And/or Sample Media	Collection			Analysis	
	Number of Sample Locations	Routine Sampling Mode	Collection Frequency	Analysis Type	Analysis Frequency
1. Direct Radiation (TLDs)	24*	Continuous	Quarterly	Gamma Dose	Each TLD
2. Airborne: Particulates	5	Continuous	Once per two weeks	Gross Beta Gamma Isotopic	Each Sample Quarterly Composite by Location
3. Waterborne					
a. Surface Water	2	Composite at two hour intervals- Downstream	Monthly	Gross Beta Gamma Isotopic Tritium (H-3)	Each Sample Each Sample Quarterly Composite
		Grab -Upstream	Monthly		
b. Ground Water	2	Grab	Quarterly	Gamma Isotopic Tritium (H-3)	Each Sample Each Sample
c. Shoreline Sediment	1	Grab	Semiannually	Gamma Isotopic	Each Sample

* Does not include General Site Area and Owner Controlled Area fence locations.

TABLE 4.1
(Continued)

Radiological Environmental Monitoring Program
(As required by ODCM Table 4.1)

Exposure Pathway And/or Sample Media	Collection			Analysis	
	Nominal Number of Sample Locations	Routine Sampling Mode	Nominal Collection Frequency	Analysis Type	Analysis Frequency
4. Ingestion					
a. Milk	1*	Grab	Monthly	Gamma Isotopic	Each sample
b. Fish	2	Grab	Semiannually (or seasonal if appropriate)	Gamma Isotopic on edible portions	Each sample
c. Food Products					
Tuberous or above ground vegetables, or fruit	3	Grab	At harvest	Gamma Isotopic on edible portion	Each sample

* See Table 4.1 in ODCM.

TABLE 4.2

Radiological Environmental Monitoring Locations (non-TLD) in 2000
Yankee Nuclear Power Station

Exposure Pathway	Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
1. Airborne					
	AP-11	Observation Stand	1	0.5	NW
	AP-12	Monroe Bridge	1	1.1	SW
	AP-13	Rowe School	1	4.2	SE
	AP-14	Harriman Station	1	3.2	N
	AP-21	Williamstown, MA	2	22.2	W
	AP-31	YAEC Visitor's Center	1	0.8	SW
2. Waterborne					
a. Surface					
	WR-11	Bear Swamp Lower	1	6.3	Down-river
	WR-21	Harriman Reservoir	2	10.1	Up-river
	WR-31	Sherman Pond	1	0.1	N
b. Ground					
	WG-11	Plant Potable	1	On-site	--
	WG-12	Sherman Spring	1	0.2	NW
c. Storm Drain					
	WW-51	East Storm Drain	1	On-site	--
	WW-52	West Storm Drain	1	On-site	--
d. Sediment					
	SE-11	No. 4 Station	1	36.2	Down-river
	SE-21	Harriman Reservoir	2	10.1	Up-river
	SE-91	Sherman Pond	1	0.1	N
3. Ingestion					
a. Milk					
	TM-21*	Williamstown, MA	2	21	WSW
b. Fish					
	FH-11	Sherman Pond	1	1.5	Near Discharge
	FH-21	Harriman Reservoir	2	10.1	Up-river

* No sampling location is available within five miles.

TABLE 4.2
(Continued)

Radiological Environmental Monitoring Locations (non-TLD) in 2000
Yankee Nuclear Power Station

Exposure Pathway	Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
Food Products					
	TF-11	Monroe Bridge, MA	1	1.3	SW
	TF-13	Monroe, MA	1	1.9	WNW
	TF-21	Williamstown, MA	2	21.0	WSW
	MS-33 (Maple Syrup)	Rowe, MA	1	1.0	S
	MS-45 (Maple Syrup)	Florida, MA	2	10.5	WSW

TABLE 4.3

Radiological Environmental Monitoring Locations (TLD) in 2000
Yankee Nuclear Power Station

Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
GM-1	YAEC Visitors' Center	1	0.8	SW
GM-2	Observation Stand	1	0.5	NW
GM-3	Rowe School	1	4.2	SE
GM-4	Harriman Station	1	3.2	N
GM-5	Monroe Bridge	1	1.1	SW
GM-6	Readsboro Road Barrier	1	1.3	N
GM-7	Whitingham Line	1	3.5	NE
GM-8	Monroe Hill Barrier	1	1.8	S
GM-9	Dunbar Brook	1	3.2	SW
GM-10	Cross Road	1	3.5	E
GM-11	Adams High Line	1	2.1	WNW
GM-12	Readsboro, VT	1	5.5	NNW
GM-13	Restricted Area Fence	F	0.08	WSW
GM-14	Restricted Area Fence	F	0.11	WNW
GM-15	Restricted Area Fence	F	0.08	NNW
GM-16	Restricted Area Fence	F	0.13	NNE
GM-17	Restricted Area Fence	F	0.14	ENE
GM-18	Restricted Area Fence	F	0.14	ESE
GM-19	Restricted Area Fence	F	0.16	SE
GM-20	Restricted Area Fence	F	0.16	SSE
GM-21	Restricted Area Fence	F	0.11	SSW
GM-22	Heartwellville, VT	2	12.6	NNW
GM-23	Williamstown Substation	2	22.2	W
GM-25	Whitingham, VT	O	7.7	NNE
GM-27	Number 9 Road	O	7.6	ENE
GM-29	Route 8A	O	8.2	ESE

TABLE 4.3
(Continued)

Radiological Environmental Monitoring Locations (TLD) in 2000
Yankee Nuclear Power Station

Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
GM-31	Legate Hill Road	O	7.6	SSE
GM-32	Rowe Road	O	7.9	S
GM-33	Zoar Road	O	6.9	SSW
GM-35	Whitcomb Summit	O	8.6	WSW
GM-36	Tilda Road	O	6.6	W
GM-38	West Hill Road	O	6.6	NW
GM-40	Readsboro Road	1	0.5	W

* 1 = Indicator TLD; 2 = Control TLD; O = Outer Ring TLD; F = Fenceline TLD.

TABLE 4.4

Environmental Lower Limit of Detection (LLD) Sensitivity Requirements

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m^3)	Fish (pCi/kg) (wet)	Milk (pCi/l)	Food Product (pCi/kg) (wet)	Sediment (pCi/kg - dry)
Gross-Beta	4	0.01				
H-3	2000					
Mn-54	15		130			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180

Additional explanatory footnotes are given in ODCM Table 4.3.

TABLE 4.5

Reporting Levels for Radioactivity Concentrations
In Environmental Samples

Analysis	Water (pCi/l)*	Airborne Particulates or Gases (pCi/m^3)	Fish (pCi/kg)	Milk (pCi/l)	Food Product (pCi/kg) (wet)
H-3	30000				
Mn-54	1000		30000		
Co-58	1000		30000		
Co-60	300		10000		
Zn-65	300		20000		
Zr-Nb-95	400				
Cs-134	30	10	1000	60	1000
Cs-137	50	20	2000	70	2000

* Reporting Level for non-drinking water pathways.

Figure 4.1 Radiological Environmental Sampling Locations Within 1 Mile of YNPS

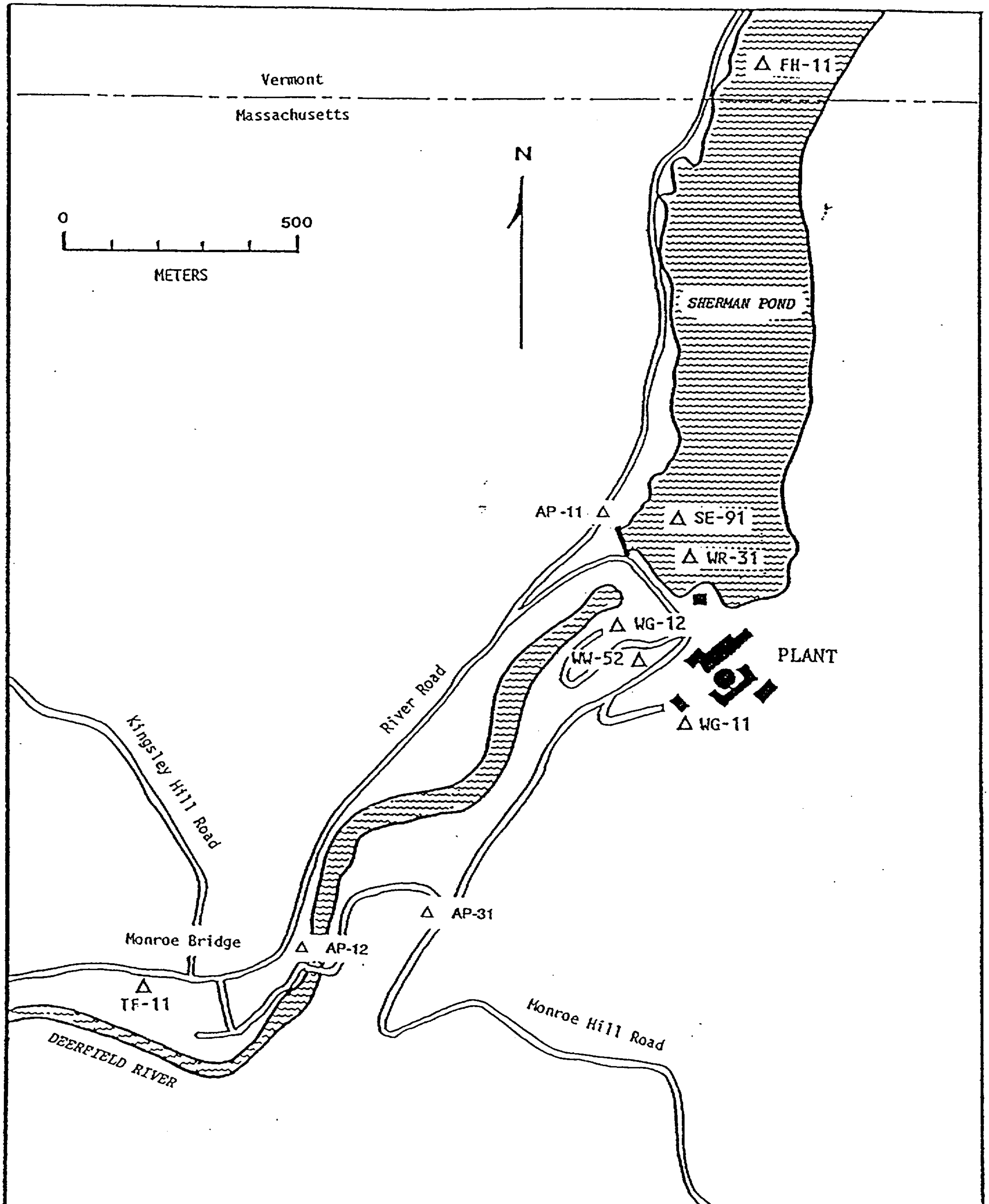


Figure 4.2 Radiological Environmental Sampling Locations Within 12 Miles of YNPS

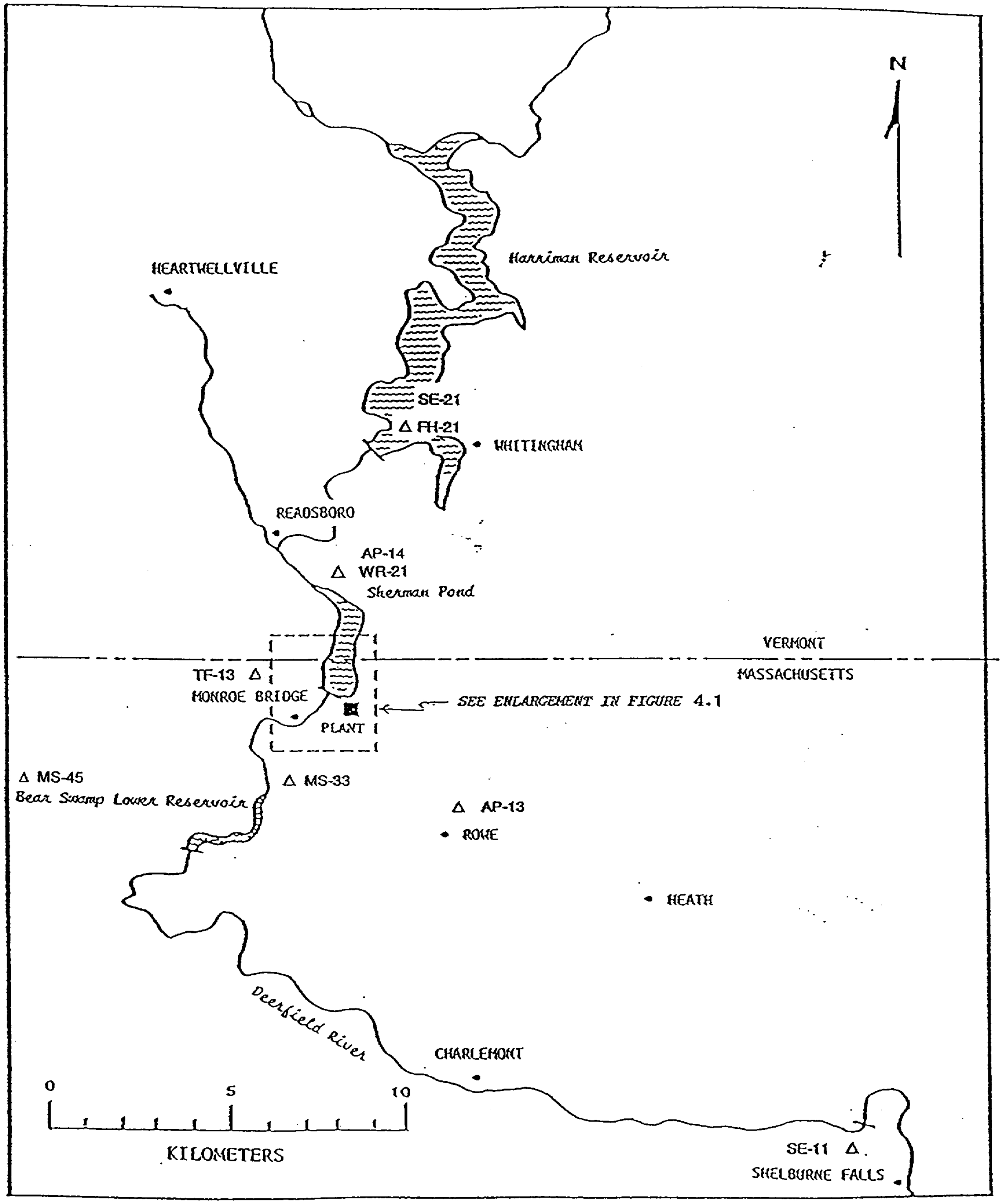


Figure 4.3 Radiological Environmental Sampling Locations Outside 12 Miles of YNPS

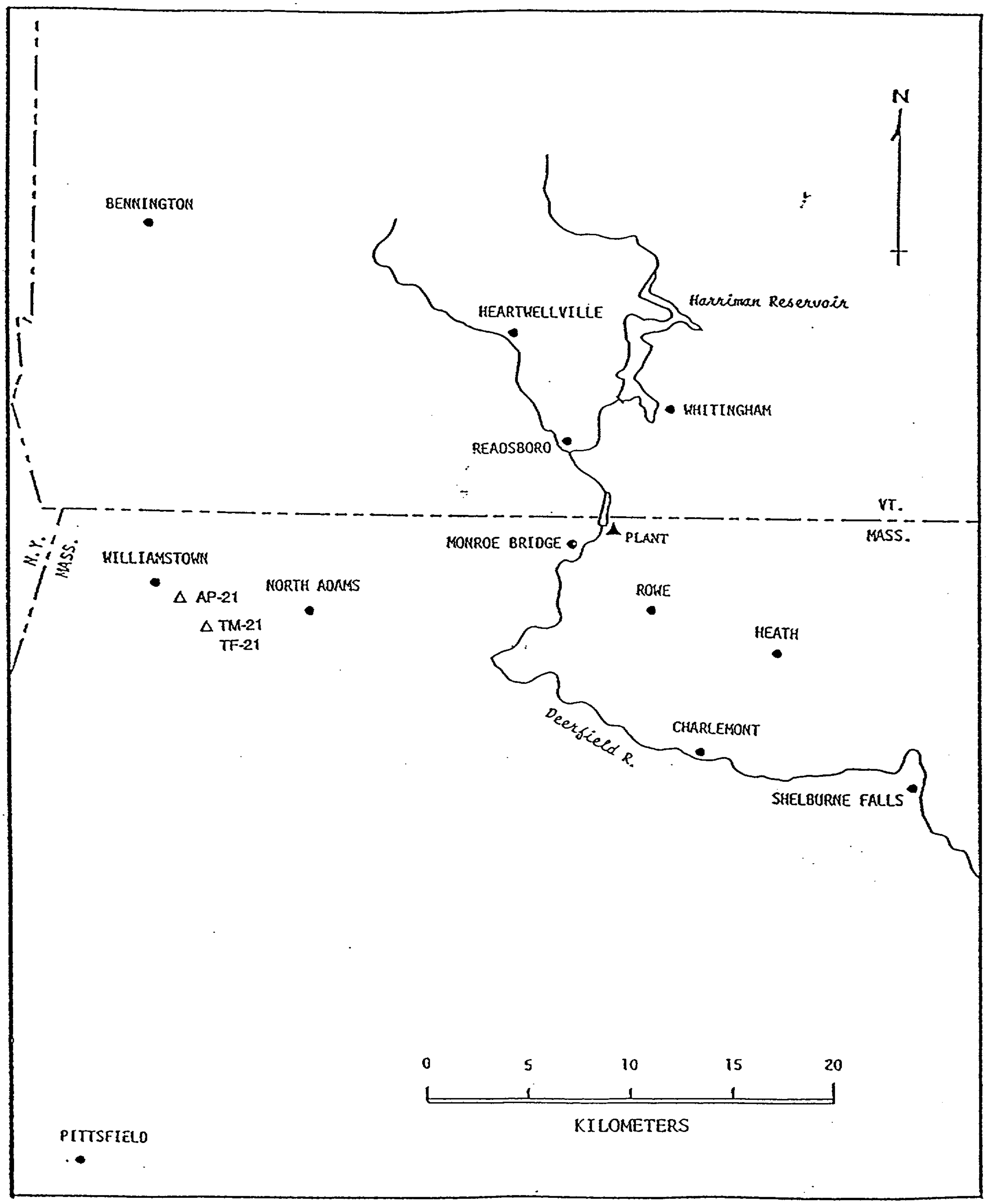


Figure 4.4 Environmental TLD Monitoring Locations at the YNPS Restricted Area Fence

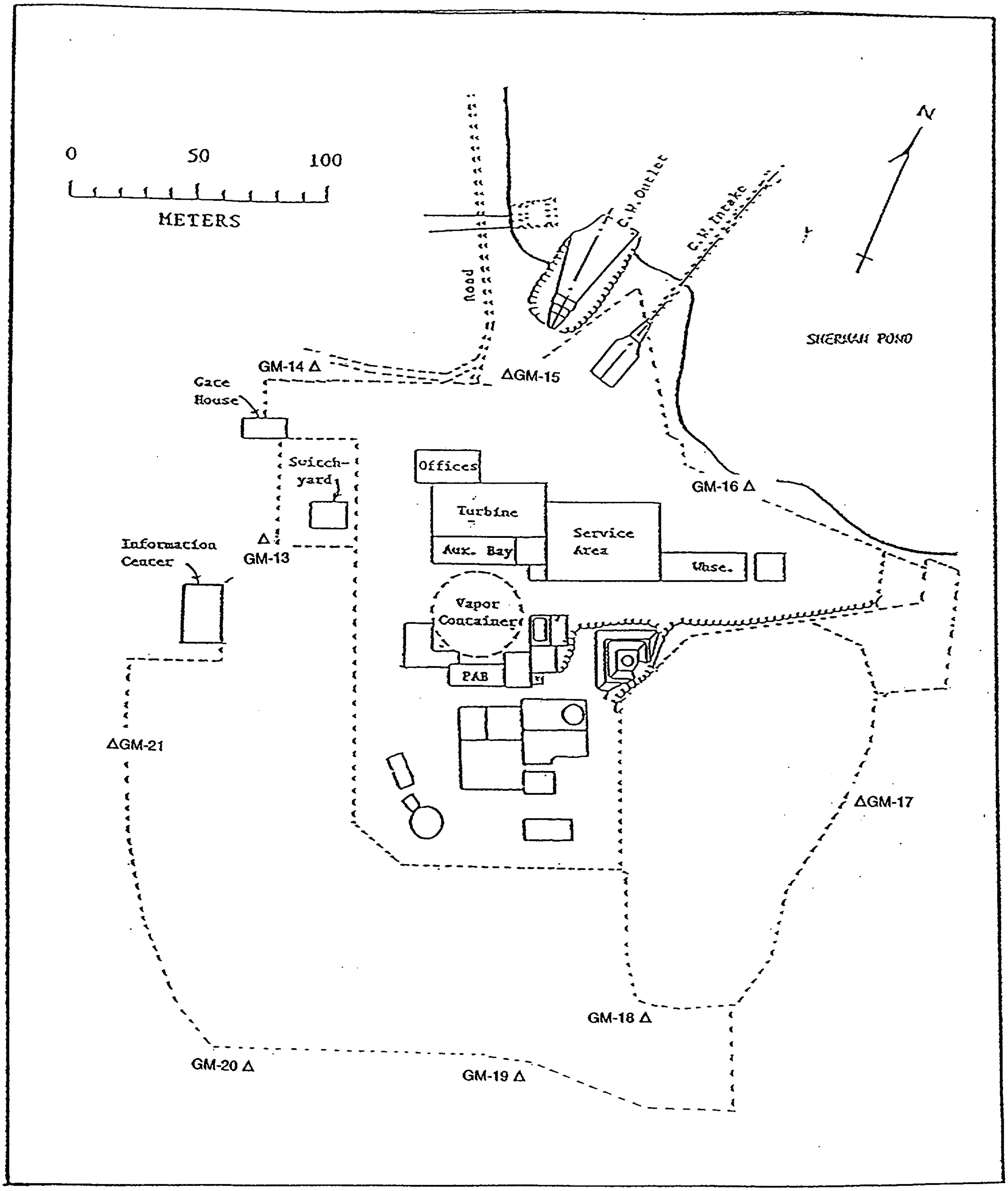


Figure 4.5 Environmental TLD Monitoring Locations Within 1 Mile of YNPS

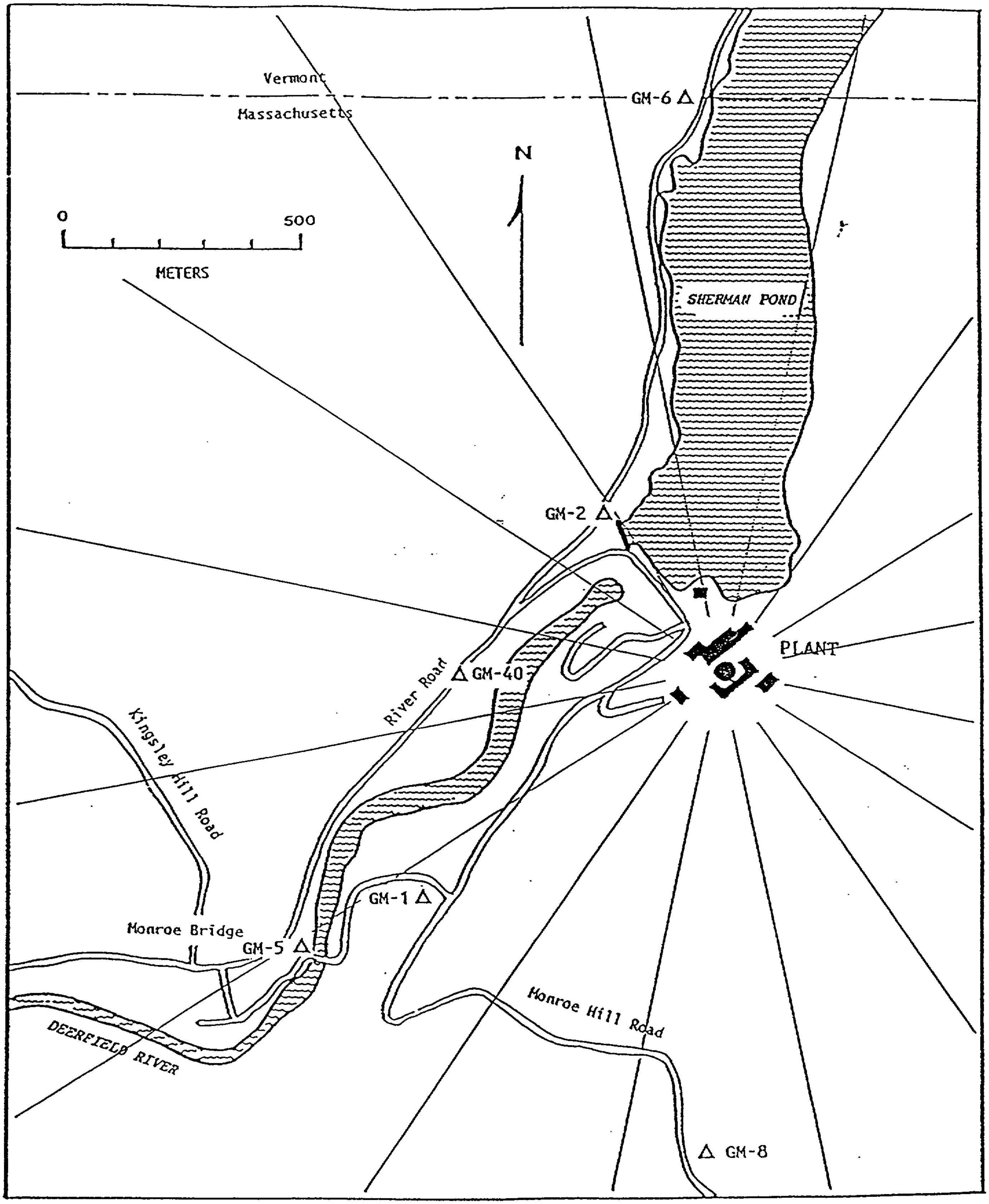


Figure 4.6 Environmental TLD Monitoring Locations Within 12 Miles of YNPS

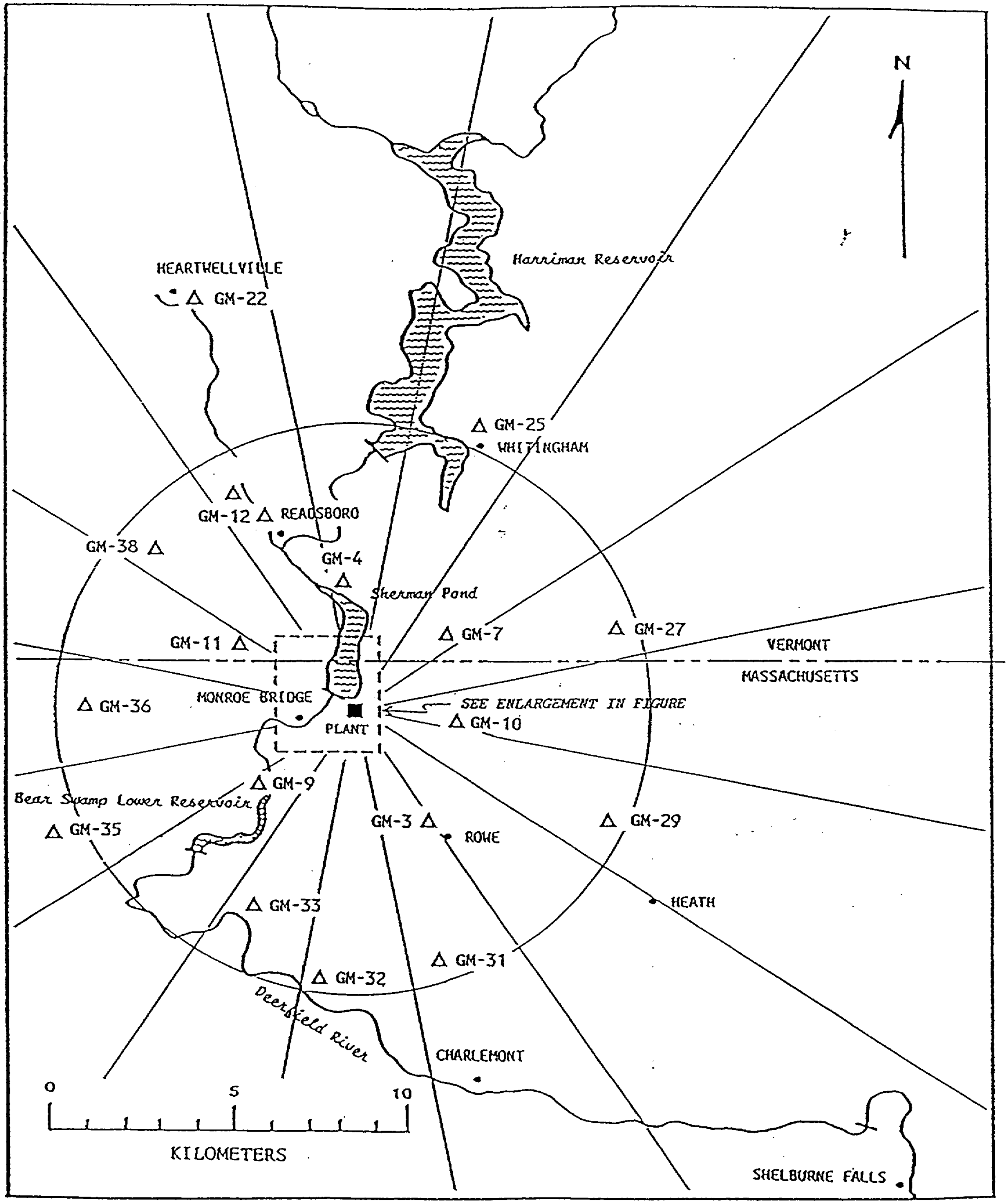
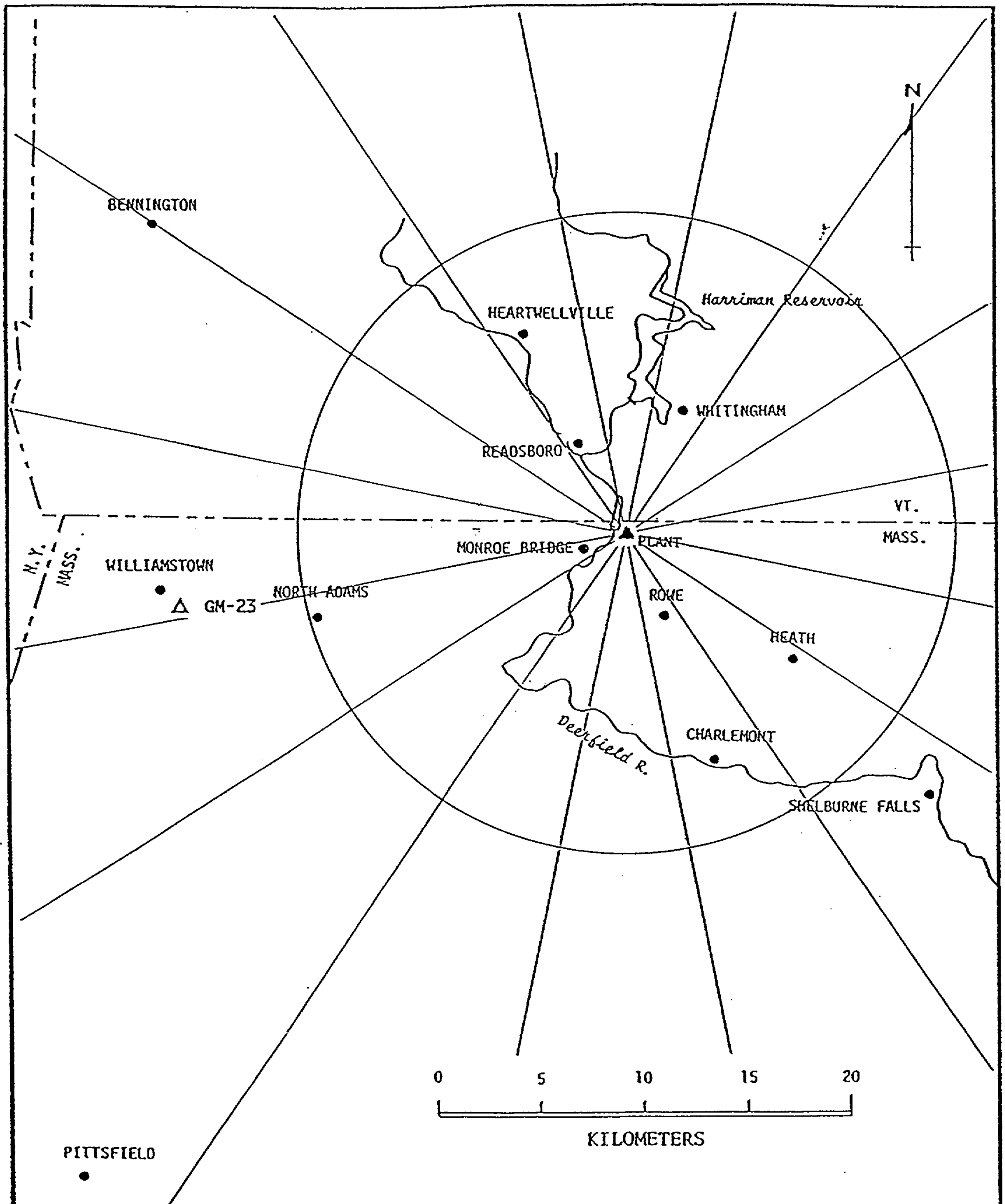


Figure 4.7 Environmental TLD Monitoring Locations Outside of 12 Miles from YNPS



5. RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples that were collected during 2000. These results, shown in Table 5.1, are presented in a format similar to that prescribed in the NRC's Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1). The results are ordered by sample media type and then by radionuclide for the pathways described in Section 4.2 and 4.3. The units for each media type are also given. Table 5.2 provides the same information for TLD direct radiation measurements.

The left-most column contains the radionuclide of interest, the total number of analyses for that radionuclide in 2000, and the number of measurements which exceeded the Reporting Levels found in Table 4.2 of the YNPS ODCM. The latter are classified as "Non-routine" measurements. The second column lists the required Lower Limit of Detection (LLD) for those radionuclides, which have detection capability requirements as specified in the ODCM Table 4.3. The absence of a value in this column indicates that no LLD is specified in the ODCM for that radionuclide in that media. The target LLD for any analysis is typically 30-40 percent of the most restrictive required LLD. Occasionally the required LLD is not met. This is usually due to malfunctions in sampling equipment, which result in low sample volume. Such cases are addressed in Section 6.2.

For each radionuclide and media type, the remaining three columns summarize the data for the following categories of monitoring locations: (1) the Indicator or Zone 1 stations, which are within the range of influence of the plant and which could conceivably be affected by plant activities; (2) the station which had the highest mean concentration during 2000 for that radionuclide; and (3) the Control or Zone 2 stations, which are beyond the influence of the plant. Direct radiation monitoring stations (using TLDs) are grouped into Indicator, Outer Ring, Fenceline and Control stations.

In each of these columns, for each radionuclide, the following are given:

- The mean value of all concentrations including negative values and values that are not considered "detectable".
- The lowest and highest concentration.
- The number of detectable measurements divided by the total number of measurements.

A sample is considered to yield a "detectable measurement" when the concentration exceeds three times its associated standard deviation. The standard deviation on each measurement 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.

The radionuclides reported in this section represent those that: 1) had a Reporting Level listed in Table 4.2 of the ODCM or, a LLD requirement in Table 4.3 of the ODCM or 2) had a positive measurement of radioactivity, whether it was naturally-occurring or man-made; or 3) were of specific interest for any other reason. The radionuclides that are routinely analyzed and reported by the DESEL in a gamma spectroscopy analysis are: Th-232, Ag-110m, Ba-140, Be-7, Ce-141, Ce-144, Co-57, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Fe-59, I-131, I-133, K-40, Mn-54, Mo-99, Np-239, Ru-103, Ru-106, Sb-124, Se-75, TeI-132, Zn-65 and Zr-95. In no case did a radionuclide not shown in Table 5.1 appear as a "detectable measurement" during 2000.

Data from direct radiation measurements made by TLDs are provided in Table 5.2 in a format essentially the same as above. The complete listing of quarterly TLD data is provided in Table 5.3.

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Air Particulates (AP) UNITS: pCi/cubic meter

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean, Range, No. Detected***	Station With Highest Mean: Sta.	Station With Highest Mean: Mean, Range, No. Detected***	Control Stations: Mean, Range, No. Detected***
GR-B	(168) (0)	0.01	2.2E -2 (8.9 - 49.0)E -3 (140/ 140)	12	2.7E -2 (1.5 - 4.3)E -2 (28/ 28)	2.1E -2 (1.2 - 3.6)E -2 (28/ 28)
Be-7	(24) (0)		7.0E -2 (4.0 - 10.4)E -2 (17/ 20)	12	8.4E -2 (5.8 - 9.9)E -2 (3/ 4)	8.3E -2 (6.4 - 10.5)E -2 (4/ 4)
Co-58	(24) (0)		3.4E -4 (-8.9 - 16.0)E -4 (0/ 20)	12	6.0E -4 (-2.0 - 16.0)E -4 (0/ 4)	5.7E -4 (2.4 - 12.3)E -4 (0/ 4)
Co-60	(24) (0)		-1.1E -5 (-6.2 - 4.1)E -4 (0/ 20)	21	7.9E -5 (-3.6 - 4.2)E -4 (0/ 4)	7.9E -5 (-3.6 - 4.2)E -4 (0/ 4)
Cs-134	(24) (0)	0.05	2.2E -4 (-4.9 - 15.8)E -4 (0/ 20)	13	7.6E -4 (-8.5 - 158.0)E -5 (0/ 4)	-8.5E -5 (-3.4 - 0.4)E -4 (0/ 4)
Cs-137	(24) (0)	0.06	8.6E -5 (-2.8 - 9.5)E -4 (0/ 20)	12	4.0E -4 (5.1 - 94.8)E -5 (0/ 4)	-3.8E -5 (-3.3 - 1.6)E -4 (0/ 4)

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: River Water (WR) UNITS: pCi/L

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations Mean Range No. Detected***	Station With Highest Mean Sta.	Mean Range No. Detected***	Control Stations Mean Range No. Detected***
GR-B	(36) (0)	4	1.1E 0 (-4.0 - 192.7)E -2 (4/ 24)	21	1.3E 0 (3.0 - 23.7)E -1 (4/ 12)	1.3E 0 (3.0 - 23.7)E -1 (4/ 12)
H-3	(14) (0)	2000	8.4E 0 (-4.1 - 9.7)E 2 (0/ 10)	31	5.6E 1 (-3.1 - 9.7)E 2 (0/ 4)	-1.9E 2 (-1.0 - 0.5)E 3 (0/ 4)
Mn-54	(38) (0)	15	-5.8E -1 (-2.2 - 1.2)E 0 (0/ 26)	31	-2.9E -1 (-1.0 - 0.9)E 0 (0/ 12)	-3.9E -1 (-1.6 - 2.9)E 0 (0/ 12)
Co-58	(38) (0)	15	-4.5E -1 (-2.9 - 2.1)E 0 (0/ 26)	11	-2.8E -1 (-1.9 - 2.1)E 0 (0/ 12)	-7.3E -1 (-4.1 - 0.9)E 0 (0/ 12)
Fe-59	(38) (0)		6.3E -1 (-5.1 - 5.3)E 0 (0/ 26)	11	1.3E 0 (-3.2 - 5.3)E 0 (0/ 12)	-4.6E -1 (-3.3 - 2.3)E 0 (0/ 12)
Co-60	(38) (0)	15	6.2E -2 (-1.9 - 4.9)E 0 (0/ 26)	31	3.1E -1 (-1.9 - 4.9)E 0 (0/ 12)	1.6E -1 (-2.0 - 1.9)E 0 (0/ 12)
Zn-65	(38) (0)	30	-8.0E -1 (-1.0 - 1.3)E 1 (0/ 26)	31	-6.8E -1 (-6.8 - 5.4)E 0 (0/ 12)	-1.1E 0 (-9.8 - 12.1)E 0 (0/ 12)
Zr-95	(38) (0)	15	-9.2E -2 (-3.7 - 3.8)E 0 (0/ 26)	91	6.9E -1 (5.5 - 8.2)E -1 (0/ 2)	-6.2E -1 (-4.6 - 2.9)E 0 (0/ 12)
I-131	(38) (0)		-2.0E -1 (-6.9 - 6.3)E 0 (0/ 26)	31	8.3E -1 (-3.1 - 6.3)E 0 (0/ 12)	1.3E -1 (-6.4 - 4.2)E 0 (0/ 12)
Cs-134	(38) (0)	15	-1.5E -1 (-3.0 - 2.1)E 0 (0/ 26)	21	1.8E -1 (-1.5 - 1.8)E 0 (0/ 12)	1.8E -1 (-1.5 - 1.8)E 0 (0/ 12)
Cs-137	(38) (0)	18	-8.0E -1 (-2.8 - 0.9)E 0 (0/ 26)	11	-4.8E -1 (-1.9 - 0.9)E 0 (0/ 12)	-4.8E -1 (-2.0 - 0.9)E 0 (0/ 12)
Ba-140	(38) (0)		-3.2E -1 (-6.7 - 4.9)E 0 (0/ 26)	91	6.7E -1 (-4.0 - 17.3)E -1 (0/ 2)	-2.4E -1 (-4.4 - 3.6)E 0 (0/ 12)

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Ground Water (WG) UNITS: pCi/L

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations Mean Range No. Detected***	Station With Highest Mean Sta.	Mean Range No. Detected***	Control Stations Mean Range No. Detected***
GR-B	(24) (0)	4	4.0E 0 (2.3 - 7.2)E 0 (22/ 24)	11	4.0E 0 (3.3 - 5.8)E 0 (12/ 12)	NO DATA
H-3	(24) (0)	2000	-4.4E 1 (-5.3 - 2.8)E 2 (0/ 24)	12	3.2E 1 (-5.3 - 2.8)E 2 (0/ 12)	NO DATA
Mn-54	(24) (0)	15	-6.9E -1 (-2.8 - 1.8)E 0 (0/ 24)	11	-6.9E -1 (-2.8 - 1.8)E 0 (0/ 12)	NO DATA
Co-58	(24) (0)	15	-5.7E -1 (-3.7 - 1.6)E 0 (0/ 24)	12	-1.9E -1 (-3.1 - 1.5)E 0 (0/ 12)	NO DATA
Fe-59	(24) (0)		-8.4E -2 (-4.9 - 7.1)E 0 (0/ 24)	11	7.9E -2 (-4.0 - 3.3)E 0 (0/ 12)	NO DATA
Co-60	(24) (0)	15	-2.6E -2 (-3.1 - 2.3)E 0 (0/ 24)	11	5.0E -1 (-1.4 - 2.3)E 0 (0/ 12)	NO DATA
Zn-65	(24) (0)	30	1.3E 0 (-8.9 - 12.3)E 0 (0/ 24)	11	3.4E 0 (-5.2 - 12.3)E 0 (0/ 12)	NO DATA
Zr-95	(24) (0)	15	8.4E -2 (-3.8 - 2.9)E 0 (0/ 24)	11	4.2E -1 (-3.8 - 2.9)E 0 (0/ 12)	NO DATA
I-131	(24) (0)		2.2E -1 (-5.4 - 7.3)E 0 (0/ 24)	12	3.3E -1 (-5.4 - 6.1)E 0 (0/ 12)	NO DATA
Cs-134	(24) (0)	15	1.7E -1 (-2.1 - 3.0)E 0 (0/ 24)	12	7.9E -1 (-7.6 - 29.9)E -1 (0/ 12)	NO DATA
Cs-137	(24) (0)	18	-5.8E -1 (-3.0 - 2.1)E 0 (0/ 24)	12	-5.1E -1 (-3.0 - 2.1)E 0 (0/ 12)	NO DATA
Ba-140	(24) (0)		-6.8E -1 (-6.0 - 3.2)E 0 (0/ 24)	12	-4.3E -1 (-3.0 - 2.8)E 0 (0/ 12)	NO DATA

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Storm Drain Water (WW) UNITS: pCi/L

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations Mean Range No. Detected***	Station With Highest Mean Sta.	Mean Range No. Detected***	Control Stations Mean Range No. Detected***
GR-B	(21) (0)	4	3.9E 0 (1.7 - 6.8)E 0 (20/ 21)	51	4.9E 0 (3.1 - 6.8)E 0 (9/ 9)	NO DATA
H-3	(21) (0)	2000	-3.0E 1 (-1.1 - 0.9)E 3 (0/ 21)	52	-2.3E 0 (-4.1 - 4.8)E 2 (0/ 12)	NO DATA
Mn-54	(21) (0)	15	-1.2E -1 (-2.8 - 3.0)E 0 (0/ 21)	52	-1.0E -1 (-1.7 - 1.8)E 0 (0/ 12)	NO DATA
Co-58	(21) (0)	15	-3.6E -1 (-3.3 - 3.1)E 0 (0/ 21)	51	-1.1E -1 (-1.7 - 0.9)E 0 (0/ 9)	NO DATA
Fe-59	(21) (0)		-1.0E 0 (-6.2 - 6.0)E 0 (0/ 21)	51	-8.9E -1 (-6.2 - 6.0)E 0 (0/ 9)	NO DATA
Co-60	(21) (0)	15	-1.7E -1 (-2.5 - 3.6)E 0 (0/ 21)	52	-8.2E -2 (-1.7 - 2.6)E 0 (0/ 12)	NO DATA
Zn-65	(21) (0)	30	-1.2E 0 (-9.3 - 10.6)E 0 (0/ 21)	52	-1.3E -1 (-9.3 - 10.6)E 0 (0/ 12)	NO DATA
Zr-95	(21) (0)	15	-1.1E -1 (-3.6 - 4.4)E 0 (0/ 21)	52	2.6E -1 (-2.3 - 4.4)E 0 (0/ 12)	NO DATA
I-131	(21) (0)		-7.6E -1 (-7.7 - 10.9)E 0 (0/ 21)	51	3.4E -1 (-5.8 - 10.9)E 0 (0/ 9)	NO DATA
Cs-134	(21) (0)	15	-6.5E -2 (-1.8 - 1.6)E 0 (0/ 21)	51	-5.8E -2 (-1.3 - 1.1)E 0 (0/ 9)	NO DATA
Cs-137	(21) (0)	18	-1.0E 0 (-3.0 - 0.5)E 0 (0/ 21)	52	-9.9E -1 (-3.0 - 0.5)E 0 (0/ 12)	NO DATA
Ba-140	(21) (0)		1.3E -1 (-4.1 - 3.3)E 0 (0/ 21)	52	4.5E -1 (-2.1 - 2.9)E 0 (0/ 12)	NO DATA

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Sediment (SE) UNITS: pCi/kg dry

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean / Range / No. Detected***	Station With Highest Mean: Sta.	Station With Highest Mean: Mean / Range / No. Detected***	Control Stations: Mean / Range / No. Detected***
Be-7	(18) (0)		1.0E 2 (-2.2 - 4.0)E 2 (0/ 12)	11	1.7E 2 (-5.7 - 39.6)E 1 (0/ 6)	7.7E 0 (-2.2 - 3.3)E 2 (1/ 6)
K-40	(18) (0)		2.0E 4 (1.4 - 2.6)E 4 (12/ 12)	91	2.4E 4 (2.3 - 2.6)E 4 (6/ 6)	1.5E 4 (1.3 - 1.6)E 4 (6/ 6)
Co-58	(18) (0)		-2.6E 1 (-7.7 - 0.2)E 1 (0/ 12)	21	-9.8E 0 (-2.3 - 0.9)E 1 (0/ 6)	-9.8E 0 (-2.3 - 0.9)E 1 (0/ 6)
Co-60	(18) (0)		1.7E 1 (-1.4 - 5.2)E 1 (1/ 12)	91	2.7E 1 (-6.7 - 52.0)E 0 (1/ 6)	-4.2E 0 (-1.3 - 1.1)E 1 (0/ 6)
Cs-134	(18) (0)	150	-6.4E -1 (-3.6 - 4.5)E 1 (0/ 12)	91	8.2E 0 (-1.6 - 4.5)E 1 (0/ 6)	5.9E 0 (-8.0 - 31.9)E 0 (0/ 6)
Cs-137	(18) (0)	180	8.4E 2 (7.8 - 221.0)E 1 (12/ 12)	91	1.5E 3 (1.1 - 2.2)E 3 (6/ 6)	9.7E 1 (-3.1 - 22.7)E 1 (3/ 6)
Th-232	(18) (0)		1.4E 3 (6.5 - 24.9)E 2 (12/ 12)	91	1.9E 3 (1.4 - 2.5)E 3 (6/ 6)	5.0E 2 (4.0 - 6.0)E 2 (6/ 6)

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Milk (TM) UNITS: pCi/L

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean, Range, No. Detected***	Station With Highest Mean: Sta.	Station With Highest Mean: Mean, Range, No. Detected***	Control Stations: Mean, Range, No. Detected***
K-40	(12) (0)		NO DATA[1]	21	1.4E 3 (1.3 - 1.5)E 3 (12/ 12)	1.4E 3 (1.3 - 1.5)E 3 (12/ 12)
Sr-89	(4) (0)		NO DATA	21	-1.1E 0 (-2.3 - 0.9)E 0 (0/ 4)	-1.1E 0 (-2.3 - 0.9)E 0 (0/ 4)
Sr-90	(4) (0)		NO DATA	21	3.1E -1 (-4.1 - 14.1)E -1 (0/ 4)	3.1E -1 (-4.1 - 14.1)E -1 (0/ 4)
I-131	(12) (0)		NO DATA	21	1.5E 0 (-3.6 - 8.4)E 0 (0/ 12)	1.5E 0 (-3.6 - 8.4)E 0 (0/ 12)
Cs-134	(12) (0)	15	NO DATA	21	6.1E -1 (-1.4 - 3.8)E 0 (0/ 12)	6.1E -1 (-1.4 - 3.8)E 0 (0/ 12)
Cs-137	(12) (0)	18	NO DATA	21	-9.9E -1 (-5.3 - 1.6)E 0 (0/ 12)	-9.9E -1 (-5.3 - 1.6)E 0 (0/ 12)
Ba-140	(12) (0)		NO DATA	21	7.4E -3 (-3.2 - 2.6)E 0 (0/ 12)	7.4E -3 (-3.2 - 2.6)E 0 (0/ 12)

1 No Location within 5 miles.

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Fish (FH) UNITS: pCi/kg

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean Range No. Detected***	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range No. Detected***	Control Stations: Mean Range No. Detected***
K-40	(4) (0)		2.8E 3 (2.5 - 3.1)E 3 (2/ 2)	11	2.8E 3 (2.5 - 3.1)E 3 (2/ 2)	2.4E 3 (2.1 - 2.6)E 3 (2/ 2)
Mn-54	(4) (0)	130	1.8E 0 (0.0 - 3.5)E 0 (0/ 2)	11	1.8E 0 (0.0 - 3.5)E 0 (0/ 2)	-6.2E 0 (-1.1 - -0.2)E 1 (0/ 2)
Co-58	(4) (0)	130	4.3E 0 (-3.6 - 12.3)E 0 (0/ 2)	11	4.3E 0 (-3.6 - 12.3)E 0 (0/ 2)	-2.8E 0 (-1.1 - 0.6)E 1 (0/ 2)
Fe-59	(4) (0)		-1.1E 1 (-1.6 - -0.7)E 1 (0/ 2)	21	1.0E 1 (-1.5 - 3.5)E 1 (0/ 2)	1.0E 1 (-1.5 - 3.5)E 1 (0/ 2)
Co-60	(4) (0)	130	-1.1E 1 (-1.1 - -1.0)E 1 (0/ 2)	21	-3.4E 0 (-6.5 - -0.4)E 0 (0/ 2)	-3.4E 0 (-6.5 - -0.4)E 0 (0/ 2)
Zn-65	(4) (0)	260	-1.2E 1 (-2.5 - 0.0)E 1 (0/ 2)	21	-3.1E 0 (-2.0 - 1.4)E 1 (0/ 2)	-3.1E 0 (-2.0 - 1.4)E 1 (0/ 2)
Cs-134	(4) (0)	130	5.2E 0 (2.5 - 8.0)E 0 (0/ 2)	21	7.0E 0 (1.6 - 12.3)E 0 (0/ 2)	7.0E 0 (1.6 - 12.3)E 0 (0/ 2)
Cs-137	(4) (0)	150	4.5E 1 (4.0 - 5.0)E 1 (0/ 2)	11	4.5E 1 (4.0 - 5.0)E 1 (0/ 2)	1.0E 1 (3.2 - 17.1)E 0 (0/ 2)

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Food Crop (TF) UNITS: pCi/kg

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean / Range / No. Detected***	Station With Highest Mean: Sta.	Mean / Range / No. Detected***	Control Stations: Mean / Range / No. Detected***
K-40	(3) (0)		3.2E 3 (8.6 - 55.7)E 2 (2/ 2)	11	5.6E 3 (1/ 1)	1.1E 3 (1/ 1)
Co-58	(3) (0)		-1.7E 1 (-2.2 - -1.2)E 1 (0/ 2)	21	-3.4E 0 (0/ 1)	-3.4E 0 (0/ 1)
Co-60	(3) (0)		-1.5E -1 (-1.8 - 1.8)E 1 (0/ 2)	11	1.8E 1 (0/ 1)	-1.9E 1 (0/ 1)
I-131	(3) (0)		-1.1E 1 (-1.5 - -0.7)E 1 (0/ 2)	21	-6.2E 0 (0/ 1)	-6.2E 0 (0/ 1)
Cs-134	(3) (0)	60	4.4E 0 (1.8 - 7.0)E 0 (0/ 2)	11	7.0E 0 (0/ 1)	-1.7E 1 (0/ 1)
Cs-137	(3) (0)	80	4.4E 1 (-2.5 - 90.3)E 0 (1/ 2)	13	9.0E 1 (1/ 1)	7.0E 0 (0/ 1)

Table 5.1
Radiological Environmental Program Summary
Yankee Nuclear Power Station, Rowe, MA
(January - December 2000)

MEDIUM: Maple Syrup (MS) UNITS: pCi/kg

Radionuclides* (No. Analyses) Non-Routine**		Required LLD	Indicator Stations: Mean Range No. Detected***	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range No. Detected***	Control Stations: Mean Range No. Detected***
K-40	**(2)** **(0)**		2.0E 3 (1/ 1)	**33**	2.0E 3 (1/ 1)	1.8E 3 (1/ 1)
Co-58	**(2)** **(0)**		-1.9E 0 (0/ 1)	**45**	-1.2E 0 (0/ 1)	-1.2E 0 (0/ 1)
Co-60	**(2)** **(0)**		-6.7E -1 (0/ 1)	**45**	6.7E -1 (0/ 1)	6.7E -1 (0/ 1)
I-131	**(2)** **(0)**		6.0E 0 (0/ 1)	**33**	6.0E 0 (0/ 1)	-4.0E 0 (0/ 1)
Cs-134	**(2)** **(0)**	60	-1.8E 0 (0/ 1)	**45**	1.1E -1 (0/ 1)	1.1E -1 (0/ 1)
Cs-137	**(2)** **(0)**	80	1.0E 1 (1/ 1)	**45**	1.8E 1 (1/ 1)	1.8E 1 (1/ 1)

Footnotes to Table 5.1:

* The only radionuclides reported in this table are those with LLD requirements and those for which positive radioactivity was detected. See Section 5 of this report for a discussion of other radionuclides that were analyzed.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table4.2.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

TABLE 5.2

ENVIRONMENTAL TLD DATA SUMMARY
YANKEE NUCLEAR POWER STATION, ROWE, MA
(JANUARY - DECEMBER 2000)

INDICATOR TLDs	OUTER RING TLDs	FENCELINE TLDs	CONTROL TLDs
MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*
6.4 ± 0.8 4.6 - 8.3 (50)	6.3 ± 1.0 4.3 - 8.2 (35)	7.4 ± 1.1 5.1 - 9.2 (36)	7.1 ± 0.8 5.6 - 8.2 (8)

OFFSITE STATION WITH HIGHEST MEAN

STA. NO.	MEAN RANGE (NO. MEASUREMENTS)*
GM-38	7.7 + 1.2 5.9 - 8.5 (4)

* Each "measurement" is based on quarterly readings from five TLD elements.

TABLE 5.3

ENVIRONMENTAL TLD MEASUREMENT 2000

(Micro-R per hour)

Sta. No.	Description	1ST QUARTER			2ND QUARTER			3RD QUARTER			4TH QUARTER			ANNUAL AVE.
		EXP.		S.D.	EXP.		S.D.	EXP.		S.D.	EXP.		S.D.	EXP.
GM-01	YNPS Visitor's Center	5.9	±	0.2	7.2	±	0.5	6.7	±	0.3	7.3	±	0.3	6.8
GM-02	Observation Stand	5.5	±	0.3	6.4	±	0.3	6.2	±	0.3	6.2	±	0.2	6.1
GM-03	Rowe School	4.6	±	0.2	5.6	±	0.2	5.2	±	0.3	5.8	±	0.2	5.3
GM-04	Harriman Station	5.1	±	0.2	6.0	±	0.2	5.3	±	0.3	6.2	±	0.3	5.6
GM-05	Monroe Bridge	6.2	±	0.2	6.9	±	0.3	6.5	±	0.5		*		6.5
GM-06	Readsboro Rd. Barrier	6.3	±	0.5	7.4	±	0.3	7.1	±	0.3	7.5	±	0.3	7.1
GM-07	Whitingham Line	6.1	±	0.3	7.6	±	0.4	7.6	±	0.3	7.7	±	0.3	7.3
GM-08	Monroe Hill Barrier	5.3	±	0.2	6.1	±	0.2	5.3	±	0.2	6.3	±	0.3	5.8
GM-09	Dunbar Brook	5.9	±	0.3	7.3	±	0.2	6.9	±	0.2	7.2	±	0.5	6.8
GM-10	Cross Rd.	5.3	±	0.3	6.8	±	0.2	6.1	±	0.2	6.5	±	0.3	6.2
GM-11	Adams High Line	5.1	±	0.2	6.6	±	0.8	6.2	±	0.3	6.4	±	0.3	6.1
GM-12	Readsboro, VT	6.9	±	0.4	8.3	±	0.4	7.6	±	0.3		**		7.6
GM-13	Indust. Area Fence	6.7	±	0.3	8.5	±	0.4	8.1	±	0.3	8.6	±	0.3	8.0
GM-14	Indust. Area Fence	6.0	±	0.3	7.5	±	0.3	6.9	±	0.3	7.5	±	0.3	7.0
GM-15	Indust. Area Fence	6.3	±	0.3	7.5	±	0.3	6.9	±	0.3	7.4	±	0.3	7.0
GM-16	Indust. Area Fence	6.2	±	0.6	7.5	±	0.3	6.8	±	0.2	7.1	±	0.4	6.9
GM-17	Indust. Area Fence	6.0	±	0.2	7.8	±	0.3	7.3	±	0.2	7.6	±	0.3	7.2
GM-18	Indust. Area Fence	8.9	±	0.7	8.9	±	0.3	8.5	±	0.4	9.2	±	0.5	8.9
GM-19	Indust. Area Fence	7.0	±	0.2	9.0	±	0.4	8.4	±	0.3	8.2	±	0.3	8.2
GM-20	Indust. Area Fence	6.6	±	0.3	9.0	±	0.3	8.3	±	0.2	8.4	±	0.4	8.1
GM-21	Indust. Area Fence	5.1	±	0.2	6.2	±	0.3	5.7	±	0.3	6.2	±	0.2	5.8
GM-22	Heartwellville, VT	5.6	±	0.2	7.5	±	0.3	7.1	±	0.3	7.1	±	0.3	6.8
GM-23	Williamstown Subst.	6.3	±	0.3	7.8	±	0.3	7.2	±	0.4	8.2	±	0.5	7.4
GM-25	Whitingham, VT	5.3	±	0.2	6.6	±	0.3	5.7	±	0.3	6.1	±	0.3	5.9
GM-27	Number 9 Rd.	5.1	±	0.3	6.4	±	0.2	5.9	±	0.3	6.2	±	0.3	5.9
GM-29	Route 8A	4.3	±	0.2	5.0	±	0.2	4.6	±	0.2	5.1	±	0.2	4.8
GM-31	Legate Hill Rd.	5.4	±	0.2	6.7	±	0.3	6.2	±	0.3	6.5	±	0.4	6.2
GM-32	Rowe Rd.	6.5	±	0.5	6.9	±	0.3	6.6	±	0.3	7.0	±	0.3	6.7
GM-33	Zoar Rd.	5.7	±	0.2	6.9	±	0.2	6.6	±	0.4	6.8	±	0.3	6.5
GM-35	Whitcomb Summit	5.6	±	0.2	7.5	±	0.5	7.4	±	0.4		*		6.8
GM-36	Tilda Rd.	5.6	±	0.2	7.1	±	0.3	6.8	±	0.4	7.2	±	0.3	6.7
GM-38	West Hill Rd.	6.7	±	0.4	8.1	±	0.4	8.0	±	0.4	8.2	±	0.3	7.8
GM-40	Readsboro Rd.	5.9	±	0.4	6.9	±	0.4	6.8	±	0.2	7.0	±	0.3	6.7

* TLD MISSING

** TLD MALFUNCTION (REFER TO SECTION 6.1)

6. ANALYSIS OF ENVIRONMENTAL RESULTS

6.1 Sampling Program Deviations

ODCM Control 4.1 allows for deviations "if specimens are unobtainable due to hazardous conditions, seasonal unavailability or malfunction of automatic sampling equipment." A few minor deviations were noted in the REMP during 2000. These deviations did not compromise the program's effectiveness and are considered insignificant with respect to what is normally anticipated for any radiological environmental monitoring program. These specific deviations were:

1. TLDs

   a. The TLDs at Station GM-05 and GM-35 were missing in the fourth quarter of 2000.

   b. During the fourth quarter, an indicator TLD at location GM12 measured a reading of 26.0 mR. The three possible causes that account for this high measurement are the Yankee Rowe Power Plant, background radiation, or a TLD malfunction. Yankee Rowe has been in decommissioning phase since the second quarter of 1992. The four "Yankee Atomic Electric Company Board of Directors Monthly Reports" describe the decommissioning activities during the 2000 fourth quarter (See Attachment A). None of the listed activities could have generated the high exposure recorded by this TLD. Historical fourth quarter exposure rates at GM12, since the plant's shutdown and prior to 2000, have an average value of 16.7 mR. Dixon's test was performed to compare the concurrent fourth quarter TLD measurement to historical fourth quarter exposure rates. It concluded with a 99.5 percent confidence that this concurrent fourth quarter measurement is beyond the expected range of historical fourth quarter exposure rates (See Attachment B). In addition, concurrent fourth quarter exposure rates from all other TLDs give a mean of 15.46 mR with a standard deviation of the mean of 3.86 mR (See Attachment C). Because historical fourth quarter measurements at location GM12 and the other concurrent fourth quarter TLD measurements consistently resulted in much lower exposure rates, it proves that this TLD's high exposure rate is not due to background radiation. Therefore, it is assumed that this high exposure rate was a TLD malfunction, most likely caused by the TLD becoming wet.

6.2 Comparison of Achieved LLDs with Requirements

Table 4.3 of the ODCM (Table 4.4 in this report) gives the required Lower Limits of Detection (LLDs) for environmental sample analyses. On occasion, an LLD is not achieved due to situations such as a low sample volume caused by sampling equipment malfunction. In such a case, Control 7.1 of the ODCM requires a discussion of the situation in the Annual Radiological Environmental Operating Report. At the DESEL, the target LLD for any analysis is typically 30-40 percent of the most restrictive required LLD. Expressed differently, the typical sensitivities achieved for each analysis are at least 2.5 to 3 times better than that required by the YNPS ODCM.

For each analysis having an LLD requirement in ODCM Table 4.3, the *a posteriori* or after the fact LLD calculated for that analysis was compared with the required LLD. Of the more than 670 analyses performed with a specified LLD requirement, all met the requirements of Table 4.3 of the ODCM in 2000.

6.3 Results Compared Against Reporting Levels

ODCM Control 4.1.a. requires the written notification to the NRC within 30 days whenever a Reporting Level in ODCM Table 4.2 is exceeded. Reporting Levels are the environmental concentrations that relate to the ALARA design dose objectives of 10 CFR 50, Appendix I. It should be noted that environmental concentrations are averaged over calendar quarters for the purposes of this comparison, and that Reporting Levels apply only to measured levels of radioactivity due to plant effluents. During 2000, no Reporting Levels were exceeded.

6.4 Data Analysis by Media Type

The 2000 REMP data for each media type are discussed below. These are arranged in the same order as in Table 5.1, and are further categorized by pathway. Graphical plots of monitoring data are shown at the end of this section in Figures 6.1 to 6.26. With respect to data plots, all values are plotted, whether they are "detectable" or "non-detectable."

6.4.1 Airborne Pathways

6.4.1.1 Air Particulates

The biweekly air particulate filters from each of the six operating sampling sites were analyzed for gross-beta radioactivity. At the end of each quarter, the individual filters collected during the quarter from each sampling site were composited for a gamma analysis. The results of the biweekly air particulate sampling program are shown in Table 5.1 and Figures 6.1 through 6.6.

As shown in Figure 6.1, there has been no significant difference between the quarterly average concentration at the indicator (near-plant) stations and the control (distant from plant) stations. Also notable is a distinct annual cycle, with the minimum concentration in the second quarter, and the maximum concentration in the first quarter.

Figures 6.2 through 6.6 show the biweekly gross beta concentration at each air particulate sampling location required by the ODCM along with the control air particulate sampling location at AP-21 (Williamstown, MA). It can be readily seen that the gross-beta measurements on air particulate filters fluctuate significantly over the course of a year. The measurements from control station AP-21 vary similarly, indicating that these fluctuations are due to regional changes in naturally-occurring airborne radioactive materials, and not due to YNPS operations. Table 5.1 shows that the mean concentration from indicator stations, on the average, are similar to those from control locations, further supporting this conclusion.

Figure 6.5 shows that a high gross beta measurement was recorded at Harriman Station (AP-14) in April of 2000. Beryllium-7 was the only isotope detected in the quarterly composite gamma spectroscopy measurement. Beryllium-7 is a naturally-occurring cosmogenic radionuclide typically found in air (See Section 2.1). No plant related radionuclides were detected in this sample.

6.4.2 Waterborne Pathways

6.4.2.1 River Water

Aliquots of river water were automatically collected every two hours from the Deerfield River downstream from the plant. These composited samples were collected monthly and sent to the DESEL for analysis. Monthly grab samples were also collected at the Harriman Reservoir control location and at Sherman Pond near the discharge area.

Table 5.1 shows that gross-beta measurements were positive in eight of the thirty-six samples collected, as would be expected, due to naturally-occurring radionuclides in the water. The historical concentrations at the indicator and control locations have not been significantly different, as shown in Figure 6.9 except during the last half of 1992 and 1998-1999 when the levels at WR-11 were slightly elevated relative to the control. This was attributed to naturally-occurring radioactivity and is discussed in the 1992, 1993, 1998, and 1999 Annual Radiological Environmental Operating Reports.

No gamma-emitting radionuclides attributable to activities at YNPS were detected in any of the samples. For each sampling site, the monthly samples were composited into quarterly samples for H-3 analyses. No H-3 was detected in river water samples during 2000.

Beginning in July 1994, a split sampling program was undertaken in cooperation with the Massachusetts Radiation Control Program (MCRP). Water samples were collected at the discharge point and then split with the MCRP, at their discretion. During 2000, two samples were split and analyzed by the DESEL and the MCRP laboratory. A gamma spectroscopy and H-3 analyses were performed on the samples. No radioactivity was detected in the 2000 samples, as analyzed at the DESEL. In Figure 4.1 and Table 4.2, this sample location is in the same vicinity as WR-31. In the data collected of Table 5.1, this location is labeled as WR-91 to distinguish it from routine REMP samples collected from WR-31.

6.4.2.2 Ground Water

Monthly ground water samples were collected from two on-site locations during 2000. (Only quarterly samples are required by ODCM Table 4.1.) Table 5.1 shows that gross-beta measurements were positive in most of the samples. This is due to naturally-occurring radionuclides in the water.

The elevated first half semiannual average gross-beta concentration in 1992 at WG-11, as seen in Figure 6.7, was due to naturally-occurring radionuclides in water which was trucked in from an off-site source. A detailed discussion can be found in the Annual Radiological Environmental Operating Reports for 1992 and 1993.

A steadily decreasing concentration of H-3 has been detected in previous years in WG-12 (Sherman Spring) samples, as shown in Figure 6.8. The water from Sherman Spring leaves the ground on YNPS property and flows into the Deerfield River. Neither the Deerfield River nor Sherman Spring are used for drinking water. No H-3 was detected in samples from either of the two ground water stations in 2000.

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

6.4.2.3 Storm Drain Water

Monthly grab samples were collected from the East and West Storm Drains (WW-51 and 52) when available during 2000. Each sample was analyzed for gross-beta and gamma-emitting radionuclides and H-3. Gross-beta measurements were positive in twenty of the twenty-one samples taken, as would be expected. The levels are consistent with those from previous years. No gamma-emitting radionuclides or H-3 were detected in any of the samples.

6.4.2.4 Sediment

Semiannual sediment core samples were collected from three locations during 2000. Each set of samples was segmented by depth (0-5, 5-10, 10-15 cm) and analyzed for gamma-emitting radionuclides. As would be expected, naturally-occurring K-40 and Th-232 were detected in all of the samples.

In addition to the naturally-occurring radionuclides, Cs-137 was detected in most segments. The results from the 0-5 cm depth segment from downstream location SE-11 are consistent with what has been measured in previous years (see Figure 6.10) and is attributed to nuclear weapons testing fallout. The Cs-137 in the 5-10 cm and 10-15 cm depth segments at SE-11 are bounded by levels previously reported at the control location (SE-21). The levels and the distribution of the Cs-137 in the core segments indicate nuclear weapons testing fallout as the origin. At both the indicator and the control location, the character of the sediment is highly dependent on the specific location sampled, which in turn is dependent on the water level in Harriman Reservoir or on the Deerfield River shoreline at the time of sampling. The diverse character of the sediment at either location and the fact that Cs-137 tends to bind more to sediment containing organic matter than to sandy and rocky sediment leads to a wide range of Cs-137 concentrations, as shown in Figure 6.10 and 6.11.

Table 5.1 and Figure 6.12 show the levels of Cs-137 at station SE-91. These samples were collected from a deep water location near the plant discharge in Sherman Pond. Although much of the Cs-137 in this sediment is due to global nuclear weapons testing fallout, some of the Cs-137 in these samples is likely due to effluents released from monitored plant discharges. It is believed that the higher Cs-137 levels at SE-91, whether due to fallout or plant effluents, are related to the physical make-up of the sediment (rich organic benthic layer) at the bottom of Sherman Pond.

Co-60 has been detected in the deep water sediment at SE-91. With respect to 2000 samples, the 0-5 cm segment from the core taken in May 2000 at SE-91 showed a concentration of 52 $\pm$ 23 pCi/kg-dry. The 5- 10 cm and 10- 15 cm segments and the sample collected in October contained no detectable Co-60. This sample, as all others at SE-91, were collected in deep water, well away from the shoreline and is attributed to licensed plant discharges in past years. None of this radioactivity is involved in any significant pathway to exposure to man.

6.4.3 Ingestion Pathways

6.4.3.1 Milk

Milk samples from cows at one control farm were collected monthly (when available) during the year. The indicator farm, sold it's milking cows in August 1998, making indicator milk samples unavailable since this time. Each sample was analyzed for gamma-emitting radionuclides. Quarterly composites, by location, were analyzed for Sr-89 and Sr-90.

As expected, naturally-occurring K-40 was detected in all samples. Cs-137 was not detected, however, in any samples in 2000. It should be noted that the annual average Cs-137 concentration in Figure 6.13 was calculated using all the measured concentrations regardless of whether they were considered "detectable" or not, or whether the measured concentration was positive or negative. Sr-90 was not detected in any of the samples. Figure 6.14 shows the decreasing trend for Sr-90 levels in milk.

Although both Cs-137 and Sr-90 are by-products of plant operations, the levels detected in milk are due to worldwide fallout from nuclear weapons tests, and to a much lesser degree from fallout from the Chernobyl incident. These two radionuclides are present throughout the natural environment as a result of atmospheric nuclear weapons testing that started primarily in the late 1950's and continued through 1980. They may be found in soil and vegetation, as well as anything that feeds upon vegetation, directly or indirectly. The Cs-137 and Sr-90 levels shown in Table 5.1 and Figures 6.13 and 6.14 are consistent with those detected in previous years near YNPS and is indicative of the residual Cs-137 and Sr-90 levels due to weapons testing fallout.

6.4.3.2 Fish

Semiannual samples of fish were collected from two locations during 2000. The edible portions of each of these were analyzed for gamma-emitting radionuclides. As expected in biological matter, naturally-occurring K-40 was detected in all samples. No other gamma emitting radionuclides were detected in 2000 fish samples. The average Cs-137 concentrations shown on Figure 6.15 for many of the previous years are not considered detectable or "positive" measurements. The radioactivity detected in 2000 and in previous years at both the indicator and control locations shown on Figure 6.15 is attributed to global nuclear weapons testing fallout.

6.4.3.3 Food

Three food samples were collected during 2000 and analyzed for gamma-emitting radionuclides. K-40 was detected in all three samples and Cs-137 was detected in one out of two indicator samples. The concentration of Cs-137 is attributed to global nuclear weapons testing fallout. No other gamma emitting radionuclides were detected.

6.4.3.4 Maple Syrup

Processed maple syrup samples were collected from an indicator and control location during the month of March. These samples had been concentrated, relative to the original tree sap, by boiling (see Section 4.3.10). Naturally-occurring K-40 and Cs-137 were detected in both samples. The concentrations of Cs-137 in 2000 samples are consistent with that detected in both indicator and control samples in previous years, and is attributed to global nuclear weapons testing fallout.

6.4.4 Direct Radiation Pathway

Direct radiation is continuously measured at 33 locations surrounding YNPS with the use of thermoluminescent dosimeters (TLDs). These are collected every calendar quarter for readout at the DESEL.

As can be seen in Figures 6.16 to 6.26, there is a distinct annual cycle at both indicator and control locations. The lowest point of the cycle occurs during the winter months. This is due primarily to the attenuating effect of the snow cover on radon emissions and on direct irradiation by naturally-occurring radionuclides in the soil. Differing amounts of these radionuclides in the underlying soil, rock or nearby building materials result in different radiation levels between one field site and another.

From Table 5.2 and 5.3, it can be seen that the mean exposure rates for the Indicator, Outer Ring, and Control categories were not significantly different in 2000. This indicates that there was no significant overall increase in direct radiation exposure rates in the plant vicinity. As shown in Figures 6.16 to 6.26, the levels in 2000 are consistent with or bounded by levels in previous years.

The Fenceline TLDs shown in Figures 6.24 and 6.25 and summarized in Tables 5.2 and 5.3 are located on the fence surrounding the Radiation Control Area within the YNPS property bounds, and are influenced by licensed plant activities. The Fenceline exposure rates have shown a declining trend as the decommissioning of the site has progressed.

FIGURE 6.1

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS
QUARTERLY AVERAGES

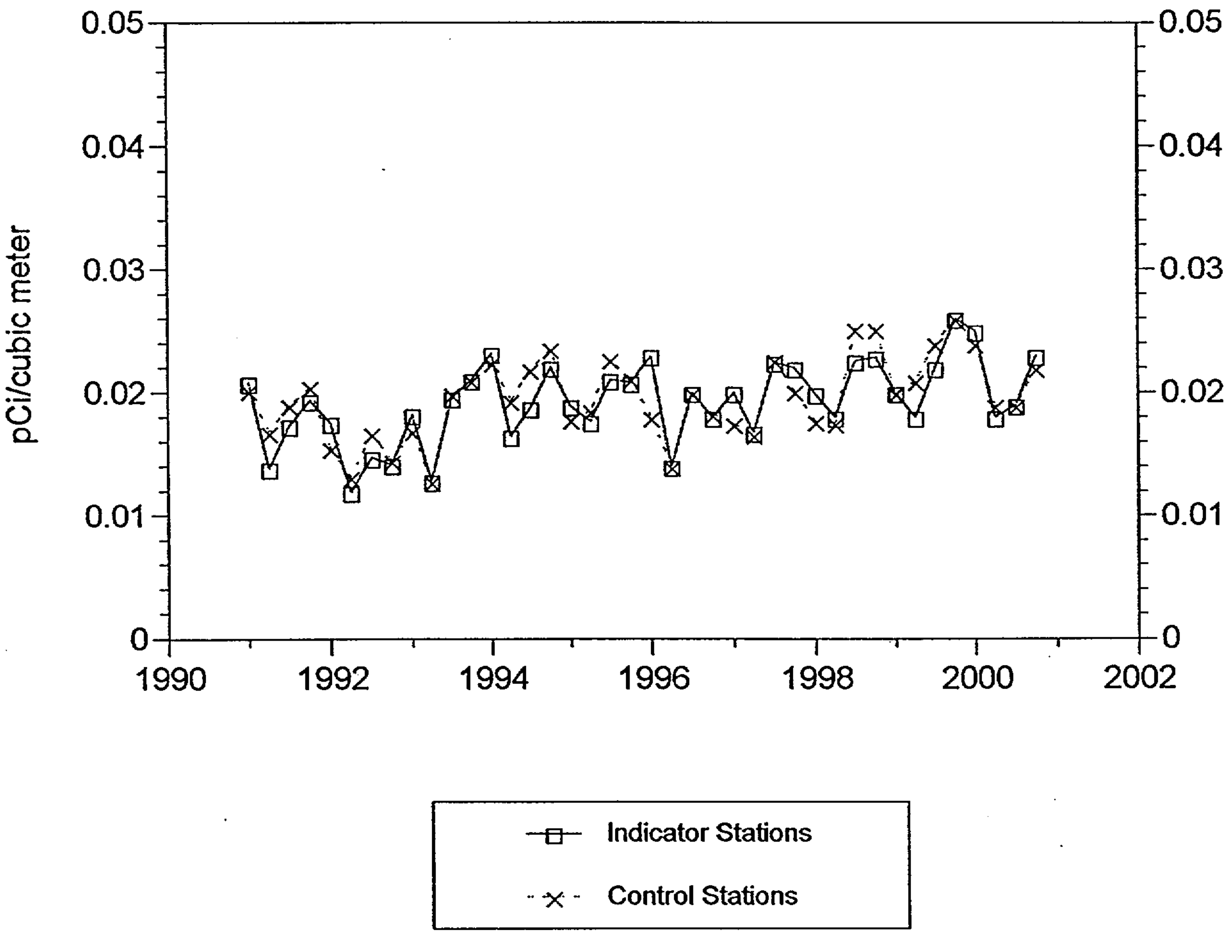


FIGURE 6.2

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

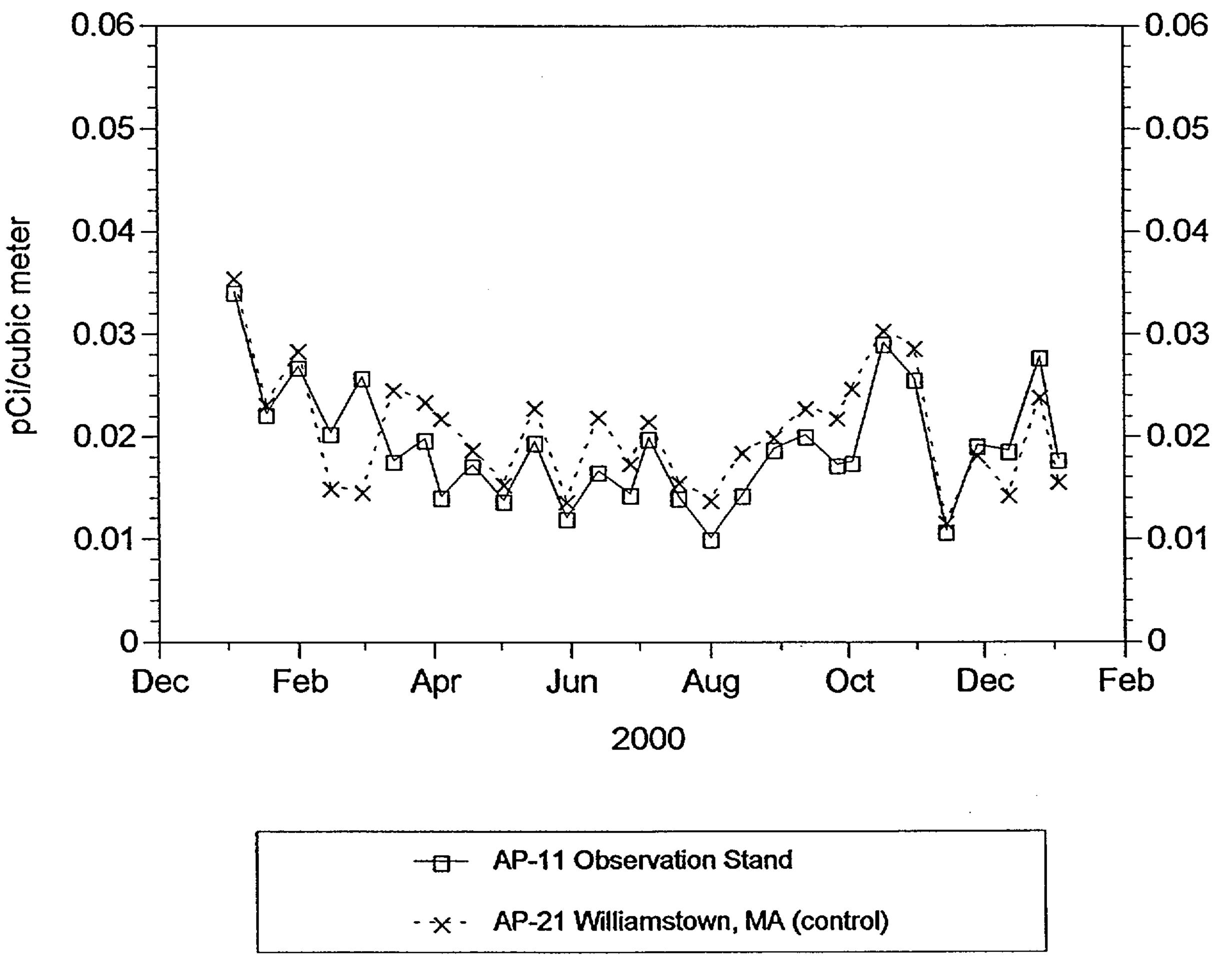


FIGURE 6.3

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

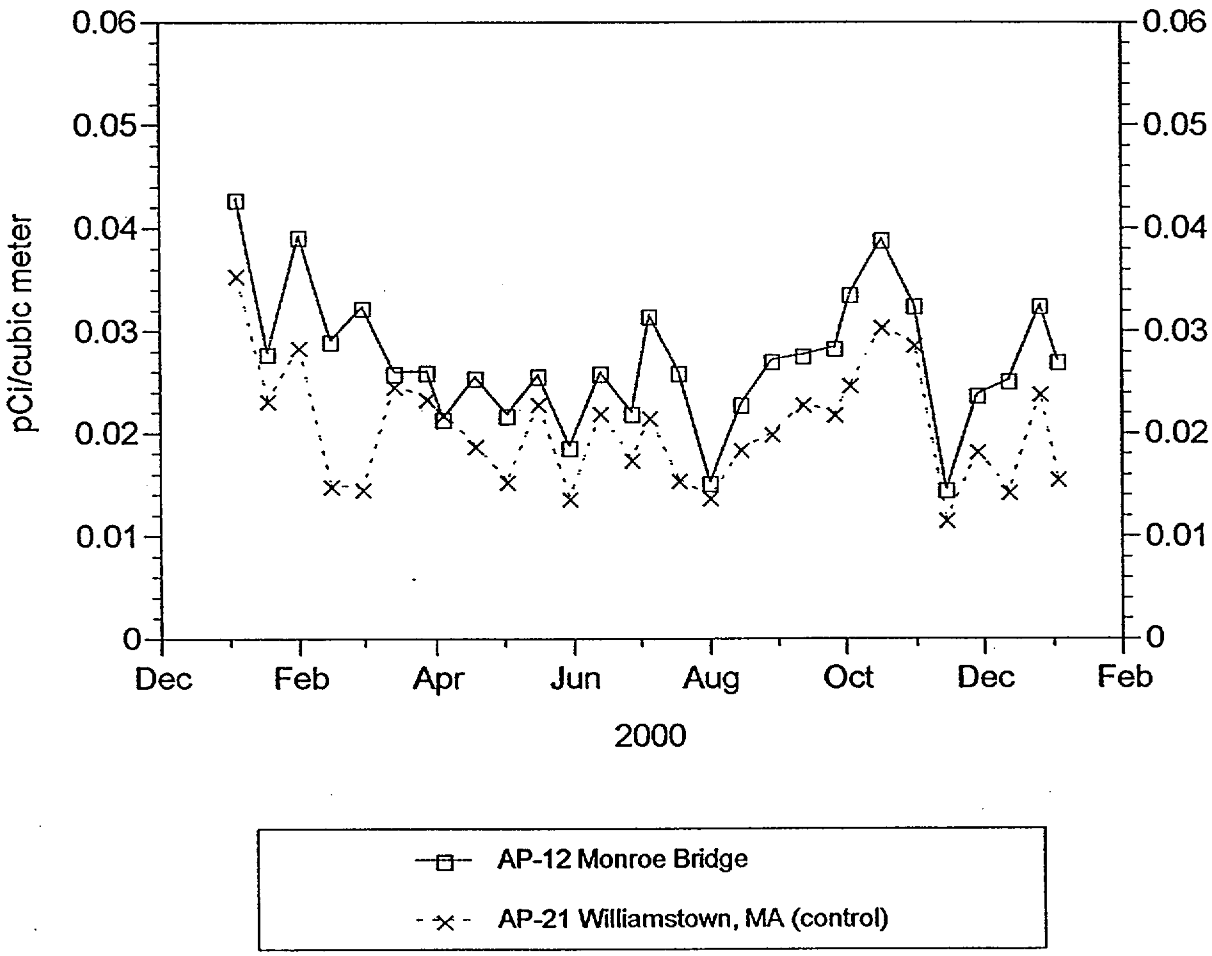


FIGURE 6.4

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

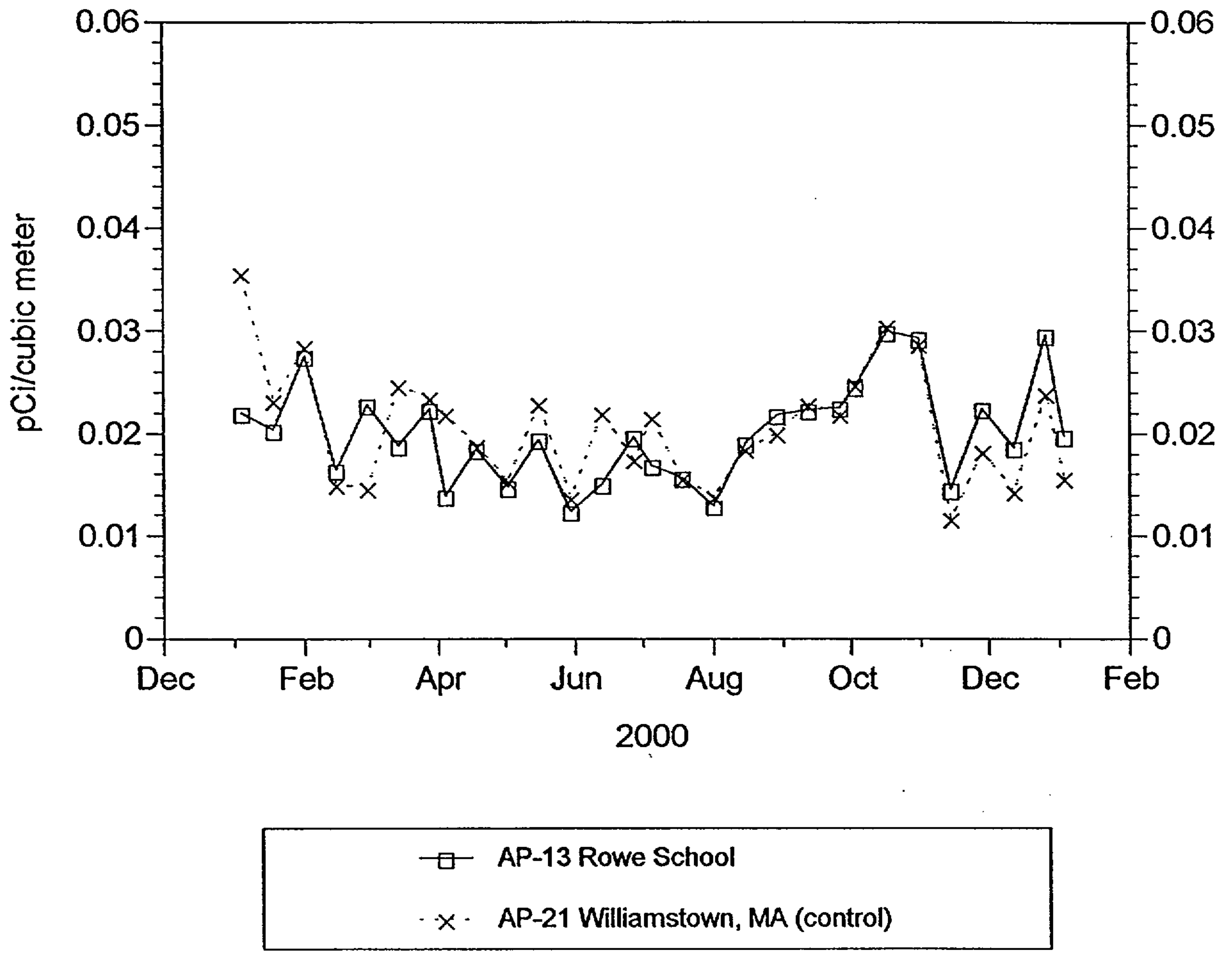


FIGURE 6.5

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

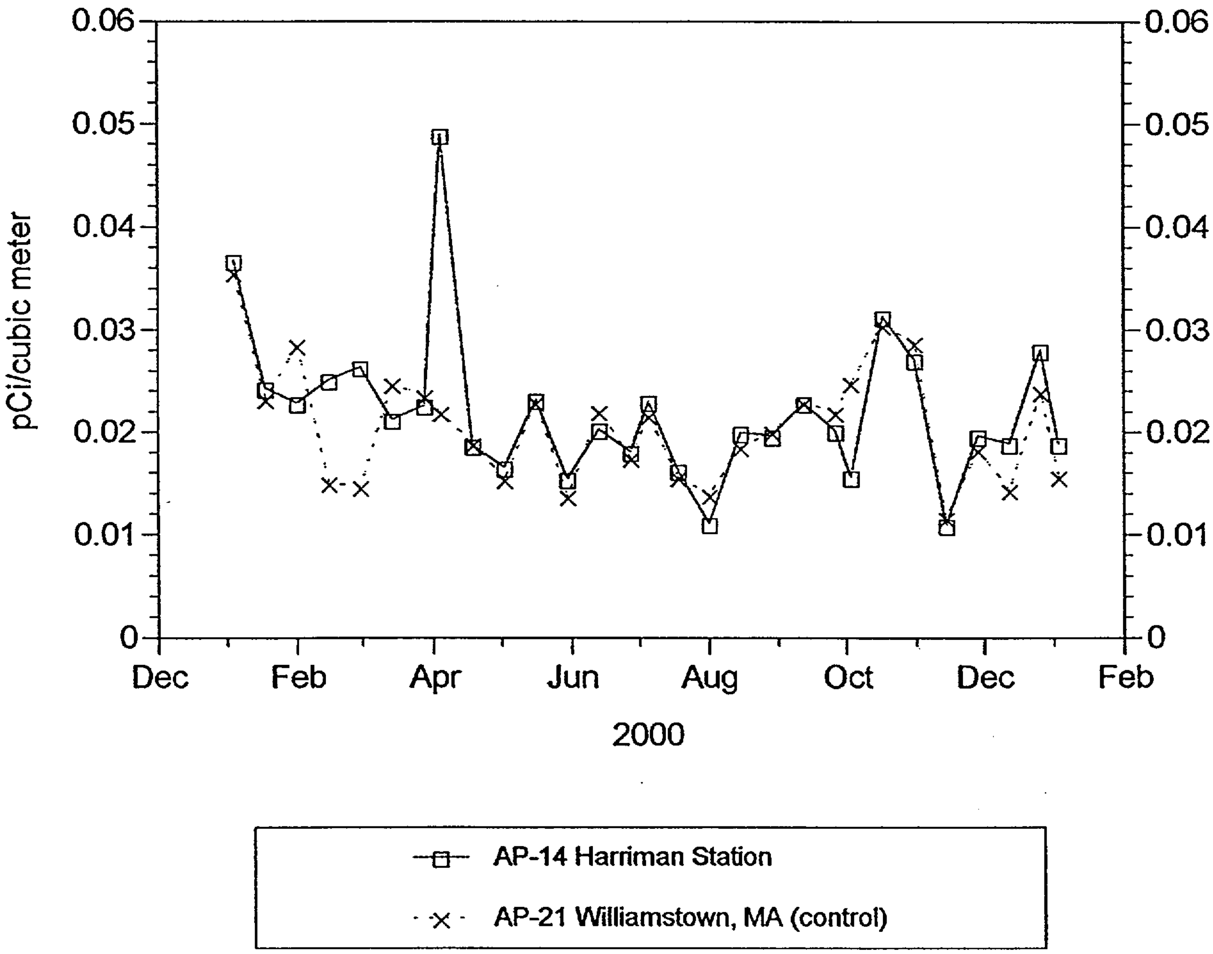


FIGURE 6.6

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

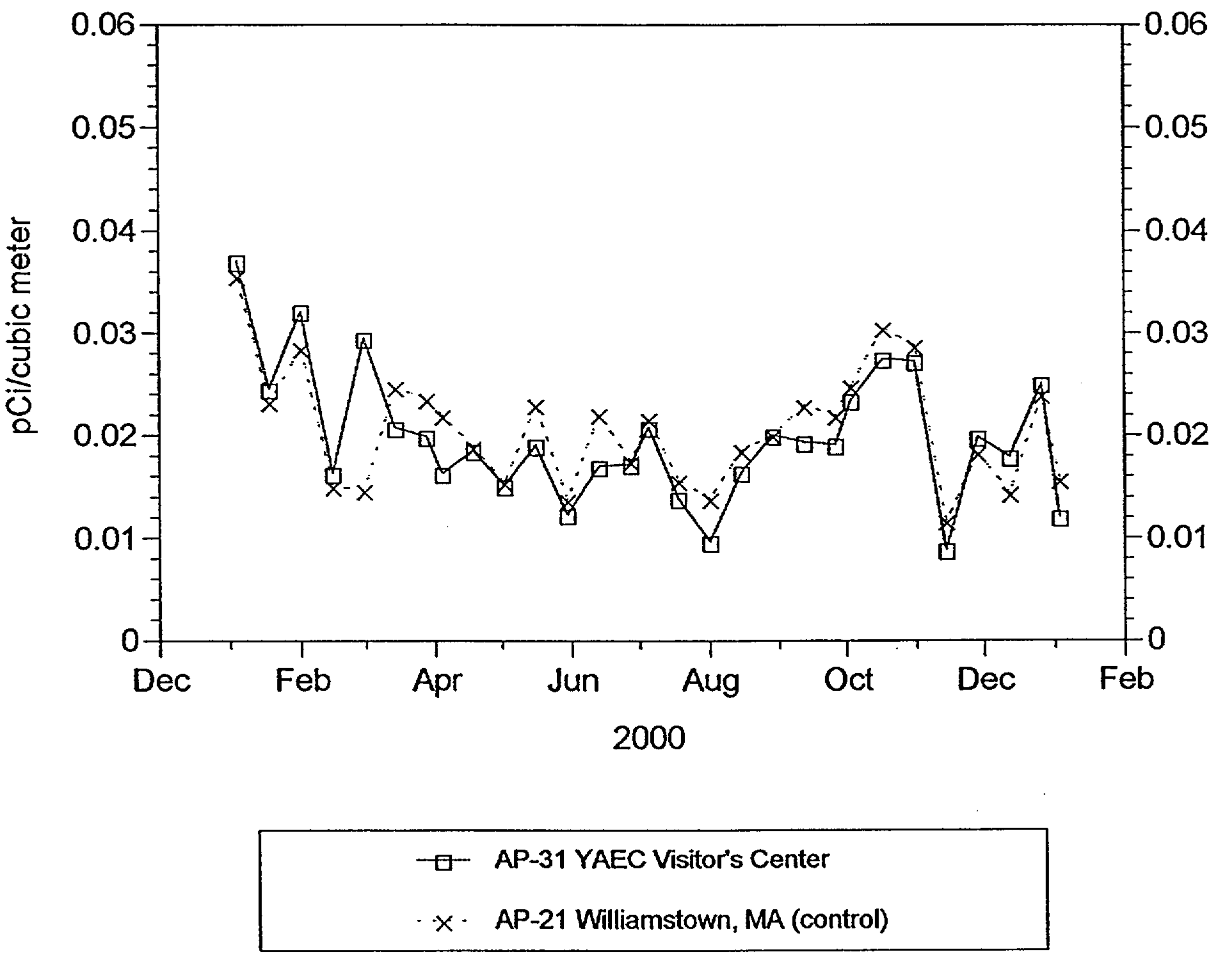


FIGURE 6.7

GROSS-BETA MEASUREMENTS OF GROUND WATER
SEMI-ANNUAL AVERAGES

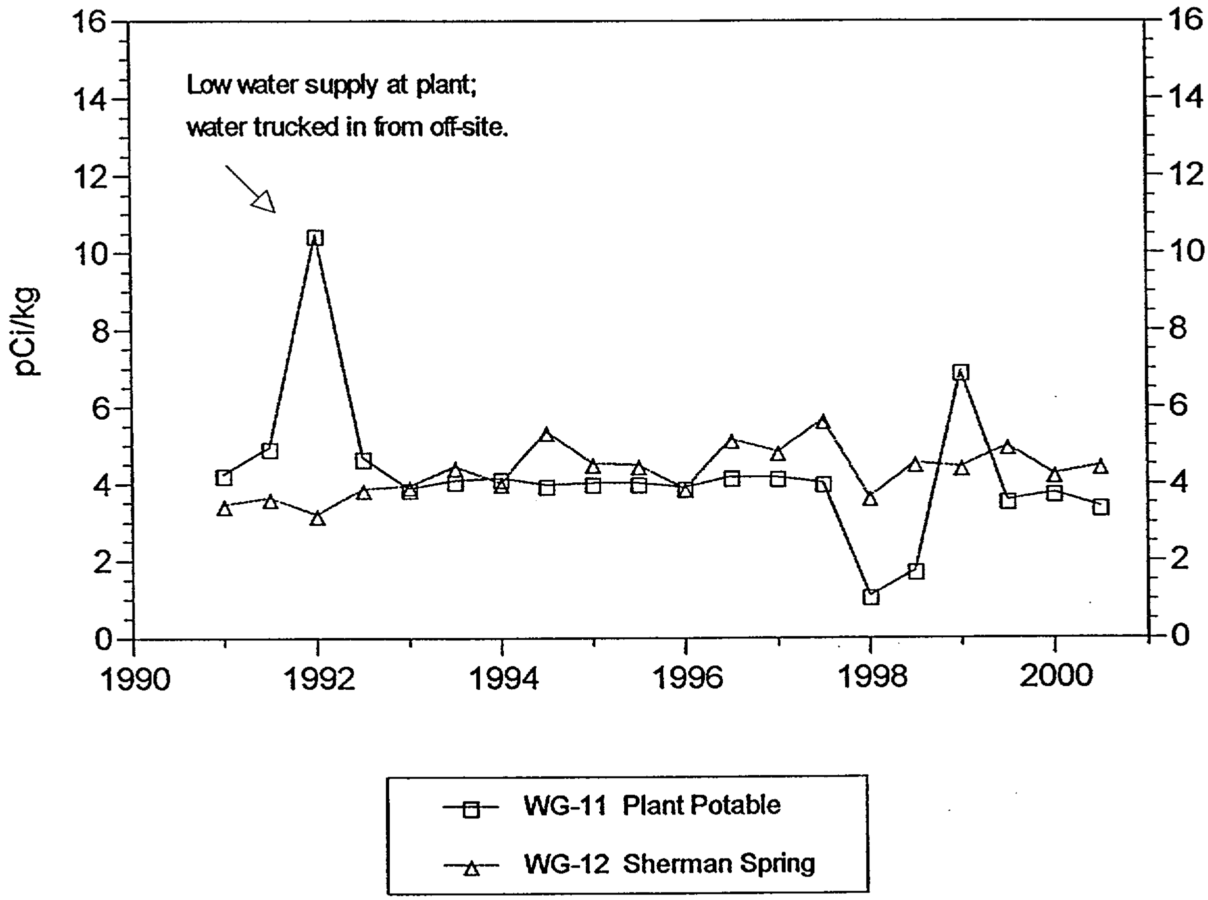


FIGURE 6.8

H-3 IN GROUND WATER
STATION WG-12, SHERMAN SPRING

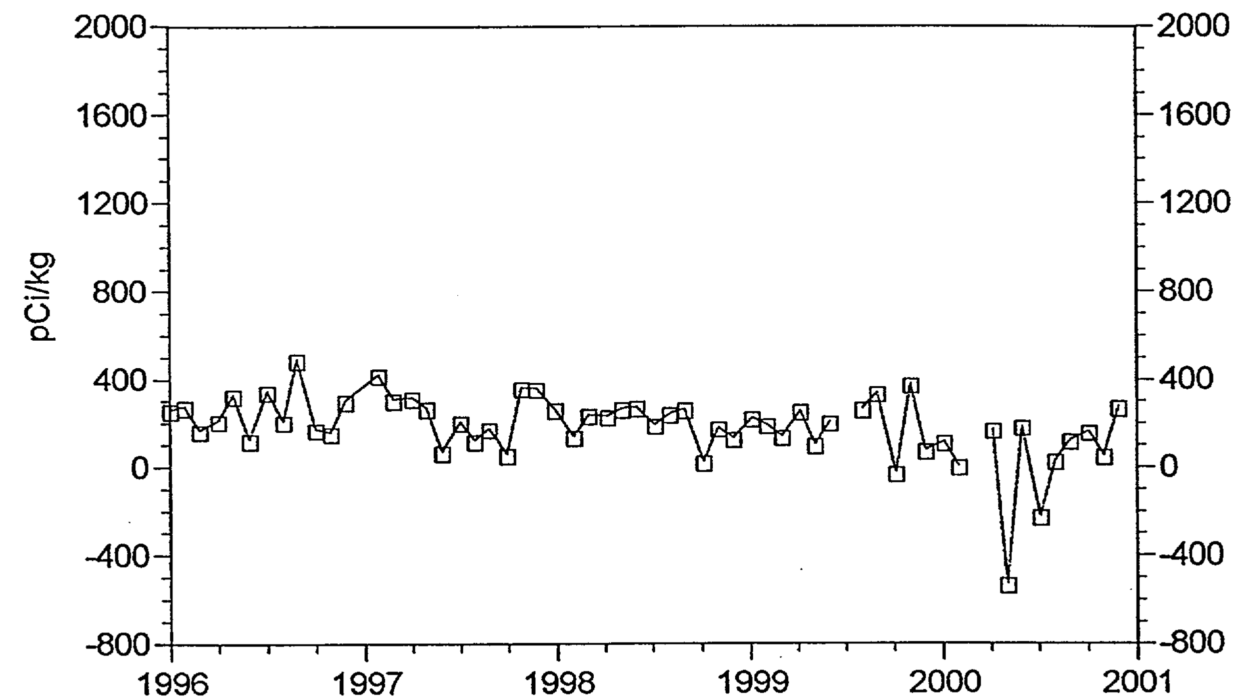


FIGURE 6.9

GROSS-BETA MEASUREMENTS OF RIVER WATER
SEMI-ANNUAL AVERAGES

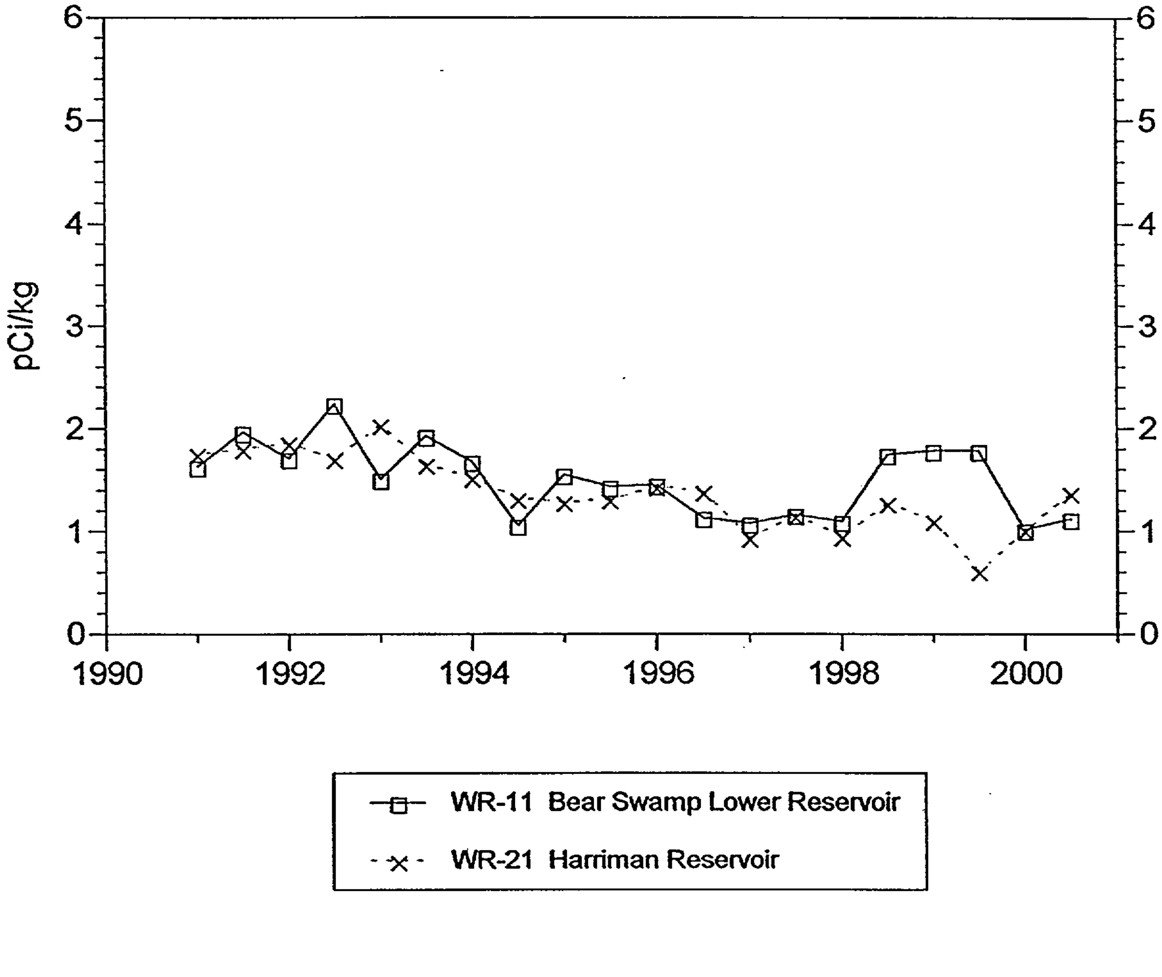


FIGURE 6.10

CESIUM-137 IN SHORELINE SEDIMENT
STATION SE-11, NO.4 STATION

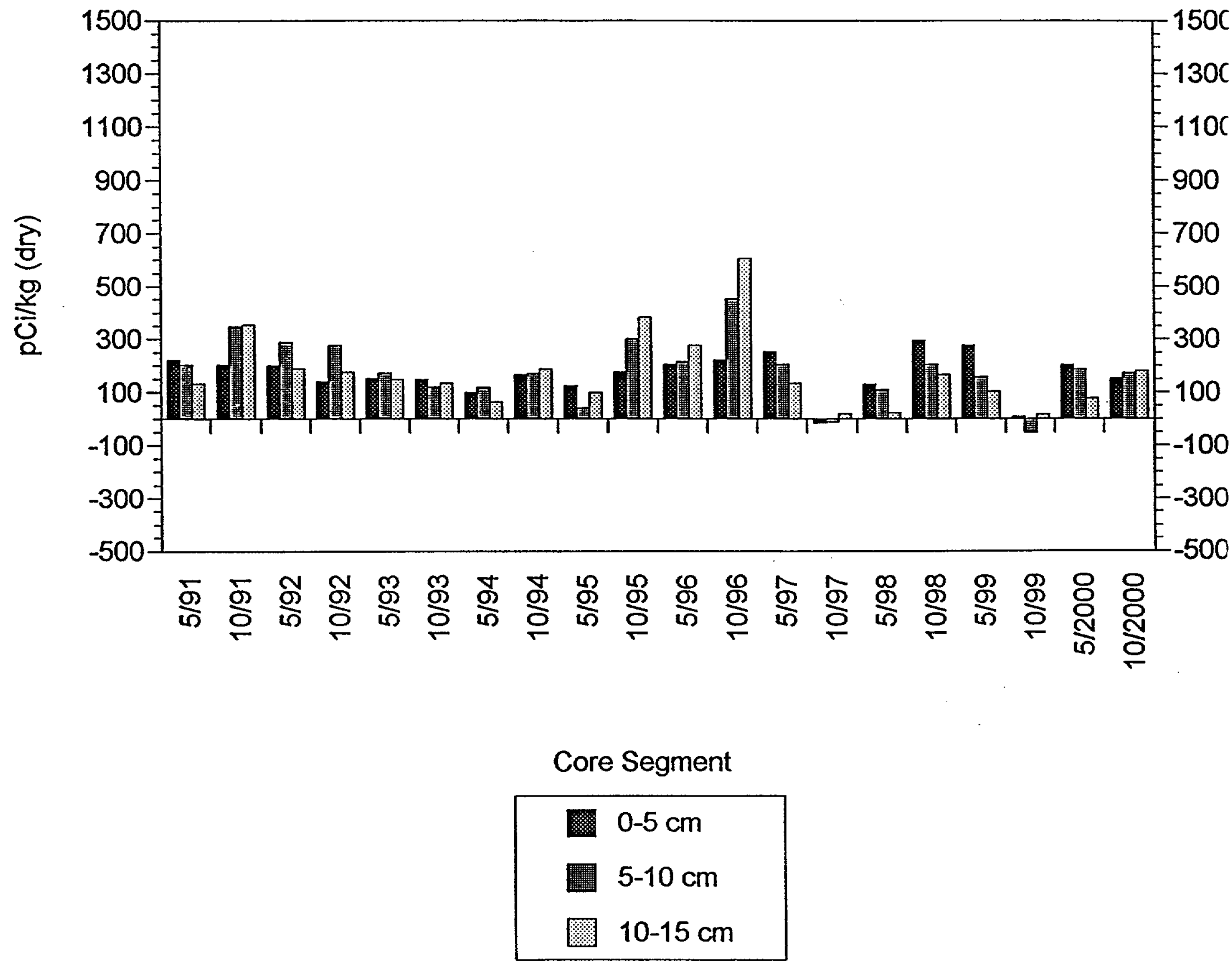


FIGURE 6.11

CESIUM - 137 IN SHORELINE SEDIMENT
STATION SE - 21, HARRIMAN RESERVOIR

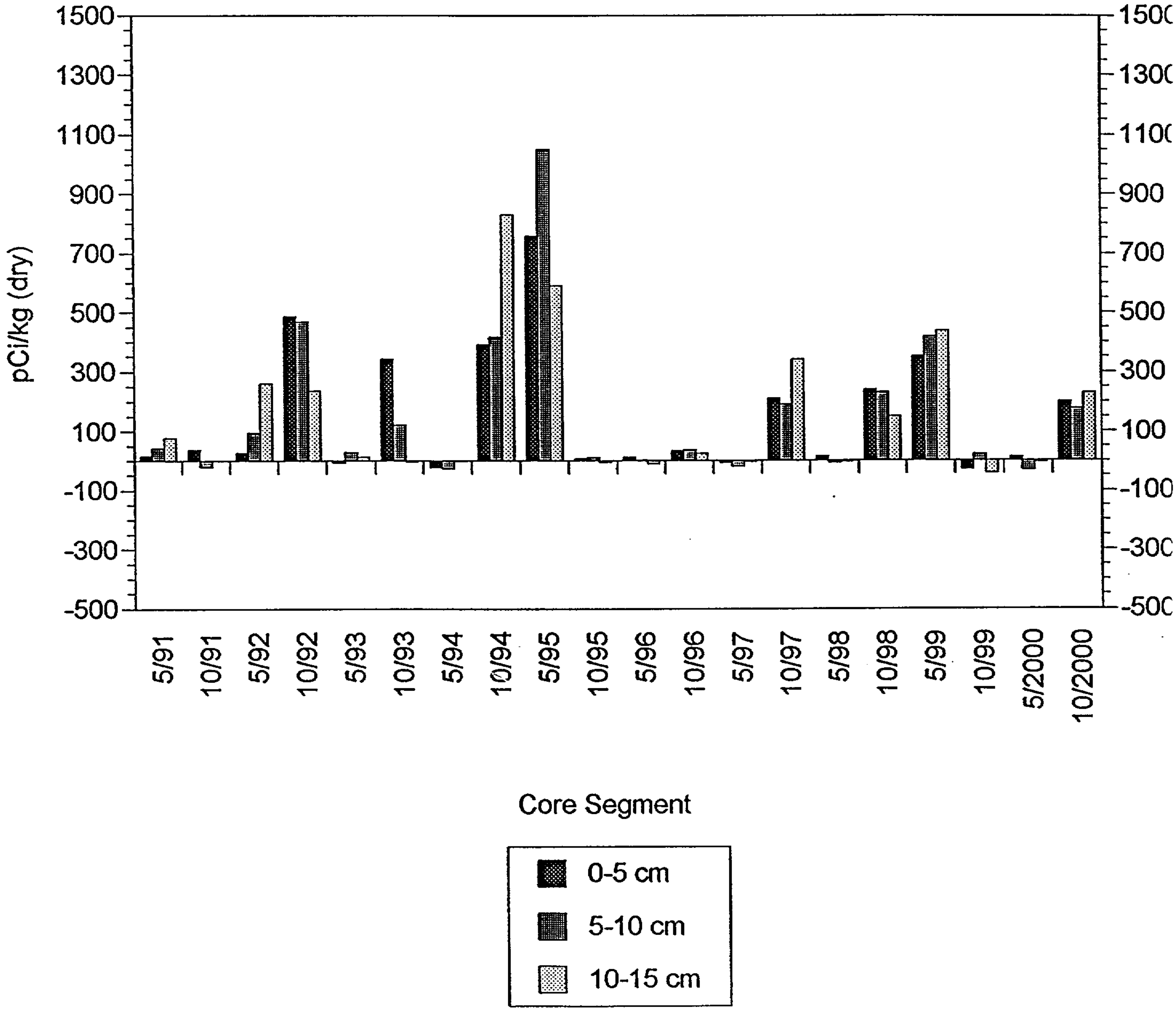


FIGURE 6.12

CESIUM - 137 IN BOTTOM SEDIMENT
STATION SE - 91, SHERMAN POND

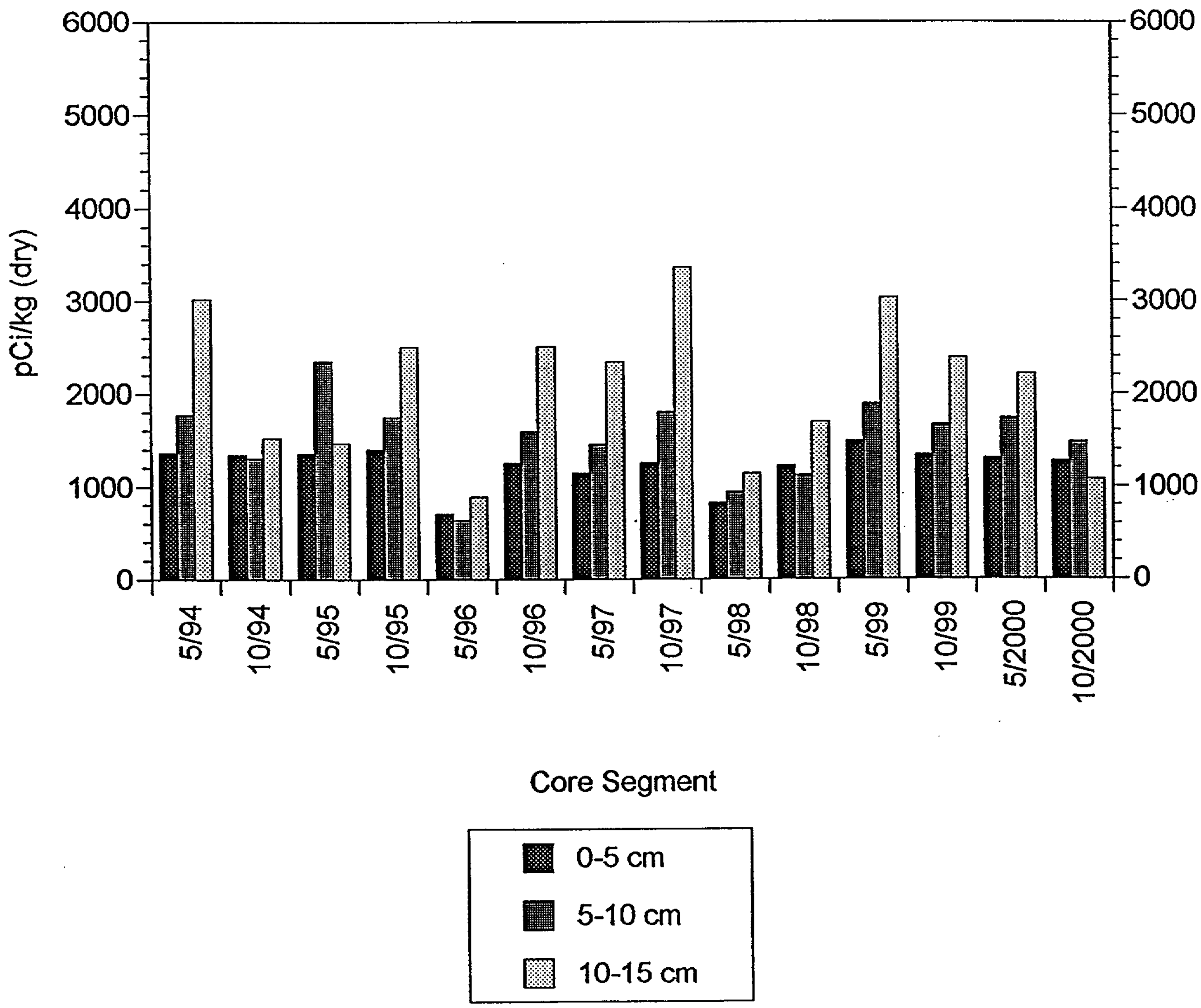
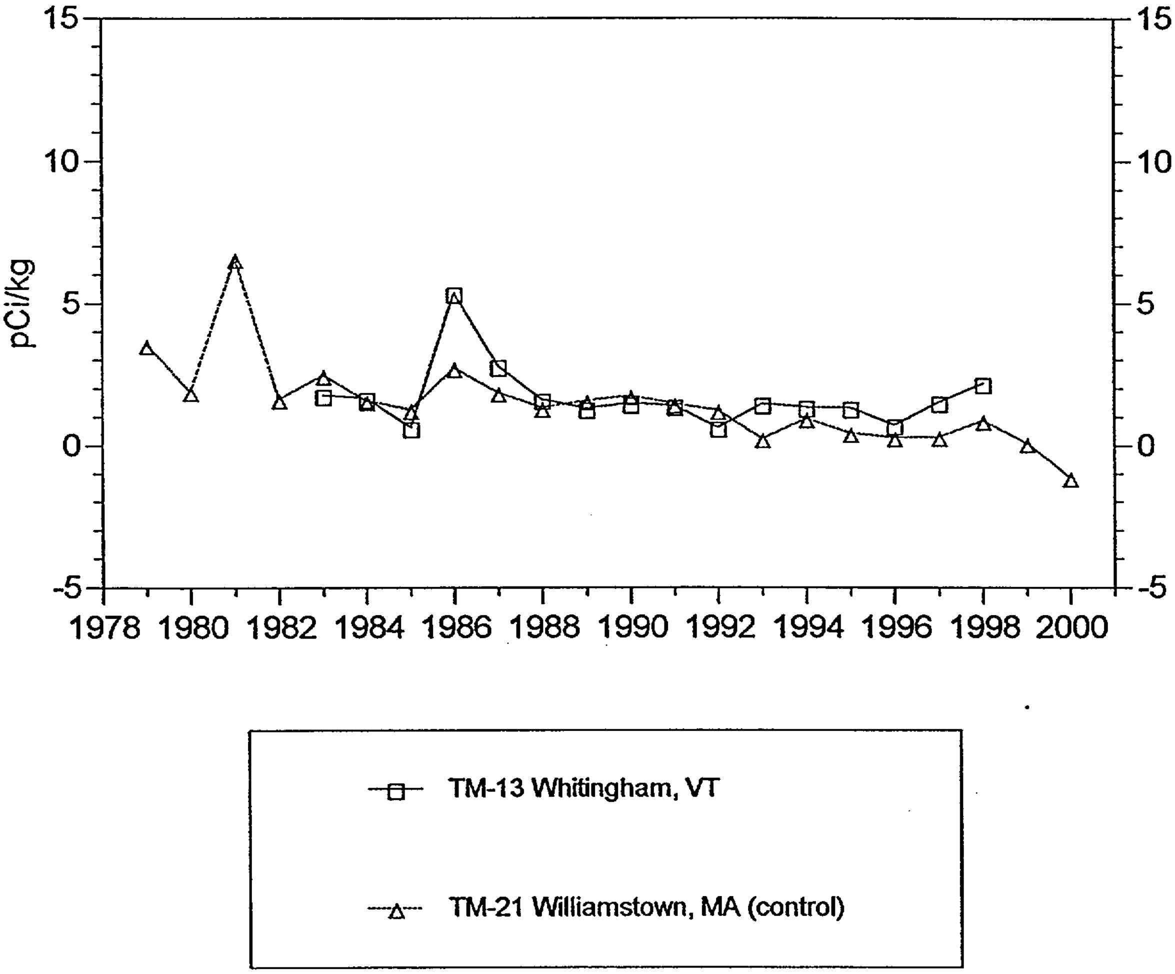


FIGURE 6.13

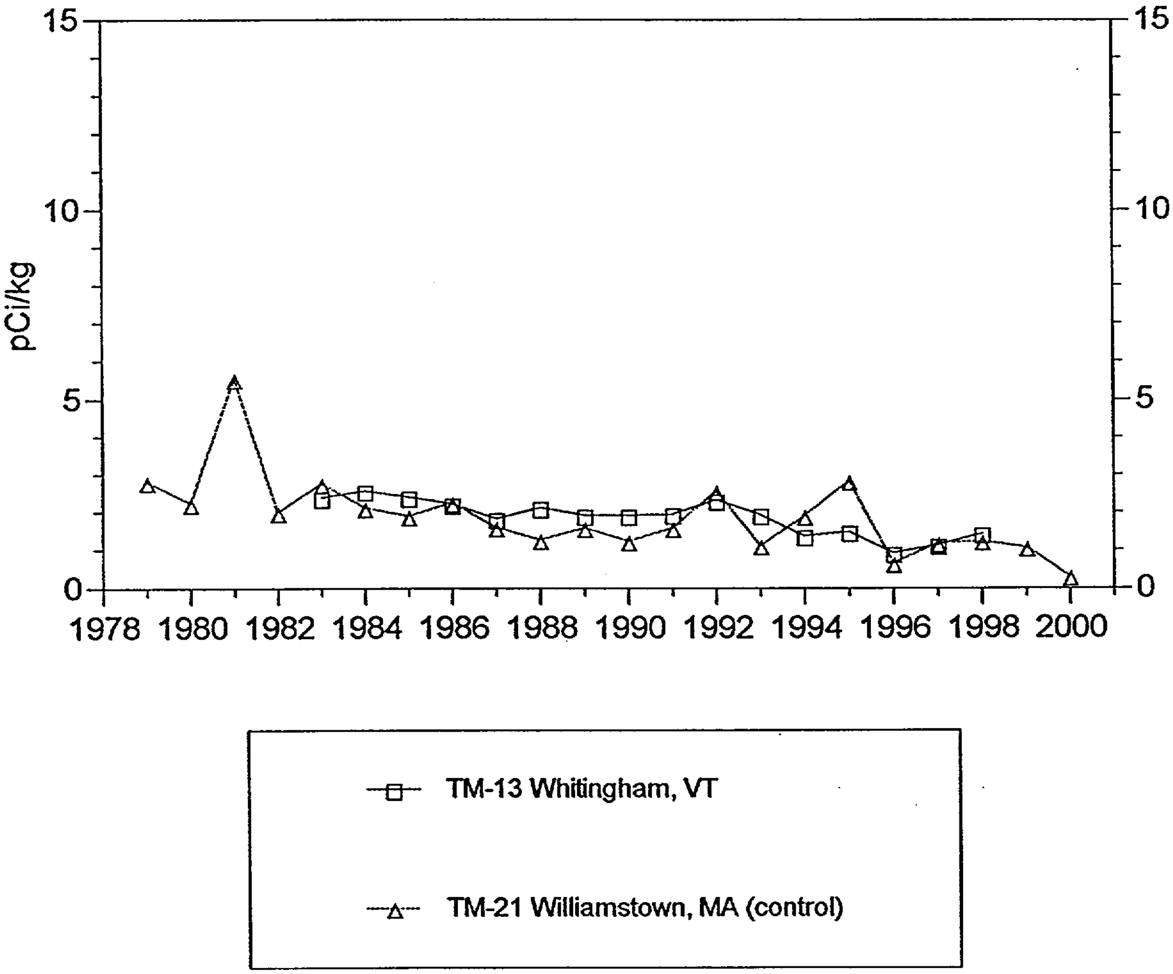
CESIUM - 137 IN MILK
ANNUAL AVERAGES



-No milk sampling location available within 5 miles

FIGURE 6.14

STRONTIUM - 90 IN MILK
ANNUAL AVERAGES



-No milk sampling location is available within 5 miles

FIGURE 6.15

CESIUM - 137 IN FISH
ANNUAL AVERAGE CONCENTRATIONS

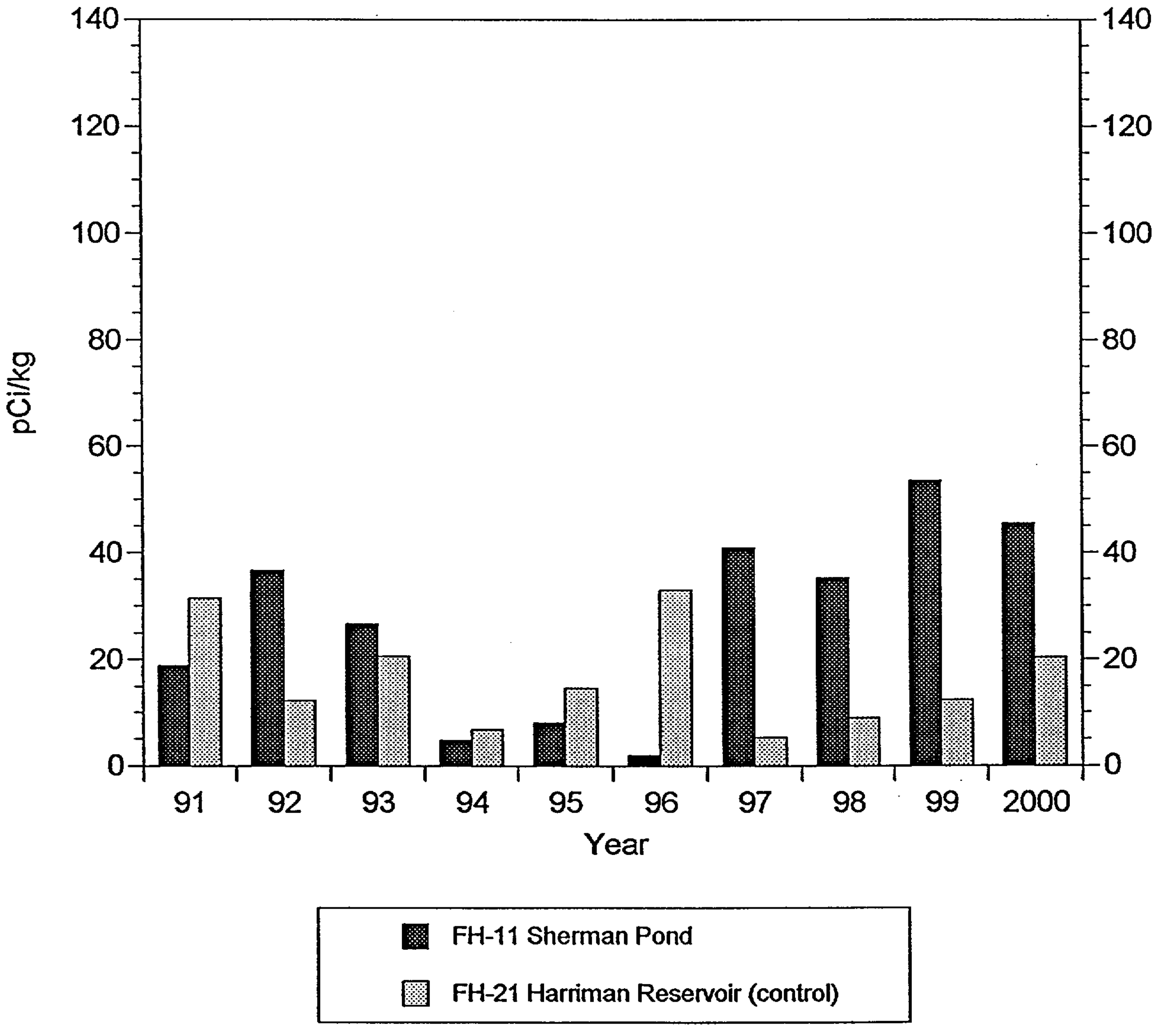


FIGURE 6.16

EXPOSURE RATE AT INDICATOR, OUTER RING AND CONTROL TLDS

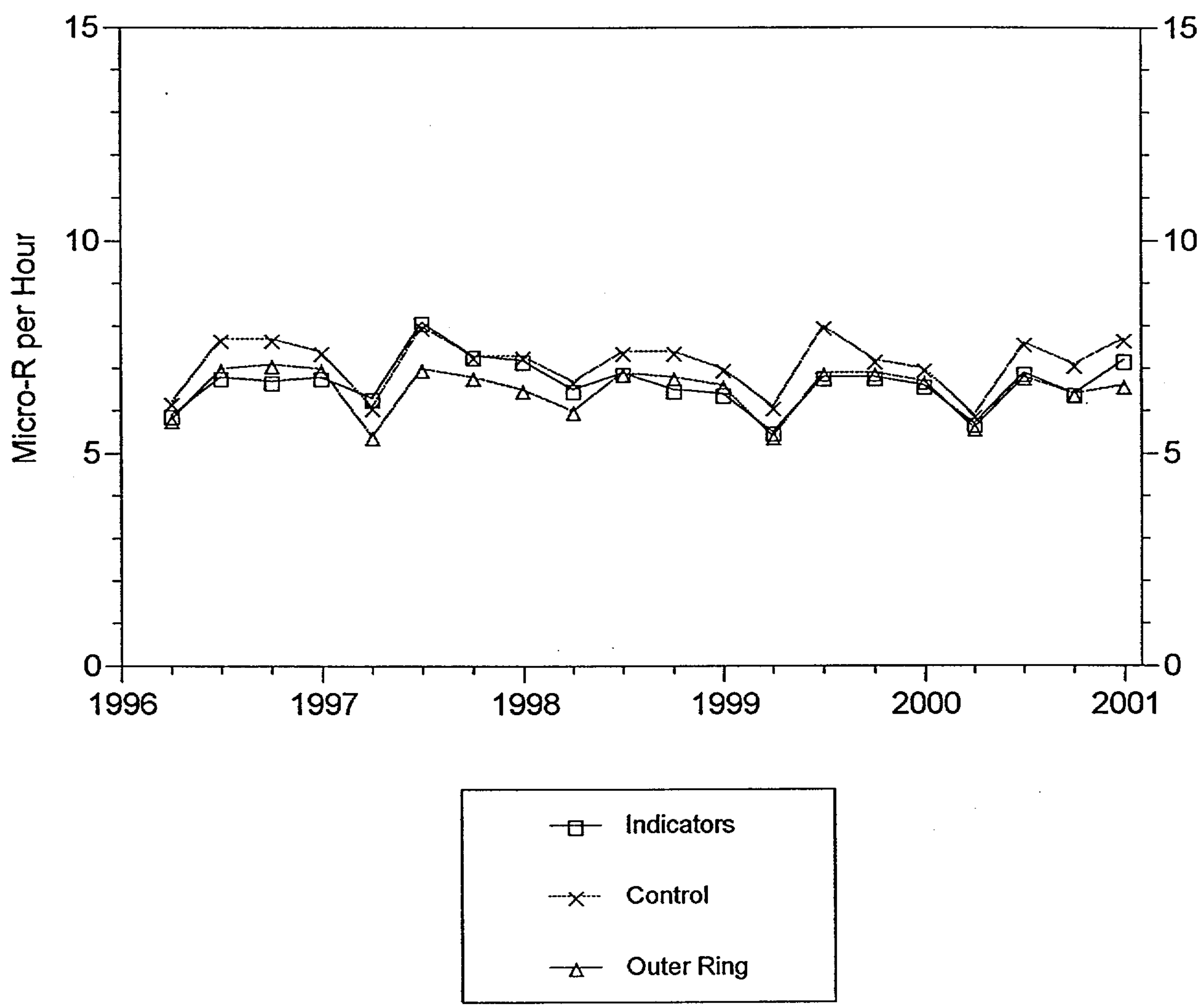


FIGURE 6.17

EXPOSURE RATE AT INDICATOR, TLDS, GM 01 - 04

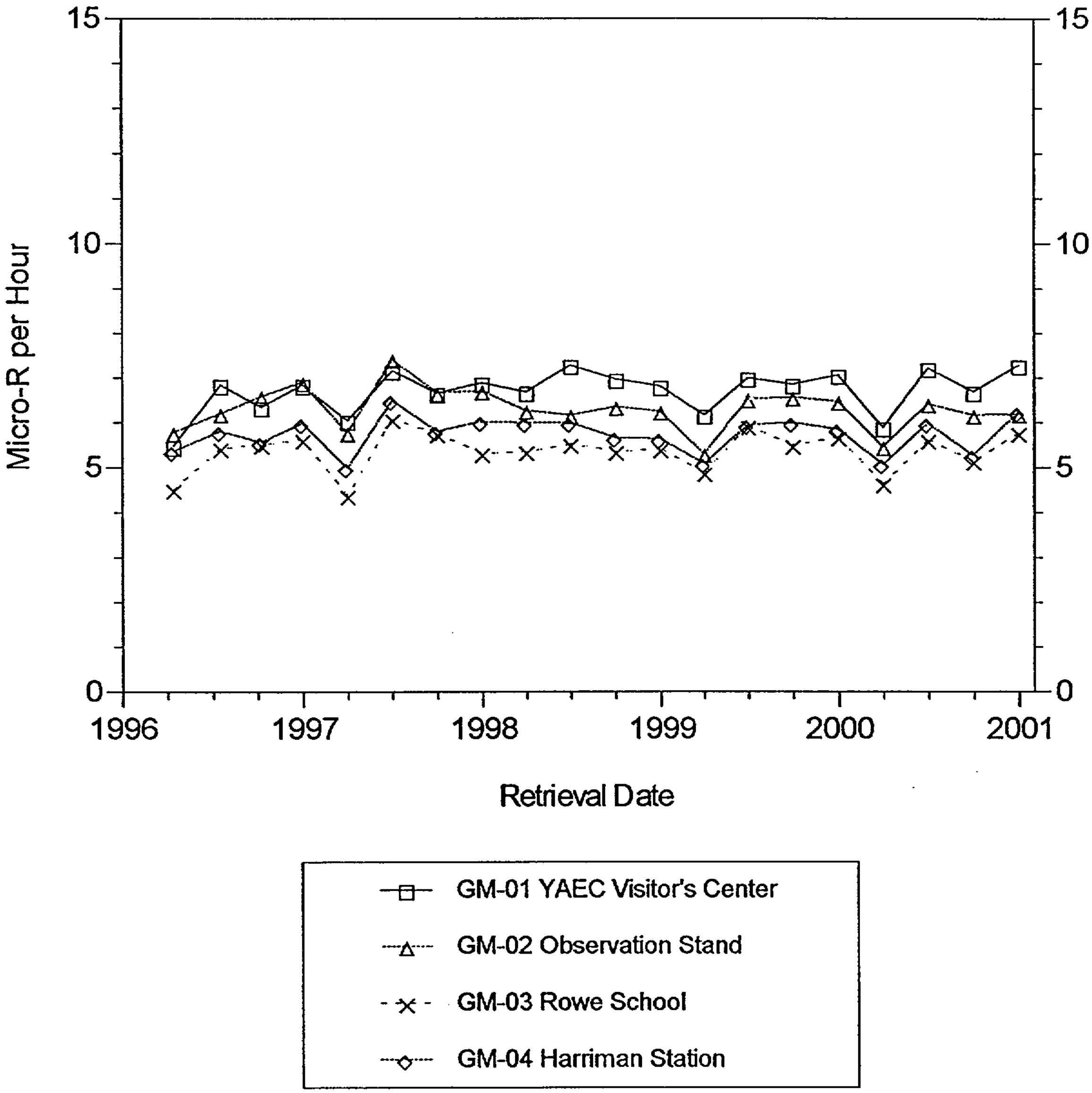


FIGURE 6.18

EXPOSURE RATE AT INDICATOR TLDS, GM 05 - 08

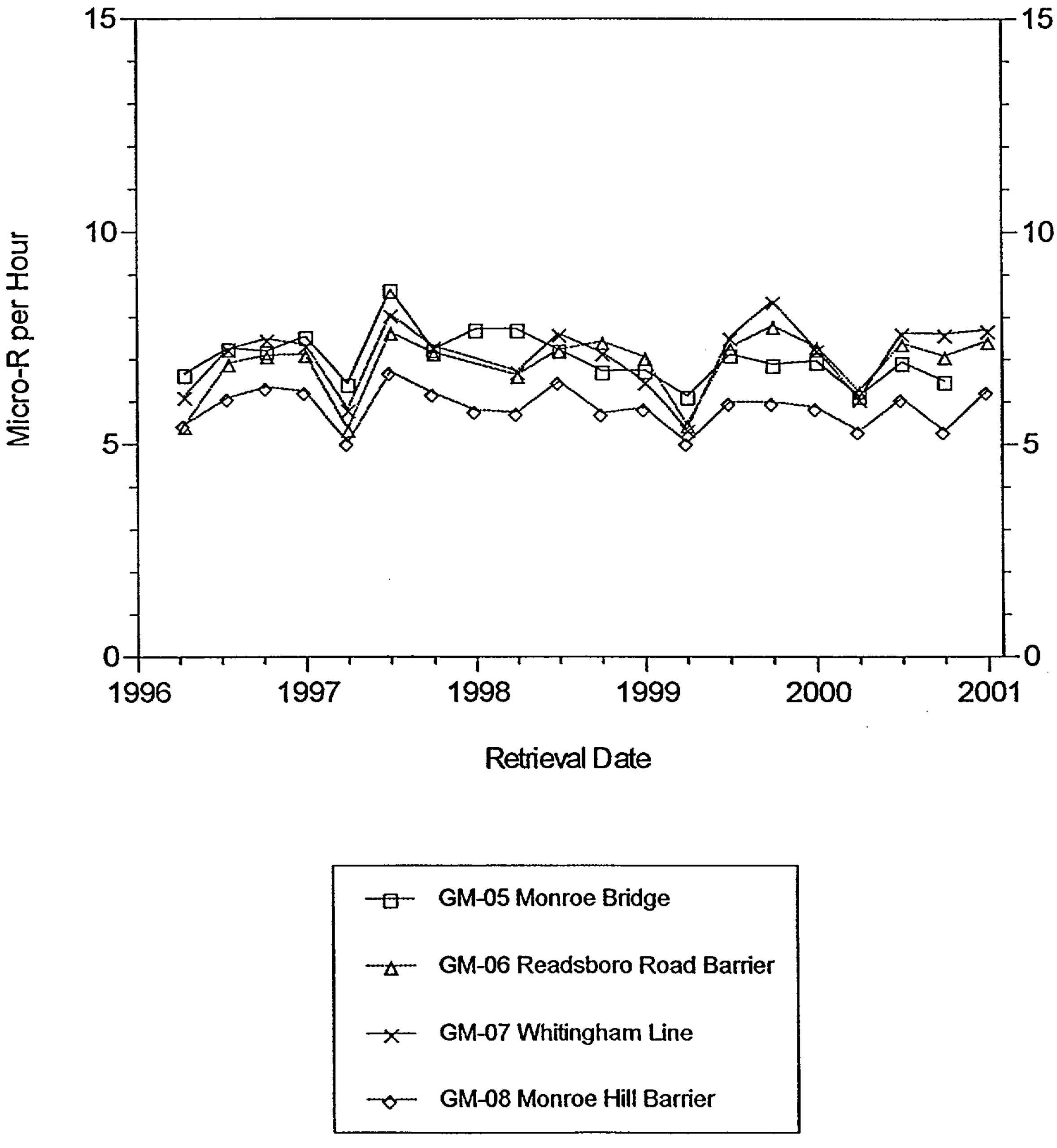


FIGURE 6.19

EXPOSURE RATE AT INDICATOR TLDS, GM 09 - 12, 40

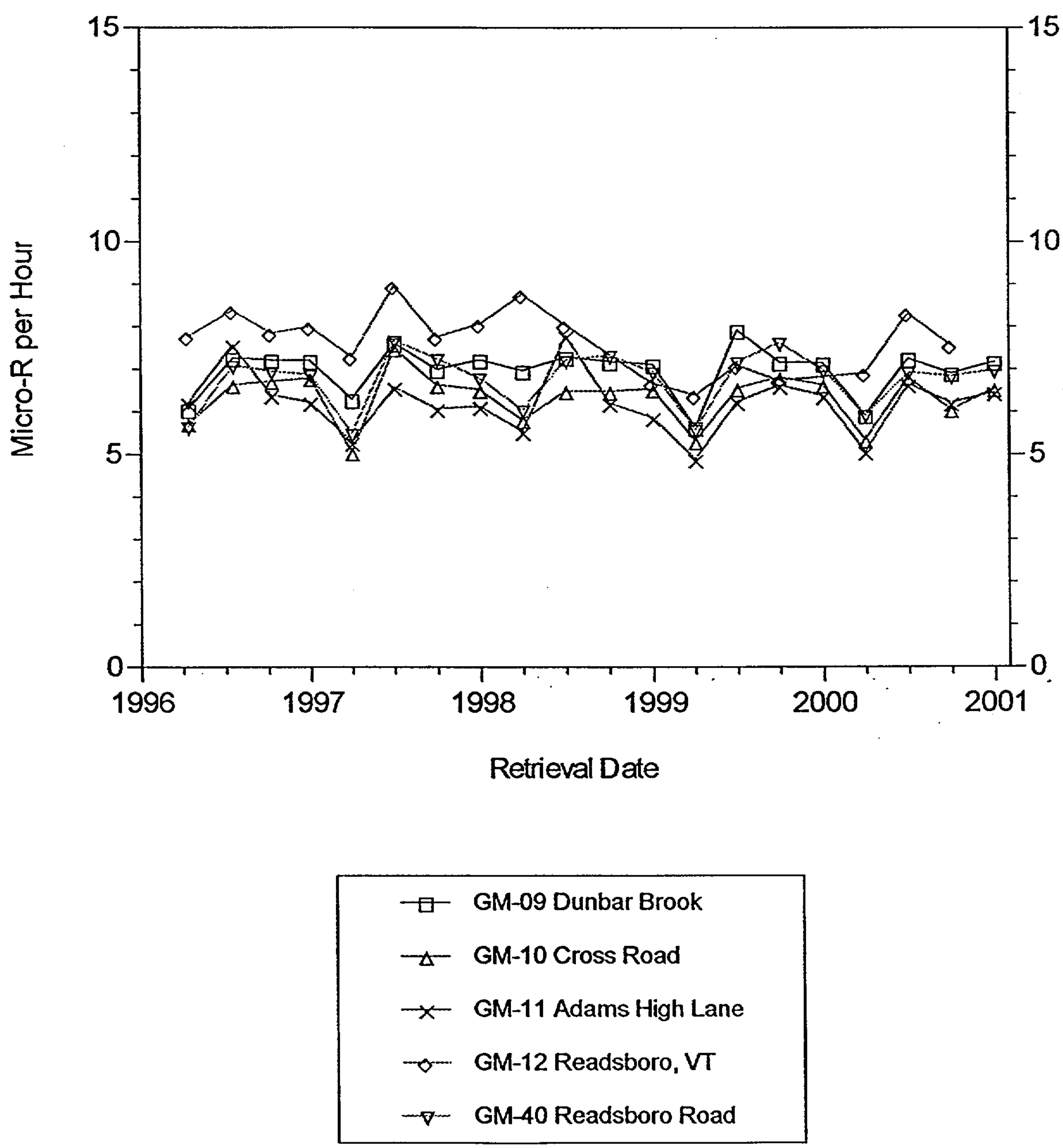


FIGURE 6.20

EXPOSURE RATE AT OUTER RING TLDS, GM 25 & 27

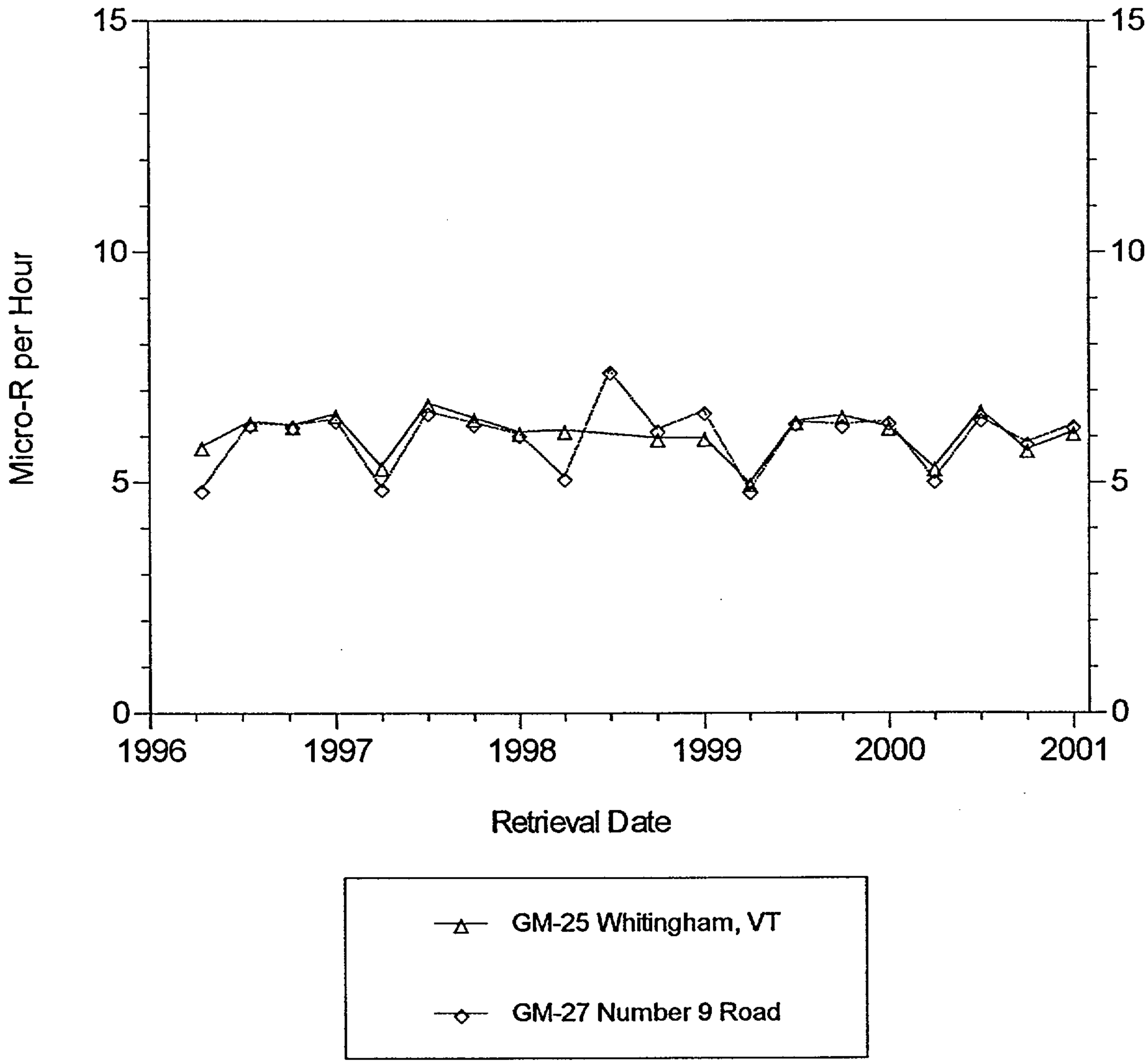


FIGURE 6.21

EXPOSURE RATE AT INDICATOR TLDS, GM 29 - 31

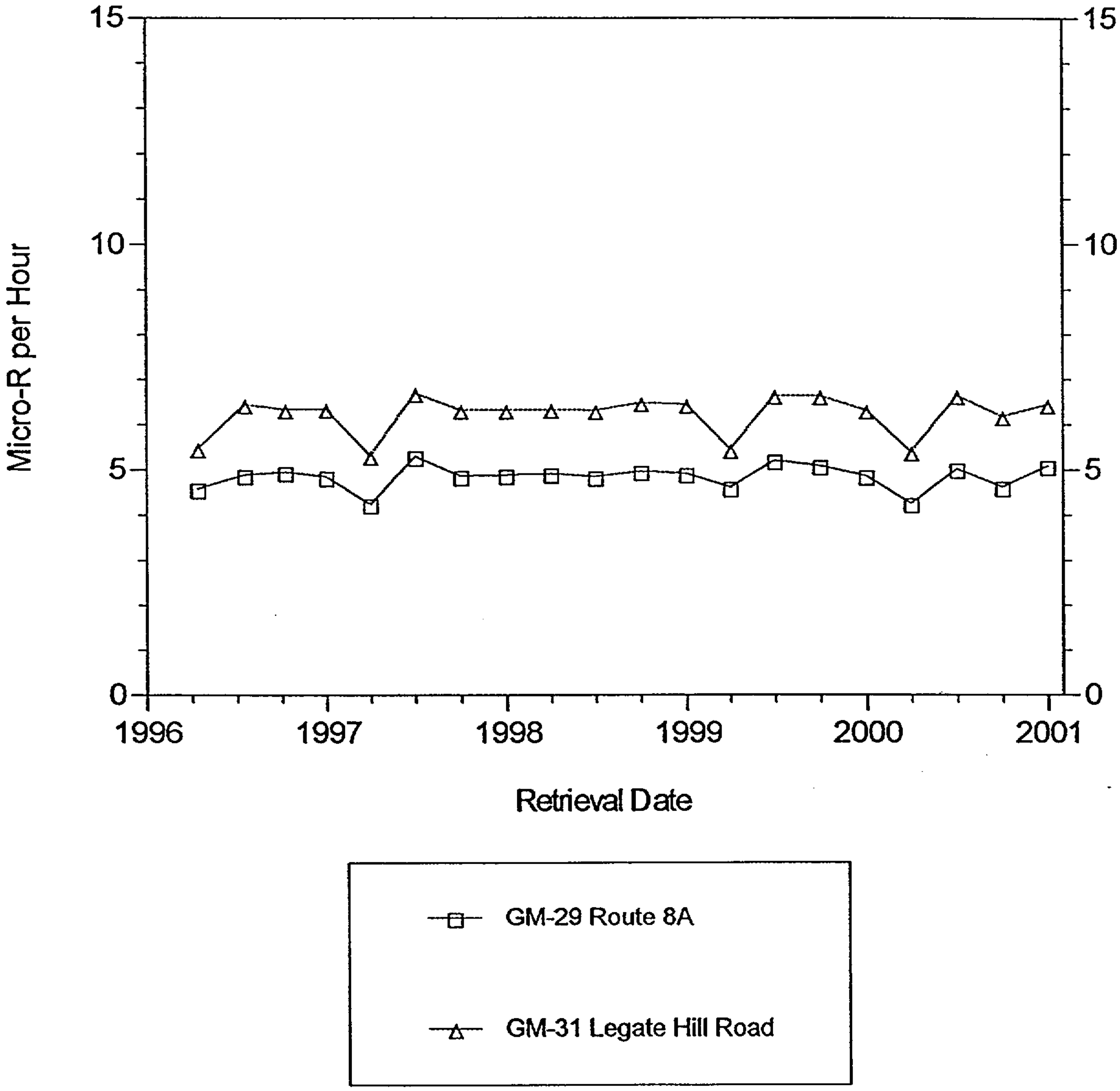


FIGURE 6.22

EXPOSURE RATE AT OUTER RING TLDS, GM 32, 33 & 35

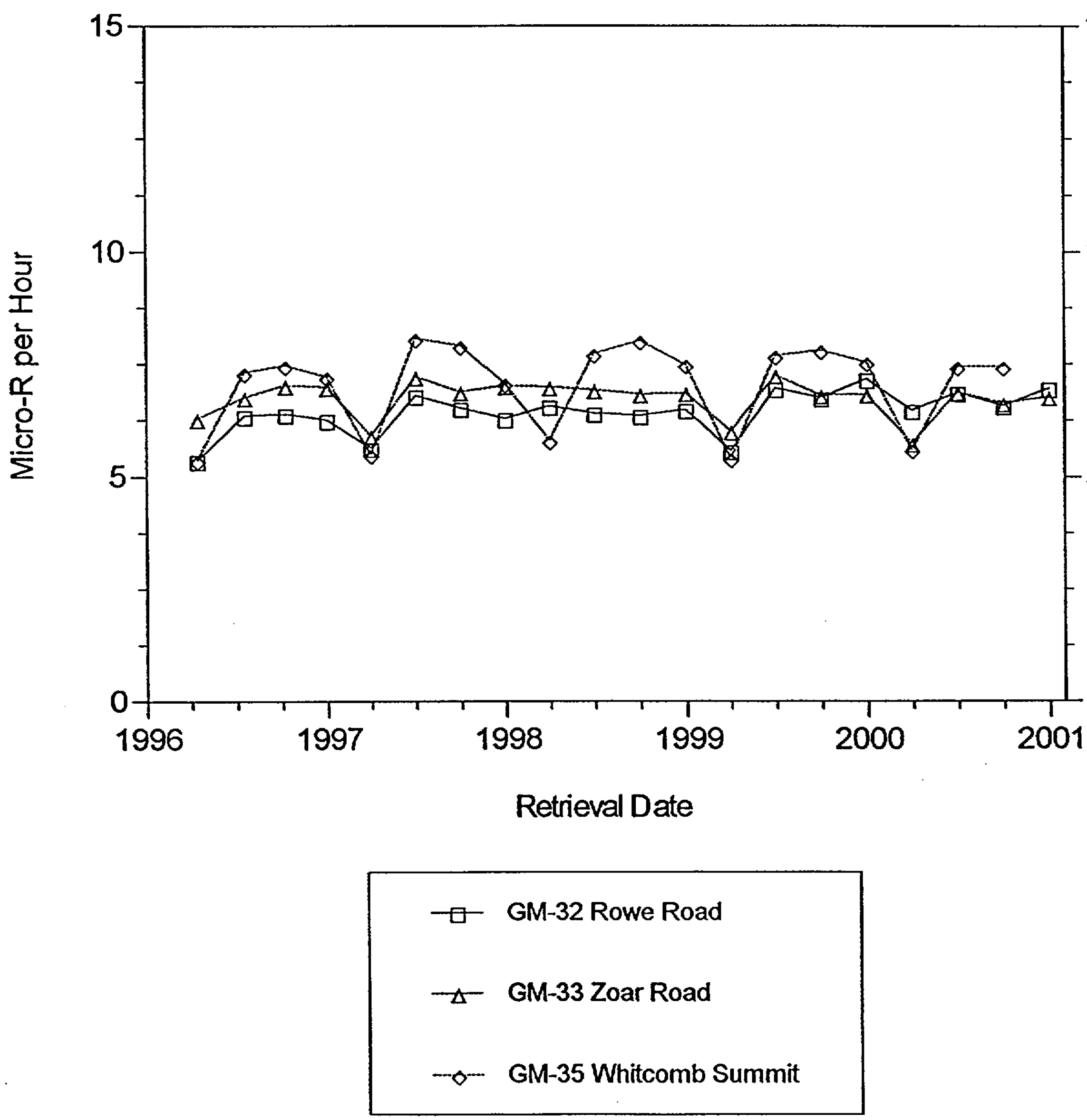


FIGURE 6.23

EXPOSURE RATE AT OUTER RING TLDS, GM 36, 38

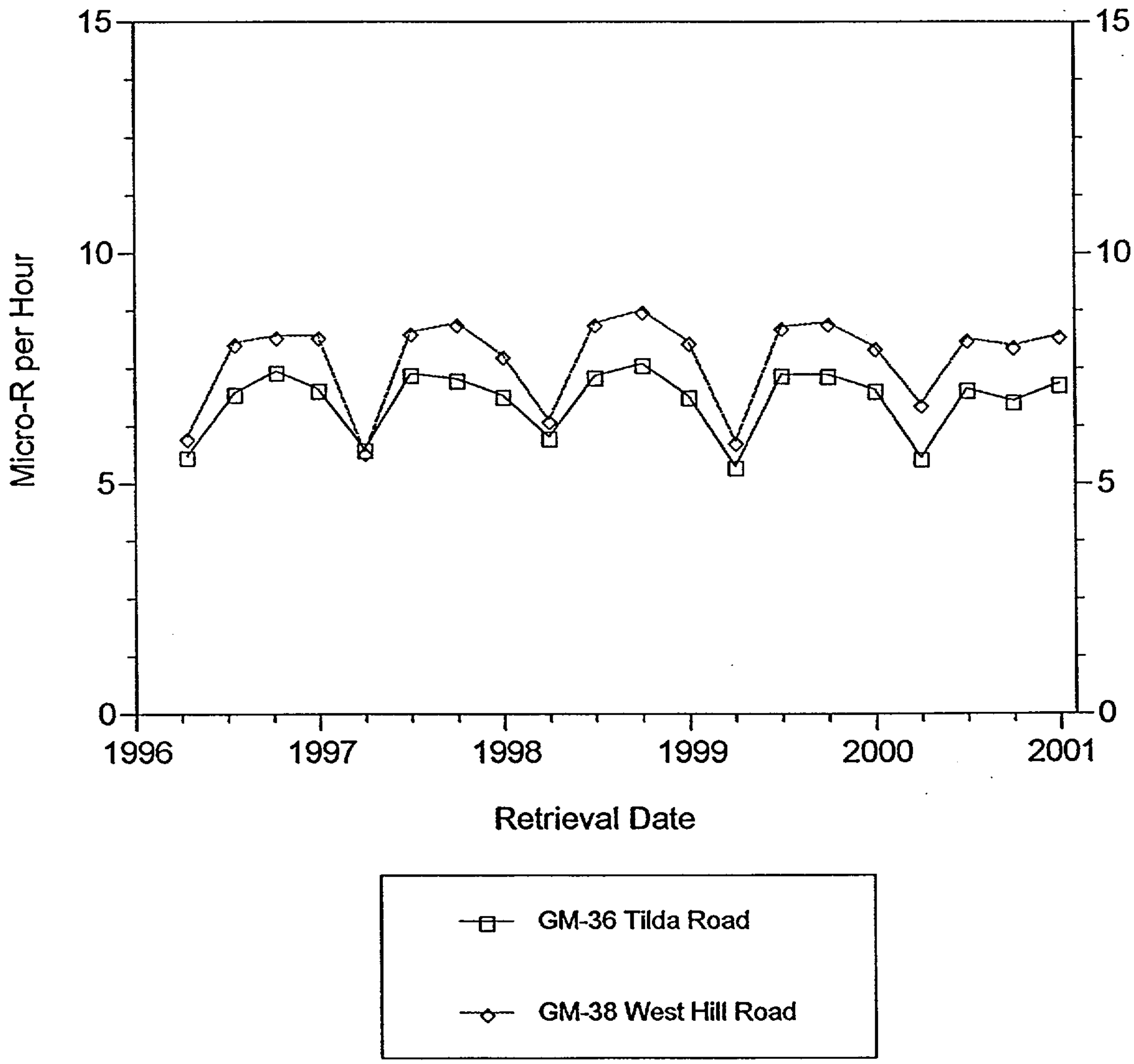


FIGURE 6.24

EXPOSURE RATE AT INDICATOR TLDS, GM 13-16

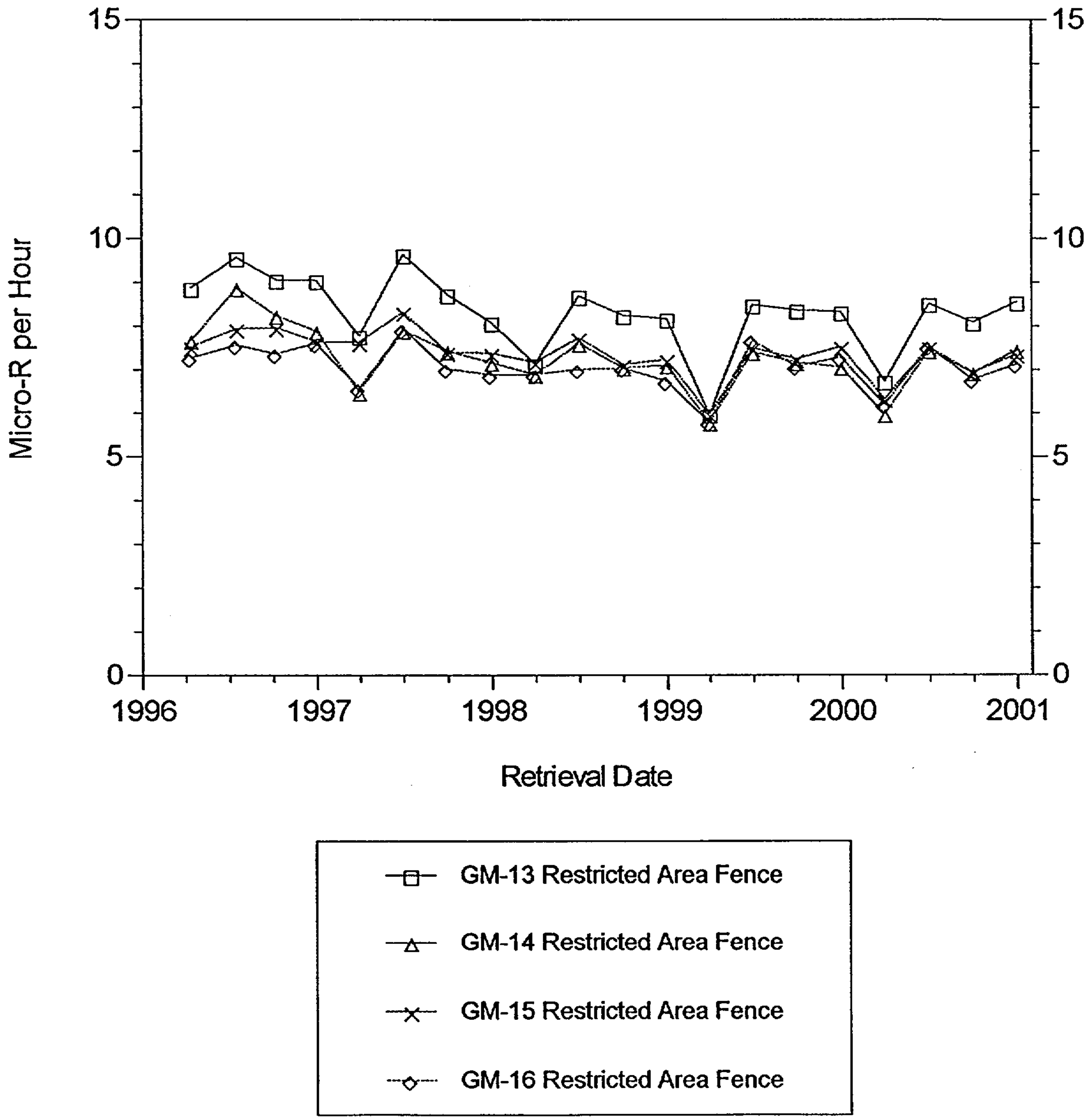


FIGURE 6.25

EXPOSURE RATE AT INDICATOR TLDS, GM 17 - 21

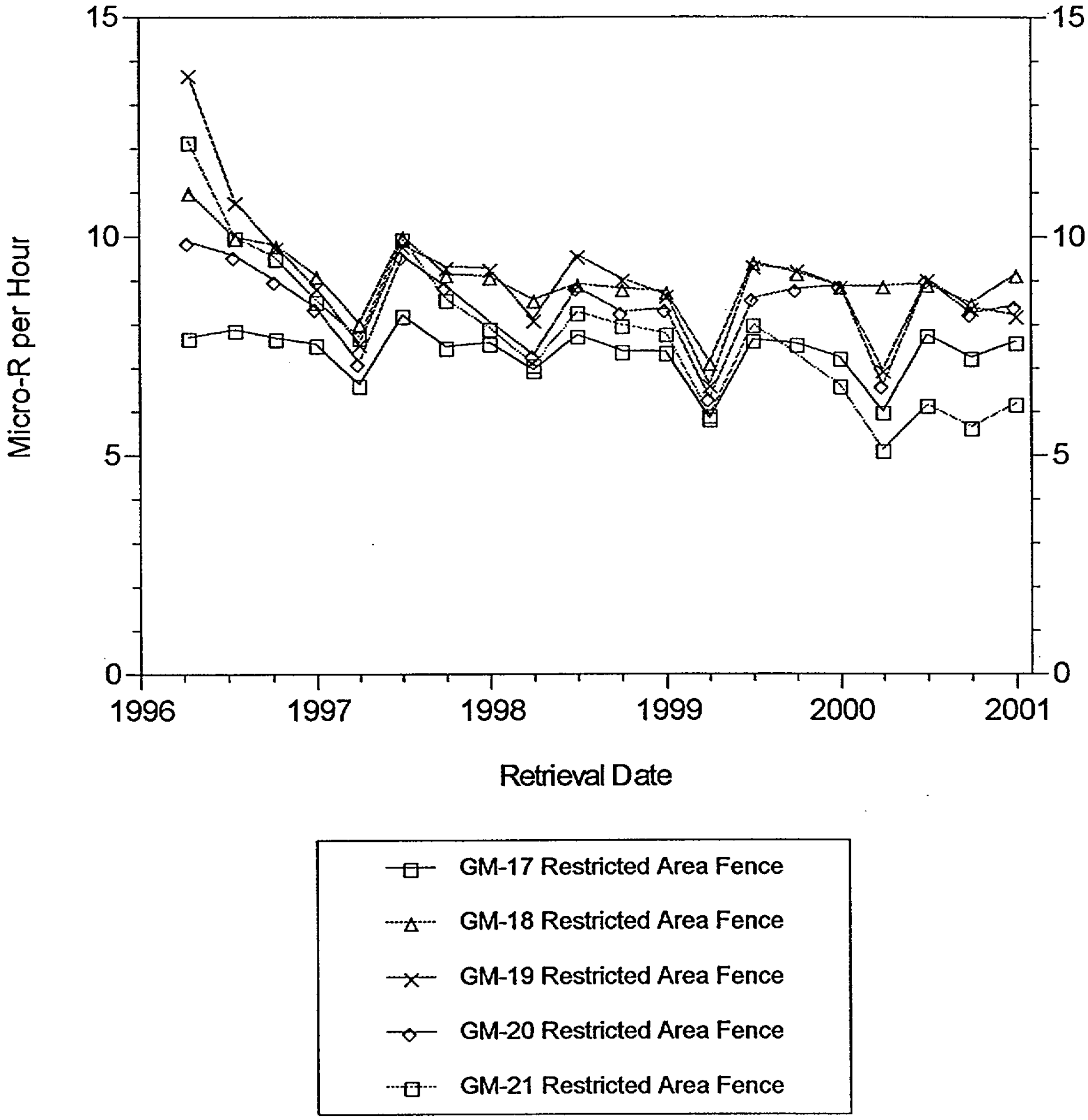
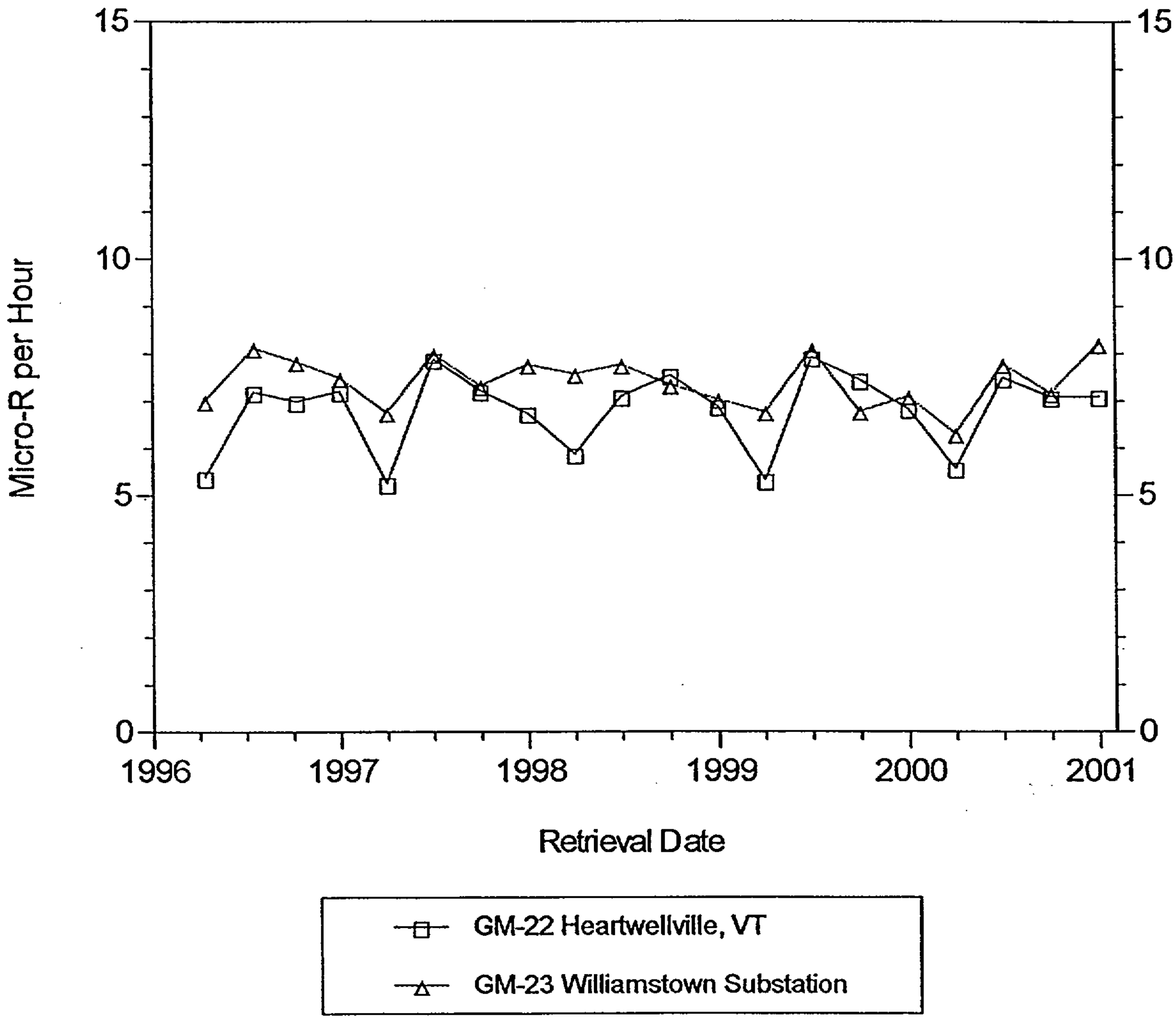


FIGURE 6.26

EXPOSURE RATE AT CONTROL TLDS, GM 22-23



7. QUALITY ASSURANCE PROGRAM

The quality assurance program at the Duke Engineering & Services Environmental Laboratory (DESEL) is designed to serve two overall purposes: 1) Establish a measure of confidence in the measurement process to assure the licensee, regulatory agencies and the public that analytical results are accurate and precise; and 2) Identify deficiencies in the sampling and/or measurement process to those responsible for these operations so that corrective action can be taken. Quality assurance is applied to all steps of the measurement process, including the collection, measurement and reporting of data, as well as the record keeping of the final results. Quality control, as part of the quality assurance program, provides a means to control and measure the characteristics of the measurement equipment and processes, relative to established requirements.

The DESEL employs a comprehensive quality assurance program designed to monitor the quality of analytical processing to ensure reliable environmental monitoring data. The program includes the use of controlled procedures for all work activities, a nonconformance and corrective action tracking system, systematic internal audits, audits by external groups, a laboratory quality control program, and a staff training program. Monitoring programs include the Intralaboratory Quality Control Program administered by the Laboratory QA Officer (used in conjunction with the National Institute of Standards and Technology Measurement Assurance Program, NIST MAP) and a third party interlaboratory program administered by Analytics, Inc. Together these programs are targeted to supply QC/QA sources at 5% of the client sample analysis load. In addition the Laboratory Quality Control Audit Committee administers a blind duplicate program conducted through client environmental monitoring programs.

This summary reports all interlaboratory known values or intralaboratory results received by DESEL on or before December 31, 2000.

7.1 Intralaboratory Quality Control Program

The DESEL QA Officer administers an extensive intralaboratory quality control program in which process check samples are submitted for analysis. These samples are submitted either in duplicate to evaluate the precision of a measurement process or are "spiked" with a known amount of radioactive material to assess the bias in the measurement. Table 7.1 contains the summary of the process check results for January to December 2000. Of the analyses, 99% passed the bias criteria and 100% of the results evaluated for precision were acceptable.

7.2 Third Party Intercomparison Program

The DESEL participates in a third party intercomparison program managed by Analytics Inc. to satisfy the requirement of the Environmental Technical Specification/ODCM. The DESEL Analytics program was originally used to augment the EPA Intercomparison Program that it now replaces. The current program is designed to be comparable to the pre-1996 EPA PE Program in terms of the number of samples, matrices and nuclides. The results for the 4th quarter 1999 through the 3rd quarter 2000 are

summarized in Table 7.2. Each sample is analyzed in triplicate and the results are evaluated against the acceptance criteria described in the DESEL Manual 100-Laboratory Quality Assurance Plan. The DESEL acceptance criteria is summarized at the end of Table 7.2. This acceptance protocol is used for all interlaboratory programs with no pre-set acceptance criteria. When results fall outside of the acceptance criteria, an investigation is initiated to determine the cause of the problem and if appropriate, corrective measures are taken.

Four Analytics results fell in the 'non-agreement' category and were under investigation for their failure at the time of this report.

7.3 Blind Duplicate Program

The Laboratory Quality Control Audit Committee (LQCAC) is comprised of representatives from several New England DESEL clients. Two of the primary functions of the LQCAC have been to conduct an annual audit of Laboratory operations and to coordinate the Blind Duplicate Quality Assurance Program. Under the Blind Duplicate Quality Assurance Program, samples are split from homogeneous environmental media by the client and sent to the DESEL for analysis. They are "blind" in that the identification of the matching sample is not identified to the Laboratory. The LQCAC analyses the results of the paired analyses to evaluate the precision of the Laboratory measurements.

Participating clients submitted a total of 36 paired samples in 2000. The measurements evaluated include twenty-five gamma emitting radionuclides, H-3, Sr-89, Sr-90, I-131 and gross-beta. All measurements are evaluated, whether the results are statistically positive or not, and whether the net concentration is positive or negative. During 2000, 99.9% of the results passed the acceptance criteria.

The samples submitted as part of this program are listed in Table 7.3.

7.4 Environmental TLD Quality Assurance Program

Performance documentation of the routine processing of the Panasonic environmental TLDs (thermoluminescent dosimeter) program at the DESEL is provided by the dosimetry quality assurance testing program. This program includes the National Voluntary Laboratory Accreditation Program, independent third party performance testing by Battelle Pacific Northwest Labs and internal performance testing conducted by the Laboratory QA Officer. Under these programs, dosimeters are irradiated to ANSI specified testing criteria and submitted for processing to the Dosimetry Services Group as "unknowns". The bias and precision of TLD processing is measured against this standard and is used to indicate trends and changes in performance. Instrumentation checks, although routinely performed by the Dosimetry Services Group and representing between 5-10% of the TLDs processed, are not presented in this report because they do not represent a true process check sample since the doses are known to the processor.

Seventy-eight performance tests were conducted in 2000 by DESEL and the third party tester. Of these, 100% of the dosimeter evaluations met the acceptance criteria for bias (± 20.1%) and precision (±12.8%). Third Party QC results are summarized below.

Dosimeter Type	Number Tested	Shallow ($7mg/cm^2$)	
		% passed bias criteria	% passed precision criteria
Panasonic Environmental	78	100	100

Summary of Third Party Testing

Dosimeter Type	Exposure Period	NVLAB Category	Shallow ($7mg/cm^2$)	
			% (Bias ± SD)	|B| + S*
Panasonic Environmental	Q4/1999	IV, high energy	-15.3 ± 2.5	0.173
"	Q1/2000	IV, high energy	0.3 ± 7.3	0.076
"	Q2/2000	IV, high energy	4.5 ± 1.2	0.058
"	Q3/2000	IV, high energy	-0.3 ± 0.4	0.007

Note: Results are expressed as the delivered exposure for environmental TLD. NVLAB Category IV, High energy photons (Cs-137 or Co-60).

* American National Standards Institute (ANSI) Performance Statistic as referenced in the Dosimetry Services Semi-Annual QA Status Report.

TABLE 7.1

DESEL RESULTS IN THE INTRALABORATORY PROCESS CONTROL PROGRAM

January - December 2000

Media Analysis	Bias Criteria (1) 1	2	3	4	Precision Criteria (2) 1	2	3	4
I. Air Charcoal								
Gamma	47	2	1	0	0	0	0	0
II. Air Filter								
Alpha	1	5	0	0	6	0	0	0
Beta	105	0	0	0	0	0	0	0
Gamma								
III. Milk								
Gamma	3	0	0	0	3	0	0	0
Iodine-LL	3	0	0	0	3	0	0	0
IV. Water								
Gross Alpha	6	2	0	0	5	0	0	0
Gross Beta	5	1	3	4	3	2	0	0
Gamma	7	2	0	0	15	6	6	0
Iodine-LL	4	2	2	0	5	2	1	0
Radium 226	3	2	0	0	3	0	0	0
Radium-228	1	9	2	0	10	0	2	0
Tritium	8	5	0	0	13	0	0	0
Strontium-89	0	0	3	0	1	1	1	0
Strontium-90	1	1	1	0	3	0	0	0
Am-241	0	4	3	0	7	0	0	0
V. Sediment/Soil								
Gamma	0	0	0	0	10	4	0	0
Radium-226	4	2	0	0	3	2	0	0
VI. Vegetation								
Gamma	0	0	0	0	4	0	0	0
Total Number in Range	198	37	15	4	94	17	10	0
% of Total Processed	78	15	6	1	78	14	8	0
Sum of Analyses	254				121			

(1) Percent Bias Criteria by Bias Category
Bias Category = 1 > 0% and < = 5%
Bias Category = 2 > 5% and < = 10%
Bias Category = 3 > 10% and < = 15%, or within 2 sigma of known
Gross alpha and beta, Sr 89/90 > 10% and < = 25%
Transuranics > 10% and < = 20%
Bias Category = 4 Outside Criteria

(2) Percent Precision Criteria by Precision Category
Precision Category = 1 > 0% and < = 5%
Precision Category = 2 > 5% and < = 10%
Precision Category = 3 > 10% and < = 15%, or within 2 sigma of mean
Precision Category = 4 Outside Criteria

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM

Quarter 4, 1999 - Quarter 3, 2000

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E1994-162	4th/99	Filter	Sr-89	107	114	0.94	Agreement
			Sr-90	52	54	0.96	Agreement
E1995-162	4th/99	Filter	Gross alpha	19	20	0.95	Agreement
			Gross beta	134	123	1.09	Agreement
E1996-162	4th/99	Water	H-3	6940	8015	0.87	Agreement
E1997-162	4th/99	Milk	I-131LL	77	77	1.00	Agreement
			I-131	76	77	0.99	Agreement
			Ce-141	127	117	1.09	Agreement
			Cr-51	268	322	0.83	Non-agreement
			Cs-134	136	138	0.99	Agreement
			Cs-137	112	106	1.06	Agreement
			Co-58	117	121	0.97	Agreement
			Mn-54	109	111	0.98	Agreement
			Fe-59	113	104	1.09	Agreement
			Zn-65	214	206	1.04	Agreement
			Co-60	155	146	1.06	Agreement
E2127-62	1st/00	Water	I-131LL	77	74	1.04	Agreement
			I-131	70	74	0.95	Agreement
			Ce-141	426	427	1.00	Agreement
			Cr-51	205	238	0.86	Agreement
			Cs-134	135	139	0.97	Agreement
			Cs-137	126	128	0.98	Agreement
			Co-58	46	44	1.05	Agreement
			Mn-54	165	159	1.04	Agreement
			Fe-59	94	92	1.02	Agreement
			Zn-65	191	196	0.97	Agreement
			Co-60	117	116	1.01	Agreement
E2128-162	1st/00	Water	Gross alpha	60	82	0.73	Non-agreement
			Gross beta	223	210	1.06	Agreement
E2129-162	1st/00	Water	U-234	62	57	1.09	Agreement
			U-235	2.5	2.7	0.93	Agreement
			U-238	64	59	1.08	Agreement
			Pu-238	80	73	1.10	Agreement
			Pu-239	69	62	1.11	Agreement
			Ra-226	87	89	0.98	Agreement
			Ra-228	77	66	1.17	Non-agreement

* pCi/Liter (Filters in pCi)

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM

Quarter 4, 1999 - Quarter 3, 2000

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E2130-162	1st/00	Milk	I-131LL	86	84	1.02	Agreement
			I-131	84	84	1.00	Agreement
			Ce-141	483	460	1.05	Agreement
			Cr-51	279	256	1.09	Agreement
			Cs-134	145	150	0.97	Agreement
			Cs-137	138	138	1.00	Agreement
			Co-58	43	47	0.91	Agreement
			Mn-54	166	171	0.97	Agreement
			Fe-59	103	99	1.04	Agreement
			Zn-65	197	208	0.95	Agreement
			Co-60	124	125	0.99	Agreement
E2131-162	1st/00	Milk	Sr-89	90	90	1.00	Agreement
			Sr-90	57	59	0.97	Agreement
E2214-162	2nd/00	Filter	Ce-141	75	80	0.94	Agreement
E2214-162			Cr-51	242	243	1.00	Agreement
E2214-162			Cs-134	89	105	0.85	Agreement
E2214-162			Cs-137	230	219	1.05	Agreement
E2214-162			Co-58	119	120	0.99	Agreement
E2214-162			Mn-54	143	136	1.05	Agreement
E2214-162			Fe-59	63	58	1.09	Agreement
E2214-162			Zn-65	182	170	1.07	Agreement
E2214-162			Co-60	159	163	0.98	Agreement
E2215-162	2nd/00	Filter	Sr-89	87	109	0.80	Agreement
E2215-162			Sr-90	62	66	0.94	Agreement
E2216-162	2nd/00	Filter	Gross Alpha	25	24	1.04	Agreement
E2216-162			Gross Beta	97	93	1.04	Agreement
E2217-162	2nd/00	Water	H-3	10627	11400	0.93	Agreement
E2218-162	2nd/00	Milk	I-131LL	81	81	1.00	Agreement
E2218-162			I-131	86	81	1.06	Agreement
E2218-162			Ce-141	75	69	1.09	Agreement
E2218-162			Cr-51	236	211	1.12	Agreement
E2218-162			Cs-134	85	91	0.93	Agreement
E2218-162			Cs-137	199	190	1.05	Agreement
E2218-162			Co-58	98	104	0.94	Agreement
E2218-162			Mn-54	122	118	1.03	Agreement

*Units in pCi/Liter

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM

Quarter 4, 1999 - Quarter 3, 2000

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E2218-162	2nd/00	Milk	Fe-59	52	50	1.04	Agreement
			Zn-65	136	148	0.92	Agreement
			Co-60	151	142	1.06	Agreement
E2359-162	3rd/00	Water	I-131LL	72	75	0.95	Agreement
			I-131	79	75	1.05	Agreement
			Ce-141	192	191	1.00	Agreement
			Cr-51	219	230	0.95	Agreement
			Cs-134	121	128	0.95	Agreement
			Cs-137	225	218	1.03	Agreement
			Co-58	58	60	0.97	Agreement
			Mn-54	92	89	1.04	Agreement
			Fe-59	56	54	1.03	Agreement
			Zn-65	129	134	0.97	Agreement
			Co-60	247	246	1.01	Agreement
E2361-162	3rd/00	Water	Sr-89	90	85	1.06	Agreement
			Sr-90	52	54	0.97	Agreement
E2360-162	3rd/00	Water	Gross Alpha	55	50	1.10	Agreement
			Gross Beta	228	205	1.11	Agreement
E2363-162	3rd/00	Milk	Sr-89	65	74	0.88	Agreement
			Sr-90	41	39	1.06	Agreement
E2362-162	3rd/00	Milk	I-131LL	66	58	1.14	Agreement
			I-131	69	58	1.20	Non-Agreement
			Ce-141	176	164	1.07	Agreement
			Cr-51	195	198	0.99	Agreement
			Cs-134	108	110	0.98	Agreement
			Cs-137	193	188	1.02	Agreement
			Co-58	50	51	0.99	Agreement
			Mn-54	81	77	1.05	Agreement
			Fe-59	50	47	1.06	Agreement
			Zn-65	117	115	1.02	Agreement
			Co-60	212	212	1.00	Agreement

*Units in pCi/Liter

Bias Acceptance Criteria ± 15%, or as noted below:
Gross alpha and beta, Sr 89/90 ± 25%
Transuranics and Radium ± 20% or,
If known value falls within 2 sigma range acceptance criteria is met

Precision Acceptance Criteria ± 15%, or as noted below:
Gross alpha and beta, Sr 89/90 ± 25%
Transuranics and Radium ± 20%

TABLE 7.3

SUMMARY OF BLIND DUPLICATE SAMPLES SUBMITTED TO THE DESEL

January - December 2000

TYPE OF SAMPLE	NUMBER OF PAIRED SAMPLES SUBMITTED
Milk	10
Ground Water	4
Surface Water	15
Irish Moss	2
Mussels	4
Food Product	1
TOTAL	36

ANALYSIS TYPE	FAILURES / TOTAL ANALYSES
Gamma	1 / 900
Gross Beta	0 / 8
I-131 low level	0 / 10
Sr-89	0 / 4
Sr-90	0 / 4
H-3	0 / 8
TOTAL	1 / 934

8. LAND USE CENSUS

A Land Use Census is conducted annually between the dates of June 1 and October 1 to identify the locations 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 16 meteorological sectors within a distance of five miles of the plant.

Immediately following the collection of field data, in compliance with ODCM Control 4.2, a dosimetric analysis is performed to compare the census locations to the "Critical Receptor" identified in the ODCM. This Critical Receptor is the location that is used in the conservative Method I dose calculations found in the ODCM (i.e. the dose calculations done in compliance with ODCM Surveillance Requirement 3.4). If a Census location has a 20% greater potential dose than that of the Critical Receptor, this fact must be announced in the Semiannual Effluent Release Report for that period. A re-evaluation of which location to use as a Critical Receptor would also be done at that time. For the 2000 Census, no such location was identified.

Pursuant to ODCM Control 4.2, a dosimetric analysis is then performed, using site specific meteorological data, to determine which milk and food product census locations would provide the optimal sampling locations. If any location has a 20% greater potential dose commitment than at a currently-sampled location, the new location is added to the routine environmental sampling program in replacement of the location with the lowest calculated dose (which is later eliminated from the program). For the 2000 Census, no such garden location was identified, and consequently no changes were mandated for the food product sampling program. Also, there were no milk animal locations that could provide milk samples for the REMP identified in the 2000 census.

The Land Use Census was carried out and completed between the dates of June 1 and October 1, as required. The results of the 2000 Land Use Census are included in this report in compliance with ODCM Surveillance Requirement 4.2. The locations identified during the Census may be found in Table 8.1.

TABLE 8.1
2000 LAND USE CENSUS LOCATIONS

SECTOR	NEAREST RESIDENCE Km (Mi)	NEAREST GARDEN Km (Mi)	NEAREST MILK ANIMAL Km (Mi)
N	5.15 (3.2)**	6.0 (3.8)	*
NNE	4.3 (2.7)	4.8 (3.0)	*
NE	3.2 (2.0)	3.4 (2.1)	*
ENE	3.7 (2.3)	5.8 (3.6)	*
E	2.8 (1.8)	3.4 (2.1)	*
ESE	3.4 (2.1)	3.4 (2.1)	*
SE	2.0 (1.3)	3.4 (2.1)	*
SSE	1.9 (1.2)	3.0 (1.9)	*
S	2.1 (1.3)	2.8 (1.8)	*
SSW	*	*	*
SW	1.2 (0.8)	7.2 (4.5)	*
WSW	1.9 (1.2)	2.0 (1.2)	*
W	2.0 (1.2)	2.8 (1.8)	*
WNW	2.1 (1.3)	2.1 (1.3)	*
NW	2.4 (1.5)	2.4 (1.5)	*
NNW	2.9 (1.8)	3.7 (2.3)	*

* No location was identified within 5 miles of the plant.

** New location in 2000

9. SUMMARY

During 2000, as in all previous years since 1958, an environmental monitoring program was conducted to assess the levels of radiation or radioactivity in the Yankee Nuclear Power Station environment. Over 400 samples were collected (including TLDs) over the course of the year, with a total of over 2,000 radionuclide or exposure rate analyses being performed on them. The samples included ground water, river water, storm drain water, sediment, fish, locally grown food products, mixed vegetation, maple syrup and milk. In addition to these samples, the air surrounding the plant was sampled continuously and the radiation levels were measured continuously with environmental TLDs.

Low levels of radioactivity from three sources were detected. Most samples had measurable levels of naturally-occurring K-40, Be-7, Th-232 or radon daughter products. Many samples (milk, sediment and maple syrup) had fallout radioactivity from atmospheric nuclear weapons tests conducted primarily from the late 1950's through 1980. Several samples had low levels of radioactivity resulting from emissions from YNPS. These were all collected in the immediate vicinity of the plant or from on-site locations. In all cases, the possible radiological impact was negligible with respect to exposure from natural background radiation. In no case did the detected levels approach or exceed the most restrictive federal regulatory or plant license limits for radionuclides in the environment.

10. REFERENCES

1. USNRC Radiological Assessment Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

2. NCRP Report No. 94, Exposure of the Population in the United States and Canada from Natural Background Radiation, National Council on Radiation Protection and Measurements, 1987.

3. Ionizing Radiation: Sources and Biological Effects, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 1982 Report to the General Assembly.

4. Kathren, Ronald L., Radioactivity and the Environment - Sources, Distribution, and Surveillance, Harwood Academic Publishers, New York, 1984.

5. Letter, "Issuance of Amendment No. 146 to Facility Possession Only License No. DPR-3- Yankee Nuclear Power Station," M. Fairtile, NRC to J. Grant, Yankee Atomic Electric Company, dated November 5, 1992.

6. NRC Generic Letter 89-01, Subject: Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program. Dated January 31, 1989.

Attachment A

Yankee Atomic Electric Company
Board Of Directors Monthly Reports
10/15/2000 - 1/15/2001

Yankee Atomic Electric Company
Board of Directors Monthly Report
9/15/00 - 10/15/00

Yankee Rowe Site Activities

- No lost time accidents. 366,092 continuous safe work hours as of 10/12. No OSHA recordable injuries.

- The PCB paint chip sampling of Sherman Pond to determine the extent of paint chip migration has been completed. In the second round of samples, only one of the fourteen samples contained detectable PCBs and it was below the regulatory limit specified by the EPA. This sampling confirms that the migration is limited to the immediate area of the east storm drain discharge outfall. The next steps in the regulatory process are to evaluate the data, perform a risk assessment of the hazard, review remediation alternatives as appropriate and file the results with the Massachusetts DEP. This process is expected to take approximately 90 days.

- The Modular Building and South Decon Room demolition activities to support the ISFSI project are continuing.

- Preparation of the Service Building for re-occupation is complete. Office furniture has been move to the office areas and conduit for the HVAC system has been installed.

- The Fuel Oil Tank and Fuel Oil Pumphouse demolition preparation activities are continuing.

Fuel Storage Activities

- Soil excavation and backfilling activities for the dry fuel storage pad have been completed. The concrete is scheduled to be placed beginning the week of October 16.

- NAC Int'l and Yankee have agreed to defer the first canister shipment until December and ship the first two fuel canisters together. The canisters will be shipped from Hitachi Zosen in Japan.

- NAC Int'l submitted an ISFSI Tech Spec Amendment to the NRC on 9/20/00 to extend the permissible time to complete certain fuel transfer activities.

Key Regulatory Correspondence

Outgoing

- 9/15/00 – From YAEC to EPA and MADEP. Discharge Monitoring Reports for August 2000.
- 9/28/00 – From YAEC to NRC. Amendment request to Yankee Security Plan to address security provisions for the Dry Cask Storage facility.

Incoming

- 9/12/00 – From Rowe Conservation Commission to YAEC. Letter indicating Commission's determination that work within the ISFSI buffer zone does not require the filing of a Notice of Intent.
- 9/15/00 – From MADEP to YAEC. Notification form and reporting requirements associated with removal of soil containing PCB's near future ISFSI.
- 9/18/00 – From MADEP to YAEC. Approval of Cross Connection Control Program Plan questionnaire for Yankee Rowe drinking water system.
- 9/28/00 – From NRC to YAEC. Routine quarterly inspection report. Received a level four non-cited violation for failing to properly document training activities in the Maintenance Department files.

Community Activities

- Yankee representatives attended the Berkshire County Chamber of Commerce breakfast in North Adams on 9/22.
- The Yankee Rowe Community Advisory Board met on 9/28 at North Adams City Hall. The CAB received a status report on decommissioning activities, including the PCB paint chip evaluation program, and on fuel storage facility construction and component fabrication activities. They also received a copy of Russ Mellor's congressional testimony regarding the impact of the federal appeals court decision upholding Yankee's right to sue the government for failure to remove used fuel. The CAB voted to request a revision to their charter to allow members to serve on the CAB indefinitely if their sponsoring organization so chooses. The meeting was attended and reported on by the Union-News.

Upcoming Activities

- 10/26/00 – Presentation to the Franklin County Regional Planning Board on fuel storage status at 7:00 p.m. at the Franklin County Courthouse in Greenfield, MA.
- 11/9/00 – Yankee Rowe Community Advisory Board meeting at 7:00 p.m. at the Charlemont Inn in Charlemont, MA.

Yankee Atomic Electric Company
Board of Directors Monthly Report
10/15/00 - 11/15/00

Yankee Rowe Site Activities

- No lost time accidents. 393,679 continuous safe work hours as of 11/9. One OSHA recordable injury.
- The PCB paint chip migration into Sherman Pond has been quantified. Sample results are being evaluated for future actions.
- Modifications were made to the warehouse electrical circuit in support of fuel storage activities.
- Asbestos abatement on the Modular building roof was completed. The Modular Office building has been dismantled and removed from the site.
- The Fuel Oil Tank and Fuel Oil Pumphouse demolition preparation activities are continuing.

Fuel Storage Activities

- Construction of the concrete storage pad is complete. Work continues on the retaining wall, curb wall and access road. Due to weather conditions, the project is a week and a half behind schedule with no impact on the overall project.
- Construction of the new Fuel Transfer Enclosure building has begun. The building foundation was will be completed by the end of November.
- Final engineering is in progress on the ISFSI electrical and security systems.

Key Regulatory Correspondence

Outgoing

- 10/20/00 – From YAEC . Discharge Monitoring Reports for September 2000.
- 10/18/00 – From YAEC to DEP. Notification of new coliform sampling locations
- .11/9/00 – From YAEC to DEP. Closeout of remediation activities associated with PCB impacted soil at the south portion of the plant.

- 11/9/00 – From YAEC to DEP. Environmental sampling data report on relocated soil from ISFSI excavation.

Incoming

- No significant incoming regulatory correspondence.

Community Activities

- 10/26/00 – Ken Heider provided a status update to the Franklin County Regional Planning Board on Yankee Rowe fuel storage activities at the Franklin County Courthouse in Greenfield, MA. The presentation provided an explanation of the dual-purpose storage and transport system, approvals and permits, component fabrication and pad construction. The meeting was well attended by Planning Board members who asked numerous questions. The meeting was attended by and reported on the Recorder.

- The Yankee Rowe Community Advisory Board met on 11/9 at the Charlemont Inn in Charlemont, MA. The CAB received a status report on decommissioning and fuel storage activities, including color photos of the latest storage pad construction activities. The CAB also received an update on the federal nuclear waste program and transportation cask funding. The CAB voted to request another revision to their charter to change the action taken when a member misses three consecutive meetings from termination to notification of the sponsoring organization. The meeting was attended by and reported on by the Union-News.

- Yankee attended the Franklin County Chamber of Commerce breakfast in Greenfield on 11/17.

Upcoming Activities

- 11/30/00 – NRC meeting at Region 1 to provide periodic status update on Yankee Rowe decommissioning and fuel storage activities.

- 12/7/00 – YAEC Board of Director's Meeting

Yankee Atomic Electric Company
Board of Directors Monthly Report
11/15/00 - 12/15/00

Yankee Rowe Site Activities

- No lost time accidents. 412,298 continuous safe work hours as of 12/10. One OSHA recordable injury.
- Yankee Rowe workers were recognized for their safety conscious work efforts and for surpassing 400,000 safe work hours without a lost time accident.
- The PCB risk analysis is underway.
- Asbestos abatement activities are underway in the Service Building Control Point area.
- The Fuel Oil Tank and lines have been cleaned and flushed. The tank demolition is scheduled to be completed by the end of December.

Fuel Storage Activities

- The selection of NAC International to transfer Yankee's used fuel to dry storage was announced on November 28.
- The retaining wall, curb wall and access road construction for the dry storage facility is complete. Work is continuing on fencing and site drainage.
- The structural steel for the Fuel Transfer Enclosure Building is scheduled to be delivered at the end of December.
- The engineering of the ISFSI electrical and security systems has been completed.
- NAC onsite mobilization is underway.

Key Regulatory Correspondence

Outgoing

- 11/15/00 – From YAEC to EPA and MADEP. Discharge Monitoring Reports for October 2000.

- 11/16/00 – From YAEC to MADEP. Notification of steps being taken to eliminate coliform bacteria from the potable water system and implementation of controls to prevent reoccurrence.

- 11/22/00 – From YAEC to NRC. Request to amend NRC license to allow transfer of certain administrative requirements from the Yankee Nuclear Power Station Technical Specifications to the Yankee Decommissioning Quality Assurance Program.

- 12/07/00 – From YAEC to MADEP. Discharge Monitoring Reports for November 2000.

Incoming

- No significant incoming regulatory correspondence.

Upcoming Activities

- 01/09/01 – Presentation to the Williamstown Rotary Club on dry fuel storage activities at Yankee Rowe.

- 01/18/01 – Yankee Rowe Community Advisory Board meeting at 7:00 p.m. at the Charlemont Inn in Charlemont, MA.

Yankee Atomic Electric Company
Board of Directors Monthly Report
12/15/00 – 1/15/01

Yankee Rowe Site Activities

- One lost time accident. 26,695 continuous safe work hours as of 12/30. One OSHA recordable injury.
- Asbestos abatement activities in the Service Building Control Point area and Chemistry Lab are complete.
- The Fuel Oil Tank demolition is complete.

Fuel Storage Activities

- NAC mobilization is ongoing. The project manager has been named, the Spent Fuel Pool physical inspections are underway and project planning is underway.
- Two fuel canisters and lids were delivered to the Yankee Rowe plant from Hitachi Zosen the last week of December 2000.
- Construction of the ISFSI fencing is scheduled to be completed in January. ISFSI security and monitoring modifications are underway.
- Construction of the Fuel Transfer Enclosure Building is underway.

Key Regulatory Correspondence

Outgoing

- 12/15/00 – From YAEC to DOE. Joint Yankee and Connecticut Yankee filing of comments regarding DOE Draft Plan for Transportation Cask Fabrication and Deployment of Waste Acceptance Capabilities.
- 12/21/00 – From YAEC to DOE. Response to DOE questionnaire on Spent Fuel Blending Capabilities.
- 01/11/01 – From YAEC to MADEP. Response to Notice of Noncompliance regarding coliform bacteria.

Incoming

- 12/26/00 – From Analytical Products Group to YAEC. Results of QA study of NPDES discharges.
- 01/02/01 – From MADEP to YAEC. Notice of Noncompliance regarding coliform bacteria.
- 01/18/01 – From DOE to YAEC. DOE questionnaire on Fuel Blending Capabilities.

Community Activities

- 12/19/00 – Yankee representatives attended the annual Franklin County Chamber of Commerce holiday breakfast.
- 01/09/01 – Presentation to the Williamstown Rotary Club on dry fuel storage activities at Yankee Rowe.

Upcoming Activities

- 01/18/01 – Yankee Rowe Community Advisory Board meeting at 7:00 p.m. at the Charlemont Inn in Charlemont, MA.
- 01/18/01 and 01/19/01 – Routine NRC plant inspection.

Attachment B

Historical 4th Quarter
Exposure Rates
At Location GM12

The purpose of the tables in this attachment is to use Dixon's test to estimate the confidence that the 2000 fourth quarter exposure rate is an outlier with respect to historical fourth quarter exposures, since YNPS ceased power operation. Table B.1 lists collected historical fourth quarter exposure rates. Table B.2 lists the resultant risk of false rejection that the 2000 exposure rate is an outlier by chance. Because the 2000 fourth quarter exposure rate at GM-12's value is higher than the listed 0.5 % risk of false rejection value, it determines with a 99.5 % confidence that the 2000 fourth quarter value is an outlier. Further explanation of Dixon's test is given in the following pages 94-97.

Table B.1

Historical Fourth Quarter Exposure Rates Since Yankee Rowe Shutdown	
Year	Exposure Rate (mR)
1992	16.4
1993	16.4
1994	17.0
1995	17.9
1996	17.7
1997	17.6
1998	14.2
1999	Missing TLD
2000	26.0
Mean[1]	16.7

1 Mean calculated without using 2000 exposure rate.

Table B.2

Comparison Of Dixon's Test Result On 2000 Fourth Quarter Exposure Rate To Outlier Confidence Levels[2]	
Dixon's Test	Value
2000 4th Quarter GM-12[3]	0.844
5.0 % Risk of False Rejection	0.554
1.0 % Risk of False Rejection	0.683
0.5 % Risk of False Rejection	0.725

2 W.J. Dixon. "Processing Data Outliers", Biometrics BIOMA, March, 1953. Vol. 9, No.1, pp 74-89.

3 The following equation was used because there were eight data points: $\tau_{11} = (X_n - X_{n-1})/(X_n - X_2)$. Refer to page 95.

The huge error is applicable (though rarely used) for screening a data set for outliers, in which application the procedure to be used is obvious. One excludes the suspect and calculates a value for s. The difference of the suspect from the mean is compared with s to calculate a value for M. The decision to reject depends on a value of $M > 4$.

The huge error approach is especially useful in deciding whether a suspected point should be plotted along with other points in a data set. The data, neglecting the questioned point for the time being, are plotted and a "best fitting" line is drawn graphically, or better by a least-squares fit (see Chapter 7 for a discussion of curve fitting). The standard deviation of the fitted points or the average residuals from the fitted line are calculated and compared with the residual for the suspect point. If $M > 4$, reject the point. Otherwise, include it in the set and refit the line. No practical problems result from substituting the average deviation of all points from the line (excluding the suspected outlier) for the standard deviation when calculating an M value.

A set of data was taken to calibrate a measuring instrument. In the course of a preliminary manual plot of the data (eye estimate), it was noticed that one point appeared to be much farther from the line than the others, so it was ignored for the moment. The analyst was tempted to reject it because he feared (and rightly so) that its inclusion (if it were an outlier) would falsify his least squares fit. The average deviation of the plotted points from the line (observed – curve) was 0.012. The deviation of the suspected point from the line was 0.06. Using the Huge Error Rule

$$M = \frac{0.06}{.012} = 5$$

The analyst decided to reject the data point.

The Dixon Test

The Dixon test [2,3] for outlying points in a data set is easy to use because of the simple calculations required. In using it, it is assumed that the population mean and standard deviation are unknown and that the data set on hand is the only source of information. A further assumption is that the data are normally distributed. The data points are ranked, serially, from the smallest to the largest. When this is done, a point at either end may appear to be considerably removed from its nearest neighbor, so that it is suspected of being an outlier. The Dixon test is based on the probability that such a situation could happen by chance, due to the variability of the data.
Use the following procedure:

1. Rank the data in order of increasing size

$$X_1 < X_2 < X_3 < \ldots < X_n$$

2. Choose the confidence level for which rejection is merited.
3. Calculate the critical Dixon ratio, depending on the number of data points in the set.

Number of Points	Ratio to be Calculated
$n = 3$ to 7	r_{10}
$n = 8$ to 10	r_{11}
$n = 11$ to 13	r_{21}
$n = 14$ to 25	r_{22}

where the ratios are as follows:

r	If X_n Is Suspect	If X_1 Is Suspect
r_{10}	$(X_n - X_{n-1})/(X_n - X_1)$	$(X_2 - X_1)/(X_n - X_1)$
r_{11}	$(X_n - X_{n-1})/(X_n - X_2)$	$(X_2 - X_1)/(X_{n-1} - X_1)$
r_{21}	$(X_n - X_{n-2})/(X_n - X_2)$	$(X_3 - X_1)/(X_{n-1} - X_1)$
r_{22}	$(X_n - X_{n-2})/(X_n - X_3)$	$(X_3 - X_1)/(X_{n-2} - X_1)$

4. Look up the critical value for the appropriate r in the table (e.g., Table A.7 in Appendix A), for the confidence level of the test
5. If the calculated value is larger than the critical value in the table, reject the suspect point, otherwise retain it.

Consider the following example to illustrate the Dixon test. Given the already ranked data set

9, 12, 12, 13, 13, 14, 15

The value 9 is suspect

Since there are 7 points, r_{10} is calculated

$$r_{10} = \frac{3}{6} = 0.500$$

Use the 95% confidence level for rejection. From Table A.7 in Appendix A, the critical value for $r_{10} = 0.507$. The decision is to retain the data point.

Look at the table and note that, for a 90% level of confidence, the critical value of r is 0.434. From this one might conclude that rejection could be made on the basis of more than a 90% confidence level but less than a 95% confidence level – say approximately a 94% confidence level.

points in

ble A.7 in

reject the

dy ranked

dix A, the

tical value
n the basis
evel – say

Suppose that X_1 had a value of 8. One would then have calculated

$$r_{10} = 4/7 = 0.571$$

This is larger than the critical value of 0.507 and rejection could be done with 95% confidence. Remember that (1 – confidence) is the risk of false rejection. This means that though there is a 95% confidence that rejecting was merited, there is also a 5% risk that the wrong decision was made.

If a point is rejected one should look at the remaining data to decide whether a second point is suspect. If so, repeat the procedure. In a good data set, the chance for a second rejection should be small, and a third rejection even smaller. If multiple rejections are indicated, the measurement process is probably not in control [1].

While the Dixon test is easy to use, one should not get overly zealous about using it or any other outlier test, for that matter. Data represent work and money and neither should be discarded lightly. The analyst should try to salvage data if at all possible. Also, the presence of outliers should be a warning that perhaps the system has problems that should be solved by other procedures rather than by cavilierly discarding data.

The Grubbs Test

Another test for outliers that is widely used is the Grubbs test [3,4]. This test requires the calculation of the sample standard deviation and is thus a little more laborious than the Dixon test. However, even simple modern pocket computers can do this computation easily, so this is not a significant objection for its use. The procedure to be used is as follows:

Step 1. Rank the data points in order of increasing value.

$$X_1 < X_2 < X_3 < \ldots\ldots < X_n$$

Step 2. Decide whether X_1 or X_n is suspect

Step 3. Calculate the sample average and standard deviation using all of the data for the moment, i.e. obtain $\overline{X}$ and s

Step 4. Calculate T as follows

$$\text{If } X_1 \text{ is suspect, } T = (\overline{X} - X_1)/s$$
$$\text{If } X_n \text{ is suspect, } T = (X_n - \overline{X})/s$$

Step 5. Choose the level of confidence for the test and compare the calculated value of T with the critical value in the table (such as Table A.8 of Appendix A).

If the calculated value exceeds the critical value, reject, otherwise retain the data.

The following example will illustrate the Grubbs test. Consider the same data set used in Section 6.2.2, namely,

9, 12, 12, 13, 13, 14, 15

Table A.7 Values for Use in the Dixon Test for Outliers

Statistic	Number of Observations, n	Risk of False Rejection 0.5%	1%	5%	10%
	3	.994	.988	.941	.886
	4	.926	.889	.765	.679
τ_{10}	5	.821	.780	.642	.557
	6	.740	.698	.560	.482
	7	.680	.637	.507	.434
	8	.725	.683	.554	.479
τ_{11}	9	.677	.635	.512	.441
	10	.639	.597	.477	.409
	11	.713	.679	.576	.517
τ_{21}	12	.675	.642	.546	.490
	13	.649	.615	.521	.467
	14	.674	.641	.546	.492
	15	.647	.616	.525	.472
	16	.624	.595	.507	.454
τ_{22}	17	.605	.577	.490	.438
	18	.589	.561	.475	.424
	19	.575	.547	.462	.412
	20	.562	.535	.450	.401

Tabulated values obtained from reference NBS Handbook 91. Original reference: W. J. Dixon. "Processing Data Outliers", Biometrics BIOMA, March, 1953. Vol. 9, No.1, pp 74-89.

Tabl

Num
Data

Tab
exte
Per
Vol

Attachment C

Concurrent Fourth Quarter Measurements
From TLD Data Other Than GM-12

Table C.1

Concurrent Fourth Quarter Measurements From TLDs Other Than GM-12		
TLD	Exposure Rate (mR)	Standard Deviation (mR)
GM1	15.9	0.61
GM2	13.52	0.48
GM3	12.63	0.52
GM4	13.6	0.6
GM6	16.27	0.54
GM7	16.84	0.69
GM8	13.68	0.58
GM9	15.64	1.01
GM10	14.26	0.66
GM11	14.07	0.75
GM13	18.68	0.69
GM14	16.26	0.71
GM15	16.05	0.54
GM16	15.55	0.79
GM17	16.59	0.66
GM18	19.99	1.17
GM19	17.95	0.58
GM20	18.42	0.8
GM21	13.52	0.5
GM22	15.51	0.69
GM23	17.92	1.04
GM25	13.33	0.6
GM27	13.63	0.68
GM29	11.12	0.52
GM31	14.08	0.95
GM32	15.19	0.57
GM33	14.8	0.67
GM36	15.68	0.61
GM38	17.95	0.67
GM40	15.24	0.68
Mean	15.46	3.86
Min	11.12	0.52
Max	19.99	1.17