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BVY 13-047

May 15, 2013

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: 2012 Annual Radiological Environmental Operating Report
Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

Dear Sir or Madam,

In accordance with Vermont Yankee Technical Specification 6.6.E, enclosed is a copy of the 2012 Annual Radiological Environmental Operating Report. This report contains a summary and analysis of the radiological environmental data collected for the calendar year 2012.

There are no new regulatory commitments being made in this submittal.

Should you have any questions or require additional information concerning this submittal, please contact me at (802) 451-3166.

Sincerely,

Robert J. Wanczyk

[RJW/plc]

Enclosure: Annual Radiological Environmental Operating Report – Year 2012

cc listing (next page)

IE25
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ENTERGY - VERMONT YANKEE
Vermont Yankee Nuclear Power Station

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Year 2012

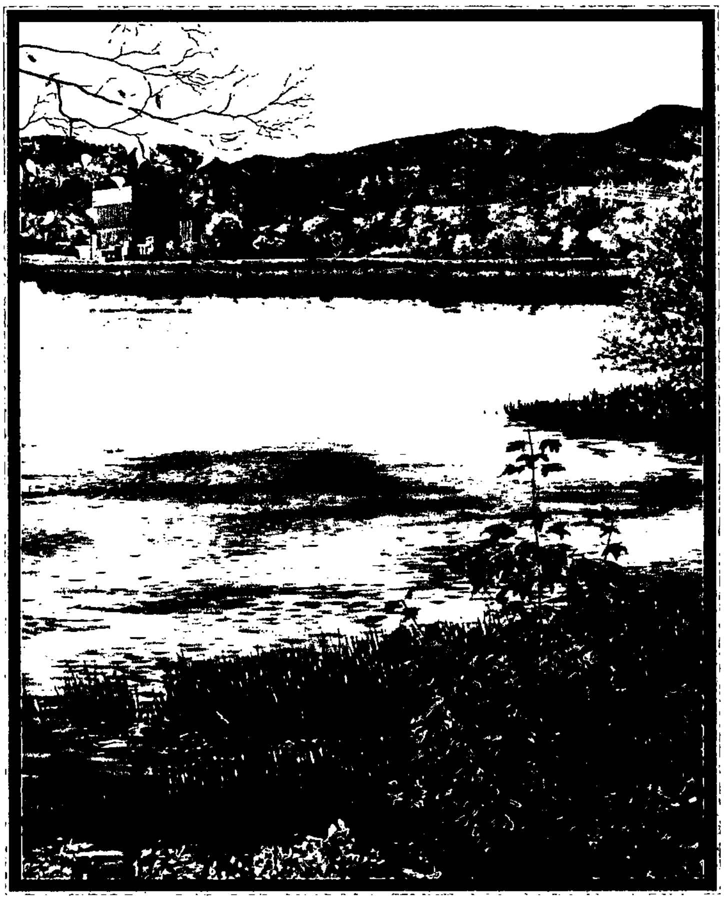

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Entergy-Vermont Yankee in the vicinity of the Vermont Yankee Nuclear Power Station (VYNPS) in Vernon, Vermont during the calendar year 2012. The analyses of samples collected indicated that no plant-generated radioactive material was found in any location off site. In all cases, the possible radiological impact was negligible with respect to exposure from natural background radiation. In no case did the detected levels exceed the most restrictive federal regulatory or plant license limits for radionuclides in the environment. Measured values were several orders of magnitude below reportable levels listed in Table 4.5 of this report. Except for sample deviations listed in Section 6.1, all other samples were collected and analyzed as required by the program.

This report is submitted annually in compliance with plant Technical Specification 6.6.E. The remainder of this report is organized as follows:

Section 2: Provides an introductory explanation of background radioactivity and radiation detected in the plant environs.

Section 3: Provides a brief description of the Vermont Yankee Nuclear Power Station site and its environs.

Section 4: Provides a description of the overall REMP program design. Included is a summary of the Vermont Yankee Nuclear Power Station (VYNPS) Off-Site Dose Calculation Manual (ODCM) requirements for REMP sampling, tables listing all locations sampled or monitored in 2012 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 VYNPS ODCM. The tables are in a format similar to that specified by the NRC Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1). Also included is a summary of the 2012 environmental TLD measurements.

Section 6: Provides the results of the 2012 monitoring program. The performance of the program in meeting regulatory requirements as given in the ODCM is discussed, and the data acquired during the year are analyzed.

Section 7: Provides an overview of the Quality Assurance programs used at AREVA Framatome ANP Environmental Laboratory, Teledyne Brown Engineering and Entergy James A. Fitzpatrick Environmental Laboratory.

Section 8: Summarizes the requirements and the results of the 2012 Land Use Census.

Section 9: Gives a summary of the 2012 Radiological Environmental Monitoring Program.

2. BACKGROUND RADIOACTIVITY

Radiation or radioactivity potentially detected in the Vermont Yankee 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 the Vermont Yankee plant. The third potential source of radioactivity is due to emissions from the Vermont Yankee plant. For the purposes of the Vermont Yankee 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 is the one that the REMP is 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 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 newly-formed "daughter" radionuclides descending from these original elements. A few of the more important radionuclides in this category are Uranium-238 (U-238), Thorium-232 (Th-232), Rubidium-87 (Rb-87), 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 air, 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 majority of this radiation comes 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 detected in the field with gamma spectroscopy equipment, high pressure ion chambers and thermoluminescent dosimeters (TLDs).

2.2 Man-Made Background Radioactivity

The second source of "background" radioactivity in the Vermont Yankee environment is from "man-made" sources not related to the power plant. The most recent contributor (prior to year 2011) to this category was the fallout from the Chernobyl accident in April of 1986, which was detected in the Vermont Yankee environment and other parts of the world. Some smaller amounts of radioactivity were detected in the environment following the Fukushima Daiichi plants accidents in March 2011. 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 as recently as October 1980. Much of the fallout detected today is due to this explosion and the last large scale test performed 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 often 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 Vermont Yankee Nuclear Power Station is located in the town of Vernon, Vermont in Windham County. The 130-acre site is on the west shore of the Connecticut River, immediately upstream of the Vernon Hydroelectric Station. The plant site is bounded on the north, south and west by privately-owned land, and on the east by the Connecticut River. The surrounding area is generally rural and lightly populated, and the topography is flat or gently rolling on the valley floor.

Construction of the single unit 540 megawatt BWR (Boiling Water Reactor) plant began in 1967. The pre-operational Radiological Environmental Monitoring Program, designed to measure environmental radiation and radioactivity levels in the area prior to station operation, began in 1970. Commercial operation began on November 30, 1972. An Extended Power Uprate, conducted in 2006, resulted in the present generation capacity of 650 megawatts electric.

4. PROGRAM DESIGN

The Radiological Environmental Monitoring Program (REMP) for the Vermont Yankee Nuclear Power Station (VYNPS) was designed with specific objectives in mind. These are:

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

The program was initiated in 1970, approximately two years before the plant began commercial operation. It has been in operation continuously since that time, with improvements made periodically over those years.

The current program is 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 Radiological Assessment Branch Technical Position of November 1979, *An Acceptable Radiological Environmental Monitoring Program;* and NRC NUREG-0473, *Radiological Effluent Technical Specifications for BWRs.* The environmental TLD program has been designed and tested around NRC Regulatory Guide 4.13, *Performance, Testing and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications.* The quality assurance program is designed around the guidance given in NRC Regulatory Guide *4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.*

The sampling requirements of the REMP are given in the Off-Site Dose Calculation Manual Table 3.5.1 and are summarized in Table 4.1 of this report. The identification of the required sampling locations is given in the Off-Site Dose Calculation Manual (ODCM), Chapter 7. These sampling and monitoring locations are shown graphically on the maps in Figures 4.1 through 4.6 of this report.

The Vermont Yankee Chemistry Department conducts the radiological environmental monitoring program and collects all airborne, terrestrial and ground water samples. VYNPS maintains a contract with Normandeau Associates to collect all fish, river water and river sediment samples. In 2012, analytical measurements of environmental samples were performed at the Entergy Nuclear J. A. Fitzpatrick Environmental Laboratory in Oswego, New York and Teledyne Brown Engineering Laboratory in Knoxville Tennessee. TLD badges are posted and retrieved by the Vermont Yankee Chemistry Department, and were analyzed by Environmental Dosimetry Company in Sterling Massachusetts.

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. Monitoring locations within the first zone are called "indicators." Those within the second zone 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 and radiation due to plant releases 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 airborne, waterborne, ingestion and direct radiation 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
  - Charcoal Cartridge (Radioiodine) Sampling
- Waterborne Pathways
  - River Water Sampling
  - Ground Water Sampling
  - Sediment Sampling
- Ingestion Pathways
  - Milk Sampling
  - Silage Sampling
  - Mixed Grass Sampling
  - Fish Sampling
- Direct Radiation Pathway
  - TLD Monitoring

4.3 Descriptions of Monitoring Programs

4.3.1 Air Sampling

Continuous air samplers are installed at seven locations. (Five are required by the VYNPS 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 50 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 on a weekly frequency and, to allow for the decay of radon daughter products, the analysis for gross beta radioactivity is delayed for more than 24 hours. The weekly filters are composited by location at the environmental laboratory for a quarterly gamma spectroscopy analysis.

If the gross-beta activity on an air particulate sample is greater than ten times the yearly mean of the control samples, ODCM Table 3.5.1, Note c, requires a gamma isotopic analysis on the sample. Whenever the main plant stack effluent release rate of I-131 is equal to or greater than 0.1 μCi/sec, weekly air particulate collection from the plant stack is required by ODCM Table 3.5.1, Note h.

4.3.2 Charcoal Cartridge (Radioiodine) Sampling

Continuous air samplers are installed at seven locations. (Five are required by the ODCM Table 3.5.1.) The sampling pumps at these locations operate continuously at a flow rate of approximately one cubic foot per minute. A 60 cc TEDA-impregnated charcoal cartridge is located downstream of the air particulate filter described in Section 4.3.1 above. 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. These cartridges are collected and analyzed weekly for I-131.

Whenever the main plant stack effluent release rate of 1-131 is equal to or greater than 0.1 μCi/sec, weekly charcoal cartridge collection from the plant stack is required, pursuant to ODCM Table 3.5.1, Note h.

4.3.3 River Water Sampling

An automatic compositing sampler is maintained at the downstream sampling location by the Vermont Yankee Chemistry Department staff. Normandeau Associates personnel maintain the pump that delivers river water to the sampler. The sampler is controlled by a timer that collects a frequent aliquot of river water. An additional grab sample is collected monthly at the upstream control location. Each sample is analyzed for gamma-emitting radionuclides. Although not required by the VYNPS ODCM, a gross-beta analysis is also performed on each sample. The monthly composite and grab samples are composited by location by the contracted environmental laboratory for a quarterly tritium (H-3) analysis.

4.3.4 Ground Water (Deep Well Potable Water) Sampling

Grab samples are collected quarterly from up to four indicator locations and one control location. Only one indicator and one control are required by the VYNPS ODCM. Each sample is analyzed for gamma-emitting radionuclides and H-3. Although not required by the VYNPS ODCM, a gross-beta analysis is also performed on each sample.

4.3.5 Sediment Sampling

River sediment grab samples are collected semiannually from the downriver location and at the North Storm Drain Outfall by Normandeau Associates. Each sample is analyzed at an offsite environmental laboratory for gamma-emitting radionuclides.

4.3.6 Milk Sampling

When milk animals are identified as being on pasture feed (May through October), milk samples are collected twice per month from that location. Throughout the rest of the year, and for the full year where animals are not on pasture, milk samples are collected on a monthly schedule. Three locations are chosen as a result of the annual Land Use Census, based on meteorological dispersion calculations. The fourth location is a control, which is located sufficiently far away from the plant to be outside any potential plant influence. Other samples may be collected from locations of interest.

Immediately after collection, each milk sample is refrigerated and then shipped to the contracted environmental laboratory. Each sample is analyzed for gamma-emitting radionuclides. A separate low-level I-131 analysis is performed to meet the Lower Limit of Detection requirements in the ODCM. Although not required by the ODCM, Sr-89 and Sr-90 analyses are also performed on quarterly composited samples.

4.3.7 Silage (Chopped Corn or Grass) Sampling

Silage samples are collected at the milk sampling location at the time of harvest, if available. The silage from each location is shipped to the contracted environmental laboratory where it is analyzed for gamma-emitting radionuclides. Although not required by the ODCM, the silage samples are analyzed for low-level I-131.

4.3.8 Mixed Grass Sampling

At each air sampling station, a mixed grass sample is collected quarterly, when available. Enough grass is clipped to provide the minimal sample weight needed to achieve the required Lower Limit of Detection (LLD). The mixed grass samples are analyzed for gamma-emitting radionuclides. Although not required by the ODCM, the grass samples are analyzed for low-level I-131.

4.3.9 Fish Sampling

Fish samples are collected semiannually at two Connecticut River locations (upstream of the plant and in the Vernon Pond) by Normandeau Associates. The samples are frozen and delivered to the environmental laboratory where the edible and inedible portions are separately analyzed for gamma-emitting radionuclides.

4.3.10 TLD Monitoring

Direct gamma radiation exposure is continuously monitored with the use of thermoluminescent dosimeters (TLDs). Specifically, Panasonic UD-801AS1 and UD-814AS1 calcium sulfate dosimeters are 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 screen cylinder. This cylinder is attached to an object such as a fence or utility pole.

A total of 40 stations are required by the ODCM. Of these, 24 must be read out quarterly, while those from the remaining 16 incident response (outer ring) stations need only be de-dosed (annealed) quarterly, unless an ODCM gaseous release limit was exceeded during the period. Although not required by the ODCM, the TLDs from the 16 outer ring stations are read out quarterly along with the other stations' TLDs. In addition to the TLDs required by the ODCM, more than thirteen are typically posted at or near the site boundary. The plant staff posts and retrieves all TLDs, while the contracted environmental laboratory (Environmental Dosimetry Company) provides processing.

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

(as required by ODCM Table 3.5.1)*

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)	40	Continuous	Quarterly	Gamma dose; Outer Ring - dc-dose only, unless gaseous release Control was exceeded	Each TLD
2. Airborne (Particulates and Radioiodine)	5	Continuous	Weekly	Particulate Sample: Gross Beta	Each Sample
				Gamma Isotopic	Quarterly Composite (by location)
				Radioiodine Canister: I-131	Each Sample
3. Waterborne					
a. Surface water	2	Downstream. Automatic composite Upstream: grab	Monthly	Gamma Isotopic Tritium (H-3)	Each Sample Quarterly Composite
b. Ground water	3	Grab	Quarterly	Gamma Isotopic Tritium (H-3)	Each Sample Each Sample
c. Shoreline Sediment	2	Downstream: grab N. Storm Drain Outfall: grab	Semiannually	Gamma Isotopic	Each Sample

- See ODCM Table 3.5.1 for complete footnotes.

TABLE 4.1, cont.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(as required by ODCM Table 3.5.1)*

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	4	Grab	Monthly (Semimonthly when on pasture)	Gamma Isotopic I-131	Each sample Each sample
b. Fish	2	Grab	Semiannually	Gamma Isotopic on edible portions	Each sample
c. Vegetation					
Grass sample	1 at each air sampling station	Grab	Quarterly when available	Gamma Isotopic	Each sample
Silage sample	1 at each milk sampling station	Grab	At harvest	Gamma Isotopic	Each sample

* See ODCM Table 3.5.1 for complete footnotes.

TABLE 4.2

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS (NON-TLD) IN 2012
VERMONT YANKEE NUCLEAR POWER STATION

Exposure Pathway	Station Code	Station Description	Zone[(a)]	Distance From Plant Stack (km)	Direction From Plant
I. Airborne					
	AP/CF-11	River Sta. No. 3.3	I	1.9	SSE
	AP/CF-12	N. Hinsdale, NH	I	3.6	NNW
	AP/CF-13	Hinsdale Substation	I	3.1	E
	AP/CF-14	Northfield, MA	I	11.6	SSE
	AP/CF-15	Tyler Hill Road	I	3.1	WNW
	AP/CF-21	Spofford Lake	C	16.4	NNE
	AP/CF-40	Gov. Hunt House	I	--	On-site
2. Waterborne					
a. Surface	WR-11	River Sta. No. 3.3	I	1.9	SSE
	WR-21	Rt.9 Bridge	C	11.8	NNW
b. Ground	WG-11	Plant Well	I	0.2	On-site
	WG-12	Vernon Nursing Well	I	2.1	SSE
	WG-14	Plant Support Bldg (PSB) Well	I	0.3	On-site
	WG-15	Southwest Well	I	0.3	On-site
	WT-14	Test Well 201	I	--	On-site
	WT-16	Test Well 202	I	--	On-site
	WT-17	Test Well 203	I	--	On-site
	WT-18	Test Well 204	I	--	On-site
	WG-22	Copeland Well	C	13.7	N
c. Sediment	SE-11	Shoreline Downriver	I	0.6	SSE
	SE-12	North Storm Drain Outfall	I	0.1	E

TABLE 4.2, cont.

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS (NON-TLD) IN 2012
VERMONT YANKEE NUCLEAR POWER STATION

Direction Exposure Pathway Stack	Station Code	Station Description	Zone[a]	Distance From Plant Stack(km)	From Plant
3. Ingestion					
a. Milk	TM-11	Miller Farm	I	0.8	W
	TM-14	Brown Farm	I	2.2	S
	TM-18	Blodgett Farm	I	3.6	SE
	TM-20	Dunklee Farm (Vern-Mont)	C	5.5	S
	TM-22	Franklin Farm	C	9.7	WSW
	TM-24	County Farm[c]	C	21.6	N
b. Fish	FH-11	Vernon Pond	I	0.6[b]	SSE
	FH-21	Rt.9 Bridge	C	11.8	NNW
c. Mixed Grass	TG-11	River Sta. No. 3.3	I	1.9	SSE
	TG-12	N. Hinsdale, NH	I	3.6	NNW
	TG-13	Hinsdale Substation	I	3.1	E
	TG-14	Northfield, MA	I	11.6	SSE
	TG-15	Tyler Hill Rd.	I	3.1	WNW
	TG-21	Spofford Lake	C	16.4	NNE
	TG-40	Gov. Hunt House	I	--	On-site
d. Silage	TC-11	Miller Farm	I	0.8	W
	TC-14	Brown Farm	I	2.2	S
	TC-18	Blodgett Farm	I	3.6	SE
	TC-20	Dunklee Farm (Vern-Mont)	C	5.2	S
	TC-22	Franklin Farm	C	9.7	WSW

(a) I = Indicator Stations; C = Control Stations
(b) Fish samples are collected anywhere in Vernon Pond, which is adjacent to the plant (see Figure 4.1).
(c) County Farm ceased operations on May 4, 2012.

TABLE 4.3

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS (TLD) IN 2012
VERMONT YANKEE NUCLEAR POWER STATION

Station Code	Station Description	Zone[a]	Distance From Plant (km) [d]	Direction From Plant[d]
DR-1	River Sta. No. 3.3	I	1.6	SSE
DR-2	N. Hinsdale, NH	I	3.9	NNW
DR-3	Hinsdale Substation	I	3.0	E
DR-4	Northfield, MA	C	11.3	SSE
DR-5	Spofford Lake	C	16.5	NNE
DR-6	Vernon School	I	0.52	WSW
DR-7	Site Boundary[c]	SB	0.28	W
DR-8	Site Boundary	SB	0.25	SSW
DR-9	Inner Ring	I	1.7	N
DR-10	Outer Ring	O	4.5	N
DR-11	Inner Ring	I	1.6	NNE
DR-12	Outer Ring	O	3.6	NNE
DR-13	InnerRing	I	1.2	NE
DR-14	Outer Ring	O	3.9	NE
DR-15	Inner Ring	I	1.5	ENE
DR-16	Outer Ring	O	2.8	ENE
DR-17	Inner Ring	I	1.2	E
DR-18	Outer Ring	O	3.0	E
DR-19	Inner Ring	I	3.7	ESE
DR-20	Outer Ring	O	5.3	ESE
DR-21	Inner Ring	I	1.8	SE
DR-22	Outer Ring	O	3.3	SE
DR-23	Inner Ring	I	2.0	SSE
DR-24	Outer Ring	O	3.9	SSE
DR-25	Inner Ring	I	1.9	S
DR-26	Outer Ring	O	3.8	S
DR-27	Inner Ring	I	1.1	SSW
DR-28	Outer Ring	O	2.2	SSW
DR-29	Inner Ring	I	0.9	SW
DR-30	Outer Ring	O	2.4	SW

TABLE 4.3, cont.

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS (TLD) IN 2012
VERMONT YANKEE NUCLEAR POWER STATION

Station Code	Station Description	Zone[a]	Distance From Plant (km)[d]	Direction From Plant[d]
DR-31	Inner Ring	I	0.71	WSW
DR-32	Outer Ring	O	5.1	WSW
DR-33	Inner Ring	I	0.66	WNW
DR-34	Outer Ring	O	4.6	W
DR-35	Inner Ring	I	1.3	WNW
DR-36	Outer Ring	O	4.4	WNW
DR-37	Inner Ring	I	2.8	NW
DR-38	Outer Ring	O	7.3	NW
DR-39	Inner Ring	I	3.1	NNW
DR-40	Outer Ring	O	5.0	NNW
DR-41[b]	Site Boundary	SB	0.38	SSW
DR-42[b]	Site Boundary	SB	0.59	S
DR-43[b]	Site Boundary	SB	0.44	SSE
DR-44[b]	Site Boundary	SB	0.19	SE
DR-45[b]	Site Boundary	SB	0.12	NE
DR-46[b]	Site Boundary	SB	0.28	NNW
DR-47[b]	Site Boundary	SB	0.50	NNW
DR-48[b]	Site Boundary	SB	0.82	NW
DR-49[b]	Site Boundary	SB	0.55	WNW
DR-50[b]	Gov. Hunt House	I	0.35	SSW
DR-51[b]	Site Boundary	SB	0.26	W
DR-52[b]	Site Boundary	SB	0.24	SW
DR-53[b]	Site Boundary	SB	0.21	WSW

(a) I = Inner Ring TLD; O = Outer Ring Incident Response TLD; C = Control TLD; SB = Site Boundary TLD.

(b) This location is not considered a requirement of ODCM Table 3.5.1.

(c) DR-7 satisfies ODCM Table 3.5.1 for an inner ring direct radiation monitoring location. However, it is averaged as a Site Boundary TLD due to its close proximity to the plant.

(d) Distance and direction is relative to the center of the Turbine Building for direct radiation monitors.

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)	Milk (pCi/l)	Vegetation (pCi/Kg)	Sediment (pCi/Kg - dry)
Gross-Beta	4	0.01				
H-3	2000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131		0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

* If no drinking water pathway exists, a value of 3000 pCi/liter may be used.

See ODCM Table 4.5.1 for additional explanatory footnotes.

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)	Sediment (pCi/Kg-dry)
H-3	20,000[(a)]					
Mn-54	1000		30,000			
Fe-59	400		10,000			
Co-58	1000		30,000			
Co-60	300		10,000			3000[(b)]
Zn-65	300		20,000			
Zr-Nb-95	400					
I-131		0.9		3	100	
Cs-134	30	10	1000	60	1000	
Cs-137	50	20	2000	70	2000	
Ba-La-140	200			300		

(a) Reporting Level for drinking water pathways. For non-drinking water, a value of 30,000 pCi/liter may be used.
(b) Reporting Level for grab samples taken at the North Storm Drain Outfall only.

See ODCM Table 3.5.2 for additional explanatory footnotes.

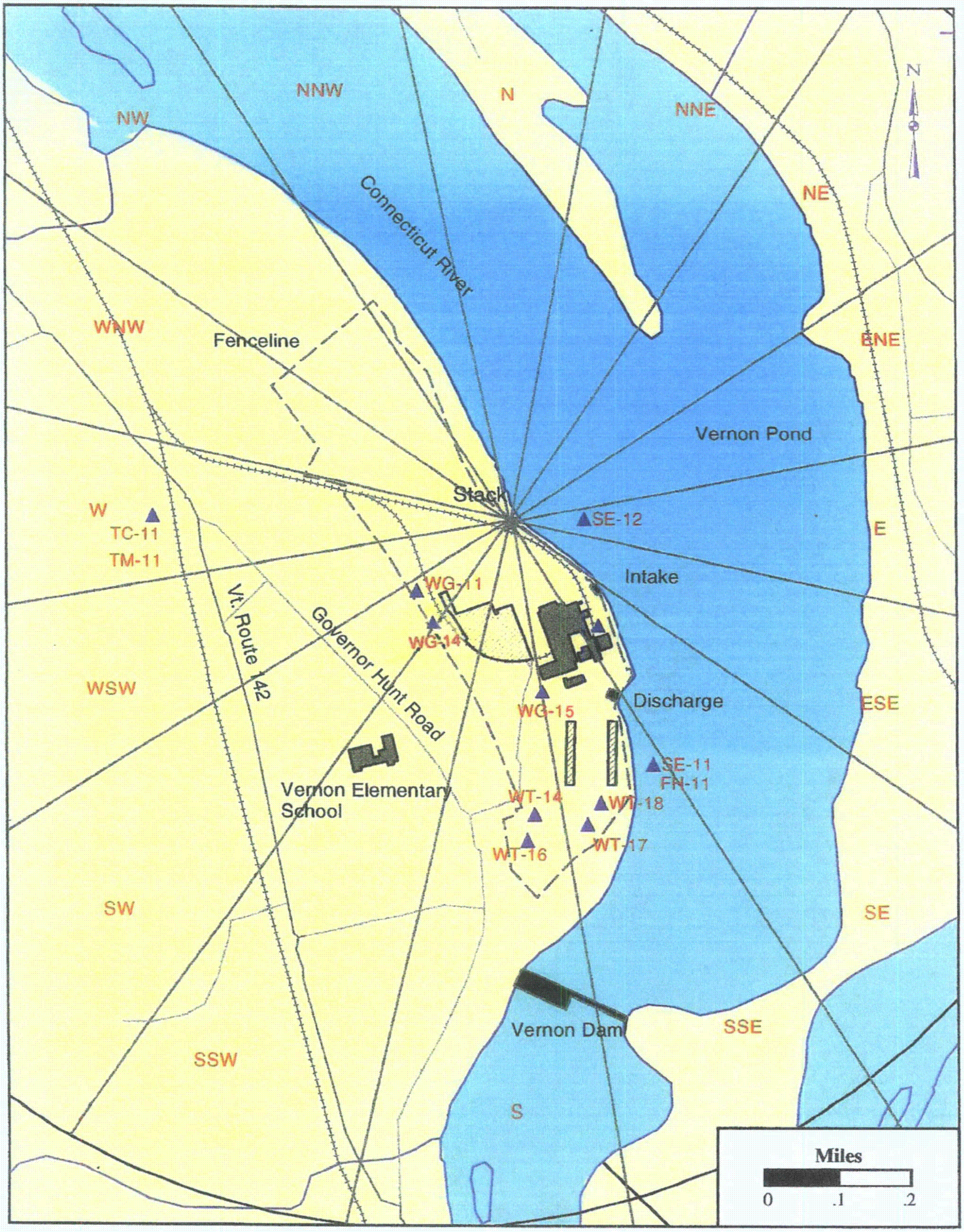

Figure 4.1 Environmental Sampling Locations In Close Proximity to Plant

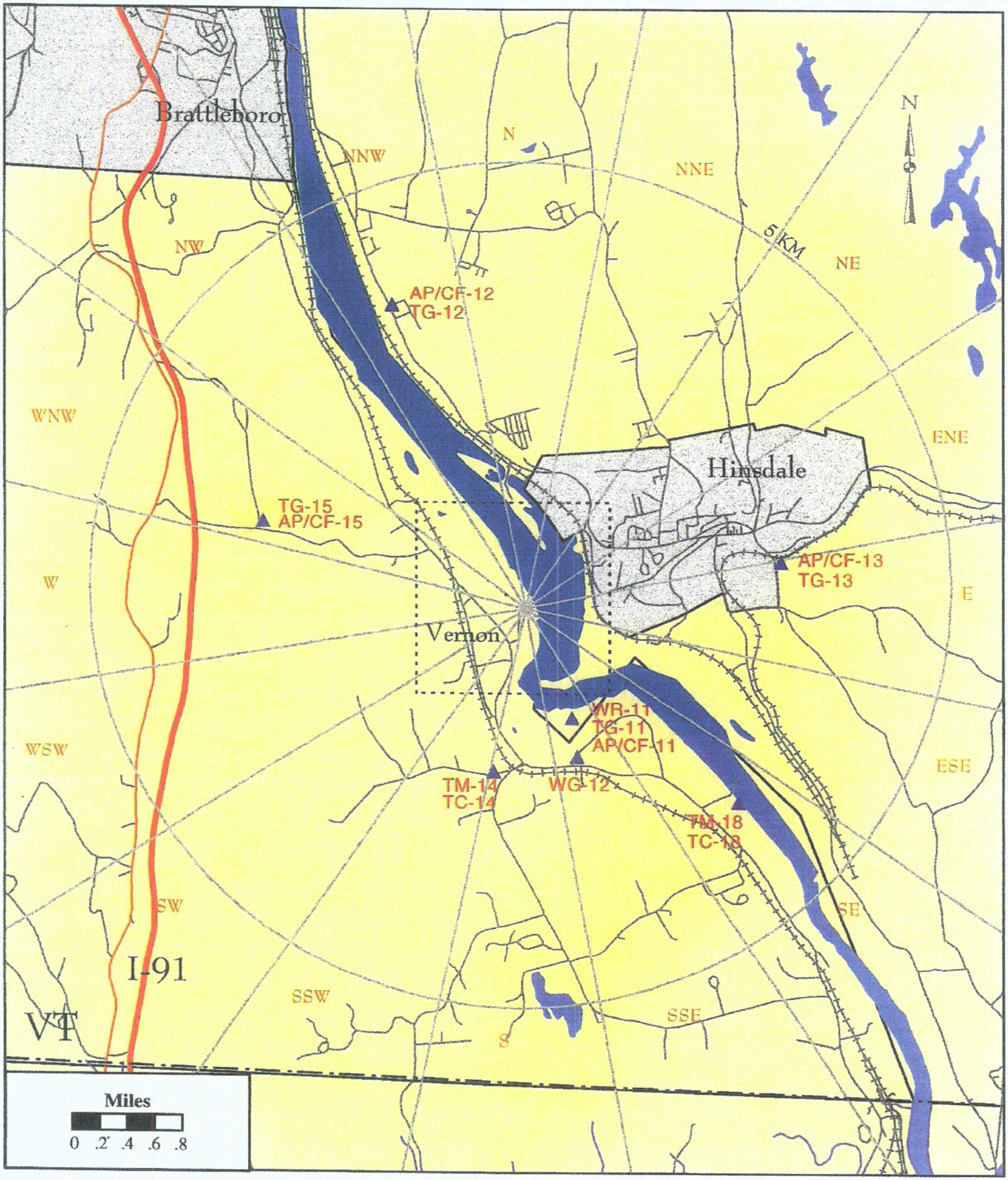

Figure 4.2 Environmental Sampling Locations Within 5 Km of Plant

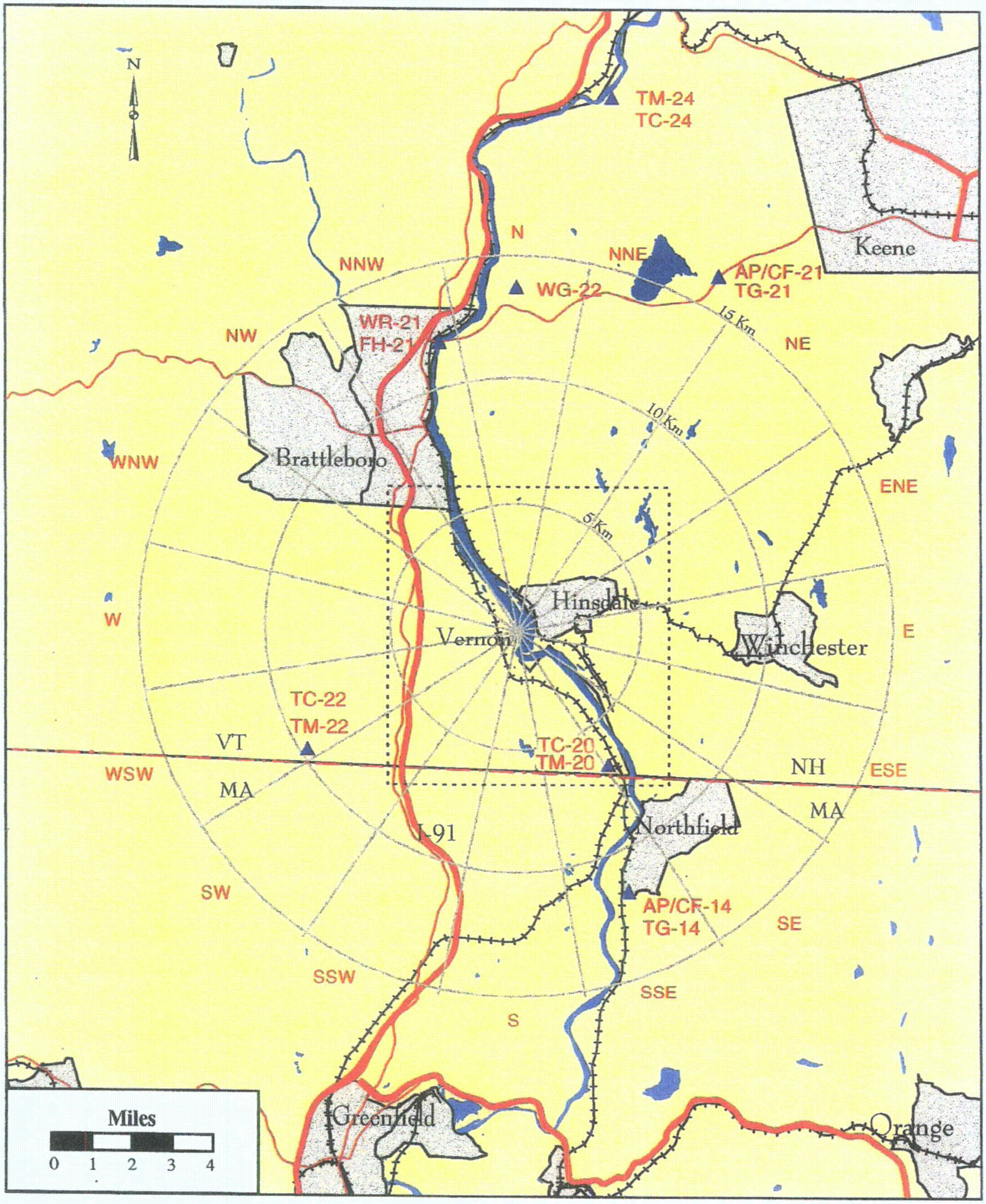

Figure 4.3 Environmental Sampling Locations Greater than 5 Km from Plant

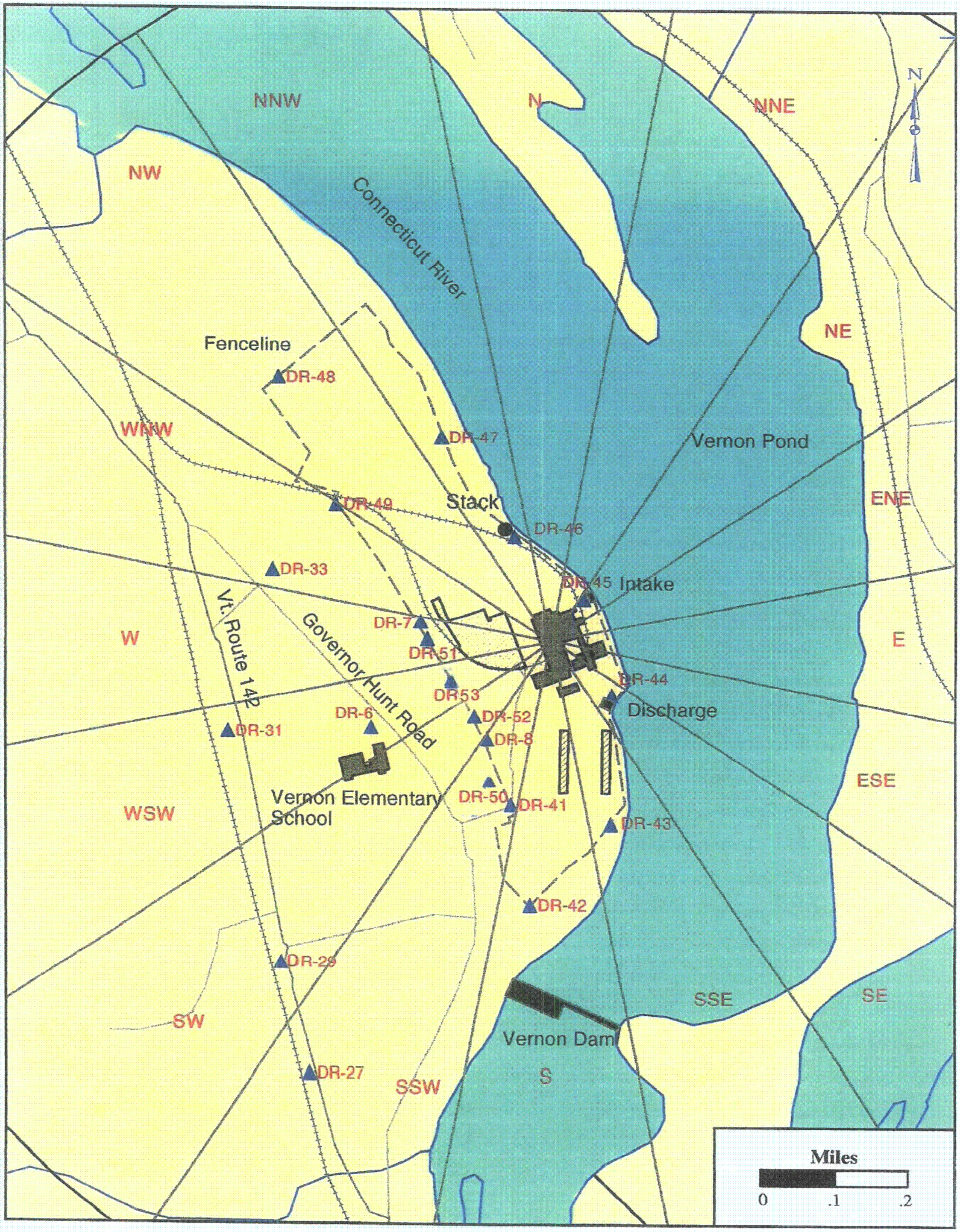

Figure 4.4 Thermoluminescent Dosimeter Locations
In Close Proximity to Plant

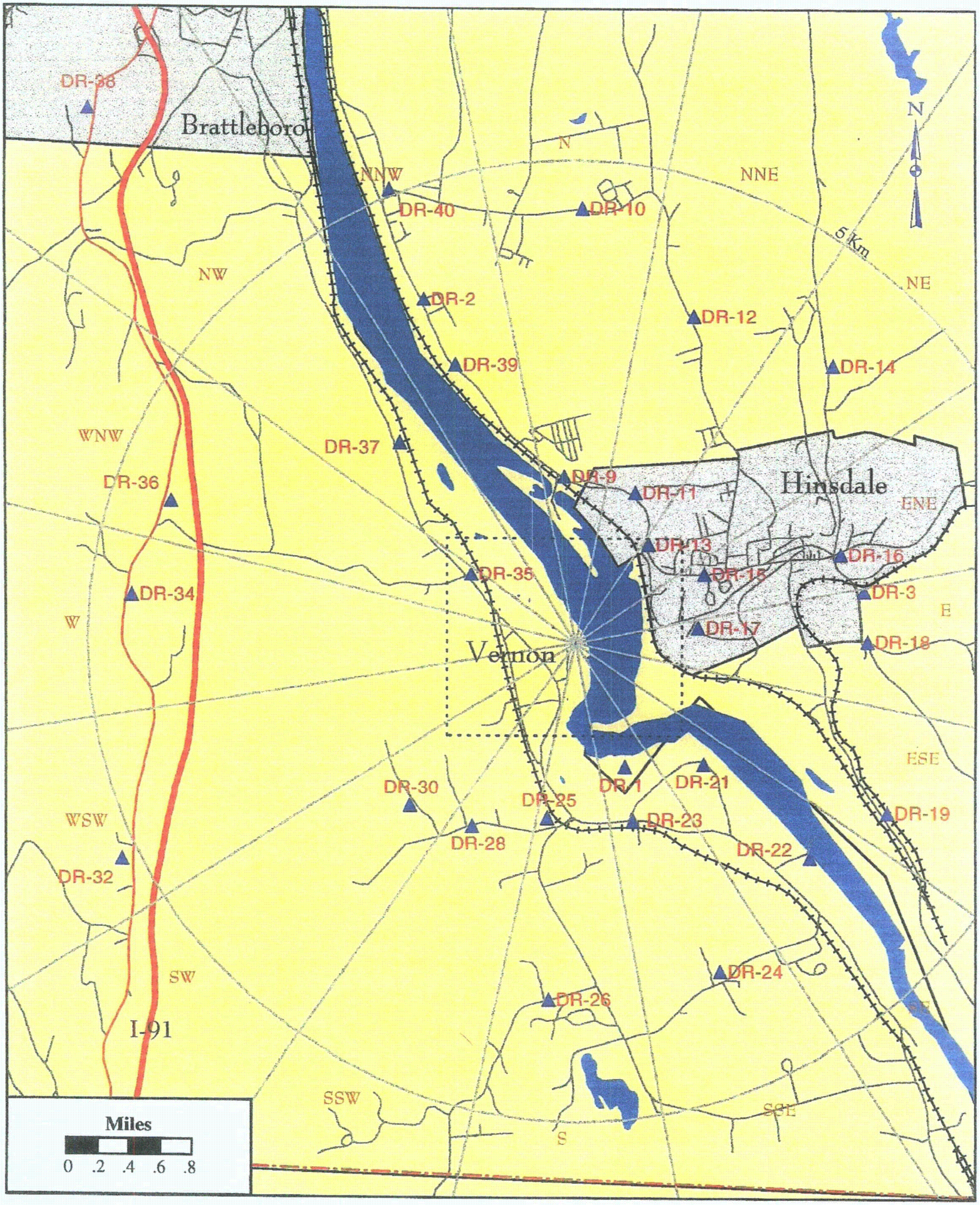

Figure 4.5 Thermoluminescent Dosimeter Locations Within 5 Km of Plant

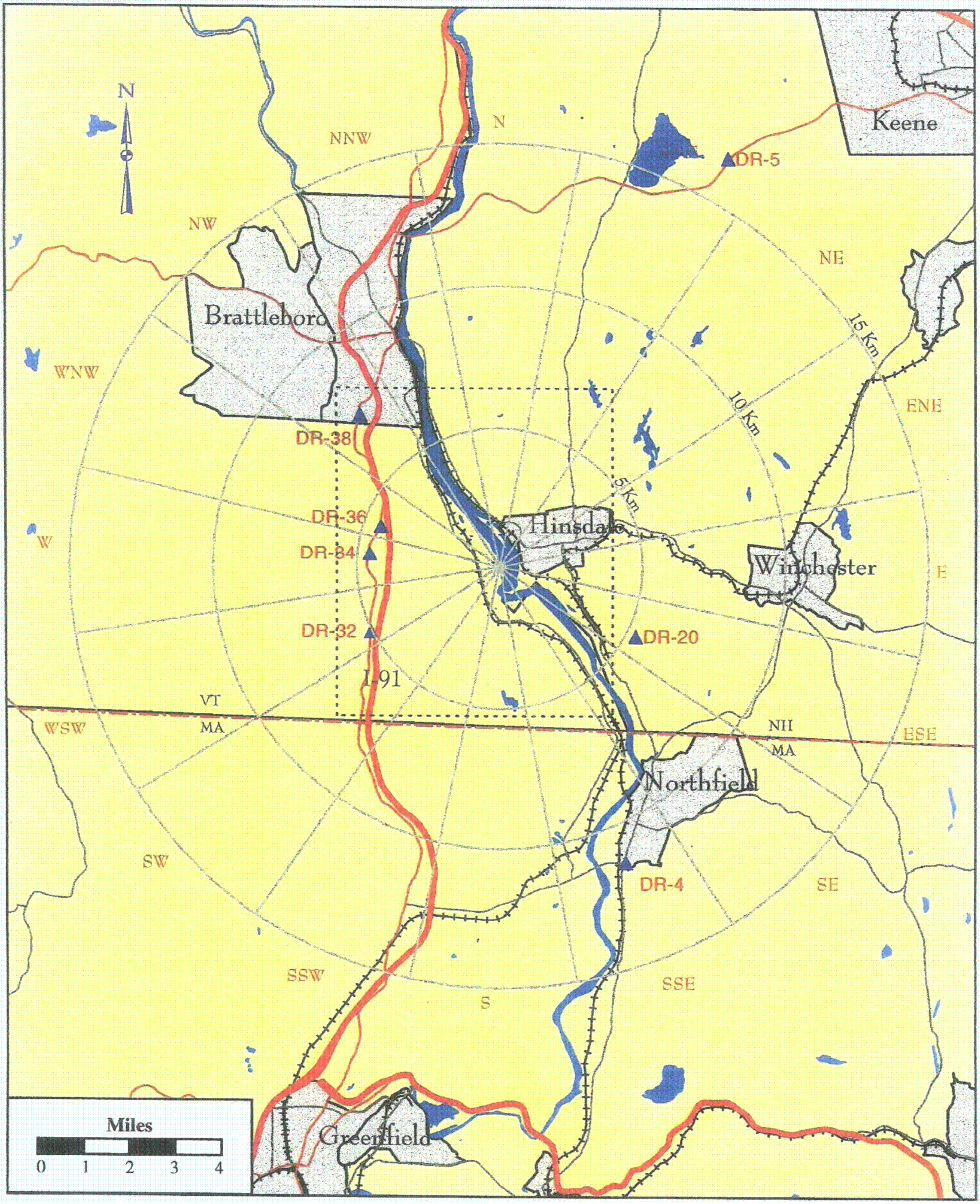

Figure 4.6 Thermoluminescent Dosimeter Locations Greater than 5 Km from Plant

5. RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples that were collected during 2012. 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. The units for each media type are also given.

In 2012, Vermont Yankee contracted with one laboratory for primary analyses of the environmental samples. A second laboratory was used to cross-check the first laboratory for selected samples and to analyze other samples for hard-to-detect radionuclides (such as Strontium-89 and 90).

The left-most column of Table 5.1 contains the radionuclide of interest, the total number of analyses for that radionuclide in 2012 and the number of measurements which exceeded the Reporting Levels found in Table 3.5.2 of the VYNPS Off-site Dose Calculation Manual. The latter are classified as "Non-routine" measurements. The second column lists the required Lower Limit of Detection (LLD) for those radionuclides that have detection capability requirements as specified in the ODCM Table 4.5.1. 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 50 percent of the most restrictive required LLD. Occasionally the required LLD may not be met. This may be due to malfunctions in sampling equipment or lack of sufficient sample quantity which would then result in low sample volume. Delays in analysis at the laboratory could also be a factor. Such cases, if and when they should occur, would be 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 stations, which are within the range of influence of the plant and which could be affected by its operation; (2) the Control stations, which are beyond the influence of the plant; and (3) the station which had the highest mean concentration during 2012 for that radionuclide. Direct radiation monitoring stations (using TLDs) are grouped into Inner Ring, Outer ring, Site Boundary and Control.

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

- The mean value of all concentrations, including those results that are less than the *a posteriori* LLD for that analysis.
- The minimum and maximum concentration, including those results that are less than the *a posteriori* LLD. In previous years, data less than the *a posteriori* LLD were converted to zero for purposes of

reporting the means and ranges.

- The "Number Detected" is the number of positive measurements. A measurement is considered positive when the concentration is greater than three times the standard deviation in the concentration and greater than or equal to the *a posteriori* LLD (Minimum Detectable Concentration or MDC).
- The "Total Analyzed" for each column is also given.

Each single radioactivity measurement datum in this report is based on a single measurement of a sample. Any concentration below the *a posteriori* LLD for its analysis is averaged with those values above the *a posteriori* LLD to determine the average of the results. Likewise, the values are reported in ranges even though they are below the *a posteriori* LLD. To be consistent with normal data review practices used by Vermont Yankee, a "positive measurement" is considered to be one whose concentration is greater than three times its associated standard deviation, is greater than or equal to the *a posteriori* LLD and satisfies the analytical laboratory's criteria for identification.

The radionuclides reported in this section represent those that: 1) had an LLD requirement in Table 4.5.1 of the ODCM, or a Reporting Level listed in Table 3.5.2 of the ODCM, or 2) had a positive measurement of radioactivity, whether it was naturally-occurring or man-made; or 3) were of special interest for any other reason. The radionuclides routinely analyzed and reported by the environmental laboratory (in a gamma spectroscopy analysis) were: Th-232, Ba/La-140, Be-7, Co-58, Co-60, Cs-134, Cs-137, Fe-59, K-40, Mn-54, Zn-65 and Zr-95.

Data from direct radiation measurements made by TLDs are provided in Table 5.2. The complete listing of quarterly TLD data is provided in Table 5.3.

Radiological Environmental Program Summary
2012 Radiological Environmental Operating Report
Vermont Yankee

Table 5.1:

Sample Medium:	Air Particulate (AP)
Sample Medium:	Charcoal Cartridge (CF)
Sample Medium:	River Water (WR)
Sample Medium:	Ground Water (WG)
Sample Medium:	Sediment (SE)
Sample Medium:	Test Well (WT)
Sample Medium:	Milk (TM)
Sample Medium:	Silage (TC)
Sample Medium:	Mixed Grass (TG)
Sample Medium:	Fish (FH)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATES (PCI/CU. METERS)	GR-B	364	0.01	0.0118 (312/312) (0.002/0.025)	0.0117 (52/52) (0.003/0.021)	0.0120 (52/52) (0.004/0.021)	40 INDICATOR GOV. HUNT HOUSE ON SITE	0
	GAMMA	28						
	BE-7		N/A	0.1011 (24/24) (0.0464/0.163)	0.0897 (4/4) (0.0694/0.1354)	0.1093 (4/4) (0.065/0.1477)	14 INDICATOR NORTHFIELD, MA 11.6 KILOMETERS SSE OF SITE	0
	K-40		N/A	0.0262 (1/24) (<0.0073/0.0843)	0.0271 (0/4) (<0.0216/<0.0305)	0.0452 (1/4) (<0.0248/0.0843)	14 INDICATOR NORTHFIELD, MA 11.6 KILOMETERS SSE OF SITE	0
	CS-134		30	0.0028 (0/24) (<0.0016/<0.0038)	0.0037 (0/4) (<0.0033/<0.0047)	0.0037 (0/4) (<0.0033/<0.0047)	21 CONTROL SPOFFORD LAKE 16.4 KILOMETERS NNE OF SITE	0
	CS-137		0.06	0.0020 (0/24) (<0.0004/<0.0029)	0.0024 (0/4) (<0.0014/<0.0032)	0.0024 (0/4) (<0.0014/<0.0032)	21 CONTROL SPOFFORD LAKE 16.4 KILOMETERS NNE OF SITE	0
	RA-226		N/A	0.0287 (0/24) (<0.0218/<0.0385)	0.0356 (0/4) (<0.0335/<0.0377)	0.0356 (0/4) (<0.0335/<0.0377)	21 CONTROL SPOFFORD LAKE 16.4 KILOMETERS NNE OF SITE	0
	ACTH-228		N/A	0.0074 (0/24) (<0.0019/<0.0145)	0.0092 (0/4) (<0.0085/<0.0102)	0.0092 (0/4) (<0.0085/<0.0102)	21 CONTROL SPOFFORD LAKE 16.4 KILOMETERS NNE OF SITE	0
AIR IODINE (PCI/CU. METERS)	GAMMA	364						
	I-131		40	0.0316 (0/312) (<0.0061/<0.0687)	0.0348 (0/52) (<0.0154/<0.0653)	0.0348 (0/52) (<0.0154/<0.0653)	21 CONTROL SPOFFORD LAKE 16.4 KILOMETERS NNE OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT — **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT — **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RIVER WATER (PCI/LITER)	GR-B	24	4	1.77 (12/12) (0.700/3.50)	1.61 (9/12) (0.800/4.40)	1.77 (12/12) (0.700/3.50)	11 INDICATOR RIVER STA. NO. 3.3 1.9 KILOMETERS SSE OF SITE	0
	H-3	10	3000	381 (0/5) (<370/<393)	381 (0/5) (<370/<393)	381 (0/5) (<370/<393)	11 INDICATOR RIVER STA. NO. 3.3 1.9 KILOMETERS SSE OF SITE	0
	GAMMA	24						
	MN-54		15	2.05 (0/12) (<0.45/<3.57)	4.27 (0/12) (<1.31/<5.91)	4.27 (0/12) (<1.31/<5.91)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CO-58		7.5	2.43 (0/12) (<0.58/<4.28)	4.4 (0/12) (<1.57/<6.51)	4.4 (0/12) (<1.57/<6.51)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	FE-59		30	6.81 (0/12) (<1.86/<12.23)	11.2 (0/12) (<4.29/<17.11)	11.2 (0/12) (<4.29/<17.11)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CO-60		15	2.09 (0/12) (<0.39/<3.53)	4.25 (0/12) (<1.28/<7.49)	4.25 (0/12) (<1.28/<7.49)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	ZN-65		30	3.78 (0/12) (<0.62/<9.12)	9.32 (0/12) (<3.08/<18.2)	9.32 (0/12) (<3.08/<18.2)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	ZR-95		15	4.15 (0/12) (<1.02/<7.08)	7.71 (0/12) (<2.53/<11.4)	7.71 (0/12) (<2.53/<11.4)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271

Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RIVER WATER (PCI/LITER)	I-131		15	12.6 (0/12) (<7.64/<15.0)	9.43 (0/12) (<4.71/<13.0)	12.6 (0/12) (<7.64/<15.0)	11 INDICATOR RIVER STA. NO. 3.3 1.9 KILOMETERS SSE OF SITE	0
	CS-134		15	1.72 (0/12) (<0.48/<3.61)	4.20 (0/12) (<0.97/<8.80)	4.20 (0/12) (<0.97/<8.80)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CS-137		15	1.94 (0/12) (<0.41/<3.37)	4.39 (0/12) (<1.22/<7.11)	4.39 (0/12) (<1.22/<7.11)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	BALA-140		15	7.28 (0/12) (<4.37/<11.1)	8.22 (0/12) (<5.31/<14.4)	8.22 (0/12) (<5.31/<14.4)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	RA-226		N/A	95.4 (12/12) (47.2/158)	102 (8/12) (59.9/<133)	102 (8/12) (59.9/<133)	21 CONTROL RT.9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
GROUND WATER (PCI/LITER)	GR-B	18	2	3.55 (14/14) (1.40/8.10)	1.37 (4/4) (1.00/2.30)	7.80 (2/2) (7.50/8.10)	15 INDICATOR SOUTHWEST WELL 0.3 KILOMETERS ON SITE	0
	H-3	13	1500	400 (0/10) (<386/<422)	398 (0/3) (<386/<422)	405 (0/3) (<386/<422)	11 INDICATOR PLANT WELL 0.2 KILOMETERS W OF SITE	0
	I-131	18	1	0.629 (0/14) (<0.465/<0.952)	0.670 (0/4) (<0.538/<0.842)	0.764 (0/2) (<0.575/<0.952)	15 INDICATOR SOUTHWEST WELL 0.3 KILOMETERS ON SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROUND WATER (PCI/LITER)	GAMMA	18						
	MN-54		7.5	6.18 (0/14) (<4.35/<9.20)	4.69 (0/4) (<3.84/<5.50)	6.92 (0/4) (<5.35/<9.20)	14 INDICATOR PLANT SUPPORT BLDG (PSB) WELL 0.3 KILOMETERS ON SITE	0
	CO-58		7.5	5.24 (0/14) (<3.29/<8.44)	4.78 (0/4) (<2.96/<6.45)	5.82 (0/4) (<4.04/<8.20)	14 INDICATOR PLANT SUPPORT BLDG (PSB) WELL 0.3 KILOMETERS ON SITE	0
	FE-59		15	15.9 (0/14) (<9.94/<21.6)	10.5 (0/4) (<9.07/<13.3)	18.1 (0/4) (<16.1/<21.5)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	CO-60		7.5	6.81 (0/14) (<3.95/<9.33)	4.85 (0/4) (<4.47/<5.24)	8.15 (0/4) (<7.68/<8.71)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	ZN-65		15	9.33 (0/14) (<5.51/<13.0)	7.56 (0/4) (<5.7/<9.29)	11.1 (0/4) (<9.46/<13.0)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	ZR-95		15	11.1 (0/14) (<7.18/<14.9)	8.15 (0/4) (<6.27/<10.8)	13.7 (0/4) (<11.6/<14.9)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	CS-134		7.5	5.19 (0/14) (<3.13/<7.20)	3.58 (0/4) (<3.16/<4.47)	5.75 (0/4) (<5.26/<6.21)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	CS-137		9	4.79 (0/14) (<3.21/<6.57)	4.44 (0/4) (<2.62/<6.53)	5.32 (0/4) (<4.08/<6.57)	12 INDICATOR VERNON NURSING WELL 2.1 KILOMETERS SSE OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (F) RANGE	**CONTROL LOCATION** MEAN (F) RANGE	**LOCATION WITH HIGHEST ANNUAL MEAN** MEAN (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROUND WATER (PCI/LITER)	BALA-140		7.5	8.82 (0/14) (<4.68/<12.9)	6.53 (0/4) (<5.29/<9.32)	10.5 (0/4) (<9.33/<12.6)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
	RA-226		2	174 (4/14) (<125/<251)	113 (2/4) (78.9/<146)	195 (2/4) (154/<224)	11 INDICATOR PLANT WELL 0.2 KILOMETERS ON SITE	0
SEDIMENT (PCI/KG DRY)	GAMMA	36						
	BE-7		N/A	1181 (0/34) (<637/<2162)	1214 (0/2) (<856/<1572)	1512 (0/2) (<863V<2162)	22 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	K-40		N/A	23458 (34/34) (10230/34270)	15370 (2/2) (13360/17380)	31135 (2/2) (28000/34270)	25 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	MN-54		N/A	75.5 (0/34) (<26.6/<101)	78.5 (0/2) (<70.3/<86.6)	97.4 (0/2) (<93.6/<101)	29 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	CO-60		N/A	69.8 (0/34) (<30.4/<96.5)	61.6 (0/2) (<52.9/<70.2)	91.0 (0/2) (<88.4/<93.5)	24 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	ZN-65		N/A	167 (0/34) (<52.9/<240)	193 (0/2) (<180/<206)	227 (0/2) (<215/<240)	29 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	NB-95		N/A	127 (0/34) (<54.5/<235)	142 (0/2) (<113/<172)	172 (0/2) (<109/<235)	19 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SEDIMENT (PCI/KG DRY)	CS-134		150	61.4 (0/34) (<21.9/<74.9)	63.2 (0/2) (<61.5/<65.0)	73.7 (0/2) (<72.6/<74.9)	23 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	CS-137		180	122 (20/34) (<47.0/309)	97.1 (1/2) (<85.2/109)	194 (1/2) (<79.6/309)	19 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	BALA-140		N/A	3226 (0/34) (<275/<11590)	3083 (0/2) (<466/<5699)	6007 (0/2) (<424/<11590)	19 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KM E OF SITE	0
	RA-226		N/A	2174 (18/34) (<930/4328)	1868 (1/2) (<1384/2352)	3522 (2/2) (3319/3724)	19 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	AC-228		N/A	2467 (26/34) (<171/5507)	1653 (1/2) (<244/3061)	5482 (2/2) (5457/5507)	31 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	TH-228		N/A	1729 (34/34) (730/2666)	1033 (2/2) (1013/1053)	2287 (2/2) (2177/2396)	25 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	TH-232		N/A	1409 (34/34) (542/2189)	974 (2/2) (935/1012)	1934 (2/2) (1679/2189)	25 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0
	U-238		N/A	7569 (0/34) (<3082/<10980)	7812 (0/2) (<7509/<8115)	9783 (0/2) (<8585/<10980)	29 INDICATOR NORTH STORM DRAIN OUTFALL 0.1 KILOMETERS E OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
TEST WELLS (PCI/LITER) (Nuclear Energy Institute Groundwater Protection Initiative Samples)	GR-B	16	4	9.50 (16/16) (5.5/18.1)	N/A	12.5 (4/4) (7.4/18.1)	14 INDICATOR TEST WELL 201 ONSITE	0
	H-3	16	3000	489 (0/16) (<454/<520)	N/A	4918 (0/4) (<461/<520)	18 INDICATOR TEST WELL 204 ONSITE	0
	GAMMA	16						
	K-40		N/A	26.3 (2/16) (<5.7/<72.2)	N/A	32.1 (1/4) (<6.9/<53.5)	16 INDICATOR TEST WELL 202 ONSITE	0
	MN-54		15	1.7 (0/16) (<0.6/<4.0)	N/A	1.9 (0/4) (<0.6/<4.0)	18 INDICATOR TEST WELL 204 ON SITE	0
	CO-58		15	1.9 (0/16) (<0.8/<3.7)	N/A	2.0 (0/4) (<0.8/<3.7)	18 INDICATOR TEST WELL 204 ON SITE	0
	FE-59		30	4.3 (0/16) (<1.8/<7.7)	N/A	4.5 (0/4) (<1.8/<7.7)	18 INDICATOR TEST WELL 204 ON SITE	0
	CO-60		15	1.8 (0/16) (<0.6/<4.5)	N/A	1.9 (0/4) (<0.8/<4.5)	14 INDICATOR TEST WELL 201 ON SITE	0
	NB-95		15	2.2 (0/16) (<0.9/<4.4)	N/A	2.3 (0/4) (<0.9/<4.4)	18 INDICATOR TEST WELL 204 ON SITE	0

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TEST WELLS (PCI/LITER) (Nuclear Energy Institute Groundwater Protection Initiative Samples)	I-131		15	4.4 (0/16) (<3.3/<6.4)	N/A	4.7 (0/4) (<3.8/<6.4)	18 INDICATOR TEST WELL 204 ON SITE	0
	CS-134		15	1.6 (0/16) (<0.6/<3.8)	N/A	1.8 (0/4) (<0.6/<3.8)	18 INDICATOR TEST WELL 204 ON SITE	0
	CS-137		18	1.9 (0/16) (<0.7/<4)	N/A	2 (0/4) (<0.7/<4)	18 INDICATOR TEST WELL 204 ON SITE	0
	BALA-140		15	5.9 (0/16) (<4.2/<7.1)	N/A	6.3 (0/4) (<4.8/<7.0)	18 INDICATOR TEST WELL 204 ON SITE	0
MILK (PCI/LITER)	I-131	90	1	0.597 (0/54) (<0.343/<0.785)	0.677 (0/36) (<0.515/<0.977)	0.689 (0/18) (<0.579/<0.786)	20 CONTROL DUNKLEE FARM 5.5 KILOMETERS S OF SITE	0
	SR-89	20	10	5.27 (0/12) (<3.31/<7.78)	5.22 (0/8) (<3.75/<9.30)	5.65 (0/4) (<3.59/<7.78)	14 INDICATOR BROWN FARM 2.2 KILOMETERS S OF SITE	0
	SR-90	20	2	0.97 (0/12) (<0.62/<1.42)	0.88 (0/8) (<0.36/<1.34)	1.06 (0/4) (<0.65/<1.42)	14 INDICATOR BROWN FARM 2.2 KILOMETERS S OF SITE	0
	GAMMA	90						
	BE-7		N/A	51.8 (0/54) (<33.9/<80.2)	52.6 (0/36) (<39.3/<73.5)	54.3 (0/18) (<41.1/<80.2)	18 INDICATOR BLODGETT FARM 3.6 KILOMETERS SE OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

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Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
MILK (PCI/LITER)	K-40		N/A	1480 (54/54) (1240/1883)	1548 (36/36) (1361/1734)	1558 (18/18) (1374/1734)	20 CONTROL DUNKLEE FARM 5.5 KILOMETERS S OF SITE	0
	CS-134		15	6.4 (0/54) (<3.8/<11.4)	6.0 (0/36) (<3.0/<10.8)	6.8 (0/18) (<3.9/<11.4)	11 INDICATOR MILLER FARM 0.8 KILOMETERS W OF SITE	0
	CS-137		18	6.8 (0/54) (<4.8/<9.9)	7.0 (0/36) (<4.4/<10.4)	7.1 (0/18) (<5.3/<9.9)	18 INDICATOR BLODGETT FARM 3.6 KILOMETERS SE OF SITE	0
	BALA-140		N/A	7.8 (0/54) (<4.3/<14.1)	7.9 (0/36) (<3.7/<13.5)	8.8 (0/18) (<5.3/<14.1)	18 INDICATOR BLODGETT FARM 3.6 KILOMETERS SE OF SITE	0
	RA-226		N/A	149 (7/54) (79.7/<196)	152 (9/36) (111/212)	158 (2/18) (79.7/<194)	18 INDICATOR BLODGETT FARM 3.6 KILOMETERS SE OF SITE	0
SILAGE (PCI/KG)	I-131		N/A	22.7 (0/3) (<18.1/<29.6)	28.2 (0/2) (<17.3/<39.1)	39.1 (0/1) (<39.1)	22 CONTROL FRANKLIN FARM 9.7 KILOMETERS WSW OF SITE	0
	GAMMA	5						
	BE-7		N/A	793 (3/3) (619/1042)	335 (1/2) (<108/562)	1042 (1/1) (1042)	11 INDICATOR MILLER FARM 0.8 KILOMETERS W OF SITE	0
	K-40		N/A	3945 (3/3) (2790/4669)	7402 (2/2) (3754/11050)	11050 (1/1) (11050)	22 CONTROL FRANKLIN FARM 9.7 KILOMETERS WSW OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER:** 50-271
Location of Facility: VERNON, VT **REPORTING PERIOD:** 2012

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATION MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SILAGE (PCI/KG)	CS-134		N/A	14.9 (0/3) (<11.1/<19.0)	17.9 (0/2) (<11.5/<24.3)	24.3 (0/1) (<24.3)	22 CONTROL FRANKLIN FARM 9.7 KILOMETERS WSW OF SITE	0
	CS-137		N/A	18.1 (0/3) (<14.1/<23.4)	21.7 (0/2) (<14.9/<28.6)	28.6 (0/1) (<28.6)	22 CONTROL FRANKLIN FARM 9.7 KILOMETERS WSW OF SITE	0
	ACTH-228		N/A	60.7 (0/3) (<42.5/<78.0)	84.3 (1/2) (<55.8/113)	113 (1/1) (113)	22 CONTROL FRANKLIN FARM 9.7 KILOMETERS WSW OF SITE	0
MIXED GRASS (PCI/KG)	I-131		N/A	43.0 (0/18) (<26.7/<58.3)	46.4 (0/3) (<33.5/<52.8)	49.1 (0/3) (<34.0/<58.3)	13 INDICATOR HINSDALE SUBSTATION 3.1 KILOMETERS E OF SITE	0
	GAMMA	21						
	BE-7		N/A	1622 (16/18) (<193/4351)	1550 (2/3) (<413/2327)	2469 (2/3) (<280/4242)	40 INDICATOR GOV. HUNT HOUSE ON SITE	0
	K-40		N/A	7356 (18/18) (4513/9932)	7656 (3/3) (7379/8115)	7953 (3/3) (6485/9932)	13 INDICATOR HINSDALE SUBSTATION 3.1 KILOMETERS E OF SITE	0
	CS-134		30	37.9 (0/18) (<19.7/<56.9)	36.0 (0/3) (<25.3/<42.3)	45.7 (0/3) (<34.7/<54.7)	12 INDICATOR N. HINSDALE NH 3.6 KILOMETERS NNW OF SITE	0
	CS-137		40	36.6 (0/18) (<26.2/<47.5)	36.6 (0/3) (<28.2/<46.8)	40.3 (0/3) (<36.0/<43.4)	13 INDICATOR HINSDALE SUBSTATION 3.1 KILOMETERS E OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

Name of Facility: VERMONT YANKEE NUCLEAR POWER PLANT **DOCKET NUMBER: 50-271**
Location of Facility: VERNON, VT **REPORTING PERIOD: 2012**

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (F) RANGE	**CONTROL LOCATION** MEAN (F) RANGE	**LOCATION WITH HIGHEST ANNUAL MEAN** MEAN (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
MIXED GRASS (PCI/KG)	RA-226		N/A	689 (9/18) (438/1119)	812 (3/3) (690/887)	859 (2/3) (532/1119)	15 INDICATOR TYLER HILL ROAD 3.1 KILOMETERS WNW OF SITE	0
	ACTH-228		N/A	136 (3/18) (<107/<171)	131 (0/3) (<106/<167)	141 (1/3) (<124/164)	15 INDICATOR TYLER HILL ROAD 3.1 KILOMETERS WNW OF SITE	0
FISH (PCI/KG WET)	GAMMA	12						
	K-40		N/A	3686 (6/6) (2501/4437)	3549 (6/6) (2443/4423)	3686 (6/6) (2501/4437)	11 INDICATOR VERNON POND 0.8 KILOMETERS W OF SITE	0
	MN-54		65	27.8 (0/6) (<17.7/<45.3)	29.5 (0/6) (<22.1/<45.9)	29.5 (0/6) (<22.1/<45.9)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CO-58		130	31.6 (0/6) (<23.5/<45.2)	36.8 (0/6) (<27.6/<53.2)	36.8 (0/6) (<27.6/<53.2)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	FE-59		260	78.2 (0/6) (<57.1/<105)	88.2 (0/6) (<69.6/<124)	88.2 (0/6) (<69.6/<124)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CO-60		130	30.4 (0/6) (<17.1/<49.2)	30.0 (0/6) (<20.8/<47.5)	30.4 (0/6) (<17.1/<49.2)	11 INDICATOR VERNON POND 0.8 KILOMETERS W OF SITE	0
	ZN-65		260	56.8 (0/6) (<38.7/<86.1)	67.1 (0/6) (<48.4/<110)	67.1 (0/6) (<48.4/<110)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0

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FISH (PCI/KG WET)	CS-134		130	27.6 (0/6) (<16.2/<45.1)	28.8 (0/6) (<20.4/<49.1)	28.8 (0/6) (<20.4/<49.1)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	CS-137		150	30.2 (0/6) (<18.8/<49.5)	32.8 (0/6) (<24.2/<55.8)	32.8 (0/6) (<24.2/<55.8)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	H-3	6	N/A	610 (0/3) (<509/<693)	635 (0/3) (<496/<736)	635 (0/3) (<496/<736)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	AM-241	12	N/A	7.2 (0/6) (<2.3/<14.3)	4.3 (0/6) (<2.6/<6.3)	7.2 (0/6) (<2.3/<14.3)	11 INDICATOR VERNON POND 0.8 KILOMETERS W OF SITE	0
	CM-242	12	N/A	4.04 (0/6) (<1.61/<7.65)	3.57 (0/6) (<1.29/<7.60)	4.04 (0/6) (<1.61/<7.65)	11 INDICATOR VERNON POND 0.8 KILOMETERS W OF SITE	0
	CM-243/244	12	N/A	7.7 (0/6) (<4.4/<14.0)	5.7 (0/6) (<2.6/<10.8)	7.7 (0/6) (<4.4/<14.0)	11 INDICATOR VERNON POND 0.8 KILOMETERS W OF SITE	0
	FE-55	12	N/A	1102 (0/6) (<779/<1377)	1315 (0/6) (<1097/<1636)	1315 (0/6) (<1097/<1636)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	PU-238	12	N/A	2.6 (0/6) (<0.8/<4.8)	3.4 (0/6) (<1.8/<6.9)	3.4 (0/6) (<1.8/<6.9)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2012

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FISH (PCI/KG WET)	PU-239/240	12	N/A	2.5 (0/6) (<0.7/<4.2)	2.7 (0/6) (<2.2/<4.0)	2.7 (0/6) (<2.2/<4.0)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	PU-241	12	N/A	492 (0/6) (<388/<605)	1029 (0/6) (<424/<3840)	1029 (0/6) (<424/<3840)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	PU-242	12	N/A	2.41 (0/6) (<0.791/<3.59)	1.76 (0/6) (<1.31/<2.65)	2.41 (0/6) (<0.791/<3.59)	11 INDICATOR VERNON POND 0.8 KM W OF SITE	0
	SR-89	12	N/A	91.0 (0/6) (<71.0/<117)	93.0 (0/6) (<69.0/<112)	93.0 (0/6) (<69.0/<112)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
	SR-90	12	N/A	31.8 (2/6) (<18.8/48.4)	49.0 (3/6) (<20.1/78.9)	49.0 (3/6) (<20.1/78.9)	21 CONTROL RT. 9 BRIDGE 11.8 KILOMETERS NNW OF SITE	0
DIRECT RADIATION (MILLI-ROENTGEN/QTR.)	TLD-QUARTERLY	212	N/A	7 (204/204) (5/13)	6 (8/8) (6/7)	12 (4/4) (12/13)	DR-45 INDICATOR SITE BOUNDARY 0.12 KILOMETERS NE OF SITE	

FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE 5.2

ENVIRONMENTAL TLD DATA SUMMARY
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT
(JANUARY - DECEMBER 2012)

INNER RING TLD	OUTER RING TLD	OFFSITE STATION WITH HIGHEST MEAN		CONTROL TLDs
MEAN* RANGE* (NO. MEASUREMENTS)**	MEAN* RANGE* (NO. MEASUREMENTS)**	STA.NO./	MEAN* RANGE* (NO. MEASUREMENTS)**	MEAN* RANGE* (NO. MEASUREMENTS)**
6.62 ± 0.33	6.75 ± 0.34	*DR36*	7.51 ± 0.33	6.45 ± 0.31
5.76 to 7.65	5.47 to 7.82		7.39 to 8.65	6.00 to 6.86
76	68		4	8

SITE BOUNDARY TLD WITH HIGHEST MEAN		SITE BOUNDARY TLD
STA.NO./	MEAN* RANGE* (NO. MEASUREMENTS)**	MEAN* RANGE * (NO. MEASUREMENTS)**
DR45	12.44 ± 0.62	8.25 ± 0.40
	11.73 to 12.16	5.53 to 13.10
	4	60

* Units are in micro-R per hour.

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

TABLE 5.3

ENVIRONMENTAL TLD MEASUREMENTS
2012
(Micro-R per Hour)

Sta. No.	Description	1ST QUARTER EXP.		S.D.	2ND QUARTER EXP.		S.D.	3RD QUARTER EXP.		S.D.	4TH QUARTER EXP.		S.D.	ANNUAL AVE. EXP.
DR-01	River Sta. No. 3.3	5.76	±	0.23	6.28	±	0.40	6.01	±	0.27	6.03	±	0.32	6.0
DR-02	N Hinsdale, NH	7.02	±	0.34	7.25	±	0.46	7.39	±	0.24	7.27	±	0.35	7.2
DR-03	Hinsdale Substation	7.13	±	0.39	7.65	±	0.27	7.64	±	0.28	7.30	±	0.43	7.4
DR-04	Northfield, MA	6.00	±	0.23	6.28	±	0.36	6.21	±	0.26	6.12	±	0.30	6.2
DR-05	Spofford Lake, NH	6.60	±	0.40	6.83	±	0.23	6.86	±	0.33	6.70	±	0.35	6.8
DR-06	Vernon School	6.53	±	0.30	7.19	±	0.32	6.89	±	0.36	6.66	±	0.36	6.8
DR-07	Site Boundary	7.76	±	0.27	8.26	±	0.40	8.24	±	0.35	8.44	±	0.39	8.2
DR-08	Site Boundary	8.38	±	0.41	8.63	±	0.39	8.86	±	0.29	8.73	±	0.41	8.7
DR-09	Inner Ring	6.44	±	0.29	6.88	±	0.34	6.40	±	0.24	6.30	±	0.37	6.5
DR-10	Outer Ring	5.64	±	0.21	5.86	±	0.31	5.76	±	0.21	5.47	±	0.32	5.7
DR-11	Inner Ring	6.01	±	0.27	6.37	±	0.52	6.07	±	0.23	5.93	±	0.31	6.1
DR-12	Outer Ring	5.75	±	0.32	5.98	±	0.26	5.91	±	0.20	5.78	±	0.39	5.9
DR-13	Inner Ring	6.67	±	0.36	6.90	±	0.38	6.54	±	0.32	6.66	±	0.33	6.7
DR-14	Outer Ring	7.58	±	0.27	7.55	±	0.27	7.76	±	0.39	7.46	±	0.42	7.6
DR-15	Inner Ring	6.44	±	0.34	6.86	±	0.35	6.92	±	0.59	6.62	±	0.37	6.7
DR-16	Outer Ring	7.21	±	0.24	7.49	±	0.50	6.90	±	0.26	7.09	±	0.40	7.2
DR-17	Inner Ring	6.30	±	0.25	6.67	±	0.26	6.24	±	0.23	6.31	±	0.37	6.4
DR-18	Outer Ring	6.64	±	0.27	6.94	±	0.28	6.73	±	0.35	6.57	±	0.46	6.7
DR-19	Inner Ring	7.26	±	0.28	7.52	±	0.32	7.60	±	0.30	7.25	±	0.39	7.4
DR-20	Outer Ring	7.00	±	0.26	7.63	±	0.32	7.34	±	0.42	7.02	±	0.42	7.2
DR-21	Inner Ring	6.30	±	0.37	6.71	±	0.32	6.67	±	0.24	6.64	±	0.31	6.6
DR-22	Outer Ring	6.73	±	0.26	7.10	±	0.27	6.79	±	0.35	6.87	±	0.34	6.9
DR-23	Inner Ring	5.79	±	0.23	6.25	±	0.23	6.09	±	0.32	6.06	±	0.32	6.1
DR-24	Outer Ring	5.95	±	0.22	6.24	±	0.33	6.11	±	0.46	5.77	±	0.39	6.0
DR-25	Inner Ring	5.98	±	0.23	6.52	±	0.26	6.54	±	0.44	6.21	±	0.42	6.3
DR-26	Outer Ring	6.44	±	0.32	6.99	±	0.37	6.97	±	0.23	6.74	±	0.38	6.8
DR-27	Inner Ring	6.54	±	0.41	6.49	±	0.29	6.42	±	0.35	6.23	±	0.30	6.4
DR-28	Outer Ring	6.47	±	0.30	6.77	±	0.34	6.70	±	0.29	6.66	±	0.39	6.7
DR-29	Inner Ring	6.68	±	0.30	6.70	±	0.35	6.66	±	0.27	6.80	±	0.33	6.7
DR-30	Outer Ring	6.08	±	0.29	6.60	±	0.26	7.00	±	0.29	6.27	±	0.34	6.5
DR-31	Inner Ring	6.15	±	0.48	6.87	±	0.27	7.09	±	0.25	6.74	±	0.37	6.7
DR-32	Outer Ring	6.04	±	0.43	6.32	±	0.46	6.87	±	0.35	6.26	±	0.35	6.4
DR-33	Inner Ring	6.77	±	0.25	7.37	±	0.46	7.09	±	0.39	6.80	±	0.37	7.0
DR-34	Outer Ring	6.59	±	0.56	7.08	±	0.31	7.25	±	0.36	6.81	±	0.32	6.9
DR-35	Inner Ring	6.17	±	0.45	6.69	±	0.25	6.77	±	0.32	6.34	±	0.38	6.5
DR-36	Outer Ring	6.95	±	0.37	7.77	±	0.26	7.82	±	0.30	7.51	±	0.39	7.5
DR-37	Inner Ring	6.24	±	0.23	6.76	±	0.36	6.97	±	0.25	6.77	±	0.31	6.7
DR-38	Outer Ring	6.42	±	0.43	7.21	±	0.47	7.12	±	0.47	7.09	±	0.44	7.0
DR-39	Inner Ring	6.29	±	0.35	6.85	±	0.31	7.00	±	0.39	6.70	±	0.37	6.7
DR-40	Outer Ring	6.05	+	0.31	6.70	+	0.26	6.33	+	0.34	7.10	+	0.33	6.5

Note: Blank spaces indicate missing TLDs

TABLE 5.3 (cont.)

ENVIRONMENTAL TLD MEASUREMENTS
2012
(Micro-R per Hour)

Sta. No.	Description	1ST QUARTER EXP.		1ST QUARTER S.D.	2ND QUARTER EXP.		2ND QUARTER S.D.	3RD QUARTER EXP.		3RD QUARTER S.D.	4TH QUARTER EXP.		4TH QUARTER S.D.	ANNUAL AVE. EXP.
DR-07	Site Boundary	7.76	±	0.27	8.26	±	0.40	8.24	±	0.35	8.44	±	0.39	8.2
DR-08	Site Boundary	8.38	±	0.41	8.63	±	0.39	8.86	±	0.29	8.73	±	0.41	8.7
DR-41	Site Boundary	6.88	±	0.32	7.39	±	0.27	7.35	±	0.33	7.13	±	0.42	7.2
DR-42	Site Boundary	6.37	±	0.21	7.10	±	0.39	6.96	±	0.31	6.96	±	0.31	6.9
DR-43	Site Boundary	7.19	±	0.34	8.00	±	0.32	8.14	±	0.32	7.79	±	0.41	7.8
DR-44	Site Boundary	8.94	±	0.62	8.71	±	0.33	8.57	±	0.42	8.75	±	0.49	8.7
DR-45	Site Boundary	12.16	±	0.64	12.78	±	0.48	11.73	±	0.65	13.10	±	0.81	12.4
DR-46	Site Boundary	8.29	±	0.50	9.07	±	0.38	9.09	±	0.43	9.08	±	0.53	8.9
DR-47	Site Boundary	7.46	±	0.26	8.01	±	0.50	8.36	±	0.31	7.95	±	0.41	7.9
DR-48	Site Boundary	5.53	±	0.27	6.32	±	0.31	6.12	±	0.22	6.02	±	0.35	6.0
DR-49	Site Boundary	6.14	±	0.31	6.80	±	0.32	6.34	±	0.42	6.50	±	0.35	6.4
DR-50	Governor Hunt House	6.68	±	0.41	7.34	±	0.37	7.52	±	0.28	7.36	±	0.44	7.2
DR-51	Site Boundary	8.00	±	0.35	8.73	±	0.27	8.98	±	0.38	8.87	±	0.44	8.6
DR-52	Site Boundary	8.85	±	0.48	9.46	±	0.35	9.62	±	0.49	9.48	±	0.48	9.4
DR-53	Site Boundary	9.09	±	0.46	9.60	±	0.31	9.84	±	0.43	9.47	±	0.58	9.5

6. ANALYSIS OF ENVIRONMENTAL RESULTS

6.1 Sampling Program Deviations

Off-site Dose Calculation Manual Control 3.5.1 allows for deviations "if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons." In 2012, two deviations were noted in the REMP. These deviations did not compromise the program's effectiveness and are considered typical with respect to what is normally anticipated for any radiological environmental program. The specific deviations for 2012 were:

a) The Southwest Well water sample was not collected in the first quarter of 2012 (January 1st through March 31st, 2012) because the submersible pump in the well was out of service during this period. A sample was collected from the Southwest Well on December 14th, 2012. A sample was scheduled to be collected in the middle of March, 2012 but it was discovered at this time that the well pump was not in service. The Southwest Well pump was replaced in early April 2012 and a sample was subsequently collected on April 16th, 2012.

b) The Northfield Massachusetts environmental air sample station (APCF-14) air pump was found to be out of service on November 20th, 2012. A new sample pump was installed immediately and normal collection of environmental air sample at this location was resumed.

c) Air sample station outages during 2012 are reflected in the air sample collection time percentages listed below.

AP/CF #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
11	100%	100%	100%	100%
12	100%	100%	99.9%	100%
13	99.8%	100%	99.9%	100%
14	100%	100%	99.9%	94.5%
15	100%	100%	99.9%	100%
21	100%	100%	100%	100%
40	100%	100%	100%	100%

6.2 Comparison of Achieved LLDs with Requirements

Table 4.5.1 of the VYNPS ODCM (also shown in Table 4.4 of this report) gives the required Lower Limits of Detection (LLDs) for environmental sample analyses. On occasion, an LLD is not achievable due to a situation such as a low sample volume caused by sampling equipment malfunction or limited sample availability. In such a case, ODCM 10.2 requires a discussion of the situation. At the contracted environmental laboratory, the target LLD for the majority of analyses is 50 percent of the most restrictive required LLD. Expressed differently, the typical sensitivities achieved for each analysis are at least 2 times greater than that required by the VYNPS ODCM.

For each analysis having an LLD requirement in ODCM Table 4.5.1, the *a posteriori* (after the fact) LLD calculated for that analysis was compared with the required LLD. During 2012, all sample analyses performed for the REMP program achieved an *a posteriori* LLD less than the corresponding LLD requirement.

6.3 Comparison of Results with Reporting Levels

ODCM Section 10.3.4 requires written notification to the NRC within 30 days of receipt of an analysis result whenever a Reporting Level in ODCM Table 3.5.2 is exceeded. Reporting Levels are the environmental concentrations that relate to the ALARA design dose objectives of 10 CFR 50, Appendix I. Environmental concentrations are averaged over the calendar quarters for the purposes of this comparison. The Reporting Levels are intended to apply only to measured levels of radioactivity due to plant effluents. During 2012, no analytical result exceeded a corresponding reporting level requirement in Table 3.5.2 of the ODCM.

6.4 Changes in Sampling Locations

The Vermont Yankee Nuclear Power Station Off-Site Dose Calculation Manual Section 10.2 states that if "new environmental sampling locations are identified in accordance with Control 3.5.2, the new locations shall be identified in the next Annual Radiological Environmental Operating Report." There were no required sampling location changes due to the Land Use Census conducted in 2012.

Milk collection from Dunklee farm (Vern-Mont Farm in Vernon) commenced in April, 2010 at the request of the farm owner. At this time, all dairy farms in Vernon are supplying milk for analysis.

This year Vermont Yankee is continuing to add data from the on-site air sampling station, AP/CF 40, at the Governor Hunt House. This location has been used continuously as a demonstration since early in the program, but the data had not previously been included in this report.

6.5 Data Analysis by Media Type

The 2012 REMP data for each media type is discussed below. Whenever a specific measurement result is presented, it is given as the concentration in the units of the sample (volume or weight). An analysis is considered to yield a "detectable measurement' when the concentration exceeds three times the standard deviation for that analysis and is greater than or equal to the Minimum Detectable Concentration (MDC) for the analysis. With respect to data plots, all net concentrations are plotted as reported, without regard to whether the value is "detectable" or "non-detectable." In previous years, values that were less than the MDC were converted to zero.

6.5.1 Airborne Pathways

6.5.1.1 Air Particulates (AP)

The periodic air particulate filters from each of the seven sampling sites were analyzed for gross-beta radioactivity. At the end of each quarter, the filters from each sampling site were composited for a gamma analysis. The results of the air particulate sampling program are shown in Table 5.1 and Figures 6.1 through 6.7.
Gross beta activity was detected in all air particulate filters that were analyzed. As shown in Figure 6.1, there is no significant difference between the quarterly average concentrations at the indicator (near-plant) stations and the control (distant from plant) stations. Notable in Figure 6.1 is a distinct annual cycle, with the minimum concentration in the fourth quarter, and the maximum concentration in the third quarter.

Figures 6.2 through 6.7 show the weekly gross beta concentration at each air particulate sampling location compared to the control air particulate sampling location at AP-21 (Spofford Lake, NH). Small differences are evident and expected between individual sampling locations. Figure 6.2 clearly demonstrates the distinct annual cycle, with the minimum concentration in the second quarter, and the maximum concentration in the first quarter. It can be 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 Vermont Yankee operations.

There were two naturally-occurring gamma-emitting radionuclides detected on the air particulate filters during this reporting period. Be-7, a naturally-occurring cosmogenic radionuclide, was detected on 28 of 28 filter sets analyzed. K-40 was detected on one out of 28 analyzed. Ra-226 and Ac/Th-228 were not detected in the 28 filter sets analyzed.

6.5.1.2 Charcoal Cartridges (CF)

Charcoal cartridges from each of the seven air sampling sites were analyzed for I-131 each time they were collected. The results of these analyses are summarized in Table 5.1. As in previous years, no I-131 attributable to the operation of Entergy Vermont Yankee was detected in any charcoal cartridge.

6.5.2 Waterborne Pathways

6.5.2.1 River Water (WR)

Aliquots of river water were automatically collected periodically from the Connecticut River downstream from the plant discharge area and hydro station, location WR-11, with the exception of the two events of short duration when the sampling equipment was out of service (see Section 6.1). Monthly grab samples were also collected at the upstream control location, also on the Connecticut River, location WR-21. The composited samples at WR-11 were collected monthly and sent along with the WR-21 grab samples to the contracted environmental laboratory for analysis. Table 5.1 shows that gross-beta measurements were positive in 12 out of 12 indicator samples and 9 out of 12 control samples, as would be expected, due to naturally-occurring radionuclides in the water. As seen in Figure 6.8, the mean concentration of the indicator locations was similar to the mean concentration at the control location in 2012.

For each sampling site, the monthly samples were composited into quarterly samples for H-3 (Tritium) analyses. None of the samples contained detectable quantities of H-3.

There was one naturally-occurring gamma-emitting radionuclides detected in river water samples during this reporting period. Ra-226, a naturally-occurring primordial radionuclide, was detected in 20 of 24 samples analyzed.

6.5.2.2 Ground Water – Potable Drinking Water (WG)

Quarterly ground water (deep wells supplying drinking water to the plant and selected offsite locations) samples were collected from four indicator locations (only one is required by VYNPS ODCM) and one control location during 2012. In 1999, WG-14 (PBS Well) another on-site well location was added to the program. In July 2012, WG-15 (Southwest Well) was added to the ODCM as a quarterly sample location. Table 5.1 and Figure 6.9 show that gross-beta measurements were positive in 14 out of 14 indicator samples and in 4 out of 4 control samples. The beta activity is due to naturally-occurring radionuclides in the water. The levels at all sampling locations, including the higher levels at station WG-13, were consistent with those detected in previous years. Naturally occurring Ra-226 was also detected in six samples and is naturally-occurring. No other gamma-emitting radionuclides or tritium were detected in any of the samples.

6.5.2.3 Sediment (SE)

Semi-annual river sediment grab samples were collected from two indicator locations during 2012. The North Storm Drain Outfall location (SE-12) is an area where up to 40 different locations can be sampled within a 20 ft by 140 ft area. In 2012, 18 locations were sampled at SE-12 during each of the semi-annual collections. Two samples were collected at SE-11 during the year. Be-7 was not detected in any of the 36 samples analyzed. As would be expected, naturally-occurring Potassium-40 (K-40) was detected in all of the samples. Cobalt-60 was not detected in any of the 36 samples. Radium-226 (Ra-226) was detected in 19 of 36 samples. Actinium-228 (Ac-228) was detected in 27 of 36 samples. Thorium-228 (Th-228) was detected in all 36 samples analyzed. Thorium-232 (Th-232) was detected in all 36 samples analyzed. Urainium-238 (U-238) was not detected in any of the 36 samples. Cesium-137 (Cs-137) was detected in 20 out of 34 of the indicator samples and one of the two control samples. The levels of Cs-137 measured were consistent with what has been measured in the previous several years and with those detected at other New England locations. Also see section 6.5.2.6 for more information.

6.5.2.4 Test Wells (WT)

During 1996, sampling was initiated at test wells around the outer edges of an area in the south portion of the VYNPS site where septic sludge is spread. This sampling continued through 2012. The test well locations are shown on Figure 4.1 and the results are summarized in Table 5.1 under the media category, Test Well (WT). In 2012, four samples were taken at each of the four locations and all were analyzed for gamma isotopic, gross beta and H-3 activity.

Prior to the gross beta analysis, each sample was filtered through a 0.45 micron Gelman Tuffryn membrane filter. Gross beta activity was detected in all 16 samples collected with levels ranging from 5.5 to 18.1 pCi/kg. Potassium-40 (K-40) was also detected in two of the 16 samples. No other radionuclides were detected.

6.5.2.5 Storm Drain System

The presence of plant-generated radionuclides in the onsite storm drain system has been identified in previous years at Vermont Yankee (VY). As a consequence, a 50.59 evaluation of radioactive materials discharged via the storm drain system was performed in 1998. This assessment was in response to Information and Enforcement Bulletin No. 80-10 and NRC Information Notice No. 91-40. The evaluation demonstrated that the total curies released via the VYNPS storm drain system are not sufficient to result in a significant dose (i.e. dose does not exceed 10% of the technical specification objective of 0.3 millirem per year to the total body, and 1.0 millirem per year to the target organ for the maximally exposed receptor). Water and sediment in the onsite storm drain system was routinely sampled throughout 2012 at various points. The results of this sampling are summarized below.

Sediment samples were taken from the storm drain system at onsite manhole locations in 2012 for a total of 11 samples. All samples were analyzed for gamma emitting isotopes. Table 6-1 summarizes the analytical results of the sediment samples. Zinc-65 was detected in one of 11 samples. The naturally-occurring isotope Ra-226 was found in nine of 11 samples as expected. The highest detected concentration for all plant-related radionuclides that were detected in sediment samples was found in sample SE-92 which is also designated by the plant as Manhole 12A.

Cobalt-60 and Cesium-137 were detected in one of 11 samples in 2012.

Table 6.1

Summary of Storm Drain System Sediment Sample Analyses*

Isotope	No. Detected**	Mean (pCi/kg)	Range (pCi/kg)	Station With Highest Detected Concentration
Ra-226	9/11	1.58 E 3	(1.14– 2.27) E 3	MH-12A (SE-92)
Cs-137	1/11	7.56 E 1	NA	MH-12A (SE-92)-
Mn-54	0/11	NA	NA	-
Co-60	1/11	1.45 E 2	NA	MH-12A (SE-92)
Zn-65	1/11	1.38 E 2	NA	MH-12A (SE-92)

* Radionuclides that were not detected in any sample are not listed

** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations). The mean and the range are determined only from the samples where activity was >3 standard deviations.

Water samples were taken from the storm drain system at various access points in 2012 including Manholes MH-8, MH-11H, MH-12A, MH-13, and MH-14. Table 6-2 summarizes the analytical results of water samples from the storm drain system (MH-12A and MH-14) in 2012. Naturally-occurring Ra-226 was detected in 15 of the 20 samples. Low levels of gross beta activity were detected in all of the 20 samples analyzed, at concentrations that are typical of any environmental water sample. Tritium (H-3) was not detected in the 20 samples analyzed.

In 1998, an additional dose assessment was performed that incorporated all of the 1998 storm drain system analytical results (including both sediment and water). The dose assessment was performed using the maximum measured concentration of radionuclides in 1998, and a conservative estimate of the volume of sediment and water discharged via the storm drain system. The results of this dose assessment are estimates of the total body and maximum organ dose equaling 3.2% and 1.6% of the corresponding Technical Specification dose limits respectively. Therefore, there was no significant dose impact from plant-related radionuclides in the storm drain system in 1998. The sampling conducted in

2012 indicates that the presence of radionuclides in the storm drain system has not changed significantly. Therefore, the storm drain system remains an insignificant impact to dose. The VYNPS staff will continue to monitor the presence of plant related radionuclides in the storm drain system.

Table 6.2

Summary of Storm Drain System Water Sample Analyses*

Isotope	No. Detected **	Mean (pCi/L)	Range (pCi/L)	Station With Highest Detected Concentration
Gross Beta	20/20	3.6 E 0	(1.2 – 6.2) E 0	MH-12A (WW-12)
H-3	0/20	NA	NA	-
Ra-226	15/20	1.1E 2	(0.67 – 1.74) E 2	MH-14 (WW-10)
I-131	0/20	NA	NA	-
Cs-134	0/20	NA	NA	-
Cs-137	0/20	NA	NA	-
ZrNb-95	0/20	NA	NA	-
Co-58	0/20	NA	NA	-
Mn-54	0/20	NA	NA	-
Zn-65	0/20	NA	NA	-
Fe-59	0/20	NA	NA	-
Co-60	0/20	NA	NA	-
Ba/La-140	0/20	NA	NA	-

* Radionuclides that were not detected in any sample are not listed

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

6.5.2.6 Air Compressor Condensate and Manhole Sampling Results

The presence of tritium in station air compressor condensate and manholes (Storm Drain System) has been identified since 1995 (ER_95-0704). An evaluation has been performed (S.R.1592) which states "...leakage of tritium found in the storm drains (manholes) to ground water beneath the site will be transported by natural ground water gradient to the Connecticut River. However, at the current measured concentrations and postulated leak rate from the storm drains, the offsite dose impact is not significant (<2.4E-5 mrem/year)." Data provided in Table 6.3 will be filed under the requirements of 10CFR50.75(g) and is presented here in response to ER_95-0704_04 commitments. Because of revisions in the security arrangements at the plant site, there was no water available for collection in Manholes 11H, 13 and 8 during 2012.

Table 6.3

Summary of Air Compressor Condensate and Manhole Water Tritium Concentrations*

Sample Location	No. Detected**	Mean (microcuries/ml)	Range (microcuries/ml)
Air Compressor Condensate	7/7	8.56E-05	(2.25 to 10.74) E-05
Manhole 11H	0/0	No Sample Available	No Sample Available
Manhole 13	0/0	No Sample Available	No Sample Available
Manhole 8	0/0	No Sample Available	No Sample Available

* Reported per ER_950704_04.

** The fraction of sample analyses yielding detectable measurements

6.5.2.7 Groundwater Monitoring Wells Samples Results (WS)

Leakage from primary system piping between the Augmented Off Gas (AOG) Building and the Turbine Building was identified early in 2010. A large pool of subsurface water became contaminated with Tritium as a result of this leak. A large number of new groundwater sample wells were installed and a significant effort was mounted to find the leak and fix it. Presently, mitigation efforts have resulted in the extraction of more than 300000 gallons of trititated water from this subsurface pool. Dose calculations have been performed assuming that this under ground plume of contaminated water is moving towards and into the Connecticut River. The dose impacts and other details of this event are provided in the year 2012 Annual Radioactive Effluent Release Report.

6.5.3 Ingestion Pathways

6.5.3.1 Milk (TM)

Milk samples from cows at several local farms were collected monthly during 2012. Twice-per-month collections were made during the "pasture season" since the milking cows or goats were identified as being fed pasture grass during that time. Each sample was analyzed for I-131 and other 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. Strontium-90 was not detected in any samples in 2012. Although Sr-90 is a by-product of nuclear power plant operations, the historic levels detected in milk are consistent with that expected from worldwide fallout from nuclear weapons tests, and to a much lesser degree from fallout from the Chernobyl incident. The Sr-90 levels shown in Figure 6.11 are consistent with those detected at other New England farms participating in other plant environmental monitoring programs. This radionuclide and Cs-137 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 are found in soil and vegetation, as well as anything that feeds upon vegetation, directly or indirectly. The detection of Cs-137 in environmental milk samples is expected and has been detected in previous years. Cs-137 was not detected in any of the 95 samples in 2012. See Figure 6.10. It should be noted here that most of the pre-2012 Cs-137 concentrations and many of the pre-2012 Sr-90 concentrations shown on Figures 6.10 and 6.11, respectively, are considered "not detectable." All values have been plotted, regardless of whether they were considered statistically significant or not. As shown in these figures, the levels are also consistent with those detected in previous years near the VYNPS plant. There is also little actual difference in concentrations between farms. As in previous years, no I-131 attributable to the operation of Entergy Vermont Yankee was detected in any milk sample.

6.5.3.2 Silage (TC)

A silage sample was collected from each of the required milk sampling stations during October. Each of these was analyzed for gamma-emitting radionuclides and I-131. As expected with all biological media, naturally-occurring Be-7 was detected in four of five samples and K-40 was detected in all samples. Naturally-occurring AcTh-228 was detected in one of the five samples. No Cs-137 or I-131 was detected in any sample.

6.5.3.3 Mixed Grass (TG)

Mixed grass samples were collected at each of the air sampling stations during three of the four quarters of 2012. As expected with all biological media, naturally-occurring Be-7 was detected in 18 of the 21 samples. Naturally-occurring K-40 was detected in all samples. Naturally-occurring Ra-226 was detected in 12 of the 21 samples. Naturally-occurring AcTh-228 was detected in three of the 21 samples. Cs-137 was not detected in any of the samples.

6.5.3.4 Fish (FH)

Semiannual samples of fish were collected from two locations in both spring and fall of 2012 for the VY REMP. Fish were also collected in response to the detection of tritium in subsurface water under the plant site in January, 2010. Several species are collected such as Walleye, Small Mouth Bass, Large Mouth Bass, Yellow Perch, White Perch, and Rock Bass. 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 12 samples. In addition to the analysis of edible portions, the inedible portions were also analyzed in response to the tritium leak. These fish were also analyzed for Gross Beta, H-3, Am-241, Cm-242, Cm-243/244, Fe-55, Ni-63, Pu-2328, Pu-239/240, Pu-241, Pu-242, Sr-89 and Sr-90.

Strontium 90 was detected in some of the inedible portions (bones, guts and skin are included in the 'inedible' portion). This is the third year in the VY REMP program that fish has been analyzed for Hard-to-Detects such as Strontium-90. The results were compared to studies done in the Hudson River by New York State officials and it was concluded that the Strontium-90 detected is a result of weapons-testing era fallout to the environment and not produced by nuclear power plants.

As shown in Table 5.1, Cs-137 was not detected in this year's samples. It should be noted that the majority of the Cs-137 concentrations plotted in Figure 6.12 are considered "not detectable." All values were plotted regardless of whether they were considered statistically significant or not. The Cs-137 levels plotted for 2012 and previous years are typical of concentrations attributable to global nuclear weapons testing fallout.

6.5.4 Direct Radiation Pathway

Direct radiation was continuously measured at 53 locations surrounding the Vermont Yankee plant with the use of thermoluminescent dosimeters (TLDs).

In 1999, DR-53 was added on the site boundary. The TLDs are collected every calendar quarter for readout at the environmental laboratory. The complete summary of data may be found in Table 5.3.

From Tables 5.2 and 5.3 and Figure 6.13, it can be seen that the Inner and Outer Ring TLD mean exposure rates were not significantly different in 2012. This indicates no significant overall increase in direct radiation exposure rates in the plant vicinity. It can also be seen from these tables that the Control TLD mean exposure rate was not significantly different than that at the Inner and Outer Rings. Figure 6.13 also shows an annual cycle at both indicator and control locations. The lowest point of the cycle occurs usually 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 naturally-occurring radionuclides in the underlying soil, rock or nearby building materials result in different radiation levels between one field site and another

Upon examining Figure 6.17, as well as Table 5.2, it is evident that in recent years, station DR-45 had a higher average exposure rate than any other station. This location is on-site, and the higher exposure rates are due to plant operations and activities in the immediate vicinity of this TLD. There is no significant dose potential to the surrounding population or any real individual from these sources since they are located on the back side of the plant site, between the facility and the river. The same can be said for station DR-46, which has shown higher exposure rates in previous years.

Environmental Program Trend Graphs

2012 Radiological Environmental Operating Report
Vermont Yankee

Graphs:

Figure 6.1 - Gross Beta Measurements on Air Particulate Filters - Quarterly Average Concentrations

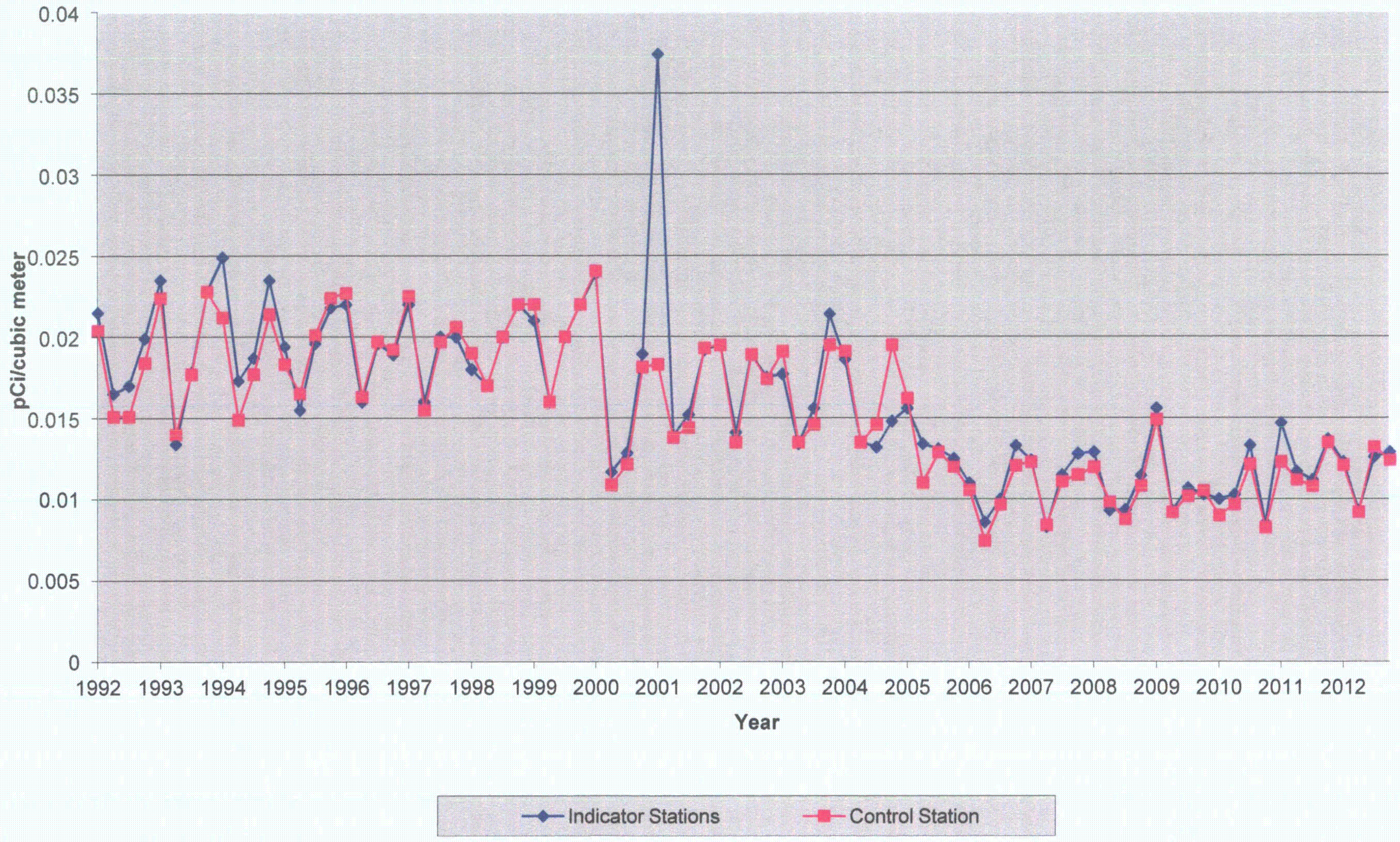


Figure 6.2 - Gross Beta Measurements on Air Particulate Filters

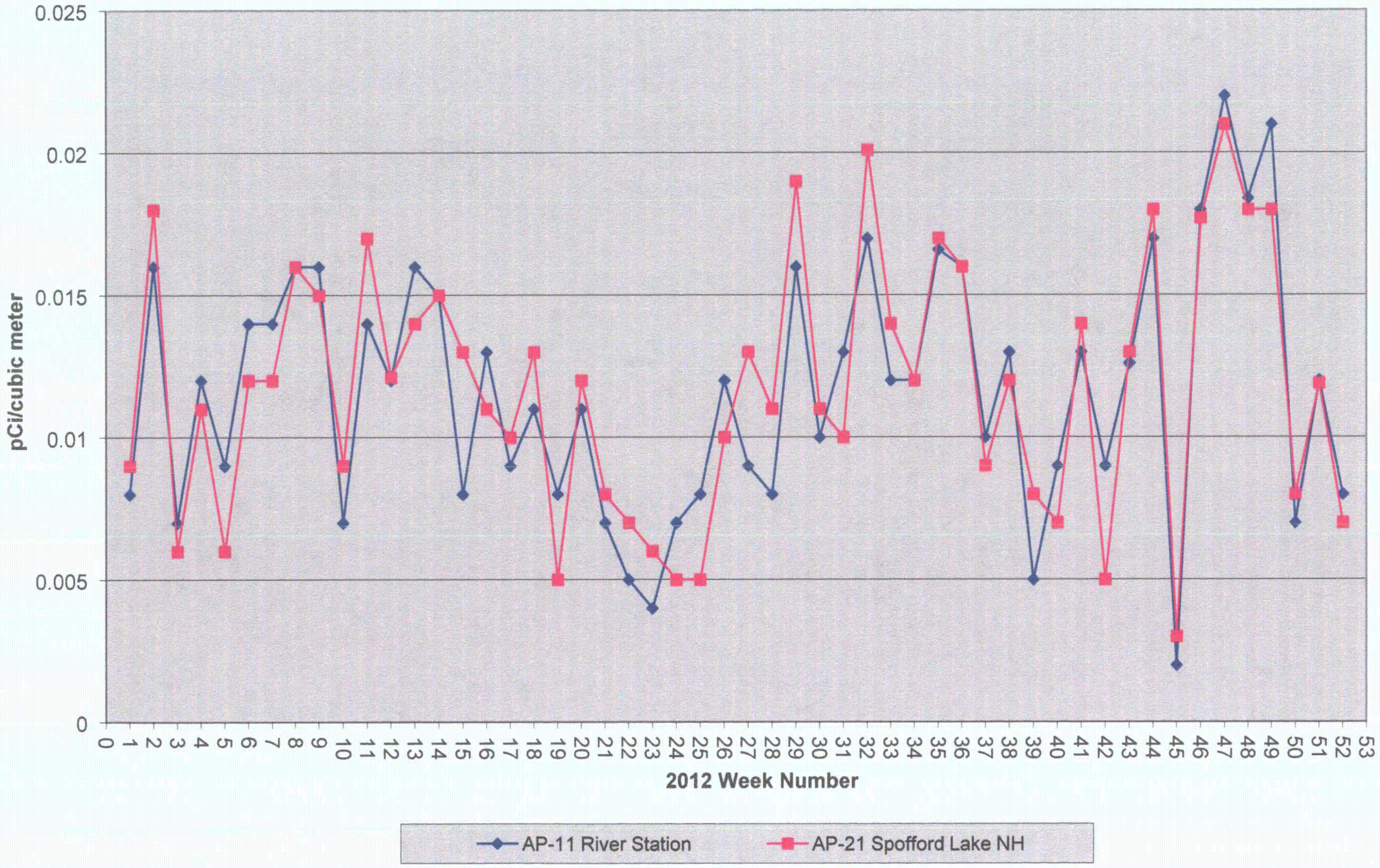


Figure 6.3 - Gross Beta Measurements on Air Particulate Filters

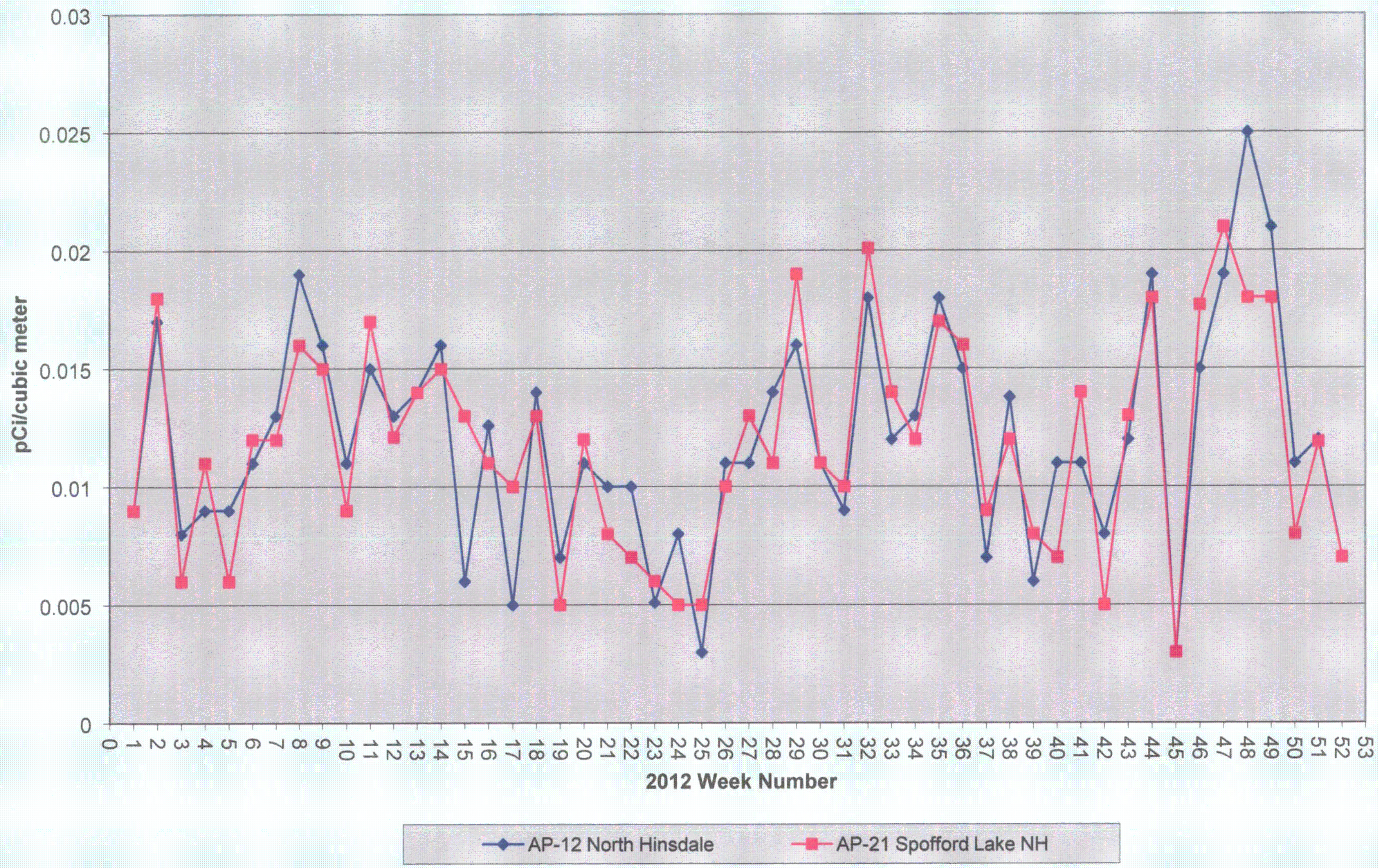


Figure 6.4 - Gross Beta Measurements on Air Particulate Filters

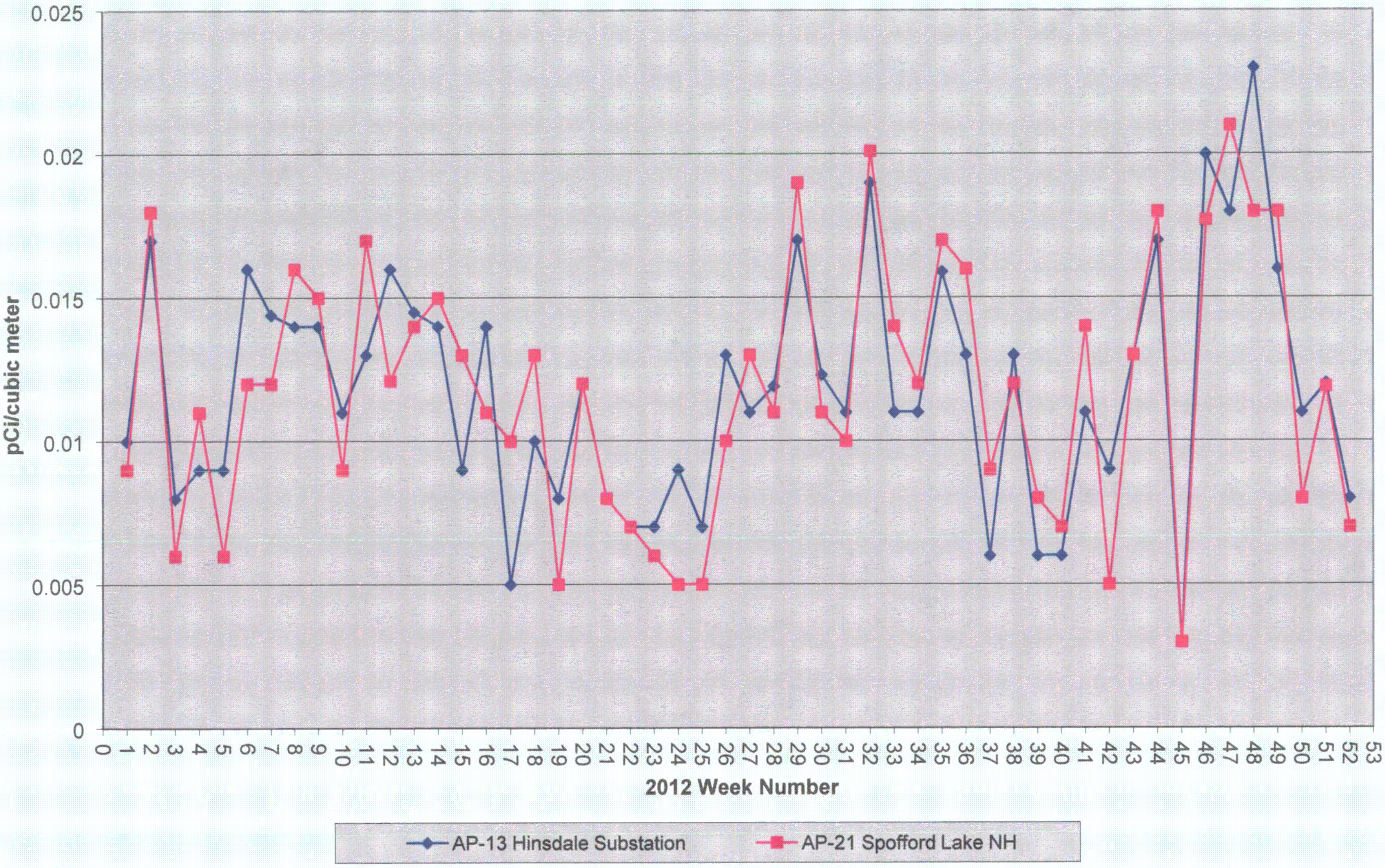


Figure 6.5 - Gross Beta Measurements on Air Particulate Filters

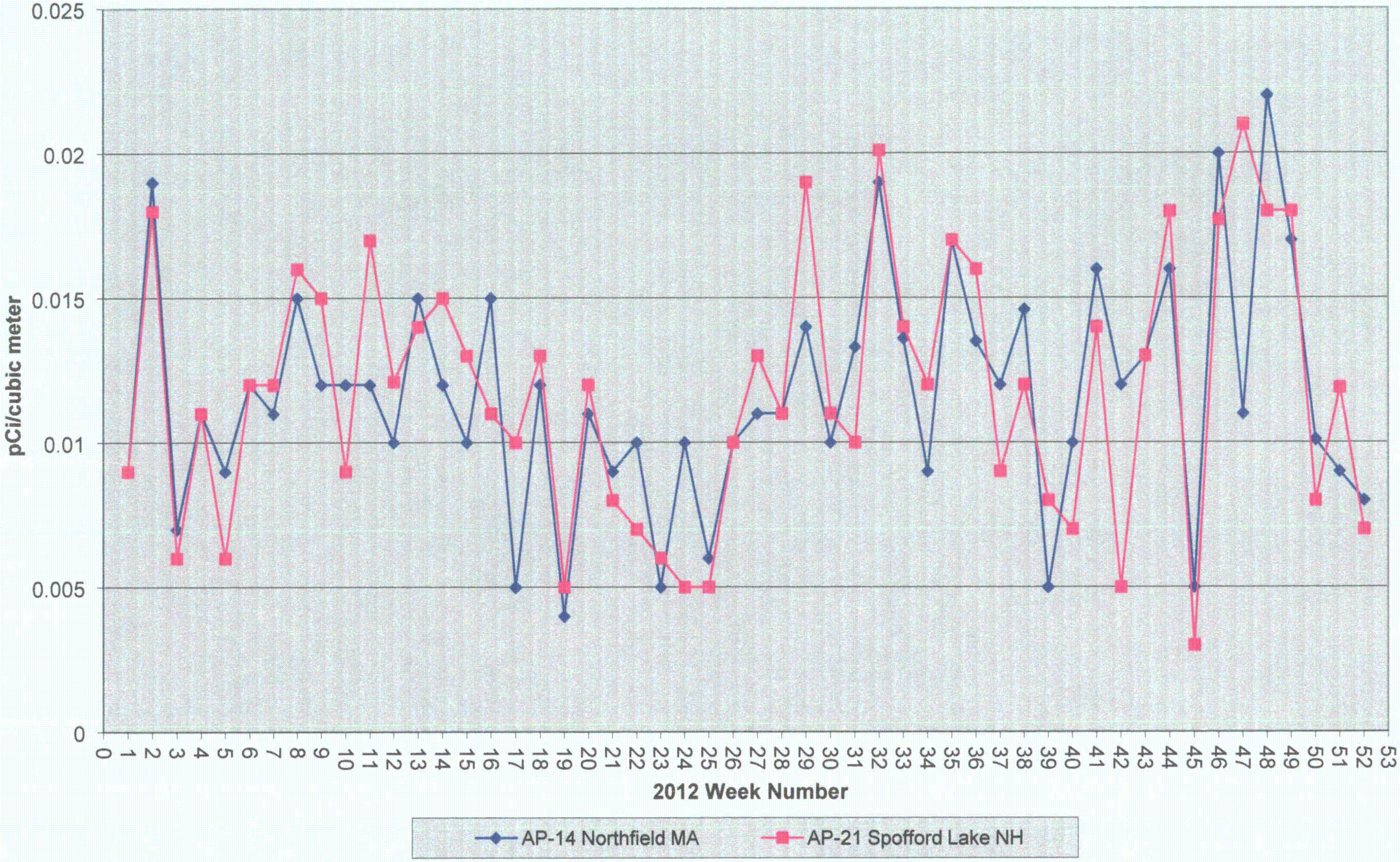


Figure 6.6 - Gross Beta Measurements on Air Particulate Filters

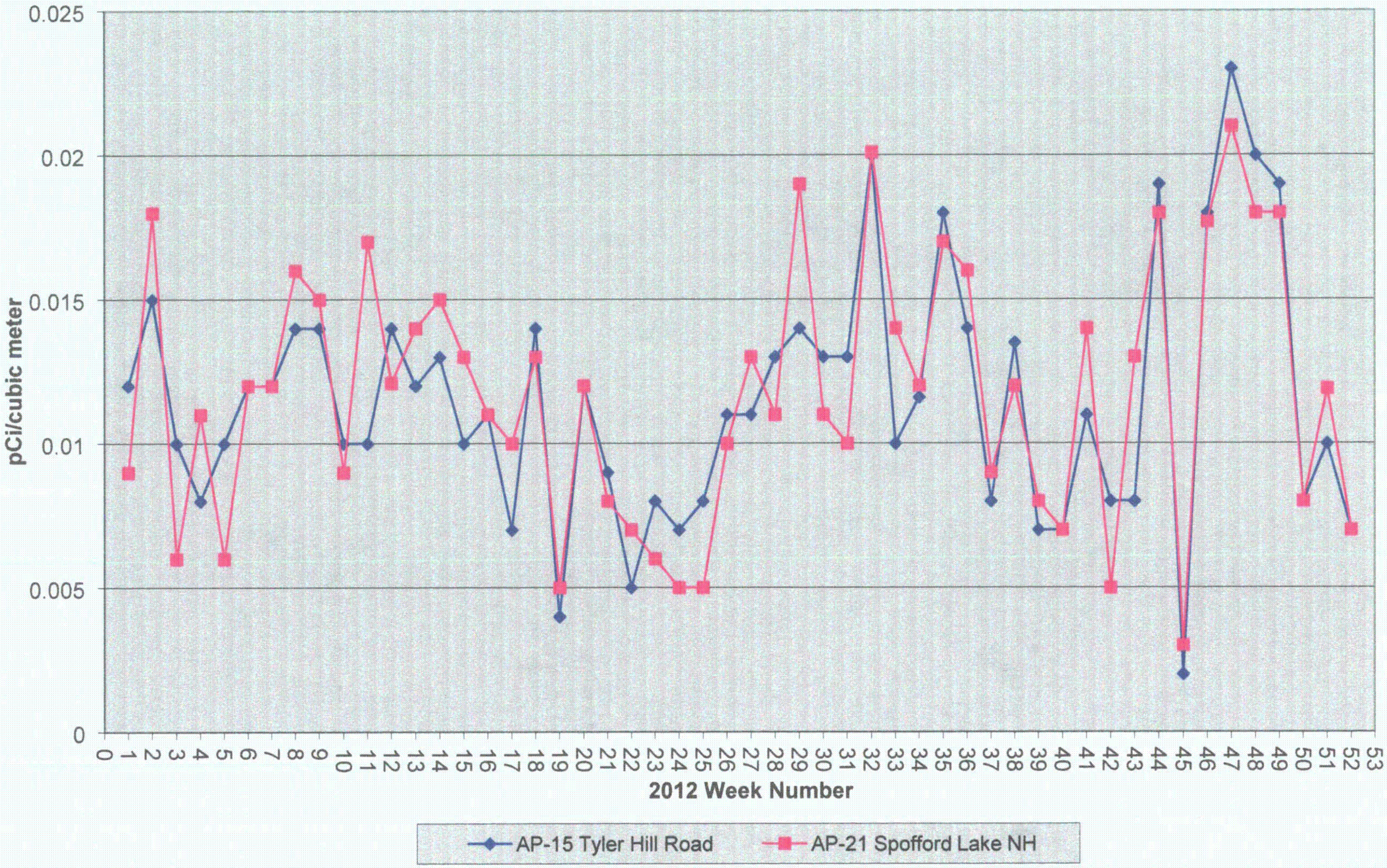


Figure 6.7 - Gross Beta Measurements of Air Particulate Filters

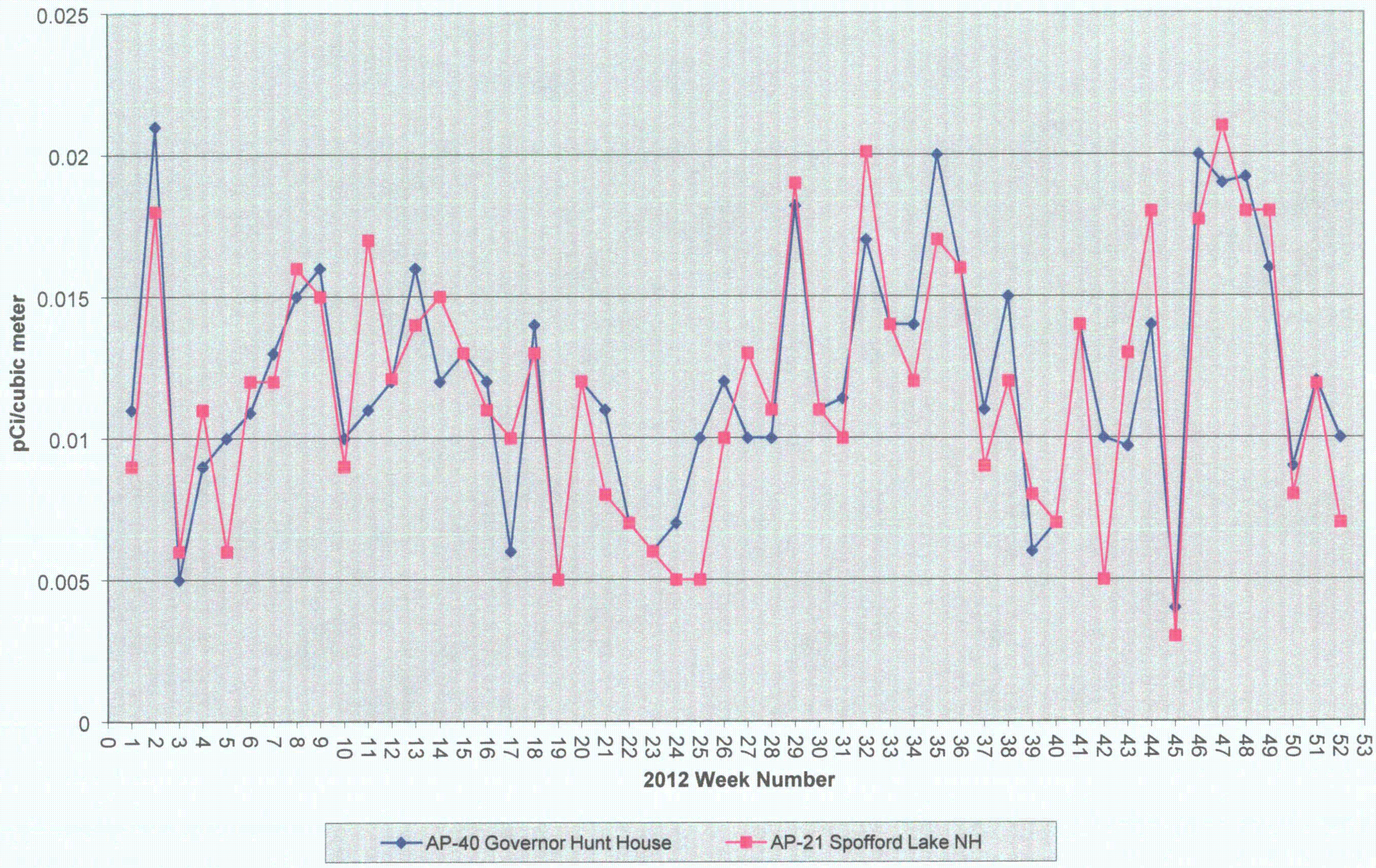


Figure 6.8 - Gross Beta Measurements on River Water Semi-Annual Average Concentration

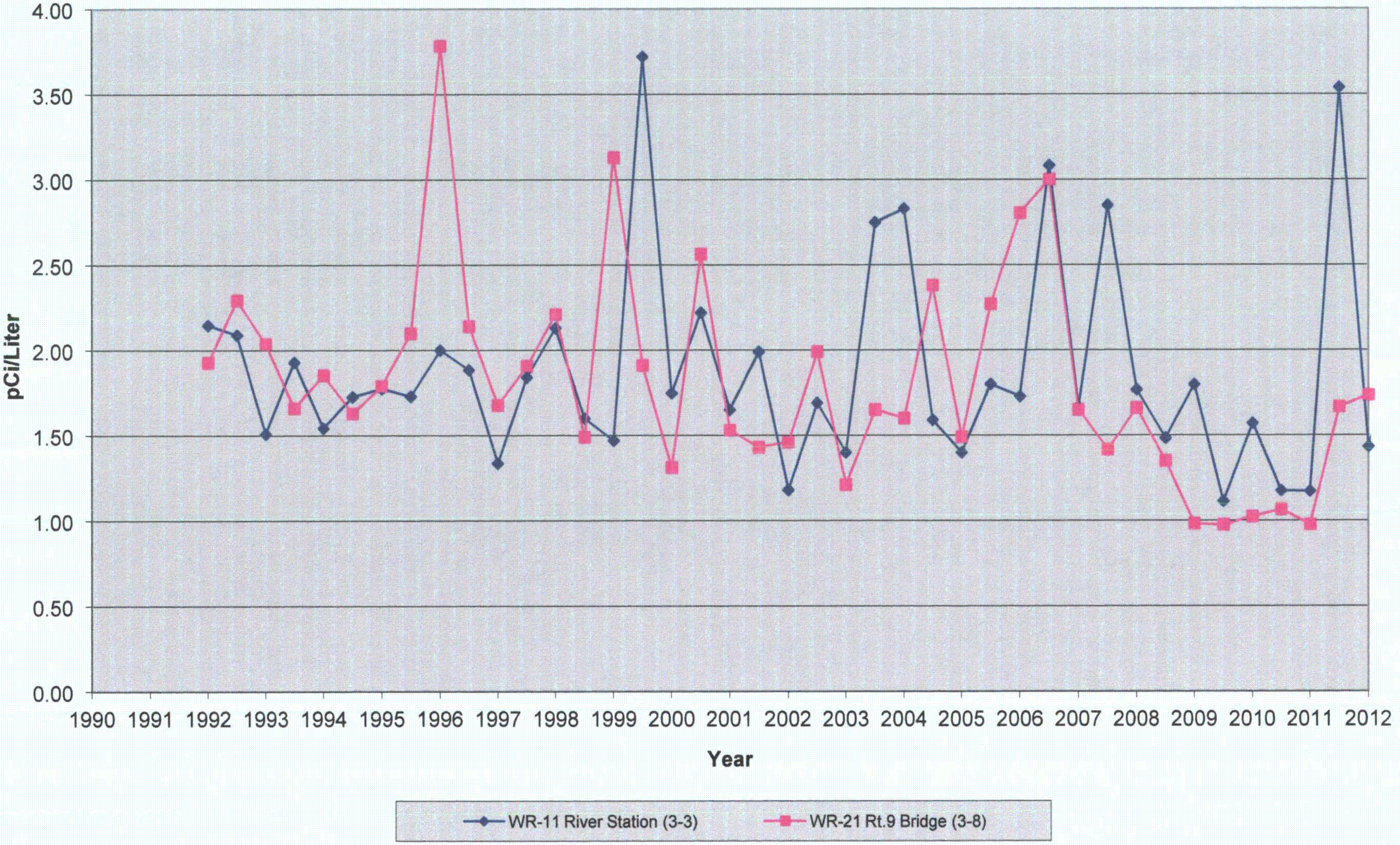
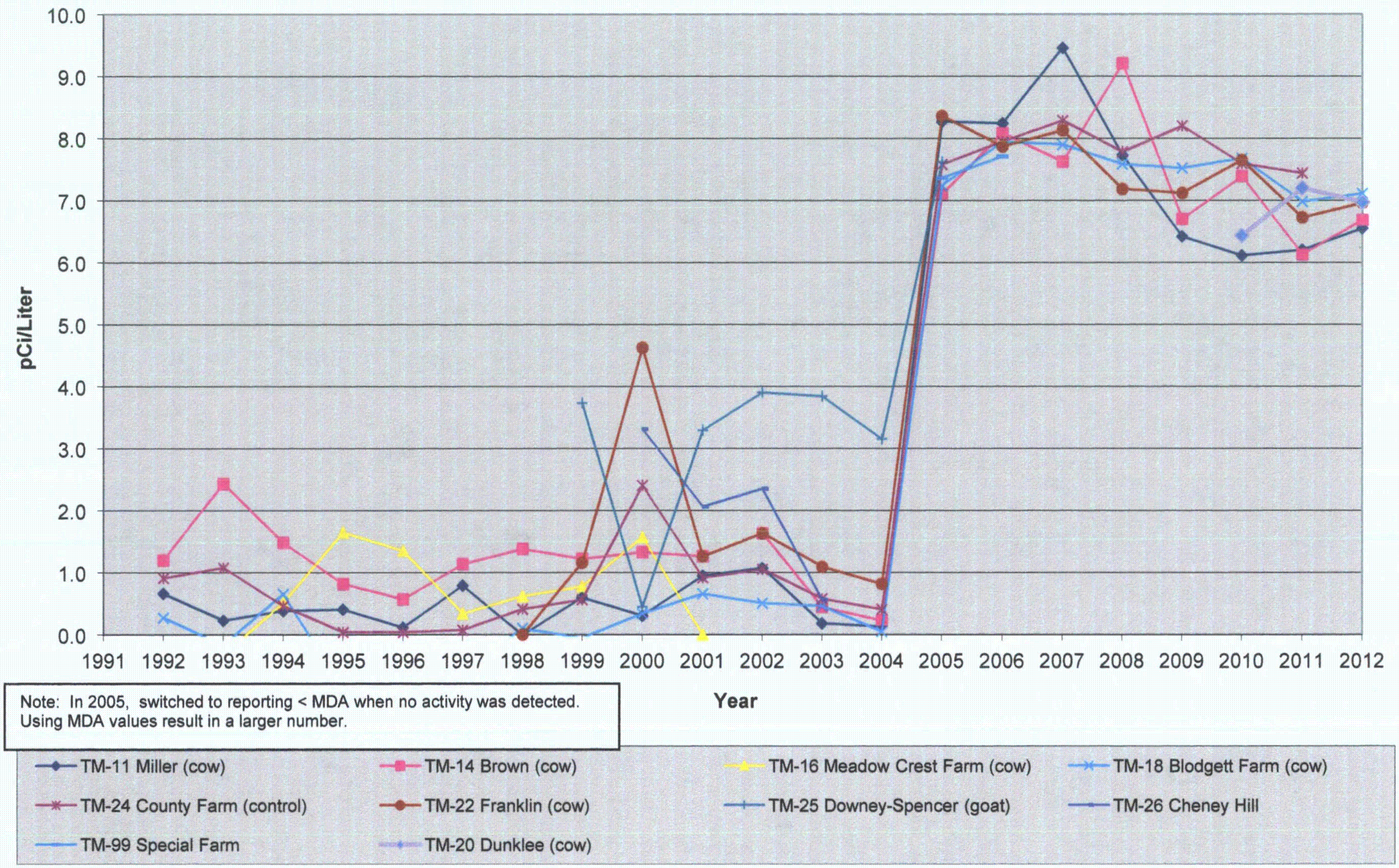


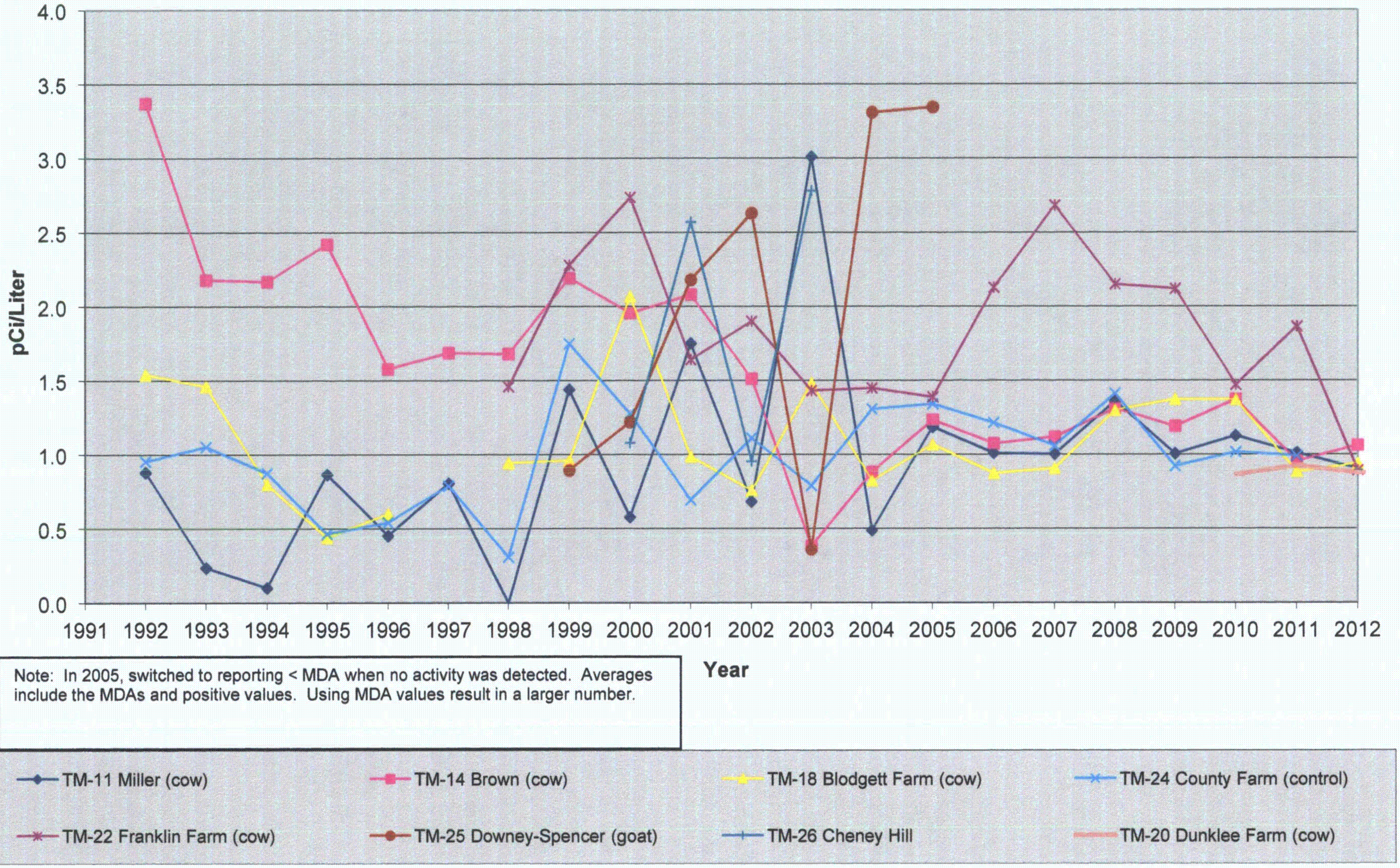
Figure 6.9 - Gross Beta Measurements on Ground Water Semi-Annual Average Concentrations

Figure 6.10 - Cesium 137 in Milk - Annual Average Concentration



Note: In 2005, switched to reporting < MDA when no activity was detected. Using MDA values result in a larger number.

Figure 6.11 - Strontium 90 in Milk - Annual Averge Concentrations



Note: In 2005, switched to reporting < MDA when no activity was detected. Averages include the MDAs and positive values. Using MDA values result in a larger number.

Figure 6.12 - Cesium 137 in Fish - Annual Average Concentrations

Note: In 2005 switched to reporting < MDA when no activity was detected. Using MDA values result in a larger number.

Figure 6.13 - Average Exposure Rate at Inner Ring, Outer Ring and Control TLDs

Figure 6.14 - Exposure Rate at Indicator TLDs, DR01-03

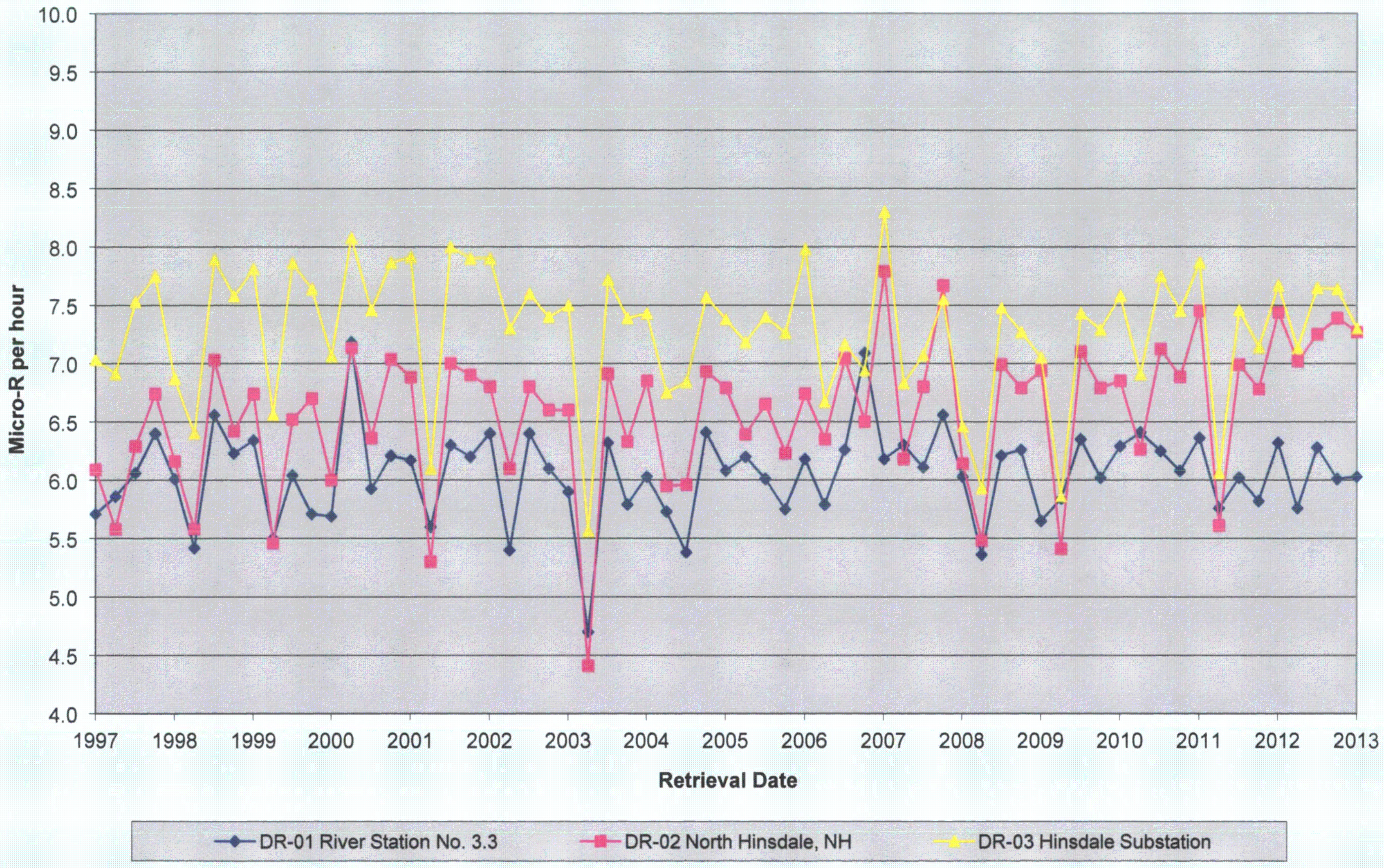


Figure 6.15 - Exposure Rate at Indicator TLDs, DR06 & DR-50

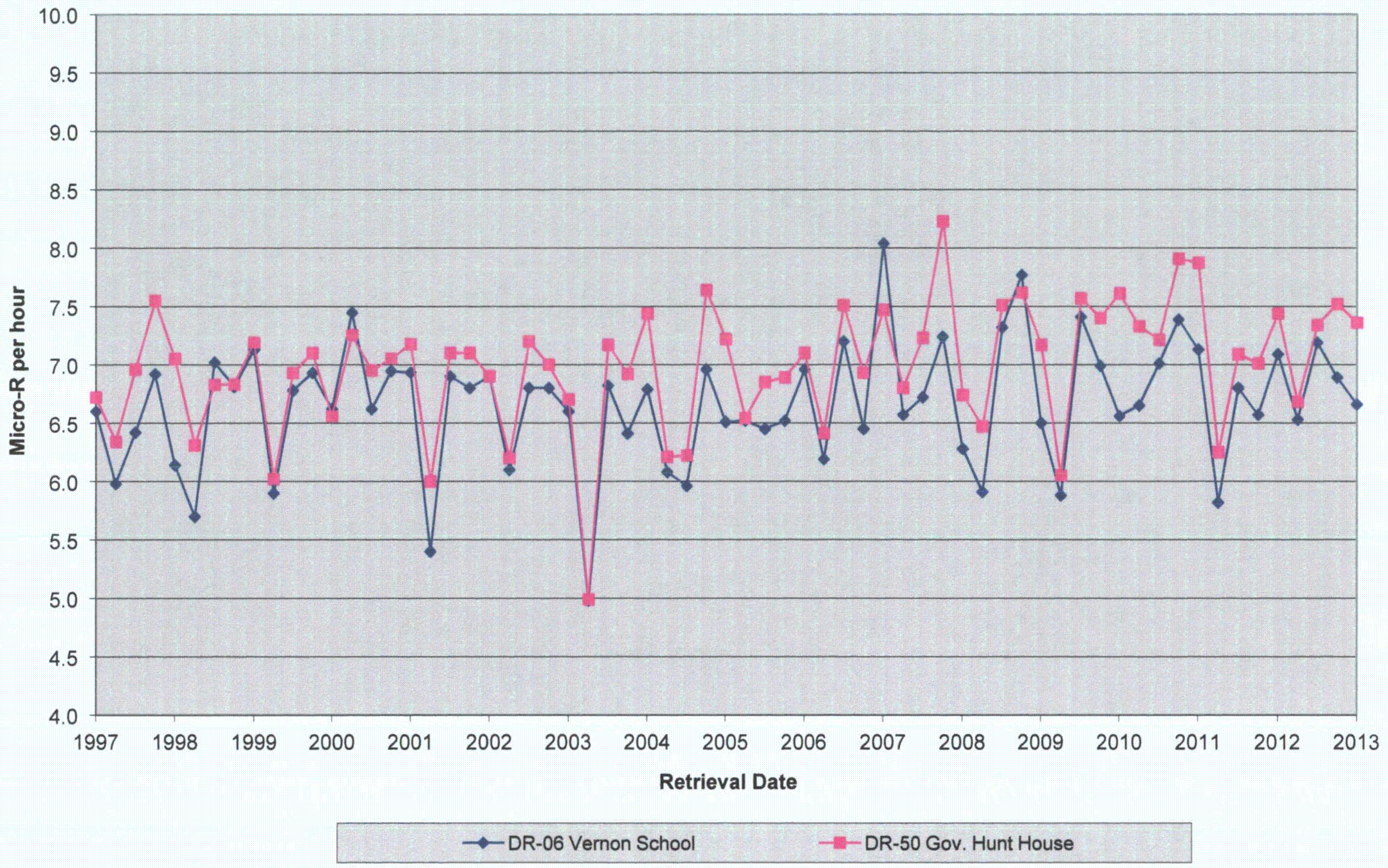


Figure 6.16 - Exposure Rate at Site Boundary TLDs DR07, 08, 41 & 42

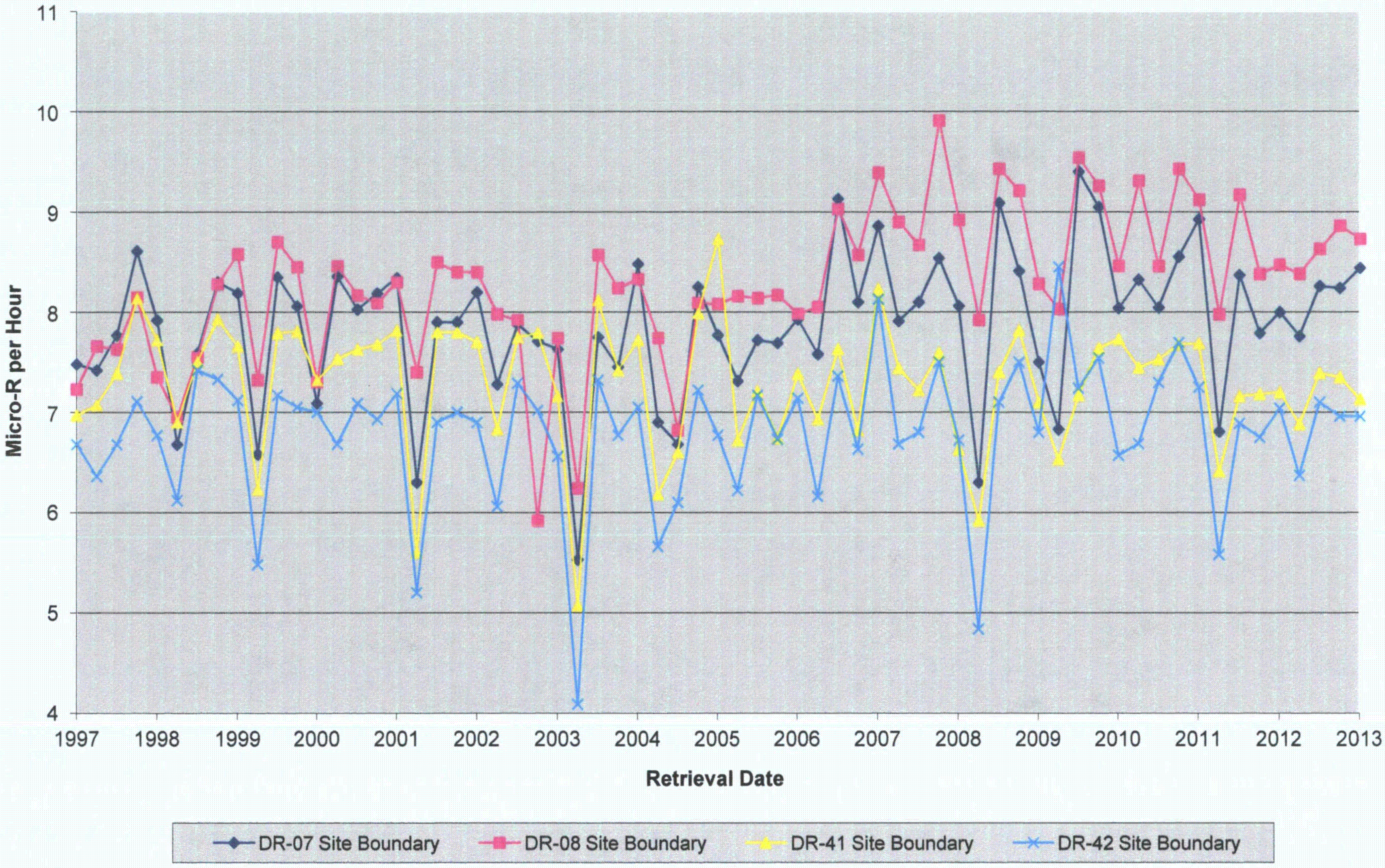


Figure 6.17 - Exposure Rate at Site Boundary TLDs - DR43 thru 46

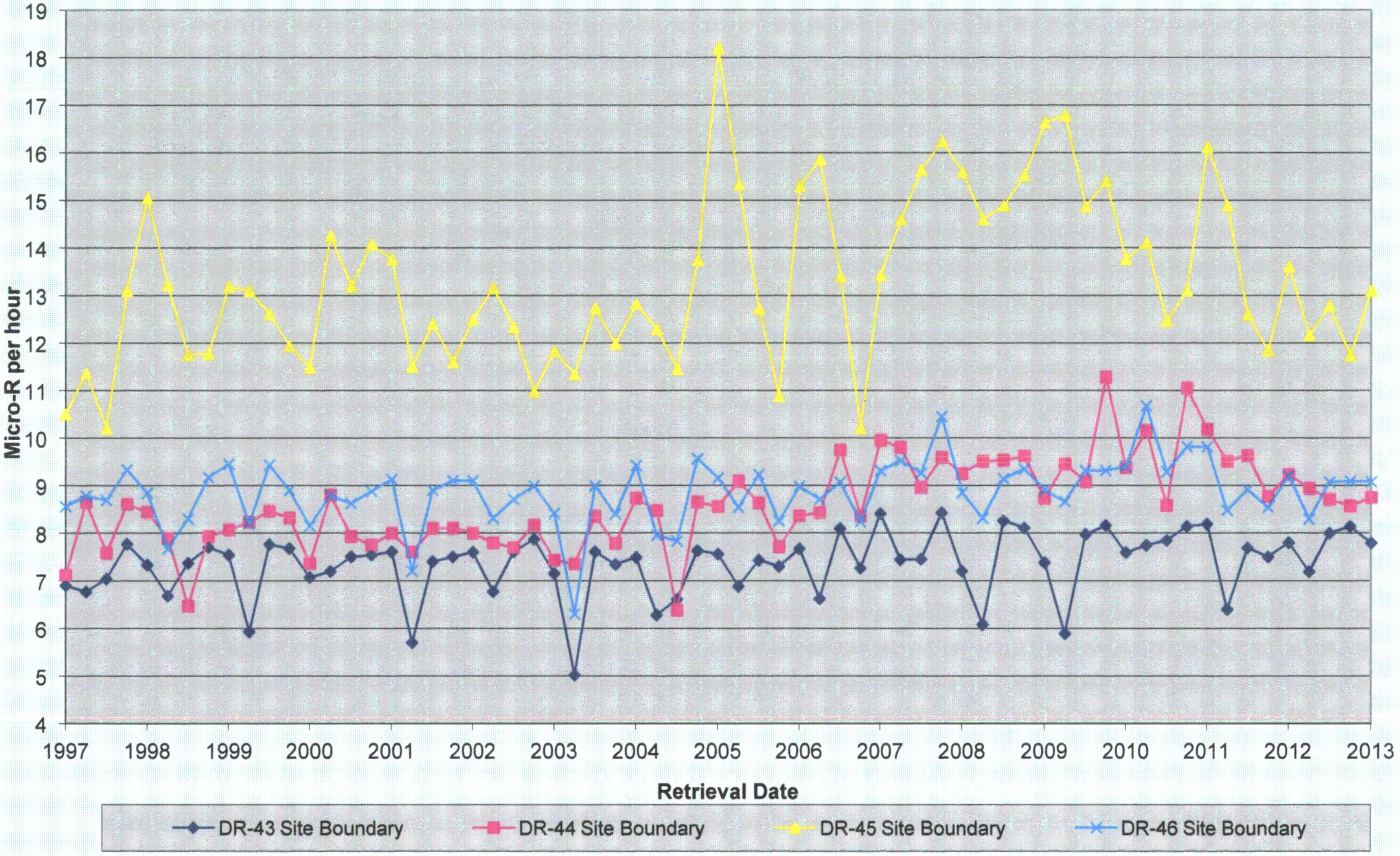


Figure 6.18 - Exposure Rate at Site Boundary TLDs DR47-49 & 51-53

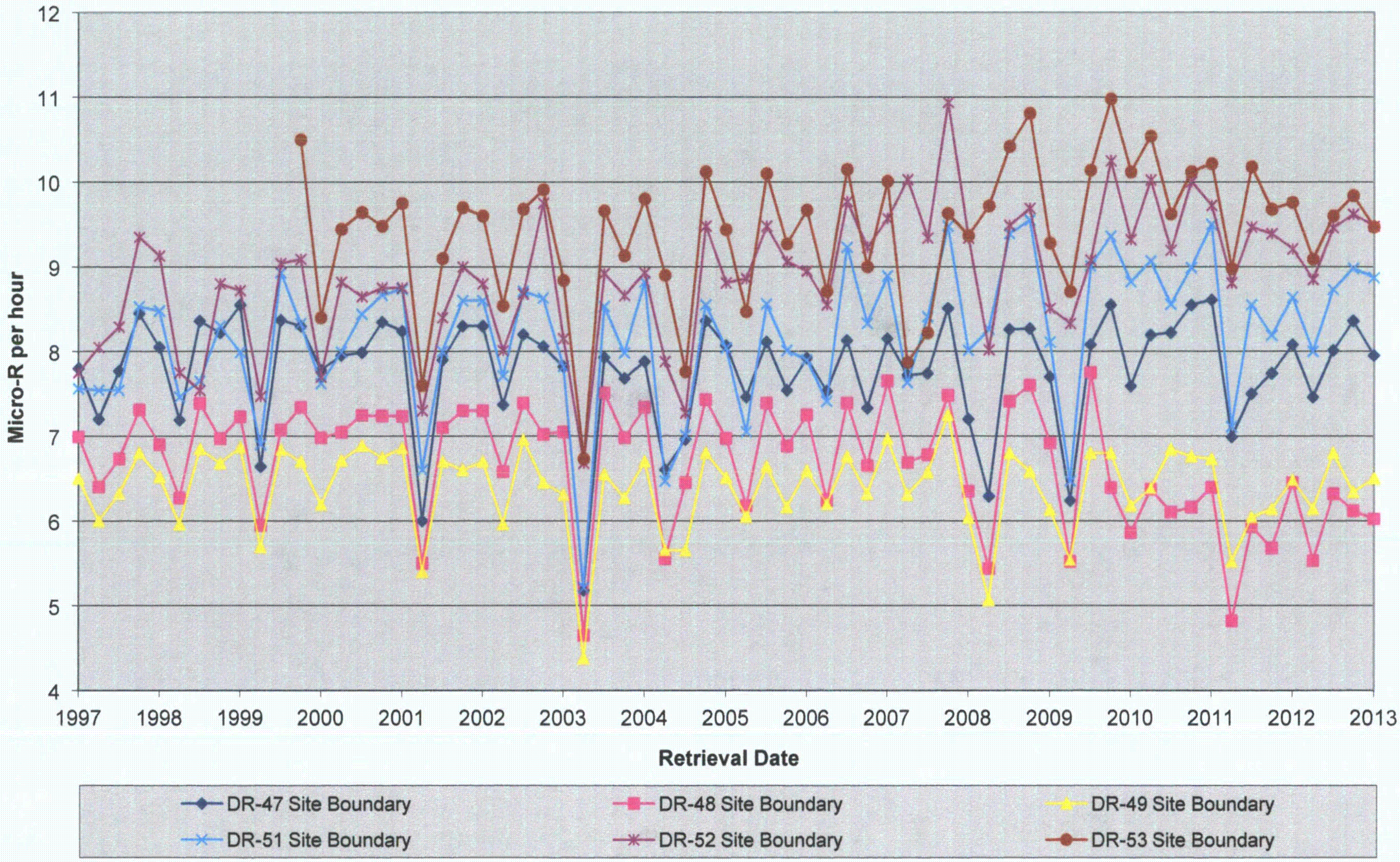


Figure 6.19 - Exposure Rate at Inner Ring TLDs DR09, 11, 13 & 15

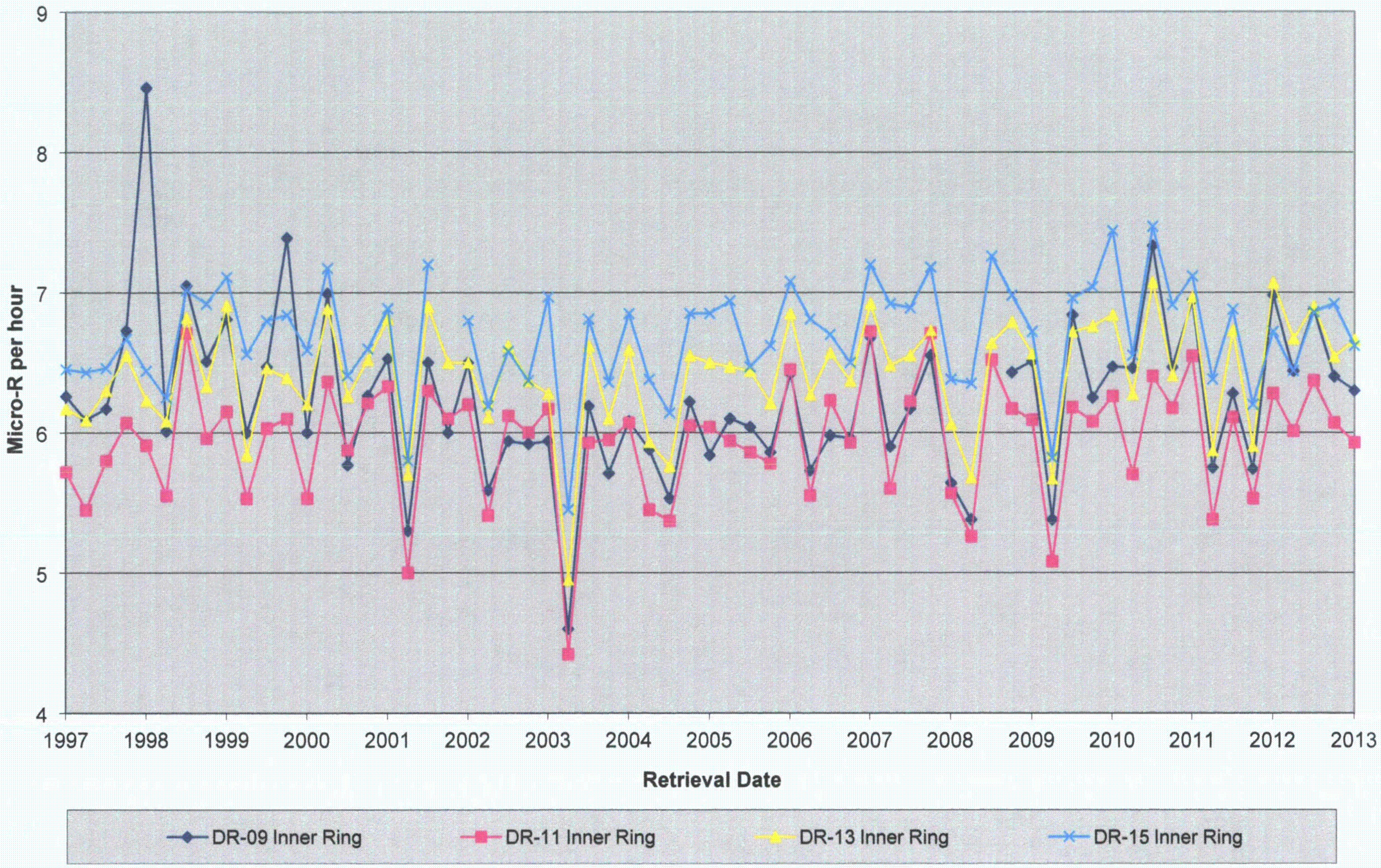


Figure 6.20 - Exposure Rate at Inner Ring TLDs DR17, 19, 21 & 23

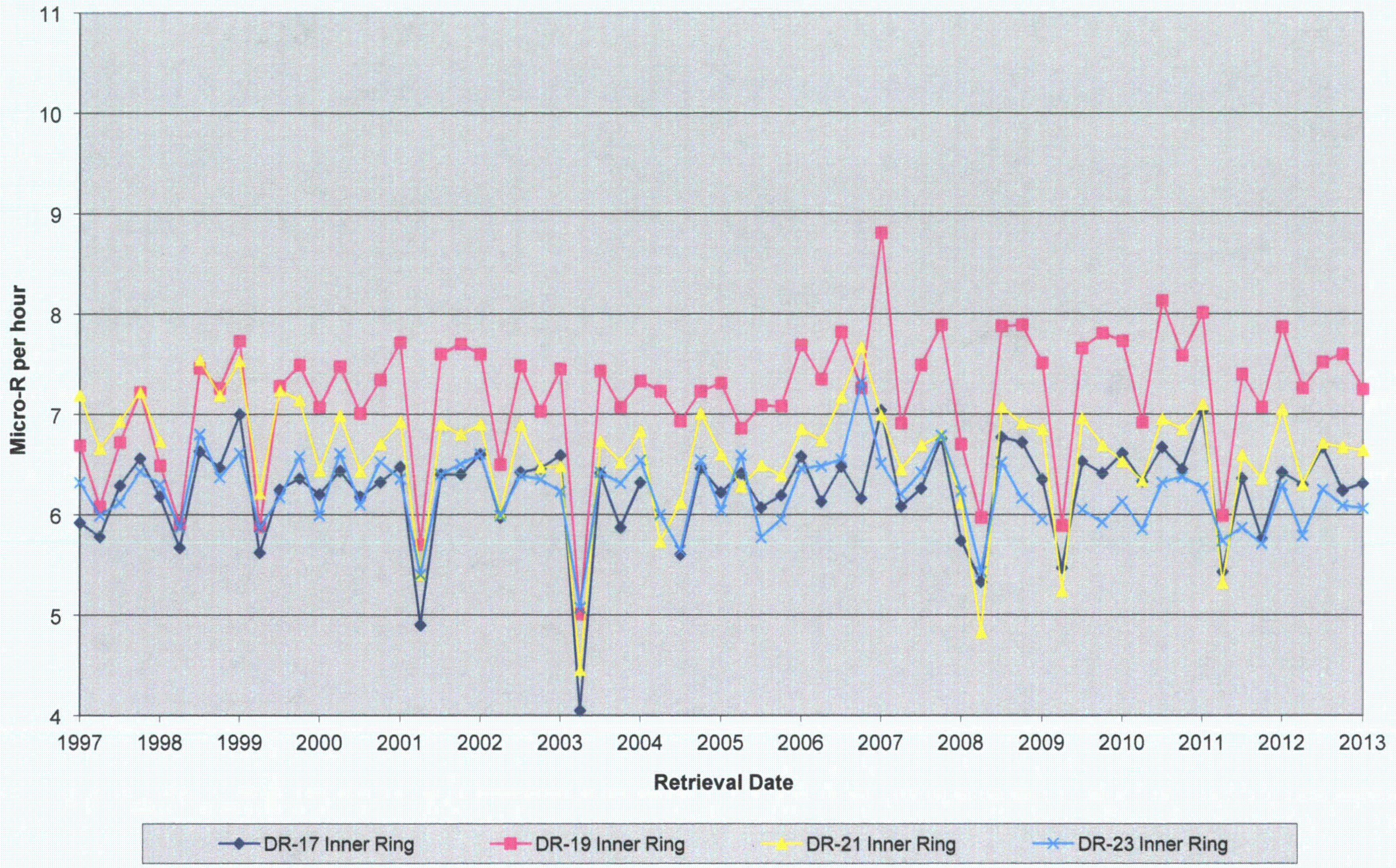


Figure 6.21 - Exposure Rate at Inner Ring TLDs DR25, 27, 29 & 31

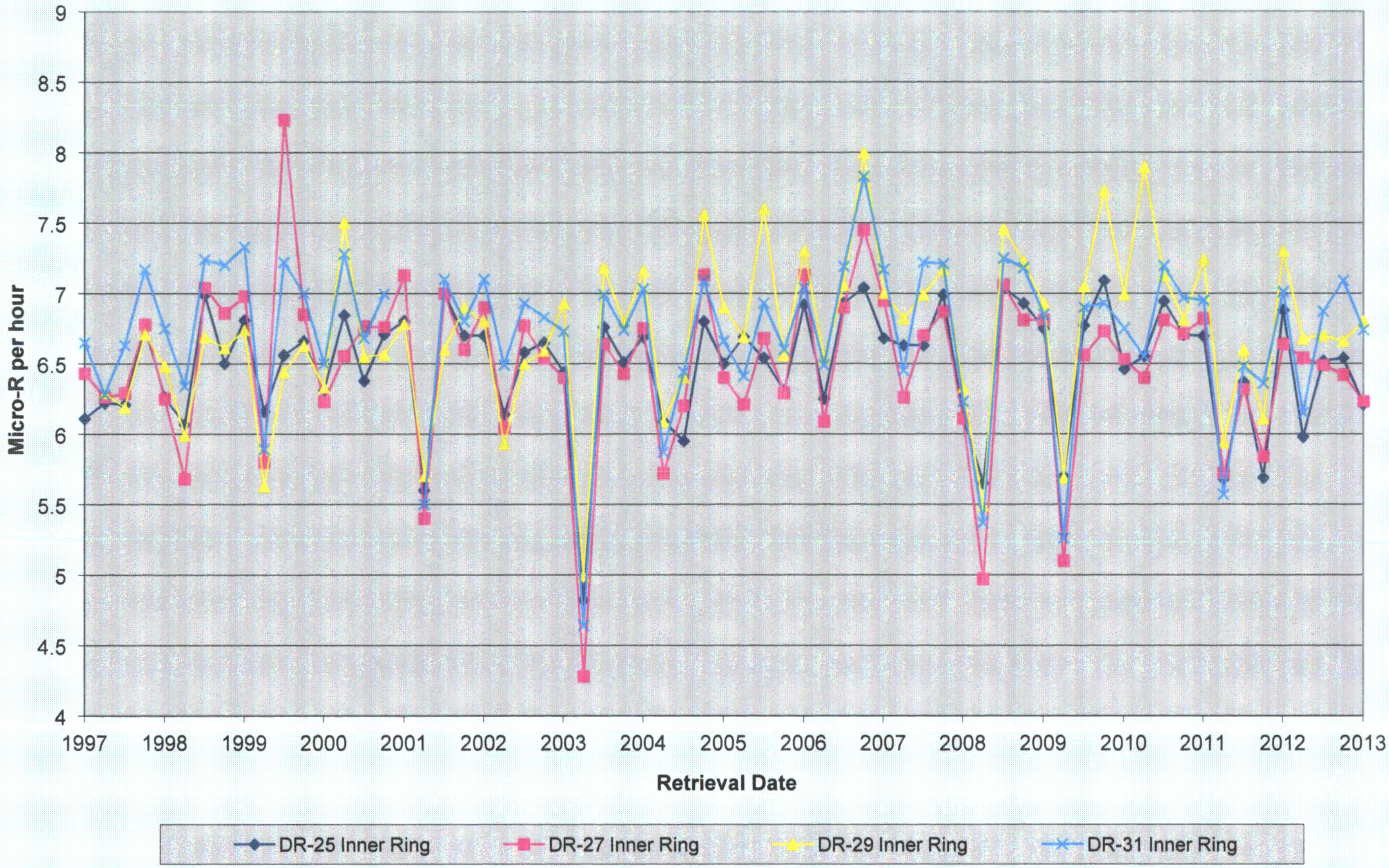


Figure 6.22 - Exposure Rate at Inner Ring TLDs DR33, 35, 37 & 39

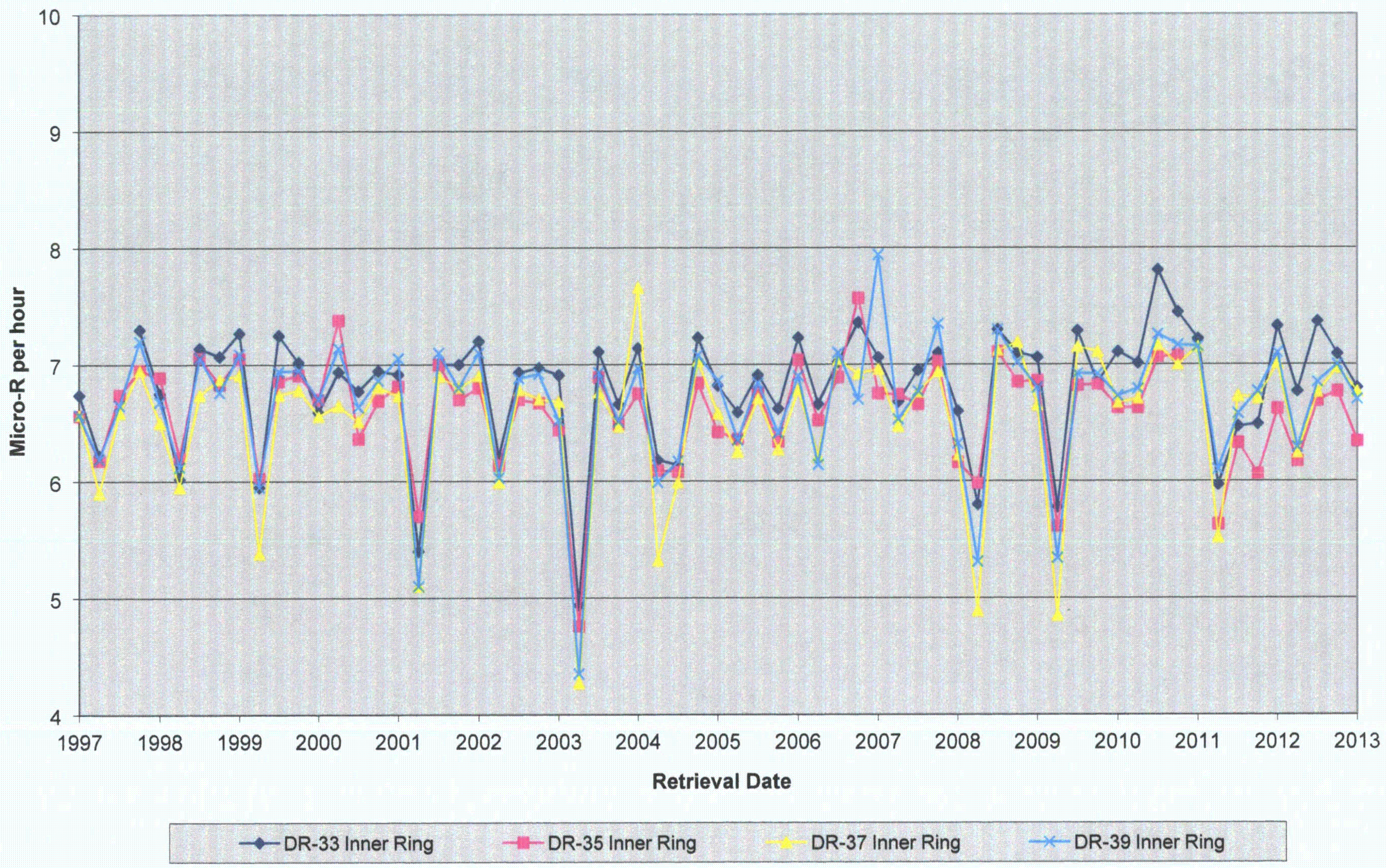


Figure 6.23 - Exposure Rate at Outer Ring TLDs DR10, 12, 14 & 16

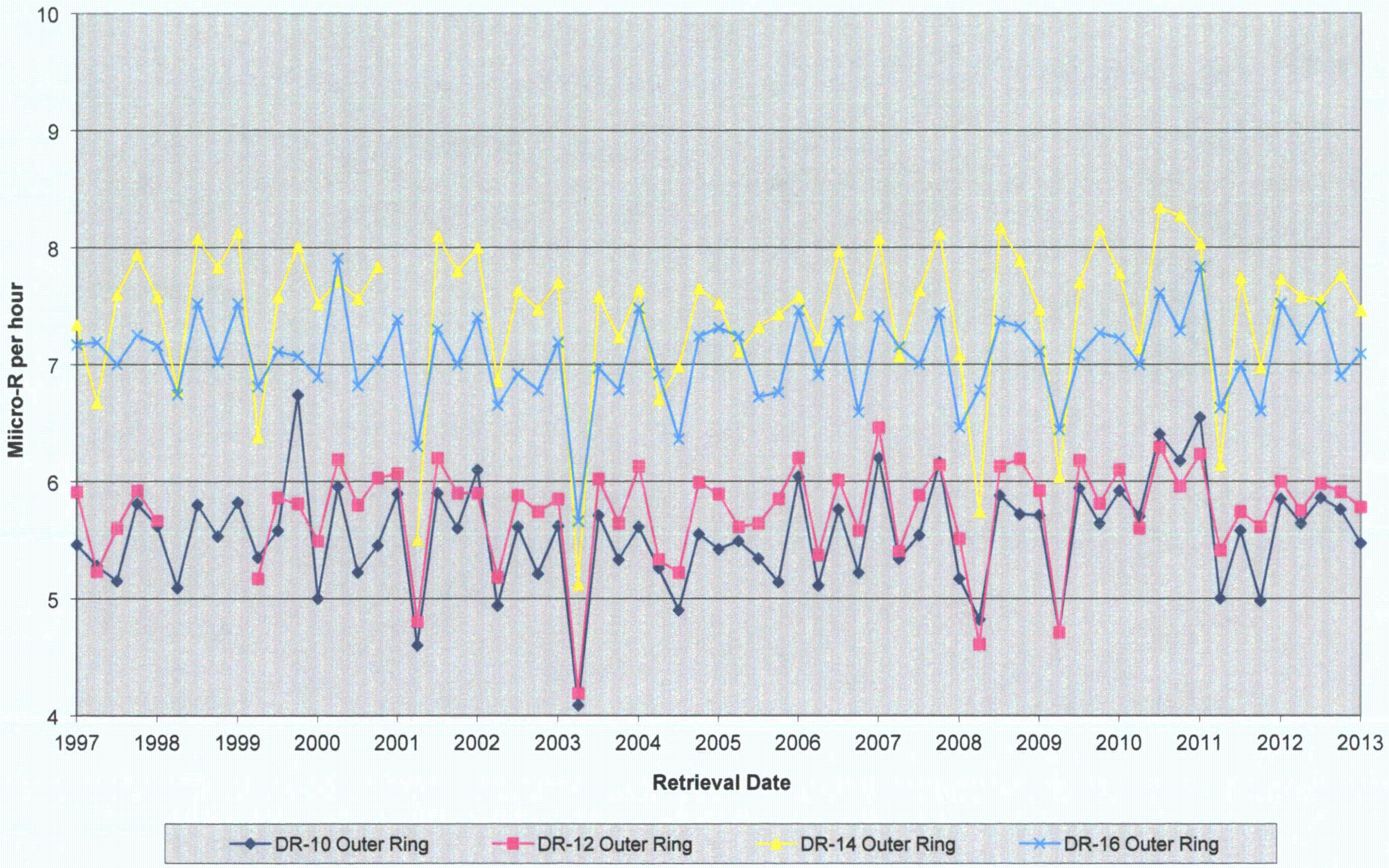


Figure 6.24 - Exposure Rate at Outer Ring TLDs DR18, 20, 22 & 24

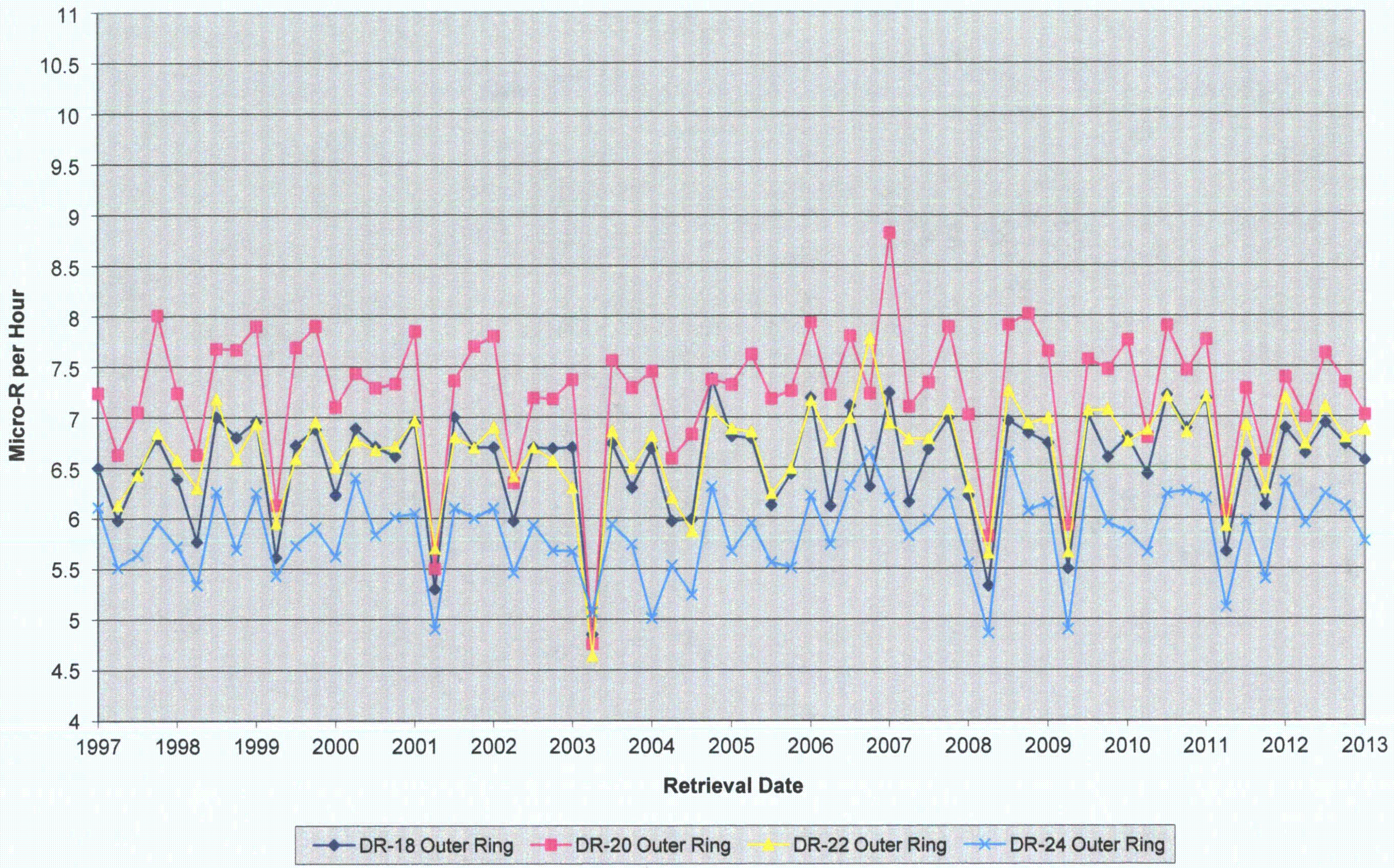


Figure 6.25 - Exposure Rate at Outer Ring TLDs DR26, 28, 30 & 32

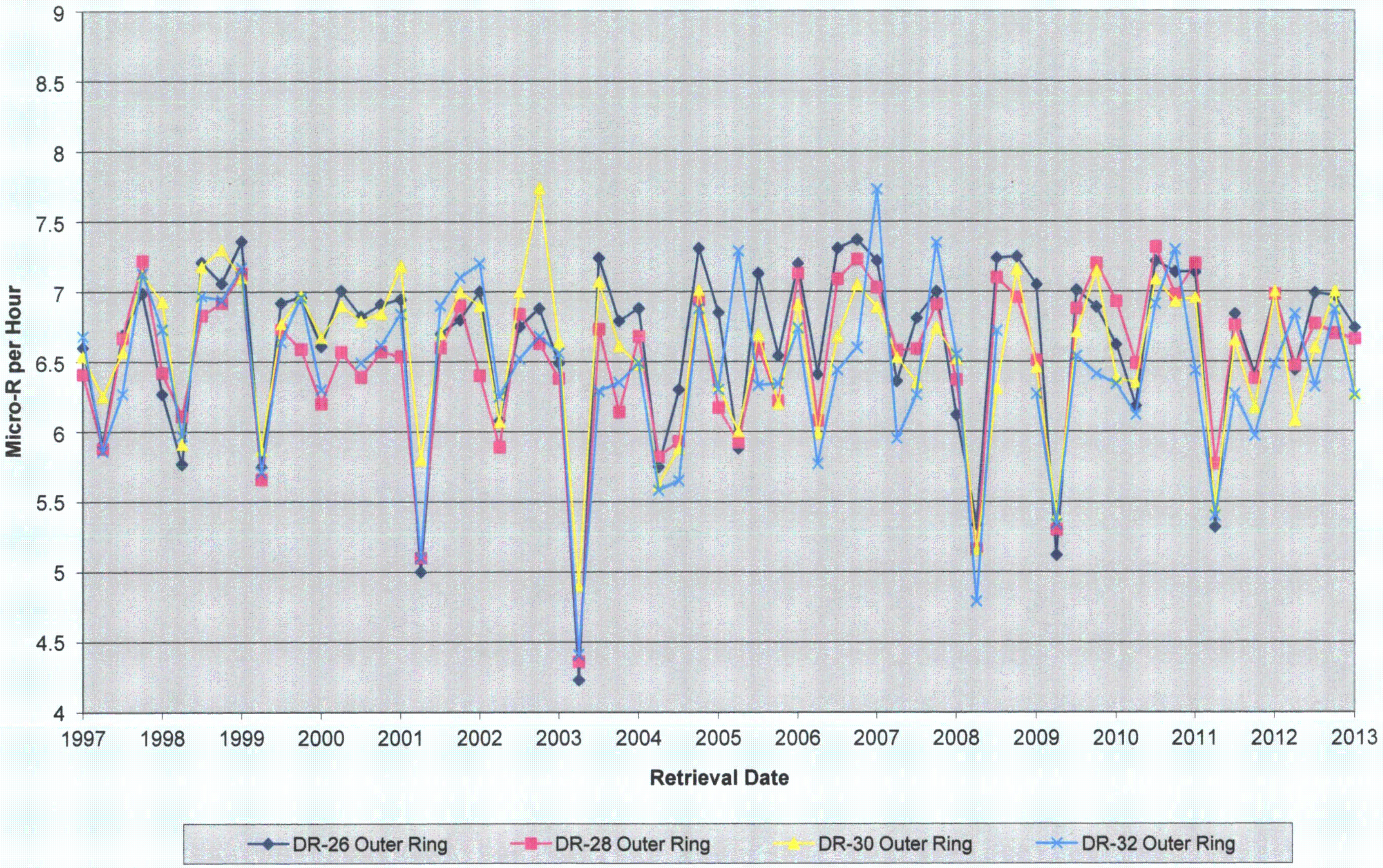
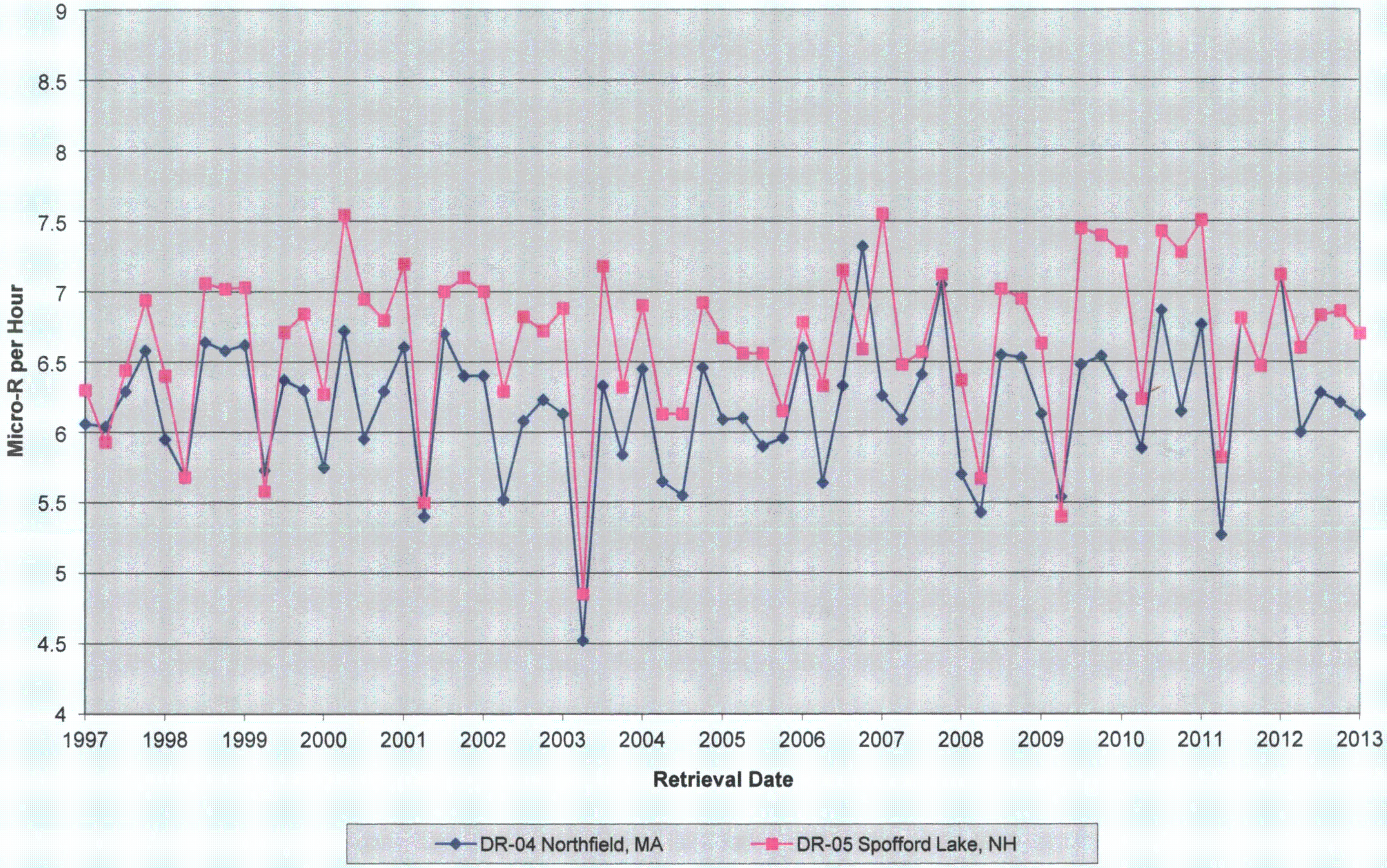


Figure 6.26 - Exposure Rate at Outer Ring TLDs DR 34, 36, 38 & 40

Figure 6.27 - Exposure Rate at Control TLDs DR04 & 05



7 QUALITY ASSURANCE PROGRAMS

7.1 Environmental Dosimetry Company

The TLD systems at the Environmental Dosimetry Company (EDC) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to EDC clients is ensured by in-house performance testing and independent performance testing by EDC clients, and both internal and client directed program assessments.

The purpose of the dosimetry quality assurance program at EDC is to provide performance documentation of the routine processing of EDC dosimeters. Performance testing provides a statistical measure of the bias and precision of dosimetry processing against a reliable standard, which in turn points out any trends or performance changes. Two programs are described below.

7.1.1 QC Program

Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in-house testing program coordinated by the EDC QA Officer and (2) independent test perform by EDC clients. In-house test are performed using six pairs of 814 dosimeters, a pair is reported as an individual result and six pairs are reported as the mean result. Results of these tests are described in this report.

Excluded from this report are instrumentation checks. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks in this report. Instrumentation checks represent between 5-10% of the TLDs processed.

7.1.2 QA Program

An internal assessment of dosimetry activities is conducted annually by the Quality Assurance Officer. The purpose of the assessment is to review procedures, results, materials or components to identify opportunities to improve or enhance processes and/or services.

7.1.3 Environmental TLD Quality Assurance Program

Results of performance tests conducted are summarized and discussed in the following sections. Summaries of the performance tests for the reporting period are given in Tables 1 through 3.

Table 1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons only. During this period, 100% (72/72) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy (+/-15.0%) and 100% (72/72) met the criterion for precision (+/-12.8%).

Table 2 provides the Bias + Standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Table 3 presents the independent blind spike results for dosimeters processed during this annual period. All results passed the performance acceptance criterion.

Table 1

Percentage of Individual Analyses that passed EDC Internal Criteria

January – December 2012(1)(2)

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

(1) This table summarizes results of tests conducted by EDC.
(2) Environmental Dosimeter results are free in air.

Table 2

Mean Dosimeter Analyses (N=6)

January – December 2012(1)(2)

Process Date	Mean Bias %	Standard Deviation %	Tolerance Limit +/- 15%
4/18/2012	7.7	1.7	Pass
4/21/2012	11.6	1.4	Pass
5/1/2012	1.1	1.4	Pass
6/5/2012	-0.5	1.3	Pass
7/19/2012	2.3	1.6	Pass
7/23/2012	-4.0	0.8	Pass
11/1/2012	2.5	2.2	Pass
11/4/2012	1.5	0.9	Pass
11/26/2012	-2.3	2.6	Pass
1/23/2013	-3.2	1.1	Pass
1/28/2013	4.4	1.3	Pass
2/2/2013	-0.1	1.2	Pass

(1) This table summarizes results of tests conducted by EDC for TLDs issued in 2012
(2) Environmental Dosimeter results are free in air.

Table 3

Summary of Independent Dosimeter Testing

January-December 2012(1)(2)

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass/Fail
1st Qtr.2012	Millstone	-10.4	2.6	Pass
2nd Qtr.2012	Millstone	-4.7	1.6	Pass
2nd Qtr.2012	Seabrook	-0.8	1.5	Pass
3rd Qtr. 2012	Millstone	-13.9	2.6	Pass
4th Qtr.2012	Millstone	4.3	1.5	Pass
4th Qtr.2012	Seabrook	-5.2	1.3	Pass

(1) Performance criteria are +/- 30%.
(2) Blind spike irradiations using Cs-137

7.2 Teledyne Brown Engineering Laboratory –Environmental Services (TBE-ES)

7.2.1 Operational Quality Control Scope

7.2.1.1 Inter-laboratory

The TBE-ES Laboratory QC Program is designed to monitor the quality of analytical processing associated with environmental, effluent (10CFR Part 50), and waste characterization (10CFR Part 61) samples.

Quality Control of environmental radioanalyses involves the internal process control program and independent third party programs administered by Analytics, Inc and Environmental Resource Associates (ERA).

TBE-ES participates in the Quality Assessment Program (QAP) administered by the Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP). The MAPEP is a set of performance evaluation samples (e.g. water, soil, air filters, etc.) designed to evaluate the ability and quality of analytical facilities performing sample measurements which contain hazardous and radioactive (mixed) analytes.

Quality Control for radioanalyses during this reporting period was divided among internal process check samples, third party process checks prepared by Analytics, Inc. (which was submitted by users or secured directly by TBE-ES for QC purposes), ERA, and DOE's MAPEP.

7.2.1.2 Intra-laboratory

The internal Quality Control program is designed to include QC functions such as instrumentation checks (to ensure proper instrument response), blank samples (to which no analyte radioactivity has been added), instrumentation backgrounds, duplicates, as well as overall staff qualification analyses and process controls. Both process control and qualification analyses samples seek to mimic the media type of those samples submitted for analyses by the various laboratory clients. These process controls (or process checks) are either actual samples submitted in duplicate in order to evaluate the accuracy of laboratory measurements, or blank samples which have been "spiked" with a known quantity of a radioisotope that is of interest to laboratory clients. These QC samples, which represent either "single" or "double-blind" unknowns, are intended to evaluate the entire radiochemical and radiometric process.

To provide direction and consistency in administering the quality assurance program, TBE-ES has developed and follows an annual quality control and audit assessment schedule. The plan describes the scheduled frequency and scope of Quality Assurance and Control considered necessary for an adequate QA/QC program conducted throughout the year. The magnitude of the process control program combines both internal and external sources targeted at 5% of the routine sample analysis load.

7.2.1.3 QA Program (Internal and External Audits)

During each reporting period at least one internal assessment is conducted in accordance with the pre-established TBE-ES Quality Control and Audit Assessment Schedule. In addition, the laboratory may be audited by prospective customers during a pre-contract audit, and/or by existing clients who wish to conduct periodic audits in accordance with their contractual arrangements. The Nuclear Utilities Procurement Issues Committee (NUPIC) conducts audits of TBE-ES as a function of a Utilities Radiological Environment Measurement Program (REMP).

TBE-ES Laboratory-Knoxville has successfully completed the New York State Department of Health's Environmental Laboratory Approval Program (NELAP), Nuclear Fuel Services, Manufacturing Sciences Corporation and State of Tennessee audits. These audits were each a comprehensive review of TBE-ES's Quality and Technical programs used to assess the laboratory's ability to produce accurate and defensible data. No significant deficiencies, which would adversely impact data quality, were identified during any of these audits. Administrative findings identified during these inspections are usually addressed promptly, according to client specifications.

7.2.2 Analytical Services Quality Control Synopsis

7.2.2.1 Results Summary

7.2.2.1.1 Environmental Services Quality Control

During year 2012 annual reporting period, twenty-seven nuclides associated with six media types were analyzed by means of the laboratory's internal process control, Analytics, ERA and DOE quality control programs. Media types representative of client company analyses performed during this reporting period were selected. The results for these programs are presented in Tables 7.2. Below is a synopsis of the media types evaluated:

- Air Filter
- Charcoal (Air Iodine)
- Milk
- Soil
- Vegetation
- Water

7.2.2.1.2 Analytics Environmental Cross-Check Program

Thirteen nuclides were evaluated during this reporting period. Iron-55 in water was added to the Analytics program and removed from the DOE MAPEP program in 2010 due to the low level of Fe-55 activity in the MAPEP samples. All environmental analyses performed were within the acceptable criteria.

7.2.2.1.3 Summary of Participation in the Department of Energy (DOE) Monitoring Program

TBE-ES participated in the semi annual Mixed Analyte Performance Evaluation Program (MAPEP) for liquid, air particulate, soil, and vegetation analyses (MAPEP-Series 26 and 27). During this reporting period, 18 nuclides were evaluated. All but three of the 18 environmental analyses performed were within the acceptable criteria. In one soil sample, a sensitivity test for Co-60 failed on the high side. No cause could be found for the conservative failure. Soil samples with low levels of Co-60 are being monitored on a case by case basis. One AP sample for Zn-65 failed on the high side. No reason could be found for the failure. All Analytics Zn-65 in AP samples were acceptable. TBE feels the failure is an anomaly specific to the MAPEP sample. One water sample for Sr-90 failed high due to an incorrect aliquot being entered in the Laboratory Information

Management System (LIMS). The correct aliquot would have resulted in an acceptable result. No Vermont Yankee samples were affected by these failures.

7.2.2.1.5 Summary of participation in the ERA Program

During this reporting period, 13 nuclides were analyzed under ERA criteria. Gross alpha in an air particulate by digestion method was added to the ERA program in May 2010. All but three of the environmental analytical results were acceptable. A Gross Alpha in water sample failed on the high side. Detector G1, used only for ERA Gross Alpha samples, appears to be slightly biased high. The ERA samples require a Th-230 attenuation curve, which is not used for client samples. A Gross Beta in water sample failed on the high side. The reanalysis fell within acceptance criteria. It appears an incorrect aliquot was entered into LIMS. A Sr-89 in water sample failed on the high side. The found to known ratio was 1.19 which TBE considers acceptable with warning. No Vermont Yankee samples were affected by these failures.

7.2.2.2 Intra-Laboratory Process Control Program

The TBE-ES Laboratory's internal process control program evaluated 5772 individual samples.

7.2.2.2.1 Spikes

All but one of the 1553 environmental spikes were analyzed with statistically appropriate activity reported for each spike. The affected work order was reanalyzed or a case narrative documented the reason the sample could not be reanalyzed.

7.2.2.2.2 Analytical Blanks

During this reporting period, all of the 1553 environmental analytical blanks analyzed reported less than MDC.

7.2.2.2.3 Duplicates

All of the 2666 duplicate sets analyzed were within acceptable limits.

7.2.2.2.4 Non-Conformance Reports

There were 12 non-conformance reports issued for this reporting period. No ENNVY data was impacted by the non-conformance in each of these cases.

7.3 J.A. FITZPATRICK ENVIRONMENTAL LABORATORY - QUALITY ASSURANCE / QUALITY CONTROL PROGRAM

7.3.1. PROGRAM DESCRIPTION

The Offsite Dose Calculation Manual (ODCM), Part 1, Section 5.3 requires that the licensee participate in an Interlaboratory Comparison Program. The Interlaboratory Comparison Program shall include sample media for which samples are routinely collected and for which comparison samples are commercially available. Participation in an Interlaboratory Comparison Program ensures that independent checks on the precision and accuracy of the measurement of radioactive material in the environmental samples are performed as part of the Quality Assurance Program for environmental monitoring. To fulfill the requirement for an Interlaboratory Comparison Program, the JAF Environmental Laboratory has engaged the services of Eckert & Ziegler Analytics, Incorporated in Atlanta, Georgia.

Eckert & Ziegler Analytics supplies sample media as blind sample spikes, which contain certified levels of radioactivity unknown to the analysis laboratory. These samples are prepared and analyzed by the JAF Environmental Laboratory using standard laboratory procedures. Eckert & Ziegler Analytics issues a statistical summary report of the results. The JAF Environmental Laboratory uses predetermined acceptance criteria methodology for evaluating the laboratory's performance.

The JAF Environmental Laboratory also analyzes laboratory blanks. The analysis of laboratory blanks provides a means to detect and measure radioactive contamination of analytical samples. The analysis of analytical blanks also provides information on the adequacy of background subtraction. Laboratory blank results are analyzed using control charts.

7.3.2 PROGRAM SCHEDULE

SAMPLE MEDIA	LABORATORY ANALYSIS	SAMPLE PROVIDER ECKERT & ZIEGLER ANALYTICS
Water	Gross Beta	3
Water	Tritium	5
Water	I-131	3
Water	Mixed Gamma	4
Air	Gross Beta	3
Air	I-131	4
Air	Mixed Gamma	2
Milk	I-131	3
Milk	Mixed Gamma	3
Soil	Mixed Gamma	1
Vegetation	Mixed Gamma	2
TOTAL SAMPLE INVENTORY		**33**

7.3.3 ACCEPTANCE CRITERIA

Each sample result is evaluated to determine the accuracy and precision of the laboratory's analysis result. The sample evaluation method is discussed below.

7.3.3.1 SAMPLE RESULTS EVALUATION

Samples provided by Analytics are evaluated using what is specified as the NRC method. This method is based on the calculation of the ratio of results reported by the participating laboratory (QC result) to the Vendor Laboratory Known value (reference result).

An Environmental Laboratory analytical result is evaluated using the following calculation:

The value for the error resolution is calculated.

$$\text{The error resolution} = \frac{\text{Reference Result}}{\text{Reference Results Error (1 sigma)}}$$

Using the appropriate row under the Error Resolution column in Table 8.3.1 below, a corresponding Ratio of Agreement interval is given.

The value for the ratio is then calculated.

$$\text{Ratio of Agreement} = \frac{\text{QC Result}}{\text{Reference Result}}$$

If the value falls within the agreement interval, the result is acceptable.

TABLE 7.3.1

ERROR RESOLUTION	RATIO OF AGREEMENT
< 4	No Comparison
4 to 7	0.5 to 2.0
8 to 15	0.6 to 1.66
16 to 50	0.75 to 1.33
51 to 200	0.8 to 1.25
>200	0.85 to 1.18

This acceptance test is generally referred to as the "NRC" method. The acceptance criteria is contained in Procedure EN-CY-102. The NRC method generally results in an acceptance range of approximately ± 25% of the Known value when applied to sample results from the Eckert & Ziegler Analytics Interlaboratory Comparison Program. This method is used as the procedurally required assessment method and requires the generation of a deviation from QA/QC program report when results are unacceptable.

7.3.4 PROGRAM RESULTS SUMMARY

The Interlaboratory Comparison Program numerical results are provided on Table 7.3.2.

7.3.4.1 ECKERT & ZIEGLER ANALYTICS QA SAMPLES RESULTS

Thirty three QA blind spike samples were analyzed as part of Analytics 2011 Interlaboratory Comparison Program. The following sample media were evaluated as part of the comparison program.

- Air Charcoal Cartridge: I-131
- Air Particulate Filter: Mixed Gamma Emitters, Gross Beta
- Water: I-131, Mixed Gamma Emitters, Tritium, Gross Beta
- Soil: Mixed Gamma Emitters
- Milk: I-131, Mixed Gamma Emitters
- Vegetation: Mixed Gamma Emitters

The JAF Environmental Laboratory performed 133 individual analyses on the 33 QA samples. Of the 135 analyses performed, 133 were in agreement using the NRC acceptance criteria for a 98.5% agreement ratio.

There were two (2) non-conformities in the 2012 program.

Eckert & Ziegler Analytics Sample E-10086, Water Gross Beta
Corrective Action No. CR-JAF-2012-05041
The JAF Environmental Lab result for the Eckert & Ziegler Analytics QA sample E-10086, water gross beta, was not in agreement with the known value. JAF reported an average value of 87.4 pCi/L when the known value was 285 pCi/L.

Three aliquots of the sample were prepared and 3 results were generated along with the mean which was reported. The sampling volume was not adjusted for the 3 aliquots. The incorrect sample volume was used to calculate the activity.

The volume used in the calculation of the activity was incorrectly entered as 0.5 L when the correct volume should have been 0.166 L. If the correct volume had been used, the activity would have been 87.4 * 3 = 262.2 pCi/L. The corrected activity would then have been in agreement with the known value.

Guidance was added to the Lab Policy Manual for calculating gross beta concentrations when more than 1 aliquot of the sample is taken.

Eckert & Ziegler Analytics Sample E-10274, Water Gross Beta
Corrective Action No. CR-JAF-2013-00770

The JAF Environmental Lab result for the Eckert & Ziegler Analytics QA sample E-10274, water gross beta, was not in agreement with the known value. JAF reported an average value of 190.6 pCi/L when the known value was 251 pCi/L. The error resolution is 59.7 which equates to a ratio of agreement of 0.8 to 1.25. The JAF / known value was 0.76. The sample was analyzed on another instrument with an average result of 187.9 pCi/L.

The vendor was contacted and suggested recommendations have been examined and have not accounted for the discrepancy in the result.

JAF's result performed on the previous Eckert & Ziegler water gross beta sample was in agreement with the known value.

7.3.4.2 NUMERICAL RESULTS TABLES

TABLE 7.3.2
INTERLABORATORY INTERCOMPARISON PROGRAM
Gross Beta Analysis of Air Particulate Filter

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi ±1 sigma				REFERENCE LAB* pCi ±1 sigma			RATIO (1)	
06/14/2012	E10151	FILTER	GROSS BETA		64	±	1.0	61	±	1.01	1.07	A
					66	±	1.0					
					64	±	1.0					
				Mean =	65	±	0.6					
12/06/2012	E10362	FILTER	GROSS BETA		71	±	0.9	66	±	1.09	1.06	A
					68	±	0.9					
					70	±	0.9					
				Mean =	70	±	0.5					
06/14/2012	E10189	FILTER	GROSS BETA		93	±	1.2	84	±	1.40	1.10	A
					94	±	1.2					
					89	±	1.1					
				Mean =	92	±	0.7					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Tritium Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma				REFERENCE LAB* pCi/liter ±1 sigma			RATIO (1)	
03/15/2012	E10083	WATER			5601	±	169.0					
			H-3		5215	±	166.0	4990	±	83.40	1.08	A
					5352	±	167.0					
				Mean =	5389	±	96.6					
06/14/2012	E10150	WATER			1001	±	121.0					
			H-3		1040	±	121.0	964	±	16.10	1.07	A
					1066	±	122.0					
				Mean =	1036	±	70.1					
09/13/2012	E10269	WATER			918	±	124.0					
			H-3		901	±	124.0	960	±	16.00	0.95	A
					915	±	125.0					
				Mean =	911	±	71.8					
12/06/2012	E10321	WATER			12011	±	209.0					
			H-3		11938	±	211.0	12100	±	202.00	0.99	A
					11994	±	211.0					
				Mean =	11981	±	121.4					
12/06/2012	E10322	WATER			12023	±	210.0					
			H-3		12054	±	212.0	12100	±	202.00	0.99	A
					12004	±	212.0					
				Mean =	12027	±	122.0					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)

Gross Beta Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma	REFERENCE LAB* pCi/liter ±1 sigma	RATIO (1)
03/15/2012	E10086	Water	GROSS BETA	90 ± 1.4 88 ± 1.4 84 ± 1.3 Mean = 87 ± 0.8	285 ± 4.8	0.31 U
06/14/2012	E10156	Water	GROSS BETA	257 ± 2.5 255 ± 2.5 257 ± 2.5 Mean = 256 ± 1.4	273 ± 4.6	0.94 A
09/13/2012	E10274	Water	GROSS BETA	192 ± 2.0 191 ± 2.0 189 ± 2.0 Mean = 191 ± 1.2	251 ± 4.2	0.76 U

(1) Ratio = Reported/Analytics.

* Sample provided by Analytics, Inc.

A=Acceptable

U=Unacceptable

TABLE 7.3.2 (Continued)

INTERLABORATORY INTERCOMPARISON PROGRAM

I-131 Gamma Analysis of Air Charcoal

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi ±1 sigma	REFERENCE LAB* pCi ±1 sigma	RATIO (1)
03/15/2012	E10013	AIR	I-131	90 ± 3.7 90 ± 3.8 90 ± 3.3 Mean = 90 ± 2.1	94.1 ± 1.57	0.96 A
06/14/2012	E10154	AIR	I-131	94 ± 2.6 92 ± 4.4 90 ± 2.5 89 ± 3.2 Mean = 91 ± 1.6	97.0 ± 1.62	0.94 A
09/13/2012	E10267	AIR	I-131	96 ± 2.6 94 ± 2.7 96 ± 2.9 Mean = 95 ± 1.6	97.1 ± 1.62	0.98 A
09/13/2012	E10273	AIR	I-131	102 ± 2.8 101 ± 2.7 101 ± 2.6 Mean = 101 ± 1.5	96.8 ± 1.62	1.05 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.

* Sample provided by Eckert & Ziegler Analytics, Inc.

A=Acceptable

U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma				REFERENCE LAB* pCi/liter ±1 sigma			RATIO (1)	
3/15/2012	E10084	WATER	Ce-141		198	±	9.1	184	±	3.07	1.06	A
					196	±	8.2					
					186	±	8.9					
					197	±	8.2					
				Mean =	194	±	4.3					
			Cr-51		189	±	49.2	309	±	5.16	0.91	A
					257	±	39.7					
					362	±	68.1					
					319	±	42.0					
				Mean =	282	±	25.5					
			Cs-134		102	±	7.1	106	±	1.77	0.95	A
					98	±	5.8					
					100	±	2.6					
					104	±	5.4					
				Mean =	101	±	2.7					
			Cs-137		103	±	3.9	113	±	1.88	0.98	A
					111	±	3.1					
					116	±	1.5					
					115	±	2.9					
				Mean =	111	±	1.5					
			Co-58		95	±	4.4	93	±	1.56	1.03	A
					92	±	3.6					
					97	±	2.4					
					100	±	3.4					
				Mean =	96	±	1.8					
			Mn-54		148	±	4.6	138	±	2.31	1.10	A
					148	±	3.7					
					157	±	1.9					
					155	±	3.6					
				Mean =	152	±	1.8					
			Fe-59		118	±	7.4	119	±	1.99	1.06	A
					130	±	5.8					
					131	±	4.8					
					125	±	5.2					
				Mean =	126	±	3.0					
			Zn-65		232	±	9.5	235	±	3.93	1.06	A
					250	±	7.5					
					257	±	3.8					
					262	±	6.9					
				Mean =	250	±	3.6					
			Co-60		209	±	3.9	197	±	3.29	1.05	A
					207	±	3.1					
					209	±	1.4					
					203	±	2.8					
				Mean =	207	±	1.5					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)

INTERLABORATORY INTERCOMPARISON PROGRAM

Gamma Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma	REFERENCE LAB* pCi/liter ±1 sigma	RATIO (1)
3/15/2012	E10084	WATER	Ce-141	198 ± 9.1		
				196 ± 8.2		
				186 ± 8.9	184 ± 3.07	1.06 A
				197 ± 8.2		
				Mean = 194 ± 4.3		
			Cr-51	189 ± 49.2		
				257 ± 39.7		
				362 ± 68.1	309 ± 5.16	0.91 A
				319 ± 42.0		
				Mean = 282 ± 25.5		
			Cs-134	102 ± 7.1		
				98 ± 5.8		
				100 ± 2.6	106 ± 1.77	0.95 A
				104 ± 5.4		
				Mean = 101 ± 2.7		
			Cs-137	103 ± 3.9		
				111 ± 3.1		
				116 ± 1.5	113 ± 1.88	0.98 A
				115 ± 2.9		
				Mean = 111 ± 1.5		
			Co-58	95 ± 4.4		
				92 ± 3.6		
				97 ± 2.4	93 ± 1.56	1.03 A
				100 ± 3.4		
				Mean = 96 ± 1.8		
			Mn-54	148 ± 4.6		
				148 ± 3.7		
				157 ± 1.9	138 ± 2.31	1.10 A
				155 ± 3.6		
				Mean = 152 ± 1.8		
			Fe-59	118 ± 7.4		
				130 ± 5.8		
				131 ± 4.8	119 ± 1.99	1.06 A
				125 ± 5.2		
				Mean = 126 ± 3.0		
			Zn-65	232 ± 9.5		
				250 ± 7.5		
				257 ± 3.8	235 ± 3.93	1.06 A
				262 ± 6.9		
				Mean = 250 ± 3.6		
			Co-60	209 ± 3.9		
				207 ± 3.1		
				209 ± 1.4	197 ± 3.29	1.05 A
				203 ± 2.8		
				Mean = 207 ± 1.5		

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc. A=Acceptable

* Sample provided by Eckert & Ziegler Analytics, Inc. U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma	REFERENCE LAB* pCi/liter ±1 sigma	RATIO (1)
6/14/2012	E10188	WATER	Ce-141	110 ± 8.3 121 ± 9.6 118 ± 8.3 115 ± 9.3 100 ± 10.0 Mean = 113 ± 4.1	112 ± 1.87	1.01 A
			Cr-51	515 ± 40.9 564 ± 50.5 532 ± 41.1 553 ± 46.3 588 ± 52.7 Mean = 550 ± 20.8	548 ± 9.14	1.00 A
			Cs-134	223 ± 12.0 217 ± 14.9 231 ± 10.4 225 ± 12.8 234 ± 14.0 Mean = 226 ± 5.8	238 ± 3.97	0.95 A
			Cs-137	281 ± 7.1 277 ± 8.6 298 ± 6.4 273 ± 7.3 282 ± 8.4 Mean = 282 ± 3.4	289 ± 4.82	0.98 A
			Co-58	118 ± 5.8 123 ± 6.9 131 ± 5.0 132 ± 5.8 127 ± 6.4 Mean = 126 ± 2.7	126 ± 2.10	1.00 A
			Mn-54	182 ± 6.4 177 ± 7.5 200 ± 5.7 184 ± 6.6 182 ± 7.4 Mean = 185 ± 3.0	180 ± 3.01	1.03 A
			Fe-59	192 ± 8.3 188 ± 10.0 190 ± 7.0 197 ± 8.5 179 ± 9.8 Mean = 189 ± 3.9	174 ± 2.91	1.09 A
			Zn-65	312 ± 13.0 317 ± 15.7 293 ± 10.8 308 ± 13.2 298 ± 15.2 Mean = 306 ± 6.1	272 ± 4.54	1.12 A
			Co-60	485 ± 7.2 488 ± 8.6 493 ± 6.3 491 ± 7.5 486 ± 8.5 Mean = 489 ± 3.8	484 ± 8.09	1.01 A
			I-131	116 ± 10.5 82 ± 12.2 101 ± 10.2 85 ± 11.5 78 ± 12.8 Mean = 93 ± 5.7	99 ± 1.66	0.93 A
			I-131**	112 ± 4.9 118 ± 4.6 114 ± 1.3 Mean = 115 ± 2.3	99 ± 1.66	1.15 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.
** Result determined by Resin Extraction/Gamma Spectral Analysis.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma				REFERENCE LAB* pCi/liter ±1 sigma			RATIO (1)	
9/13/2012	E10270	WATER	Ce-141		166	±	6.2	159	±	2.65	1.04	A
					167	±	7.1					
					170	±	6.5					
					159	±	7.7					
				Mean =	166	±	3.4					
			Cr-51		269	±	26.5	241	±	4.02	1.12	A
					286	±	31.2					
					300	±	27.6					
					225	±	32.6					
				Mean =	270	±	14.8					
			Cs-134		107	±	7.6	105	±	1.76	0.98	A
					106	±	9.9					
					101	±	8.4					
					96	±	10.8					
				Mean =	102	±	4.6					
			Cs-137		169	±	4.9	169	±	2.82	0.98	A
					158	±	6.7					
					175	±	5.6					
					159	±	6.5					
				Mean =	165	±	3.0					
			Co-58		95	±	3.8	98	±	1.63	1.00	A
					102	±	5.7					
					99	±	4.4					
					95	±	5.7					
				Mean =	98	±	2.5					
			Mn-54		196	±	5.3	190	±	3.17	1.04	A
					208	±	7.1					
					195	±	6.0					
					194	±	7.2					
				Mean =	198	±	3.2					
			Fe-59		160	±	5.4	147	±	2.46	1.11	A
					161	±	7.7					
					167	±	6.5					
					166	±	7.9					
				Mean =	164	±	3.5					
			Zn-65		187	±	8.3	187	±	3.12	0.98	A
					191	±	11.2					
					191	±	9.6					
					166	±	11.4					
				Mean =	184	±	5.1					
			Co-60		148	±	3.5	147	±	2.46	1.05	A
					170	±	5.2					
					154	±	4.2					
					148	±	5.0					
				Mean =	155	±	2.2					
			I-131		61.4	±	3.6	63	±	1.06	1.07	A
					69.2	±	5.0					
					66.2	±	4.0					
					72.3	±	5.4					
				Mean =	67.3	±	2.3					
			I-131**		68	±	0.9	63	±	1.06	1.08	A
					68	±	0.9					
					69	±	0.9					
				Mean =	68	±	0.5					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
A=Acceptable
* Sample provided by Eckert & Ziegler Analytics, Inc.
U=Unacceptable
** Result determined by Resin Extraction/Gamma Spectral Analysis.

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Water

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma				REFERENCE LAB* pCi/liter ±1 sigma			RATIO (1)	
12/6/2012	E10320	WATER	Ce-141		51	±	6.0	53	±	0.89	0.92	A
					54	±	5.8					
					43	±	7.2					
					47	±	6.2					
				Mean =	49	±	3.2					
			Cr-51		379	±	33.0	362	±	6.05	0.96	A
					382	±	34.5					
					321	±	38.3					
					311	±	35.3					
				Mean =	348	±	17.7					
			Cs-134		172	±	9.2	173	±	2.88	0.96	A
					159	±	9.8					
					150	±	12.4					
					180	±	10.8					
				Mean =	165	±	5.3					
			Cs-137		121	±	4.3	122	±	2.03	0.99	A
					118	±	4.5					
					120	±	5.7					
					122	±	5.1					
				Mean =	120	±	2.5					
			Co-58		107	±	4.1	103	±	1.72	0.98	A
					99	±	4.6					
					95	±	5.5					
					103	±	4.8					
				Mean =	101	±	2.4					
			Mn-54		134	±	4.7	121	±	2.01	1.06	A
					134	±	4.9					
					120	±	6.0					
					127	±	5.3					
				Mean =	129	±	2.6					
			Fe-59		119	±	5.4	121	±	2.01	1.00	A
					131	±	6.1					
					109	±	7.5					
					123	±	6.8					
				Mean =	121	±	3.2					
			Zn-65		205	±	8.9	194	±	3.24	1.03	A
					201	±	9.3					
					200	±	12.2					
					197	±	10.5					
				Mean =	201	±	5.2					
			Co-60		185	±	3.9	177	±	2.96	1.05	A
					182	±	4.2					
					183	±	5.3					
					193	±	4.0					
				Mean =	186	±	2.2					
			I-131		82.8	±	8.1	73	±	1.21	1.05	A
					75.0	±	8.1					
					74.3	±	10.4					
					75.8	±	9.3					
				Mean =	77.0	±	4.5					
			I-131**		85	±	1.6	73	±	1.21	1.12	A
					86	±	1.8					
					75	±	2.5					
					81	±	2.2					
				Mean =	81	±	1.0					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.
** Result determined by Resin Extraction/Gamma Spectral Analysis.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Milk

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma	REFERENCE LAB* pCi/liter ±1 sigma	RATIO (1)
3/15/2012	E10014	MILK	Ce-141	250 ± 10.6 272 ± 9.0 255 ± 10.1 243 ± 10.5 Mean = 255 ± 5.0	260 ± 4.34	0.98 A
			Cr-51	390 ± 43.3 495 ± 42.2 364 ± 48.9 514 ± 49.7 Mean = 441 ± 23.1	436 ± 7.28	1.01 A
			Cs-134	134 ± 8.1 142 ± 11.2 129 ± 14.0 140 ± 13.5 Mean = 136 ± 6.0	149 ± 2.50	0.91 A
			Cs-137	157 ± 7.7 153 ± 6.0 157 ± 7.7 140 ± 6.9 Mean = 152 ± 3.6	159 ± 2.66	0.95 A
			Co-58	133 ± 7.8 130 ± 6.0 127 ± 7.8 122 ± 8.0 Mean = 128 ± 3.7	132 ± 2.20	0.97 A
			Mn-54	204 ± 8.8 214 ± 7.1 206 ± 8.6 203 ± 8.5 Mean = 207 ± 4.1	195 ± 3.26	1.06 A
			Fe-59	182 ± 11.5 192 ± 9.1 161 ± 11.0 163 ± 10.9 Mean = 175 ± 5.3	168 ± 2.81	1.04 A
			Zn-65	312 ± 18.4 326 ± 14.4 320 ± 18.0 329 ± 17.7 Mean = 322 ± 8.6	333 ± 5.56	0.97 A
			Co-60	273 ± 7.8 279 ± 6.1 278 ± 7.6 273 ± 7.4 Mean = 276 ± 3.6	279 ± 4.65	0.99 A
			I-131	107 ± 13.8 97.2 ± 10.2 90.9 ± 13.1 120 ± 13.7 Mean = 104 ± 6.4	93 ± 1.54	1.12 A
			I-131**	120 ± 7.1 125 ± 6.5 105 ± 7.6 112 ± 7.1 Mean = 116 ± 3.5	93 ± 1.54	1.25 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
A=Acceptable
* Sample provided by Eckert & Ziegler Analytics, Inc.
U=Unacceptable
** Result determined by Resin Extraction/Gamma Spectral Analysis.

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Milk

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma				REFERENCE LAB* pCi/liter ±1 sigma			RATIO (1)	
6/14/2012	E10152	MILK	Ce-141		81	±	5.7	82	±	1.37	0.97	A
					83	±	6.4					
					75	±	7.8					
					81	±	7.1					
				Mean =	80	±	3.4					
			Cr-51		429	±	31.4	402	±	6.71	1.04	A
					411	±	30.8					
					417	±	38.5					
					414	±	45.0					
				Mean =	418	±	18.4					
			Cs-134		166	±	6.0	174	±	2.91	0.94	A
					164	±	11.0					
					163	±	12.7					
					159	±	6.5					
				Mean =	163	±	4.7					
			Cs-137		203	±	6.2	212	±	3.54	0.95	A
					203	±	6.5					
					198	±	7.1					
					202	±	6.4					
				Mean =	202	±	3.3					
			Co-58		93	±	4.7	92	±	1.54	0.98	A
					92	±	4.5					
					90	±	5.9					
					88	±	5.6					
				Mean =	91	±	2.6					
			Mn-54		140	±	5.5	132	±	2.21	1.04	A
					129	±	5.6					
					135	±	6.5					
					144	±	6.0					
				Mean =	137	±	3.0					
			Fe-59		130	±	6.4	128	±	2.13	1.05	A
					127	±	6.6					
					142	±	8.0					
					137	±	7.7					
				Mean =	134	±	3.6					
			Zn-65		207	±	10.7	199	±	3.33	1.02	A
					192	±	11.0					
					207	±	12.7					
					208	±	11.5					
				Mean =	204	±	5.8					
			Co-60		370	±	6.3	355	±	5.93	1.02	A
					364	±	6.4					
					356	±	7.3					
					365	±	6.5					
				Mean =	364	±	3.3					
			I-131		102	±	4.4	100	±	1.66	0.95	A
					100	±	4.6					
					88.4	±	6.4					
					89.9	±	10.7					
				Mean =	95.1	±	3.5					
			I-131**		118	±	5.0	100	±	1.66	1.08	A
					99	±	5.2					
					104	±	2.2					
					109	±	1.5					
				Mean =	108	±	1.9					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc. A=Acceptable
* Sample provided by Eckert & Ziegler Analytics, Inc. U=Unacceptable
** Result determined by Resin Extraction/Gamma Spectral Analysis.

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Milk

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/liter ±1 sigma	REFERENCE LAB* pCi/liter ±1 sigma	RATIO (1)
9/13/2012	E10272	MILK	Ce-141	159 ± 7.5 174 ± 7.2 154 ± 8.1 164 ± 6.7 Mean = 163 ± 3.7	164 ± 2.73	0.99 A
			Cr-51	284 ± 33.2 258 ± 28.3 218 ± 33.2 263 ± 26.0 Mean = 256 ± 15.2	248 ± 4.14	1.03 A
			Cs-134	99 ± 9.5 101 ± 9.3 105 ± 10.4 100 ± 7.4 Mean = 101 ± 4.6	108 ± 1.81	0.94 A
			Cs-137	149 ± 6.3 161 ± 5.8 159 ± 6.4 173 ± 5.0 Mean = 161 ± 3.0	174 ± 2.91	0.92 A
			Co-58	104 ± 5.5 100 ± 4.7 102 ± 5.6 116 ± 4.2 Mean = 106 ± 2.5	100 ± 1.68	1.06 A
			Mn-54	201 ± 7.1 193 ± 6.2 197 ± 7.3 211 ± 5.5 Mean = 201 ± 3.3	196 ± 3.27	1.02 A
			Fe-59	157 ± 7.9 163 ± 6.7 154 ± 7.8 168 ± 5.7 Mean = 161 ± 3.5	152 ± 2.53	1.06 A
			Zn-65	186 ± 12.4 213 ± 10.5 220 ± 11.5 198 ± 8.8 Mean = 204 ± 5.4	192 ± 3.21	1.06 A
			Co-60	155 ± 5.0 150 ± 4.3 160 ± 5.0 157 ± 3.6 Mean = 156 ± 2.3	152 ± 2.53	1.02 A
			I-131	95.2 ± 5.4 95.4 ± 4.5 94.1 ± 5.3 99.3 ± 4.2 Mean = 96.0 ± 2.4	100 ± 1.66	0.96 A
			I-131**	106 ± 1.1 108 ± 1.3 102 ± 1.2 105 ± 0.7 Mean = 105 ± 0.5	100 ± 1.66	1.06 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.
** Result determined by Resin Extraction/Gamma Spectral Analysis.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Air Particulate Filter

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi ±1 sigma	REFERENCE LAB* pCi ±1 sigma	RATIO (1)
3/15/2012	E10085	FILTER	Ce-141	198 ± 7.0 198 ± 6.5 186 ± 6.3 Mean = 194 ± 3.8	184 ± 3.07	1.05 A
			Cr-51	276 ± 39.3 355 ± 41.1 292 ± 36.9 Mean = 308 ± 22.6	308 ± 5.14	1.00 A
			Cs-134	85 ± 7.9 98 ± 8.5 89 ± 7.9 Mean = 91 ± 4.7	106 ± 1.76	0.86 A
			Cs-137	118 ± 3.9 118 ± 4.3 110 ± 4.0 Mean = 115 ± 2.3	112 ± 1.88	1.03 A
			Co-58	95 ± 4.8 105 ± 5.8 96 ± 4.8 Mean = 99 ± 3.0	93 ± 1.56	1.06 A
			Mn-54	163 ± 4.9 155 ± 5.4 148 ± 5.1 Mean = 155 ± 3.0	138 ± 2.30	1.13 A
			Fe-59	132 ± 7.4 130 ± 9.1 130 ± 8.4 Mean = 131 ± 4.8	119 ± 1.98	1.10 A
			Zn-65	260 ± 10.1 280 ± 12.0 272 ± 11.0 Mean = 271 ± 6.4	235 ± 3.92	1.15 A
			Co-60	201 ± 4.1 210 ± 4.8 206 ± 4.6 Mean = 206 ± 2.6	197 ± 3.28	1.04 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.

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U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Air Particulate Filter

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi ±1 sigma				REFERENCE LAB* pCi ±1 sigma			RATIO (1)	
9/13/2012	E10271	FILTER			135	±	3.2					
					136	±	3.0					
			Ce-141		134	±	3.2	132	±	2.20	1.03	A
					141	±	3.5					
				Mean =	137	±	1.6					
					223	±	14.7					
					195	±	14.2					
			Cr-51		212	±	16.2	200	±	3.33	1.05	A
					206	±	16.2					
				Mean =	209	±	7.7					
					83	±	7.5					
					78	±	7.0					
			Cs-134		89	±	7.7	87	±	1.45	0.94	A
					77	±	7.0					
				Mean =	82	±	3.6					
					139	±	4.2					
					139	±	4.1					
			Cs-137		140	±	4.6	140	±	2.34	1.01	A
					145	±	4.2					
				Mean =	141	±	2.1					
					86	±	3.7					
					92	±	3.7					
			Co-58		87	±	4.0	81	±	1.35	1.08	A
					84	±	3.5					
				Mean =	87	±	1.9					
					172	±	5.0					
					167	±	4.6					
			Mn-54		168	±	5.1	157	±	2.63	1.07	A
					168	±	4.6					
				Mean =	169	±	2.4					
					149	±	5.6					
					146	±	5.1					
			Fe-59		135	±	5.6	122	±	2.04	1.15	A
					133	±	5.0					
				Mean =	141	±	2.7					
					171	±	8.3					
					175	±	8.0					
			Zn-65		173	±	8.7	155	±	2.59	1.10	A
					164	±	7.6					
				Mean =	171	±	4.1					
					126	±	3.6					
					124	±	3.3					
			Co-60		126	±	3.7	122	±	2.04	1.03	A
					128	±	3.2					
				Mean =	126	±	1.7					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc.
* Sample provided by Eckert & Ziegler Analytics, Inc.
** Result determined by Resin Extraction/Gamma Spectral Analysis.

A=Acceptable
U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Soil

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi /g±1 sigma				REFERENCE LAB* pCi/g ±1 sigma			RATIO (1)	
6/14/2012	E10153	SOIL	Ce-141		0.161	±	0.021	0.137	±	0.002	1.19	A
					0.169	±	0.021					
					0.165	±	0.022					
					0.156	±	0.019					
				Mean =	0.163	±	0.010					
			Cr-51		0.717	±	0.106	0.671	±	0.011	0.97	A
					0.699	±	0.110					
					0.599	±	0.111					
					0.600	±	0.124					
				Mean =	0.654	±	0.056					
			Cs-134		0.286	±	0.032	0.292	±	0.005	0.97	A
					0.283	±	0.036					
					0.269	±	0.029					
					0.292	±	0.035					
				Mean =	0.283	±	0.017					
			Cs-137		0.434	±	0.021	0.441	±	0.007	0.97	A
					0.426	±	0.023					
					0.437	±	0.019					
					0.413	±	0.021					
				Mean =	0.428	±	0.010					
			Co-58		0.137	±	0.016	0.154	±	0.003	0.96	A
					0.166	±	0.018					
					0.143	±	0.015					
					0.145	±	0.018					
				Mean =	0.148	±	0.008					
			Mn-54		0.206	±	0.017	0.221	±	0.004	0.94	A
					0.201	±	0.020					
					0.230	±	0.017					
					0.198	±	0.018					
				Mean =	0.209	±	0.009					
			Fe-59		0.268	±	0.022	0.213	±	0.004	1.14	A
					0.255	±	0.026					
					0.209	±	0.023					
					0.237	±	0.026					
				Mean =	0.242	±	0.012					
			Zn-65		0.332	±	0.031	0.333	±	0.006	0.97	A
					0.331	±	0.035					
					0.282	±	0.029					
					0.342	±	0.033					
				Mean =	0.322	±	0.016					
			Co-60		0.588	±	0.018	0.594	±	0.010	0.98	A
					0.568	±	0.020					
					0.617	±	0.018					
					0.549	±	0.019					
				Mean =	0.581	±	0.009					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc. A=Acceptable
* Sample provided by Eckert & Ziegler Analytics, Inc. U=Unacceptable

TABLE 7.3.2 (Continued)
INTERLABORATORY INTERCOMPARISON PROGRAM
Gamma Analysis of Vegetation

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/g ±1 sigma	REFERENCE LAB* pCi/g ±1 sigma	RATIO (1)
6/14/2012	E10155	VEG	Ce-141	0.195 ± 0.013 0.195 ± 0.014 0.191 ± 0.012 0.196 ± 0.014 Mean = 0.194 ± 0.007	0.204 ± 0.003	0.95 A
			Cr-51	0.926 ± 0.076 0.902 ± 0.082 1.040 ± 0.071 0.943 ± 0.087 Mean = 0.953 ± 0.040	0.996 ± 0.017	0.96 A
			Cs-134	0.363 ± 0.030 0.402 ± 0.034 0.397 ± 0.028 0.379 ± 0.027 Mean = 0.385 ± 0.015	0.432 ± 0.007	0.89 A
			Cs-137	0.476 ± 0.016 0.470 ± 0.019 0.472 ± 0.016 0.487 ± 0.014 Mean = 0.476 ± 0.008	0.525 ± 0.009	0.91 A
			Co-58	0.222 ± 0.013 0.251 ± 0.015 0.236 ± 0.012 0.221 ± 0.012 Mean = 0.233 ± 0.006	0.229 ± 0.004	1.02 A
			Mn-54	0.323 ± 0.014 0.317 ± 0.017 0.295 ± 0.014 0.323 ± 0.013 Mean = 0.315 ± 0.007	0.328 ± 0.005	0.96 A
			Fe-59	0.325 ± 0.018 0.323 ± 0.021 0.330 ± 0.018 0.303 ± 0.016 Mean = 0.320 ± 0.009	0.317 ± 0.005	1.01 A
			Zn-65	0.451 ± 0.029 0.486 ± 0.036 0.536 ± 0.030 0.513 ± 0.027 Mean = 0.497 ± 0.015	0.494 ± 0.008	1.01 A
			Co-60	0.832 ± 0.017 0.861 ± 0.020 0.831 ± 0.016 0.815 ± 0.014 Mean = 0.835 ± 0.008	0.881 ± 0.015	0.95 A

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc. A=Acceptable
* Sample provided by Eckert & Ziegler Analytics, Inc. U=Unacceptable

TABLE 7.3.2 (Continued)

INTERLABORATORY INTERCOMPARISON PROGRAM

Gamma Analysis of Vegetation

DATE	SAMPLE ID NO.	MEDIUM	ANALYSIS	JAF ELAB RESULTS pCi/g ±1 sigma				REFERENCE LAB* pCi/g ±1 sigma			RATIO (1)	
9/13/2012	E10268	VEG	Ce-141		0.388	±	0.017	0.385	±	0.006	1.00	A
					0.404	±	0.018					
					0.368	±	0.015					
				Mean =	0.387	±	0.010					
			Cr-51		0.625	±	0.075	0.583	±	0.010	1.02	A
					0.576	±	0.083					
					0.584	±	0.067					
				Mean =	0.595	±	0.043					
			Cs-134		0.262	±	0.029	0.255	±	0.004	1.00	A
					0.258	±	0.033					
					0.243	±	0.025					
				Mean =	0.254	±	0.017					
			Cs-137		0.456	±	0.019	0.410	±	0.007	1.13	A
					0.486	±	0.020					
					0.447	±	0.015					
				Mean =	0.463	±	0.010					
			Co-58		0.232	±	0.014	0.236	±	0.004	1.01	A
					0.252	±	0.016					
					0.230	±	0.012					
				Mean =	0.238	±	0.008					
			Mn-54		0.497	±	0.020	0.460	±	0.008	1.08	A
					0.491	±	0.021					
					0.496	±	0.016					
				Mean =	0.495	±	0.011					
			Fe-59		0.385	±	0.023	0.357	±	0.006	1.08	A
					0.389	±	0.024					
					0.384	±	0.017					
				Mean =	0.386	±	0.012					
			Zn-65		0.464	±	0.033	0.452	±	0.008	1.02	A
					0.451	±	0.034					
					0.471	±	0.026					
				Mean =	0.462	±	0.018					
			Co-60		0.389	±	0.015	0.357	±	0.006	1.07	A
					0.392	±	0.016					
					0.368	±	0.011					
				Mean =	0.383	±	0.008					

(1) Ratio = Reported/Eckert & Ziegler Analytics, Inc. A=Acceptable

* Sample provided by Eckert & Ziegler Analytics, Inc. U=Unacceptable

7.3.5 REFERENCES

7.3.5.1 Radioactivity and Radiochemistry, The Counting Room: Special Edition, 1994 Caretaker Publications, Atlanta, Georgia.

7.3.5.2 Data Reduction and Error Analysis for the Physical Sciences, Bevington P.R., McGraw Hill, New York (1969).

8. Land Use Census

The Vermont Yankee Nuclear Power Station Off-site Dose Calculation Manual 3/4.5.2 requires that a Land Use Census be conducted annually between the dates of June 1 and October 1. The census identifies the locations of the nearest milk animal and the nearest residence in each of the 16 meteorological sectors within a distance of five miles of the plant. The census also identifies the nearest milk animal (within three miles of the plant) to the point of predicted highest annual average D/Q (deposition factor for dry deposition of elemental radionuclides and other particulates) value due to elevated releases from the plant stack in each of the three major meteorological sectors. The 2012 Land Use Census was conducted in the summer of 2012 in accordance with the ODCM.

Following the collection of field data and in compliance with Off-site Dose Calculation Manual (ODCM) Section 10.1, a dosimetric analysis would be 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 Method 1 screening dose calculations found in the ODCM (i.e. the dose calculations done in compliance with ODCM Surveillance 4.3.3). If a census location has a 20% greater potential dose than that of the critical receptor, this fact must be announced in the annual Radioactive Effluent Release Report for that period. A re-evaluation of the critical receptor would also be done at that time. No changes in the census data from year 2008 occurred in the 2012 census; therefore no revisions of the 2008 calculations were required.

Pursuant to ODCM 3.5.2.a, a dosimetric analysis would be performed, using site specific meteorological data, to determine which milk animal locations would provide the optimal sampling locations. If any location had experienced a 20% greater potential dose commitment than at a currently sampled location, the new location would be added to the routine environmental sampling program in replacement of the location with the lowest calculated dose (which is eliminated from the program). The 2012 Land Use Census did not identify any locations, meeting the criteria of ODCM Table 3.5.1, with a greater potential dose commitment than at currently sampled locations. No changes to the Radiological Environmental Monitoring Program (REMP) were required based on the Land Use Census.

The results of the 2012 Land Use Census are included in this report in compliance with ODCM 4.5.2 and ODCM 10.2. The locations identified during the census may be found in Table 8.1.

TABLE 8.1

2012 LAND USE CENSUS LOCATIONS*

SECTOR	NEAREST RESIDENCE Km (Mi)	NEAREST MILK ANIMAL Km (Mi)
N	1.4 (0.9)	----
NNE	1.4 (0.9)	5.5 (3.4) Cows
NE	1.3 (0.8)	----
ENE	1.0 (0.6)	----
E	0.9 (0.6)	----
ESE	1.9 (1.1)	----
SE	2.0 (1.2)	3.6 (2.2) Cows**
SSE	2.1 (1.3)	----
S	0.6 (0.4)	2.2 (1.4) Cows**
SSW	0.5 (0.3)	----
SW	0.4 (0.3)	8.2 (5.1) Cows
WSW	0.5 (0.3)	----
W	0.6 (0.4)	0.8 (0.5) Cows
WNW	1.1 (0.7)	----
NW	2.3 (1.4)	----
NNW	1.7 (1.0)	----

* Sectors and distances are relative to the plant stack as determined by a Global Positioning System survey conducted in 1997.

** Location of nearest milk animal within 3 miles of the plant to the point of predicted highest annual average D/Q value in each of the three major meteorological sectors.

9. SUMMARY

During 2012 as in all previous years of plant operation, a program was conducted to assess the levels of radiation or radioactivity in the Vermont Yankee Nuclear Power Station environment. Over 1000 samples were collected (including TLDs) over the course of the year, with a total of over 2700 radionuclide or exposure rate analyses performed. The samples included groundwater, river water, sediment, fish, milk, silage, mixed grass, storm drain sediment, and storm drain water. In addition to these samples, the air surrounding the plant was sampled continuously and the radiation levels were measured continuously with environmental TLDs.

Three of the objectives of the Radiological Environmental Monitoring Program (REMP) are:

- To provide an early indication of the appearance or accumulation of any radioactive material in the environment caused by the operation of the station.
- To provide assurance to regulatory agencies and the public that the station's environmental impact is known and within anticipated limits.
- To verify the adequacy and proper functioning of station effluent controls and monitoring systems..

Low levels of radioactivity from three sources (discussed below) were detected in samples collected off-site as a part of the radiological environmental monitoring program. Most samples had measurable levels of naturally-occurring K-40, Be-7, Th-232 or radon daughter products. These are the most common of the naturally-occurring radionuclides.

Samples of sediment contained fallout radioactivity such as Cs-137 from atmospheric nuclear weapons tests conducted primarily from the late 1950s through 1980.

Tritium, at concentrations significantly higher than background levels, was detected in on-site groundwater monitoring wells installed in 2007 and in 2010 in response to industry events and the discovery of primary system leakage from underground Augmented Off Gas (AOG) System condensate return piping into the subsurface groundwater pool under the plant site. The leakage from this piping was terminated in early February, 2010. Extensive sampling and analysis was performed on groundwater samples and other media throughout all of year 2012. Further steps to remediate the contamination of the subsurface groundwater layer under the plant site are underway. Additional assessment of the dose contribution of radioactive waterborne releases from this event is provided in the 2012 Annual Radioactive Effluent Release Report.

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. Till, John E. and Robert H. Meyer, ed., *Radiological Assessment - A Textbook on Environmental Dose Analysis,* NUREG/CR-3332, U.S. Nuclear Regulatory Commission, Washington, D.C., 1983.

6. NUREG/CR-3130, *Influence of Leach Rate and Other Parameters on Groundwater Migration,* February 1983.