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Vermont Yankee Nuclear Power Station
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10 CFR 50, Appx I, SEC IV.B.2 and IV.B.3

BVY 25-015

May 12, 2025

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

SUBJECT: 2024 Radiological Environmental Operating Report
Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

Dear Sir or Madam:

In accordance with 10 CFR 50, Appendix I, Sections IV.B.2 and IV.B.3 and the Vermont Yankee Off-site Dose Calculation Manual, please find enclosed a copy of the 2024 Annual Radiological Environmental Operating Report.

This letter contains no new regulatory commitments.

Should you have any questions concerning this letter, or require additional information, please contact Mr. Thomas B. Silko at (802) 451-5354, Ext 2506.

Sincerely,

CRD/tbs

Enclosure: Annual Radiological Environmental Operating Report for 2024.

cc: Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
475 Allendale Road, Suite 102
King of Prussia, PA 19406-1415

Commissioner
Vermont Department of Public Service
112 State Street – Drawer 20
Montpelier, Vermont 05602-2601

Massachusetts Department of Public Health
Director, Radiation Control Program
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Charlestown, MA 02129

Commissioner
Massachusetts Department of Conservation and Recreation
251 Causeway Street
Boston, MA 02114

Enclosure

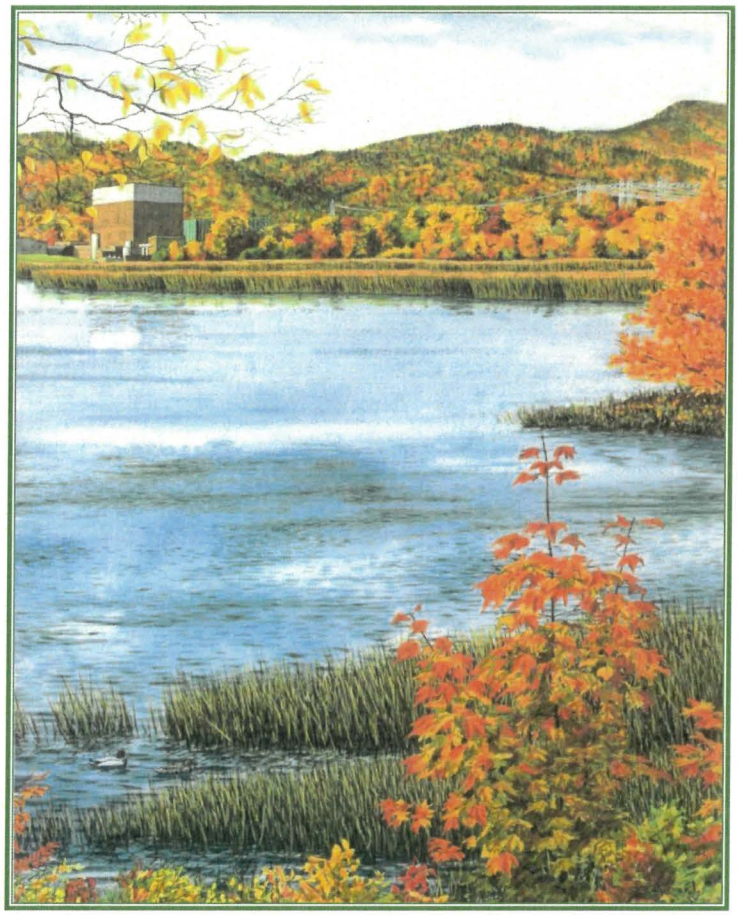
Vermont Yankee Nuclear Power Station

Annual Radiological Environmental Operating Report for 2024
(78 pages excluding this cover sheet)

NORTHSTAR - VERMONT YANKEE
Vermont Yankee Nuclear Power Station

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Year 2024



Reviewed by: A Miller / 05/12/2025
Andy Miller, RP Manager Plant — Date

Approved for Distribution: / 5/12/2025
Scott Dorval, RP Manager ISFSI — Date

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1. INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Northstar-Vermont Yankee in the vicinity of the Vermont Yankee Nuclear Power Station (VY) in Vernon, Vermont during the calendar year 2024. 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 the Vermont Yankee Offsite Dose Calculation Manual (ODCM), Section 10.2. 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 (VY) Off-Site Dose Calculation Manual (ODCM) requirements for REMP sampling, tables listing all locations sampled or monitored in 2024 with compass sectors and distances from the plant, and maps showing each REMP location. Tables listing Lower Limit of Detection requirements and Reporting Levels are also included.

Section 5: Consists of the summarized data as required by the ODCM. The tables are in 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 2024 environmental TLD measurements.

Section 6: Provides the results of the 2024 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 Environmental Dosimetry Company and Teledyne Brown Engineering for contracted analyses of environmental media.

Section 8: Summarizes the requirements and the results of the 2024 Land Use Census.

Section 9: Gives a summary of the 2024 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 significant 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 concentrated and 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 weapons-testing 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 generation capacity increasing to 650 megawatts electric.

Vermont YankeeNuclear Power Station permanently shutdown on December 29, 2014.

4. PROGRAM DESIGN

The Radiological Environmental Monitoring Program (REMP) for the Vermont Yankee Nuclear Power Station (VY) 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 functioning 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 Radiation Protection/Chemistry Department conducts the radiological environmental monitoring program and facilitates the collection of all airborne, terrestrial and ground water samples. VY maintains a contract with Normandeau Associates to collect all fish and river sediment samples. In 2024, analytical measurements of environmental samples were performed at Teledyne Brown Engineering Laboratory in Knoxville, Tennessee. TLD badges are posted and retrieved by the Vermont Yankee Chemistry Department and were analyzed by the 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

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

Ingestion Pathways
- 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 were installed at seven locations until August 4, 2015, when sample collection was discontinued at one station not required by the ODCM. Another station was removed from service in March 2016 (ODCM Rev 36) because it was a non-required control sample and with the plant in permanent shut down, it was deleted from the REMP. In December 2016, two more air sample stations were removed from service with the release of ODCM Rev 37. At the beginning of 2021, three air sample stations were situated to support the program. Currently there are two indicator stations and one control station. Data from all samples collected in 2024 are included in this report. 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 were collected on a weekly frequency through the end of October 2018. Due to changes in the ODCM, the weekly collections were revised to monthly during November and December 2018. To allow for the decay of radon daughter products, the analysis for gross beta radioactivity is delayed for more than 24 hours. The monthly 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, then a gamma isotopic analysis of the sample is required.

4.3.2 Charcoal Cartridge (Radioiodine) Sampling

Continuous air samplers were installed at seven locations until August 4, 2015 when sample collection was discontinued at one station not required by the ODCM. One station was removed in March 2016 (ODCM Rev 36) because it was a non-required control sample and with the plant in permanent shut down, it was removed from the REMP. In December 2016 all charcoalfilters were removed from sample stations with the implementation of ODCM Rev 37. With the radioactive decay and ultimate cessation of I-131 in the plant effluent stream, there is no longer a credible source of radioiodine generated by VY.

4.3.3 River Water Sampling

A grab sample is collected monthlyat the upstream control location. Each sample is analyzed for gamma-emitting radionuclides. Although not required by the ODCM, a gross-beta analysis is also performed on each sample. The monthly samples are composited by location by the contracted environmental laboratory for a minimum frequency of quarterly tritium (H-3) analysis. The Service Water System was removed from service in December of 2018. There has not been a continuous discharge of water to the river since that time. Revision 41 of the ODCM (July 2021) eliminated the requirement for the automatic composite sampler at the downstream location and replaced it with a monthly grab sample.

4.3.4 Ground Water (Deep Well Potable Water) Sampling

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

4.3.5 Sediment Sampling

River sediment grab samples were 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

Milk sample collection was terminated in December 2016 based upon assessment of potential releases of radioiodine from the plant and a concurrent revision of the Vermont Yankee Offsite Dose Calculation Manual. Radioactive decay has removed I-131 from plant radioactive materials inventory.

4.3.7 Silage (Chopped Corn or Grass) Sampling

Silage samples are collected on a quarterly basis from two Land Use Census-identified indicator farms and one control farm. The silage from each location is shipped to the contracted environmental laboratory where each sample is analyzed for gamma-emitting radionuclides.

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. Until iodine sampling was discontinued by ODCM Rev 37 in December 2016, the grass samples were analyzed for low-level I-131. This analysis was not required by the ODCM but had been performed for a number of years.

4.3.9 Fish Sampling

Fish samples were collected semiannually at two Connecticut River locations (upstream of the plant and in the Vernon Pond) by Normandeau Associates during 2024. 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 10 stations were required by the ODCM in 2024 and must be read out quarterly unless gaseous release controls were exceeded during the period. Vermont Yankee Radiation Protection/Chemistry Department 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)	10	Continuous	Quarterly	Gamma dose; de-dose only, unless gaseous release Control was exceeded	Each TLD
2. Airborne (Particulates)	3	Continuous	Monthly	Particulate Sample: Gross Beta	Each Sample
				Gamma Isotopic	Quarterly Composite (by location)
3. Waterborne					
a. Surface water	2	Downstream. grab Upstream: grab	Monthly	Gamma Isotopic	Each Sample
				Tritium (H-3)	Quarterly Composite
b. Ground water	3	Grab	Quarterly	Gamma Isotopic	Each Sample
				Tritium (H-3)	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	
	Number of Sample Locations	Routine Sampling Mode	Collection Frequency	Number of Sample Locations	Routine Sampling Mode
4. Ingestion					
a. Fish	2	Grab	Semiannually	Gamma Isotopic on Edible Portions	Each Sample
b. Vegetation					
Grass Sample	1 at each air sampling station	Grab	Quarterly when available	Gamma Isotopic	Each Sample
Silage Sample	2 Indicator 1 Control	Grab	Quarterly	Gamma Isotopic	Each Sample

* See ODCM Table 3.5.1 for complete footnotes.

Table 4.2 Radiological Environmental Monitoring Locations (Non-TLD) In 2024

Exposure Pathway	Station Code	Station Description	Zone [a]	Distance from Plant Stack (km)	Direction from Plant
1. 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-21	Spofford Lake	C	16.4	NNE
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	Main Plant Well	I	0.2	On-site
	WG-12	Vernon Green Well	I	2.1	SSE
	WT-14[c]	Test Well 201	I	--	On-site
	WT-16[c]	Test Well 202	I	--	On-site
	WT-17[c]	Test Well 203	I	--	On-site
	WT-18[c]	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
3. Ingestion					
a. Fish	FH-11	Vernon Pond	I	0.6 [b]	SSE
	FH-21	Rt.9 Bridge	C	11.8	NNW
b. Mixed Grass	TG-11	River Sta. No. 3.3	I	1.9	SSE
	TG-12	N. Hinsdale, NH	I	3.6	NNW
	TG-21	Spofford Lake	C	16.4	NNE
c. Silage	TC-11	Miller Farm	I	0.8	W
	TC-18	Blodgett Farm	I	3.6	SE
	TC-22	Franklin Farm	C	9.7	WSW

(a) I = Indicator Stations; C = Control Stations

(b) Fish samples are collected anywhere in Vernon Pond (Connecticut River, Vernon Hydro Station impoundment), which is adjacent to the plant (see Figure 4.1).

(c) Abandoned after first quarter 2023. No further sampling.

Table 4.3 Radiological Environmental Monitoring Locations (TLD) In 2024

Station Code	Station Description	Zone[a]	Distance from Plant (km) [b]	Direction from Plant [b]
DR-l	River Sta. No. 3.3	AI	1.6	SSE
DR-2	N. Hinsdale, NH	AI	3.9	NNW
DR-5	Spofford Lake	C	16.5	NNE
DR-6	Vernon School	AI	0.52	WSW
DR-7	Site Boundary	SB	0.28	W
DR-8	Site Boundary	IR	0.25	SSW
DR-43	Site Boundary	IR	0.44	SSE
DR-45	Site Boundary	IR	0.12	NE
DR-46	Site Boundary	IR	0.28	NNW
DR-53A	West Cornfield	SB	0.34	WSW

(a) IR = Incident Response TLD; AI = Area of Interest TLD; C = Control TLD; SB = Site Boundary TLD.
(b) 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)	Vegetation (pCi/kg)	Sediment (pCi/kg dry)
Gross-Beta	4	0.01			
H-3	2,000[(a)]				
Mn-54	15		130		
Co-60	15		130		
Zn-65	30		260		
Zr- 95	15				
Cs-134	15	0.05	130	60	150
Cs-137	18	0.06	150	60	180

(a) If no drinking water pathway exists, a value of 3,000 picocuries/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)	Food Product (pCi/kg)	Sediment (pCi/kg dry)
H-3	20,000[(a)]				
Mn-54	1,000		30,000		
Co-60	300		10,000		3,000[(b)]
Zn-65	300		20,000		
Zr- 95	400				
Cs-134	30	10	1,000	1,000	
Cs-137	50	20	2,000	2,000	

(a) Reporting Level for drinking water pathways. For non-drinking water, a value of 30,000pCi/liter may be used.

(b) Reporting level for individual grab samples taken at 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 the Plant

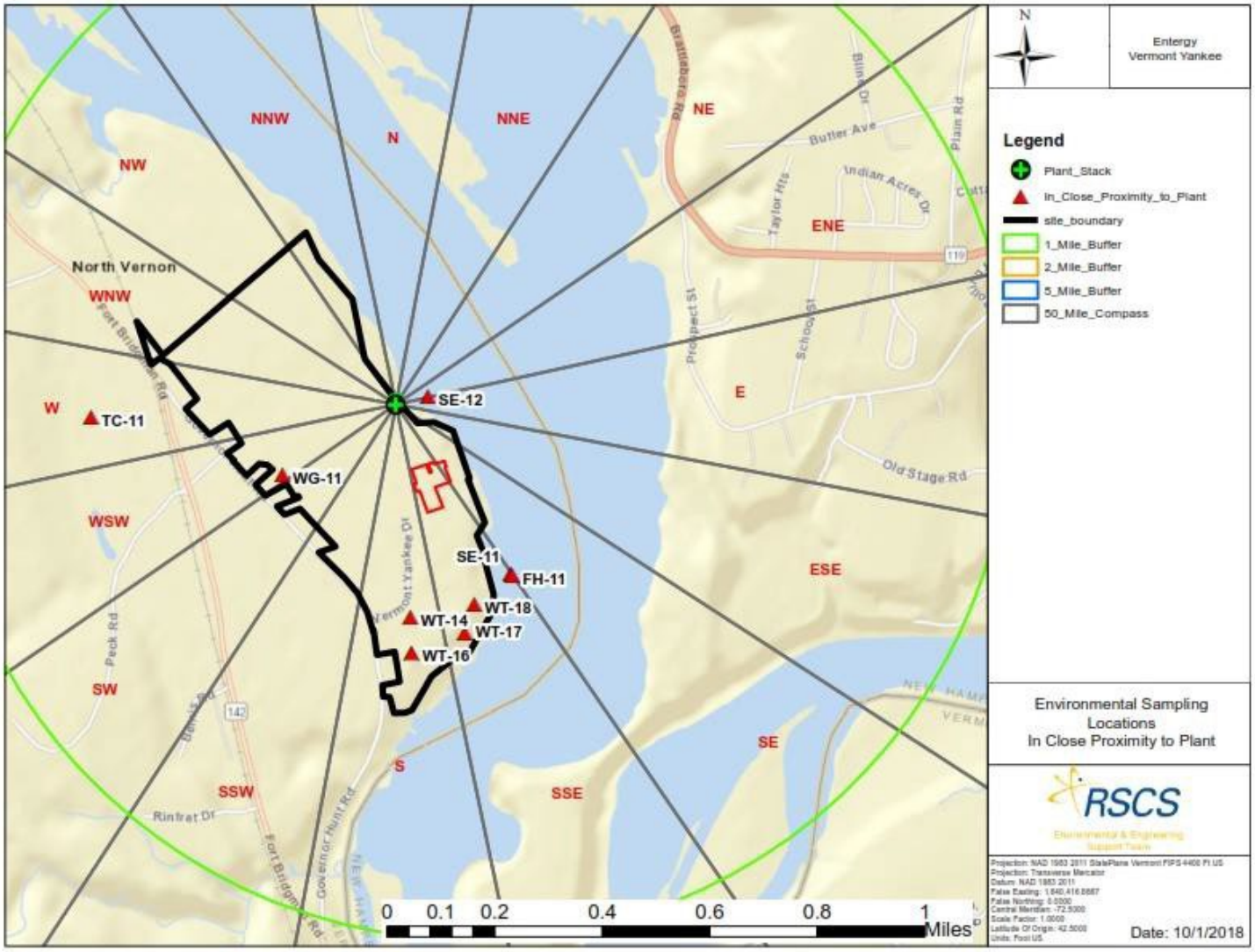


Figure 4.2 Environmental Sampling Locations Within 5 km of the Plant

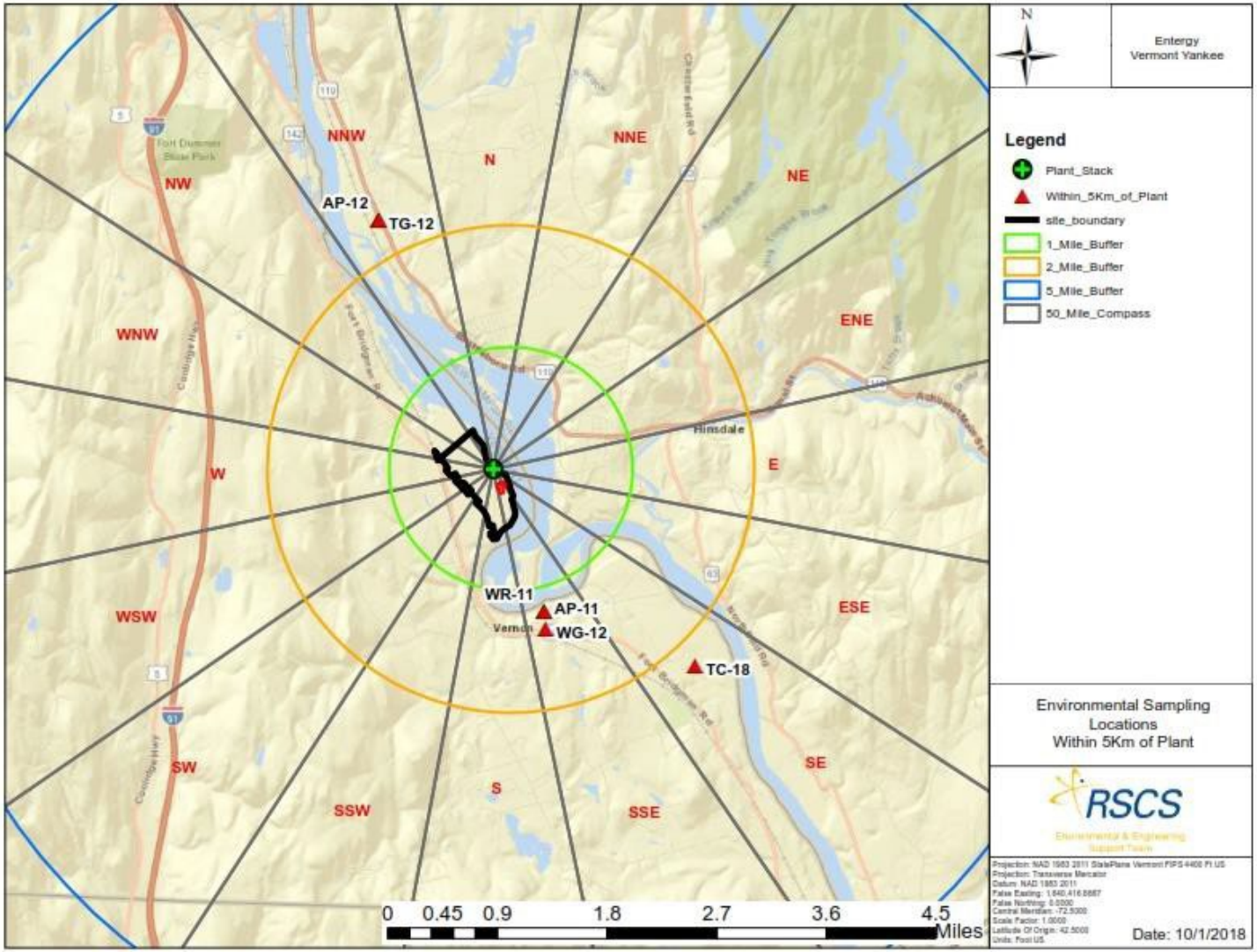


Figure 4.3 Environmental Sampling Locations Greater Than 5 km from the Plant

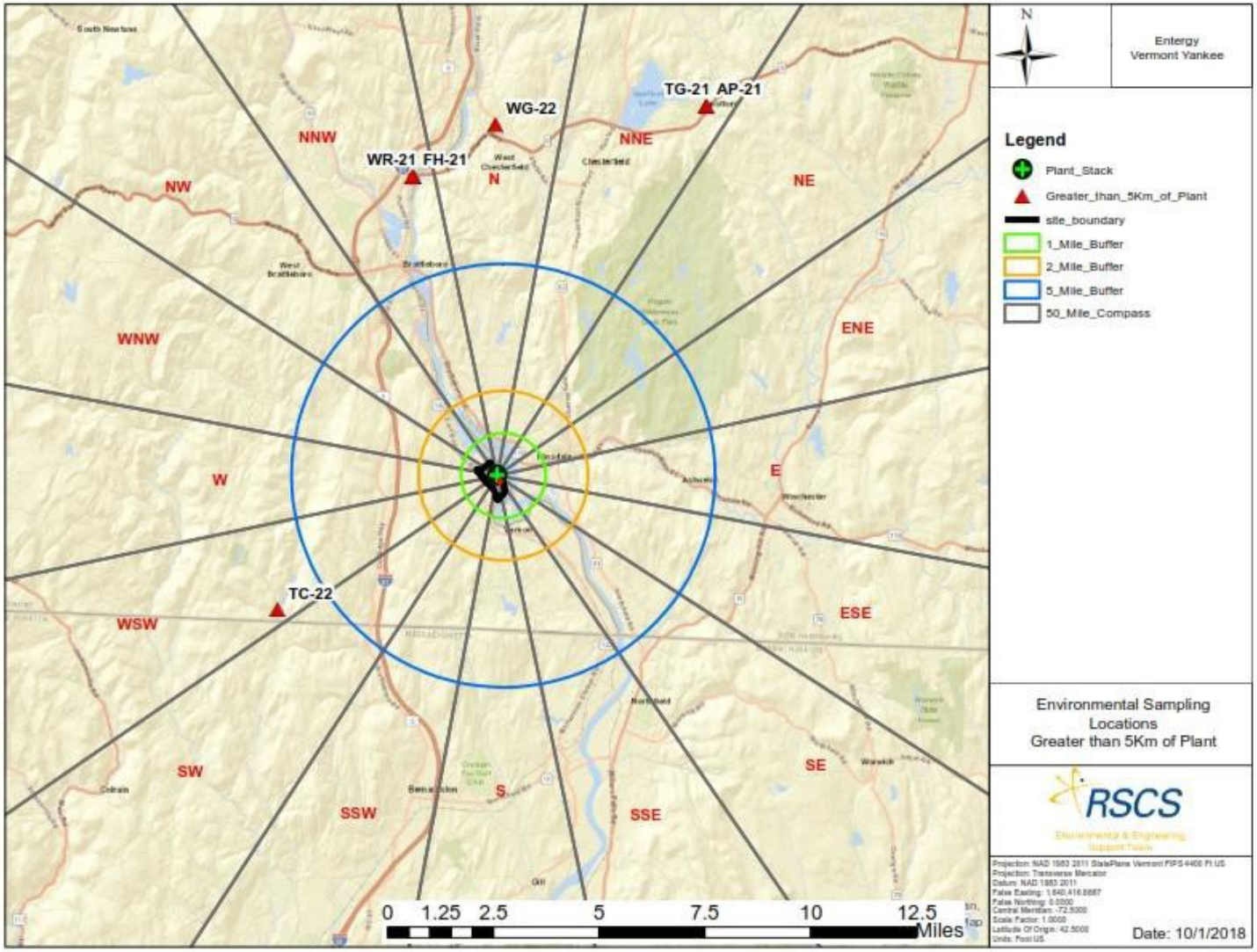


Figure 4.4 TLD Locations in Close Proximity to the Plant

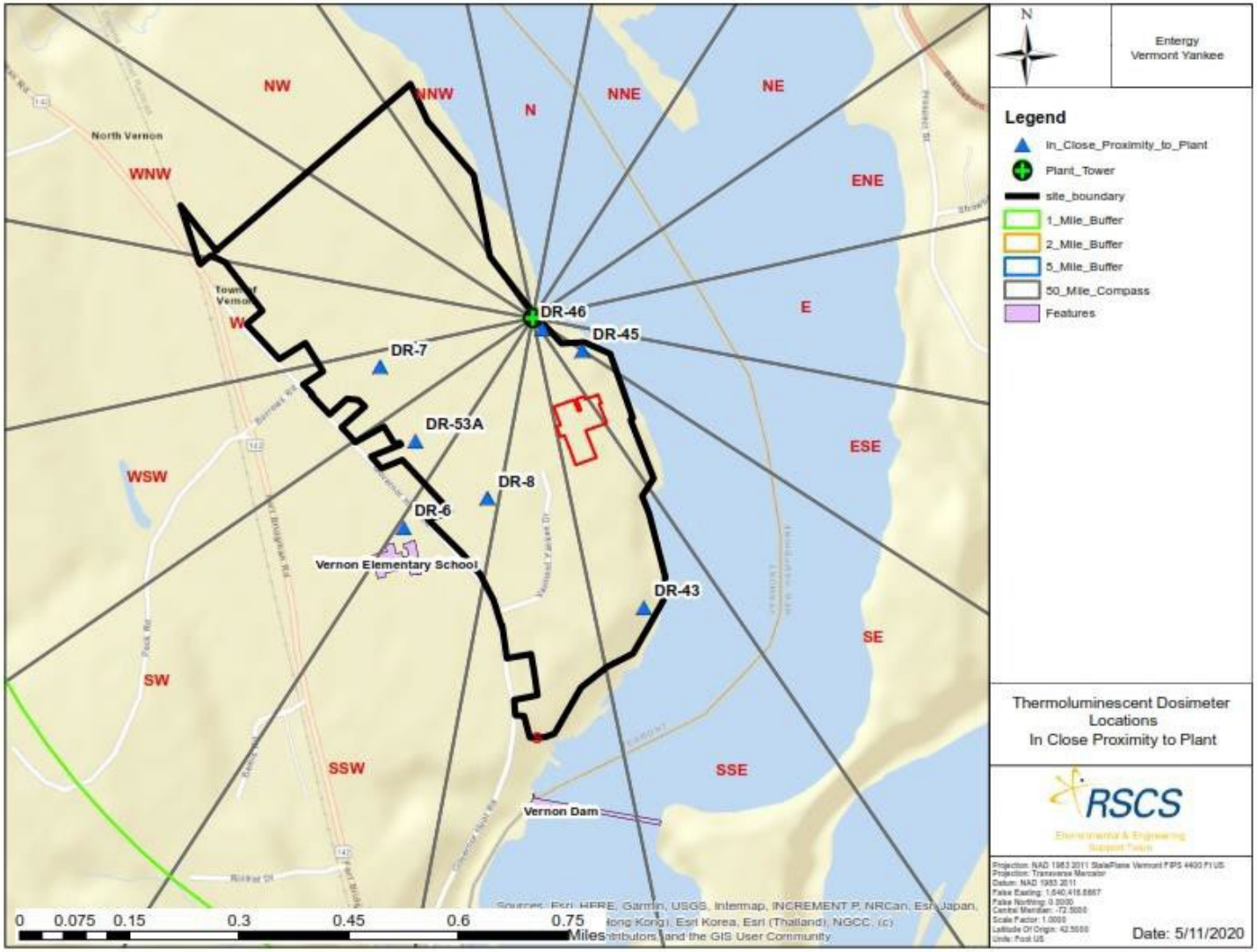


Figure 4.5 TLD Locations within 5 km of the Plant

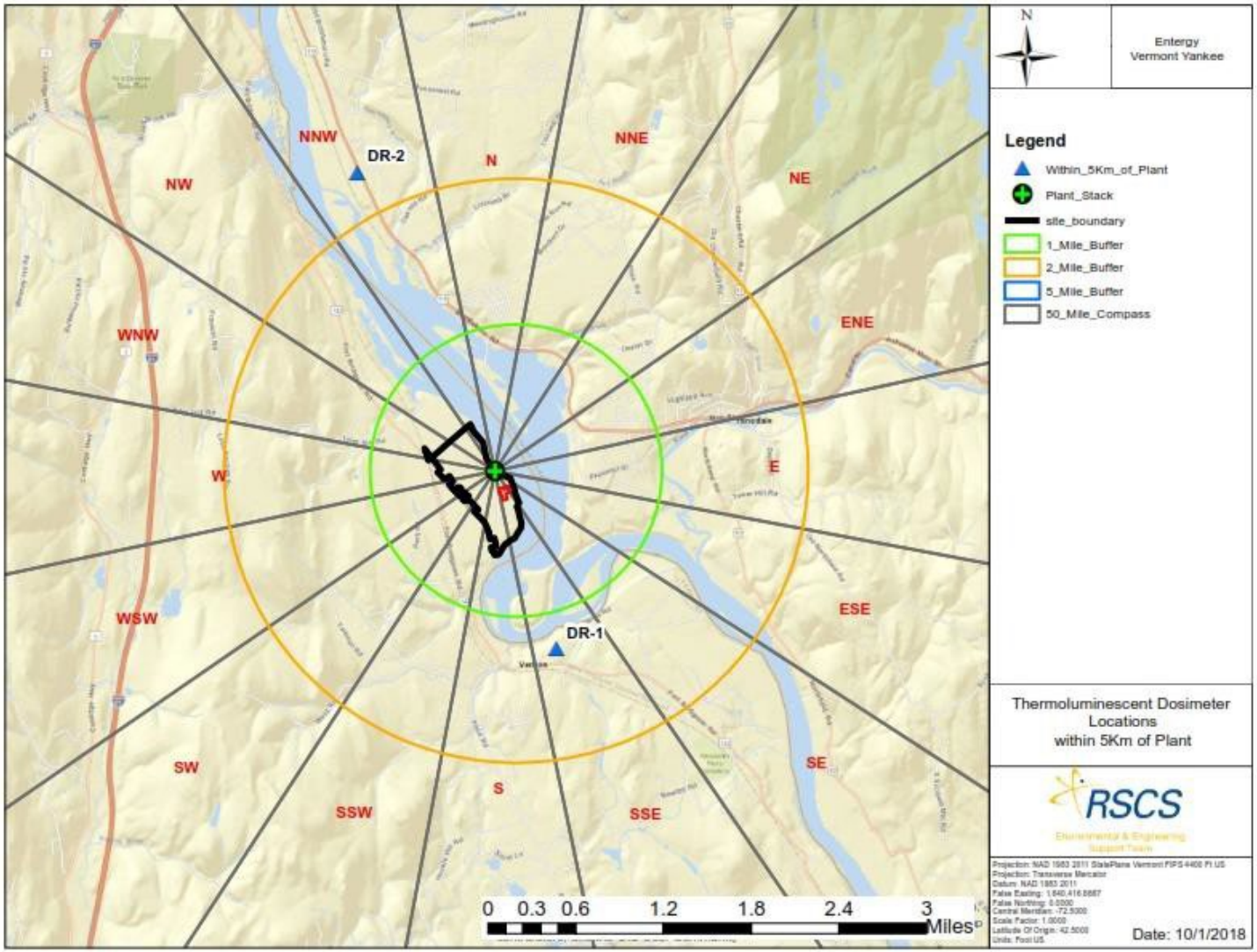
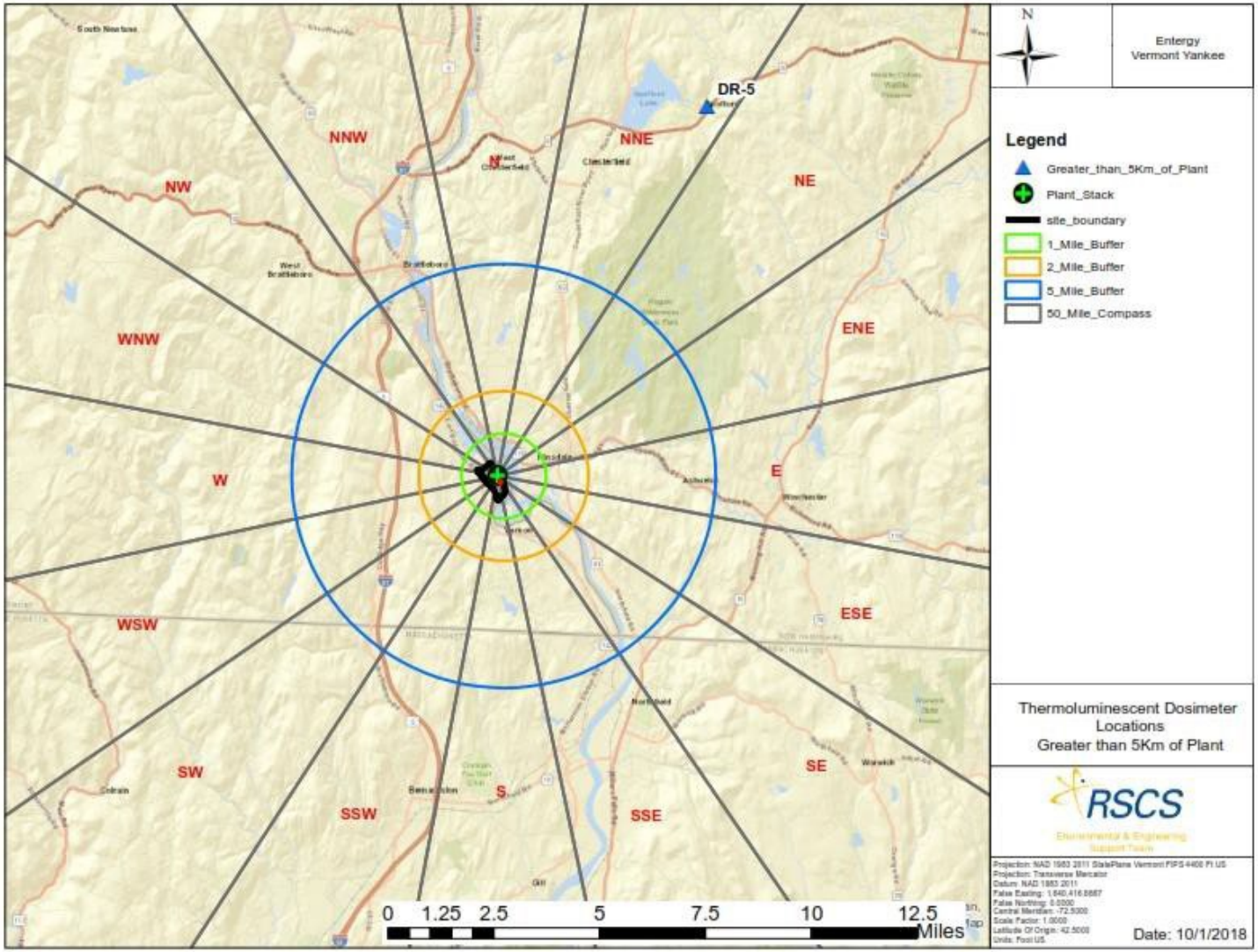


Figure 4.6 TLD Locations Greater Than 5 km of the Plant



5. RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples that were collected during 2024. 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 2024, Vermont Yankee contracted with one laboratory for primary analyses of the environmental samples. A second laboratory was available, if needed, 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 columns of Table 5.1 contains the medium or pathway sampled, the radionuclide of interest, the total number of analyses for that radionuclide in 2024 and the number of measurements which exceeded the Reporting Levels found in Table 3.5.2 of the Off-site Dose Calculation Manual. The latter are classified as "Non-routine" measurements. The second columnlists 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 2024 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.

TABLE 5.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE VERMONT YANKEE NUCLEAR POWER PLANT, 2024

Name of Facility:	**VERMONT YANKEE NUCLEAR POWER PLANT**			**DOCKET NUMBER:**		**50-271**		
Location of Facility:	**VERNON, VT**			**REPORTING PERIOD:**		**2024**		
				INDICATOR LOCATIONS	**CONTROL LOCATION**	**LOCATION WITH HIGHEST ANNUAL MEAN**		
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	MEAN (F) RANGE	MEAN (F) RANGE	MEAN (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATES (PCI/M^3)	GR-B	36	0.01	0.0150 (24/24) (0.0100/ 0.0304)	0.0144 (12/12) (0.0092/ 0.0207)	0.0153 (12/12) (0.0100/ 0.0242)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
	GAMMA	12						
	BE-7		N/A	0.0879 (8/8) (0.0486/ 0.1389)	0.0894 (4/4) (0.0405/ 0.1447)	0.0949 (4/4) (0.0486/ 0.1389)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
	K-40		N/A	0.0266 (0/8) (< 0.0205/< 0.0345)	0.0296 (0/4) (< 0.0161/< 0.0373)	0.0296 (0/4) (< 0.0161/< 0.0373)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	CS-134		0.05	0.0017 (0/8) (< 0.0011/< 0.0022)	0.0019 (0/4) (< 0.0016/< 0.0022)	0.0019 (0/4) (< 0.0016/< 0.0022)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	CS-137		0.06	0.0014 (0/8) (< 0.0012/< 0.0017)	0.0018 (0/4) (< 0.0015/< 0.0022)	0.0018 (0/4) (< 0.0015/< 0.0022)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	RA-226		N/A	0.0268 (0/8) (< 0.0242/< 0.0302)	0.0302 (0/4) (< 0.0218/< 0.0352)	0.0302 (0/4) (< 0.0218/< 0.0352)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	AC-228		N/A	0.0065 (0/8)	0.0077 (0/4)	0.0077 (0/4)	21 CONTROL SPOFFORD LAKE	0

				(< 0.0059/< 0.0070)	(< 0.0061/< 0.0091)	(< 0.0061/< 0.0091)	16.4 KM NNE OF SITE	
	TH-228		N/A	0.0024 (0/8) (< 0.0021/< 0.0029)	0.0027 (0/4) (< 0.0023/< 0.0030)	0.0027 (0/4) (< 0.0023/< 0.0030)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
RIVER WATER (PCI/LITER)	GR-B	24	4	2.158 (5/12) (< 1.550/ 4.060)	1.810 (4/12) (< 1.310/ 2.290)	2.158 (5/12) (< 1.550/ 4.060)	11 INDICATOR RIVER STA. NO. 3.3 1.9 KM SSE OF SITE	0
	H-3	24	2000	518 (0/12) (<393/<641)	522 (0/12) (<398/<639)	522.25 (0/12) (<398/<639)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	GAMMA	24						
	MN-54		15	2.066 (0/12) (< 1.298/< 3.512)	2.118 (0/12) (< 1.475/< 4.450)	2.118 (0/12) (< 1.475/< 4.450)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	CO-58		N/A	2.073 (0/12) (< 1.222/< 3.463)	2.186 (0/12) (< 1.550/< 4.470)	2.186 (0/12) (< 1.550/< 4.470)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	FE-59		N/A	4.443 (0/12) (< 2.701/< 7.108)	4.578 (0/12) (< 3.007/< 9.924)	4.578 (0/12) (< 3.007/< 9.924)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	CO-60		15	2.290 (0/12) (< 1.445/< 3.735)	2.410 (0/12) (< 1.543/< 5.576)	2.410 (0/12) (< 1.543/< 5.576)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	ZN-65		30	4.267 (0/12) (< 2.793/< 7.549)	4.432 (0/12) (< 2.847/< 8.929)	4.432 (0/12) (< 2.847/< 8.929)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	ZR-95		15	3.673 (0/12) (< 2.311/< 6.292)	3.720 (0/12) (< 2.555/< 6.788)	3.720 (0/12) (< 2.555/< 6.788)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0

	I-131		N/A	4.296 (0/12) (< 2.344/< 8.520)	4.466 (0/12) (< 2.542/<11.02)	4.466 (0/12) (< 2.542/<11.02)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
RIVER WATER (cont'd) (PCI/LITER)	CS-134		15	1.957 (0/12) (< 1.202/< 3.430)	2.065 (0/12) (< 1.402/< 4.475)	2.065 (0/12) (< 1.402/< 4.475)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	CS-137		18	2.161 (0/12) (< 1.342/< 3.604)	2.178 (0/12) (< 1.453/< 3.989)	2.178 (0/12) (< 1.453/< 3.989)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	BA/LA-140		N/A	3.865 (0/12) (< 2.110/< 8.242)	4.035 (0/12) (< 2.660/<10.26)	4.035 (0/12) (< 2.660/<10.26)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
	RA-226		N/A	50.263 (0/12) (<31.66/<88.83)	53.997 (0/12) (<35.21/<125.9)	53.997 (0/12) (<35.21/<125.9)	21 CONTROL RT.9 BRIDGE 11.8 KM NNW OF SITE	0
GROUND WATER (PCI/LITER)	GR-B	12	4	3.891 (8/8) (2.560/ 5.650)	2.763 (4/4) (2.020/ 3.670)	4.218 (4/4) (3.170/ 5.130)	11 INDICATOR MAIN PLANT WELL 0.2 KM ONSITE	0
	H-3	12	2000	537 (0/8) (<502/<612)	531 (0/4) (<499/<601)	539 (0/4) (<502/<612)	11 INDICATOR MAIN PLANT WELL 0.2 KM ONSITE	0
	GAMMA	12						
	MN-54		15	1.907 (0/8) (< 1.491/< 2.264)	2.123 (0/4) (< 1.917/< 2.356)	2.123 (0/4) (< 1.917/< 2.356)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
	CO-58		N/A	1.930 (0/8) (< 1.456/< 2.205)	2.116 (0/4) (< 1.884/< 2.267)	2.116 (0/4) (< 1.884/< 2.267)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
	FE-59		N/A	4.087 (0/8) (< 2.856/< 4.795)	4.554 (0/4) (< 3.988/< 4.881)	4.554 (0/4) (< 3.988/< 4.881)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
GROUND WATER (cont'd)	CO-60		15	2.086	2.302	2.302	22 CONTROL	0

(PCI/LITER)				(0/8) (< 1.742/< 2.373)	(0/4) (< 2.029/< 2.615)	(0/4) (< 2.029/< 2.615)	COPELAND WELL 13.7 KM N OF SITE	
	ZN-65		30	4.154 (0/8) (< 3.021/< 5.058)	4.173 (0/4) (< 3.721/< 4.944)	4.206 (0/4) (< 3.630/< 5.058)	12 INDICATOR VERNON GREEN WELL 2.1 KM SSE OF SITE	0
	ZR-95		15	3.446 (0/8) (< 2.527/< 4.102)	3.635 (0/4) (< 3.241/< 4.178)	3.635 (0/4) (< 3.241/< 4.178)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
	CS-134		15	1.892 (0/8) (< 1.399/< 2.356)	1.884 (0/4) (< 1.768/< 2.045)	1.903 (0/4) (< 1.601/< 2.356)	12 INDICATOR VERNON GREEN WELL 2.1 KM SSE OF SITE	0
	CS-137		18	1.981 (0/8) (< 1.412/< 2.313)	2.083 (0/4) (< 1.941/< 2.295)	2.083 (0/4) (< 1.941/< 2.295)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
	BA/LA-140		N/A	3.208 (0/8) (< 2.261/< 3.723)	3.604 (0/4) (< 2.871/< 4.148)	3.604 (0/4) (< 2.871/< 4.148)	22 CONTROL COPELAND WELL 13.7 KM N OF SITE	0
	RA-226		N/A	51.934 (0/8) (<45.32/<63.14)	50.38 (0/4) (<44.32/<55.27)	53.238 (0/4) (<48.73/<63.14)	11 INDICATOR MAIN PLANT WELL 0.2 KM ONSITE	0
SEDIMENT	GAMMA	36						
(PCI/KG DRY)	BE-7		N/A	927.58 (0/30) (<401.6/<1400)	913.97 (0/6) (<703.6/<1205)	1187.8 (0/2) (<975.6/<1400)	36 INDICATOR N.STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	0
	K-40		N/A	16425.93 (30/30) (9555/19820)	16188.33 (6/6) (10030/19900)	19720 (2/2) (19540/19900)	24 INDICATOR N. STORM DRAIN OUTFALL U-3 0.1 KM E OF SITE	0
SEDIMENT (cont'd) (PCI/KG DRY)	MN-54		N/A	67.25 (0/30) (<35.84/<87.77)	69.98 (0/6) (<50.83/<86.79)	80.87 (0/2) (<74.25/<87.49)	36 INDICATOR N. STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	0
	CO-60		N/A	66.38 (0/30) (<34.45/<112)	67.64 (0/6) (<51.51/<92.98)	96.37 (0/2) (<80.73/<112)	17 INDICATOR N.STORM DRAIN OUTFALL T-1 0.1 KM E OF SITE	0
	ZN-65		N/A	155.59	164.75	188.25	36 INDICATOR	0

				(0/30) (<78.68/<212.1)	(0/6) (<118.8/<200.8)	(0/2) (<177.5/<199)	N. STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	
	NB-95		N/A	114.08 (0/30) (<51.27/<174.6)	118.08 (0/6) (<81.1/<136.4)	142.95 (0/2) (<135/<150.9)	36 INDICATOR N. STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	0
	CS-134		150	57.05 (0/30) (<24.82/<74.6)	58.71 (0/6) (<43.2/<70.62)	73.04 (0/2) (<71.47/<74.6)	31 INDICATOR N. STORM DRAIN OUTFALL V-5 0.1 KM E OF SITE	0
	CS-137		180	79.85 (6/30) (<42.92/118)	75.98 (0/6) (<55/<88.7)	101.27 (1/2) (<84.54/118)	12 INDICATOR N. STORM DRAIN OUTFALL S-1 0.1 KM E OF SITE	0
	BA/LA-140		N/A	1538.54 (0/30) (<333.7/<3410)	1678.28 (0/6) (<693.1/<3340)	2122.35 (0/2) (<834.7/<3410)	41 INDICATOR N. STORM DRAIN OUTFALL X-5 0.1 KM E OF SITE	0
	RA-226		N/A	2282.07 (23/30) (<1118/3915)	1738.92 (3/6) (<971.5/2807)	2847 (2/2) (2731/2963)	25 INDICATOR N. STORM DRAIN OUTFALL U-4 0.1 KM E OF SITE	0
	AC-228		N/A	2072.81 (20/30) (<217.5/4692)	2415.77 (5/6) (<469.6/3879)	3884 (2/2) (3076/4692)	30 INDICATOR N. STORM DRAIN OUTFALL V-4 0.1 KM E OF SITE	0
SEDIMENT (cont'd) (PCI/KG DRY)	TH-228		N/A	1160.11 (30/30) (533.1/1507)	1050.15 (6/6) (572.6/1323)	1468 (2/2) (1447/1489)	31 INDICATOR N. STORM DRAIN OUTFALL V-5 0.1 KM E OF SITE	0
	TH-232		N/A	1020.27 (30/30) (622.3/1336)	962.77 (6/6) (715.3/1251)	1177 (2/2) (1083/1271)	36 INDICATOR N. STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	0
	U-238		N/A	6679.67 (0/30) (<3318/<8918)	7168 (0/6) (<4904/<8363)	8086 (0/2) (<8047/<8125)	36 INDICATOR N. STORM DRAIN OUTFALL W-5 0.1 KM E OF SITE	0
SILAGE (PCI/KG WET)	GAMMA	12						0
	BE-7		N/A	608.16 (2/8) (<135.3/3726)	193 (0/4) (<122/<248.4)	1053.25 (1/4) (<135.3/3726)	18 INDICATOR BLODGETT FARM 3.6 KM SE OF SITE	0

	K-40		N/A	5487.88 (8/8) (3279/7856)	11180.75 (4/4) (5703/14410)	11180.75 (4/4) (5703/14410)	22 CONTROL FRANKLIN FARM 9.7 KM WSW OF SITE	
	CS-134		60	16.13 (0/8) (<11.28/<24.93)	21.23 (0/4) (<14.21/<26.97)	21.23 (0/4) (<14.21/<26.97)	22 CONTROL FRANKLIN FARM 9.7 KM WSW OF SITE	0
	CS-137		60	18.38 (0/8) (<14.61/<25.95)	98.25 (3/4) (<35.24/157.1)	98.25 (3/4) (<35.24/157.1)	22 CONTROL FRANKLIN FARM 9.7 KM WSW OF SITE	0
	AC-228		N/A	84.04 (0/8) (<64.61/<125.6)	99.01 (0/4) (<66.53/<116.2)	99.01 (0/4) (<66.53/<116.2)	22 CONTROL FRANKLIN FARM 9.7 KM WSW OF SITE	0
	TH-228		N/A	32.97 (0/8) (<25.14/<48.51)	44.43 (1/4) (<35.81/<51.75)	44.43 (1/4) (<35.81/<51.75)	22 CONTROL FRANKLIN FARM 9.7 KM WSW OF SITE	0
MIXED GRASS (PCI/KG WET)	GAMMA	7						
	BE-7		N/A	735.62 (4/5) (<177.8/1638)	1251.65 (2/2) (289.3/2214)	1251.65 (2/2) (289.3/2214)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	K-40		N/A	5236.4 (5/5) (3617/6834)	4359 (2/2) (3805/4913)	5633 (3/3) (3617/6834)	11 INDICATOR RIVER STA. NO. 3.3 1.9 KM SSE OF SITE	0
	I-131		N/A	22.42 (0/5) (<10.04/<27.61)	25.25 (0/2) (<22.27/<28.22)	26.45 (0/2) (<25.28/<27.61)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
	CS-134		60	10.06 (0/5) (< 5.99/<15.93)	11.6 (0/2) (< 7.42/<15.77)	12.3 (0/2) (< 8.68/<15.93)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
	CS-137		60	11.52 (0/5) (< 6.88/<16.41)	12.36 (0/2) (< 7.84/<16.88)	12.71 (0/2) (< 9.02/<16.41)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
	RA-226		N/A	233.96 (0/5) (<161.9/<372.1)	289.7 (0/2) (<172.1/<407.3)	289.7 (0/2) (<172.1/<407.3)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0

	AC-228		N/A	46.78 (0/5) (<29.08/<73.84)	59.78 (0/2) (<31.76/<87.79)	59.78 (0/2) (<31.76/<87.79)	21 CONTROL SPOFFORD LAKE 16.4 KM NNE OF SITE	0
	TH-228		N/A	19.11 (0/5) (<10.93/<32.99)	20.45 (0/2) (<12.43/<28.47)	23.55 (0/2) (<14.1/<32.99)	12 INDICATOR N. HINSDALE NH 3.6 KM NNW OF SITE	0
FISH (PCI/KG WET)	GAMMA K-40	8	N/A	2963.5 (4/4) (2274/3384)	2722.5 (4/4) (1635/3435)	2963.5 (4/4) (2274/3384)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	MN-54		130	19.23 (0/4) (<14.78/<23.11)	20.073 (0/4) (<18.62/<22.39)	20.073 (0/4) (<18.62/<22.39)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	CO-58		N/A	29.89 (0/4) (<23.54/<35.84)	28.82 (0/4) (<26.37/<31.94)	29.89 (0/4) (<23.54/<35.84)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	FE-59		N/A	91.45 (0/4) (<66.37/<113.2)	86.56 (0/4) (<79.41/<92.44)	91.45 (0/4) (<66.37/<113.2)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	CO-60		130	19.375 (0/4) (<14.88/<22.89)	19.588 (0/4) (<17.49/<21.68)	19.588 (0/4) (<17.49/<21.68)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	ZN-65		260	44.488 (0/4) (<35.96/<51.14)	43.913 (0/4) (<41.37/<46.87)	44.488 (0/4) (<35.96/<51.14)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	CS-134		130	17.2 (0/4) (<14.42/<20.58)	17.388 (0/4) (<15.69/<18.96)	17.388 (0/4) (<15.69/<18.96)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	CS-137		150	17.623 (0/4) (<13.5/<22.2)	17.723 (0/4) (<16.31/<21.07)	17.723 (0/4) (<16.31/<21.07)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0

	H-3	4	0.2	65 (0/2) (<56/<74)	67 (0/2) (<42/<91)	66.6 (0/2) (<42.2/<91)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
FISH (cont'd) (PCI/KG WET)	AM-241	8	N/A	5.346 (0/4) (< 1.570/<11.79)	4.017 (0/4) (< 3.354/< 4.576)	5.346 (0/4) (< 1.570/<11.79)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	CM-242	8	N/A	2.305 (0/4) (< 1.554/< 4.128)	1.961 (0/4) (< 0.554/< 2.966)	2.305 (0/4) (< 1.554/< 4.128)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	CM-243/244	8	N/A	2.003 (0/4) (< 0.739/< 4.128)	1.437 (0/4) (< 0.564/< 2.966)	2.003 (0/4) (< 0.739/< 4.128)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	FE-55	8	N/A	1381.6 (0/4) (<652.4/<1925)	1425 (0/4) (<1057/<1975)	1425 (0/4) (<1057/<1975)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	NI-63	8	N/A	391.5 (0/8) (<283/<560)	345 (0/8) (<236/<448)	391.5 (0/8) (<283/<560)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	PU-238	8	N/A	4.268 (0/4) (< 1.966/< 8.008)	8.750 (0/4) (< 1.626/<25.86)	8.750 (0/4) (< 1.626/<25.86)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	PU-239/240	8	N/A	3.143 (0/4) (< 1.200/< 5.663)	5.623 (0/4) (< 1.247/<15.83)	5.623 (0/4) (< 1.247/<15.83)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
	PU-241	8	N/A	466.5 (0/4) (<286/<805)	458.5 (0/4) (<292/<827)	466.5 (0/4) (<286/<805)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
	PU-242	8	N/A	1.269 (0/4) (< 0.499/< 2.780)	3.344 (0/4) (< 0.454/< 9.366)	3.344 (0/4) (< 0.454/< 9.366)	21 CONTROL RT. 9 BRIDGE 11.8 KM NNW OF SITE	0
FISH (cont'd)	SR-89	8	N/A	494.75	334.25	494.75	11 INDICATOR	0

(PCI/KG WET)				(0/4) (<129/<943)	(0/4) (<198/<521)	(0/4) (<129/<943)	VERNON POND 0.6 KM SSE OF SITE	
	SR-90	8	60	46.275 (0/4) (<30/<54.7)	45.675 (0/4) (<33.5/<53.4)	46.275 (0/4) (<30/<54.7)	11 INDICATOR VERNON POND 0.6 KM SSE OF SITE	0
DIRECT RADIATION (MILLI-ROENTGEN/QTR.)	TLD- QUARTERLY	40	N/A	7.0 (36/36) (6/9)	7.0 (4/4) (7/8)	8.7 (4/4) (8.1/ 9.5)	DR45 INDICATOR SITE BOUNDARY 0.12 KM NE OF SITE	0

TABLE 5.2

ENVIRONMENTAL TLD DATA SUMMARY
VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VT
(JANUARY - DECEMBER 2024)

INNER RING TLD	OUTER RING TLD	OFFSITE STATION WITH HIGHEST MEAN	CONTROL TLDs
MEAN*	MEAN*	STA.NO./ MEAN*	MEAN*
RANGE*	RANGE*	RANGE*	RANGE*
(N0. MEASUREMENTS)**	(N0. MEASUREMENTS)**	(N0. MEASUREMENTS)**	(N0. MEASUREMENTS)**
6.28 ± 0.32	6.89 ± 0.29	*DR02* 6.89 ± 0.22	6.95 ± 0.31
5.64 to 6.64	6.69 to 7.13	6.69 to 7.13	6.68 to 7.66
8	4	4	4

SITE BOUNDARY TLD WITH HIGHEST MEAN	SITE BOUNDARY TLD
STA.NO./ MEAN*	MEAN*
RANGE*	RANGE *
(NO. MEASUREMENTS)**	(NO. MEASUREMENTS)**
DR45 8.74 ± 0.42	7.28 ± 0.36
8.13 to 9.47	6.49 to 9.47
4	24

* 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
2024
(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	±	0.34	5.64	±	0.34	5.86	±	0.26	6.64	±	0.40	6.0
DR-02	N Hinsdale, NH	6.69	±	0.29	6.96	±	0.27	6.80	±	0.23	7.13	±	0.36	6.9
DR-05	Spofford Lake, NH	6.68	±	0.39	6.73	±	0.29	6.72	±	0.18	7.66	±	0.38	7.0
DR-06	Vernon School	6.54	±	0.32	6.64	±	0.29	6.63	±	0.29	6.56	±	0.34	6.6
DR-07	Site Boundary	6.66	±	0.28	6.73	±	0.38	6.76	±	0.16	6.95	±	0.36	6.8
DR-08	Site Boundary	6.49	±	0.34	7.02	±	0.42	6.81	±	0.37	6.98	±	0.60	6.8
DR-43	Site Boundary	7.00	±	0.54	6.76	±	0.28	6.64	±	0.34	6.98	±	0.34	6.8
DR-45	Site Boundary	9.47	±	0.44	8.40	±	0.36	8.94	±	0.33	8.13	±	0.53	8.7
DR-46	Site Boundary	7.06	±	0.39	6.87	±	0.24	6.61	±	0.28	7.51	±	0.37	7.0
DR-53A	West Cornfield	7.11	±	0.31	7.56	±	0.30	7.33	±	0.26	7.83	±	0.42	7.5

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 2024, eleven 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 2024 were:

a) Environmental Air Sampling Stations # 11, 12, and 21 (AP-11, located at River Station No. 3.3, AP-12, located in N. Hinsdale, NH, and AP-21, located in Spofford, NH) sample timers were short by one hour due to entry into Daylight Savings Time (DST), 3/26/2024 (Week 13-24). Additional ~10 hours loss at AP-21 due to localized outages. Documented in Condition Report 2024-000004.

b) Environmental Air Sampling Stations # 11, 12, and 21 (AP-11, located at River Station No. 3.3, AP-12, located in N. Hinsdale, NH, and AP-21, located in Spofford, NH) experienced short duration power outages due to thunderstorms (~1 to 3 hours loss), 6/25/2024 (Week 26-24). Documented in Condition Report 2024-000004.

c) Environmental Air Sampling Station # 21 (AP-21, located in Spofford, NH) experienced a loss of power due to the power supply fuse failure on 7/30/2024 (Week 31-24). The power supply fuse was blown, approximately 619 sampling hours were lost. The fuse was replaced. Documented in Condition Report 2024-000004.

d) Environmental Air Sampling Stations # 11, 12, and 21 (AP-11, located at River Station No. 3.3, AP-12, located in N. Hinsdale, NH, and AP-21, located in Spofford, NH) experienced a loss of power due to thunderstorms in the area. A fallen tree severed the power line to AP-11 (516.9 hours lost), Green Mountain Power must repair. AP-12 lost 2.3 hours, AP-21 lost 5.7 hours, 8/27/2024 (Week 35-24). Documented in Condition Report 2024-000004.

e) Environmental Air Sampling Station # 11 (AP-11, located at River Station No. 3.3) downed power line was repaired on 9/9/2024. Switch repair and power not restored until later in September (603.7 hours loss) 9/24/2024 (Week 39-24). Documented in Condition Report 2024-000004.

f) Environmental Air Sampling Station # 11 (AP-11, located at River Station No. 3.3) power supply fuse was blown and sample pump motor had failed. Replaced sample pump and power supply fuse. 368.9 hours lost, 10/29/2024 (Week 44-24). Documented in Condition Report 2024-000004.

g) Environmental Air Sampling Stations # 11, 12, and 21 (AP-11, located at River Station No. 3.3, AP-12, located in N. Hinsdale, NH, and AP-21, located in Spofford, NH) sample timers had one hour in excess due to the end of Daylight Savings Time (DST), 11/26/2024 (Week 48-24). Documented in Condition Report 2024-000004.

Air sample station outages during 2024 are reflected in the air sample collection time percentages listed below.

AP/CF #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
11	**99.9%**	**99.9%**	**48.7%**	**84.3%**
12	**99.9%**	**99.9%**	**99.9%**	**100.0%**
21	**99.5%**	**100.0%**	**71.4%**	**100.0%**

6.2 Comparison of Achieved LLDs with Requirements

Table 4.5.1 of the VY 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 two times greater than that required by the VY 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 2024, 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 2024, 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 2024.

Milk collection from Dunklee farm (Vern-Mont Farm in Vernon) commenced in April, 2010 at the request of the farm owner. After the shutdown of Vermont Yankee, sampling from this location was terminated in August 2015. All milk sampling was terminated by the implementation of ODCM Rev 37 in December 2016 due to the decay of radioiodines following shutdown.

6.5 Data Analysis by Media Type

The 2024 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 three 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 6.3.

Gross beta activity was detected in all of the 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 second quarter, and the maximum concentration in the third quarter.

Figures 6.2 through 6.3 show the monthly 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 first quarter, and the maximum concentration in the third 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 was one 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 all 12 filter sets analyzed.

6.5.1.2 Charcoal Cartridges (CF)

Charcoal cartridges are no longer analyzed as part of the Environmental Monitoring Program.

6.5.2 Waterborne Pathways

6.5.2.1 River Water (WR)

Monthly grab samples of river water were collected from the Connecticut River downstream from the plant discharge area and hydro station, location WR-11 and upstream control location WR-21. The samples from WR-11 and WR-21 were sent to the contracted environmental laboratory for analysis. Table 5.1 shows that gross-beta measurements were positive in five out of 12 indicator samples as would be expected due to naturally-occurring radionuclides in the water. Gross-beta was detected in four of the 12 control samples. As seen in Figure 6.8, the mean concentration of the indicator locations was similar to the mean concentration at the control location in 2024.

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

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 two indicator locations (only one is required by VY ODCM) and one control location during 2024. In 1999, WG-14 (PSB 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 all eight indicator samples and in four out of four control samples. The beta activity is due to naturally-occurring radionuclides in the water. The levels at all sampling locations were consistent with those detected in previous years. 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 2024. 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 2024, 15 locations were sampled at SE-12 during each of the semi-annual

collections. Two samples were collected at SE-11 during the year. 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 samples. Radium-226 (Ra-226) was detected in 26 of 36 samples. Actinium-228 (Ac-228) was detected in 25 of 36 samples. Thorium-228 (Th-228) was detected in all of the samples analyzed. Thorium-232 (Th-232) was detected in all of the 36 samples analyzed. Uranium-238 (U-238) was not detected in any of the 36 samples. Cesium-137 (Cs-137) was detected in six of the 36 samples. 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 VY site where septic sludge is spread. The test wells are summarized in Table 5.1 under the media category, Test Well (WT). Test Wells were abandoned after the first quarter of 2023. No further sampling.

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 VY 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 in the onsite storm drain system was routinely sampled throughout 2024 at the south storm drain. These samples are analyzed for tritium; no tritium was detected in any sample. A gamma isotopic analysis was also completed monthly on the Storm Drain System and no plant related isotopes were detected.

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 6.1 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 2024. Collection from the Air Compressor drains has been discontinued due to there being no source of tritium to the compressor air intakes and the drain were redirected.

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 300,000 gallons of tritiated water from this subsurface pool. Dose calculations have been performed assuming that this underground 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 2024 Annual Radioactive Effluent Release Report.

6.5.3 Ingestion Pathways

6.5.3.1 Milk (TM)

As a result of re-evaluation of source terms (and subsequent revision of the Vermont Yankee Offsite Dose Calculation Manual) which identified that radioiodine releases were no longer of measurable significance in plant releases, no milk samples were collected or analyzed during 2024.

6.5.3.2 Silage (TC)

A silage sample was collected from each of the three Land Use Census-identified farm locations during each quarter of 2024. Each of these was analyzed for gamma-emitting radionuclide. As expected with all biological media, naturally-occurring Be-7 was detected in two of 12 samples and K-40 was detected in all samples. Cs-137 was detected in three of the 12 samples analyzed. Naturally occurring Thorium-228 (Th-228) was detected in one of the 12 samples analyzed.

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 2024 for location 11, and two of the four quarters for locations 12 and 21. As expected with all biological media, naturally-occurring Be-7 was detected in six of the seven samples collected. Naturally-occurring K-40 was detected in all seven samples.

6.5.3.4 Fish (FH)

Semiannual samples of fish were collected from two locations in both spring and fall of 2024 for the VY REMP. Several species may be collected such as Large Mouth Bass and Yellow Perch. The edible portions of each of these were analyzed for gamma-emitting radionuclides. In addition to the analysis of edible portions, the inedible portions were also analyzed. As expected in biological matter, naturally-occurring K-40 was detected in all eight samples (4 edible and four inedible). These fish portions were also analyzed for H-3, Am-241, Cm-242, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Pu-242, Sr-89 and Sr-90.

Strontium 90 was not detected in any of the four inedible portions (bones, guts and skin are included in the 'inedible' portion). This is the fourteenth 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 from nuclear power plant releases.

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 2014 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 10 locations surrounding the Vermont Yankee plant with the use of thermoluminescent dosimeters (TLDs).

The TLDs are collected every calendar quarter for readout at the environmental TLD 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 2024. 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.

Table 6.2 Trend Graph Summary Table

Figure	Title
6.1	Gross Beta Measurements on Air Particulate Filters - Quarterly Average Concentrations
6.2	Gross Beta Measurements on Air Particulate Filters (11)
6.3	Gross Beta Measurements on Air Particulate Filters (12)
6.4	Deleted
6.5	Deleted
6.6	Deleted
6.7	Deleted
6.8	Gross Beta Measurements on River Water Semi-Annual Average Concentrations
6.9	Gross Beta Measurements on Ground Water Semi-Annual Average Concentrations
6.10	Deleted
6.11	Deleted
6.12	Cesium-137 in Fish - Annual Average Concentrations
6.13	Average Exposure Rate at Inner Ring, Outer Ring, and Control TLDS

Figure	Title
6.14	Exposure Rate at Indicator TLDs, DR1-3
6.15	Exposure Rate at Indicator TLDs, DR-6 & DR-50
6.16	Exposure Rate at Site Boundary TLDs DR-7, DR-8 and DR-53A
6.17	Exposure Rate at Site Boundary TLDs DR-43 thru DR-46
6.18	Deleted
6.19	Deleted
6.20	Deleted
6.21	Deleted
6.22	Deleted
6.23	Deleted
6.24	Deleted
6.25	Deleted
6.26	Deleted
6.27	Exposure Rate at Control TLDs DR-4 & 5

Note: No year 2024 data was obtained from locations previously provided in “Deleted” graphs due to ODCM changes implemented in January 2017 as a result of source term changes in the plant. These graphs may be viewed in the year 2016 Annual Radiological Environmental Operating Report (AREOR) for comparison purposes.

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

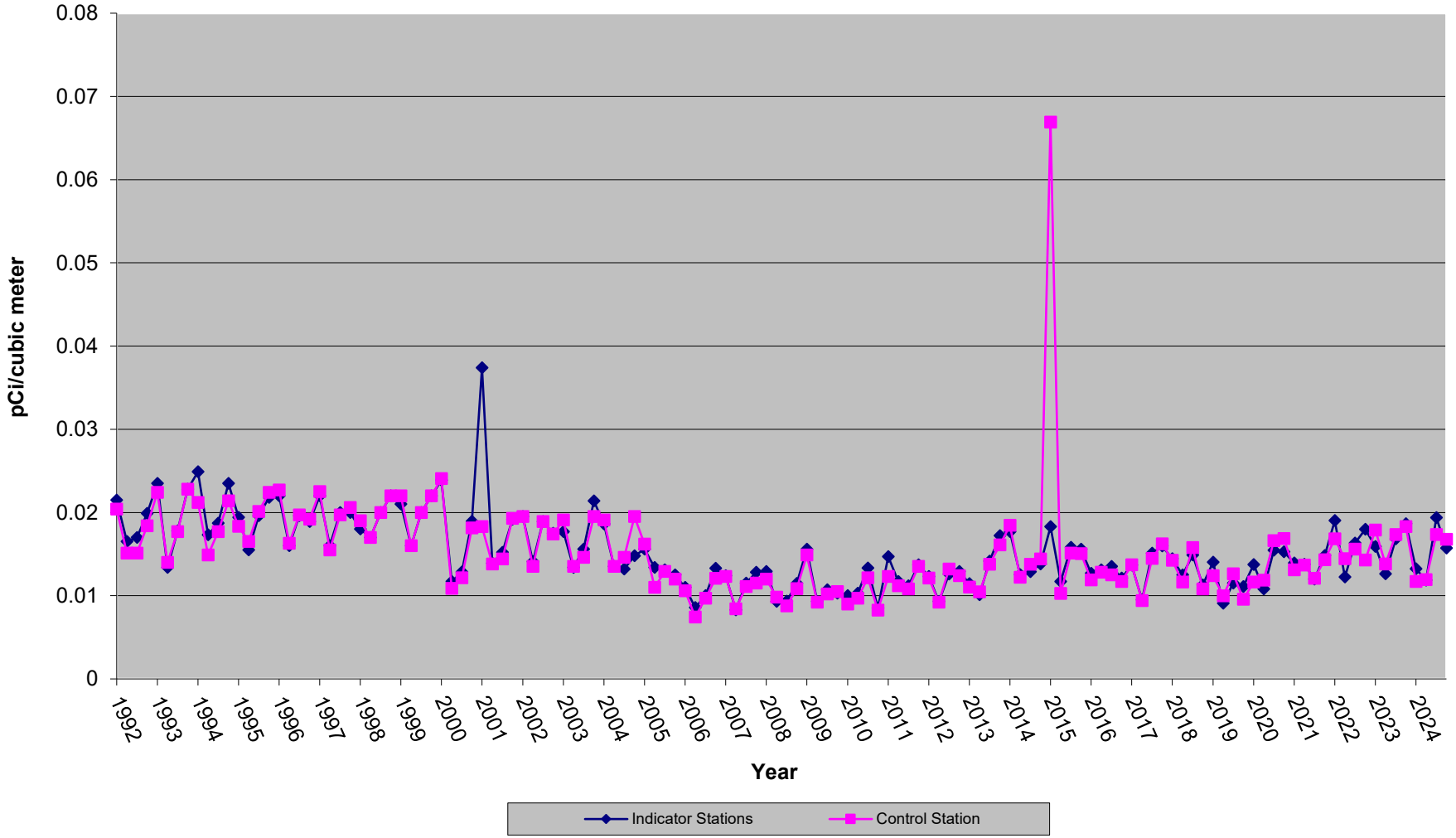


Figure 6.2 - Gross Beta Measurements on Air Particulate Filters

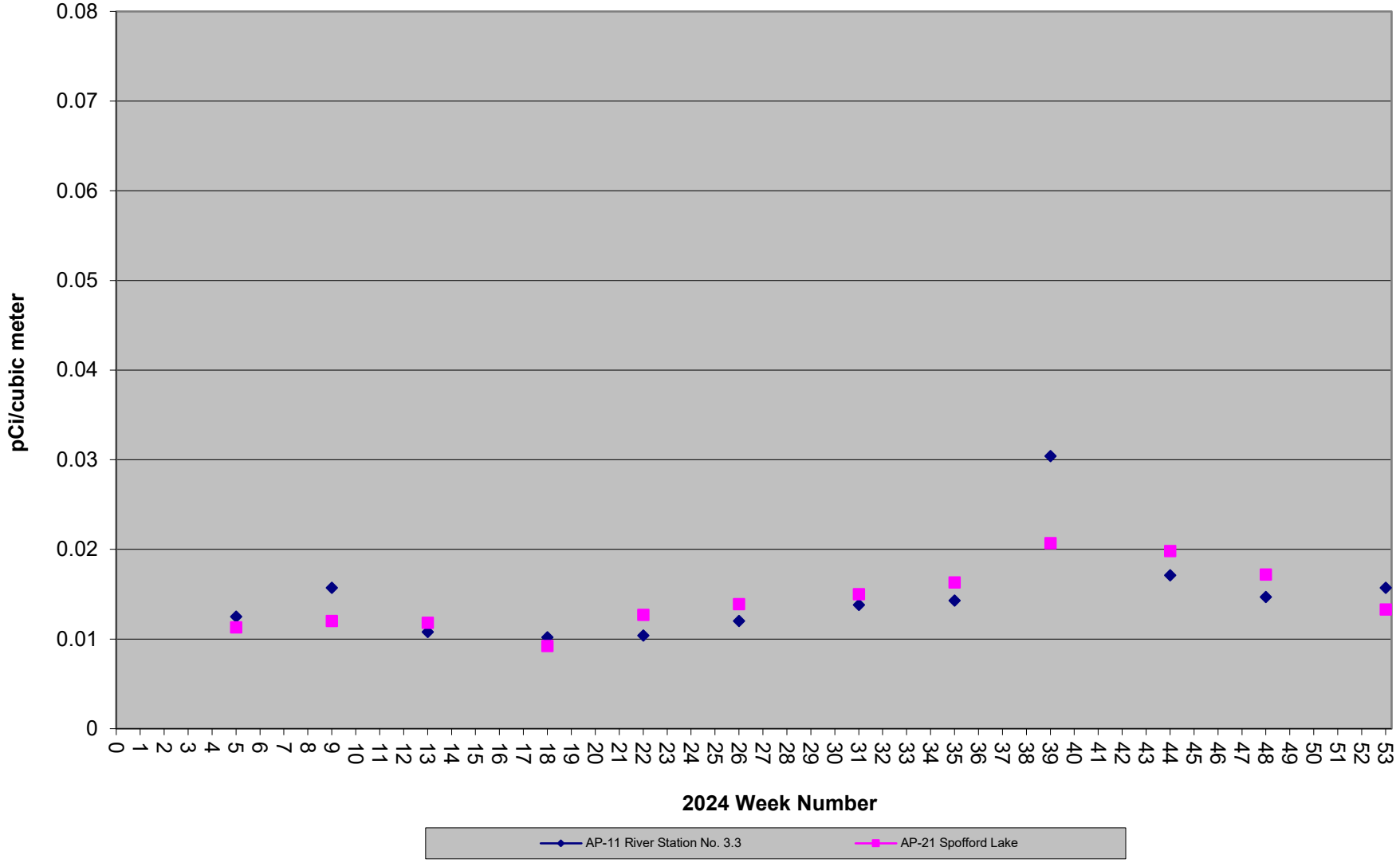


Figure 6.3 - Gross Beta Measurements on Air Particulate Filters

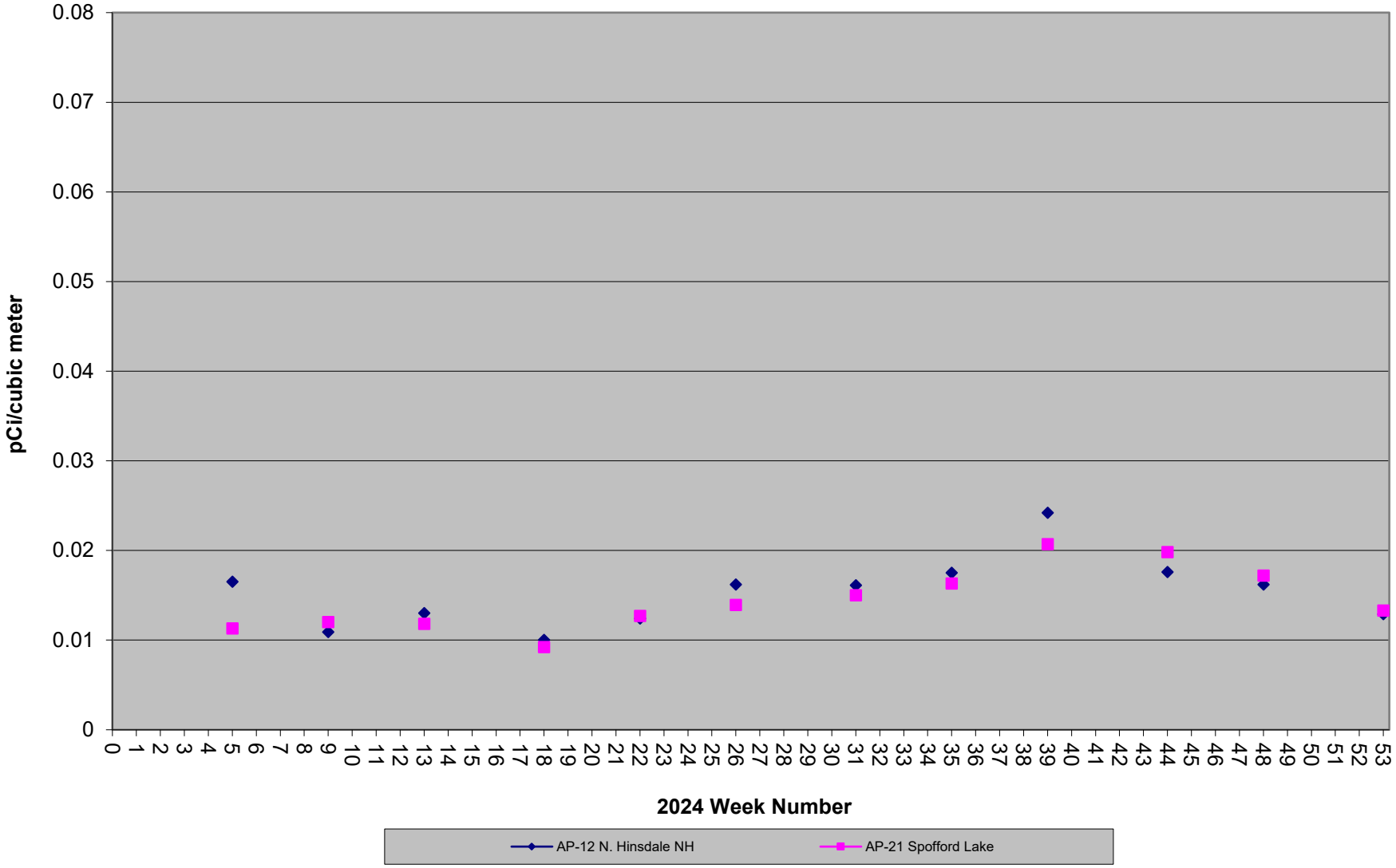


Figure 6.8 - Gross Beta Measurements on River Water Semi-Annual Average Concentration

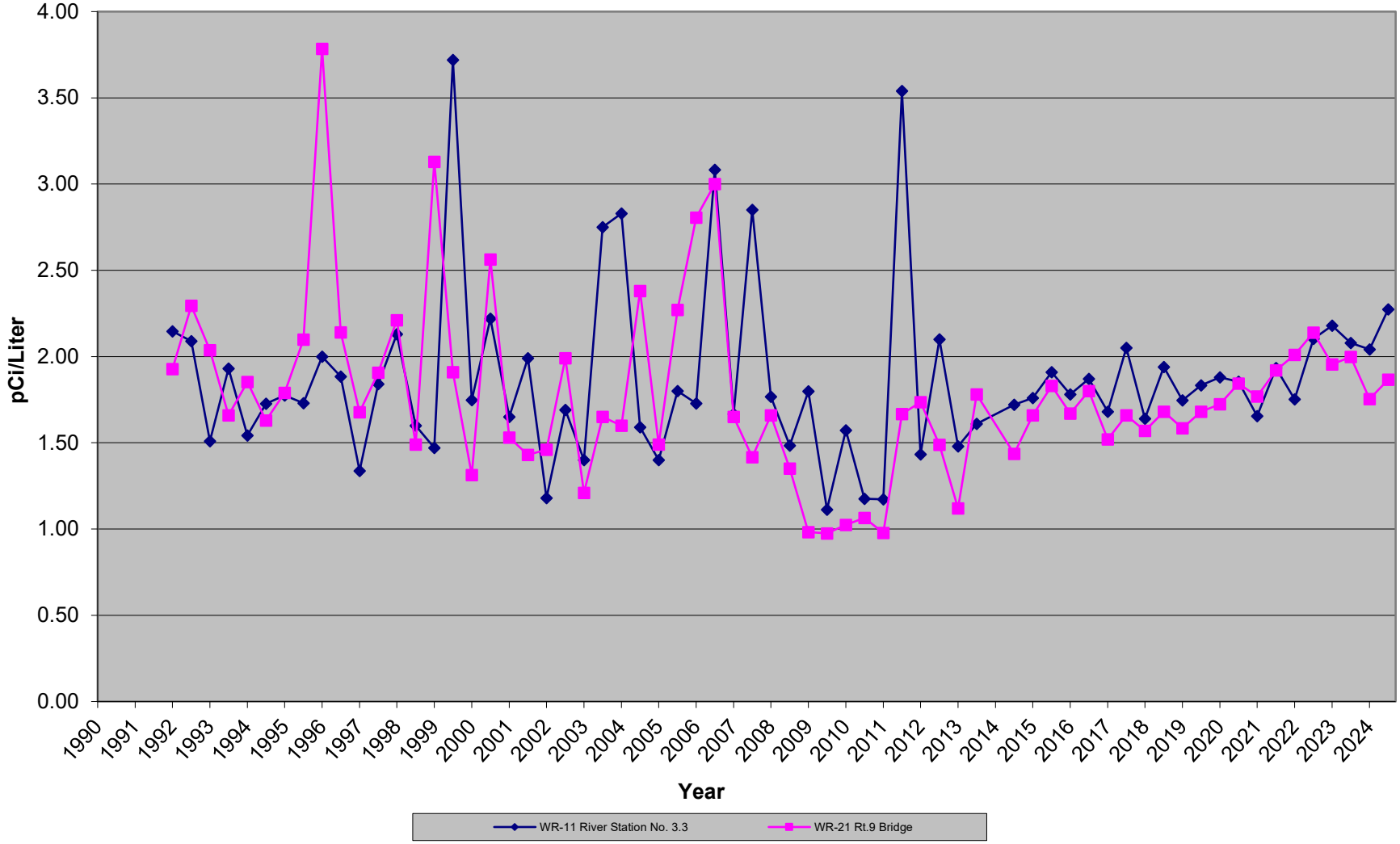


Figure 6.9 - Gross Beta Measurements on Ground Water Semi-Annual Average Concentrations

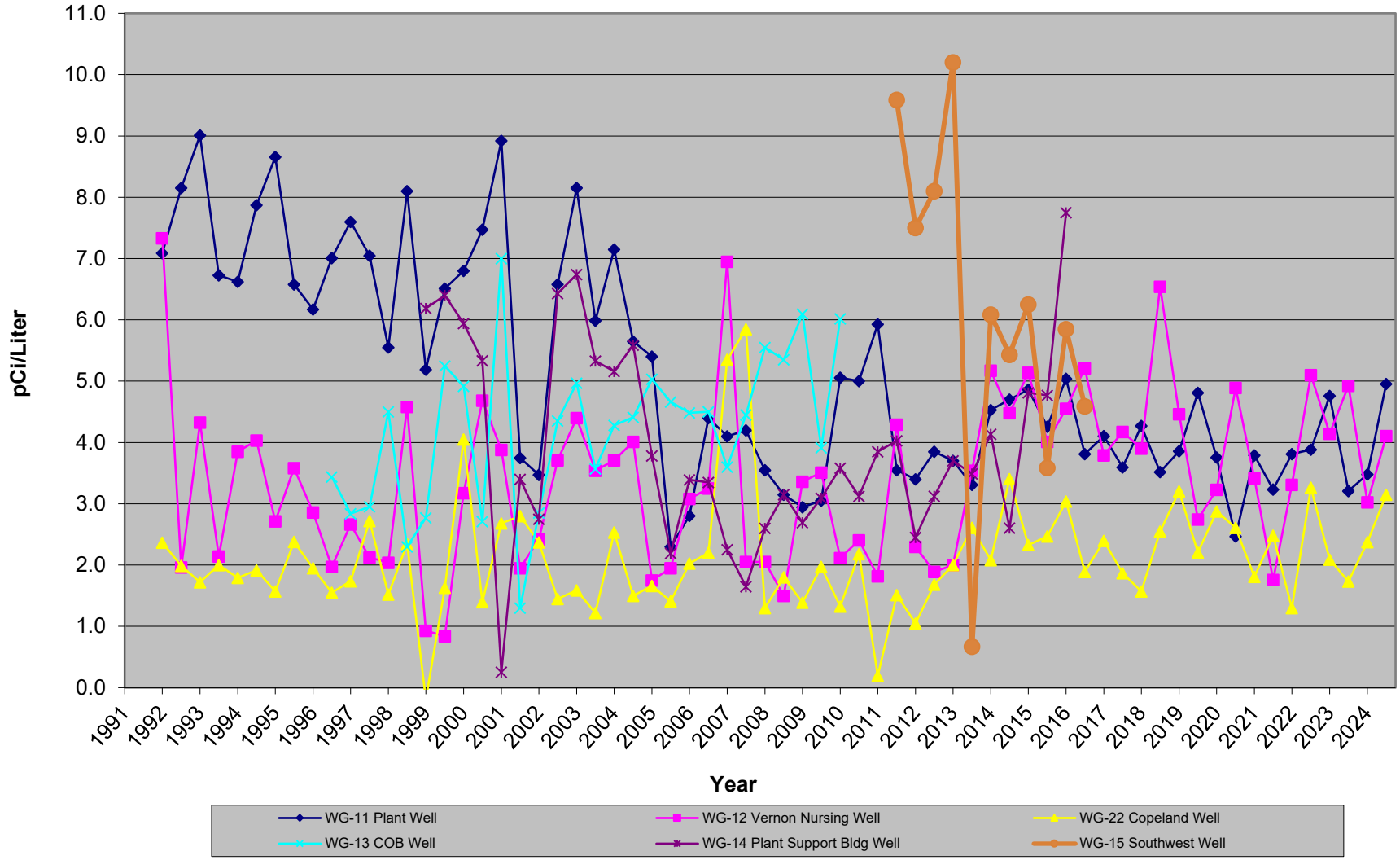


Figure 6.12 - Cesium 137 in Fish - Annual Average Concentrations

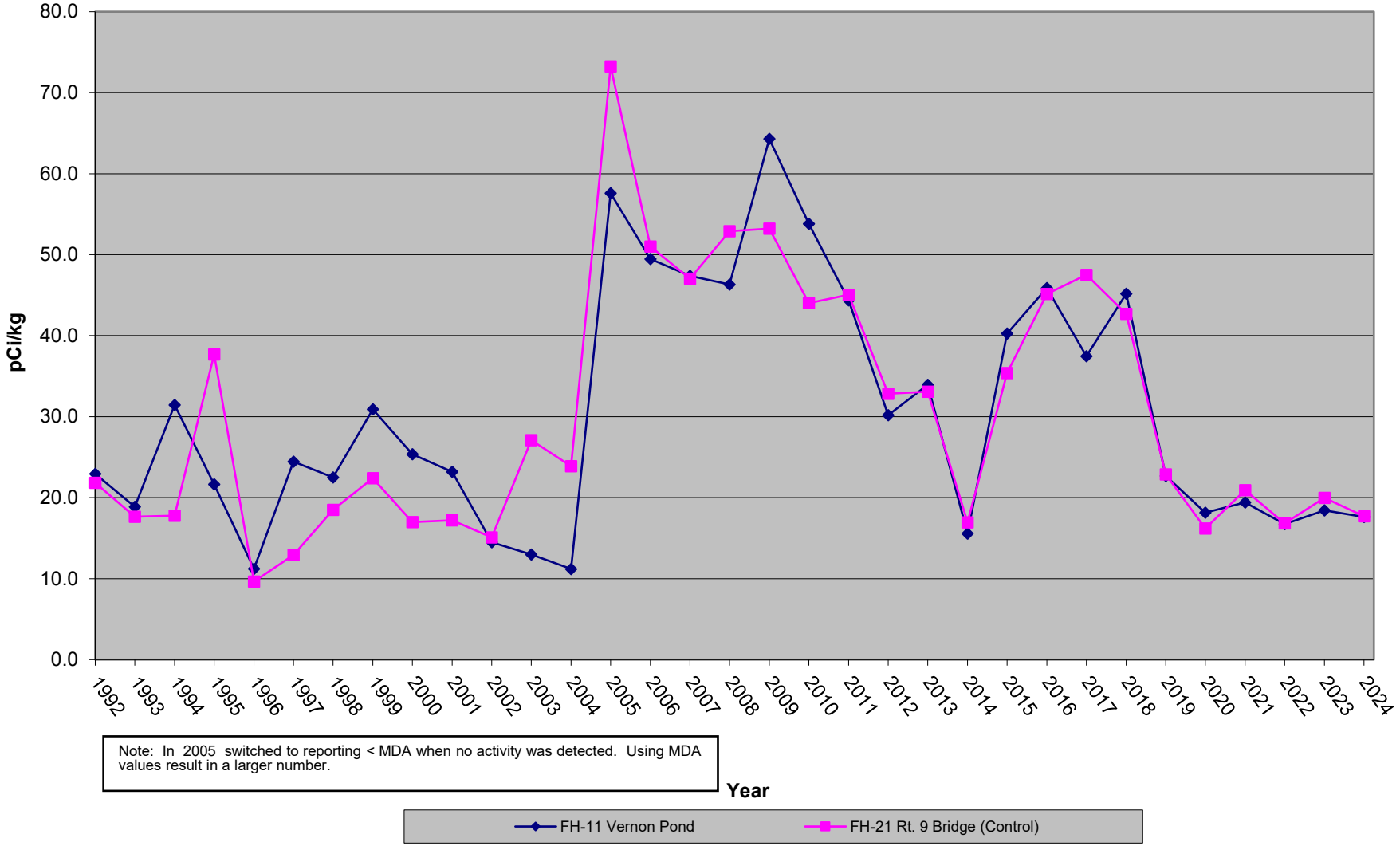


Figure 6.13 - Average Exposure Rate at Inner Ring, Outer Ring and Control TLDs

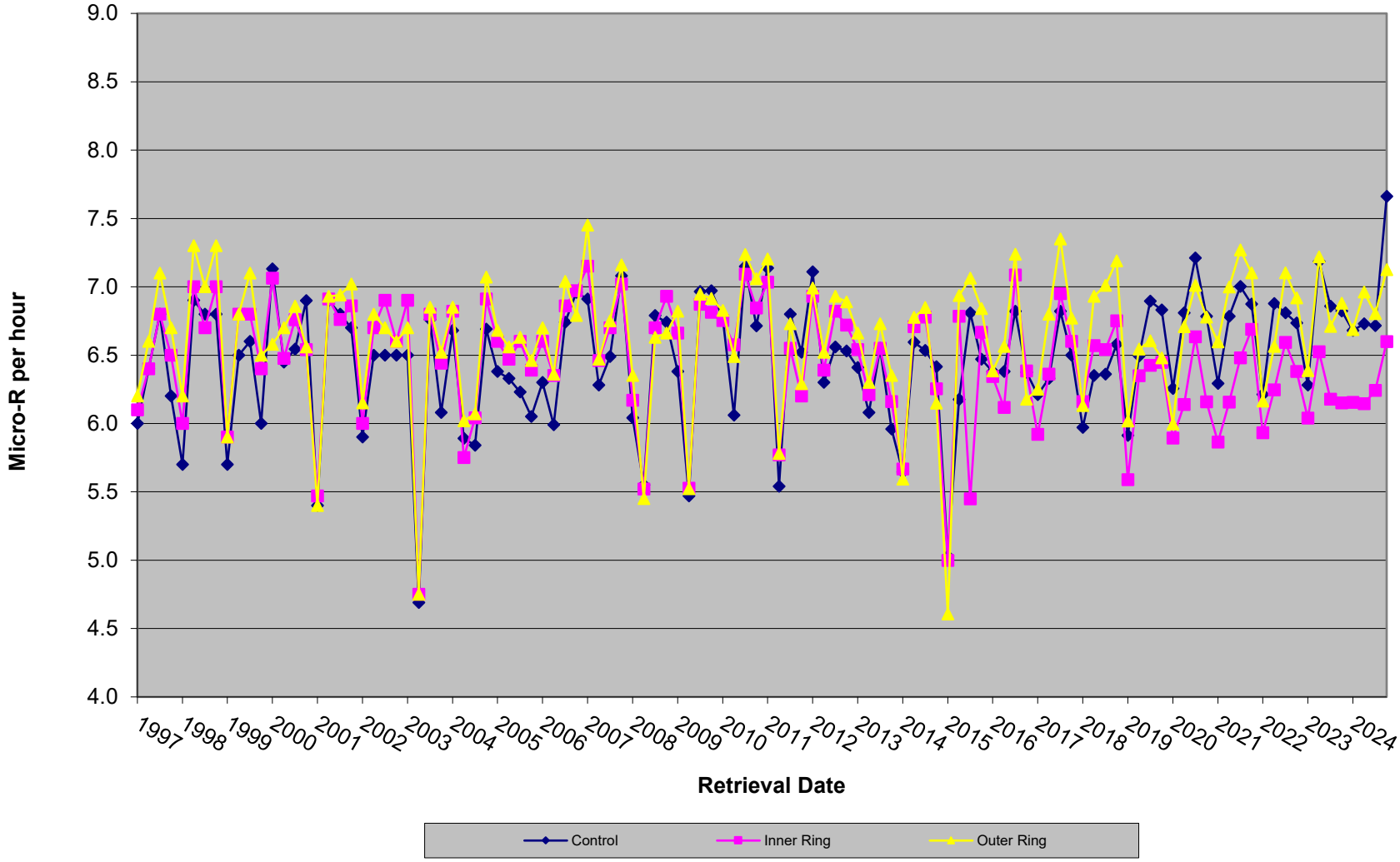


Figure 6.14 - Exposure Rate at Indicator TLDs, DR1-3

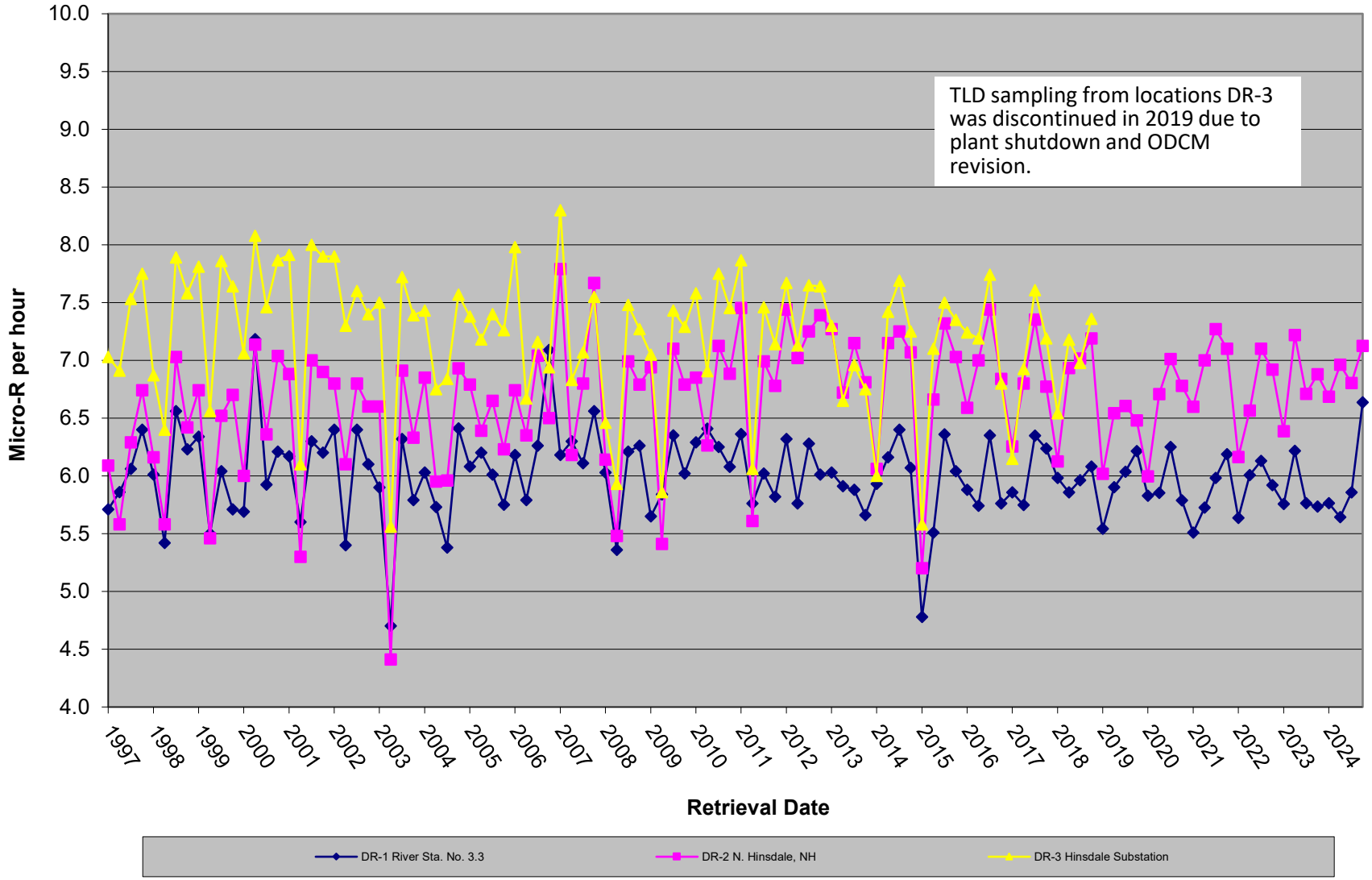


Figure 6.15 - Exposure Rate at Indicator TLDs, DR-6 & DR-50

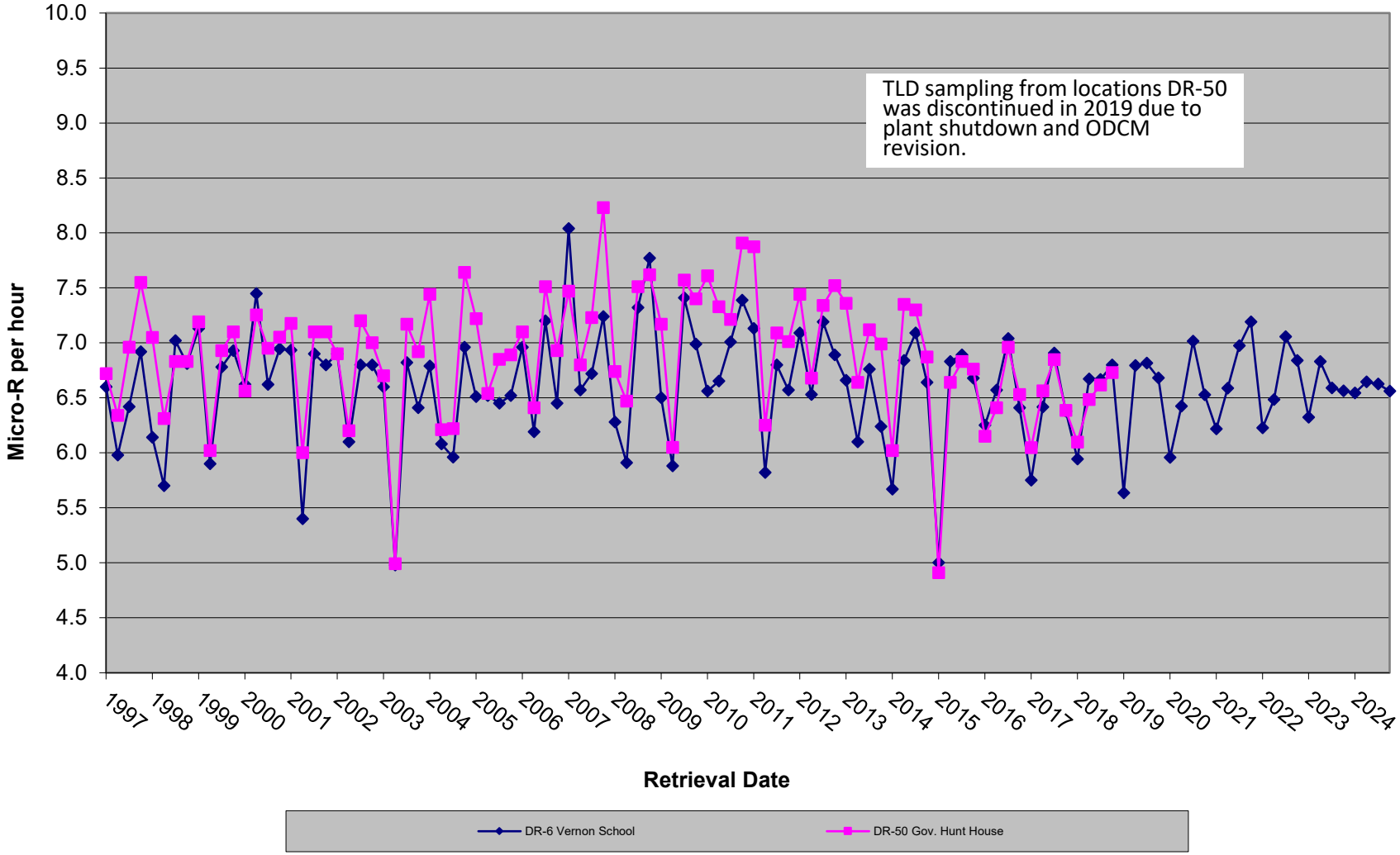


Figure 6.16 - Exposure Rate at Site Boundary TLDs DR-7, DR-8 and DR-53A

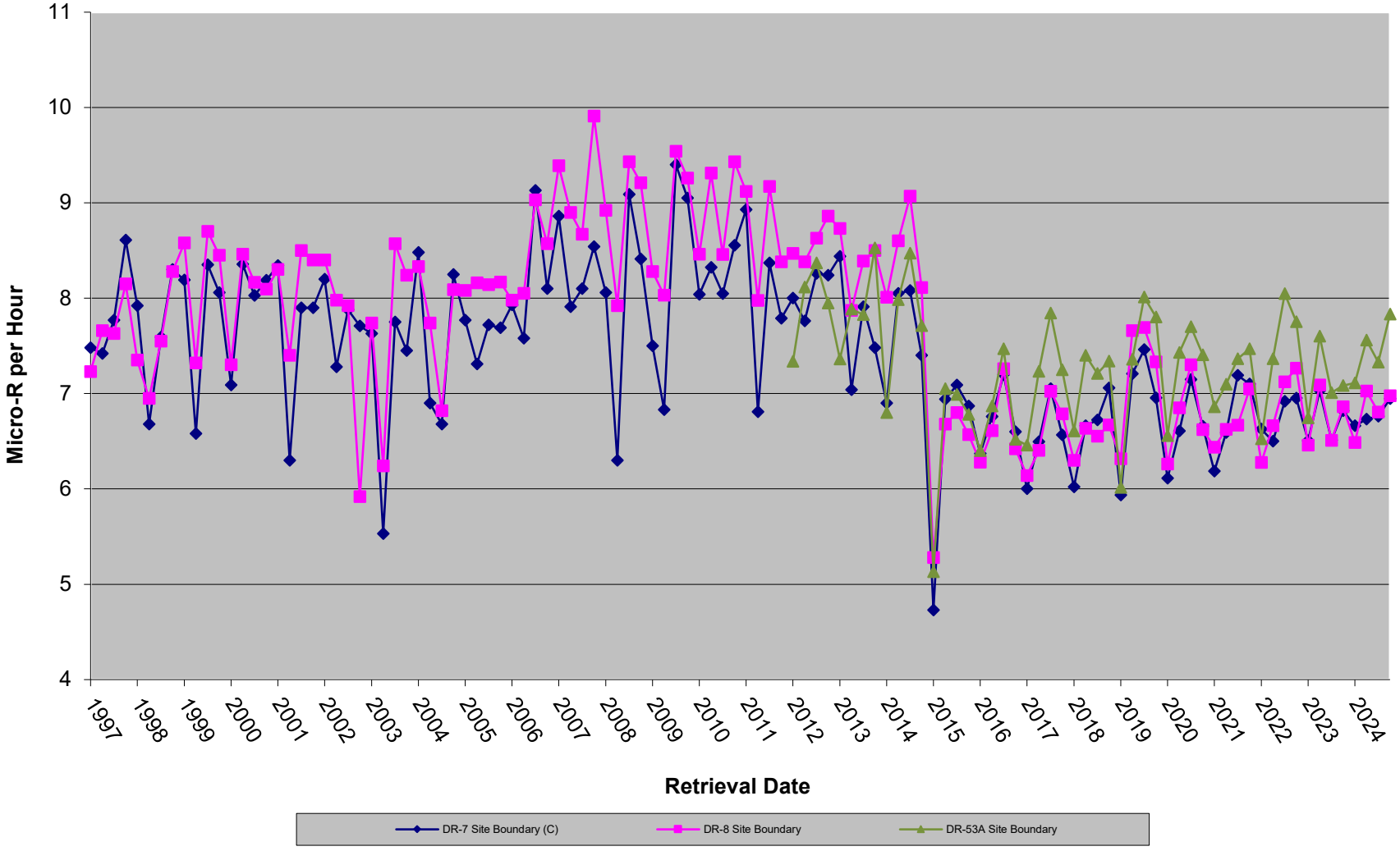


Figure 6.17 - Exposure Rate at Site Boundary TLDs - DR-43 thru 46

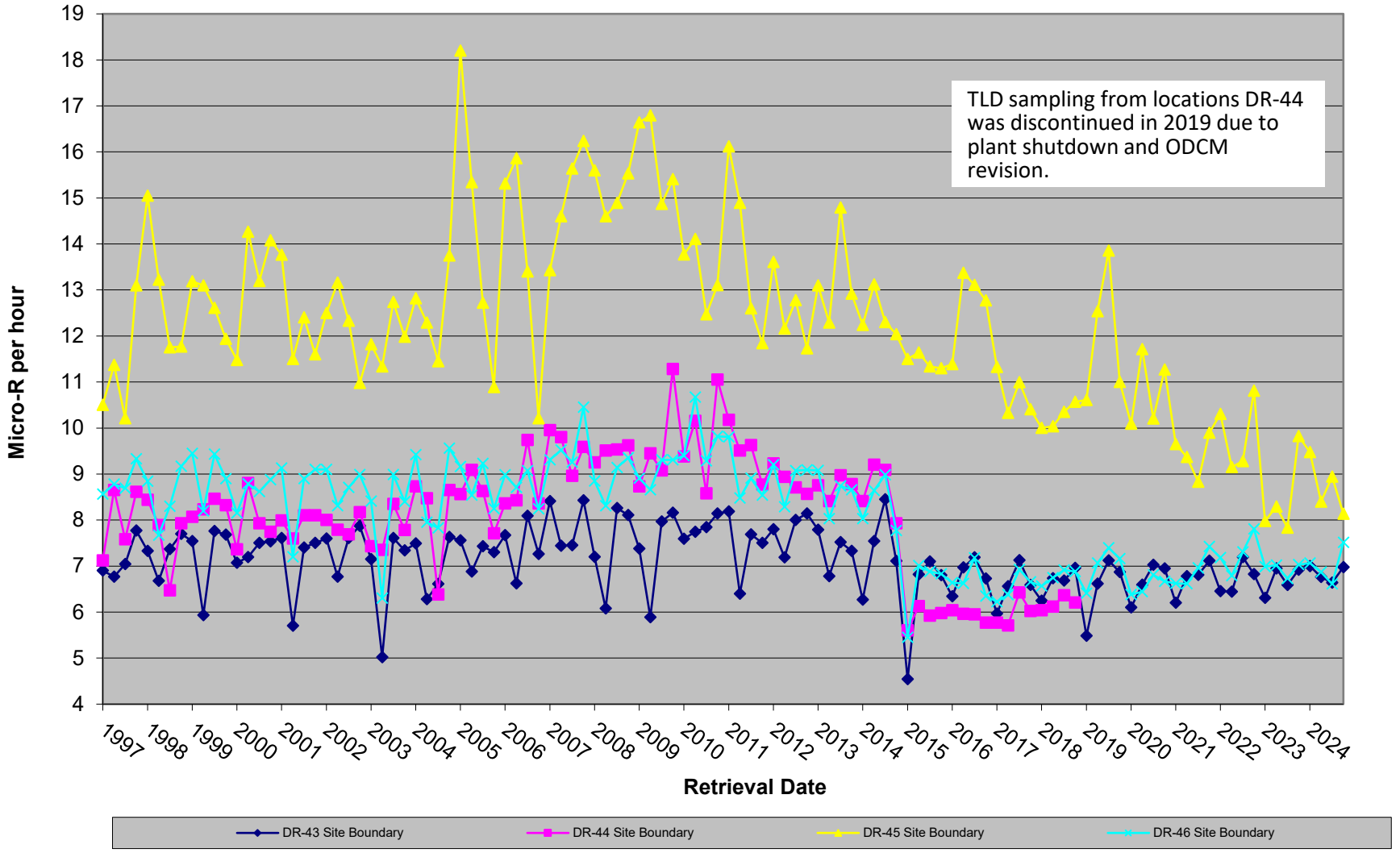
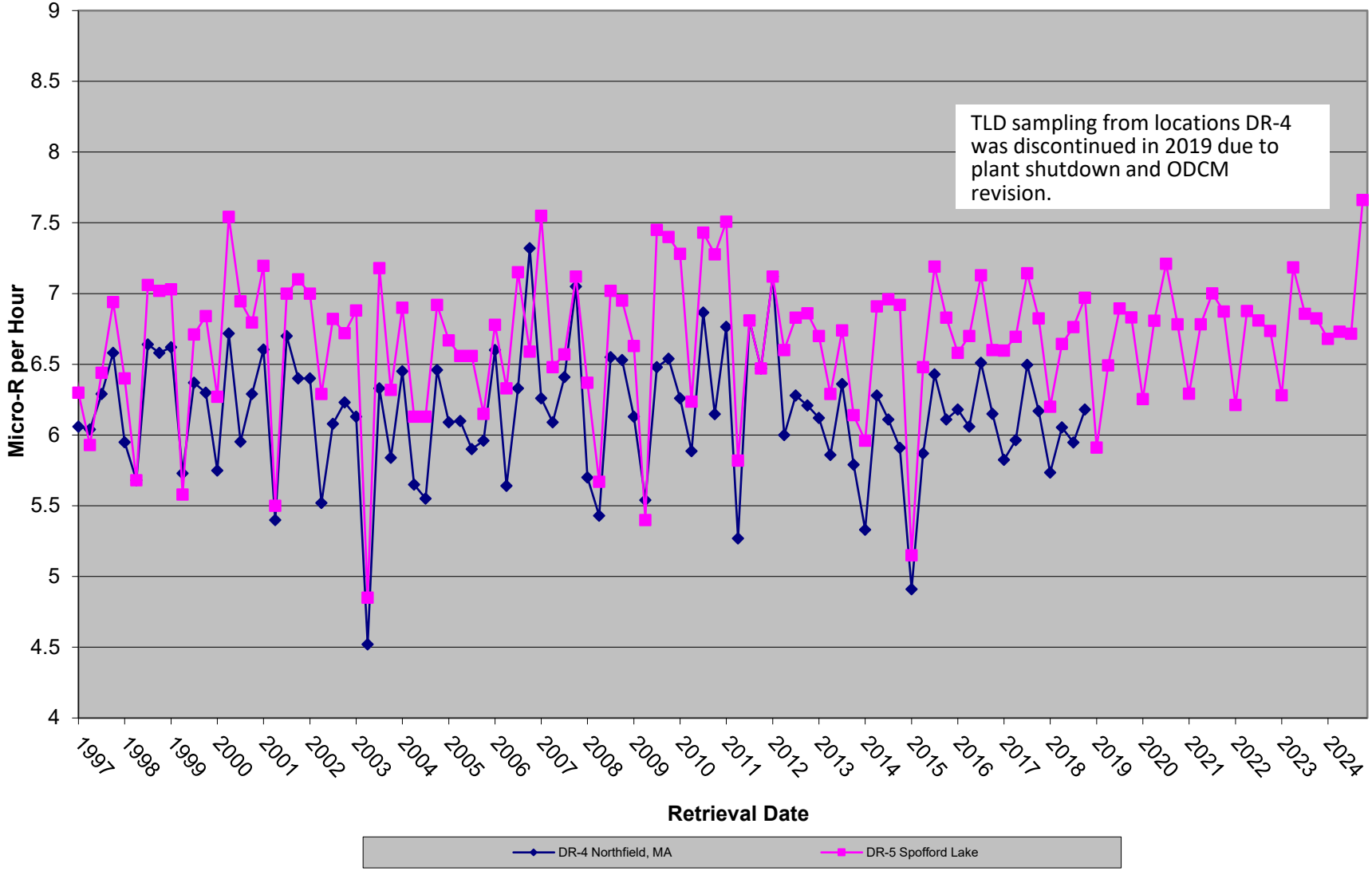


Figure 6.27 - Exposure Rate at Control TLDs DR-4 & 5



7. Quality Assurance Program

7.1 Environmental Dosimetry Company Laboratory

ENVIRONMENTAL DOSIMETRY COMPANY

ANNUAL QUALITY ASSURANCE STATUS REPORT

January - December 2024

Prepared By: James R Dias Q Date: 2/27/25

Approved By: [signature] Date: 2/27/25

Environmental Dosimetry Company
10 Ashton Lane
Sterling, MA 01564

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EXECUTIVE SUMMARY

Routine quality control (QC) testing was performed for dosimeters issued by the Environmental Dosimetry Company (EDC).

During this annual period 100% (72/72) of the individual dosimeters, evaluated against the EDC internal performance acceptance criteria (high-energy photons only), met the criterion for accuracy and 100% (72/72) met the criterion for precision (Table 1). In addition, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance limits met EDC acceptance criteria (Table 2) and 100% of independent testing passed the performance criteria (Table 3). Trending graphs, which evaluate performance statistic for high-energy photon irradiations and co-located stations are given in Appendix A.

One internal assessment was performed in 2024. There were no findings.

I. INTRODUCTION

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 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 used:

A. 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.

B. QA Program

An internal assessment of dosimetry activities is conducted annually by the Quality Assurance Officer (Reference 1). The purpose of the assessment is to review procedures, results, materials or components to identify opportunities to improve or enhance processes and/or services.

II. PERFORMANCE EVALUATION CRITERIA

A. Acceptance Criteria for Internal Evaluations

1. Bias

For each dosimeter tested, the measure of bias is the percent deviation of the reported result relative to the delivered exposure. The percent deviation relative to the delivered exposure is calculated as follows:

$$\frac{\left(H_i' - H_i\right)}{H_i} 100$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated dosimeter (i.e., the delivered exposure)

2. Mean Bias

For each group of test dosimeters, the mean bias is the average percent deviation of the reported result relative to the delivered exposure. The mean percent deviation relative to the delivered exposure is calculated as follows:

$$\sum\left(\frac{(H_i' - H_i)}{H_i}\right)100\left(\frac{1}{n}\right)$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated test dosimeter (i.e., the delivered exposure)

n = the number of dosimeters in the test group

Precision

For a group of test dosimeters irradiated to a given exposure, the measure of precision is the percent deviation of individual results relative to the mean reported exposure. At least two values are required for the determination of precision. The measure of precision for the i^{th} dosimeter is:

$$\left(\frac{\left(H_i' - \bar{H}\right)}{\bar{H}}\right)100$$

where:

H_i' = the reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

$\bar{H}$ = the mean reported exposure; i.e., $\bar{H} = \sum H_i'\left(\frac{1}{n}\right)$

n = the number of dosimeters in the test group

3. EDC Internal Tolerance Limits

All evaluation criteria are taken from the “EDC Quality System Manual,” (Reference 2). These criteria are only applied to individual test dosimeters irradiated with high-energy photons (Cs-137) and are as follows for Panasonic Environmental dosimeters: ± 15% for bias and ± 12.8% for precision.

B. QC Investigation Criteria and Result Reporting

EDC Quality System Manual (Reference 2) specifies when an investigation is required due to a QC analysis that has failed the EDC bias criteria. The criteria are as follows:

1. No investigation is necessary when an individual QC result falls outside the QC performance criteria for accuracy.

2. Investigations are initiated when the mean of a QC processing batch is outside the performance criterion for bias.

C. Reporting of Environmental Dosimetry Results to EDC Customers

1. All results are to be reported in a timely fashion.

2. If the QA Officer determines that an investigation is required for a process, the results shall be issued as normal unless if the QC results prompting the investigation have a mean bias from the known of greater than ±20%, then the results shall be issued with a note indicating that they may be updated in the future, pending resolution of a QA issue.

3. Environmental dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±15%.

III. DATA SUMMARY FOR ISSUANCE PERIOD JANUARY-DECEMBER 2024

A. General Discussion

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 and Figures 1 through 4.

Table 1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons only. During this period100% (72/72) of the individual dosimeters, evaluated against these criteria, met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision. A graphical interpretation is provided in Figures 1 and 2.

Table 2 provides the bias and 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. A graphical interpretation is provided in Figure 3.

Table 3 presents the independent blind spike results for dosimeters processed during this annual period. All results passed the performance acceptance criterion. Figure 4 is a graphical interpretation of Seabrook Station blind co-located station results.

B. Result Trending

One of the main benefits of performing quality control tests on a routine basis is to identify trends or performance changes. The results of the Panasonic environmental dosimeter performance tests are presented in Appendix A. The results are evaluated against each of the performance criteria listed in Section II, namely: individual dosimeter accuracy, individual dosimeter precision, and mean bias.

All of the results presented in Appendix A are plotted sequentially by processing date.

IV. STATUS OF EDC CONDITION REPORTS (CR)

No condition reports were issued during this annual period.

V. STATUS OF AUDITS/ASSESSMENTS

1. Internal

EDC Internal Quality Assurance Assessment was conducted during the fourth quarter 2024. There were no findings identified.

2. External

None.

VI. PROCEDURES AND MANUALS REVISED DURING JANUARY - DECEMBER 2024

No procedures or manuals were revised in 2024.

VII. CONCLUSION AND RECOMMENDATIONS

The quality control evaluations continue to indicate the dosimetry processing programs at the EDC satisfy the criteria specified in the Quality System Manual. The EDC demonstrated the ability to meet all applicable acceptance criteria.

VIII. REFERENCES

1. EDC Quality Control and Audit Assessment Schedule, 2024.

2. EDC Manual 1, Quality System Manual, Rev. 4, September 28, 2020

TABLE 1

PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA JANUARY – DECEMBER 2024[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 2024[1], [2]

Process Date	Exposure Level	Mean Bias %	Standard Deviation %	Tolerance Limit +/-15%
5/05/2024	37	-0.3	2.2	Pass
5/08/2024	51	2.2	1.5	Pass
5/15/2024	83	2.5	2.2	Pass
7/30/2024	27	1.1	1.8	Pass
8/06/2024	63	6.6	1.2	Pass
9/25/2024	95	-3.1	1.8	Pass
10/24/2024	42	4.9	2.6	Pass
10/30/2024	73	6.8	1.6	Pass
11/27/2024	107	-6.7	1.6	Pass
01/20/2025	32	1.9	1.0	Pass
01/26/2025	47	2.8	1.5	Pass
01/29/2025	117	2.6	2.1	Pass

[1]This table summarizes results of tests conducted by EDC for TLDs issued in 2024.
[2]Environmental dosimeter results are free in air.

TABLE 3
SUMMARY OF INDEPENDENT DOSIMETER TESTING JANUARY – DECEMBER 2024[1], [2]

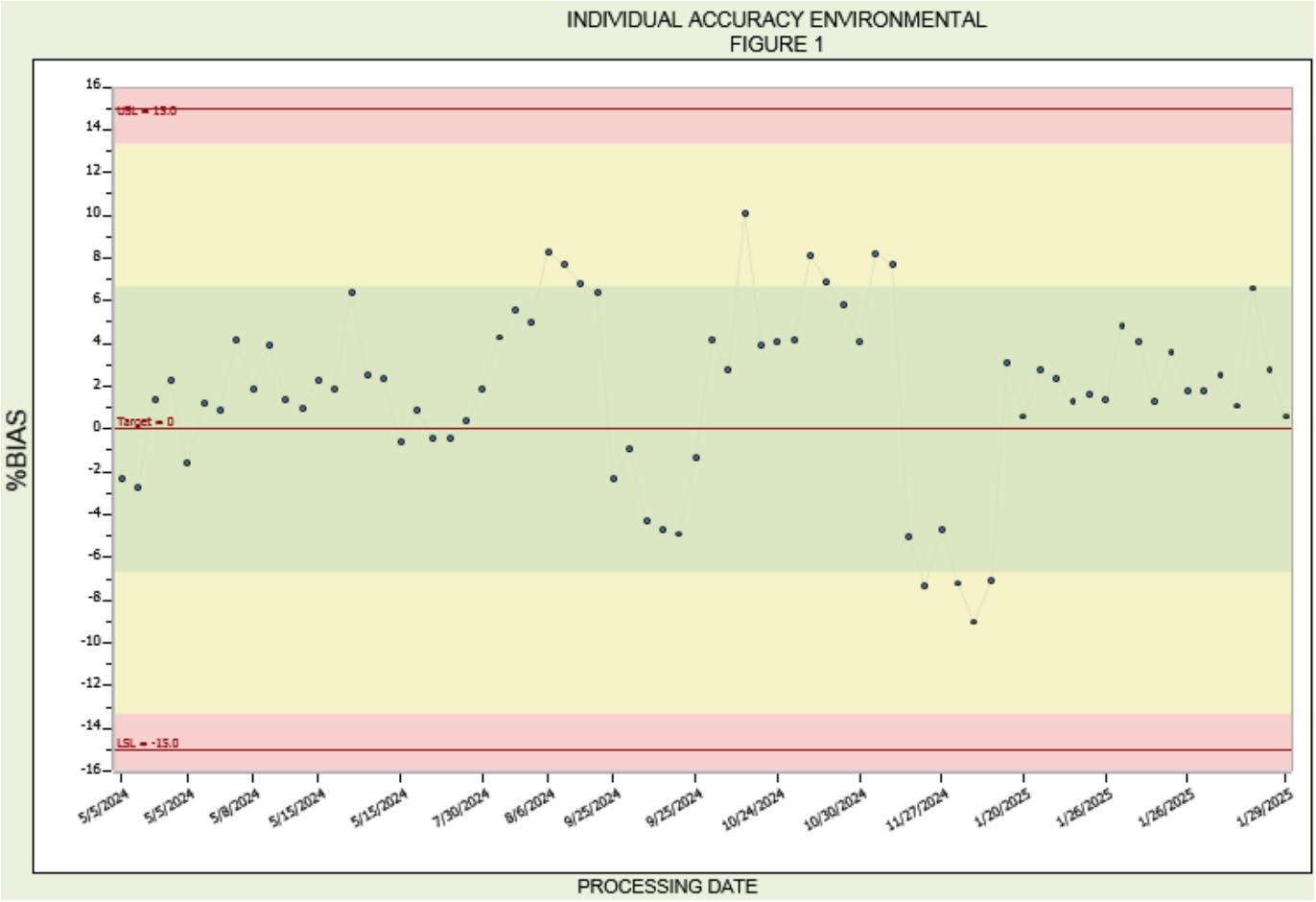
Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2024	Millstone	-.1	0.2	Pass
2nd Qtr.2024	Seabrook	1.7	2.8	Pass
2nd Qtr. 2024	Millstone	-4.3	0.9	Pass
3rd Qtr. 2024	SONGS	-9.7	1.4	Pass
3rd Qtr. 2024	Millstone	-1.4	2.5	Pass
4th Qtr.2024	Millstone	1.5	1.4	Pass
4th Qtr.2024	Seabrook	3.8	1.5	Pass

[1]Performance criteria are +/- 15%.
[2]Blind spike irradiations using Cs-137

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS

ISSUE PERIOD JANUARY - DECEMBER 2024


INDIVIDUAL ACCURACY ENVIRONMENTAL
FIGURE 1
%BIAS
USL = 15.0
Target = 0
LSL = -15.0
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
5/5/2024
5/5/2024
5/8/2024
5/15/2024
5/15/2024
7/30/2024
8/6/2024
9/25/2024
9/25/2024
10/24/2024
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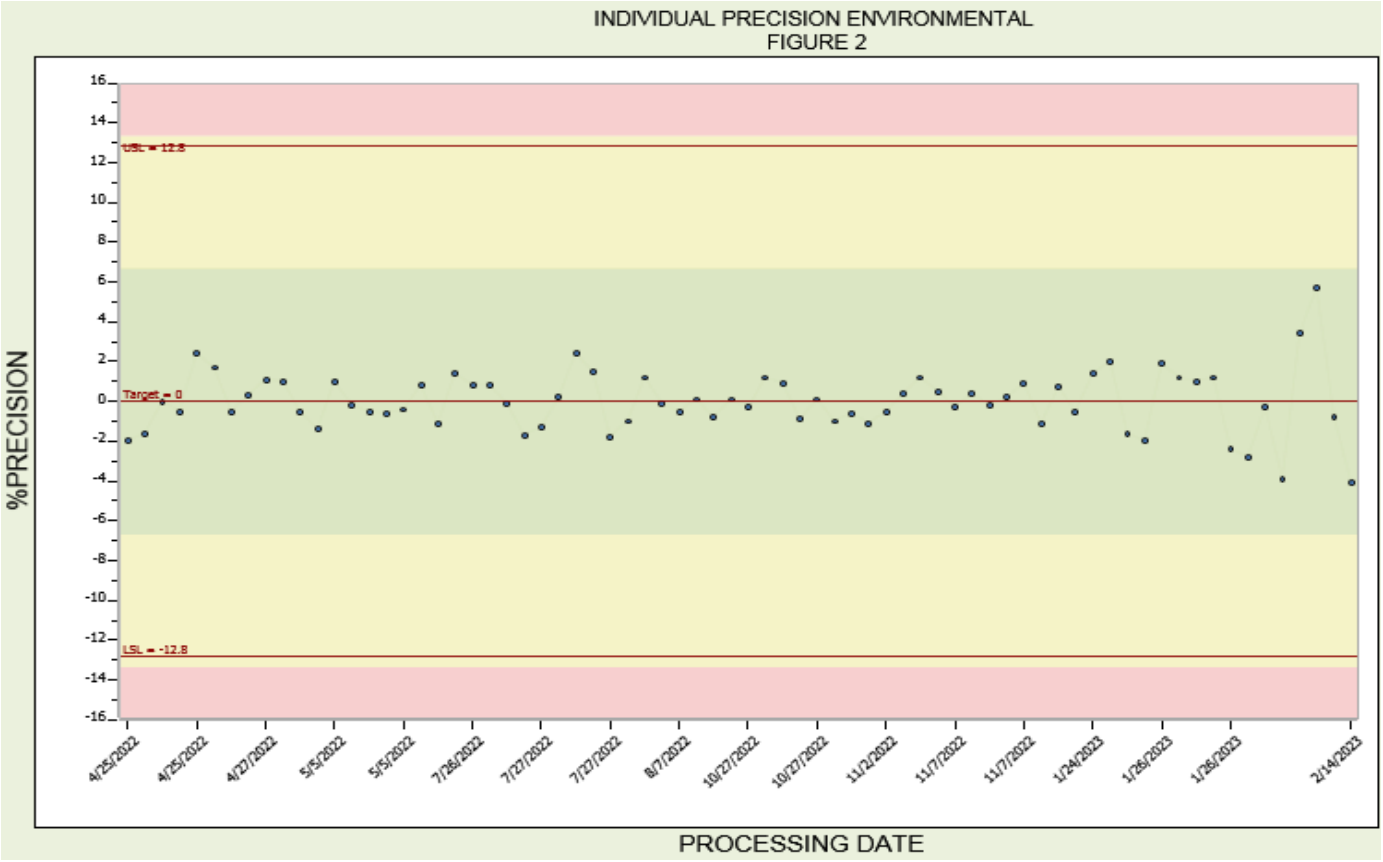
1/26/2025
1/26/2025
1/29/2025
PROCESSING DATE


INDIVIDUAL PRECISION ENVIRONMENTAL
FIGURE 2
%PRECISION
USL = 12.8
Target = 0
LSL = -12.8
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4/25/2022
4/25/2022
4/27/2022
5/5/2022
5/5/2022
7/26/2022
7/27/2022
7/27/2022
8/7/2022
10/27/2022
10/27/2022
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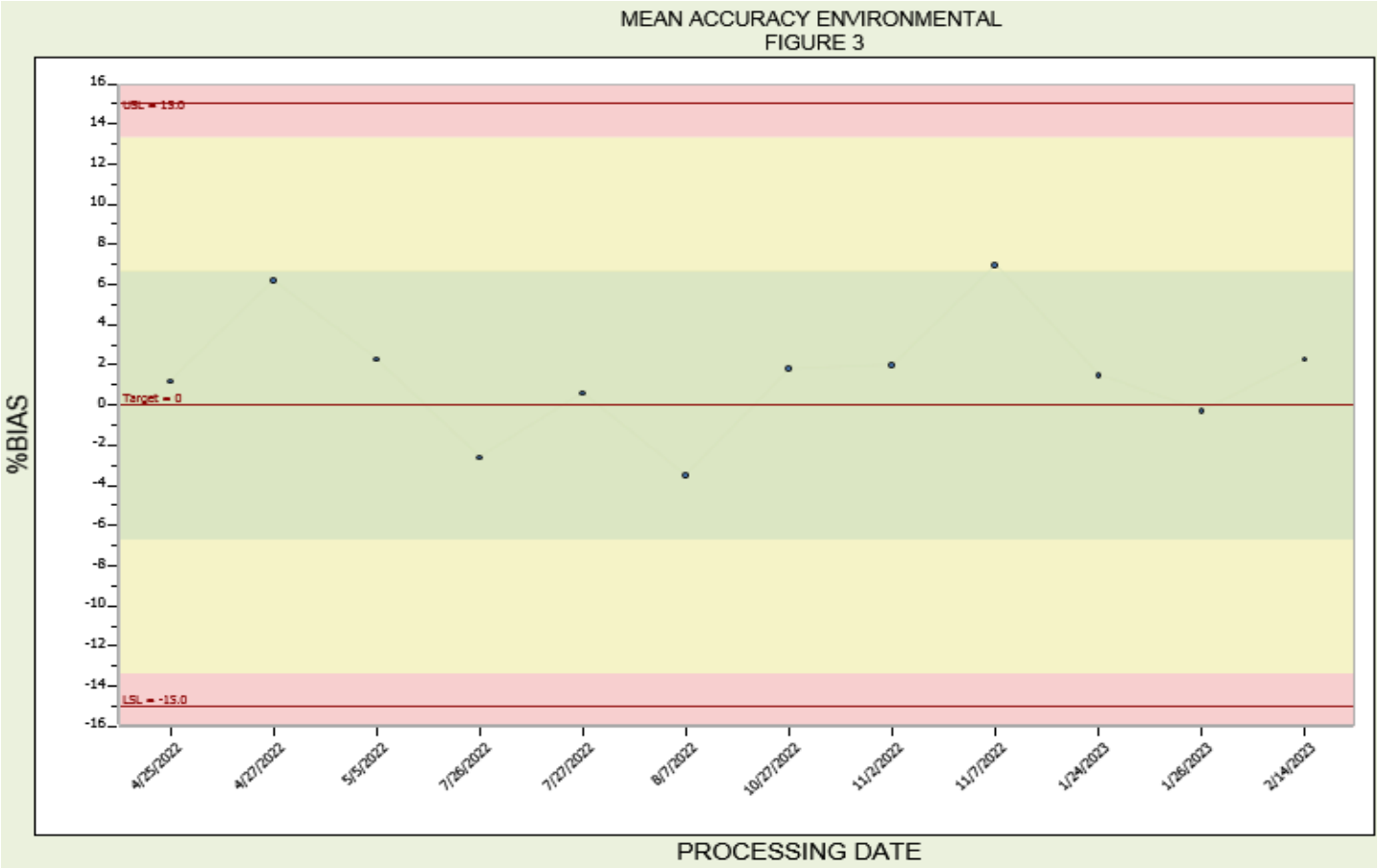
1/26/2023
1/26/2023
2/14/2023
PROCESSING DATE


MEAN ACCURACY ENVIRONMENTAL
FIGURE 3
%BIAS
USL = 15.0
Target = 0
LSL = -15.0
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4/25/2022
4/27/2022
5/5/2022
7/26/2022
7/27/2022
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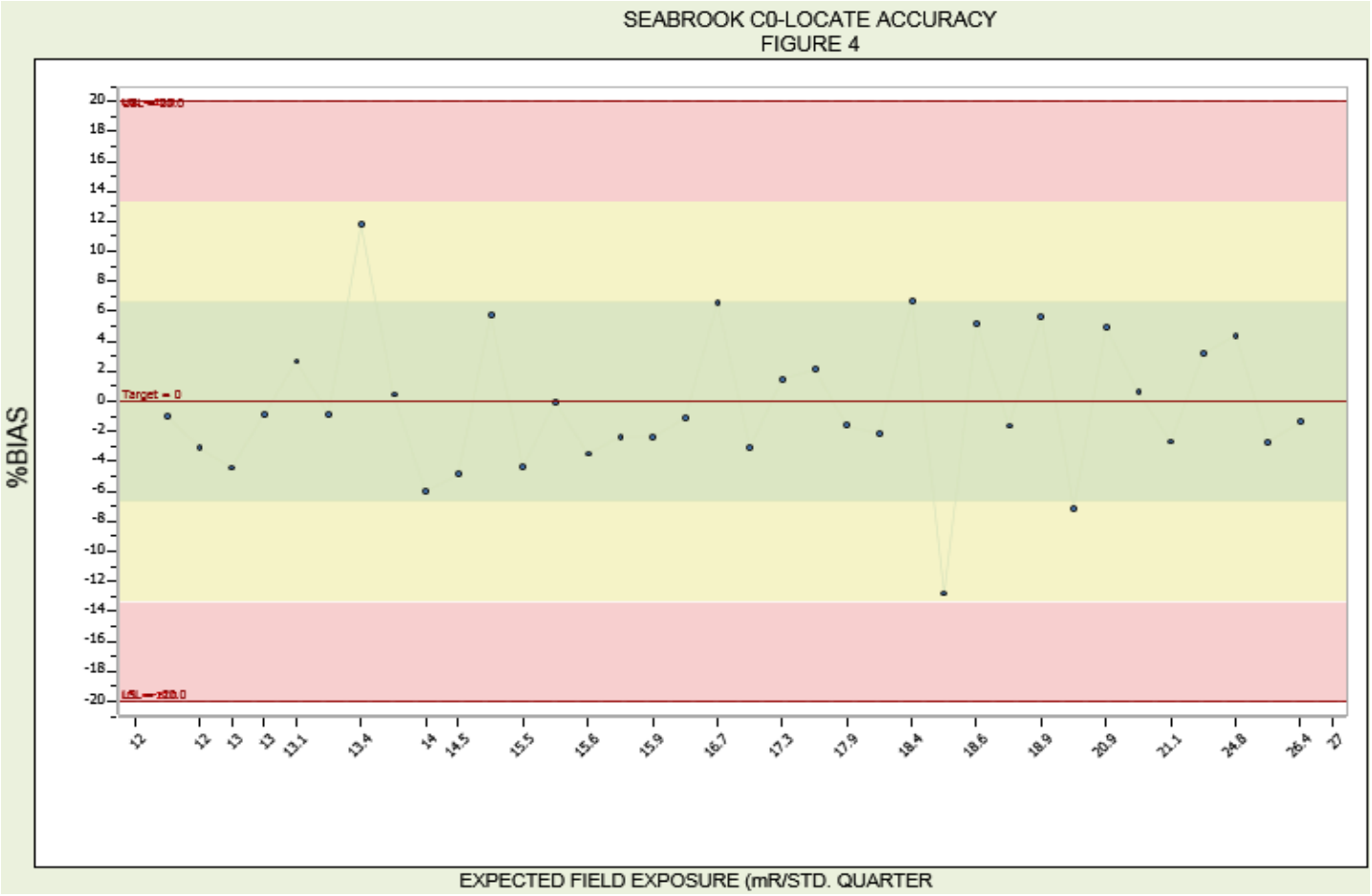
1/24/2023
1/26/2023
2/14/2023
PROCESSING DATE


SEABROOK C0-LOCATE ACCURACY
FIGURE 4
%BIAS
Target = 0
EXPECTED FIELD EXPOSURE (mR/STD. QUARTER

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

7.2.1 Operational Quality Control Scope

7.2.1.1 Inter-laboratory

The Teledyne Brown Engineering Environmental Services Laboratory Quality Control (QC) Program is designed to monitor the quality of analytical processing associated with environmental, effluent (10CFR Part 50), bioassay, industrial process, and waste characterization (10CFR Part 61) samples.

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

TBE-ES also participates in the Department of Energy's (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) administered by the U. S. Department of Energy. The MAPEP is a set of performance evaluation samples (e.g., water, soil, vegetation, etc.) designed to evaluate the ability and quality of analytical facilities performing measurement on samples that contain hazardous and radioactive (mixed) analytes.

Quality Control for radioanalyses during this reporting period consisted of internal process check samples. Results for third-party process check prepared by Analytics, ERA and the DOE's MAPEP are not reported during the first quarter of the year due to the receipt date from the vendors.

7.2.1.2 Intra-laboratory

The internal QC 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), for contamination checks, and instrumentation backgrounds. Process controls (or process checks) are either actual samples submitted in duplicate (duplicates) in order to evaluate the precision of laboratory measurements. Blank samples which have been spiked (spikes) with a known quantity of a radioisotope that is of interest to laboratory clients measure the accuracy of analyses. QC samples are intended to evaluate the entire radiochemical and radiometric process. Process control and qualification analyses samples seek to mimic the media type of those samples submitted for analysis by the various laboratory clients. The magnitude of the process control program combines both internal and external sources targeted at 10% of the routine sample analysis load.

To provide direction and consistency in administering the quality assurance program, TBE-ES has developed and follows a Quality Manual and a set of Standard Operating Procedures (SOP). The plan describes the

scheduled frequency and scope of Quality Assurance and Quality Control (QA/QC) considered necessary for an adequate QA/QC program conducted throughout the year.

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 successfully completed client on-site audits including the Nuclear Utility Procurement Issues Committee (NUPIC) in 2024. In 2024, a reassessment audit was performed for ISO-17025:2017 DoD-ELAP and DOECAP radiological analyses by Perry Johnson Laboratory Accreditation (PJLA). Each audit included a comprehensive review of TBE-ES's Quality and Technical programs and assessed 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 this annual reporting period, twenty-nine nuclides associated with seven media types were analyzed by means of the laboratory's internal process control, Analytics, ERA, MAPEP 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
- Urine
- Vegetation
- Water

7.2.2.1.2 Analytics Environmental Cross-Check Program

Fourteen nuclides in air particulate, charcoal filter, milk , soil and water matrices were evaluated for two sets of cross-checks during 2024. All analyses performed were within the acceptable criteria except for air particulate Co-60 (E14092) and soil Ce-141 (E14093). Both nuclides were resolved and returned with acceptable criteria in a following study.
E&Z Analytics March E14092 air particulate study Co-60 evaluated as "Not Acceptable." TBE reported 168 pCi and the known value returned at 126 pCi. Additionally, March E14093 soil Ce-141 evaluated as "Not Acceptable." TBE reported 0.106 pCi/g and the known value returned at 0.071 pCi/g. The root cause investigation was unable to determine any anomaly thus no proposed corrective action. No recurrence has occurred. (NCR 24-06)

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

Sixteen nuclides in water, soil, urine and vegetation samples were evaluated twice in 2024. All other environmental analyses that were reported were within the acceptable/acceptable with warning criteria except for soil Fe-55 (24-MaS50/24-MaS51) and Ni-63 (24-MaS50), water Tc-99 (24-MaW50), and vegetation Sr-90 (24-RdV50/24-RdV51).

MAPEP February 24-MaS50 soil study Fe-55 evaluated as "Not Acceptable." TBE reported 297 Bq/Kg and the known value returned at 650 Bq/Kg (range 455-845). The root cause investigation suspects that the current analytical procedure is not sufficient to add the interferences added to the sample by MAPEP. This investigation is still ongoing (See NCR 24-16) as the suggested corrective action did not provide desired results. CAR 24-02 (CAR 23-31)

MAPEP February 24-MaS50 soil study Ni-63 evaluated as "Not Acceptable." TBE reported 1070 Bq/Kg and the known value returned at 1530 Bq/Kg (range 1071-1989). The root cause investigation suspected that the sample contained added interferences that are not typically seen in client samples. All QC efforts associated with the sample were acceptable and no anomalies found, even after reanalysis. To correct and prevent recurrence, samples suspected of additional interferences will include the addition of Ni-59 tracer to determine yield results when calculating results. TBE analytical procedure TBE-2013 was updated to include this change. (NCR 24-08)

MAPEP February 24-MaSU50 urine study Zn-65 evaluated as "Not Acceptable." The root cause investigation determined that the sample was spiked lower than TBE's typical detection limit and client requirements. The

report was revised by MAPEP indicating “Not Evaluated,” resulting in this nuclide to not be considered a failure. (NCR 24-09)

MAPEP February 24-MaW50 water study Tc-99 evaluated as “Not Acceptable.” TBE reported 9.95Bq/L and the known value returned 7.47Bq/L (range 5.23-9.71). The root cause investigation suspects Thorium interference that was not removed during the column separation process of the analytical procedure; however, it cannot be confirmed as all QC efforts associated with the sample were acceptable and with no anomalies found. To potentially correct and prevent recurrence, an additional rinse step was added to the procedure. Acceptable results returned in a later sample study, supporting effectiveness of corrective action. (NCR 24-10)

MAPEP February 24-RdV50 vegetation study Sr-90 evaluated as “Not Acceptable.” TBE reported 0.276Bq/sample and the known value returned 0.529Bq/sample (range 0.370-0.688). The root cause investigation determined a laboratory accident resulting in a spilled (loss) of sample. No corrective action was performed as the cause was an unintentional sample spill. (NCR 24-11) L.

MAPEP August 24-MaS51 soil study Fe-55 evaluated as “Not Acceptable.” TBE did not report a value and the known value returned 780Bq/Kg (range 546-1014). The root cause is still under investigation. (NCR 24-16)

MAPEP August 24-RdV51 vegetation study Sr-90 evaluated as “Not Acceptable.” TBE reported 0.95Bq/sample and the known value returned 2.39Bq/sample (range 1.67-3.11). The root cause is still under investigation. (NCR 24-17)

7.2.2.1.4 Summary of Participation in the ERA Program

Eighteen nuclides were evaluated in water, air particulate, and soil samples twice during 2024. All analyses performed were within the acceptable criteria except for the MRAD-40 air particulate Am-241 and gross beta, RAD-137 water gross alpha, MRAD-41 water Fe-55 and air particulate U-234 and U-238. Both Am-241 and Gr-B in air particulate, and Gr-A in water failures were resolved and returned within acceptable criteria in a following study.

ERA March MRAD-40 study with Air Particulate AM-241 evaluated as “Not Acceptable.” TBE reported 38.8 pCi/filter and the known value returned at 55.0 pCi/filter (range 39.3-73.3). The root cause investigation determined that the sample was not logged into the system correctly and therefore not prepared with the required tracer. To correct and prevent recurrence, personnel involved are to utilize a template to ensure all analyses are logged as required and the QA Manager will perform sample log review as a back up to ensure accuracy. Acceptable results returned in a later sample study, supporting effectiveness of corrective action. (NCR 24-02)

ERA March MRAD-40 air particulate study GR-B evaluated as “Not Acceptable.” TBE reported 42.1 pCi/filter and the known value returned at 22.2 pCi/filter (range 13.5-33.5). The root cause investigation determined that alpha-to-beta crosstalk was more significant than normal which caused the beta activity to report falsely high data. To correct and prevent recurrence, personnel involved are to adjust the alpha-to-beta crosstalk via correction calculation measures when high alpha activities are observed. Acceptable results returned in a later sample study, supporting effectiveness of corrective action. (NCR 24-03)

ERA April RAD-137 water study GR-A evaluated as “Not Acceptable.” TBE reported 35.2 pCi/L and the known value returned at 52.6 pCi/L (range 39.6-65.6). The root cause investigation determined that the provided samples contained a solids content that was significantly higher than the typical client samples tested by the laboratory. A set aliquot volume for prior ERA samples was used and not adjusted to account for the sudden increase in solid content. To correct and prevent recurrence, new sample types were ordered from ERA that used Am-241 to better reflect client sample testing and acceptable results were achieved. Acceptable results returned in a later sample study, supporting effectiveness of corrective action. (NCR 24-05)

ERA September MRAD-41 air particulate study U-234/238 evaluated as “Not Acceptable.” TBE reported 14.0/14.2 pCi/filter and the known value returned at 31.1/30.9 pCi/filter (range 23.1-36.9). The root cause investigation determined that the laboratory technician placed double the amount of tracer in the sample by error. To correct and prevent recurrence, samples that have been digested/leached with carrier/tracer added will have a label placed over the cap indicating it has already been added. Additionally, the beaker that aliquot is put in should have markings to indicate carrier/tracer has already been added to the sample. (NCR 24-14)

ERA September MRAD-41 water study Fe-55 evaluated as “Not Acceptable.” TBE reported 615 pCi/L and the known value returned at 1230 pCi/L (range 723-1790). The root cause is still under investigation. (NCR 24-15)

7.2.2.2 Intra-Laboratory Process Control Program

The TBE-ES Laboratory's internal process control program evaluated 6,018 individual samples.

7.2.2.2.1 Spikes/Matrix Spikes

During this reporting period, all 1,650 workgroup and matrix spikes analyzed

were within the acceptance criteria.

7.2.2.2.2 Analytical Blanks

During this reporting period, 1661/1663 environmental blanks analyzed were less than the MDC. There were two blanks that were positive due to high activity in the associated workgroup samples. Results were >5 times the blank value, which was documented in the case narrative with the sample results.

7.2.2.2.3 Duplicates Total

All the 2704/2705 duplicate sets analyzed were within acceptance criteria. One duplicate RPD was outside acceptance criteria, and a case narrative was provided with the sample results.

7.2.2.2.4 Non-Conformance Reports

There were 17 non-conformance reports issued for this reporting period. No VY data was impacted by the non-conformance in each of these cases.

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 2024 Land Use Census was completed on September 24, 2024. The requirement to identify the location of the nearest milk animal in each meteorological sector from the land use census was eliminated from the ODCM in December of 2016. This was eliminated because the primary isotope, I-131 had decayed away. Since no additional farms have started up within five kilometers of the plant, nor have any of the nearest residences changed locations since the 2008 Land Use Census, we are using the census analysis results from that period.

No locations were identified in the census that had "at least a 20% greater dose commitment than the values currently being calculated in accordance with ODCM Control 4.3.3." This assessment included a review of dispersion factors for all of the identified residence locations. Therefore, no change in the critical receptors assumed in the ODCM dose calculations needs to be identified in the Annual Radiological Effluent Release Report.

The 2008 Land Use Census Analysis ranked the farms according to the calculated critical organ dose. The two highest ranked farms within five kilometers of the plant (per requirement of ODCM Table 3.5.1) were Blodgett Farm and Miller Farm. These farms were part of the milk sampling program until the cessation of milk sampling in December 2016 due to the decay of radioiodines since plant shut down. No additional farms are available within a five kilometer radius of the plant. We are not required to, nor are we able to add any additional farm (or farms) to the program at this time.

The results of the 2024 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 2024 Land Use Census Locations*

SECTOR	NEAREST RESIDENCE km (mi)	NEAREST MILK ANIMAL km (mi)
N	1.4 (0.9)	----
NNE	1.4 (0.9)	5.52 (3.42) Cows
NE	1.3 (0.8)	----
ENE	1.0 (0.6)	----
E	0.9 (0.6)	----
ESE	1.9 (1.2)	----
SE	2.0 (1.2)	6.67 (4.4) Cows
SSE	2.1 (1.3)	----
S	0.6 (0.4)	3.6 (2.23) Cows**
SSW	0.8 (0.5)	----
SW	0.4 (0.3)	----
WSW	0.5 (0.3)	9.73 (6.03) Cows
W	0.6 (0.4)	0.82 (0.5) Cows
WNW	1.1 (0.7)	1.1 (0.7) Cows
NW	2.3 (1.4)	----
NNW	1.7 (1.1)	----

* 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 2024, as in previous years during plant operation, a program was conducted to assess the levels of radiation or radioactivity in the Vermont Yankee Nuclear Power Station environment. Samples were collected (including TLDs) over the course of the year, with radionuclide or exposure rate analyses performed. The samples included groundwater, river water, sediment, fish, silage, mixed grass, storm drain sediment, and storm drain water. In additionto 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 Potassium-40, Beryllium-7, Thorium-232 or radon daughter products. These are the most common of the naturally-occurring radionuclides.

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

Tritium (Hydrogen-3), at concentrations 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 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. Steps to remediate the contamination of the subsurface groundwater layer under the plant site were terminated in December 2014. Additional assessment of the dose contribution of radioactive waterborne releases from this event is provided in the 2024 Annual Radioactive Effluent Release Report.

10. REFERENCES

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

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