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NL-14-068

May 9, 2014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: 2013 Annual Radiological Environmental Operating Report
Indian Point Unit Nos. 1, 2 and 3
Docket Nos. 50-03, 50-247, 50-286
License Nos. DPR-5, DPR-26, DPR-64

Dear Sir or Madam:

Enclosed please find one copy of the Entergy Nuclear Operations, Inc. (Entergy) Indian Point Energy Center (IPEC) Annual Radiological Environmental Operating Report for the period January 1, 2013 to December 31, 2013.

This report is submitted in accordance with facility Technical Specification Appendix A section 6 of the provisional operating license for DPR-5 and section 5.6.2 for DPR-26, and DPR-64, Indian Point Unit Nos. 1, 2 and 3 respectively. There are no commitments being made by this report.

Should you or your staff have any questions, please contact Mr. Frank Mitchell, Radiation Protection Manager at 914-254-5236.

Sincerely,

RW/ai

cc: next page

IE25
FSME20
NRR
FSME

Enclosure: 1. 2013 Annual Radiological Environmental Operating Report

cc: Mr. William Dean, Regional Administrator, NRC Region 1
Mr. Douglas Pickett, Senior Project Manager, NRC NRR DORL
IPEC NRC Resident Inspector's Office
Mr. Stephen Giebel, IPEC NRC Unit 1 Project Manager
Mr. John B. Rhodes, President and CEO, NYSERDA
Ms. Bridget Frymire, New York State Department of Public Service
Mr. Timothy Rice, Bureau of Hazardous Waste & Radiation Mgmt, NYSDEC

ENCLOSURE 1 TO NL-14-068

2013 Annual Radiological Environmental Operating Report

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT UNIT 1, 2, and 3 NUCLEAR POWER PLANTS
DOCKET Nos. 50-03, 50-247, and 50-286

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

ENTERGY NUCLEAR

INDIAN POINT NUCLEAR GENERATING STATION
UNITS 1, 2, AND 3

Docket No. 50-003 Indian Point Unit 1 (IP1)
Docket No. 50-247 Indian Point Unit 2 (IP2)
Docket No. 50-286 Indian Point Unit 3 (IP3)

January 1 - December 31, 2013

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EXECUTIVE SUMMARY

INTRODUCTION

This report summarizes the results of the Radiological Environmental Monitoring Program (REMP) conducted in the vicinity of Indian Point Energy Center (IPEC) during the period from January 1 to December 31, 2013. The Indian Point site consists of Units 1, 2 and 3, which are operated by Entergy Nuclear Operations Inc. Unit 1 was retired as a generating facility in 1974, and its reactor is no longer operated.

The REMP has been established to monitor/measure the radiation and radioactivity detectable in the environment that may be attributable to the operation of IPEC. This program, initiated in 1958, includes the collection, analysis, and evaluation of radiological data in order to assess the impact of IPEC on the environment.

SAMPLING AND ANALYSIS

The environmental sampling media collected in the vicinity of IPEC and at distant locations included air particulate filters and charcoal cartridges, soil, drinking water, ground water, broadleaf vegetation, river water, precipitation, shoreline sediment, bottom sediment, aquatic vegetation, fish, and invertebrates.

During 2013, there were 1015 samples collected from the atmospheric, aquatic, and terrestrial environments. In addition, 164 exposure measurements were obtained using environmental thermoluminescent dosimeters (TLDs).

A small number of inadvertent issues were encountered in 2013 in the collection of environmental samples in accordance with the IPEC Offsite Dose Calculation Manual (ODCM). Equipment failures and electrical outages resulted in a small number of instances in which lower than normal sampling volumes were collected at the airborne monitoring stations. A full description of all discrepancies encountered with the environmental monitoring program is presented in the Table B-1 of this report.

There were 1444 analyses performed on the environmental media samples. The analysis of the 2013 Indian Point environmental samples was performed by several laboratories. General Engineering Labs (GEL) of Charlestown, SC, performed the ground water analyses. Thermoluminescent dosimeters were analyzed by Environmental Dosimetry Company (formerly Stanford Associates) of Sterling, MA. Teledyne Brown Engineering, Inc. of Knoxville, TN performed all the remaining analyses for 2013. Samples were analyzed as required by the IPEC ODCM.

LAND USE CENSUS

The annual land use census in the vicinity of IPEC was conducted as required by the IPEC ODCM in May through October. No dairy animals within 5 miles of the Station were located during the census. Due to the difficulty of locating individual gardens and determining those having an area greater than 500 square feet, broadleaf sampling was performed. As allowed for in the ODCM, monthly broad leaf sampling may be used in lieu of a garden census.

SUMMARY OF RESULTS

Most samples collected as part of the IPEC REMP continued to contain detectable amounts of naturally-occurring and man-made radioactive materials. There was no plant related activity detected in any of the terrestrial samples. Offsite ambient radiation measurements using environmental TLDs beyond the site boundary ranged between 42 and 64 milli-Roentgens (mR) per year. The range of ambient radiation levels observed with the TLDs is consistent with natural background radiation levels for New York.

Monitoring of the aquatic environment in the area of the discharge indicated the presence of the following station related radionuclides: Tritium, Cs-137, and Sr-90. These station related nuclide were only found downstream from and in the mixing zone of the discharge at levels that were expected from routine plant operation. No other plant related activity was detected in any offsite samples. The predominant radioactivity for all samples was from non-plant related sources, such as fallout from nuclear weapons tests and naturally occurring radionuclides.

CONCLUSIONS

The 2013 Radiological Environmental Monitoring Program for IPEC resulted in the collection and analysis of over a thousand environmental samples and measurements. The data obtained were used to determine the impact of IPEC's operation on the environment and on the general public.

An evaluation of direct radiation measurements, environmental sample analyses, and dose calculations demonstrates that all applicable federal criteria were met. Furthermore, radiation levels and resulting doses from station operation were a small fraction of those attributed to natural and man-made background radiation.

In summary, the levels of radionuclides in the environment surrounding Indian Point were within the historical ranges, i.e., previous levels resulting from natural and anthropogenic sources for the detected radionuclides. Further, IPEC operations in 2013 did not result in exposure to the public greater than environmental background levels.

SECTION 1.0

INTRODUCTION

1.1 Overview

The Radiological Environmental Monitoring Program (REMP) for 2013 performed by Entergy for the Indian Point Energy Center (IPEC) is discussed in this report. Since the operation of a nuclear power plant results in the release of small amounts of radioactivity and low levels of radiation, the Nuclear Regulatory Commission (NRC) requires a program to be established to monitor radiation and radioactivity in the environment (Reference 1). This report, which is submitted to the NRC annually per Indian Point Technical Specifications, summarizes the results of measurements of radiation and radioactivity in the environment in the vicinity of the IPEC and at distant locations during the period January 1 to December 31, 2013.

The REMP is used to measure the direct radiation and the airborne and waterborne pathway activity in the vicinity of the Indian Point site. Direct radiation pathways include radiation from buildings and plant structures, airborne and liquid material that might be released from the plant, cosmic radiation, and the naturally occurring radioactive materials in the ground. Analysis of thermoluminescent dosimeters (TLDs), used to measure direct radiation, indicated that there were no increased radiation levels attributable to plant operations.

The airborne pathway includes measurements of air, precipitation, drinking water, and broad leaf vegetation samples. The airborne pathway measurements indicated that there was no adverse radiological impact to the surrounding environment attributed to Indian Point Station operations.

The waterborne pathway consists of Hudson River water, fish and invertebrates, aquatic vegetation, bottom sediment, and shoreline sediment. Measurements of the media comprising the waterborne pathway indicated that there was no adverse radiological impact to the surrounding environment attributed to Indian Point Station operations.

The ground water table is listed after the rain water and drinking water tables for ease of data comparison. However, ground water is not a dose pathway since it is not a drinking water pathway at IPEC.

These results are reviewed by IPEC's staff and have been reported semiannually or annually to the Nuclear Regulatory Commission and others for over 30 years.

This report contains a description of the REMP for IPEC and the conduct of that program in 2013 as required by the IPEC ODCM. Also included are summaries and discussions of the results of the 2013 program, trend analyses (where appropriate), comparison to historical results and trend analyses (where appropriate) and evaluation of any potential impact on the environment. Results of the annual land use census, as well as the inter-laboratory comparison program are included, per the ODAs requirements.

SECTION 2

BACKGROUND

2.0 BACKGROUND

2.1 Site Description

The Indian Point site occupies 239 acres on the east bank of the Hudson River on a point of land at Mile Point 42.6. The site is located in the Village of Buchanan, Westchester County, New York. Three nuclear reactors, Indian Point Unit Nos. 1, 2 and 3, and associated buildings occupy approximately 35 acres. Unit 1 began operation in 1962 and was retired as a generating facility in 1974. Units 2 and 3 began operation 1974 and 1978. Indian Point Units 1 and 2 are owned by Entergy Nuclear Indian Point 2, LLC and Unit 3 is owned by Entergy Nuclear Indian Point 3 LLC. All three units are operated by Entergy Nuclear, although only Units 2 and 3 continue to operate.

2.2 Program Background

Environmental monitoring and surveillance have been conducted at Indian Point since 1958, four years prior to the start-up of Unit 1. The pre-operational program was designed and implemented to determine the background radioactivity and to measure the variations in activity levels from natural and other sources in the vicinity, as well as fallout from atmospheric nuclear weapons tests. Thus, as used in this report, background levels consist of those resulting from both natural and anthropogenic sources of environmental radioactivity. . Accumulation of this background data permits the detection and assessment of environmental activity attributable to plant operations.

2.3 Program Objectives

The current environmental monitoring program is designed to meet two primary objectives:

1. To enable the identification and quantification of changes in the radioactivity of the area.
2. To measure radionuclide concentrations in the environment attributable to operations of the Indian Point site.

To identify changes in activity, the environmental sampling schedule requires that analyses be conducted for specific environmental media on a regular basis. The radioactivity profile of the environment is established and monitored through routine evaluation of the analytical results obtained.

The REMP designates sampling locations for the collection of environmental media for analysis. These sample locations are divided into indicator and control locations. Indicator locations are established near the site, where the presence of environmental radioactivity of plant origin is most likely to be detected. Control locations are established farther away (and upwind/upstream, where applicable) from the site, where the level would not generally be affected by plant discharges. The use of indicator and control locations enables the identification of potential sources of detected radioactivity, thus meeting one of the program objectives.

Verification of expected radionuclide concentrations resulting from effluent releases attributable to the site is another objective of the REMP, which is met by meeting the two primary program objective described above. Verifying projected concentrations through the REMP is difficult since the environmental concentrations resulting from plant releases are typically too small to be detected. Plant related radionuclides were detected in 2013 in very low levels; however, residual radioactivity from atmospheric weapons tests and naturally occurring radioactivity were the predominant sources of radioactivity in the samples collected. Analysis of the 2013 REMP sample results confirms that radiological effluents were well below regulatory limits.

SECTION 3

PROGRAM DESCRIPTION

3.0 PROGRAM DESCRIPTION

To achieve the objectives of the REMP and ensure compliance with the ODCM, sampling and analysis of environmental media are performed as outlined in Table A-1 and described in section 3.3.

3.1 Sample Collection

Entergy personnel perform collection of environmental samples for the Indian Point site, with the exception of groundwater and fish/invertebrate samples. The groundwater samples are collected by a contracted environmental vendor, GZA Geo Environmental, Inc. Collection of fish and invertebrate samples is performed by a contracted environmental vendor - Normandeau Associates, Inc.

3.2 Sample Analysis

The analysis of the 2013 Indian Point environmental samples was performed by several laboratories. General Engineering Labs (GEL) of Charlestown, SC, performed the ground water analyses. Thermoluminescent dosimeters were analyzed by Environmental Dosimetry Company (formerly Stanford Associates) of Sterling, MA. Teledyne Brown Engineering, Inc. of Knoxville, TN performed all the remaining analyses.

3.3 Sample Collection and Analysis Methodology

3.3.1 Direct Radiation

Direct gamma radiation is measured using integrating calcium sulfate thermoluminescent dosimeters (TLDs), which provide cumulative measurements of radiation exposure (i.e., total integrated exposures in milli-roentgen, mR) for a given period. The area surrounding the Indian Point site is divided into 16 compass sectors. Each sector has two TLD sample locations. The inner ring is located near the site boundary at approximately 1 mile (1.6 km). The outer ring is located at approximately 5 miles (8 km) from the site (6.7- 8.0 km), see Figures A-1 and A-2. Additional TLD locations include a control location at Roseton (20.7 miles north) and eight locations of special interest. In total, there are 41 TLD sample sites, designated DR-1 through DR-41, with two TLDs placed at each site. TLDs are collected and processed on a quarterly basis. The results are reported as mR per standard quarter (91 days). The data reported is the average of the two TLDs from each sample site.

3.3.2 Airborne Particulates and Radioiodine

Air samples were taken at eight locations varying in distance from 0.28 to 20.7 miles (0.4 to 33 km) from the plant. These locations represent one control at sampling station 23 (A5) and seven indicator locations. These indicator locations are at sampling stations 4 (A1), 5 (A4), 27, 29, 44, 94 (A2), and 95 (A3). The locations are shown on Figures A-1, A-2, and A-3. The air samples are collected continuously by means of fixed air particulate filters followed by in-line charcoal cartridges. Both filters and cartridges are changed on a weekly basis. The filters are analyzed for gross beta and the cartridge samples for radioiodine. In addition, gamma spectroscopy analysis (GSA) is performed on quarterly composites of the air particulate filters.

3.3.3 Precipitation

Precipitation samples are continuously collected at one indicator location (sampling station 44) and one control location (23); see Figure A-3. They are collected in sample bottles designed to hinder evaporation. They are composited quarterly and analyzed by gamma spectroscopy and for tritium.

3.3.4 Drinking Water

Samples of drinking water are collected monthly from the Camp Field Reservoir (3.4 miles NE, sample station 7, sample designation Wb1) and New Croton Reservoir (6.3 miles SE, sample station 8); see Figure A-3. Each monthly sample is approximately 4 liters and is analyzed for gross beta and gamma-emitting radionuclides. Monthly samples are composited quarterly and analyzed for tritium.

3.3.5 Groundwater Water

Groundwater samples are obtained semi-annually at Lafarge (106.) Samples are analyzed for tritium, strontium-90, and nickel-63 and by gamma spectroscopy.

3.3.6 Soil

Soil samples are collected from two indicator locations (sampling stations 94 and 95), and one control location (23) on an annual basis; see Figure A-3. They are approximately 2 kg in size and consist of about twenty 2-inch deep cores. The soil samples are analyzed by gamma spectroscopy.

3.3.7 Broad Leaf Vegetation

Broad leaf vegetation samples are collected from three locations during the growing season. The indicator locations are sampling stations 94 (Ic2) and 95 (Ic1), and the control location is at sampling station 23 (Ic3). See Figures A-1 and A-2. The samples are collected monthly, when available, and analyzed by gamma spectroscopy. These samples consist of at least 1 kg of leafy vegetation and are used in the assessment of the food product and milk ingestion pathways.

3.3.8 Hudson River Water

Hudson River water sampling is performed continuously at the intake structure (sampling station 9, Wa1) and at a point exterior to the discharge canal where Hudson River water and water from the discharge canal mix (sampling station 10, Wa2); see Figure A-1. An automatic composite sampler is used to take representative samples. On a weekly basis, accumulated samples are taken from both sample points. These weekly river water samples are composited for monthly gamma spectroscopy analysis and quarterly for tritium analysis.

3.3.9 Hudson River Bottom Sediment

Bottom sediment and benthos are sampled at four locations: three indicator locations (sampling stations 10, 17, and 28) and one control location (84), along the Hudson River, once each spring and summer; see Figure A-3. These samples are obtained using a Peterson grab sampler or similar instrument. The bottom sediment samples are analyzed by gamma spectroscopy.

3.3.10 Hudson River Shoreline Soil

Shoreline soil samples are collected at three indicator and two control locations along the Hudson River. The indicator locations are at sampling stations 53 (Wc1), 28, and 17. The control locations are at sampling stations 50 (Wc2) and 84. Figures A-1, A-2, and A-3 show these locations. The samples are gathered at a level above low tide and below high tide and are approximately 2-kg grab samples. These samples are collected at greater than 90 days apart and are analyzed by gamma spectroscopy and for strontium-90.

3.3.11 Hudson River Aquatic Vegetation

During the spring and summer, aquatic vegetation samples are collected from the Hudson River at two indicator locations (sampling stations 17 and 28) and one control location (84); see Figure A-3. Samples of aquatic vegetation are obtained depending on sample availability. These samples are analyzed by gamma spectroscopy.

3.3.12 Fish and Invertebrates

Fish and invertebrate samples are obtained from the Hudson River at locations upstream and downstream of the plant discharge. The indicator location (downstream sample point) is designated as sampling station 25 (Ib1), and a second sampling point is located further downstream. The control location (upstream) is at sampling station 23 (Ib2). See Figures A-1 and A-2. These samples are collected in season or semiannually if they are not seasonal. The fish and invertebrates sampled are analyzed by gamma spectroscopy as well as for strontium-90 and for nickel-63.

3.3.13 Land Use Census

Each year a land use census consisting of milch animal and residence surveys is conducted during the growing season to determine the current utilization of land within 5 miles (8 km) of the site. These surveys are used to determine whether there are changes in existing conditions that warrant changing the sampling program.

For example, the milch animal census is used to identify animals producing milk for human consumption within 5 miles (8 km) of Indian Point. This census consists of visual field surveys of the areas where a high probability of milch animals exists and confirmation through New York State records or with personnel such as feed suppliers who deal with farm animals and dairy associations (See Tables B-21 and B-22).

Visual inspections are made of the 5-mile area around the Indian Point Site during routine sample collections and emergency plan equipment inspections in the area throughout the year. An extensive land survey is conducted of the 5-mile area in an attempt to identify new residential areas, commercial developments and to identify milch animals in pasture.

Although there are presently no animals producing milk for human consumption within 5 miles (8 km) of the site, the census is performed to determine if a milk-sampling program needs to be conducted.

A residence census is also performed to identify the nearest residence(s) to the site in each of the 16 sectors surrounding Indian Point. See Table B-22.

A garden census was not performed, since the ODCM allows sampling of vegetation in two sectors near the site boundary in lieu of a garden census. The sectors are chosen to be in the pre-dominant wind directions with the highest predicted deposition rates.

3.4 Statistical Methodology

There are several statistical calculation methodologies used in evaluating the data from the Indian Point REMP. These methods include determination of Lower Limits of Detection (LLD) and the Minimum Detectable Concentration (MDC), and estimation of the mean and associated propagated error.

3.4.1 LOWER LIMIT OF DETECTION (LLD)

The LLD is the smallest concentration of radioactive material in a sample that will yield a net count above system background, and be detected with 95% probability, with a 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{\frac{2.71}{T_s} + 3.29 s_b * \sqrt{1 + (\frac{T_b}{T_s})}}{E * V * k * Y * e^{-\lambda t}}$$

Where:

LLD =	The lower limit of detection as defined above (as picocurie per unit mass or volume)
Ts =	The sample counting time in minutes
s_b =	The standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)
T_b =	The background count time in minutes
E =	The counting efficiency (as counts per transformation)
V =	The sample size (in units of mass or volume)
k =	A constant for the number of transformations per minute per unit of activity (normally, 2.22E+6 dpm per uCi)
Y =	The fractional radiochemical yield (when applicable)
λ =	The radioactive decay constant for the particular radionuclide
t =	The elapsed time between midpoint of sample collection and time of counting

Note: The above LLD formula accounts for differing background and sample count times. The Radiological Environmental Monitoring Program, REMP, may use an LLD formula that assumes equal background and sample count times, when appropriate. The constants 2.71 and 3.29 and the general LLD equation were derived from References 2 and 3.

The value of S_b used in the calculation of the LLD for a detection system shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance. In calculating the LLD for a radionuclide determined by gamma ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples. Typical values of E, V, Y, and t shall be used in the calculation. The background count rate is calculated from the background counts that are determined by a separate background count or in the case of gamma ray spectroscopy, from adjacent channels of the energy band of the gamma ray peak used for the quantitative analysis for that radionuclide.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement process and not as an a posteriori (after the fact) limit for a particular measurement. To document the post priori (after the fact) measurement statistics, the MDC is calculated after the measurement using the same equation as above.

To handle the a posteriori problem, a decision level must be defined. To minimize the number of false positives, a value is not considered positive unless it is greater than the MDC or 3 times the total standard deviation of the post priori measurement, where MDC is the post priori (after the fact) measurement statistic calculated similar to the LLD equation listed above (for $T_b = T_s$, the term $3.29\ \sigma_b * [(1 + (T_b / T_s))^{1/2}] = 4.66\ \sigma_b$).

3.4.2 Table Statistics

The averages shown in the summary table (Table B-2) are the averages of the positive values in accordance with the NRC's Branch Technical Position (BTP) to Regulatory Guide 4.8 (Reference 4). Samples with "<" values are not included in the averages.

It should be noted that this statistic for the mean using only positive values tends to strongly bias the average high, particularly when only a few of the data are measurably positive. The REMP data show few positive values; thus the corresponding means are biased high. Exceptions to this include direct radiation measured by TLDs and gross beta radioactivity in air, which show positive monitoring results throughout the year.

The historical data tables contain the annual averages of the positive values for each year. The historical averages are calculated using only the positive values presented for 2003 through 2013. The 2013 average values are included in these historic tables for purposes of comparison.

SECTION 4

RESULTS AND DISCUSSION

4.0 RESULTS AND DISCUSSION

The 2013 Radiological Environmental Monitoring Program (REMP) was conducted in accordance with Indian Point's Offsite Dose Calculation Manual ODCM. The ODCM contains requirements for the number and distribution of sampling locations, the types of samples to be collected, and the types of analyses to be performed for measurement of radioactivity.

The REMP at Indian Point includes measurements of radioactivity levels in the following environmental pathways.

- Direct Gamma Radiation
- Precipitation
- Groundwater
- Broad Leaf Vegetation
- Bottom Sediment
- Aquatic Vegetation
- Airborne Particulates and Radioiodine
- Drinking Water
- Soil
- Hudson River Water
- Shoreline Soil
- Fish and Invertebrates

An annual land use and milch animal census is also part of the REMP.

To evaluate the contribution of plant operations to environmental radioactivity levels, other man-made and natural sources of environmental radioactivity, as well as the aggregate of past monitoring data, must be considered. It is not merely the detection of a radionuclide, but the evaluation of the location, magnitude, source, and history of its detection that determines its significance. Therefore, we have reported the data collected in 2013 and assessed the significance of the findings.

A summary of the results of the 2013 REMP is presented in Table B-2. This Table lists the mean and range of all positive results obtained for each of the media sampled at ODCM indicator and control locations. Discussions of these results and their evaluations are provided below.

The radionuclides detected in the environment can be grouped into three categories: (1) naturally occurring radionuclides; (2) radionuclides resulting from weapons testing and other non-plant related, anthropogenic sources; and (3) radionuclides that could be related to plant operations.

The environment contains a broad inventory of naturally occurring radionuclides which can be classified as, cosmic ray induced (e.g., Be-7, H-3) or geologically derived (e.g., Ra-226 and progeny, Th-228 and progeny, and K-40.) These radionuclides constitute the majority of the background radiation source and thus account for a majority of the annual background dose detected. Since the detected concentrations of these radionuclides were consistent at indicator and control locations, and unrelated to plant operations, their presence is noted only in the data tables and will not be discussed further.

The second group of radionuclides detected in 2013 consists of those resulting from past weapons testing in the earth's atmosphere. The more recent contamination events resulting from the Chernobyl and Fukushima accidents only indicated detectable activity shortly after their occurrences (Reference 5). However, weapons testing in the 1950's and 1960's resulted in a significant atmospheric radionuclide inventory, which, in turn, still contributes to the concentrations in the ecological systems. Although reduced in frequency, atmospheric weapons testing continued into the 1980's. The resultant radionuclide inventory of some radionuclides, although diminishing with time (e.g., through radioactive decay and natural dispersion processes), remains detectable.

In 2013, the detected radionuclide that may be attributable to past atmospheric weapons testing consisted of Cs-137 in several media. The levels detected were consistent with the historical levels of radionuclides resulting from weapons tests as measured in previous years.

The final group of radionuclides detected by the 2013 REMP comprises those that may be attributable to current plant operations. During 2013, Cs-137, H-3 (Tritium), and Sr-90 were the only potentially plant-related radionuclides detected in any environmental samples.

H-3 may be present in the local environment due to either natural occurrence, other man-made sources, or as a result of plant operations. Natural occurrence is very low (on the order of approximately 5 pCi/liter - well below typical detectable levels). The major source of H-3 is typically from above ground nuclear weapons testing, in the range of 50 to 150 pCi/liter). Other sources include weapons production and industrial uses where levels are highly dependent on the release rates and distance from the source term. One such industrial source is nuclear power plant operation.

Cs-137 is ubiquitous in the environment from atmospheric testing debris and a lesser amount from the Chernobyl accident. In 2013, there were two detections of Cs-137 in shoreline soil (2 indicator samples). In bottom sediment there were five positive detections of Cs-137 (all at indicator stations or near the plant). The two discharge canal samples are consistent with historical values.

Shoreline sediment and bottom sediment samples showed detectable levels of Cs-137 somewhat higher at the indicator locations than at the control location at Cold Spring (distant location). The fact that there was no Cs-134 present (recent plant releases would contain Cs-134) and that there was detection also at a distant location indicates that the activity may be due to atmospheric weapons testing, with some contribution from plant releases from the past several years. None of the fish samples indicated any detectable levels of these isotopes.

Strontium-90 (Sr-90) may also be present in the environment from atmospheric testing debris. None of the fish samples, or any other media (except for blue crab) where Sr-90 was tested, indicated any detectable levels of this isotope. However, very low levels of Sr-90 were detected in one indicator and one control location sample of blue crab.

I-131 is also produced in fission reactors, but can result from non-plant related anthropogenic sources, e.g., medical administrations, such as in previous years. I-131 was not detected in 2013 in aquatic or terrestrial vegetation indicator and control locations.

Co-58 and Co-60 are activation/corrosion products also related to plant operations. They are produced by neutron activation in the reactor core. Co-58 has a much shorter half-life than Co-60. If Co-58 and Co-60 are concurrently detected in environmental samples, then the source of these radionuclides is more likely the result of recent releases. When significant concentrations of Co-60 are detected but no Co-58, there is an increased likelihood that the Co-60 is due to residual Co-60 from past operations. There was no Co-58 or Co-60 detected in the 2013 REMP, although they were observed in historical data.

In the following sections, a summary of the results of the 2012 REMP is presented by sample medium and the significance of any positive findings discussed. It should be noted that naturally occurring radionuclides are omitted from the summary table (Table B-2) and further discussion.

4.1 Direct Radiation

The environmental TLDs used to measure the direct radiation were TLDs supplied and processed by Environmental Dosimetry Company. In 2013, the TLD program produced a consistent picture of ambient background radiation levels in the vicinity of the Indian Point Station. A summary of the annual TLD data is provided in Table B-2 and all the TLD data are presented in Tables B-3, B-4 and B-5. TLD sample site DR-40 is the control site for the direct radiation (DR) series of measurements.

Table B-3 provides the quarterly and annual average reported doses in mR per standard quarter for each of the direct radiation sample points, DR-1 through DR-41. The table also provides the sector for each of the DR sample points. Table B-4 provides the mean, standard deviation, minimum and maximum values in mR per standard quarter for the years 2003 through 2013. The 2013 means are also presented in Table B-4. Table B-5 presents the 2013 TLD data for the inner ring and outer ring of TLDs.

The 2013 mean value for the indicator direct radiation sample points was 13.7 mR per standard quarter – which is consistent with historical values. At those locations where the 2013 mean value was higher than historical means, they are within historical bounds for the respective locations.

The DR sample locations are arranged so that there are two concentric rings of TLDs around the Indian Point site. The inner ring (DR-1 to DR-16) is close to the site boundary. The outer ring (DR-17 to DR-32) has a radius of approximately 5 miles from the three Indian Point units. The results for these two rings of TLDs are provided in Table B-5. The annual average for the inner ring was 13.2 mR per standard quarter and also average for the outer ring was 14.1 mR per standard quarter. The control location average for 2013 was 12.5 mR per standard quarter.

Table C-1 and Figure C-1 present the 10-year historical averages for the inner and outer rings of TLDs. The 2013 averages are consistent with the historical data. The 2013 and previous years' data show that there is no measurable direct radiation in the environment due to the operation of the Indian Point site.

4.2 Airborne Particulates and Radioiodine

An annual summary of the results of the 2012 air particulate filter and charcoal cartridge analyses is presented in Table B-2. As shown, there were no radionuclides detected in the air attributable to plant operations.

The results of the analyses of weekly air particulate filter samples for gross beta activity are presented in Table B-6 and the weekly charcoal cartridge analytical results are presented in Table B-7.

Gross beta activity was found in air particulate samples throughout the year at all indicator and control locations. The average gross beta activity for the eight indicator air sample locations was 0.014 pCi/m^3 and the average for the control location was 0.014 pCi/m^3. The activities detected were consistent for all locations, with no significant differences in gross beta activity in any sample due to location. All the charcoal cartridge results were less than MDC, consistent with historical trends when there were no episodes of fresh fallout from Weapons Testing or accidents.

The results of the GSA of the quarterly composites of these samples are in Table B-8. These quarterly composite air samples showed that no reactor-related radionuclides were detected and that only naturally-occurring radionuclides were present at detectable levels.

The mean annual gross beta concentrations and Cs-137 concentrations in air for the past 10 years are presented in Table C-2. From this table and Figure C-2, it can be seen that the average 2013 gross beta concentration was consistent with historical levels. Cs-137 has not been detected since 1987. This is consistent with the trend of decreasing ambient Cs-137 concentrations in recent years.

From the data, it can be seen that no airborne radioactivity attributable to the operation of Indian Point was detected in 2013.

4.3 Precipitation

A summary of the precipitation sample analysis results is presented in Table B-2. Table B-9 contains the results of the precipitation samples for 2013. Only naturally occurring radionuclides were detected in the precipitation samples.

A review of historical data over the last 10 years indicates tritium had been detected in one indicator precipitation sample in 2010 and both indicator and control locations in 2010; however, there have been no instances of positive values in 2013.

4.4 Drinking Water

The annual program summary table (Table B-2) contains a summary of the 2013 drinking water sample analysis results. Results of the tritium and gamma spectroscopy analyses of the monthly drinking water samples are in Table B-10. Other than naturally occurring radionuclides, no radioactivity was detected in drinking water samples. This has historically been the case for the radionuclide results for this media. Operation of the Indian Point units had no detectable radiological impact on drinking water.

4.5 Ground Water

A summary of the groundwater samples for 2013 is contained in Table B-2. Data resulting from analysis of the groundwater samples for gamma emitters, tritium analysis, Ni-63 and Sr-90 are given in Table B-11. No plant related nuclides were noted in these samples.

4.6 Soil

A summary of the soil sample analysis results is presented in Table B-2. Table B-12 contains the results of the soil samples for 2013. Other than naturally occurring radionuclides, no activity was detected in any of the soil samples.

4.7 Broad Leaf Vegetation

Table B-2 contains a summary of the broad leaf vegetation sample analysis results. Data from analysis of the 2013 samples are presented in Table B-13.

Table C-3 contains an historical summary and Figure C-3 is an illustration of the broad leaf vegetation analysis results. There were no plant related nuclides detected in the 2013 samples. The detection of low levels of Cs-137 has occurred sporadically at both indicator and control locations at relatively low concentrations for the past ten years, most likely the result of previous atmospheric weapons testing.

4.8 Hudson River Water

A summary of the radionuclides detected in the Hudson River water is contained in Table B-2. Data resulting from analysis of monthly Hudson River water samples for gamma emitters and quarterly composites of H-3 are presented in Tables B-14.

The only plant related activity detected was H-3, and it was detected at low levels in indicator and control samples. The levels are consistent with occasional historical detection of H-3. Table C-3 shows historical H-3 concentrations at the plant inlet and discharge points. Table C-8 contains a comparison of H-3 detected at the plant discharge (Hudson River Water mixing point) versus quarterly average effluents concentrations. Table C-8 provides assurance that the REMP is indeed providing verification of the calculation of radionuclide concentrations resulting from effluent releases attributable to the site.

4.9 Hudson River Bottom Sediment

A summary of the Hudson River bottom sediment analysis results is included in Table B-2. Table B-15 contains the results of the analysis of bottom sediment samples for 2013. Cs-137 was detected in all 10 indicator station samples, and 2 of 3 control location samples. Detection of positive levels of Cs-137 in river bottom sediment is not unusual. Cs-134 was not detected in any bottom sediment samples. The lack of Cs-134 points to the primary source of the Cs-137 in bottom sediment as being from prior historical plant releases over the years and from residual weapons test fallout.

The discharge canal bottom sediment sample results were higher than the levels seen in recent years. The average concentration was 2738 pCi/kg, and the range was 153-13870 pCi/kg.

The levels observed during 2013 sampling are within the range of levels identified in historical samples. Given the significant movement of silt and sediment observed in the river during the 2013 hurricane season it is likely that deeper sediment material was redistributed and re-deposited during the storm events. The elevated sediment concentrations are most likely the result of the observed higher sediment in the river. Additionally the effluents from Indian Point in particular for Cs-137 continue to remain at very low concentrations in particular when compared to historical effluent releases where river sediment concentrations were at the higher end of the historical range.

4.10 Hudson River Shoreline Soil

A summary of the radionuclide concentrations detected in the shoreline soil samples is contained in Table B-2. Table B-16 contains the results of the gamma spectroscopic and strontium-90 analyses of the shoreline soil samples.

In addition to the naturally occurring radionuclides, Cs-137 was identified in the Hudson River shoreline soil samples in 2013. Cs-137 was detected at the Verplank location in both samples from that location, for a total of two positive values out of eight samples from indicator locations. Cs-137 was not detected at the control location (Manitou Inlet). The average concentration for the indicator locations that had positive indication of Cs-137 was 133 pCi/kg (dry) with a maximum concentration of 158 pCi/kg (dry).

An historical look at Cs-137 detected in shoreline soil at indicator and control locations can be viewed in Table C-6 and Figure C-6. Cs-137 has been and continues to be present in this media, both at indicator and occasionally at the control location, at a consistent level over the past ten years. Cs-134 and Cs-137 are both discharged from the plant in similar quantities. The lack of Cs-134 activity is an indication that the primary source of the Cs-137 in the shoreline soil is legacy contamination from weapons fallout.

No Sr-90 was detected in any collected shoreline soil samples.

4.11 Aquatic Vegetation

A summary of the aquatic sample analysis results is presented in Table B-2. Table B-17 contains the results of the analysis of aquatic vegetation samples for 2013. No plant related radionuclides were detected.

4.12 Fish and Invertebrates

A summary of the fish and invertebrate sample analysis results is presented in Table B-2. Table B-18 contains the results of the analysis of fish and invertebrate samples for 2013 The only plant related nuclide detected was Sr-90, which was detected at very low levels in one sample each of blue crab from both the control (4.1 pCi/kg) and indicator locations (6.1 pCi/kg). This was attributed to the presence of notable amounts of shell pieces in those samples. In addition, these values are well within the range of those identified by NYSDEC in their study of Sr-90 in fish and invertebrate in the lower Hudson River, reported in 2009.

4.13 Land Use Census

A census was performed in the vicinity of Indian Point in 2013. This census consisted of a milch animal and a residence census. Results of this census are presented in Tables B-21 and B-22.

The results of the 2013 census were generally same as the 2012 census results, with one exception. In August 2013, the presence of goats was noted on a property located 3.5 – 4 miles NNE of IPEC. However, discussions with the owner confirmed that the goats were all male and therefore not milch animals.

The second part of this census revealed that the two nearest residences in different sectors are located 0.44 miles (0.71 km) ESE and 0.73 miles (1.13 km) S of the plant. The 2013 land use census indicated there were no new residences that were closer in proximity to IPEC.

The ODCM allows the sampling of broad leaf vegetation in two sectors at the site boundary in lieu of performing a garden census. Analysis results for these two sectors are discussed in Section 4.6 and presented in Table B-14, Table C-6 and Figure C-6.

4.14 Conclusion

The Radiological Environmental Monitoring Program is conducted each year to determine the radiological impact of Indian Point operations on the environment. The preceding discussions of the results of the 2013 REMP reveal that operations at the station did not result in an impact on the environment.

The 2013 REMP results demonstrate the relative contributions of different radionuclide sources, both natural and anthropogenic, to the environmental concentrations. The results indicate that the fallout from previous atmospheric weapons testing continues to contribute to detection of Cs-137 in some environmental samples. There are infrequent detections of plant related radionuclides in the environs; however, the radiological levels are very low and are significantly less than those from natural background and other anthropogenic sources.

SECTION 5

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APPENDIX A

ENVIRONMENTAL SAMPLING AND ANALYSIS REQUIREMENTS

APPENDIX A

Environmental media are sampled at the locations specified in Table A-1 and shown in Figures A-1, A-2, and A-3. The samples are analyzed according to criteria established in the ODCM. These requirements include: methods of sample collection; types of sample analysis; minimum sample size required; lower limit of detection, which must be attained for each medium, sample, or analysis type, and environmental concentrations requiring special reports.

Table A-1 provides the sampling station number, location, sector, and distance from Indian Point, sample designation code, and sample type. This table gives the complete listing of sample locations used in the 2013 REMP.

Three maps are provided to show the locations of REMP sampling. Figure A-1 shows the sampling locations within two miles of Indian Point. Figures A-2 and A-3 show the sampling locations within ten miles of Indian Point.

The ODCM required lower limits of detection (LLD) for Indian Point sample analyses are presented in Table A-2. These required lower limits of detection are not the same as the lower limits of detection or critical levels actually achieved by the laboratory. The laboratory's lower limits of detection and critical levels must be equal to or lower than the required levels presented in Table A-2.

Table A-3 provides the reporting level for radioactivity in various media. Sample results that exceed these levels and are due to plant operations require that a special report be submitted to the NRC.

In addition to the sampling outlined in Table A-1, there is an environmental surveillance requirement that an annual land use and milch animal census be performed. See Tables B-19 and B-20 for the milch animal and land use census.

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
3	DR8	Service Center Building	Onsite - 0.35 Mi (SSE) at 158°	Direct Gamma
4	A1 A1	Algonquin Gas Line	Onsite - 0.28 Mi (SW) at 234°	Air Particulate Radioiodine
5	A4 A4 DR10	NYU Tower	Onsite - 0.88 Mi (SSW) at 208°	Air Particulate Radioiodine Direct Gamma
7	Wb1	Camp Field Reservoir	3.4 Mi (NE) at 51°	Drinking Water
8	**	Croton Reservoir	6.3 Mi (SE) at 124°	Drinking Water
9	Wa1	Plant Inlet (Hudson River Intake)*	Onsite - 0.16 Mi (W) at 273°	HR Water
10	Wa2 **	Discharge Canal (Mixing Zone)	Onsite - 0.3 Mi (WSW) at 249°	HR Water HR Bottom Sediment
14	DR7	Water Meter House	Onsite - 0.3 Mi (SE) at 133°	Direct Gamma
17	** ** **	Off Verplanck	1.5 Mi (SSW) at 202.5°	HR Aquatic Vegetation HR Shoreline Soil HR Bottom Sediment
20	DR38	Cortlandt Yacht Club (AKA Montrose Marina)	1.5 Mi (S) at 180°	Direct Gamma
23	** A5 A5 DR40 Ic3 ** Ib2	Roseton*	20.7 Mi (N) at 357°	Precipitation Air Particulate, Radioiodine Direct Gamma Broad Leaf Vegetation Soil Fish & Invertebrates
25	Ib1	Downstream	Downstream	Fish & Invertebrates
27	** ** DR41	Croton Point	6.36 Mi (SSE) at 156°	Air Particulate Radioiodine Direct Gamma
28	** DR4 ** **	Lent's Cove	0.45 Mi (ENE) at 069°	HR Shoreline Soil Direct Gamma HR Bottom Sediment HR Aquatic Vegetation
29	** ** DR39	Grassy Point	3.37 Mi (SSW) at 196°	Air Particulate Radioiodine Direct Gamma

* = Control location
** = Locations listed do not have sample designation locations specified in the ODCM
HR = Hudson River   R/S = Reuter Stokes

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
33	DR33	Hamilton Street (Substation)	2.88 Mi (NE) at 053°	Direct Gamma
34	DR9	South East Corner of Site	Onsite - 0.52 Mi (S) at 179°	Direct Gamma
35	DR5	Broadway & Bleakley Avenue	Onsite - 0.37 Mi (E) at 092°	Direct Gamma
38	DR34	Furnace Dock (Substation)	3.43 Mi (SE) at 141°	Direct Gamma
44	** ** **	Peekskill Gas Holder Bldg	1.84 Mi (NE) at 052°	Precipitation Air Particulate Radioiodine
50	Wc2	Manitou Inlet*	4.48 Mi (NNW) at 347°	HR Shoreline Soil
53	Wc1 DR11	White Beach	0.92 Mi (SW) at 226°	HR Shoreline Soil Direct Gamma
56	DR37	Verplanck - Broadway & 6th Street	1.25 Mi (SSW) at 202°	Direct Gamma
57	DR1	Roa Hook	2 Mi (N) at 005°	Direct Gamma
58	DR17	Route 9D - Garrison	5.41 Mi (N) at 358°	Direct Gamma
59	DR2	Old Pemart Avenue	1.8 Mi (NNE) at 032°	Direct Gamma
60	DR18	Gallows Hill Road & Sprout Brook Road	5.02 Mi (NNE) at 029°	Direct Gamma
61	DR36	Lower South Street & Franklin Street	1.3 Mi (NE) at 052°	Direct Gamma
62	DR19	Westbrook Drive (near the Community Center)	5.03 Mi (NE) at 062°	Direct Gamma
64	DR20	Lincoln Road - Cortlandt (School Parking Lot)	4.6 Mi (ENE) at 067°	Direct Gamma
66	DR21	Croton Avenue - Cortlandt	4.87 Mi (E) at 083°	Direct Gamma
67	DR22	Colabaugh Pond Road - Cortlandt	4.5 Mi (ESE) at 114°	Direct Gamma
69	DR23	Mt. Airy & Windsor Road	4.97 Mi (SE) at 127°	Direct Gamma
71	DR25	Warren Ave - Haverstraw	4.83 Mi (S) at 188°	Direct Gamma
72	DR26	Railroad Avenue & 9W - Haverstraw	4.53 Mi (SSW) at 203°	Direct Gamma
73	DR27	Willow Grove Road & Captain Faldermeyer Drive	4.97 Mi (SW) at 226°	Direct Gamma
74	DR12	West Shore Drive - South	1.59 Mi (WSW) at 252°	Direct Gamma
75	DR31	Palisades Parkway	4.65 Mi (NW) at 225°	Direct Gamma
76	DR13	West Shore Drive - North	1.21 Mi (W) at 276°	Direct Gamma
77	DR29	Palisades Parkway	4.15 Mi (W) at 272°	Direct Gamma
78	DR14	Rt. 9W across from R/S #14	1.2 Mi (WNW) at 295°	Direct Gamma
79	DR30	Anthony Wayne Park	4.57 Mi (WNW) at 296°	Direct Gamma

* = Control location
** = Locations listed do not have sample designation locations specified in the ODCM
HR = Hudson River R/S = Reuter Stokes

TABLE A-1
INDIAN POINT REMP SAMPLING STATION LOCATIONS

SAMPLING STATION	SAMPLE DESIGNATION	LOCATION	DISTANCE	SAMPLE TYPES
80	DR15	Route 9W South of Ayers Road	1.02 Mi (NW) at 317°	Direct Gamma
81		Palisades Pkwy - Lake Welch Exit	4.96 Mi (WSW) at 310°	Direct Gamma
82	DR16	Ayers Road	1.01 Mi (NNW) at 334°	Direct Gamma
83	DR32	Route 9W - Fort Montgomery	4.82 Mi (NNW) at 339°	Direct Gamma
84	** ** **	Cold Spring *	10.88 Mi (N) at 356°	HR Aquatic Vegetation HR Shoreline Soil HR Bottom Sediment
88	DR6	Reuter Stokes Pole #6	0.32 Mi (ESE) at 118°	Direct Gamma
89	DR35	Highland Ave & Sprout Brook Road (near rock cut)	2.89 Mi (NNE) at 025°	Direct Gamma
90	DR3	Charles Point	0.88 Mi (NE) at 047°	Direct Gamma
92	DR24	Warren Road - Cortlandt	3.84 Mi (SSE) at 149°	Direct Gamma
94	A2 A2 Ic2 **	IPEC Training Center	Onsite- 0.39 Mi (S) at 193°	Air Particulate Radioiodine Broad Leaf Vegetation Soil
95	A3 A3 Ic1 **	Meteorological Tower	Onsite - 0.46 Mi (SSW) at 208°	Air Particulate Radioiodine Broad Leaf Vegetation Soil
106	**	Lafarge Monitoring Well	0.63 mi SW	Groundwater
107	**	Vicinity of Haverstraw Bay	2.5 mi SSW (downstream)	Fish & Invertebrates

* = Control location
** = Locations listed do not have sample designation locations specified in the ODCM
HR = Hudson River R/S = Reuter Stokes

FIGURE A-1

SAMPLING LOCATIONS
Within Two Miles of Indian Point

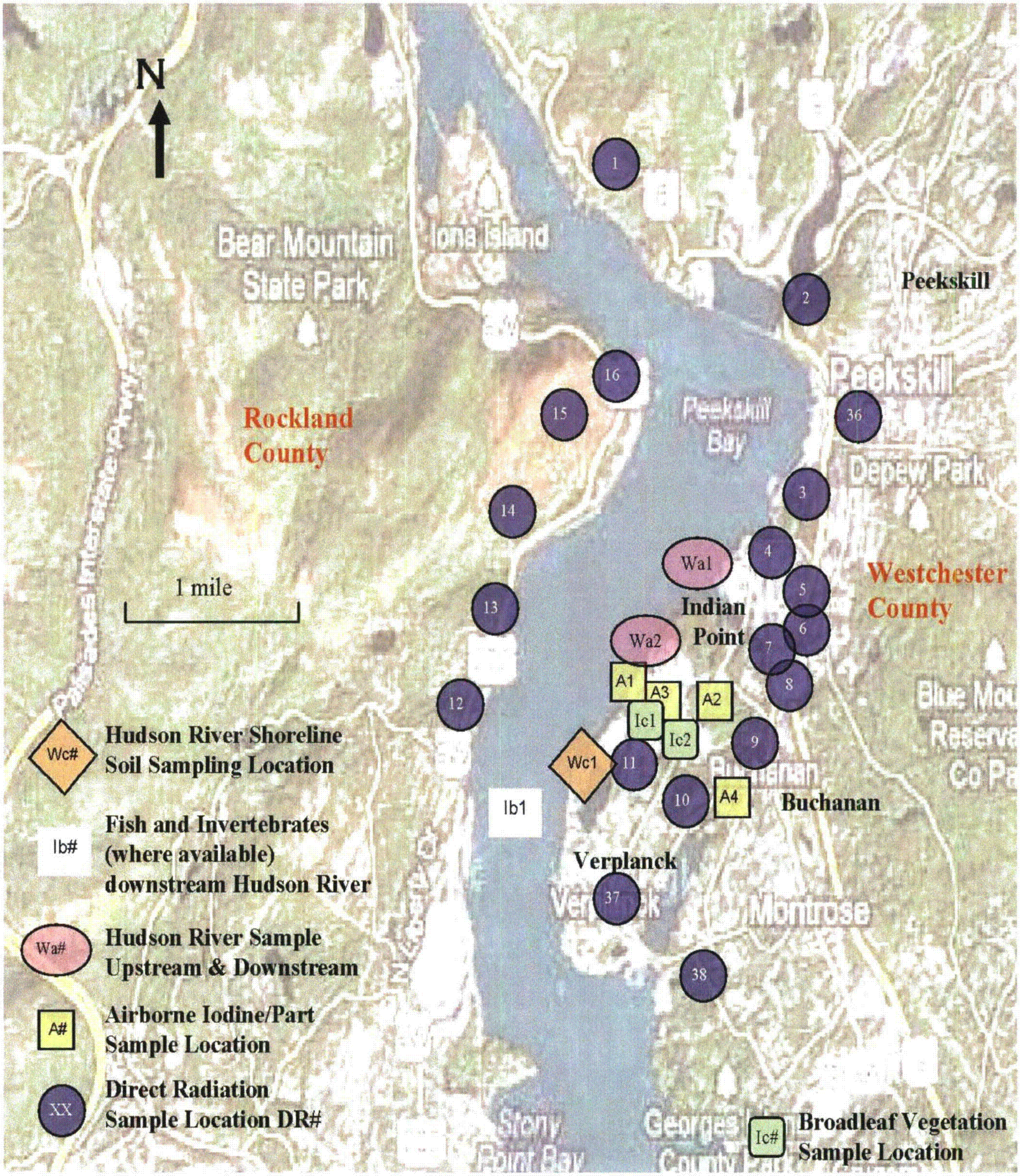


FIGURE A-2

SAMPLING LOCATIONS
Greater than Two Miles from Indian Point

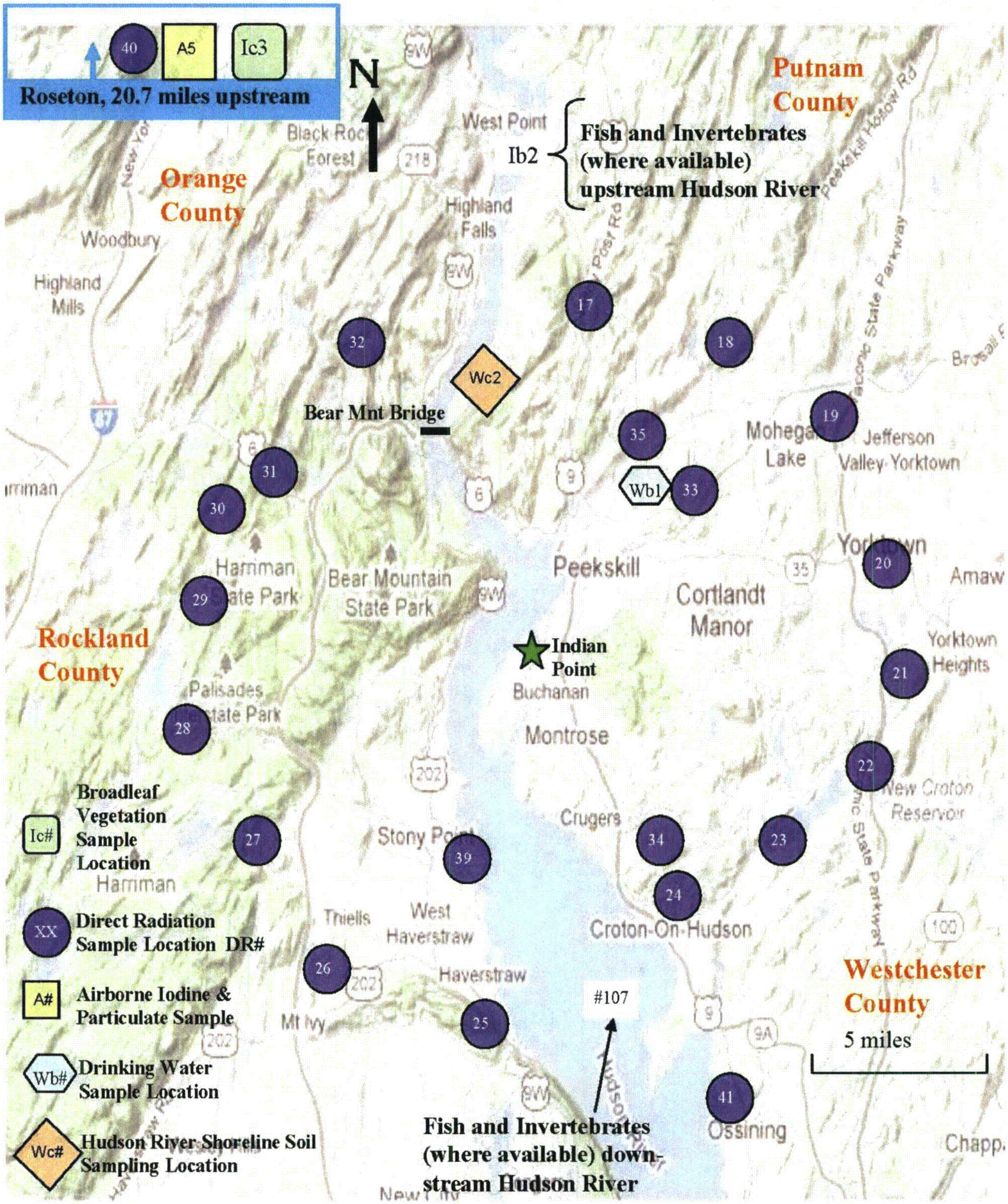


FIGURE A-3

SAMPLING LOCATIONS
Additional Sampling Locations

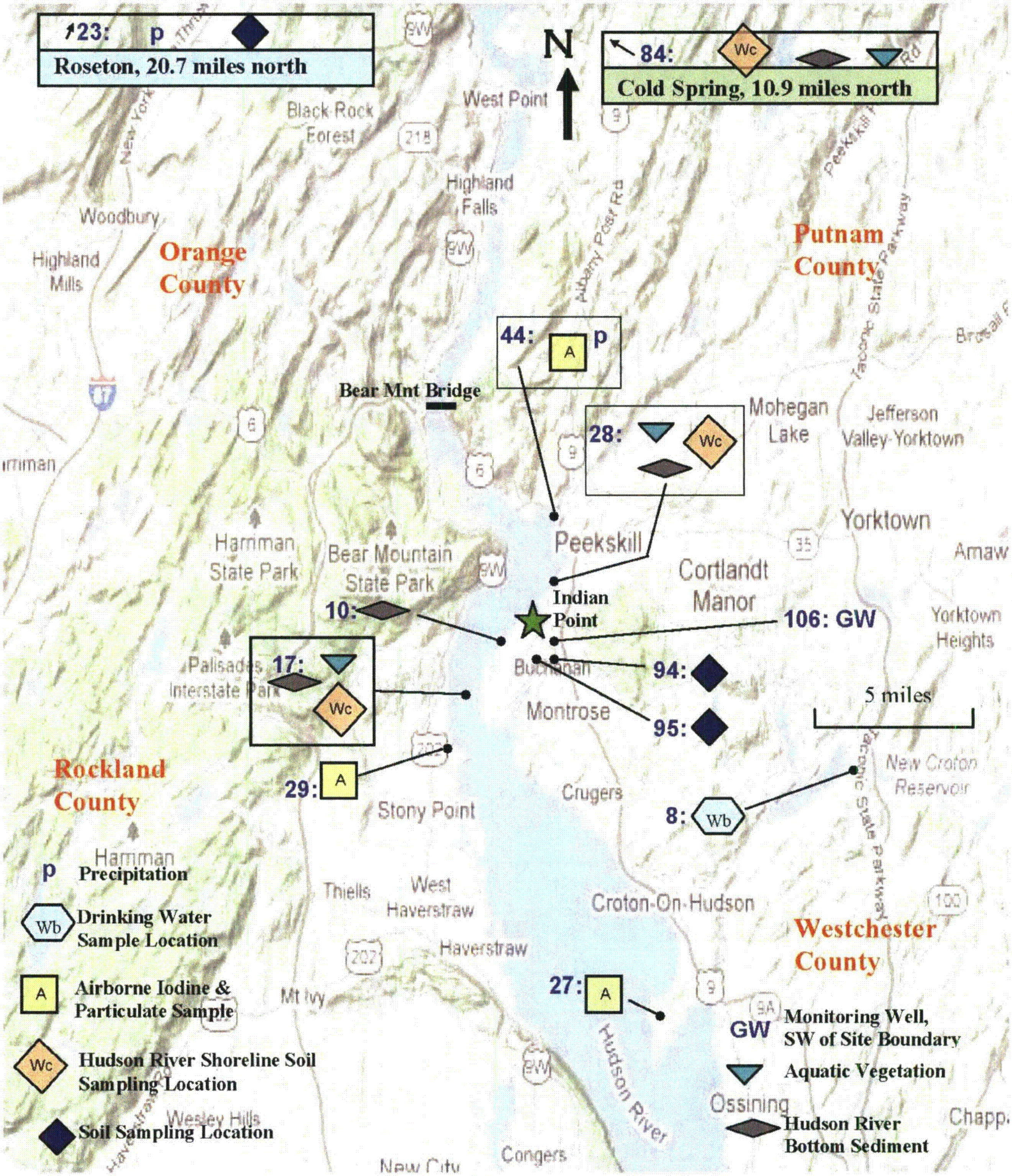


TABLE A-2

LOWER LIMIT OF DETECTION (LLD) REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

RADIONUCLIDE ANALYSIS	WATER (pCi/L)	AIRBORNE PARTIUCLATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/L)	FOOD PRODUCTS (pCi/kg, wet)	SOIL or SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2,000 (d)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Ni-63 (f)	30		100			
Zn-65	30		260			
Sr-90 (f)	1		5			5000
Zr-95	30					
Nb-95	15					
I-131	1 (d)	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

TABLE A-2

LOWER LIMIT OF DETECTION (LLD) REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

Table Notation

(a) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to the ODCM.

(b) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

(c) The LLD is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable.

In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to the ODCM.

(d) These LLDs are for drinking water samples. If no drinking water pathway exists, the LLDs may be increased to 3,000 for H-3 and 15 for I-131.

(e) These required lower limits of detection are associated only with the REMP requirements. The Radiological Ground Water Monitoring Program may involve unique reporting level criteria, independent of the REMP, and defined in station procedures.

(f) Sr-90 and Ni-63 are included in this table due to their historical presence in ground water and possible migration to the environment.

TABLE A-3

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

RADIONUCLIDE ANALYSIS	WATER (pCi/L)	AIRBORNE PARTIUCLATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/L)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000 *				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Ni-63 ***	300		1,000		
Zn-65	300		20,000		
Sr-90 ***	8*		40		
Zr-95	400				
Nb-95	400				
I-131	2 *	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-140	200			300	
La-140	200			300	

* Values provided are for drinking water pathways. If no drinking water pathway exists, higher values are allowed, as follows:

H-3 30,000 pCi/L (This is a 40 CFR 141 value)

Sr-90 12 pCi/L

I-131 20 pCi/L

** These reporting levels are associated only with the REMP requirements. The Radiological Ground Water Monitoring Program may involve unique reporting level criteria, independent of the REMP, and defined in station procedures.

*** Sr-90 and Ni-63 are included in this table due to their historical presence in ground water and possible migration to the environment.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS SUMMARY

APPENDIX B

B.1 2013 Annual Radiological Environmental Monitoring Program Summary

The results of the 2013 radiological environmental sampling program are presented in Tables B-2 through B-18. Table B-2 is a summary table of the sample results for 2013. The format of this summary table conforms to the reporting requirements of the ODCM, NRC Regulatory Guide 4.8, and NRC Branch Technical Position to Regulatory Guide 4.8 (Reference 4). In addition, the data obtained from the analysis of samples are provided in Tables B-3 through B-18.

REMP samples were analyzed by various counting methods as appropriate. The methods are; gross beta, gamma spectroscopy analysis, liquid scintillation, radiochemical analysis, and TLD processing. Gamma spectroscopy analysis was performed for the following radionuclides; Be-7, K-40, Mn-54, Co-58, Co-60, Fe-59, Zn-65, Zr-95, Nb-95, Ru-103, Ru-106, I-131, Cs-134, Cs-137, Ba/La-140, Ce-141, Ce-144, Ra-226 and Ac/Th-228. Radiochemical analyses were performed for H-3, Ni-63, Sr-90 and I-131 for specific media and locations as required in the ODCM.

B.2 Land Use Census

In accordance with Sections IP2-D3.5.2 and IP3-2.8 of the ODCM, a land use census was conducted to identify the nearest milch animal and the nearest residence. The results of the milch animal and land use census are presented in Tables B-19 and B-20, respectively. In lieu of identifying and sampling the nearest garden of greater than 50 m^2, at least three kinds of broad leaf vegetation were sampled near the site boundary in two sectors and at a designated control location (results are presented in Table B-13).

B.3 Sampling Deviations

During 2013, environmental sampling was performed for 12 unique media types addressed in the ODCM and for direct radiation. A total of 1178 samples of 1182 scheduled were obtained. Of the scheduled samples, 99.8% were collected and analyzed for the program. Sampling deviations are summarized in Table B-1. Discussions of the reasons for the deviations are provided in Table B-1a for the air samples and Table B-1b for other media.

B.4 Analytical Deviations

One precipitation sample could not be analyzed by gamma spectroscopy due to insufficient sample size being obtained.

B.5 Special Reports

No special reports were required under the REMP.

TABLE B-1

Summary of Sampling Deviations - 2013

MEDIA	TOTAL SCHEDULED SAMPLES	NUMBER OF DEVIATIONS*	SAMPLING EFFICIENCY %	NUMBER OF ANALYSES**	REASON FOR DEVIATION
MEDIA					
TLD	164	0	100%	328	N/A
PARTICULATES IN AIR	416	0	100%	415	See Table B-1a
CHARCOAL FILTER	416	0	100%	416	See Table B-1a
PRECIPITATION	8	0	100%	14	See Table B-1c
DRINKING WATER	24	0	100%	48	N/A
GROUNDWATER SAMPLES	2	0	100%	8	N/A
SOIL	3	0	100%	3	N/A
BROAD LEAF VEGETATION	61	0	100%	67	N/A
HUDSON RIVER WATER	24	0	100%	40	N/A
SHORELINE SOIL	10	0	100%	20	N/A
HUDSON RIVER BOTTOM SEDIMENT	13	0	100%	13	N/A
AQUATIC VEGETATION	6	2	67%	4	See Table B-1b
FISH & INVERTEBRATES	34	0	100%	68	N/A
TOTALS	1181	2	99.8%	1444	

TOTAL NUMBER OF SAMPLES COLLECTED = 1179

* Samples not collected or unable to be analyzed.

** Several sample types require more than one analysis

TABLES B-1a / B-1b / B-1c

TABLE B-1a
2013 Air Sampling Deviations

LOCATION	WEEK	PROBLEM / ACTIONS TO PREVENT RECURRENCE
Training Bldg.	5	121.5 hours lost (power outage). Breaker reset and work order issued fix a circuit issue.
NYU tower	21	106.8 hrs of sample time loss due to GFCI trip; probable cause was insect infestation. Breaker was reset.
Roseton	34	Hour-meter malfunction*; sample volume appeared to be routine amount.
Grassy Point	39	Hour-meter malfunction*; sample volume appeared to be routine amount.
Algonquin	41	Hour-meter malfunction*; sample volume appeared to be routine amount.
NYU tower	44	16.6 hours lost (short power outage, no repairs necessary).
Training Bldg.	45	17 hours lost; sample pump's carbon vanes were broken. New pump installed.
Training Bldg.	47	Approximately 57 hours lost; pump seized. New pump installed.

Note: All air particulate filters and charcoal cartridges were analyzed.

* Not actual deviations, listed for information only. All hour meters have since been replaced with new hour-meters.

TABLE B-1b
2013 Other Media Deviations

LOCATION	Week	PROBLEM / ACTIONS TO PREVENT RECURRENCE
Hudson River Discharge	5	Loss of AC power at this location; power tagged out for excavation in the area. Grab sample taken at time of routine composite sample collection.
Hudson River Discharge	6	Loss of AC power at this location; power tagged out for excavation in the area. Grab sample taken at time of routine composite sample collection.
Hudson River Discharge	7	Loss of AC power at this location; power tagged out for excavation in the area. Grab sample taken at time of routine composite sample collection.
Hudson River Discharge	8	Loss of AC power at this location; power tagged out for excavation in the area. Grab sample taken at time of routine composite sample collection.
Hudson River Discharge	9	Loss of AC power at this location; power tagged out for excavation in the area. Power restored on 3/4.
Hudson River Discharge	13	GFCI found tripped. Loss of autimatic sampling for 122 hours. Sufficient sample found for weekly sample.
Lents Cove	22 & 37	Aquatic vegetation not available at this location.
Gas Holder	39	Less than expected amount of rain noted in collection device. Since less than 1 gallon was samples, not sufficient valume for gamma analysis - only H-3 analysis was requested.

Note: Only samples not obtained were Week 22 & 37 aquatic vegetation samples and sufficient volume for the Week 39 rain sample.

TABLE B-1c
2013 Analysis Deviations

LOCATION	Media	PROBLEM / ACTIONS TO PREVENT RECURRENCE
Gas Holder	Rain Water	Insufficient volume for gamma analysis (see above)

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Direct Radiation (mR/Standard Quarter)	Tld-Quarterly	164	NA	13 7 (160/160) (9.5/20.7)	DR-28	4 96 Mi WSW	19 4 (4/4) (17 8/20 7)	14.2 (4/4) (12.2/15 4)	0
Air Particulate (pCi/m^3)	Gr-B	416	0 01	0.014 (363/364) (0 004/0 030)	44	1 84 Mi. NE	0.014 (51/52) (0 006/0.030)	0.014 (52/52) (0.005/0 030)	0
Air Iodine (pCi/m^3)	GAMMA	416							
	I-131		0 07	<LLD			-	<LLD	0
Air Particulate (10^{-3} pCi/m^3)	GAMMA	32							
	Be-7		NA	107 (28/28) (74.7/152)	4	0 28 Mi SW	120 (4/4) (109/130)	95 3 (4/4) (67 8/136)	0
	K-40		NA	22.0 (1/28)	5	0 88 Mi. SSW	22 0 (1/4)	<LLD	
	Cs-134		0.05	<LLD			-	<LLD	0
	Cs-137		0 06	<LLD			-	<LLD	0
	Th-228		NA	<LLD			-	<LLD	0
Rainwater (pCi/liter)	H-3	8	3000	<LLD			-	<LLD	0
	GAMMA	6							
	Co-60		15	<LLD			-	<LLD	0
	Cs-134		15	<LLD			-	<LLD	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Rainwater (cont'd) (pCi/liter)	Cs-137		18	<LLD			-	<LLD	0
Drinking Water (pCi/liter)	H-3	8	2000	<LLD			-	NA	0
	Gr-B	24	4	3.02 (15/24) (2.15/4.14)	08	6.3 Mi SE	3.02 (8/12) (2.47/4.14)	NA	0
	GAMMA	24							
	Mn-54		15	<LLD			-	NA	0
	Co-58		15	<LLD			-	NA	0
	Fe-59		30	<LLD			-	NA	0
	Co-60		15	<LLD			-	NA	0
	Zn-65		30	<LLD			-	NA	0
	Nb-95		15	<LLD			-	NA	0
	Zr-95		15	<LLD			-	NA	0
	I-131		15	<LLD			-	NA	0
	Cs-134		15	<LLD			-	NA	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations	Location with Highest Mean			Control Locations	Non-Routine Reported Measurements
				Mean ** (Range)	Location Number	Distance Direction	Mean (Range)	Mean (Range)	
Drinking Water (cont'd) (pCi/liter)	Cs-137		18	<LLD			-	NA	0
	Ba-140		60	<LLD			-	NA	0
	La-140		15	<LLD			-	NA	0
Groundwater (pCi/liter)	H-3	2	2000	<LLD			-	NA	0
	Ni-63	2	NA	<LLD			-	NA	0
	Sr-90	2	NA	<LLD			-	NA	0
	GAMMA	2							
	Mn-54		15	<LLD			-	NA	0
	Co-58		15	<LLD			-	NA	0
	Fe-59		30	<LLD			-	NA	0
	Co-60		15	<LLD			-	NA	0
	Zn-65		30	<LLD			-	NA	0
	Nb-95		15	<LLD			-	NA	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Groundwater (cont'd) (pCi/liter)	Zr-95		15	<LLD			-	NA	0
	I-131		15	<LLD			-	NA	0
	Cs-134		15	<LLD			-	NA	0
	Cs-137		18	<LLD			-	NA	0
	Ba-140		60	<LLD			-	NA	0
	La-140		15	<LLD			-	NA	0
Soil (pCi/kg dry)	GAMMA Be-7	3	NA	411 (1/2)	94	0.39 Mi. S	411 (1/2)	<LLD	0
	K-40		NA	9339 (2/2) (6758/11920)	23	20.7 Mi. N	19780 (1/1)	19780 (1/1)	0
	Co-60		NA	<LLD			-	<LLD	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	<LLD			-	<LLD	0
	Ra-226		NA	<LLD	23	20.7 Mi. N	1350 (1/1)	1350 (1/1)	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Soil (cont'd) (pCi/kg dry)	Th-228		NA	201 (2/2) (178/224)	23	20.7 Mi. N	1135 (1/1)	1135 (1/1)	0
Broadleaf Vegetation (pCi/kg wet)	I-131	7	60	<LLD			-	<LLD	0
	GAMMA	61							
	BE-7		NA	1223 (41/42) (256/2867)	23	20.7 Mi. N	1576 (19/19) (369/2854)	1576 (19/19) (369/2854)	0
	K-40		NA	4793 (42/42) (1869/10160)	95	0 46 Mi SSW	4977 (21/21) (2385/10160)	4789 (19/19) (2099/8351)	0
	Co-60		NA	<LLD			-	<LLD	0
	I-131		60	<LLD			-	<LLD	0
	Cs-134		60	<LLD			-	<LLD	0
	Cs-137		80	<LLD			-	<LLD	0
	Th-228		NA	36 0 (2/42) (35.2/36 8)	23	20 7 Mi. N	40.5 (1/19)	40 5 (1/19)	0
River Water (pCi/liter)	H-3	20	3000	410 (3/10) (306/566)	10	0.3 Mi. WSW	410 (3/10) (306/566)	241 (2/10) (216/266)	0
	GAMMA	24							
	Mn-54		15	<LLD			-	<LLD	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
River Water (cont'd) (pCi/liter)	Co-58		15	<LLD			-	<LLD	0
	Fe-59		30	<LLD			-	<LLD	0
	Co-60		15	<LLD			-	<LLD	0
	Zn-65		30	<LLD			-	<LLD	0
	Nb-95		15	<LLD			-	<LLD	0
	Zr-95		15	<LLD			-	<LLD	0
	I-131		15	<LLD			-	<LLD	0
	Cs-134		15	<LLD			-	<LLD	0
	Cs-137		18	<LLD			-	<LLD	0
	Ba-140		15	<LLD			-	<LLD	0
	La-140		15	<LLD			-	<LLD	0
Bottom Sediment (pCi/kg dry)	GAMMA	13							
	K-40		NA	19900 (10/10) (14550/26550)	84	10 88 Mi. N	23157 (3/3) (21300/26470)	23157 (3/3) (21300/26470)	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	**Location with Highest Mean** Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Bottom Sediment (cont'd) (pCi/kg dry)	Co-60		NA	<LLD			-	<LLD	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	2738 (10/10) (153/13870)	10	0.3 Mi. WSW	6451 (4/4) (153/13870)	263 (2/3) (179/348)	0
	Ra-226		NA	3254 (4/10) (2128/4051)	10	0.3 Mi. WSW	3690 (2/4) (3328/4051)	2757 (1/3)	0
	Th-228		NA	1156 (10/10) (808/1491)	84	10 88 Mi. N	1505 (3/3) (1215/1779)	1505 (3/3) (1215/1779)	0
Shoreline Soil (pCi/kg dry)	Sr-90	10	5000	<LLD			-	<LLD	0
	GAMMA	10							
	K-40		NA	14343 (8/8) (10900/18580)	84	10 88 Mi N	29220 (2/2) (18110/40330)	29220 (2/2) (18110/40330)	0
	Cs-134		150	<LLD			-	<LLD	0
	Cs-137		180	133 (2/8) (108/158)	17	1 5 Mi SSW	133 (2/2) (108/158)	<LLD	0
	Ra-226		NA	3551 (4/8) (1696/6160)	50	4.48 Mi NNW	3928 (2/2) (1696/6160)	1229 (1/2)	0
	Th-228		NA	733 (8/8) (93.2/1558)	28	0.45 Mi ENE	1365 (2/2) (1171/1558)	442 (2/2) (324/560)	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Aquatic Vegetation	GAMMA	4							
(pCi/g wet)	Be-7		NA	299 (2/2) (190/408)	17	1.5 Mi SSW	299 (2/2) (190/408)	183 (2/2) (180/186)	0
	K-40		NA	2409 (2/2) (2243/2574)	17	1 5 Mi SSW	2409 (2/2) (2243/2574)	1868 (2/2) (1512/2224)	0
	Co-60		NA	<LLD			-	<LLD	0
	I-131		NA	<LLD			-	<LLD	0
	Cs-134		NA	<LLD			-	<LLD	0
	Cs-137		NA	<LLD			-	<LLD	0
	Ra-226		NA	<LLD			-	355 (1/2)	0
	Ac-228		NA	<LLD	84	10 88 Mi N	71 6 (1/2)	71.6 (1/2)	0
	Th-228		NA	60.4 (2/2) (59.2/61.6)	17	1 5 Mi. SSW	60.4 (2/2) (59.2/61.6)	42.6 (1/2) (24.7/60.4)	0
Fish (pCi/kg wet)	Ni-63	34	100	<LLD			-	<LLD	0
	Sr-90	34	5	6.1 (1/23)	25	Downstream	6.1 (1/12)	4 1 (1/11)	0

TABLE B-2 RADIOLOGICIAL ENVIRONMENT MONITORING PROGRAM SUMMARY
INDIAN POINT ENERGY CENTER - 2013
Dockets 50-03, 50-247 & 50-286

Medium or Pathway Sampled (Units)	Analysis Type	Total Number	LLD*	Indicator Locations Mean ** (Range)	Location with Highest Mean Location Number	Distance Direction	Mean (Range)	Control Locations Mean (Range)	Non-Routine Reported Measurements
Fish (cont'd)	GAMMA	34							
(pCi/kg wet)	K-40		NA	2907 (23/23) (1917/3881)	25	Downstream	3005 (12/12) (2036/3881)	2702 (11/11) (1304/4391)	0
	Mn-54		130	<LLD			-	<LLD	0
	Co-58		130	<LLD			-	<LLD	0
	Fe-59		260	<LLD			-	<LLD	0
	Co-60		130	<LLD			-	<LLD	0
	Zn-65		260	<LLD			-	<LLD	0
	Cs-134		130	<LLD			-	<LLD	0
	Cs-137		150	<LLD			-	<LLD	0
	Th-228		NA	<LLD			-	<LLD	0

* LLD IS THE LOWER LIMIT OF DETECTION
** THE MEAN VALUES ARE CALCULATED USING THE POSITIVE VALUES
*** MDC IS THE MIMINUM DETECTABLE CONCENTRATION

INDIAN POINT ENERGY CENTER
TABLE B-3
DIRECT RADIATION, QUARTERLY DATA - 2013

mR/Quarter ± 1 sigma

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Annual Average	Annual Total
TLD	DR-01	13.4 ± 0.6	14.0 ± 0.6	15.7 ± 0.8	16.5 ± 0.8	14.9	59.7
	DR-02	12.5 ± 0.7	13.5 ± 0.5	15.0 ± 0.6	15.4 ± 0.5	14.1	56.4
	DR-03	9.7 ± 0.5	11.3 ± 0.5	12.0 ± 0.6	12.7 ± 0.7	11.4	45.7
	DR-04	11.1 ± 0.6	12.8 ± 0.6	14.0 ± 0.5	14.6 ± 1.3	13.1	52.5
	DR-05	11.4 ± 0.6	13.0 ± 0.6	14.2 ± 0.6	14.7 ± 0.8	13.3	53.3
	DR-06	11.7 ± 0.5	13.9 ± 0.7	14.3 ± 0.7	15.0 ± 0.7	13.7	54.9
	DR-07	14.0 ± 0.6	15.3 ± 0.6	16.4 ± 0.7	16.4 ± 0.7	15.5	62.1
	DR-08	10.0 ± 0.4	11.6 ± 0.8	11.9 ± 0.6	12.4 ± 0.5	11.5	46.0
	DR-09	11.3 ± 0.6	12.6 ± 0.7	13.1 ± 0.5	13.7 ± 0.6	12.7	50.7
	DR-10	12.1 ± 0.7	13.5 ± 0.7	14.3 ± 0.7	14.8 ± 0.6	13.6	54.6
	DR-11	9.5 ± 0.5	10.6 ± 0.4	11.1 ± 0.7	11.1 ± 0.6	10.6	42.2
	DR-12	15.0 ± 0.8	14.9 ± 0.8	16.2 ± 1.1	16.2 ± 0.6	15.6	62.2
	DR-13	15.1 ± 0.6	15.3 ± 0.6	16.8 ± 1.0	17.1 ± 0.7	16.1	64.3
	DR-14	12.7 ± 0.5	12.6 ± 0.6	14.1 ± 0.7	13.9 ± 1.0	13.3	53.3
	DR-15	12.7 ± 0.6	12.7 ± 0.6	13.4 ± 0.5	14.2 ± 0.6	13.3	53.0
	DR-16	13.7 ± 0.6	13.9 ± 0.8	15.0 ± 0.8	15.5 ± 0.6	14.5	58.1
	DR-17	13.9 ± 0.8	13.8 ± 0.7	15.6 ± 0.8	15.3 ± 0.9	14.6	58.6
	DR-18	12.4 ± 0.5	13.7 ± 0.8	15.1 ± 0.7	14.5 ± 0.6	13.9	55.6
	DR-19	13.1 ± 0.8	14.4 ± 0.8	15.3 ± 0.6	15.9 ± 0.6	14.6	58.6
	DR-20	12.2 ± 0.5	13.4 ± 0.6	15.1 ± 0.6	14.5 ± 0.9	13.8	55.3
	DR-21	12.1 ± 0.5	12.9 ± 1.0	13.9 ± 0.9	14.2 ± 0.6	13.3	53.1
	DR-22	9.8 ± 0.4	10.4 ± 0.7	11.4 ± 0.6	11.7 ± 0.5	10.8	43.4
	DR-23	12.4 ± 0.6	13.3 ± 0.8	14.7 ± 0.9	14.4 ± 0.8	13.7	54.8
	DR-24	12.7 ± 0.7	14.4 ± 0.6	15.3 ± 0.6	14.8 ± 0.5	14.3	57.2
	DR-25	11.5 ± 0.7	11.7 ± 0.6	12.4 ± 0.7	12.7 ± 0.7	12.1	48.3

INDIAN POINT ENERGY CENTER
TABLE B-3
DIRECT RADIATION, QUARTERLY DATA - 2013

mR/Quarter ± 1 sigma

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Annual Average	Annual Total
TLD	DR-26	13.2 ± 0.8	13.6 ± 0.6	14.0 ± 0.7	14.5 ± 1.1	13.8	55.2
	DR-27	12.9 ± 0.7	13.1 ± 0.5	13.9 ± 0.7	14.3 ± 0.7	13.5	54.2
	DR-28	17.8 ± 0.7	18.7 ± 1.0	20.7 ± 1.1	20.3 ± 0.8	19.4	77.1
	DR-29	12.8 ± 0.7	13.4 ± 0.6	15.3 ± 0.9	15.0 ± 0.5	14.1	56.6
	DR-30	13.4 ± 0.7	13.8 ± 0.5	15.5 ± 0.8	15.3 ± 0.6	14.5	58.0
	DR-31	14.7 ± 0.6	15.7 ± 0.7	17.5 ± 0.7	17.2 ± 0.8	16.3	65.1
	DR-32	12.2 ± 0.6	12.6 ± 0.5	13.8 ± 0.8	13.4 ± 0.8	13.0	52.0
	DR-33	11.4 ± 0.5	13.4 ± 0.5	14.1 ± 0.5	14.0 ± 0.5	13.2	52.9
	DR-34	11.0 ± 0.5	12.9 ± 0.5	13.3 ± 0.6	13.4 ± 0.6	12.7	50.6
	DR-35	11.4 ± 0.6	12.6 ± 0.7	12.9 ± 0.8	13.1 ± 0.9	12.5	49.9
	DR-36	12.9 ± 0.6	13.7 ± 0.6	15.3 ± 0.7	14.8 ± 0.6	14.2	56.6
	DR-37	11.7 ± 0.5	13.4 ± 0.7	14.4 ± 0.5	14.4 ± 0.8	13.5	53.9
	DR-38	10.3 ± 0.5	11.7 ± 0.7	12.5 ± 0.8	13.1 ± 0.7	11.9	47.6
	DR-39	13.0 ± 0.7	13.7 ± 0.8	14.8 ± 0.6	15.1 ± 0.6	14.2	56.6
	DR-40*	12.2 ± 0.7	14.3 ± 0.7	15.1 ± 0.6	15.4 ± 0.6	14.2	57.0
	DR-41	11.2 ± 0.5	12.3 ± 0.7	13.3 ± 0.7	13.3 ± 0.6	12.5	50.1
AVERAGE (Indicator Locations)		12.4	13.4	14.4	14.6	13.7	54.7

* Control location
(a) TLD missing, the annual total is based on using the 3 quarters average for the first quarter.

INDIAN POINT ENERGY CENTER
TABLE B-4
DIRECT RADIATION, 2003 THROUGH 2013 DATA

mR per Year

Station Number	Mean (2003-2013)	Standard Deviation (2003-2013)	Minimum Value (2003-2013)	Maximum Value (2003-2013)	2013 Mean
DR-01	66.2	2.2	55.6	63.6	59.7
DR-02	63.0	1.8	53.6	60.0	56.4
DR-03	51.5	1.9	44.0	50.0	45.7
DR-04	58.5	2.7	46.8	58.0	52.5
DR-05	59.5	2.2	48.4	56.8	53.3
DR-06	60.2	3.1	46.4	57.6	54.9
DR-07	68.9	2.9	55.6	66.4	62.1
DR-08	53.5	2.5	45.2	53.6	46.0
DR-09	57.4	2.3	47.2	55.2	50.7
DR-10	62.2	1.7	53.6	58.8	54.6
DR-11	47.6	1.6	40.8	45.6	42.2
DR-12	70.2	3.3	59.6	68.4	62.2
DR-13	79.9	6.8	62.4	82.0	64.3
DR-14	57.9	1.7	50.0	55.2	53.3
DR-15	57.1	2.2	46.4	54.8	53.0
DR-16	63.3	1.8	55.2	60.8	58.1
DR-17	64.0	1.9	55.6	61.2	58.6
DR-18	62.1	2.0	52.4	59.1	55.6
DR-19	64.4	2.0	55.2	60.8	58.6
DR-20	58.2	2.2	47.6	55.3	55.3
DR-21	59.7	2.2	50.0	57.6	53.1
DR-22	48.7	1.8	40.4	46.4	43.4
DR-23	60.3	2.2	49.6	58.0	54.8
DR-24	62.5	2.7	49.2	58.8	57.2
DR-25	53.6	2.1	44.8	52.4	48.3
DR-26	60.4	2.3	50.4	58.8	55.2
DR-27	58.8	2.6	46.8	56.4	54.2
DR-28	82.6	5.5	64.0	79.1	77.1
DR-29	62.9	2.3	54.8	63.2	56.6
DR-30	63.9	2.8	52.4	61.9	58.0
DR-31	72.6	2.6	61.5	70.0	65.1
DR-32	56.4	2.3	46.0	54.8	52.0

INDIAN POINT ENERGY CENTER
TABLE B-4
DIRECT RADIATION, 2003 THROUGH 2013 DATA

mR per Year

Station Number	Mean (2003-2013)	Standard Deviation (2003-2013)	Minimum Value (2003-2013)	Maximum Value (2003-2013)	2013 Mean
DR-33	59.2	1.7	49.2	55.2	52.9
DR-34	55.4	2.6	43.2	53.6	50.6
DR-35	58.0	2.5	48.8	56.4	49.9
DR-36	64.0	2.3	52.4	60.2	56.6
DR-37	59.4	2.5	48.8	58.0	53.9
DR-38	55.3	2.7	46.7	56.0	47.6
DR-39	65.2	2.8	54.8	63.2	56.6
DR-40*	66.4	8.3	49.3	75.2	57.0
DR-41	55.6	2.4	44.4	53.6	50.1
AVERAGE (Indicator Locations)	61.0				54.7

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-5
DIRECT RADIATION, INNER AND OUTER RINGS - 2013
(mR per Year)

Inner Ring ID	Outer Ring ID	Sector	Inner Ring Annual Average	Outer Ring Annual Average
DR-01	DR-17	N	59.7	58.6
DR-02	DR-18	NNE	56.4	55.6
DR-03	DR-19	NE	45.7	58.6
DR-04	DR-20	ENE	52.5	55.3
DR-05	DR-21	ENE	53.3	53.1
DR-06	DR-22	ESE	54.9	43.4
DR-07	DR-23	SE	62.1	54.8
DR-08	DR-24	SSE	46.0	57.2
DR-09	DR-25	S	50.7	48.3
DR-10	DR-26	SSW	54.6	55.2
DR-11	DR-27	SW	42.2	54.2
DR-12	DR-28	WSW	62.2	77.6
DR-13	DR-29	WSW	64.3	56.6
DR-14	DR-30	WNW	53.3	58.0
DR-15	DR-31	NW	53.0	65.1
DR-16	DR-32	NNW	58.1	52.0
Average			54.3	56.5

INDIAN POINT ENERGY CENTER
TABLE B-6
GROSS BETA ACTIVITY IN AIRBORNE PARTICULATE SAMPLES - 2013

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Peekskill 44	Training Building 94	Met Tower 95
01/08/13	0.020 ± 0.003	0.020 ± 0.003	0.030 ± 0.004	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.003
01/15/13	0.020 ± 0.000	0.020 ± 0.000	0.020 ± 0.000	0.020 ± 0.000	0.020 ± 0.000	0.020 ± 0.000	0.020 ± 0.000	0.017 ± 0.002
01/22/13	0.014 ± 0.002	0.015 ± 0.003	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.016 ± 0.003	0.015 ± 0.002
01/28/13	0.014 ± 0.003	0.012 ± 0.002	0.012 ± 0.002	0.015 ± 0.003	0.013 ± 0.002	0.018 ± 0.003	0.012 ± 0.002	0.013 ± 0.002
02/04/13	0.017 ± 0.003	0.018 ± 0.003	0.017 ± 0.003	0.018 ± 0.003	0.019 ± 0.002	0.017 ± 0.002	0.023 ± 0.006	0.018 ± 0.002
02/11/13	0.019 ± 0.003	0.020 ± 0.003	0.015 ± 0.002	0.018 ± 0.003	0.017 ± 0.002	0.019 ± 0.003	0.019 ± 0.003	0.019 ± 0.003
02/19/13	0.011 ± 0.002	0.014 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.010 ± 0.002	0.015 ± 0.002	0.013 ± 0.002
02/25/13	0.009 ± 0.002	0.008 ± 0.002	0.008 ± 0.002	0.010 ± 0.003	0.008 ± 0.002	0.009 ± 0.002	0.007 ± 0.002	0.009 ± 0.002
03/04/13	0.011 ± 0.002	0.008 ± 0.002	0.008 ± 0.002	0.009 ± 0.002	0.006 ± 0.002	0.007 ± 0.002	0.009 ± 0.002	0.007 ± 0.002
03/11/13	0.006 ± 0.002	0.008 ± 0.002	0.009 ± 0.002	0.007 ± 0.002	0.005 ± 0.002	0.006 ± 0.002	0.006 ± 0.002	0.006 ± 0.002
03/18/13	0.015 ± 0.003	0.014 ± 0.003	0.015 ± 0.003	0.014 ± 0.003	0.014 ± 0.002	0.011 ± 0.002	0.014 ± 0.002	0.014 ± 0.002
03/25/13	0.012 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.012 ± 0.002	0.010 ± 0.002	0.010 ± 0.002
04/01/13	0.008 ± 0.002	0.006 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.007 ± 0.002	0.006 ± 0.002	0.006 ± 0.002
04/08/13	0.014 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.013 ± 0.002
04/15/13	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002
04/22/13	0.008 ± 0.002	0.010 ± 0.002	0.008 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.009 ± 0.002
04/29/13	0.014 ± 0.002	0.015 ± 0.002	0.017 ± 0.003	0.014 ± 0.002	0.015 ± 0.003	0.018 ± 0.002	0.016 ± 0.002	0.012 ± 0.002
05/06/13	0.013 ± 0.002	0.012 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
05/13/13	0.007 ± 0.002	0.006 ± 0.002	0.007 ± 0.002	0.006 ± 0.002	0.008 ± 0.002	0.007 ± 0.002	0.008 ± 0.002	0.008 ± 0.002
05/20/13	0.011 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.012 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.011 ± 0.002
05/28/13	0.010 ± 0.002	0.016 ± 0.004	0.011 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002
06/03/13	0.018 ± 0.003	0.014 ± 0.003	0.019 ± 0.003	0.017 ± 0.003	0.016 ± 0.003	0.018 ± 0.003	0.018 ± 0.003	0.019 ± 0.003
06/10/13	0.008 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.008 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.007 ± 0.002
06/17/13	0.010 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
06/24/13	0.010 ± 0.002	0.013 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
07/01/13	0.017 ± 0.003	0.017 ± 0.002	0.018 ± 0.002	0.015 ± 0.002	0.017 ± 0.002	0.016 ± 0.002	0.016 ± 0.002	0.017 ± 0.002

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-6
GROSS BETA ACTIVITY IN AIRBORNE PARTICULATE SAMPLES - 2013

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Peekskill 44	Training Building 94	Met Tower 95
07/08/13	0.008 ± 0.002	0.008 ± 0.002	0.008 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.006 ± 0.002
07/15/13	0.013 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.011 ± 0.002	0.012 ± 0.002
07/22/13	0.016 ± 0.002	0.018 ± 0.002	0.017 ± 0.002	0.016 ± 0.002	0.017 ± 0.002	0.016 ± 0.002	0.017 ± 0.002	0.016 ± 0.002
07/29/13	0.011 ± 0.002	0.008 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.011 ± 0.002
08/05/13	0.013 ± 0.002	0.014 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.015 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.013 ± 0.002
08/12/13	0.011 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.011 ± 0.002	0.012 ± 0.002	0.011 ± 0.002
08/19/13	0.015 ± 0.002	0.011 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.013 ± 0.002	0.014 ± 0.002	0.013 ± 0.002
08/26/13	0.017 ± 0.003	0.017 ± 0.003	0.019 ± 0.003	0.017 ± 0.002	0.020 ± 0.003	0.019 ± 0.003	0.019 ± 0.003	0.017 ± 0.002
09/03/13	0.020 ± 0.003	0.019 ± 0.002	0.019 ± 0.002	0.019 ± 0.002	0.022 ± 0.003	0.020 ± 0.002	0.020 ± 0.002	0.018 ± 0.002
09/09/13	0.012 ± 0.003	0.012 ± 0.003	0.008 ± 0.002	0.009 ± 0.002	0.012 ± 0.003	0.013 ± 0.003	0.009 ± 0.002	0.014 ± 0.003
09/16/13	0.021 ± 0.003	0.022 ± 0.003	0.019 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.003	0.018 ± 0.003	0.018 ± 0.003
09/23/13	0.010 ± 0.002	0.013 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.010 ± 0.002	0.010 ± 0.002	0.011 ± 0.002
09/30/13	0.005 ± 0.002	0.005 ± 0.002	0.005 ± 0.002	0.004 ± 0.002	0.004 ± 0.002	< 0.003	0.005 ± 0.002	0.004 ± 0.002
10/07/13	0.027 ± 0.003	0.026 ± 0.003	0.023 ± 0.003	0.028 ± 0.003	0.029 ± 0.003	0.030 ± 0.003	0.025 ± 0.003	0.027 ± 0.003
10/15/13	0.015 ± 0.002	0.015 ± 0.002	0.014 ± 0.002	0.015 ± 0.002	0.013 ± 0.002	0.015 ± 0.002	0.016 ± 0.002	0.016 ± 0.002
10/21/13	0.020 ± 0.003	0.018 ± 0.003	0.023 ± 0.003	0.018 ± 0.003	0.018 ± 0.003	0.020 ± 0.003	0.018 ± 0.003	0.017 ± 0.003
10/28/13	0.012 ± 0.002	0.013 ± 0.002	0.010 ± 0.002	0.013 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.011 ± 0.002
11/04/13	0.019 ± 0.003	0.017 ± 0.003	0.018 ± 0.002	0.019 ± 0.003	0.018 ± 0.003	0.018 ± 0.003	0.017 ± 0.002	0.017 ± 0.002
11/12/13	0.012 ± 0.002	0.012 ± 0.002	0.010 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.011 ± 0.002	0.009 ± 0.002	0.011 ± 0.002
11/18/13	0.014 ± 0.003	0.013 ± 0.003	0.011 ± 0.002	0.013 ± 0.003	0.014 ± 0.003	0.015 ± 0.003	0.013 ± 0.003	0.014 ± 0.003
11/25/13	0.009 ± 0.002	0.010 ± 0.002	0.009 ± 0.002	0.009 ± 0.002	0.008 ± 0.002	0.007 ± 0.002	0.010 ± 0.003	0.011 ± 0.002
12/02/13	0.013 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.012 ± 0.002	0.013 ± 0.002	0.013 ± 0.002	0.013 ± 0.003	0.013 ± 0.002
12/09/13	0.028 ± 0.003	0.025 ± 0.003	0.024 ± 0.003	0.023 ± 0.003	0.028 ± 0.003	0.028 ± 0.003	0.026 ± 0.003	0.027 ± 0.003
12/16/13	0.020 ± 0.003	0.018 ± 0.002	0.018 ± 0.002	0.019 ± 0.003	0.019 ± 0.003	0.020 ± 0.003	0.021 ± 0.003	0.021 ± 0.003
12/23/13	0.017 ± 0.003	0.018 ± 0.003	0.017 ± 0.002	0.018 ± 0.003	0.017 ± 0.002	0.020 ± 0.003	0.021 ± 0.003	0.016 ± 0.002
12/30/13	0.018 ± 0.003	0.016 ± 0.002	0.015 ± 0.002	0.015 ± 0.002	0.015 ± 0.002	0.017 ± 0.002	0.015 ± 0.002	0.018 ± 0.003

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-7
IODINE-131 ACTIVITY IN AIRBORNE CHARCOAL SAMPLES - 2013

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Peekskill 44	Training Building 94	Met Tower 95
01/08/13	< 0.0331	< 0.0330	< 0.0272	< 0.0324	< 0.0211	< 0.0244	< 0.0316	< 0.0260
01/15/13	< 0.0202	< 0.0203	< 0.0357	< 0.0198	< 0.0278	< 0.0324	< 0.0191	< 0.0335
01/22/13	< 0.0157	< 0.0157	< 0.0183	< 0.0152	< 0.0139	< 0.0164	< 0.0149	< 0.0167
01/28/13	< 0.0242	< 0.0243	< 0.0300	< 0.0239	< 0.0223	< 0.0266	< 0.0232	< 0.0282
02/04/13	< 0.0187	< 0.0186	< 0.0183	< 0.0182	< 0.0142	< 0.0167	< 0.0623	< 0.0171
02/11/13	< 0.0486	< 0.0486	< 0.0333	< 0.0476	< 0.0257	< 0.0300	< 0.0474	< 0.0308
02/19/13	< 0.0190	< 0.0188	< 0.0169	< 0.0185	< 0.0127	< 0.0153	< 0.0180	< 0.0154
02/25/13	< 0.0346	< 0.0349	< 0.0433	< 0.0346	< 0.0338	< 0.0390	< 0.0332	< 0.0402
03/04/13	< 0.0206	< 0.0204	< 0.0207	< 0.0217	< 0.0160	< 0.0189	< 0.0196	< 0.0191
03/11/13	< 0.0092	< 0.0092	< 0.0147	< 0.0091	< 0.0114	< 0.0134	< 0.0088	< 0.0136
03/18/13	< 0.0250	< 0.0250	< 0.0208	< 0.0244	< 0.0160	< 0.0190	< 0.0238	< 0.0192
03/25/13	< 0.0166	< 0.0168	< 0.0143	< 0.0163	< 0.0111	< 0.0131	< 0.0158	< 0.0132
04/01/13	< 0.0179	< 0.0179	< 0.0180	< 0.0175	< 0.0139	< 0.0160	< 0.0169	< 0.0165
04/08/13	< 0.0247	< 0.0246	< 0.0206	< 0.0240	< 0.0159	< 0.0189	< 0.0235	< 0.0187
04/15/13	< 0.0218	< 0.0216	< 0.0220	< 0.0210	< 0.0171	< 0.0201	< 0.0205	< 0.0198
04/22/13	< 0.0388	< 0.0383	< 0.0334	< 0.0370	< 0.0259	< 0.0299	< 0.0362	< 0.0297
04/29/13	< 0.0384	< 0.0380	< 0.0260	< 0.0366	< 0.0268	< 0.0227	< 0.0357	< 0.0234
05/06/13	< 0.0215	< 0.0213	< 0.0186	< 0.0205	< 0.0178	< 0.0150	< 0.0201	< 0.0166
05/13/13	< 0.0249	< 0.0243	< 0.0416	< 0.0233	< 0.0436	< 0.0416	< 0.0231	< 0.0408
05/20/13	< 0.0237	< 0.0234	< 0.0250	< 0.0227	< 0.0266	< 0.0264	< 0.0221	< 0.0250
05/28/13	< 0.0318	< 0.0681	< 0.0236	< 0.0298	< 0.0244	< 0.0241	< 0.0297	< 0.0233
06/03/13	< 0.0507	< 0.0500	< 0.0324	< 0.0484	< 0.0336	< 0.0331	< 0.0469	< 0.0329
06/10/13	< 0.0347	< 0.0337	< 0.0446	< 0.0328	< 0.0458	< 0.0450	< 0.0323	< 0.0436
06/17/13	< 0.0142	< 0.0140	< 0.0205	< 0.0134	< 0.0213	< 0.0211	< 0.0134	< 0.0207
06/24/13	< 0.0233	< 0.0228	< 0.0296	< 0.0221	< 0.0303	< 0.0299	< 0.0217	< 0.0295
07/01/13	< 0.0448	< 0.0440	< 0.0469	< 0.0422	< 0.0484	< 0.0473	< 0.0417	< 0.0462

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-7
IODINE-131 ACTIVITY IN AIRBORNE CHARCOAL SAMPLES - 2013

pCi/m^3 ± 2 Sigma

PERIOD ENDING	Algonquin 4	NYU Tower 5	Roseton 23*	Croton Point 27	Grassy Point 29	Peekskill 44	Training Building 94	Met Tower 95
07/08/13	< 0.0142	< 0.0139	< 0.0136	< 0.0133	< 0.0139	< 0.0136	< 0.0133	< 0.0136
07/15/13	< 0.0193	< 0.0188	< 0.0219	< 0.0181	< 0.0226	< 0.0221	< 0.0181	< 0.0217
07/22/13	< 0.0328	< 0.0321	< 0.0279	< 0.0309	< 0.0286	< 0.0278	< 0.0306	< 0.0279
07/29/13	< 0.0276	< 0.0270	< 0.0328	< 0.0262	< 0.0341	< 0.0328	< 0.0261	< 0.0326
08/05/13	< 0.0360	< 0.0352	< 0.0318	< 0.0337	< 0.0329	< 0.0320	< 0.0341	< 0.0320
08/12/13	< 0.0296	< 0.0293	< 0.0241	< 0.0287	< 0.0251	< 0.0242	< 0.0277	< 0.0232
08/19/13	< 0.0302	< 0.0294	< 0.0352	< 0.0283	< 0.0359	< 0.0351	< 0.0286	< 0.0359
08/26/13	< 0.0431	< 0.0421	< 0.0236	< 0.0404	< 0.0239	< 0.0237	< 0.0407	< 0.0240
09/03/13	< 0.0325	< 0.0317	< 0.0371	< 0.0307	< 0.0384	< 0.0374	< 0.0305	< 0.0365
09/09/13	< 0.0496	< 0.0493	< 0.0463	< 0.0479	< 0.0472	< 0.0476	< 0.0473	< 0.0463
09/16/13	< 0.0117	< 0.0114	< 0.0148	< 0.0109	< 0.0155	< 0.0150	< 0.0111	< 0.0155
09/23/13	< 0.0388	< 0.0378	< 0.0258	< 0.0364	< 0.0272	< 0.0268	< 0.0370	< 0.0270
09/30/13	< 0.0340	< 0.0334	< 0.0408	< 0.0322	< 0.0422	< 0.0427	< 0.0326	< 0.0424
10/07/13	< 0.0692	< 0.0678	< 0.0590	< 0.0671	< 0.0614	< 0.0612	< 0.0647	< 0.0595
10/15/13	< 0.0300	< 0.0286	< 0.0267	< 0.0281	< 0.0276	< 0.0282	< 0.0281	< 0.0280
10/21/13	< 0.0390	< 0.0375	< 0.0338	< 0.0372	< 0.0358	< 0.0359	< 0.0370	< 0.0351
10/28/13	< 0.0227	< 0.0216	< 0.0228	< 0.0212	< 0.0229	< 0.0236	< 0.0212	< 0.0232
11/04/13	< 0.0399	< 0.0386	< 0.0333	< 0.0381	< 0.0360	< 0.0360	< 0.0377	< 0.0349
11/12/13	< 0.0429	< 0.0409	< 0.0296	< 0.0405	< 0.0310	< 0.0316	< 0.0440	< 0.0305
11/18/13	< 0.0325	< 0.0307	< 0.0261	< 0.0307	< 0.0269	< 0.0280	< 0.0343	< 0.0275
11/25/13	< 0.0370	< 0.0361	< 0.0309	< 0.0352	< 0.0327	< 0.0329	< 0.0536	< 0.0309
12/02/13	< 0.0120	< 0.0115	< 0.0116	< 0.0115	< 0.0124	< 0.0123	< 0.0135	< 0.0118
12/09/13	< 0.0290	< 0.0280	< 0.0274	< 0.0274	< 0.0286	< 0.0285	< 0.0290	< 0.0293
12/16/13	< 0.0317	< 0.0306	< 0.0330	< 0.0299	< 0.0349	< 0.0349	< 0.0324	< 0.0342
12/23/13	< 0.0534	< 0.0515	< 0.0356	< 0.0506	< 0.0375	< 0.0374	< 0.0529	< 0.0368
12/30/13	< 0.0437	< 0.0408	< 0.0424	< 0.0422	< 0.0451	< 0.0448	< 0.0425	< 0.0447

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-8
GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2013

10^{-3} pCi/m^3 ± 2 Sigma

	Algonquin 4				NYU Tower 5			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	130 ± 34	109 ± 22	127 ± 30	114 ± 24	80 ± 36	152 ± 27	99 ± 24	97 ± 32
K-40	< 12	< 20	< 12	< 26	< 31	< 14	22 ± 11	< 24
Mn-54	< 2	< 1	< 2	< 2	< 2	< 2	< 1	< 2
Co-58	< 3	< 2	< 3	< 3	< 3	< 2	< 2	< 4
Fe-59	< 9	< 6	< 13	< 9	< 13	< 8	< 7	< 12
Co-60	< 1	< 1	< 2	< 1	< 2	< 2	< 1	< 2
Zn-65	< 4	< 3	< 7	< 4	< 5	< 3	< 5	< 7
Nb-95	< 3	< 2	< 4	< 3	< 5	< 3	< 3	< 4
Zr-95	< 5	< 4	< 6	< 5	< 8	< 5	< 5	< 7
Ru-103	< 5	< 3	< 6	< 3	< 5	< 5	< 4	< 6
Ru-106	< 15	< 9	< 17	< 11	< 20	< 10	< 14	< 16
I-131	< 993	< 506	< 1013	< 866	< 1055	< 537	< 771	< 1070
Cs-134	< 2	< 1	< 2	< 2	< 2	< 2	< 2	< 2
Cs-137	< 1	< 1	< 2	< 1	< 2	< 1	< 1	< 2
Ba-140	< 296	< 173	< 383	< 234	< 333	< 230	< 246	< 405
La-140	< 116	< 60	< 72	< 98	< 179	< 149	< 74	< 189
Ce-141	< 8	< 6	< 8	< 8	< 7	< 6	< 13	< 8
Ce-144	< 9	< 5	< 7	< 8	< 8	< 7	< 14	< 8
Ra-226	< 26	< 18	< 29	< 24	< 26	< 23	< 35	< 31
Ac-228	< 6	< 4	< 7	< 5	< 6	< 6	< 6	< 8
Th-228	< 3	< 2	< 2	< 2	< 3	< 2	< 3	< 3

INDIAN POINT ENERGY CENTER
TABLE B-8
GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2013

10^{-3} pCi/m^3 ± 2 Sigma

	Roseton 23*				Croton Point 27			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	68 ± 27	136 ± 37	96 ± 34	82 ± 34	109 ± 32	113 ± 26	112 ± 31	90 ± 23
K-40	< 21	< 34	< 15	< 32	< 26	< 21	< 37	< 18
Mn-54	< 1	< 2	< 2	< 2	< 1	< 1	< 2	< 1
Co-58	< 2	< 4	< 3	< 3	< 3	< 2	< 3	< 2
Fe-59	< 7	< 10	< 10	< 14	< 5	< 8	< 13	< 6
Co-60	< 1	< 2	< 2	< 2	< 2	< 1	< 2	< 2
Zn-65	< 3	< 5	< 4	< 6	< 4	< 3	< 6	< 4
Nb-95	< 2	< 4	< 4	< 4	< 3	< 3	< 4	< 2
Zr-95	< 4	< 8	< 6	< 6	< 5	< 5	< 7	< 4
Ru-103	< 3	< 7	< 6	< 6	< 5	< 5	< 5	< 4
Ru-106	< 9	< 18	< 16	< 18	< 17	< 12	< 15	< 11
I-131	< 590	< 1136	< 887	< 971	< 733	< 815	< 918	< 737
Cs-134	< 1	< 3	< 2	< 2	< 2	< 1	< 2	< 2
Cs-137	< 1	< 2	< 1	< 2	< 1	< 1	< 2	< 1
Ba-140	< 183	< 379	< 331	< 298	< 230	< 225	< 324	< 227
La-140	< 104	< 185	< 104	< 113	< 100	< 55	< 130	< 66
Ce-141	< 4	< 8	< 9	< 7	< 7	< 8	< 7	< 7
Ce-144	< 5	< 7	< 10	< 8	< 6	< 9	< 8	< 8
Ra-226	< 18	< 24	< 29	< 24	< 23	< 25	< 23	< 20
Ac-228	< 4	< 9	< 6	< 7	< 5	< 4	< 7	< 4
Th-228	< 2	< 3	< 3	< 2	< 2	< 2	< 2	< 2

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-8
GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2013

10^{-3} pCi/m^3 ± 2 Sigma

	Grassy Point 29				Peekskill 44			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	86 ± 18	128 ± 31	116 ± 24	100 ± 31	75 ± 22	114 ± 28	107 ± 22	112 ± 29
K-40	< 15	< 13	< 17	< 36	< 13	< 23	< 15	< 39
Mn-54	< 1	< 1	< 1	< 2	< 1	< 2	< 1	< 2
Co-58	< 2	< 2	< 2	< 4	< 2	< 2	< 2	< 4
Fe-59	< 6	< 7	< 7	< 13	< 4	< 8	< 7	< 10
Co-60	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 2
Zn-65	< 3	< 4	< 3	< 6	< 3	< 4	< 2	< 5
Nb-95	< 2	< 2	< 3	< 4	< 2	< 3	< 2	< 4
Zr-95	< 3	< 4	< 3	< 7	< 3	< 6	< 4	< 6
Ru-103	< 3	< 4	< 3	< 6	< 3	< 4	< 3	< 7
Ru-106	< 6	< 12	< 10	< 20	< 10	< 11	< 8	< 18
I-131	< 480	< 741	< 533	< 1036	< 517	< 754	< 519	< 959
Cs-134	< 1	< 2	< 2	< 2	< 1	< 1	< 1	< 2
Cs-137	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 2
Ba-140	< 131	< 225	< 156	< 405	< 173	< 302	< 177	< 384
La-140	< 71	< 72	< 80	< 187	< 46	< 37	< 76	< 169
Ce-141	< 5	< 5	< 5	< 8	< 5	< 7	< 4	< 8
Ce-144	< 5	< 7	< 5	< 8	< 5	< 7	< 5	< 7
Ra-226	< 16	< 19	< 18	< 28	< 17	< 24	< 16	< 27
Ac-228	< 4	< 5	< 5	< 8	< 3	< 4	< 5	< 9
Th-228	< 1	< 2	< 2	< 3	< 2	< 2	< 1	< 2

INDIAN POINT ENERGY CENTER
TABLE B-8
GAMMA EMITTERS IN AIRBORNE PARTICULATE SAMPLES - 2013

10^{-3} pCi/m^3 ± 2 Sigma

	Training Building 94				Met Tower 95			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	99 ± 25	117 ± 24	113 ± 26	109 ± 33	80 ± 27	113 ± 30	94 ± 23	93 ± 26
K-40	< 14	< 12	< 16	< 23	< 14	< 10	< 13	< 20
Mn-54	< 2	< 1	< 2	< 3	< 2	< 2	< 1	< 1
Co-58	< 3	< 1	< 2	< 4	< 2	< 2	< 2	< 2
Fe-59	< 9	< 6	< 5	< 14	< 9	< 6	< 5	< 6
Co-60	< 2	< 1	< 1	< 2	< 2	< 2	< 1	< 1
Zn-65	< 4	< 3	< 3	< 5	< 4	< 4	< 3	< 3
Nb-95	< 3	< 2	< 2	< 4	< 3	< 3	< 2	< 2
Zr-95	< 5	< 4	< 4	< 8	< 7	< 5	< 3	< 4
Ru-103	< 5	< 4	< 4	< 7	< 5	< 3	< 3	< 4
Ru-106	< 17	< 11	< 14	< 22	< 15	< 12	< 11	< 12
I-131	< 895	< 701	< 618	< 1348	< 849	< 780	< 653	< 684
Cs-134	< 2	< 1	< 2	< 2	< 2	< 1	< 1	< 2
Cs-137	< 1	< 1	< 1	< 2	< 2	< 1	< 1	< 1
Ba-140	< 305	< 180	< 209	< 482	< 314	< 205	< 202	< 228
La-140	< 71	< 66	< 58	< 180	< 116	< 120	< 99	< 84
Ce-141	< 8	< 5	< 6	< 9	< 9	< 6	< 6	< 7
Ce-144	< 10	< 5	< 7	< 8	< 9	< 6	< 6	< 7
Ra-226	< 32	< 17	< 20	< 33	< 26	< 20	< 21	< 23
Ac-228	< 6	< 4	< 5	< 7	< 6	< 5	< 4	< 2
Th-228	< 3	< 2	< 2	< 3	< 3	< 2	< 2	< 2

INDIAN POINT ENERGY CENTER
TABLE B-9
RADIONUCLIDES IN RAINWATER SAMPLES - 2013

pCi/mL ± 2 Sigma

	Roseton 23*				Peekskill 44			
DATE	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
RADIOCHEMICAL								
H-3	< 163	< 184	< 184	< 176	< 190	< 185	< 184	< 175
GAMMA								
Be-7	< 19	< 11	< 18	44 ± 25	39 ± 24	< 9	(a)	(a)
K-40	< 12	30 ± 15	< 7	< 21	< 8	38 ± 19		
Mn-54	< 1	< 1	< 1	< 1	< 1	< 1		
Co-58	< 2	< 1	< 1	< 1	< 1	< 1		
Fe-59	< 6	< 2	< 5	< 3	< 3	< 2		
Co-60	< 1	< 1	< 1	< 1	< 1	< 0		
Zn-65	< 3	< 1	< 2	< 2	< 2	< 1		
Nb-95	< 2	< 1	< 2	< 1	< 1	< 1		
Zr-95	< 4	< 2	< 4	< 2	< 2	< 2		
Ru-103	< 3	< 2	< 2	< 2	< 2	< 1		
Ru-106	< 12	< 6	< 9	< 7	< 8	< 6		
I-131	< 77	< 73	< 439	< 85	< 51	< 64		
Cs-134	< 1	< 1	< 1	< 1	< 1	< 1		
Cs-137	< 1	< 1	< 1	< 1	< 1	< 1		
Ba-140	< 61	< 43	< 165	< 50	< 37	< 39		
La-140	< 19	< 11	< 44	< 13	< 11	< 11		
Ce-141	< 4	< 3	< 6	< 4	< 3	< 3		
Ce-144	< 8	< 6	< 6	< 6	< 6	< 5		
Ra-226	< 23	< 14	< 17	< 17	< 17	< 17		
Ac-228	< 5	< 3	< 4	< 4	< 4	< 3		
Th-228	< 2	< 2	< 1	< 2	< 1	< 1		

* Control location
(a) Gamma not ordered

INDIAN POINT ENERGY CENTER
TABLE B-10
RADIONUCLIDES IN DRINKING WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Camp Field 7					
DATE	1/15/2013	2/11/2013	3/11/2013	4/8/2013	5/13/2013	6/10/2013
RADIOCHEMICAL						
Gr-B	< 2.5	< 3.2	2.2 ± 1.4	2.9 ± 1.2	2.28 ± 1.38	3.87 ± 1.41
H-3 (a)			< 186			< 166
GAMMA						
Be-7	< 37	< 44	< 31	< 25	< 38.2	< 38.3
K-40	< 36	< 79	< 27	< 22	< 38.7	< 72.4
Mn-54	< 3	< 4	< 4	< 3	< 5.0	< 4.3
Co-58	< 3	< 5	< 3	< 3	< 4.4	< 4.7
Fe-59	< 8	< 11	< 7	< 6	< 8.4	< 9.7
Co-60	< 3	< 5	< 4	< 3	< 4.2	< 4.2
Zn-65	< 7	< 10	< 6	< 5	< 7.7	< 9.7
Nb-95	< 4	< 5	< 4	< 3	< 4.0	< 5.3
Zr-95	< 6	< 9	< 6	< 5	< 8.7	< 7.7
Ru-103	< 4	< 5	< 4	< 3	< 5.2	< 4.7
Ru-106	< 37	< 43	< 35	< 26	< 42.9	< 37.5
I-131	< 7	< 9	< 6	< 5	< 9.2	< 8.1
Cs-134	< 4	< 4	< 3	< 3	< 4.1	< 4.8
Cs-137	< 4	< 5	< 4	< 3	< 5.0	< 4.6
Ba-140	< 19	< 28	< 18	< 14	< 24.3	< 21.9
La-140	< 4	< 8	< 5	< 5	< 7.4	< 7.9
Ce-141	< 8	< 9	< 7	< 6	< 9.5	< 8.7
Ce-144	< 31	< 33	< 27	< 23	< 34.1	< 35.5
Ra-226	< 103	< 125	< 94	< 82	< 107.4	< 107.6
Ac-228	< 18	< 20	< 13	< 12	29.18 ± 10.44	< 17.9
Th-228	< 7	< 10	< 8	< 5	< 8.8	< 9.7

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-10
RADIONUCLIDES IN DRINKING WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

Camp Field
7

DATE	7/9/2013	8/19/2013	9/16/2013	10/21/13	11/18/13	12/09/13
RADIOCHEMICAL						
Gr-B	3.12 ± 1.14	3.40 ± 1.60	3.40 ± 1.53	< 2.9	< 3.7	< 2.3
H-3 (a)			< 170			< 196
GAMMA						
Be-7	< 34.1	< 36.5	< 54.5	< 21.5	< 34.8	< 45.9
K-40	< 61.9	< 59.0	< 101.5	< 47.4	< 27.6	< 36.6
Mn-54	< 2.8	< 4.3	< 6.3	< 2.5	< 3.3	< 4.5
Co-58	< 3.6	< 3.4	< 5.2	< 2.8	< 3.6	< 4.5
Fe-59	< 9.0	< 8.9	< 12.8	< 6.0	< 7.0	< 10.1
Co-60	< 3.1	< 3.8	< 6.1	< 2.8	< 3.0	< 4.5
Zn-65	< 6.3	< 8.4	< 12.9	< 5.0	< 6.7	< 8.9
Nb-95	< 3.9	< 4.9	< 7.1	< 2.9	< 3.8	< 5.4
Zr-95	< 5.7	< 7.5	< 10.5	< 4.6	< 6.1	< 8.7
Ru-103	< 3.8	< 4.6	< 6.8	< 2.9	< 4.4	< 5.3
Ru-106	< 38.6	< 36.8	< 37.8	< 21.6	< 30.7	< 48.3
I-131	< 5.8	< 8.5	< 10.2	< 7.8	< 13.3	< 13.5
Cs-134	< 3.5	< 3.8	< 5.3	< 2.3	< 3.2	< 4.7
Cs-137	< 3.3	< 4.1	< 5.4	< 2.7	< 3.5	< 4.9
Ba-140	< 18.1	< 21.7	< 30.2	< 18.0	< 26.5	< 27.1
La-140	< 6.2	< 7.4	< 11.6	< 6.0	< 7.8	< 8.7
Ce-141	< 7.8	< 9.0	< 11.1	< 4.0	< 9.0	< 11.0
Ce-144	< 29.4	< 35.4	< 41.0	< 14.2	< 29.3	< 38.7
Ra-226	< 81.5	< 94.8	< 142.2	< 45.0	< 86.6	< 137.4
Ac-228	< 15.4	< 14.8	< 23.2	< 9.7	< 13.2	< 19.1
Th-228	< 6.7	< 7.0	< 9.0	< 3.9	< 6.6	< 10.7

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-10
RADIONUCLIDES IN DRINKING WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Croton 8					
DATE	1/15/2013	2/11/2013	3/11/2013	4/8/2013	5/13/2013	6/10/2013
RADIOCHEMICAL						
Gr-B	3.15 ± 2.0	3.1 ± 2.0	< 2.1	4.14 ± 1.5	2.6 ± 1.4	2.7 ± 1.3
H-3 (a)			< 182.0			< 170.0
GAMMA						
Be-7	< 37.4	< 40.2	< 42.5	< 27.7	< 49.1	< 36.3
K-40	< 38.3	< 38.8	< 55.4	58.1 ± 36.1	< 97.1	< 48.8
Mn-54	< 4.3	< 4.0	< 5.5	< 3.0	< 6.5	< 5.1
Co-58	< 4.1	< 4.2	< 5.6	< 3.1	< 6.9	< 4.5
Fe-59	< 9.1	< 8.1	< 12.2	< 6.7	< 14.8	< 9.3
Co-60	< 4.0	< 4.1	< 5.5	< 2.8	< 6.1	< 4.4
Zn-65	< 9.3	< 6.4	< 9.1	< 5.8	< 13.4	< 9.5
Nb-95	< 4.9	< 4.8	< 5.8	< 3.3	< 7.5	< 4.8
Zr-95	< 7.3	< 7.2	< 9.2	< 5.2	< 9.6	< 7.9
Ru-103	< 4.6	< 4.3	< 5.6	< 3.1	< 6.2	< 5.1
Ru-106	< 41.9	< 43.2	< 52.1	< 27.6	< 50.4	< 39.3
I-131	< 7.0	< 9.8	< 8.7	< 5.7	< 10.1	< 7.7
Cs-134	< 4.2	< 3.7	< 5.0	< 2.6	< 6.4	< 4.5
Cs-137	< 4.0	< 4.8	< 5.4	< 2.9	< 6.0	< 4.8
Ba-140	< 19.7	< 23.2	< 27.8	< 13.9	< 31.1	< 20.3
La-140	< 6.1	< 7.5	< 8.4	< 5.1	< 8.9	< 7.4
Ce-141	< 8.4	< 9.9	< 7.2	< 5.5	< 11.4	< 7.9
Ce-144	< 34.5	< 38.8	< 28.7	< 22.1	< 42.3	< 31.5
Ra-226	< 99.7	< 113.1	< 99.5	< 70.0	< 163.2	< 107.4
Ac-228	< 17.6	< 20.3	< 20.1	< 12.2	< 21.5	< 15.0
Th-228	< 8.1	< 8.7	< 8.8	< 6.5	< 10.8	< 6.7

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-10
RADIONUCLIDES IN DRINKING WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Croton 8					
DATE	7/9/2013	8/19/2013	9/16/2013	10/21/13	11/18/13	12/09/13
RADIOCHEMICAL						
Gr-B	2.9 ± 1.1	2.5 ± 1.1	3.1 ± 1.5	< 2.8	< 2.9	< 2.4
H-3 (a)			< 172.0			< 183.0
GAMMA						
Be-7	< 39.1	< 47.6	< 54.5	< 17.8	< 32.7	< 58.2
K-40	< 55.6	< 50.3	< 108.5	< 37.6	< 22.8	< 58.7
Mn-54	< 4.9	< 4.5	< 5.6	< 1.8	< 3.2	< 7.8
Co-58	< 4.6	< 5.7	< 4.8	< 2.1	< 3.5	< 6.5
Fe-59	< 11.0	< 11.9	< 9.6	< 4.2	< 7.5	< 16.6
Co-60	< 5.0	< 7.1	< 5.9	< 2.0	< 3.0	< 8.3
Zn-65	< 9.6	< 9.5	< 10.4	< 3.9	< 5.8	< 13.5
Nb-95	< 4.5	< 6.3	< 6.1	< 2.1	< 3.8	< 7.8
Zr-95	< 8.1	< 9.6	< 9.0	< 3.7	< 6.7	< 14.8
Ru-103	< 5.2	< 5.5	< 6.1	< 2.5	< 4.4	< 7.7
Ru-106	< 34.9	< 45.0	< 51.9	< 17.9	< 31.0	< 60.6
I-131	< 7.7	< 10.2	< 10.3	< 6.6	< 13.7	< 14.2
Cs-134	< 4.2	< 4.0	< 6.4	< 1.8	< 3.3	< 6.2
Cs-137	< 5.1	< 5.1	< 6.6	< 1.9	< 3.6	< 6.2
Ba-140	< 20.7	< 24.7	< 28.4	< 14.1	< 27.9	< 39.9
La-140	< 5.5	< 7.2	< 6.3	< 4.9	< 8.0	< 12.0
Ce-141	< 8.3	< 8.8	< 12.6	< 4.4	< 9.1	< 10.7
Ce-144	< 30.9	< 36.0	< 51.4	< 14.8	< 31.4	< 34.6
Ra-226	< 113.9	< 120.4	< 169.5	< 51.8	< 91.9	< 135.8
Ac-228	< 17.5	< 21.7	< 20.1	< 7.4	< 13.1	< 28.8
Th-228	< 9.5	< 9.4	< 12.8	< 4.0	< 7.6	< 11.0

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-11
RADIONUCLIDES IN GROUNDWATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Lafarge Monitoring Well 106			
DATE	5/24/2013		11/26/2013	
RADIOCHEMICAL				
H-3	< 383		< 392	
Ni-63	< 17.5		< 16.3	
Sr-90	< 1.89		< 1.88	
GAMMA				
Be-7	< 121		< 75	
K-40	< 101		< 128	
Mn-54	< 11		< 10	
Co-58	< 14		< 9	
Fe-59	< 27		< 26	
Co-60	< 10		< 10	
Zn-65	< 20		< 24	
Nb-95	< 13		< 11	
Zr-95	< 23		< 18	
Ru-106	< 92		< 73	
Cs-134	< 12		< 10	
Cs-137	< 11		< 9	
Ba-140	< 64	(a)	< 41	
La-140	< 64	(a)	< 41	(a)
Ce-141	< 27		< 20	
Ce-144	< 58		< 46	
Ac-228	< 39		< 31	

(a) LLD not met due to age of sample

INDIAN POINT ENERGY CENTER
TABLE B-12
GAMMA EMITTERS IN SOIL SAMPLES, 2013

pCi/kg dry ± 2 Sigma

	Roseton 23*	Training Building 94	Met Tower 95
DATE	9/23/2013	9/23/2013	9/23/2013
Be-7	< 517	411 ± 248	< 426
K-40	19780 ± 1180	6758 ± 607	11920 ± 1034
Mn-54	< 45	< 26	< 36
Co-58	< 52	< 35	< 44
Fe-59	< 129	< 80	< 114
Co-60	< 58	< 36	< 42
Zn-65	< 102	< 73	< 103
Nb-95	< 62	< 39	< 54
Zr-95	< 95	< 61	< 80
Ru-103	< 58	< 39	< 48
Ru-106	< 411	< 251	< 342
I-131	< 335	< 243	< 296
Cs-134	< 43	< 26	< 34
Cs-137	< 46	< 29	< 41
Ba-140	< 545	< 333	< 495
La-140	< 155	< 116	< 78
Ce-141	< 112	< 68	< 89
Ce-144	< 295	< 179	< 237
Ra-226	1350 ± 897	< 649	< 766
Th-228	1135 ± 75	178 ± 40	224 ± 47

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Roseton 23*						
DATE	04/29/13	05/20/13	05/20/13	05/20/13	06/17/13	06/17/13	07/15/13
RADIOCHEMICAL							
I-131 (a)	< 27						
GAMMA							
Be-7	685 ± 209	476 ± 163	369 ± 156	576 ± 203	1966 ± 185	991 ± 237	1877 ± 227
K-40	4104 ± 436	3269 ± 326	5780 ± 506	5515 ± 547	7447 ± 458	3920 ± 487	4674 ± 444
Mn-54	< 16	< 11	< 19	< 26	< 15	< 21	< 21
Co-58	< 19	< 14	< 22	< 26	< 13	< 22	< 19
Fe-59	< 51	< 28	< 46	< 51	< 35	< 58	< 49
Co-60	< 21	< 19	< 26	< 30	< 18	< 27	< 23
Zn-65	< 42	< 33	< 44	< 51	< 40	< 39	< 50
Nb-95	< 18	< 15	< 20	< 24	< 15	< 25	< 22
Zr-95	< 32	< 23	< 35	< 38	< 29	< 39	< 32
Ru-103	< 15	< 14	< 19	< 26	< 16	< 25	< 20
Ru-106	< 137	< 116	< 163	< 198	< 134	< 192	< 203
I-131	< 36	< 28	< 39	< 50	< 32	< 47	< 37
Cs-134	< 16	< 13	< 16	< 21	< 12	< 20	< 22
Cs-137	< 18	< 13	< 18	< 27	< 14	< 22	< 23
Ba-140	< 89	< 77	< 106	< 141	< 77	< 91	< 109
La-140	< 23	< 19	< 33	< 30	< 20	< 30	< 29
Ce-141	< 25	< 24	< 28	< 43	< 30	< 41	< 33
Ce-144	< 98	< 88	< 101	< 174	< 103	< 155	< 127
Ra-226	< 407	< 341	< 396	< 549	< 333	< 537	< 460
Th-228	< 29	< 22	< 32	< 43	< 30	< 44	< 42

* Control location
(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Roseton 23*						
DATE	07/15/13	07/15/13	07/15/13	08/12/13	08/12/13	08/12/13	09/09/13
RADIOCHEMICAL							
I-131 (a)							
GAMMA							
Be-7	918 ± 187	1441 ± 194	637 ± 205	1508 ± 233	2497 ± 264	2813 ± 259	2804 ± 222
K-40	2099 ± 330	8351 ± 542	3124 ± 434	5846 ± 474	4791 ± 477	4984 ± 393	6112 ± 394
Mn-54	< 17	< 18	< 17	< 15	< 22	< 17	< 16
Co-58	< 14	< 21	< 19	< 15	< 20	< 16	< 16
Fe-59	< 26	< 42	< 49	< 41	< 54	< 37	< 40
Co-60	< 18	< 24	< 24	< 22	< 25	< 19	< 18
Zn-65	< 39	< 46	< 43	< 38	< 49	< 36	< 36
Nb-95	< 17	< 19	< 21	< 15	< 23	< 18	< 16
Zr-95	< 32	< 32	< 38	< 25	< 39	< 31	< 30
Ru-103	< 20	< 18	< 19	< 16	< 22	< 16	< 18
Ru-106	< 127	< 170	< 170	< 132	< 157	< 144	< 156
I-131	< 32	< 38	< 48	< 37	< 47	< 41	< 39
Cs-134	< 16	< 17	< 19	< 15	< 20	< 14	< 17
Cs-137	< 18	< 19	< 21	< 17	< 18	< 16	< 15
Ba-140	< 93	< 86	< 111	< 96	< 117	< 94	< 99
La-140	< 24	< 27	< 36	< 24	< 29	< 27	< 21
Ce-141	< 30	< 33	< 36	< 25	< 29	< 30	< 34
Ce-144	< 112	< 109	< 137	< 94	< 98	< 109	< 130
Ra-226	< 381	< 389	< 486	< 317	< 411	< 368	< 421
Th-228	< 29	< 37	< 36	< 28	< 32	< 29	< 30

* Control location
(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Roseton 23*				
DATE	09/09/13	09/09/13	10/07/13	10/07/13	10/07/13
RADIOCHEMICAL					
I-131 (a)					
GAMMA					
Be-7	2052 ± 138	2854 ± 230	2851 ± 238	1768 ± 144	863 ± 140
K-40	2472 ± 199	4260 ± 342	6335 ± 365	4236 ± 249	3680 ± 231
Mn-54	< 10	< 14	< 13	< 11	< 10
Co-58	< 11	< 16	< 15	< 12	< 11
Fe-59	< 20	< 33	< 34	< 30	< 26
Co-60	< 11	< 21	< 15	< 14	< 11
Zn-65	< 21	< 37	< 28	< 26	< 21
Nb-95	< 11	< 17	< 15	< 13	< 12
Zr-95	< 18	< 29	< 27	< 21	< 21
Ru-103	< 13	< 17	< 18	< 13	< 13
Ru-106	< 100	< 133	< 109	< 94	< 88
I-131	< 28	< 37	< 58	< 59	< 58
Cs-134	< 10	< 14	< 12	< 10	< 9
Cs-137	< 11	< 18	< 14	< 10	< 11
Ba-140	< 65	< 87	< 116	< 105	< 106
La-140	< 15	< 21	< 31	< 27	< 25
Ce-141	< 24	< 25	< 28	< 25	< 21
Ce-144	< 91	< 99	< 86	< 72	< 66
Ra-226	< 311	< 347	< 288	< 270	< 236
Th-228	< 21	< 26	< 23	< 21	41 ± 18

* Control location
(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Training Center 94						
DATE	04/29/13	04/29/13	04/29/13	05/20/13	05/20/13	05/20/13	06/17/13
RADIOCHEMICAL							
I-131 (a)	< 37	< 44	< 37				
GAMMA							
Be-7	746 ± 220	377 ± 198	256 ± 134	1214 ± 252	502 ± 147	1350 ± 208	844 ± 174
K-40	3743 ± 512	5528 ± 548	3802 ± 434	3106 ± 469	4577 ± 388	5971 ± 622	4472 ± 410
Mn-54	< 23	< 24	< 18	< 22	< 17	< 27	< 17
Co-58	< 23	< 24	< 17	< 20	< 16	< 26	< 17
Fe-59	< 54	< 63	< 43	< 43	< 40	< 66	< 37
Co-60	< 31	< 30	< 21	< 24	< 21	< 29	< 23
Zn-65	< 50	< 54	< 46	< 49	< 34	< 65	< 39
Nb-95	< 27	< 24	< 21	< 20	< 17	< 30	< 19
Zr-95	< 38	< 45	< 37	< 36	< 32	< 47	< 30
Ru-103	< 28	< 28	< 20	< 22	< 18	< 25	< 18
Ru-106	< 182	< 195	< 180	< 189	< 150	< 237	< 158
I-131	< 58	< 50	< 40	< 44	< 36	< 56	< 34
Cs-134	< 24	< 21	< 16	< 20	< 14	< 22	< 16
Cs-137	< 27	< 25	< 19	< 20	< 18	< 26	< 20
Ba-140	< 130	< 122	< 109	< 109	< 91	< 131	< 92
La-140	< 47	< 42	< 25	< 34	< 26	< 43	< 29
Ce-141	< 50	< 34	< 27	< 36	< 32	< 33	< 25
Ce-144	< 172	< 117	< 100	< 132	< 113	< 125	< 88
Ra-226	< 597	< 486	< 415	< 438	< 408	< 505	< 300
Th-228	< 40	< 38	< 33	< 33	< 34	< 41	< 29

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Training Center 94						
DATE	06/17/13	06/17/13	07/15/13	07/15/13	07/15/13	07/15/13	08/12/13
RADIOCHEMICAL							
I-131 (a)							
GAMMA							
Be-7	844 ± 174	2123 ± 233	1638 ± 279	1223 ± 255	765 ± 182	440 ± 250	2567 ± 205
K-40	4472 ± 410	6208 ± 451	4427 ± 509	8275 ± 678	3515 ± 386	6297 ± 678	7170 ± 442
Mn-54	< 17	< 17	< 21	< 24	< 17	< 27	< 15
Co-58	< 17	< 17	< 23	< 24	< 17	< 27	< 16
Fe-59	< 37	< 41	< 54	< 61	< 37	< 66	< 38
Co-60	< 23	< 21	< 29	< 30	< 25	< 34	< 19
Zn-65	< 39	< 40	< 46	< 55	< 38	< 69	< 36
Nb-95	< 19	< 17	< 19	< 23	< 17	< 29	< 15
Zr-95	< 30	< 33	< 40	< 44	< 35	< 52	< 29
Ru-103	< 18	< 19	< 25	< 27	< 20	< 29	< 18
Ru-106	< 158	< 129	< 211	< 192	< 163	< 229	< 139
I-131	< 34	< 38	< 49	< 51	< 37	< 56	< 40
Cs-134	< 16	< 15	< 21	< 22	< 15	< 23	< 14
Cs-137	< 20	< 17	< 21	< 22	< 19	< 24	< 18
Ba-140	< 92	< 98	< 129	< 128	< 96	< 168	< 85
La-140	< 29	< 22	< 36	< 25	< 31	< 45	< 21
Ce-141	< 25	< 33	< 34	< 43	< 31	< 39	< 35
Ce-144	< 88	< 124	< 131	< 166	< 110	< 148	< 132
Ra-226	< 300	< 415	< 468	< 550	< 403	< 600	< 386
Th-228	< 29	< 33	< 41	< 43	< 33	< 45	< 29

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Training Center 94						
DATE	08/12/13	08/13/13	09/10/13	09/10/13	09/10/13	10/07/13	10/07/13
RADIOCHEMICAL							
I-131 (a)							
GAMMA							
Be-7	1619 ± 266	1110 ± 232	1944 ± 246	2397 ± 179	1093 ± 263	940 ± 128	959 ± 146
K-40	3463 ± 445	1869 ± 329	6442 ± 473	2196 ± 270	3886 ± 535	4251 ± 271	4771 ± 331
Mn-54	< 22	< 15	< 17	< 17	< 26	< 10	< 15
Co-58	< 22	< 16	< 16	< 16	< 24	< 12	< 16
Fe-59	< 48	< 38	< 39	< 34	< 47	< 28	< 35
Co-60	< 26	< 20	< 24	< 18	< 24	< 14	< 15
Zn-65	< 52	< 36	< 40	< 34	< 55	< 26	< 30
Nb-95	< 24	< 21	< 17	< 17	< 25	< 13	< 15
Zr-95	< 45	< 27	< 31	< 28	< 41	< 22	< 23
Ru-103	< 22	< 19	< 20	< 17	< 28	< 13	< 16
Ru-106	< 211	< 174	< 143	< 141	< 222	< 100	< 113
I-131	< 51	< 43	< 38	< 35	< 58	< 59	< 57
Cs-134	< 20	< 16	< 17	< 15	< 21	< 10	< 12
Cs-137	< 24	< 17	< 16	< 16	< 25	< 10	< 13
Ba-140	< 98	< 100	< 107	< 90	< 147	< 110	< 111
La-140	< 32	< 25	< 21	< 27	< 32	< 31	< 30
Ce-141	< 39	< 36	< 34	< 25	< 51	< 23	< 30
Ce-144	< 132	< 132	< 121	< 95	< 186	< 69	< 92
Ra-226	< 458	< 404	< 480	< 380	< 662	< 259	< 334
Th-228	< 32	< 34	< 31	< 25	< 50	< 22	< 27

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Met Tower 95						
DATE	4/29/2013	4/29/2013	4/29/2013	5/20/2013	5/20/2013	5/20/2013	6/17/2013
RADIOCHEMICAL							
I-131 (a)	< 28	< 36	< 41				
GAMMA							
Be-7	454 ± 226	< 175	617 ± 182	1267 ± 227	494 ± 193	804 ± 245	589 ± 182
K-40	6589 ± 550	5624 ± 381	3750 ± 435	6888 ± 574	3920 ± 412	3180 ± 435	4299 ± 386
Mn-54	< 24	< 17	< 21	< 22	< 16	< 19	< 17
Co-58	< 25	< 17	< 20	< 21	< 19	< 24	< 18
Fe-59	< 56	< 40	< 46	< 44	< 39	< 49	< 39
Co-60	< 30	< 20	< 24	< 25	< 20	< 27	< 21
Zn-65	< 50	< 37	< 56	< 43	< 42	< 48	< 41
Nb-95	< 30	< 19	< 24	< 24	< 18	< 22	< 17
Zr-95	< 45	< 32	< 40	< 38	< 35	< 43	< 34
Ru-103	< 27	< 19	< 26	< 19	< 21	< 23	< 17
Ru-106	< 213	< 161	< 226	< 142	< 155	< 199	< 174
I-131	< 59	< 41	< 56	< 42	< 34	< 55	< 35
Cs-134	< 24	< 18	< 20	< 18	< 17	< 25	< 17
Cs-137	< 25	< 18	< 26	< 17	< 19	< 23	< 19
Ba-140	< 142	< 99	< 113	< 117	< 114	< 129	< 98
La-140	< 37	< 24	< 26	< 17	< 31	< 26	< 22
Ce-141	< 52	< 34	< 41	< 35	< 31	< 46	< 30
Ce-144	< 181	< 128	< 152	< 131	< 111	< 167	< 115
Ra-226	< 617	< 390	< 531	< 453	< 438	< 561	< 440
Th-228	< 49	< 34	< 37	< 32	< 28	< 41	< 29

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Met Tower 95						
DATE	6/17/2013	6/17/2013	7/15/2013	7/15/2013	7/15/2013	8/12/2013	8/12/2013
RADIOCHEMICAL							
I-131 (a)							
GAMMA							
Be-7	1013 ± 237	2362 ± 227	1316 ± 318	650 ± 169	995 ± 203	2867 ± 299	2416 ± 222
K-40	3859 ± 428	8023 ± 483	7074 ± 632	3409 ± 384	4587 ± 475	6469 ± 496	10160 ± 494
Mn-54	< 18	< 15	< 29	< 20	< 20	< 20	< 18
Co-58	< 21	< 15	< 26	< 19	< 24	< 18	< 18
Fe-59	< 39	< 41	< 70	< 41	< 46	< 47	< 43
Co-60	< 20	< 20	< 33	< 21	< 26	< 27	< 25
Zn-65	< 45	< 36	< 67	< 45	< 52	< 45	< 41
Nb-95	< 19	< 18	< 29	< 20	< 22	< 19	< 17
Zr-95	< 40	< 25	< 44	< 32	< 41	< 32	< 34
Ru-103	< 23	< 16	< 26	< 21	< 25	< 19	< 19
Ru-106	< 201	< 138	< 202	< 152	< 210	< 163	< 164
I-131	< 48	< 34	< 46	< 42	< 48	< 48	< 44
Cs-134	< 21	< 16	< 23	< 18	< 19	< 17	< 16
Cs-137	< 22	< 13	< 24	< 18	< 23	< 18	< 17
Ba-140	< 123	< 88	< 124	< 108	< 131	< 112	< 104
La-140	< 25	< 12	< 44	< 21	< 22	< 27	< 25
Ce-141	< 45	< 29	< 31	< 30	< 40	< 37	< 33
Ce-144	< 166	< 101	< 119	< 113	< 149	< 131	< 123
Ra-226	< 578	< 411	< 411	< 412	< 554	< 438	< 434
Th-228	< 47	< 32	< 39	< 36	< 37	< 33	< 31

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-13
GAMMA EMITTERS IN BROADLEAF VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Met Tower 95						
DATE	8/12/2013	8/12/2013	9/10/2013	9/10/2013	9/10/2013	10/9/2012	10/9/2012
RADIOCHEMICAL							
I-131 (a)							
GAMMA							
Be-7	2867 ± 299	2416 ± 222	1354 ± 259	1684 ± 216	930 ± 127	1471 ± 350	2295 ± 174
K-40	6469 ± 496	10160 ± 494	3384 ± 436	5181 ± 480	5503 ± 300	5022 ± 755	2688 ± 278
Mn-54	< 20	< 18	< 17	< 18	< 12	< 28	< 13
Co-58	< 18	< 18	< 22	< 20	< 12	< 30	< 14
Fe-59	< 47	< 43	< 44	< 48	< 26	< 73	< 30
Co-60	< 27	< 25	< 25	< 27	< 12	< 33	< 15
Zn-65	< 45	< 41	< 50	< 45	< 24	< 77	< 28
Nb-95	< 19	< 17	< 24	< 20	< 12	< 25	< 15
Zr-95	< 32	< 34	< 37	< 35	< 22	< 59	< 25
Ru-103	< 19	< 19	< 24	< 20	< 11	< 30	< 15
Ru-106	< 163	< 164	< 177	< 174	< 99	< 241	< 132
I-131	< 48	< 44	< 52	< 41	< 23	< 59	< 31
Cs-134	< 17	< 16	< 19	< 19	< 11	< 25	< 14
Cs-137	< 18	< 17	< 21	< 20	< 12	< 27	< 14
Ba-140	< 112	< 104	< 122	< 116	< 62	< 162	< 78
La-140	< 27	< 25	< 29	< 27	< 19	< 53	< 23
Ce-141	< 37	< 33	< 39	< 32	< 15	< 45	< 25
Ce-144	< 131	< 123	< 137	< 114	< 54	< 170	< 91
Ra-226	< 438	< 434	< 564	< 450	< 195	< 664	< 352
Th-228	< 33	< 31	< 37	< 32	< 20	37 ± 48	35 ± 19

(a) Iodine-131 by low level analysis

INDIAN POINT ENERGY CENTER
TABLE B-14
RADIONUCLIDES IN RIVER WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Plant Inlet Hudson River Intake 9*					
DATE	1/28/2013	2/25/2013	3/25/2013	4/29/2013	5/28/2013	6/24/2013
RADIOCHEMICAL						
H-3 (a)	< 176	< 171	216 ± 126	< 168	< 174	< 185
H-3, Quarterly			266 ± 119			< 171
GAMMA						
K-40	< 29	< 18	< 16	< 12	< 14	< 12
Mn-54	< 4	< 2	< 2	< 1	< 2	< 1
Co-58	< 5	< 2	< 2	< 2	< 2	< 1
Fe-59	< 10	< 6	< 4	< 3	< 4	< 3
Co-60	< 4	< 2	< 2	< 1	< 2	< 2
Zn-65	< 9	< 4	< 3	< 3	< 3	< 3
Nb-95	< 5	< 2	< 2	< 2	< 2	< 2
Zr-95	< 8	< 4	< 3	< 3	< 3	< 3
Ru-103	< 6	< 3	< 2	< 2	< 2	< 2
Ru-106	< 37	< 18	< 15	< 12	< 15	< 12
I-131	< 45	< 13	< 10	< 12	< 12	< 9
Cs-134	< 4	< 2	< 1	< 1	< 1	< 1
Cs-137	< 4	< 2	< 2	< 1	< 2	< 1
Ba-140	< 55	< 22	< 19	< 18	< 19	< 15
La-140	< 23	< 7	< 6	< 6	< 6	< 5
Ce-141	< 13	< 5	< 4	< 4	< 5	< 3
Ce-144	< 35	< 16	< 12	< 11	< 14	< 9
Ra-226	< 120	< 52	< 40	< 30	< 41	57 ± 31
Ac-228	< 17	< 6	< 7	< 5	< 6	< 5
Th-228	< 7	7 ± 4	< 3	4 ± 2	< 3	< 2

* Control location
(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-14
RADIONUCLIDES IN RIVER WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

Plant Inlet Hudson River Intake
9*

DATE	7/29/2013	8/27/2013	10/1/2013	10/29/2013	12/2/2013	12/30/2013
RADIOCHEMICAL						
H-3 (a)						
H-3, Quarterly			< 186			< 192
GAMMA						
K-40	< 13	< 15	55 < 25	57 ± 29	48 ± 31	< 31
Mn-54	< 1	< 2	< 2	< 2	< 1	< 2
Co-58	< 2	< 2	< 2	< 2	< 1	< 2
Fe-59	< 4	< 4	< 5	< 5	< 3	< 4
Co-60	< 1	< 2	< 2	< 2	< 1	< 2
Zn-65	< 3	< 3	< 4	< 4	< 2	< 3
Nb-95	< 2	< 2	< 2	< 2	< 2	< 2
Zr-95	< 3	< 4	< 4	< 4	< 3	< 4
Ru-103	< 2	< 3	< 3	< 3	< 2	< 3
Ru-106	< 13	< 16	< 16	< 17	< 10	< 17
I-131	< 11	< 14	< 15	< 12	< 12	< 14
Cs-134	< 1	< 2	< 2	< 2	< 1	< 2
Cs-137	< 1	< 2	< 2	< 2	< 1	< 2
Ba-140	< 18	< 21	< 22	< 21	< 19	< 22
La-140	< 6	< 7	< 7	< 7	< 5	< 6
Ce-141	< 4	< 5	< 4	< 5	< 4	< 6
Ce-144	< 10	< 15	< 12	< 16	< 10	< 17
Ra-226	< 31	< 45	< 38	< 46	< 35	< 48
Ac-228	< 4	< 7	< 7	< 8	< 7	< 7
Th-228	< 3	4 ± 3	< 3	< 4	< 3	< 4

* Control location
(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-14
RADIONUCLIDES IN RIVER WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Discharge Canal 10					
DATE	1/28/2013	2/25/2013	3/25/2013	4/29/2013	5/28/2013	6/24/2013
RADIOCHEMICAL						
H-3 (a)	< 178	< 183	566 ± 142	< 171	< 177	< 183
H-3, Quarterly			357 ± 126			< 170
GAMMA						
K-40	< 32	< 16	44 ± 21	101 ± 30	< 14	< 17
Mn-54	< 4	< 2	< 1	< 2	< 1	< 2
Co-58	< 6	< 2	< 2	< 2	< 2	< 2
Fe-59	< 12	< 5	< 4	< 4	< 4	< 5
Co-60	< 5	< 2	< 2	< 2	< 2	< 2
Zn-65	< 9	< 4	< 3	< 3	< 3	< 4
Nb-95	< 5	< 2	< 2	< 2	< 2	< 2
Zr-95	< 8	< 4	< 3	< 3	< 3	< 4
Ru-103	< 7	< 3	< 2	< 2	< 2	< 3
Ru-106	< 38	< 18	< 14	< 14	< 13	< 17
I-131	< 42	< 14	< 8	< 15	< 10	< 12
Cs-134	< 4	< 2	< 1	< 1	< 1	< 2
Cs-137	< 4	< 2	< 2	< 2	< 2	< 2
Ba-140	< 67	< 22	< 14	< 21	< 17	< 21
La-140	< 20	< 7	< 4	< 6	< 5	< 6
Ce-141	< 12	< 5	< 4	< 6	< 4	< 4
Ce-144	< 35	< 17	< 12	< 17	< 10	< 11
Ra-226	< 110	< 46	< 36	< 48	< 33	< 38
Ac-228	< 15	< 8	< 6	< 7	< 7	10 ± 6
Th-228	< 8	< 4	< 3	< 3	< 3	< 3

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-14
RADIONUCLIDES IN RIVER WATER SAMPLES - 2013

pCi/liter ± 2 Sigma

	Discharge Canal 10					
DATE	7/29/2013	8/27/2013	10/1/2013	10/29/2013	12/2/2013	12/30/2013
RADIOCHEMICAL						
H-3 (a)						
H-3, Quarterly			< 186			306 ± 137
GAMMA						
K-40	< 14	< 33	65 ± 28	< 16	< 35	< 33
Mn-54	< 2	< 2	< 1	< 2	< 1	< 2
Co-58	< 2	< 2	< 2	< 2	< 2	< 2
Fe-59	< 5	< 4	< 4	< 4	< 3	< 4
Co-60	< 2	< 2	< 1	< 2	< 1	< 2
Zn-65	< 3	< 3	< 3	< 4	< 2	< 3
Nb-95	< 2	< 2	< 2	< 2	< 2	< 2
Zr-95	< 4	< 3	< 3	< 3	< 3	< 3
Ru-103	< 3	< 2	< 2	< 2	< 2	< 2
Ru-106	< 16	< 16	< 14	< 16	< 12	< 15
I-131	< 15	< 13	< 14	< 11	< 11	< 13
Cs-134	< 2	< 2	< 1	< 2	< 1	< 2
Cs-137	< 2	< 2	< 2	< 2	< 1	< 2
Ba-140	< 23	< 22	< 20	< 18	< 15	< 21
La-140	< 7	< 7	< 6	< 6	< 4	< 7
Ce-141	< 5	< 5	< 4	< 4	< 4	< 5
Ce-144	< 14	< 13	< 11	< 14	< 9	< 13
Ra-226	< 40	< 46	< 34	< 46	< 34	< 37
Ac-228	< 7	< 6	< 7	< 6	< 5	< 7
Th-228	< 3	< 4	< 3	< 4	< 3	< 3

(a) Quarterly composite

INDIAN POINT ENERGY CENTER
TABLE B-15
GAMMA EMITTERS IN BOTTOM SEDIMENT SAMPLES - 2013

pCi/kg dry ± 2 Sigma

	Discharge Canal 10				Off Verplanck 17		
DATE	6/19/2013	9/10/2013	9/10/2013	10/9/2013	6/19/2013	9/10/2013	10/9/2013
Be-7	< 713	< 1157	< 1351	< 1194	< 814	< 623	< 565
K-40	15370 ± 1260	26550 ± 2319	20610 ± 2405	24030 ± 1765	20790 ± 1837	22730 ± 1874	14550 ± 1814
Mn-54	< 83	< 85	< 98	< 76	< 83	< 75	< 61
Co-58	< 90	< 92	< 79	< 72	< 83	< 73	< 32
Fe-59	< 208	< 225	< 212	< 196	< 223	< 155	< 121
Co-60	< 103	< 109	< 113	< 103	< 90	< 87	< 65
Zn-65	< 232	< 199	< 263	< 182	< 187	< 157	< 130
Nb-95	< 95	< 102	< 111	< 89	< 93	< 89	< 59
Zr-95	< 168	< 181	< 191	< 145	< 173	< 116	< 134
Ru-103	< 100	< 124	< 134	< 138	< 102	< 72	< 71
Ru-106	< 698	< 757	< 893	< 774	< 639	< 559	< 478
I-131	< 418	< 427	< 411	< 411	< 438	< 213	< 265
Cs-134	< 100	< 87	< 93	< 83	< 72	< 56	< 60
Cs-137	153 ± 47	6171 ± 270	5609 ± 315	13870 ± 340	326 ± 84	272 ± 77	156 ± 67
Ba-140	< 790	< 794	< 766	< 769	< 766	< 384	< 476
Ce-141	< 148	< 184	< 201	< 153	< 165	< 120	< 119
Ce-144	< 449	< 578	< 680	< 514	< 498	< 407	< 368
Ra-226	< 1657	3328 ± 1642	< 2932	4051 ± 1393	3510 < 1660	2128 ± 1210	< 1268
Th-228	1038 ± 89	1491 ± 168	988 ± 299	1355 ± 128	1382 ± 127	1275 ± 119	808 ± 128

INDIAN POINT ENERGY CENTER
TABLE B-15
GAMMA EMITTERS IN BOTTOM SEDIMENT SAMPLES - 2013

pCi/kg dry ± 2 Sigma

	Lent's Cove 28			Cold Spring 84*		
DATE	6/12/2013	9/9/2013	10/9/2013	6/12/2013	9/9/2013	10/9/2013
Be-7	< 1063	< 819	< 992	< 996	< 992	< 545
K-40	18550 ± 1641	18420 ± 1930	17400 ± 2214	21300 ± 2138	26470 ± 2214	21700 ± 1573
Mn-54	< 99	< 85	< 107	< 104	< 107	< 54
Co-58	< 95	< 78	< 94	< 123	< 94	< 57
Fe-59	< 229	< 170	< 278	< 341	< 278	< 170
Co-60	< 95	< 83	< 113	< 121	< 113	< 73
Zn-65	< 182	< 197	< 241	< 215	< 241	< 129
Nb-95	< 120	< 101	< 144	< 136	< 144	< 67
Zr-95	< 201	< 157	< 218	< 242	< 218	< 111
Ru-103	< 123	< 91	< 126	< 140	< 126	< 71
Ru-106	< 804	< 595	< 863	< 955	< 863	< 476
I-131	< 957	< 264	< 400	< 1425	< 400	< 302
Cs-134	< 87	< 73	< 92	< 84	< 92	< 51
Cs-137	232 < 69	273 ± 84	321 ± 124	348 < 82	± 124	179 ± 59
Ba-140	< 1365	< 684	< 898	< 1635	< 898	< 592
Ce-141	< 235	< 166	< 226	< 207	< 226	< 121
Ce-144	< 627	< 557	< 761	< 484	< 761	< 355
Ra-226	< 1918	< 2083	< 2270	< 1558	< 2270	2757 ± 886
Th-228	939 ± 138	1146 ± 124	1134 ± 173	1215 ± 132	1779 ± 173	1521 ± 125

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-16
RADIONUCLIDES IN SHORELINE SEDIMENT SAMPLES - 2013

pCi/kg dry ± 2 Sigma

	Off Verplanck 17		Lent's Cove 28		Manitou Inlet 50	
DATE	6/19/2013	9/10/2013	6/12/2013	9/9/2013	6/12/2013	9/9/2013
RADIOCHEMICAL						
Sr-90	< 35	< 46	< 43	< 48	< 27	< 41
GAMMA						
Be-7	< 486	< 496	< 786	< 654	< 954	< 525
K-40	18010 ± 1307	18580 ± 1388	13660 ± 1350	14340 ± 1415	14600 ± 1398	13300 ± 1188
Mn-54	< 48	< 59	< 71	< 78	< 98	< 56
Co-58	< 53	< 58	< 70	< 73	< 114	< 69
Fe-59	< 136	< 129	< 214	< 153	< 281	< 145
Co-60	< 60	< 62	< 90	< 73	< 105	< 67
Zn-65	< 119	< 118	< 137	< 151	< 300	< 134
Nb-95	< 59	< 66	< 101	< 93	< 117	< 94
Zr-95	< 99	< 107	< 149	< 139	< 191	< 113
Ru-103	< 55	< 64	< 87	< 85	< 125	< 63
Ru-106	< 440	< 504	< 517	< 608	< 753	< 467
I-131	< 243	< 175	< 575	< 271	< 803	< 194
Cs-134	< 41	< 50	< 59	< 69	< 138	< 59
Cs-137	108 ± 53	158 ± 55	< 74	< 84	< 101	< 61
Ba-140	< 418	< 395	< 881	< 545	< 1245	< 463
La-140	< 144	< 95	< 276	< 140	< 381	< 152
Ce-141	< 99	< 110	< 143	< 156	< 199	< 117
Ce-144	< 287	< 368	< 388	< 545	< 521	< 374
Ra-226	< 892	< 1161	3503 ± 1406	2845 < 1385	1696 ± 1017	6160 ± 1320
Ac-228	< 317	< 338	< 249	< 455	< 469	< 208
Th-228	798 ± 72	696 ± 85	1558 ± 117	1171 ± 117	806 ± 90	628 ± 79

INDIAN POINT ENERGY CENTER
TABLE B-16
RADIONUCLIDES IN SHORELINE SEDIMENT SAMPLES - 2013

pCi/kg dry ± 2 Sigma

	White Beach 53		Cold Spring 84*	
DATE	6/19/2013	9/10/2013	6/12/2013	9/10/2013
RADIOCHEMICAL				
Sr-90	< 33	< 43	< 28	< 50
GAMMA				
Be-7	< 296	< 327	< 390	< 285
K-40	11350 ± 967	10900 ± 1009	40330 ± 1539	18110 ± 1340
Mn-54	< 31	< 34	< 45	< 35
Co-58	< 29	< 40	< 47	< 33
Fe-59	< 66	< 101	< 139	< 102
Co-60	< 40	< 47	< 59	< 46
Zn-65	< 74	< 91	< 120	< 98
Nb-95	< 32	< 38	< 53	< 34
Zr-95	< 59	< 77	< 93	< 69
Ru-103	< 38	< 40	< 56	< 31
Ru-106	< 226	< 340	< 357	< 247
I-131	< 155	< 95	< 370	< 105
Cs-134	< 25	< 31	< 36	< 27
Cs-137	< 31	< 40	< 45	< 37
Ba-140	< 281	< 210	< 568	< 185
La-140	< 65	< 62	< 115	< 56
Ce-141	< 65	< 69	< 84	< 56
Ce-144	< 192	< 228	< 221	< 193
Ra-226	< 770	± 683	1229 ± 747	< 711
Ac-228	< 105	< 182	< 240	< 222
Th-228	110 ± 46	93 ± 48	560 ± 54	324 ± 70

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-17
GAMMA EMITTERS IN AQUATIC VEGETATION SAMPLES - 2013

pCi/kg wet ± 2 Sigma

	Off Verplanck 17		Cold Spring 84*	
DATE	6/19/2013 Myrophyllium	9/10/2013 Myrophyllium	6/12/2013 Myrophyllium	9/9/2013 Myrophyllium
Be-7	408 ± 63	190 ± 74	186 ± 51	180 ± 83
K-40	2574 ± 127	2243 ± 170	1512 ± 98	2224 ± 170
Mn-54	< 7	< 7	< 5	< 9
Co-58	< 7	< 8	< 6	< 11
Fe-59	< 15	< 18	< 15	< 23
Co-60	< 7	< 9	< 6	< 11
Zn-65	< 13	< 17	< 11	< 19
Nb-95	< 8	< 8	< 7	< 11
Zr-95	< 12	< 14	< 10	< 18
Ru-103	< 9	< 9	< 7	< 12
Ru-106	< 57	< 65	< 47	< 87
I-131	< 43	< 25	< 57	< 37
Cs-134	< 6	< 7	< 5	< 10
Cs-137	< 7	< 9	< 6	< 12
Ba-140	< 69	< 51	< 78	< 74
La-140	< 19	< 16	< 24	< 19
Ce-141	< 15	< 15	< 13	< 22
Ce-144	< 47	< 49	< 34	< 72
Ra-226	< 145	< 156	< 100	± 209
Ac-228	< 29	< 27	< 25	72 < 32
Th-228	59 ± 9	62 ± 14	25 ± 6	60 < 19

* Control location

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Roseton 23*					
DATE	5/10/2013 Catfish	05/10/13 White Perch	5/14/2013 American Eel	6/12/2013 Sunfish	6/19/2013 Striped Bass	8/8/2013 White Perch
RADIOCHEMICAL						
Ni-63	< 40	< 39	< 41	< 41	< 33	< 46
Sr-90	< 3	< 3	< 4	< 4	< 3	< 3
GAMMA						
Be-7	< 475	< 814	< 470	< 455	< 423	< 692
K-40	2687 ± 563	2693 ± 820	1665 ± 533	2971 ± 652	4169 ± 789	1875 ± 297
Mn-54	< 32	< 55	< 35	< 45	< 42	< 26
Co-58	< 46	< 82	< 53	< 43	< 45	< 49
Fe-59	< 151	< 248	< 136	< 113	< 97	< 167
Co-60	< 39	< 64	< 42	< 46	< 41	< 20
Zn-65	< 74	< 128	< 97	< 90	< 81	< 45
Nb-95	< 58	< 99	< 59	< 53	< 43	< 56
Zr-95	< 82	< 175	< 88	< 89	< 91	< 106
Ru-103	< 60	< 117	< 77	< 59	< 46	< 133
Ru-106	< 298	< 514	< 349	< 410	< 411	< 240
I-131	< 2552	< 4952	< 2461	< 251	< 133	< 216300
Cs-134	< 36	< 46	< 37	< 46	< 44	< 21
Cs-137	< 34	< 66	< 38	< 45	< 42	< 23
Ba-140	< 1982	< 3195	< 1563	< 417	< 319	< 22570
La-140	< 502	< 1004	< 476	< 128	< 99	< 4875
Ce-141	< 103	< 187	< 140	< 97	< 78	< 494
Ce-144	< 151	< 287	< 238	< 279	< 286	< 304
Ra-226	< 619	< 1065	< 732	< 998	< 1018	< 751
Th-228	< 46	< 88	< 63	< 91	< 87	< 65

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Roseton 23*				
DATE	8/8/2013 Striped Bass	8/22/2013 White Perch	8/28/2013 Blue Crab	9/5/2013 Sunfish	9/5/2013 Eel
RADIOCHEMICAL					
Ni-63	< 39	< 37	< 55.8	< 47	< 46
Sr-90	< 4	< 4	4.1 ± 2.5	< 3	< 4
GAMMA					
Be-7	< 397	< 536	< 171.1	< 228	< 482
K-40	4391 ± 352	3069 ± 307	2326 ± 243.2	1304 ± 255	2577 ± 322
Mn-54	< 20	< 24	< 13.34	< 14	< 21
Co-58	< 38	< 45	< 16.59	< 22	< 40
Fe-59	< 126	< 147	< 42.34	< 67	< 129
Co-60	< 20	< 21	< 12.09	< 13	< 20
Zn-65	< 48	< 50	< 27.28	< 32	< 47
Nb-95	< 41	< 53	< 18.37	< 25	< 47
Zr-95	< 75	< 87	< 30.33	< 39	< 80
Ru-103	< 71	< 101	< 23.92	< 38	< 83
Ru-106	< 183	< 217	< 120.5	< 116	< 203
I-131	< 21910	< 82370	< 352.8	< 6208	< 37410
Cs-134	< 18	< 21	< 12.99	< 10	< 20
Cs-137	< 19	< 21	< 13.13	< 13	< 20
Ba-140	< 5653	< 12960	< 359.7	< 1875	< 7375
La-140	< 1874	< 3516	< 100.1	< 735	< 1931
Ce-141	< 127	< 217	< 37.25	< 85	< 180
Ce-144	< 118	< 146	< 80.92	< 94	< 146
Ra-226	< 386	< 389	< 245.8	< 264	< 400
Th-228	< 34	< 34	< 24.74	< 21	< 35

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Downstream 25					
DATE	5/8/2013 American Eel	5/8/2013 Striped Bass	5/9/2013 Whiter Perch	5/9/2013 Catfish	5/13/2013 Sunfish	6/10/2013 Blue Crab
RADIOCHEMICAL						
Ni-63	< 40	< 37	< 45	< 33	< 40	< 51
Sr-90	< 3	< 3	< 3	< 3	< 4	6.1 < 2.7
GAMMA						
Be-7	< 647	< 675	< 1035	< 515	< 547	< 515
K-40	3548 ± 721	3881 ± 699	2036 ± 794	2691 ± 625	3099 ± 604	2159 ± 689
Mn-54	< 50	< 45	< 70	< 41	< 36	< 47
Co-58	< 61	< 64	< 91	< 55	< 55	< 52
Fe-59	< 188	< 154	< 215	< 162	< 141	< 127
Co-60	< 48	< 48	< 60	< 42	< 35	< 56
Zn-65	< 98	< 83	< 133	< 70	< 85	< 91
Nb-95	< 75	< 69	< 102	< 70	< 65	< 54
Zr-95	< 141	< 106	< 179	< 93	< 102	< 119
Ru-103	< 103	< 95	< 149	< 80	< 78	< 69
Ru-106	< 482	< 378	< 677	< 329	< 363	< 435
I-131	< 4002	< 4311	< 5721	< 3054	< 2465	< 278
Cs-134	< 44	< 38	< 61	< 39	< 36	< 49
Cs-137	< 46	< 44	< 66	< 34	< 34	< 44
Ba-140	< 2809	< 2613	< 4430	< 2282	< 1729	< 487
La-140	< 835	< 1019	< 1368	< 450	< 583	< 126
Ce-141	< 181	< 145	< 278	< 121	< 148	< 100
Ce-144	< 265	< 229	< 390	< 159	< 238	< 306
Ra-226	< 920	< 822	< 1177	< 717	< 908	< 922
Th-228	< 85	< 71	< 116	< 63	< 64	< 86

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Downstream 25					
DATE	8/22/2013 Catfish	8/22/2013 White Perch	8/29/2013 Eel	9/4/2013 Striped Bass	9/5/2013 Sunfish	9/6/2013 Blue Crab
RADIOCHEMICAL						
Ni-63	< 39	< 45	< 46	< 41	< 35	< 51
Sr-90	< 3	< 3	< 3	< 3	< 3	< 4
GAMMA						
Be-7	< 651	< 538	< 733	< 980	< 514	< 238
K-40	3583 ± 413	2970 ± 334	3382 ± 481	3676 ± 551	2831 ± 425	2200 ± 258
Mn-54	< 30	< 24	< 34	< 44	< 24	< 14
Co-58	< 56	< 44	< 64	< 76	< 48	< 26
Fe-59	< 190	< 159	< 219	< 256	< 139	< 70
Co-60	< 26	< 21	< 34	< 38	< 23	< 16
Zn-65	< 62	< 53	< 77	< 93	< 57	< 36
Nb-95	< 59	< 59	< 79	< 94	< 51	< 28
Zr-95	< 102	< 88	< 132	< 162	< 82	< 42
Ru-103	< 114	< 98	< 136	< 166	< 90	< 39
Ru-106	< 259	< 203	< 334	< 403	< 232	< 127
I-131	< 67380	< 56360	< 62070	< 69310	< 28420	< 4372
Cs-134	< 26	< 21	< 33	< 40	< 22	< 13
Cs-137	< 24	< 21	< 34	< 41	< 20	< 14
Ba-140	< 12850	< 10060	< 12620	< 14400	< 6738	< 1750
La-140	< 3293	< 2942	< 3723	< 3728	< 2028	< 527
Ce-141	< 229	< 187	< 256	< 363	< 157	< 66
Ce-144	< 175	< 140	< 210	< 316	< 144	< 77
Ra-226	< 477	< 395	< 570	< 835	< 467	< 261
Th-228	< 50	< 34	< 52	< 73	< 40	< 25

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Downstream 107					
DATE	5/8/2013 Eel	5/9/2013 White Perch	5/9/2013 Catfish	5/10/2013 Striped Bass	6/3/2013 Sunfish	6/10/2013 Blue Crab
RADIOCHEMICAL ANALYSIS:						
Ni-63	< 42	< 36	< 39	< 35	< 37.1	< 61
Sr-90	< 3	< 3	< 3	< 3	< 3	< 3.9
GAMMA SPECTRUM ANALYSIS:						
Be-7	< 434	< 718	< 609	< 945	< 654	< 406
K-40	1917 ± 453	2520 ± 925	3125 ± 691	3073 ± 811	2658 ± 977	2136 ± 650
Mn-54	< 38	< 50	< 40	< 64	< 61	< 43
Co-58	< 46	< 71	< 66	< 99	< 54	< 42
Fe-59	< 116	< 247	< 168	< 259	< 151	< 124
Co-60	< 40	< 63	< 50	< 54	< 72	< 46
Zn-65	< 73	< 132	< 83	< 146	< 66	< 111
Nb-95	< 49	< 87	< 66	< 106	< 75	< 52
Zr-95	< 86	< 100	< 106	< 155	< 112	< 84
Ru-103	< 72	< 126	< 79	< 125	< 75	< 58
Ru-106	< 276	< 434	< 381	< 539	< 605	< 445
I-131	< 3226	< 4512	< 3283	< 5391	< 533	< 285
Cs-134	< 31	< 46	< 39	< 53	< 63	< 46
Cs-137	< 30	< 53	< 43	< 62	< 63	< 40
Ba-140	< 1736	< 3537	< 2531	< 3452	< 897	< 423
La-140	< 607	< 619	< 672	< 1066	< 173	< 176
Ce-141	< 131	< 216	< 147	< 231	< 118	< 80
Ce-144	< 186	< 348	< 225	< 387	< 278	< 258
Ra-226	< 711	< 1228	< 891	< 1308	< 1144	< 973
Th-228	< 49	< 106	< 59	< 113	< 92	< 83

INDIAN POINT ENERGY CENTER
TABLE B-18
RADIONUCLIDES IN FISH / INVERTEBRATES - 2013

pCi/kg wet ± 2 Sigma

	Downstream 107				
DATE COLL	6/10/2013 Blue Crab	8/22/2013 Sunfish	8/29/2013 Eel	8/30/2013 Catfish	9/5/2013 White Perch
RADIOCHEMICAL ANALYSIS:					
Ni-63	< 60	< 31	< 41	< 35	< 40
Sr-90	< 4	< 4	< 3	< 3	< 3
GAMMA SPECTRUM ANALYSIS:					
Be-7	< 377	< 412	< 445	< 355	< 406
K-40	3474 ± 307	3586 ± 335	2769 ± 325	3433 ± 271	3474 ± 298
Mn-54	< 20	< 21	< 22	< 17	< 20
Co-58	< 32	< 38	< 39	< 33	< 38
Fe-59	< 99	< 118	< 135	< 120	< 137
Co-60	< 20	< 19	< 18	< 17	< 21
Zn-65	< 47	< 45	< 48	< 42	< 46
Nb-95	< 36	< 41	< 44	< 37	< 42
Zr-95	< 66	< 76	< 78	< 63	< 75
Ru-103	< 61	< 75	< 83	< 65	< 73
Ru-106	< 189	< 189	< 185	< 145	< 180
I-131	< 9206	< 26180	< 56220	< 36900	< 37480
Cs-134	< 19	< 19	< 18	< 15	< 18
Cs-137	< 19	< 19	< 17	< 15	< 18
Ba-140	< 3174	< 6175	< 9905	< 7090	< 7320
La-140	< 921	< 1462	< 2988	< 2380	< 2384
Ce-141	< 108	< 151	< 185	< 109	< 129
Ce-144	< 124	< 133	< 130	< 87	< 101
Ra-226	< 339	< 411	< 366	< 289	< 287
Th-228	< 30	< 34	< 37	< 26	< 26

Table B-19
LAND USE CENSUS - RESIDENCE and MILCH ANIMAL RESULTS
2013

The 2013 land use census indicated there were no new residences that were closer in proximity to IPEC. IPEC maintains a complete nearest residence survey with updated distances.

No milch animals were observed during this reporting period within the 5-mile zone. There are no animals producing milk for human consumption within five miles of Indian Point.

TABLE B-20
LAND USE CENSUS
2013

INDIAN POINT ENERGY CENTER

UNRESTRICTED AREA BOUNDARY
AND NEAREST RESIDENCES

Sector	Compass Point	Distance to site Boundary from Unit 2 Plant Vent (meters)	Distance to site Boundary from Unit 3 Plant Vent (meters)	Distance to nearest resident, from Unit 1 superheater (meters)	Address of nearest resident, Last Census
1	N	RIVER	RIVER	1788	41 River Road Tomkins Cove
2	NNE	RIVER	RIVER	3111	Chateau Rive Apts. John St. Peekskill
3	NE	550	636	1907	211 Viewpoint Terrace, Peekskill
4	ENE	600	775	1478	1018 Lower South St. Peekskill
5	E	662	785	1371	1103 Lower South St. Peekskill
6	ESE	569	622	715	461 Broadway Buchanan
7	SE	553	564	1168	223 First St. Buchanan
8	SSE	569	551	1240	5 Pheasant's Run Buchanan
9	S	700	566	1133	320 Broadway Verplanck
10	SSW	755	480	1574	240 Eleventh St. Verplanck
11	SW	544	350	3016	8 Spring St. Tomkins Cove
12	WSW	RIVER	RIVER	2170	9 West Shore Dr. Tomkins Cove
13	W	RIVER	RIVER	1919	712 Rt. 9W Tomkins Cove
14	WNW	RIVER	RIVER	1752	770 Rt. 9W Tomkins Cove
15	NW	RIVER	RIVER	1693	807 Rt. 9W Tomkins Cove
16	NNW	RIVER	RIVER	1609	4 River Rd. Tomkins Cove

APPENDIX C

HISTORICAL TRENDS

APPENDIX C

The past ten years of historical data for various radionuclides and media are presented both in tabular form and graphical form to facilitate the comparison of 2013 data with historical values. Although other samples were taken and analyzed, values were only tabulated and plotted where positive indications were present.

Averaging the positive values in these tables can result in a biased high value, especially, when the radionuclide is detected in only one or two quarters for the year.

TABLE C-1

DIRECT RADIATION ANNUAL SUMMARY 2003-2013

Average Quarterly Dose (mR/Quarter)			
Year	**Inner Ring**	**Outer Ring**	**Control Location**
2003	14.3	13.9	14.7
2004	13.0	13.0	14.0
2005	14.1	14.1	15.9
2006	13.9	14.3	17.5
2007	14.4	14.6	18.8
2008	14.5	14.2	17.3
2009	14.5	14.2	17.3
2010	14.0	14.3	13.0
2011	13.6	14.4	13.4
2012	13.2	13.5	12.5
2013	13.4	13.8	14.2

Historical Average 2003-2012	14.0	14.1	15.4

FIGURE C-1 TLD

DIRECT RADIATION, ANNUAL SUMMARY
2003 to 2013

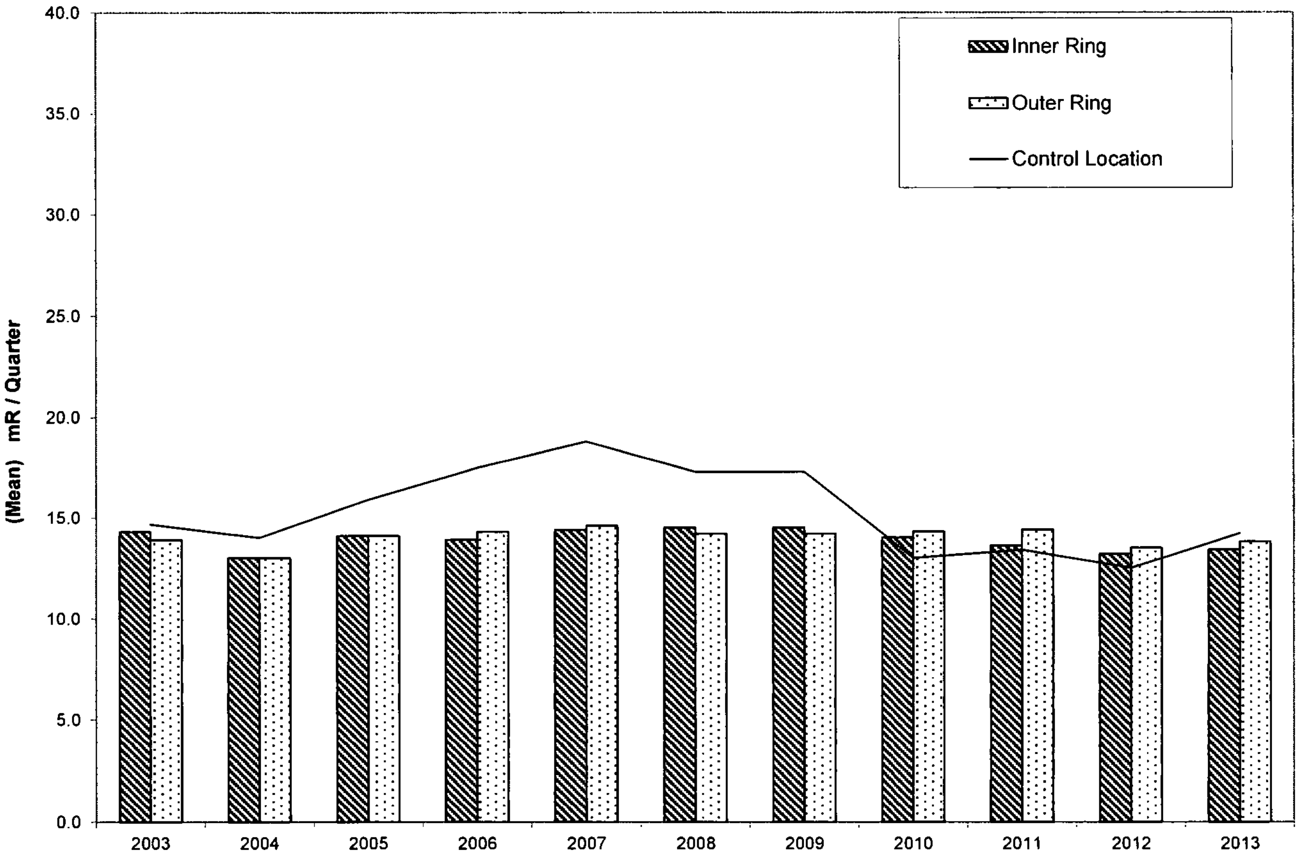


TABLE C-2

RADIONUCLIDES IN AIR
2003 to 2013
(pCi/m^3)

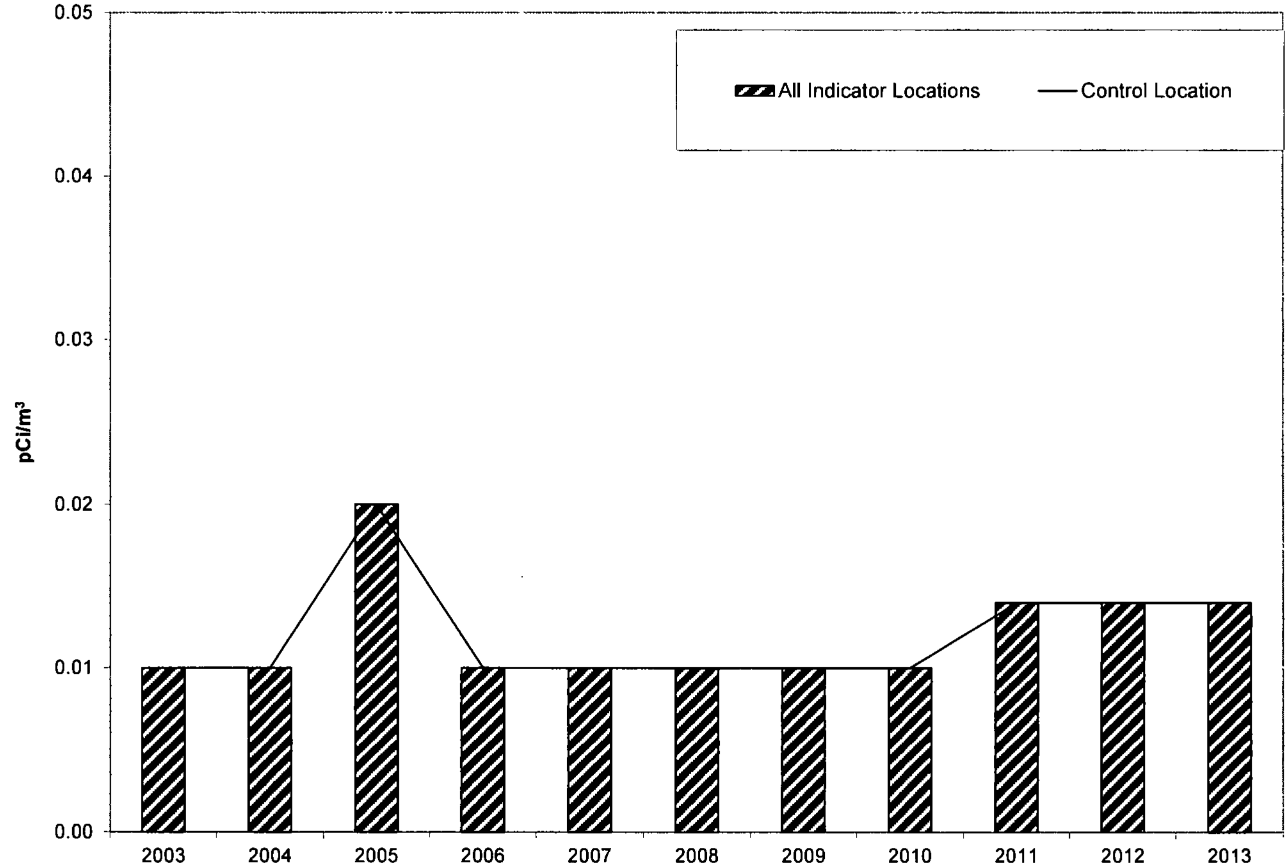
Year	Gross Beta		Cs-137	
	All Indicator Locations	Control Location	All Indicator Locations	Control Location
2003	0.01	0.01	< Lc	< Lc
2004	0.01	0.01	< Lc	< Lc
2005	0.02	0.02	< Lc	< Lc
2006	0.01	0.01	< Lc	< Lc
2007	0.01	0.01	< Lc	< Lc
2008	0.01	0.01	< Lc	< Lc
2009	0.01	0.01	< Lc	< Lc
2010	0.01	0.01	< Lc	< Lc
2011	0.014	0.014	$< L_c$	$< L_c$
2012	0.014	0.014	$< L_c$	$< L_c$
2013	**0.014**	**0.014**	$< L_c$	$< L_c$
Historical Average 2003-2012	0.01	0.01	$< L_c$	$< L_c$

Critical Level (L_c) is less than the ODCM required LLD.

$<L_c$ indicates no positive values above sample critical level.

FIGURE C-2 AP Beta

RADIONUCLIDES IN AIR - GROSS BETA
2003 to 2013



* Includes ODCM and non-ODCM indicator locations.

Gross Beta ODCM required LLD = 0.01 pCi/m^3

TABLE C-3

RADIONUCLIDES IN HUDSON RIVER WATER
2003 to 2013
(pCi/L)

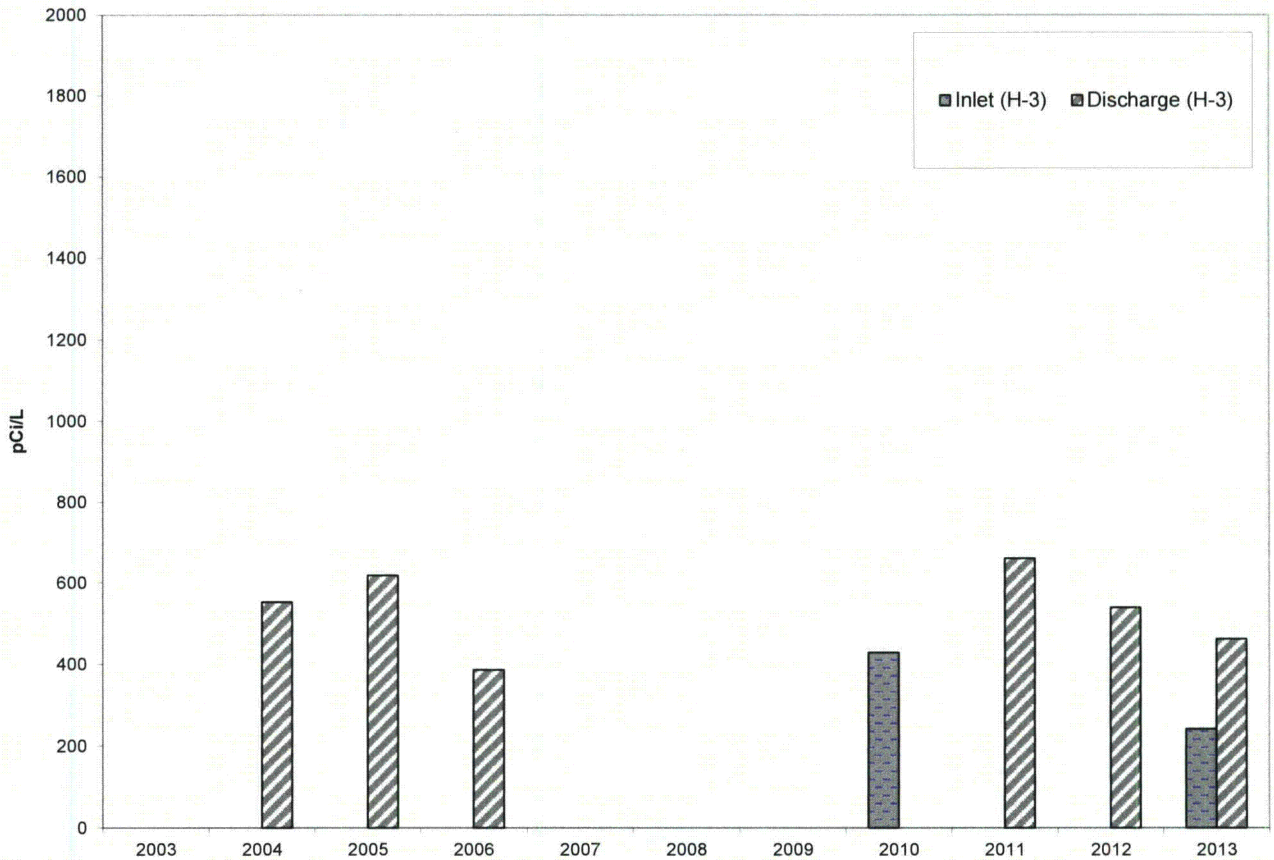
	Tritium (H-3)		Cs-137	
Year	**Inlet**	**Discharge**	**Inlet**	**Discharge**
2003	< Lc	< Lc	< Lc	< Lc
2004	< Lc	553	< Lc	< Lc
2005	< Lc	618	< Lc	< Lc
2006	< Lc	386	< Lc	< Lc
2007	< Lc	< Lc	< Lc	< Lc
2008	< Lc	< Lc	< Lc	< Lc
2009	< Lc	< Lc	< Lc	< Lc
2010	428	< Lc	< Lc	< Lc
2011	< Lc	661	< L_c	< L_c
2012	< Lc	539	< L_c	< L_c
2013	241	462	< L_c	< L_c
Historical Average 2003-2012	428	551	< L_c	< L_c

Critical Level (L_c) is less than the ODCM required LLD.

$<L_c$ indicates no positive values above sample critical level.

FIGURE C-3 WR H-3

RADIONUCLIDES IN HUDSON RIVER WATER - TRITIUM
2003 to 2013



Tritium ODCM required LLD = 3000 pCi/L

TABLE C-4

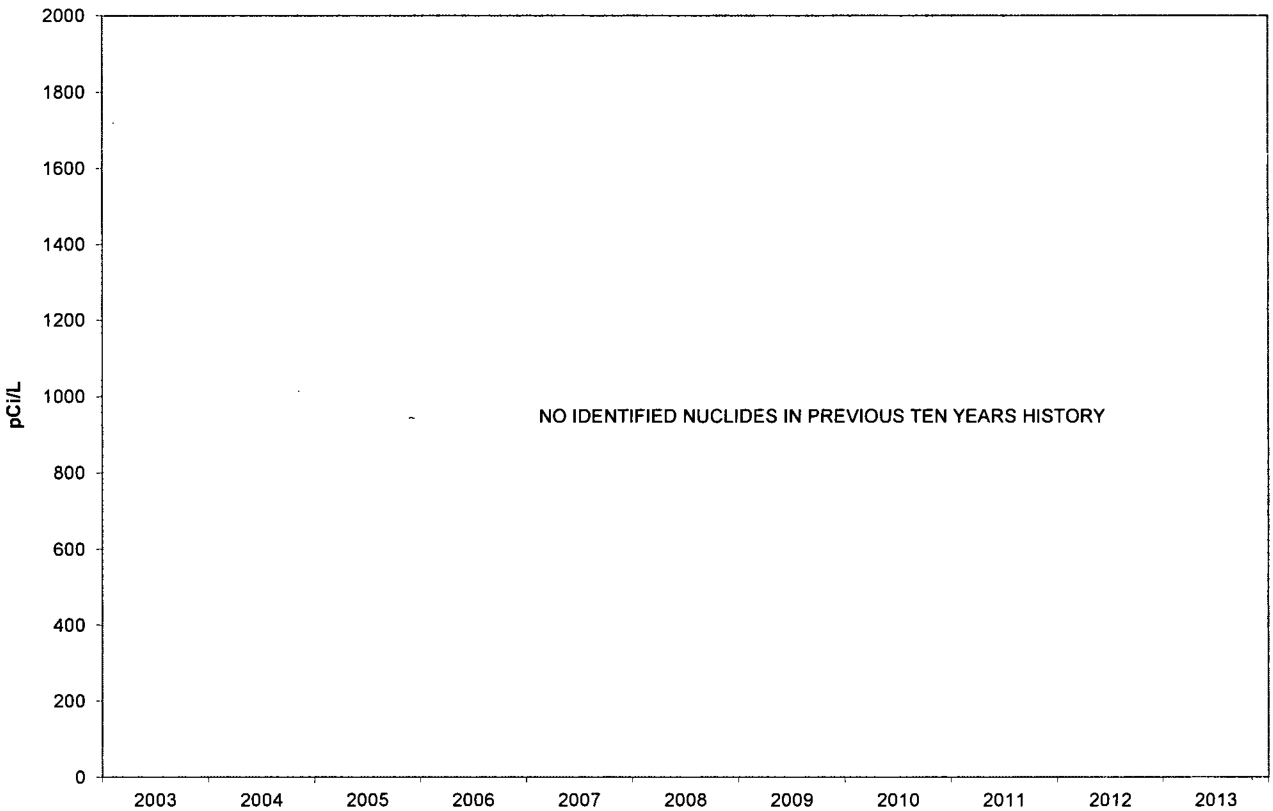
RADIONUCLIDES IN DRINKING WATER
2003 to 2013
(pCi/L)

Year	Tritium (H-3)	Cs-137
2003	< Lc	< Lc
2004	< Lc	< Lc
2005	< Lc	< Lc
2006	< Lc	< Lc
2007	< Lc	< Lc
2008	< Lc	< Lc
2009	< Lc	< Lc
2010	< Lc	< Lc
2011	**< L_c**	**< L_c**
2012	**< L_c**	**< L_c**
2013	**< L_c**	**< L_c**
Historical Average 2003-2012	< L_c	< L_c

Critical Level (L_c) is less than the ODCM required LLD.
<L_c indicates no positive values above sample critical level.

FIGURE C-4 WD H-3

RADIONUCLIDES IN DRINKING WATER - TRITIUM
2003 to 2013



Tritium ODCM required LLD = 2000 pCi/L

TABLE C-5

RADIONUCLIDES IN SHORELINE SOIL
2003 to 2013
(pCi/Kg, dry)

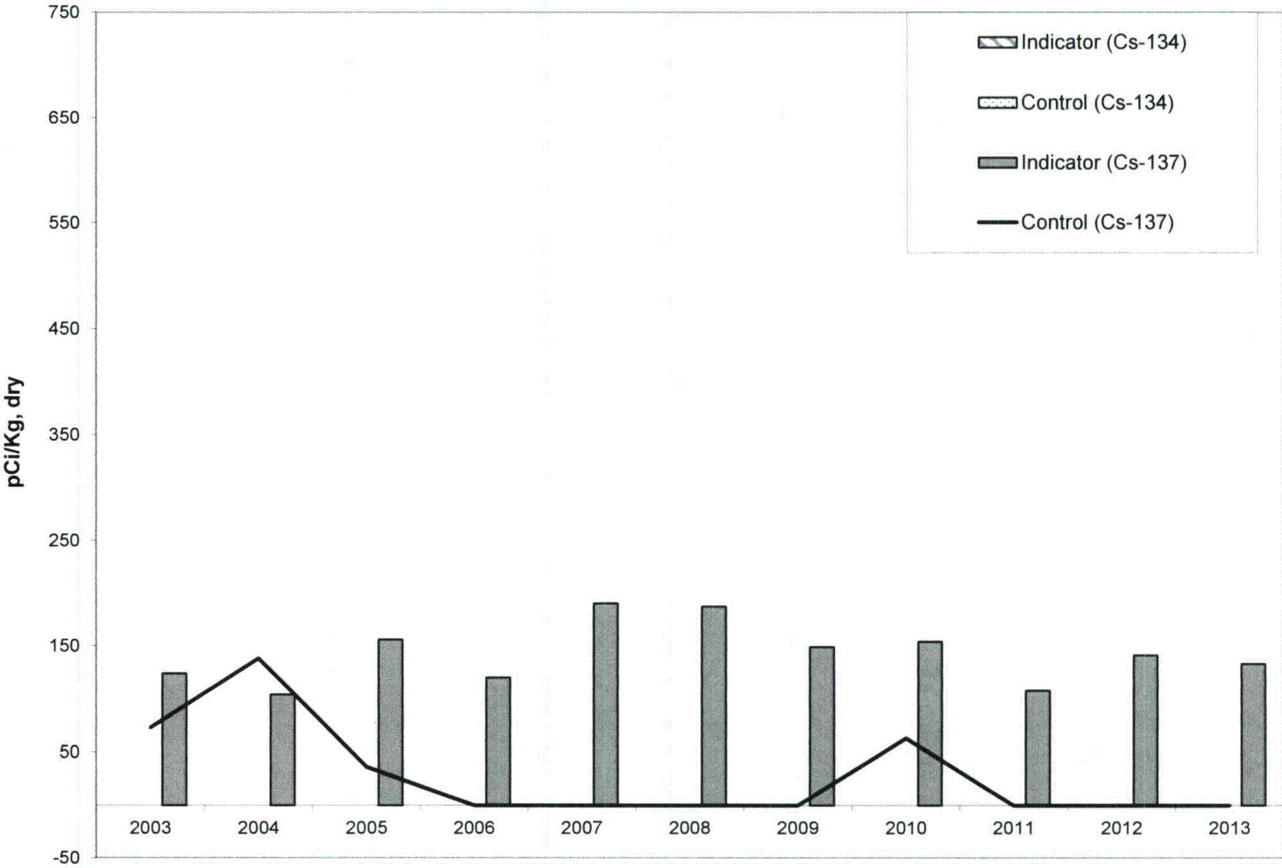
	Cs-134		Cs-137	
Year	**Indicator**	**Control**	**Indicator**	**Control**
2003	< Lc	< Lc	124	73
2004	< Lc	< Lc	104	138
2005	< Lc	< Lc	156	36
2006	< Lc	< Lc	120	< Lc
2007	< Lc	< Lc	190	< Lc
2008	< Lc	< Lc	187	< Lc
2009	< Lc	< Lc	149	< Lc
2010	< Lc	< Lc	154	63
2011	< L_c	< L_c	108	< L_c
2012	< L_c	< L_c	141	< L_c
2013	< L_c	< L_c	**133**	< L_c
Historical Average 2003-2012	< L_c	< L_c	143	78

Critical Level (L_c) is less than the RETS required LLD.

<L_c indicates no positive values above sample critical level.

FIGURE C-5 SS Cs134 137

RADIONUCLIDES IN SHORELINE SOIL - CESIUM-134 AND CESIUM-137
2003 to 2013



Cs-134 ODCM required LLD = 150 pCi/Kg, dry
Cs-137 ODCM required LLD = 175 pCi/Kg, dry

TABLE C-6

BROAD LEAF VEGETATION - Cs-137
2003 to 2013
(pCi/Kg, wet)

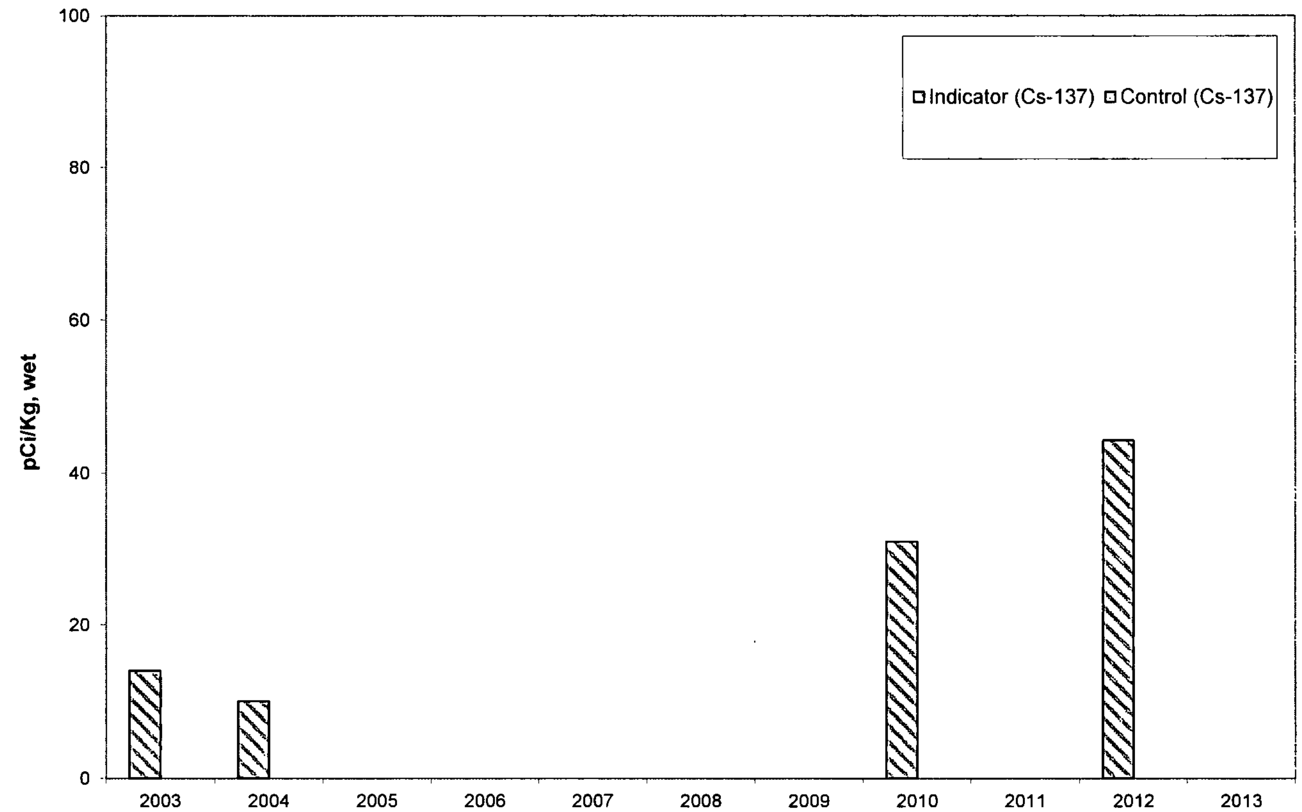
	Cs-137	
Year	**Indicator**	**Control**
2003	14	< Lc
2004	10	< Lc
2005	< Lc	< Lc
2006	< Lc	< Lc
2007	< Lc	< Lc
2008	< Lc	< Lc
2009	< Lc	< Lc
2010	31	< Lc
2011	< Lc	< L_c
2012	44	**< L_c**
2013	**< L_c**	**< L_c**
Historical Average 2003-2012	18	< Lc

Critical Level (L_c) is less than the ODCM required LLD.

<L_c indicates no positive values above sample critical level.

FIGURE C-6 Veg Cs137

BROAD LEAF VEGETATION - CESIUM-137
2003 to 2013



ODCM required LLD = 80 pCi/Kg, wet

TABLE C-7

FISH AND INVERTEBRATES - Cs-137
2003 to 2013
(pCi/Kg, dry)

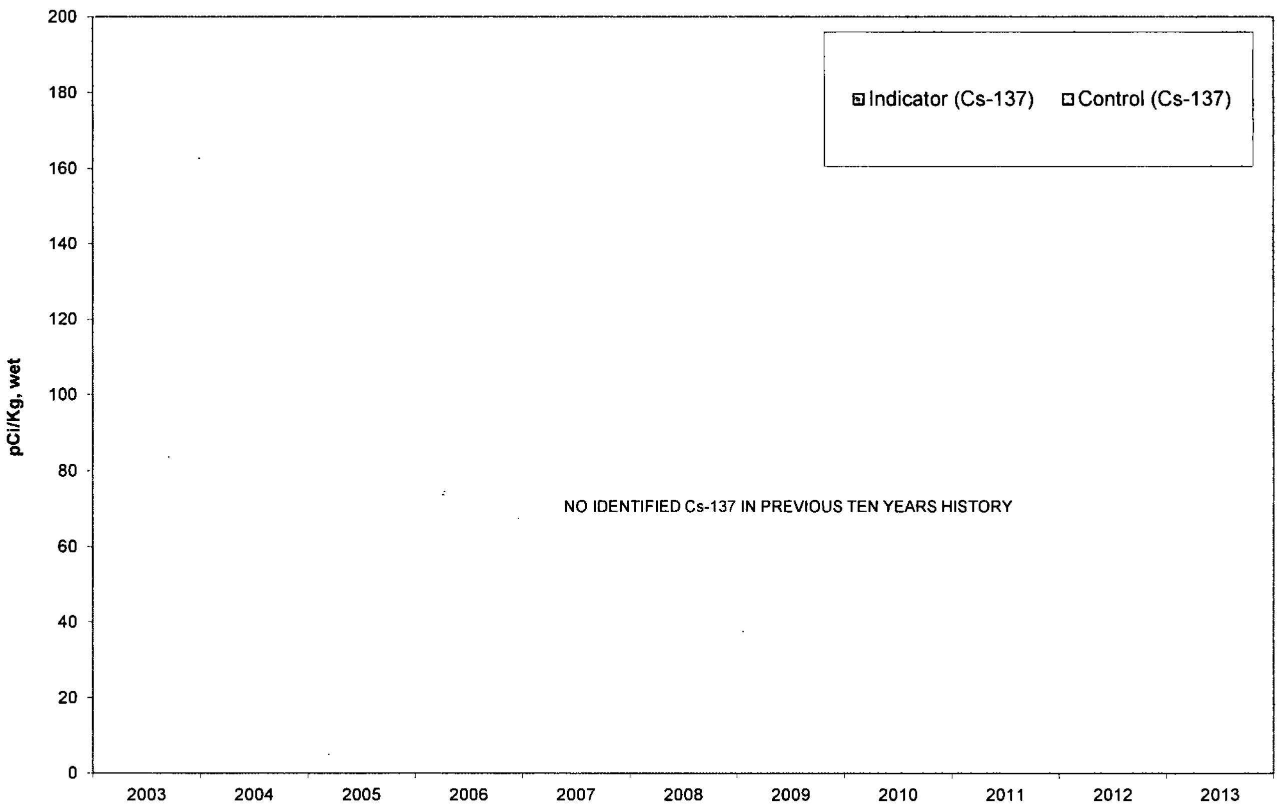
	Cs-137	
Year	**Indicator**	**Control**
2003	< Lc	< Lc
2004	< Lc	< Lc
2005	< Lc	< Lc
2006	< Lc	< Lc
2007	< Lc	< Lc
2008	< Lc	< Lc
2009	< Lc	< Lc
2010	< Lc	< Lc
2011	$< L_c$	$< L_c$
2012	$< L_c$	$< L_c$
2013	$< L_c$	$< L_c$
Historical Average 2003-2012	$< L_C$	$< L_C$

Critical Level (L_C) is less than the ODCM required LLD.

$<L_C$ indicates no positive values above sample critical level.

FIGURE C-7 Fish Cs137

FISH AND INVERTEBRATES - CESIUM-137
2003 to 2013



Cs-137 ODCM required LLD = 150 pCi/Kg, wet

TABLE C-8

RIVER WATER - Discharge Area - Tritium
REMP vs. EFFLUENT
(pCi/liter)

Year	REMP*	EFFLUENT **
1Q 2010	< 403	959
2Q 2010	< 397	239
3Q 2010	< 409	261
4Q 2010	< 408	796
1Q 2011	661	2192
2Q 2011	< 424	400
3Q 2011	< 412	493
4Q 2011	< 182	389
1Q 2102	617	2186
2Q 2012	< 178	394
3Q 2012	< 193	489
4Q 2012	460	860
1Q 2103	357	1813
2Q 2013	< 170	223
3Q 2013	< 186	428
4Q 2013	306	896
Four Year Average, by Quarter, 2010 - 2013	480	814

* Sample from mixing zone, expected to be less than average activity in the discharge canal.

** Based upon Effluent Report data, average activity in the discharge canal calculated from the total H-3 discharged divided by the total dilution volume for the quarter.

APPENDIX D

INTERLABORATORY COMPARISON PROGRAM

APPENDIX D

INTERLABORATORY COMPARISON PROGRAM

This section presents the results of the interlaboratory comparison program for the Teledyne Brown Engineering Environmental Services and Environmental Dosimetry Company. Since General Engineering Labs only analyzed 2 samples, their interlaboratory data is not presented. However, their results can be provided upon request.

D.1 Program Description – Teledyne Brown Engineering Environmental Services Comparison Programs

The Teledyne Brown Engineering Environmental Services participates in several interlaboratory comparison programs. These programs include sample media for which samples are routinely collected and for which comparison samples are commercially available. Participation in these interlaboratory comparison programs ensure that independent checks on the precision and accuracy of the measurement of radioactive material in the environmental samples are performed as part of the Quality Assurance Program for environmental monitoring. To fulfill the requirement for an Interlaboratory Comparison Program, Teledyne Brown Engineering Environmental Services has engaged the following programs:

- Eckert & Ziegler Analytics Environmental Radioactivity Cross Check Program
- Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP)
- Environmental Resource Associates (ERA) Cross Check Program

These programs supply sample media as blind samples (typically spikes), which contain certified levels of radioactivity unknown to the analysis laboratory. These samples are prepared and analyzed by the Teledyne Brown Engineering Environmental Services using standard laboratory procedures. Each program issues a statistical summary report of the results. Teledyne Brown Engineering Environmental Services uses predetermined acceptance criteria methodology for evaluating its laboratory performance.

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

D.2 Acceptance Criteria

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

D.2.1 Analytics Sample Results Evaluation

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

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

The value for the error resolution is calculated.

$$\text{Error Resolution} = \frac{\text{Reference Result}}{\text{Reference Results Error (1 sigma)}}$$

Using the appropriate row under the Error Resolution column in Tables D-3.1, D-3.2, and D-3.3, a corresponding Ratio of Agreement interval is given.

The value for the ratio is then calculated.

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

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

TABLE D-2.1 Ratio of Agreement

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

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

D.2.2 ERA and MAPEP Sample Result Evaluation

Both these programs supply an acceptance range for evaluating the results.

D.3 Program Results Summary

The Interlaboratory Comparison Program numerical results are summarized in the following tables.

TABLE D-3.1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES
(PAGE 1 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2013	E10477	Milk	Sr-89	pCi/L	120	99.7	1.20	A
			Sr-90	pCi/L	9.21	11.0	0.84	A
	E10478	Milk	I-131	pCi/L	87.1	100	0.87	A
			Ce-141	pCi/L	186	187	0.99	A
			Cr-51	pCi/L	463	472	0.98	A
			Cs-134	pCi/L	201	214	0.94	A
			Cs-137	pCi/L	262	266	0.98	A
			Co-58	pCi/L	200	208	0.96	A
			Mn-54	pCi/L	215	208	1.03	A
			Fe-59	pCi/L	266	252	1.06	A
			Zn-65	pCi/L	311	301	1.03	A
			Co-60	pCi/L	384	400	0.96	A
	E10480	AP	Ce-141	pCi	95.3	95.6	1.00	A
			Cr-51	pCi	264	241	1.10	A
			Cs-134	pCi	123	109	1.13	A
			Cs-137	pCi	142	136	1.04	A
			Co-58	pCi	112	106	1.06	A
			Mn-54	pCi	115	106	1.08	A
			Fe-59	pCi	139	129	1.08	A
			Zn-65	pCi	163	153	1.07	A
			Co-60	pCi	212	204	1.04	A
	E10479	Charcoal	I-131	pCi	90.1	92.6	0.97	A
	E10481	Water	Fe-55	pCi/L	1840	1890	0.97	A
June 2013	E10564	Milk	Sr-89	pCi/L	110	95.0	1.16	A
			Sr-90	pCi/L	15.8	17.0	0.93	A
	E10545	Milk	I-131	pCi/L	92.6	95.5	0.97	A
			Ce-141	pCi/L	83.1	90.4	0.92	A
			Cr-51	pCi/L	253	250	1.01	A
			Cs-134	pCi/L	118	125	0.94	A
			Cs-137	pCi/L	143	151	0.95	A
			Co-58	pCi/L	87.1	94.0	0.93	A
			Mn-54	pCi/L	171	172	0.99	A
			Fe-59	pCi/L	125	120	1.04	A
			Zn-65	pCi/L	220	217	1.01	A
			Co-60	pCi/L	169	175	0.97	A
	E10547	AP	Ce-141	pCi	56.8	56.7	1.00	A
			Cr-51	pCi	168	157	1.07	A
			Cs-134	pCi	85.2	78.4	1.09	A
			Cs-137	pCi	101	94.6	1.07	A
			Co-58	pCi	62.7	58.9	1.06	A
			Mn-54	pCi	125	108	1.16	A
			Fe-59	pCi	85.7	75.0	1.14	A
			Zn-65	pCi	169	136	1.24	W
			Co-60	pCi	116	110	1.05	A
	E10546	Charcoal	I-131	pCi	86.5	89.7	0.96	A

TABLE D-3.1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
June 2013	E10549	Water	Fe-55	pCi/L	1610	1610	1.00	A
September 2013	E10646	Milk	Sr-89	pCi/L	63.9	96.0	0.67	N (1)
			Sr-90	pCi/L	8.88	13.2	0.67	N (1)
	E10647	Milk	I-131	pCi/L	93.9	98.3	0.96	A
			Ce-141	pCi/L				NA (2)
			Cr-51	pCi/L	272	277	0.98	A
			Cs-134	pCi/L	150	172	0.87	A
			Cs-137	pCi/L	125	131	0.95	A
			Co-58	pCi/L	105	108	0.97	A
			Mn-54	pCi/L	138	139	0.99	A
			Fe-59	pCi/L	125	130	0.96	A
			Zn-65	pCi/L	264	266	0.99	A
			Co-60	pCi/L	187	196	0.95	A
	E10672	AP	Ce-141	pCi				NA (2)
			Cr-51	pCi	208	223	0.93	A
			Cs-134	pCi	143	139	1.03	A
			Cs-137	pCi	106	105	1.01	A
			Co-58	pCi	97.0	86.5	1.12	A
			Mn-54	pCi	116	112	1.04	A
			Fe-59	pCi	98.6	105	0.94	A
			Zn-65	pCi	219	214	1.02	A
			Co-60	pCi	166	158	1.05	A
	E10648	Charcoal	I-131	pCi	76.3	71.7	1.06	A
	E10673	Water	Fe-55	pCi/L	1790	1690	1.06	A
December 2013	E10774	Milk	Sr-89	pCi/L	97.3	93.8	1.04	A
			Sr-90	pCi/L	13.3	12.9	1.03	A
	E10775	Milk	I-131	pCi/L	89.7	96.1	0.93	A
			Ce-141	pCi/L	99.8	110	0.91	A
			Cr-51	pCi/L	297	297	1.00	A
			Cs-134	pCi/L	129	142	0.91	A
			Cs-137	pCi/L	126	126	1.00	A
			Co-58	pCi/L	116	112	1.04	A
			Mn-54	pCi/L	167	168	0.99	A
			Fe-59	pCi/L	117	110	1.06	A
			Zn-65	pCi/L	757	741	1.02	A
			Co-60	pCi/L	141	147	0.96	A
	E10777	AP	Ce-141	pCi	85.1	88.0	0.97	A
			Cr-51	pCi	278	238	1.17	A
			Cs-134	pCi	123	114	1.08	A
			Cs-137	pCi	102	101	1.01	A
			Co-58	pCi	84.4	89.9	0.94	A
			Mn-54	pCi	132	135	0.98	A
			Fe-59	pCi	101	88.3	1.14	A
			Zn-65	pCi	506	595	0.85	A
			Co-60	pCi	118	118	1.00	A

TABLE D-3.1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2013	E10776	Charcoal	I-131	pCi	84.7	80.5	1.05	A
	E10778	Water	Fe-55	pCi/L	2010	1910	1.05	A

(1) Milk, Sr-89/90 - The failure was due to analyst error. No client samples were affected by this failure. NCR 13-15

(2) The sample was not spiked with Ce-141.

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation based on TBE internal QC limits: A= Acceptable, reported result falls within ratio limits of 0.80-1.20. W-Acceptable with warning, reported result falls within 0.70-0.80 or 1.20-1.30. N = Not Acceptable, reported result falls outside the ratio limits of < 0.70 and > 1.30.

TABLE D-3.2 DOE's MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES
(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2013	13-MaW28	Water	Cs-134	Bq/L	21.0	24.4	17.1 - 31.7	A
			Cs-137	Bq/L	0.0446		(1)	A
			Co-57	Bq/L	28.3	30.9	21.6 - 40.2	A
			Co-60	Bq/L	18.2	19.56	13.69 - 25.43	A
			H-3	Bq/L	506	507	355 - 659	A
			Mn-54	Bq/L	25.7	27.4	19.2 - 35.6	A
			K-40	Bq/L	2.09		(1)	A
			Sr-90	Bq/L	10.5	10.5	7.4 - 13.7	A
			Zn-65	Bq/L	29.2	30.4	21.3 - 39.5	A
	13-GrW28	Water	Gr-A	Bq/L	2.74	2.31	0.69 - 3.93	A
			Gr-B	Bq/L	15.6	13.0	6.5 - 19.5	A
	13-MaS28	Soil	Cs-134	Bq/kg	859	887	621 - 1153	A
			Cs-137	Bq/kg	633	587	411 - 763	A
			Co-57	Bq/kg	0.256		(1)	A
			Co-60	Bq/kg	738	691	484 - 898	A
			Mn-54	Bq/kg	0.671		(1)	A
			K-40	Bq/kg	714	625.3	437.7 - 812.9	A
			Sr-90	Bq/kg	442	628	440 - 816	W
			Zn-65	Bq/kg	1057	995	697 - 1294	A
	13-RdF28	AP	Cs-134	Bq/sample	1.73	1.78	1.25 - 2.31	A
			Cs-137	Bq/sample	2.73	2.60	1.82 - 3.38	A
			Co-57	Bq/sample	2.38	2.36	1.65 - 3.07	A
			Co-60	Bq/sample	0.0302		(1)	A
			Mn-54	Bq/sample	4.36	4.26	2.98 - 5.54	A
			Sr-90	Bq/sample	1.43	1.49	1.04 - 1.94	A
			Zn-65	Bq/sample	3.14	3.13	2.19 - 4.07	A
	13-GrF28	AP	Gr-A	Bq/sample	0.767	1.20	0.36 - 2.04	A
			Gr-B	Bq/sample	0.871	0.85	0.43 - 1.28	A
	13-RdV28	Vegetation	Cs-134	Bq/sample	-0.197		(1)	A
			Cs-137	Bq/sample	7.39	6.87	4.81 - 8.93	A
			Co-57	Bq/sample	9.87	8.68	6.08 - 11.28	A
			Co-60	Bq/sample	6.08	5.85	4.10 - 7.61	A
			Mn-54	Bq/sample	-0.0104		(1)	A
			Sr-90	Bq/sample	1.28	1.64	1.15 - 2.13	W
			Zn-65	Bq/sample	6.84	6.25	4.38 - 8.13	A
September 2013	13-MaW29	Water	Cs-134	Bq/L	29.1	30.0	21.0 - 39.0	A
			Cs-137	Bq/L	34.5	31.6	22.1 - 41.1	A
			Co-57	Bq/L	0.0358		(1)	A
			Co-60	Bq/L	24.6	23.58	16.51 - 30.65	A
			H-3	Bq/L	2.45		(1)	A
			Mn-54	Bq/L	0.0337		(1)	A
			K-40	Bq/L	0.193		(1)	A
			Sr-90	Bq/L	9.12	7.22	5.05 - 9.39	W
			Zn-65	Bq/L	38.1	34.6	24.2 - 45.0	A
	13-GrW29	Water	Gr-A	Bq/L	1.13	0.701	0.210 - 1.192	A
			Gr-B	Bq/L	7.61	5.94	2.97 - 8.91	A

TABLE D-3.2 DOE's MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2013	13-MaS29	Soil	Cs-134	Bq/kg	1150	1172	820 - 1524	A
			Cs-137	Bq/kg	1100	977	684 - 1270	A
			Co-57	Bq/kg	670		(1)	N (2)
			Co-60	Bq/kg	502	451	316 - 586	A
			Mn-54	Bq/kg	758	674	472 - 876	A
			K-40	Bq/kg	796	633	443 - 823	W
			Sr-90	Bq/kg	664	460	322 - 598	N (2)
			Zn-65	Bq/kg	210		(1)	N (2)
	13-RdF29	AP	Cs-134	Bq/sample	-0.570		(1)	N (2)
			Cs-137	Bq/sample	2.85	2.7	1.9 - 3.5	A
			Co-57	Bq/sample	3.30	3.4	2.4 - 4.4	A
			Co-60	Bq/sample	2.41	2.3	1.6 - 3.0	A
			Mn-54	Bq/sample	3.65	3.5	2.5 - 4.6	A
			Sr-90	Bq/sample	1.40	1.81	1.27 - 2.35	W
			Zn-65	Bq/sample	2.90	2.7	1.9 - 3.5	A
	13-GrF29	AP	Gr-A	Bq/sample	0.872	0.9	0.3 - 1.5	A
			Gr-B	Bq/sample	1.57	1.63	0.82 - 2.45	A
	13-RdV29	Vegetation	Cs-134	Bq/sample	5.29	5.20	3.64 - 6.76	A
			Cs-137	Bq/sample	7.48	6.60	4.62 - 8.58	A
			Co-57	Bq/sample	0.0129		(1)	A
			Co-60	Bq/sample	0.0523		(1)	A
			Mn-54	Bq/sample	8.78	7.88	5.52 - 10.24	A
			Sr-90	Bq/sample	1.63	2.32	1.62 - 3.02	W (2)
			Zn-65	Bq/sample	3.18	2.63	1.84 - 3.42	W

(1) False positive test.

(2) Soil, Co-57 & Zn-65 identified by gamma software as not detected, MAPEP evaluated as failing the false positive test. A large concentration of Eu-152 was spiked into the sample, causing interference in the analysis. Gamma software recognized the interference and identified them as not detected. MAPEP does not allow clients to enter non-detect designation. NCR 13-04

Soil, Sr-90 - incorrect results were submitted to MAPEP. Should have been 332 bq/kg, which would have passed. NCR 13-04

AP, Cs-134 - MAPEP evaluated the -0.570 as a failed false positive test. No client samples were affected by these failures. NCR 13-04

Vegetation, Sr-90 - it appears that the carrier was double spiked into the sample, resulting in the low activity for this sample. NCR 13-04

(a) Teledyne Brown Engineering reported result.

(b) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) DOE/MAPEP evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

TABLE D-3.3 ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2013	RAD-93	Water	Sr-89	pCi/L	48.3	41.3	31.6 - 48.4	A
			Sr-90	pCi/L	19.3	23.9	17.2 - 28.0	A
			Ba-133	pCi/L	81.9	82.1	69.0 - 90.3	A
			Cs-134	pCi/L	40.9	42.8	34.2 - 47.1	A
			Cs-137	pCi/L	44.0	41.7	37.0 - 48.8	A
			Co-60	pCi/L	61.9	65.9	59.3 - 75.0	A
			Zn-65	pCi/L	202	189	170 - 222	A
			Gr-A	pCi/L	34.2	40.8	21.1 - 51.9	A
			Gr-B	pCi/L	18.0	21.6	13.0 - 29.7	A
			I-131	pCi/L	23.8	23.8	19.7 - 28.3	A
			U-Nat	pCi/L	60.4	61.2	49.8 - 67.9	A
			H-3	pCi/L	3970	4050	3450 - 4460	A
	MRAD-18	Filter	Gr-A	pCi/filter	Lost during processing			
November 2013	RAD-95	Water	Sr-89	pCi/L	25.5	21.9	14.4 - 28.2	A
			Sr-90	pCi/L	14.3	18.1	12.8 - 21.5	A
			Ba-133	pCi/L	57.2	54.2	44.7 - 59.9	A
			Cs-134	pCi/L	83.3	86.7	71.1 - 95.4	A
			Cs-137	pCi/L	201	206	185 - 228	A
			Co-60	pCi/L	104	102	91.8 - 114	A
			Zn-65	pCi/L	361	333	300 - 389	A
			Gr-A	pCi/L	29.5	42.8	22.2 - 54.3	A
			Gr-B	pCi/L	30.1	32.2	20.8 - 39.9	A
			I-131	pCi/L	23.1	23.6	19.6 - 28.0	A
			U-Nat	pCi/L	5.53	6.24	4.70 - 7.44	A
			H-3	pCi/L	17650	17700	15500 - 19500	A
	MRAD-19	Filter	Gr-A	pCi/filter	33.0	83.0	27.8 - 129	A

(a) Teledyne Brown Engineering reported result.

(b) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

D.4 Environmental TLD Quality Assurance

Environmental dosimetry services for the reporting period of January – December, 2013 were provided by the Environmental Dosimetry Company (EDC), Sterling, Massachusetts. 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.

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. Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in house testing program conducted by the EDC QA Officer and (2) independent test perform by EDC clients.

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.

Table D-4.1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons (Cs-137) only. The internal acceptance (tolerance) criteria for the Panasonic Environmental dosimeters are: ± 15% for bias and ± 12.8% for precision. During this period, 100% (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.

Table D-4.2 provides the Bias + Standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Table D-4.3 presents the independent blind spike results for irradiated dosimeters provided by client utilities during this annual period. All results passed the performance acceptance criterion.

TABLE D-4.1

PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA JANUARY – DECEMBER 2013 (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 D-4.2

MEAN DOSIMETER ANALYSES (N=6)
JANUARY – DECEMBER 2013 (1), (2)

Process Date	Mean Bias %	Standard Deviation %	Tolerance Limit +/-15%
4/22/2013	4.1	1.9	Pass
4/24/2013	4.5	1.2	Pass
5/23/2013	-1.1	1.9	Pass
7/24/2013	0.8	1.0	Pass
8/4/2013	-1.1	1.6	Pass
8/6/2013	0.1	2.3	Pass
10/31/2013	1.5	1.2	Pass
11/10/2013	0.1	1.7	Pass
11/15/2013	-1.8	1.0	Pass
1/27/2014	3.7	2.3	Pass
1/31/2014	2.6	0.9	Pass
2/5/2014	0.7	0.6	Pass

(1)This table summarizes results of tests conducted by EDC for TLDs issued in 2013.
(2)Environmental dosimeter results are free in air.

TABLE D-4.3
SUMMARY OF INDEPENDENT DOSIMETER TESTING
JANUARY – DECEMBER 2013 (1), (2)

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
2^{nd} Qtr.2013	Millstone	0.7	1.5	Pass
2^{nd} Qtr.2013	Seabrook	-2.3	2.7	Pass
3^{rd} Qtr. 2013	Millstone	-4.7	4.0	Pass
4^{th} Qtr.2013	Seabrook	-0.9	0.9	Pass

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