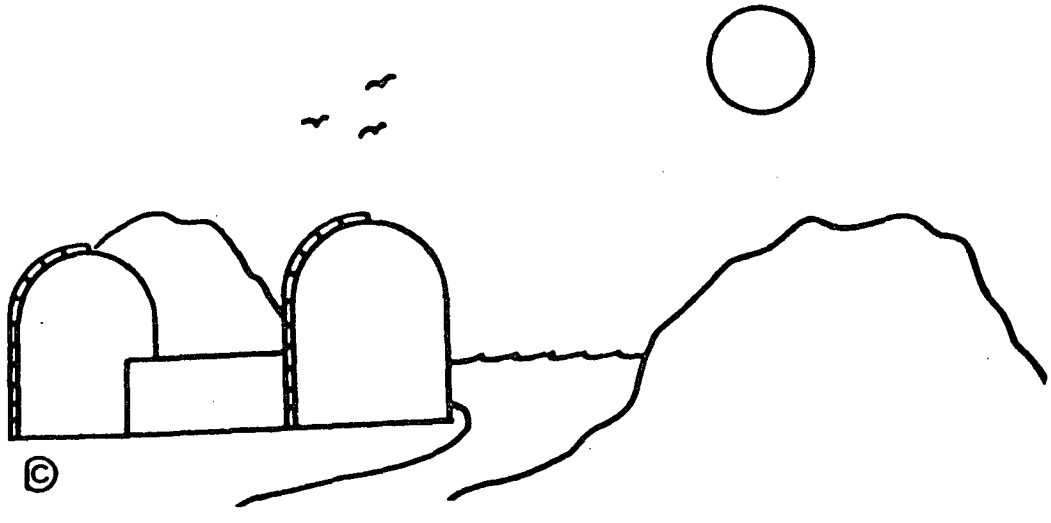
1988
RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

INDIAN POINT
NUCLEAR POWER PLANTS
January 1 through December 31, 1988



NEW YORK POWER AUTHORITY
CONSOLIDATED EDISON COMPANY OF NEW YORK

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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

NEW YORK POWER AUTHORITY
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

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

January 1 - December 31, 1988

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

SECTION I

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report contains a description and results of the 1988 Radiological Environmental Monitoring Program (REMP) for the Indian Point site. The Indian Point site consists of Units 1, 2 and 3. Units 1 and 2 are owned by the Consolidated Edison Company of New York, Unit 3 by the New York Power Authority.

The REMP is used to measure direct radiation, as well as the airborne and waterborne pathways to the environment. Direct radiation pathways include radiation from buildings and structures of the plant, airborne material that might be released from the plant, cosmic radiation, and the naturally occurring radioactive materials in soil, air and water. Analysis of Thermoluminescent Dosimeters (TLD) used to measure direct radiation showed no indication of increased radiation levels resulting from plant operation.

The airborne pathway includes measurements of air, precipitation, drinking water and broad leaf vegetation samples. The 1988 airborne pathway measurements indicated that there was no detection of radioactivity attributable to the Indian Point Station.

The waterborne pathway consists of Hudson River water, fish and invertebrates, and shoreline sediment. Measurements of the media comprising the waterborne pathway provided results consistent with historical averages.

Overall, concentrations of nuclides detected in the vicinity of Indian Point were well within historical background ranges for the entire year.

This report contains a description of the REMP and the conduct of that program as required by the Radiological Environmental Technical Specifications (RETS). It also contains summaries of the results of the 1988 program and discussions of those results including trend analyses, potential impact on the environment, land use census and interlaboratory comparisons.

During 1988 a total of 1189 RETS samples were collected. A summary of the numbers of samples collected is presented in Table B-1. The actual sampling frequency in 1988 was higher than required, due to the inclusion of additional (non-RETS) sample locations and media.

In summary, the measured concentrations of radionuclides in the environment surrounding Indian Point are not increasing as a result of releases of radioactive materials from Units 1, 2, and 3. The concentrations present in 1988 were within the historic background ranges (i.e. environmental levels resulting from natural and past anthropogenic sources) for the detected radionuclides; any calculated doses would be primarily attributable to background radiation. Consequently, the operation of the plants in 1988 did not result in any meaningful dose to man above background levels.

SECTION 2

INTRODUCTION

2.0 INTRODUCTION

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 35 acres near the southern end of the site. Unit 1 has been retired as a generating facility, Units 2 and 3 are owned and operated by Con Edison and New York Power Authority, respectively.

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 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, and

2. To verify projected and anticipated radionuclide concentrations in the environment from releases of radioactive materials from the site.

In order 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.

Environmental sample locations are designated 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 further away (and upwind/ upstream, where applicable) from the site, where the level would not 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 from the site is another program objective. Verifying projected concentrations through the REMP is difficult since the environmental concentrations resulting from plant releases are normally too small to be detected. Since effluent releases in 1988 were kept to the lowest level practicable, predictive models for plant releases indicate that the resultant environmental concentrations should be virtually undetectable. Residual radioactivity from the accident at Chernobyl, atmospheric bomb tests and naturally occurring radioactivity were the predominant sources of radioactivity in the samples collected. Their presence makes the detection of the predicted low level concentrations due to plant operations difficult. Nonetheless, analysis of the data verified that plant effluents resulted in environmental concentrations far below regulatory limits and of no health significance.

SECTION 3

PROGRAM DESCRIPTION

3.0 PROGRAM DESCRIPTION

In order to achieve the objectives of the REMP and ensure compliance with the Radiological Environmental Technical Specifications (RETS), sampling and analysis of environmental media are performed as outlined in Table A-1 and described in section 3.3 below.

3.1 Sample Collection

Collection of environmental samples for the entire Indian Point Site is performed by Con Edison Nuclear Environmental Monitoring personnel.

Assistance in the collection of fish and invertebrate samples was provided by a contracted environmental vendor, Normandeau Associates.

3.2 Sample Analysis

The analysis of Indian Point environmental samples is performed by two laboratories: the New York Power Authority's Radiological Environmental lab in Fulton, New York; and a commercial analytical laboratory, Teledyne Isotopes, Inc. of Westwood, New Jersey. The NYPA lab at Fulton analyzes all samples except TLDs, which are processed by Teledyne. In addition, the spiked samples used as part of the analytical Quality Assurance Program are prepared by Eberline, Inc.

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 background radiation (e.g., total integrated exposures) for a given period. Two TLD holders are posted at each of various locations within a 5 mile (8 km) radius of the site. Their locations include two sites in each of the 16 compass sectors, comprising two rings of TLD's.

The inner ring is located near the site boundary; the outer ring is located 4-6 km from the site. Additional TLD's are located at Roseton (20 miles north) as a control and at seven other locations of special interest. TLD's are collected and evaluated on a quarterly basis (i.e., mrem per quarter).

3.3.2 Air Particulates and Radioiodine

Air samples are taken at nine locations varying in distance from 0.25 to 20 miles from the plant. These locations represent 1 control and 8 indicator locations. The air samples are collected continuously by means of fixed air particulate filters followed by in-line charcoal cartridges, both of which are changed on a weekly basis. The filter and cartridge samples are analyzed weekly for gross beta and radioiodine, respectively. In addition, gamma spectroscopy is performed on quarterly composites of the air particulate filters.

3.3.3 Hudson River Water

Hudson River water samples are collected continuously from the intake structure (control location) and the discharge canal (indicator location), both of which are located on-site. The sampling apparatus used takes a composite sample, and ensures that representative samples are obtained. On a weekly basis, approximately 4-liter samples are taken at the inlet and discharge from 5-gallon composite containers. These weekly river water samples are composited for monthly gamma spectroscopy analysis (GSA), and quarterly for tritium analysis and GSA.

3.3.4 Drinking Water

Samples of drinking water are collected from the Camp Field Reservoir (3.5 miles NE). These samples are each approximately 4 liters. They are obtained monthly and are analyzed for gamma-emitting radionuclides and I-131; they are also composited quarterly and analyzed for tritium.

3.3.5 Hudson River Shoreline Soil

Shoreline soil samples are collected at 3 indicator and 2 control locations along the Hudson River. They are approximately 2 kg grab samples, obtained where available. These samples are collected during the spring and summer and gamma spectroscopy analysis is performed on them.

3.3.6 Broad Leaf Vegetation

Broad leaf vegetation samples are collected from 3 locations. They are collected monthly when available and analyzed for gamma-emitting radionuclides and radioiodine. These samples consist of at least 1 kg of leafy vegetation and are used in assessment of the food product and milk ingestion pathways.

3.3.7 Fish and Invertebrates

Various fish and invertebrate samples are obtained from the Hudson River at locations upstream and downstream of the plant discharge. These samples are taken in the spring and fall depending upon their availability. The edible portions of fish and invertebrates collected are analyzed by gamma spectroscopy.

3.3.8 Hudson River Aquatic Vegetation (Non-RETS)

During the spring and summer, aquatic vegetation samples are collected from the Hudson River at 3 locations. At each location samples of *Potomogeton perfoliatus* and *Myriophyllium verticullatum* are obtained when available. These samples are analyzed for gamma-emitting radionuclides and I-131.

3.3.9 Hudson River Bottom Sediment (Non-RETS)

Bottom sediment and benthos are sampled at four locations along the Hudson River, once each spring and summer. These samples are obtained using a Peterson grab sampler or similar instrument. Gamma spectroscopy analyses are performed on these bottom sediment samples.

3.3.10 Precipitation (Non-RETS)

Precipitation samples are continuously collected at one indicator and one control location. They are collected in sample bottles designed to hinder evaporation. They are composited quarterly and analyzed for gamma-emitting radionuclides and tritium.

3.3.11 Soil (Non-RETS)

Soil samples are collected from one control and 2 indicator locations. They are approximately 2 kg in size and consist of about twenty 2-inch deep cores. Gamma spectroscopy analyses are performed on the soil samples.

3.3.12 Land Use Census

Each year a land use census consisting of milch animal and residence surveys is conducted to determine the current utilization of land within 8 km of the site. These censuses are used to determine whether there are changes in existing conditions which warrant changing the sampling program.

The milch animal census is used to identify animals producing milk for human consumption within 8 km (5 miles) of Indian Point. It consists of a visual field survey of the areas where a high probability of milch animals exists and confirmation through personnel who deal with farm animals, such as veterinarians, feed suppliers and dairy associations.

Although there are presently no animals producing milk for human consumption within 8 km of the site, the census is performed to determine if the 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. Sampling of vegetation at the site boundary is performed in lieu of the garden census as per Technical Specifications.

3.4 Statistical Methodology

There are a number of statistical calculation methodologies used in evaluation of data from the Indian Point REMP. These methods include determination of Lower Limit of Detection (LLD) and Critical Level (CL), and estimation of the mean and the associated propagated error.

3.4.1 Lower Limit of Detection and Critical Level

The LLD is a predetermined concentration or activity level used to establish a detection limit for the analytical procedures.

The LLD's are specified by the Nuclear Regulatory Commission for each radionuclide in specific media, and are determined by taking into account overall measurement methods. The equation used to calculate the LLD is: LLD = 4.66 K Sb,

where, Sb is the standard deviation in the background counting rate and K consists of variables which account for such parameters as:

- Instrument characteristics (e.g., efficiency)
- Sample size
- Counting time
- Media density (self-absorption)
- Radioactive decay
- Chemical yield

In the RETS program, LLD's are used to ensure that minimum acceptable detection capabilities are met with specified statistical confidence levels (95% detection probability with 5% probability of a false negative). Table A-2 presents the RETS program required LLDs for specific media and radionuclides as specified by the NRC. The LLDs actually achieved are usually much lower since the "required LLD's" represent the maximum allowed.

Because LLDs are utilized to determine detection limits, they cannot be used to determine whether or not the sample results are to be considered positive. For that purpose, the Critical Level (CL) determination is utilized.

The CL is defined as that net sample counting rate which has a probability (p) of being exceeded when the actual sample activity is zero (e.g., when counting background only). It is determined using the following equation.

$CL = kp\ Sb\ (1 + tb/ts)^{0.5}$ in cpm, where

CL = Critical Level
kp = 1.645 (corresponds to a 95% confidence level)
Sb = $(Rb/tb)^{0.5}$ (cpm) = standard deviation of the background count rate (Rb)
tb = background count time (min)
ts = sample count time (min)

For the REMP, net sample results which are less than the CL value are reported as not detectable; the CL value is reported as the "less than" value. Values above the CL are considered positively detected radioactivity in the environmental media of interest (with a 5% chance of false positive).

3.4.2 Determination of Mean and Propagated Error

In accordance with program policy, recounts of samples are often performed. When the initial count reveals the presence of radioactivity at a value greater than the CL, two recounts are performed. When a radionuclide is positively identified in two or more counts, the analytical result for the radionuclide is reported as the mean of the positive detections and the associated propagated error for that mean. In cases where more than one sample result is available, the mean of the sample results and the estimated error for the mean are reported in the Annual Report.

The mean (X) and propagated error (PE) are calculated using the following equations:

$$X = \frac{\sum_{i=1}^{N} Xi}{N}$$

where X = mean
X = value of each individual observation
N = number of observations

$$PE = \frac{\sqrt{\sum_{i=1}^{N} (ERRi)^2}}{N}$$

where PE = propagated error of the mean at 2 sigma,
ERRi = 2 sigma error of the individual analysis,
N = number of observations

3.4.3 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 16). Samples with "LLD" 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 averages high, particularly when only a few of the data are measurably positive. Most of 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 radioactively in air, which show positive monitoring results throughout the year.

In the data tables (Tables B-6 through B-15), values shown are based on the CL value. If a radionuclide was detected at or above the CL value in two or more counts, the mean and error are calculated as per Section 3.4.2, and reported in the data table. Values listed as "<" in the data tables are the CL values for that sample. If multiple counts were performed on a sample and a radionuclide's values are "<CL" each time, the most conservative (i.e., largest) critical level is reported in the data table.

The historical data tables contain the annual averages of the positive values for each year. The historical average and historical standard deviation, as shown, are calculated using only the positive values presented therein.

3.4.4 Evaluation of TLD Data

The monitoring of direct radiation by TLDs each quarter results in the generation of 160 data points. In order to evaluate the data it is normalized and then examined for deviations. The method used is outlined below.

The average dose for each quarter is calculated using the quarterly results from each of the 40 TLD locations. Using the dose from the fourth quarter of the previous year, a five quarter average is then determined. The difference between the five quarter average and each quarter's average dose is applied to each data point within that quarter. The resultant normalized data, consisting of 160 adjusted or normalized data points, take seasonal variations in direct radiation into account. Finally, the annual average deviation and percent deviation are calculated for each location using the normalized data. An acceptance limit of a 10% deviation is applied to identify outliers or anomalies.

SECTION 4

RESULTS AND DISCUSSION

4.0 RESULTS AND DISCUSSION

The 1988 Radiological Environmental Monitoring Program (REMP) was conducted in accordance with the Radiological Environmental Technical Specifications (RETS). The RETS contain 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.

Hudson River - water
shoreline soil
fish and invertebrates
aquatic vegetation (Non-RETS)
sediments (Non-RETS)

Airborne Particulates and Radioiodine
Precipitation (Non-RETS)
Drinking Water
Milk/Food Products (Non-RETS)
Terrestrial Broad Leaf Vegetation
Soil (Non-RETS)
Direct Gamma Radiation

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

In order 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 an isotope but the evaluation of the location, magnitude, source and history of its detection which determines its significance. Therefore, we have reported the data collected in 1988 and assessed the significance of the findings.

A summary of the results of the 1988 REMP is presented in Table B-2. This table presents the mean and range of all positive results obtained for each of the media sampled at RETS indicator and control locations.

The radionuclides detected in the atmosphere in 1988 can be grouped into three categories: (1) naturally occurring radionuclides; (2) radionuclides resulting from weapons testing and other nonplant related, anthropogenic sources; and (3) radionuclides that could be related to plant operations.

The environment contains a broad inventory of naturally occurring radionuclides; i.e., cosmic ray induced (Be-7, H-3) or geologically derived (Ra-226, Th-228, K-40). These radionuclides constitute the majority of the background radiation source and thus account for a majority of the annual background dose. 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.

In addition to the naturally occurring radionuclides discussed above, H-3 (which may result from man's activities as well as from natural occurrence), Cs-134 and Cs-137 were detected at above background levels in various media in the vicinity of Indian Point. The sources and significance of the presence, of these radionuclides are described in the following sections.

The second group of radionuclides detected in 1988 consists of those resulting from past weapons testing in the earth's atmosphere. Such testing in the 1950's and 1960's resulted in a significant atmospheric radionuclide inventory which, in turn, contributed significantly to the concentrations in the lower atmosphere and ecological systems. Although reduced in frequency, atmospheric weapons testing continued until 1980. The resultant radionuclide inventory, although diminishing with time (i.e., through decay, deposition and sedimentation, etc.), remains detectable.

In 1988, the detected radionuclide(s) attributable to past atmospheric weapons testing consisted of Cs-137 and H-3 in some media. The levels detected were consistent with the decreasing levels of radionuclides resulting from weapons tests measured over the past ten years. Another reason for attributing Cs-137's presence in some media to weapons testing is the absence of the power reactor related short-lived Cs-134 as described below.

The final group of radionuclides detected through the 1988 REMP comprise those which may be attributable to current plant operations. During 1988, H-3, Cs-134 and Cs-137 were the only potentially plant-related radionuclides detected in the RETS 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. The H-3 detected in 1988 appears to have resulted from a combination of sources. There was no H-3 detected at concentrations above the required LLD, in 1988.

Cs-137 and Cs-134 are both produced in fission reactors and were introduced into the environment from the accident at Chernobyl, but only Cs-137 is found in weapons test debris. Since Cs-134 has a significantly shorter half-life, detected concentrations of Cs-137 attributable to plant operations (e.g., recent releases), should be accompanied by Cs-134. An absence of such corroborating Cs-134 concentrations would indicate that the presence of Cs-137 in these samples is not distinguishable from the existing background and should be attributed primarily to weapons testing and residual concentrations; i.e., not to recent plant operations.

In the following sections, a summary of the results of the 1988 REMP are presented by medium, and the significance of any positive findings discussed. It should be noted that naturally occurring radionuclides are omitted from the summary table and further discussion.

4.1 Direct Radiation

In 1988, the TLD program produced a consistent picture of ambient radiation levels in the vicinity of the Indian Point Station. A summary of the annual TLD data is provided in Table B-2.

Results of the quarterly measurements for 1988 are presented in Tables B-3 to B-5. Table B-3 contains a listing of the 1988 quarterly dose readings for each location, as well as the readings for the fourth quarter of 1987. Quarterly averages, and the five quarter averages are also provided. The quarterly dose for each location, normalized for seasonal variations as per Section 3.4.4, is presented in Table B-4. Calculated annual average dose, standard deviation and percent standard deviation are shown for each location in Table B-5.

As illustrated in Table B-5, the percent standard deviation of the quarterly dose readings was not greater than 10% at any location. Thus, the results of the direct radiation monitoring program did not indicate any anomalies requiring further investigation.

In addition, annual averages for previous years were calculated and compared with the 1988 average. As can be seen from Table C-1 and Figure C-1, there was no observable increase in ambient radiation levels over the years of 1979 - 1988.

4.2 Airborne Particulates and Radioiodine

An annual summary of the results of the 1988 air particulate filter and charcoal cartridge analyses is presented in Table B-2. As shown, there were no radionuclides detected in the air which would be attributable to plant operations in 1988.

The results of the analyses of weekly air particulate filter samples for gross beta activity are presented in Table B-6, and the results of the gamma spectroscopic analyses of the quarterly composites of these samples in Table B-7.

Gross beta activity was found in air particulate samples throughout the year, at all indicator and control locations. The activities detected are consistent for all locations, with no significant change in gross beta activity in any sample. Gamma spectroscopic analyses of the quarterly composites revealed that only naturally-occurring radionuclides were present at detectable levels.

The mean annual concentration of air particulates 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 gross beta concentration was consistent with historical levels. Cs-137 was not detected at concentrations above the LLD in 1988, consistent with the trend of decreasing ambient Cs-137 concentrations in recent years (Figure C-3).

The charcoal cartridge analytical results are presented in Table B-8. There was no I-131 detected above the LLD (0.07 pCi/m^3) in the charcoal cartridge samples. As illustrated in Table C-2, this is consistent with historical trends.

From the data it can be seen that during 1988, no air particulate radioactivity attributable to the operation of Indian Point was detected in 1988.

4.3 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 H-3 analysis of quarterly composites are presented in Tables B-9 and B-10, respectively.

In addition to naturally occurring radionuclides, the only radionuclide detected in the Hudson River water in 1988 was tritium. It was detected in both the inlet and discharge canal with concentrations ranging from 210 pCi/l to 240 pCi/l and 540 pCi/l to 1100 pCi/l, respectively. The H-3 detected in the inlet (average concentration 223 pCi/l) may be considered the background concentration. The somewhat greater concentrations in the discharge (average 820 pCi/l) are indicative of some contribution from plant operations. However, the concentrations detected at both locations were far below the required LLD of 2000 pCi/l. Thus, the operation of Indian Point in 1988 did not result in an adverse radiological impact on Hudson River water.

Data on radionuclides detected in the Hudson River water over the past ten years is summarized in Table C-3. From this table and Figure C-4, it can be seen that the detected H-3, as well as the absence of detectable Co-60 and Cs-137 are consistent with the historical data trends.

4.4 Drinking Water

The annual program summary table (Table B-2) contains a summary of the 1988 drinking water sample analysis results. Results of the gamma spectroscopic analysis of the monthly drinking water samples are in Table B-11; results of tritium analysis of quarterly composites are in Table B-12.

There were no radionuclides attributable to plant operations detected in the monthly drinking water samples. H-3 was the only radionuclide detected in any of the samples. It was detected in two of the four quarterly composite samples with an average activity of 375 pCi/l and a range of 370 to 380 pCi/l, which are all below the required LLD of 2000 pCi/l. Although plant operations are a potential source of H-3, there was no apparent pathway between the plant and the reservoir from which the drinking water samples were obtained. However, the H-3 levels detected were evaluated since the 1988 average is not with in the historic range, as shown in Table C-4 and Figure C-5.

The potential dose to the maximum exposed individual from ingestion of Campfield Reservoir drinking water throughout the year, was conservatively calculated to be 0.4 mrem/year. This dose is a small fraction of the annual average dose from natural radiation of 300 mrem/year (Reference 22). Also, the calculated dose is a very conservative estimate based on the following assumptions: 1) the maximum exposed individual is a child whose entire intake of water is from Campfield with an average H-3 concentration of 375 pCi/liter; and 2) the water is ingested at a rate of 510 liters/year (Reference 23). The dose conversion factor for drinking tritiated water is 2.03 E-07 mrem total body per pCi of H-3 ingested (Reference 23).

The dosimetric impact of the H-3 in the drinking water is negligible. Factors such as the absence of H-3 in any precipitation samples, except control samples, indicates that the H-3 present in the drinking water should not be attributed to plant operations. Thus, examination of the data indicates that the current operation of Indian Point did not have a radiological impact on drinking water.

4.5 Hudson River Shoreline Soil

A summary of the radionuclide concentrations detected in the shoreline soil samples is contained in Table B-2; Table B-13 contains the results of the gamma spectroscopic analyses of these samples.

As shown, Cs-134 and Cs-137 were the only potential reactor products detected in shoreline soils in 1988. They were detected at indicator and control locations. The average Cs-134 concentration was 29.7 pCi/kg at indicator locations and 49.2 pCi/kg at control locations, and the average Cs-137 concentrations at indicator and control locations were 122.6 pCi/kg and 69.3 pCi/kg, respectively. Of the samples in which they were detected, none of the Cs-134 and only one of the Cs-137 activities was above the required LLD.

In the majority of the samples, the only potential reactor product detected was Cs-137, which was detected at indicator and control locations. The absence of Cs-134 in these samples combined with the presence of the Cs-137 at control locations, indicates that the Cs-137 detected in these samples was not due to recent plant operations.

In samples where Cs-134 was detected along with the Cs-137 the Cs-134 would tend to "date" the radioactivity as resulting from recent plant operations. In fact, Cs-134 was detected with the Cs-137 at only one indicator and one control location. Both the Cs-134 and Cs-137 activities in these samples were greater at the control than the indicator locations, indicating a source other than recent plant operations. Thus, the detection of Cs-134 and Cs-137 in these samples does not appear to indicate that recent plant operations are causing increased radioactivity levels in the shoreline soils.

A summary of the shoreline soil analysis data for the past ten years is provided in Table C-5 and illustrated in Figure C-6. From this it can be seen that the concentrations of Cs-134 and Cs-137 detected in 1988 are consistent with the historical data. The operation of the Indian Point station did not result in any increase in the radioactivity of shoreline soils along the Hudson River in 1988.

4.6 Broad Leaf Vegetation

Table B-2 contains a summary of the broadleaf vegetation sample analysis results; data from analysis of the 1988 samples is presented in Table B-14.

Cs-137 was the only potential reactor product detected in the broadleaf vegetation samples. It was detected in 2 of 15 samples from the control location at an average concentration of 21.3 pCi/kg, and in none of the indicator location samples. This, combined with the absence of detectable Cs-134, reveals that there were no radionuclides attributable to current plant operations detected in broadleaf vegetation in 1988.

Table C-6 contains a summary, and Figure C-7 an illustration, of the broadleaf vegetation analysis results for the past 10 years. The detection of Cs-137 at the control locations, as well as the absence of radionuclides attributable to recent plant operations, are consistent with this historical data.

4.7 Fish and Invertebrates

The fish and invertebrate sample analysis results are summarized in Table B-2, and the analytical data presented in Table B-15. There were no radionuclides attributable to plant operations detected in any of the fish and invertebrate samples. Thus, it can be concluded that plant operations in 1988 did not contribute to the activity levels in fish and invertebrates in the Hudson River.

A summary of the fish and invertebrate analytical data over the past ten years is provided in Table C-7, and illustrated in Figure C-8. The absence of detectable radionuclides in fish and invertebrates is consistent with the trend of decreasing concentrations over the past ten years.

4.8 Additional Media Sampling

Although not required by the RETS, sampling and analysis were performed on aquatic vegetation, Hudson River sediment, soil and precipitation samples. A summary of the analytical results obtained is presented in Table B-16. As shown by these data, the radionuclides detected were within their respective historic ranges. Also these data illustrate that there has been no build up of radioactivity in the aquatic vegetation, Hudson River sediment, or soil in the vicinity of Indian Point. Since these samples were not required by the RETS, data tables and graphs are not presented for the data.

4.9 Land Use Census

A census was performed in the vicinity of Indian Point in 1988. This census consisted of a milch animal and a residence census. Results of this census are presented in Tables B-17 and B-18.

During the milch animal census, there were no animals producing milk for human consumption were found within 8 km of the plant. The second part of this census revealed that the nearest residences are located 0.4 miles ESE and 0.4 miles E of the plant.

It should be noted that sampling of vegetation at the site boundary is performed in lieu of the garden census, as permitted by the RETS.

4.10 Conclusion

The REMP is conducted each year to determine the radiological impact of Indian Point operations on the environment. The preceding discussions of the results of the 1988 REMP reveal that there was no appreciable (i.e., measurable) impact on the environment due to operations at the station. Examination of the historical data indicates an overall decreasing trend in radionuclide concentrations in the various media sampled and analyzed.

The results of the 1988 REMP also revealed that the impact on the environment of fallout from previous atmospheric weapons testing continues to represent the greatest long-term radiological environmental impact. The background radiation contribution to overall doses to man is much more significant than that associated with normal plant operations, as demonstrated by the relative contributions of the different sources to the environmental radionuclide concentrations.

SECTION 5

QUALITY ASSURANCE

5.0 QUALITY ASSURANCE

Sampling and analysis of environmental media at Indian Point were conducted in accordance with quality assurance requirements specified in Regulatory Guide 4.15 (Reference 12) and in internal procedures (Reference 2). The annual review of the Radiological Environmental Monitoring Program consisted of the following:

- Audit of all Indian Point and radioanalytical contractor procedures related to the Radiological Environmental Monitoring Program by NYPA Quality Assurance (QA) and Consolidated Edison Quality Assurance and Reliability (QA&R) personnel.

- Audit of Indian Point sample collections and radioanalytical laboratory techniques by QA personnel and QA&R personnel.

- Submission for analysis of duplicate (split) samples to the radioanalytical contractor to verify reproducibility (precision) of results.

  Submission for analysis of environmental samples spiked with known levels of radioactivity to the radioanalytical contractor to verify accuracy of results.

  Assessment of the radioanalytical contractor's performance in the Environmental Protection Agency (EPA) Interlaboratory Comparison Study (Appendix D).

Audit of the 1988 Radiological Environmental Monitoring Program demonstrated that sampling and analysis of environmental media were conducted by qualified personnel, in accordance with approved procedures, to ensure reproducibility and consistency of analytical techniques. Adherence to internal procedure requirements ensured that the program met or exceeded requirements stated in the Radiological Effluent Technical Specifications for Indian Point Station.

Review of the quality assurance programs of the New York Power Authority's Radiological Environmental Laboratory and Teledyne Isotopes demonstrated that all requirements specified in 10CFR Part 50 Appendix B and Regulatory Guide 4.15 were achieved. In addition, the Authority laboratory's performance in the EPA Interlaboratory Comparison Study was satisfactory; 47 out of 49 measurements were in agreement (see Appendix D).

In summary, the quality assurance program conducted in conjunction with the Indian Point Environmental Monitoring Program included audits and evaluations of in-house and contractor procedures, work functions, and quality assurance programs. Review of the 1988 quality assurance program indicated that the Radiological Environmental Monitoring Program was performed in accordance with the Radiological Effluent Technical Specifications.

SECTION 6

REFERENCES

6.0 REFERENCES

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APPENDIX A

ENVIRONMENTAL SAMPLING AND ANALYSIS REQUIREMENTS

APPENDIX A

ENVIRONMENTAL SAMPLING AND ANALYSIS REQUIREMENTS

Environmental media are sampled at the locations specified in Table A-1 and shown in Figures A-1 and A-2. The samples are analyzed according to criteria established in the Radiological Effluent Technical Specification (RETS). These RETS requirements include: methods of sample collection; types of sample analysis; minimum sample size required; and minimum detectable concentrations which must be attained for each medium, sample, or analysis type.

The required lower limits of detection for Indian Point sample analysis are presented in Table A-2.

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 in accordance with RETS. The number and location of animals producing milk for human consumption must be determined within eight kilometers of the plant. Also, the nearest residence and the nearest garden greater than 50 m^2 size producing broad leaf vegetation must be identified.

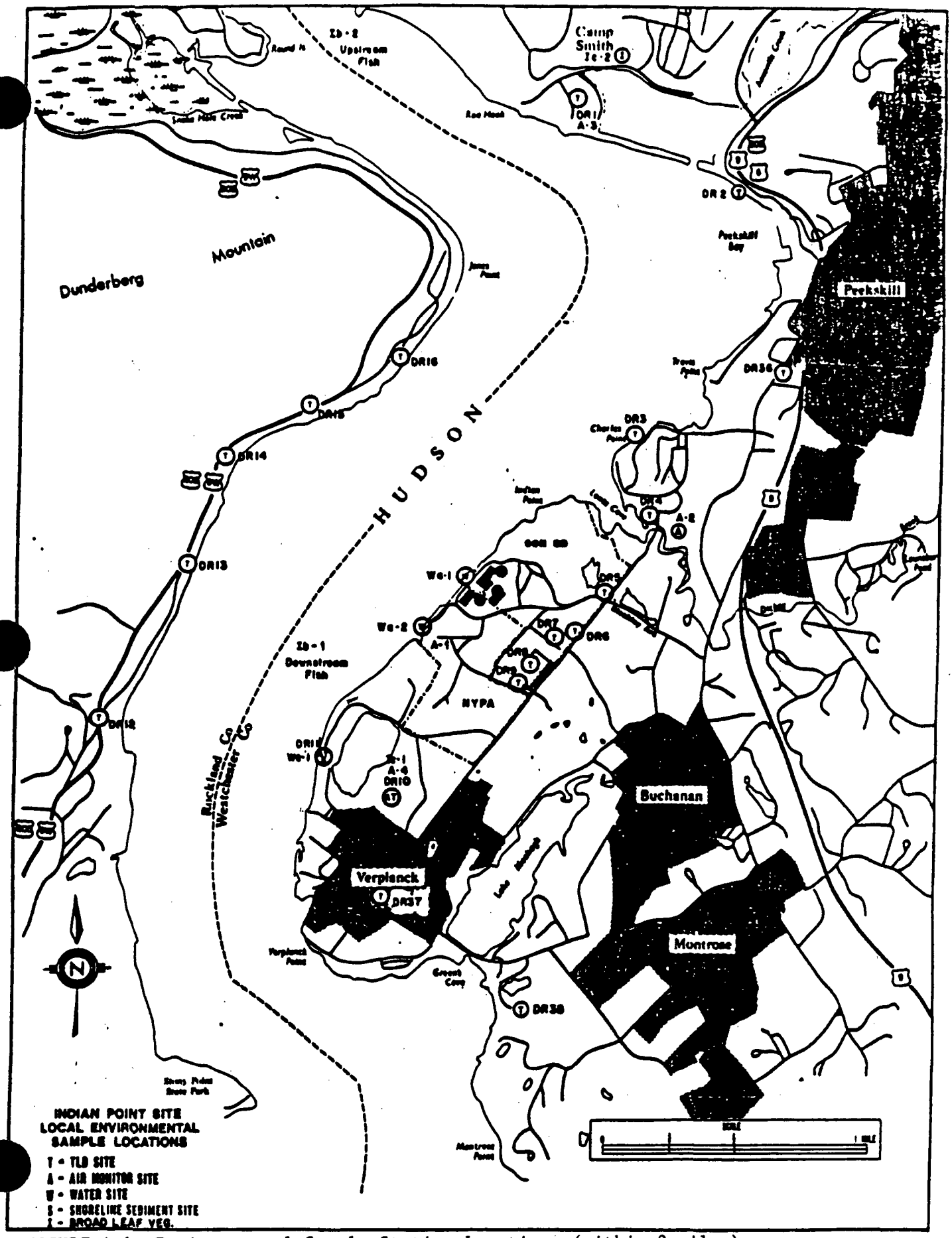

FIGURE A-1: Environmental Sample Station Locations (within 2 miles)

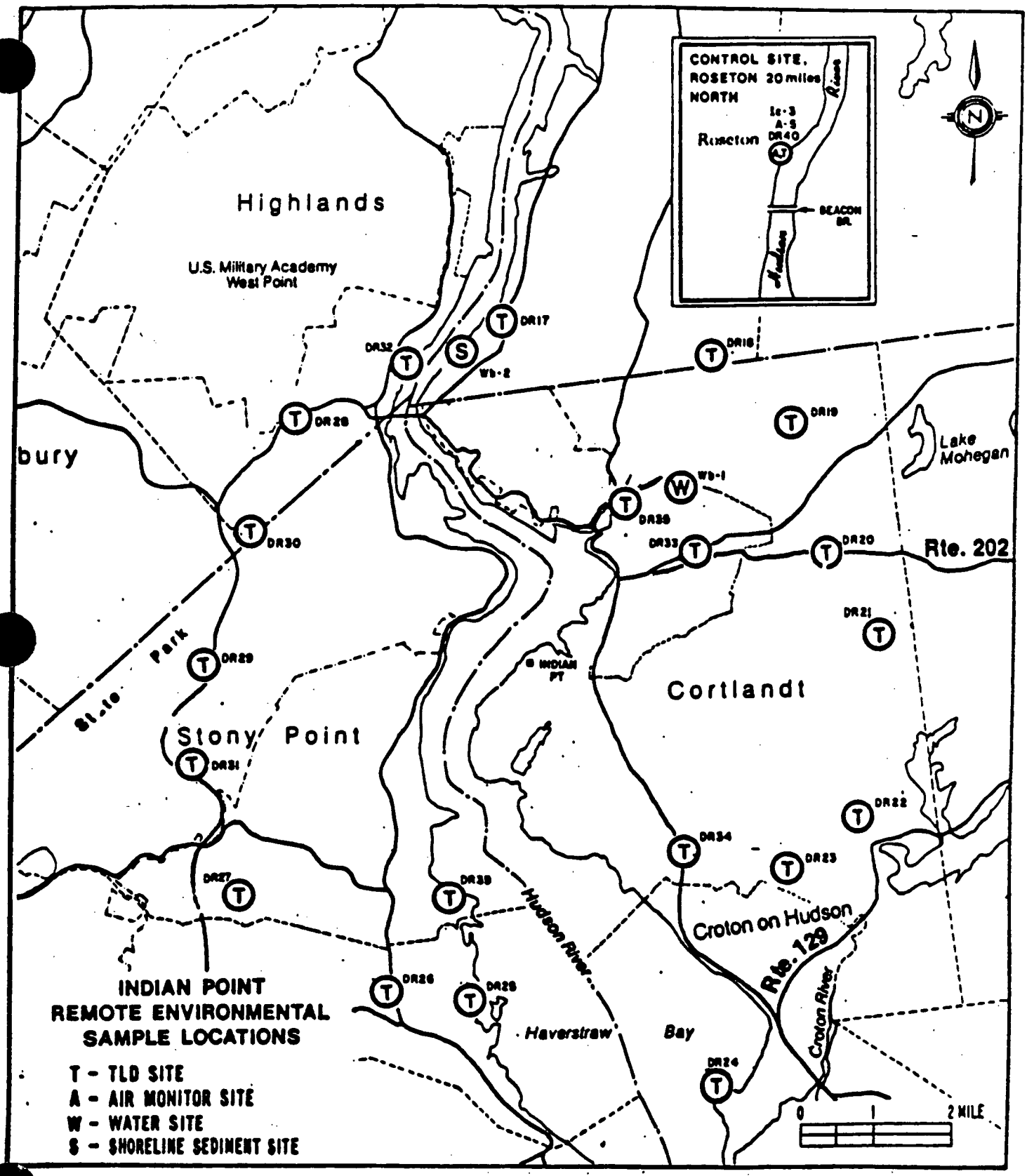

FIGURE A-2: Environmental Sample Station Locations (greater than 2 miles)

TABLE A-1 INDIAN POINT STATION SAMPLING STATION LOCATIONS

Sampling Station	Location/Distances	Designation	RETS Sample Sample Types
3	Service Building, Onsite - SSE	DR-08	Direct Gamma
4	Algonquin Gas Line, 0.25 MI - SW	A-1 A-1	Air Particulate Radioiodine
5	NYU Tower	A-4	Air Particulate
1	Mi - SSW	A-4 DR-10 N.A. Ic-1	Radioiodine Direct Gamma Soil Broadleaf Vegetation
6	Camp Smith, 2.5 MI - NNE	N.A. Ic-2	Soil Broadleaf Vegetation
7	Camp Field Reservoir, 3.5 MI - NE	Wb-1	Drinking Water
8	Inlet pipe into plants, NE	Wa-1	HR[a] Water
10	Discharge Canal, Onsite - SW	Wa-2	HR[a] Water
14	Water Meter House, Onsite - SE	DR-7	Direct Gamma
17	Off Verplanck, 1 MI - SSW	N.A. N.A. N.A.	HR[a] Aquatic Vegetation HR[a] Shoreline Soil HR[a] Bottom Sediment
20	Montrose Marina, 1.5 MI S	DR-38	Direct Gamma

TABLE A-1 CONTINUED

Sampling Station	Location/Distances	RETS Sample Designation	Sample Types
22	Lovett, 1.5 MI - WSW	N.A N.A.	Air Particulate Radioiodine
23	Roseton, 20 MI - N	N.A. A-5 A-5 DR-40 Ic-3 N.A.	Precipitation, [b] Air Particulate, [b] Radioiodine, [b] Direct Gamma, [b] Broadleaf Vegetation Soil
25	Where available	Ib 1&2	Fish/Invertebrates
27	Croton Pt., 6.4 MI - SSE	N.A. N.A. DR-24	Air Particulate Radioiodine Direct Gamma
28	Lent's Cove, 0.5 MI - ENE	N.A. DR-4	HRa Shoreline Soil Direct Gamma
29	Grassy Pt., 3.3 MI - SSW	N.A. N.A. DR-39	Air Particulate Radioiodine Direct Gamma
33	Hamilton St., SS, 3 MI-NE	DR-33	Direct Gamma
34	SE Corner Onsite SE	DR-9	Direct Gamma
35	Bleakley & Broadway Onsite - E	DR-5	Direct Gamma
38	Furnace Dock, 3.5 MI - SE	DR-34	Direct Gamma
44	Peekskill Gas Holder Bldg. 1.7 MI NE	N.A. N.A. N.A.	Precipitation Air Particulate Radioiodine
50	Manitou Inlet, 4.5 MI-NNW (control)	Wc-2	HR[a] Shoreline Soil
53	White Beach, 0.9 MI - SW	Wc-1 DR-11	HR[a] Shoreline Soil Direct Gamma

TABLE A-1 CONTINUED

Sampling Station	Location/Distances	RETS Sample Designation	Sample Types
56	Verplanck 1.3 MI-SSW	DR-37	Direct Gamma
57	Cortlandt Sanitation Garage, 2 MI - N	A-3 A-3 DR-1	Air Particulate Radioiodine Direct Gamma
58	Rt. 9D Garrison, 5 MI-N	DR-17	Direct Gamma
59	Old Pemart Avenue Pole 1.8 MI - NNE	DR-2	Direct Gamma
60	Gallows Hill Road CH G&M Pole #6639F, 5 MI - NNE	DR-18	Direct Gamma
61	Lower South St. & Bay St. NYT Pole #17, 1.3 MI - NE	DR-36	Direct Gamma
62	Westbrook Drive Pole #CP2, 5 MI - NE	DR-19	Direct Gamma
4	Pine Road - Cortlandt, 4.8 MI - ENE	DR-19	Direct Gamma
66	Croton Avenue - Cortlandt Pole #NYT-A, 5 MI - E	DR-21	Direct Gamma
67	Colabaugh Pond Road Cortlandt Pole #30, 5 MI - ESE	DR-22	Direct Gamma
69	Mt. Airy & Windsor Road Pole #W-66-2-40, 5 MI - SE	DR-23	Direct Gamma
71	Warren Ave - Haverstraw, 4.8 MI - S	DR-25	Direct Gamma
72	Railroad Avenue & 9W Haverstraw, 4.6 MI - SSW	DR-26	Direct Gamma
73	Willow Grove Rd. & Birch Dr. 5 MI - SW	DR-27	Direct Gamma
74	Gays Hill Road S, 1.5 MI - WSW	DR-12	Direct Gamma

TABLE A-1 CONTINUED

Sampling Station	Location/Distances	RETS Sample Designation	Sample Types
75	Sign (NY and NJ) Palisades Parkway Southbound, 5 MI - WSW	DR-28	Direct Gamma
76	Gays Hill Road N, 1.2 MI W	DR-13	Direct Gamma
77	Palisades Parkway, 4.2 MI - W	DR-29	Direct Gamma
78	Rt. 9W Pirates Cove - Pole #O&R 233, 1.2 MI - WNW	DR-14	Direct Gamma
79	Anthony Wayne Park, 4.5 MI - WNW	DR-30	Direct Gamma
80	RT. 9W South of Ayers Road Pole #NYT 255, 1 MI - NW	DR-15	Direct Gamma
81	Palisades Parkway Lake Welch Exit, 4.7 MI - NW	DR-31	Direct Gamma
82	Ayers Road Pole 1 MI - NNW	DR-16	Direct Gamma
83	Rt. 9W Fort Montgomery Pole #142, 5 MI - NNW	DR-32	Direct Gamma
84	Cold Spring, 10.8 MI - N (Control)	N.A.	HR[a] Aquatic Vegetation
		N.A.	HR[a] Shoreline Soil
		N.A.	HR[a] Bottom Sediment
85	Amicus Reservoir		
88	Sector 6 Reuter Stokes Pole, 0.5 MI - ESE	DR-6	Direct Gamma
89	Highland Avenue & Sprout Brook Rd (near rock cut) 3 Mi - NNE	DR-35	Direct Gamma
90	Charles Point, 0.8 MI - NE	DR-3	Direct Gamma
1	Burnwell Gas Co., 0.8 MI-ENE	A-2	Air Particulate
		A-2	Radioiodine
		N.A.	Direct Gamma

TABLE A-1 CONTINUED

(a) HR = Hudson River

(b) Control Station

N.A. = Not Applicable

TABLE A-2

LOWER LIMIT OF DETECTION (LLD) CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (a) (b)

Analysis	Water (PCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	4	0.01				
H-3	2000(c)					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-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-La-140	15			15		

a This list does not mean that only these nuclides are to be considered. Other identifiable peaks shall also be analyzed and reported in the Annual Radiological Environmental Operating Report.

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

c LLD for drinking water samples. If no drinking water pathway exists, a value of 3000 pCi/l may be used.

d LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS SUMMARY

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS SUMMARY

B.1 1988 Annual Radiological Environmental Monitoring Program Summary

Environmental monitoring data are summarized and presented in tabular form by media type. The results of the program as outlined in Table A-1 are summarized in tabular form in Table B-2. The format of this summary tables conforms to the reporting requirements of the RETS and NRC Regulatory Guide 4.8 (Reference 5). In addition, the data obtained from the analysis of the RETS samples are provided in Tables B-3 through B-15.

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, Ru-103, Ru-106, I-131, Cs-134, Cs-137, Ba-140, Ce-141, Ce-144, Ra-226 and Th-228. Radiochemical (I-131) and tritium analyses were performed for specific media and locations as required in the RETS.

B.2 Land Use Census

In accordance with Sections 4.11B of the Con Ed RETS and 2.8.A of the NYPA RETS, a land use census was conducted to identify the nearest milch animal and the nearest residence. The results of the land use census and milch animal census are presented in Tables B-17 and B-18, respectively. In lieu of identifying and sampling the nearest garden of greater than $50m^2$, at least three kinds of broad leaf vegetation were sampled (results are presented in Table B-14).

B.3 Sampling Deviations

During 1988, environmental sampling was performed for a total of 10 media types (6 RETS required and 4 other) and for direct radiation. A total of 1215 samples (> 99%) were collected and analyzed for the program; a total of 1189 or >99% of the RETS required samples were collected and analyzed.

Sampling deviations are summarized in Table B-1.

B.4 Analytical Deviations

During 1988, all analytical requirements (e.g., lower limits of detection) were met or exceeded. Thus, no analytical deviations occurred in the 1988 REMP Program.

TABLE B-1

SUMMARY OF SAMPLING DEVIATIONS, 1988

Media	Total Scheduled Samples	Number of Deviations	Sampling Efficiency %	Reason for Each Deviation
Particulates in Air	468	3	99.4	Equipment Malfunction
Charcoal Filter	468	3	99.4	Equipment Malfunction
TLD	160[a]	2	98.8	Vandalism
Hudson River Water	24	0	100	
Drinking Water	12	0	100	
Shoreline Soil	10	0	100	
Broadleaf Vegetation	45	0	100	
Fish & Invertebrate	10	0	100	
TOTALS:	1197	8	99.3	
Non-RETS Samples				
Aquatic Vegetation	8	1	87.5	Not Available
Hudson River Sediment	8	0	100	
Soil	3	0	100	
Precipitation	8	0	100	
OVERALL TOTALS:	1224	9	99.3	

[a] - This value represents each of the two TLDs at each location as a single sample.

TABLE B-2
INDIAN POINT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY - 1988*

Medium (units)	Type and Number of Analysis	LLD	Indicator Locations: Mean (a) Range	Location (b) of Highest Annual Mean: Location &	Mean (a) Range	Control Location: Mean (a) Range	Number of Nonroutine Reports
TLD (mrem per standard quarter)	Gamma Dose (160):	N/A	13.2 (154/156) 8.0-18.9	#59-Old Pemart Ave. 1.8mi. @ 34°	18.7(4/4) 18.5-18.9	14.0 (4/4) 12.7-14.8	0
Air Particulates and Radioiodine (pCi/m^3)	G.B. (263):	0.01	0.021 (210/210) 0.007-0.043	#57-Cortlandt 2.0mi. @ 5°	0.026(53/53) 0.011-0.043	0.007 (53/53) 0.011-0.043	0
	I-131(263):	0.07	<LLD	<LLD		<LLD	0
	GSA (20):						
	Cs-134	0.05	<LLD	<LLD		<LLD	0
	Cs-137	0.06	<LLD	<LLD		<LLD	0

G.B. = Gross Beta

TABLE B-2 (Continued)
INDIAN POINT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY - 1988*

Medium (units)	Type and Number of Analysis	LLD	Indicator Locations: Mean (a) Range	Location (b) of Highest Annual Mean: Location & Mean (a) Range	Control Location: Mean (a) Range	Number of Nonroutine Reports
Surface (Hudson River Water) (pCi/liter)	H-3 (8):	3000	820 (4/4) 540-1100	#10-Discharge Canal Onsite @ 229° 820 540-1100	220 (3/4) 210-240	0
	GSA (24):					
	Mn-54	15	<LLD	<LLD	<LLD	0
	Co-58	15	<LLD	<LLD	<LLD	0
	Fe-59	30	<LLD	<LLD	<LLD	0
	Co-60	15	<LLD	<LLD	<LLD	0
	Zn-65	30	<LLD	<LLD	<LLD	0
	Zr/Nb-95	15	<LLD	<LLD	<LLD	0
	I-131	15	<LLD	<LLD	<LLD	0
	Cs-134	15	<LLD	<LLD	<LLD	0
	Cs-137	18	<LLD	<LLD	<LLD	0
	Ba/La-140	15	<LLD	<LLD	<LLD	0

TABLE B-2 (Continued)
INDIAN POINT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY - 1988*

Medium (units)	Type and Number of Analysis	LLD	Indicator Locations: Mean (a) Range	Location (b) of Highest Annual Mean: Location & Mean (a) Range		Control Location: Mean (a) Range	Number of Nonroutine Reports
Drinking Water (pCi/liter)	G.B. (12):	4	2.41 (11/12) 1.26-3.64	#7 Camp Field 3.5mi. @ 48°	2.41(11/12) 1.26-3.64	NONE	0
	H-3 (4):	2000	375 (2/4) 370-380	#7 Camp Field 3.5mi. @ 48°	375 (2/4) 370-380	NONE	0
	GSA (12):						
	Mn-54	15	<LLD	<LLD		NONE	0
	Co-58	15	<LLD	<LLD		NONE	0
	Fe-59	30	<LLD	<LLD		NONE	0
	Co-60	15	<LLD	<LLD		NONE	0
	Zn-65	30	<LLD	<LLD		NONE	0
	Zr/Nb-95	15	<LLD	<LLD		NONE	0
	I-131	1	<LLD	<LLD		NONE	0
	Cs-134	15	<LLD	<LLD		NONE	0
	Cs-137	18	<LLD	<LLD		NONE	0
	Ba/La-140	15	<LLD	<LLD		NONE	0

TABLE B-2 (Continued)
INDIAN POINT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY - 1988*

Medium (units)	Type and Number of Analysis	LLD	Indicator Locations: Mean (a) Range	Location (b) of Highest Annual Mean: Location & Mean (a) Range	Control Location: Mean (a) Range	Number of Nonroutine Reports
Shoreline Soil (pCi/kg-dry)	GSA (10):					
	Cs-134	150	29.7(1/6)	#50-Manitou Inlet 4.5mi. @ 336° 49.2(1/2)	49.2(1/4)	0
	Cs-137	180	124 (5/6) 43-201	#17-Verplanck 1.0mi. @ 201° 195(2/2) 188-201	69 (3/4) 31-116	0
Broadleaf Vegetation (pCi/kg-wet)	GSA (45):					
	I-131	60	<LLD	<LLD	<LLD	0
	Cs-134	60	<LLD	<LLD	<LLD	0
	Cs-137	80	<LLD	#23-Roseton 20mi. @ 347° 21.3(2/15) 14.4-28.1	21.3(2/15) 14.4-28.1	0
Fish and Invertebrates (pCi/kg-wet)	GSA (10):					
	Mn-54	130	<LLD	<LLD	<LLD	0
	Fe-59	260	<LLD	<LLD	<LLD	0
	Co-58	130	<LLD	<LLD	<LLD	0
	Co-60	130	<LLD	<LLD	<LLD	0
	Zn-65	260	<LLD	<LLD	<LLD	0
	Cs-134	130	<LLD	<LLD	<LLD	0
	Cs-137	150	<LLD	<LLD	<LLD	0

INDIAN POINT
1988
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
ANNUAL SUMMARY TABLE NOTES

* = Data for the Annual Summary Tables is based on RETS required samples only.

N/A = Not applicable.

(a) = Fraction of detectable measurement to total measurement.

(b) = Location is distance in miles, and direction in compass degrees.

TABLE B-3

DIRECT RADIATION, QUARTERLY DATA (mr)
1988

ID#	SECTOR	1987 FOURTH QUARTER	1988 FIRST QUARTER	1988 SECOND QUARTER	1988 THIRD QUARTER	1988 FOURTH QUARTER	FIVE QUARTER AVERAGE
DR-01	N	12.1	11.7	13.0	13.0	13.0	12.6
DR-02	NNE	A	18.6	18.8	18.5	18.9	18.7
DR-03	NE	11.4	11.1	12.9	11.6	12.3	11.9
DR-04	ENE	13.7	12.0	13.8	12.0	13.5	13.0
DR-05	E	13.3	13.4	14.7	13.1	13.7	13.6
DR-06	ESE	13.1	12.2	13.4	13.3	13.5	13.1
DR-07	SE	18.0	17.2	15.3	14.6	16.1	16.2
DR-08	SSE	12.5	11.0	12.3	12.8	12.7	12.3
DR-09	SE	A	12.5	A	13.2	14.0	9.9
DR-10	SSW	12.4	11.9	14.9	12.3	14.3	13.2
DR-11	SW	10.4	9.6	11.4	10.5	10.8	10.5
DR-12	WSW	13.4	14.3	15.2	14.8	15.2	14.6
DR-13	W	16.3	16.1	16.0	15.8	16.1	16.1
DR-14	WNW	12.2	12.0	13.1	14.2	13.0	12.9
DR-15	NW	12.1	11.4	12.3	11.6	12.3	11.9
DR-16	NNW	13.7	12.8	A	13.7	13.7	10.8
DR-17	N	12.9	10.9	14.0	11.8	12.5	12.4
DR-18	NNE	13.1	11.3	12.9	15.1	12.5	13.0
DR-19	NE	13.4	13.3	15.5	14.6	14.4	14.2
DR-20	ENE	12.9	12.8	13.3	13.5	13.4	13.2
DR-21	E	12.4	12.5	13.8	13.7	13.2	13.1
DR-22	ESE	10.8	10.7	11.8	10.8	12.4	11.3
DR-23	SE	12.8	13.1	13.0	13.3	13.8	13.2
DR-24	SSE	11.5	10.8	11.8	11.6	11.8	11.5
DR-25	SE	11.2	11.1	12.3	12.2	11.5	11.7
DR-26	SSW	12.4	12.7	12.6	12.8	13.5	12.8
DR-27	SW	11.7	12.6	12.1	12.2	12.4	12.2
DR-28	WSW	13.5	13.8	14.6	15.0	13.7	14.1
DR-29	W	16.1	14.7	16.8	15.4	16.8	16.0
DR-30	WNW	14.5	12.6	14.2	13.9	14.4	13.9
DR-31	NW	16.8	14.6	17.0	17.0	16.9	16.5
DR-32	NNW	13.1	12.3	13.1	12.0	12.5	12.6
DR-33	NE	8.8	8.6	9.3	8.0	8.8	8.7
DR-34	SE	12.5	11.3	13.1	12.1	13.5	12.5
DR-35	NNE	13.7	12.7	15.2	14.2	14.2	14.0
DR-36	NE	12.5	11.1	13.3	14.8	12.6	12.9
DR-37	SSW	13.5	12.3	13.2	14.2	11.5	12.9
DR-38	S	8.4	8.6	9.2	8.9	9.1	8.8
DR-39	SSW	13.7	12.6	14.1	12.6	13.7	13.3
DR-40	N	14.7	12.7	14.8	13.8	14.6	14.1
AVERAGE		12.3	12.4	13.0	13.2	13.4	
DEVIATION			2.0	3.5	2.0	1.9	
ANNUAL AVERAGE				13.0			

A - No Data, TLD Missing

TABLE B-4

DIRECT RADIATION, NORMALIZED DATA (mr)
1988

ID#	SECTOR	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
DR-01	N	12.4	12.5	12.9	12.7
DR-02	NNE	19.3	18.3	18.4	18.6
DR-03	NE	11.8	12.4	11.5	12.0
DR-04	ENE	12.7	13.3	11.9	13.2
DR-05	E	14.1	14.2	13.0	13.4
DR-06	ESE	12.9	12.9	13.2	13.2
DR-07	SE	17.9	14.8	14.5	15.8
DR-08	SSE	11.7	11.8	12.7	12.4
DR-09	SE	13.2	A	13.1	13.7
DR-10	SSW	12.7	14.4	12.2	14.0
DR-11	SW	10.3	10.9	10.4	10.5
DR-12	WSW	15.0	14.7	14.7	14.9
DR-13	W	16.8	15.5	15.7	15.8
DR-14	WNW	12.7	12.6	14.1	12.7
DR-15	NW	12.1	11.8	11.5	12.0
DR-16	NNW	13.5	A	13.6	13.4
DR-17	N	11.6	13.5	11.7	12.2
DR-18	NNE	12.0	12.4	15.0	12.2
DR-19	NE	14.0	15.0	14.5	14.1
DR-20	ENE	13.5	12.8	13.4	13.1
DR-21	E	13.2	13.3	13.6	12.9
DR-22	ESE	11.4	11.3	10.7	12.1
DR-23	SE	13.8	12.5	13.2	13.5
DR-24	SSE	11.5	11.3	11.5	11.5
DR-25	SE	11.8	11.8	12.1	11.2
DR-26	SSW	13.4	12.1	12.7	13.2
DR-27	SW	13.3	11.6	12.1	12.1
DR-28	WSW	14.5	14.1	14.9	13.4
DR-29	W	15.4	16.3	15.3	16.5
DR-30	WNW	13.3	13.7	13.8	14.1
DR-31	NW	15.3	16.5	16.9	16.6
DR-32	NNW	13.0	12.6	11.9	12.2
DR-33	NE	9.3	8.8	7.9	8.5
DR-34	SE	12.0	12.6	12.0	13.2
DR-35	NNE	13.4	14.7	14.1	13.9
DR-36	NE	11.8	12.8	14.7	12.3
DR-37	SSW	13.0	12.7	14.1	11.2
DR-38	S	9.3	8.7	8.8	8.8
DR-39	SSW	13.3	13.6	12.5	13.4
DR-40	N	13.4	14.3	13.7	14.3

A - No Data, TLD Missing

TABLE B-5

DIRECT RADIATION, ANNUAL AVERAGE DOSE (mr)
1988

ID#	SECTOR	DOSE	DEVIATION	% DEVIATION
DR-01	N	12.7	0.2	1.5
DR-02	NNE	18.7	0.4	2.1
DR-03	NE	12.0	0.3	2.7
DR-04	ENE	12.8	0.6	4.3
DR-05	E	13.7	0.5	3.6
DR-06	ESE	13.1	0.2	1.2
DR-07	SE	15.8	1.3	8.4
DR-08	SSE	12.2	0.4	3.4
DR-09	SE	10.0	0.3	2.6
DR-10	SSW	13.3	0.9	6.9
DR-11	SW	10.6	0.2	2.2
DR-12	WSW	14.9	0.1	0.9
DR-13	W	16.0	0.5	3.2
DR-14	WNW	13.1	0.6	4.8
DR-15	NW	11.9	0.2	1.9
DR-16	NNW	10.1	0.1	0.8
DR-17	N	12.3	0.8	6.2
DR-18	NNE	12.9	1.2	9.5
DR-19	NE	14.4	0.4	2.7
DR-20	ENE	13.2	0.3	2.1
DR-21	E	13.3	0.3	1.9
DR-22	ESE	11.4	0.5	4.4
DR-23	SE	13.3	0.5	3.6
DR-24	SSE	11.5	0.1	0.8
DR-25	SE	11.8	0.3	2.8
DR-26	SSW	12.9	0.5	3.9
DR-27	SW	12.3	0.6	5.1
DR-28	WSW	14.3	0.6	3.9
DR-29	W	15.9	0.5	3.3
DR-30	WNW	13.8	0.3	2.1
DR-31	NW	16.4	0.6	3.7
DR-32	NNW	12.5	0.4	3.3
DR-33	NE	8.7	0.5	5.9
DR-34	SE	12.5	0.5	4.0
DR-35	NNE	14.1	0.5	3.3
DR-36	NE	12.9	1.1	8.5
DR-37	SSW	12.8	1.0	8.1
DR-38	S	8.9	0.2	2.6
DR-39	SSW	13.2	0.4	3.2
DR-40	N	14.0	0.4	2.8

TABLE B-6

INDIAN POINT
ENVIRONMENTAL AIRBORNE PARTICULATE SAMPLES - 1988
GROSS BETA ACTIVITY pCi/m^3 ± 2 sigma

LOCATION

WEEK END DATE	4	5	27	44	91	22	23	29	57
88/01/05	0.028±0.007	0.029±0.007	0.028±0.007	0.028±0.006	0.030±0.007	0.028±0.007	0.032±0.007	0.030±0.007	0.027±0.007
88/01/12	0.025±0.007	0.023±0.007	0.023±0.007	0.025±0.007	0.023±0.007	0.030±0.008	0.031±0.007	0.029±0.008	0.031±0.007
88/01/20	0.032±0.008	0.032±0.007	0.029±0.007	0.028±0.007	0.025±0.007	0.039±0.007	0.030±0.007	0.030±0.008	0.040±0.007
88/01/27	*	0.020±0.008	0.018±0.008	0.019±0.008	0.019±0.008	0.022±0.007	0.022±0.007	0.023±0.008	0.021±0.007
88/02/02	0.025±0.007	0.026±0.007	0.027±0.007	0.023±0.007	0.024±0.006	0.030±0.008	0.028±0.008	0.034±0.009	0.039±0.008
88/02/09	0.021±0.007	0.023±0.008	0.020±0.008	0.020±0.008	0.022±0.007	0.022±0.008	0.026±0.008	0.031±0.009	0.023±0.008
88/02/17	0.025±0.005	0.025±0.006	0.025±0.006	0.031±0.006	0.022±0.006	0.031±0.006	0.028±0.006	0.025±0.007	0.034±0.006
88/02/23	0.018±0.007	0.024±0.007	0.019±0.007	0.018±0.007	0.023±0.007	0.024±0.008	0.024±0.007	0.021±0.008	0.028±0.007
88/03/01	0.026±0.006	0.019±0.007	0.021±0.007	0.022±0.007	0.022±0.007	0.028±0.007	0.023±0.007	0.027±0.008	0.032±0.007
88/03/08	0.017±0.006	0.018±0.007	0.018±0.007	0.022±0.007	0.018±0.007	0.025±0.008	0.026±0.007	0.021±0.008	0.030±0.007
88/03/15	0.017±0.006	0.017±0.007	0.018±0.007	0.019±0.007	0.020±0.007	0.015±0.007	0.016±0.007	0.017±0.008	0.017±0.007
88/03/21	0.014±0.006	0.012±0.007	0.013±0.007	0.013±0.007	0.012±0.006	0.019±0.008	0.012±0.008	0.015±0.009	0.013±0.008
88/03/29	0.022±0.005	0.023±0.006	0.023±0.006	0.023±0.006	0.022±0.006	0.020±0.006	0.020±0.006	0.021±0.006	0.024±0.006
88/04/05	0.023±0.008	0.018±0.009	0.022±0.009	0.021±0.009	0.015±0.008	0.028±0.008	0.043±0.008	0.037±0.009	0.043±0.008
88/04/12	0.011±0.006	0.011±0.007	0.010±0.007	0.011±0.007	0.011±0.007	0.014±0.007	0.012±0.007	0.015±0.008	0.015±0.007
88/04/19	0.013±0.007	0.014±0.007	0.013±0.007	0.012±0.008	0.013±0.007	0.024±0.008	0.019±0.007	0.024±0.008	0.026±0.008
88/04/26	0.016±0.007	0.014±0.007	0.016±0.008	0.017±0.008	0.018±0.007	0.026±0.008	0.025±0.008	0.027±0.009	0.031±0.008
88/05/03	0.010±0.006	0.013±0.007	0.014±0.007	0.012±0.007	0.008±0.006	0.014±0.007	0.013±0.007	0.011±0.008	0.014±0.007
88/05/10	0.015±0.007	0.014±0.007	0.016±0.007	0.015±0.007	0.015±0.007	0.022±0.008	0.022±0.007	0.021±0.008	0.019±0.007
88/05/17	0.018±0.006	0.014±0.007	0.018±0.007	0.019±0.007	0.016±0.006	0.018±0.007	0.016±0.006	0.019±0.007	0.019±0.007
88/05/24	0.013±0.007	0.008±0.007	0.009±0.007	0.008±0.007	0.009±0.007	0.011±0.008	0.014±0.007	0.013±0.007	0.019±0.008
88/06/01	0.017±0.006	0.017±0.006	0.018±0.007	0.016±0.007	0.019±0.006	0.022±0.007	0.025±0.007	0.022±0.007	0.021±0.007
88/06/07	0.018±0.007	0.017±0.008	0.017±0.008	0.021±0.008	0.017±0.007	0.021±0.008	0.018±0.008	0.019±0.008	0.021±0.008
88/06/14	0.022±0.007	0.019±0.007	0.020±0.007	0.021±0.007	0.020±0.007	0.029±0.008	0.029±0.007	0.029±0.007	0.031±0.007
88/06/21	0.029±0.007	0.030±0.007	0.033±0.007	0.029±0.007	0.030±0.007	0.036±0.007	0.035±0.007	0.037±0.007	0.038±0.007
88/06/28	0.021±0.007	0.022±0.008	0.023±0.008	0.019±0.008	0.023±0.007	0.038±0.008	0.032±0.008	0.029±0.008	0.033±0.008
88/07/06	0.019±0.006	0.017±0.006	0.017±0.007	0.016±0.007	0.018±0.006	0.026±0.007	0.032±0.007	0.033±0.007	0.036±0.007

* PUMP NOT OPERATIONAL

TABLE B-6 (Continued)

INDIAN POINT
ENVIRONMENTAL AIRBORNE PARTICULATE SAMPLES - 1988
GROSS BETA ACTIVITY pCi/m^3 ± 2 sigma

LOCATION

WEEK END DATE	4	5	27	44	91	22	23	29	57
88/07/12	0.030±0.008	0.030±0.009	0.031±0.009	0.029±0.009	0.028±0.009	0.036±0.009	0.038±0.009	0.033±0.009	0.031±0.009
88/07/19	0.028±0.007	0.024±0.007	0.028±0.008	0.028±0.008	0.027±0.007	0.031±0.008	0.031±0.007	0.035±0.008	0.036±0.008
88/07/26	0.015±0.007	0.013±0.007	0.012±0.007	0.012±0.007	0.013±0.007	0.021±0.008	0.024±0.008	0.025±0.008	0.025±0.008
88/08/02	0.029±0.007	0.030±0.008	0.027±0.008	0.031±0.008	0.026±0.007	0.033±0.008	0.035±0.009	0.034±0.008	0.033±0.008
88/08/09	0.022±0.007	0.026±0.008	0.023±0.008	0.023±0.008	0.022±0.007	0.034±0.009	0.038±0.008	0.032±0.008	0.035±0.008
88/08/16	0.023±0.006	0.023±0.007	0.022±0.007	0.023±0.007	0.022±0.006	0.024±0.007	0.028±0.007	0.026±0.007	0.027±0.007
88/08/23	0.019±0.006	0.015±0.006	0.013±0.006	0.016±0.007	0.018±0.006	0.018±0.007	0.017±0.006	0.021±0.007	0.022±0.007
88/08/30	0.017±0.005	0.019±0.006	0.018±0.006	0.018±0.006	0.017±0.006	0.023±0.006	0.023±0.006	0.021±0.006	0.023±0.006
88/09/07	0.017±0.005	0.014±0.005	0.015±0.005	0.015±0.005	0.016±0.005	0.023±0.006	0.025±0.006	0.036±0.006	0.022±0.005
88/09/13	0.019±0.007	0.020±0.007	0.020±0.007	0.018±0.007	0.020±0.007	0.026±0.008	0.026±0.007	0.029±0.008	0.031±0.007
88/09/20	0.017±0.006	0.016±0.006	0.020±0.006	0.019±0.006	0.017±0.006	0.027±0.006	0.026±0.006	0.030±0.006	0.034±0.006
88/09/27	0.018±0.005	0.019±0.005	0.017±0.005	0.017±0.005	0.017±0.005	0.024±0.006	0.029±0.006	0.020±0.006	0.030±0.006
88/10/04	0.021±0.005	0.022±0.006	0.021±0.006	0.020±0.006	0.017±0.005	0.023±0.006	0.023±0.006	0.022±0.006	0.023±0.006
88/10/12	0.013±0.004	0.014±0.005	0.014±0.005	0.012±0.005	0.013±0.004	0.016±0.005	0.018±0.005	0.015±0.005	0.014±0.005
88/10/18	0.011±0.006	0.017±0.007	0.017±0.007	0.016±0.007	0.016±0.007	0.021±0.007	0.021±0.007	0.021±0.007	0.023±0.007
88/10/25	0.013±0.005	0.012±0.006	0.009±0.006	0.012±0.006	0.011±0.005	0.014±0.006	0.013±0.006	0.012±0.006	0.014±0.006
88/11/02	0.018±0.006	0.017±0.006	0.020±0.006	0.016±0.006	0.015±0.006	0.024±0.007	0.021±0.005	0.024±0.006	0.026±0.005
88/11/07	*	0.018±0.006	0.019±0.006	0.018±0.006	0.018±0.006	*	0.023±0.008	0.024±0.009	0.023±0.008
88/11/14	0.011±0.004	0.010±0.006	0.008±0.006	0.011±0.006	0.011±0.006	0.009±0.006	0.011±0.006	0.009±0.006	0.011±0.006
88/11/21	0.023±0.005	0.018±0.005	0.022±0.006	0.019±0.006	0.018±0.005	0.020±0.006	0.020±0.006	0.018±0.006	0.016±0.005
88/11/28	0.024±0.006	0.025±0.006	0.021±0.006	0.023±0.007	0.020±0.006	0.019±0.006	0.019±0.006	0.022±0.006	0.023±0.006
88/12/05	0.018±0.006	0.016±0.006	0.017±0.006	0.019±0.007	0.018±0.006	0.018±0.006	0.016±0.006	0.018±0.006	0.019±0.006
88/12/12	0.022±0.006	0.022±0.006	0.024±0.006	0.020±0.007	0.021±0.006	0.021±0.006	0.022±0.006	0.025±0.006	0.023±0.006
88/12/19	0.030±0.005	0.024±0.006	0.023±0.005	0.028±0.006	0.019±0.009	0.027±0.006	0.027±0.006	0.032±0.006	0.037±0.006
88/12/27	0.019±0.005	0.022±0.005	0.020±0.005	0.021±0.006	0.007±0.008	0.020±0.005	0.017±0.005	0.022±0.005	0.019±0.005
89/01/03	0.027±0.006	0.026±0.006	0.027±0.006	0.028±0.006	0.026±0.006	0.024±0.006	0.024±0.006	0.029±0.006	0.030±0.006

* PUMP NOT OPERATIONAL

TA[illegible]3-7
CONCENTRATIONS OF GAMMA EM[illegible]RS IN QUARTERLY COMPOSITES
OF INDIAN POINT AIR PARTICULATE SAMPLES
1988

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Nuclides	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		#4 - ALGONQUIN		
Be-7	146±10	162±17	132±18	103±21
K-40	13.1±4.1	26.7±8.8	11.1±7.0	<3.49
Mn-54	<0.46	<0.36	<0.28	<0.25
Co-58	<0.62	<0.41	<0.45	<0.50
Co-60	<0.43	<0.29	<0.42	<0.50
Zr-95	<1.45	<1.21	<1.06	<2.02
Ru-103	<0.83	<3.16	<0.82	<0.61
Cs-134	<0.40	<0.29	<0.34	<0.64
Cs-137	<0.33	<0.34	<0.38	<0.63
Ce-141	<1.12	<1.07	<0.88	<1.00
Ce-144	<2.01	<1.73	<1.93	<1.88
Ra-226	11.4±5.2	<7.60	<7.00	<9.15
Ac/Th-228	<2.07	<1.54	<2.49	<1.55
Others	<CL	<CL	<CL	<CL
		#5 - NYU		
Be-7	126±18	151±19	113±14	103±23
K-40	<5.29	29.0±10.6	19.8±7.1	<7.14
Mn-54	<0.16	<0.43	<0.32	<0.57
Co-58	<0.46	<0.54	<0.37	<0.81
Co-60	<0.42	<0.49	<0.13	<1.26
Zr-95	<1.30	<1.24	<0.85	<1.11
Ru-103	<0.76	<0.75	<0.65	<0.96
Cs-134	<0.32	<0.49	<0.30	<0.51
Cs-137	<0.30	<0.41	<0.27	<0.46
Ce-141	<1.03	<1.17	<0.79	<5.36
Ce-144	<1.56	<2.17	<1.56	<2.30
Ra-226	<5.68	<8.61	<5.80	<10.0
Ac/Th-228	<1.49	<1.65	<1.73	<2.75
Others	<CL	<CL	<CL	<CL

* Control Location

TABLE B-[illegible] (Continued)
CONCENTRATIONS OF GAMMA EM[illegible]RS IN QUARTERLY COMPOSITES
OF INDIAN POINT AIR PARTICULATE SAMPLES
1988

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Nuclides	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		#22 - LOVETT		
Be-7	150±19	130±21	117±16	96.4±19.4
K-40	<6.60	12.7±7.9	23.0±8.5	22.4±12.4
Mn-54	<0.24	<0.51	<0.41	<0.63
Co-58	<0.42	<0.65	<0.48	<0.66
Co-60	<0.67	<0.22	<0.42	<0.43
Zr-95	<1.15	<1.56	<1.21	<2.13
Ru-103	<0.80	<0.88	<0.61	<1.06
Cs-134	<0.28	<0.42	<0.29	<0.55
Cs-137	<0.31	<0.47	<0.34	<0.58
Ce-141	<0.73	<0.95	<0.94	<1.52
Ce-144	<1.71	<2.28	<1.92	<2.84
Ra-226	<7.15	<6.94	<6.55	<9.65
Ac/Th-228	<1.92	<2.03	<2.08	<2.25
Others	<CL	<CL	<CL	<CL
		#23 - ROSETON*		
Be-7	153±19	148±21	126±16	70.4±19
K-40	<5.95	<10.3	23.0±8.5	<13.5
Mn-54	<0.29	<0.34	<0.42	<0.48
Co-58	<0.46	<0.72	<0.42	<0.90
Co-60	<0.21	<0.36	<0.31	<0.36
Zr-95	<1.25	<1.15	<1.17	<1.46
Ru-103	<0.66	<0.96	<0.84	<1.04
Cs-134	<0.38	<0.35	<0.39	<0.53
Cs-137	<0.19	<0.46	<0.43	<0.54
Ce-141	<0.89	<1.19	<1.01	<1.44
Ce-144	<1.46	<2.20	<1.88	<2.92
Ra-226	<6.48	<9.75	<6.79	<9.12
Ac/Th-228	<1.34	<3.09	<1.59	<2.79
Others	<CL	<CL	<CL	<CL

* Control Location

TABLE B-7 (Continued)
CONCENTRATIONS OF GAMMA EMITTERS IN QUARTERLY COMPOSITES
OF INDIAN POINT AIR PARTICULATE SAMPLES
1988

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Nuclides	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		#27 - CROTON POINT		
Be-7	135±18	139±19	127±16	122±26
K-40	<3.65	<6.93	19.3±8.4	13.2±11.5
Mn-54	<0.29	<0.51	<0.40	<0.55
Co-58	<0.46	<0.66	<0.59	<0.88
Co-60	<0.30	<0.47	<0.31	<0.47
Zr-95	<1.18	<1.44	<1.28	<1.34
Ru-103	<0.72	<0.90	<0.70	<1.59
Cs-134	<0.36	<0.45	<0.35	<0.81
Cs-137	<0.33	<0.43	<0.39	<0.65
Ce-141	<0.97	<1.23	<0.97	<1.29
Ce-144	<1.54	<1.99	<1.93	<2.62
Ra-226	<6.44	<6.85	<7.03	<12.2
Ac/Th-228	<2.12	<1.77	2.36±1.94	<4.61
Others	<CL	<CL	<CL	<CL
		#29 - GRASSY POINT		
Be-7	143±19	131±19	102±14	90.0±20.2
K-40	<7.17	<6.90	31.4±9.0	<6.36
Mn-54	<0.54	<0.31	<0.25	<0.53
Co-58	<0.57	<0.58	<0.55	<0.65
Co-60	<0.49	<0.54	<0.28	<0.38
Zr-95	<0.71	<1.34	<1.22	<1.15
Ru-103	<0.68	<0.85	<0.70	<0.75
Cs-134	<0.41	<0.50	<0.28	<0.40
Cs-137	<0.18	<0.39	<0.34	<0.30
Ce-141	<1.01	<1.20	<0.95	<1.14
Ce-144	<1.57	<2.15	<1.62	<2.14
Ra-226	<5.43	<8.23	<6.04	<8.03
Ac/Th-228	<1.87	<2.24	<1.99	<3.06
Others	<CL	<CL	<CL	<CL

TABLE B-7 (Continued)
CONCENTRATIONS OF GAMMA EMITTERS IN QUARTERLY COMPOSITES
OF INDIAN POINT AIR PARTICULATE SAMPLES
1988

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Nuclides	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		#44 - PEEKSKILL GAS HOLDER		
Be-7	121±17	136±21	135±19	89.3±21.1
K-40	23.1±9.5	23.5±11.6	24.6±10.0	<6.50
Mn-54	<0.42	<0.51	<0.45	<0.60
Co-58	<0.53	<0.51	<0.50	<0.66
Co-60	<0.40	<0.54	<0.52	<0.77
Zr-95	<1.20	<1.64	<1.17	<1.42
Ru-103	<0.55	<4.80	<6.07	<1.20
Cs-134	<0.34	<0.54	<0.27	<0.68
Cs-137	<0.45	<0.42	<0.30	<0.48
Ce-141	<1.26	<1.52	<0.99	<1.41
Ce-144	<1.89	<2.38	<1.96	<2.09
Ra-226	<7.64	<8.98	<7.31	<10.4
Ac/Th-228	<1.39	<1.92	<2.10	<1.18
Others	<CL	<CL	<CL	<CL
		#57 - CORTLANDT		
Be-7	122±18	147±17	119±16	102±24
K-40	<6.99	33.3±9.9	21.6±8.7	15.8±11.8
Mn-54	<0.27	<0.38	<0.41	<0.44
Co-58	<0.32	<0.56	<0.56	<0.87
Co-60	<0.41	<0.15	<0.39	<0.80
Zr-95	<0.84	<1.17	<1.59	<2.09
Ru-103	<0.75	<0.80	<0.68	<1.02
Cs-134	<0.31	<0.32	<0.35	<0.56
Cs-137	<0.40	<0.25	<0.39	<0.54
Ce-141	<0.80	<1.12	<1.11	<1.55
Ce-144	<1.48	<1.78	<1.65	<2.94
Ra-226	<5.72	<7.97	10.7±6.7	<10.1
Ac/Th-228	<1.47	<1.05	<1.66	<2.72
Others	<CL	<CL	<CL	<CL

TABLE B (continued)
CONCENTRATIONS OF GAMMA EMITTERS IN QUARTERLY COMPOSITES
OF INDIAN POINT AIR PARTICULATE SAMPLES
1988

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

Nuclides	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		#91 - BURNWELL		
Be-7	128±18	144±20	115±14	78.4±21.8
K-40	<2.30	19.7±10.7	31.8±8.8	<14.1
Mn-54	<0.35	<0.50	<0.31	<0.56
Co-58	<0.22	<0.47	<0.38	<0.64
Co-60	<0.62	<0.50	<0.22	<0.83
Zr-95	<1.43	<1.34	<0.91	<2.17
Ru-103	<0.57	<0.69	<0.59	<1.15
Cs-134	<0.34	<0.46	<0.26	<0.54
Cs-137	<0.27	<0.47	<0.30	<0.44
Ce-141	<0.82	<1.30	<0.80	<1.81
Ce-144	<1.50	<1.90	<1.59	<3.23
Ra-226	<5.72	<8.18	7.97±4.99	<12.4
Ac/Th-228	<1.92	<2.13	<1.45	<2.84
Others	<CL	<CL	<CL	<CL

TABLE B-8

INDIAN POINT
ENVIRONMENTAL CHARCOAL CARTRIDGE SAMPLES - 1988
I-131 ACTIVITY pCi/m^3 ± 2 sigma

LOCATION

WEEK END DATE	4	5	27	44	91	22	23	29	57
88/01/05	<0.021	<0.020	<0.014	<0.021	<0.021	<0.018	<0.018	<0.024	<0.019
88/01/12	<0.024	<0.014	<0.021	<0.027	<0.022	<0.027	<0.020	<0.022	<0.020
88/01/20	<0.023	<0.023	<0.020	<0.024	<0.020	<0.017	<0.015	<0.024	<0.016
88/01/27	*	<0.020	<0.028	<0.028	<0.029	<0.016	<0.020	<0.021	<0.021
88/02/02	<0.021	<0.015	<0.023	<0.025	<0.019	<0.027	<0.023	<0.027	<0.022
88/02/09	<0.018	<0.023	<0.028	<0.026	<0.029	<0.021	<0.021	<0.020	<0.025
88/02/17	<0.016	<0.022	<0.026	<0.019	<0.017	<0.020	<0.018	<0.021	<0.013
88/02/23	<0.027	<0.017	<0.024	<0.027	<0.027	<0.024	<0.021	<0.029	<0.023
88/03/01	<0.026	<0.018	<0.015	<0.022	<0.016	<0.022	<0.017	<0.023	<0.022
88/03/08	<0.026	<0.029	<0.026	<0.029	<0.021	<0.019	<0.022	<0.020	<0.019
88/03/15	<0.017	<0.020	<0.019	<0.034	<0.017	<0.028	<0.024	<0.024	<0.014
88/03/21	<0.019	<0.019	<0.027	<0.018	<0.017	<0.028	<0.016	<0.028	<0.025
88/03/29	<0.014	<0.024	<0.018	<0.011	<0.018	<0.020	<0.019	<0.012	<0.016
88/04/05	<0.022	<0.011	<0.030	<0.019	<0.026	<0.021	<0.023	<0.032	<0.016
88/04/12	<0.018	<0.021	<0.029	<0.024	<0.033	<0.025	<0.022	<0.026	<0.014
88/04/19	<0.018	<0.028	<0.021	<0.027	<0.024	<0.009	<0.024	<0.028	<0.026
88/04/26	<0.021	<0.023	<0.023	<0.021	<0.024	<0.024	<0.014	<0.024	<0.019
88/05/03	<0.023	<0.030	<0.024	<0.027	<0.026	<0.027	<0.019	<0.020	<0.023
88/05/10	<0.017	<0.019	<0.027	<0.030	<0.022	<0.019	<0.025	<0.024	<0.024
88/05/17	<0.018	<0.029	<0.017	<0.026	<0.028	<0.017	<0.023	<0.025	<0.018
88/05/24	<0.030	<0.015	<0.022	<0.025	<0.022	<0.033	<0.027	<0.018	<0.024
88/06/01	<0.017	<0.025	<0.025	<0.017	<0.020	<0.024	<0.016	<0.017	<0.017
88/06/07	<0.029	<0.025	<0.030	<0.031	<0.027	<0.033	<0.021	<0.034	<0.024
88/06/14	<0.015	<0.025	<0.026	<0.013	<0.028	<0.021	<0.020	<0.022	<0.034
88/06/21	<0.020	<0.030	<0.027	<0.027	<0.027	<0.021	<0.019	<0.025	<0.020
88/06/28	<0.023	<0.027	<0.027	<0.018	<0.018	<0.018	<0.019	<0.021	<0.023
88/07/06	<0.014	<0.023	<0.016	<0.016	<0.026	<0.027	<0.016	<0.022	<0.017

* PUMP NOT OPERATIONAL

TABLE B-8 (Continued)

INDIAN POINT
ENVIRONMENTAL CHARCOAL CARTRIDGE SAMPLES -1988
I-131 ACTIVITY pCi/m^3 ± 2 sigma

LOCATION

WEEK END DATE	4	5	27	44	91	22	23	29	57
88/07/12	<0.024	<0.026	<0.026	<0.022	<0.026	<0.028	<0.020	<0.024	<0.027
88/07/19	<0.028	<0.022	<0.022	<0.019	<0.016	<0.027	<0.021	<0.023	<0.026
88/07/26	<0.019	<0.029	<0.022	<0.031	<0.019	<0.022	<0.021	<0.023	<0.020
88/08/02	<0.022	<0.020	<0.023	<0.030	<0.022	<0.020	<0.034	<0.020	<0.019
88/08/09	<0.031	<0.035	<0.021	<0.020	<0.021	<0.030	<0.021	<0.031	<0.030
88/08/16	<0.015	<0.021	<0.030	<0.031	<0.025	<0.033	<0.022	<0.020	<0.018
88/08/23	<0.028	<0.031	<0.025	<0.022	<0.024	<0.018	<0.022	<0.022	<0.031
88/08/30	<0.030	<0.027	<0.034	<0.029	<0.024	<0.020	<0.022	<0.023	<0.024
88/09/07	<0.014	<0.020	<0.025	<0.028	<0.022	<0.019	<0.026	<0.022	<0.014
88/09/13	<0.034	<0.020	<0.024	<0.020	<0.029	<0.041	<0.014	<0.025	<0.022
88/09/20	<0.021	<0.031	<0.029	<0.022	<0.026	<0.023	<0.019	<0.022	<0.021
88/09/27	<0.030	<0.025	<0.026	<0.020	<0.034	<0.017	<0.023	<0.021	<0.032
88/10/04	<0.018	<0.018	<0.025	<0.021	<0.021	<0.028	<0.018	<0.020	<0.023
88/10/12	<0.015	<0.020	<0.018	<0.019	<0.021	<0.014	<0.022	<0.014	<0.020
88/10/18	<0.030	<0.032	<0.021	<0.027	<0.029	<0.028	<0.022	<0.028	<0.026
88/10/25	<0.022	<0.018	<0.024	<0.026	<0.021	<0.026	<0.027	<0.024	<0.026
88/11/02	<0.029	<0.023	<0.026	<0.025	<0.020	<0.025	<0.020	<0.019	<0.022
88/11/07	*	<0.019	<0.027	<0.024	<0.021	*	<0.039	<0.029	<0.030
88/11/14	<0.017	<0.026	<0.027	<0.028	<0.024	<0.020	<0.023	<0.021	<0.019
88/11/21	<0.021	<0.030	<0.019	<0.018	<0.028	<0.026	<0.020	<0.023	<0.025
88/11/28	<0.027	<0.022	<0.021	<0.027	<0.015	<0.022	<0.021	<0.022	<0.026
88/12/05	<0.021	<0.029	<0.018	<0.025	<0.029	<0.021	<0.022	<0.028	<0.017
88/12/12	<0.014	<0.026	<0.026	<0.020	<0.029	<0.025	<0.018	<0.025	<0.021
88/12/19	<0.021	<0.024	<0.021	<0.013	<0.043	<0.022	<0.018	<0.021	<0.026
88/12/27	<0.020	<0.022	<0.015	<0.022	<0.033	<0.022	<0.019	<0.028	<0.019
89/01/03	<0.026	<0.021	<0.018	<0.026	<0.025	<0.021	<0.016	<0.024	<0.016

* PUMP NOT OPERATIONAL

TABLE B-9
CONCENTRATIONS OF GAMMA EMITTERS IN HUDSON RIVER WATER SAMPLES - 1988
Results in Units of pCi/l ± 2 Sigma

Nuclide	January	February	March	April	May	June
#8 - HUDSON RIVER INLET*						
Be-7	<24.7	<16.0	<6.8	<13.9	<12.9	<14.0
K-40	286±34	252±39	379±10	250±33	243±30	221±32
Mn-54	<1.17	<1.47	<0.63	<1.21	<1.04	<1.14
Co-58	<1.27	<1.62	<0.79	<1.46	<1.28	<1.45
Fe-59	<3.10	<3.90	<1.67	<2.95	<2.75	<3.00
Co-60	<0.99	<1.51	<0.66	<1.31	<1.18	<1.07
Zn-65	<2.59	<2.82	<1.33	<2.42	<2.13	<2.35
Zr-95	<3.11	<3.64	<1.72	<3.43	<3.17	<3.34
I-131	<5.64	<7.27	<3.93	<5.95	<5.53	<7.41
Cs-134	<1.08	<1.36	<0.59	<1.21	<1.14	<1.14
Cs-137	<1.15	<1.32	<0.62	<1.28	<1.10	<1.16
Ba/La-140	<2.89	<4.55	<2.54	<3.18	<3.41	<3.68
Ra-226	103±39	93.3±41.4	57.1±13.1	93.2±32.7	66.9±32.0	76.7±29.
AcTh-228	10.5±4.5	<5.17	<2.34	8.71±4.86	8.15±5.03	8.94±5.16
Others	<CL	<CL	<CL	<CL	<CL	<CL
#10 - HUDSON RIVER DISCHARGE						
Be-7	<15.9	<16.1	<12.4	<17.1	<16.2	<10.2
K-40	238±43	75.3±26.7	80.4±23.2	210±36	210±37	252±21
Mn-54	<1.47	<1.42	<1.33	<1.63	<1.59	<0.83
Co-58	<1.67	<1.75	<1.29	<1.87	<1.86	<1.02
Fe-59	<3.04	<4.43	<2.89	<3.81	<4.05	<2.11
Co-60	<1.54	<1.74	<1.28	<1.42	<1.46	<0.79
Zn-65	<2.95	<3.18	<2.18	<3.08	<2.91	<1.91
Zr-95	<3.89	<3.72	<3.01	<4.16	<3.81	<2.47
I-131	<7.27	<7.23	<6.25	<7.17	<7.40	<5.83
Cs-134	<1.51	<1.62	<1.17	<1.38	<1.50	<0.81
Cs-137	<1.59	<1.45	<1.13	<1.57	<1.68	<0.88
Ba/La-140	<3.66	<5.11	<3.78	<4.04	<4.01	<2.72
Ra-226	80.0±45.7	<38.9	66.9±24.4	141±46	121±34	76.4±22.4
AcTh-228	<4.92	<5.91	<4.45	<6.52	<5.89	8.39±4.27
Others	<CL	<CL	<CL	<CL	<CL	<CL

* Control Location

TABLE B-9 (Continued)
CONCENTRATIONS OF GAMMA EMITTERS IN HUDSON RIVER WATER SAMPLES - 1988
Results in Units of pCi/l ± 2 Sigma

Nuclide	July	August	September	October	November	December
#8 - HUDSON RIVER INLET*						
Be-7	<9.59	<14.0	<12.5	<10.5	<14.3	<9.29
K-40	245±24	154±27	213±26	286±24	218±33	200±20
Mn-54	<0.79	<1.22	<1.18	<0.95	<1.34	<0.85
Co-58	<0.99	<1.52	<1.33	<1.08	<1.36	<0.98
Fe-59	<1.92	<3.47	<2.83	<2.25	<3.05	<1.89
Co-60	<0.85	<1.28	<0.98	<0.88	<1.48	<0.81
Zn-65	<1.63	<2.64	<2.53	<1.97	<2.61	<1.71
Zr-95	<2.31	<3.57	<3.18	<2.47	<3.33	<2.34
I-131	<4.54	<7.04	<6.33	<4.66	<5.79	<4.38
Cs-134	<0.79	<1.16	<1.09	<0.91	<1.25	<0.87
Cs-137	<0.86	<1.26	<1.18	<0.93	<1.34	<0.83
Ba/La-140	<2.36	<4.09	<3.60	<2.61	<3.15	<2.20
Ra-226	94.6±24.5	83.1±24.4	102±30	73.5±27.9	95.1±33.5	92.1±27.6
AcTh-228	<3.00	<4.66	<4.35	<3.65	<5.53	10.1±4.5
Others	<CL	<CL	<CL	<CL	<CL	<CL
#10 - HUDSON RIVER DISCHARGE						
Be-7	<13.0	<8.62	<8.83	<13.2	<16.1	<13.6
K-40	236±30	237±21	235±22	279±30	231±33	218±26
Mn-54	<1.21	<0.78	<0.84	<1.16	<1.41	<1.16
Co-58	<1.38	<0.88	<0.97	<1.40	<1.84	<1.47
Fe-59	<3.02	<1.98	<2.14	<2.96	<3.88	<2.99
Co-60	<1.13	<0.79	<0.77	<1.24	<1.23	<1.12
Zn-65	<2.45	<1.57	<1.58	<2.52	<3.44	<2.15
Zr-95	<3.23	<2.07	<2.26	<3.34	<4.07	<2.91
I-131	<6.13	<5.04	<4.51	<5.80	<6.36	<6.40
Cs-134	<1.22	<0.73	<0.79	<1.19	<1.79	<1.12
Cs-137	<1.16	<0.81	<0.82	<1.21	<1.59	<1.18
Ba/La-140	<3.54	<2.61	<2.40	<3.24	<4.34	<3.14
Ra-226	85.1±29.9	73.4±25.5	60.8±20.0	57.5±25.2	131±44	83.6±29.6
AcTh-228	<4.54	5.02±2.47	5.12±3.07	<4.61	<5.64	<4.62
Others	<CL	<CL	<CL	<CL	<CL	<CL

* Control Location

TABLE B-10

CONCENTRATIONS OF TRITIUM IN HUDSON RIVER WATER SAMPLES
(QUARTERLY COMPOSITE SAMPLES)
1988

Results in Units of pCi/l ± 2 sigma

PERIOD	DATE	TRITIUM
#8 - HUDSON RIVER INLET*		
First Quarter	12/31/87 to 03/31/88	<200
Second Quarter	04/01/88 to 07/01/88	220±110
Third Quarter	07/01/88 to 09/30/88	210±90
Fourth Quarter	09/30/88 to 12/30/88	240±90
#10 - HUDSON RIVER DISCHARGE		
First Quarter	12/31/87 to 03/31/88	540±130
Second Quarter	04/01/88 to 07/01/88	1100±100
Third Quarter	07/01/88 to 09/30/88	910±140
Fourth Quarter	09/30/88 to 12/30/88	730±170

* Control Location

TABLE B-11
GROSS BETA ACTIVITY AND
CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES - 1988
Results in Units of pCi/l ± 2 Sigma

Nuclide	January	February	March	April	May	June
			#7 - CAMP FIELD RESERVOIR			
Be-7	<22.5	<13.6	<14.5	<13.3	<19.9	<22.2
K-40	<29.2	66.4±29.0	227±40	60.5±29.0	<35.7	131±43
Mn-54	<2.56	<1.09	<1.65	<1.69	<2.28	<2.53
Co-58	<1.85	<1.51	<1.43	<1.35	<2.66	<2.70
Fe-59	<4.49	<2.97	<2.95	<3.19	<3.89	<4.57
Co-60	<2.16	<1.30	<1.45	<1.53	<2.69	<1.76
Zn-65	<5.17	<2.40	<2.61	<2.77	<5.31	<4.89
Zr-95	<6.09	<3.24	<3.59	<3.73	<5.57	<5.11
I-131	<0.32	<0.35	<0.30	<0.38	<0.35	<0.43
Cs-134	<1.89	<1.38	<1.48	<1.56	<2.12	<2.28
Cs-137	<2.30	<1.62	<1.80	<1.56	<2.70	<2.74
Ba/La-140	<2.09	<2.51	<1.81	<1.71	<2.95	<3.64
Ra-226	<62.0	99.2±46.6	122±46	<40.5	57.6±42.7	142±66
AcTh-228	<9.05	<5.91	<6.57	<5.51	<10.3	<9.87
Others	<CL	<CL	<CL	<CL	<CL	<CL
Gross Beta	<CL	2.47±0.83	1.59±0.81	3.26±0.89	2.26±0.93	2.51±0.93

	July	August	September	October	November	December
Be-7	<17.0	<19.4	<11.7	<18.5	<12.9	<17.6
K-40	125±37	202±46	58.3±24.9	219±46	70.2±27.5	172±49
Mn-54	<1.85	<1.85	<1.50	<1.96	<1.46	<2.10
Co-58	<1.59	<2.10	<1.50	<2.05	<1.39	<2.05
Fe-59	<3.85	<4.44	<2.75	<4.12	<3.58	<4.20
Co-60	<1.84	<1.81	<1.31	<2.48	<1.45	<2.34
Zn-65	<4.06	<4.08	<2.70	<4.02	<2.64	<5.16
Zr-95	<4.23	<4.72	<2.86	<5.23	<3.37	<5.21
I-131	<0.39	<0.29	<0.35	<0.28	<0.32	<0.28
Cs-134	<1.88	<2.13	<1.39	<2.15	<1.38	<2.21
Cs-137	<1.70	<2.34	<1.62	<2.05	<1.45	<2.12
Ba/La-140	<2.77	<3.40	<2.01	<2.96	<1.95	<2.61
Ra-226	82.4±43.9	145±78	<40.7	135±55	<41.0	72.6±44.1
AcTh-228	<6.87	<8.29	8.19±5.66	<7.85	<5.30	<8.74
Others	<CL	<CL	<CL	<CL	<CL	<CL
Gross Beta	1.69±0.89	2.70±0.95	1.26±0.86	2.78±0.85	2.41±0.86	3.64±0.93

TABLE B-12

CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES
(QUARTERLY COMPOSITE SAMPLES)
1988

Results in Units of pCi/l ± 2 sigma

PERIOD	DATE	TRITIUM
	#7 - CAMP FIELD RESERVOIR	
First Quarter	01/11/88 to 03/15/88	<200
Second Quarter	04/11/88 to 06/06/88	370±90
Third Quarter	06/06/88 to 09/06/88	380±90
Fourth Quarter	10/11/88 to 12/12/88	<200

TABLE B-13
CONCENTRATIONS OF GAMMA EMITTERS IN SHORELINE SOIL SAMPLES - 1988
Results in Units of pCi/kg (dry) ± 2 Sigma

COLLECTION DATE	K-40	Co-60	Cs-134	Cs-137	Ra-226	OTHERS
#17 - VERPLANCK						
05/31/88	11,200±790	<13.3	<12.0	201±29	730±360	Ac/Th-228 170±73
08/29/88	9,070±350	<13.9	<11.9	188±13	720±160	Ac/Th-228 171±35
#28 - LENT'S COVE						
05/31/88	2,850±770	<47.2	<37.3	<43	2,640±880	Be-7 997±349
08/30/88	10,400±710	<14.3	<11.3	81±24	1,110±310	Be-7 378±213 Ac/Th-228 368±86
#50 - MANNITOU INLET*						
06/01/88	9,360±490	<13.2	49.2±18.2	116±29	2,260±360	Ac/Th-228 542±79
08/30/88	8,340±710	<11.7	<15.2	<17	501±220	<CL
#53 - WHITE BEACH						
05/31/88	7,820±610	<13.3	<10.1	43±20	466±250	<CL
08/29/88	8,000±370	<11.9	29.7±12.3	108±16	2,060±270	Ac/Th-228 352±51
#84 - COLD SPRING*						
06/01/88	16,800±1,080	<20.1	<17.9	31±23	<440	Ac/Th-228 682±130
08/30/88	17,400±1,050	<17.0	<18.4	61±28	720±390	Ac/Th-228 559±120

* Control Location

TABLE B-14

CONCENTRATIONS OF GAMMA EMITTERS IN BROADLEAF VEGETATION - 1988
Results in Units of pCi/kg (wet) ± 2 Sigma

#5 - NYU

DATE	TYPE	Be-7	K-40	Co-58	Fe-59	Co-60	Cs-134	Cs-137	Ra-226	OTHERS
										Ac/Th-228
5/23/88	Rock Cress	1,480±107	4,410±254	<5.2	<12.8	<5.7	<5.6	<6.3	532±182	62±28
	Wild Rhubarb	412±70	4,250±228	<4.4	<9.9	<4.6	<4.1	<4.6	213±75	<CL
	Grape Leaves	497±112	3,340±362	<9.0	<19.6	<10.7	<8.1	<9.4	271±177	<CL
										Ac/Th-228
6/20/88	Rock Cress	1,050±115	7,870±373	<8.5	<19.0	<8.2	<8.1	<8.3	572±155	63±41
	Wild Rhubarb	444±147	5,870±494	<10.1	<25.2	<10.1	<12.4	<11.3	452±205	<CL
	Grape Leaves	604±99	4,770±325	<7.3	<17.3	<8.3	<7.7	<8.4	394±144	<CL
7/18/88	Rock Cress	848±142	4,630±390	<9.5	<19.1	<8.8	<7.9	<10.3	382±173	<CL
	Wild Rhubarb	1,370±144	7,380±457	<9.0	<19.7	<9.0	<8.5	<8.6	311±170	<CL
	Grape Leaves	450±104	3,630±330	<8.8	<16.9	<9.0	<8.5	<9.3	654±188	<CL
8/08/88	Wild Rhubarb	1,180±138	8,450±493	<10.2	<22.9	<10.2	<9.3	<10.1	443±161	<CL
	Grape Leaves	656±92	3,450±263	<6.3	<12.5	<5.0	<6.0	<5.9	372±120	<CL
	Milkweed	1,160±165	4,980±410	<10.3	<22.2	<10.8	<8.4	<10.1	364±146	<CL
9/12/88	Wild Rhubarb	1,270±167	9,090±600	<11.6	<26.2	<13.7	<13.1	<12.5	698±353	<CL
	Grape Leaves	740±126	3,050±287	<7.0	<16.6	<9.9	<7.3	<7.5	396±177	<CL
	Milkweed	1,300±66	3,250±138	<7.0	<15.0	<6.4	<6.5	<7.1	258±66	<CL

TABLE B-14 (Continued)

CONCENTRATIONS OF GAMMA EMITTERS IN BROADLEAF VEGETATION - 1988
Results in Units of pCi/kg (wet) ± 2 Sigma

#6 - CAMP SMITH

DATE	TYPE	Be-7	K-40	Co-58	Fe-59	Co-60	Cs-134	Cs-137	Ra-226	OTHERS
										Ac/Th-228
5/23/88	Rock Cress	666±89	4,100±282	<5.7	<13.4	<6.4	<4.9	<5.8	244±101	89±49
	Wild Rhubarb	561±62	4,270±217	<3.6	<8.5	<4.0	<3.5	<3.9	200±71	<CL
	Skunk Cabbage	383±192	5,340±460	<10.1	<24.8	<10.1	<10.4	<11.4	383±192	<CL
6/20/88	Rock Cress	1,220±187	6,890±571	<14.0	<25.3	<13.4	<14.1	<14.3	864±377	<CL
	Wild Rhubarb	428±123	8,120±581	<12.6	<28.0	<14.8	<11.8	<13.1	596±230	<CL
										Ac/Th-228
	Skunk Cabbage	382±150	6,040±525	<14.7	<28.8	<14.5	<13.9	<13.8	626±284	79±44
										Ac/Th-228
7/18/88	Rock Cress	957±100	5,030±298	<6.0	<12.9	<5.9	<5.9	<6.4	406±143	71±33
	Wild Rhubarb	1,270±134	5,650±401	<8.8	<21.2	<11.4	<8.5	<9.4	334±165	<CL
										Ac/Th-228
	Grape Leaves	513±111	3,640±343	<9.6	<19.8	<7.9	<9.6	<9.7	432±185	55±33
8/08/88	Rock Cress	1,680±157	5,240±364	<7.9	<16.2	<8.4	<8.3	<8.7	627±259	<CL
	Wild Rhubarb	266±110	7,430±569	<13.2	<30.6	<15.8	<10.3	<12.9	532±220	<CL
										Ac/Th-228
	Grape Leaves	529±140	4,870±415	<11.4	<22.6	<10.7	<10.7	<11.0	817±285	74±43
9/12/88	Rock Cress	902±176	6,340±579	<15.4	<25.1	<16.2	<14.2	<15.3	657±307	<CL
	Wild Rhubarb	555±169	7,030±673	<13.5	<32.1	<16.2	<12.8	<15.4	452±264	<CL
	Grape Leaves	502±179	4,290±548	<14.2	<27.9	<15.5	<13.7	<13.7	532±324	<CL

TABLE B-14 (Continued)

CONCENTRATIONS OF GAMMA EMITTERS IN BROADLEAF VEGETATION - 1988
Results in Units of pCi/kg (wet) ± 2 Sigma

#23 - ROSETON*

DATE	TYPE	Be-7	K-40	Co-58	Fe-59	Co-60	Cs-134	Cs-137	Ra-226	OTHERS
5/24/88	Rock Cress	603±51	4,470±164	<6.2	<14.5	<6.4	<6.2	<7.1	335±66	<CL
	Wild Rhubarb	688±51	5,660±183	<7.5	<16.8	<6.9	<6.4	<7.3	329±74	<CL
	Skunk Cabbage	200±75	4,960±392	<9.4	<19.4	<9.1	<9.0	<9.2	653±200	<CL
										Ac/Th-228
6/21/88	Rock Cress	1,130±100	6,920±236	<23.3	<52.7	<30.5	<23.6	28.1±7.6	716±137	50±20
	Wild Rhubarb	535±114	9,720±476	<9.7	<22.9	<9.7	<9.1	<9.3	515±193	<CL
	Skunk Cabbage	282±154	6,390±629	<16.3	<39.7	<18.7	<16.4	<19.0	812±34	<CL
7/19/88	Rock Cress	1,450±75	4,440±188	<5.9	<12.2	<7.0	<5.4	14.4±5.5	401±93	<CL
	Wild Rhubarb	234±62	3,780±248	<5.3	<11.3	<6.6	<5.3	<5.9	312±107	<CL
										Ac/Th-228
	Grape Leaves	423±112	3,340±363	<10.7	<21.7	<8.8	<10.0	<10.4	444±198	51±30
8/09/88	Rock Cress	1,950±228	5,880±546	<15.6	<27.9	<14.0	<12.6	<12.8	735±264	<CL
	Wild Rhubarb	313±86	3,750±296	<5.8	<14.5	<7.2	<5.1	<7.0	243±102	<CL
	Grape Leaves	278±73	4,140±284	<6.8	<13.7	<6.2	<6.5	<6.6	415±151	<CL
9/13/88	Milkweed	1,570±211	6,640±548	<10.3	<27.1	<11.0	<11.7	<10.5	380±213	<CL
	Wild Rhubarb	138±68	4,570±349	<8.0	<18.0	<8.1	<7.5	<8.8	497±159	<CL
	Grape Leaves	453±106	3,680±363	<10.0	<18.3	<10.6	<9.2	<10.3	535±192	<CL

* Control Location

TABLE B-15
CONCENTRATIONS OF GAMMA EMITTERS IN FISH AND INVERTEBRATE SAMPLES - 1988
Results in Units of pCi/kg (wet) ± 2 Sigma

#23 - Roseton*

DATE	TYPE	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
06/07/88	White Perch	2,960±308	<7.5	<8.1	<17.3	<8.5	<19.8	<8.4	<10.4	426±172
06/07/88	Catfish	2,490±317	<9.6	<10.7	<21.1	<9.3	<24.7	<9.9	<10.4	391±167
08/30/88	Alewives	4,010±422	<10.0	<10.5	<22.9	<11.1	<26.4	<9.8	<10.6	447±174
08/30/88	White Perch	3,160±397	<10.5	<10.1	<18.2	<11.7	<23.1	<11.9	<11.2	467±219
08/30/88	Crabs	3,360±192	<9.3	<9.3	<20.0	<10.2	<20.6	<8.8	<9.1	327±110

* Control Location

TABLE B-15 (Continued)
CONCENTRATIONS OF GAMMA EMITTERS IN FISH AND INVERTEBRATE SAMPLES -1988
Results in Units of pCi/kg (wet) ± 2 Sigma

#25 - Indian Point Hudson River

DATE	TYPE	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	OTHERS
06/07/88	White Perch	3,290±376	<10.7	<9.7	<21.4	<9.4	<22.1	<11.4	<11.8	<CL
06/07/88	Blue Back Herring	4,490±616	<16.7	<19.8	<51.3	<20.8	<42.7	<15.4	<17.9	<CL
09/12/88	Eels	3,650±390	<10.0	<11.1	<23.7	<10.8	<18.6	<10.7	<10.7	Ra-226 577±220
09/12/88	White Perch	1,970±320	<9.8	<9.5	<18.7	<8.4	<23.4	<10.7	<11.7	<CL
09/12/88	Crabs	2,260±310	<7.4	<8.5	<17.9	<11.0	<20.5	<8.4	<9.8	Ra-226 296±140

TA[illegible]16

ANNUAL SUMMARY, Non-RETS SAMPLE RESULTS - 1988

Sample Medium (units)	Nuclide Detected	LLD	Indicator Locations: Avg. of Positive Samples	Indicator Locations: Highest Positive Sample	Indicator Locations: Lowest Positive Sample	Indicator Locations: No. of Positive Samples	Indicator Locations: Total No. of Samples	Control Locations: Avg. of Positive Samples	Control Locations: Highest Positive Sample	Control Locations: Lowest Positive Sample	Control Locations: No. of Positive Samples	Control Locations: Total No. of Samples	Historical Average Value*: Indicator	Historical Average Value*: Control
Aquatic Vegetation (pCi/kg-wet)	Co-58	None	17.9	26.5	9.4	2	3	ND	ND	ND	0	4	103	12
	Co-60	None	22.0	29.6	14.3	2	3	ND	ND	ND	0	4	100	13
	Cs-137	100	18.2	28.6	11.7	3	3	18.9	29.4	10.7	3	4	83	32
Bottom Sediment (pCi/kg-dry)	Co-60	None	133	258	58	6	6	ND	ND	ND	0	2	320	227
	Cs-134	150	55.7	73.7	30.5	3	6	28.0	28.0	28.0	1	2	229	A
	Cs-137	180	780	1880	340	6	6	592	845	340	2	2	742	1203
Soil (pCi/kg-dry)	Cs-137	180	723	1410	35	2	2	88	88	88	1	1	388	B
Precipitation (pCi/L)	H-3	2000	ND	ND	ND	0	4	275	400	150	2	4	275	182

A - Not detected at control location, 1975-1984.
B - No differential between indicator and control locations for historical data.
ND- Not Detected.
* - $\frac{\text{(Avg 1975-1984) x 10 + Avg 1987}}{11}$

TABLE B-17

MILCH ANIMAL CENSUS, 1988

DIRECTION FROM INDIAN POINT	DISTANCE (MILE)	NO. OF ANIMALS	SPECIES
ESE	2.1	2	Goats (Non Milkers)
SE	3.0	1	Goat (Non Milker)
W	1.3	9	Goats (2 Milkers)* (7 Non Milkers)
NNW	4.5	3	Goats (Non Milkers)
NNW	5.0	13	Goats (4 Milkers)* (9 Non Milkers)

NOTE: * Milk produced by these goats is not used for human consumption.

TABLE B-18

LAND USE CENSUS, 1988

SECTOR	MILE	LOCATION OF NEAREST RESIDENCE
1 - NNE	3.0	Old Stone Restaurant - Caretaker
2 - NE	3.0	Camp Smith - 2 Residences
3 - ENE	1.2	South Street, Peekskill
4 - E	1.5	South Street, Peekskill
5 - ESE	0.4	Bleakley Ave., Buchanan
6 - SE	0.4	Broadway, Buchanan
7 - SSE	0.6	Westchester Ave., Buchanan
8 - S	0.7	Westchester Ave., Buchanan
9 - SSW	0.75	Broadway, Verplanck
10 - SW	0.8	St. Pats Church Rectory, Verplanck
[illegible] - WSW	1.75	Rt. 9W, Tomkins Cove
12 - W	1.4	Rt. 9W, Tomkins Cove
13 - WNW	1.3	Gays Hill Rd., Tomkins Cove
14 - NW	1.2	Gays Hill Rd., Tomkins Cove
15 - NNW	4.2	Bear Mountain Lodge
16 - N	1.1	Jones Point

APPENDIX C

HISTORICAL TRENDS

APPENDIX C

HISTORICAL TRENDS

Historical data for various radionuclides and media are presented both in tabular form and in graphical form to facilitate the comparison of 1988 data with historical values. Comparison to other data from outside sources is presented as available. Although other samples were taken and analyzed, values were only tabulated and plotted where positive indications were present.

TEN YEAR HISTORICAL DATA

TABLE C-1

DIRECT RADIATION ANNUAL SUMMARY
1979 to 1988

Average Quarterly Dose (mR/Quarter)			
Year	Inner Ring	Outer Ring	Control Location
1979*	15	12	17
1980*	14	12	16
1981*	16	15	16
1982*	15	13	16
1983*	15	13	16
1984	15	14	16
1985	15	15	16
1986	14	14	18
1987	14	14	15
1988	14	13	14

* Prior to 1984 only 21 of the existing 40 TLD locations were in use.

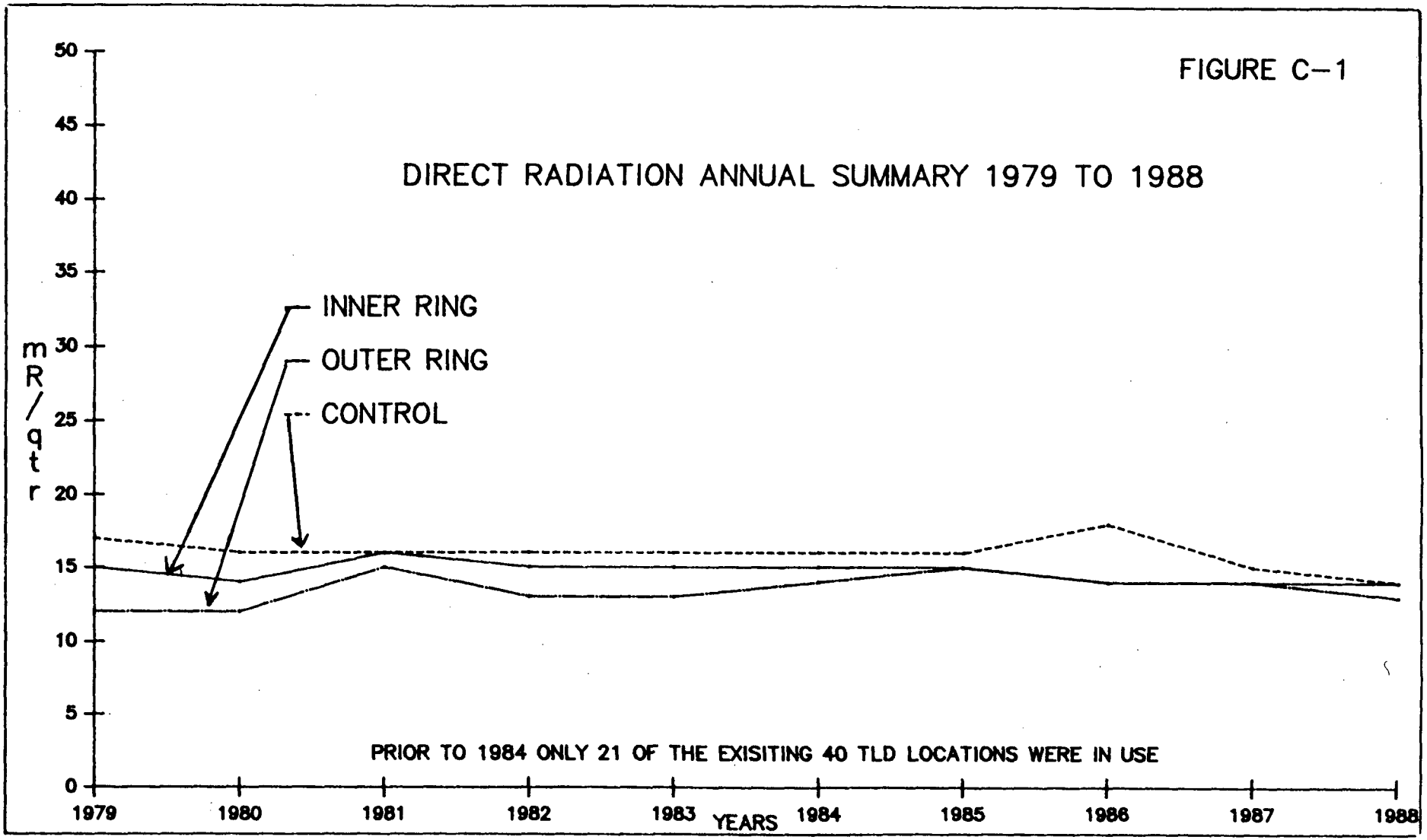
FIGURE C-1
DIRECT RADIATION ANNUAL SUMMARY 1979 TO 1988
INNER RING
OUTER RING
CONTROL
mR/qtr
50
45
40
35
30
25
20
15
10
5
0
PRIOR TO 1984 ONLY 21 OF THE EXISITING 40 TLD LOCATIONS WERE IN USE
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-2

RADIONUCLIDES IN AIR
1979 TO 1988

pCi/m^3

Year	Gross Beta		Cs-137	
	All RETS Indicator Locations	Control Location	All RETS Indicator Locations	Control Location
1979	0.03	0.03	0.04	0.03
1980	0.03	0.04	0.01	0.01
1981	0.19	0.19	0.02	0.02
1982	0.03	0.04	0.07	a
1983	0.02	0.02	0.01	a
1984	0.02	0.02	a	a
1985	0.02	0.02	a	a
1986	0.03	0.03	0.06	0.07
1987	0.02	0.03	a	a
1988	0.02	0.02	a	a
Historical Average	0.04	0.04	0.03	0.03
Historical Std. Dev.	0.05	0.05	0.02	0.03

(a) Not detected above LLD.

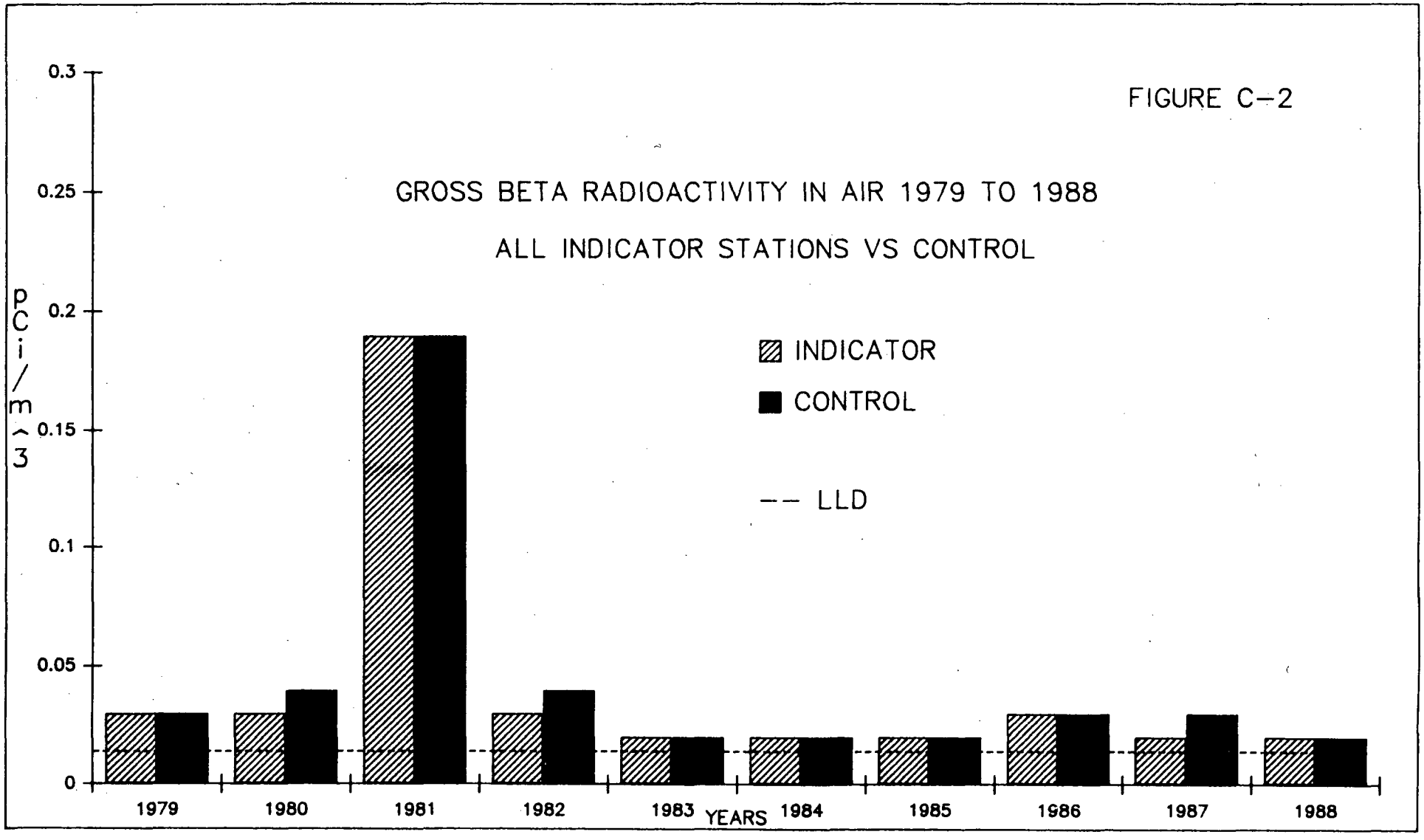
FIGURE C-2
GROSS BETA RADIOACTIVITY IN AIR 1979 TO 1988
ALL INDICATOR STATIONS VS CONTROL
INDICATOR
CONTROL
-- LLD
pCi/m^3
0.3
0.25
0.2
0.15
0.1
0.05
0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

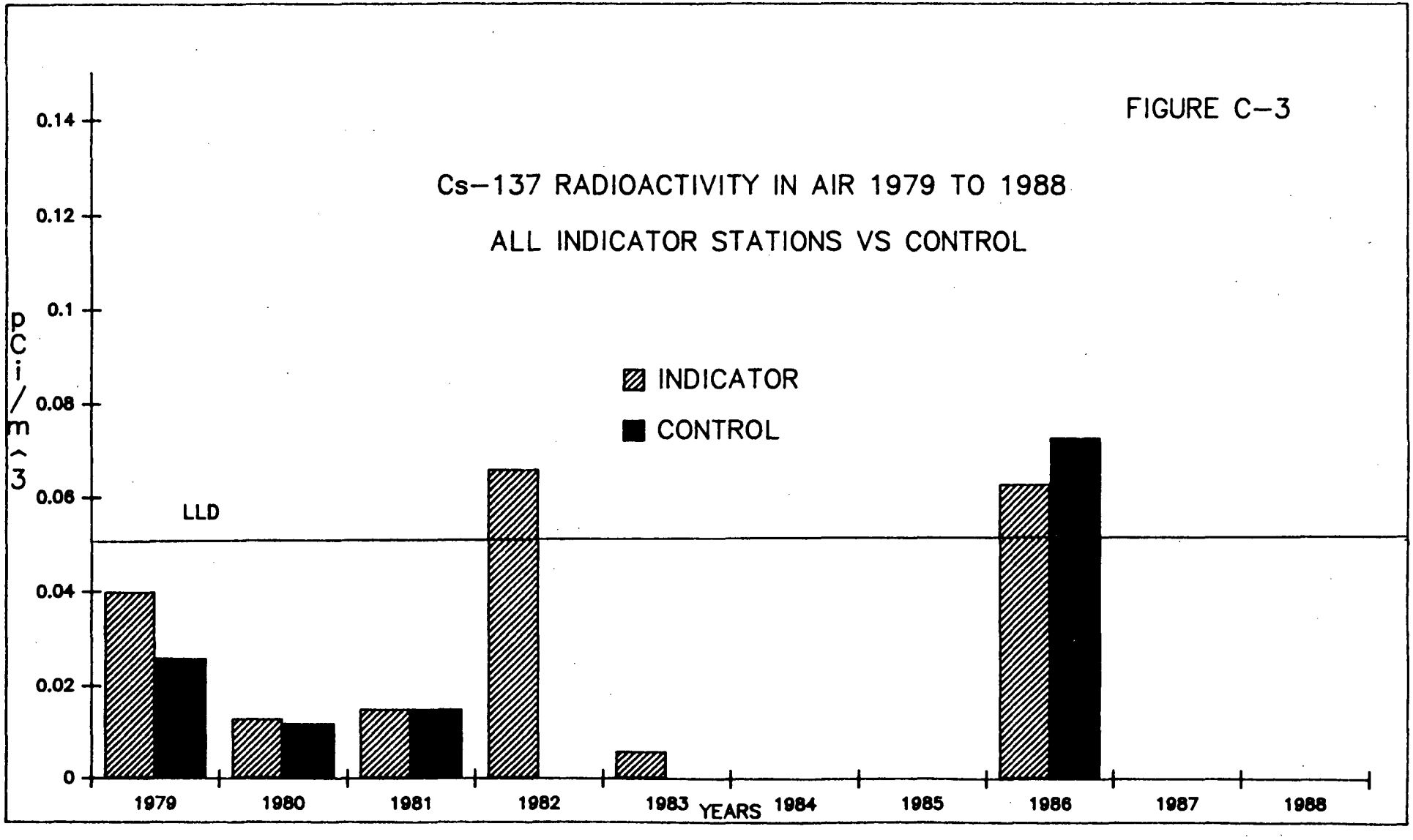
FIGURE C-3
Cs-137 RADIOACTIVITY IN AIR 1979 TO 1988
ALL INDICATOR STATIONS VS CONTROL
INDICATOR
CONTROL
LLD
pCi/m^3
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-3

RADIONUCLIDES IN HUDSON RIVER WATER
INLET AND DISCHARGE
1979 TO 1988
pCi/l

Year	Tritium		Cs-137	
	Inlet	Discharge	Inlet	Discharge
1979	380	330	4.6	6.8
1980	230	610	a	15.0
1981	300	480	6.0	6.8
1982	120	500	a	6.1
1983	260	820	4.2	4.4
1984	a	540	a	a
1985	a	900	a	a
1986	a	a	a	8.0
1987	280	695	a	a
1988	220	820	a	a
Historical Average	260	630	4.9	7.9
Historical Std. Dev.	80	190	0.9	3.7

(a) Not detected above LLD.

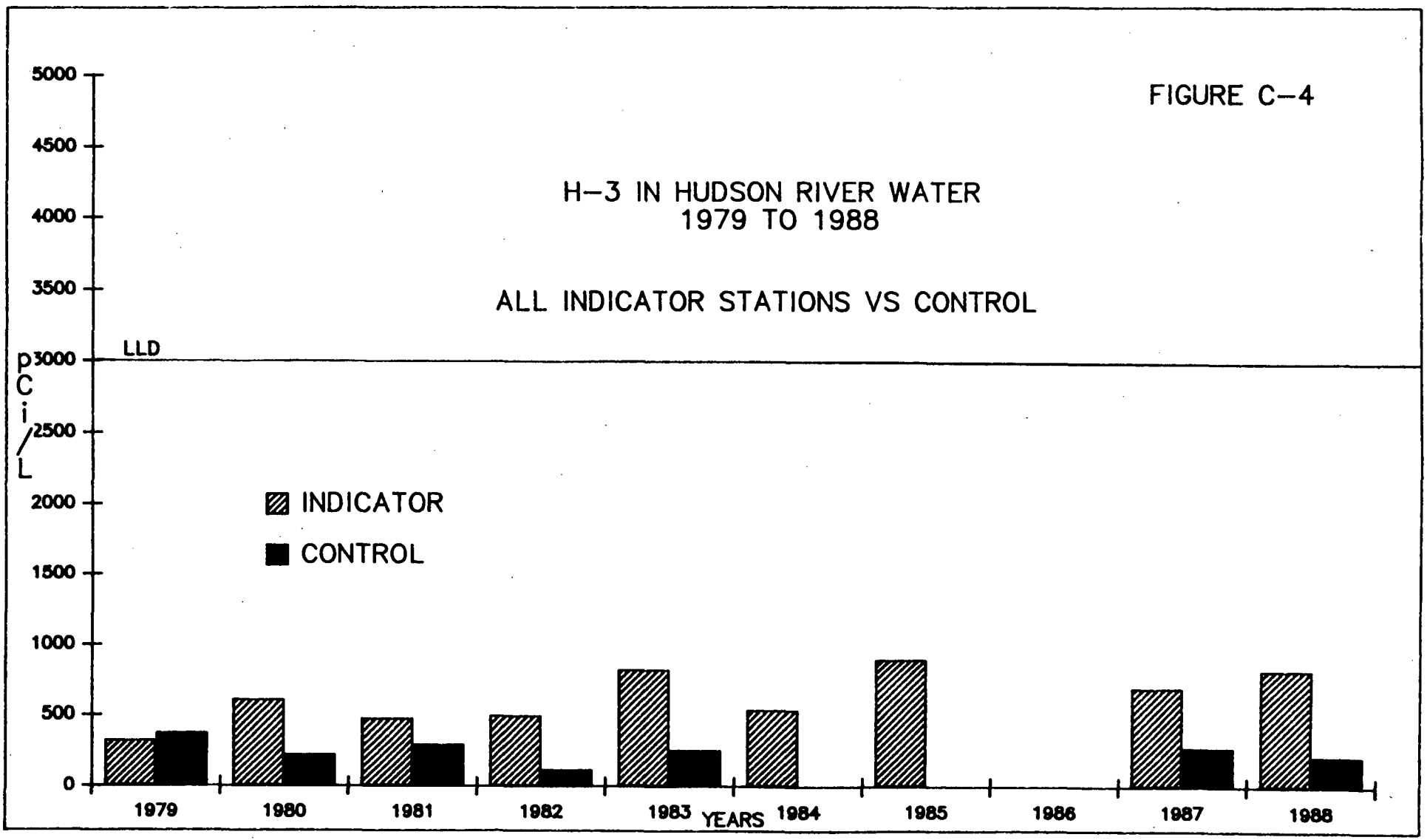
FIGURE C-4
H-3 IN HUDSON RIVER WATER
1979 TO 1988
ALL INDICATOR STATIONS VS CONTROL
pCi/L
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
LLD
INDICATOR
CONTROL
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-4

RADIONUCLIDES IN DRINKING WATER
CAMP FIELD RESERVOIR (a)
1979 TO 1988
pCi/l

Year	Tritium	Cs-137
1979	170	4
1980	267	b
1981	240	b
1982	190	b
1983	122	6
1984	178	b
1985	b	b
1986	b	b
1987	280	b
1988	375	b
Historical Average	228	5
Historical Std. Dev.	80	1

(a) Data for 1985 includes Roseton.
(b) Not detected above LLD.

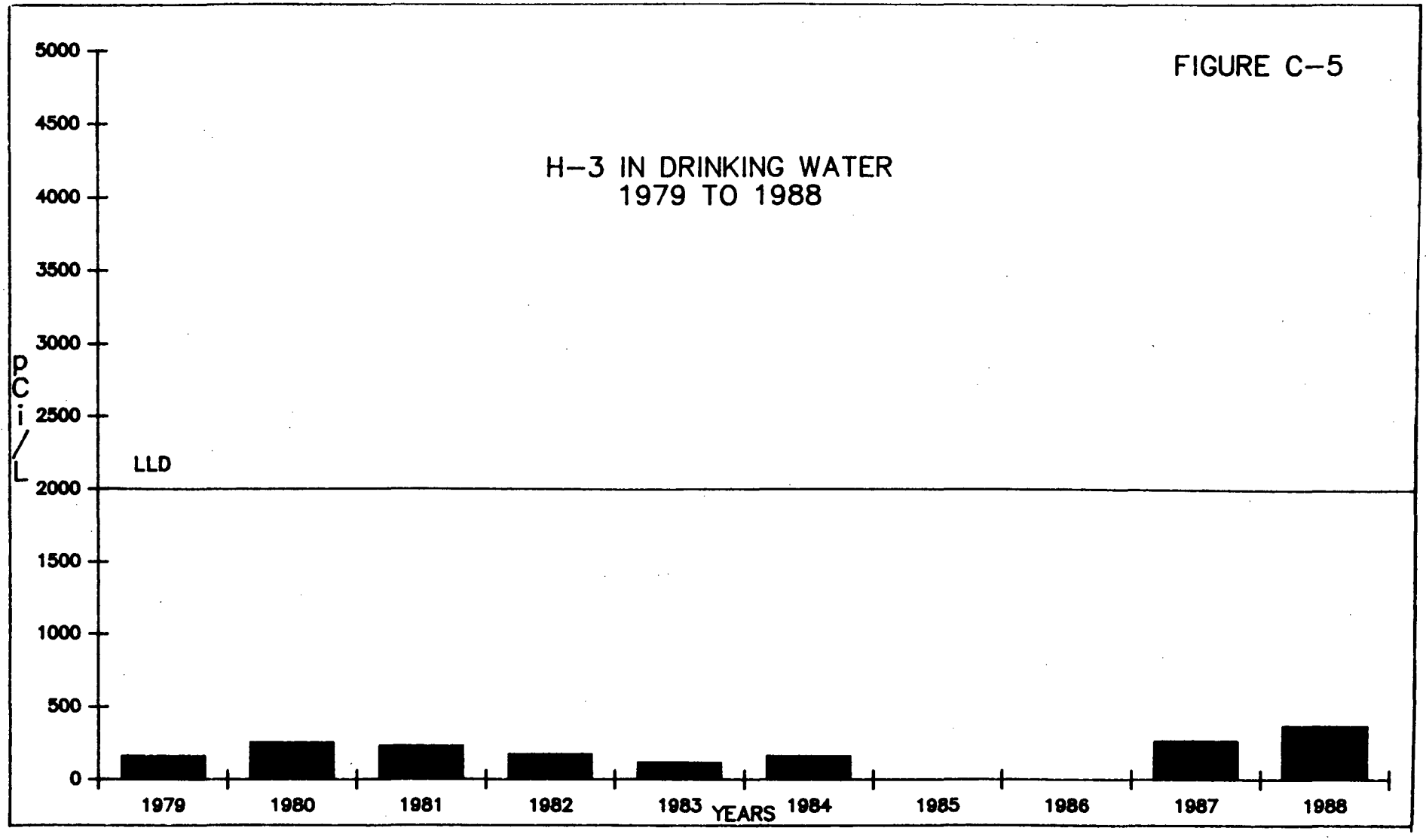
FIGURE C-5
H-3 IN DRINKING WATER
1979 TO 1988
PCi/L
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
LLD
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-5

RADIONUCLIDES IN SHORELINE SOILS
1979 TO 1988
pCi/kg (dry)

Year	Cs-134		Cs-137		Co-60	
	Indicator	Control	Indicator	Control	Indicator	Control
1979	a	a	179	205	a	a
1980	89	a	419	a	72	a
1981	60	70	410	160	20	a
1982	70	a	420	140	a	a
1983	24	a	439	197	85	a
1984	34	a	286	142	38	a
1985	a	a	166	278	a	a
1986	a	a	253	212	a	a
1987	a	a	99	121	a	a
1988	30	49	61	116	a	a
Historical Average	51	60	273	175	54	a
Historical Std. Dev.	26	15	143	53	30	a

(a) Not detected above LLD.

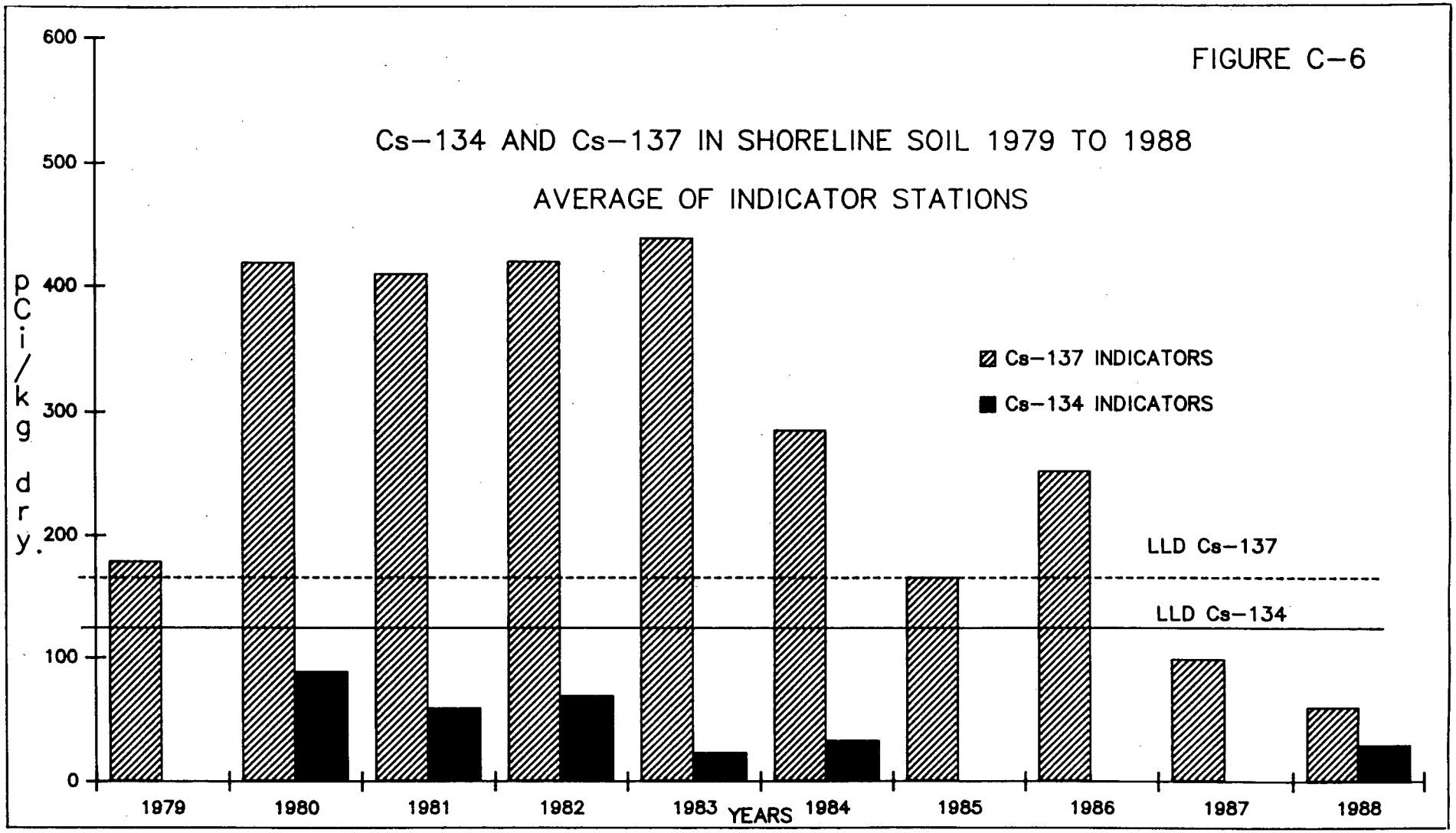
FIGURE C-6
Cs-134 AND Cs-137 IN SHORELINE SOIL 1979 TO 1988
AVERAGE OF INDICATOR STATIONS
pCi/kg dry.
600
500
400
300
200
100
0
Cs-137 INDICATORS
Cs-134 INDICATORS
LLD Cs-137
LLD Cs-134
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-6

RADIONUCLIDES IN BROAD LEAF VEGETATION
1979 TO 1988 (a)
pCi/kg (wet)

Year	Cs-137	
	Indicator	Control
1979	b	b
1980	b	b
1981	b	b
1982	b	b
1983	17	b
1984	b	b
1985	98	b
1986	30	37
1987	b	b
1988	b	21
Historical Average	48	29
Historical Std. Dev.	43	11

(a) Leafy green vegetation prior to 1984.
(b) Not detected above LLD.

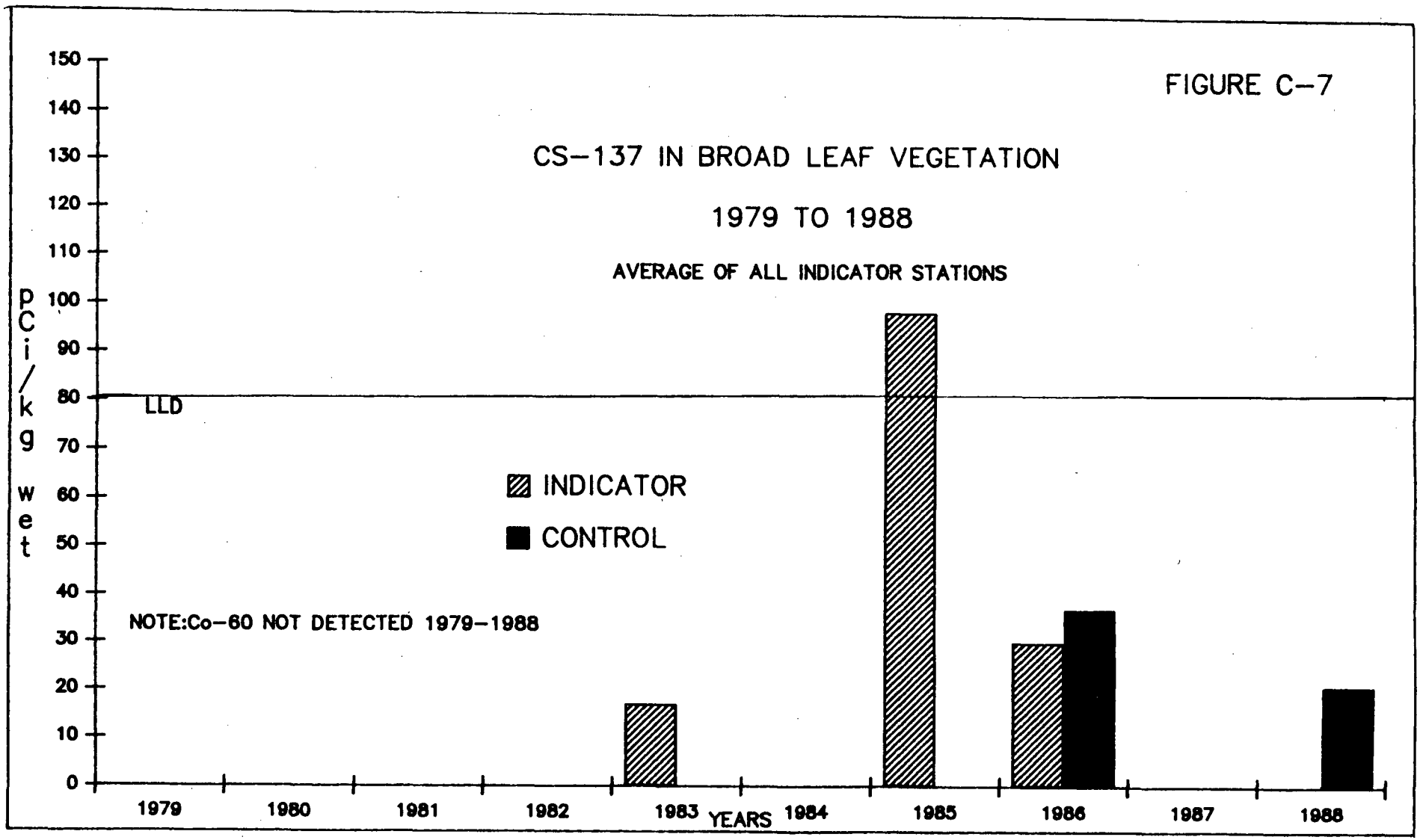
FIGURE C-7
CS-137 IN BROAD LEAF VEGETATION
1979 TO 1988
AVERAGE OF ALL INDICATOR STATIONS
pCi/kg wet
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
LLD
INDICATOR
CONTROL
NOTE:Co-60 NOT DETECTED 1979-1988
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

TEN YEAR HISTORICAL DATA

TABLE C-7

RADIONUCLIDES IN FISH AND INVERTEBRATES
1979 to 1988
pCi/kg (wet)

Year	Cs-137	
	Indicator	Control
1979	24	a
1980	106	a
1981	50	a
1982	36	a
1983	43	a
1984	33	a
1985	32	19
1986	12	24
1987	a	24
1988	a	a
Historical Average	42	22
Historical Std. Dev.	28	3

(a) Not detected above LLD.

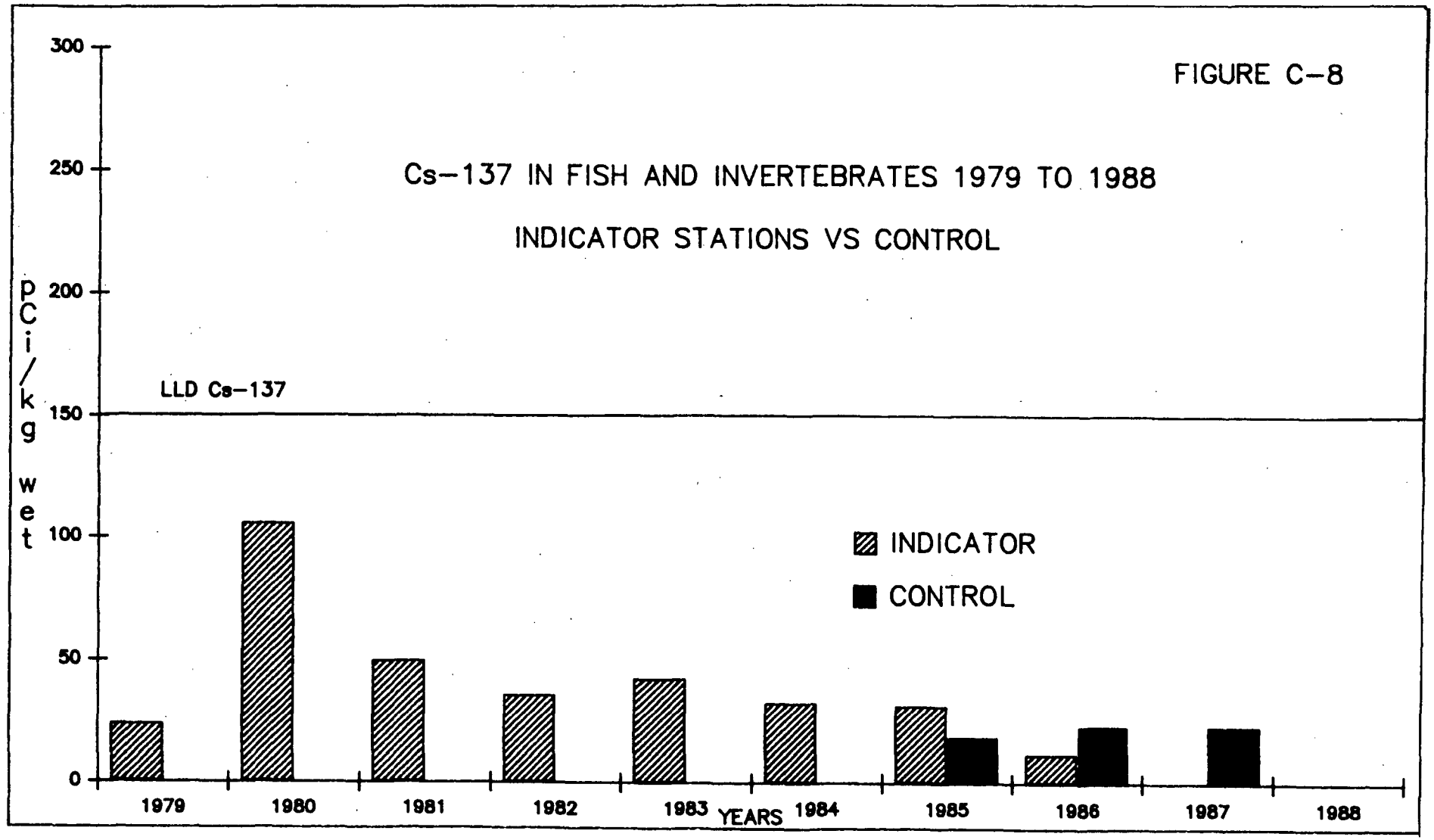
FIGURE C-8
Cs-137 IN FISH AND INVERTEBRATES 1979 TO 1988
INDICATOR STATIONS VS CONTROL
pCi/kg wet
300
250
200
150
100
50
0
LLD Cs-137
INDICATOR
CONTROL
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
YEARS

APPENDIX D

EPA INTERLABORATORY COMPARISON PROGRAM

APPENDIX D

EPA INTERLABORATORY COMPARISON PROGRAM

The New York Power Authority's James A. Fitzpatrick NPP Environmental Laboratory participates in the EPA Interlaboratory Comparison program. Samples of various media containing known activities of radionuclides were sent from the EPA to participating laboratories for analyses. Results of the analyses were compared to the EPA known values.

In 1988, samples of environmental media were provided and appropriate analyses were performed as indicated in Table D-1.

EPA reports interlaboratory results in term of normalized deviations from a known EPA value. Interlaboratory results are considered acceptable, by the EPA, if the laboratory's normalized deviation for a sample is less than 3 or greater than minus 3. For example, the normalized deviation for QA 88-041 is 1.50. Since it is less than 3 and greater than minus 3, EPA considers this value as acceptable. The Laboratory's performance in this program was acceptable; results within 3 normalized deviations were obtained for 47 of 49 samples.

TABLE D-1

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Gross Beta Analysis of Air Particulate Filters (pCi/filter)

Gross Beta Analysis of Water (pCi/liter)

DATE	JAF ENV ID NUMBER	MEDIUM	ANAYLSIS	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
03/88	QA88-031	APF	BETA	62±4 (3) 62±4 63±4	50±5	4.27
04/88	QA88-041	WATER	BETA	60±2 (3) 63±2 61±2	57±5	1.50
08/88	QA88-101	APF	BETA	28±3 (3) 28±3 29±3	29±5	-0.23
10/88	QA88-134	WATER	BETA	52±5 (3) 49±5 52±5	54±5	-1.04

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Tritium Analysis of Water (pCi/L)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
02/88	QA88-013	WATER	H-3	3503±441 (3) 3435±435 3569±437	3327±362	0.84
				3300±100 (4) 3230±200 3530±100	3327±362	0.13
06/88	QA88-070	WATER	H-3	6050±280 (3) 6017±255 6068±306	5565±557	1.49
				6300±300 (4) 5800±300 5700±400	5565±557	1.15
10/88	QA88-129	WATER	H-3	2524±137 (3) 2504±138 2485±138	2316±350	0.93
				2300±100 (4) 2400±100 2200±200	2316±350	-0.08

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Iodine Analysis of Water (pCi/L) and Milk (pCi/L)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
02/88	QA88-018	MILK	I-131	4.0±1 (3) 5.0±1.5 5.0±1.1	4.0±0.4	2.89
				4.0±0.5 (4) 3.0±0.5 4.0±0.4	4.0±0.4	-1.44
04/88	QA88-037	WATER	I-131	8±1 (3) 8±1 8±1	7.5±0.5	1.15
06/88	QA88-071	MILK	I-131	94±2 (3) 94±2 95±2	94±9	0.06
				110±15 (4) 102±12 98±13	94±9	1.76
08/88	QA88-090	WATER	I-131	77±3 (3) 79±3 79±3	76±8	0.51
10/88	QA88-135	MILK	I-131	90±2 (3) 89±2 89±3	91±9	-0.32
12/88	QA88-162	WATER	I-131	118±6 (3) 119±7 118±6	115±12	0.38
				99±2 (4) 110±10 110±10	115±12	-1.25

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Gamma Analysis of Milk, Water (pCi/L)

Air Particulate Filters (pCi/filter) and Food Products (pCi/kg)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
01/88	QA88-006	FOOD	Cs-137	81±4 (3) 82±2 83±8	91±5	-3.118
			I-131	95±10 (3) 96±7 98±6	102±10	-0.962
02/88	QA88-007	WATER	Co-60	66±7 (3) 69±4 70±2	69±5	-0.231
			Zn-65	95±11 (3) 100±6 100±3	94±9	0.798
			Ru-106	100±30 (3) 104±14 110±11	105±11	-0.055
			Cs-134	63±6 (3) 60±3 60±1	64±5	-1.039
			Cs-137	93±7 (3) 91±3 91±2	94±5	-0.808
03/88	QA88-031	APF	Cs-137	19±4 (3) 20±3 20±4	16±5	1.27

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Gamma Analysis of Milk, Water (pCi/L)

Air Particulate Filters (pCi/filter) and Food Products (pCi/kg)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
04/88	QA88-041	WATER	Co-60	52±6 (3) 49±6 52±6	50±5	0.35
			Cs-134	5±2 (3) 6±2 7±4	7±5	-0.35
			Cs-137	8±3 (3) 6±2 6±2	7±5	-0.12
06/88	QA88-068	WATER	Cr-51	278±52 (3) 294±50 359±49	302±30	0.48
			Co-60	14±4 (3) 13±4 13±3	15±5	-0.58
			Zn-65	81±12 (3) 106±16 95±11	101±10	-1.21
			Ru-106	184±40 (3) 206±47 192±32	195±20	-0.09
			Cs-134	25±7 (3) 21±5 17±3	20±5	0.35
			Cs-137	24±5 (3) 26±6 25±4	25±5	0.00
06/88	QA88-071	MILK	Cs-137	48±5 (3) 54±7 48±5	51±5	-0.35

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Gamma Analysis of Milk, Water (pCi/L)

Air Particulate Filters (pCi/filter) and Food Products (pCi/kg)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
07/88	QA88-089	FOOD	I-131	110±16 (3) 104±12 107±10	107±11	0.00
			Cs-137	45±7 (3) 49±6 45±6	49±5	-0.92
08/88	QA88-101	APF	Cs-137	19±6 (3) 18±6 20±6	12±5	2.42
10/88	QA88-128	WATER	Cr-51	286±35 (3) 284±41 272±47	251±25	2.06
			Co-60	29±4.4 (3) 27±5.4 29±6.0	25±5	1.15
			Zn-65	143±13 (3) 152±16 148±17	151±15	-0.38
			Ru-106	127±30 (3) 123±34 129±36	152±15	-2.96
			Cs-134	28±6 (3) 28±4 27±5	25±5	0.92
			Cs-137	16±3 (3) 18±4 15±5	15±5	0.46

TABLE D-1 (Continued)

USEPA ENVIRONMENTAL RADIOACTIVITY LABORATORY
INTERCOMPARISON STUDY PROGRAM - 1988

Gamma Analysis of Milk, Water (pCi/L)

Air Particulate Filters (pCi/filter) and Food Products (pCi/kg)

DATE	JAF ENV ID NUMBER	MEDIUM	NUCLIDE	JAF RESULT (1)	EPA RESULT (2)	NDKV(5)
10/88	QA88-134	WATER	Cs-134	13±2 (3) 12±3 12±2	15±5	-0.92
			Cs-137	15±3 (3) 13±4 16±3	15±5	-0.12
10/88	QA88-135	MILK	Cs-137	47±7 (3) 44±8 47±7	50±5	-1.39

* K-40 results reported as mg per unit of total potassium for EPA results only.
(1) Results reported as activity ± the error (2 sigma).
(2) Results reported as activity ± the standard deviation of the error.
(3) Analyzed at the site environmental laboratory.
(4) Analyzed at a vendor laboratory.
(5) NDKV is the Normalized Deviation from Known Value as determined by the EPA.