Consolidated Edison Company of New York, Inc.
4 Irving Place, New York, N.Y. 10003
Telephone (212) 460-3819

June 30, 1980
RE: Indian Point Unit Nos. 1,2&3
Docket Nos. 50-03, 50-247 and 50-286

Mr. Boyce H. Grier
Director of Region I
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, Pa. 19406

Dear Mr. Grier

Pursuant to the original submittal letter dated April 29, 1980 and Section 5.6.1 of Appendix B the Environmental Technical Specification Requirements for Indian Point Nos. 1, 2 and 3 we respectfully submit the supplemental report to the Indian Point Station Annual Environmental Operating Report-Radiological Part B.

Please find enclosed two copies of above mentioned report.

Very truly yours

enc.

CC: Director of Nuclear Reactor Regulation
Attn: Mr. Victor Stello, Jr., Director (20 copies)
Office of Inspection and Enforcement

Director of Nuclear Reactor Regulation
Attn: Mr. William G. McDonald, Director (2 copies)
Office of Management Information and Program Control

Power Authority of the State of New York
Attn: Mr. George T. Berry, Executive Director
10 Columbus Circle
New York, New York 10019

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INDIAN POINT NUCLEAR GENERATING STATION

UNIT NOS. 1, 2 and 3

JANUARY 1, - DECEMBER 31, 1979

ANNUAL ENVIRONMENTAL MONITORING REPORT

PART B: RADIOLOGICAL REPORT

SUPPLEMENTAL REPORT

JUNE 30, 1980

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The following is a revised Table 4 with all typographical and calculational errors corrected.

This Table supersedes Table 4 submitted with the original 1979 Annual Environmental Operating Report - Part B-Radiological dated April 29, 1980.

Also included is Table 1 (Page 7 & 8 of original submittal). Please note change in last footnote, was "Liquids 100 Ci/l is now Liquids 100 pCi/l.

An updated and revised Table 6, Annual Road Survey Results appears following the discussion section on Direct Gamma Radiation Monitoring.

TABLE 1

INDIAN POINT STATION - RADIOLOGICAL ENVIRONMENTAL MONITORING SURVEY

	Sample	Sample Location	Method of Collection	Frequency	Type of Analysis
1.	Hudson River Water	Inlet pipe into plant-Point 9 Discharge Canal - Point 10	Continuing flow regulated to fill 2 gallon drums. Representative sample taken once a week and drums emptied.	Monthly Quarterly	Composite for GSA* Composite for T, Sr-90 once per year****
2.	Hudson River Aquatic Vegetation	Points 10, 15, 16, 17, 22, 28, 49 and 50	Grab samples along shore-line	Once each in Spring and Summer	GSA
3.	Hudson River Bottom Sediment (Including Benthos)	Same as Item 2 and Points 53, 54	Same as Item 2	Same as Item 2	Same as Item 2
4.	Hudson River Shore-line Sediment	Points 49, 50, 53, 54	Same as Item 2	Same as Item 2	Same as Item 2
5.	Hudson River Crabs/Clams	Point 25	Catch or grab samples	One in the Summer or Fall	GSA, Sr-90 once per Year****
6.	Hudson River Fish	Point 25	Same as Item 4	Monthly	GSA on edible portion, Sr-90 once per year****

*GSA - Gamma Spectrum Analysis

**GBG - Gross Beta Gamma. If the weekly analysis indicates results which are three times higher than previous results, then additional weekly analysis shall be carried out to determine the cause of high results and corrective action taken to reduce levels.

***Modified to reduce evaporation effects.

****Analysis for Sr-89 + Sr-90 shall also be performed in those months when the gamma spectrum analysis reveals the presence of Cs-137 in the following quantities: Liquids - 100 pCi/l aquatic vegetation, crabs, fish - 1 pCi/gm.

TABLE 1 (Continued)

INDIAN POINT STATION - RADIOLOGICAL ENVIRONMENTAL MONITORING SURVEY

	Sample	Sample Location	Method of Collection	Frequency	Type of Analysis
7.	Fallout (Rain Water)	Points 1, 23, 24, 27, 29 and 38	Open pot type collector***	Monthly	GSA, T
8.	Drinking Water	Points 7, 8, and 56	Grab Samples	Monthly	GSA, I-131, Sr-90 once per year****
9.	Air Particulate	Points 1, 2, 3, 4, 5, 23, 27, 29, 38, 43, 44 for one week periods consecutively	Membrane filter preceding charcoal cartridge - continuous sampling	Weekly Monthly/ Quarterly	GBG**, Composite for GSA, Sr-90
10.	Radioiodine	Same as Item 9	Charcoal cartridge	Same as Item 9	I-131
11.	Surface Lake Water	Points 11, 12 and 13	Grab 1 liter sample offshore	Monthly Quarterly	GSA Composite for T, Sr-90 once per year****
12.	Well Water	Points 6, 18	Grab sample from deep-well pumps	Quarterly	Composite for GSA and T

*GSA - Gamma Spectrum Analysis

**GBG - Gross Beta Gamma. If the weekly analysis indicates results which are three times higher than previous results, then additional weekly analysis shall be carried out to determine the cause of high results and corrective action taken to reduce levels.

***Modified to reduce evaporation effects.

****Analysis for Sr-89 + Sr-90 shall also be performed in those months when the gamma spectrum analysis reveals the presence of Cs-137 in the following quantities: Liquids - 100 pCi/l aquatic vegetation, crabs, fish - 1 pCi/gm.

TABLE 4

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
Air Particulate $X10^{-14}$ uCi/cc (weekly)	Gross Beta	565	Table 3	3.28	1.0-7.7	565/565	38	3.41	1.50-7.30	52/52	3.27	1.0-7.7	52/52	
	Gamma Spectra													
	Be-7	565	"	13.45	3.67-45.30	531/565	38	14.17	5.99-45.30	50/53	13.17	5.07-36.4	47/52	
	K-40	565	"	9.40	0.0-15.10	7/565	3	21.40	---	1/51	---	---	0/52	
	Co-58	565	"	0.64	---	1/565	1	0.64	---	1/53	---	---	0/52	
	Co-60	565	"	1.04	---	1/565	29	1.04	---	1/52	---	---	0/52	
	Ce-141	565	"	1.46	---	1/565	43	1.46	---	1/52	---	---	0/52	
	Cs-137	565	"	0.51	0.26-0.80	10/565	2	0.80	---	1/51	0.26	---	1/52	
	Ra-226	565	"	1.56	---	1/565	5	1.56	---	1/52	---	---	0/52	
	Th-228	565	"	2.39	1.90-2.88	2/565	3	2.88	---	1/52	---	---	0/52	
Air Particulate $X10^{-14}$ uCi/cc (Monthly Composite)	Gamma Spectra													
	Be-7	127	"	12.46	6.40-21.60	126/127	27	13.55	8.59-20.80	10/10	11.92	6.61-21.60	12/12	
	K-40	127	"	3.26	---	1/127	4	3.26	---	1/12	---	---	---	
	Co-58	127	"	0.17	---	1/127	1	0.17	---	1/12	---	---	---	
	Co-60	127	"	0.257	0.146-0.475	3/127	29	0.475	---	1/12	---	---	---	
	Cs-137	127	"	0.141	0.049-0.289	48/127	29	0.162	.124-.208	4/12	0.13	0.103-.171	3/12	
	Ce-144	127	"	0.522	0.347-0.955	19/127	03	0.619	.457-.781	2/12	---	---	0/12	
Air Particulate $X10^{-16}$ uCi/cc (Quarterly Composite)	Sr-89	44	"	MDC	---	---	---	---	---	---	---	---	---	
	Sr-90	44	"	3.21	0.71-7.4	40/44	44	4.87	2.0-7.4	3/4	3.54	0.72-4.80	3/40	
Air Gas Charcoal Filters $X10^{-14}$ uCi/cc (weekly)	I-131	565	"	7.23	4.85-11.90	4/565	01	8.40	4.85-11.90	3/53	0.0	---	0/52	

TABLE 4 (Con't.)

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
Fish, X10 uCi/g (Wet)	Gamma Spectra													
	K-40	11	Table 3	8.43	1.86-33.20	11/11	25				---	---	---	*
	Cs-137	11	"	0.24	0.025-0.64	3/11	25				---	---	---	*
	Sr-90	9	"	0.0042	---	1/9	25				---	---	---	*
Shellfish X10 uCi/g (Wet)														
	Gamma Spectra													
	K-40	1	"	14.0	---	1/1	25	14.0	---	1/1	---	---	---	---
	Radio Chemical													
	Sr-90	1	"	0.07	---	1/1	25	0.07	---	1/1	---	---	---	---
Sed/Silt X10 uCi/g (Dry)	Gamma Spectrum													
	K-40	17	"	195	136-241	17/17	17	219	197-241	2/2	214	193-234	2/2	
	Cr-58	17	"	--	---	0/17	--	--	---	0/2	--	---	0/2	
	Co-60	17	"	4.14	1.61-15.4	9/17	10	11.6	7.82-15.40	2/2	2.27	---	1/2	
	Zr-95	17	"	--	---	0/17	--	--	---	0/2	--	---	0/2	
	Cs-134	17	"	3.95	1.55-8.21	5/17	10	6.44	4.67-8.21	2/2	--	---	0/2	
	Cs-137	17	"	17.29	1.75-76.1	17/17	10	60.2	44.2-76.1	2/2	17.0	12.3-21.6	2/2	
	Ce-144	17	"	5.99	5.96-6.02	2/17	17	6.02	---	1/2	---	---	0/2	
	Mn-54	17	"	1.13	0.99-1.27	2/17	10	1.27	---	1/2	---	---	0/2	
	Ra-226	17	"	20.9	14.0-30.8	10/17	22	29.5	28.1-30.8	2/2	---	---	0/2	
	Th-228	17	"	14.0	10.4-17.0	17/17	17	15.2	13.3-17.0	2/2	13.8	13.0-14.6	2/2	

*Note only one sample site

TABLE 4 (Con't.)

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
River Aquatic Vegetation $X10^{-8}$ uCi/g (Wet)	Gamma Spectra													
	Be-7	16	Table 3	151.4	30.7-272.0	2/16	15	272.0	---	1/2	---	---	---	
	K-40	16	"	483.0	167-2850	11/16	15	1508.5	167-2850	2/2	---	---	---	
	Mn-54	16	"	7.35	5.66-10.30	4/16	16	7.6	5.66-10.30	3/5	---	---	---	
	Co-58	16	"	7.08	---	1/16	16	7.08	---	1/5	---	---	---	
	CO-60	16	"	11.25	4.25-17.8	5/16	16	13.97	11.30-17.80	3/5	---	---	---	
	Cs-137	16	"	10.20	6.49-16.0	4/16	28	16.0	---	1/2	---	---	---	
	Th-228	16	"	11.74	7.68-15.8	2/16	28	15.80	---	1/2	---	---	---	
Shoreline Soil $X10^{-7}$ uCi/g Dry	Gamma Spectrum													
	K-40	12	"	127	72.2-167	12/12	54	16.3	159-167	2/2	96.6	72.2-121	2/2	
	Zr-95	12	"	0.68	---	1/12	49	0.68	---	1/2	---	---	0/2	
	Cs-137	12	"	1.79	0.75-5.32	12/12	54	4.03	2.74-5.32	2/2	2.05	2.00-2.05	2/2	
	Ra-226	12	"	18.73	7.27-23.10	7/12	50	19.90	--	1/2	19.90	---	1/2	
	Th-228	12	"	8.34	0.80-19.90	12/12	50	18.55	17.20-19.90	2/2	18.55	17.2-19.9	2/2	

5)

TABLE 4 (Con't.)

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
Milk $X10^{-8}$ uCi/ml	Sr-89	26	Table 3	MDC	---	0/26	---	---	---	---	---	---	---	
	Sr-90	26	"	0.47	0.15-0.85	26/26	51	0.50	0.23-0.85	12/12	0.44	0.15-0.70	12/12	
	I-131	26	"	MDC	---	0,26	---	---	---	---	---	---	---	
	Cs-134/137	26	"	MDC	---	0/26	---	---	---	---	---	---	---	
	Gamma Spectra K-40	26	"	113	92-169	26/26	52	115	102-128	12/12	115	102-128	12/12	
	Cs-137	26	"	1.26	0.52-4.50	12/26	51	1.51	0.78-4.50	8/12	0.63	0.52-0.74	3/12	
Soil $X10^{-7}$ uCi/g Dry	Gamma Spectra K-40	10	"	133.02	94.1-154.0	10/10	06	154	---	1/1	---	---	---	
	Cs-137	10	"	4.54	1.58-10.90	9/10	02	10.9	---	1/1	---	---	---	
	Ra-226	10	"	17.45	14.1-25.5	4/10	02	25.5	---	1/1	---	---	---	
	Th-228	10	"	9.45	4.84-16.60	10/10	02	16.6	---	1/1	---	---	---	
	Sr-90	10	"	1.35	0.68-3.10	7/10	20	3.1	---	1/1	---	---	---	
Leafy Green Vegetables $X10^{-7}$ uCi/g Wet	Gamma Spectra K-40	7	"	30.46	21.0-61.9	7/7	4109	55.2	48.4-61.9	2/2	---	---	---	

TABLE 4 (Con't.)

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
River Water $X10^{-7}$ uCi/ml	Gamma Spectra													
	Be-7	24	Table 3	.0.005	---	1/24	10	0.005	---	1/12	---	---	---	
	Cs-137	24	"	0.057	.046-.068	2/24	10	0.068	---	1/12	---	---	---	
	Th-228	24	"	0.47	---	1/24	10	0.47	---	1/12	---	---	---	
	H-3 (Quarter)	8	"	3.54	1.10-6.40	8/8	9	3.8	1.20-6.40	4/4	---	---	---	
	Radio Chem Sr-90 (Yearly)	3	"	0.005	---	1/3	10	0.005	---	1/2	---	---	---	
Precipitation $X10^{-7}$ uCi/ml	Gamma Spectra													
	Be-7	72	"	0.94	---	1/72	01	0.94	---	1/2	---	---	0/12	
	K-40	72	"	6.56	3.76-9.36	2/72	27	9.36	---	1/12	---	---	0/12	
	Co-60	72	"	0.08	---	1/72	01	0.08	---	1/12	---	---	0/12	
	Cs-137	72	"	0.037	---	1/72	27	0.037	---	1/12	---	---	0/12	
	Th-228	72	"	0.50	---	1/72	29	0.50	---	1/12	---	---	0/12	
	H-3	66	"	2.23	1.0-7.2	54/66	01	2.85	1.20-5.00	12/12	1.8	1.10-2.30	9/12	

*NOTE- Results from station 24 not included for January through June. High sample activity due to releases from local manufacturer.

TABLE 4 (Con't.)

1979 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis Type	Analysis No.	MDC	All Indicator Samples Mean	All Indicator Samples Range	All Indicator Samples Fraction	Location With Highest Mean Station	Location With Highest Mean Mean	Location With Highest Mean Range	Location With Highest Mean Fraction	Control Locations Mean	Control Locations Range	Control Locations Fraction	Misc.
Drinking Water $\times 10^{-7}$ uCi/ml	Tritium H-3 (Monthly)	3	Table 3	1.7	1.3-2.0	3/3	56	2.0	---	1/1	---	---	---	
	Tritium H-3 (Quarterly)	6	"	1.46	1.0-1.9	5/6	56	1.9	---	1/1	---	---	---	
	Gamma Spectra													
	Cs-137	9	"	0.043	---	1/9	18	0.043	---	1/3	---	---	---	
	Th-228	9	"	0.408	0.227-0.542	3/9	08	0.455	---	1/3	---	---	---	
Ground Water $\times 10^{-7}$ uCi/ml	Tritium H-3 (Monthly)	8	"	2.57	1.0-3.8	7/8	18	3.80	---	1/1	---	---	---	
	Tritium H-3 (Quarter)	8	"	1.95	1.0-3.5	8/8	18	3.50	---	1/1	---	---	---	
	Gamma Spectra													
	Th-228	24	"	0.147	---	1/24	06	0.147	---	1/12	---	---	---	
Surface Water $\times 10^{-7}$ uCi/ml	Gamma Spectra													
	K-40	36	"	0.74	---	1/36	11	0.74	---	1/12	---	---	---	
	Th-228	36	"	0.142	0.134-0.15	2/36	11	0.15	---	1/12	---	---	---	
	H-3 (Quarter)	12	"	2.44	1.30-3.50	12/12	11	3.50	---	1/4	---	---	---	

Introduction

The intent and purpose of this Annual Environmental Operating Report Supplement Radiological, Part B: is to complete our responsibility pursuant to Section 5.6.1d of the Environmental Technical Specification Requirements Appendix B.

This supplement includes summaries, interpretations and statistical evaluations of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impact of the plant operation on the environment.

The interpretations will attempt to establish significant and pertinent correlations between measured environmental levels, plant operations and non-plant related factors.

Results and Discussions

Table 4 summarizes those natural and man-made isotopes which were detected during 1979 by the site environmental studies. Past site environmental radiological studies and the published results of various Federal and International agencies (Reference 11,12) demonstrate that the major source of fission and activation products already present in the environment is due to past weapons tests. Fallout from tests conducted during the period of above ground testing prior to the treaty banning above ground testing in the early 1960s, added to the fallout from open air Chinese nuclear tests in 1976, 1977 and 1978, greatly complicates the task of isolating the low environmental radioactivity levels expected from the radioactive materials released by the Indian Point nuclear units.

The environmental radiological monitoring program as it exists, is capable of measuring radioactivity in various environmental media at low concentrations. An interpretation of the distribution of specific nuclides, both in time and space, comparisons of measured values vs. levels calculated from site releases and the results of confirmatory analyses of the specific media in question or comparison with other media on the source pathway of exposure, allow determinations to be made as to whether the activity may be plant related. In any case, the measured activity in a medium allows an approximate calculation of dose to individuals. These calculations demonstrate very

low doses compared to the other significant sources of radiation exposure, which include the natural environment, man's use of ionizing radiation as a medical diagnostic tool and several miscellaneous components of population radiation exposure noted in the conclusion of this discussion.

Discussed below, by medium, is an interpretation and evaluation of the measured results including, as appropriate, a comparison with pre-operational data, operational control stations, and previous environmental radiological reports or effluent monitoring data and impact calculations (see Reference 6,7). Since the pre-operational, data obtained from 1958 until 1962, when Unit 1 became operational, and the radiological environmental report up until the early 1970s consisted mainly of gross beta-gamma measurements, their comparison to present data is limited.

II-2

II-2A Air Particulates 1979

Air particulate gross beta radioactivity measured in the environment around Indian Point, and summarized below, indicates that throughout the year, there were no significant differences between measured values at indicator stations and those measured at the control location (Roseton 20 miles north).

1979 Air Particulates
Gross Beta ($X10^{-14}$uCi/cc)

	INDICATOR STATION		CONTROL STATION	
Quarter	Average	Range	Average	Range
1	3.69	1.0-7.7	3.82	1.0-7.7
2	3.52	1.8-7.2	3.65	2.4-5.5
3	2.75	1.2-4.4	2.74	2.0-3.8
4	3.12	1.2-7.3	2.84	1.4-4.6
All	3.28	1.0-7.7	3.27	1.0-7.7

As seen above, there were negligible differences between the Indicator and Control Stations in each of the four quarters and for the year. This supports the conclusion that the Indian Point Site had no significant effect on airborne gross beta radioactivity levels. While the gross beta measurements is non-specific and sums a number of radionuclides in the environment, both natural and man-made, it is a useful screening analysis sensitive to relatively slight increases in background.

The average level of gross beta activity during 1979 was approximately 67% less than that noted in 1978. Airborne gross beta levels, in general, over the four quarters of 1979 were consistently lower than 1978. There were no atmospheric bomb tests in calendar 1979 as there had been in 1978.

The preoperational data indicated gross beta air activity from 2.0×10^{-14} uCi/cc to 8×10^{-12} uCi/cc. The average yearly value dropped from the peak of 8×10^{-12} uCi/cc in 1963 to an average of approximately 2.0×10^{-13} uCi/cc throughout the rest of the 1960s and early 1970s. Since 1973, the average has fluctuated from 3.5×10^{-14} uCi/cc to 2.0×10^{-13} uCi/cc. The 1979 data is consistent with these previous data.

Cs-137 was detected in both weekly and monthly composites in the first three quarters of 1979 only.

Fractions* 1979 (Cs-137-Air Particulate filters)

Quarter	Monthly	Weekly
1	11/33	1/43
2	25/33	7/141
3	12/33	2/142
4	0/28	0/139
Annual	48/127	10/565

* Total positive indications of Radionuclide measured / Total no. of samples taken

In the first quarter of 1979, nine (9) of 11 sample locations saw Cs-137 in the monthly composite samples. Of these 9 indicator stations, Station 01, the Environmental Laboratory-onsite sse, saw Cs-137 in both weekly 3/20 - 3/27/79 and monthly composite (March) samples. In the first quarter, the month showing the greatest prevalence of Cs-137 indications was March, while in January and February there were no weekly indications and one monthly indication (Station 01). There were no Cs-137 indications seen at the control station, Roseton 20 mi N.

In the second quarter of 1979, all 11 sample locations had positive Cs-137 indications in their monthly composites. These values ranged from $0.13\text{-}0.19 \times 10^{-14}$ uCi/cc, with the control station being at the lower end of that range. The weekly samples that had positive Cs-137 indications showed random dispersion of values over different weeks and different locations making it difficult to establish correlative factors to explain the values (second quarter fraction 7/141). In general, the second quarter weekly sample positive Cs-137 values ranged from 0.26×10^{-14} uCi/cc to 0.80×10^{-14} uCi/cc with Roseton again being at the low end of that range.

In the 3rd quarter of 1979 positive Cs-137 was detected in monthly composite samples at 7 of 11 sample locations, but not at the control station. The range of mean values for all indicator stations (monthly composites) in the third quarter was $0.064\text{-}0.140 \times 10^{-14}$ uCi/cc. These values were comparable to, but as a group lower, than the first and second quarters of 1979. In the weekly samples in the third quarter, 2 of 142 samples showed positive Cs-137. These positive Cs-137 indications were at different stations on different weeks and were probably statistical anomalies.

II-2A - Air Particulates 1979 (Con't.)

The fourth quarter of 1979 had no positive Cs-137 indications in either weekly or monthly samples at any of the eleven sample locations.

Cs-137 Comparison Table (1978 & 1979) $X10^{-14}$ uCi/cc)

	1978 Weekly	1979 Weekly	1978 Monthly	1979 Monthly
Annual Mean, all indicator	0.74 (48/563)*	0.51 (10/565)	0.39 (87/131)	0.14 (48/127
1st Quarter	0.77 (35/137)	0.33 (1/143)	0.37 (31/33)	0.14 (11/33)
2nd Quarter	0.73 (27/138)	0.56 (7/141)	0.49 (33/33)	0.16 (25/33)
3rd Quarter	0.76 (24/148)	0.37 (2/142)	0.31 (17/33)	0.11 (12/33)
4th Quarter	0.50 (2/143)	N.D. (0/139)	0.12 (6/32)	N.D. (0/28)

Comparison of Cs-137 values found in weekly air particulate samples from 1978 and 1979, on a quarterly and yearly basis (see above table) shows that only general statements can be made. Most obvious is the difference in total positive indications seen in both 1978 and 1979. This rather large disparity in sample population seems to negate any comparison of annual statistics presented above. In all quarters, except the second quarter of 1979, mean values for 1979 ran approximately 50% lower than 1978. The explanation of results in the second quarter will be addressed in this discussion.

The monthly data for both years does better lend itself to comparison. Again, both annual mean and quarterly mean values for 1979 indicate levels to be approximately two third's less than 1978.

The more extensive distribution of positive Cs-137 levels seen in the first and second quarters of 1979 was investigated to establish if these levels could be related to plant operation. It was learned that gaseous effluent releases, which included Cs-137, from Unit #2 were higher in the first two quarters than in the third and fourth quarter of 1979. Unit #3 gaseous effluent levels released for the entire year was equal to or lower than Unit #2.

*See definition Page 12

Further investigation revealed that in late 1978 the new integrated liquid waste evaporator system was going into service. This, in part, would explain the extensive distribution of the positive Cs-137 indications. Comparatively the table shows concentration levels in the environment to be decreasing on a quarterly and yearly basis.

The absence of measurable Cs-134 activity in any airborne particulate analysis lends partial credence to the hypothesis that some, if not all, Cs-137 indications may be due to fallout from past nuclear weapons tests.

Although Cs-134 site releases for the year were approximately 33% of the Cs-137 releases, no Cs-134 was detected in the environmental monitoring program. Since Cs-134 detection sensitivities are slightly better than those for Cs-137 it would be possible to see Cs-134 as well as Cs-137 if substantial Cesium releases were occurring from the plant.

Based on total site Cs-137 airborne releases (ref: 6,7) it is possible to calculate the average airborne Cs-137 concentration which would be present at the closest occupied point in the Indian Point offsite environment. This location, at 730 Meters east, would, for the year 1979, would be likely to see an average airborne Cs-137 concentration from plant operation of about 1.02×10^{-14} uCi/cc.

II-2A Air Particulates 1979 (Con't.)

The dose to a critical individual (infant age group) inhaling air with Cs-137 at this concentration would be approximately 0.010 mrem/yr to the liver. This is approximately equivalent to the exposure received by an individual from natural background radiation in a period of ½ hour and less than the variation in annual background from one location to another.

Co-58 was detected only once in 565 weekly samples (6.4×10^{-15} uCi/cc - 9/4 - 9/11/79) and once in 127 monthly composite samples, (1.7×10^{-15} uCi/cc September). Both these indications occurred in the third quarter at the same sample location, Station 01, the Environmental Lab onsite SSE.

These positive indications were both below Technical Specification limits of 1×10^{-14} uCi/cc. Additionally these values were lower than values detected last year and appear to be normal environmental levels (See table below). They appear to be an isolated situation.

Co-58 Comparison Table (1978 & 1979) $\times 10^{-14}$ uCi/cc)

	Sample Period			
	1978 Weekly	1979 Weekly	1978 Monthly	1979 Monthly
Annual Mean	1.19 (3/563)*	0.64 (1/565)	0.56 (1/131)	0.17 (1/127)
1st Quarter	N.D. (0.137)	N.D. (0.143)	N.D. (0/33)	N.D. (0/33)
2nd Quarter	0.72 (2/135)	N.D. (0/141)	N.D. (0/33)	N.D. (0/33)
3rd Quarter	N.D, (0/148)	0.64 (1/142)	N.D. (0/33)	0.17 (1/33)
4th Quarter	2.14 (1/143)	N.D. (1/139)	0.57 (1/32)	N.D. (0/28)

Co-60 was detected only once in 565 weekly samples and three times in the 127 monthly samples analyzed. All positive values for both the weekly and three monthly composite samples were at or below Technical Specification limits. Co-60 was not detected at the Control Station in any quarter of 1979.

* See difinition Page 12

In the first quarter Co-60 was detected both weekly and monthly at Station 29, Grassy Point 3 mi S. (weekly, 1.0×10^{-14} uCi/cc - monthly, 0.48×10^{-14} uCi/cc. It should be noted that no other locations that lie along the same general southerly meridian at approximately the same distance and closer to the Indian Point Site saw any Co-60. Additionally, no Co-58 was detected along with Co-60 in the first quarter of 1979. These facts would tend to support the conclusion that these indications were not plant related but due to residual fallout.

The second quarter indications of Co-60 (monthly composite) was below Technical Specification limits. Detections sensitivities are better for monthly samples and it is likely this Co-60 measurement was a statistical anomaly and not indicative of actual Co-60 acitivity.

In the third quarter Co-60 was detected once in a monthly composite sample (September) at Station 01, the Environmental Lab. onsite SSE. This does correlate with positive Co-58 indications at the same location during the same month. These levels were however, well below Technical Specification limits.

There were no Co-60 detections in the fourth quarter for weekly or monthly composite samples.

Ce-141 was not detected in any monthly composite samples and only once in 565 weekly samples (1.5×10^{-14} uCi/cc Station 43, Oregon Rd. 3.7 mi NE.) This lone detection was made in August and does not correlate in the measurements at other station or control in terms of time or geography. The level measured is also very close to the detectable limits for Ce-141.

Ce-144 was not detected in any weekly samples. It was detected in 19 of 127 monthly composite samples.

Ce-144 Summary Table (Monthly Composites) $X10^{-14}$ uCi/cc

Period	Mean Value	Fraction*	Range
Annual (1979	0.52	19/127	0.35-0.96
1st Quarter	0.42	4/33	0.35-0.48
2nd Quarter	0.54	14/33	0.35-0.96
3rd Quarter	0.70	1/33	0.70
4th Quarter	N.D.	0/28	---

All detections for 1979 were below the Technical Specification limit of $1X10^{-14}$ uCi/cc. At no time during 1979 was Ce-144 detected at the control station.

In the first quarter Ce-144 was detected at 3 of 11 sample locations. Since these detections were seen at sample locations as far north as 3.7 mi NE (Oregon Rd) and as far south as 7.5 mi SSE (Croton Point) and no other location closer into the plant, it would appear these measurements were a result of residual weapons testing fallout and not plant operations.

In the second quarter Ce-144 was detected at 9 of 11 stations. The majority of these detections (7) came in the month of May where Ce-144 was detected at two locations onsite and outward as far as 7.5 mi SSE and 3.7 mi N. There was Ce-144 released from Unit #3 only in the second quarter as part of their gaseous effluent releases (ref #6), but the level released was so small ($1.46X10^{-6}$ Ci) that the extent of detection cannot be explained by attributing it to plant operation. It would appear that rainfall, commonly higher in the 2nd quarter, washed out residual nuclear weapons fallout from the atmosphere and this seems to be the most reasonable explanation of what was

* See difinition Page 12

observed in the environment. (May 1979 rainfall was approximately twice normal normal=3" May 1979=6"). The remaining 7 detections took place in April and June of the second quarter and were geographically spread out, with none seen in near site locations. As for the May indications, these other second quarter indications appear to be due to residual fallout from past nuclear weapons tests.

There was a lone indication of Ce-144 in a monthly composite sample in the 3rd quarter which was below Technical Specification limits. This lone indication appears to be a statistical anomaly.

There were no Ce-144 indications, either weekly or monthly in the fourth quarter.

In summary, all Ce-144 indications for 1979 were below Technical Specification limits and appear to be the result of residual fallout from past nuclear weapons tests.

Other fission products, Zr-95, Ru-103, Ru-106 and Ba-140 were not detected either in weekly or monthly composite samples at any of the stations in 1979.

Sr-89 was not detected in any air particulate samples in 1979.

Sr-90 was detected in 1979 in 40 of 44 quarterly composite samples with an annual mean value for all indicator stations of 3.2×10^{-16} uCi/cc compared to 1978 where Sr-90 was detected in 42 of 44 quarterly composite samples with an annual mean value of 14.4×10^{-16} uCi/cc. The 1978 average was approximately four times higher than 1979 average. The following is a breakdown by quarter of the 1979 Sr-90 measurements.

1979 - Sr-90 Air Particulates (Quarterly Composites)
($X10^{-16}$ uCi/cc)

Period	Mean Value	Fraction	Range
1st Quarter	4.11	11/11	0.96-5.8
2nd Quarter	4.69	11/11	1.2-7.4
3rd Quarter	1.87	11/11	0.72-4.5
4th Quarter	1.61	7/11	0.71-4.8
Annual 1979	3.2	40/44	0.71-7.4

(Spec. limit $1X10^{-15}$ uCi/cc)

In the first three quarters of 1979 Sr-90 activity was detected at the control station, Roseton, but not in the fourth quarter. All Sr-90 activity measurements in 1979 air particulate samples were below Technical Specification limits.

Using total site Sr-90 airborne releases (ref 6&7) it is possible to calculate the average airborne Sr-90 concentration which would be present at the closest occupied point in the Indian Point environs. Based on these releases, the location 730 meters East would, for the year 1979, have seen an average airborne Sr-90 concentration from plant operation of about $9.7X10^{-18}$ uCi/cc. This concentration is well below analytical sensitivity and several orders of magnitude less than the average measured airborne activity at the sampling station. This calculation indicates that Sr-90 levels detected are most probably due to fallout from past nuclear weapons tests and insignificantly, if at all, from plant operations.

Several other radionuclides, which are naturally occurring, were detected at various locations and frequencies. These were Be-7, K-40, Ra-226 & Th-228.

II-2B Radioiodine 1979

Airborne I-131 measurements were made throughout 1979 with positive indications in 4 of 565 samples with none at the control station. The following table is a breakdown of 1979 and 1978 I-131 data for comparison and explanation.

1978 & 1979 Radioiodine Values $X10^{-14}$ uCi/cc

1979			1978		
Period	Mean Values	Fraction	Period	Mean Value	Fraction
1st Quarter	N.D.	0/143	1st Quarter	3.80	21/137
2nd Quarter	N.D.	0/141	2nd Quarter	1.31	7/135
3rd Quarter	N.D.	0/142	3rd Quarter	N.D.	0/148
4th Quarter	7.23	4/139	4th Quarter	5.43	11/143
Annual 1979	7.23	4/565	Annual 1978	3.82	39/563

(Spec limit $4X10^{-14}$ uCi/cc)

As can be seen all 1979 I-131 indications occurred in the fourth quarter. During this period a considerable amount of liquid waste was processed at Unit No. 1 ($20X10^{+6}$ liters in the 4th Quarter vs $7X10^{+6}$ liters in the third quarter -ref. 7) and considerable purging of containment, Unit No. 2, for two mini-outages in November and December took place. 3 of the 4 indications were made in the same weeks as the mini-outages (last week of November and the first week of December). All four indicators were at onsite locations at or just above Technical Specification limits.

Comparison of radioiodine data from just the viewpoint of annual mean values for all indicator stations in 1978 and 1979 is misleading. First, the sample populations being compared differ by a factor of 10. I-131 levels, in 1978, were in part explained by the fallout from Chinese atmospheric nuclear bomb tests in almost corresponding quarters. In 1979 there were no atmospheric nuclear weapons test.

The 1979 I-131 data is basically 4th quarter data and not truly representative of a full year.

II-2B Radioiodine 1979 (Con't.)

In order to accomplish a more accurate comparison of the average airborne I-131 activity in the environment for 1978 vs 1979 one can average in all measured "less than values" as if actual activity was at the lower limit of detection. This gives us a new annual mean value for I-131 of $2.3X10^{-14}$ uCi/cc. In 1978 this value $3.8X10^{-14}$ uCi/cc using 39/563 as the fraction. When 1978 data were handled as above, including less than values as actual activity at the lower limit of detection, the annual mean calculated was $4X10^{-14}$ uCi/cc. In both cases the comparison of 1979 to 1978 values indicate a temporal decrease in airborne I-131 activity in the environment.

The average annual airborne I-131 activity about Indian Point is conservatively bounded on the upper end by environmental data at about $2.3X10^{-14}$ uCi/cc as calculated by the method mentioned above. This upper limit produces a calculated thyroid inhalation dose to a two year old individual breathing 7 cubic meters/day of less than 0.1 mr/yr. This calculated inhalation dose is insignificant in comparison to the annual dose an individual of the same age group would receive from sources in the environment.

II-2C Fish 1979

Results of fish sampling in the Hudson River show detectable concentrations of Cs-137 in 3 of 11 samples during the months of April, August and December 1979. The mean annual value for Cs-137 in fish, in 1979, was $0.24X10^{-7}$ uCi/g (wet) as compared to an annual value in 1978 of $0.53X10^{-7}$ uci/g (wet). The presence of Cs-137 without significant amount of Cs-134 indicates that much of the Cs-137 in fish is old and not due to recent plant effluents, but attributable to nuclear weapons fallout and plant effluents from previous years. Taking into account the total amount of Cs-137 detected in fish, the annual dose to man from fish consumption would be approximately less than 0.02 mr/yr, or about one half of the levels of 1978. The levels detected in 1979 were in agreement with and a bit lower than results for prior years. This is believed consistent with decreasing levels of fallout. Naturally occurring K-40 was detected in all samples.

Only one positive Sr-90 ($0.004X10^{-7}$ uCi/g wet) and no positive Sr-89 indications were noted in 1979 fish samples. In 1978, Sr-90 was seen at higher levels ($0.09X10^{-7}$ uCi/g wet). Strontium-90 was seen in liquid effluent releases in 1979. However based on data from previous years, Sr-90 has been found in fish even when there had been no detectable releases from the plant. Sr-90 was detected in Hudson River water samples only once in 1979 and at comparable levels to that found in fish ($0.005X10^{-7}$ uCi/ml). This was detected at Station 10, the Discharge Tunnel onsite. Fish samples are taken offsite, where available, near the site. In conclusion,

for the fish away from the site to have measurable Sr-90 it would appear these levels could not be attributable to plant releases but must most likely be due to nuclear weapons test fallout over a number of years.

Shellfish were sampled once from the Hudson River in 1979. Sr-90 was detected in plant liquid effluent releases in 1979. However, based on data for previous years it has been noted that Sr-90 is found in the shellfish even though there is no detectable releases from the plant. We conclude then the Sr-90 detected in shellfish in 1979 is most likely attirbutable to nuclear weapons tests fallout over a period of years. The only other isotope positively detected in this sample was naturally occurring K-40.

II-2D Sediment/Silt 1979

During 1979 sediment was monitored at ten locations up to 5 miles upstream and 7.5 miles downstream from the site discharge. A number of plant related isotopes including Mn-54, Co-60, Cs-134, Cs-137 Ce-144 were measured throughout the year. The highest concentrations were seen in the discharge canal monitoring station, with concentrations falling off rapidly away from the Indian Point Site (see table). The only exception to the above statement is Ce-144 which was not seen in 1979 at the discharge canal or the control station but was detected at two locations, one upstream, one downstream, in the second quarter and the third quarter respectively. Both these indications reveal no correlative factors to show plant related origin of the materials detected and were probably due to pre-existing build up occurring over several years. Sediment radioactivity is a useful integrating indicator of radionuclide presence in river water over time. Activity measured during 1979 was apparently due to a build up taking place over several years as well as a very slight contribution from current discharges.

1979 Sediment/Silt
($\times 10^{-7}$ uCi/g-Dry)
Average Measured Activity by Isotope

Measured Isotope	Discharge Canal Station 01	Monitor Control Station 50	Mean Values All Indicator Stations
Mn-54	1.3 (1/2)	- (0/2)	1.1 (2/17)
Co-58	-* (0/2)	- (0/2)	- (0/17)
Co-60	11.6(2/2)	2.35(1/2)	4.1 (9/17)
Zr-95	- (0/2)	- (0/2)	- (0/17)
Ru-103	- (0/2)	- (0/2)	- (0/17)
Ru-106	- (0/2)	- (0/2)	- (0/17)
Ru-106	- (0/2)	- (0/2)	- (0/17)
Cs-134	6.4 (2/2)	- (0/2)	4.0 (5/17)
Cs-137	60.2(2/2)	17.0(2/2)	17.3 (17/17)
Ce-141	- (0/2)	- (0/2)	- (0/17)
Ce-141	- (0/2)	- (0/2)	6.0 (2/17)

* - Not detected.

From the above table it can be seen that all plant related isotope concentrations fall below the minimum detectable limits as the control station is approached (MDC=5 pCi/gm(dry)).

All concentrations of plant related isotopes show a steady downward trend from the values of 1978. For example, in 1978, for Cs-137, the Control Station (Manitou Inlet) had an annual mean value of $6X10^{-6}$ uCi/g dry while in 1979 the mean annual value dropped to $1.7X10^{-7}$ uCi/g dry. This also indicates a downward trend in base level of Cs-137 in the Hudson River due to previous nuclear weapons fallout. It is of interest to note that the average Cs-134 level is approximately one tenth of the Cs-137. Since the initial release ratio of Cs-137/Cs-134 is approximately 2 to 1 this indicates that cesium levels reflect an earlier buildup because the shorter half life of Cs-134 causes the initial ratio of Cs-137/Cs-134 to increase with increasing time after deposition in the river. This supports the hypothesis that the radionuclide concentrations noted in the sediment were not due solely to radioactive materials discharged during 1979.

The main exposure pathways to man by sediment is by direct contact over a protracted period of time and ingestion of bottom feeding fish. Fish are monitored directly and the results of the monitoring program have been discussed in a previous section. It is not feasible for someone to remain in direct contact with sediment at the bottom of the river for any considerable length of time. Therefore, samples of

soil were obtained along the shoreline where persons could theoretically remain corresponding to those general areas where sediment is currently sampled on the river bottom. This allows a more precise estimate of plant influence on shoreline dose rates than is possible using sediment data.

II-2E Shoreline Soil 1979

During 1979, shoreline soil was monitored at six (6) locations up to 5 miles upstream and 7.5 miles downstream of the site discharge. A number of plant related isotopes including Zr-95 and Cs-137 were measured throughout the year.

1979 Shoreline Soil
(uCi/g-Dry) - Activity by Isotope

Measured Isotope	Highest Level All Stations	Control Sta.(Manitou Inlet) Station 50
Zr-95	6.78×10^{-8}	N.D.*
Cs-137	5.32×10^{-7}	2.05×10^{-7}

From the above table, it can be seen that the plant related isotope concentrations in 1979 fell below the minimum detectable limits, (5×10^{-6} uCi/gm dry). The absence of Cs-134 tends to indicate that the Cs-137 present is old and not due to recent effluent releases, but is attributed to nuclear weapons test fallout and plant effluent releases in the past. It was also observed that the average level of all stations for Cs-137 was lower in 1979 than the average for all stations in 1978.

* N.D. - Not detected

II-2F Aquatic Vegetation 1979

During the year, 1979, no aquatic lake vegetation was collected. Numerous attempts were made but no vegetation was present. The results of Hudson River aquatic vegetation sampling indicate that activation and corrosion products such as Mn-54 and Co-60 were detected at several sample sites. In addition, the fission related nuclide, Cs-137 was detected at several of the locations. Only a single positive detection of Co-58 was noted.

Comparison of these results with historical concentrations in aquatic vegetation does not indicate any significant differences. No comparison can be made with preoperational levels since the preoperational environmental monitoring program did not include aquatic vegetation samples. The highest concentration of corrosion/activation and fission products were factors of 4 to 50 less than the concentration of naturally occurring K-40. Hudson River aquatic vegetation in the vicinity of Indian Point is not used for human consumption and analyses of fish samples indicates negligible food chain intake. Hence there is no significant exposure contribution from this pathway to the general public.

II-2G Milk 1979

Results of milk sampling in 1979 indicated Sr-90 and Cs-137 in both indicator and control stations. There were no positive indications of Sr-89 or I-131. The observed levels of Sr-90 and Cs-137 indicate typical environmental levels. Furthermore, the absence of any positive Cs-134 indications suggests the conclusion that the origin of the Cs-137 detected is not plant related.

1979 Milk ($X10^{-8}$ uCi/ml)

Isotope	All indicators (mean value)-Fraction	Control Station Shenandoah Farms-Sta.52-Fraction	
Sr-90	0.47 (26/26)*	0.44	(12/12)
Cs-137	1.26 (12/26)	0.63	(3/12)

II-2H Terrestrial Vegetation 1979

Terrestrial Vegetation

The only radionuclide detected in terrestrial vegetation samples during 1979 was naturally occurring K-40. There were no positive indications of I-131 in 14 samples analyzed. Hence, there was no exposure to the general public through this pathway. These results are comparable to historical levels and are lower than those observed in preoperational studio due to frequent atmospheric nuclear weapons testing in the late 1950s and early 1960s.

* See difinition Page 12

II-2I Soil 1979

Soil sample results for 1979 indicate naturally occurring radionuclides and relatively small amounts of the fission products Sr-90 and Cs-137.

Sr-90 was detected in 7 of 10 samples in 1979 with a annual mean value for all indicator stations of $1.35X10^{-7}$ uCi/g dry and an annual range of $0.68-3.10X10^{-7}$ uCi/g dry. In comparison, the 1978 annual mean value was $0.74X10^{-7}$ uCi/g with a range of $0.5-1.10X10^{-7}$ uCi/g. Comparison of the annual mean values for 1978 and 1979 are misleading. A closer look at 1979 Sr-90 data for all stations show a range comparable to 1978 if a single value, at station 20 Montrose Marina 1.5 mi South is excluded. The basis for exclusion of this value is that it appears excessively high in comparison to other stations and excessively high in comparison to the other stations that are closer in to plant along the same general meridian. A determination of a mean value for Sr-90 for all stations (including station 20) and a standard deviation shows that the one value at station 20 to be better than two standard deviation from the mean. The basic statistical test indicates a high degree of unreliability in that one value.

If that value is excluded, the new Sr-90 annual mean value becomes $1.06X10^{-7}$ uCi/g. This new mean value is roughly equal in concentration to 1978 mean value for Sr-90 of $0.74X10^{-7}$ uCi/g. The 1979 annual mean value for Sr-90 is still below the Technical Specification limit of $5X10^{-6}$ uCi/g for Sr-90 in soil.

II-2I Soil 1979 (Con't.)

Additionally, the absence of positive Cs-134 indicates the Cs-137 detected is not due to plant related operations. In 1979, Cs-137 levels ($4.54X10^{-7}$ uCi/g dry) were comparable to 1978 levels for Cs-137 ($4.39X10^{-7}$ uCi/g dry).

It can be concluded that the fission products detected were due to nuclear weapons fallout. No radionuclides solely attributable to plant operations were detected in the Indian Point environs.

II-2J Drinking Water 1979

Results of drinking water samples indicated one positive indication of Cs-137. This result was close to the limit of detection which suggests that this may be a statistical anomaly. No other plant related radionuclides were seen in 1979. The tritium (H-3) results were comparable to those observed in recent years:

Drinking Water - Tritium

Year	Mean Value-All Indicator Stations
1977	$1.20X10^{-7}$ uCi/ml
1978	$2.08X10^{-7}$ uCi/ml
1979	$1.46X10^{-7}$ uCi/ml

II-2K Ground Water 1979

The results of ground water samples for 1979 indicates no plant related radionuclides were present in any of the twenty four (24) samples taken over this reporting period.

Tritium analysis was done, as per technical specification, on quarterly composites of ground water samples. To obtain these quarterly composites, monthly samples were taken and composited. Although not required, tritium data appears for both monthly and quarterly composites. The 1979 tritium levels are consistent and somewhat lower than those observed over the past several years.

Ground Water - Tritium

Year	mean value all indicator stations	Fraction
1978	2.3×10^{-7} uCi/ml	(7/8)
1979	1.95×10^{-7} uCi/ml	(8/8)

II-2L Surface Water (Lake) 1979

Surface water sample results for 1979 showed that there were no plant related radionuclides found at any location throughout the year. Tritium results agree closely with levels measured in earlier years.

Surface Water - Tritium

Year	mean value all indicator stations	Fraction
1978	2.62×10^{-7} uCi/ml	11/12
1979	2.44×10^{-7} uCi/ml	12/12

II-2M River Water 1979

The only radionuclides positively detected in Hudson River water were Sr-90, Cs-137 and H-3. Although there was one positive indication of Sr-90, the level detected, $5.0X10^{-10}$ uCi/ml was well below the specified min. detectable concentration of $1.0X10^{-9}$ uCi/ml. Therefore, it appears that this positive indication is a statistical anomaly. Cs-137 was detected in two samples ($4.68X10^{-9}$ uCi/ml and $6.8X10^{-9}$ uCi/ml). These levels of positive detection were extremely close to the limit of detection, $5.0X10^{-9}$ uCi/ml. With detected levels of Cs-137 close to limits of detection and the absence of Cs-134, it appears that the positive detections of Cs-137 could be attributed to previous nuclear weapons tests, previous plant operations or possibly a statistical anomaly. Tritium levels are in agreement with those observed over the past several years.

II-2N Precipitation (Fallout)

The results of precipitation samples indicate that the two radionuclides Co-60 and Cs-137 which may be attributable to plant operations, were detected in 1979.

Co-60 was detected in precipitation samples one (1) out of 72 samples in 1979. This lone Co-60 detection was seen at Station 01, the Environmental Lab onsite SSE. No other detections took place at any location or Control Station. This Co-60 detection was seen in the third quarter of 1979 and measured at $8.0X10^{-9}$ uCi/ml. Its singular presence over the entire year does not exhibit any exposure problem to the public. It is possible that this one detection was plant related but in the light of Unit #2 refueling outage for 3/4 cycle in the third quarter of 1979 and extremely minimal levels seen in gaseous effluent releases (from Unit #3 predominantly) in the third quarter of 1979, the probability of plant relatedness drops off considerably.

Cs-137 was detected once in 72 samples taken in 1979. This lone detection occurred in the first quarter of 1979 at Station 27, Croton Point 7.5 mi SSE. It was not seen at any station closer to the plant along the same general meridian in the first quarter. The level measured was $3.7X10^{-9}$ uCi/ml, well below Technical Specification limits. This lone Cs-137 detection appears to be from residual nuclear weapons testing fallout.

Tritium was detected in precipitation samples 54 of 66 times, at or a little above Technical Specification limits (mean annual value for all indicator stations,

II-2N Precipitation (Fallout) (Con't.)

$2.2X10^{-7}$ uCi/ml). These results are consistent with normal environmental levels for tritium seen over the past several years. In comparison to 1978, the annual mean value for 1979 approximately 33% lower.

Precipitation (tritium)
($X10^{-7}$ uCi/ml)

Year	mean value indicator stations	Fraction*
1978	3.8	57/62
1979	2.2	54/66

As indicated in Table 4 of our original April 29, 1980 Annual Report results for tritium in precipitation at Station 24 (Eastview 15 mi SE) were excluded from the tabulated data for the months of January to June due to high sample activity traceable to a local manufacturer. The following is a list of Licensee Event Reports filed with the U.S. NRC Region I.

(1) LER 79-015/04T-0

(2) LER 79-019/04T-0

LER's were not submitted for those months that tritium levels did not exceed ten times control station levels. During these months, a close watch was made on tritium levels from Station 24,Eastview, but none were ten times the control station levels. Although these levels were not reportable, they were sufficiently elevated to make their use in determining a annual mean unreliable and suspect. With

* See definition Page 12

II-2N Precipitation (Fallout) (Con't.)

the return of anticipated environmental levels in July 1979, tritium values from Station 24 Eastview were included in all statistical regimens.

Precipitation as an indicator of fallout was compared to results from prior years. The 1979 precipitation results were comparable to those from recent years but were generally less than 10% of preoperational levels due to the relatively more frequent nuclear weapons testing in the preoperational period of the late 1950s and early 1960s. The results of precipitation samples did not indicate any plant related radionuclides which would result in any significant radiation exposure to the general public.

III

CONCLUSION

An evaluation of the results of the radiological environmental monitoring program for the Indian Point site has not indicated any areas of significant radiation exposure to the general public or to any part of the environment. The following table summarizes the annual doses from various natural and man-made sources, including any doses calculated as a result of environmental monitoring surveys. This information shows that the maximum doses to the general public from operation of the Indian Point Nuclear Power Station are negligible and are in keeping with the philosophy of maintaining exposure as low as is reasonable achievable.

Comparison of Sources of Exposure

Natural or Man-Made Sources (Average U.S.)	Annual Doses, MREM-Whole Body
External Dose from Natural Terrestrial Radioactivity (Reference 8)	65
External Dose from Cosmic Radiation (Reference 8)	45
Internal Dose from Natural Radionuclides (Reference 9)	30
Medical and Dental Radiation (Reference 10)	72
Weapons Test Fallout (long-term) (Reference 8)	4.4
Doses Calculated from Environmental 1979 Monitoring Results	0.2

IV

1979 SUMMARY OF EXCEEDED MINIMAL DETECTABLE AMOUNTS

In 1978, following a U.S. Nuclear Regulatory Commission Audit of our radiological monitoring program, it was suggested that we change our method of calculating minimal detectable amounts to that found in the HASL Procedure Manual-HASL-300. Our radiological laboratory contractor was notified of this change and they adopted this new calculational method starting with samples collected July 1,1978. In essence, the definition of lower limit of detection was changed from 2Sb to 3.3 Sb, where $Sb=2\sqrt{\frac{\text{counts}}{\text{counting time}}}$. At that time it was understood that since the definition of MDA had changed a corresponding change of MDA levels listed in our ETSR had to be made. Steps in this direction were initiated early in 1979. To compensate more immediately for this more restrictive requirement, counting time was increased by a ratio of 3.3 to 2, or 1.65. In the case of Cs-134, Cs-137 in milk and water, for example, where the MDA is 5pCi/l, counting time was increased from 15 hrs. to 24 hrs. This method of adapting to the new definition of MDA, given the limits which had been set for use with the older definition was not successful in all cases.

The change in the calculation of the M.D.A. also explains the inability to meet current technical specifications MDA's in two charcoal samples and aquatic vegetation. Additionally, in 5 charcoal samples the air volume sampled was considerably lower than normal resulting in a sample size too small to allow us to meet their MDA's.

A second feature which applies to milk, but not water, and which causes higher MDA's is the contribution to the background count rate from the Compton plateau of 1460 KEV gamma of K40 which occurs naturally in milk.

A third problem arose with a few precipitation samples. MDA could not be met in June and July due to low rainfall and consequently small sample volume.

In early 1979 an Environmental Technical Specification Requirements change package was submitted to the Commission for approval. Presently, this package is being reviewed by the Commission. The proposed change would incorporate the recommended MDA's of the U.S. NRC Model Technical Specification, Rev.2, Table 4.12-1. We would like to note that in every case we met the MDA's listed in the U.S.N.R.C. Model Technical Specification Rev. 2 Table 4.12-1, which are considered state of the art by NRC, in 1979.

Approval of our ETSR package by the Commission is likely to minimize the probability of any recurrence of this problem in the future.

Attached is a summary table of all MDA's not met in 1979 for the reasons explained in the preceding text.

Water - 1979

Station# *	Collection Date	MDA not met for	Type
06	February	Cs-134/137	WD-Drinking
47	March	Cs-134	WG-Ground
01	March	Cs-134/137	WP-Precipitatior
38	February	Cs-134	WP
23	February	Cs-134	WP
24	February	Cs-134	WP
29	January	Cs-134/137	WP
09	January	Cs-134	WR-River
10	February	Cs-134/137	WR
46	March	Cs-134/137	WT-Surface
23	April	Cs-134	WP
23	June	Cs-134/137	WP
24	June	Cs-134/137	WP
27	May	Cs-134/137	WP
27	June	Cs-134/137	WP
29	April	Cs-134	WP
29	May	Cs-134	WP
29	June	Cs-134/137	WP
38	June	Cs-134/137	WP
07	May	Cs-134	WD
08	June	Cs-134	WD
18	April	Cs-134	WG
15	May	Cs-134	WG
47	June	Cs-134/137	WG
09	May	Cs-134	WR
09	June	Cs-134/137	WR
11	June	Cs-134/137	WT
12	June	Cs-134	WT
13	April	Cs-134	WT
56	July	Cs-134/137	WD
06	July	Cs-134/137	WG
18	August	Cs-137	WG
47	July	Cs-134/137	WG
01	July	Cs-134/137	WP
23	July	Cs-134/137	WP
24	July	Cs-134/137	WP
27	July	Cs-134/137	WP
29	July	Cs-134/137	WP
38	July	Cs-134/137	WP
13	August	Cs-137	WT
47	December	Cs-134	WG
01	October	Cs-134/137	WP
23	December	Cs-134/137	WP
29	November	Cs-134/137	WP
11	November	Cs-134/137	WT
12	December	Cs-134/137	WT
13	November	Cs-134/137	WT
46	December	Cs-134	WT

*See original April 29, 1980 submittal for definition of Station locations.

Milk - 1979

Station#*	Collection Date	MDA not met for
40	1/15	Cs-134
45	1/17	Cs-134/137
45	3/14	Cs-137
51	1/15	Cs-134
51	2/5	Cs-134
52	1/17	Cs-134
52	2/14	Cs-134
51	4/9	Cs-134
52	6/20	Cs-134
45	7/18	Cs-134/137
51	7/16	Cs-134
51	8/13	Cs-134
52	8/15	Cs-134/137
52	9/15	Cs-134/137
55	8/13	Cs-137
45	10/17	Cs-137
45	11/21	Cs-134/137
45	12/19	Cs-134
51	10/15	Cs-134/137
51	11/19	Cs-134/137
52	10/17	Cs-134/137
52	11/21	Cs-134/137
55	10/15	Cs-134/137
55	11/19	Cs-134/137

*See original April 29, 1980 submittal for definition of station locations.

Charcoal Filters: I-131 - 1979

Station#	Collection Date	MDA not met for
01	3/27-29	1.68E 0S cc - low volume
27	3/27-29	1.70E 0S cc - low volume
29	1/10-17	1.50E 0S cc - low volume
43	3/28-4/3	
02	12/24-31	
03	11/20-27	2.86E 0S cc - low volume
3S	12/18-24	1.72E 0S cc - low volume

Aquatic Vegetation - 1979

Station#	Collection Date	MDA not met for
15 Myr.	9/13	Cs-134/137
15 Per.	9/13	Cs-134/137
16 Myr.	9/13	Cs-134/137
16 Per.	9/13	Cs-134/137
17 Myr.	9/13	Cs-137
22 Myr.	9/13	Cs-134/137
49 Myr.	9/13	Cs-134/137

V Direct Gamma Radiation Monitoring

Thermoluminescent Dosimetry (TLDs) is one method presently utilized to obtain continuous integrated measurements of background radiation. Calcium sulfate ($CaSO_4$) TLDs are posted at 21 locations onsite and in the environs of Indian Point. These locations are delineated in Table 7. Two holders are posted at each location each holder normally containing two TLDs. One of the TLD's is changed monthly while the other is changed quarterly. For the purposes of this report the quarterly exposures were used in all statistical regimens and in deriving all tables. The monthly exposures provided additional information for cross-check purposes and studying variations in background exposure in that particular quarter.

The TLD results in Table 8 have been revised to reflect the correction of typographical and calculational errors found in the original report submittal, April 29, 1980. These results are a more comprehensive measurement of background radiation since they are continuously posted and this represents the total integrated exposure a person would receive if they were standing in that location for the entire quarter.

The results of direct gamma radiation monitoring utilizing TLD equipment ranged from 10.5 mrem/quarter (avg) at Hamilton St. Substation, 3 mi NNE of the plant to 20.8 mrem/quarter (avg.) at the Northeast corner of the plant site.

In an attempt to determine if a significant fraction of the 1979 exposures was due to plant operations, a statistical regimen was applied to the results in Table 8. Our goal in this statistical treatment of the TLD Data was to identify abnormally deviant values and to establish causality if possible.

Initially the quarterly results from each station were averaged (annual mean) and a standard deviation developed for each station (See Table 8). All stations were then averaged by quarter and a correction factor for each quarter developed. This correction factor was then applied to each reading of that quarter to negate the effects of seasonal variations. This rendered a set of "normalized TLD values" from which a new annual mean and standard deviation for each station was developed. These new annual means for the individual stations were then taken and used to develop an annual mean and standard deviation for the entire year for all stations (1979 Annual Mean Value for all stations 14.43 ± 2.49 mrem/quarter).

At this point all annual mean values for each station were compared to the annual mean for all stations by the use of a $\pm$ two standard deviation test. This procedure gave us a 95% reliability to our data and allowed us to further investigate those station values that fell outside $\pm$ two standard deviations. It was found that only one TLD location station 37, N.E. corner of plant site-onsite fell outside this range and station 01, the Environmental Laboratory onsite SSE, fell within range but close enough to $\pm$ two standard deviations to be investigated. These findings will be discussed later in this section.

V Direct Gamma Radiation Monitoring (Contd.)

An additional statistical analysis was then employed to further examine these two stations. From the normalized set of data a relative standard deviation (RSD) was derived for each station by taking the standard deviation for that station and dividing by the annual mean for that same station. When this was done for each station, the values (RSDs) were averaged and a standard deviation determined. The individual RSDs were compared to the mean RSD by a $\pm$ two standard deviation test. This statistical approach allowed us to establish if an individual station in question was consistently high or low for all quarters or inconsistent from quarter to quarter. The former case would indicate reliable values due to specific set of conditions, e.g. location. The later case would indicate less reliable values problably due to a specific cause such as equipment problems.

As mentioned above, all but two stations passed our 95% reliability test ($\pm$ 2 std. dev.), station 37 NE corner of plant site-onsite and station 01, the Environmental Laboratory, onsite SSE.

Station 37 was better than two standard deviations from the annual mean for all stations. When the additional statistical regimen (RSDs) was applied to the normalized values for station 37 it was determined that station 37 as a whole was consistently high for all quarters. This would indicate that the values were reliable and consistently high due to another cause. Further investigation of the exact geography of station 37 revealed that this location

V Direct Gamma Radiation Monitoring (Cont.d)

was situated in direct line of sight to the Integrated Waste Evaporator Tanks by Unit Nos. 1&2 and the Unit No. 2 Refueling Water Storage Tanks (RWSTs) the external gamma dose from which probably accounts for the consistently high values seen all year at station 37.

Station 01, the Environmental Laboratory onsite SSE, annual mean was not quite two standard deviations out ($+1.86\sigma$) but needed explanation. As with the station 37, we applied this additional statistical approach (RSDs) to station 01 values. Again, consistency within the station was determined and this consistency was high for all quarters. Station 01's geography was investigated and revealed the following. Station 01, onsite, sits on a hill SSE of Unit No. 2 and east of Unit No. 3. It sits in direct line of sight with Unit Nos. 1&2 Integrated Waste Evaporator Tanks and Unit No.3's RWSTs. As with the explanation for station 37, the consistently high values were probably due to this line of sight direct gamma radiation exposure.

Other onsite stations showed annual mean values very consistent with the mean for all stations. Investigation revealed that these other onsite stations were physically blocked, whether by hills or buildings, from the sources of exposure that stations 01 and 37 saw.

In summary, the TLD data for 1979 indicates a normal range of background radiation values seen in the environment and comparable to past years. This applies to all stations looked at for an individual quarter as well as an individual station looked at for all quarters. These 1979 TLD readings, also indicate that there was no significant increase in background exposure to the general public in the

environs of Indian Point due to plant operations. The exceptions, where it appears some of the exposure was plant related, station 01 and 37 were still within the normal acceptable range.

After the initial instantaneous direct gamma measurements results were submitted it was discovered that calibration correction factors were not applied to the 1979 calibration therefore, influencing the 1979 Road Survey data. The corrected results appear in the revised Table 6 following this discussion.

In the revised Table 6, a four year comparison is presented for each site. One can see from Table 6, 1977 and 1979 results agree with each other but are slightly higher than 1976 and 1978. The 1977 and 1979 surveys were performed in the fourth quarter of the respective years while the 1976 and 1978 were performed in the third quarter of those years.

During the week June 9-13, 1980, forty (40) locations were rechecked to see if there was seasonal variations in the data. Two (2) Reuter-Stokes RSS-111 pressurized ionization chambers were used. After applying calibration correction factors to the results obtained from both instruments, the two instruments agreed at almost all locations. The difference between the June 1980 readings and the December 1979 readings showed the December 1979 readings to be between 20-30% higher at the resurveyed locations. When a calibration is performed a background reading is taken first and subtracted from all readings in the calibration. The background reading obtained at the December 1979 calibration was 12.7 μR/hr. The June 1980 background reading was 10.8 μR/hr. a 17.6% difference.

V Direct Gamma Radiation Monitoring (Con't.)

Although the above case in inconclusive it appears that the 20-30% difference between December 1979 and June 1980 readings may be due to seasonal variations. Further study of the possible causes of the observed discrepancies is continuing.

TABLE 6

ANNUAL ROAD SURVEY RESULTS

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/7[illegible]
1	Con Ed Parking Lot #3 at Pole #17255	12.2	22.3	11.2	21.0
2	Old Con Ed Visitors Parking Lot Center Pole One W/O Transformer #17229	6.5	7.8	7.2	6.7
3	B'way 60' N/W corner Bleakley Ave.	6.5	7.2	6.7	7.9
4	W/S B'way 150' S/O First St. Opposite Pole T-12	6.5	7.8	6.7	8.7
5	B'way Opposite Pole #W27783	6.5	7.8	6.7	8.2
6	E/S Westchester Avenue E/O Pole #25	6.5	7.2	6.2	8.1
7	W/S B'way N/W Corner 11th Street at Pole #T-48	6.5	7.8	7.2	7.4
8	E/S B'way S/E Corner 6th Street W/O Pole #73	7.2	7.8	6.2	8.9
9	W/S B'way S/W Corner 4th Street at Pole #W63	6.5	7.8	6.7	8.5
10	W/S B'way 60 ft. N/O Hardie Street at Pole #72	7.2	7.8	6.7	9.3
11	6th Street at Hudson River 100 ft. W/O Pole #89	5.8	7.2	6.2	6.8
12	N/S 6th Street 20 ft. E/O Highland Avenue at Hydrant	6.5	7.8	6.7	9.1
13	S/E Corner 6th St. S/O Westchester Ave. at Pole #1.	7.2	8.8	6.7	9.7
14.	6th Street at Lake Meahagh at Pole #W12505	5.8	7.2	7.2	6.8
15	E/S Kings Ferry Road Opposite Pole #27564	5.7	7.8	6.7	7.3
16	Intersection of Kings Ferry Road and Tate Avenue Pole #22	6.5	7.2	7.2	7.8
17	W/S Westchester Avenue & 4th Street F/O Pole #9	6.5	7.8	6.2	7.7

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
18	W/S Westchester Avenue N/O First Street at Pole #WL.C.13	5.8	7.2	6.2	8.2
19	Westchester Avenue & Tate Avenue F/O Pole #WI L114	6.5	7.2	5.6	8.8
20	E/S Route 9A Pole #W106 Next to 219 N.Y. Albany Post Road	5.8	7.2	6.7	8.7
21	N/S Bleakley Avenue 500 ft. W/O Route 9A Pole #W6 & Hydrant	5.8	7.2	6.2	8.6
22	F/O Pole 29715 N/W Corner South Street and Route 9A	5.8	6.6	6.2	7.6
23	S/W Corner Welcher Avenue & Route 9A Pole #W15	6.5	7.8	6.2	8.9
24	South Street 500 ft. N/O Welcher Avenue Pole #W109	5.8	7.8	7.2	9.1
25	W/S South Street Opposite Junkyard F/O Pole T44	5.8	6.6	6.2	8.1
26	S/S Travis Lane Off South Street Pole #W3	7.9	7.2	7.2	9.8
27	W/S South Street S/O Franklin Avenue F/O Pole #W69	5.0	7.2	6.2	7.8
28	Franklin Avenue N/S W/O Route 9A F/O Pole #W5	7.2	8.8	6.7	10.9
29	S/S Bay Street W/O Route 9A F/O Service Pole Opposite Pole #3	7.2	7.8	7.2	11.8
30	Corner Bay Street & South Street Pole #W63	7.2	8.8	6.7	9.2
31	W/S Route 9A 4 Miles S/O Franklin Street Bridge (Mileage Marker 3005)	5.8	7.8	6.2	7.5
32	W/S Route 9A at Welcher Avenue Exit Sign 30 MPH	7.2	7.8	6.8	7.7
33	N/S Woodale Avenue W/O Maple Avenue Pole #WLC1	6.5	7.8	6.7	9.2
34	N/W Corner Hudson & Maple Avenue Pole #13	5.8	7.8	6.2	8.6

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN uR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
35	Hudson Avenue S/E Corner Walnut Street Pole #W39	6.5	7.2	6.7	8.9
36	Park Drive Between Freemont & Union Avenue at Light Pole	5.8	7.8	6.2	7.6
37	N/S Union Avenue N/O Franklin Street Pole #W31	5.8	7.8	6.7	8.4
38	W/S Ridge Street S/O Franklin Street F/O 622 Pole #3	5.8	7.8	6.7	9.0
39	Shenandoah Avenue & Washington Street Pole #W48	7.2	7.8	6.2	8.6
40	Washington Street E/S N/O Welcher Avenue Pole #W83	6.5	7.8	6.2	7.5
41	W/S Washington Street S/O Short Street Pole #W96	6.5	7.8	6.7	8.0
42	E/S Washington Street S/O Pine Lane Pole #W106	6.5	7.8	6.2	7.1
43	E/S Washington Street S/O Boulder Drive Pole #114	5.8	7.2	6.7	7.4
44	E/S Washington Street N/O Montrose Station Road Pole #122	6.5	7.8	6.2	7.6
45	N/S Factory Street 200 ft. E/O Route 9A Pole #W5	6.5	7.2	6.7	8.1
46	S/W Corner Albany Post Road & Catherine St. Pole #W121	6.5	7.2	6.7	7.2
47	S/W Corner Lane Street Albany Post Road Pole #728	5.7	8.8	6.2	8.1
48	N/S Trolley Road & Kings Ferry Road	6.5	7.8	6.7	8.0
49	N/E Corner King Ferry Road & Harper Avenue Pole #6	5.0	7.2	6.2	7.1
50	S/W Corner Route 9A S/O Kings Ferry Road Pole #717	5.7	7.7	6.7	4.6

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
51	W/S Route 9A S/O Lancaster Avenue Pole #707	6.5	7.8	6.2	7.7
52	W/S Route 9A Opposite Kaufman Auto Pole #T692	5.0	7.2	6.7	8.3
53	W/S Route 9A Front Crugers Substation Pole #189	5.7	7.8	6.2	7.9
54	W/S Route 9A at Pole #26577 Opposite Trailer Park	5.7	7.8	6.2	8.0
55	W/S Route 9A S/O Crugers Station Road Pole #26333	5.7	7.2	7.2	9.1
56	W/S Route 9A S/O Laurel Hill Road Pole #26342	6.5	7.8	6.7	8.7
57	W/S Route 9A at Gulf Gas Station Opposite Pole #3319	5.7	7.8	6.2	7.7
58	W/S Route 9A Front of Furnace Dock Unit Substation	5.8	7.2	6.2	8.2
59	W/S Route 9A Front of Pole #101	5.8	7.8	6.7	8.1
60	W/S Route 9A S/O Warren Road Pole #88	5.8	7.8	6.7	8.5
61	W/S Route 9A Front of Sky View Haven Home Pole #66A	7.2	7.2	6.7	8.9
62	N/S Wolf Road W/O Route 9A First Pole	5.8	7.2	6.2	7.2
63	S/S Wolf Road South W/O Route 9A Pole #4611	5.8	7.8	5.6	7.4
64	North Riverside Avenue & Brook Street Pole #W133	5.0	7.2	6.7	7.5
65	E/S Washington Street N/O Watch Hill Road Pole #155	5.8	7.8	6.7	8.0
66	E/S Washington Street N/O Watch Hill Pole #181	5.8	7.8	6.7	7.6
67	E/S Washington Street N/O Watch Hill Pole #192	5.0	7.8	6.7	7.5
68	W/S Washington Street N/O Watch Hill Pole #205	5.8	7.8	6.7	8.1

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
69	At Turnoff Past Toll Gate on Bear Mountain Bridge Going West 50 ft. Past Toll Plaza	7.9	7.2	7.2	8.1
70	W/S 9W Just South of Traffic Circle at Sign A.K. Morgon Overlook Lodge	7.9	7.8	6.2	9.3
71	W/S 9W Driveway in Front of Garage Door	7.9	8.8	7.2	9.9
72	W/S 9W at Signs for 202 & 9W 50 ft. Before Entrance to Bear Mountain Inn	8.6	8.8	7.2	9.7
73	E/S 9W at Sign "Service Road Do Not Enter" (Granite Rock Nearby)	9.4	17.0	30.0	36.7
74	E/S 9W at Entrance to Palisades Interstate Park Comm. Receiving Dept.	10.1	7.8	11.2	13.2
75	W/S 9W Road Marker 9W-8501-1255	9.4	8.8	7.2	10.5
76	W/S 9W at Stop Sign at Exit to Bear Mountain Park	7.9	7.8	7.6	10.9
77	W/S 9W at Sign "Use Two Lanes"	7.9	9.8	8.0	10.0
78	W/S 9W at Sign "Hill Trucks Use Lower Gear" Marker #150	10.1	11.0	8.4	11.4
79	E/S 9W Marker 9W-8501-1230	8.6	9.8	8.0	11.1
80	E/S 9W at Stop Sign at Entrance to Revival Church	7.2	7.2	7.6	7.8
81	E/S 9W at Pole #247	6.5	8.8	7.6	8.1
82	W/S 9W in Front of Marshall's Drive-Inn	7.9	7.8	7.2	8.1
83	W/S 9W Entrance to Private Drive-way Telephone Pole #220	6.5	8.8	7.6	8.3
84	W/S 9W Near Snuffy's Restaurant Pole #207	7.9	8.8	8.0	8.5
85	E/S 9W at River Tower Overlook	8.6	7.8	8.0	7.9
86	E/S 9W Cedar Restaurant Telephone Pole #6	7.9	7.8	6.2	8.8
87	W/S 9W in Front of Public Library at Sign "Tomkins Cove Library"	7.9	8.8	7.2	10.3

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN uR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
88	W/S 9W at Big Tree in Connors Bar Parking Lot	7.2	7.2	8.0	8.8
89	W/S 9W Gulf Gas Station at Big Gulf Sign	7.9	7.2	7.2	7.9
90	W/S 9W Esso Gas Station at Big Esso Sign	7.9	7.2	7.6	7.3
91	W/S 9W American Gas Station at Big American Sign	7.9	7.2	7.6	7.6
92	E/S 9W R&H Pancake House Telephone Pole #88	7.9	7.2	7.6	7.8
93	W/S 9W Stoney Point Appliance Co. at Sign	8.6	7.8	7.6	7.6
94	W/S 9W Citgo Gas Station at Big Citgo Sign	7.9	8.8	6.7	9.1
95	E/S 9W in Front of State Police Station Telephone Pole #11	8.6	8.8	6.7	7.5
96	W/S 9W B.P. Gas Station at Big B.P. Sign	7.9	7.8	7.2	7.6
97	W/S 9W Chevron Gas Station at Big Chevron	7.2	7.8	8.0	8.5
98	W/S 9W Haverstraw Motors at Big Ford Sign	7.2	8.8	7.6	8.8
99	W/S 9W Samsondale Shopping Center at Big Sign	7.2	8.8	6.7	8.6
100	W/S 9W Jack-In-The-Box Drive-In at Big Sign	7.2	7.8	6.7	8.3
101	W/S 9W Conger & Gurnee Avenues S/W Corner (Marker 8501-1162)	7.2	7.8	6.2	7.3
102	W/S 9W Conger & Westside Avenues N/W Corner	7.2	7.8	7.2	7.3
103	N/S 202 Broad Street at Pole #W3	7.9	7.2	7.2	7.9
104	N/S 202 Grant Avenue at Pole #W4	7.2	7.2	7.2	7.8
105	S/E Corner 202 at Pole #WL65A, Cayuga Road	7.2	7.2	6.7	8.8

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
106	S/W Corner 202 & Buttonwood Avenue Pole #W6	7.2	7.8	6.7	8.8
107	E/S 202 Near Taylor Avenue Opposite Deli at Pole #5	8.6	7.8	6.7	8.0
108	S/E Corner Northridge Road & 202 Pole #WL33	8.6	7.8	6.2	8.4
109	S/W Corner Crestview Avenue & 202 at Pole #72	7.9	7.2	6.7	8.2
110	Route 202 Near Lane Pole #81	7.2	7.8	6.7	8.7
111	Route 202 & Bear Mountain Parkway Pole #91	7.9	8.8	6.2	8.1
112	W/S Croton Avenue at Pole #W11 After Mailbox #66	9.4	8.8	7.6	9.4
113	W/S Croton Avenue at Pole #W20 After Mailbox #105	9.4	7.8	6.7	8.4
114	W/S Croton Avenue at Pole #W45 After Mailbox #170 (Croton Egg Farm)	8.6	8.8	6.7	8.6
115	E/S Furnace Dock Road at Pole #W209 After Mailbox #519	8.6	8.8	6.7	7.7
116	E/S Furn. Dock Road at Pole #W197 at Harmony Hill	7.9	7.2	7.2	9.1
117	N/E Maple Avenue & Furn. Dock Road Pole	7.2	7.2	6.7	7.3
118	N/S Maple Avenue & Shaw Highway at Pole #11	7.2	7.8	6.2	7.3
119	N/S Maple Avenue & Gallaway Lane at Pole #92	7.9	6.6	6.2	7.7
120	S/S Maple Avenue & Furnace Woods Road at Pole #76	7.2	7.8	7.2	7.8
121	N/S Maple Avenue & Montrose Station Road at Pole	7.2	7.2	6.7	8.2
122	N/S Maple Avenue & Chapel Place at Pole #54	7.9	7.8	6.7	8.4
123	S/S Route 202 at Pole #W95	7.9	7.8	6.2	8.7
124	S/S 202 (Fuel Oil) at Pole #W88	7.9	7.2	6.2	8.3

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
125	S/S 202 Buttonwood Road at Pole #1	8.6	7.2	6.2	8.3
126	E/S Route 9 at South Street Exit Pole #W34	6.5	7.8	7.6	8.3
127	E/S Route 9 at Main Street Exit by Road Sign 6 & 202	7.9	7.8	7.6	9.3
128	W/S Route 9A,.4 Miles North of Main Street Exit	8.6	7.2	7.2	8.6
129	E/S Route 9 at Intersection 9A Route 6 & 202 N/W Corner Mile Marker 8701	9.4	9.8	7.2	8.3
130	N/S Route 6 & 202 Front of Police Station	7.9	7.8	7.6	7.5
131	Service Road @ Gate Esso Gas Plant Pole CE4	7.9	7.8	7.2	7.6
132	E/S Service Road to Esso Gas Plant Pole CE2	7.2	7.8	7.2	8.7
133	Bear Mountain Road & Roa Hook Road at Pole	8.6	7.8	7.6	8.5
134	Bear Mountain Road N/O Roa Hook Road,.1 Mile Pole #W6	8.6	8.8	8.0	10.1
135	E/S Route 202 & 6 at Pole #W17	7.9	7.8	8.0	9.1
136	W/S Route 202 & 6,.4 Miles N/O Pole #W17 Near Highway Mark 87	7.9	8.8	7.6	12.4
137	E/S 202 & 6,.8 Miles N/O #W17 20 ft. S/O 2nd 20 MPH Sign	10.1	12.0	8.0	15.7
138	E/S 202 & 6, 1.5 Miles N/O Pole #W1 at Turn Off	8.6	8.8	7.2	7.7
139	W/S Routes 202 & 6 at Parking Log	8.6	9.8	6.7	8.6
140	E/S Routes 202 & 6 S/O Bear Mountain Bridge	7.9	7.8	8.0	8.0
141	N/S Route 6 Corner Lexington Avenue Pole #W81	8.6	7.8	6.2	7.9
142	N/S Route 6 S/O Baker Street Pole #W2	7.9	7.8	6.2	9.0

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/24/79
143	N/S 6 Front of Lakeland School Pole #W236	7.2	7.2	6.7	7.1
144	N/S 6 S/O Renee Gate Pole #299	7.9	7.8	6.7	7.7
145	N/S 6 E/O Jerome Drive Pole #W213	8.6	8.8	6.7	7.7
146	N/S 6 N/O Millington Road Pole #201	8.6	7.8	6.7	8.2
147	N/S 6 S/O Locust Avenue Pole #W196	7.9	9.8	7.2	8.6
148	S/S 6 Main Street & Parkway Drive Pole #50	9.4	9.8	7.2	8.3
149	N/S 6 Opposite Food Store (Pantry Pride) Pole #169	7.9	8.8	6.7	8.8
150	N/S 6 Opposite Beach Shopping Center Pole #148	8.6	8.8	6.2	8.2
151	N/O 6 W/S Husted Avenue Pole #26946	8.6	7.8	7.2	9.9
152	Charles Street S/O Route 6 Pole #W2	6.5	7.8	7.2	9.2
153	E/S 6 & Broad Street Pole #W72	5.8	7.8	6.7	7.6
154	Park Street & South Division Street S/E Corner at Street Sign	8.6	8.8	7.2	9.6
155	E/S Division Street N/O Orchard Street Pole #W5	7.9	7.8	7.2	7.9
156	W/S North Division Street & Pemart Avenue Pole #56	7.9	8.8	7.6	9.1
157	W/S North Division Street N/W Corner Lockwood Drive Pole #37	7.9	7.8	7.2	8.9
158	E/S Catherine Street & Oregon Road Pole #W6	7.9	7.8	7.2	8.7
159	N/E Corner Oregon Road & Oak Street Pole #W17	8.6	7.8	7.2	9.4
160	Oregon Road & Gallons Hill Road Pole #13527	7.9	8.8	7.6	9.2
161	Oregon Road & Adams Rush Street Pole #W60	7.9	8.8	7.6	8.6

TABLE 6 (Continued)

POINT NUMBER	LOCATION	READINGS IN μR/hr. 7/21/76	10/29/77	9/14/78	12/27/79
162	Oregon Road N/E Varian Road Pole #1	7.9	7.8	7.2	8.6
163	Oregon Road & Westbrook Drive F/O Carvel Stand	7.2	7.8	7.6	8.2
164	Casparian Road W/O Oregon Road Pole #123	8.6	7.8	7.6	8.4
165	Air Monitor House	6.5	7.8	6.7	9.9
166	Algonquin Air Sampling Location	7.2	7.8	7.2	8.8
167	Fleischmanns (Gin Building))	7.2	-	7.2	10.5
168	Furnace Dock Air Sampling Station	5.8	6.6	6.2	8.1
169	Hamilton Street Air Sampling Station	6.5	7.2	7.2	8.2
170	Factory Street Air Sampling Station	7.2	7.8	6.7	8.5
171	Croton Air Sampling Station At Croton Point Park	6.5	7.2	6.2	7.1
172	Grassy Point Air Sampling Station at U.S. Gypsum	6.5	7.8	7.6	9.9
173	Service Building (Parking Lot)	6.5	7.8	7.2	7.7
174	N.Y.U. Air Sampling Station	5.8	7.2	6.7	6.8
175	Roseton Air Sampling Station at Roseton Power Plant	7.9	7.8	8.0	10.0
176	Oregon Road in Front of Substation	6.5	8.8	7.2	7.7

TABLE 7

TLD LOCATIONS AND SAMPLE FREQUENCY

FOR MEASUREMENT OF DIRECT GAMMA RADIATION

LOCATION	SAMPLE FREQUENCY
1. Environmental Laboratory, Onsite - SSE	Monthly/Quarterly
2. Standard Brands. 0.6 mi. - NNE	"
3. Service Building, Onsite - SSE	"
4. Algonquin Gas Line, 0.25 mi - S	"
5. NYU Tower, 1 mi. - SSE	"
14. Water Meter House, Onsite - E	"
20. Montrose Marina, 1.5 mi. - S	"
23. Roseton, ** 20 mi. - N	"
26. Verplank (Broadway & 6th St.)	"
27. Croton Point, 7.5 mi. - SSE	"
28. Lent's Cove, 0.9 mi. - NE	"
29. Grassy Point, 3 mi. - S	"
30. Dock, Onsite - W	"
31. Onsite Pole - S	"
32. Factory St. SS, 1 mi. - ESE	"
33. Hamilton St. SS, 3 mi. - NNE	"
34. SE Corner, Onsite - SE	"
35. Bleakley & Broadway, Onsite - E.	"
36. Old Dump, 0.5 mi. - ENE	"
37. NE Corner, Onsite - NE	"
38. Furnace Dock SS, 3.5 mi. - SE	"

** Control Station

TABLE 8 (revised)

Results of Direct Gamma Radiation Monitoring (TLDs)
mR/quarter

LOCATION	1st Q	2nd Q	3rd Q	4th Q	AVERAGE
1	18.35	17.50	17.90	22.50	19.06±2.32
2	18.95	15.70	13.00	15.80	15.86±2.43
3	15.30	12.60	10.55	13.00	12.86±1.94
4	17.55	15.55	13.25	16.80	15.79±1.88
5	19.50	14.00	11.90	14.90	15.08±3.21
14	18.75	14.95	12.85	15.25	15.45±2.45
20	12.65	11.60	8.65	10.50	10.85±1.71
23*	15.80	18.80	14.15	18.05	16.70±2.12
26	14.15	14.20	10.50	14.45	13.33±1.89
27	13.10	12.70	10.30	13.50	12.40±1.44
28	15.90	15.65	14.05	17.20	15.70±1.29
29	13.95	14.15	10.70	13.20	12.95±1.59
30	17.70	11.85	10.00	12.50	13.01±3.30
31	15.10	15.30	11.60	14.10	14.03±1.70
32	12.15	14.15	10.50	12.90	12.45±1.53
33	14.20	10.50	7.75	9.60	10.59±2.71
34	**	14.65	12.75	14.80	14.07±1.14
35	18.70	13.95	12.00	14.30	14.74±2.83
36	13.45	12.85	9.95	3.80	12.08±1.87
37	20.35	22.55	20.00	20.40	20.83±1.16
38	13.95	16.35	13.00	14.80	14.53±1.42

NOTE: The results of the control badges were subtracted from all readings. All results in mR/Quarter.
** -Data unattainable due to theft of TLD equipment.
*-Control Station

TABLE 9

Normalized TLD Values
(Corrected for seasonal Variation)

LOCATION	1st Q	2nd Q	3rd Q	4th Q	AVERAGE
1	16.77	17.19	20.19	22.10	19.06±2.53
2	17.37	15.39	15.29	15.40	15.86±1.01
3	13.72	12.29	12.84	12.60	12.86±0.61
4	15.97	15.24	15.54	16.40	15.79±0.51
5	17.92	13.69	14.19	14.50	15.08±1.93
14	17.17	14.64	15.14	14.85	15.45±1.16
20	11.07	11.29	10.94	10.10	10.85±0.52
23	14.22	18.49	16.44	17.65	16.70±1.86
26	12.57	13.89	12.79	14.05	13.33±0.75
27	11.52	12.39	12.59	13.40	12.40±0.66
28	14.32	15.34	16.34	16.80	15.70±1.10
29	12.37	13.84	12.99	12.80	12.95±0.62
30	16.12	11.54	12.29	12.10	13.01±2.10
31	13.52	14.99	13.89	13.70	14.03±0.66
32	10.57	13.84	12.79	12.50	12.43±1.36
33	12.62	10.19	10.04	9.20	10.51±1.47
34	*	14.34	15.04	14.40	14.59±0.39
35	17.12	13.64	14.29	13.90	14.74±1.61
36	11.87	12.54	12.24	--	12.22±0.34
37	18.77	22.24	22.29	20.00	20.83±1.74
38	12.37	16.04	15.29	14.40	14.53±1.59

Annual mean for all stations
14.43±2.49 Mrem/quarter

References

6. "Effluent and waste Disposal Semiannual Report", Indian Point Nuclear Power Station (January 1 - June 30, 1979, and July 1 to December 31, 1979. Licensee: Consolidated Edison Company of New York, Inc., and the Power Authority of the State of New York.

7. "Effluent and Waste Disposal Semiannual Report". Indian Point Nuclear Power Station (January 1 - June 30, 1979, and July 1 to December 31, 1979). Prepared by the Power Authority of the State of New York.

8. United States Environmental Protection Agency, "Radiological Quality of the Environmental in the United States, 1977". EPA 520/177-009 .

9. "Natural Background Radiation in the United States". National Council on Radiation Protection and Measurements, NCRP Report No. 45, 1975.

10. "Estimates of Ionizing Radiation Doses in the United States, 1960-2000" ORPICSD72-1, U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC 1972.

11. Energy Research and Development Administration, Health and Safety Laboratory, Environmental Quarterly, HASL Reports, NY, NY 10014 (1958-1978).

12. United Nations Scientific Committee on the Effects of Atomic Radiation, 1977 Report to the General Assembly, with Annexes, "Sources and Effects of Ionizing Radiation" NY, NY 1977.