RADIOLOGICAL ASSESSMENT BRANCH

INDIAN POINT NUCLEAR GENERATING STATION

UNIT NOS. 1,2 AND 3

JANUARY 1, - DECEMBER 31, 1981

ANNUAL ENVIRONMENTAL OPERATING REPORT

RADIOLOGICAL

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1.0 INTRODUCTION

1.1 Scope

An environmental surveillance program has been continuously conducted at the Indian Point Nuclear Generating Station since 1958, four years prior to start-up of Unit No. 1 (initial criticality attained on August 2, 1962). The purpose of the pre-operational program was to determine natural background radioactivity and to measure the variations in activities that may be expected from natural sources, fallout from nuclear weapons tests, and other sources in the vicinity. The current operational program is designed to meet the objectives of the Environmental Technical Specification Requirements (ETSR), Part II Section 5.2 (Reference 1), for Unit Nos. 1, 2 (startup 1973) and 3 (startup 1976). These objectives are:

1. To establish a sampling schedule for the entire Indian Point site and vicinity which will recognize changes in the radioactivity in the environs of the plants;

2. To assure that the effluent releases are kept as low as practicable and within allowable limits in accordance with 10CFR50 and 10CFR20, respectively;

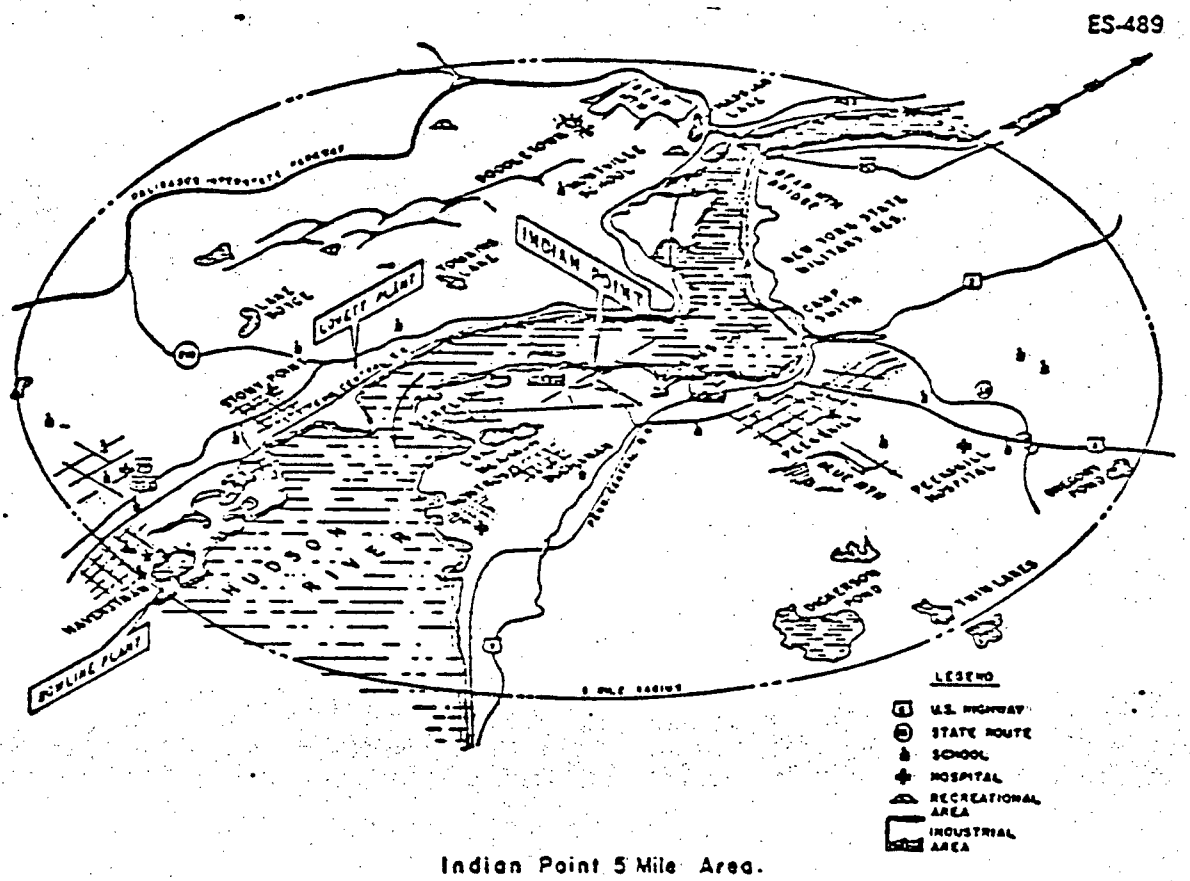
3. To verify radioactivity concentrations in the environment and projected related exposures from releases of radioactive materials from the Indian Point Unit Nos. 1, 2 and 3.

This report contains the results of the radiological environmental monitoring program conducted at Indian Point for the reporting period of January 1 to December 31, 1981. Summaries of the data are presented in compliance with the Environmental Technical Specification Requirements (ETSR), for Unit Nos. 1, 2 and 3.

1.2 Site Description

The Indian Point site occupies 239 acres on the east bank of the Hudson River on a point of land inside a bend in the river at Mile Point 42.6 (Figure 1-1). The site is about 24 miles north of the New York City boundary line in the village of Buchanan in upper Westchester County of New York State. Three nuclear reactors, Indian Point Unit Nos. 1, 2 and 3, and associated buildings are compactly placed on 35 acres of riverbank near the southern end of the site (Figure 1-2).

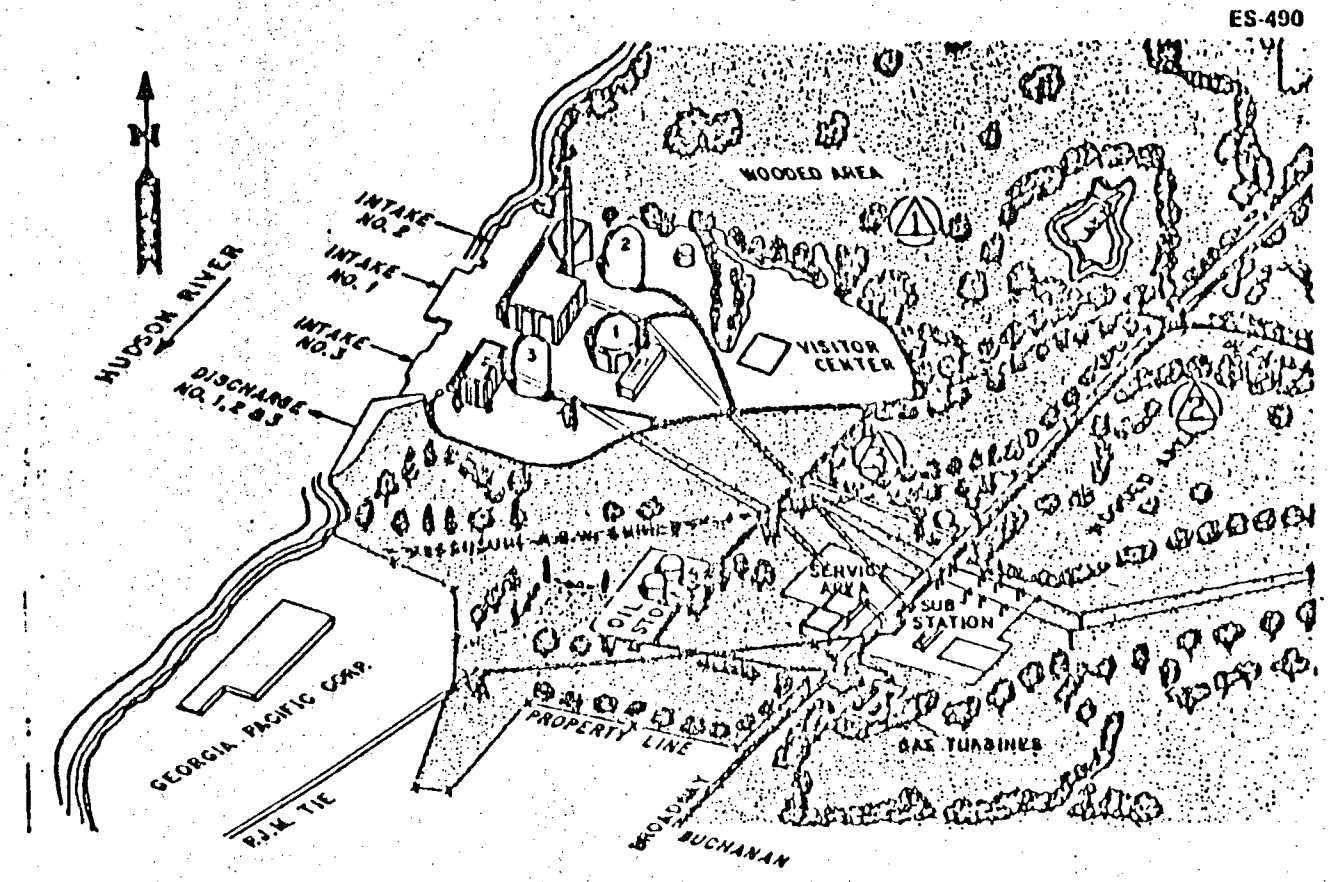
Figure 1-1



Indian Point 5 Mile Area.

Important features within a 5-mile radius of the Indian Point site.

Figure 1-2
Indian Point Site Description



2.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

2.1 Introduction

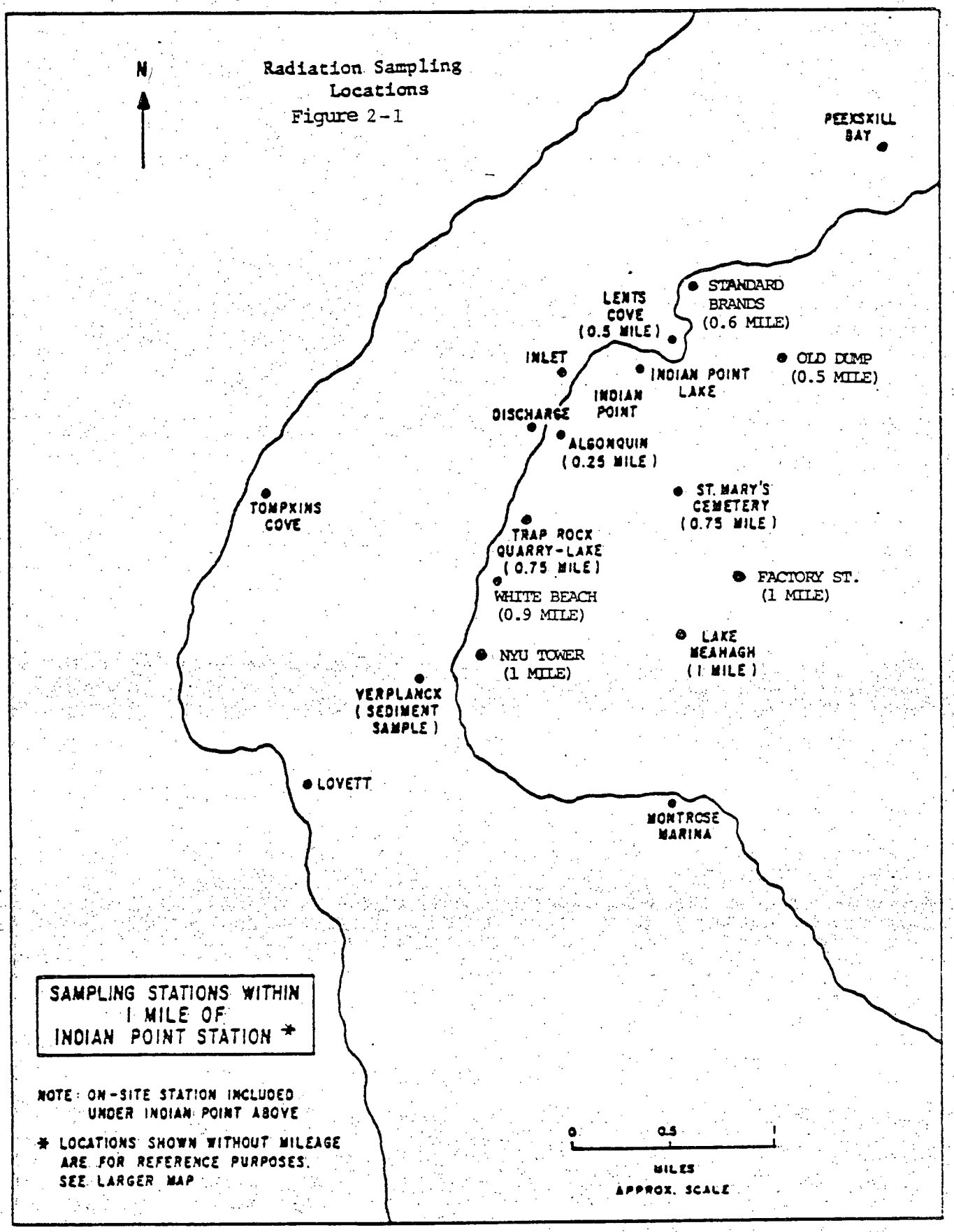
The radiological environmental monitoring program conducted at Indian Point is based on the Environmental Technical Specification Requirements (Reference 1). The program includes measurements of radioactivity levels in the following environmental media:

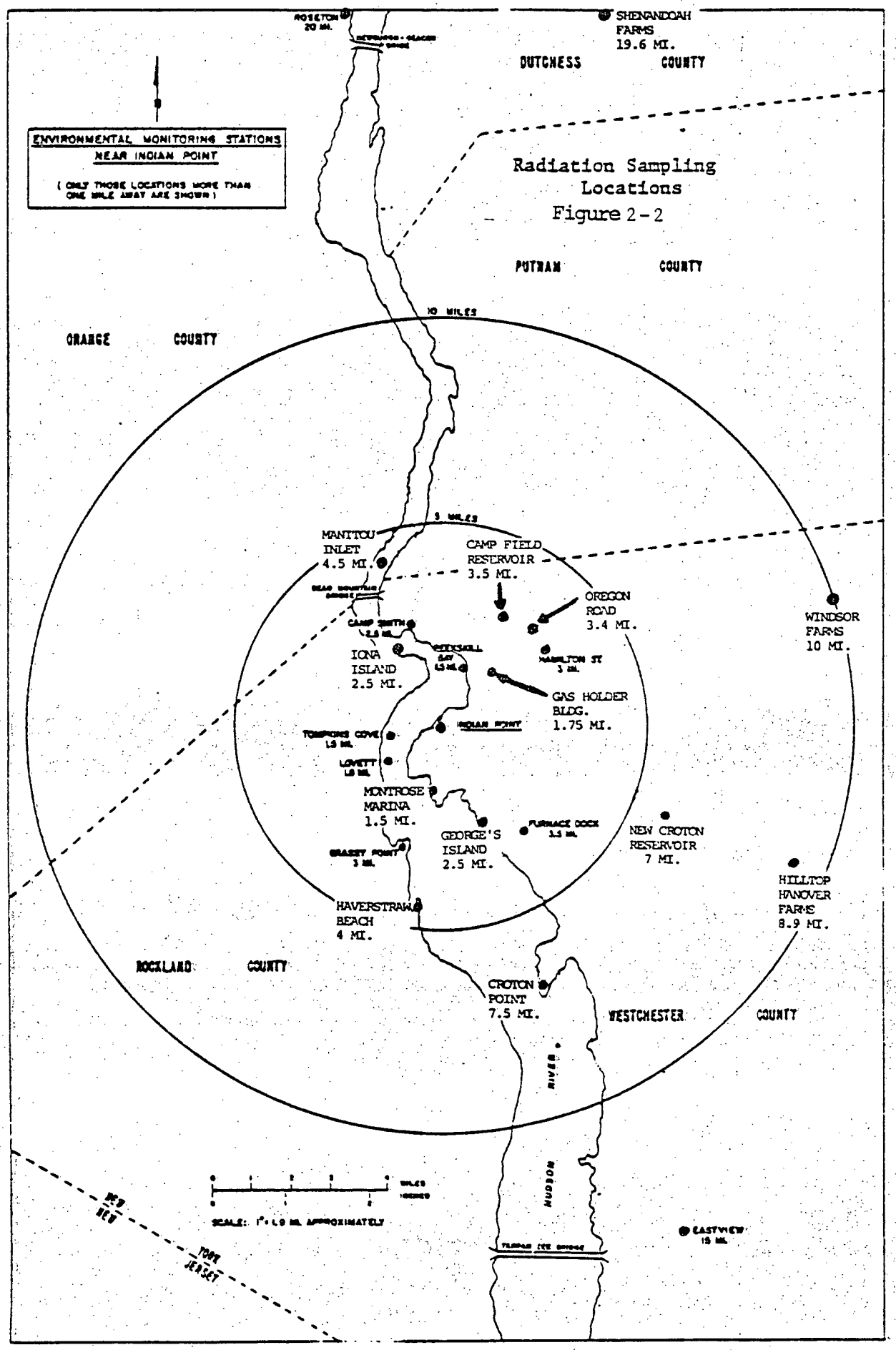
- Hudson River - water, aquatic vegetation, bottom sediments (including benthos), shoreline soils, crabs, clams and fish.
- Well water
- Airborne particulates and radioiodine
- Precipitation
- Lakes - water and aquatic vegetation
- Drinking water
- Milk
- Terrestrial vegetation - green leafy vegetables (food products)
- Soil
- Direct gamma radiation

In addition, a milch animal census is conducted annually to determine the number of cows and goats within a ten mile radius of the site.

2.2 Sample Station Locations

Environmental sampling station locations are plotted on Figures 2-1 for near-site samples (within two miles of the site) and Figure 2-2 for more remote locations (out to 10 miles or more). Sampling station locations are described in more detail in Table 2-1, which also gives the types of samples collected at each location.


N
Radiation Sampling Locations
Figure 2-1
PEEKSKILL BAY
STANDARD BRANDS (0.6 MILE)
LENTS COVE (0.5 MILE)
INLET
INDIAN POINT LAKE
OLD DUMP (0.5 MILE)
INDIAN POINT
DISCHARGE
ALGONQUIN (0.25 MILE)
ST. MARY'S CEMETERY (0.75 MILE)
TOMPKINS COVE
TRAP ROCK QUARRY-LAKE (0.75 MILE)
WHITE BEACH (0.9 MILE)
FACTORY ST. (1 MILE)
LAKE MEAHAGH (1 MILE)
NYU TOWER (1 MILE)
VERPLANCK (SEDIMENT SAMPLE)
LOVETT
MONTROSE MARINA
SAMPLING STATIONS WITHIN 1 MILE OF INDIAN POINT STATION *
NOTE: ON-SITE STATION INCLUDED UNDER INDIAN POINT ABOVE
* LOCATIONS SHOWN WITHOUT MILEAGE ARE FOR REFERENCE PURPOSES. SEE LARGER MAP
0 0.5 1
MILES
APPROX. SCALE



Radiation Sampling Locations
Figure 2-2

TABLE 2-1

INDIAN POINT STATION - LOCATION OF SAMPLING STATION POINTS

Sample Station Points	Location/Distances	Sample Types
1	Environmental Laboratory, Onsite - SSE	Air Particulate Radioiodine Direct Gamma Precipitation
2	Standard Brands, 0.6 MI - NNE	Air Particulate Radioiodine Direct Gamma Soil
3	Service Building, Onsite - SSE	Air Particulate Radioiodine Direct Gamma Soil
4	Algonquin Gas Line, 0.25 MI - S	Air Particulate Radioiodine Direct Gamma Soil
5	NYU Tower, 1 MI - SSE	Air Particulate Radioiodine Direct Gamma Soil
6	Camp Smith, 2.5 MI - NNE	Well Water Soil
7	Camp Field Reservoir, 3.5 MI - NE	Drinking Water
8	New Croton Reservoir, 7 MI - ESE	Drinking Water
9	Inlet pipe into plants, NNE	HR* Water
10	Discharge Canal, Onsite - SW	HR Aquatic Vegetation HR Water HR Bottom Sediment/Silt HR Shoreline Soil
11	Iroquois Lake, Onsite - E	Surface Lake Water Lake Aquatic Vegetation
12	Trap Rock Lake, 0.75 MI - SSE	Surface Lake Water Lake Aquatic Vegetation

*HR - Hudson River

TABLE 2-1 (Continued)

Sample Station Points	Location/Distances	Sample Types
13	Lake Meahagh, 1 MI - SEE	Surface lake Water Lake Aquatic Vegetation
14	Water Meter House, Onsite - E	Direct Gamma
15	Peekskill Bay, 1.5 MI - NE	HR Aquatic Vegetation HR Bottom Sediment/Silt Shoreline Soil
16	Tompkins Cove, 1.5 MI - WSW	HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil
17	Off Verplanck, 1 MI - SSW	HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil
18	Indian Point - Onsite - SE	Soil Well Water
19	St. Mary's Cemetery, 0.75 - SSE	Soil
20	Montrose Marina, 1.5 MI - S	Soil Direct Gamma
21	George's Island - 2.5 MI - SSE	Soil
22	Lovett, 1.5 MI - WSW	HR Aquatic Vegetation HR Bottom Sediment/ Silt HR Shoreline Soil
23	Roseton**, 20 MI - N	Fallout** Air Particulate** Radioiodine** Direct Gamma
24	Eastview, 15 MI - SE	Precipitation
25	Where available near site	Fish/Clams/Crabs
26	N.Y.C. Aqueduct-onsite -SSE Environmental Bldg.	Drinking Water

**Control Station

TABLE 2-1 (Continued)

Sample Station Points	Location/Distances	Sample Types
27	Croton Point, 7.5 MI - SSE	Air Particulate Radioiodine Direct Gamma Precipitation HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil
28	Lent's Cove, 0.5 MI - NE	HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil Direct Gamma
29	Grassy Point, 3 MI - S	Air Particulate Radioiodine Direct Gamma Precipitation
30	Dock, Onsite - W	Direct Gamma
31	Onsite Pole - S	Direct Gamma Soil
32	Factory St. SS, 1 MI - ESE	Direct Gamma
33	Hamilton St. SS, 3 MI - NNE	Direct Gamma
34	SE Corner Onsite - SE	Direct Gamma
35	Bleakley & Broadway, Onsite - E	Direct Gamma
36	Old Dump, 0.5 MI - SE	Direct Gamma
37	NE corner, Onsite - NE	Direct Gamma
38	Furnace Dock, 3.5 MI - SE	Air Particulate Radioiodine Direct Gamma Precipitation

TABLE 2-1 (Continued)

Sample Station Points	Location/Distances	Sample Types
43	Oregon Road, 3.7 MI - NE	Air Particulate Radioiodine
44	Peekskill Gas Holder Bldg., 1.7 MI - NE	Air Particulate Radioiodine
49	Iona Island, 3.2 MI - NNW	HR Shoreline Soil HR Bottom Sediment/Silt HR Aquatic Vegetation
50	Manitou Inlet, 4.5 MI- NNW	HR Shoreline Soil HR Bottom Sediment/Silt HR Aquatic Vegetation
51	Windsor Farms, 10 MI - ENE	Milk/Grass
52	Shenandoah Farms**, 19.6 MI - NNE	Milk/Grass**
53	White Beach 0.9 MI - SSW	HR Shoreline Soil HR Aquatic Vegetation HR Bottom Sediment/Silt
54	Haverstraw Beach, 4.0 MI - SSW	HR Shoreline Soil HR Aquatic Vegetation HR Bottom Sediment/Silt
55	Hilltop-Hanover Farms, 8.9 MI - ESE	Milk/Grass
56	Verplanck 1.0 MI - SSW	Direct Gamma
84	Cold Springs** 10.8 MI - N	HR Aquatic Vegetation** HR Shoreline Soil** HR Bottom Sediment/Silt**

** Control Station

Note: Stations 45-48 used for quality assurance split samples
Stations 39, 40, 42 no longer used as sample designations - Milk Farms that for one reason or another have ceased commercial operation.

2.3 Monitoring Methods and Schedules

The methods and frequencies of sample collection and analysis are summarized in Table 2-2. The sampling and analysis program is described in more detail below. Descriptions are grouped by sample type.

Airborne Radioactivity

Air samples are collected at eleven points in the environs. Two of these points are onsite, eight are at various offsite locations up to 15 miles from the site and one, used as a control, is twenty miles north. The samples are collected continuously by means of fixed air particulate filters followed by charcoal filters both of which are changed on a weekly basis. The samples are analyzed weekly for gross-beta, radioiodine, and gamma spectra. The choice of number and location of air sampling stations both onsite and offsite is based on meteorological and population data and the types of postulated releases from the plant.

Water

Drinking water is grab sampled monthly from two nearby reservoirs (New Croton and Camp Field) and the New York City Aqueduct and analyzed for gamma spectra and I-131. Additionally, quarterly composite samples of drinking water are analyzed for tritium.

Lake water is sampled monthly from the three lakes monitored in our program, one of which is onsite and the other two are in the vicinity of the site. Lake water samples are analyzed for gamma spectra monthly and for tritium on quarterly composite samples.

Two wells, one onsite and the other at Camp Smith, are grab sampled monthly and analyzed for gamma spectra with tritium analysis being performed on quarterly composite samples.

Rain water is sampled at six locations, one of which is onsite, four are offsite and one is the control station located twenty miles north of the site. Collection is continuous using an "open pot" type of collector with samples retrieved on a monthly basis.

These samples are analyzed monthly for gamma spectra and tritium.

Hudson River water is sampled at both the inlet and outlet to the condenser cooling system of the Indian Point Plant. The continuously collected river water samples are retrieved daily and used to develop a weekly composite. The weekly composites are used to create monthly composites which are submitted for the monthly gamma spectra analysis. Compositing continues with part of the monthly composites used to generate quarterly composites and submitted for tritium analysis.

All water samples requiring compositing for monthly or quarterly frequency of analysis are performed by Con Edison personnel taking sufficient aliquots of collected water samples and creating the desired composites for analyses.

Vegetation

Lake aquatic vegetation is sampled in the spring and summer, when available, during the growing season and analyzed for gamma spectra, Sr-89, Sr-90 and I-131. River aquatic vegetation is also collected in the spring and summer at twelve points along the Hudson River ranging from 10.8 miles upstream to 7.5 miles downstream of the site. Hudson River aquatic vegetation is analyzed for gamma spectra and I-131. Land vegetation (Leafy green vegetables-food crops) is sampled during harvest time at appropriate locations in critical wind sectors within several miles of the site. They are analyzed for gamma spectra and I-131.

Sediments and Soils

Hudson River bottom sediment is sampled during the spring and summer at twelve locations and analyzed for gamma spectra. Shoreline soil samples are taken at these same twelve locations during the spring and summer and are analyzed for gamma spectra, Sr-89, and Sr-90.

Soil samples are collected on a yearly basis from eleven locations in the vicinity of the site up to 2.5 miles away. Gamma spectra and Sr-90 analyses are performed on these samples.

Fish and Shellfish

Hudson river fish are caught monthly in the vicinity of the plant and submitted for gamma spectra analysis. Once during the year, a fish sample is analyzed for Sr-89 and Sr-90. Shellfish, originating from the Hudson River in the vicinity of the plant, are collected for analysis annually, once in summer or fall, and analyzed for gamma spectra. Sr-89 and Sr-90.

Milk

Milk is sampled monthly from dairy farms in the vicinity of the Indian Point site. The control station is located 19.6 miles north of the site. Milk samples are analyzed for gamma spectra, Sr-89, Sr-90, and I-131.

Direct Gamma Radiation

Instantaneous gamma background is measured yearly along principal roads within a five mile radius of the site, at approximately 0.10 mile intervals, using a Reuter Stokes RSS-111 pressurized ionization chamber. Integrated gamma monitoring using thermoluminescent dosimeters (TLDs) is performed continuously at selected locations in Buchanan, Verplanck, Montrose, Peekskill and at a number of points on the site perimeter.

Milch Animal Census

The milch animal census is conducted annually out to ten miles from the site using data obtained from the New York State Department of Agriculture and Markets and from telephone contact with individual owners. In addition, a visual field survey is conducted, by vehicle, within the limits of the 15 mrem/year isodose boundary.

2.4 Laboratory Analyses

All environmental samples collected during 1981 were sent to Chemical Waste Management of Massachusettes, Inc. (formerly Interex Corp.), a commercial analytical laboratory contracted to perform the analyses specified in Table 2-2. The minimum detectable concentrations (MDCs) specified by the ETSR are presented in Table 2-3 for each analytical procedure and sample type, along with the minimum sample size required to attain the analytical MDC. In addition, the annual dose

to the critical organ is given for selected enviro-mental media based on exposure to or intake of these media at conservatively assumed levels (e.g., 18.3 kg clams/crabs ingested per year).

Thermoluminescent dosimeter (TLDs) emplaced to accumulate direct gamma exposures were sent to Teledyne Isotopes, Inc., of Westwood, New Jersey, for analysis. An MDC of one mrem/month is required as per ETSR (Table 2-3).

TABLE 2-2

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 09 Discharge Canal - Point 10	Continuous flow regulated to fill 2 gallon drums. Representative sample, taken once a week and drums emptied	Monthly Quarterly Annually	Composite for GSA Composite for T, Sr-89, 90 once per year***
2) Hudson River Aquatic Vegetation	Points 10, 15 16, 17, 22, 27, 28, 49, 50, 53, 54, 84	Grab samples along shore-line	Once each in Spring and Summer	GSA
3) Hudson River Bottom Sediment/Silt (Including Benthos)	Same as Item 2	Same as Item 2	Same as Item 2	GSA
4) Hudson River Shore-line Soil	Same as Item 2	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 at Item 5	Monthly	GSA on edible portions Sr-90 once per year***

See footnotes at end of table.

TABLE 2-2 (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 26	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	Weekly	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	Monthly Quarterly	GSA Composite for T

See footnotes at end of table.

TABLE 2-2 (Continued)

INDIAN POINT STATION - RADIOLOGICAL ENVIRONMENTAL MONITORING SURVEY

Sample	Sample Location	Method of Collection	Frequency	Type of Analysis*
13) Lake Aquatic Vegetation	Points 11, 12 and 13	Same as Item 2	Same as Item 2	Same as Item 2
14) Soil	Points 1, 2, 3, 4, 5, 6, 18, 19, 20, 21, 31	Grab	Once per 3 years	GSA, Sr-90, Cs-137
15) Direct	Along principal roads withing a 5 mile radius of plant	Spotchecks	Annually	GGB* (Ion Chamber)
16) Direct Gamma	Selected locations in Buchanan, Montrose, Peekskill, and at a number of points onsite at plant perimeter	Continuous	Quarterly	GGB (TLD)
17) Milk	Selected locations of cows as determined from ETSR Sect. 4.2.1.2 Points 51, 52 and 55	Grab samples	Monthly (when in pasture)	GSA, Sr-89, Sr-90, I-131 Cs-134, Cs-137

See footnotes at end of table.

TABLE 2-2 (Continued)

INDIAN POINT STATION - RADIOLOGICAL ENVIRONMENTAL MONITORING SURVEY

Sample	Sample Location	Method of Collection	Frequency	Type of Analysis*
18) Grass***	Same as Item 17	Same as Item 17	Same as Item 17	Same as Item 17
19) Leafy Green Vegetables (Food Products)	Appropriate locations in critical wind Sectors	Grab samples at point of source	At time of harvest	GSA, I-131

* Type of Analysis:
GSA - Gamma Spectrum Analysis
T - Tritium
GBA - Gross Beta Gamma - If the weekly analysis indicated results which are more than three times higher than previous results additional weekly analysis shall be carried out to determine the cause of high results and corrective action taken to reduce levels.
GGB - Gross Gamma Background
TLD - Thermoluminescent Dosimeters

** Modified to reduce evaporation

*** Analysis for Sr-89 and 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 2-3

MINIMUM DETECTABLE CONCENTRATIONS IN ENVIRONMENTAL SAMPLES AND RESULTING DOSES

Sample	Analysis	Sample Size	Minimum Detectable Concentration MDC (a)	Annual Dose Associated with MDC mrem (d)	Critical Organ	Annual Intake
Hudson River Water	Composite for GSA	3 liter	5 pCi/l (b)	--	--	--
	Composite for T	2 liter	200 pCi/l	0.016	Body Tissue	--
	Sr-90	2 liter	1.0 pCi/l	1.0	Bone	--
Hudson River Aquatic Vegetation	GSA	1 kg	0.05 pCi/g (b)	--	--	--
	I-131	1 kg	0.05 pCi/g	--	--	--
Hudson River Bottom Sediment (including Benthos)	GSA	1 kg	5.0 pCi/g (b)	--	--	--
Hudson River Crabs/Clams	GSA	100 g	0.5 pCi/g(b)	--		
	Sr-90	100 g	0.01 pCi/g	0.4	Bone	18.3 kg
Hudson River Fish	GSA on edible protions	100 g	1.0 pCi/g(b)	--	--	--
	Sr-90	100 g	0.01 pCi/g	--	--	--
Fallout (Rain Water)	GSA	3 liter when available	5 pCi/l(b)	--	--	--
	T	2 liter	200 pCi/l	0.016	Body Tissue	--
Drinking Water	GSA	3 liter	5 pCi/l (b)	--	--	--
	I-131	4 liter	0.5 pCi/l	1.6	Child's Thyroid	440 l
	Sr-90	2 liter	1.0 pCi/l	1.0(e)	bone	440 l
Air Particulate	GBG**	270 m^3	0.01 pCi/m^3(c)	--	--	--
	Composite for GSA	1.080 m^3	0.02 pCi/m^3(b)	--	--	--
	Sr-90	3,240 m^3	0.001 pCi/m^3			

See footnotes at end of Table.

TABLE 2-3 (Continued)

MINIMUM DETECTABLE CONCENTRATIONS IN ENVIRONMENTAL SAMPLES AND RESULTING DOSES

Sample	Analysis	Sample Size	Minimum Detectable Concentration MDC (a)	Annual Dose Associated with MDC mrem (d)	Critical Organ	Annual Intake
Radioiodine	I-131	270m^3	0.04 pCi/m^3	0.05	Child's Thyroid	1100 m^3
Surface Lake Water	Same as Item 1	Same as Item 1	Same as Item 1	Same as Item 1	Same as Item I	Same as Item 1
Well Water	Composite for GSA	3 liter	5 pCi/l(b)	--	--	--
	T	2 liter	200 pCi/l	0.016(e)	Body Tissue	440 l
Lake Aquatic	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2
Soil	GSA	1 kg	5.0 pCi/g(b)	--	--	--
	Sr-90	1 kg	5.0 pCi/g	--	--	--
	Cs-137	1 kg	0.2 pCi/g	--	--	--
Direct Gamma	GGB***	1 month exposure	5 mrem	--	Whole body	12 month exposure
Direct Gamma	GGB(TLD)****	1 month exposure	1 mrem	--	Whole body	12 month exposure
Milk	GSA	1 liter	5.0 pCi/l	--	--	
	Sr-80	1 liter	2.0 pCi/l	0.08	Bone	
	Sr-90	1 liter	1.0 pCi/l	0.40	Bone	
	I-131	4 liter	0.5 pCi/l	1.6	Child's thyroid	183 l
	Cs-134/137	1 liter	5.0 pCi/l	0.006	Whole Body	183 l
Grass	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2
Leafy Green Vegetables (Food Products)	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2	Same as Item 2

See Footnotes on next page.

TABLE 2-3 (Footnotes)

* - GSA - Gamma Spectrum Analysis

** - GBG - Gross Beta Gamma Analysis

*** - GGB - Gross Gamma Background (Ion Chambers)

**** - TLD - Thermoluminescent Dosimeters

(a) - These are minimum practical detectable concentrations (MDC) as opposed to theroretical detection limits. They apply to the activity at the time of sample collection.

(b) - For Cs-137 assuming no interference from other nuclides.

(c) - Cs-137 used as a reference source.

(d) - Based on the Federal Radiation Council reports on Radiation Protection Guides and associated dose.

(e) - Applies to drinking water only.

(f) - Dose to a child's thyroid through the air-grass-cow-milk-man food chain for an annual intake of 183 l.

(g) - From WASH-1258 (July 1973)

3.0 SUMMARY OF RESULTS

3.1 General

This section summarizes the results of the 1981 radiological environmental monitoring program for Indian Point Unit Nos. 1, 2, and 3. Included are summaries of deviations experienced in both the sampling and analysis portions of the program. In addition, results of two required surveys, the annual road survey (instantaneous gamma dose rates) and the annual milch animal census, are summarized in this section.

3.2 Sampling and Analysis

The results of the 1981 radiological environmental monitoring program are summarized in Table 3-1 for each medium monitored. The format of the summary table conforms to the reporting requirements of the ETSR and NRC Regulatory Guide 4.8 (Reference 2).

Discussions of results are presented in section 4.0 of this report for each medium monitored. For convenience, the discussions are arranged by medium in the same order presented in Table 3-1. Discussions include interpretations and evaluations of measured results. Where appropriate, 1981 results are compared with preoperational data, operational control stations, and other pertinent information.

3.3 Sampling Deviations

During 1981, a few samples of environmental media scheduled for collection were not obtained. These samples are identified in Table 3-2 and the reason for sampling failure is specified. All other media were sampled at 100% of the required collection schedule.

Air sample losses were due to failure in automatic sampling equipment or their power supplies. Precipitation sample losses resulted when there was insufficient precipitation during the month to obtain a sample. Lake aquatic vegetation was not present at two of the lakes, although repeated attempts were made throughout the summer to collect samples. Lastly, the cows at station 51 were not producing milk for three months. Since these three months do not coincide with the period milch animals are in pasture, no deviation from ETSR occurred.

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
River Water X 10^{-7} uCi/ml	Be-7	24	*		0/24							
	K-40	24	2.9	1. - 6.7	3/24	10	3.9	1.1-6.7	2/12			
	Mn-54	24	0.08	-	1/24	09	0.08	-	1/12			
	Co-58	24	*		0/24							
	Co-60	24	*		0/24							
	Zr-95	24	*		0/24							
	Ru-103	24	*		0/24							
	Ru-106	24	*		0/24							
	I-131	24	*		0/24							
	Cs-134	24	0.1	-	1/24	09	0.1	-	1/12			
	Cs-137	24	0.07	0.06-0.07	6/24	10	0.07	0.06-0.07	5/12			
	Ba-140	24	*		0/24							
	Ce-141	24	*		0/24							
	Ce-144	24	*		0/24							
	Ra-226	24	*		0/24							
	Th-228	24	*		0/24							
	Tritium											
	H-3	8	4.1	2.1-7.7	5/8	10	4.8	3.2-7.7	3/4			
	Radio											
	Chemical											
	Sr 89	2										
	Sr 90	2	0.007	-	1/2	10	0.007	-	1/1			

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraytion	Mean	Range	Fraction
Hudson River Aquatic Vegetation X 10^{-8} uCi/g (Wet)	Be-7	22	22.3	15-27	4/24	50	27	-	1/2	12	-	1/3
	K-40	22	141.4	70-280	24/24	15	190	122-260	2/2	150	142-159	3/3
	Mn-54	22	2.0	0.7-6	14/24	17	4.4	2.7-6	2/2	*		0/3
	Co-58	22	54.9	0.7-642	15/24	28	46	-	1/2	1.2	-	1/3
	Co-60	22	10.8	0.6-500	22/24	17	68	12.7-123	2/2	1.1	0.6-1.6	2/3
	Zr-95	22	2.3	1.4-3	4/24	22/50	3	-	1/2	1.3	-	1/3
	Ru-103	22	*		0/24					*		0/3
	Ru-106	22	*		0/24					*		0/3
	I-131	22	*		0/24					*		0/3
	Cs-134	22	2.5	1.6-4.8	4/24	22	4.8	-	1/3	1.2	-	1/3
	Cs-137	22	6.4	1.0-13.3	22/24	17	13.3	3.6-23	2/2	2.5	1.2-4.5	3/3
	Ba-140	22	*		0/24					*		0/3
	Ce-141	22	*		0/24					*		0/3
	Ce-144	22	*		0/24					*		0/3
	Ra-226	22	5.9	2.5-10	4/24	22	10	-	1/3	*		0/3
	Th-228	22	6	5-7	3/24							0/3

See footnote at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Bottom Sediment X 10^{-7} uCi/g	Be-7	21	*		0/21					*		0/2
	K-40	21	177.1	127-220	21/21	16	215	210-220	2/2	198	180-215	2/2
	Mn-54	21	*		0/21					*		0/2
	Co-58	21	2.0	1.3-3.0	5/21	10	2.3	1.5-3.0	2/2	*		0/2
	Co-60	21	5.1	0.8-25	20/21	10	16.3	7.6-25.0	2/2	*		0/2
	Zr-95	21	1.9	1.2-3.0	3/21	17	2.3	1.5-3.0	2/2	*		0/2
	Ru-103	21	*		0/21					*		0/2
	Ru-106	21	*		0/21					*		0/2
	I-131	21	*		0/21					*		0/2
	Cs-134	21	2.4	1.1-9.1	17/21	10	5.5	1.9-9.1	2/2	*		0/2
	Cs-137	21	28.0	0.01-180	21/21	10	104	27.1-180	2/2	13.2	12.4-14	2/2
	Ba-140	21	*		0/21					*		0/2
	Ce-141	21	*		0/21					*		0/2
	Ce-144	21	*		0/21					*		0/2
	Ra-226	21	5.8	2.0-8.3	21/21	16	8.3	8.3-8.3	2/2	7.0	5.6-8.3	2/2
	Th-228	21	8.5	1.1-13.0	21/21	16	11.5	11-12	2/2	10.0	9.0-11	2/2

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Shoreline Soil X 10^{-7} uCi/g (Dry)	Be-7	22	*		0/22					*		0/2
	K-40	22	114.3	64-159	22/22	54	159	147-170	2/2	287	273-300	2/2
	Mn-54	22	*		0/22					*		0/2
	Co-58	22	0.5	0.4-0.6	2/22	10	0.6	-	1/2	*		0/2
	Co-60	22	0.2	0.5-1.2	3/22	28	0.5	-	1/2	*		0/2
	Zr-95	22	*		0/22					*		0/2
	Ru-103	22	*		0/22					*		0/2
	Ru-106	22	*		0/22					*		0/2
	I-131	22	*		0/22					*		0/2
	Cs-134	22	0.6	0.2-2.7	10/22	10	1.5	1.4-1.6	2/2	0.7	0.6-0.8	2/2
	Cs-137	22	4.1	0.7-14.7	21/22	10	13.8	-	1/2	1.6	1.5-1.6	2/2
	Ba-140	22	*		0/22					*		0/2
	Ce-141	22	*		0/22					*		0/2
	Ce-144	22	*		0/22					*		0/2
	Ra-226	22	4.5	1.1-18.6	22/22	50	14.3		2/2	6.0	-	1/2
	Th-228	22	5.3	0.7-21	21/22	50	13.0	12-14	2/2	*		0/2
	Radio											
	Chemical											
	Sr-89	22	*		0/22					*		0/2
	Sr-90	22	0.6	0.06-4.0	10/22	15	4.0	-	1/2	0.1	-	1/2

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Shellfish X 10^{-7} uCi/g (Wet)	Be-7	1	*		0/1							
	K-40	1	17	-	1/1							
	Mn-54	1	*		0/1							
	Co-58	1	*		0/1							
	CO-60	1	*		0/1							
	Zr-95	1	*		0/1							
	Ru-103	1	*		0/1							
	Ru-106	1	*		0/1							
	I-131	1	*		0/1							
	Cs-134	1	*		0/1							
	Cs-137	1	*		0/1							
	Ba-140	1	*		0/1							
	Ce-141	1	*		0/1							
	Ce-144	1	*		0/1							
	Ra-226	1	*		0/1							
	Th-228	1	*		0/1							
	Radio											
	Chemical											
	Sr-89	1	*		0/1							
	Sr-90	1	0.9	-	1/1							

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
	Be-7	12	*		0/12							
	K-40	12	17	1.5-6.0	10/12							
Fish	Mn-54	12	*		0/12							
X 10^{-7}	Co-58	12	*		0/12							
uCi/g	Co-60	12	*		0/12							
(Wet)	Zr-95	12	*		0/12							
	Ru-103	12	*		0/12							
	Ru-106	12	*		0/12							
	I-131	12	*		0/12							
	Cs-134	12	*		0/12							
	Cs-137	12	0.5	0.3-0.7	4/12							
	Ba-140	12	*		0/12							
	Ce-141	12	*		0/12							
	Ce-144	12	*		0/12							
	Ra-226	12	*		0/12							
	Th-228	12	*		0/12							
	Radio											
	Chemical											
	Sr 89	4	*		0/4							
	Sr 90	4	0.2	0.2-0.3	2/4							

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Ground Water X 10^{-7} uCi/ml	Be-7	24	*		0/24							
	K-40	24	1.0	0.9-1.0	2/24	06	1.0	0.9-1.0	2/12			
	Mn-54	24	*		0/24							
	Co-58	24	*		0/24							
	Co-60	24	*		0/24							
	Zr-95	24	*		0/24							
	Ru-103	24	*		0/24							
	Ru-106	24	*		0/24							
	I-131	24	*		0/24							
	Cs-134	24	*		0/24							
	Cs-137	24	*		0/24							
	Ba-140	24	*		0/24							
	Ce-141	24	*		0/24							
	Ce-144	24	*		0/24							
	Ra-226	24	0.1	0.1-0.1	2/24	06	0.1	0.1-0.1	2/12			
	Th-228	24	*		0/24							
	Tritium											
	H-3	8	3.8	3.5-4	2/8	18	4	-	1/4			

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Air Particulate X 10^{-14} uCi/cc (weekly)	Be-7	514	15.1	1.8-40.0	155/514	01	20.0	12.0-40.0	11/51	14.6	1.2-20	21/52
	K-40	514	33.1	20.0-70.0	13/514	05	53.3	30.0-70.0	3/52	50		1/52
	Mn-54	514	*		0/514					*		0/52
	Co-58	514	*		0/514					*		0/52
	Co-60	514	*		0/514					*		0/52
	Zr-95	514	4.6	2.0-16.0	110/514	01	6.3	3.0-16.0	11/51	5.7	4.2-7.2	9/52
	Ru-103	514	3.3	1.9-4.0	141/514	38	5.7	2.2-25.0	10/52	3.3	1.7-7.2	14/52
	Ru-106	514	6.3	1.2-12.0	5/514	03	12.0		1/52	*		0/52
	I-131	514	3.0	-	1/514	03	3.0		1/52	*		0/52
	Cs-134	514	*		0/514					*		0/52
	Cs-137	514	1.5	1.4-1.5	2/514	01	1.5		1/51	1.5	1.4-1.6	2/52
	Ba-140	514	*		0/514					*		0/52
	Ce-141	514	3.0	1.2-9.0	6/514	44	9.0		1/52	5.4	1.7-9.0	2/52
	Ce-144	514	7.7	1.2-11.0	8/514	03,29	9.0	6.0-11.0	1/52,3/51	*		0/52
	Ra-226	514	3.7	3.0-7.0	12/514	01	7.0	-	1/51	3.0	-	1/52
	Th-228	514	3.0	2.0-4.0	2/514	03	4.0		1/52	*		0/52
	Gross Beta											
	Gr-B	514	18.7	1.1-68.1	513/514	38	19.7	2.4-68.1	52/52	19.3	1.7-61.1	52/52

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Air Particulate X 10^{-14} uCi/cc Monthly Composite	Be-7	120	10.3	5-16	100/120	44	11.3	6-16	12/12	12.1	8-14	8/12
	K-40	120	14		1/120	04	14	-	1/12	*		0/12
	Mn-54	120	*		0/120					*		0/12
	Co-58	120	*		0/120					*		0/12
	Co-60	120	*		0/120					*		0/12
	Zr-95	120	2.9	1-6	52/120	43	3.3	1.6-4.4	4/12	3.7	2.1-5.9	6/12
	Ru-103	120	2.1	0.9-3.4	55/120	01	2.4	1.1-3.3	5/12	2.7	1.8-4	6/12
	Ru-106	120	5.0	3-7	3/120	05	7	-	1/12	*		0/12
	I-131	120	*		0/120					*		0/12
	Cs-134	120	*		0/120					*		0/12
	Cs-137	120	0.5	0.4-0.5	3/120	03,38	0.5	-	1/12	0.6	-	1/12
	Ba-140	120	*		0/120					*		0/12
	Ce-141	120	3.8	0.7-4.6	4/120	05	2.7	0.7-4.6	2/12	*		0/12
	Ce-144	120	5.9	5-7	5/120	29	7	-	1/12	*		0/12
	Ra-226	120	*		0/120					*		0/12
	Th-228	120	*		0/120					*		0/12

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
	Radio											
	Chemical											
Air	Sr 89	40	1.1	0.01-1.7	29/40	01	1.5	0.2-1.6	3/4	1.1	0.2-1.6	3/4
Particlate	Sr 90	40	0.2	0.01-0.2	38/40	05	0.1	0.06-0.2	3/4	0.1	0.08-0.2	3/4
X 10^{-14}												
Quarterly												
Composite												
Air Gas	I-131	514	6.0	3.0-10.0	3/514	01	7.5	5.0-10.0	2.51	*		0/52
Charcoal												
Filters												
X 10^{-14}												
uCi/cc												
Weekly												

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Pre-cipitation X 10^{-7} uCi/ml	Be-7	58	0.7	0.5-1.2	6/58	38	0.9	0.6-1.2	2/12	1.0	0.6-1.5	3/10
	K-40	58	0.8	0.6-1.2	5/58	29	0.9	0.8-0.9	2/12	1.5		1/10
	Mn-54	58	*		0/58					*		0/10
	Co-58	58	*		0/58					*		0/10
	Co-60	58	0.4	0.2-0.5	3/58	24	0.5	0.5-0.5	2/12	*		0/10
	Zr-95	58	0.1	0.1-0.2	3/58	27	0.2		1/12	0.1		1/10
	Ru-103	58	0.1	0.06-0.1	8/58	27	0.1	0.1-0.1	3/12	0.1		1/10
	Ru-106	58	*		0/58				0/12	*		0/10
	I-131	58	*		0/58				0/12	*		0/10
	Cs-134	58	*		0/58					*		0/10
	Cs-137	58	0.6	0.3-0.7	3/58	24	0.7	0.7-0.7	2/12	*		0/10
	Ba-140	58	*		0/58					*		0/10
	Ce-141	58	*		0/58					*		0/10
	Ce-144	58	*		0/58					*		0/10
	Ra-226	58	4.0	-	1/58	27	4.0	-	1/12	*		0/10
	Th-228	58	*		0/58					*		0/10
	Tritium											
	H-3	58	3.6	2.3-8.9	23/58	01	4.6	2.3-8.9	5/10	2.6	2.5-2.6	2/10

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Surface Water X 10^{-7} uCi/ml	Be-7	36	*		0/36							
	K-40	36	0.7		1/36	11	0.7	-	1/12			
	Mn-54	36	*		0/36							
	Co-58	36	*		0/36							
	Co-60	36	*		0/36							
	Zr-95	36	*		0/36							
	Ru-103	36	*		0/36							
	Ru-106	36	*		0/36							
	I-131	36	*		0/36							
	Cs-134	36	*		0/36							
	Cs-137	36	*		0/36							
	Ba-140	36	*		0/36							
	Ce-141	36	*		0/36							
	Ce-144	36	*		0/36							
	Ra-226	36	*		0/36							
	Th-228	36	*		0/36							
	Tritium											
	H-3	12	2.4	2.1-2.7	2/12	12	2.4	2.1-2.7	2/4			
	Radio											
	Chemical											
	Sr 89	3	*									
	Sr 90	3	0.006	0.004-0.01	3/3	12	0.01	-	1/1			

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
	Be-7	4	50	-	1/4	12	50	-	1/1			
Lake	K-40	4	143.3	90-220	3/4	13	170	120-220	2/2			
Aquatic	Mn-54	4	*		0/4							
Vegetation	Co-58	4	*		0/4							
X 10^{-8}	Co-60	4	*		0/4							
uCi/g	Zr-95	4	41.5	15-68	2/4	13	68	-	1/2			
(Wet)	Ru-103	4	35.5	11-60	2/4	12	60	-	1/2			
	Ru-106	4	*		0/4							
	I-131	4	*		0/4							
	Cs-134	4	*		0/4							
	Cs-137	4	*		0/4							
	Ba-140	4	*		0/4							
	Ce-141	4	*		0/4							
	Ce-144	4	*		0/4							
	Ra-226	4	*		0/4							
	Th-228	4	*		0/4							

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
	Be-7	36	*		0/36							
	K-40	36	0.9	0.7-1.1	2/36	07	0.9	0.7-1.1	2/12			
Drinking Water X 10^{-7} uCi/ml	Mn-54	36	*		0/36							
	Co-58	36	*		0/36							
	Co-60	36	*		0/36							
	Zr-95	36	*		0/36							
	Ru-103	36	*		0/36							
	Ru-106	36	*		0/36							
	I-131	36	*		0/36							
	Cs-134	36	*		0/36							
	Cs-137	36	*		0/36							
	Ba-140	36	*		0/36							
	Ce-141	36	*		0/36							
	Ce-144	36	*		0/36							
	Ra-226	36	*		0/36							
	Th-228	36	*		0/36							
	Tritium											
	H-3	12	2.4	-	1/36	08	2.4	-	1/4			
	Radio											
	Chemical											
	Sr-89	3	*		0/3							
	Sr-90	3	*		0/3							
	I-131	12	*		0/12							

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Milk X 10^{-8} uCi/ml	Be-7	21	*		0/21					*		0/12
	K-40	21	128	94-150	21/21	52	134	108-150	12/12	134	108-150	12/12
	Mn-54	21	*		0/21					*		0/12
	Co-58	21	*		0/21					*		0/12
	Co-60	21	*		0/21					*		0/12
	Zr-95	21	*		0/21					*		0/12
	Ru-103	21	*		0/21					*		0/12
	Ru-106	21	*		0/21					*		0/12
	I-131	21	*		0/21					*		0/12
	Cs-134	21	*		0/21					*		0/12
	Cs-137	21	0.7	0.6-1.1	6/21	51	0.7	0.6-1.1	6/9	0.7	0.4-0.9	2/12
	Ba-140	21	*		0/21					*		0/12
	Ce-141	21	*		0/21					*		0/12
	Ce-144	21	*		0/21					*		0/12
	Ra-226	21	*		0/21					*		0/12
	Th-228	21	*		0/21					*		0/12
	Radio											
	Chemical											
	Sr-89	21	0.4	0.1-1.1	7/21	51	0.5	0.2-1.1	4/9	0.2	0.2-0.2	4/12
	Sr-90	21	0.5	0.04-0.9	21/21	51	0.7	0.5-0.9	9/9	0.4	0.04-0.7	12/12
	I-131	21	*		0/21					*		0/12

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Leafy Green Veg. X 10^{-7} uCi/g (Wet)	Be-7	12	2.7	-	1/12	41-10	2.7	-	1/2			
	K-40	12	35.3	21-68	12/12	41-05	59.5	51-68	2/2			
	Mn-54	12	*		0/12							
	Co-58	12	*		0/12							
	Co-60	12	*		0/12							
	Zr-95	12	*		0/12							
	Ru-103	12	*		0/12							
	Ru-106	12	*		0/12							
	I-131	12	*		0/12							
	Cs-134	12	*		0/12							
	Cs-137	12	*		0/12							
	Ba-140	12	*		0/12							
	Ce-141	12	*		0/12							
	Ce-144	12	*		0/12							
	Ra-226	12	*		0/12							
	Th-228	12	*		0/12							

See footnotes at end of table

TABLE 3-1

1981 ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Medium or Pathway	Analysis		All Indicator Samples			Location with Highest Mean				Control Locations		
	Type	No.	Mean	Range	Fraction	Station	Mean	Range	Fraction	Mean	Range	Fraction
Soil X 10^{-7} uCi/g (Dry)	Be-7	11	6		1/11	01	6	-	1/1			
	K-40	11	144.2	69-183	11/11	19,21	183	-	1/1			
	Mn-54	11	*		0/11							
	Co-58	11	*		0/11							
	Co-60	11	*		0/11							
	Zr-95	11	1.4	1.2-1.5	2/11	01	1.5	-	1/1			
	Ru-103	11	*		0/11							
	Ru-106	11	*		0/11							
	I-131	11	*		0/11							
	Cs-134	11	*		0/11							
	Cs-137	11	2.9	1-5.6	11/11	05	5.6	-	1/1			
	Ba-140	11	*		0/11							
	Ce-141	11	*		0/11							
	Ce-144	11	*		0/11							
	Ra-226	11	5.7	2.8-9.1	11/11	20	9.1	-	1/1			
	Th-228	11	7.7	5.8-10.8	10/11	06	10.8	-	1/1			
	Radio											
	Chemical											
	Sr-89	11	0.3	.12-.7	4/11	01	0.7	-	1/1			
	Sr-90	11	0.7	.05-1.4	10/11	04	1.4	-	1/1			

\- not applicable single positive detection

* no positive detection

$$\text{Fraction} = \frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$$

TABLE 3-2

SUMMARY OF SAMPLES NOT COLLECTED - 1981

Media	Sample Period	Station(s)	Required* Analyses	Reason
Air	4/28 - 5/5	29	GB, GSA, I	Defective Diaphragm
	5/4 - 5/11	01	GB, GSA, I	No Power (AC)
	6/15 - 6/22	02	GB, GSA, I	Vandalized
	6/29 - 7/6	04	GB, GSA, I	No Power (AC)
	7/13 - 7/20	02	GB, GSA, I	No Power (AC)
	11/30 - 21/7	05	GB, GSA, I	Low Volume
Precipitation	January	01	GSA, H-3	No Volume (Dry)
	February	23	GSA, H-3	No Volume (Dry)
	August	01, 12	GSA, H-3	No Volume (Dry)
Lake Aquatic Vegetation	Summer	11, 12	GSA	None Available
Milk	January to March	51	GSA, Sr, I	None Available

* GB - gross beta analysis
GSA - gamma spectra analysis
I - Iodine
H-3 - tritium
Sr - Sr-90

3.4 Analytical Deviations

Minimum Detectable Concentrations (MDCs) Exceeded

Results of sample analyses were compared with the minimum detectable concentration (MDC) for given nuclides as specified in the ETSR. MDCs for specific nuclides within each media are listed in Table 2-3.

Samples analyzed during 1981 for which the MDCs were not met are listed in Table 3-3. The reason for not meeting an MDC is briefly stated in the table. A more complete discussion is presented below.

Air

Air samples which did not meet the MDC requirements had volumes of less than the nominal sample size (350 cubic meters). Two exceptions to this occurred in December, when sample counting was delayed for two weeks when the counting system malfunctioned.

Water (Excluding Precipitation)

No MDCs were exceeded after September. The reason is that the detector normally used malfunctioned and was replaced by another detector in October. The new detector was more efficient than the original, hence MDCs were not exceeded after it was put into service. The new detector has permanently replaced the malfunctioning unit, consequently future problems due to equipment limitations should be minimized.

Precipitation

Precipitation samples which did not meet the MDCs were low-volume samples. Two exceptions to this occurred for samples collected on 2/27 and 11/30, when operator error resulted in these samples being counted for insufficient time periods.

TABLE 3-3

SUMMARY OF EXCEEDED MDC's - 1981

Media	Sample Period	Station(s)	Analysis Exceeding MDC	Reason
Air	1/12 - 1/19	05	Cs-137 I-131	Small sample volume
	4/15 - 4/22	44	Cs-137	Small sample volume
	5/26 - 6/01	01	I-131	Small sample volume
	8/17 - 8/24	02	Cs-137	Small sample volume
	9/21 - 9/28	04	Cs-137 I-131	Small sample volume
	11/30-12/07	38	I-131	Counting System Malfunction
	12/14-12/21	12	Cs-137 I-131	Counting System Malfunction
Hudson River Water	7/31-8/28	09	Cs-137	Insufficient Counting Time
	8/28-9/30	09	Cs-137	Insufficient Counting Time
Lake Surface Water	8/20	11, 13	Cs-137	Insufficient Counting Time
	9/24	11, 13	Cs-137	Insufficient Counting Time
Well Water	4/24	18	Cs-137	Insufficient Counting Time
	8/20	18	Cs-137	Insufficient Counting Time
	9/24	18	Cs-137	Insufficient Counting Time
Precipitation	1/30	23,27,29,38	Cs-137	Small Sample Volume
	2/27	23		Small Sample Volume
	2/27	38		Insufficient Counting Time
	3/30 -3/31	01,27,29,38		Small Sample Volume
	4/30	23, 27		Small Sample Volume
	5/29	01,24,38		Small Sample Volume
	6/30	01,24,27,29, 38		Small Sample Volume
	7/31	27,38		Small Sample Volume
	8/31	24,27,29,38		Small Sample Volume
	9/30	23,24,27,29, 38		Small Sample Volume
	10/30	23		Small Sample Volume
	11/30	27		Small Sample Volume
	11/30	38		Insufficient Counting Time

Corrective Actions

The more efficient Ge(Li) detector, originally on loan, has been purchased by the contractor thus reducing the potential for non-achievement of MDCs.

For air particulate and airborne iodine (charcoal) samples, a system has been implemented whereby smaller-volume samples are brought to the attention of the counting room operator so that counting times can be increased, where reasonable, to meet the required MDCs. In addition, sample collection periods have been extended as necessary to ensure achievement of the nominal sample size.

The above changes should minimize the number of samples that do not meet the required MDCs.

Anomalous Measurements

An anomalous measurement is defined as a radionuclide concentration in a given sample that exceeds the historical or the control station concentration for that media by equal to or greater than a factor of ten (Reference 1). One analytical result during 1981 was classified as an anomalous measurement. A sample of aquatic vegetation (*Potamogeton perfoliatus*), collected from Station 17 (Verplanck) on September 23 exceeded the control location (Station 84- Cold Spring) by more than a factor of ten for Co-58 and Co-60.

This anomaly was investigated and reported to the NRC in a letters to Ronald Haynes (NRC) dated November 12, 1981, November 16, 1981 and February 26, 1982. To summarize these letters, the measured concentrations are not easily related to a specific site release since there are many environmental factors affecting the concentrations in this vegetation. Nevertheless, PASNY has initiated an increased demineralizer sampling scheme to ensure timely change out of waste water demineralizer beds, and thus ensure that releases via this system are maintained ALARA.

3.5 Direct Gamma Radiation

This section summarizes the results of the TLD monitoring program and the annual roadway gamma survey.

Thermoluminescent Dosimeters (TLDs)

Calcium sulfate ($CaSO_4$) TLDs are posted at 21 locations in the vicinity of the Indian Point site. The average of quarterly readings for each station are presented in Table 3-4. The two highest averages occurred onsite. All other averages including those for six additional locations, are within ± 5 mR/quarter of the control station average.

Annual Roadway Gamma Survey

The annual road survey involves measurement, using a pressurized ion chamber, of gamma exposure rates at 176 fixed locations within 5 miles of the site.

Results for the 1981 survey, conducted in October, yielded an average (± 2 sigma) exposure rate of 9.0 ± 2.2 microR/hour for 174 of the 176 stations (range: 6.2 - 15.0). The two remaining stations were not included in this average (and range) since they clearly do not represent typical background readings. Location No. 1 (see section 4.18) is an onsite location influenced by site operations (30.8 microR /hour). Location No. 73, which yielded 45.0 microR/hour, is located in an area where exposed rocks contain elevated natural radioactivity (see Section 4.18).

3.6 Milch Animal Census

In accordance with Section 4.2.1.3 of Apendix B, the Environmental Technical Specification Requirements for Indian Point Unit Nos. 1, 2 and 3, an Annual Milch Animal Census was conducted for the reporting period of 1981 and contained within as Table 3-5.

TABLE 3-4

DIRECT GAMMA RADIATION MONITORING

RESULTS BY TLD LOCATION - 1981

Location		mR/Quarter (Av. $\pm \sigma$)
1.	Environmental Laboratory, Onsite - SSE	23.8 ± 3.9
2.	Standard Brands, 0.6 mi - NNE	15.4 ± 2.4
3.	Service Building, Onsite - SSE	13.1 ± 1.2
4.	Algonquin Gas Line, 0.25 mi - S	18.8 ± 3.3
5.	NYU Tower, 1 mi - SSE	15.0 ± 1.9
14.	Water Meter House, Onsite - E	18.4 ± 7.5
20.	Montrose Marina, 1.5 mi - S	11.9 ± 1.7
23.	Roseton, * 20 mi - N	15.5 ± 2.0
27.	Croton Point, 7.5 mi - SSE	14.8 ± 1.2
28.	Lent's Cove, 0.9 mi - NE	20.5 ± 3.3
29.	Grassy Point, 3 mi - NE	14.2 ± 2.8
30.	Dock, Onsite - W	13.1 ± 1.1
31.	Onsite Pole - S	13.2 ± 1.3
32.	Factory St. SS, 1 mi - ESE	13.5 ± 1.8
33.	Hamilton St. SS, 3 mi - NNE	11.0 ± 1.0
34.	SE Corner, Onsite - SE	16.4 ± 1.9
35.	Bleakley & Broadway, Onsite - E	13.7 ± 2.2
36.	Old Dump. 0.5 mi - ENE	12.5 ± 1.7
37.	NE Corner, Onsite - NE	26.5 ± 6.3
38.	Furnace Dock SS, 3.5 mi - SE	15.8 ± 2.4
56.	Verplank (Broadway & 6th St.)	14.6 ± 0.5

* Control Station

TABLE 3-5

1981 ANNUAL MILCH ANIMAL CENSUS FOR INDIAN POINT

County	No. of Animals	Species	Distance (Miles)*	Direction*
Westchester	15	Cows	10.2	ENE
Westchester	56	Cows	8.9	ESE
Westchester	1	Goats	7.35	ENE
Westchester	2	Goats	6.75	ENE
Rockland	2	Goats	7.0	SW
Orange	None			

* From Indian Point

Note: Data obtained from New York State Department of Agriculture and Markets, Direct Telephone Contact and Field Survey.

Source: Letter dated January 27, 1982 from Con Edison to NRC

4.0 DISCUSSION OF RESULTS

4.1 Introduction

Discussed below, by medium, is an interpretation and evaluation of the results of measurements taken during the 1981 environmental monitoring program. Discussions include, as appropriate, a comparison with preoperational data, operational control stations, previous environmental radiological reports or effluent monitoring data, and impact calculations. Since the preoperational data obtained from 1958 until 1962 (when Unit 1 became operational), and the early radiological environmental reports consisted mainly of gross beta-gamma measurements, their comparison to present data is limited.

Discussions generally include tables that present detectable activity measured during sample analyses. Although these tables may include results for naturally occurring radionuclides (e.g., K-40), only those isotopes potentially relatable to plant operations are discussed in the text. Also, these tables may specify a lower limit of detection (LLD) for a specific nuclide in a given medium. The laboratory LLD values equal the ETSR MDCs for those nuclide/media combinations for which MDCs are specified (See Table 2-3). All other values represent LLDs typically obtained by the laboratory for that particular analysis. Actual LLD values vary with sample size and background interference. In many cases, positive (detectable) results are reported that are below the typical LLD. This indicates that LLDs achieved by the laboratory contractor are routinely below the MDCs specified in the ETSR (Reference 1).

4.2 Hudson River Water

Sampling during 1981 resulted in positive detection of six of the nineteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected at the Indian Point Generating Station intake and discharge, were as follows:

TABLE 4.2-1

HUDSON RIVER WATER
MEAN ANNUAL ACTIVITY (uCi/ml) BY ISOTOPE

Isotope	Intake	Ratio **	Discharge	Ratio **	LLD*
K-40	1.0 E-07	1/12	3.9 E-07	2/12	1. E-07
Mn-54	8.0 E-09	1/12	ND	0/12	1. E-08
Cs-134	1.0 E-08	1/12	ND	0/12	1. E-08
Cs-137	6.0 E-09	1/12	6.8 E-09	5/12	5. E-09
Sr-90	ND	0/1	7.0 E-10	1/1	1. E-09
H-3	3.0 E-07	2/4	4.8 E-07	3/4	2. E-07

ND - Not Detected

* Lower Limit of Detection - Typical values only See discussion Section 4.1.

**Ratio = # Positive Detections / Total Samples Analyzed

As in previous years, positive detection occurred for Sr-90, H-3, and Cs-137. Additionally, positive results were obtained for Cs-134, and Mn-54, which were detected exclusively at the intake station. The range of activity levels (Table 3-1) for nuclides detected at both the intake and discharge sampling stations were comparable. As evidenced by Table 4.2-1, measured activity levels were at or below the LLD values for these nuclides.

4.3 Hudson River Aquatic Vegetation

Sampling during 1981 resulted in positive detection of ten of the sixteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.3-1

HUDSON RIVER AQUATIC VEGETATION

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Indicator Station Isotope	Activity	Ratio **	Control Station Activity	Ratio **	LLD*
Be-7	2.2 E-07	4/24	1.2 E-07	1/3	2 E-07
K-40	1.4 E-06	24/24	1.5 E-06	3/3	2 E-07
Mn-54	2.0 E-07	14/24	ND	0/3	6 E-08
Co-58	5.5 E-07	15/24	1.2 E-08	1/3	6 E-08
Co-60	1.1 E-07	22/24	1.1 E-08	2/3	4 E-08
Zr-95	2.2 E-08	4/24	1.3 E-08	1/3	6 E-08
Cs-134	2.5 E-08	4/24	1.2 E-08	1/3	5 E-08
Cs-137	6.4 E-08	22/24	2.5 E-08	3/3	5 E-08
Ra-226	5.9 E-08	4/24	ND	0/3	1 E-07
Th-228	6.0 E-08	3/24	ND	0/3	1 E-07

ND - Not Detected.

* Lower Limit of Detection - Typical values only - See Discussion Section 4.1.

$$**\text{Ratio} = \frac{\#\ \text{Positive Detections}}{\text{Total Samples Analyzed}}$$

As indicated in Section 3.4, an anomalous measurement occurred for Co-58 and Co-60 at station No. 17. Inclusion of these values in calculations of annual mean detection levels for these nuclides introduces a significant bias, and results in a non-representative estimate of typical activity levels.

In order to better reflect typical activity levels observed for these nuclides, mean annual activity levels were recalculated excluding the anomalous measurements for Co-58 and Co-60. Revised means are presented in Table 4.3-2 along with results from previous years for comparison. Review of Table 4.3-2 shows that the revised means for 1981 closely approximate levels observed during previous sampling years.

Other radionuclides detected that are potentially relatable to plant operations were Mn-54, Zr-95, Cs-134 and Cs-137. Activity levels measured during 1981, were comparable to control station values and fell below the LLD specified for these nuclides (Table 4.3-1). Activity levels for Mn-54 were above LLD, but fell within the range of values observed during previous years.

TABLE 4.3-2

MEAN ANNUAL ACTIVITY LEVELS (uCi/g) FOR

Co-58 and Co-60 IN HUDSON RIVER AQUATIC VEGETATION

1976 - 1981

		Co-58	Co-60
1976	Activity	5.2 E-08	1.4 E-07
	Ratio*	5/15	5/15
1977	Activity	3.35 E-07	2.67 E-08
	Ratio*	18/24	13/24
1978	Activity	7.3 E-08	6.8 E-08
	Ratio*	13/23	12/23
1979	Activity	7.08 E-08	1.13 E-07
	Ratio*	1/16	5/16
1980	Activity	ND	8.05 E-08
	Ratio*	0/24	12/24
1976-1980	Activity	1.33 E-07	1.34 E-07
1981**	Activity	1.1 E-07	5.3 E-08
	Ratio*	14/23	21/23

ND - Not Detected

*Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

** Excludes anomalous measurement for 9/23/81 at Station #17.

4.4 Hudson River Bottom Sediments

Sampling during 1981 resulted in positive detection of eight of the sixteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

Table 4.4-1

HUDSON RIVER BOTTOM SEDIMENT

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Isotope	Indicator Station Activity	Ratio**	Control Station Activity	Ratio**	LLD*
K-40	1.8 E-05	21/21	2.0 E-05	2/2	1. E-04
Co-58	2.0 E-07	5/21	ND	0/2	1. E-05
Co-60	5.1 E-07	20/21	ND	0/2	1. E-05
Zr-95	1.9 E-07	3/21	ND	0/2	3. E-05
Cs-134	2.4 E-07	17/21	ND	0/2	1. E-05
Cs-137	2.8 E-06	21/21	1.3 E-06	2/2	5. E-06
Ra-226	5.8 E-07	21/21	7.0 E-07	2/2	2. E-05
Th-228	8.5 E-07	21/21	1.0 E-06	2/2	3. E-05

ND - Not Detected

* - Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

** - Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Mean activity levels for 1981 are compared with historical mean values in Table 4.4-2. These means, calculated based on positive results only, show that 1981 values are consistent with those for previous years.

Table 4.4-2

HUDSON RIVER BOTTOM SEDIMENT

MEAN ANNUAL ACTIVITY (uCi/g)

BY ISOTOPE 1977 - 1980 VS 1981

Isotope	1977-1980 Activity	1981 Activity	LLD*
Co-58	1.62 E-07	1.96 E-07	1 E-07
Co-60	4.40 E-07	5.43 E-07	1 E-07
Zr-95	2.33 E-07	1.93 E-07	2 E-07
Cs-134	3.23 E-07	2.46 E-07	2 E-07
Cs-137	1.87 E-06	2.79 E-06	5 E-06

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

4.5 Hudson River Shoreline Soils

Sampling during 1981 resulted in positive detection of eight of the eighteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

Table 4.5-1

HUDSON RIVER SHORELINE SOILS

MEAN ANNUAL ACTIVITY (uCi/g)

BY ISOTOPE

Isotope	Indicator Station Activity	Ratio**	Control Station Activity	Ratio**	LLD*
K -40	1.19 E-05	22/22	2.9 E-05	2/2	2. E-06
Co-58	5. E-08	2/22	ND	0/2	1. E-07
Co-60	2.4 E-08	3/22	ND	0/2	1. E-07
Cs-134	6.3 E-08	10/22	7.0 E-08	2/2	2. E-07
Cs-137	4.1 E-07	21/22	1.6 E-07	2/2	2. E-07
Ra-226	4.5 E-07	22/22	6.0 E-07	1/2	2. E-07
Th-228	4.6 E-07	21/22	1.2 E-06	2/2	2. E-07
Sr-90	6.5 E-08	10/22	1.4 E-08	1/2	1. E-08

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1

** Ratio - $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Levels detected at indicator stations during 1981 closely approximated control station levels and LLD values for these nuclides (Table 4.5-1).

Comparison of 1981 mean annual values with those from previous years indicates that levels detected were consistent among years (Table 4.5-2).

Table 4.5-2

HUDSON RIVER SHORELINE SOIL

MEAN ANNUAL ACTIVITY LEVELS (uCi/g)

1978 - 1981

Isotope	1978 Activity	1978 Ratio*	1979 Activity	1979 Ratio*	1980 Activity	1980 Ratio*	1981 Activity	1981 Ratio*
Co-58	ND	0/6	ND	0/12	ND		5.0 E-08	2/22
Co-60	ND	0/6	ND	0/12	7.2 E-08	2/24	2.4 E-08	3/22
Cs-134	8.5 E-08	1/6	ND	0/12	8.9 E-08	7/24	6.3 E-08	10/22
Cs-137	ND	5/6	1.8 E-07	12/12	4.2 E-07	24/24	4.1 E-07	21/22
Sr-90	ND	0/6	ND	0/12	5.3 E-08	6/24	6.5 E-08	10/22

$$*\text{Ratio} = \frac{\#\ \text{Positive Detections}}{\text{Total Samples Analyzed}}$$

4.6 Hudson River Shellfish

Sampling during 1981 resulted in positive detection of two of the eighteen radionuclides for which analyses were performed. Specific nuclides and activity levels were as follows:

TABLE 4.6-1

HUDSON RIVER SHELLFISH

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Isotope	Activity	Ratio **	LLD*
K -40	1.7 E-06	1/1	2 E-08
Sr-90	8.5 E-08	1/1	1 E-08

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

$$**\text{Ratio} = \frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$$

Results of shellfish analysis conducted during previous years also indicated the presence of Sr-90 in detectable quantities. Comparison of 1980 and 1981 mean annual activity levels for this nuclide showed an increase in measured levels during 1981 (mean annual activity level calculated for Sr-90 in 1980 was 1.3×10^{-8}). The activity level for Sr-90 in 1981 fell within the range of values measured during previous monitoring efforts (Table 4.6-2).

TABLE 4.6-2

Annual Activity Level For Sr-90 in

uCi/g (Wet) for Shellfish 1977-1981

Year	Activity
1977	1.1 E-08
1978	1.3 E-07
1979	7.0 E-09
1980	1.3 E-08
1981	8.5 E-08

4.7 Hudson River Fish

Results of monthly fish analysis resulted in positive detection of three of the eighteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.7-1

HUDSON RIVER FISH

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
K -40	1.7 E-06	10/12	2. E-08
Cs-137	5.3 E-08	4/12	1. E-09
Sr-90	2.4 E-08	2/4	1. E-08

* Lower limit of detection - Typical values only. See Discussion Section 4.1.

** Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Results for 1981 indicated the presence of Cs-137 and Sr-90 in detectable quantities. Comparison with 1980 mean annual activity levels for Cs-137 (1.1×10^{-7} uci/g) and Sr-90 (1.1×10^{-8} uci/g) indicates detected levels for both years are comparable for these nuclides.

4.8 Ground Water

Sampling during 1981 resulted in positive detection of three of the seventeen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.8-1

GROUND WATER

MEAN ANNUAL ACTIVITY (uCi/ml) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
K-40	9.5 E-08	2/24	1. E-07
Ra-226	1.2 E-08	2/24	2. E-08
H-3	3.8 E-07	2/8	2. E-07

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

$$**\text{Ratio} = \frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$$

Mean annual activity levels measured for tritium are consistent with those measured during previous years, and fell below the 400 pCi/l value considered as background by the New York State Department of Environmental Conservation (Reference 3).

4.9 Airborne Particulates

Results of analysis of continuously collected air particulate samples are summarized in Table 3-1. A total 566 weekly air filters and 132 monthly composites of weekly filters were analyzed for gamma emitting nuclides by gamma spectrometry. Weekly filters were also analyzed for gross beta activity. In addition to four naturally occurring nuclides (Be-7, K-40, Ra-226, and Th-228), positive results were obtained for the seven nuclides (and gross beta) in Table 4.9-1.

Table 4.9-1

WEEKLY AIR PARTICULATE

MEAN ANNUAL ACTIVITY

($\times 10^{-14}$ uCi/cc) BY ISOTOPE

	Indicator Locations			Control Locations			
Isotope	Mean	Range	Ratio**	Mean	Range	Ratio**	LLD*
Zr-95	4.6	2.0-16.0	110/514	5.7	4.2- 7.2	9/52	5
Ru-103	3.3	1.9- 4.0	141/514	3.3	1.7- 7.2	14/52	4
Ru-106	6.3	1.2-12.0	5/514	ND	---	0/52	30
I -131	3.0	---	1/514	ND	---	0/52	4
Cs-137	1.5	1.4- 1.5	2/514	1.5	1.4- 1.6	2/52	2
Ce-141	3.0	1.2- 9.0	6/514	5.4	1.7- 9.0	2/52	4
Ce-144	7.6	1.2-11.0	8/514	ND	---	0/52	10
Gross Beta	19	1.1-68	513/514	19	1.7-61	52/52	2

ND - Not Detected

* LLD = Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

**Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

The above table shows that, excluding gross beta activity, nuclides were detected in concentrations at or below the LLD typically reported for these analyses. In addition, the means and ranges of radionuclide activities found in samples from indicator locations are entirely consistent with concentrations found at the control location. This statement is also true for gross beta analyses. Therefore, no plant related activity was detected in weekly air filters.

Monthly composites of weekly air filters also yielded positive results for the same nuclides (excluding I-131). Results are summarized in Table 4.9-2. Results for monthly composites are seen to be consistent with weekly results, as expected since monthly samples are simply composites of the weekly filters.

Quarterly composites of weekly air filters are analyzed for Sr-89 and Sr-90 content. Results are summarized in Table 4.9-3. Results show that Sr-89 and Sr-90 concentrations from the indicator locations are essentially identical to those from the control location. These levels thus reflect ambient conditions and are not plant related.

Table 4.9-2

MONTHLY AIR PARTICULATE COMPOSITE

MEAN ANNUAL ACTIVITY (X 10^{-14} uCi/cc) BY ISOTOPE

	Indicator Locations			Control Locations			
Isotope	Mean	Range	Ratio**	Mean	Range	Ratio**	LLD*
Zr-95	2.9	1.0-6.0	52/120	3.7	2.1-5.9	6/12	5
Ru-103	2.1	0.9-3.4	55/120	2.7	1.8-4.0	6/12	4
Ru-106	5.0	3.0-7.0	3/120	ND	---	0/12	30
Cs-137	0.5	0.4-0.5	3/120	0.6	---	1/12	2
Ce-141	3.8	0.7-4.6	4/120	ND	---	0/12	4
Ce-144	5.9	5.0-7.0	5/120	ND	---	0/12	10

ND - Not Detected

* LLD = Lower Limit of Detection. Typical values only. See Discussion Section 4.1.

** Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Table 4.9-3

QUARTERLY AIR PARTICULATE COMPOSITE

MEAN ANNUAL ACTIVITY (X 10^{-14} uCi/cc) BY ISOTOPE

	Indicator Locations			Control Locations			
Nuclide	Mean	Range	Ratio**	Mean	Range	Ratio**	LLD*
Sr-89	1.06	0.01-1.68	29/40	1.08	0.19-1.62	3/4	0.2
Sr-90	0.15	0.01-0.23	33/40	0.12	0.08-0.19	3/4	0.1

* LLD = Lower Limit of Detection. Typical values only. See discussion Section 4.1.

** Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

4.10 Airborne Radioiodine

Continuous sampling of air for radioiodine content using charcoal filter cartridges changed on a weekly basis yielded results for a total of 566 cartridges. Only three of these results were positive. They ranged from $3x10^{-14}$ uCi/cc to $10x10^{-14}$ uCi/cc and averaged $6x10^{-14}$ uCi/cc. The typical LLD for these analyses is $4x10^{-14}$ uCi/cc. Thus results that were positive were just above the typical LLD. These results are consistent with those reported for the previous two years.

4.11 Precipitation

During 1981, 58 precipitation samples were collected at indicator locations and 10 at the control location. Analyses yielding positive results are presented in Table 4.11-1.

Table 4.11-1

PRECIPITATION

MEAN ANNUAL ACTIVITY

($X\ 10^{-7}$ uCi/ml) BY ISOTOPE

Indicator Location				Control Location			
Nuclide	Mean	Range	Ratio**	Mean	Range	Ratio**	LLD*
Co-60	0.40	0.19-0.50	3/58	ND	---	0/10	0.1
Zr-95	0.11	0.08-0.15	3/58	0.11	---	1/10	0.3
Ru-103	0.09	0.06-0.12	8/58	0.09	---	1/10	0.2
Cs-137	0.6	0.3 -0.7	3/58	ND	---	0/10	0.05
H-3	3.6	2.3 -8.9	23/58	2.6	---	2/10	2.0

ND - Not Detected

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

** Ratio = $\frac{\text{\# Positive Detection}}{\text{Total Samples Analyzed}}$

Results for Zr-95, Ru-103 and H-3 at indicator locations are consistent with results from control locations. Cobalt-60 and Cs-137 were each found in only three of 58 indicator samples.

All three Co-60 and two of the Cs-137 detections occurred in the first quarter of 1981. The third Cs-137 value occurred in the second quarter. Review of gaseous effluent data reveals that the largest releases for 1981 occurred in the fourth quarter for Co-60 and in the third quarter for Cs-137. Also, no Co-58 was detected in the first quarter of 1981, even though the Co-58 releases were 2.4 times that of Co-60. In addition, the highest values measured were at the most distant station (station 24, 15 miles SE of the plant. It is thus unlikely that these results were plant related.

4.12 Surface Water

Sampling during 1981 resulted in positive detection of three of the nineteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.12-1

SURFACE WATER

MEAN ANNUAL ACTIVITY (uCi/ml) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
K-40	7.0 E-08	1/36	1. E-08
H-3	2.4 E-07	2/12	2. E-07
Sr-90	6.3 E-10	3/3	3. E-09

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

$$**\text{Ratio} = \frac{\#\ \text{Positive Detections}}{\text{Total Samples Analyzed}}$$

Detected levels of H-3 and Sr-90, fell at or below the typical LLD values for these nuclides. The Sr-90 levels are in fact, less than the minimum detectable sensitivity typically reported for this nuclide by the New York State Department of Environmental Conservation (Reference 3). Additionally, measured levels of H-3 fell below the 400 pCi/l level considered as background by the State.

4.13 Lake Aquatic Vegetation

Sampling during 1981 resulted in positive detection of four of the sixteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

Table 4.13

LAKE AQUATIC VEGETATION

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
Be-7	5.0 E-07	1/4	2. E-07
K-40	1.4 E-06	3/4	2. E-07
Zr-95	4.2 E-07	2/4	6. E-08
Ru-103	3.6 E-07	2/4	6. E-08

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

**Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Mean annual activity levels measured for these nuclides in 1981 closely approximate previously detected levels. Based on historical data, mean activity levels for Zr-95 and Ru-103 are 4.91 E-07 and 1.29 E-07 uCi/g (wet), respectively.

4.14 Drinking Water

Sampling during 1981 resulted in positive detection of two of the nineteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.14-1

DRINKING WATER

MEAN ANNUAL ACTIVITY (uCi/ml) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
K-40	9.0 E-08	2/36	1. E-08
H-3	2.4 E-07	1/36	2. E-07

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

**Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

The single positive detection of tritium closely approximated the LLD value, and fell below the 400 pCi/l level considered as background by the New York State Department of Environmental Conservation (Reference 3).

4.15 Milk

Sampling during 1981 resulted in positive detection of four of the nineteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.15-1

MILK MEAN ANNUAL

ACTIVITY (uCi/ml) BY ISOTOPE

Isotope	Indicator Station Activity	Ratio**	Control Station Activity	Ratio**	LLD*
K-40	1.3 E-06	21/21	1.3 E-06	12/12	1. E-07
Cs-137	7.3 E-09	6/21	6.5 E-09	2/12	5. E-09
Sr-89	3.8 E-09	7/21	1.8 E-09	4/12	3. E-09
Sr-90	5.1 E-09	2/21	4.3 E-09	12/12	1. E-09

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

**Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Detected levels for fission-product isotopes closely approximated both the LLD and the control station values for these isotopes. Comparision of detected levels with current ambient levels for Cs-137, Sr-89, and Sr-90 in milk, as measured by the New York State Department of Environmental Conservation (Reference 3), indicates that detected levels were at or below ambient.

4.16 Leafy Green Vegetation (Food Crops)

Sampling during 1981 resulted in positive detection of two of the sixteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

TABLE 4.16-1

LEAFY GREEN VEGETATION

MEAN ANNUAL ACTIVITY (uCi/g) BY ISOTOPE

Isotope	Activity	Ratio**	LLD*
Be-7	2.7 E-07	1/12	2. E-07
K-40	3.5 E-06	12/12	2. E-07

* Lower Limit of Detection - Typical values only. See Discussion Section 4.1.

$$**\text{Ratio} = \frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$$

No radionuclides relatable to plant operations were detected during 1981.

4.17 Soil

Sampling during 1981 resulted in positive detection of eight of the eighteen radionuclides for which analyses were performed. Specific nuclides and mean annual activity levels detected were as follows:

Table 4.17-1

SOIL

MEAN ANNUAL ACTIVITY

(uCi/g) BY ISOTOPE

Isotope	Mean Activity	Ratio**	LLD*
Be-7	6.0 E-07	1/11	2. E-06
K -40	1.4 E-05	11/11	2. E-06
Zr-95	1.4 E-07	2/11	2. E-07
Cs-137	2.9 E-07	11/11	2. E-07
Ra-226	5.7 E-07	11/11	2. E-07
Th-228	7.7 E-07	10/11	2. E-07
Sr-89	3.1 E-08	4/11	2. E-05
Sr-90	7.2 E-08	10/11	2. E-06

* Lower Limit of Detection - Typical values only. See Discussion, Section 4.1.

** Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

Comparison of 1981 mean annual values with those from previous years indicates that levels detected were at or below typical LLDs and were consistent among years (Table 4.17-2). Detected levels for Sr-89 and Sr-90 were factors of about 1000 and 100, respectively, below ETSR specified MDCs for these nuclides. These low positive detection levels resulted from the contractor's conservative estimate of required count time to ensure the ETSR specified MDC's were achieved.

Table 4.17-2

SOIL

MEAN ANNUAL ACTIVITY LEVELS

(uCi/g) 1978-1981

Isotope	1978 Activity	1978 Ratio*	1979 Activity	1979 Ratio*	1980 Activity	1980 Ratio*	1981 Activity	1981 Ratio*
Zr-95	7. E-08	1/10	ND	0/10	ND	0/10	1.4 E-07	2/11
Cs-137	4.4 E-07	10/10	4.5 E-07	9/10	4.8 E-07	10/10	2.9 E-07	11/11
Sr-89	ND	0/10	ND	0/10	ND	0/10	3.1 E-08	4/11
Sr-90	ND	0/10	1.4 E-07	7/10	1.4 E-0 7	4/10	7.2 E-08	10/11

ND - Not Detected

* Ratio = $\frac{\text{\# Positive Detections}}{\text{Total Samples Analyzed}}$

4.18 Direct Gamma Radiation

Direct gamma radiation in the vicinity of the Indian Point Station is measured on a year-round basis using integrating dosimeters, and by an annual spot check along roadways using an exposure-rate measuring instrument (a pressurized ion chamber). Results of these measurements are presented separately below.

Thermoluminescent Dosimeters

Calcium sulfate ($CaSO_4$) thermoluminescent dosimeters (TLDs) are used to obtain measurements of direct gamma radiation levels at 21 locations (see Table 3-4) in the vicinity of Indian Point. Emplaced TLDs provide comprehensive measurements of background radiation because they are continuously posted and thus represent the total integrated exposures for the time period of emplacement (e.g., mrem per quarter).

Two TLD holders are posted at each location, each holder normally containing two TLDs. One of the TLDs is changed monthly while the other is changed quarterly. For the purposes of this report only quarterly exposures are reported. The monthly exposures provided additional information for cross-check purposes and studying variations in background exposure in that particular quarter.

Results of quarterly measurements for 1981 are presented in Table 4.18-1 by location. Means and standard deviations are also presented, both by location and quarter. All results are normalized to a 91.2 day quarter.

In order to better interpret these results, they are compared with results from the previous five years in Table 4-18.2.

The five-year averages were calculated for each station and compared with the 1981 average. In addition, the quarterly and annual averages for all stations are included on the second page of the table for each year and for the five-year averages. The standard error is presented as a percent (i.e. coefficient of variation) for each of the calculated means.

TABLE 4.18-1

1981 RESULTS OF DIRECT GAMMA RADIATION MONITORING (TLDs)[a,b]

mR/Quarter

Location	1st Q	2nd Q	3rd Q	4th Q	Average ± σ
1(c)	19.2	28.6	24.2	23.2	23.8 ± 3.9(f)
2	14.8	17.9	12.4	16.4	15.4 ± 2.4
3	12.5	14.2	13.9	11.7	13.1 ± 1.2
4	16.4	19.6	23.2	16.1	18.8 ± 3.3
5	15.5	12.8(d)	17.3	14.3	15.0 ± 1.9
14	13.6	29.5(c)	15.4	15.0	18.4 ± 7.5
20	10.6	12.4	14.1	10.5	11.9 ± 1.7
23(g)	15.9	16.9	12.6	16.6	15.5 ± 2.0
27	15.2	15.8	14.9	13.1	14.8 ± 1.2
28	25.1	20.4	19.0(e)	17.6	20.5 ± 3.3
29	13.3	18.4	12.9	12.3	14.2 ± 2.8
30	12.4	14.3	13.7	12.0	13.1 ± 1.1
31	12.4	15.1	13.1	12.2	13.2 ± 1.3
32	12.0	15.4	14.7	12.0	13.5 ± 1.8
33	10.2	12.2	11.3	10.2	11.0 ± 1.0
34	14.5	17.9	18.0	15.0	16.4 ± 1.9
25	13.7	13.9(d)	16.3	10.9	13.7 ± 2.2
36	11.4	14.0	13.8	10.6(d)	12.5 ± 1.7
37(c)	20.5	26.7	35.1	23.8	26.5 ± 6.3(f)
38	13.3	17.3	18.3	14.3	15.8 ± 2.4
56	14.6	15.2	14.8	13.9	14.6 ± 0.5
Avg.	13.5	15.8	15.2	13.4	14.8
± σ	± 1.8	± 2.4	± 2.9	± 2.3	± 2.4

(a) Values are normalized to 91.2 day/quarter

(b) The results of the transit control badges were subtracted from each reading.

(c) Not included in quarterly averages.

(d) Quarterly badge vandalized; values calculated based on 3 times the monthly average.

(e) Quarterly badge vandalized; value represents sum of monthly badge collected during the quarter.

(f) Not included in annual average.

(g) Control Station.

Stations 1 and 37 were excluded from the annual and quarterly averages since they are onsite locations and subject to plant related variations that could mask seasonal or annual trends. In addition, an occasional outlying observation was excluded from the quarterly averages (see footnotes at bottom of Table 4.18-2 for excluded observations).

The data in the table that should be reviewed first are the annual averages for all stations (second page of the table). The average for 1981 is 14.8 mR/qtr., consistent with the data from previous years (5-year average = 14.4 mR/qtr.). The coefficient of variation is also consistent with those for previous years.

The next set of data to compare are the quarterly averages for all stations, by years. The five-year averages show essentially no variation from quarter to quarter (i.e., season to season). Seasonal variations are also not apparent in the 1981 data.

Lastly, the data in the table can be compared on a station by station basis. The last column presents the percent change in the 1981 value from the average value for the past five years for each station. Any station where the 1981 value differs from the five-year average by more than twice the standard deviation of that average should be further reviewed. This occurs only at stations 1 and 37. As was previously stated, these stations are located on site and are thus subject to variable exposures from non-environmentally related plant parameters.

Table 4.18-2(a)

1981 TLD RESULTS - COMPARISON WITH PAST FIVE YEARS(a)

Location	1976	1977	1978	1979	1980	1976-1980 Mean ± σ	1976-1980 CV(%) (b)	1981 Mean ± σ	1981 CV(%) (b)	Δ(%) (c)
1	21.4	16.6	19.7	19.1	17.4	18.8 ± 1.9	10	23.8 ± 3.9	16	+27
2	16.8	15.3	18.1	15.9	3.6	15.9 ± 1.7	11	15.4 ± 2.4	16	- 3
3	15.7	12.6	14.9	12.9	11.2	13.5 ± 1.8	13	13.1 ± 1.2	9	- 3
4	19.7	15.5	17.1	15.8	15.4	16.7 ± 1.8	11	18.8 ± 3.3	18	+13
5	17.6	13.2	15.4	15.1	13.8	15.0 ± 1.7	11	15.0 ± 1.9	13	0
14	18.1	15.3	17.2	15.4	13.6	15.9 ± 1.8	11	18.4 ± 7.5	41	+16
20	14.4	10.1	12.0	10.8	9.2	11.5 ± 2.1	18	11.9 ± 1.7	14	+ 4
23	19.8	14.8	21.0	16.7	15.7	17.6 ± 2.7	15	15.5 ± 2.0	13	-12
27	16.3	8.8	15.2	12.4	11.7	12.9 ± 3.0	23	14.8 ± 1.2	8	+15
28	17.5	12.3	18.3	15.7	16.0	16.0 ± 2.3	14	20.5 ± 3.3	16	+28
29	16.9	11.0	18.6	13.0	12.2	14.3 ± 3.2	22	14.2 ± 2.8	20	- 1
30	15.4	11.9	14.1	13.0	10.0	12.9 ± 2.1	16	13.1 ± 1.1	8	+ 2
31	16.1	13.6	16.2	14.0	12.3	14.4 ± 1.7	12	13.2 ± 1.3	10	- 8
32	15.4	13.0	14.2	12.4	10.6	13.1 ± 1.8	14	13.5 ± 1.8	13	+ 3
33	16.3	9.3	11.3	10.5	8.8	11.2 ± 3.0	27	11.0 ± 1.0	9	- 2
34	18.2	14.0	16.7	14.6	14.4	15.6 ± 1.8	12	16.4 ± 1.9	12	+ 5
35	17.3	13.8	17.8	14.7	12.8	15.3 ± 2.2	14	13.7 ± 2.2	16	-10
36	14.8	11.4	16.8	12.2	10.8	13.2 ± 2.5	19	12.5 ± 1.7	14	- 5
37	18.1	14.0	18.4	20.8	18.4	17.9 ± 2.5	14	26.5 ± 6.3	24	+48
38	18.4	13.7	16.8	14.5	13.4	15.4 ± 2.2	14	15.8 ± 2.4	15	- 3
56	17.4	11.8	13.8	13.3	11.3	13.5 ± 2.4	18	14.6 ± 0.5	3	- 8

See footnotes at end of table.

Table 4.18-2 (Continued)

All Stations		1976	1977	1978	1979	1980	1976-1980	1981	Δ(%)
1st Qtr.	Mean ± σ	17.7±1.6	13.9±2.0	12.2±1.2(d)	15.6±2.4	12.1±2.1	14.3±2.4	13.5±1.8(f)	- 6
	CV (%)	9	14	9	15	17	17	13	
2nd Qtr.	Mean ± σ	14.0±1.3	12.3±2.3	23.5±3.4	14.2±1.9	13.5±2.4	15.5±4.5	15.8±2.4(g)	+ 2
	CV (%)	9	19	15	14	18	29	15	
3rd Qtr.	Mean ± σ	15.1±1.9	15.4±2.3	12.7±1.5	11.3±1.7	13.1±2.5	13.5±1.7	15.2±2.9	+13
	CV (%)	13	15	12	15	18	13	19	
4th Qtr.	Mean ± σ	21.0±2.7	9.8±1.5	14.1±2.4	14.2±2.1(e)	10.9±2.1	14.0±4.4	13.4±2.3	- 4
	CV (%)	13	15	17	15	19	31	17	
Year (n=21)	Mean ± σ	17.0±1.5	12.7±2.0	16.1±2.3	13.8±1.7	12.4±2.1	14.4±1.7	14.8±2.4	+ 3
	CV (%)	9	16	14	13	17	12	16	

(a) Results are in average mR per quarter.

(b) CV = Coefficient of Variation (0 Mean) x 100.

(c) = the percent change (±) in 1981 means from the five-year means.

(d) Excludes stations 23 and 29.

(e) Excludes station 36.

(f) Excludes station 28.

(g) Excludes station 14.

Annual Roadway Survey

A second method of obtaining background radiation measurements entails taking instantaneous direct gamma measurements utilizing a Reuter Stokes (RSS-111) pressurized ion chamber. The Reuter Stokes RSS-111 is capable of measuring low level exposure rates with an accuracy in the microroentgen per hour range. Our method takes the form of a road survey performed annually. Readings are taken at approximately one-tenth-mile intervals on principal roads within a five mile radius of the Indian Point site. Table 4.18-3 provides a brief description of the 176 locations at which readings are taken.

Results of surveys taken in 1981 and the five previous years are presented in Table 4.18-4. Means and standard deviations (2σ-values) were calculated for each station for the years 1976-1980 to provide comparison data for the 1981 results. In addition, the average ($\pm 2\sigma$) for all readings taken in a given year were calculated, excluding those from stations 1 and 73.

Station 1 is an onsite location, thus readings reflect variations in plant-related services. Station 73 is located in Bear Mountain Park in an area where rock outcroppings high in natural radioactivity yield large variations in exposure levels from one point to the next. An extensive survey of this area with a portable scintillation detector (Eberline Model PRM-7) yielded results ranging from 30 to 2000 uR/hr within a radius of 75 feet from the road survey measurement location. Large variations can thus be expected in the road survey measurement taken at this point.

Annual averages indicate that 1981 results are consistent with those from the previous two years. Averages from the 1976-1978 surveys are slightly lower than from the three most recent years, although the difference in averages between the lowest and highest years are not statistically significant.

Comparison of results on a station by station basis indicates that 1981 results are consistent with those from the previous five years. Out of 176 measurements made in 1981, all but 15 lie within two standard deviations of the five year average for that station. Two of the 15 stations (1 & 73) have been previously discussed. The remaining 13 stations are numbers 22, 23, 88, 92, 96, 101, 126, 127, 130, 132, 155, & 158. The 1981 readings for station 23 is 25% greater than the 1980 value. The 1981 readings for the other 12 stations are within 17% of the 1980 values. Thus it is seen that readings from these stations, while apparently different from the five year averages, are generally consistent with 1980 values.

It should be emphasized that the purpose of the road survey is to determine if any gross changes in background gamma levels have taken place from one year to the next at a specific location. In depth explanations of the few minor variations described above would not be meaningful. In general, however, it can be seen that measurements are fairly consistent from one year to the next and no stations exhibited any gross change in radiation levels. The two exceptions to this (i.e., stations 1 and 73) have been previously explained.

TABLE 4.18-3

ANNUAL ROAD SURVEY LOCATIONS

Point Number	Location*
1	Con Ed Parking Lot #3 at Pole #17255.
2	Old Con Ed Visitors Parking Lot Center Pole One W/O Transformer #17229.
3	B'Way 60' N/W corner Bleakley Avenue.
4	W/S B'way 150' S/O First St. Opposite Pole T-12.
5	B'way Opposite Pole #W27783.
6	E/S Westchester Avenue E/O Pole #25.
7	W/S B'way N/W Corner 11th Street at Pole #T-48.
8	E/S B'way S/E Corner 6th Street W/O Pole #73.
9	W/S B'way S/W Corner 4th Street at Pole #W63.
10	W/S B'way 60 ft. N/O Hardie Street at Pole #72.
11	6th Street at Hudson River 100 ft. W/O Pole #89.
12	N/S 6th Street 20 ft. E/O Highland Avenue at hydrant.
13	S/E Corner 6th Street S/O Westchester Avenue at Pole #1.
14	6th Street at Lake Meahagh at Pole #W12505.
15	E/S Kings Ferry Road Opposite Pole #27564.
16	Intersection of Kings Ferry Road and Tate Avenue Pole #22.
17	W/S Westchester Avenue and 4th Street F/O Pole #9.
18	W/S Westchester Avenue N/O First Street at Pole #WL.C.13.
19	Westchester Avenue and Tate Avenue F/O Pole #WI L114.

Annual Road Survey Locations (Continued)

Point Number	Location
20	E/S Route 9A Pole #W106 Next to 219 N.Y. Albany Post Road.
21	N/S Bleakley Avenue 500 ft. W/O Route 9A Pole #W6 and Hydrant.
22	F/O Pole 29715 N/W Corner South Street and Route 9A.
23	S/W Corner Welcher Avenue and Route 9A Pole #W15.
24	South Street 500 ft. N/O Welcher Avenue Pole #W109.
25	W/S South Street Opposite Junkyard F/O Pole T44.
26	S/S Travis Lane Off South Street Pole #W3.
27	W/S South Street S/O Franklin Avenue F/O Pole #W69.
28	Franklin Avenue N/S W/O Route 9A F/O Pole #W5.
29	S/S Bay Street W/O Route 9A F/O Service Pole Opposite Pole #3.
30	Corner Bay Street and South Street Pole #W63.
31	W/S Route 9A 4 miles S/O Franklin Street Bridge (Mileage Marker 3005).
32	W/S Route 9A at Welcher Avenue Exit Sign 30 mph.
33	N/S Woodale Avenue W/O Maple Avenue Pole #WLCI.
34	N/W Corner Hudson and Maple Avenue Pole #13.
35	Hudson Avenue S/E Corner Walnut Street Pole #W39.
36	Park Drive Between Freemont and Union Avenue at Light Pole.
37	N/S Union Avenue N/O Franklin Street Pole #W31.
38	W/S Ridge Street S/O Franklin Street F/O 622 Pole #3.
39	Shenandoah Avenue and Washington Street Pole #W48.
40	Washington Street E/S N/O Welcher Avenue pole #W83.

Annual Road Survey Locations (Continued)

Point Number	Location
41	W/S Washington Street S/O Short Street Pole #W96.
42	E/S Washington Street S/O Pine Lane Pole #W106.
43	E/S Washington Street S/O Boulder Drive Pole #114.
44	E/S Washington Street N/O Montrose Station Road Pole #122.
45	N/S Factory Street 200 ft. E/O Route 9A Pole #W5.
46	S/W Corner Albany Post Road and Catherine St. Pole #W121.
47	S/W Corner Lane Street Albany Post Road Pole #728.
48	N/S Trolley Road and Kings Ferry Road.
49	N/E Corner King Ferry Road and Harper Avenue Pole #6.
50	S/W Corner Route 9A S/O Kings Ferry Road Pole #717.
51	W/S Route 9A S/O Lancaster Avenue Pole #707.
52	W/S Route 9A Opposite Kaufman Auto Pole #T692.
53	W/S Route 9A Front Crugers Substation Pole #189.
54	W/S Route 9A at Pole #26577 Opposite Trailer Park.
55	W/S Route 9A S/O Crugers Station Road Pole #26333.
56	W/S Route 9A S/O Laurel Hill Road Pole #26342.
57	W/S Route 9A at Gulf Gas Station Opposite Pole #3319.
58	W/S Route 9A Front of Furnace Dock Unit Substation.
59	W/S Route 9A Front of Pole #101.
60	W/S Route 9A S/O Warren Road Pole #88.
61	W/S Route 9A Front of Sky View Haven Home Pole #66A.

Annual Road Survey Locations (Continued)

Point Number	Location
62	N/S Wolf Road W/O Route 9A First Pole.
63	S/S Wolf Road South W/O Route 9A Pole #4611.
64	North Riverside Avenue and Brook Street Pole #W133.
65	E/S Washington Street N/O Watch Hill Road Pole #155.
66	E/S Washington Street N/O Watch Hill Pole #181.
67	E/S Washington Street N/O Watch Hill Pole #192.
68	W/S Washington Street N/O Watch Hill Pole #205.
69	At Turnoff Past Toll Gate on Bear Mountain Bridge going West 50 ft. Past Toll Plaza.
70	W/S 9W Just South of Traffic Circle at Sign A.K. Morgon Overlook Lodge.
71	W/S 9W Driveway in Front of Garage Door.
72	W/S 9W at Signs for 202 and 9W 50 ft. Before Entrance to Bear Mountain Inn.
73	E/S 9W at Sign "Service Road Do Not Enter" (Granite Rock Nearby).
74	E/S 9W at Entrance to Palisades Interstate Park Comm. Receiving Dept.
75	W.S 9W Road Marker 9W-8501-1255.
76	W/S 9W at Stop Sign at Exit to Bear Mountain Park.
77	W/S 9W at Sign "Use Two Lanes".
78	W/S 9W at Sign "Hill Trucks Use Lower Gear" Marker #150.
79	E/S 9W Marker 9W-8501-1230.
80	E/S 9W at Stop Sign at Entrance to Revival Church.
81	E/S 9W at Pole #247.

Annual Road Survey Location (Continued)

Point Number	Location
82	W/S 9W in Front of Marshall's Drive-Inn.
83	W/S 9W Entrance to Private Driveway Telephone. Pole #220.
84	W/S 9W Near Snuffy's Restaurant Pole #207.
85	E/S 9W at River Tower Overlook.
86	E/S 9W Cedar Restaurant Telephone Pole #6.
87	W/S 9W in Front of Public Library at Sign "Tompkins Cove Library".
88	W/S 9W at Big Tree in Connors Bar Parking Lot.
89	W/S 9W Gulf Gas Station at Big Gulf Sign.
90	W/S 9W Esso Gas Station at Big Esso Sign.
91	W/S 9W American Gas Station at Big American Sign.
92	E/S 9W R&H Pancake House Telephone Pole #88.
93	W/S 9W Stoney Point Appliance Co. at Sign.
94	W/S 9W Citgo Gas Station at Big Citgo Sign.
95	E/S 9W in Front of State Police Station Telephone Pole #11.
96	W/S 9W B.P. Gas Station at Big B.P. Sign.
97	W/S 9W Chevron Gas Station at Big Chevron.
98	W/S 9W Haverstraw Motors at Big Ford Sign.
99	W/S 9W Samsondale Shopping Center at Big Sign.
100	W/S 9W Jack-In-The-Box Drive-In at Big Sign.
101	W/S 9W Conger and Gurnee Avenues S/W Corner (Marker 8501-1162)
102	W/S 9W Conger and Westside Avenues N/W Corner.
103	N/S 202 Broad Street at Pole #W3.

Annual Road Survey Locations (Continued)

Point Number	Location
104	N/S 202 Grant Avenue at Pole #W4.
105	S/E Corner 202 at Pole #WL65A, Cayuga Road.
106	S/W Corner 202 and Buttonwood Avenue Pole #W6.
107	E/S 202 Near Taylor Avenue Opposite Deli at Pole #5.
108	S/E Corner Northridge Road and 202 Pole #WL33.
109	S/W Corner Crestview Avenue and 202 at Pole #72.
110	Route 202 Near Lane Pole #81.
111	Route 202 and Bear Mountain Parkway Pole #91.
112	W/S Croton Avenue at Pole #W11 After Mailbox #66.
113	W/S Croton Avenue at Pole #W20 After Mailbox #105.
114	W/S Croton Avenue at Pole #W45 After Mailbox #170 (Croton Egg Farm).
115	E/S Furnace Dock Road at Pole #W209 After Mailbox #519.
116	E/S Furn. Dock Road at Pole #W197 at Harmony Hill.
117	N/E Maple Avenue and Furn. Dock Road Pole.
118	N/S Maple Avenue and Shaw Highway at Pole #11.
119	N/S Maple Avenue and Gallaway Lane at Pole #92.
120	S/S Maple Avenue and Furnace Woods Road at Pole #76.
121	N/S Maple Avenue and Montrose Station Road at Pole.
122	N/S Maple Avenue and Chapel Place at Pole #54.
123	S/S Route 202 at Pole #W95.
124	S/S 202 (Fuel Oil) at Pole #W88.
125	S/S 202 Buttonwood Road at Pole #1.
126	E/S Route 9 at South Street Exit Pole #W34.

Annual Road Survey Locations (Continued)

Point Number	Location
127	E/S Route 9 at Main Street Exit by Road Sign 6 & 202.
128	W/S Route 9A, .4 Miles North of Main Street Exit.
129	E/S Route at Intersection 9A, Route 6 and 202 N.W Corner Mile Marker 8701.
130	N/S Route 6 and 202 Front of Police Station.
131	Service Road @ Gate Esso Gas Plant Pole CE4.
132	E/S Servce Road to Esso Gas Plant Pole CE2.
133	Bear Mountain Road and Roa Hook Road at Pole.
134	Bear Mountain Road N/O Roa Hook Road, .1 Mile Pole #W6.
135	E/S Route 202 and 6 at Pole #W17.
136	W/S Route 202 and 6, .4 miles N/O Pole #W17 Near Highway Mark 87.
137	E/S 202 and 6, .8 Miles N/O #W17 20 ft. S/O 2nd 20 MPH Sign.
138	E/S 202 and 6, 1.5 Miles N/O Pole #W1 at Turn Off.
139	W/S Routes 202 and 6 at Parking Lot.
140	E/S Routes 202 and 6 S/O Bear Mountain Bridge.
141	N/S Route 6 Corner Lexington Avenue Pole #W81.
142	N/S Route 6 S/O Baker Street Pole #W2.
143	N/S 6 Front of Lakeland School Pole #W236.
144	N/S 6 S/O Renee Gate Pole #299.
145	N/S 6 E/O Jerome Drive Pole #W213.
146	N/S 6 N/O Millington Road Pole #201.
147	N/S 6 S/O Locust Avenue Pole #W196.

Annual Road Survey Locations (Continued)

Point Number	Location
148	S/S 6 Main Street and Parkway Drve Pole #50.
149	N/S 6 Opposite Food Store (Pantry Pride) Pole #169.
150	N/S 6 Opposite Beach Shopping Center Pole #148.
151	N/O 6 W/S Husted Avenue Pole #26946.
152	Charles Street S/O Route 6 Pole #W2.
153	E/S 6 and Broad Street Pole #W72.
154	Park Street and South Division Street S/E Corner at Street Sign.
155	E/S Division Street N/O Orchard Street Pole #W5.
156	W/S North Division Street and Pemart Avenue Pole #56.
157	W/S North Division Street N/W Corner Lockwood Drive Pole #37.
158	E/S Catherine Street and Oregon Road Pole #W6.
159	N/E Corner Oregon Road and Oak Street Pole #W17.
160	Oregon Road and Gallows Hill Road Pole #13527.
161	Oregon Road and Adams Rush Street Pole #W60.
162	Oregon Road N/E Varian Road Pole #1.
163	Oregon Road and Westbrook Drive F/O Carvel Stand.
164	Casparian Road W/O Oregon Road pole #123.
165	Air Monitor House.
166	Algonquin Air Sampling Location.
167	Fleishmanns.
168	Furnace Dock Air Sampling Station.

Annual Road Survey Locations (Continued)

Point Number	Location
169	Hamilton Street Air Sampling Station.
170	Factory Street Air Sampling Station.
171	Croton Air Sampling Station at Croton Point Park.
172	Grassy point Air Sampling Station at U.S. Gypsum.
173	Service Building (Parking Lot).
174	N.Y.U. Air Sampling Station.
175	Roseton Air Sampling Station at Roseton Power Plant.
176	Oregon Road in Front of Substation.

* W/O = without
N/W = northwest
W/S = West side
S/O = South of
E/S = East side
E/O = East of
N/S = North side
S/E = Southeast
F/O = Front of
S/S = South side
N/O = North of

TABLE 4.18-4

Annual Road Survey Data*

Point Number	READINGS IN uR/hr. 1976	1977	1978	1979	1980	1976-80 5-year Av. ± 2σ	1981
1	12.2	22.3	11.2	21.0	15.4	16.4 ± 10.1	30.8
2	6.5	7.8	7.2	6.7	8.1	7.3 ± 1.4	6.2
3	6.5	7.2	6.7	7.9	9.0	7.5 ± 2.0	8.3
4	6.5	7.8	6.7	8.7	9.2	7.8 ± 2.4	10.0
5	6.5	7.8	6.7	8.2	9.9	7.8 ± 2.8	9.9
6	6.5	7.2	6.2	8.1	8.7	7.3 ± 2.0	8.3
7	6.5	7.8	7.2	7.4	8.5	7.5 ± 1.4	8.0
8	7.2	7.8	6.2	8.9	8.8	7.8 ± 2.2	8.4
9	6.5	7.8	6.7	8.5	10.1	7.9 ± 3.0	9.5
10	7.2	7.8	6.7	9.3	9.4	8.1 ± 2.4	8.8
11	5.8	7.2	6.2	6.8	8.3	6.9 ± 2.0	8.0
12	6.5	7.8	6.7	9.1	10.1	8.0 ± 3.1	9.7
13	7.2	8.8	6.7	9.7	9.2	8.3 ± 2.6	9.0
14	5.8	7.2	7.2	6.8	9.2	7.2 ± 2.5	8.5
15	5.7	7.8	6.7	7.3	9.1	7.3 ± 2.5	7.5
16	6.5	7.2	7.2	7.8	8.8	7.5 ± 1.7	8.2
17	6.5	7.8	6.2	7.7	9.6	7.6 ± 2.7	8.1
18	5.8	7.2	6.2	8.2	8.9	7.3 ± 2.6	8.0
19	6.5	7.2	5.6	8.8	8.7	7.4 ± 2.8	8.0
20	5.8	7.2	6.7	8.7	8.9	7.5 ± 2.6	8.4
21	5.8	7.2	6.2	8.6	8.7	7.3 ± 2.7	9.5
22	5.8	6.6	6.2	7.6	8.7	7.0 ± 2.3	10.2
23	6.5	7.8	6.2	8.9	9.2	7.7 ± 2.7	11.5
24	5.8	7.8	7.2	9.1	9.9	8.0 ± 3.2	8.5
25	5.8	6.6	6.2	8.1	9.4	7.2 ± 3.0	10.0
26	7.9	7.2	7.2	9.8	11.3	8.7 ± 3.6	10.5
27	5.0	7.2	6.2	7.8	10.1	7.3 ± 3.8	9.5
28	7.2	8.8	6.7	10.9	11.5	9.0 ± 4.3	11.1
29	7.2	7.8	7.2	11.8	12.0	9.2 ± 5.0	10.8
30	7.2	8.8	6.7	9.2	9.9	8.4 ± 2.7	9.5
31	5.8	7.8	6.2	7.5	10.3	7.5 ± 3.5	9.2
32	7.2	7.8	6.8	7.7	10.4	8.0 ± 2.8	9.8
33	6.5	7.8	6.7	9.2	9.5	7.9 ± 2.8	8.8
34	5.8	7.8	6.2	8.6	9.2	7.5 ± 3.0	8.8
35	6.5	7.2	6.7	8.9	9.2	7.7 ± 2.5	8.4
36	5.8	7.8	6.2	7.6	9.9	7.5 ± 3.2	8.4
37	5.8	7.8	6.7	8.4	10.5	7.8 ± 3.6	8.0
38	5.8	7.8	6.7	9.0	9.8	7.8 ± 3.3	8.4
39	7.2	7.8	6.2	8.6	9.2	7.8 ± 2.4	8.6
40	6.5	7.8	6.2	7.5	8.6	7.3 ± 2.0	8.5

TABLE 4.18-4 (Continued)

Annual Road Survey Data*

READINGS IN uR/hr.

Point Number	1976	1977	1978	1979	1980	1976-80 5-year Av. ± 2σ	1981
41	6.5	7.8	6.7	8.0	8.7	7.5 ± 1.8	8.8
42	6.5	7.8	6.2	7.1	8.6	7.2 ± 2.0	8.0
43	5.8	7.2	6.7	7.4	8.7	7.2 ± 2.1	7.6
44	6.5	7.8	6.2	7.6	8.4	7.3 ± 1.8	7.6
45	6.5	7.2	6.7	8.1	9.0	7.5 ± 2.1	8.6
46	6.5	7.2	6.7	7.2	8.6	7.2 ± 1.6	8.4
47	5.7	8.8	6.2	8.1	8.9	7.5 ± 3.0	8.0
48	6.5	7.8	6.7	8.0	8.7	7.5 ± 1.8	8.0
49	5.0	7.2	6.2	7.1	9.0	6.9 ± 2.9	8.7
50	5.7	7.7	6.7	4.6	8.7	6.7 ± 3.2	7.5
51	6.5	7.8	6.2	7.7	8.6	7.4 ± 2.0	7.5
52	5.0	7.2	6.7	8.3	8.2	7.1 ± 2.7	7.8
53	5.7	7.8	6.2	7.9	8.6	7.2 ± 2.5	7.8
54	5.7	7.8	6.2	8.0	8.8	7.3 ± 2.6	8.0
55	5.7	7.2	7.2	9.1	8.3	7.5 ± 2.6	9.0
56	6.5	7.8	6.7	8.7	9.0	7.7 ± 2.3	8.0
57	5.7	7.8	6.2	7.7	8.8	7.2 ± 2.5	9.0
58	5.8	7.2	6.2	8.2	9.2	7.3 ± 2.8	9.2
59	5.8	7.8	6.7	8.1	8.9	7.5 ± 2.4	8.4
60	5.8	7.8	6.7	8.5	9.3	7.6 ± 2.8	8.0
61	7.2	7.2	6.7	8.9	10.1	8.0 ± 2.9	8.5
62	5.8	7.2	6.2	7.2	9.1	7.1 ± 2.6	8.6
63	5.8	7.8	5.6	7.4	9.2	7.2 ± 3.0	7.5
64	5.0	7.2	6.7	7.5	9.0	7.1 ± 2.9	8.2
65	5.8	7.8	6.7	8.0	9.5	7.6 ± 2.8	8.4
66	5.8	7.8	6.7	7.6	9.6	7.5 ± 2.8	8.6
67	5.0	7.8	6.7	7.5	9.4	7.3 ± 3.2	8.0
68	5.8	7.8	6.7	8.1	9.3	7.5 ± 2.7	8.4
69	7.9	7.2	7.2	8.1	10.9	8.3 ± 3.1	8.3
70	7.9	7.8	6.2	9.3	8.7	8.0 ± 2.3	8.0
71	7.9	8.8	7.2	9.9	10.9	8.9 ± 3.0	10.8
72	8.6	8.8	7.2	9.7	9.0	8.7 ± 1.8	10.5
73	9.4	17.0	30.0	36.7	18.6	22.3 ± 21.8	45.0
74	10.1	7.8	11.2	13.2	13.5	11.2 ± 4.7	15.0
75	9.4	8.8	7.2	10.5	13.9	10.0 ± 5.0	10.8
76	7.9	7.8	7.6	10.9	9.6	8.8 ± 2.9	8.8
77	7.9	9.8	8.0	10.0	8.3	8.8 ± 2.0	9.5
78	10.1	11.0	8.4	11.4	10.1	10.2 ± 2.3	10.2
79	8.6	9.8	8.0	11.1	10.6	9.6 ± 2.6	11.2
80	7.2	7.2	7.6	7.8	8.7	7.7 ± 1.2	8.4

TABLE 4.18-4 (Continued)

Annual Road Survey Data*

Point Number	READINGS IN uR/hr. 1976	1977	1978	1979	1980	1976-80 5-year Av. ± 2σ	1981
81	6.5	8.8	7.6	8.1	10.1	8.2 ± 2.7	9.7
82	7.9	7.8	7.2	8.1	8.6	7.9 ± 1.0	8.5
83	6.5	8.8	7.6	8.3	9.5	8.1 ± 2.3	9.0
84	7.9	8.8	8.0	8.5	9.4	8.5 ± 1.2	9.1
85	8.6	7.8	8.0	7.9	8.5	8.2 ± 0.7	8.7
86	7.9	7.8	6.2	8.8	9.0	7.9 ± 2.2	8.3
87	7.9	8.8	7.2	10.3	8.9	8.6 ± 2.3	9.2
88	7.2	7.2	8.0	8.8	9.0	8.0 ± 1.7	10.3
89	7.9	7.2	7.2	7.9	8.7	7.8 ± 1.2	8.5
90	7.9	7.2	7.6	7.3	8.8	7.8 ± 1.3	8.2
91	7.9	7.2	7.6	7.6	9.0	7.9 ± 1.4	8.5
92	7.9	7.2	7.6	7.8	9.1	7.9 ± 1.4	9.4
93	8.6	7.8	7.6	7.6	9.2	8.2 ± 1.4	9.8
94	7.9	8.8	6.7	9.1	8.8	8.3 ± 2.0	9.5
95	8.6	8.8	6.7	7.5	8.8	8.1 ± 1.9	8.5
96	7.9	7.8	7.2	7.6	8.4	7.8 ± 0.9	9.5
97	7.2	7.8	8.0	8.5	9.1	8.1 ± 1.4	9.2
98	7.2	8.8	7.6	8.8	9.8	8.4 ± 2.1	10.2
99	7.2	8.8	6.7	8.6	9.2	8.1 ± 2.2	9.0
100	7.2	7.8	6.7	8.3	9.6	7.9 ± 2.0	9.1
101	7.2	7.8	6.2	7.3	8.4	7.4 ± 1.6	9.6
102	7.2	7.8	7.2	7.8	9.4	7.9 ± 1.8	9.0
103	7.9	7.2	7.2	7.9	10.2	8.1 ± 2.5	9.2
104	7.2	7.2	7.2	7.8	10.5	8.0 ± 2.9	9.0
105	7.2	7.2	6.7	8.8	10.8	8.1 ± 3.4	9.0
106	7.2	7.8	6.7	8.8	9.2	7.9 ± 2.1	7.8
107	8.6	7.8	6.7	8.0	9.3	8.1 ± 1.9	8.0
108	8.6	7.8	6.2	8.4	9.0	8.0 ± 2.2	7.8
109	7.9	7.2	6.7	8.2	8.8	7.8 ± 1.6	8.0
110	7.2	7.8	6.7	8.7	9.7	8.0 ± 2.4	9.2
111	7.9	8.8	6.2	8.1	9.2	8.0 ± 2.3	8.6
112	9.4	8.8	7.6	9.4	9.6	9.0 ± 1.6	10.4
113	9.4	7.8	6.7	8.4	9.3	8.3 ± 2.2	8.6
114	8.6	8.8	6.7	8.6	10.3	8.6 ± 2.6	8.6
115	8.6	8.8	6.7	7.7	10.2	8.4 ± 2.6	8.5
116	7.9	7.2	7.2	9.1	8.1	7.9 ± 1.6	8.6
117	7.2	7.2	6.7	7.3	8.1	7.3 ± 1.0	8.2
118	7.2	7.8	6.2	7.3	8.9	7.5 ± 2.0	8.0
119	7.9	6.6	6.2	7.7	8.7	7.4 ± 2.0	7.8
120	7.2	7.8	7.2	7.8	8.1	7.6 ± 0.8	8.0

TABLE 4.18-4 (Continued)

Annual Road Survey Data*

Point Number	READINGS IN uR/hr. 1976	1977	1978	1979	1980	1976-80 5-year Av. ± 2σ	1981
121	7.2	7.2	6.7	8.2	8.4	7.5 ± 1.5	8.6
122	7.9	7.8	6.7	8.4	8.7	7.9 ± 1.5	8.6
123	7.9	7.8	6.2	8.7	8.8	7.9 ± 2.1	8.8
124	7.9	7.2	6.2	8.3	9.2	7.8 ± 2.3	8.0
125	8.6	7.2	6.2	8.3	9.9	8.0 ± 2.8	8.4
126	6.5	7.8	7.6	8.3	8.9	7.8 ± 1.8	9.8
127	7.9	7.8	7.6	9.3	10.0	8.5 ± 2.1	10.8
128	8.6	7.2	7.2	8.6	10.2	8.4 ± 2.5	8.8
129	9.4	9.8	7.2	8.3	10.4	9.0 ± 2.5	8.9
130	7.9	7.8	7.6	7.5	8.5	7.9 ± 0.8	9.2
131	7.9	7.8	7.2	7.6	8.7	7.8 ± 1.1	8.8
132	7.2	7.8	7.2	8.7	8.7	7.9 ± 1.5	9.6
133	8.6	7.8	7.6	8.5	8.8	8.2 ± 1.1	9.2
134	8.6	8.8	8.0	10.1	10.2	9.1 ± 1.9	10.6
135	7.9	7.8	8.0	9.1	10.6	8.7 ± 2.4	9.8
136	7.9	8.8	7.6	12.4	9.9	9.3 ± 3.9	11.4
137	10.1	12.0	8.0	15.7	10.3	11.2 ± 5.8	14.8
138	8.6	8.8	7.2	7.7	9.4	8.3 ± 1.8	9.2
139	8.6	9.8	6.7	8.6	8.9	8.5 ± 2.3	9.6
140	7.9	7.8	8.0	8.0	10.3	8.4 ± 2.1	9.0
141	8.6	7.8	6.2	7.9	9.0	7.9 ± 2.1	8.6
142	7.9	7.8	6.2	9.0	8.5	7.9 ± 2.1	8.8
143	7.2	7.2	6.7	7.1	7.7	7.2 ± 0.7	8.2
144	7.9	7.8	6.7	7.7	8.7	7.8 ± 1.4	8.6
145	8.6	8.8	6.7	7.7	9.3	8.2 ± 2.1	9.0
146	8.6	7.8	6.7	8.2	9.0	8.1 ± 1.8	9.2
147	7.9	9.8	7.2	8.6	9.2	8.5 ± 2.1	8.4
148	9.4	9.8	7.2	8.3	9.4	8.8 ± 2.1	8.6
149	7.9	8.8	6.7	8.8	7.6	8.0 ± 1.8	8.8
150	8.6	8.8	6.2	8.2	9.2	8.2 ± 2.4	9.2
151	8.6	7.8	7.2	9.9	11.1	8.9 ± 3.2	11.8
152	6.5	7.8	7.2	9.2	10.4	8.2 ± 3.1	9.6
153	5.8	7.8	6.7	7.6	8.8	7.3 ± 2.3	8.0
154	8.6	8.8	7.2	9.6	9.0	8.6 ± 1.8	10.0
155	7.9	7.8	7.2	7.9	8.5	7.9 ± 0.9	9.0
156	7.9	8.8	7.6	9.1	10.0	8.7 ± 1.9	9.8
157	7.9	7.8	7.2	8.9	9.2	8.2 ± 1.7	8.3
158	7.9	7.8	7.2	8.7	8.7	8.1 ± 1.3	10.2
159	8.6	7.8	7.2	9.4	9.4	8.5 ± 2.0	8.4
160	7.9	8.8	7.6	9.2	9.2	8.5 ± 1.5	9.6

TABLE 4.18-4 (Continued)

Annual Road Survey Data*

Point Number	1976	1977	1978	1979	1980	1976-80 5-year Av. ± 2σ	1981
	READINGS IN uR/hr.						
161	7.9	8.8	7.6	8.6	10.0	8.6 ± 1.8	9.4
162	7.9	7.8	7.2	8.6	9.2	8.1 ± 1.6	8.9
163	7.2	7.8	7.6	8.2	8.9	7.9 ± 1.3	9.0
164	8.6	7.8	7.6	8.4	9.2	8.3 ± 1.3	9.8
165	6.5	7.8	6.7	9.9	12.7	8.7 ± 5.2	9.7
166	7.2	7.8	7.2	8.8	10.3	8.3 ± 2.6	10.8
167	7.2	-	7.2	10.5	10.3	8.8 ± 3.7	10.2
168	5.8	6.6	6.2	8.1	9.0	7.1 ± 2.7	9.2
169	6.5	7.2	7.2	8.2	8.1	7.4 ± 1.4	7.6
170	7.2	7.8	6.7	8.5	8.9	7.8 ± 1.8	8.6
171	6.5	7.2	6.2	7.1	8.7	7.1 ± 1.9	8.6
172	6.5	7.8	7.6	9.9	9.2	8.2 ± 2.7	9.4
173	6.5	7.8	7.2	7.7	9.2	7.7 ± 2.0	9.6
174	5.8	7.2	6.7	6.8	7.9	6.9 ± 1.5	8.2
175	7.9	7.8	8.0	10.0	10.1	8.8 ± 2.4	10.8
176	6.5	8.8	7.2	7.7	9.1	7.6 ± 3.3	8.4
Average**	7.2	7.9	6.9	8.5	9.3	8.0	9.0
± 2σ (uR/hr)	±2.2	±1.5	±1.5	±2.4	±1.8	±1.4	±2.2
2σ (%)	31%	19%	22%	28%	19%	18%	24%

* Pressurized in chamber measurements. Actual survey dates were: 7/21/76, 10/29/77, 9/14/78, 12/27/79, 9/11/80, 10/29/81.

** Excludes stations 1 and 73.

5.0 Quality Assurance

Environmental sample analysis was conducted by Teledyne Isotopes of Westwood New Jersey, and Chemical Waste Management, Inc. Teledyne Isotopes performed monthly and quarterly analysis of TLD's. Chemical Waste Management, Inc. was the principal contractor responsible for analysis of all other environmental sample media.

The validity of our environmental data is tested in two ways: (1) A quality assurance program maintained by Consolidated Edison. (2) The laboratory contractor's internal quality assurance program.

The quality assurance program maintained by Consolidated Edison for 1981 was comprised of the following:

(A) Spike/Split, Blind Duplicate Sample Program: In 1981 Con Edison retained N.U.S. Corporation of Rockville, Maryland to prepare spiked environmental samples with known amounts of radionuclide or radionuclide mixture for submittal to our laboratory contractors. Advantage was taken of the fact that certain media received the same analytical preparation and analysis. For this reason there was no need to distinguish between various categories of water or organic solids (aquatic vegetation, fish, clams/crabs etc.). This helped avoid additional blind Q.C. sample locations for water and organic solid samples. Splits and blind duplicates for milk and water samples were submitted under existing blind locations. The total spike/split and blind duplicate sample program exceeded the 10% spikes plus split and blind duplicate requirement of Nuclear Environmental Monitoring Procedure NEM-AD-08, Section 5.5.3.2 (Reference 4).

(B) Procedure Review: On a continuous basis throughout 1981 Nuclear Environmental Monitoring procedures were reviewed by the NEM staff and technicians. This type of review allowed the technicians, who implement these procedures daily, to have input in making procedures more efficient and fulfill the necessary annual retraining in their jobs. To complete the retraining and to follow up the review, NEM staff accompanied technicians into the field to observe the actual execution of procedures and monitor performance. The objective was to detect deficiencies, correct them and improve program reliability.

(C) Contractor Performance Review: This is an essential part of any program that utilizes the services of a laboratory contractor. Some of the methods used by Con Edison are as follows:

1. Review routine reports of analysis. -NEM staff reviews, on a random basis, analysis results for compliance to required minimum detectable concentrations (MDCs). Problems in this area are resolved by Con Edison requesting contractor investigation into the causation. Where applicable the contractor is asked to respond on how to prevent a recurrence of the same problem in the future. Occasional visits to the contractor's laboratory, phone calls and data surveillance are the follow up techniques used in monitoring such situations.

2. Per Nuclear Environmental Monitoring Procedure NEM-A-03, an in-depth audit of Chemical Waste Management, Inc. was conducted jointly by Con Edison and PASNY. Results of the audit indicated that Chemical Waste Management, Inc. analytical laboratory quality assurance program complies with requirements specified in NRC Regulatory Guide 4.15 Rev. 1 (Reference 5).

3. Review results of Q.C. samples - Results of spike/split and blind duplicate samples are compared to themselves or the known values for the spike samples. In general, data is acceptable when there is agreement within $\pm$ 2 standard deviations of known values. Discrepancies are discussed with the contractor and resolved in the same manner described in Item 1 above.

4. E.P.A. Interlaboratory Comparison Program. Con Edison routinely reviews the laboratory contractors performance in this program. Should there be anything found to be unusual the contractor is questioned about the results in an attempt to identify the cause of the problem(s). Early detection of problem areas and their correction helps the contractor avoid things that may impact negatively on our results. Follow-up to this type of review is basically the same as items 1 and 3 above.

5. New York State Department of Environmental Conservation (NYS-DEC) Split Sample Program - Con Edison submits split samples to the N.Y.S.-D.E.C. and to our laboratory contractor for analysis. This entails supplying samples in the following media: (1) a quarterly composite of both inlet and outlet Hudson River water samples; (2) milk, quarterly; (3) continuously

air samples of varying duration from location 5; (4) fish, biannually; (5) crabs, annually; (6) Food Crops, at harvest time. The review and follow-up process is the same as earlier mentioned. This program is a little more difficult to monitor due to the approximately one year backlog that exists at N.Y.S.-D.E.C. in rendering results to program participants.

Both Teledyne Isotopes Inc. and Chemical Waste Management, Inc. maintain their own comprehensive quality assurance programs. Teledyne Isotopes program is divided into Stability Checks, Operational Checks, and Accuracy Checks. Stability checks are performed on analytical equipment using standards and on backgrounds to monitor the stability and reproducibility of counting instruments. Operational checks are performed utilizing blanks, spikes and splits (including internal cross-checks) to monitor the quality of analytical procedures and the quality of analyses performed by laboratory personnel. Accuracy checks are performed by laboratory participation in the Environmental Protection Agency (EPA) and other laboratory intercomparison programs and by maintaining equipment calibrations with standards from the National Bureau of Standards (NBS), Amersham, or IAEA.

Chemical Waste Management, Inc. basically conforms to the program just outlined for Teledyne Isotopes. Additionally, weekly Q.A./Q.C. meetings are held by those responsible for their program to discuss performance, identify and resolve problems and improve the program in general. Quarterly, Chemical Waste Management, Inc. prepares a Q.A./Q.C. Report for their clientele outlining their performance in their quality assurance program. The NEM staff reviews this material as part of the contractor performance review.

The Teledyne Isotopes and Chemical Waste Management, Inc. programs are delineated in their "Nuclear Environmental Monitoring Quality Assurance Program Manuals (References 6 & 7) which Consolidated Edison maintains copies of. Q.A. Manuals are updated by the contractors on a semiannual basis and reviewed at the time of the update.

Review of the 1981 quality assurance program indicated that environmental sample analyses performed by Teledyne Isotopes Inc. and Chemical Waste Management, Inc. 1981 was found to be satisfactory in terms of precision and accuracy (using $\pm$ two standard deviation acceptance criteria). Both laboratory contractors responded admirably in the investigation and resolution of problems that occurred in the operation of the Con Edison NEM Program for 1981.

6.0 CONCLUSION

An evaluation of the results of the radiological environmental monitoring program for the Indian Point site has indicated no 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, and includes calculated doses from plant effluents. This information shows that the 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 reasonably 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 11)	65
External Dose from Cosmic Radiation (Reference 11)	45
Internal Dose from Natural Radionuclides (Reference 12)	30
Medical and Dental Radiation (Reference 13)	72
Weapons Test Fallout (long-term) (Reference 11)	4.4
Calculated Average Doses to Individuals from Plant Effluents (Reference 9 & 10)	<0.01

7.0 REFERENCES

(1) "Environmental Technical Specification Requirements", Appendix B Part II for Indian Point Nuclear Generating 1, 2, and 3, 1975 as amended.

(2) United States Nuclear Regulatory Commission. Regulatory Guide 4.8 "Environmental Technical Specifications for Nuclear Power Plants", December 1975.

(3) New York State Department of Environmental Conservation. "Radioactivity in Air, Milk, and Water", Environmental Radiation Bulletin 81-1 and 81-2.

(4) Consolidated Edison Company of New York. Nuclear Environmental Monitoring Procedure. NEM-AD-08 Revision 4. "Quality Control Program", February 1982.

(5) United States Nuclear Regulatory Commission. Regulatory Guide 4.15, Revision 1 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams And The Environment", February 1979.

(6) Consolidated Edison Company of New York. Nuclear Environmental Monitoring Procedure NEM-A-03 Revision 0. "Quality Control and Audits", October 1977.

(7) "Nuclear Reactor Environmental Monitoring Quality Assurance Program", Teledyne Isotopes, Westwood, N.J.

(8) Q.A./Q.C. Manual Interex Corporation - Natick Mass. December 12, 1980. (Presently Chemical Waste Management, Inc.)

(9) "Effluent and Waste Disposal Semiannual Report", Indian Point Nuclear Power Station (January 1 - June 30, 1981, and July 1 to December 31, 1981). Licensee: Consolidated Edison Company of New York, Inc., and the Power Authority of the State of New York.

(10) "Effluent and Waste Disposal Semiannual Report", Indian Point Nuclear Power Station (January 1 - June 30, 1981, and July 1 to December 31, 1981). Prepared by the Power Authority of the State of New York.

7.0 REFERENCES (Continued)

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

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

(13) "Estimates of Ionizing Radiation Doses in the United States, 1960-2000" ORP/SID72-1, U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC 1972.