LILCO LONG ISLAND LIGHTING

LONG ISLAND LIGHTING COMPANY
SHOREHAM NUCLEAR POWER STATION
P.O. BOX 618, NORTH COUNTRY ROAD • WADING RIVER, N.Y. 11792

WILLIAM E. STEIGER, JR.
ASSISTANT VICE PRESIDENT-NUCLEAR OPERATIONS

SNRC-1707

APR 27 1990

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Radiological Environmental Monitoring Program
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Gentlemen:

Enclosed is a copy of the Shoreham Radiological Environmental Monitoring Program (REMP) Annual Report which provides detailed information for the full 1989 calendar year. Shoreham's Technical Specification 6.9.1.6 requires this report to be submitted prior to May 1.

Except for the period January 3, 4, 5, 1989 when reactor training criticals were performed, Shoreham was shutdown during all of 1989.

If you require additional information, please do not hesitate to contact me.

Very truly yours,

W. E. Steiger
W. E. Steiger, Jr.
Assistant Vice President
Nuclear Operations

MAP/ap
Enclosure

cc: S. Brown
T. T. Martin
L. Doerflein

IE25
1/1

SHOREHAM NUCLEAR POWER STATION
OPERATIONAL
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

ANNUAL REPORT

JANUARY 1 TO DECEMBER 31, 1989

ISSUED BY

NUCLEAR ENGINEERING DEPARTMENT

ENVIRONMENTAL ENGINEERING DEPARTMENT

LILCO
LONG ISLAND LIGHTING

SHOREHAM NUCLEAR POWER STATION

OPERATIONAL

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1989 ANNUAL REPORT

JANUARY 1 to DECEMBER 31, 1989

Prepared by

LONG ISLAND LIGHTING COMPANY
and
TELEDYNE ISOTOPES

April 15, 1990

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF TABLES (Cont.)

LIST OF TABLES (CONT.)

LIST OF TABLES (CONT.)

Appendix H

LIST OF FIGURES

APPENDIX B - SAMPLE DESIGNATION AND SAMPLING LOCATIONS

LIST OF MAPS

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report summarizes the Shoreham Nuclear Power Station's (SNPS) Radiological Environmental Monitoring Program (REMP) for 1989. During the first half of 1989 the plant was in a cold shutdown condition, except for training criticals performed on January 3, 4, and 5. In June the shareowners approved the Shoreham Settlement Agreement to transfer the plant to the Long Island Power Authority (LIPA). In compliance with this agreement the reactor was defueled during the summer and remains defueled awaiting NRC approval for transfer of the plant to LIPA.

The objective of the operational REMP is to identify and measure plant related radioactivity in the environment and calculate the potential dose to the surrounding population. The operational phase uses the preoperational baseline data to identify plant contributed radiation and evaluates the possible effects of radioactive plant effluents on the environment. The SNPS REMP is designed to comply with the plant's Technical Specifications and NRC Regulatory Guides.

The REMP data is acquired by sampling various media in the environment which are then analyzed for any radiation present. Media sampled within the aquatic environment included surface water, algae, fish, invertebrates (clams, lobsters, etc.) and sediment. The atmospheric environment was sampled for airborne particulates, airborne iodine and noble gases. Milk, potable water, precipitation, game, food products and soil were obtained from the terrestrial environment. Direct radiation was measured using thermoluminescent dosimeters (TLDs).

Radioactivity in environmental media varies from sample to sample as well as geographically; therefore, a number of sampling locations for each medium were selected using available meteorological, land and water use data. Sampling locations are designated as either indicator or control locations. The indicator locations are placed close enough to Shoreham so that plant contributed radioactivity will be at its highest concentration. The control sample locations are placed so that they will be beyond measurable influence of Shoreham and any other nuclear facility. An exception to this occurred at the on shore site for REMP location 13G2, at the entrance to Port Jefferson Harbor. During preoperational testing aquatic samples revealed the presence of low levels of iodine-131. An investigation revealed that the iodine-131 was from area hospitals treating patients for thyroid carcinoma. Thereafter, a second onshore aquatic background location was sampled at the entrance to Mt. Sinai Harbor.

A number of radioanalyses were performed on each medium sampled. All samples did not undergo all types of radioanalyses; only those analyses appropriate for the particular medium were performed. The analyses included gamma spectrometry, strontium-89 and -90, iodine-131, tritium, gross beta radiation, direct radiation and noble gases.

Dose calculations for the SNPS environs were performed using positive concentrations of radioactivity detected in the samples collected. In all cases the calculated doses were similar to the background doses calculated for the previous years. Therefore, no environmental radioactivity was identified as having originated from SNPS.

I. PROGRAM

THE PROGRAM

The Shoreham Nuclear Power Station's (SNPS) Radiological Environmental Monitoring Program (REMP) is conducted in compliance with NRC Regulatory Guide 4.15, licensing commitments, LILCO's Updated Safety Analysis Report (USAR) 11.6, and Technical Specification Section 3/4.12. The REMP was developed in general accordance with the NRC Radiological Assessment Branch Technical Position (BTP), Rev. 1, Nov. 1979, and findings in the Environmental Report (ER) 6.1.5. All samples were collected by personnel of the Long Island Lighting Company (Environmental Engineering Department) or biological contractors hired for the collection of aquatic samples. A synopsis of the sampling program can be found in Table 1. Maps and a description of sampling locations appear in Appendix B.

During 1989 sample analyses were performed by Teledyne Isotopes (TI) of Westwood, New Jersey (referred to throughout the text as "the laboratory"), under contract to LILCO. A summary of analytical results appears in Appendix A and individual analysis results in Appendix C. Aquatic sample collections were performed by EA Engineering Science and Technology, Inc. in the spring and Energy & Environmental Analysts Inc. (EEA Inc.) in the fall.

A. Objectives

The objectives of the operational radiological environmental monitoring program are:

1. Identify and measure radiation and radioactivity in the plant environs for the calculation of potential dose to the population.

2. Verify the effectiveness of in-plant measures used for controlling the release of radioactive materials.

3. Provide reasonable assurance that the predicted doses, based on effluent data, have not been substantially underestimated and are consistent with applicable standards.

4. Comply with regulatory requirements and SNPS Technical Specifications and provide records to document compliance.

B. Sample Collection

1. Aquatic Environment

The aquatic environment at the SNPS site was examined by analyzing samples of surface water, fish, invertebrates, aquatic plants and sediment. Surface water samples were taken at six locations in May and October using a Niskin bottle or by wading into the water and filling a new two gallon polyethylene bottle. The samples were placed in new polyethylene bottles following three rinses with the sample medium prior to collection. Samples of Winter Flounder (Pseudopleuronectes americanus), Windowpane (Scophthalmus aquosus), Searobin (Prionotus spp), Little Skate (Raja erinacea) and Bluefish (Pomatomus saltatrix) were taken by trawl, sealed in plastic bags, frozen, and shipped to the laboratory for analysis.

Invertebrate samples of American Lobster (Homarus americanus), Squid (Loligo pealeii) and Channeled Whelk (Busycon canaliculata) were collected by trawl. Channeled Whelk were also collected using pots. These invertebrate samples were sealed in plastic bags, frozen and shipped to the laboratory for analysis. Blue Mussels (Mytilus edulis) were collected by hand along jetties. Soft-shell clams (Mya arenaria) and Oysters (Crassostrea virginica) from Wading River were shelled and sealed in plastic bags, frozen and shipped to the laboratory.

Aquatic plants (Fucus sp., Ulva lactuca, Enteromorpha sp., and Codium sp.), among others were collected from along the shoreline, then sealed in plastic bags, refrigerated and shipped. Deep water sediment was collected using a Smith-MacIntyre bottom sampler, sealed in plastic bags, frozen and shipped. Beach sediment samples were also collected, sealed in plastic bags, frozen and shipped to the laboratory.

2. Atmospheric Environment

The atomspheric environment was examined by analyzing airborne particulates collected on Gelman Type A/E filters using low volume air samplers (approximately 1 cfm). Airborne iodine was collected by absorption on triethylenediamine (TEDA) impregnated charcoal cartridges, manufactured by Scott, which were connected in series behind the airborne particulate filters. The samplers used were equipped with a vacuum recorder for sample volume correction to ensure sample validity and to indicate any maintenance problems. Should the sampler lose vacuum due to a leak the vacuum level reading will drop to zero. Since this may occur without a corresponding loss of electric supply the exact time of the maintenance problem will be evident on the vacuum recorder chart.

Sample volumes were measured using dry gas meters and corrected for differences between the actual pressure seen by the volume meter and the average atmospheric pressure. Sample volumes are corrected to standard pressure using average weekly barometric pressure (measured at Environmental Engineering Department, Melville) and air sampler vacuum readings. Time totalizers indicate the duration of time the sample was taken.

Air samples were collected weekly at St. Joseph's Villa and analyzed for the noble gases krypton-85 and xenon-133. The samples were collected using a modified low pressure air compressor. Outside air is drawn into an interim holding tank evacuated to 20" Hg and then transferred to a sample tank for transport to the laboratory for analysis.

3. Terrestrial Environment

The terrestrial environment was examined by analyzing samples of milk, precipitation, potable water, game, food products, and soil. When available, milk samples were collected from four locations monthly, except during the pasture season (May through October) when the sampling was increased to twice a month. Milk samples were shipped on ice with sodium bisulfite ($NaHSO_3$) preservative added. Precipitation was collected at two locations weekly. In order to ensure sufficient sample volume, weekly precipitation samples were combined for a monthly sample composite. Potable water was collected quarterly from three well locations. However, samples were unavailable from well 13S2 presumably due to a change in the water table. Game samples of Raccoon, (Procyon lotor) were obtained semiannually from on site locations, sealed in plastic bags, frozen and then shipped. Food products consisting of vegetables and fruit were collected from area farm stands and shipped fresh to the laboratory.

4. Direct Radiation

Direct radiation levels in the environs were measured with energy compensated calcium sulfate ($CaSO_4$:Dy) TLDs, each containing four separate readout areas. The TLDs are annealed by LILCO prior to placement in the field. Two TLDs were placed at 41 locations and exchanged on a monthly and quarterly cycle. These 41 units include 4 additional TLDs that were added in 1989 at various area schools to better determine direct radiation levels at these sites. The units were then packaged and shipped to the laboratory for analysis along with a control dosimeter.

C. Quality Assurance

1. Teledyne Isotopes

Teledyne Isotopes (TI) has an extensive quality assurance program designed to ensure the precision and accuracy of the data generated. An Interlaboratory Comparison Program is conducted with the Environmental Protection Agency (EPA). The results of the Program analyses are listed in Appendix E. Participation in this program permits estimation of bias in TI results from the deviation from the "known" value given, or by comparison with means of all participants. The TI Quality Assurance Program for Radiological Monitoring is described in various TI publications (references 15, 16, 17).

Approximately 10 percent of TI's total analytical effort is spent on quality control including process quality control, instrument quality control, intra and interlaboratory cross-check, and comprehensive data review. In addition, LILCO specifically requires that two percent of its analyses be duplicated for further quality control cross check.

Additional information on the LILCO Quality Assurance Program is provided in NED 4170004, Quality Assurance Program for Radiological Environmental Monitoring Program, Shoreham Nuclear Power Station.

D. Data Interpretation

1. General

The analytical data generated during the program are routinely evaluated by the TI project leader who is the liaison with Long Island Lighting Company's Environmental and Nuclear Engineering Departments. Several factors are important in the interpretation of the data. These factors are discussed here to avoid repetition in sections that follow.

Within the data tables (Appendix C) an approximate 95 percent (±2 sigma) confidence interval is supplied for those data points above the lower limit of detection (LLD). These intervals represent the range of values into which 95 percent of repeated analyses of the same sample would fall. Tables C-20 and C-21 present typical and required LLD's, respectively.

Results for each type of sample were grouped according to the analysis performed. Means and standard deviations of these results are calculated when applicable. The calculated standard deviations of grouped data represent sample rather than analytical variability. For these calculations any values below LLD are considered to be at the

LLD. As a result, the means are biased high and the standard deviations are biased low. When a group of data is composed of mainly LLD values (>50%), averages are not calculated.

Grab sampling is a useful and acceptable procedure for taking environmental samples of a medium in which the concentration of radionuclides is expected to vary minimally with time or where intermittent sampling is deemed sufficient to establish the radiological characteristics of the medium. This method, however, is only representative of the sampled medium for that specific location and instant of time. As a result, variation of radionuclide concentrations in the samples will normally occur. Since these variations will tend to counterbalance one another, the extraction of averages based upon repetitive grab samples is valid.

2. <u>Gamma Isotopic Analyses</u>

SNPS Technical Specifications Table 3.12.1-1 requires that analyses be performed on all media for gamma emitting radionuclides which may be attributable to effluents from the plant. These analyses are in addition to requirements for specific gamma emitters such as I-131, Cs-134, Cs-137, Ba-140, Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-95 and Nb-95. Industry experience suggests that these are the most likely radionuclides to find their way into the environment from a BWR nuclear power plant. Gamma spectroscopy is expected to identify most other nuclides which may be discharged when the LLD's for specified gamma emitters are met by this technique.

Tables 3.1 and 3.2 of the Shoreham Final Environmental Statement list the calculated liquid and gaseous effluents by radionuclide in curies per year. These release rates assume normal operation of the plant, including anticipated operational occurrences. Those nuclides listed in Tables 3.1 and 3.2 which are not routinely observable by gamma spectroscopy and which are not specifically analyzed in other ways fall into two categories:

1. Those radionuclides with half-lives on the order of hours or minutes which cannot accumulate appreciably in the environment (Na-24, Cu-64, Zn-69m, Zn-69, Sr-91, Y-91m, Y-92, Y-93, Tc-99m, Rh-103m, Rh-105, Rh-106, Te-129, Te-131m, Te-131, I-132, I-135, Ba-137m, Pr-143, Ce-143, Pr-144 and W-187).

2. Those radionuclides with no gammas (P-32, Fe-55), those with a trivial percentage of their transitions going by gamma emissions (Y-91), or those with their primary gamma occurring at such a low energy and at such low abundance that it is

not routinely observable in the presence of other gamma activity (Nd-147). With only 10 pCi of Nd-147 calculated to be released per year in Shoreham's liquid effluents, the nuclide cannot be an important contributor to dose.

E. Dose Assessment

The methodology for determining doses is similar for all pathways. Laboratory analyses from the REMP for each sample type are compiled. Data from all locations taken on the same date are averaged to obtain the most reliable approximation of the radioactivity concentration on that date for that sample type. The averages of all dates are then taken to provide the best approximation of radioactivity concentrations for the year.

When an average value has been obtained which represents a sample medium or an exposure pathway, it can then be used to calculate the dose for the year. Additional information, such as the quantity of fish, milk, meat, vegetables, etc., consumed per year by the maximum individual is also needed to calculate the total dose (13).

The dose due to direct radiation exposure is monitored by TLDs. The laboratory results for TLD's are expressed in dose units directly and do not require any additional calculations.

The dose to the total body or to a specific organ is then calculated by the product of the radionuclide specific dose conversion factor for its applicable exposure pathway, the environmental sample radionuclide concentration, and the ingestion or inhalation rate of the sample or medium of interest. For example, the following general equation expresses this principle:

Dose (mRem/yr) = Concentration per sample X Quantity ingested per year X Dose factor

The sample concentration is typically expressed in pCi/l or pCi/kg. For the ingestion pathway, the quantity ingested or consumed per year is expressed in kg/year or l/year. Finally, the dose conversion factor is expressed in terms of mRem/pCi ingested or inhaled.

F. Program Summary

Table 1 summarizes information on the REMP as performed during the period of this report, January 1 through December 31, 1989. During this reporting period 3311 analyses were performed on 2613 environmental samples. Appendix A summarizes the analytical results obtained from the SNPS REMP. The format used is that recommended in NRC Radiological Assessment Branch Technical Position (BTP), Rev. 1, Nov. 1979. Appendix B describes the sample coding system, which specifies sample type and relative locations at a glance. In addition, pertinent information on individual sampling locations, and maps which show their geographic location, are included. Appendix C presents the analytical results of the Shoreham Nuclear Power Station's Radiological Environmental Monitoring Program for the period January 1 through December 31, 1989. Appendix D contains a synopsis of the analytical procedures used in the REMP. Results of the EPA interlaboratory comparison program can be found in Appendix E. Appendix F lists the program exceptions for 1989, and Appendix G reports the land use surveys performed by LILCO's Environmental Engineering Department during 1989 in the vicinity of the SNPS. Common and scientific names of species collected in the program are presented in Appendix H.

TABLE 1

SYNOPSIS OF THE SHOREHAM NUCLEAR POWER STATION'S OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR THE PERIOD JANUARY 1 THROUGH DECEMBER 31, 1989

SAMPLE TYPE	SAMPLING FREQUENCY	LOCATIONS	NUMBER COLLECTED	ANALYSIS	ANALYSIS FREQUENCY	NUMBER PERFORMED
Aquatic Environment						
Surface Water	Semiannual	6	12	I-131	Semiannual	12
				H-3	Semiannual	12
				Gamma	Semiannual	12
				Sr-89	Semiannual	12
				Sr-90	Semiannual	12
Fish	Semiannual	3	29	Gamma	Semiannual	29
				Sr-89	Semiannual	29
				Sr-90	Semiannual	29
Invertebrates	Semiannual	6	25	Gamma	Semiannual	25
				Sr-89	Semiannual	25
				Sr-90	Semiannual	25
Aquatic Plants	Semiannual	6	10	Gamma	Semiannual	10
				Sr-89	Semiannual	10
				Sr-90	Semiannual	10
Sediment - Beach	Semiannual	6	8	Gamma	Semiannual	8
				Sr-89	Semiannual	8
				Sr-90	Semiannual	8
Sediment -Offshore	Semiannual	4	4	Gamma	Semiannual	4
				Sr-89	Semiannual	4
				Sr-90	Semiannual	4
Atmospheric Environment						
Airborne Particulates	Weekly	16	847	Gross Beta	Weekly	847
				Gamma	Quarterly	64
				Sr-89	Quarterly	64
				Sr-90	Quarterly	64
Airborne Iodine	Weekly	16	847	I-131	Weekly	847
Noble Gas	Weekly	1	53	Kr-85	Weekly	53

TABLE 1 (Cont.)

SYNOPSIS OF THE SHOREHAM NUCLEAR POWER STATION'S OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR THE PERIOD JANUARY 1 THROUGH DECEMBER 31, 1989

SAMPLE TYPE	SAMPLING FREQUENCY	LOCATIONS	NUMBER COLLECTED	ANALYSIS	ANALYSIS FREQUENCY	NUMBER PERFORMED
Terrestrial Environment						
Milk	Biweekly (1)	7	63	I-131	Biweekly	63
				Gamma	Biweekly	63
				Sr-89	Monthly	43
				Sr-90	Monthly	43
Potable Water	Quarterly	3	11	Gamma	Quarterly	11
				I-131	Quarterly	11
				H-3	Quarterly	11
Precipitation	Monthly	2	24	Gamma	Quarterly	24
				I-131	Quarterly	24
				H-3	Quarterly	24
Game	Semiannual	1	2	Gamma	Semiannual	2
Food Products	Annual (2)	6	24	Gamma	Monthly	24
				I-131	Monthly	24
Soil	Every Three Years	10	10	Gamma	Every Three Years	10
				Sr-90	Every Three Years	10
Direct Radiation						
TLDs	Quarterly	41	160	Gamma Dose	Quarterly	160
	Monthly	41 (3)	484	Gamma Dose	Monthly	484

(1) Milk is collected biweekly during the pasture season and monthly during the nongrazing season.
(2) When milk samples are discontinued food product samples are collected monthly during harvest if necessary to comply with SNPS Technical Specification 3.12.1.
(3) Four new TLD stations were added to the program in March 1989.

II. RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The analytical results for the reporting period of January 1 through December 31, 1989, have been divided into four categories: aquatic, atmospheric, terrestrial, and direct radiation. The individual samples and analyses within each category display the unique radiological characteristics of that type of environment. Analytical results of the REMP are summarized in Appendix A. The data for individual analyses are presented in Appendix C.

A. Aquatic Environment

The aquatic environment in the vicinity of SNPS consists primarily of Long Island Sound. The radiological characteristics were studied by analyzing samples of surface water, Winter Flounder, Windowpane, Searobin, Little Skate, Bluefish, American Lobster, Squid, Channeled Whelk, Blue Mussels, Soft Shell Clams, Oysters, aquatic plants and sediment. The samples were collected by LILCO's Environmental Engineering Department, EA Engineering Science and Technology, Inc. and Energy & Environmental Analysts Inc. (EEA Inc.) (under contract to LILCO).

1. Surface Water (Table C-1)

Semiannual surface water samples were taken at six locations and were analyzed for tritium, gamma emitters, iodine-131, and strontium-89 and strontium-90.

Three surface water samples analyzed for tritium showed detectable levels of 200, 4400 and 4700 pCi/l respectively. The other nine samples were below the lower limit of detection. Except for the two samples with 4400 and 4700 pCi/l, the results are consistent with tritium concentrations observed in surface water during 1983 and 1984, the preoperational period, and in 1985, 1986, 1987 and 1988. Both of the samples with high tritium concentrations were from the same control location. No explanation has been determined for these high concentrations.

Naturally occurring potassium-40 was measured in nine of the samples with an average of 273 pCi/l and a range between 195 and 357 pCi/l. No other gamma activity above the detectable levels was measured in the twelve surface water samples as analyzed by gamma spectroscopy.

Surface water samples were also analyzed for iodine-131, strontium-89, and strontium-90. None of these nuclides were observed within the limits of detection.

2. Fish (Table C-2)

Twenty-nine fish samples were collected at three locations and the edible portions analyzed for gamma emitters. Gamma spectrometry showed potassium-40 present in all samples with an average concentration of 3981 pCi/kg wet and a range between 2060 and 5130 pCi/kg wet. Cesium-137 was detected in six samples with an average activity of 9.57 pCi/kg wet and a range between 7.04 and 11.8 pCi/kg wet. These activities are less than those reported in 1983 and 1984 during the preoperational period, and comparable to those reported in 1985, 1986, 1987 and 1988.

3. Invertebrates (Table C-3)

Twenty-five invertebrate samples, comprised of soft shell clams, oysters, mussels, lobsters, squid, and whelks, were collected at six locations and analyzed for gamma emitters, strontium-89 and strontium-90. Gamma spectrometry showed detectable levels of potassium-40 in all samples, ranging from 1470 to 4620 pCi/kg wet with an average activity of 2960 pCi/kg wet. Naturally occurring beryllium-7 was measured in one sample with an activity of 91.9 pCi/kg wet. Neither strontium-89 nor strontium-90 was detected.

4. Aquatic Plants (Table C-4)

Marine algae, collected at six locations (ten samples) in Long Island Sound and at one location in Wading River Marsh (two samples), were analyzed for gamma emitters and strontium-89 and strontium-90. Gamma spectrometry showed detectable potassium-40 in all samples ranging from 3310 to 36100 pCi/kg dry with an average activity of 16598 pCi/kg dry. Cesium-137 was measured in two samples with an average activity of 62.2 pCi/kg dry and a range of 40.4 to 83.9 pCi/kg dry. Iodine-131 was detected in one sample location 13G2 background site, at a level of 238 ± 93 pCi/kg dry. This iodine is believed to be from Port Jefferson area hospitals. Naturally occurring thorium-228 was measured in nine samples with an average activity of 383 pCi/kg dry and a range of 77.9 to 755 pCi/kg dry. Radium-226 was measured in two samples with an average activity of 830 pCi/kg dry and a range of 801 to 858 pCi/kg dry. Strontium-89 and strontium-90 were not observed.

5. Sediment (Table C-5)

Four offshore sediment samples were collected in April and May at four offshore locations and analyzed for gamma emitters and strontium-89 and strontium-90. Gamma spectrometry showed detectable levels of potassium-40 in all samples ranging from 1840 to 6410 pCi/kg dry with an average activity of 3316 pCi/kg dry. Naturally occurring radium-226 was observed in one sample with an activity of 699 pCi/kg dry. Thorium-228, also naturally occurring, was measured all four samples within the range of

136 to 766 pCi/kg dry with an average activity of 356 pCi/kg dry. All other gamma emitters were below the lower limit of detection.

Eight beach sediment samples were collected and analyzed for strontium-89, strontium-90 and gamma emitters. No strontium-89 was detected. Strontium-90 was measured in one sample with an activity of 2.9 pCi/kg dry. All samples had measurable activities of naturally occurring potassium-40 with an average activity of 2380 pCi/kg dry and a range of 1450 to 3540 pCi/kg dry. Radium-226 was measured in one sample with an activity of 200 pCi/kg dry. All eight samples had measurable thorium-228 with an average activity of 141 pCi/kg dry and a range of 75.0 to 319 pCi/kg dry. All other gamma emitters were below the lower limit of detection.

B. Atmospheric Environment

The atmospheric environment in the vicinity of the SNPS was examined by analyzing samples of airborne particulates and airborne iodine at 16 sampling locations. TEDA-impregnated charcoal cartridges used to collect airborne iodine were collected weekly and analyzed by gamma spectrometry for iodine-131. Airborne particulate filters were collected weekly and analyzed for beta emitters. Quarterly composites from each station were analyzed for gamma emitters and radiostrontium.

1. Airborne Particulates (Tables C-6, C-7, and C-8)

Beta-emitter concentrations ranged from 0.004 to 0.060 pCi/m^3 with an annual average for the 16 sampling locations of 0.018 pCi/m^3 (Table C-6). Of the 847 measurements two were below the detection limit, nominally 0.004 pCi/m^3. Figure 1 shows the average weekly gross beta fluctuations in airborne particulates from all stations for 1989. Figure 2 represents the average monthly gross beta results in airborne particulates from January 1, 1977 through December 31, 1989.

Results of gamma spectrometry (Table C-7) showed detectable levels of naturally occurring beryllium-7 in all sixty-four samples. The average beryllium-7 activity in the quarterly analyses was 0.062 pCi/m^3 with a range of 0.043 to 0.080 pCi/m^3. Naturally occurring potassium-40 was observed four times with an average of 0.008 pCi/m^3 and a range of 0.0063 to 0.0114 pCi/m^3. All other gamma emitters were below the lower limit of detection.

The radiostrontium analyses (Table C-8) on the 64 quarterly composites showed no detectable levels of strontium-89 or strontium-90.

2. Airborne Iodine (Table C-9)

Analytical results of airborne iodine-131 were all below the lower limit of detection which ranged between <0.008 and <0.5 pCi/m^3.

3. Noble Gas (Table C-19)

Air samples were collected weekly at St. Joseph's Villa and analyzed for Krypton-85 and Xenon-133. Xenon-133 was not found in any sample. All 53 samples had positive concentrations of Krypton-85 ranging from 26 to 46 pCi/m^3, with an average concentration of 35 pCi/m^3, similar to the average concentrations found during the preoperational years.

C. Terrestrial Environment

The terrestrial environment in the vicinity of the SNPS was examined by analyzing samples of game (raccoon), milk, food products, rainwater and potable water and soil. Gamma spectrometry was performed on all samples. In addition, iodine-131, strontium-89 and strontium-90 analyses were performed on the milk samples, while tritium and iodine-131 analyses were performed on the potable water samples. Rainwater samples were analyzed for gross beta, tritium and gamma emitters. Soil samples were analyzed by gamma spectrometry and radiochemically for strontium-90.

1. Milk (Tables C-11 and C-12)

All of the 63 monthly and semimonthly cow and goat milk samples analyzed for iodine-131 were below the LLD which ranged between <0.2 and <0.6 pCi/l. Naturally occurring potassium-40 was observed in all the milk samples. The goat milk samples had an average measurement of 1749 pCi/l and a range of 1390 to 2050 pCi/l. The cow milk samples had an average concentration of 1073 pCi/l with a range of 885 to 1470 pCi/l. Cesium-137 was detected in one of the 40 goat milk samples with an activity of 8.5 pCi/l. Ten of the 23 cow milk samples had detectable measurements of cesium-137 with an average of 8.4 pCi/l and a range of 4.7 to 16.2 pCi/l.

All other gamma emitters, as well as strontium-89 were below the detection limit. Strontium-90 was observed in all 16 cow samples and 22 of the 23 goat milk samples. In the 16 cow milk samples, the average strontium-90 concentration was 5.7 pCi/l with a range from 0.55 to 14.0 pCi/l. For the 22 goat milk samples, the average strontium-90 concentration was 2.5 pCi/l and the range was from 0.71 to 5.1 pCi/l. The activities reported for strontium-90 are consistent

with those found in cow and goat milk samples from 1983 to the present.

2. Potable Water (Table C-13)

Ten potable water samples were collected at three locations during 1989. All tritium results were below the lower limit of detection (100 pCi/l). No iodine-131 was measured above the lower limit of detection which was between <0.2 and <0.3 pCi/l. All other gamma emitters were below the lower limit of detection.

3. Game (Table C-14)

Potassium-40 was observed in the two raccoon samples with an average activity of 2360 pCi/Kg wet and a range of 2020 to 2700 pCi/kg wet. Cesium-137, the only other observed gamma emitter was measured over a greater range of activity due possibly to seasonal effects. The average cesium-137 activity was 263 pCi/kg wet and a range of 34.1 to 492 pCi/kg wet. These results are consistent with the previous several years. The average cesium-137 activity for 1988 was 307 pCi/kg wet with a range of 76.7 to 538 pCi/kg wet.

4. Food Products (Table C-15)

Twenty-four human food products from local farms were analyzed, including tomatoes, potatoes, cabbage, lettuce, beets, onions, strawberries, and corn. All samples contained naturally occurring potassium-40 with an average of 2895 pCi/kg wet and a range of 1490 to 6100 pCi/kg wet. Also naturally occurring beryllium-7 was observed in one sample with a concentration of 266 pCi/kg wet. All other gamma emitters were below the lower limit of detection. The samples were also analyzed for iodine-131 by a radiochemical procedure. No activity was found. The detection limit varied from 4 to 10 pCi/kg wet.

5. Precipitation (Table C-10)

Twenty-four precipitation samples were collected at two stations during the twelve months and analyzed for gross beta, tritium and gamma emitters.

Gross beta activity was measured in the 24 samples with an average activity of 5.5 and a range of 1.6 to 19 pCi/l.

Tritium was measured in five of the 24 samples with an average activity of 176 pCi/l and a range of 120 to 250 pCi/l.

Naturally occurring beryllium was observed in five samples. Two samples from station 9S1 had an average of 59.6 pCi/l and a range of 52.3 to 66.8 pCi/l. Beryllium was also observed in three samples from station 12A1 with an average of 44.2 pCi/l and a range of 43.4 to 45.8 pCi/l. All other gamma emitters were below detection limits.

6. Soil (Table C-16)

Soil samples are collected once every three years. They were collected during 1989 from ten locations and analyzed for strontium-90 and gamma emitters. Strontium-90 was detected in four samples with an average activity of 23 pCi/kg dry and a range of 15 to 35 pCi/kg dry. Gamma spectrometry measured potassium-40 in all samples with an average activity of 3849 pCi/kg dry and a range of 1800 to 7060 pCi/kg dry. Naturally occurring radium-226 was measured in six samples with an average activity of 1914 pCi/kg dry and a range of 604 to 1620 pCi/kg dry. Thorium-228, also naturally occurring, was measured in all samples with an average activity of 605 pCi/kg dry and a range of 256 to 1300 pCi/kg dry. Cesium-137 was measured in eight samples with an average activity of 242 pCi/kg dry and a range of 37.7 to 456 pCi/kg dry. All other gamma emitters were below the lower limit of detection.

D. Direct Radiation (Tables C-17 and C-18)

Direct radiation measurements were taken monthly and quarterly at 41 locations using $CaSO_4$:Dy thermoluminescent dosimeters (TLDs). Four new locations were added to the program in March 1989. TLDs were used to detect radiation levels near ground level in the vicinity of the Shoreham site due to terrestrial and cosmic gamma ray emitters and possible SNPS contributed direct radiation. Figure 3 presents a comparison of average TLD results from 1977 to 1989. All TLD results presented in this report have been normalized to a standard month (30.4 days) to eliminate the apparent differences caused by the variations in exposure period. The average of the quarterly exposures was 3.6 mR/standard month and the average of the monthly exposures was 3.6 mR/standard month. This is less than quarterly and monthly values, respectively, measured during the preoperational years 1983 and 1984.

E. Dose Assessment

Tables 2 summarizes the results of the dose assessment determinations based on 1989 data.

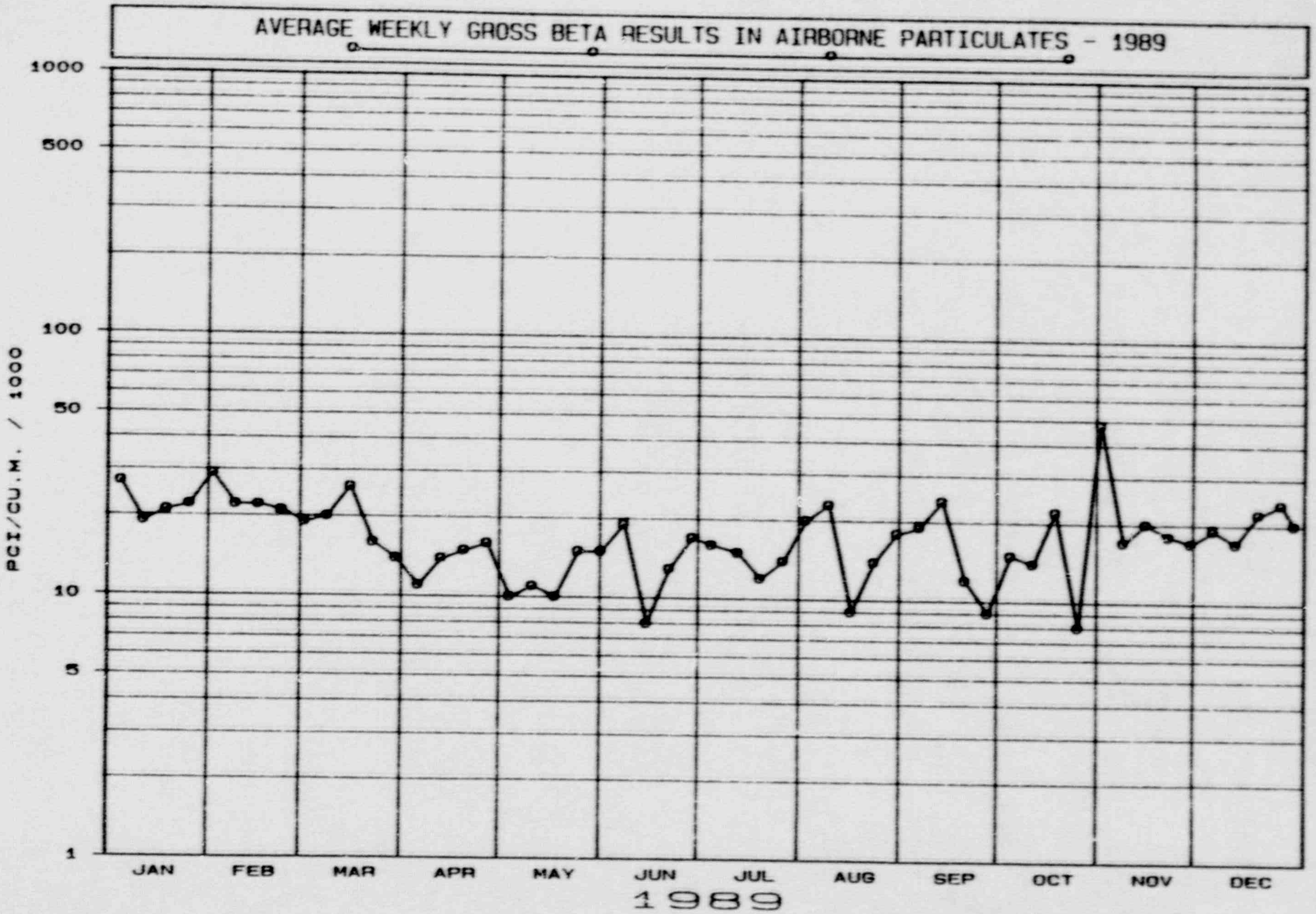
Initially, all positive concentrations of radionuclides in indicator samples, as shown in Appendix A, were considered for inclusion in the dose calculation. In an attempt to factor out as much of the contribution due to natural and man-made background radiation as possible, indicator and control sample results were compared. If the control location results were greater than those at the indicator location, the indicator sample results were not included in the dose assessment. Surface water, aquatic plants and precipitation were not considered as significant human exposure pathways, therefore, not considered in the dose assessment. The dose due to standing on soil/sediment was not calculated since this is accounted for in the direct radiation dose. Also, potable water was excluded from dose calculations because it is not considered a pathway. (Since ground water drainage is to the north, no water sources for drinking or irrigation can be affected.)

Beryllium-7, potassium-40, radium-226, radium-228 and thorium-228 are all naturally occurring isotopes and not likely to be produced as a result of the operation of Shoreham, so they were excluded. Krypton-85 was also excluded as an individual contributor to dose since it is not absorbed or ingested and is included in the direct radiation component. The remaining positive isotope, cesium-137, could be produced as a result of plant operation so it was included in the dose calculations. It should be noted that cesium-137 also exists in the environment as a result of atmospheric weapons testing and the Chernobyl accident.

Comparison of the results of the dose assessment of 1989 with those of the preoperational years 1983 and 1984, show similar results for all three years. Doses calculated for 1983 were based on ingestion factors for the average individual, whereas the maximum individual ingestion factors were used in 1984 and 1989. This makes exact comparison of the results difficult; however, the dose is directly proportional to the activity in the medium: in all cases considered, the concentrations found in 1989 are consistent with those of 1983.

It should be noted that cesium-137 found in game samples was considered as a dose contributor by using ingestion factors for meat. This is highly conservative.

FIGURE 1



AVERAGE WEEKLY GROSS BETA RESULTS IN AIRBORNE PARTICULATES - 1989
1000
500
100
50
10
5
1
PCI/CU.M. / 1000
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1989

FIGURE 2

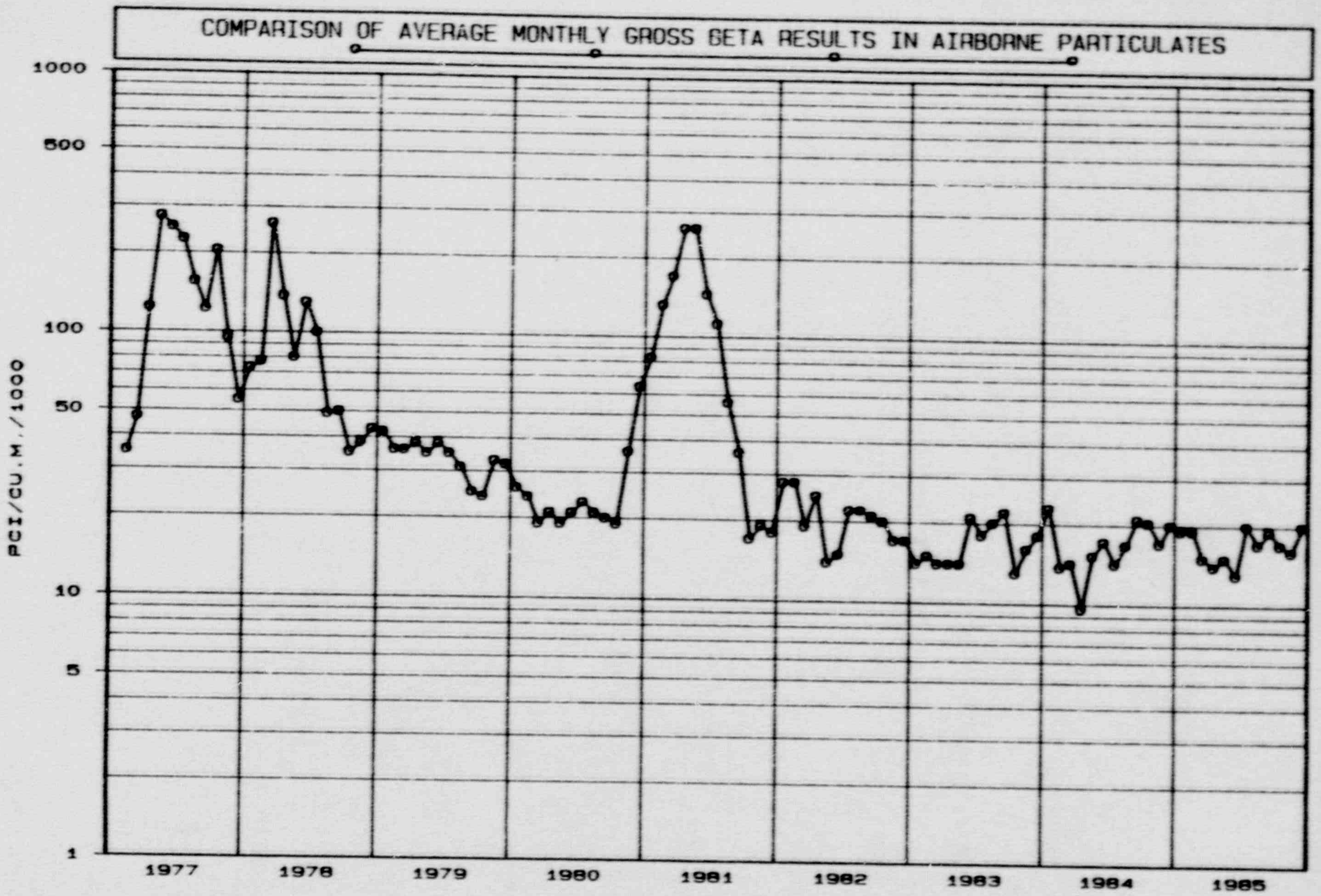

COMPARISON OF AVERAGE MONTHLY GROSS BETA RESULTS IN AIRBORNE PARTICULATES
1000
500
100
50
10
5
1
PCI/CU.M./1000
1977
1978
1979
1980
1981
1982
1983
1984
1985

FIGURE 2 (Cont.)

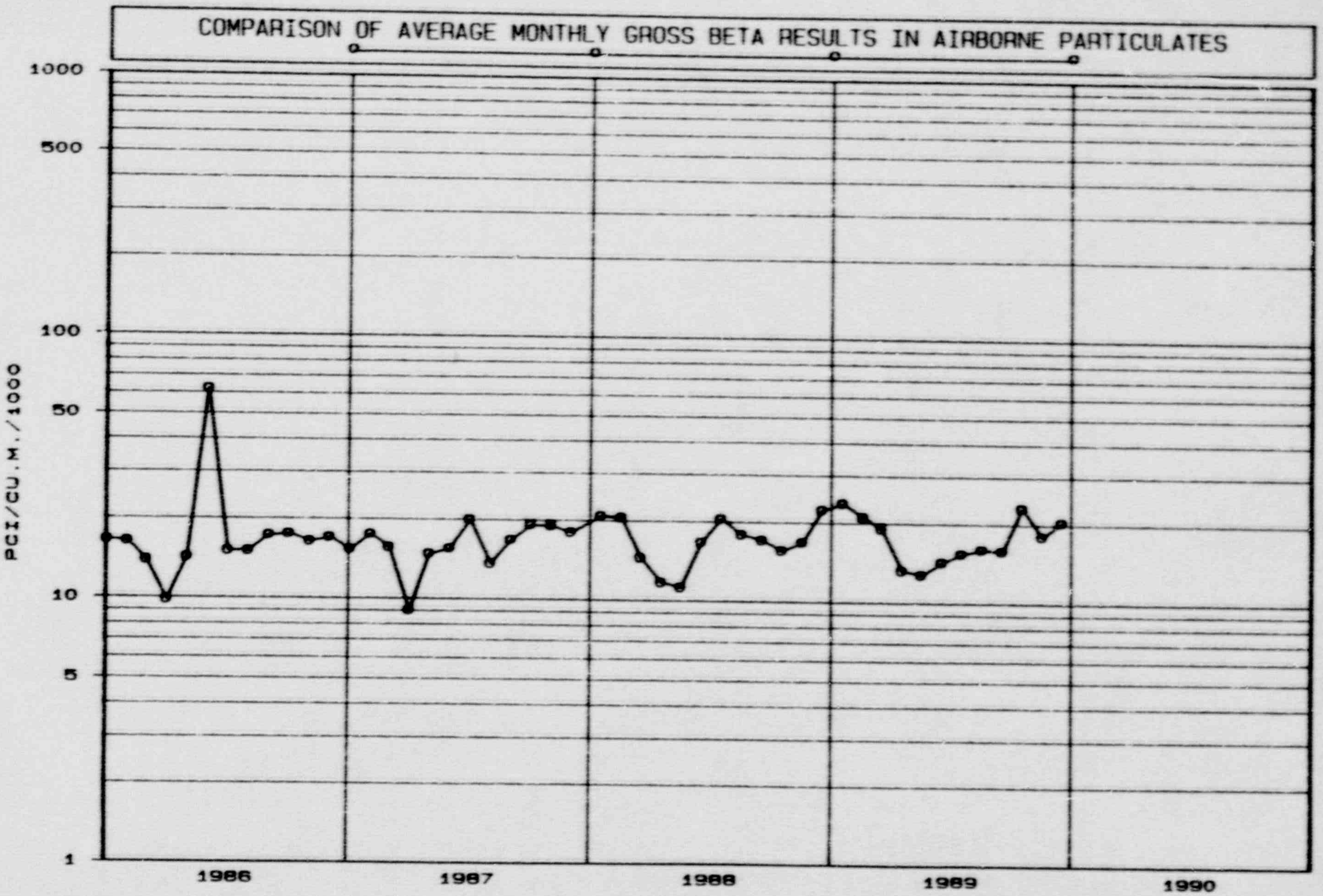
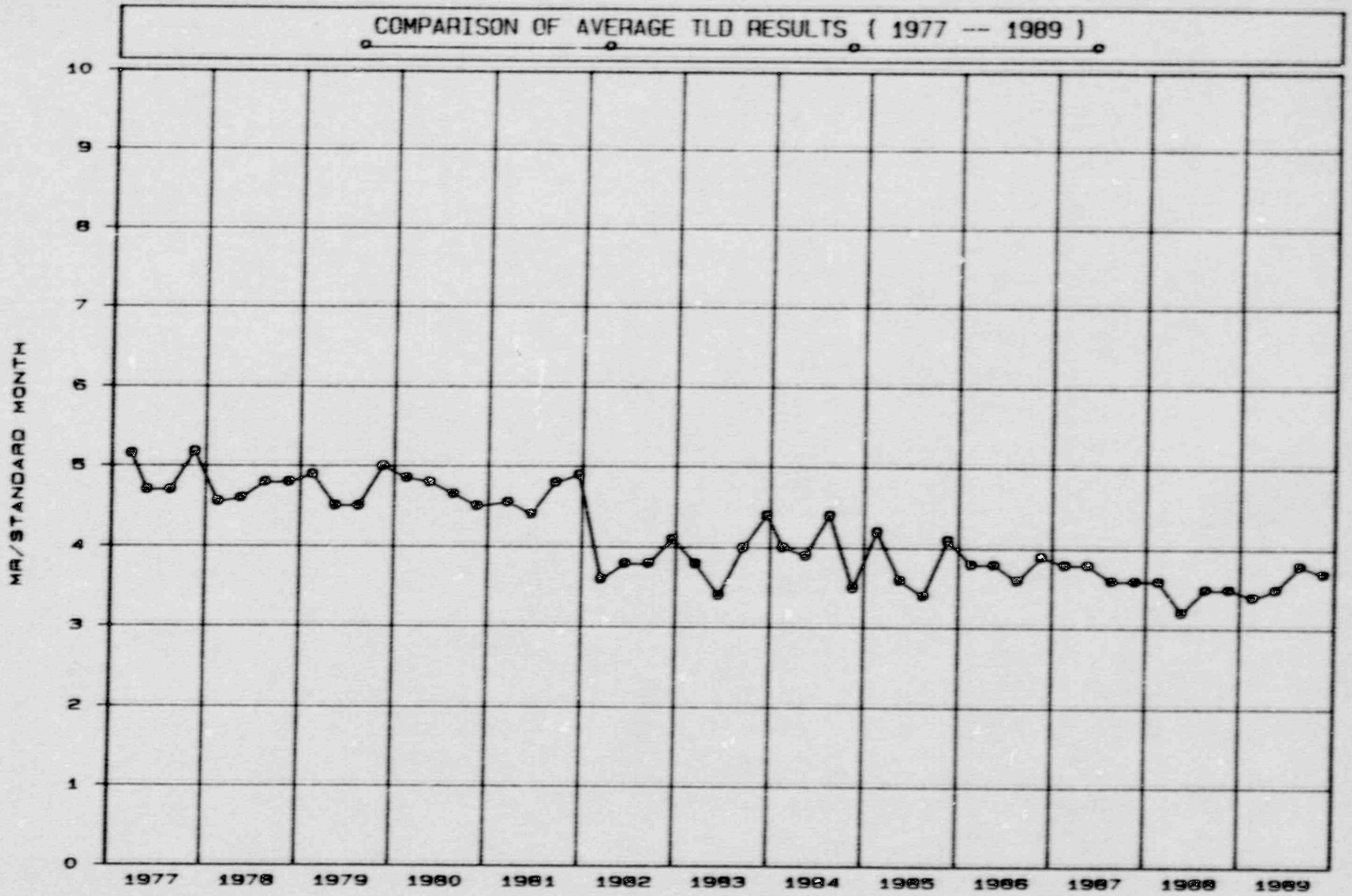


FIGURE 3



COMPARISON OF AVERAGE TLD RESULTS (1977 -- 1989)
MR/STANDARD MONTH
10
9
8
7
6
5
4
3
2
1
0
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989

TABLE 2

SUMMARY OF DOSE DETERMINATION FOR 1989

PATHWAY MOST SENSITIVE AGE GROUP(S)	RADIONUCLIDE OR TLD	ACTIVITY IN MEDIUM	QUANTITY INGESTED(1)	TOTAL BODY DOSE FACTOR mRem/pCi INGESTED(2)	CRITICAL ORGAN DOSE FACTOR (mRem/pCi INGESTED(2))	TOTAL BODY DOSE (mRem/yr.)	CRITICAL ORGAN DOSE (mRem/yr.)
Milk							
Adult	Cs-137	8.5 pCi/l	310 l/yr.	7.14 E-5	1.09 E-4 liver	1.88 E-1	2.87 E-1 liver
Infant			330 l/yr.	4.33 E-5	6.11 E-4 liver	1.21 E-1	1.71 E+0 liver
Game							
Adult	Cs-137	263 pCi/kg wet	110 kg/yr(3)	7.14 E-5	1.09 E-4 liver	2.07 E+0	3.15 E+0 liver
Infant			41. kg/yr(3)	4.62 E-5	3.27 E-4 bone	4.98 E-1	3.52 E+0 bone

* Comparison of the 1989 doses with those of the preoperational years 1983 and 1984 shows no significant differences.
(1) From Table E-5 maximum exposed individual. Reg. Guide 1.109.
(2) From Tables E-11, E-12, E-13 and E-14, Reg. Guide 1.109.
(3) Meat and Poultry pathway, Table E-5, Reg. Guide 1.109. Utilizing 110. kg/yr. for adults and 41. kg/yr. for children as the quantity of game consumed results in a conservatively high calculated dose.

III. CONCLUSIONS

CONCLUSIONS

Except for training criticals on January 3, 4 and 5, the Shoreham Nuclear Power Station was in a cold shutdown condition during the first half of 1989. After approval of the Shoreham Settlement Agreement the unit was defueled for the remainder of 1989.

Analyses of environmental samples show results consistent with those found during the preoperational years of 1983 and 1984. In addition, comparison of results reveals little difference between indicator and control locations. Therefore, no isotopes could be identified as having originated from SNPS.

Sensitive indicators revealed minute quantities of radioactive fallout from the October 1980 atmospheric nuclear weapons test by the Peoples Republic of China and the Chernobyl accident, in addition to radioactivity remaining from two decades of atmospheric testing.

Aside from these anomalies in the environment, expected normal background radioactivity has been measured in REMP samples. Aquatic and terrestrial samples were analyzed and reflected the normal background radiation found in the environment. The atmospheric environment was sampled for airborne weekly gross beta results in airborne particulates from January through December 1989. Figure 2 shows the average monthly gross beta results in airborne particulates from February 1977 to December 1989. Direct radiation levels were relatively low and approximately the same at all locations. Figure 3 shows the average quarterly TLD results in mR/standard month from January 1977 to December 1989.

IV. REFERENCES

IV. REFERENCES

(1) Long Island Lighting Company. "Shoreham Nuclear Power Station, Environmental Report, Construction Permit Stage", December 1977.

(2) United States Atomic Energy Commission, Directorate of Licensing "Final Environmental Statement Related to Operation of Shoreham Nuclear Power Station", Docket No. 50-322, September 1972.

(3) Long Island Lighting Company. "Shoreham Nuclear Power Station, Updated Safety Analysis Report".

(4) Radiation Management Corporation. "Shoreham Nuclear Power Station Radiological Environmental Monitoring Program - 1977 Annual Report", March 1978.

(5) Radiation Management Corporation. "Shoreham Nuclear Power Station Radiological Environmental Monitoring Program - 1978 Annual Report", April 1979.

(6) Radiation Management Corporation. "Shoreham Nuclear Power Station Radiological Environmental Monitoring Program - 1979 Annual Report", June 1980.

(7) Radiation Management Corporation. "Shoreham Nuclear Power Station Preoperational Radiological Monitoring Program - 1980 Annual Report", September 1981.

(8) Radiation Management Corporation "Shoreham Nuclear Power Station Preoperational Radiological Monitoring Program - 1981 Annual Report," October 1982.

(9) Eisenbud, M., Environmental Radioactivity, 2nd Ed., 1973.

(10) National Academy of Sciences, Radioactivity in the Marine Environment, National Research Council, Washington, D.C., 1971.

(11) Long Island Lighting Company, Environmental Engineering Dept., Radiological Environmental Monitoring Program Procedures.

(12) EA Science and Technology Shoreham Project Quality Assurance and Procedures Manual, March 1985.

IV. REFERENCES (Cont.)

(13) U.S. Nuclear Regulatory Commission Regulatory Guide 1.109, Rev. 1-1977.

(14) Health Physics Journal, Vol. 38, No.4, April 1980.

(15) Teledyne Isotopes "Nuclear Reactor Environmental Radiation Monitoring Quality Control Manual", IWL-0032-361.

(16) Teledyne Isotopes "Quality Control Internal Controls and Audits, Environmental Analysis Department", IWL-0032-365.

(17) Teledyne Isotopes "Quality Assurance Manual, Environmental Analysis Department Compliance with 10CFR50 Appendix B and Reg. Guide 4.15", IWL-0032-395.

(18) Long Island Lighting Co. and Teledyne Isotopes, 1982 Radiological Environmental Monitoring Program Annual Report.

(19) Long Island Lighting Co. and Teledyne Isotopes, 1983 Radiological Environmental Monitoring Program Annual Report.

(20) Long Island Lighting Co. and Teledyne Isotopes, 1984 Radiological Environmental Monitoring Program Annual Report.

(21) Long Island Lighting Co. and Teledyne Isotopes, 1985 Radiological Environmental Monitoring Program Annual Report.

(22) Long Island Lighting Co. and Teledyne Isotopes, 1986 Radiological Environmental Monitoring Program Annual Report.

(23) Long Island Lighting Co. and Teledyne Isotopes, 1987 Radiological Environmental Monitoring Program Annual Report.

(24) Long Island Lighting Co. and Teledyne Isotopes, 1988 Radiological Environmental Monitoring Program Annual Report.

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM

SUMMARY

1989

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Potable Water (pCi/liter)	H-3	10	100	-(0/7) -	N/A	N/A	-(0/3) -	0
	I-131	10	0.2	-(0/7) -	N/A	N/A	-(0/3) -	0
	Gamma	10						
	K-40		50	-(0/7) -	N/A	N/A	-(0/3) -	0
Game (pCi/kg wet)	Gamma	2						
	K-40		300	2360(2/2) (2020-2700)	13S3 0.2 mi W	2360(2/2) (2020-2700)	-(0/0) -	0
	Cs-137		7	263(2/2) (34.1-492)	13S3 0.2 mi W	263(2/2) (34.1-492)	-(0/0) -	0
Direct Radiation (mR/Standard month)	Gamma Dose Monthly	484	1.5	3.6(412/412) (2.6-60)	6A1 0.7 mi ESE	4.8(12/12) (4.1-5.6)	3.8(72/72) (2.9-5.0)	0
	Gamma Dose Quarterly	160	1.5	3.6(136/136) (2.8-5.2)	6A1 0.7 mi ESE	4.8(4/4) (4.4-5.1)	3.8(24/24) (3.0-5.0)	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.

(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.

(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Airborne Particulates (10^{-3}pCi/m^3)	Gross Beta	847	4	18(633-635) (4-60)	8A3 0.6 mi SSE	19(52/53) (7-60)	18(212/212) (6-53)	0
	Sr-89	64	0.2	-(0/48) -	N/A	N/A	-(0/16) -	0
	Sr-90	64	.03	-(0/48) -	N/A	N/A	-(0/16) -	0
	Gamma	64						
	Be-7		-	62.0(48/48) (43.1-80.1)	12D1 3.7 mi WSW	70.0(4/4) (63.5-80.1)	61.0(16/16) (48.0-69.5)	0
	K-40		5	7.02(3/48) (6.33-7.94)	12G2 15.4 mi WSW	11.4(1/4) -	11.4(1/16) -	0
Airborne Iodine (10^{-3}pCi/m^3)	I-131	847	10	-(0/635) -	N/A	N/A	-(0/212) -	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.

(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.

(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Aquatic Plants (pCi/kg dry)	Sr-89	10	20	-(0/7) -	N/A	N/A	-(0/3) -	0
	Sr-90	10	2	-(0/7) -	N/A	N/A	-(0/3) -	0
	Gamma	10						
	K-40		300	14136(7/7) (3310-27700)	13F1 9.4 mi W	36100(1/1) -	22343(3/3) (9030-36100)	0
	Cs-137		10	62.2(2/7) (40.4-83.9)	4A3 0.2 mi ENE	62.2(2/2) (40.4-83.9)	-(0/3)	0
	Ra-226		200	801(1/7) -	13F1 9.4 mi W	858(1/1) -	858(1/3) -	0
	Th-228		50	460(7/7) (121-755)	16A1 0.4 mi NNW	628(1/1) -	111(2/3) (77.9-145)	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Milk (pCi/liter)	I-131	63	0.2	-(0/36) -	N/A	N/A	-(0/27) -	0
	Sr-89	39	2	-(0/24) -	N/A	N/A	-(0/18) -	0
	Sr-90	39	1	2.0(21/22) (0.59-5.1)	8G2 10.8 mi SSE	7.1(12/12) (0.55-14)	6.2(16/16) (0.55-14)	0
	Gamma	63						
	K-40		100	1740(36/36) (1290-2050)	13B1 1.9 mi W	1806(17/17) (1640-2050)	1186(27/27) (885-1700)	0
	Cs-137		4	8.50(1/36) -	13B1 1.9 mi W	8.50(1/17) -	8.38(10/27) (4.68-16.2)	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Food Products (pCi/kg wet)	Gamma 24						
	I-131	1	-(0/18) -	N/A	N/A	-(0/6) -	0
	K-40	300	2823(18/18) (1490-6100)	5C2 2.8 mi E	3592(5/5) (1920-6100)	3110(6/6) (1540-4640)	0
	Be-7	50	266(1/18) -	5C2 21.8 mi E	266(1/5) -	-(0/6) -	0
	Cs-137	6	-(0/18) -	N/A	N/A	-(0/6) -	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.

(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.

(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Aquatic Invertebrates (pCi/kg wet)	Sr-89	25	1	-(0/15) -	N/A	N/A	-(0/10) -	0
	Sr-90	25	1	-(0/15) -	N/A	N/A	-(0/10) -	0
	Gamma	25						
	K-40 (2060-5130)		300	2926(15/15) (1700-4020)	3C1 2.9 mi NE	3348(4/4) (2500-4020)	3026(10/10) (1470-4620)	0
	Be-7		40	-(0/15) -	13F1 9.4 mi W	109(1/1) -	100.5(2/10) (91.9-109)	0
	Cs-137		4	-(0/15) -	N/A	N/A	-(0/10) -	0
	Th-228		7	-(0/15) -	N/A	N/A	-(0/10) -	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Sediment (Beach) (pCi/kg dry)	Sr-89	8	2	-(0/5) -	N/A	N/A	-(0/3) -	0
	Sr-90	8	1	2.9(1/5) -	N/A	N/A	-(0/3) -	0
	Gamma	8						
	K-40		900	2344(5/5) (1710-3410)	13F1 9.4 mi W	3540(1/1) -	2440(3/3) (1450-3540)	0
	Cs-137		8	-(0/5) -	N/A	N/A	-(0/3) -	0
	Ra-226		200	200(1/5) -	14A1 0.8 mi WNW	200(1/1) -	-(0/3) -	0
	Th-228		60	163(5/5) (99.7-319)	2A4 0.4 mi NNE	224(2/2) (128-319)	104(3/3) (75.0-158)	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.

(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.

(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Sediment (Offshore) (pCi/kg dry)	Sr-89	4	1	-(0/3) -	N/A	N/A	-(0/1) -	0
	Sr-90	4	0.9	-(0/3) -	N/A	N/A	-(0/1) -	0
	Gamma	4						
	K-40		-	4320(3/3) (2020-6410)	16B1 1.3 mi NNW	6410(1/1) -	1840(1/1) -	0
	Cs-137		10	-(0/3) -	N/A	N/A	-(0/1) -	0
	Ra-226		200	699(1/3) -	16B1 1.3 mi NNW	699(1/1) -	-(0/1) -	0
	Th-228		60	429(3/3) (161-766)	16B1 1.3 mi NNW	766(1/1) -	136(1/1) -	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Soil (pCi/kg dry)	Sr-90	10	0.9	24.8(4/9) (16-35)	8A3 0.6 mi SSE	35(1/1) -	-(0/1) -	0
	Gamma	10						
	K-40		900	3492(9/9) (1800-6400)	5F3 7.8 mi E	7060(1/1) -	7060(1/1) -	0
	Cs-137		10	252(7/9) (37.7-456)	8A3 0.6 mi SSE	532(1/1) -	169(1/1) -	0
	Ra-226		300	833(5/9) (604-1180)	5F3 7.8 mi E	1620(1/1) -	1620(1/1) -	0
	Th-228		60	527(9/9) (256-947)	5F3 7.8 mi E	1300(1/1) -	1300(1/1) -	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.

(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.

(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Surface Water (pCi/liter)	H-3	12	100	-(0/7) -	13F1 9.4 mi W	4550(2/2) (4400-4700)	3100(3/5) (200-4700)	0
	Sr-89	12	1	-(0/7) -	N/A	N/A	-(0/5) -	0
	Sr-90	12	0.5	-(0/7) -	N/A	N/A	-(0/5) -	0
	Gamma	12						
	K-40		60	257(5/7) (211-314)	13G2 13.2 mi W	295(3/3) (195-357)	293(4/5) (195-357)	0
Fish (pCi/kg wet)	Sr-89	29	0.7	-(0/19) -	N/A	N/A	-(0/10) -	0
	Sr-90	29	0.6	-(0/19) -	N/A	N/A	-(0/10) -	0
	Gamma	29						
	K-40		300	4042(19/19) (2060-5130)	3C1 2.9 mi NE	4217(9/9) (2380-5130)	3866(10/10) (2540-5000)	0
	Th-228		7	-(0/19) -	N/A	N/A	-(0/10) -	0
	Cs-137		5	9.1(4/19) (7.04-10.8)	13G2 13.2 mi W	10.4(2/10) (9.08-11.8)	10.4(2/10) (9.08-11.8)	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SHOREHAM NUCLEAR POWER STATION — DOCKET NO. 50-322

SUFFOLK COUNTY, NEW YORK — JANUARY 1 to DECEMBER 31, 1989

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS(3) MEAN (2) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(2) RANGE	CONTROL LOCATION(3) MEAN(2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENT
Precipitation (pCi/liter)	Gross Beta	24	-	4.5(24/24) (1.6-19)	9S1 0.2 mi S	4.8(12/12) (1.9-19)	No control	0
	H-3	24	100	176(5/24) (120-250)	9S1 0.2 mi S	187(3/12) (150-250)	No Control	0
	Gamma	24						
	Be-7		30	50.4(5/24) (43.4-66.8)	9S1 0.2 mi S	59.5(2/12) (52.3-66.8)	No Control	0
	K-40		40	-(0/24) -	N/A	N/A	No Control	0
Noble Gas	Kr-85	53	-	35.2(53/53) (26-46)	14S2 0.4 mi WNW	(35.2(53/53) (26-46)	No Control	0
	Xe-133	53	60	-(0/53) -	N/A	N/A	No Control	0

(1) The LLDs quoted are the lowest actual LLDs obtained in the various media during the reporting period. Typical LLDs were determined for each nuclide as found on Tables C-20 and C-21.
(2) Means calculated using detectable measurements only. Fractions of detectable measurements in parentheses.
(3) Indicator and control locations are noted in Appendix B, Table B-1.

APPENDIX B

SAMPLE DESIGNATION AND LOCATIONS

APPENDIX B

Sample Designation

LILCO's Radiological Environmental Monitoring Program (REMP) identifies samples by a three part code. The first two letters are the power station identification code, in this case "SN". The next three letters are for the media sampled.

SWA	=	Surface Water (Long Island Sound)	GMK	=	Goat Milk
AQF	=	Fish (1)	PWA	=	Potable Water (ground water)
AQI	=	Invertebrates (1)	GAX	=	Game (1)
AQP	=	Aquatic Plants (1)	FPV	=	Food Products (1)
AQS	=	Sediment	FPF	=	Fruit
APT	=	Airborne Particulates	IDM	=	Immersion Dose (TLD)
AIO	=	Airborne Iodine	NBG	=	Noble Gas
MLK	=	Milk	RWA	=	Precipitation (Rainwater)
			SOL	=	Soil

The last four symbols are a location code based on direction and distance from the site. Of these, the first two represent each of the sixteen angular sectors of 22 1/2 degrees centered about the reactor site. Sector one is divided evenly by the north axis, and other sectors are numbered in a clockwise direction, i.e., 2=NNE, 3=NE, 4=ENE, etc. The next digit is a letter which represents the radial distance from the plant:

S	=	On site location	E	=	4-5 miles off site
A	=	0-1 miles off site	F	=	5-10 miles off site
B	=	1-2 miles off site	G	=	10-20 miles off site
C	=	2-3 miles off site	H	=	>20 miles off site
D	=	3-4 miles off site			

The last number is the location numerical designation within each sector and zone, e.g., 1,2,3,.....for example, the designation SN-SWA-3C1 would indicate a sample in the SNPS program SN, consisting of surface water SWA, which had been collected in the 22-1/2 degree sector centered on the northeast axis (3) between the site boundary and 2-3 miles off site (C). The number 1 indicates that this is sampling station No. 1 in the designated area.

Sampling Locations

All sampling locations and specific information about the individual locations are given in Table B-1. Tables B-2 through B-5 list the sampling locations and media required by Technical Specifications.

(1) A more specific means of classification will be noted in the comment section of each laboratory report for these samples. For example, AQI will be designated, in the sample description, as aquatic invertebrate. However, the comment section will specify the sample type by the generally accepted common name of the sample involved. In this case, clam, lobster, crab or other aquatic invertebrate would be listed in the comment section.

APPENDIX B

Sampling Locations

Maps B-1, B-2 and B-3 show the locations of 1989 sampling stations with respect to the site. These maps are tracings of portions of larger maps prepared by LILCO's Survey Division after an extensive land survey of REMP monitoring locations. Additional information can be obtained by referring to the Site and Vicinity Map of the Shoreham Nuclear Power Station (Map B-2), the map of Long Island and Connecticut Shore (Map B-3) and by contacting either LILCO's Environmental Engineering Department or Survey Division.

SECTOR	LOCATION CODE	TABLE B-1 LOCATION	SAMPLE TYPE
N	1S1	Beach east of intake, 0.3 mi. N	IDM(•)
NNE	2S1	Well, on site, 0.1 mi. NNE	PWA(•)
NE	3S1	Site Boundary, 0.1 mi. NE	APT(•),AIO(•),IDM(•)
ENE	4S1	Site Boundary, 0.1 mi. ENE	IDM(•)
E	5S2	Site Boundary, 0.1 mi. E	IDM(•)
ESE	6S2	Site Boundary, 0.1 mi. ESE	APT(•),AIO(•),IDM(•)
S	9S1	Service Road, 0.2 mi. S	APT,AIO,IDM(•),RWA
S	9S2	East Gate SNPS, 0.3 mi. S	IDM(•)
W	13S2	Well, on site, 0.2 mi. W	PWA(•)
W	13S3	Site Boundary, 0.2 mi. W	IDM(•),GAX
WNW	14S1	St. Joseph's Villa, 0.4 mi. WNW	GAX
WNW	14S2	St. Joseph's Villa, 0.4 mi. WNW	IDM(•), NBG
NW	15S1	Beach west of intake, 0.3 mi. NW	IDM(•)
NNW	16S2	Site Boundary, 0.3 mi. NNW	IDM(•)
NNE	2A2	West end of Creek Road, 0.2 mi. NNE	APT(•),AIO(•),IDM(•)
NNE	2A3	Residence, 0.3 mi. NNE	APT,AIO,IDM(•),PWA
NNE	2A4	Beach, 0.4 mi. NNE	AQS(•)
NE	3A2	Riverhead Town Beach, 0.7 mi. NE	AQS
ENE	4A3	Wading River, Eastern Marsh, 0.2 mi. ENE	SWA,AQI,AQP,AQS
ESE	6A1	Sound Road, 0.7 mi. ESE	IDM(•)
SE	7A2	North Country Road, 0.7 mi. SE	APT,AIO,IDM(•)
SSE	8A3	North Country Road, 0.6 mi. SSE	APT,AIO,IDM(•)
SSW	10A1	North Country Road, 0.3 mi. SSW	APT,AIO,IDM(•)
SW	11A1	Site Boundary, 0.3 mi. SW	IDM(•)
WSW	12A1	Meteorological Tower, 0.9 mi. WSW	APT,AIO,IDM(•),RWA
WNW	14A1	Brookhaven Town Beach, 0.8 mi. WNW	AQS
NNW	16A1	Aquatic location, west jetty of intake canal 0.4 mi. NNW	AQI,AQP

TABLE B-1

SECTOR		LOCATION CODE	LOCATION	SAMPLE TYPE
ENE		4B1	Little Flower Institute, Wading River, 1.5 mi. ENE	IDM
ESE	C	6B1	Remsen Road, Wading River, 1.6 mi. ESE	PWA
SE		7B1	Overhill Road, Wading River, 1.4 mi. SE	APT(*), AIO(*),IDM(*)
SE		7B3	Farm stand, 1.7 mi. E	FPV
SE		7B4	Wading River Elementary School, Wading River, 1.6 mi. SE	IDM
SSE		8B1	Farm stand 1.2 mi. SSE	FPV(*),FPF
S		9B2	Shoreham-Wading River High School, Shoreham, 1.2 mi. S	IDM
WSW		12B2	Miller Avenue School, Shoreham, 1.6 mi. WSW	IDM
W		13B1	Briarcliff Road, 1.9 mi. W	GMK
NNW		16B1	Long Island Sound, 1.3 mi. NNW	AQS,SWA
NE		3C1	Outfall area, aquatic location B-5, 2.9 mi. NE	AQP,AQS
E		5C2	Farm, 2.8 mi. E	FPV,FPF(*)
WSW		12C1	Local Store, McCarricks Dairy, 2.7 mi WSW	MLK
WNW		14C1	Outfall area, aquatic location B-4, 2.1 mi. WNW	SWA(*),AQF(*), AQI(*),AQP,AQS
E		5D1	Wildwood State Park, 3.4 mi. E	IDM(*)
E		5D3	Wildwood State Park, 3.1 mi. E	APT,IDM,AIO
WSW		12D1	North Shore Beach Substation 3.7 mi. WSW	APT,AIO,IDM(*)
E		5E2	Calverton, 4.5 mi. E	IDM(*)
ESE		6E1	LILCO ROW, 4.8 mi. ESE	IDM(*)
SE		7E1	Calverton, 4.9 mi. SE	IDM(*)
SSE		8E1	Calverton, 4.4 mi. SSE	IDM(*)
S		9E1	Brookhaven National Laboratory 5.0 mi. S	IDM(*)
SSW		10E1	Ridge Substation, 4.0 mi. SSW	IDM(*)
SW		11E1	LILCO ROW, 4.7 mi. SW	IDM(*)
W		13E1	Longview Ave. and Rocky Point Landing Rd., 4.5 mi. W	IDM(*)
E	C	5F2	Farm, 6.1 mi. E	FPV
E	C	5F3	Farm, 7.8 mi. E	APT,AIO,IDM(*)
SSE		8F2	Goat Farm, Wading River Rd., 9.5 mi. SSE	GMK
SSW	C	10F1	Goat Farm, 9.2 mi. SSW	GMK(*)
W	C	13F1	Background aquatic location 9.4 mi. W	AQI,AQP,SWA,AQS

SECTOR		LOCATION CODE	TABLE B-1 LOCATION	SAMPLE TYPE
ESE	C	6G1	Francis Court, Hampton Bays, 19.0 mi. ESE	IDM(*)
SSE	C	8G1	Wading River Rd., 10.1 mi. SSE	APT,AIO,IDM(*)
SSE	C	8G2	Dairy Farm, Center Moriches, 10.8 mi. SSE	MLK
SW	C	11G1	MacArthur Substation, 16.6 mi. SW	APT(*),AIO(*), IDM(*)
WSW	C	12G1	Central Islip Substation, 19.9 mi. WSW	IDM(*)
WSW	C	12G2	Flowerfield Substation, 15.4 mi. WSW	APT,AIO,IDM(*)
W	C	13G2	Background aquatic location, 13.2 mi. W	SWA(*),AQP,AQS AQF(*),AQI(*)
WSW	C	12H1	Farm, 25.8 mi. WSW	FPV(*),FPF(*)
WSW	C	12H2	Farm, 32.1 mi. WSW	FPV, FPF

C Denotes Control Location

* Denotes SNPS Technical Specification sampling locations and sample type.

** Bottled Milk

REMP LOCATIONS REQUIRED BY SNPS TECHNICAL SPECIFICATIONS

TABLE B-2

Airborne Particulate and Airborne Iodine Monitoring Stations

Location NUREG-0473	Codes SHOREHAM REMP	Location Description
A1	[illegible]	Site Boundary, 0.1 mi. ESE
A2	2A2	West end of Creek Road, 0.2 mi. NNE
A3	3S1	Site Boundary, 0.1 mi., NE
A4	7B1	Overhill Road, 1.4 mi. SE
A5	11G1	MacArthur Substation, 16.6 mi. SW

TABLE B-3

Waterborne Monitoring Stations

Location NUREG-0473	Codes SHOREHAM REMP	Location Description
WA1	13G2	Surface, background area, 13.2 mi. W
WA2	14C1	Surface, outfall area, 2.1 mi. WNW
WA3	3C1	Surface, outfall area, 2.9 mi. NE
Wb1	2S1	Potable Water, well on site, 0.1 mi. NNE
Wb2	13S2	Potable Water, well on site, 0.2 mi. W
Wd1	2A4	Sediment, Beach, 0.4 mi. NNE

TABLE B-4

Ingestion Monitoring Stations

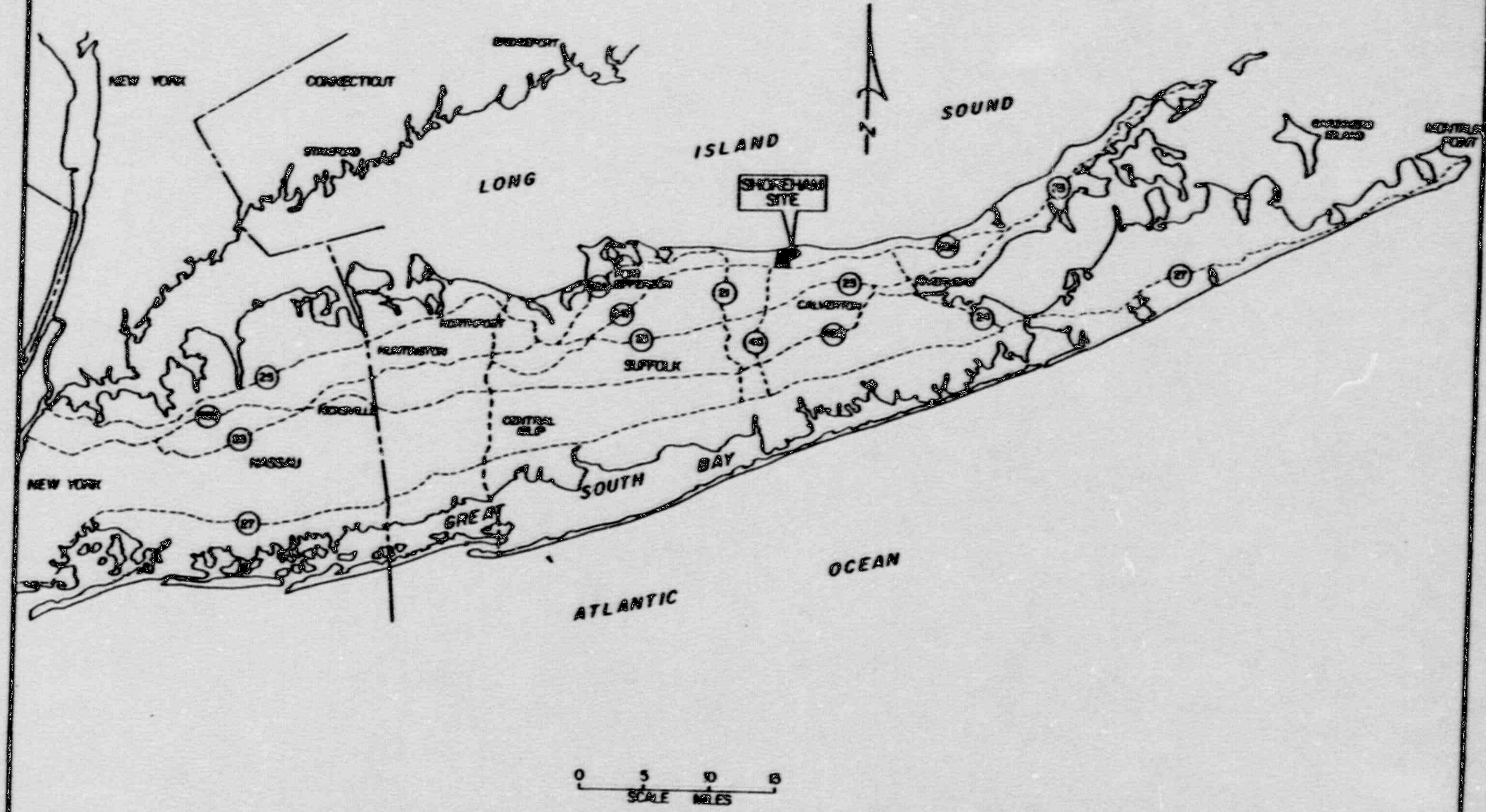
Location NUREG-0473	Codes SHOREHAM REMP	Location Description
Ia1	13B1	Goat Farm, 1.9 mi. W
Ia2	10F1	Goat Farm, 9.2 mi. SSW
Ib1	3C1	Fish and Invertebrates, outfall area, 2.9 mi. NE
Ib2	14C1	Fish and Invertebrates, outfall area, 2.1 mi. WNW
Ib3	13G2	Fish and Invertebrates, background, 13.2 mi. W
Ic1	8B1	Local Farm, 1.2 mi. SSE
Ic2	5C2	Local Farm, 2.8 mi. E
Ic3	12H1	Background Farm, 25.8 mi. WSW

REMP LOCATIONS REQUIRED BY SNPS TECHNICAL SPECIFICATIONS

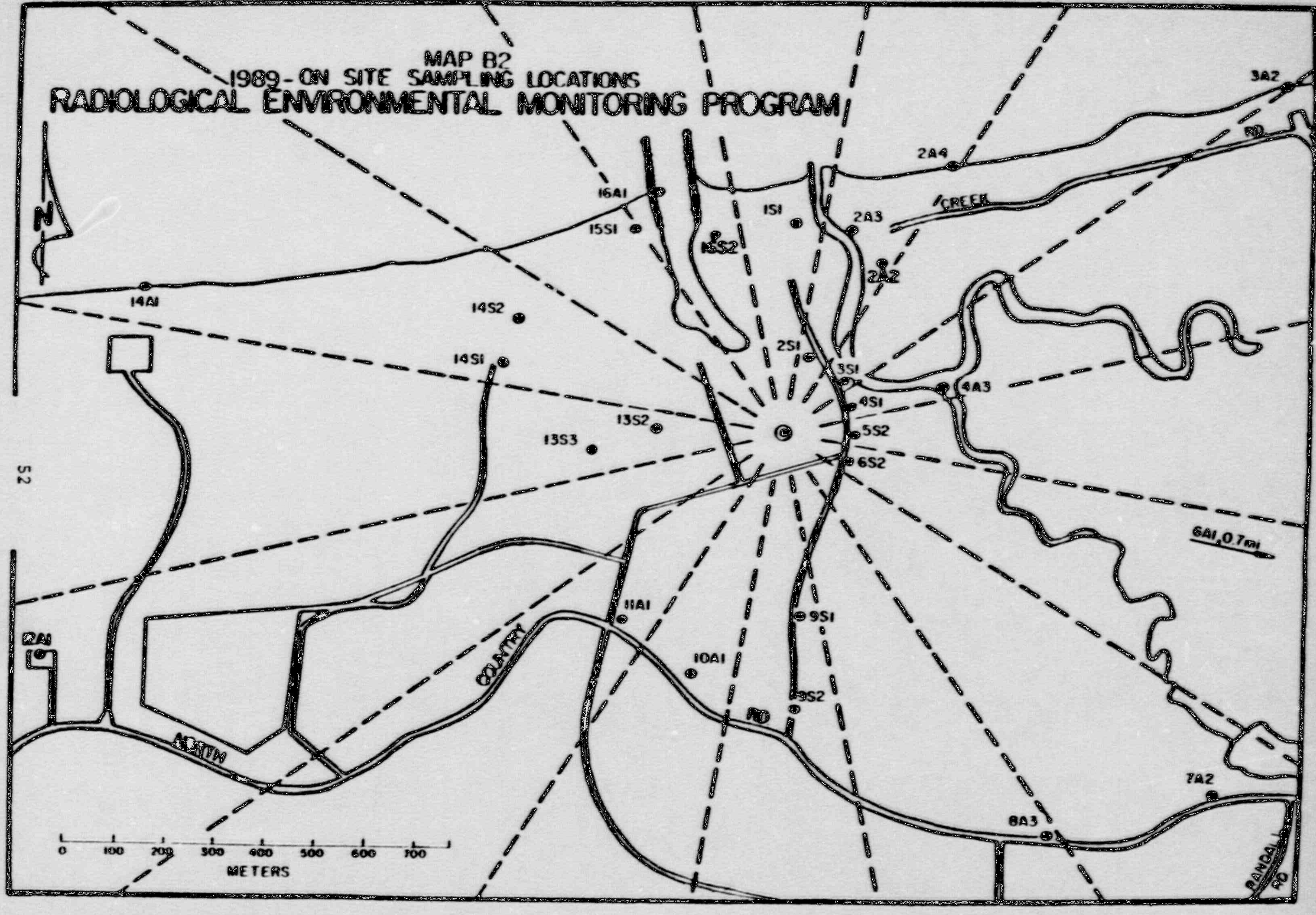
TABLE B-5

Direct Radiation Monitoring Stations

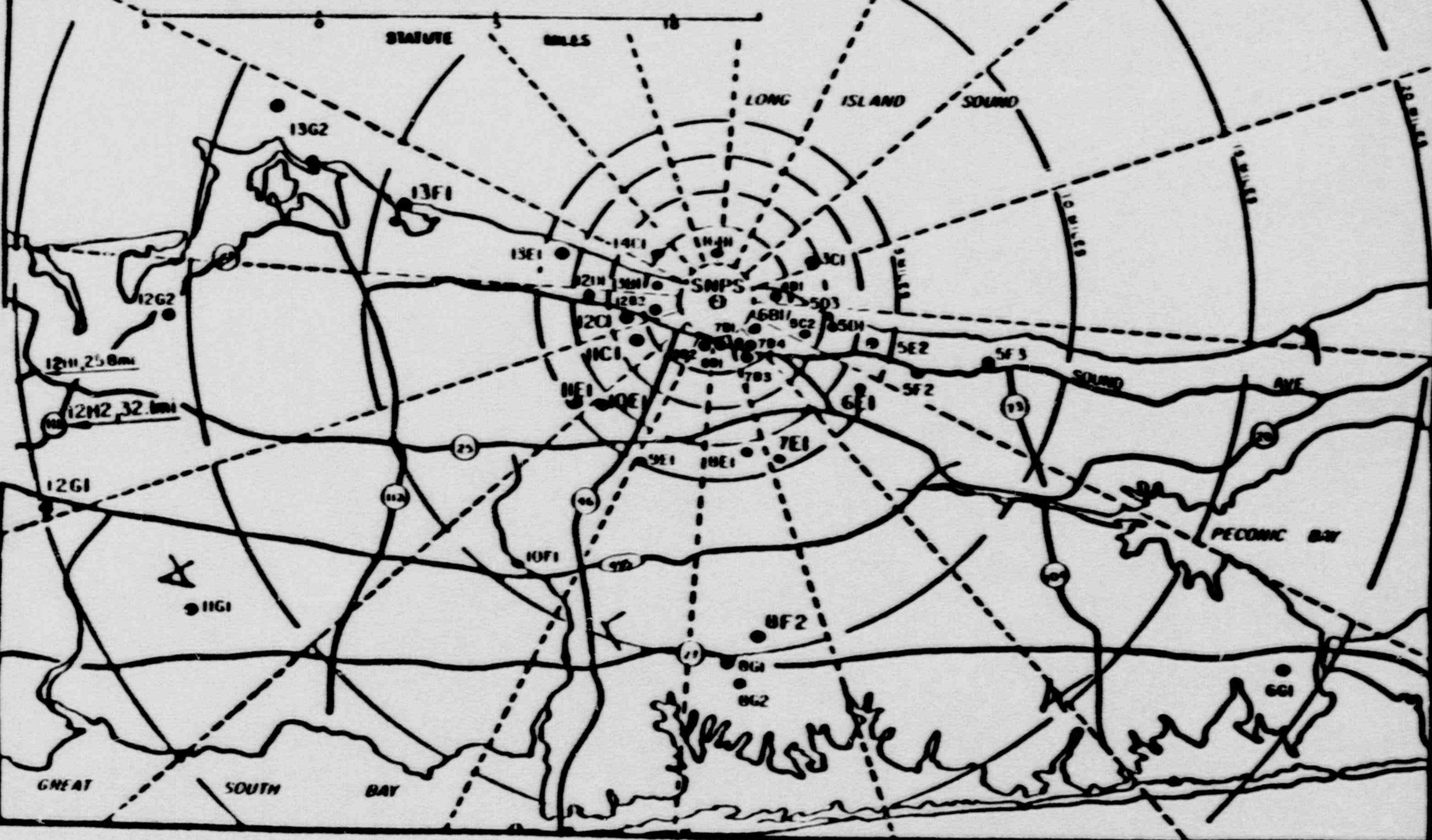
Location NUREG-0473	Codes SHOREHAM REMP	Location Description
DR1	1S1	Beach east of intake, 0.3 mi. N
DR2	2A2	West end of Creek Road, 0.2 mi. NNE
DR3	3S1	Site Boundary, 0.1 mi. NE
DR4	4S1	Site Boundary, 0.1 mi. ENE
DR5	5S2	Site Boundary, 0.1 mi. E
DR6	6S2	Site Boundary, 0.1 mi. ESE
DR7	7A2	North Country Road, 0.7 mi. SE
DR8	8A3	North Country Road, 0.6 mi. SSE
DR9	9S1	Service Road SNPS, 0.2 mi. S
DR10	10A1	North Country Road, 0.3 mi. SSW
DR11	11A1	Site Boundary, 0.3 mi. SW
DR12	12A1	Meteorological Tower, 0.9 mi. WSW
DR13	13S3	Site Boundary, 0.2 mi. W
DR14	14S2	St. Joseph's Villa, 0.4 mi. WNW
DR15	15S1	Beach west of intake, 0.3 mi. NW
DR16	16S2	Site Boundary, 0.3 mi. NNW
DR17	5E2	Calverton, 4.5 mi. E
DR18	6E1	LILCO ROW, 4.8 mi. ESE
DR19	7E1	Calverton, 4.9 mi. SE
DR20	8E1	Calverton, 4.4 mi. SSE
DR21	9E1	Brookhaven National Laboratory, 5.0 mi. S
DR22	10E1	Ridge Substation, 4.0 mi. SSW
DR23	11E1	LILCO ROW, 4.7 mi. SW
DR24	12D1	North Shore Beach Substation, 3.7 mi. WSW
DR25	13E1	Longview Ave. and Rocky Point Landing Rd. 4.5 mi. W
DR26	5D1	Wildwood State Park, 3.4 mi. E
DR27	5F3	Dairy Farm, 7.8 mi. E
DR28	7B1	Overhill Road, 1.4 mi. SE
DR29	12G2	Flowerfield Substation, 15.4 mi. WSW
DR30	12G1	Central Islip Substation, 19.9 mi. WSW
DR31	11G1	MacArthur Substation, 16.6 mi. SW
DR32	8G1	Wading River Road, 10.1 mi. SSE
DR33	6G1	Hampton Bays Substation, 19.0 mi. ESE
DR34	6A1	Sound Road, 0.7 mi. ESE
DR35	2A3	Nearest Residence, 0.3 mi. NNE
DR36	9S2	East Gate SNPS, 0.3 mi. S
DR37	5D3	Wildwood State Park, 3.1 mi. E



MAP B-1
SHOREHAM SITE LOCATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM


MAP B2
1989-ON SITE SAMPLING LOCATIONS
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
N
3A2
RD
2A4
CREEK
16A1
15S1
1S1
16S2
2A3
2A2
14A1
14S2
14S1
2S1
3S1
4A3
4S1
13S2
5S2
13S3
6S2
6A1,0.7mi
11A1
9S1
12A1
10A1
COUNTRY
RD
9S2
NORTH
7A2
8A3
0 100 200 300 400 500 600 700
METERS
RANDALL RD

MAP B3
1989-OFF SITE SAMPLING LOCATIONS
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM



APPENDIX C

DATA TABLES

TABLE C-1

CONCENTRATIONS OF TRITIUM, STRONTIUM-89* and -90 AND GAMMA EMITTERS**

IN SURFACE WATER SAMPLES

Results in Units of pCi/l ± 2 sigma

LOCATION CODE	COLLECTION DATE	H-3	I-131***	Sr-89*	Sr-90	K-40	Cs-137
SN-SWA-4A3	05/01/89	< 200	< 0.4	< 4	< 1	< 100	< 5
SN-SWA-4A3	10/11/89	< 100	< 0.3	< 3	< 1	< 60	< 4
SN-SWA-3C1	04/25/89	< 100	< 0.3	< 2	< 0.9	272 ± 46	< 4
SN-SWA-3C1	10/13/89	< 100	< 0.2	< 3	< 0.5	314 ± 52	< 4
SN-SWA-13G2 (cl)	05/31/89	200 ± 110	< 0.2	< 3	< 0.8	195 ± 46	< 4
SN-SWA-13G2 (cl)	10/13/89	< 100	< 0.2	< 3	< 0.5	333 ± 53	< 4
SN-SWA-13G2 (cl)	10/23/89	< 100	< 0.2	< 2	< 0.5	357 ± 60	< 6
SN-SWA-13F1 (cl)	06/08/89	4400 ± 100 (a)	< 0.3	< 4	< 0.8	< 200	< 6
SN-SWA-13F1 (cl)	07/31/89	4700 ± 200	< 0.3	< 4	< 1	287 ± 49	< 5
SN-SWA-14C1	04/25/89	< 200	< 0.3	< 1	< 0.5	211 ± 50	< 4
SN-SWA-14C1	10/13/89	< 100	< 0.2	< 2	< 0.5	248 ± 50	< 4
SN-SWA-16B1	04/25/89	< 100	< 0.3	< 2	< 0.6	238 ± 45	< 5

* Sr-89 results are corrected for decay to the sample stop date.
** All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.
*** I-131 results determined by radiochemical analysis.
(a) Liquid scintillation measurements gave results of 4100±400 and 4700±500 pCi/l on two separate recounts.
(cl) Denotes Control Location

TABLE C-2

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND GAMMA EMITTERS** IN FISH SAMPLES

Results in Units of pCi/kg (wet) ± 2 sigma

LOCATION CODE	COLLECTION DATE	DESCRIPTION	Sr-89	Sr-90	K-40	Cs-137	Th-228
SN-AQF-3C1	05/22/89	Little Skate	< 5	< 1	3240 ± 320	10.8 ± 5.9	< 10
	05/22/89	Searobin	< 2	< 1	5050 ± 510	< 10	< 20
	05/22/89	Windowpane	< 2	< 0.8	4320 ± 430	8.42 ± 4.67	< 10
	05/22/89	Winter Flounder	< 0.7	< 0.6	5090 ± 510	< 6	< 9
	10/10/89	Blue Fish	< 3	< 2	5130 ± 510	< 10	< 10
	10/10/89	Windowpane	< 4	< 2	3770 ± 380	< 10	< 20
	10/10/89	Searobin	< 20	< 10	4360 ± 540	< 60	< 90
	10/10/89	Winter Flounder	< 3	< 1	4610 ± 460	< 6	< 9
	10/10/89	Little Skate	< 5	< 3	2380 ± 240	< 7	< 10
SN-AQF-13G2 (cl)	05/31/89	Windowpane	< 2	< 1	3420 ± 340	< 8	< 10
	05/31/89	Searobin	< 2	< 0.9	4510 ± 450	< 9	< 20
	05/31/89	Little Skate	< 5	< 2	2540 ± 250	< 8	< 10
	05/31/89	Winter Flounder	< 1	< 0.8	5000 ± 500	< 6	< 8
	10/11/89	Bluefish	< 1	< 0.8	4320 ± 430	9.08 ± 5.15	< 10
	10/11/89	Little Skate	< 3	< 2	2840 ± 280	11.8 ± 4.9	< 10
	10/11/89	Winter Flounder	< 3	< 2	4130 ± 410	< 10	< 20
	10/11/89	Searobin	< 40	< 10	4330 ± 870	< 80	< 200
	10/11/89	Windowpane	< 1	< 1	3620 ± 360	< 7	< 10
	10/11/89	Winter Flounder	< 3	< 2	3950 ± 390	< 10	< 20
SN-AQF-14C1	05/23/89	Little Skate	< 1	< 1	2560 ± 260	< 7	< 10
	05/23/89	Searobin	< 2	< 1	4630 ± 460	< 10	< 20
	05/23/89	Windowpane	< 0.7	< 0.6	3700 ± 370	10.3 ± 4.6	< 9
	05/23/89	Winter Flounder	< 1	< 0.8	4650 ± 460	< 5	< 7
	10/12/89	Winter Flounder	< 2	< 1	4110 ± 410	7.04 ± 4.14	< 8
	10/12/89	Searobin	< 20	< 10	4270 ± 570	< 60	< 100
	10/12/89	Bluefish	< 5	< 4	4500 ± 450	< 20	< 30
	10/12/89	Little Skate	< 3	< 3	2060 ± 210	< 9	< 10
	10/12/89	Windowpane	< 7	< 4	4150 ± 410	< 20	< 50
	10/12/89	Winter Flounder	< 2	< 2	4210 ± 420	< 7	< 10

* Sr-89 results are corrected for decay to the sample stop date.

** All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.

(cl) Denotes Control Location

TABLE C-3

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND GAMMA EMITTERS IN INVERTEBRATE SAMPLES**

Results in Units of pCi/kg (wet) ± 2 sigma

LOCATION CODE	COLLECTION DATE	DESCRIPTION	Sr-89	Sr-90	Be-7	K-40	Cs-137	Th-228
SN-AQI-4A3	05/01/89	Soft Shell Clams	< 2	< 0.6	< 40	2840 ± 280	< 5	< 9
	10/11/89	Soft Shell Clams	< 3	< 3	< 50	2350 ± 230	< 5	< 9
	10/11/89	Oysters	< 1	< 1	< 50	1700 ± 170	< 4	< 8
SN-AQI-16A1	05/02/89	Blue Mussels	< 3	< 2	< 40	2960 ± 300	< 5	< 8
	10/23/89	Blue Mussels	< 5	< 3	< 60	1770 ± 180	< 5	< 9
SN-AQI-3C1	05/22/89	Lobster	< 2	< 4	< 100	3880 ± 390	< 10	< 20
	10/10/89	Squid	< 1	< 0.8	< 60	2990 ± 300	< 5	< 9
	10/10/89	Lobster	< 3	< 2	< 70	4020 ± 400	< 7	< 10
	10/13/89	Whelk	< 10 (a)	< 7	< 1000	2500 ± 800	< 90	< 100
SN-AQI-14C1	05/23/89	Lobster	< 3	< 5	< 90	3150 ± 310	< 10	< 20
	06/08/89	Whelk	< 4	< 3	< 40	2810 ± 280	< 5	< 8
	10/12/89	Squid	< 1	< 0.8	< 50	3470 ± 350	< 5	< 7
	10/12/89	Squid	< 2	< 1	< 80	3160 ± 320	< 7	< 10
	10/12/89	Lobster	< 1	< 0.6	< 70	3740 ± 370	< 8	< 10
	10/13/89	Whelk	< 2	< 0.9	< 70	2550 ± 250	< 6	< 9
SN-AQI-13F1 (cl)	06/08/89	Blue Mussels	< 4	< 2	109 ± 37	2070 ± 210	< 4	< 8
SN-AQI-13G2 (cl)	05/31/89	Whelk	< 3	< 1	< 40	2840 ± 280	< 5	< 8
	05/30/89	Blue Mussels	< 2	< 0.7	91.9 ± 28.7	2280 ± 230	< 4	< 7
	05/31/89	Lobster	< 5	< 4	< 400	1960 ± 420	< 40	< 70
	10/11/89	Lobster	< 3	< 2	< 100	4620 ± 460	< 10	< 20
	10/11/89	Squid	< 1	< 1	< 70	3710 ± 370	< 6	< 10
	10/11/89	Lobster	< 3	< 2	< 100	4620 ± 460	< 10	< 20
	10/11/89	Lobster	< 2	< 3	< 100	4130 ± 410	< 10	< 20
	10/13/89	Whelk	< 2	< 1	< 80	2560 ± 260	< 6	< 10
	10/23/89	Blue Mussels	< 5	< 2	< 50	1470 ± 150	< 4	< 8

* Sr-89 results are corrected for decay to the sample stop date.
** All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.
(cl) Denotes Control Location
(a) LLD not met due to small sample size received.

TABLE C-4

CONCENTRATIONS OF STRONTIUM-89* and -90 AND GAMMA EMITTERS**
IN AQUATIC PLANTS
Results in Units of pCi/kg (dry) ± 2 sigma

LOCATION DATE	COLLECTION DATE	Sr-89	Sr-90	Be-7	K-40	I-131	Cs-137	Ra-226	Th-228
SN-AQP-4A3 Ulva Chondrus	05/01/89	< 30	< 20	1800 ± 280	21000 ± 2100	< 100	83.9 ± 26.0	< 600	511 ± 51
SN-AQP-4A3 Ulva Lact	10/11/89	< 30	< 6	1120 ± 220	7650 ± 760	< 90	40.4 ± 19.0	801 ± 349	630 ± 63
SN-AQP-13F1 (cl) Codium Sp.	06/08/89	< 30	< 20	660 ± 264	36100 ± 3600	< 300	< 30	858 ± 482	< 50
SN-AQP-13G2 (cl) Enteromorpha Sp.	05/30/89	< 20	< 10	530 ± 214	21900 ± 2200	238 ± 93(a)	< 30	< 600	145 ± 38
SN-AQP-13G2 (cl) Fucus. Sp.	10/23/89	< 30	< 10	< 100	9030 ± 900	< 200	< 10	< 200	77.9 ± 8.9
SN-AQP-16A1 Enteromorpha Sp.	05/02/89	< 30	< 7	1960 ± 330	27700 ± 2800	< 200	< 40	< 700	628 ± 63
SN-AQP-14C1 Ulva Lact	05/24/89	< 20	< 10	1240 ± 300	21900 ± 2200	< 100	< 40	< 600	397 ± 56
SN-AQP-14C1 Codium. Sp.	10/24/89	< 30	< 2	495 ± 173	3310 ± 330	< 300	< 20	< 300	181 ± 18
SN-AQP-3C1 Ulva Lact	05/24/89	< 30	< 20	166 ± 82	7420 ± 740	< 40	< 10	< 200	121 ± 20
SN-AQP-3C1 Codium, Sp.	10/23/89	< 20	< 20	1280 ± 500	9970 ± 1000	< 1000	< 60	< 900	755 ± 76

* Sr-89 results are corrected for decay to the sample stop date.
** All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.
(a) Probably from area hospitals.
(cl) Denotes Control Location

TABLE C-5

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND GAMMA EMITTERS** IN SEDIMENT SAMPLES

Results in Units of pCi/kg (dry) ± 2 sigma

LOCATION CODE	SAMPLE LOCATION	COLLECTION DATE	Sr-89	Sr-90	K-40	Ra-226	Th-228	Cs-137
SN-AQS-2A4	Beach	04/26/89	< 2	< 1	2250 ± 220	< 300	128 ± 24	< 10
SN-AQS-2A4	Beach	10/18/89	< 3	2.9 ± 1.8	3410 ± 550	< 700	319 ± 37	< 30
SN-AQS-3A2	Beach	04/26/89	< 2	< 1	2400 ± 240	< 200	121 ± 14	< 20
SN-AQS-3C1	Offshore	04/25/89	< 1	< 0.9	4530 ± 450	< 400	359 ± 36	< 20
SN-AQS-4A3	Beach	05/01/89	< 1	< 1	1710 ± 220	< 300	146 ± 18	< 20
SN-AQS-13G2 (cl)	Offshore	05/31/89	< 4	< 1	1840 ± 190	< 200	136 ± 14	< 20
SN-AQS-13G2 (cl)	Beach	05/30/89	< 4	< 1	2330 ± 230	< 200	75.0 ± 13.9	< 10
SN-AQS-13G2 (cl)	Beach	10/23/89	< 5	< 2	1450 ± 220	< 300	80.2 ± 35.7	< 20
SN-AQS-14A1	Beach	04/26/89	< 2	< 1	1950 ± 190	200 ± 114	99.7 ± 16.8	< 8
SN-AQS-14C1	Offshore	04/25/89	< 1	< 1	2020 ± 200	< 200	161 ± 16	< 10
SN-AQS-16B1	Offshore	04/25/89	< 3	< 2	6410 ± 640	699 ± 359	766 ± 77	< 30
SN-AQS-13F1 (cl)	Beach	06/08/89	< 4	< 1	3540 ± 350	< 300	158 ± 24	< 20
Average ± 2 s.d.				**2.9 ± 1.8**	**2820 ± 2885**	**450 ± 708**	**298 ± 629**	

* Sr-89 results are corrected for decay to the sample stop date.

** All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.

(cl) Denotes Control Location

TABLE C-6

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

Results in Units of 10^{-3} pCi/m³ ± 2 sigma

COLLECTION DATES	LOCATION CODES SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
JANUARY 89								
12/27/88-01/03/89	26 ± 4	28 ± 4	27 ± 4	24 ± 4	25 ± 4	26 ± 4	24 ± 4	31 ± 4
01/03/89-01/10/89	20 ± 3	16 ± 3	18 ± 3	19 ± 3	19 ± 3	19 ± 3	22 ± 4	25 ± 4
01/10/89-01/17/89	19 ± 3	22 ± 3	20 ± 4	22 ± 4	23 ± 3	21 ± 3	21 ± 4	19 ± 3
01/17/89-01/24/89	20 ± 6	22 ± 3	19 ± 3	22 ± 4	24 ± 4	20 ± 3	20 ± 3	20 ± 3
01/24/89-01/31/89	27 ± 4	26 ± 4	27 ± 4	30 ± 4	29 ± 4	28 ± 4	27 ± 4	28 ± 4
FEBRUARY								
01/31/89-02/07/89	22 ± 3	21 ± 3	20 ± 3	23 ± 3	20 ± 3	23 ± 3	28 ± 4	19 ± 3
02/07/89-02/14/89	19 ± 3	19 ± 3	25 ± 3	22 ± 3	22 ± 3	21 ± 3	22 ± 3	20 ± 3
02/14/89-02/21/89	22 ± 3	20 ± 3	21 ± 3	16 ± 3	19 ± 3	20 ± 3	21 ± 3	22 ± 3
02/21/89-02/28/89	17 ± 3	20 ± 3	20 ± 3	20 ± 3	17 ± 3	16 ± 3	21 ± 3	18 ± 3
MARCH								
02/28/89-03/07/89	20 ± 3	20 ± 3	18 ± 3	20 ± 3	18 ± 3	22 ± 3	23 ± 4	20 ± 3
03/07/89-03/14/89	25 ± 3	24 ± 3	28 ± 4	27 ± 3	25 ± 3	27 ± 3	28 ± 3	25 ± 3
03/14/89-03/21/89	16 ± 3	15 ± 3	17 ± 3	14 ± 3	15 ± 3	17 ± 3	16 ± 3	15 ± 3
03/21/89-03/28/89	13 ± 3	14 ± 3	6 ± 2	15 ± 3	18 ± 3	11 ± 3	15 ± 3	10 ± 3
APRIL								
03/28/89-04/04/89	11 ± 3	11 ± 3	4 ± 2	11 ± 3	11 ± 3	9 ± 3	11 ± 3	9 ± 3
04/04/89-04/11/89	13 ± 3	14 ± 3	16 ± 3	13 ± 3	13 ± 3	12 ± 3	13 ± 3	10 ± 3
04/11/89-04/18/89	14 ± 3	18 ± 3	16 ± 3	14 ± 3	15 ± 3	18 ± 3	14 ± 3	14 ± 3
04/18/89-04/25/89	15 ± 3	15 ± 3	15 ± 3	18 ± 3	13 ± 3	17 ± 3	16 ± 3	16 ± 3
04/25/89-05/02/89	9 ± 3	10 ± 3	12 ± 3	12 ± 3	6 ± 3	6 ± 3	10 ± 3	8 ± 3

(cl) Denotes Control Location

TABLE C-6 (Cont.)

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

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

COLLECTION DATES	LOCATION CODES SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
MAY								
05/02/89-05/09/89	13 ± 3	10 ± 3	10 ± 3	14 ± 3	12 ± 3	9 ± 3	11 ± 3	12 ± 3
05/09/89-05/16/89	10 ± 3	11 ± 3	12 ± 3	10 ± 3	10 ± 3	11 ± 3	9 ± 3	9 ± 3
05/16/89-05/23/89	16 ± 3	17 ± 3	13 ± 3	16 ± 3	17 ± 3	13 ± 3	11 ± 3	15 ± 4
05/23/89-05/30/89	17 ± 3	15 ± 3	15 ± 3	16 ± 3	17 ± 3	13 ± 3	16 ± 3	17 ± 3
JUNE								
05/30/89-06/06/89	19 ± 3	17 ± 3	19 ± 3	20 ± 3	21 ± 3	22 ± 3	19 ± 3	17 ± 3
06/06/89-06/13/89	8 ± 3	7 ± 3	8 ± 3	6 ± 3	6 ± 3	10 ± 3	6 ± 3	7 ± 3
06/13/89-06/20/89	11 ± 3	13 ± 3	12 ± 3	12 ± 3	14 ± 3	15 ± 3	< 3 (a)	14 ± 3
06/20/89-06/27/89	20 ± 3	16 ± 3	19 ± 3	19 ± 3	20 ± 3	17 ± 3	15 ± 3	15 ± 3
JULY								
06/27/89-07/03/89	16 ± 4	15 ± 4	14 ± 4	16 ± 4	20 ± 4	18 ± 4	19 ± 4	15 ± 4
07/03/89-07/11/89	15 ± 3	15 ± 3	11 ± 3	15 ± 3	18 ± 3	13 ± 3	15 ± 3	10 ± 3
07/11/89-07/18/89	13 ± 3	15 ± 3	12 ± 3	11 ± 3	13 ± 3	13 ± 3	14 ± 3	8 ± 3
07/18/89-07/25/89	13 ± 3	16 ± 3	12 ± 3	13 ± 3	15 ± 3	17 ± 3	14 ± 3	12 ± 3
07/25/89-08/01/89	23 ± 4	20 ± 4	19 ± 4	21 ± 4	24 ± 4	15 ± 3	22 ± 4	17 ± 3
AUGUST								
08/01/89-08/08/89	26 ± 4	23 ± 4	25 ± 4	21 ± 4	25 ± 4	22 ± 4	23 ± 4	22 ± 4
08/08/89-08/15/89	9 ± 3	7 ± 3	9 ± 3	12 ± 3	10 ± 3	8 ± 3	7 ± 3	8 ± 3
08/15/89-08/22/89	14 ± 4	15 ± 4	12 ± 4	13 ± 4	17 ± 4	15 ± 4	12 ± 4	11 ± 3
08/22/89-08/29/89	17 ± 3	15 ± 3	15 ± 3	15 ± 3	17 ± 4	15 ± 3	18 ± 3	16 ± 3

(cl) Denotes Control Location
(a) Results confirmed by recount; light deposit on air filter.

TABLE C-6 (Cont.)

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

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

COLLECTION DATES	LOCATION CODES SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
SEPTEMBER								
08/29/89-09/05/89	21 ± 4	19 ± 3	19 ± 3	17 ± 3	21 ± 3	20 ± 3	17 ± 3	19 ± 3
09/05/89-09/12/89	24 ± 3	26 ± 4	23 ± 3	25 ± 4	25 ± 4	27 ± 4	22 ± 3	22 ± 3
09/12/89-09/19/89	10 ± 3	11 ± 3	13 ± 3	12 ± 3	14 ± 3	10 ± 3	14 ± 3	12 ± 3
09/19/89-09/26/89	11 ± 3	10 ± 3	7 ± 3	10 ± 3	10 ± 3	10 ± 3	8 ± 3	8 ± 3
09/26/89-10/03/89	14 ± 3	11 ± 3	16 ± 3	14 ± 3	20 ± 4	17 ± 4	16 ± 3	13 ± 3
OCTOBER								
10/03/89-10/10/89	16 ± 3	13 ± 3	14 ± 3	15 ± 3	15 ± 3	9 ± 3	19 ± 4	13 ± 3
10/10/89-10/17/89	21 ± 4	26 ± 4	15 ± 3	22 ± 4	23 ± 4	22 ± 4	21 ± 4	21 ± 3
10/17/89-10/24/89	9 ± 4	8 ± 3	6 ± 2	7 ± 3	9 ± 3	9 ± 3	7 ± 3	8 ± 3
10/24/89-10/31/89	(a)	50 ± 5	48 ± 4	48 ± 4	47 ± 4	50 ± 5	47 ± 4	45 ± 4
NOVEMBER								
10/31/89-11/07/89	17 ± 4	16 ± 3	15 ± 3	17 ± 3	19 ± 3	16 ± 3	16 ± 3	17 ± 3
11/07/89-11/14/89	18 ± 3	18 ± 3	20 ± 3	20 ± 3	19 ± 3	23 ± 3	18 ± 3	22 ± 3
11/14/89-11/21/89	19 ± 3	20 ± 4	20 ± 3	17 ± 3	18 ± 4	13 ± 3	20 ± 4	17 ± 3
11/21/89-11/28/89	16 ± 3	16 ± 3	17 ± 3	19 ± 3	16 ± 3	21 ± 3	17 ± 3	15 ± 3
DECEMBER								
11/28/89-12/05/89	22 ± 3	17 ± 3	19 ± 3	19 ± 3	18 ± 3	19 ± 3	19 ± 3	18 ± 3
12/05/89-12/12/89	15 ± 3	15 ± 4	20 ± 4	14 ± 3	18 ± 4	19 ± 4	22 ± 4	14 ± 3
12/12/89-12/19/89	20 ± 3	24 ± 4	23 ± 4	23 ± 4	24 ± 4	23 ± 4	17 ± 3	19 ± 3
12/19/89-12/26/89	25 ± 3	29 ± 3	24 ± 3	23 ± 3	25 ± 3	23 ± 3	21 ± 3	22 ± 3
12/26/89-01/02/90	19 ± 3	13 ± 3	17 ± 3	20 ± 3	18 ± 3	23 ± 3	22 ± 3	20 ± 3
Average ± 2 s.d.	**17 ± 10**	**17 ± 14**	**17 ± 14**	**18 ± 13**	**18 ± 13**	**18 ± 14**	**18 ± 13**	**17 ± 14**

(cl) Denotes Control Location

(a) Sampler malfunction; no sample available.

TABLE C-6 (Cont.)

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

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

COLLECTION DATES	LOCATION CODES SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9B1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)	Average ± 2 s.d.
JANUARY 89									
12/27/88-01/03/89	28 ± 4	26 ± 4	28 ± 4	28 ± 4	31 ± 4	27 ± 4	26 ± 4	25 ± 4	27 ± 4
01/03/89-01/10/89	19 ± 3	21 ± 3	20 ± 4	17 ± 3	19 ± 3	18 ± 3	17 ± 3	18 ± 3	19 ± 4
01/10/89-01/17/89	21 ± 3	27 ± 4	22 ± 3	23 ± 4	23 ± 3	22 ± 3	25 ± 4	9 ± 3	21 ± 8
01/17/89-01/24/89	22 ± 3	23 ± 3	25 ± 4	22 ± 3	21 ± 3	23 ± 3	24 ± 4	23 ± 3	22 ± 4
01/24/89-01/31/89	30 ± 4	31 ± 4	28 ± 4	34 ± 4	30 ± 4	28 ± 4	27 ± 4	27 ± 4	29 ± 4
FEBRUARY									
01/31/89-02/07/89	24 ± 3	20 ± 3	20 ± 3	21 ± 3	22 ± 3	22 ± 3	21 ± 3	23 ± 3	22 ± 4
02/07/89-02/14/89	22 ± 3	23 ± 3	21 ± 3	22 ± 3	23 ± 3	23 ± 3	26 ± 3	25 ± 3	22 ± 4
02/14/89-02/21/89	23 ± 3	18 ± 3	21 ± 3	20 ± 3	21 ± 3	24 ± 3	19 ± 3	22 ± 3	21 ± 4
02/21/89-02/28/89	18 ± 3	20 ± 3	21 ± 3	19 ± 3	20 ± 3	20 ± 3	19 ± 3	20 ± 3	19 ± 3
MARCH									
02/28/89-03/07/89	18 ± 3	24 ± 3	19 ± 3	21 ± 3	20 ± 3	23 ± 3	22 ± 3	19 ± 3	20 ± 4
03/07/89-03/14/89	27 ± 3	25 ± 3	25 ± 3	26 ± 3	28 ± 3	24 ± 3	26 ± 3	25 ± 3	26 ± 3
03/14/89-03/21/89	14 ± 3	18 ± 3	17 ± 3	13 ± 3	18 ± 3	16 ± 3	14 ± 3	19 ± 3	16 ± 3
03/21/89-03/28/89	13 ± 3	15 ± 3	14 ± 3	12 ± 3	14 ± 3	20 ± 3	11 ± 3	15 ± 3	14 ± 6
APRIL									
03/28/89-04/04/89	10 ± 3	12 ± 3	10 ± 3	11 ± 3	18 ± 3	11 ± 3	10 ± 3	9 ± 3	11 ± 5
04/04/89-04/11/89	15 ± 3	14 ± 3	15 ± 3	13 ± 3	15 ± 3	13 ± 3	13 ± 3	15 ± 3	14 ± 3
04/11/89-04/18/89	17 ± 3	16 ± 3	15 ± 3	15 ± 3	15 ± 3	15 ± 3	14 ± 3	14 ± 3	15 ± 3
04/18/89-04/25/89	17 ± 3	13 ± 3	16 ± 3	17 ± 3	15 ± 3	17 ± 3	15 ± 3	18 ± 3	16 ± 3
04/25/89-05/02/89	9 ± 3	10 ± 3	10 ± 3	17 ± 3	10 ± 3	10 ± 3	10 ± 3	10 ± 3	10 ± 5

(cl) Denotes Control Location

TABLE C-6 (Cont.)

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

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

COLLECTION DATES	SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9B1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)	Average ± 2 s.d.
MAY									
05/02/89-05/09/89	10 ± 3	13 ± 3	12 ± 3	9 ± 3	12 ± 3	8 ± 3	11 ± 3	10 ± 3	11 ± 3
05/09/89-05/16/89	7 ± 3	7 ± 3	10 ± 5	8 ± 3	9 ± 3	9 ± 3	11 ± 3	9 ± 3	10 ± 3
05/16/89-05/23/89	15 ± 3	16 ± 3	13 ± 3	12 ± 3	14 ± 3	16 ± 3	14 ± 3	15 ± 3	15 ± 4
05/23/89-05/30/89	17 ± 3	15 ± 3	13 ± 3	14 ± 3	14 ± 3	16 ± 3	15 ± 3	15 ± 3	15 ± 3
JUNE									
05/30/89-06/06/89	19 ± 3	17 ± 3	20 ± 3	17 ± 3	21 ± 3	16 ± 3	21 ± 3	22 ± 3	19 ± 4
06/06/89-06/13/89	7 ± 3	7 ± 3	7 ± 3	8 ± 3	9 ± 3	8 ± 3	10 ± 3	6 ± 2	8 ± 3
06/13/89-06/20/89	12 ± 3	13 ± 3	11 ± 3	14 ± 3	16 ± 3	13 ± 3	11 ± 3	11 ± 3	13 ± 3
06/20/89-06/27/89	16 ± 3	19 ± 3	13 ± 3	17 ± 3	18 ± 4	15 ± 3	15 ± 3	17 ± 3	17 ± 4
JULY									
06/27/89-07/03/89	13 ± 4	12 ± 3	17 ± 4	12 ± 4	18 ± 4	16 ± 4	16 ± 4	17 ± 4	16 ± 5
07/03/89-07/11/89	14 ± 3	16 ± 3	13 ± 3	15 ± 3	17 ± 3	16 ± 3	20 ± 3	15 ± 3	15 ± 5
07/11/89-07/18/89	< 4 (a)	14 ± 3	12 ± 3	11 ± 3	13 ± 3	13 ± 3	11 ± 3	11 ± 3	12 ± 3
07/18/89-07/25/89	14 ± 3	12 ± 3	11 ± 3	12 ± 3	13 ± 3	15 ± 3	16 ± 3	15 ± 3	14 ± 4
07/25/89-08/01/89	22 ± 4	18 ± 3	18 ± 4	18 ± 4	18 ± 4	18 ± 4	21 ± 4	22 ± 4	20 ± 5
AUGUST									
08/01/89-08/08/89	23 ± 4	27 ± 4	23 ± 4	20 ± 4	23 ± 4	23 ± 4	22 ± 4	20 ± 4	23 ± 4
08/08/89-08/15/89	7 ± 3	10 ± 3	9 ± 3	7 ± 3	7 ± 3	10 ± 3	7 ± 3	9 ± 3	9 ± 3
08/15/89-08/22/89	12 ± 4	15 ± 3	17 ± 4	12 ± 4	12 ± 3	14 ± 4	14 ± 3	12 ± 3	14 ± 4
08/22/89-08/29/89	60 ± 5(b)	15 ± 3	16 ± 3	15 ± 3	16 ± 3	14 ± 3	15 ± 3	13 ± 3	18 ± 22

(cl) Denotes Control Location
(a) Results confirmed by a recount; light deposition on filter.
(b) Second measurement gave result of 78 ± 50.

TABLE C-6 (Cont.)

CONCENTRATIONS OF GROSS BETA EMITTERS IN WEEKLY AIRBORNE PARTICULATES

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

COLLECTION DATES	SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9B1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)	Average ± 2 s.d.
	LOCATION CODES								
SEPTEMBER									
08/29/89-09/05/89	18 ± 3	21 ± 3	19 ± 3	18 ± 3	19 ± 3	19 ± 3	19 ± 3	18 ± 3	19 ± 3
09/05/89-09/12/89	22 ± 3	23 ± 3	23 ± 3	31 ± 4	24 ± 3	24 ± 4	24 ± 3	23 ± 3	24 ± 5
09/12/89-09/19/89	16 ± 3	11 ± 3	13 ± 3	13 ± 3	12 ± 3	16 ± 3	11 ± 3	11 ± 3	12 ± 4
09/19/89-09/26/89	7 ± 1	10 ± 3	8 ± 3	6 ± 3	10 ± 3	9 ± 3	8 ± 3	6 ± 3	9 ± 3
09/26/89-10/03/89	17 ± 4	15 ± 3	13 ± 3	13 ± 3	14 ± 3	15 ± 4	14 ± 3	13 ± 3	15 ± 4
OCTOBER									
10/03/89-10/10/89	15 ± 3	12 ± 3	11 ± 3	14 ± 3	15 ± 3	15 ± 3	15 ± 3	13 ± 3	14 ± 4
10/10/89-10/17/89	23 ± 4	22 ± 4	25 ± 4	27 ± 4	15 ± 3	24 ± 4	23 ± 3	23 ± 4	22 ± 7
10/17/89-10/24/89	8 ± 3	11 ± 3	9 ± 3	7 ± 3	9 ± 3	7 ± 3	8 ± 3	10 ± 3	8 ± 3
10/24/89-10/31/89	48 ± 4	45 ± 4	49 ± 4	50 ± 4	47 ± 5	47 ± 4	49 ± 4	53 ± 5	48 ± 4
NOVEMBER									
10/31/89-11/07/89	18 ± 3	19 ± 3	18 ± 3	19 ± 3	17 ± 3	19 ± 3	18 ± 3	18 ± 3	17 ± 3
11/07/89-11/14/89	20 ± 3	20 ± 3	19 ± 3	20 ± 3	21 ± 3	19 ± 3	18 ± 3	20 ± 3	20 ± 3
11/14/89-11/21/89	22 ± 4	14 ± 3	20 ± 4	17 ± 3	18 ± 3	20 ± 3	16 ± 3	23 ± 4	18 ± 5
11/21/89-11/28/89	16 ± 3	14 ± 3	17 ± 3	20 ± 3	15 ± 3	20 ± 3	17 ± 3	16 ± 3	17 ± 4
DECEMBER									
11/28/89-12/05/89	18 ± 3	21 ± 3	17 ± 3	17 ± 3	19 ± 3	21 ± 3	20 ± 3	18 ± 3	19 ± 3
12/05/89-12/12/89	16 ± 3	19 ± 3	18 ± 4	17 ± 4	8 ± 3	20 ± 4	21 ± 4	17 ± 3	17 ± 7
12/12/89-12/19/89	22 ± 3	23 ± 3	20 ± 3	23 ± 4	21 ± 3	24 ± 4	24 ± 3	23 ± 3	22 ± 4
12/19/89-12/26/89	23 ± 3	25 ± 3	23 ± 3	24 ± 3	21 ± 3	24 ± 3	25 ± 3	22 ± 3	24 ± 4
12/26/89-01/02/90	19 ± 3	23 ± 3	18 ± 3	22 ± 3	16 ± 3	23 ± 3	22 ± 3	23 ± 3	20 ± 6
Average ± 2 s.d.	**19 ± 18**	**18 ± 13**	**17 ± 14**	**18 ± 15**	**18 ± 13**	**18 ± 13**	**18 ± 14**	**17 ± 15**	**18 ± 1**

(cl) Denotes Control Location
(a) Results confirmed by a recount

TABLE C-7

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITE OF AIRBORNE PARTICULATE SAMPLES

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

LOCATION CODES	NUCLIDES	FIRST QUARTER 01/03/89-03/28/89	SECOND QUARTER 03/28/89-07/03/89	THIRD QUARTER 07/03/89-10/03/89	FOURTH QUARTER 10/03/89-01/02/90	AVERAGE ± 2 s.d.
SN-APT-2A2	Be-7	74.1 ± 7.4	69.4 ± 6.9	67.6 ± 7.5	58.6 ± 5.9	67.4 ± 13.0
	K-40	< 6	< 10	< 10	< 20	-
	Cs-134	< 0.3	< 0.4	< 0.5	< 0.5	-
	Cs-137	< 0.4	< 0.5	< 0.5	< 0.5	-
SN-APT-2A3	Be-7	67.3 ± 6.8	63.7 ± 6.6	64.3 ± 6.7	43.8 ± 4.8	59.8 ± 21.5
	K-40	< 9	7.94 ± 3.34	< 9	< 8	7.94 ± 3.34
	Cs-134	< 0.5	< 0.3	< 0.3	< 0.4	-
	Cs-137	< 0.5	< 0.4	< 0.4	< 0.6	-
SN-APT-3S1	Be-7	66.3 ± 6.6	65.1 ± 6.5	43.1 ± 6.1	59.6 ± 6.0	58.5 ± 21.4
	K-40	< 9	< 8	< 10	< 10	-
	Cs-134	< 0.5	< 0.4	< 0.6	< 0.5	-
	Cs-137	< 0.4	< 0.3	< 0.6	< 0.5	-
SN-APT-5D3	Be-7	63.7 ± 6.5	60.0 ± 8.4	57.3 ± 7.0	52.7 ± 5.3	58.4 ± 9.3
	K-40	< 10	< 30	< 20	< 9	-
	Cs-134	< 0.6	< 0.8	< 0.6	< 0.5	-
	Cs-137	< 0.5	< 0.8	< 0.7	< 0.5	-

* All other gamma emitters not listed were <LLD; typical LLDs are found in Tables C-20 and C-21.

TABLE C-7 (Cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITE OF AIRBORNE PARTICULATE SAMPLES

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

LOCATION CODES	NUCLIDES	FIRST QUARTER 01/03/89-03/28/89	SECOND QUARTER 03/28/89-07/03/89	THIRD QUARTER 07/03/89-10/03/89	FOURTH QUARTER 10/03/89-01/02/90	AVERAGE ± 2 s.d.
SN-APT-5F3	Be-7	62.9 ± 6.3	63.6 ± 6.5	66.9 ± 6.7	49.8 ± 5.3	60.8 ± 15.1
(cl)	K-40	< 10	< 9	< 9	< 8	-
	Cs-134	< 0.5	< 0.5	< 0.4	< 0.4	-
	Cs-137	< 0.5	< 0.5	< 0.4	< 0.5	-
SN-APT-6S2	Be-7	66.6 ± 6.7	71.8 ± 7.2	66.1 ± 6.7	65.8 ± 6.6	67.6 ± 5.7
	K-40	< 8	< 8	< 9	6.33 ± 3.50	6.33 ± 3.50
	Cs-134	< 0.4	< 0.4	< 0.4	< 0.4	-
	Cs-137	< 0.4	< 0.4	< 0.5	< 0.4	-
SN-APT-7A2	Be-7	63.5 ± 6.3	51.0 ± 5.6	61.9 ± 6.2	49.1 ± 5.0	56.4 ± 14.7
	K-40	< 8	< 10	< 9	< 10	-
	Cs-134	< 0.4	< 0.6	< 0.3	< 0.5	-
	Cs-137	< 0.5	< 0.5	< 0.5	< 0.5	-
SN-APT-7B1	Be-7	70.0 ± 7.0	55.5 ± 6.0	56.7 ± 6.9	50.4 ± 5.0	58.2 ± 16.7
	K-40	< 8	< 10	< 20	< 10	-
	Cs-134	< 0.4	< 0.5	< 0.7	< 0.4	-
	Cs-137	< 0.4	< 0.5	< 0.6	< 0.4	-

* All other gamma emitters not listed were <LLD; typical LLDs are found in Tables C-20 and C-21.

TABLE C-7 (Cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITE OF AIRBORNE PARTICULATE SAMPLES

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

LOCATION CODES	NUCLIDES	FIRST QUARTER 01/03/89-03/28/89	SECOND QUARTER 03/28/89-07/03/89	THIRD QUARTER 07/03/89-10/03/89	FOURTH QUARTER 10/03/89-01/02/90	AVERAGE ± 2 s.d.
SN-APT-8A3	Be-7	75.9 ± 7.6	66.1 ± 6.6	54.9 ± 6.8	52.0 ± 5.2	62.2 ± 21.9
	K-40	< 8	< 8	< 9	< 6	-
	Cs-134	< 0.4	< 0.4	< 3	< 0.3	-
	Cs-137	< 0.3	< 0.4	< 0.5	< 0.3	-
SN-APT-8G1 (cl)	Be-7	63.2 ± 6.3	62.6 ± 6.3	61.3 ± 7.6	55.9 ± 7.3	60.8 ± 6.7
	K-40	< 6	< 8	< 20	< 20	-
	Cs-134	< 0.4	< 0.4	< 0.7	< 0.6	-
	Cs-137	< 0.3	< 0.5	< 0.8	< 0.6	-
SN-APT-9B1	Be-7	69.8 ± 7.0	55.4 ± 5.7	58.2 ± 7.1	62.6 ± 6.3	61.5 ± 12.6
	K-40	< 10	< 8	< 9	< 8	-
	Cs-134	< 0.5	< 0.4	< 0.5	< 0.4	-
	Cs-137	< 0.5	< 0.4	< 0.6	< 0.4	-
SN-APT-10A1	Be-7	63.0 ± 7.5	65.6 ± 6.6	61.1 ± 6.9	51.3 ± 5.1	60.3 ± 12.5
	K-40	< 9	< 8	< 9	< 7	-
	Cs-134	< 0.5	< 0.3	< 0.4	< 0.3	-
	Cs-137	< 0.5	< 0.4	< 0.4	< 0.3	-

* All other gamma emitters not listed were <LLD; typical LLDs are found in Tables C-20 and C-21.

TABLE C-7 (Cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITE OF AIRBORNE PARTICULATE SAMPLES

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

LOCATION CODES	NUCLIDES	FIRST QUARTER 01/03/89-03/28/89	SECOND QUARTER 03/28/89-07/03/89	THIRD QUARTER 07/03/89-10/03/89	FOURTH QUARTER 10/03/89-01/02/90	AVERAGE ± 2 s.d.
SN-APT-11G1	Be-7	64.6 ± 6.5	60.5 ± 7.0	61.9 ± 6.2	48.0 ± 6.0	58.8 ± 14.7
(cl)	K-40	< 5	< 20	< 10	< 9	-
	Cs-134	< 0.3	< 0.5	< 0.6	< 0.4	-
	Cs-137	< 0.2	< 0.6	< 0.6	< 0.5	-
SN-APT-12A1	Be-7	78.3 ± 7.8	64.8 ± 6.5	50.8 ± 6.1	62.0 ± 6.2	64.0 ± 22.6
	K-40	< 9	6.78 ± 3.76	< 10	< 8	6.78 ± 3.76
	Cs-134	< 0.5	< 0.4	< 0.5	< 0.5	-
	Cs-137	< 0.5	< 0.4	< 0.5	< 0.5	-
SN-APT-12D1	Be-7	80.1 ± 8.0	68.4 ± 6.8	67.8 ± 6.8	63.5 ± 6.3	70.0 ± 14.2
	K-40	< 9	< 7	< 9	< 20	-
	Cs-134	< 0.4	< 0.3	< 0.4	< 0.6	-
	Cs-137	< 0.4	< 0.3	< 0.4	< 0.6	-
SN-APT-12G2	Be-7	69.5 ± 6.9	64.0 ± 6.4	68.3 ± 6.8	53.6 ± 5.4	63.9 ± 14.5
(cl)	K-40	11.4 ± 6.1	< 6	< 10	< 20	11.4 ± 6.1
	Cs-134	< 0.6	< 0.3	< 0.3	< 0.6	-
	Cs-137	< 0.5	< 0.3	< 0.4	< 0.5	-

* All other gamma emitters not listed were <LLD; typical LLDs are found in Tables C-20 and C-21.

TABLE C-8

CONCENTRATIONS OF STRONTIUM-89* AND -90 IN QUARTERLY COMPOSITES OF AIRBORNE PARTICULATE SAMPLES

Results in Units of 10^{-4} pCi/m^3 ± 2 sigma

LOCATION CODES		FIRST QUARTER 01/03/89-03/28/89		SECOND QUARTER 03/28/89-07/03/89		THIRD QUARTER 07/03/89-10/03/89		FOURTH QUARTER 10/03/89-01/02/90	
		Sr-89	Sr-90	Sr-89	Sr-90	Sr-89	Sr-90	Sr-89	Sr-90
SN-APT-2A2		< 4	< 0.9	< 2	< 0.3	< 3	< 0.8	< 3	< 0.8
SN-APT-2A3		< 3	< 3	< 3	< 0.5	< 5	< 1	< 4	< 1
SN-APT-3S1		< 3	< 1	< 2	< 0.3	< 3	< 0.7	< 3	< 1
SN-APT-5D3		< 4	< 0.9	< 2	< 0.3	< 4	< 1	< 2	< 0.6
SN-APT-5F3	(cl)	< 4	< 0.8	< 3	< 0.3	< 3	< 1	< 3	< 0.8
SN-APT-6S2		< 3	< 1	< 2	< 0.3	< 3	< 0.6	< 3	< 0.5
SN-APT-7A2		< 4	< 1	< 3	< 0.4	< 3	< 0.6	< 3	< 0.7
SN-APT-7B1		< 4	< 1	< 3	< 0.6	< 5	< 0.9	< 2	< 0.6
SN-APT-8A3		< 5	< 0.8	< 4	< 0.	< 5	< 0.9	< 3	< 1
SN-APT-8G1	(cl)	< 4	< 0.6	< 2	< 0.4	< 3	< 0.5	< 3	< 0.5
SN-APT-9S1		< 3	< 0.5	< 3	< 0.4	< 4	< 0.7	< 3	< 0.5
SN-APT-10A1		< 4	< 0.5	< 3	< 0.4	< 4	< 0.8	< 4	< 0.5
SN-APT-11G1	(cl)	< 3	< 0.7	< 3	< 0.6	< 2	< 0.7	< 3	< 0.4
SN-APT-12A1		< 4	< 0.5	< 4	< 0.5	< 2	< 0.6	< 4	< 0.5
SN-APT-12D1		< 4	< 0.5	< 3	< 0.4	< 2	< 0.6	< 2	< 0.5
SN-APT-12G2	(cl)	< 4	< 0.6	< 4	< 0.4	< 3	< 0.7	< 3	< 0.8

* Sr-89 results are corrected for decay to sample stop date.
(cl) Denotes Control Location

TABLE C-9

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

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

COLLECTION DATES	LOCATION CODES SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
JANUARY 89								
12/27/88-01/03/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
01/03/89-01/10/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
01/10/89-01/17/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
01/17/89-01/24/89	< 30	< 20	< 20	< 20	< 10	< 30	< 30	< 30
01/24/89-01/31/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
FEBRUARY								
01/31/89-02/07/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
02/07/89-02/14/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
02/14/89-02/21/89	< 20	< 20	< 30	< 20	< 20	< 20	< 20	< 20
02/21/89-02/28/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
MARCH								
02/28/89-03/07/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
03/07/89-03/14/89	< 30	< 30	< 30	< 30	< 20	< 30	< 30	< 30
03/14/89-03/21/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
03/21/89-03/28/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
APRIL								
03/28/89-04/04/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
04/04/89-04/11/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10
04/11/89-04/18/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
04/18/89-04/25/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
04/25/89-05/02/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20

(cl) Denotes Control Location

TABLE C-9 (Cont.)

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

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

	LOCATION CODES							
COLLECTION DATES	SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
MAY								
05/02/89-05/09/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
05/09/89-05/16/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
05/16/89-05/23/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
05/23/89-05/30/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
JUNE								
05/30/89-06/06/89	< 20	< 20	< 20	< 20	< 20	< 30	< 30	< 30
06/06/89-06/13/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
06/13/89-06/20/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
06/20/89-06/27/89	< 30	< 30	< 30	< 30	< 20	< 40	< 40	< 40
JULY								
06/27/89-07/03/89	< 40	< 40	< 40	< 40	< 30	< 30	< 30	< 30
07/03/89-07/11/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
07/11/89-07/18/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
07/18/89-07/25/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
07/25/89-08/01/89	< 50	< 50	< 50	< 50	< 30	< 30	< 30	< 30
AUGUST								
08/01/89-08/08/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
08/08/89-08/15/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
08/15/89-08/22/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
08/22/89-08/29/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20

(cl) Denotes Control Location

TABLE C-9 (Cont.)

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

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

COLLECTION DATES	SN-APT-2A2	SN-APT-2A3	SN-APT-3S1	SN-APT-5D3	SN-APT-5F3 (cl)	SN-APT-6S2	SN-APT-7A2	SN-APT-7B1
				LOCATION CODES				
SEPTEMBER								
08/29/89-09/05/89	< 20	< 20	< 20	< 20	< 10	< 30	< 30	< 30
09/05/89-09/12/89	< 20	< 20	< 20	< 20	< 20	< 30	< 30	< 30
09/12/89-09/19/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
09/19/89-09/26/89	< 30	< 20	< 20	< 20	< 20	< 20	< 20	< 20
09/26/89-10/03/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
OCTOBER								
10/03/89-10/10/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
10/10/89-10/17/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
10/17/89-10/24/89	< 50 (a)	< 30	< 30	< 30	< 20	< 30	< 30	< 30
10/24/89-10/31/89	(b)	< 20	< 20	< 20	< 20	< 20	< 20	< 20
NOVEMBER								
10/31/89-11/07/89	< 30 (c)	< 20	< 20	< 20	< 20	< 20	< 20	< 20
11/07/89-11/14/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
11/14/89-11/21/89	< 50	< 60	< 50	< 50	< 40	< 40	< 40	< 30
11/21/89-11/28/89 (d)	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
DECEMBER								
11/28/89-12/05/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
12/05/89-12/12/89	< 30	< 30	< 30	< 30	< 20	< 20	< 20	< 20
12/12/89-12/19/89	< 20	< 20	< 20	< 20	< 10	< 30	< 30	< 30
12/19/89-12/26/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
12/26/89-01/02/90	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20

(a) Sampler malfunction; low sample volume.
(b) Sampler malfunction; no sample available.
(c) Collection dates 11/02/89-11/07/89.
(d) Several collection dates 11/20/89-11/28/89.
(cl) Denotes Control Location

TABLE C-9 (Cont.)

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

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

COLLECTION DATES	LOCATION CODES SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9S1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)
JANUARY 89								
12/27/88-01/03/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10
01/03/89-01/10/89	< 20	< 20	< 20	< 20	< 10	< 20	< 10	< 20
01/10/89-01/17/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10
01/17/89-01/24/89	< 30	< 20	< 20	< 20	< 20	< 20	< 20	< 30
01/24/89-01/31/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
FEBRUARY								
01/31/89-02/07/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
02/07/89-02/14/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 30
02/14/89-02/21/89	< 20	< 20	< 10	< 20	< 20	< 20	< 10	< 20
02/21/89-02/28/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 40
MARCH								
02/28/89-03/07/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
03/07/89-03/14/89	< 30	< 20	< 20	< 20	< 20	< 20	< 10	< 10
03/14/89-03/21/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10
03/21/89-03/28/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 30
APRIL								
03/28/89-04/04/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 10
04/04/89-04/11/89	< 10	< 10	< 20	< 20	< 20	< 20	< 20	< 20
04/11/89-04/18/89	< 20	< 10	< 30	< 30	< 30	< 30	< 20	< 20
04/18/89-04/25/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
04/25/89-05/02/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10

(cl) Denotes Control Location

TABLE C-9 (Cont.)

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

Results in Units of 10^{-3} $pCi/m^3 \pm 2$ sigma

COLLECTION DATES	LOCATION CODES SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9S1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)
MAY								
05/02/89-05/09/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
05/09/89-05/16/89	< 20	< 20	< 30	< 20	< 20	< 20	< 10	< 30
05/16/89-05/23/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 30
05/23/89-05/30/89	< 20	< 10	< 30	< 30	< 30	< 30	< 20	< 20
JUNE								
05/30/89-06/06/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
06/06/89-06/13/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
06/13/89-06/20/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 10
06/20/89-06/27/89	< 40	< 20	< 30	< 30	< 40	< 30	< 20	< 20
JULY								
06/27/89-07/03/89	< 30	< 20	< 30	< 30	< 30	< 30	< 20	< 20
07/03/89-07/11/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
07/11/89-07/18/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
07/18/89-07/25/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
07/25/89-08/01/89	< 30	< 30	< 50	< 50	< 50	< 50	< 30	< 30
AUGUST								
08/01/89-08/08/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
08/08/89-08/15/89	< 20	< 20	< 30	< 30	< 30	< 30	< 20	< 20
08/15/89-08/22/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
08/22/89-08/29/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20

(cl) Denotes Control Location

TABLE C-9 (Cont)

CONCENTRATIONS OF IODINE-131 IN AIR CARTRIDGE SAMPLES

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

COLLECTION DATES	LOCATION CODES SN-APT-8A3	SN-APT-8G1 (cl)	SN-APT-9S1	SN-APT-10A1	SN-APT-11G1 (cl)	SN-APT-12A1	SN-APT-12D1	SN-APT-12G2 (cl)
SEPTEMBER								
08/29/89-09/05/89	< 30	< 20	< 20	< 20	< 20	< 20	< 20	< 10
09/05/89-09/12/89	< 30	< 10	< 30	< 30	< 30	< 30	< 20	< 30
09/12/89-09/19/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 30
09/19/89-09/26/89	< 20	< 10	< 20	< 20	< 20	< 20	< 10	< 10
09/26/89-10/03/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 30
OCTOBER								
10/03/89-10/10/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 30
10/10/89-10/17/89	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
10/17/89-10/24/89	< 30	< 20	< 20	< 20	< 20	< 20	< 20	< 20
10/24/89-10/31/89	< 20	< 20	< 20	< 20	< 30	< 20	< 20	< 20
NOVEMBER								
10/31/89-11/07/78	< 20	< 10	< 30	< 30	< 30	< 30	< 20	< 30
11/07/89-11/14/89	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
11/14/89-11/21/89	< 40	< 30	< 40	< 40	< 30	< 30	< 30	< 30
11/21/89-11/28/89 (a)	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 20
DECEMBER								
11/28/89-12/05/89	< 20	< 20	< 40	< 30	< 30	< 30	< 20	< 20
12/05/89-12/12/89	< 20	< 10	< 30	< 30	< 30	< 30	< 20	< 20
12/12/89-12/19/89	< 30	< 10	< 20	< 20	< 20	< 20	< 20	< 20
12/19/89-12/26/89	< 20	< 10	< 20	< 20	< 20	< 20	< 20	< 20
12/26/89-01/02/90	< 20	< 10	< 30	< 30	< 30	< 30	< 20	< 20

(a) Several collection dates 11/20/89-11/28/89.
(cl) Denotes Control Location

TABLE C-10

CONCENTRATIONS OF TRITIUM, GROSS BETA AND GAMMA EMITTERS* IN PRECIPITATION

Results in units of pCi/liter ± 2 sigma

COLLECTION DATES	H-3	GROSS BETA	Be-7	K-40
STATION 9B1				
01/03/89-01/31/89	250 ± 100	3.9 ± 0.8	52.3 ± 13.7	< 50
02/07/89-02/28/89	< 200	3.8 ± 0.8	< 40	< 100
03/21/89-03/27/89	< 100	6.1 ± 0.9	< 40	< 60
04/03/89-04/17/89	160 ± 60	4.0 ± 0.8	< 40	< 100
05/02/89-05/30/89	< 100	5.8 ± 0.9	66.8 ± 35.7	< 200
06/03/89-06/20/89	< 100	3.3 ± 0.7	< 40	< 80
07/06/89-07/25/89	< 200	2.5 ± 0.7	< 40	< 70
08/12/89	< 100	2.5 ± 0.8	< 30	< 40
09/05/89-09/26/89	< 100	1.9 ± 0.6	< 40	< 100
10/03/89-10/24/89	< 100	2.1 ± 0.7	< 40	< 60
11/03/89-11/28/89	< 200	2.9 ± 0.7	< 40	< 50
12/19/89 (a)	150 ± 90	19 ± 3	< 200	< 300
STATION 12A1				
01/03/89-01/30/89	< 100	5.0 ± 0.9	45.8 ± 22.3	< 40
02/07/89-02/28/89	< 100	3.4 ± 0.8	43.4 ± 20.6	< 50
03/21/89-03/27/89	200 ± 80	2.3 ± 0.7	< 40	< 50
04/03/89-04/17/89	< 100	10.0 ± 1.0	< 40	< 60
05/01/89-05/30/89	< 200	5.5 ± 0.9	43.5 ± 14.2	< 70
06/03/89-06/20/89	< 200	3.9 ± 0.8	< 40	< 50
07/06/89-07/25/89	< 200	2.4 ± 0.7	< 30	< 50
08/12/89	< 200	2.3 ± 0.8	< 30	< 50
09/05/89-09/26/89	< 200	1.6 ± 0.6	< 50	< 200
10/03/89-10/24/89	< 200	2.3 ± 0.7	< 40	< 60
11/03/89-11/28/89	< 100	3.2 ± 0.7	< 40	< 70
12/19/89 (a)	120 ± 70	9.2 ± 2.5	< 100	< 200

* All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.

(a) These samples had less than 1 liter of water when they arrived 17 days after collection; LLD's not met for several isotopes.

TABLE C-11

CONCENTRATIONS OF IODINE-131 IN MILK SAMPLES

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	LOCATION CODES SN-GMK-13B1	SN-MILK-8G2 (cl)	SN-GMK-10F1 (cl)	SN-GMK-8F2	SN-MILK-12C1 (b)
JANUARY 11, 12	< 0.2	< 0.2	(1)	(1)	
FEBRUARY 08, 09	< 0.2	< 0.3			
MARCH 08, 09	< 0.2	< 0.2			< 0.2
APRIL 03, 05, 06	< 0.3	< 0.2	< 0.2	< 0.2	
MAY 01, 02, 03, 04	(c)	< 0.2	< 0.3	< 0.2	
MAY 16, 17, 18	< 0.2	< 0.4	< 0.3	< 0.3	< 0.2
MAY 29, 30, JUNE 01	< 0.5	< 0.3	< 0.4	< 0.3	
JUNE 13, 14, 15	< 0.2	< 0.2	< 0.2	< 0.2	
JUNE 23, 27, 28, 29	< 0.2	< 0.2	< 0.3	< 0.2	
JULY 11, 12, 13	< 0.3	< 0.2	< 0.2	< 0.2	
JULY 23, 24, 25, 26, 27	< 0.3	< 0.3	< 0.3	< 0.3	
AUGUST 08, 09, 10	< 0.3	< 0.3		< 0.3	
AUGUST 23, 24	< 0.3	< 0.3		< 0.3	
SEPTEMBER 05, 06, 07	< 0.3	< 0.3		< 0.5	
SEPTEMBER 20, 21	< 0.2	< 0.2		< 0.2	< 0.1
OCTOBER 03, 04, 05	< 0.2	< 0.3		< 0.3	
OCTOBER 15, 16, 17, 18, 19	< 0.2	< 0.2		< 0.3	
NOVEMBER 15, 16		< 0.4		< 0.4	
DECEMBER 13, 14, 15	< 0.2	< 0.4			< 0.2

GMK Goat's Milk
MILK Cow's Milk
N/A Not Available
(cl) Denotes Control Location
(1) No goat's milk available during winter because of kidding.
(b) Bottled milk collected quarterly for quality control sample.
(c) Not Home

TABLE C-12

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS* IN MILK SAMPLES

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	NUCLIDE	LOCATION CODES SN-GMK-13D1	SN-MILK-8G2 (cl)	SN-GMK-10F1 (cl)	SN-GMK-8F2	SN-MILK-12C1 (a)
JANUARY 11, 12	Sr-89	< 4	< 4	(b)	(b)	
	Sr-90	2.5 ± 0.9	3.7 ± 1.2			
	K-40	1860 ± 190	1060 ± 110			
	Cs-137	< 4	4.68 ± 2.68			
FEBRUARY 08, 09	Sr-89	< 3	< 3			
	Sr-90	2.8 ± 0.5	10 ± 2			
	K-40	1980 ± 200	1020 ± 100			
	Cs-137	< 5	9.54 ± 3.77			
MARCH 08, 09	Sr-89	< 3	< 5			< 2
	Sr-90	1.1 ± 0.4	4.0 ± 1.4			1.6 ± 1.1
	K-40	1800 ± 180	1030 ± 100			1470 ± 150
	Cs-137	< 4	< 5			< 4
APRIL 03, 05, 06	Sr-89	< 4	< 5	< 3	< 3	
	Sr-90	4.3 ± 3.5	11 ± 1.0	2.0 ± 0.7	2.4 ± 0.6	
	K-40	1680 ± 170	1070 ± 110	1490 ± 150	1700 ± 170	
	Cs-137	< 4	< 5	< 4	< 4	
MAY 01, 02, 03, 04	Sr-89	(c)	(c)	(c)	(c)	
	Sr-90	(c)	(c)	(c)	(c)	
	K-40	(d)	1070 ± 110	1570 ± 160	1390 ± 140	
	Cs-137		6.28 ± 3.11	< 4	< 5	
MAY 16, 17, 18	Sr-89	< 2	< 4	< 3	< 2	< 2
	Sr-90	1.5 ± 0.5	2.6 ± 0.7	2.1 ± 0.8	3.1 ± 0.6	2.3 ± 0.5
	K-40	1640 ± 160	1020 ± 100	1480 ± 150	1560 ± 160	1390 ± 140
	Cs-137	< 5	< 5	< 5	< 4	< 4

Note: See footnotes at end of table.

TABLE C-12 (Cont.)

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS* IN MILK SAMPLES

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	NUCLIDE	LOCATION CODES SN-GMK-13D1	SN-MLK-8G2 (el)	SN-GMK-10F1 (el)	SN-GMK-8F2	SN-MLK-12C1 (a)
MAY 29, 30, 31	Sr-89	(c)	(c)	(c)	(c)	
JUNE, 01	Sr-90	(c)	(c)	(c)	(c)	
	K-40	1670 ± 170	887 ± 89	1700 ± 170	1410 ± 140	
	Cs-137	< 5	< 5	< 4	< 4	
JUNE 13, 14, 15	Sr-89	(c)	(c)	(c)	(c)	
	Sr-90	(c)	(c)	(c)	(c)	
	K-40	1790 ± 180	983 ± 98	1700 ± 170	1800 ± 180	
	Cs-137	< 4	5.53 ± 2.87	< 5	< 5	
JUNE 23, 27, 28, 29	Sr-89	< 4	< 3	< 3	< 3	
	Sr-90	3.3 ± 0.9	9.2 ± 1.0	4.6 ± 0.8	2.1 ± 0.6	
	K-40	1680 ± 170	938 ± 94	1620 ± 160	1850 ± 180	
	Cs-137	8.50 ± 4.17 (e)	< 5	< 5	< 4	
JULY 11, 12, 13	Sr-89	(c)	(c)	(c)	(c)	
	Sr-90	(c)	(c)	(c)	(c)	
	K-40	2050 ± 200	1030 ± 100	1700 ± 170	1780 ± 180	
	Cs-137	< 5	< 5	< 5	< 5	
JULY 23, 24, 25, 27	Sr-89	< 3	< 3	< 5	< 2	
	Sr-90	1.9 ± 0.6	1.9 ± 0.5	5.1 ± 1.0	2.2 ± 0.5	
	K-40	1930 ± 190	1050 ± 100	1590 ± 160	1940 ± 190	
	Cs-137	< 4	< 5	< 5	< 5	
AUGUST 08, 09, 10	Sr-89	(c)	(c)	(c)	(c)	
	Sr-90	(c)	(c)	(c)	(c)	
	K-40	1690 ± 170	1010 ± 100		1770 ± 180	
	Cs-137	< 8	5.85 ± 3.44		< 4	

Note: See footnotes at end of table.

TABLE C-12 (Cont.)

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS* IN MILK SAMPLES

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	NUCLIDE	LOCATION CODES SN-GMK-13B1	SN-MLK-8G2 (el)	SN-GMK-10F1 (el)	SN-GMK-8F2	SN-MLK-12C1 (a)
AUGUST 23, 24	Sr-89	< 2	< 3		< 2	
	Sr-90	0.85 ± 0.46	14 ± 2		0.80 ± 0.44	
	K-40	1890 ± 190	885 ± 89		1730 ± 170	
	Cs-137	< 5	11.0 ± 3.5		< 6	
SEPTEMBER 05, 06, 07	Sr-89	(c)	(c)		(c)	
	Sr-90	(c)	(c)		(c)	
	K-40	1880 ± 190	931 ± 93		1930 ± 190	
	Cs-137	< 4	< 5		< 4	
SEPTEMBER 20, 21	Sr-89	< 4	< 4		< 2	< 2
	Sr-90	2.5 ± 1.1	8.7 ± 1.3		1.7± 0.6	1.4 ± 0.6
	K-40	1650 ± 170	1020 ± 100		1960 ± 200	1370 ± 140
	Cs-137	< 6	16.2 ± 4.8 (e)		< 5	< 4
OCTOBER 03, 04, 05	Sr-89	(c)	(c)		(c)	
	Sr-90	(c)	(c)		(c)	
	K-40	1840 ± 180	897 ± 90		1780 ± 180	
	Cs-137	< 6	7.05 ± 3.61		< 4	
OCTOBER 15, 16, 17 18, 19	Sr-89	< 4	< 5		< 4	
	Sr-90	< 1	6.2 ± 1.2		2.7 ± 0.9	
	K-40	1930 ± 190	928 ± 93		1870 ± 190	
	Cs-137	< 4	< 5		< 5	

TABLE C-12 (Cont.)

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS° IN MILK SAMPLES

Results in Units of pCi/liter ± 2 sigma

COLLECTION DATES	NUCLIDE	LOCATION CODES SN-GMK-13B1	SN-MLK-8G2 (cl)	SN-GMK-10F1 (cl)	SN-GMK-8F2	SN-MLK-12C1 (a)
NOVEMBER 15, 16	Sr-89		< 4		< 3	
	Sr-90		0.55 ± 0.28		0.59 ± 0.43	
	K-40		1030 ± 100		1940 ± 190	
	Cs-137		6.35 ± 3.51		< 6	
DECEMBER 13, 14, 15	Sr-89	< 3	< 5			< 3
	Sr-90	0.71 ± 0.41	13 ± 2			1.1 ± 0.6
	K-40	1750 ± 180	1300 ± 130			1290 ± 136
	Cs-137	< 6	11.3 ± 3.8			< 4

° All other gamma emitte[illegible]ted were <LLD; typical LLD's are given in Tables C-20 and C-21.
GMK Goat's Milk
MLK Cow's Milk
(a) Bottled Milk
(b) No goat milk available during the winter due to kidding.
(d) Not Home
(c) Strontium analysis performed once a month.
(e) Result confirmed by recount.
(cl) Denotes Control Location

TABLE C-13

CONCENTRATIONS OF TRITIUM, IODINE-131 AND GAMMA EMITTERS** IN POTABLE WATER

Results in Units of pCi/liter ± 2 sigma

LOCATION CODES	COLLECTION DATE	H-3	I-131*	K-40	Cs-137	Th-228
PWA-2B1	03/16/89	< 200	< 0.2	< 60	< 4	< 7
	06/08/89	< 200	< 0.2	< 60	< 4	< 7
	12/07/89	< 200	< 0.2	< 60	< 4	< 7
PWA-6B1 (cl)	03/16/89	< 100	< 0.2	< 50	< 3	< 6
	06/08/89	< 200	< 0.2	< 90	< 6	< 10
	12/07/89	< 100	< 0.2	< 70	< 4	< 8
PWA-2A3	03/16/89	< 100	< 0.2	< 60	< 4	< 7
	05/31/89	< 200	< 0.3	< 60	< 4	< 7
	06/08/89	< 200	< 0.4	< 60	< 4	< 7
	12/07/89	< 100	< 0.3	< 200	< 6	< 8

* Iodine-131 results are corrected for decay to sample stop date. Determined by radiochemical analysis.
** All other gamma emitters not listed were <LLD; typical LLDs are found in Tables C-20 and C-21.
(cl) Denotes Control Location

TABLE C-14

CONCENTRATIONS OF GAMMA EMITTERS* IN GAME SAMPLES

Results in Units of pCi/kg (wet) ± 2 sigma

LOCATION CODE	COLLECTION DATE	SAMPLE TYPE	K-40	Cs 137
SN-GAX-13S3	04/11/89	RACCOON	2700 ± 270	34.[illegible] ± 5.1
SN-GAX-13S3	10/12/89	RACCOON	2020 ± 200	492 ± 49
Average ± 2 s.d.			2360 ± 962	263 ± 648

* All other gamma emitters not listed were <LLD: typical LLDs are found in Tables C-20 and C-21.

TABLE C-15

CONCENTRATIONS OF GAMMA EMITTERS* AND I-131 IN FOOD PRODUCT SAMPLES

Results in Units of pCi/kg (wet) ± 2 sigma

LOCATION CODE	SAMPLE TYPE	COLLECTION DATE	K-40	I-131**	Cs-137	Be-7
SN-FPF-5C2	Strawberries	06/15/89	1920 ± 190	< 10	< 10	< 80
SN-FPL-5C2	Spinach	08/16/89	6100 ± 610	< 7	< 20	266 ± 118
SN-FPL-5C2	Cabbage	08/16/89	2430 ± 240	< 1	< 9	< 80
SN-FPV-5C2	Potatoes	08/16/89	3860 ± 390	< 6	< 20	< 200
SN-FPV-5C2	Carrots	08/16/89	3650 ± 360	< 6	< 10	< 100
SN-FPV-7B3	Corn	08/23/89	3700 ± 600	< 10	< 50	< 400
SN-FPL-7B3	Lettuce	08/23/89	3380 ± 340	< 6	< 9	< 80
SN-FPL-7B3	Cabbage	08/23/89	2820 ± 280	< 7	< 10	< 100
SN-FPF-6B21	Strawberries	06/22/89	1490 ± 150	< 5	< 9	< 80
SN-FPV-6B21	Tomatoes	08/23/89	2090 ± 210	< 5	< 9	< 70
SN-FPV-6B21	Stringbeans	09/27/89	1960 ± 200	< 5	< 10	< 100
SN-FPF-8B1	Strawberries	06/22/89	1580 ± 160	< 5	< 7	< 60
SN-FPV-8B1	Potatoes	08/16/89	2800 ± 280	< 5	< 10	< 100
SN-FPV-8B1	Beets	08/16/89	3480 ± 350	< 7	< 20	< 200
SN-FPL-8B1	Lettuce	08/23/89	2290 ± 230	< 5	< 20	< 200
SN-FPL-8B1	Cabbage	09/27/89	1610 ± 160	< 4	< 10	< 90
SN-FPV-8B1	Tomatoes	09/27/89	2740 ± 270	< 4	< 10	< 80
SN-FPV-8B1	Corn	09/27/89	2920 ± 290	< 7	< 8	< 70
SN-FPV-12H1 (cl)	Beets	08/23/89	3580 ± 360	< 10	< 20	< 100
SN-FPL-12H1	Lettuce	08/23/89	3220 ± 320	< 6	< 8	< 90
SN-FPV-12H1	Carrots	08/23/89	4640 ± 460	< 6	< 10	< 100
SN-FPV-12H1	Potatoes	09/27/89	3380 ± 340	< 5	< 8	< 70
SN-FPV-12H1	Corn	09/27/89	2300 ± 230	< 4	< 7	< 70
SN-FPF-12H2 (cl)	Strawberries	06/15/89	1540 ± 150	< 10	< 6	< 50

* All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20and C-21.

** I-131 by Radiochemistry

(cl) Denotes Control Location

TABLE C-16

CONCENTRATIONS OF STRONTIUM 90 AND GAMMA EMITTERS* IN SOIL SAMPLES

Results in Units of pCi/kg (dry) ± 2 sigma

LOCATION CODE	COLLECTION DATE	Sr-90	K-40	Ra-226	Th-228	Cs-137
SN-SOL-1B1	11/13/89	< 0.9	2100 ± 210	< 300	256 ± 20	< 10
SN-SOL-2A2	11/13/89	< 1	1800 ± 180	604 ± 230	358 ± 36	< 20
SN-SOL-5D3	11/20/89	16 ± 2	4860 ± 490	1020 ± 410	947 ± 95	456 ± 46
SN-SOL-5F3 (cl)	11/20/89	< 5	7060 ± 710	1620 ± 410	1300 ± 130	169 ± 25
SN-SOL-7B1	11/13/89	< 2	3320 ± 340	633 ± 339	398 ± 40	37.7 ± 18.6
SN-SOL-8A3	11/13/89	35 ± 6	2130 ± 310	< 500	595 ± 59	532 ± 53
SN-SOL-9B1	11/20/89	< 2	3170 ± 320	< 300	370 ± 37	69.3 ± 19.8
SN-SOL-10A1	11/20/89	24 ± 3	3370 ± 340	< 300	375 ± 38	211 ± 21
SN-SOL-12A1	11/20/89	24 ± 3	6400 ± 640	1180 ± 330	736 ± 74	243 ± 24
SN-SOL-12D1	11/13/89	< 2	4280 ± 430	727 ± 317	710 ± 71	214 ± 26
Average ± 2 s.d.		**25 ± 16**	**3849 ± 3803**	**964 ± 788**	**605 ± 654**	**242 ± 345**

* All other gamma emitters not listed were <LLD; typical LLD's are given in Tables C-20 and C-21.

(cl) Denotes Control Location

TABLE C-17

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS

mR/standard month*

LOCATION CODES	FIRST QUARTER 01/05/89-04/06/89	SECOND QUARTER 04/06/89-07/06/89	THIRD QUARTER 07/06/89-10/06/89	FOURTH QUARTER 10/05/89-01/04/90	ANNUAL AVERAGE ± 2 s.d.
SN-IDM-1S1	3.1 ± 0.2	3.3 ± 0.4	3.2 ± 0.1	3.1 ± 6.1	3.2 ± 0.2
SN-IDM-3S1	3.1 ± 0.1	3.2 ± 0.5	3.2 ± 0.1	3.8 ± 0.2	3.3 ± 0.6
SN-IDM-4S1	3.4 ± 0.1	3.3 ± 0.2	3.6 ± 0.2	4.3 ± 0.4	3.7 ± 0.9
SN-IDM-5S2	3.3 ± 0.2	3.8 ± 0.1	3.8 ± 0.3	4.1 ± 0.4	3.8 ± 0.7
SN-IDM-6S2	3.2 ± 0.3	2.9 ± 0.2	3.6 ± 0.2	3.3 ± 0.6	3.3 ± 0.6
SN-IDM-9S1	3.4 ± 0.1	3.3 ± 0.2	3.5 ± 0.2	3.6 ± 0.2	3.5 ± 0.3
SN-IDM-9S2	3.3 ± 0.2	3.3 ± 0.3	3.5 ± 0.2	3.6 ± 0.1	3.4 ± 0.3
SN-IDM-13S3	3.4 ± 0.0	3.3 ± 0.2	3.6 ± 0.1	3.5 ± 0.1	3.5 ± 0.3
SN-IDM-14S2	3.1 ± 0.1	3.0 ± 0.2	3.1 ± 0.1	3.0 ± 0.1	3.1 ± 0.1
SN-IDM-15S1	2.9 ± 0.1	2.9 ± 0.1	3.0 ± 0.1	2.9 ± 0.1	2.9 ± 0.1
SN-IDM-16S2	3.3 ± 0.2	3.3 ± 0.2	3.4 ± 0.2	3.4 ± 0.1	3.4 ± 0.1
SN-IDM-2A2	3.2 ± 0.1	2.8 ± 0.3	3.2 ± 0.1	2.9 ± 0.1	3.0 ± 0.4
SN-IDM-2A3	3.0 ± 0.2	2.9 ± 0.2	3.2 ± 0.1	3.7 ± 0.3	3.2 ± 0.7
SN-IDM-6A1	4.4 ± 0.2	4.9 ± 0.1	4.8 ± 0.3	5.1 ± 0.5	4.8 ± 0.6
SN-IDM-7A2	3.1 ± 0.3	2.9 ± 0.0	3.4 ± 0.1	3.2 ± 0.1	3.2 ± 0.4
SN-IDM-8A3	3.3 ± 0.2	3.2 ± 0.2	3.5 ± 0.2	3.3 ± 0.1	3.3 ± 0.3
SN-IDM-10A1	3.6 ± 0.7	3.4 ± 0.2	3.3 ± 0.2	3.3 ± 0.1	3.4 ± 0.3
SN-IDM-11A1	3.3 ± 0.1	3.4 ± 0.1	3.4 ± 0.2	3.6 ± 0.2	3.4 ± 0.3
SN-IDM-12A1	3.7 ± 0.3	3.8 ± 0.3	3.9 ± 0.1	3.8 ± 0.1	3.8 ± 0.2
SN-IDM-4B1	(a)	3.6 ± 0.5	4.6 ± 0.2	3.7 ± 0.2	4.0 ± 1.1
SN-IDM-7B1	3.1 ± 0.2	3.7 ± 0.1	3.5 ± 0.1	3.4 ± 0.4	3.4 ± 0.5

* The standard month = 30.4 days.

(a) New Station added to program 04/89.

TABLE C-17 (Cont.)

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS

mR/standard month*

LOCATION CODES		FIRST QUARTER 01/05/89-04/05/89	SECOND QUARTER 04/05/89-07/08/89	THIRD QUARTER 07/08/89-10/05/89	FOURTH QUARTER 10/05/89-01/04/90	ANNUAL AVERAGE ± 2 s.d.
SN-IDM-7B4		(a)	3.9 ± 0.4	4.9 ± 0.3	3.9 ± 0.2	4.2 ± 1.2
SN-IDM-9B2		(a)	3.4 ± 0.1	4.7 ± 0.2	3.6 ± 0.1	3.9 ± 1.4
SN-IDM-12B2		(a)	3.3 ± 0.2	4.8 ± 0.3	3.7 ± 0.1	3.9 ± 1.6
SN-IDM-5D1		4.3 ± 0.2	3.8 ± 0.6	4.5 ± 0.2	5.2 ± 0.2	4.5 ± 1.2
SN-IDM-5D3		3.8 ± 0.1	4.4 ± 0.2	4.2 ± 0.1	4.7 ± 0.3	4.3 ± 0.8
SN-IDM-12D1		3.6 ± 0.2	4.0 ± 0.4	4.0 ± 0.1	4.0 ± 0.2	3.9 ± 0.4
SN-IDM-5E2		3.8 ± 0.1	3.6 ± 0.2	4.1 ± 0.2	3.8 ± 0.1	3.8 ± 0.4
SN-IDM-6E1		3.4 ± 0.3	4.0 ± 0.1	3.8 ± 0.2	3.3 ± 0.1	3.6 ± 0.7
SN-IDM-7E1		3.1 ± 0.1	3.8 ± 0.1	3.5 ± 0.1	3.2 ± 0.1	3.4 ± 0.6
SN-IDM-8E1		3.6 ± 0.3	3.5 ± 0.3	3.8 ± 0.2	3.6 ± 0.1	3.6 ± 0.3
SN-IDM-9E1		3.5 ± 0.3	3.5 ± 0.5	3.7 ± 0.2	3.7 ± 0.3	3.6 ± 0.2
SN-IDM-10E1		3.4 ± 0.1	3.8 ± 0.3	3.8 ± 0.1	3.7 ± 0.2	3.7 ± 0.4
SN-IDM-11E1		2.9 ± 0.1	3.0 ± 0.2	3.1 ± 0.1	3.2 ± 0.2	3.1 ± 0.3
SN-IDM-13E1		3.7 ± 0.1	3.6 ± 0.2	3.8 ± 0.1	3.7 ± 0.2	3.7 ± 0.2
SN-IDM-5F3	(cl)	4.3 ± 0.3	4.5 ± 0.2	4.8 ± 0.1	5.0 ± 0.2	4.7 ± 0.6
SN-IDM-6G1	(cl)	3.1 ± 0.2	3.6 ± 0.2	3.7 ± 0.2	3.5 ± 0.2	3.5 ± 0.5
SN-IDM-8G1	(cl)	3.4 ± 0.1	3.4 ± 0.2	3.6 ± 0.1	3.8 ± 0.2	3.6 ± 0.4
SN-IDM-11G1	(cl)	3.4 ± 0.1	3.3 ± 0.3	3.5 ± 0.1	3.4 ± 0.1	3.4 ± 0.2
SN-IDM-12G1	(cl)	3.2 ± 0.1	3.0 ± 0.1	3.4 ± 0.4	3.3 ± 0.1	3.2 ± 0.3
SN-IDM-12G2	(cl)	4.2 ± 0.1	4.0 ± 0.3	4.2 ± 0.2	4.5 ± 0.5	4.2 ± 0.4
Average ± 2 s.d.		**3.4 ± 0.8**	**3.5 ± 0.9**	**3.8 ± 1.0**	**3.7 ± 1.0**	**3.6 ± 0.4**

* The standard month = 30.4 days.
(a) New Station added to program 04/89.
(cl) Denotes Control Location.

TABLE C-18

DIRECT RADIATION MEASUREMENTS - MONTHLY TLD RESULTS

mR/standard month*

LOCATION CODES 1990	JANUARY 01/05-02/02	FEBRUARY 02/02-03/02	MARCH 03/02-04/03	APRIL 04/03-05/04	MAY 05/04/06/03	JUNE 06/03-07/05
SN-IDM-1S1	3.2 ± 0.3	2.9 ± 0.5	3.2 ± 0.2	3.0 ± 0.2	3.2 ± 0.5	3.2 ± 0.2
SN-IDM-3S1	2.9 ± 0.2	2.8 ± 0.2	2.9 ± 0.3	2.9 ± 0.2	3.1 ± 0.4	3.2 ± 0.5
SN-IDM-4S1	3.3 ± 0.0	3.3 ± 0.4	3.3 ± 0.1	3.4 ± 0.5	3.4 ± 0.3	3.6 ± 0.3
SN-IDM-5S2	3.4 ± 0.2	3.1 ± 0.3	3.3 ± 0.1	3.3 ± 0.3	3.5 ± 0.2	4.2 ± 0.5
SN-IDM-6S2	3.0 ± 0.2	3.0 ± 0.2	3.2 ± 0.2	3.3 ± 0.3	3.2 ± 0.4	3.6 ± 0.5
SN-IDM-9S1	3.5 ± 0.5	3.5 ± 0.5	3.4 ± 0.3	3.7 ± 0.5	3.4 ± 0.1	3.6 ± 0.6
SN-IDM-9S2	3.5 ± 0.2	3.7 ± 0.6	3.7 ± 0.3	3.3 ± 0.4	3.4 ± 0.3	3.6 ± 0.3
SN-IDM-13S3	3.3 ± 0.2	3.3 ± 0.4	3.7 ± 0.4	3.3 ± 0.2	4.3 ± 1.4	3.4 ± 0.2
SN-IDM-14S2	3.0 ± 0.2	2.8 ± 0.3	3.2 ± 0.3	2.9 ± 0.3	3.5 ± 1.0	3.1 ± 0.3
SN-IDM-15S1	3.2 ± 0.3	3.2 ± 0.3	3.3 ± 0.4	2.8 ± 0.1	3.8 ± 1.1	3.0 ± 0.3
SN-IDM-16S2	3.4 ± 0.2	3.1 ± 0.3	3.4 ± 0.3	3.2 ± 0.2	3.9 ± 0.6	3.5 ± 0.4
SN-IDM-2A2	3.0 ± 0.3	2.7 ± 0.3	3.0 ± 0.2	2.9 ± 0.1	3.4 ± 1.0	3.1 ± 0.2
SN-IDM-2A3	3.3 ± 0.5	2.8 ± 0.3	3.1 ± 0.3	2.9 ± 0.3	3.2 ± 0.4	3.4 ± 0.5
SN-IDM-6A1	4.7 ± 0.0	4.1 ± 0.6	4.6 ± 0.2	4.7 ± 1.0	5.0 ± 0.6	4.7 ± 0.2
SN-IDM-7A2	3.1 ± 0.1	2.8 ± 0.1	3.1 ± 0.2	3.2 ± 0.1	3.3 ± 0.4	3.7 ± 0.6
SN-IDM-8A3	3.3 ± 0.4	2.9 ± 0.2	3.3 ± 0.2	3.3 ± 0.2	3.3 ± 0.5	3.5 ± 0.4
SN-IDM-10A1	3.4 ± 0.1	3.8 ± 0.2	4.2 ± 0.6	3.6 ± 0.5	3.5 ± 0.2	3.8 ± 0.8
SN-IDM-11A1	3.5 ± 0.6	3.3 ± 0.4	3.6 ± 0.0	4.2 ± 0.6	3.7 ± 0.1	3.5 ± 0.3
SN-IDM-12A1	3.8 ± 0.5	3.6 ± 0.2	3.9 ± 0.3	3.9 ± 0.3	4.2 ± 0.4	4.2 ± 0.7
SN-IDM-4B1	(a)	(a)	3.8 ± 0.1	3.3 ± 0.2	4.0 ± 0.7	3.9 ± 0.2
SN-IDM-7B1	3.3 ± 0.1	3.0 ± 0.2	3.0 ± 0.2	3.1 ± 0.1	3.3 ± 0.4	3.1 ± 0.2
SN-IDM-7B4	(a)	(a)	4.2 ± 0.3	3.8 ± 0.6	4.0 ± 0.5	3.8 ± 0.3
SN-IDM-9B2	(a)	(a)	3.8 ± 0.6	3.3 ± 0.2	3.7 ± 0.2	3.6 ± 0.3
SN-IDM-12B2	(a)	(a)	3.7 ± 0.1	3.5 ± 0.2	3.7 ± 0.2	3.6 ± 0.3
SN-IDM-5D1	4.1 ± 0.8	3.9 ± 0.8	4.4 ± 0.1	4.4 ± 0.6	4.2 ± 0.2	4.6 ± 0.2
SN-IDM-5D3	3.8 ± 0.7	3.6 ± 0.1	3.7 ± 0.2	3.7 ± 0.2	3.7 ± 0.4	3.8 ± 0.1
SN-IDM-12D1	4.2 ± 0.4	3.5 ± 0.3	3.9 ± 0.2	3.8 ± 0.4	4.5 ± 0.4	4.2 ± 0.6
SN-IDM-5E2	3.7 ± 0.2	3.6 ± 0.2	3.8 ± 0.2	3.7 ± 0.5	4.2 ± 0.8	4.2 ± 0.2
SN-IDM-6E1	3.7 ± 0.4	3.0 ± 0.4	3.3 ± 0.4	3.7 ± 1.2	3.5 ± 0.2	3.7 ± 0.2
SN-IDM-7E1	3.2 ± 0.5	3.0 ± 0.2	3.2 ± 0.1	3.4 ± 0.3	3.3 ± 0.3	3.5 ± 0.4
SN-IDM-8E1	3.4 ± 0.6	3.2 ± 0.0	3.5 ± 0.1	3.6 ± 0.2	3.7 ± 0.4	3.9 ± 0.4
SN-IDM-9E1	3.5 ± 0.5	3.7 ± 0.3	4.0 ± 0.2	3.9 ± 0.1	3.8 ± 0.2	3.7 ± 0.4
SN-IDM-10E1	3.6 ± 0.1	3.5 ± 0.4	3.8 ± 0.2	3.8 ± 0.7	3.7 ± 9.5	4.1 ± 0.7
SN-IDM-11E1	3.2 ± 0.3	2.8 ± 0.4	3.7 ± 0.4	3.4 ± 0.3	3.3 ± 0.5	3.5 ± 0.2
SN-IDM-13E1	3.5 ± 0.3	3.8 ± 0.8	3.9 ± 0.3	3.3 ± 0.5	4.5 ± 1.4	3.7 ± 0.2
SN-IDM-5F3 (cl)	3.7 ± 0.1	4.1 ± 0.4	4.1 ± 0.3	4.1 ± 0.2	4.2 ± 0.5	4.8 ± 1.1
SN-IDM-6G1 (cl)	3.2 ± 0.2	3.0 ± 0.2	3.1 ± 0.3	3.2 ± 0.5	3.3 ± 0.4	3.3 ± 0.6
SN-IDM-8G1 (cl)	3.6 ± 0.4	3.3 ± 0.3	3.4 ± 0.3	3.7 ± 0.7	3.6 ± 0.3	3.6 ± 0.2
SN-IDM-11G1 (cl)	3.6 ± 0.6	3.8 ± 0.7	3.5 ± 0.3	3.2 ± 0.4	3.5 ± 0.3	2.5 ± 0.3
SN-IDM-12G1 (cl)	3.3 ± 0.3	3.1 ± 0.1	3.5 ± 0.4	3.2 ± 0.3	3.7 ± 0.3	3.4 ± 0.3
SN-IDM-12G2 (cl)	4.6 ± 0.1	4.2 ± 0.2	4.4 ± 0.2	3.9 ± 0.8	4.7 ± 0.5	4.4 ± 0.5
Average ± 2 s.d.	**3.5 ± 0.8**	**3.3 ± 0.8**	**3.6 ± 0.8**	**3.5 ± 0.8**	**3.7 ± 0.9**	**3.7 ± 0.9**

* The standard month = 30.4 days.
(cl) Denotes Control Location
(a) New station added March 1989.

TABLE C-18 (Cont.)

DIRECT RADIATION MEASUREMENTS - MONTHLY TLD RESULTS

mR/standard month*

LOCATION CODES 1989	JULY 07/05-08/04	AUGUST 08/04-09/07	SEPTEMBER 09/07-10/05	OCTOBER 10/05-11/09	NOVEMBER 11/09/12/08	DECEMBER 12/08-01/04	ANNUAL AVERAGE ± 2 s.d.
SN-IDM-1S1	3.8 ± 0.5	2.8 ± 0.1	3.6 ± 0.5	3.4 ± 0.3	2.9 ± 0.2	3.9 ± 0.9	3.3 ± 9.7
SN-IDM-3S1	3.2 ± 0.5	2.6 ± 0.4	3.7 ± 1.0	3.4 ± 0.3	3.1 ± 0.1	3.1 ± 0.1	3.1 ± 0.6
SN-IDM-4S1	3.9 ± 0.3	3.3 ± 0.2	4.1 ± 0.8	4.0 ± 0.2	3.4 ± 0.4	3.3 ± 0.2	3.5 ± 0.6
SN-IDM-5S2	3.7 ± 0.5	2.8 ± 0.3	3.9 ± 0.6	3.8 ± 0.3	3.4 ± 0.3	3.2 ± 0.2	3.5 ± 0.8
SN-IDM-6S2	3.5 ± 0.4	3.2 ± 0.4	3.9 ± 1.1	3.7 ± 0.4	3.3 ± 0.1	3.1 ± 0.3	3.3 ± 0.6
SN-IDM-9S1	3.7 ± 0.6	3.3 ± 0.3	4.5 ± 1.1	3.6 ± 0.5	3.3 ± 0.2	3.2 ± 0.3	3.6 ± 0.7
SN-IDM-9S2	3.8 ± 0.2	3.5 ± 0.4	4.1 ± 0.3	3.5 ± 0.2	3.4 ± 0.1	3.5 ± 0.6	3.6 ± 0.4
SN-IDM-13S3	3.9 ± 0.7	3.1 ± 0.2	6.0 ± 1.1	3.7 ± 0.2	3.8 ± 0.4	3.8 ± 0.3	3.8 ± 1.5
SN-IDM-14S2	3.4 ± 0.2	2.9 ± 0.2	4.0 ± 0.5	2.9 ± 0.3	3.1 ± 0.3	3.3 ± 0.3	3.2 ± 0.7
SN-IDM-15S1	3.4 ± 0.3	2.8 ± 0.4	4.1 ± 0.8	3.1 ± 0.1	3.0 ± 0.1	3.3 ± 0.7	3.3 ± 0.8
SN-IDM-16S2	3.8 ± 0.7	3.3 ± 0.4	3.7 ± 0.1	3.5 ± 0.2	3.6 ± 0.3	3.8 ± 0.5	3.5 ± 0.5
SN-IDM-2A2	3.4 ± 0.3	2.8 ± 0.2	3.7 ± 0.4	3.1 ± 0.3	3.1 ± 0.2	3.0 ± 0.1	3.1 ± 0.6
SN-IDM-2A3	3.4 ± 0.2	2.7 ± 0.4	3.6 ± 1.1	3.5 ± 0.1	3.1 ± 0.2	3.2 ± 0.2	3.2 ± 0.6
SN-IDM-6A1	5.5 ± 0.6	4.3 ± 0.3	5.6 ± 0.3	5.2 ± 0.4	4.5 ± 0.4	4.3 ± 0.2	4.8 ± 0.9
SN-IDM-7A2	3.6 ± 0.3	3.0 ± 0.4	4.1 ± 0.9	4.3 ± 0.2	3.2 ± 0.1	3.2 ± 0.2	3.4 ± 0.9
SN-IDM-8A3	3.3 ± 0.3	3.0 ± 0.3	3.7 ± 0.5	3.9 ± 0.4	3.3 ± 0.4	3.2 ± 0.1	3.3 ± 0.5
SN-IDM-10A1	3.5 ± 0.1	3.3 ± 0.2	4.1 ± 0.6	3.7 ± 0.2	3.6 ± 0.2	3.2 ± 0.2	3.6 ± 0.6
SN-IDM-11A1	3.6 ± 0.2	3.4 ± 0.2	4.1 ± 0.4	3.6 ± 0.5	3.5 ± 0.5	3.3 ± 0.3	3.6 ± 0.6
SN-IDM-12A1	4.3 ± 0.2	3.5 ± 0.1	6.0 ± 0.6	3.8 ± 0.1	3.8 ± 0.4	3.4 ± 0.2	4.0 ± 14
SN-IDM-4B1	4.2 ± 0.5	3.6 ± 0.3	4.4 ± 0.7	3.7 ± 0.2	3.5 ± 0.2	3.5 ± 0.4	3.8 ± 0.7
SN-IDM-7B1	3.8 ± 0.4	3.1 ± 0.1	3.7 ± 0.2	3.5 ± 0.8	3.1 ± 0.2	3.4 ± 0.3	3.3 ± 0.5
SN-IDM-7B4	4.4 ± 0.6	4.2 ± 0.5	4.5 ± 0.1	3.9 ± 0.3	3.6 ± 0.5	4.0 ± 0.3	3.8 ± 0.7
SN-IDM-9B2	3.6 ± 0.3	3.6 ± 0.4	4.4 ± 0.5	3.5 ± 0.1	3.4 ± 0.2	3.6 ± 0.3	3.7 ± 0.8
SN-IDM-12B2	3.8 ± 0.1	3.5 ± 0.3	4.2 ± 0.4	3.7 ± 0.5	3.8 ± 0.2	3.4 ± 0.1	3.7 ± 0.5
SN-IDM-5D1	4.8 ± 0.4	4.4 ± 0.7	4.7 ± 0.5	4.3 ± 0.6	4.1 ± 0.1	4.5 ± 0.4	4.4 ± 0.5
SN-IDM-5D3	3.7 ± 0.1	3.4 ± 0.5	4.4 ± 0.1	4.0 ± 0.2	3.8 ± 0.6	3.6 ± 0.4	3.8 ± 0.5
SN-IDM-12D1	4.5 ± 0.6	3.8 ± 0.6	5.1 ± 0.4	3.8 ± 0.2	4.0 ± 0.5	3.6 ± 0.2	4.1 ± 0.9
SN-IDM-5E2	4.1 ± 0.3	3.4 ± 0.4	4.9 ± 1.1	4.0 ± 0.4	4.1 ± 0.3	3.8 ± 0.4	4.0 ± 0.8
SN-IDM-6E1	4.1 ± 0.3	3.6 ± 0.8	4.0 ± 0.5	3.9 ± 0.4	3.4 ± 0.2	3.3 ± 0.2	3.6 ± 0.6
SN-IDM-7E1	3.4 ± 0.6	3.1 ± 0.6	3.8 ± 0.4	4.1 ± 0.4	3.3 ± 0.4	3.1 ± 0.2	3.4 ± 0.6
SN-IDM-8E1	3.8 ± 0.5	3.7 ± 0.8	4.3 ± 0.3	3.9 ± 0.8	3.4 ± 0.2	4.3 ± 0.8	3.7 ± 0.7
SN-IDM-9E1	3.8 ± 0.4	3.4 ± 0.3	4.5 ± 0.9	3.6 ± 0.2	3.7 ± 0.4	3.5 ± 0.5	3.8 ± 0.6
SN-IDM-10E1	3.9 ± 0.3	3.4 ± 0.4	3.9 ± 0.5	4.0 ± 0.2	3.5 ± 0.3	3.3 ± 0.3	3.7 ± 0.5
SN-IDM-11E1	3.2 ± 0.3	2.9 ± 0.4	4.1 ± 0.4	3.5 ± 0.3	3.3 ± 0.3	2.7 ± 0.3	3.3 ± 0.8
SN-IDM-13E1	4.0 ± 0.4	3.3 ± 0.1	4.8 ± 0.8	3.7 ± 0.1	4.2 ± 0.6	3.8 ± 0.3	3.9 ± 0.9
SN-IDM-5F3 (cl)	4.5 ± 0.6	3.9 ± 0.5	4.8 ± 0.2	4.4 ± 0.6	4.1 ± 0.2	4.0 ± 0.2	4.2 ± 0.9
SN-IDM-6G1 (cl)	3.6 ± 0.4	3.2 ± 0.5	3.9 ± 0.6	4.0 ± 0.9	3.2 ± 0.5	3.5 ± 0.2	3.4 ± 0.6
SN-IDM-8G1 (cl)	3.8 ± 0.5	3.3 ± 0.4	4.1 ± 1.0	3.7 ± 0.3	3.4 ± 0.3	3.6 ± 0.3	3.6 ± 0.5
SN-IDM-11G1 (cl)	3.6 ± 0.2	3.0 ± 0.2	4.2 ± 0.5	3.2 ± 0.3	3.9 ± 0.4	3.2 ± 0.1	3.5 ± 0.7
SN-IDM-12G1 (cl)	3.5 ± 0.4	2.9 ± 0.2	3.8 ± 0.1	3.7 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	3.4 ± 0.5
SN-IDM-12G2 (cl)	4.8 ± 0.4	4.0 ± 0.3	4.9 ± 0.7	4.5 ± 0.3	5.0 ± 0.4	4.1 ± 0.2	4.5 ± 0.7
Average ± 2 s.d.	**3.8 ± 1.0**	**3.3 ± 0.9**	**4.3 ± 1.2**	**3.8 ± 0.8**	**3.5 ± 0.8**	**3.5 ± 0.8**	**3.6 ± 0.5**

* The standard month = 30.4 days.

(cl) Denotes Control Location

TABLE C-19

NOBLE GAS

CONCENTRATIONS OF KRYPTON-85 AND XENON-133 IN AIR SAMPLES

Results in units of (pCi/m³)

LOCATION CODE - **1482**

COLLECTION DATES	Kr-85	Xe-133	COLLECTION DATES	Kr-85	Xe-133
12/27/88-01/03/89	32 ± 7	< 100	06/27/89-07/03/89	39 ± 9	< 100
01/03/89-01/10/89	30 ± 7	< 100	07/03/89-07/11/89	33 ± 6	< 100
01/10/89-01/17/89	30 ± 7	< 100	07/11/89-07/18/89	34 ± 8	< 100
01/17/89-01/24/89	33 ± 7	< 100	07/18/89-07/25/89	39 ± 7	< 130
01/24/89-01/31/89	31 ± 7	< 100	07/25/89-08/01/89	34 ± 10	< 200
01/31/89-02/07/89	34 ± 7	< 100	08/01/89-08/08/89	37 ± 7	< 100
02/07/89-02/14/89	37 ± 7	< 100	08/08/89-08/15/89	35 ± 7	< 100
02/14/89-02/21/89	44 ± 7	< 180	08/15/89-08/22/89	36 ± 8	< 160
02/21/89-02/28/89	39 ± 7	< 100	08/22/89-08/29/89	31 ± 7	< 80
02/28/89-03/07/89	35 ± 15	< 104	08/29/89-09/05/89	40 ± 8	< 70
03/07/89-03/14/78	35 ± 6	< 110	09/05/89-09/12/89	36 ± 7	< 77
03/14/89-03/21/89	35 ± 7	< 110	09/12/89-09/19/89	40 ± 7	< 80
03/21/89-03/28/89	32 ± 6	< 110	09/19/89-09/26/89	36 ± 8	< 110
03/28/89-04/04/89	34 ± 6	< 110	09/26/89-10/03/89	31 ± 7	< 90
04/04/89-04/11/89	41 ± 7	< 106	10/03/89-10/10/89	33 ± 7	< 150
04/11/89-04/18/89	30 ± 8	< 93	10/10/89-10/17/89	38 ± 11	< 87
04/18/89-04/25/89	33 ± 6	< 103	10/17/89-10/24/89	34 ± 7	< 78
04/25/89-05/02/89	26 ± 7	< 70	10/24/89-10/31/89	34 ± 10	< 70
05/02/89-05/09/89	46 ± 8	< 60	10/31/89-11/07/89	38 ± 9	< 75
05/09/89-05/16/89	34 ± 11	(a)	11/07/89-11/14/89	37 ± 7	< 93
05/16/89-05/23/89	36 ± 8	< 70	11/14/89-11/21/89	33 ± 10	< 130
05/23/89-05/30/89	34 ± 6	< 75	11/21/89-11/28/89	31 ± 10	< 110
05/30/89-06/06/89	44 ± 5	< 90	11/28/89-12/05/89	35 ± 8	< 83
06/06/89-06/13/89	41 ± 8	< 130	12/05/89-12/12/89	34 ± 8	< 110
06/13/89-06/20/89	43 ± 11	< 60	12/12/89-12/19/89	30 ± 8	< 91
06/20/89-06/27/89	32 ± 8	< 170	12/19/89-12/26/89	35 ± 7	< 70
			12/26/89-01/02/90	31 ± 10	< 74
Average ± 2 s.d.				**36 ± 8**	

(a) Sample inadvertently not analyzed.

TABLE C-20

TYPICAL LLDs ACHIEVED FOR GAMMA SPECTROMETRY

NUCLIDES	MILK AND WATER (pCi/l)	FISH, GAME AND AQUATIC INVERTEBRATES (pCi/kg wet)	AQUATIC PLANTS (pCi/kg dry)	SOIL AND AQUATIC SEDIMENT (pCi/kg dry)	AIR PARTICULATES (10^{-3} pCi/m^3)
Be-7	60	80	80	200	20
Na-22	7	8	10	30	2
K-40	100	300	300	900	20
Cr-51	50	100	70	200	10
Mn-54	5	7	9	30	2
Co-58	5	8	8	20	2
Fe-59	15	20	15	50	2
Co-60	5	8	9	20	2
Zn-65	10	20	20	60	2
Zr-95	30	10	10	40	2
Nb-95	15	(a)	(a)	(a)	(a)
Mo-99	10	10	10	20	5
Ru-103	7	10	10	30	2
Ru-106	50	60	80	200	10
Ag-110m	7	10	10	40	2
Sb-125	15	20	25	80	4
Te-129m	6	10	10	30	2
I-131	10	10	10	30	10
Te-132	10	6	6	25	2
I-133	10	10	10	40	15
Cs-134	6	7	10	30	2
Cs-136	10	10	10	30	2
Cs-137	6	7	10	30	2
Ba-140	60	10	10	5	5
La-140	15	(a)	(a)	(a)	(a)
Ce-141	10	10	15	30	3
Ce-144	30	40	60	150	7
Ra-226	90	100	150	400	20
Th-228	10	10	25	60	3

(a) No Tech. Spec. Requirements

TABLE C-21

LLD's AND REPORTING ACTION LEVELS - 1989
REQUIRED BY TECH. SPECS. AND CONTRACT

SAMPLE TYPE			Units	Sr-90	Zr-95	Nb-95	I-131	Xe-133	Cs-134	Cs-137	Ba-140	La-140
WATER												
Potable	LLD*	Tech S.	pCi/l	-	30	15	1.0	-	15	18	60	15
Surface	LLD	Contract		2	30	15	0.5	-	15	18	60	15
Precip.	RAL**	Tech S.		-	400	400	2	-	30	50	200	200
	RAL	Contract		20	400	400	2	-	30	50	200	200
AIR												
Air Sample	LLD	Tech S.	pCi/m^3	-	-	-	.07	-	.05	.06	-	-
	LLD	Contract		.0001	-	-	.07	-	.05	.06	-	-
	RAL	Tech S.		-	-	-	0.9	-	10	20	-	-
	RAL	Contract		0.1	-	-	0.9	-	10	20	-	-
MILK												
Milk	LLD	Tech S.	pCi/l	-	-	-	1.0	-	15	18	60	15
	LLD	Contract		1	-	-	0.5	-	15	18	60	15
	RAL	Tech S.		-	-	-	3	-	60	70	300	300
	RAL	Contract		8	-	-	3	-	60	70	300	300
Aquatic (1)												
Fish												
Invertebrate	LLD	Tech S.	pCi/kg	-	-	-	-	-	130	150	-	-
Aquatic Plants/	Contract			5	-	-	-	-	130	150	-	-
Game	RAL	Contract		20	-	-	-	-	1,000	2,000	-	-
FOOD												
Food	LLD	Tech S.	pCi/kg	-	-	-	60	-	60	80	-	-
Products	LLD	Contract	(wet)	-	-	-	60	-	60	80	-	-
	RAL	Tech S.		-	-	-	100	-	1,000	2,000	-	-
	RAL	Contract		-	-	-	100	-	1,000	2,000	-	-
SEDIMENTS/SOILS												
Sediments	LLD	Tech S.	pCi/kg	-	-	-	-	-	150	180	-	-
Soils	LLD	Contract	(dry)	5	-	-	-	-	150	180	-	-
	RAL	Tech S.		-	-	-	-	-	-	-	-	-
	RAL	Contract		80	-	-	-	-	1,000	2,000	-	-
NOBLE GAS	LLD	Tech S.	pCi/m^3	-	-	-	-	-	-	-	-	-
	LLD	Contract		-	-	-	-	130	-	-	-	-
	RAL	Tech S.		-	-	-	-	100	-	-	-	-
	RAL	Contract		-	-	-	-	-	-	-	-	-

* Lower limit of detection

** Reporting action level

(1) There are no Technical Specification requirements for game or aquatic plants. Aquatic contract LLD's and RAL's for gamma spectrometry apply to game and aquatic plants. Sr-89/90 LLD's and RAL's for aquatic plants are 30 pCi/kg (dry) and 45 pCi/kg (dry), respectively.

TABLE C-21 (Cont.)

LLD's AND REPORTING ACTION LEVELS - 1989
REQUIRED BY TECH. SPECS. AND CONTRACT

SAMPLE TYPE	Requirements		Units	Gross Beta	H-3	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Kr-85	Sr-90
ATMOSPHERIC/AIRBORNE												
Air Sample	LLD*	Tech S.	pCi/m^3	0.01	-	-	-	-	-	-	-	-
	LLD	Contract		0.01	-	-	-	-	-	-		-
	RAL**	Tech S.		-	-	-	-	-	-	-	-	.0001
	RAL	Contract		1	-	-	-	-	-	-	-	0.1
AQUATIC												
Fish	LLD	Tech S.	pCi/kg	-	-	130	130	260	130	260	-	-
Invertebrate/	LLD	Contract	(wet)	-	-	130	130	260	130	260		5
Algae	RAL	Tech S.		-	-	30,000	30,000	10,000	10,000	20,000		-
	RAL	Contract		-	-	30,000	30,000	10,000	10,000	20,000	-	20
WATERBORNE												
Potable	LLD	Tech S.	pCi/l	4	3,000	15	15	30	15	30	-	-
Surface	LLD	Contract		4	200	15	15	30	15	30	-	10
Precip.	RAL	Tech S.		-	30,000	1,000	1000	400	300	300	-	-
	RAL	Contract		50	30,000	1,000	1,000	400	300	300	-	20
TERRESTRIAL												
Food	LLD	Tech S.	pCi/kg	-	-	-	-	-	-	-	-	-
Products	LLD	Contract	(wet)	-	-	-	-	-	-	-	-	-
	RAL	Tech S.		-	-	-	-	-	-	-	-	-
	RAL	Contract		-	-	-	-	-	-	-	-	-
MILK												
Milk	LLD	Tech S.	pCi/l	-	-	-	-	-	-	-	-	-
	LLD	Contract		-	-	-	-	-	-	-	-	5
	RAL	Tech S.		-	-	-	-	-	-	-	-	-
	RAL	Contract		-	-	-	-	-	-	-	-	20
SEDIMENT/SOILS												
Sediments	LLD	Tech S.	pCi/kg	-	-	-	-	-	-	-	-	-
Soils	LLD	Contract	(dry)	-	-	-	-	-	-	-	-	5
	RAL	Tech S.		-	-	-	-	-	-	-	-	-
	RAL	Contract		-	-	-	-	-	-	-	-	80
NOBLE GAS	LLD	Tech S.	pCi/m^3	-	-	-	-	-	-	-	-	-
	LLD	Contract		-	-	-	-	-	-	-	25	-
	RAL	Tech S.		-	-	-	-	-	-	-	-	-
	RAL	Contract		-	-	-	-	-	-	-	-	-
DIRECT	LLD	Tech S.		-	-	-	-	-	-	-	-	-
RADIATION	LLD	Contract	1.5 mR/std. month	-	-	-	-	-	-	-	-	-
TLD												

* Lower limit of detection

** Reporting action level

APPENDIX D

ANALYTICAL PROCEDURES SYNOPSIS

ANALYTICAL PROCEDURES SYNOPSIS

Appendix D is a synopsis of the analytical procedures performed on samples collected for the Shoreham Nuclear Power Station's Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by Long Island Lighting Company and Teledyne Isotopes and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979.

DETERMINATION OF GROSS BETA ACTIVITY IN WATER SAMPLES

1.0 INTRODUCTION

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. A smaller volume may be used if the sample has a significant salt content as measured by a conductivity meter. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size.

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchet which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps.

Residue mass is determined by weighing the planchet before and after mounting the sample. The planchet is counted for beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves which allow for the change in effective counting efficiency caused by the residue mass.

2.0 DETECTION CAPABILITY

Detection capability depends upon the sample volume actually represented on the planchet, the background and the efficiency of the counting instrument, and upon self-absorption of beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picocuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/l at the 2.83 sigma level), assuming that 1 liter of sample is used and that $\frac{1}{2}$ gram of sample residue is mounted on the planchet. These figures are based upon a counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 and 1.2 cpm, respectively.

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 picocuries per liter. These values reflect a beta counting efficiency of 0.38.

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

After a delay of five or more days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter. An unused air particulate filter, supplied by LILCO, is counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD):

RESULT (pCi/m^3) = $((S/T) - (B/t))/(2.22\ V\ E)$

TWO SIGMA ERROR (pCi/m^3) = $2((S/T^2) + (B/t^2))^{1/2}/(2.22\ V\ E)$

LLD (pCi/m^3) = $4.66\ (B^{1/2})/(2.22\ V\ E\ t)$

where:

- S = Gross counts of sample including blank
- B = Counts of blank
- E = Counting efficiency
- T = Number of minutes sample was counted
- t = Number of minutes blank was counted
- V = Sample aliquot size (cubic meters)

ANALYSIS OF SAMPLES FOR TRITIUM

Water

Approximately 2 ml of water are converted to hydrogen by passing the water, heated to its vapor state, over a granular zinc conversion column heated to 400° C. The hydrogen is loaded into a one liter proportional detector and the volume is determined by recording the pressure.

The proportional detector is passively shielded by lead and steel and an electronic, anticoincidence system provides additional shielding from cosmic rays.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/l:

RESULT = $3.234\ T_N\ V_N(C_G - B)/(C_N\ V_S)$

TWO SIGMA ERROR = $2((C_G + B)\Delta t)^{1/2} 3.234\ T_N\ V_N/((C_N\ V_S)\ (C_G - B))$

LLD = $4.66\ (3.234) T_N\ V_N (C_G)^{1/2}/(\Delta t\ C_N\ V_S)$

where:

	T_N	=	tritium units of the standard
	3.234	=	conversion factor changing tritium units to pCi/l
	V_N	=	volume of the standard used to calibrate the efficiency of the detector in psia
	V_S	=	volume of the sample loaded into the detector in psia
	C_N	=	the cpm activity of the standard of volume V_N
	CG	=	the gross activity in cpm of the sample of volume V_S and the detector volume
	B	=	the background of the detector in cpm
	Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Water

Stable strontium carrier is added to 1 liter of sample and the volume is reduced by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using nitric acid. A barium scavenge and an iron (ferric hydroxide) scavenge are performed followed by addition of stable yttrium carrier and a minimum of 5 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolved and precipitated as $SrNO_3$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Soil and Sediment

The sample is first dried under heat lamps and an aliquot is taken. Stable strontium carrier is added and the sample is leached in hydrachloric acid. The mixture is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Organic Solids

A wet portion of the sample is dried and then ashed in a muffle furnace. Stable strontium carrier is added and the ash is leached in hydrochloric acid. The sample is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)$ using fuming (90%) nitric acid. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a minimum of 5 days period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Air Particulates

Stable strontium carrier is added to the sample and it is leached in nitric acid to bring deposits into solution. The mixture is then filtered and

the filtrate is reduced in volume by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium scavenge is used to remove some interfering species. An iron (ferric hydroxide) scavenge is performed, followed addition of stable yttrium carrier and a 7 to 10 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with 80 mg/cm^2 aluminum absorber for level beta counting.

Calculations of the results, two sigma errors and lower limits of detection (LLD) are expressed in activity of pCi/volume or pCi/mass:

RESULT Sr-89 = $(N/\Delta t - B_C - B_A)/(2.22\ V\ Y_S\ DF_{SR\text{-}89}\ E_{SR\text{-}89})$

TWO SIGMA ERROR Sr-89 = $2((N/\Delta t + B_C + B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S\ DF_{SR\text{-}89}\ E_{SR\text{-}89}$

LLD Sr-89 = $4.66((B_C + B_A)/\Delta t)^{1/2}/(2.22\ V\ YS\ DF_{SR\text{-}89}\ E_{SR\text{-}89})$

RESULT Sr-90 = $(N/\Delta t - B)/(2.22\ V\ Y_1\ Y_2\ DF\ IF\ E)$

TWO SIGMA ERROR Sr-90 = $2((N/\Delta t + B)/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ DF\ E\ IF))$

LLD Sr-90 = $4.66(B/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

where: N	=	total counts from sample (counts)
Δt	=	counting time for sample (min)
B_C	=	background rate of counter (cpm) using absorber configuration
2.22	=	dpm/pCi
V	=	volume or weight of sample analyzed
B_A	=	background addition from Sr-90 and ingrowth of Y-90
B_A	=	$0.016\ (K) + (K)\ E_{Y/abs})\ (IG_{Y-90})$
Y_S	=	chemical yield of strontium
DF_{SR-89}	=	decay factor from the mid collection date to the counting date for SR-89
E_{SR-89}	=	efficiency of the counter for SR-89 with the 80 mg/cm.sq. aluminum absorber
K	=	$(N\Delta t - B_C)_{Y-90}/(E_{Y-90}\ IF_{Y-90}\ DF_{Y-90} Y_1)$
$DF_{Y-90})$	=	the decay factor for Y-90 from the "milk" time to the mid count time
E_{Y-90}	=	efficiency of the counter for Y-90
IF_{Y-90}	=	ingrowth factor for Y-90 from scavenge time to milking time
IG_{Y-90}	=	the ingrowth factor for Y-90 into the strontium mount from the "milk" time to the mid count time
0.016	=	the effieiency of measuring SR-90 through a No. 6 absorber
$E_{Y/abs}$	=	the efficiencv of counting Y-90 through a No. 6 absorber
B	=	background rate of counter (cpm)
Y_1	=	chemical yield of yttrium
Y_2	=	chemical yield of strontium
DF	=	decay factor of yttrium from the radiochemical milking time to the mid count time
E	=	efficiency of the counter for Y-90
IF	=	ingrowth factor for Y-90 from scavenge time to the radio-chemical milking time

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water

Two liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodine from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, reduced with hydroxylamine hydrochloride and extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchet for low level beta counting. The chemical yield is corrected by measuring the stable iodide content of the milk or the water with a specific ion electrode.

Calculations of results, two sigma error and the lower limit of detection (LLD) in pCi/l:

RESULT = $(N/\Delta t-B)/(2.22\ E\ V\ Y\ DF)$

TWO SIGMA ERROR = $2((N/\Delta t+B)/\Delta t)^{1/2}(2.22\ E\ V\ Y\ DF)$

LLD = $= 4.66(B/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$

where:

N	=	total counts from sample (counts)
Δt	=	counting time for sample (min)
B	=	background rate of counter (cpm)
2.22	=	dpm/pCi
V	=	volume or weight of sample analyzed
Y	=	chemical yield of the mount or sample counted
DF	=	decay factor from the collection to the counting date
E	=	efficiency of the counter for I-131, corrected for self absorption effects by the formula
E	=	$E_s(\exp-0.0061M)/(\exp-0.0061M_s)$
E_s	=	efficiency of the counter determined from an I-131 standard mount
Ms	=	mass of PdI_2 on the standard mount, mg
M	=	mass of PdI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

A 1.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Dried Solids Other Than Soils and Sediments

A large quantity of the sample is dried at a low temperature, less than 100°C. As much as possible (up to the total sample) is loaded into a tared 1-liter Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Soils and Sediments

Soils and sediments are dried at a low temperature, less than 100°C. The soil or sediment is loaded fully into a tared, standard 300 cc container and weighed. The sample is then counted for approximately six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height and analysis.

Charcoal Cartridges (Air Iodine)

Charcoal cartridges are counted up to five at a time, with one positioned on the face of a Ge(Li) detector and up to four on the side of the Ge(Li) detector. Each Ge(Li) detector is calibrated for both positions. The detection limit for I-131 of each charcoal cartridge can be determined (assuming no positive I-131) uniquely from the volume of air which passed through it. In the event I-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately, positioned on the face of the detector.

Air Particulate

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

A mini-computer software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region. The calculation of results, two sigma error and the lower limit of detection (LLD) in pCi/volume of pCi/mass:

RESULT = (S-B)/2.22 t E V F DF)

TWO SIGMA ERROR = $2(S+B)^{1/2}$/(2.22 t E V F DF)

LLD = $4.66(B)^{1/2}$/(2.22 t E V F DF)

where:

S = Area, in counts, of sample peak and background (region of spectrum of interest)

B = Background area, in counts, under sample peak, determined by a linear interpolation of the representative backgrounds on either side of the peak

t = length of time in minutes the sample was counted

2.22 = dpm/pCi

E = detector efficiency for energy of interest and geometry of sample

V = sample aliquot size (liters, cubic meters, kilograms, or grams)

F = fractional gamma abundance (specific for each emitted gamma)

DF = decay factor from the mid-collection date to the counting date

ENVIRONMENTAL DOSIMETRY

Teledyne Isotopes uses a $CaSO_4$:Dy thermoluminescent dosimeter (TLD) which the company manufactures. This material has a high light output, negligible thermally induced signal loss (fading), and negligible self dosing. The energy response curve (as well as all other features) satisfies NRC Reg. Guide 4.13. Transit doses are accounted for by use of separate TLDs.

Following the field exposure period the TLDs are placed in a Teledyne Isotopes Model 8300. One fourth of the rectangular TLD is heated at a time and the measured light emission (luminescence) is recorded. The TLD is then annealed and exposed to a known Cs-137 dose; each area is then read again. This provides a calibration of each area of each TLD after every field use. The transit controls are read in the same manner.

Calculations of results and the two sigma error in net milliRoentgen (mR):

RESULT = $D = (D_1+D_2+D_3+D_4)/4$

TWO SIGMA ERROR = $2((D_1-D)^2+(D_2-D)^2+(D_3-D)^2+(D_4-D)^2)/3)^{1/2}$

WHERE: D_1 = the net mR of area 1 of the TLD, and similarly for D_2, D_3, and D_4

$D1$ = I_1 K/R_1 - A

I_1 = the instrument reading of the field dose in area 1

K = the known exposure by the Cs-137 source

R_1 = the instrument reading due to the Cs-137 dose on area 1

A = average dose in mR, calculated in similar manner as above, of the transit control TLDs

D = the average net mR of all 4 areas of the TLD.

APPENDIX E

SUMMARY OF EPA INTERLABORATORY COMPARISONS

US EPA INTERLABORATOTRY COMPARISON PROGRAM 1989

Collection Date	Media	Nuclide	EPA Result(a)	Teledyne Isotopes Result(b)	
01/06/89	Water	Sr-89	40.00 ± 5.00	37.00 ± 2.65	
		Sr-90	25.00 ± 1.50	26.00 ± 2.00	
01/20/89	Water	Gr-Alpha	8.00 ± 5.00	8.00 ± 1.00	
		Gr-Beta	4.00 ± 5.00	6.00 ± 0.00	
02/10/89	Water	Cr-51	235.00 ± 24.00	245.67 ± 11.72	
		Co-60	10.00 ± 5.00	12.67 ± 1.53	
		Zn-65	159.00 ± 16.00	181.33 ± 5.51	(c)
		Ru-106	178.00 ± 18.00	191.00 ± 9.85	
		Cs-134	10.00 ± 5.00	10.33 ± 0.58	
		Cs-137	10.00 ± 5.00	13.67 ± 0.58	
02/17/89	Water	I-131	106.00 ± 11.00	98.67 ± 0.58	
02/24/89	Water	H-3	2754.00 ± 356.00	2866.67 ± 251.66	
03/10/89	Water	Ra-226	4.90 ± 0.70	5.07 ± 0.29	
		Ra-228	1.70 ± 0.30	1.47 ± 0.29	
03/31/89	Air Filter	Gr-Alpha	21.00 ± 5.00	28.67 ± 1.15	(d)
		Gr-Beta	62.00 ± 5.00	65.67 ± 1.53	
		Sr-90	20.00 ± 1.50	19.67 ± 2.08	
		Cs-137	20.00 ± 5.00	18.00 ± 1.00	
04/18/89	Lab Perf.	Gr-Alpha	29.00 ± 7.00	21.33 ± 2.31	
	Water	Ra-226	3.50 ± 0.50	3.47 ± 0.23	
	Sample A	Ra-228	3.60 ± 0.50	3.60 ± 0.10	
	Sample B	Gr-Beta	57.00 ± 5.00	53.00 ± 3.61	
		Sr-89	8.00 ± 5.00	8.00 ± 0.00	
		Sr-90	8.00 ± 1.50	7.67 ± 0.58	
		Cs-134	20.00 ± 5.00	19.67 ± 1.53	
		Cs-137	20.00 ± 5.00	20.00 ± 2.65	
04/28/89	Milk	Sr-89	39.00 ± 5.00	36.67 ± 1.15	
		Sr-90	55.00 ± 3.00	56.33 ± 1.53	
		Cs-137	50.00 ± 5.00	53.33 ± 2.31	
		K	1600.00 ± 80.00	1760.00 ± 113.58	(e)
05/05/89	Water	Sr-89	6.00 ± 5.00	6.33 ± 0.58	
		Sr-90	6.00 ± 1.50	6.33 ± 0.58	

Footnotes at end of table.

US EPA INTERLABORATORY COMPARISON PROGRAM 1989 (Cont.

Collection Date	Media	Nuclide	EPA Result(a)	Teledyne Isotopes Result(b)	
06/09/89	Water	Ba-133	49.00 ± 5.00	33.00 ± 3.61	(f)
		Co-60	31.00 ± 5.00	30.00 ± 2.65	
		Zn-65	165.00 ± 17.00	165.33 ± 0.58	
		Ru-106	128.00 ± 13.00	113.67 ± 17.50	
		Cs-134	39.00 ± 5.00	34.00 ± 2.65	
		Cs-137	20.00 ± 5.00	22.00 ± 3.61	
06/23/89	Water	H-3	4503.00 ± 450.00	4466.67 ± 152.75	
08/25/89	Air Filter	Gr-Alpha	6.00 ± 5.00	8.33 ± 0.98	
		Cs-137	10.00 ± 5.00	12.00 ± 1.00	
09/22/89	Water	Gr-Alpha	4.00 ± 5.00	5.00 ± 5.00	
		Gr-Beta	6.00 ± 5.00	8.00 ± 0.00	
10/06/89	Water	Ba-133	59.00 ± 6.00	51.00 ± 4.36	(g)
		Co-60	30.00 ± 5.00	30.67 ± 2.08	
		Zn-65	129.00 ± 13.00	128.33 ± 2.89	
		Ru-106	161.00 ± 16.00	139.00 ± 15.72	(g)
		Cs-134	29.00 ± 5.00	23.67 ± 1.15	
		Cs-137	59.00 ± 5.00	61.67 ± 1.53	
10/20/89	Water	H-3	3496.00 ± 364.00	3433.33 ± 57.74	
10/31/89	Lab Perf.	Gr-Alpha	49.00 ± 12.00	42.33 ± 5.77	
	Water	Ra-226	8.40 ± 1.30	9.20 ± 0.46	
	Sample A	Ra-228	4.10 ± 0.60	4.00 ± 0.50	
	Sample B	Gr-Beta	32.00 ± 5.00	30.33 ± 0.58	
		Sr-89	15.00 ± 5.00	15.00 ± 3.46	
		Sr-90	7.00 ± 1.50	7.00 ± 0.00	
		Cs-134	5.00 ± 5.00	5.33 ± 1.15	
		Cs-137	5.00 ± 5.00	7.00 ± 0.00	
11/10/89	Water	Ra-226	8.70 ± 1.30	8.47 ± 0.49	
		Ra-228	8.57 ± 1.40	8.57 ± 1.46	

Footnotes at end of table.

US EPA INTERLABORATORY COMPARISON PROGRAM 1989 (Cont.)

Footnotes:

(a) EPA Results-Expected laboratory precision (1 sigma). Units are pCi/liter for water, and milk except K is in mg/liter. Units are total pCi for air particulate filters.

(b) Teledyne Results - Average ± one sigma. Units are pCi/liter for water and milk except K is in mg/liter. Units are total pCi for air particulate filters.

(c) The three Zn-65 measurements were 184, 175 and 185 pCi/liter. These were measured on three detectors using the same aliquot. The other reported results (Cr-51, Co-60, Ru-106, Cs-134, Cs-137) were all within two standard deviations of the EPA results. This would indicate that the dilution made was correct (except that possibly the Zn-65 was not well mixed). Other parameters were investigated. The branching intensity, decay factor, and detection efficiencies were checked. Since one of the Co-60 gamma ray energies is only 60 KeV from Zn-65, the detector efficiencies must be correct. There is no obvious reason for the deviation. Another aliquot was counted yielding 165 pCi/liter.

(d) The EPA deposits activity on the filter over a small diameter (nearly a point source) whereas our calibration is based on a deposit nearly 2 inches in diameter. In order to correct to point source geometry our practice has been to divide our results by 1.2. We neglected to do it on this test.

(e) There is no apparent reason why the potassium was high. Three separate detectors were used and the K-40 value for each was correctly divided by 0.86 to convert to potassium in mG/liter.

(f) There is no apparent reason why Ba-133 was low by 5.54 standard deviation while the other isotopes were within ± 2 standard deviations. The detector efficiencies and Ba-133 branching intensities were checked and found to be correct. On 10/31/89, 300 ml of the original, irradiated sample was counted giving 43.9 ± 5.8 pCi/liter Ba-133.

(g) This EPA sample was counted in two geometries; one in diluted stage, the other undiluted. There was no significant difference. Comparing detector efficiencies between two annual sets did not reveal any significant difference. Thus there is no apparent reason why our results differed as much as they did.

APPENDIX F

REMP SAMPLING AND ANALYTICAL EXCEPTIONS

TABLE F-1

REMP Exceptions for Scheduled
Fish Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
Various	Fish		Samples collected did not meet specified amount; however, all required analyses were performed
3C1	Searobin	05/22/89	Collected: 600 g Required: 1.2 kg
3C1	Searobin	10/10/89	Collected: 50 g Required: 1.2 kg
3C1	Windowpane	10/10/89	Collected: 300 g Required: 1.2 kg
13G2	Searobin	10/11/89	Collected: 150 g Required: 1.2 kg
14C1	Searobin	10/12/89	Collected: 150 g Required: 1.2 kg
14C1	Windowpane	10/12/89	Collected: 225 g Required: 1.2 kg

TABLE F-2

REMP Exceptions for Scheduled
Invertebrate Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
Various	Invertebrates		Samples collected did not meet specified amount; however, all required analyses were performed
14C1	Whelk	06/08/89	Collected: 900 g Required: 1.2 kg
3C1	Whelk	06/16/89	Collected: 180 g Required: 1.2 kg
13G2	Lobster	06/02/89	Collected: 400 g Required: 1.2 kg
3C1	Whelk	10/13/89	Collected: 100 g Required: 1.2 kg

TABLE F-3

REMP Exceptions for Scheduled
Airborne Particulates Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
2A2	Particulate Filter	10/17/89-10/24/89	Electrical power failure; however, particulate filter was collected. Sample volume was lower than normal.
2A2	Particulate Filter	10/24/89-10/31/89	Electrical power failure, no sample collected.

TABLE F-4

REMP Exceptions for Scheduled
Airborne Iodine Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
2A2	Canister	10/17/89-10/24/89	Electrical power failure; however, canister was collected. Sample volume was lower than normal.
2A2		10/24/89-10/31/89	Electrical power failure, no sample collected.

TABLE F-5

REMP Exceptions for Scheduled
Milk Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
10F1	Goat Milk	10/12/89-03/08/89	Goats dired up for kidding
8F2	Goat Milk	01/12/89-03/08/89	Goats dired up for kidding
13B1	Goat Milk	05/04/89	Sample not available, resident not at home
10F1	Goat Milk	08/10/89-12/31/89	Goats dired up
13B1	Goat Milk	11/16/89	Sample not available, reason unknown
8F2	Goat Milk	12/15/89	Goats dried up for kidding

TABLE F-6

REMP Exceptions for Scheduled
Food Products Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
12H1	Cabbage, Spinach and Radishes	08/16/89	Not locally grown
8B1	Spinach, Carrots and Radishes	08/16/89	Not locally grown
6B21	Lettuce, Cabbage, Spinach, Carrots, Radishes, Beets, and Potatoes	08/16/89	Not grown at this location
5C2	Lettuce, Radishes and Beets	08/16/89	Not grown at this location
7B3	Spinach, Carrots, Radishes, Beets, and Potatoes	08/23/89	Not locally grown

TABLE F-7

REMP Exceptions for Scheduled
Potable Water Sampling and Analysis During 1989

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
13S2	Groundwater	03/16, 06/18 09/13, 12/07/89	Well dry

APPENDIX G

SNPS LAND USE SURVEYS

SNPS LAND USE CENSUS

OPERATIONAL

The operational program complies with Section 3/4.12.2 of SNPS Technical Specifications. This requires a survey of all milk animals and gardens greater than $50m^2$ ($500 ft^2$) producing broad leaf vegetation within a radial distance of 8 Km (5 miles). LILCO is also required to identify the nearest milk animal, residence and garden in each of the 16 meteorological sectors.

Environmental Engineering Department conducted the 1989 dairy animal census, during April through July. This survey was conducted by Environmental Technicians driving through each neighborhood within the 5 mile radial distance and visually checking for dairy animals. When a dairy animal was observed the technicians requested information from the owner concerning the amount of milk produced, feed, number of animals and grazing methods.

The 1989 census results indicated that there are no milk producing cows within a 5 mile radial distance from the site; however, the survey did locate the following milk producing goats:

1. Sector 13, 1.9 miles west of SNPS
   Poole
   Briarcliff Road
   Shoreham, New York 11786

   REMP Monitoring Location 13B1

   Inventory: 2 milking goats
   5 non-milking goat

   Inventory Date: May 1, 1989

2. Sector 11, 2.40 miles southwest of SNPS
   Shoreham-Wading River School District
   Middle School
   Randall Road
   Shoreham, New York 11786

   REMP Monitoring Location 11C1 (Milk not being sampled due to owners decision not to participate).

   Inventory: 2 milking goats
   1 non-milking gcat

   Inventory Date: May 11, 1989

Table G-1 lists the nearest milk animal in the sixteen meteorological sectors. Additional field survey data are filed in the Shoreham Record Retrieval System.

The Garden Census was also conducted by Environmental Engineering Technicians visually noting each garden of $50m^2$ ($500 ft^2$) or greater. The 1989 census was performed during July, August, and September locating a total of 291 gardens. Table G-2 lists the nearest garden in the sixteen meteorological sectors. The field survey sheets and maps are filed at Environmental Engineering Melville and in the Shoreham Record Retrieval System.

Environmental Engineering identifies nearest residences by utilizing both aerial photography and visual confirmation. This year's census was conducted in December. Table G-3 lists the nearest residence in each meteorological sector.

TABLE G-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
1989 Land Use Census
Nearest Milk Animal (within 8 km)*

Sector	Direction	Location
1	N	Area within sector is Long Island Sound
2	NNE	None
3	NE	None
4	ENE	None
5	E	None
6	ESE	None
7	SE	None
8	SSE	None
9	S	None
10	SSW	None
11	SW	Shoreham - Wading River Middle School Randall Road, Shoreham
12	WSW	None
13	W	C.B. Poole residence, Briarcliff Road, Shoreham
14	WNW	None
15	NW	Area within sector is Long Island Sound
16	NNW	Area within sector is Long Island Sound

* SNPS Technical Specification 3/4 12.2

TABLE G-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
1989 Land Use Census
Nearest Garden (> $50m^2$ within 8 km)*

Sector	Garden Code #	Location & Direction
1	-	Area within sector is Long Island Sound
2	-	None
3	-	None
4	4A10G (5A13G on map)	Misiano, Little Bay Road, Wading River, 4642' ENE of SNPS
5	5A11G	Loggia, Little Bay Road, Wading River, 3978' E. of SNPS.
6	6A12G	Punda, Sound Ave., Wading River, 4343' ESE of SNPS.
7	7A15G	Meyer, Gabriel Mills Road, Wading River, 4918' SE of SNPS
8	8B1G (8A?G on map)	Pierzchanowski, Randall Road, Wading River, 5191' SSE of SNPS
9	9B1G	Smith, Randall Road, Wading River, 6027' S of SNPS.
10	10A14G	Johnson, Defense Hill Road, Shoreham, 5053' SSW of SNPS
11	11B29G	Rasile, Jomarr Road, Shoreham, 7317' SW of SNPS
12	12B31G	Murtash, Harvard Road, Shoreham, 6401' WSW of SNPS
13	13B22G	Connoly, Valentine Road, Shoreham, 4893' W of SNPS
14	-	None
15	-	Area within sector is Long Island Sound
16	-	Area within sector is Long Island Sound

* SNPS Technical Specification 3/4 12.2

TABLE G-3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
1989 Land Use Census
Nearest Residence (within 8 km)*

Sector	Direction	Location
1	N	Area within sector is Long Island Sound
2	NNE	Thurber-Creek Road, Wading River, 1503' from SNPS
3	NE	Creek Road, Wading River, 1916' from SNPS (First house east of Field and Tennis Club).
4	ENE	Hughes-Creek Road, Wading River, 3444' from SNPS (fifth house west of Riverhead Town Beach)
5	E	Peterson-Sound Road, Wading River, 3598' from SNPS
6	ESE	Bartow-Sound Road, Wading River, 2917' from SNPS
7	SE	Larsen-North Country Road and Thomas Drive, Wading River, 3304' from SNPS
8	SSE	North Country Road, fourth house west of Pheasant Run, Wading River, 2588' from SNPS
9	S	Fugelsang- 20 Long Bow, Wading River, 3839' from SNPS
10	SSW	16 Defense Hill Road, Wading River, 4877' from SNPS
11	SW	170 North Country Road, Wading River, 1632' from SNPS
12	WSW	Gildea-Valentine Road, Shoreham, 5557' from SNPS
13	W	Brice, 55 Valentine Road, Shoreham, 4620' from SNPS

TABLE G-3 (Cont.)

Sector	Direction	Location
14	WNW	St. Joseph's Villa, Wading River, 2178' from SNPS
15	NW	Area within sector is Long Island Sound
16	NNW	Area within sector is Long Island Sound

* SNPS Technical Specification 33/4 12.2

APPENDIX H

COMMON AND SCIENTIFIC NAMES OF SPECIES COLLECTED IN THE REMP

TABLE H-1

COMMON AND SCIENTIFIC NAMES OF SPECIES COLLECTED IN THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Common Name	Scientific Name
Fish	
Winter Flounder	Pseudopleuronectes americanus
Windowpane	Scophthalmus aquosus
Searobin	Prionotus spp.
Little Skate	Raja erinacea
Invertebrates	
American Lobster	Homarus americanus
Squid	Loligo pealeii
Blue Mussel	Mytilus edulis
Channeled Whelk	Busycon canaliculata
Soft-Shell Clam	Mya arenaria
Algae	
	Fucus sp.
	Ulva Lactuca
	Enteromorpha sp.
	Polysiphonia sp.
	Chondrus crsispus
	Scytosiphon lomentaria
	Codium sp.
	Ascophyllum sp.
Game	
Raccoon	Procyon lotor