



A Member of the
Constellation Energy Group

May 1, 2000

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Calvert Cliffs Independent Spent Fuel Storage Installation, Docket No. 72-8
Radiological Environmental Monitoring Program Annual Report

REFERENCES: (a) Calvert Cliffs Nuclear Power Plant Technical Specification 5.6.2
(b) Calvert Cliffs Independent Spent Fuel Storage Installation Technical Specification 6.2

In accordance with References (a) and (b), Baltimore Gas and Electric Company is submitting the Annual Radiological Environmental Monitoring Report, dated May 2000.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Chris Earls', is written over a horizontal line.

C. E. Earls
General Supervisor - Chemistry

CEE/JKK/bjd

Attachment

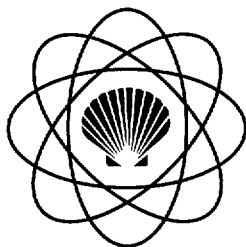
cc: R. S. Fleishman, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
A. W. Dromerick, NRC
H. J. Miller, NRC

Resident Inspector, NRC
R. I. McLean, DNR
J. H. Walter, PSC
P. Perzynski, MDE

JE25

RADIOLOGICAL
ENVIRONMENTAL MONITORING PROGRAM
ANNUAL REPORT

May 2000



*Calvert Cliffs Nuclear Power Plant
Units 1 and 2
and the
Independent Spent Fuel Storage Installation*

•

January 1 to December 31, 1999

BGE

**RADIOLOGICAL ENVIRONMENTAL
MONITORING PROGRAM
FOR THE
CALVERT CLIFFS NUCLEAR POWER PLANT
UNITS 1 AND 2
AND THE
INDEPENDENT SPENT FUEL STORAGE INSTALLATION**

January 1 - December 31, 1999

G. K. BARLEY
L. J. BARTAL, Ph.D.
A. J. KAUPA

BALTIMORE GAS AND ELECTRIC COMPANY

MAY 2000

(LEFT BLANK)

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES	v
<u>I. SUMMARY</u>	1
<u>II. CALVERT CLIFFS NUCLEAR POWER PLANT</u>	3
<u>II.A. INTRODUCTION</u>	3
<u>II.B. PROGRAM</u>	3
II.B.1 <u>Objectives</u>	3
II.B.2 <u>Sample Collection</u>	4
II.B.3 <u>Data Interpretation</u>	4
II.B.4 <u>Program Exceptions</u>	4
<u>II.C. RESULTS AND DISCUSSIONS</u>	4
II.C.1 <u>Aquatic Environment</u>	5
II.C.1.a <u>Bay Water</u>	5
II.C.1.b <u>Aquatic Organisms</u>	5
II.C.1.c <u>Shoreline Sediment</u>	6
II.C.2 <u>Atmospheric Environment</u>	9
II.C.2.a <u>Air Particulate Filters</u>	9
II.C.2.b <u>Air Iodine</u>	9
II.C.3 <u>Terrestrial Environment</u>	9
II.C.3.a <u>Vegetation</u>	11
II.C.4 <u>Direct Radiation</u>	11
<u>II.D. CONCLUSION</u>	13
<u>III. INDEPENDENT SPENT FUEL STORAGE INSTALLATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM</u>	21
<u>III.A. INTRODUCTION</u>	21
<u>III.B. PROGRAM</u>	21
III.B.1 <u>Objectives</u>	21
III.B.2 <u>Sample Collection</u>	22
III.B.3 <u>Data Interpretation</u>	22
III.B.4 <u>Program Exceptions</u>	22
<u>III.C. RESULTS AND DISCUSSIONS</u>	22
III.C.1 <u>Atmospheric Environment</u>	22
III.C.1.a <u>Air Particulate Filters</u>	22
III.C.2 <u>Terrestrial Environment</u>	23
III.C.2.a <u>Vegetation</u>	23
III.C.2.b <u>Soils</u>	23
III.C.3 <u>Direct Radiation</u>	24
<u>III.D. CONCLUSION</u>	25
<u>IV. REFERENCES</u>	29
<u>APPENDIX A</u>	33
<u>APPENDIX B</u>	47
<u>APPENDIX C</u>	71
<u>APPENDIX D</u>	87
<u>APPENDIX E</u>	89

(LEFT BLANK)

LIST OF FIGURES

Figure	Title	Page
1	Tritium in Chesapeake Bay Water	7
2	Silver-110m and Potassium-40 in Chesapeake Bay Oysters	8
3	Nuclear Fallout in the Calvert Cliffs Area	10
4	Mean TLD Gamma Dose, Calvert Cliffs Nuclear Power Plant	12
5	Atmospheric Dispersion Around CCNPP 1999 Average Relative Air Concentrations	15
6	Atmospheric Dispersion Around CCNPP 1999 Average Relative Ground Deposition	17
7	Mean TLD Gamma Dose, ISFSI	26
A-1	Map of Southern Maryland and Chesapeake Bay Showing Location of Calvert Cliffs Nuclear Power Plant	38
A-2	Calvert Cliffs Nuclear Power Plant Sampling Locations, Scale 1=1.35 km	39
A-3	Calvert Cliffs Nuclear Power Plant Sampling Locations, Scale 1=4.0 km	41
A-4	Independent Spent Fuel Storage Installation Sampling Locations	44
A-5	Enlarged Map of the Independent Spent Fuel Storage Installation Sampling Locations	45

(LEFT BLANK)

LIST OF TABLES

Table	Title	Page
1	Synopsis of 1999 Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program	19
2	Annual Summary of Radioactivity in the Environs of the Calvert Cliffs Nuclear Power Plant Units 1 and 2	20
3	Synopsis of 1999 Calvert Cliffs Nuclear Power Plant Independent Spent Fuel Storage Installation Radiological Environmental Monitoring Program	27
4	Annual Summary of Radioactivity in the Environs of the Calvert Cliffs Nuclear Power Plant Independent Spent Fuel Storage Installation	28
A-1	Locations of Environmental Sampling Stations for the Calvert Cliffs Nuclear Power Plant.....	37
A-2	Locations of Environmental Sampling Stations for the Independent Spent Fuel Storage Installation at Calvert Cliffs	43
B-1	Concentration of Tritium and Gamma Emitters in Bay Water	50
B-2	Concentration of Gamma Emitters in the Flesh of Edible Fish	51
B-3	Concentration of Gamma Emitters in Oyster Samples	52
B-4	Concentration of Gamma Emitters in Shoreline Sediment.....	53
B-5	Concentration of Iodine-131 in Filtered Air	54
B-6	Concentration of Beta Emitters in Air Particulates.....	56
B-7	Concentration of Gamma Emitters in Air Particulates	60
B-8a	Concentration of Gamma Emitters in Vegetation Samples	61
B-8b	Concentration of Gamma Emitters in Vegetation From Locations Around the IFSFI.....	63
B-9	Concentration of Gamma Emitters in Soil Samples From Locations Around the ISFSI	64
B-10	Typical MDA Ranges for Gamma Spectrometry.....	65
B-11	Typical LLDs for Gamma Spectrometry	66
B-12	Direct Radiation	67
C-1	Results of Participation in Analytics Cross Check Program	75
C-2	Results of Quality Assurance Program for 1999	77
C-3	Teledyne Brown Engineering's Typical MDAs for Gamma Spectrometry	86
D-1	Land Use Survey	87
E-1	Locations of Non-ODCM Environmental Sampling Stations for Calvert Cliffs Nuclear Power Plant.....	92
E-2	Synopsis of 1999 Calvert Cliffs Nuclear Power Plant Non-ODCM Radiological Environmental Monitoring Program.....	93
E-3	Annual Summary for Calvert Cliffs Nuclear Power Plant Units 1 & 2 Non-ODCM Radiological Environmental Monitoring Program	94
E-4	Concentration of Gamma Emitters in Bottom Sediment	95
E-5	Concentration of Iodine-131 in Filtered Air	96
E-6	Concentration of Beta Emitters in Air Particulates.....	98
E-7	Concentration of Gamma Emitters in Air Particulates	100
E-8	Concentration of Tritium and Gamma Emitters in Taylors Island Well Water.....	101
E-9	Direct Radiation as Measured in Pressurized Ion Chamber	102
E-10	Direct Radiation	103
E-11	Direct Radiation from Resin Storage Area	104

(LEFT BLANK)

I. SUMMARY

During the 1999 operating period for Calvert Cliffs Nuclear Power Plant (CCNPP) Units 1 and 2, radiochemical analyses were performed on environmental samples, and thermoluminescent dosimeters (TLDs) were analyzed for ambient radiation exposure rates. These analyses were performed to satisfy the requirements of the CCNPP Off-Site Dose Calculation Manual (ODCM), Sections 3/4.12.

For the Independent Spent Fuel Storage Installation (ISFSI), radiochemical analyses were performed on environmental samples, some of which were in common with the power plant program. Additional TLDs, some of which are also in common with the power plant program, were analyzed for ambient radiation exposure rates. These analyses were performed to satisfy the requirements of the ODCM.

In addition, radiochemical analyses were performed on quality assurance samples as part of an internal and external quality assurance program associated with Teledyne Brown Engineering, Environmental Services. Performance evaluation samples obtained from the Analytics Inc. Cross-Check Program were also analyzed.

And lastly, analyses were performed on extra environmental samples, and extra TLDs were analyzed for ambient radiation exposure rates. Also, six pressurized ion chambers continuously monitored the environs around the plant for ambient radiation levels. The additional analyses reflect a commitment to maintain historical continuity for samples and sampling pathways discontinued from the program when the Environmental Technical Specifications were changed in March 1985 and to satisfy our commitment to the community.

Samples collected from the aquatic environment included bay water, fish, oysters, and shoreline sediment samples. Bay water was analyzed for tritium and gamma emitters. Fish, oysters, and shoreline sediments were analyzed for gamma emitting radionuclides.

Monitoring the atmospheric environment involved sampling the air at various locations surrounding CCNPP and the ISFSI. Air particulates and gaseous iodine were collected on glass fiber filters and silver zeolite molecular sieve cartridges, respectively. The particulate filters were analyzed for beta activity and gamma emitting nuclides. The molecular sieve cartridges were analyzed for airborne gaseous radioiodine.

Samples from the terrestrial environment consisted of vegetation and soil samples, collected and analyzed for gamma emitters. Vegetation samples for the CCNPP REMP were also analyzed for I-131.

Measurements of direct radiation, as required by the ODCM, were performed by analyzing TLDs from forty locations surrounding CCNPP and the ISFSI.

Low levels of various man-made fission were observed in the environment surrounding the plant during 1999. Some of these observations were attributed to fallout from past atmospheric weapons testing. The others cited were related to the operation of the plant (e.g., H-3 in quarterly composited bay water samples and Ag-110m in oyster samples).

To assess the plant's contribution to the radiation levels of the ambient environment, dose calculations were performed using the plant's effluent release data, on-site meteorological data, and appropriate pathways. The results of these dose calculations indicate:

- a. a maximum thyroid dose of 1.09×10^{-2} mrem via liquid and gaseous pathways, which is about 0.01% of the acceptable limit of 75 mrem/yr as specified in 40 CFR 190;
- b. a maximum whole body dose of 1.27×10^{-2} mrem via liquid and gaseous pathways, which is < 0.1% of the acceptable limit of 25 mrem/yr as specified in 40 CFR 190;
- c. a maximum calculated dose to all other organs via liquid and gaseous pathways was equal to 6.86×10^{-1} mrem to the GI-Tract. This dose was about 3% of the allowable limit of 25 mrem/yr as specified in 40 CFR 190.

Thus, it is concluded based upon the levels of radioactivity observed and the various dose calculations performed, that Calvert Cliffs Nuclear Power Plant Units 1 and 2 and the ISFSI did not cause any significant radiological impact on the surrounding environment during 1999.

II. CALVERT CLIFFS NUCLEAR POWER PLANT RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

II.A. INTRODUCTION

Baltimore Gas and Electric Company (BGE) has been conducting a radiological environmental monitoring program in the environs of the Calvert Cliffs Nuclear Power Plant since the summer of 1970. The Calvert Cliffs site is an operating nuclear generating station consisting of two pressurized water reactors. Unit 1 achieved criticality on October 7, 1974 and commenced commercial operation in May 1975. Unit 2 achieved criticality on November 30, 1976 and went into commercial operation April 1, 1977.

Originally the Radiological Environmental Monitoring Program (REMP) was conducted under separate Environmental Technical Specifications (37,38). On July 29, 1977 the monitoring program began operation under a combined set of Technical Specifications (39) for both Units. The program has operated as such until March 1, 1985 when the Environmental Technical Specifications were revised to reflect a new generic format for radiological environmental monitoring adopted by the Nuclear Regulatory Commission (40). Changes in the program (sample locations, sample types, and/or sampling frequencies) were implemented to conform to these revisions. In October 1996, the Nuclear Regulatory Commission approved the relocation of these Technical Specifications to the ODCM in accordance with Generic Letter 89-01. (50)

Results of the monitoring program for the pre-operational and previous operational periods through December 31, 1997 have been reported in a series of documents (1-35).

Results of the monitoring program for the current operational period of January 1, 1999 through December 31, 1999 are included in this report. The report presents the content of the Radiological Environmental Monitoring Program (Table 1), the sampling locations (Appendix A), the summary of the analytical results of 1999 (Table 2), a compilation of the analytical data for 1999 (Appendix B), the results of the Analytics Intercomparison Program and the Quality Assurance Program (Appendix C), the results of the Land Use Survey (Appendix D), and a compilation of the analytical data for extra samples collected in 1999 (Appendix E). Interpretation of the data and conclusions are presented in the body of the report.

The environmental surveillance data collected during this reporting period were compared with that generated in previous periods whenever possible to evaluate the environmental radiological impact of Calvert Cliffs Nuclear Power Plant Units 1 and 2 during 1999.

II.B. PROGRAM

II.B.1 Objectives

The objectives of the REMP for the Calvert Cliffs Nuclear Power Plant are:

- a. To verify that radioactivity and ambient radiation levels attributable to plant operation are within the limits specified in the ODCM (41) and the Environmental Radiation Protection Standards as stated in 40 CFR Part 190,
- b. To detect any measurable buildup of long-lived radionuclides in the environment,
- c. To monitor and evaluate ambient radiation levels,
- d. To determine whether any statistically significant increase occurs in the concentration of radionuclides in important pathways.

II.B.2 Sample Collection

The locations of the individual sampling stations are listed in Table A-1 and shown in Figures A-2 and A-3. All samples were collected by contractors to, or personnel of, the Baltimore Gas and Electric Company according to Calvert Cliffs Nuclear Power Plant Procedures (42).

II.B.3 Data Interpretation

Many results in environmental monitoring occur at or below the minimum detectable activity (MDA). In this report, all results at or below the relevant MDA are reported as being "less than" the MDA value.

II.B.4 Program Exceptions

Throughout 1998 and 1999, oysters have not been available at Kenwood Beach (1a6) which is the designated control location. During this time control samples were obtained from an alternate location at Hog Island (1a10). In addition to the challenges encountered at Kenwood Beach, the amount of oysters available at the Camp Conoy (1a3), which is the designated indicator location, was greatly diminished in the fourth quarter of 1999. Due to these ongoing problems with oyster collection, alternate options for sampling and analyses of other invertebrate species are being considered.

II.C. RESULTS AND DISCUSSIONS

All the environmental samples collected during the year were analyzed using BGE's laboratory procedures (44). The analytical results for this reporting period are presented in Appendix B and are also summarized in Table 2. For discussion, the analytical results are divided into four categories. The categories are the Aquatic Environment, the Atmospheric Environment, the Terrestrial Environment, and Direct Radiation. These categories are further divided into subcategories according to sample type (e.g., Bay Water, Aquatic Organisms, etc., for the Aquatic Environment).

II.C.1 Aquatic Environment

The aquatic environment surrounding the plant was monitored by analyzing samples of bay water, aquatic organisms, and shoreline sediment. These samples were obtained from various sampling locations on the Chesapeake Bay near the plant.

II.C.1.a Bay Water

Monthly bay water samples were taken from two locations during the year. These locations are the Intake Area (sample code Wa1) and the Discharge Area (sample code Wa2). The samples were obtained from a composite sampling system operating at each location for the entire sampling period. These samples were analyzed for tritium and gamma emitters.

The tritium analyses, performed on quarterly composites of the monthly bay water samples, showed the presence of tritium in the Discharge (Wa2) samples in each of the four quarters, while no detectable readings were observed in the Intake (Wa1) samples. The concentrations observed in the discharge ranged from 103 ± 40 to 616 ± 43 pCi/L, which is similar to those ranges observed in previous years, (7-35).

Figure 1 compares tritium observed in the plant discharge and intake with annual effluent releases in 1999 as reported in the Radioactive Effluent Release Report.

Monthly analyses of bay water samples from both locations for gamma emitters exhibited no detectable concentrations of any plant-related radionuclides.

II.C.1.b Aquatic Organisms

Samples of aquatic organisms were obtained from four locations during the year. Samples of fish, when in season, are normally collected from the Intake-Discharge Area (sample codes Ia1 and Ia2) and from the Patuxent River (sample codes Ia4 and Ia5). As shown in Table B-2, two species of fish were sampled at both the plant intake and the control point in the Patuxent River. Oyster samples were obtained quarterly from Camp Conoy (sample code Ia3) and Hog Island (sample code Ia10). As mentioned previously, Hog Island was utilized as a control location in lieu of Kenwood Beach, due to the lack of sample at Kenwood Beach. Edible portion of the fish and oyster samples were analyzed for gamma emitters.

Gamma spectrometric analyses of the fish exhibited no detectable concentrations of any plant-related radionuclides. Oyster samples exhibited low levels of detectable concentrations of the plant-related radionuclide, Ag-110m, in all samples obtained from Camp Conoy (Ia3). These concentrations, which ranged from 35 ± 9 to 101 ± 13 pCi/kg, are consistent with that expected due to liquid effluents from the plant in 1999. Three of the four quarterly oyster samples taken from Hog Island (Ia10) also exhibited low levels of Ag-110m. These concentrations, which ranged from 6 ± 2 to 14 ± 8 pCi/kg, are less than or equal to the typical LLD for Ag-110m as reported in Table B-11 and are the result of a special study, involving very long counting times, which was designed to determine the true background levels of this radionuclide at this site. In addition, the flow dynamics of the Chesapeake Bay suggests that low levels of Ag-110m may be expected.

II.C.1.c Shoreline Sediment

Semiannual shoreline sediment samples were taken from one location during the year. This location is Shoreline at Barge Road (sample code Wb1). The samples obtained from this location were analyzed for gamma emitters.

Gamma spectrometric analyses of these samples exhibited no detectable concentrations of any plant-related radionuclides.

FIGURE 1
Tritium in Chesapeake Bay Water

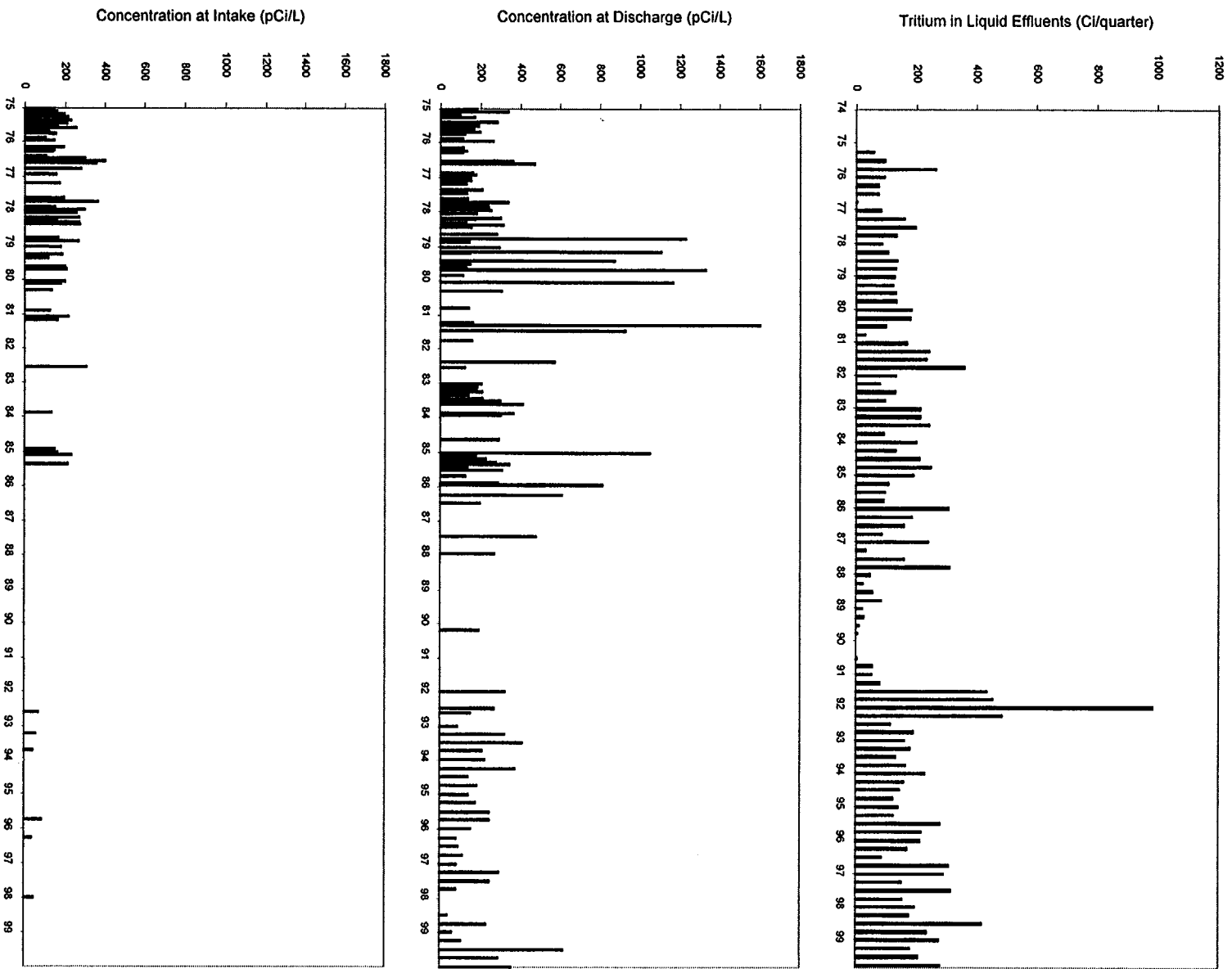
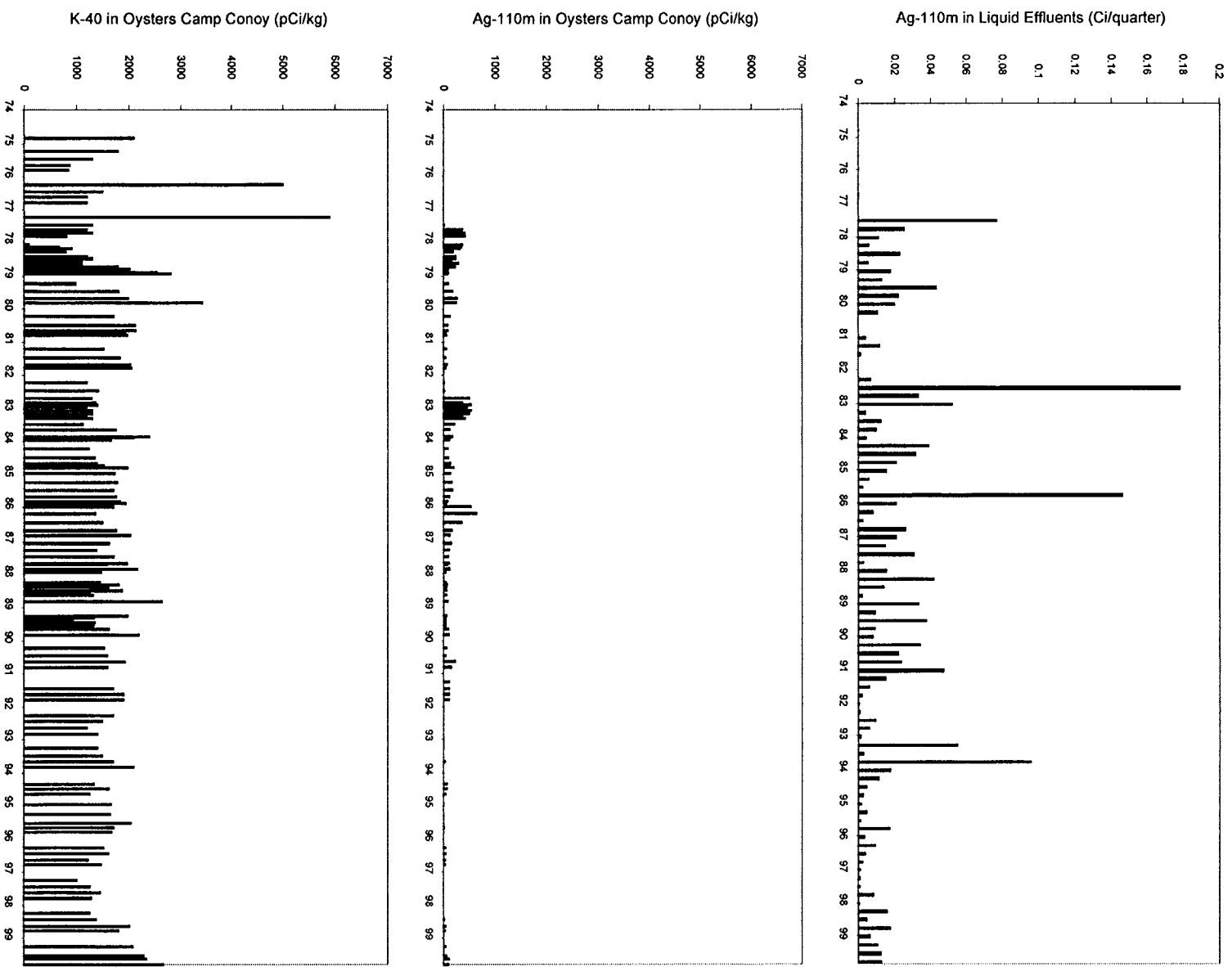


FIGURE 2
Silver-110m and Potassium-40 in Chesapeake Bay Oysters



II.C.2 Atmospheric Environment

The atmospheric environment was monitored by analyzing air particulate filters and silver zeolite cartridges (for trapping radioiodine species). These samples were collected from five locations surrounding the plant. These locations are On Site before the Entrance to Camp Conoy (sample code A1), Camp Conoy Road at the Emergency Siren (sample code A2), Bay Breeze Road (sample code A3), Route 765 at Lusby (sample code A4), and at the Emergency Operations Facility (sample code A5).

II.C.2.a Air Particulate Filters

Weekly composite air particulate filter samples were collected from the five locations during the year. These samples were analyzed for beta activity and gamma emitters.

Weekly analyses for beta activity on air particulate filters collected from all five locations showed values characteristic of background levels (7-35). The values ranged from 0.6×10^{-2} to 3.9×10^{-2} pCi/m³ for the indicator locations and 0.9×10^{-2} to 3.9×10^{-2} pCi/m³ at the control location. The location with the highest overall mean of 1.7×10^{-2} pCi/m³ was A5, EOF.

Gamma spectrometric analyses of monthly composited air particulate samples exhibited no detectable concentrations of any plant-related radionuclides in any of these samples.

Figure 3 depicts the historical trends of beta activity.

II.C.2.b Air Iodine

Weekly composited silver zeolite cartridges (for trapping radioiodine species) were collected from the same five locations as the air particulate filters during the year. These samples were analyzed for radioiodine species.

Weekly radioiodine analyses of silver zeolite cartridges collected from all five locations exhibited no detectable concentrations of I-131.

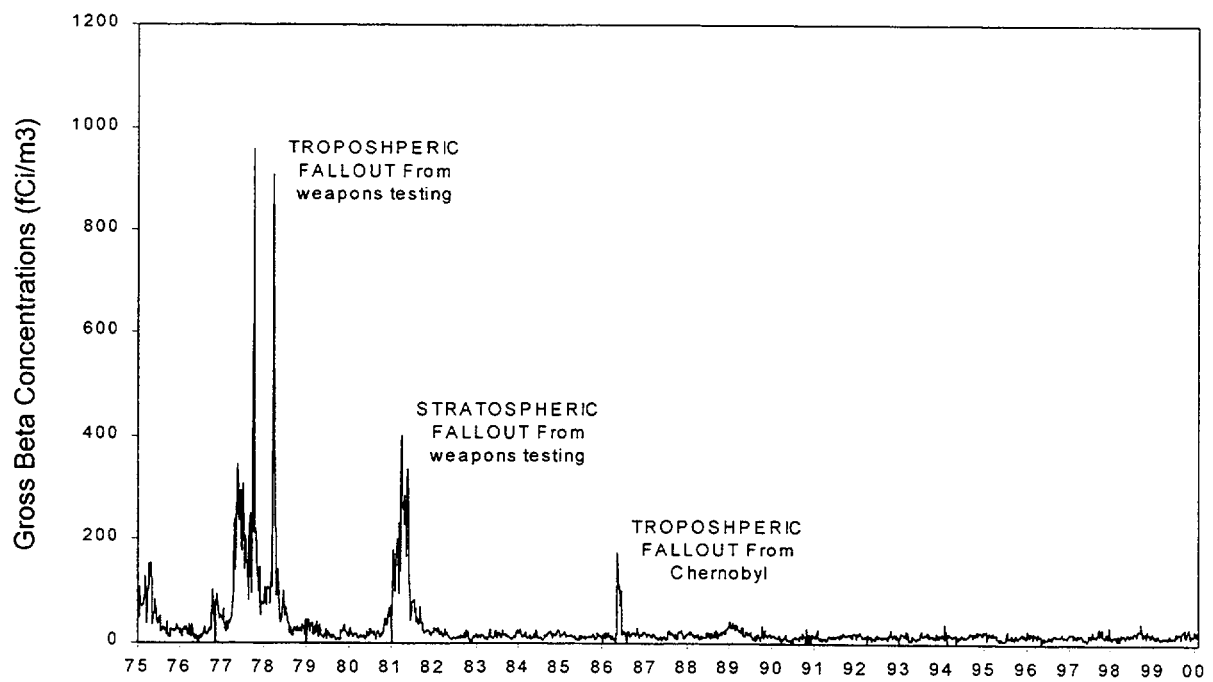
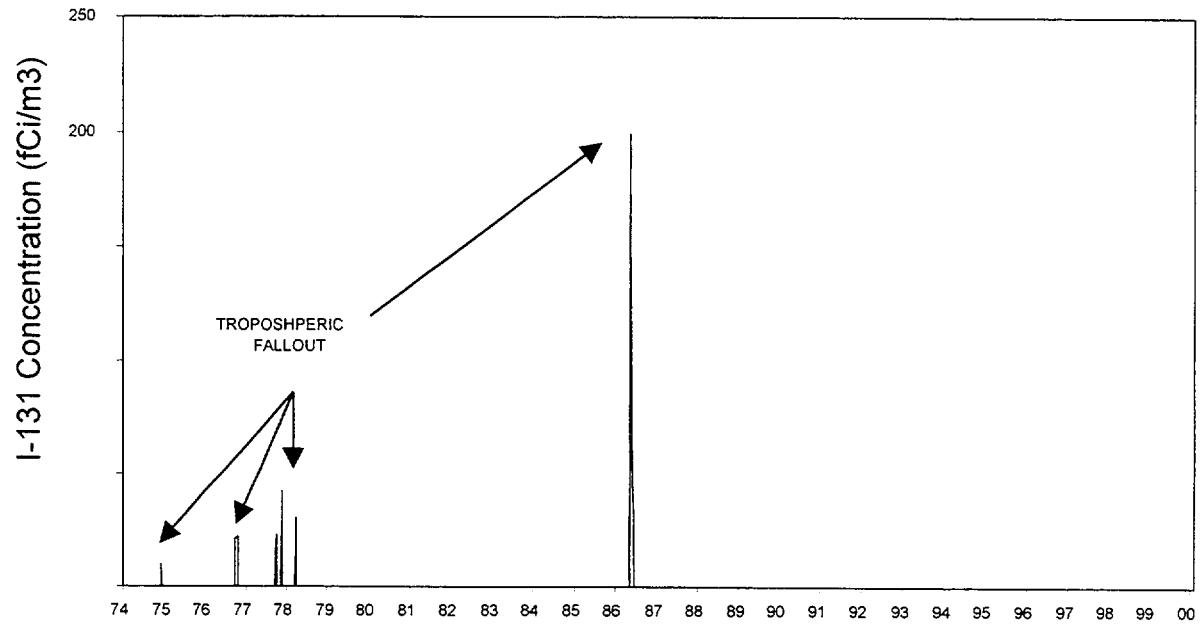
Figure 3 depicts the historical trends of radioiodine.

II.C.3 Terrestrial Environment

The terrestrial environment was monitored by analyzing samples of vegetation collected monthly, when available, from various sampling locations near the plant during the normal growing season.

FIGURE 3
Nuclear Fallout in the Calvert Cliffs Area

SURFACE AIR VAPORS, LUSBY, MD (A4)



II.C.3.a Vegetation

Vegetation samples were collected from three locations during the year. These locations are Garden Plot off Bay Breeze Road (sample codes Ib1, Ib2, and Ib3), On Site before the Entrance to Camp Conoy (sample codes Ib4, Ib5, and Ib6), and the Emergency Operations Facility (sample codes Ib7, Ib8, and Ib9). These samples were analyzed for gamma emitters, including analyses for I-131.

Gamma spectrometric analyses exhibited no detectable concentrations of plant-related radionuclides in any of these samples.

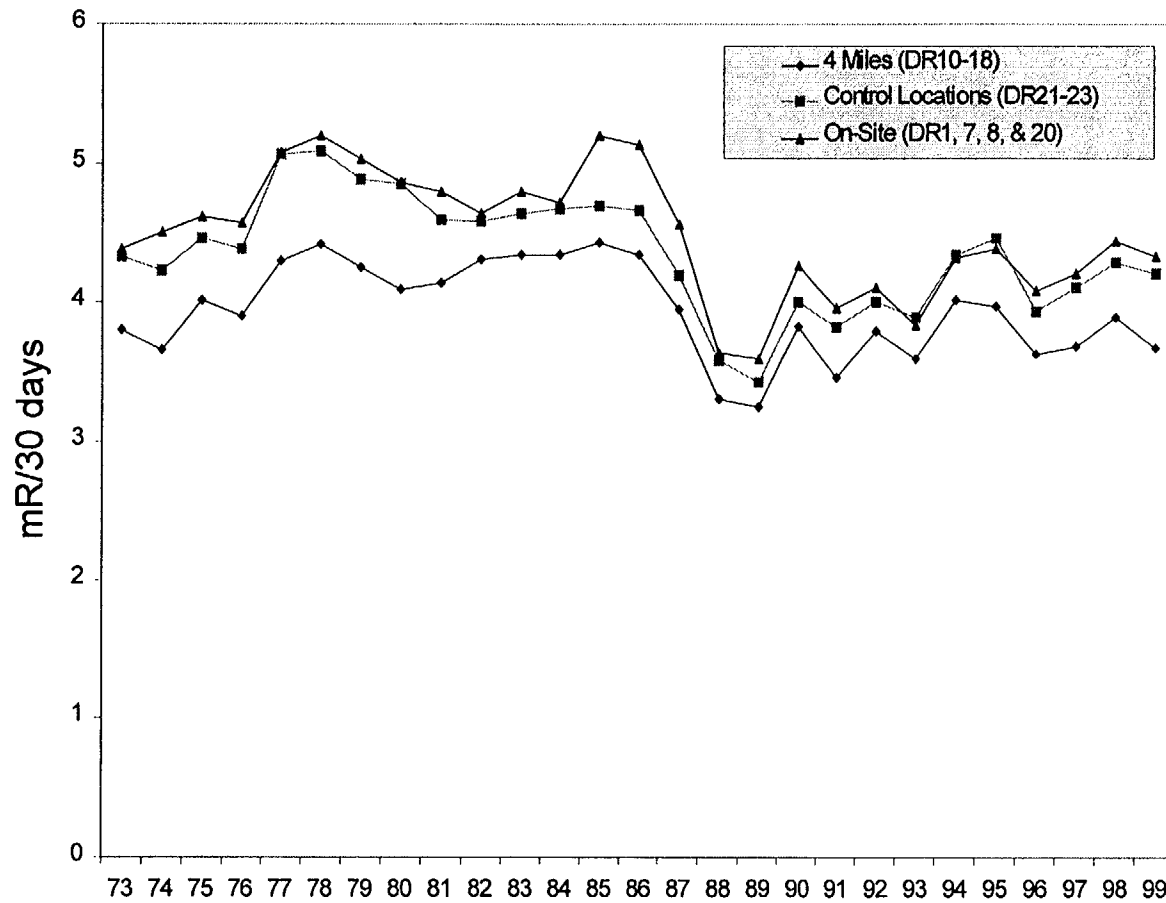
II.C.4 Direct Radiation

Direct radiation is measured by a network of TLDs in each overland sector surrounding the Plant both at the plant boundary and at 4 miles from the Plant.

Thermoluminescent dosimeters were collected quarterly from twenty-three locations surrounding the plant. The twenty indicator locations are On Site Along the Cliffs (sample code DR1), Route 765 Auto Dump (sample code DR2), Giovanni's Tavern (sample code DR3), Route 765 across from White Sands (sample code DR4), John's Creek (sample code DR5), Lusby (sample code DR6), On Site before the Entrance to Camp Conoy (sample code DR7), On Site at Emergency Siren (sample code DR8), Bay Breeze Road (sample code DR9), Decatur and Calvert Beach Roads (sample code DR10), Dirt Road off Mackall and Parran Roads (sample code DR11), Mackall and Bowen Roads (sample code DR12), Wallville (sample code DR13), Rodney Point (sample code DR14), Mill Bridge and Turner Roads (sample code DR15), Appeal School (sample code DR16), Cove Point and Little Cove Point Roads (sample code DR17), Cove Point (sample code DR18), Long Beach (sample code DR19), and On Site Near Shore (sample code DR20). The three control locations are the Emergency Operations Facility (sample code DR21), Solomons Island (sample code DR22), and Taylors Island, Carpenters Property (sample code DR23).

The mean 90 day ambient radiation measured at the indicator locations was 11.43 mR and ranged from 8.96 to 15.83 mR as reported in Table 2. The control locations showed a 90 day mean of 12.61 mR with ranges from 9.07 to 16.32 mR. The location with the highest overall mean of 15.34 was DR23, Taylors Island, Carpenters Property, which ranged from 14.32 to 16.32 mR. A comparison of the means and ranges of the current TLD data with those of both the historical data and the regional data (7-35) shows no plant-related contribution to the measured direct radiation exposure for 1999. Figure 4 shows the historical comparison of the average monthly radiation levels per calendar year for TLDs on site, at four miles, and at the control locations.

FIGURE 4
Mean TLD Gamma Dose, Calvert Cliffs Nuclear Power Plant



II.D. CONCLUSION

Low levels of various man-made fission by-products were observed in the environment surrounding the plant during 1999. Some of these observations were attributed to fallout from past atmospheric weapons testing. The others cited were related to the operation of the plant (e.g., tritium in quarterly composited bay water samples and Ag-110m in oysters).

Historical trends for tritium in bay water, Ag-110m and K-40 in oyster samples, nuclear fallout in the Calvert Cliffs area, and TLD data are depicted in Figures 1 through 4. As can be seen from these figures, the plant made no adverse radiological contributions to the surrounding environment during 1999.

To assess the plant's contribution to the ambient radiation levels of the surrounding environment, dose calculations were performed using the plant's effluent release data, on site meteorological data (see X/Q and D/Q values presented in Figures 5 and 6), and appropriate pathways. The results of these dose calculations indicate:

Gaseous Pathways

A maximum thyroid dose of 7.84×10^{-3} mrem to a child via the plume, ground, vegetable, meat, and inhalation pathways at 1.7 km SW of the containments at Calvert Cliffs. This is about 0.01% of the acceptable limit of 75 mrem/year as specified in 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

A maximum whole body gamma dose of 2.39×10^{-4} mrem to a child at 1.7 km SW of the containments at Calvert Cliffs, which is < 0.01% of the acceptable dose limit of 25 mrem/year as specified in 40 CFR 190.

A maximum dose to any other organ, in this case the skin, of 1.17×10^{-3} mrem at 1.7 km SW of the containments at Calvert Cliffs. This is < 0.01% of the acceptable dose limit of 25 mrem/year as specified in 40 CFR 190.

Liquid Pathways

A maximum thyroid dose of 3.10×10^{-3} mrem to a teenager for all liquid pathways, which is < 0.01% of the acceptable dose limit of 75 mrem/year as specified in 40 CFR 190.

A maximum whole body dose of 1.25×10^{-2} mrem to a teen via all liquid pathways, which is about 0.05% of the acceptable dose limit of 25 mrem/year as stated in 40 CFR 190.

A maximum dose to any organ, in this case the GI-Tract, of 6.86×10^{-1} mrem to an adult for all pathways, which is about 3% of the acceptable dose limit of 25 mrem/year specified in 40 CFR 190.

Gaseous and Liquid Pathways Combined

A maximum thyroid dose of 1.09×10^{-2} mrem via liquid and gaseous pathways, which is about 0.01% of the acceptable limit of 75 mrem/year specified in 40 CFR 190.

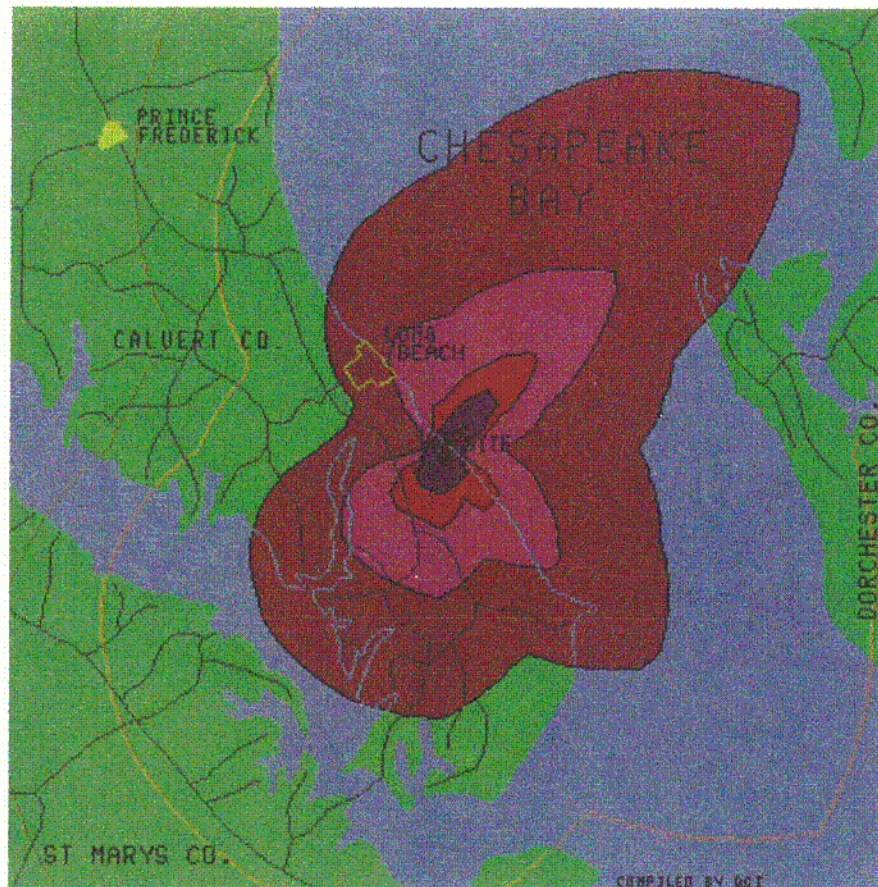
A maximum whole body dose of 1.27×10^{-2} mrem via liquid and gaseous pathways which is < 0.1% of the acceptable limit of 25 mrem/year as specified in 40 CFR 190.

A maximum calculated dose to all other organs via liquid and gaseous pathways was equal to 6.86×10^{-1} mrem to the GI-Tract. This dose is about 3% of the allowable limit of 25 mrem/year as specified in 40 CFR 190.

In all cases, the calculated doses are a small fraction of the applicable limits specified in 40 CFR 190. Therefore, it is concluded, based upon the levels of radioactivity being significantly below the limits of the Offsite Dose Calculation Manual and 40 CFR Part 190, that Calvert Cliffs Nuclear Power Plant Units 1 and 2 did not cause any significant radiological impact on the surrounding environment during 1999.

FIGURE 5

Atmospheric Dispersion Around CCNPP 1999 Average Relative Air Concentrations

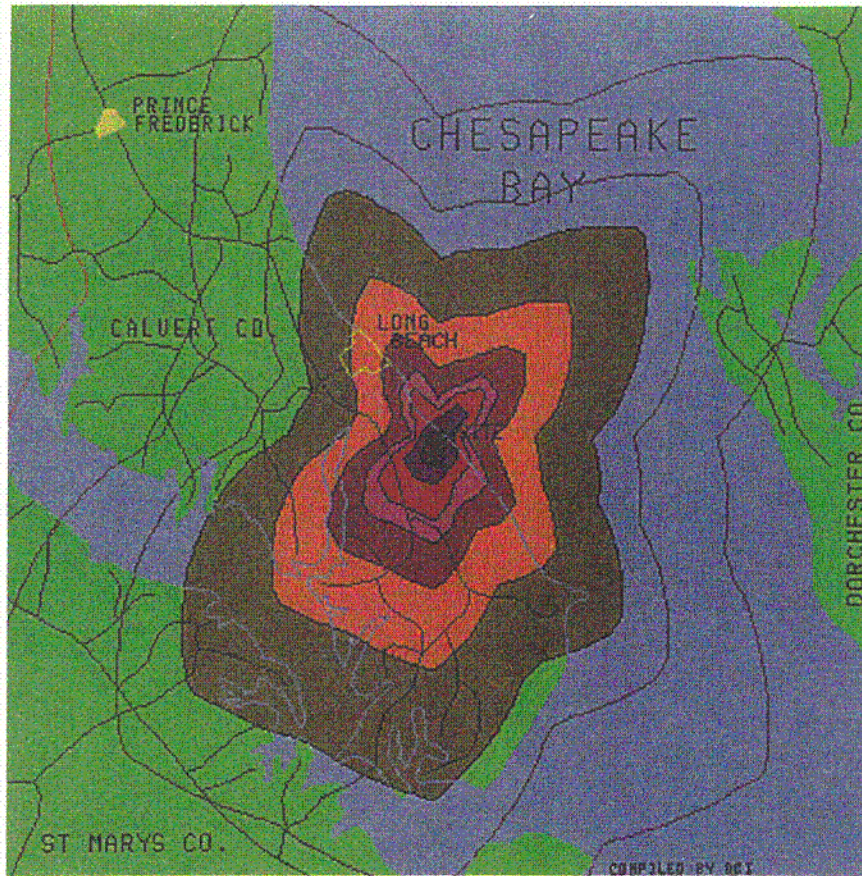


CONTOUR LEGEND	X/Q (SEC/N3)
1	2.0E-07+
2	1.0E-07-2.0E-07
3	7.0E-08-1.0E-07
4	4.0E-08-7.0E-08
5	2.0E-08-4.0E-08
6	1.0E-08-2.0E-08
7	7.0E-09-1.0E-08
8	4.0E-09-7.0E-09

(LEFT BLANK)

FIGURE 6

Atmospheric Dispersion Around CCNPP 1999 Average Relative Ground Deposition



CONTOUR LEGEND	D/Q (1/N ₂)
1	4.0E-09+
2	2.0E-09-4.0E-09
3	1.0E-09-2.0E-09
4	7.0E-10-1.0E-09
5	4.0E-10-7.0E-10
6	2.0E-10-4.0E-10
7	1.0E-10-2.0E-10
8	7.0E-11-1.0E-10
9	4.0E-11-7.0E-11
10	2.0E-11-4.0E-11

(LEFT BLANK)

Table 1

Synopsis of 1999 Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program

Sample Type	Sampling Frequency ¹	Number of Locations	Number Collected	Analysis	Analysis Frequency ¹	Number Analyzed
Aquatic Environment						
Bay Water	MC	2	24	Gamma	M	24
				H-3	QC	8
Fish ²	A	2	4	Gamma	A	4
Oysters	Q	2	8	Gamma	Q	8
Shoreline Sediment	SA	1	2	Gamma	SA	2
Atmospheric Environment						
Air Iodine ³	W	5	261	I-131	W	261
Air Particulates ⁴	W	5	262	Gross Beta	W	262
				Gamma	MC	60
Direct Radiation						
Ambient Radiation	Q	23	540	TLD	Q	540
Terrestrial Environment						
Vegetation ⁵	M	3	45	Gamma	M	45

¹ W-weekly, M-monthly, Q-quarterly, SA-semiannual, A-annual, C-composite² Once in Season, July Through September³ The collection device contains silver zeolite⁴ Beta counting is performed after ≥ 72 hour decay. Gamma spectroscopy performed on monthly composites of weekly samples⁵ Monthly during Growing Season

Table 2

**Annual Summary of Radioactivity in the Environs of the
Calvert Cliffs Nuclear Power Plant Units 1 and 2**

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	Indicator Locations Mean (F)/Range ¹	Location with Highest Annual Mean Name/Distance & Direction ²	Highest Annual Mean (F) / Range ¹	Control Locations Mean (F)/Range ¹
Aquatic Environment						
Bay Water (pCi/L)	H-3 (8)	54	342 (4/4) (103-616)	Discharge Vicinity Wa2 0.3 km N	342 (4/4) (103-616)	-- --
Oysters (pCi/kg)	Gamma (8) Ag110m	14	70 (4/4) (35-101)	Camp Conoy Ia3 0.9 km E	70 (4/4) (35-101)	11 (3/4) (6-14)
Atmospheric Environment						
Air Particulates (10 ⁻² pCi/m ³)	Gross Beta (262)	0.5	1.5 (209/209) (0.6-3.9)	EOF A5 19.3 km WNW	1.7 (53/53) (0.9-3.9)	1.7 (53/53) (0.9-3.9)
Direct Radiation						
Ambient Radiation (mR/90 days)	TLD (540)	--	11.43 (474/474) (8.96-15.83)	Taylors Island DR23 12.6 km ENE	15.34 (24/24) (14.72-16.32)	12.61 (66/66) (9.07-16.32)

¹ Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.

² From the centerpoint between the two containment buildings.

III. INDEPENDENT SPENT FUEL STORAGE INSTALLATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

III.A. INTRODUCTION

In August 1990 BGE initiated a program of additional radiological environmental monitoring around the site for the Independent Spent Fuel Storage Facility (ISFSI). The first dry fuel storage canister was loaded into the ISFSI in November of 1993.

Results of the monitoring program for the ISFSI for the current period of January 1, 1999 through December 31, 1999 are included in this report.

This report presents the content of the ISFSI radiological environmental monitoring program (Table 3), the ISFSI sampling locations (Appendix A), the summary of the analytical results of the period (Table 4), and a compilation of the analytical data for the period (Appendix B). Interpretation of the data and conclusions are presented in the body of the report.

The ISFSI monitoring program is as described in this section of the report with the exception of the Pressurized Ion Chambers (PICs). Pressurized Ion Chambers, because they duplicate direct surveillance by TLDs and because they experience problems with reliability, were excluded from the Technical Specification portion of the ISFSI REMP (49). Pressurized Ion Chambers' results, however, are given in table E-9 and will continue to be a surveillance to satisfy our commitment to the community.

The results for 1999 were compared with that generated during the previous ISFSI pre-operational periods (36) and the current and previous CCNPP REMP periods (7-35). These comparisons demonstrate the consistency of data throughout the CCNPP site, which are very close to the natural background levels for the region. A discussion of these results is given in Section III. C. 3.

III.B. PROGRAM

III.B.1 Objectives

The objectives of the radiological environmental monitoring program for the ISFSI are:

- a. To satisfy the community concern regarding the impact of the ISFSI on the environment,
- b. To verify that radioactivity and ambient radiation levels attributable to operation of the ISFSI are within the limits specified in the Environmental Radiation Protection Standards as stated in 40 CFR Part 190,
- c. To detect any measurable buildup of long-lived radionuclides in the environment due to the ISFSI,

- d. To monitor and evaluate ambient radiation levels around the ISFSI,
- e. To determine whether any statistically significant increase occurs in the concentration of radionuclides near the ISFSI.

III.B.2 Sample Collection

The locations of the individual sampling sites are listed in Table A-2 and shown in Figures A-4 and A-5. All samples were collected by BGE personnel according to Calvert Cliffs Nuclear Power Plant Procedures (42).

III.B.3 Data Interpretation

Many results in environmental monitoring occur at or below the minimum detectable activity (MDA). In this report, all results at or below the relevant MDA are reported as being "less than" the MDA value.

III.B.4 Program Exceptions

During 1999 the monitoring program was conducted in accordance with the ODCM (41) and applicable procedures (42,44). During an internal Quality Assurance audit it was noted that the Safety Analysis Report (SAR) for the ISFSI had not been updated to reflect a quarterly TLD reading frequency. A safety analysis was performed in accordance with 10 CFR 72.48. The results reaffirmed the acceptability of the quarterly frequency. The SAR is being updated.

III.C. RESULTS AND DISCUSSIONS

All environmental samples collected during the year were analyzed using BGE's laboratory procedures (44). The analytical results for this reporting period are presented in Appendix B and are also summarized for the period in Table 4. For discussion, the analytical results are divided into three categories. The categories are the Atmospheric Environment, the Terrestrial Environment, and Direct Radiation. These categories are further divided into subcategories according to sample type (e.g., Vegetation and Soil for Terrestrial Environment).

III.C.1 Atmospheric Environment

The atmospheric environment was monitored by analyzing air particulate filters. These samples were collected from five locations surrounding the ISFSI.

Since no source of airborne radioiodine exists for the ISFSI, sampling and analysis for this radioiodine are not performed.

III.C.1.a Air Particulate Filters

Weekly composite air particulate filter samples were collected from five locations during the period. These locations are On Site before the Entrance to Camp Conoy (sample code A1; in

common with the CCNPP REMP), Meteorological Station (SFA1), CCNPP Visitor's Center (SFA2), NNW of the ISFSI (SFA3), and South of the ISFSI (SFA4). These samples were analyzed for beta radioactivity and gamma emitting radionuclides.

Weekly analyses for beta activity on air particulate filters collected from all five locations showed values characteristic of levels routinely observed in the REMP (7-35). These values ranged from 0.6×10^{-2} to 4.2×10^{-2} pCi/m³ for the indicator locations and 0.7×10^{-2} to 3.4×10^{-2} pCi/m³ for the control location. The location with the highest overall mean of 1.8×10^{-2} pCi/m³ was SFA3, NNW of ISFSI.

Gamma spectrometric analyses of monthly composited air particulate samples exhibited no detectable concentrations of any plant-related radionuclides in any of these samples.

III.C.2 Terrestrial Environment

The terrestrial environment was monitored by analyzing samples of vegetation and soil collected quarterly from the vicinity of the air sampling locations for the ISFSI.

III.C.2.a Vegetation

Vegetation samples were collected quarterly from five locations during the year. These locations are: Meteorological Station (sample code SFb1), CCNPP Visitor's Center (sample code SFb2), NNW of the ISFSI (sample code SFb3), South of the ISFSI (sample code SFb4), and On Site before the Entrance to Camp Conoy (sample code SFb5). These samples were analyzed for gamma emitters.

Gamma spectrometric analyses of these samples exhibited no detectable concentration of any plant-related radionuclides in any of these samples.

III.C.2.b Soils

Soil samples were collected quarterly from five locations surrounding the ISFSI in the vicinity of the air samplers. These locations are: Meteorological Station (sample code SFS1), CCNPP Visitor's Center (sample code SFS2), NNW of the ISFSI (sample code SFS3), South of the ISFSI (sample code SFS4), and On Site before the Entrance to Camp Conoy (sample code SFS5).

Soil samples were analyzed for gamma emitting radionuclides. Cesium-137 was detected in fourteen quarterly samples from both indicator and control locations. The Cs-137 concentrations ranged from 38 ± 42 to 920 ± 86 pCi/kg. While the presence of Cs-137 in these samples may be plant-related, this range is consistent with that found to be due to the residual fallout from past atmospheric nuclear weapons testing. The activities of this radionuclide are well below the federal limits established in 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations" and are comparable to those observed in previous annual reporting periods for the CCNPP REMP (7-35) and in the earlier pre-operational data for the ISFSI (36).

III.C.3 Direct Radiation

Direct radiation is measured by a network of TLDs surrounding the ISFSI. These thermoluminescent dosimeters are collected quarterly from seventeen locations surrounding the ISFSI, plus one control TLD location at the Visitor's Center (sample code SFDR7). The locations include On Site before the Entrance to Camp Conoy (sample code DR7, common to both the CCNPP Program and the ISFSI Program) and the Meteorological Station (sample code DR30, previously a location maintained for historical continuity.) The other sampling locations are: SW of ISFSI, Collocated with Plant TLD #159, (sample code SFDR1); N of ISFSI, Collocated with Plant TLD #160, (sample code SFDR2); NNE of ISFSI, Collocated with Plant TLD #161, (sample code SFDR3); NE of ISFSI, Collocated with Plant TLD #162, (sample code SFDR4); E of ISFSI, Collocated with Plant TLD #163, (sample code SFDR5); ESE of ISFSI, Collocated with Plant TLD #164, (sample code SFDR6); North Northwest of ISFSI, (sample code SFDR8); South of ISFSI, (sample code SFDR9); NNW of ISFSI, (sample code SFDR10); WNW of ISFSI, (sample code SFDR11); West of ISFSI, (sample code SFDR12); SSW of ISFSI, (sample code SFDR13); SSE of ISFSI, (sample code SFDR14); ENE of ISFSI, (sample code SFDR15); and WSW of ISFSI, (sample code SFDR16). Sampling locations are shown on Figures A-4 and A-5.

The mean 90 day ambient radiation measured at the ISFSI indicator locations was 18.21 mR and ranged from 9.91 to 42.99 mR as reported in Table 4. The control location showed a 90 day mean of 13.45 mR and ranged from 12.55 to 15.32 mR. A comparison of the mean and ranges of the current TLD data with those of both the historical data and the regional data (7 - 36) reveals only one set of elevated TLD readings. That location with the highest overall mean of 39.78 mR with a range of 36.24 to 42.99 mR was SFDR10, North Northwest of ISFSI. These readings are consistent with those expected from the storage of spent fuel in the ISFSI (7 - 36). A comparison of the average monthly radiation levels per calendar year of the ISFSI TLD data from the indicator locations with the ISFSI control location at the Visitor's Center, SFDR7, can be seen in Figure 7.

III.D. CONCLUSION

Low levels of Cs-137 were observed in the environment surrounding the ISFSI during the period. The Cs-137 observations were attributed to fallout from past atmospheric weapons testing.

In general, the results in the following tables continue the historical trends previously observed at the official sites of the Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program (7-35).

FIGURE 7
Mean TLD Gamma Dose, ISFSI

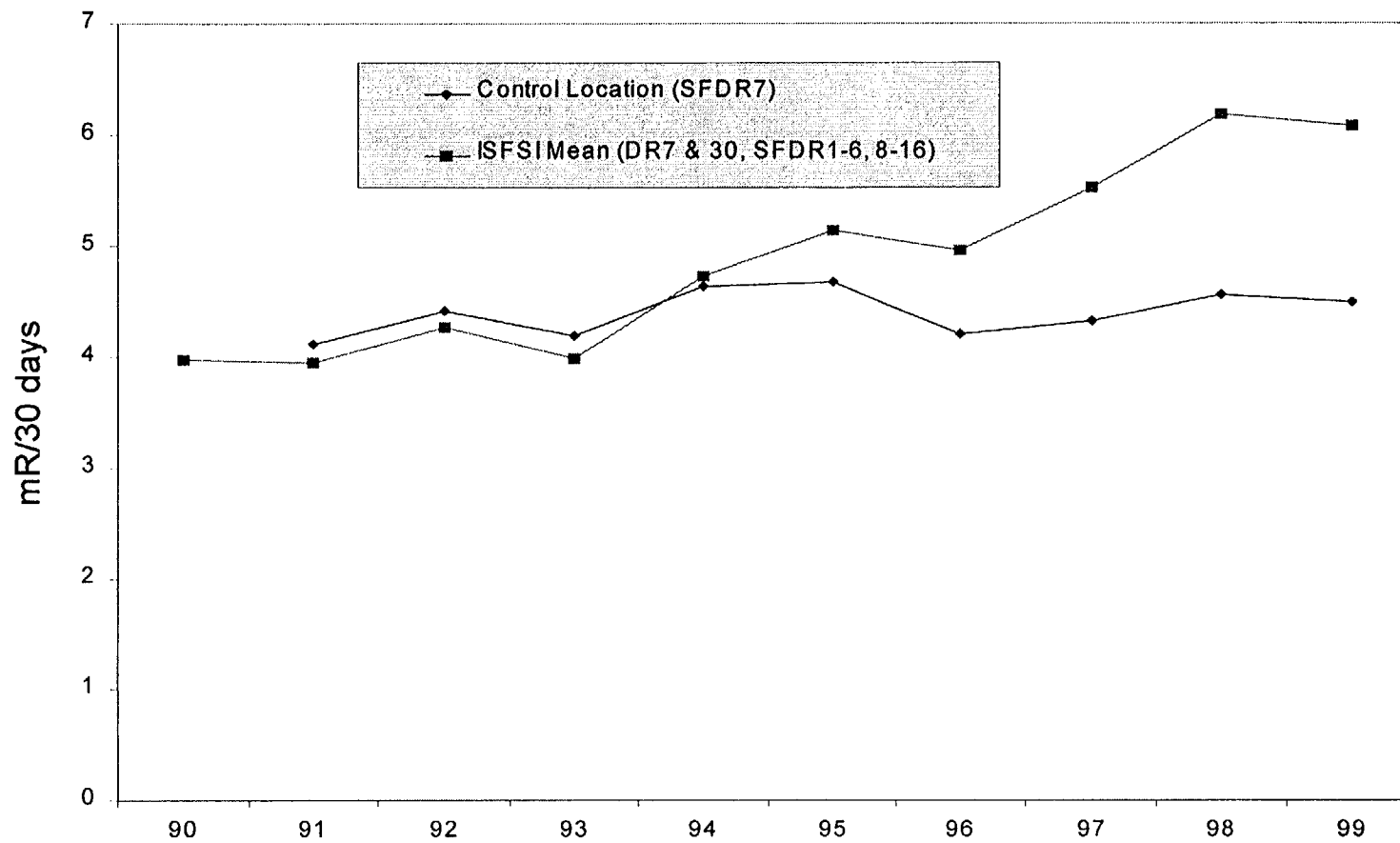


Table 3

**Synopsis of 1999 Calvert Cliffs Nuclear Power Plant
Independent Spent Fuel Storage Installation
Radiological Environmental Monitoring Program**

Sample Type	Sampling Frequency ¹	Number of Locations	Number Collected	Analysis	Analysis Frequency ¹	Number Analyzed
Atmospheric Environment Air Particulates ²	W	5	261	Gross Beta Gamma	W MC	261 60
Direct Radiation Ambient Radiation	Q	18	432	TLD	Q	432
Terrestrial Environment Vegetation	Q	5	20	Gamma	Q	20
Soil	Q	5	20	Gamma	Q	20

¹ W-weekly, M-monthly, Q-quarterly, SA-semiannual, A-annual, C-composite

² Beta counting is performed after ≥ 72 hour decay. Gamma spectroscopy performed on monthly composites of weekly samples

Table 4

**Annual Summary of Radioactivity in the Environs of the
Calvert Cliffs Nuclear Power Plant Independent Spent Fuel Storage Installation**

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	Indicator Locations Mean (F)/Range ¹	Location with Highest Annual Mean Name/Distance & Direction ²	Highest Annual Mean (F) / Range ¹	Control Locations Mean (F)/Range ¹
Atmospheric Environment						
Air Particulates (10 ⁻² pCi/m ³)	Gross Beta (261)	0.5	1.7 (209/209) (0.6-4.2)	NNW of ISFSI SFA3 0.1 km NNW	1.8 (53/53) (0.8-3.6)	1.7 (52/52) (0.7-3.4)
Direct Radiation						
Ambient Radiation (mR/90 days)	TLD (432)	--	18.21 (408/408) (9.91-42.99)	NNW of ISFSI SFDR10 0.1 km NNW	39.78 (24/24) (36.24-42.99)	13.45 (24/24) (12.55-15.32)
Terrestrial Environment						
Soil (pCi/kg)	Gamma (20) Cs-137	17	521 (10/16) (38-920)	NNW of ISFSI SFs3 0.1 km NNW	770 (4/4) (655-920)	135 (4/4) (99-229)

¹ Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.

² From the centerpoint of the ISFSI facility.

IV. REFERENCES

- (1) Cohen, L. K., "Preoperational Environmental Radioactivity Monitoring Program at Calvert Cliffs Units 1 and 2", NUS No. 882 Semiannual Report January-June 1971, December 1971; NUS No. 1025 Annual Report 1971, March 1973.
- (2) Cohen, L. K., "Preoperational Environmental Radioactivity Monitoring Program at Calvert Cliffs Units 1 and 2", NUS No. 1137 Annual Report 1972, December 1973.
- (3) Cohen, L. K. and Malmberg, M. S., "Preoperational Environmental Radioactivity Monitoring Program at Calvert Cliffs Units 1 and 2", NUS No. 1188, Annual Report 1973, October 1974.
- (4) Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant Radiological Environmental Analyses, December 1971 - December 1973 RMC-TR-74-13, August 1974.
- (5) Malmberg, M. S., "Environmental Radioactivity Monitoring Program at Calvert Cliffs Nuclear Power Plant", NUS No. 1331 Annual Report 1974, February 1975.
- (6) Malmberg, M. S., "Preoperational Environmental Radioactivity Monitoring Program at Calvert Cliffs Units 1 and 2", NUS No. 1333, Data Summary Report, September 1970 to September 1974, July 1975.
- (7) Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant - Radiological Environmental Surveillance Program, January 1 to June 30, 1974, December 1974.
- (8) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant - Semiannual Operating Report, July - December 1974, March 1975.
- (9) Radiation Management Corporation, Radiological Environmental Monitoring Program - Semiannual Report for Calvert Cliffs Nuclear Power Plant, July 1 through December 31, 1974, RMC-TR-75-06, August 1975.
- (10) Baltimore Gas and Electric Company and Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Semiannual Report, January 1 - June 30, 1975, RMC-TR-75-11, September 1975.
- (11) Baltimore Gas and Electric Company and Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Semiannual Report, July 1 - December 31, 1975, RMC-TR-76-02, March 1976.
- (12) Baltimore Gas and Electric Company and Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Semiannual Report, January 1 - June 30, 1976, RMC-TR-76-06, September 1976.

- (13) Baltimore Gas and Electric Company and Radiation Management Corporation, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Semiannual Report, July 1 - December 31, 1976, RMC-TR-77-07, March 1977.
- (14) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1977, March 1978.
- (15) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1978, March 1979.
- (16) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1979, March 1980.
- (17) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1980, March 1981.
- (18) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1981, March 1982.
- (19) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1982, March 1983.
- (20) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1983, March 1984.
- (21) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1984, March 1985.
- (22) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1985, March 1986.
- (23) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1986, March 1987.
- (24) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1987, March 1988.

- (25) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1988, March 1989.
- (26) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1989, March 1990.
- (27) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1990, March 1991.
- (28) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1991, March 1992.
- (29) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1992, March 1993.
- (30) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1993, March 1994.
- (31) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1994, March 1995.
- (32) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1995, March 1996.
- (33) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1996, March 1997.
- (34) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1997, March 1998.
- (35) Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program Annual Report, January 1 - December 31, 1998, March 1999.
- (36) Baltimore Gas and Electric Company, Radiological Environmental Monitoring Program Pre-Operational Report for the Calvert Cliffs Independent Spent Fuel Storage Installation, August 1990 - November 1993, February 1994.

- (37) Calvert Cliffs Nuclear Power Plant, Unit Number 1, License No. DPR-53, Appendix A, Technical Specifications; Appendix B, Environmental Technical Specifications.
- (38) Calvert Cliffs Nuclear Power Plant, Unit Number 2, License No. DPR-69, Appendix A, Technical Specifications; Appendix B, Environmental Technical Specifications.
- (39) Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, License Nos. DPR-53 and DPR-69, Amendment No. 23 for Unit No. 1, Amendment No. 7 for Unit No. 2, Appendix A Technical Specifications; Appendix B, Environmental Technical Specifications.
- (40) Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, License Nos. DPR-53 and DPR-69, Amendment No. 100 for Unit No. 1, Amendment No. 83 for Unit No. 2, Appendix A Technical Specifications.
- (41) Off-Site Dose Calculation Manual for the Baltimore Gas & Electric Company Calvert Cliffs Nuclear Power Plant, Revision 3, April 1998.
- (42) CP-234, Specification and Surveillance for the Radiological Environmental Monitoring Program, Revision 2, November 1996.
- (43) Teledyne Brown Engineering Environmental Services, Laboratory Procedures.
- (44) Baltimore Gas and Electric Company, Laboratory Procedures Manual, Chemistry Unit, Fossil Engineering and Maintenance Dept., 1998.
- (45) Calvert Cliffs Nuclear Power Plant, Docket Nos. 50-317/318 Semiannual Effluent Release Reports: January - June 1998 and July - December 1998.
- (46) U.S. NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", Revision 1, October 1977.
- (47) U.S. NRC Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", Revision 1, July 1977.
- (48) Baltimore Gas and Electric Company, "Land Use Survey Around Calvert Cliffs Nuclear Power Plant", 1999.
- (49) Letter from Mr. R. E. Denton (BGE) to Mr. T. T. Martin (NRC), dated November 24, 1993, Annual Report of Changes, Tests, and Experiments - 10 CFR 72.48.
- (50) Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, License Nos. DPR-53 and DPR-69, Amendment No. 217 for Unit No. 1, Amendment No. 194 for Unit No. 2, October 1996.

APPENDIX A

Appendix A contains information concerning the environmental samples which were collected during the period January 1, 1999 to December 31, 1999.

Sample locations and specific information about individual locations for the CCNPP Radiological Environmental Monitoring Program are given in Table A-1. Figure A-1 shows the location of the Calvert Cliffs Nuclear Power Plant in relation to Southern Maryland and the Chesapeake Bay. Figures A-2 and A-3 show the locations of the power plant sampling sites in relation to the plant site at different degrees of detail.

Sample locations and specific information about individual locations for the ISFSI radiological environmental monitoring program are given in Table A-2. Figures A-4 and A-5 show the locations of the ISFSI sampling sites in relation to the plant site at different degrees of detail.

(LEFT BLANK)

TABLE OF CONTENTS - SAMPLING LOCATIONS

Table	Title	Page
A-1	Locations of Environmental Sampling Stations for the Calvert Cliffs Nuclear Power Plant..	37
A-2	Locations of Environmental Sampling Stations for the Independent Spent Fuel Storage Installation at Calvert Cliffs.....	43

Figure	Title	Page
A-1	Map of Southern Maryland and Chesapeake Bay Showing Location of Calvert Cliffs Nuclear Power Plant	38
A-2	Calvert Cliffs Nuclear Power Plant Sampling Locations, Scale 1" = 1.35 km.....	39
A-3	Calvert Cliffs Nuclear Power Plant Sampling Locations, Scale 1" = 4.0 km.....	41
A-4	Independent Spent Fuel Storage Installation Sampling Locations	44
A-5	Enlarged Map of the Independent Spent Fuel Storage Installation Sampling Locations	45

(LEFT BLANK)

TABLE A-1
Locations of Environmental Sampling Stations
for the Calvert Cliffs Nuclear Power Plant

Station	Description	Distance¹ (Kilometers)	Direction¹ (Sector)
A1 ²	On Site before Entrance to Camp Conoy	0.7	S
A2	Camp Conoy at Emergency Siren	2.5	SSE
A3	Bay Breeze Road	2.6	SE
A4	Route 765 Lusby	2.9	SSW
A5	Emergency Operations Facility (EOF)	19.3	WNW
DR1	On Site along Cliffs	0.6	NW
DR2	Route 765, Auto Dump	2.7	WNW
DR3	Route 765, Giovanni's Tavern (Knotty Pine)	2.3	W
DR4	Route 765, across from White Sands Drive	2.0	WSW
DR5	Route 765, John's Creek	2.4	SW
DR6 ²	Route 765 Lusby	2.9	SSW
DR7 ²	On Site before Entrance to Camp Conoy	0.7	S
DR8	Camp Conoy at Emergency Siren	2.5	SSE
DR9	Bay Breeze Road	2.6	SE
DR10	Calvert Beach Rd. and Decatur Street	6.4	NW
DR11	Dirt road off Mackall & Parran Roads	6.6	WNW
DR12	Mackall and Bowen Roads	6.7	W
DR13	Mackall Rd. near Wallville	6.1	WSW
DR14	Rodney Point	6.4	SW
DR15	Mill Bridge and Turner Roads	6.2	SSW
DR16	Across from Appeal School	6.5	S
DR17	Cove Point and Little Cove Point Roads	5.9	SSE
DR18	Cove Point	7.1	SE
DR19	Long Beach	4.4	NW
DR20	On Site near shore	0.4	NNW
DR21	Emergency Operations Facility (EOF)	19.3	WNW
DR22	Solomons Island	12.5	S
DR23	Taylor's Island, Carpenter's Property	12.6	ENE
Ia1,2	Discharge Area	0.3	N
Ia3	Camp Conoy	0.9	E
Ia4,5	Patuxent River	N/A	N/A
Ia6	Kenwood Beach ³	10.7	NNW
Ia10	Hog Island	15.3	SSE
Ib1,2,3	Garden Off Bay Breeze Road	2.6	SSE
Ib4,5,6	On Site before Entrance to Camp Conoy	0.7	S
Ib7,8,9	Emergency Operations Facility (EOF)	19.3	WNW
Wa1	Intake Area	0.2	NNE
Wa2	Discharge Area	0.3	N
Wb1	Shoreline at Barge Rd.	0.6	ESE

¹ Distance and direction from the central point between the two containment buildings.

² Common to both the REMP and ISFSI monitoring program.

³ Samples were collected at Hog Island (Ia10) in lieu of Kenwood Beach. See discussion in Program Exceptions (II.b.4).

FIGURE A-1
Map of Southern Maryland and Chesapeake Bay Showing Location of Calvert Cliffs Nuclear Power Plant

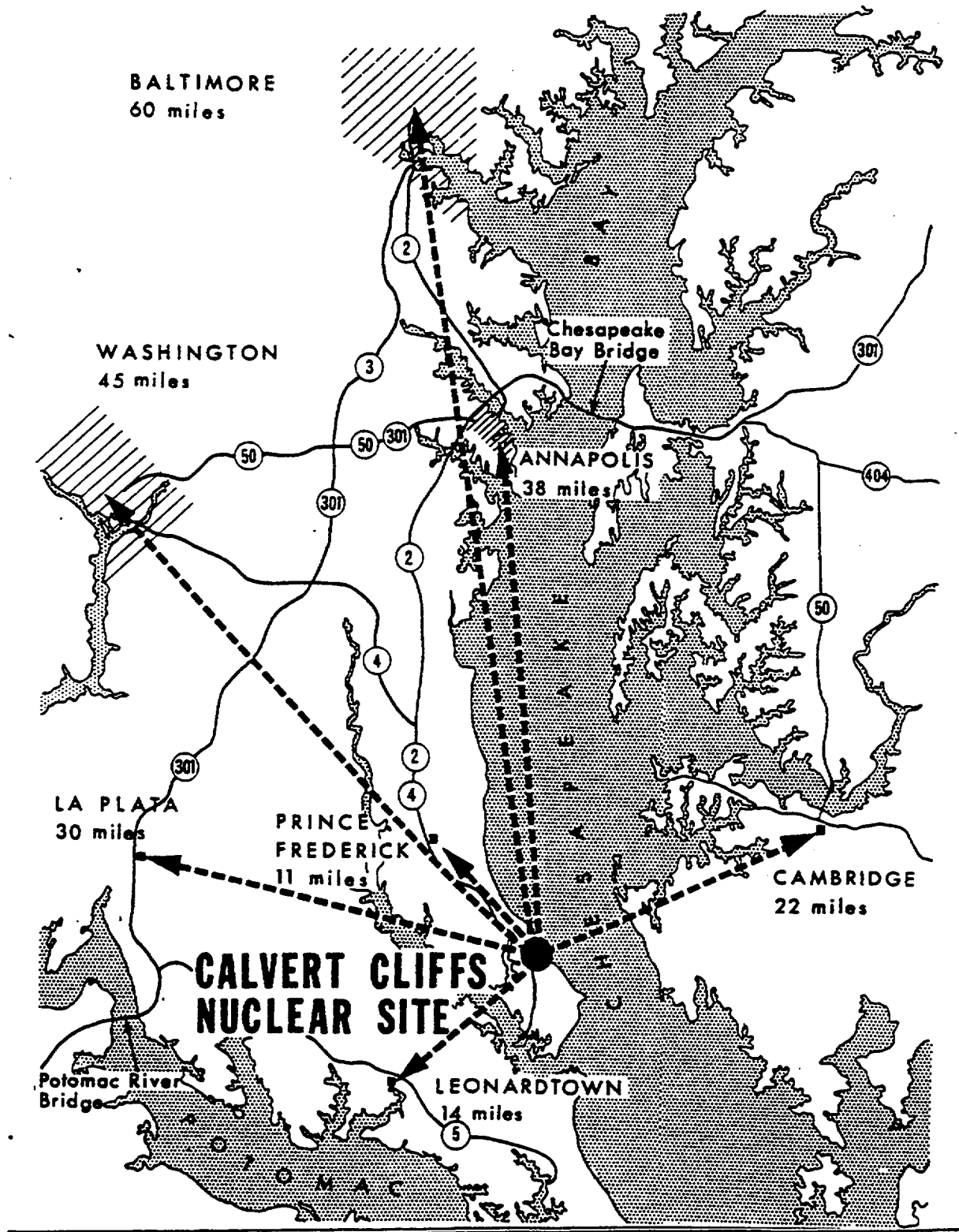
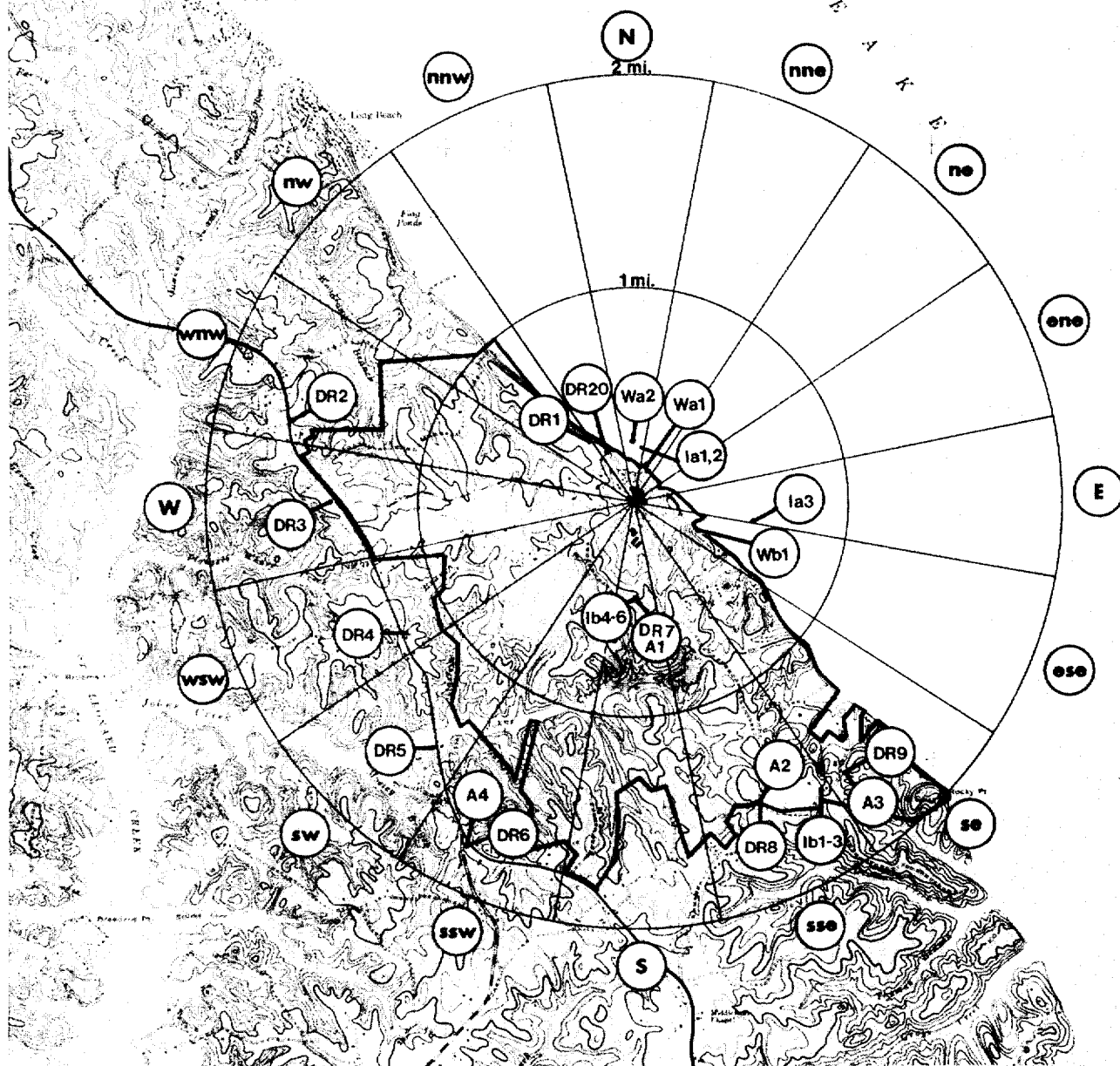


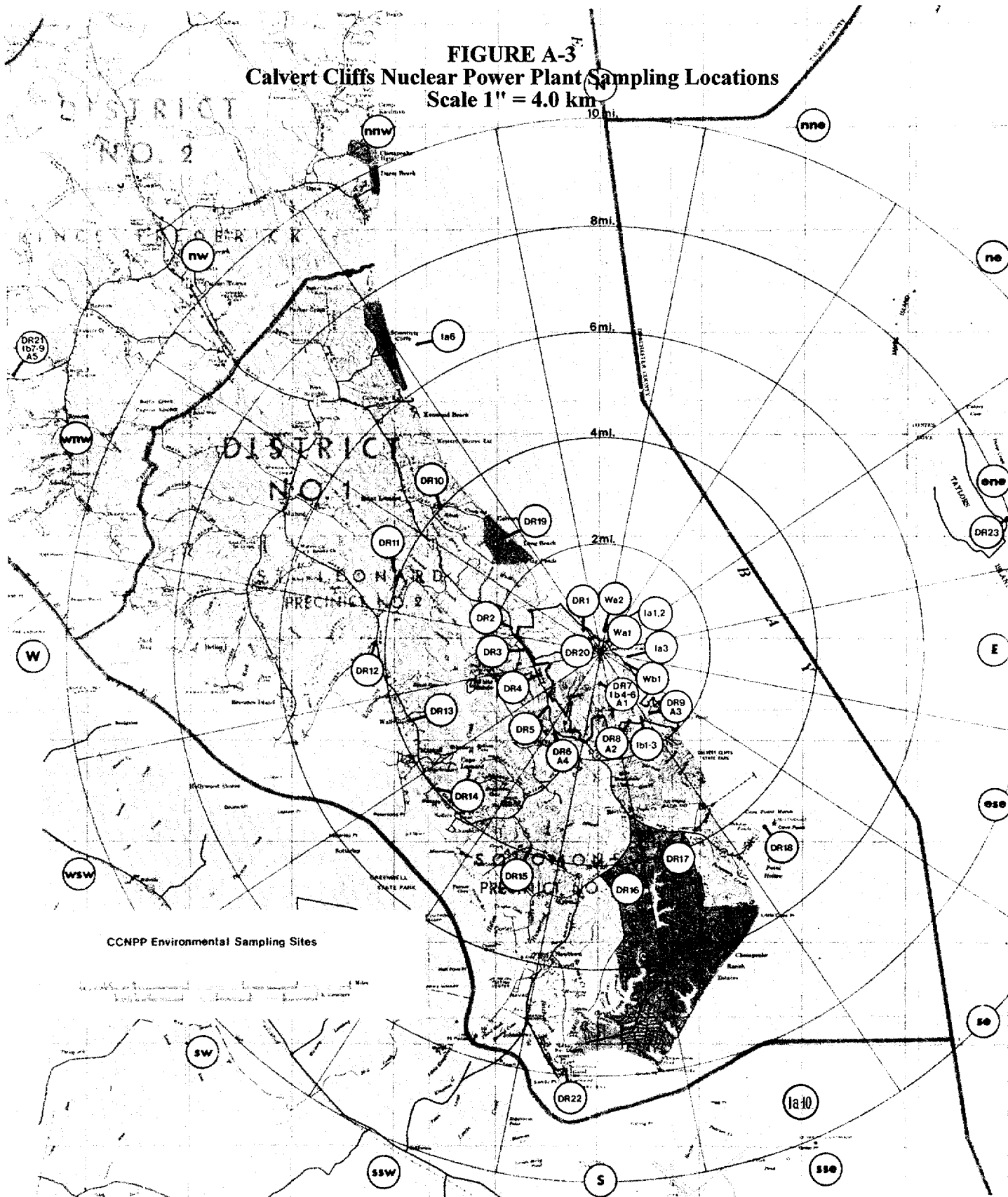
FIGURE A-2
Calvert Cliffs Nuclear Power Plant Sampling Locations
Scale 1" = 1.35 km



CCNPP Environmental Sampling Sites

(LEFT BLANK)

FIGURE A-3
Calvert Cliffs Nuclear Power Plant Sampling Locations
Scale 1" = 4.0 km



CCNPP Environmental Sampling Sites

(LEFT BLANK)

TABLE A-2
Locations of Environmental Sampling Stations for the
Independent Spent Fuel Storage Installation at Calvert Cliffs

Station	Description	Distance¹ (Kilometers)	Direction¹ (Sector)
A1 ²	On Site before Entrance to Camp Conoy	0.7	SE
SFA1	Meteorological Station	0.4	NW
SFA2	CCNPP Visitor's Center	0.7	NNE
SFA3	NNW of ISFSI	0.1	NNW
SFA4	South of ISFSI	0.1	S
SFDR1	Collocated with Plant TLD #159	0.1	SW
SFDR2	Collocated with Plant TLD #160	0.1	N
SFDR3	Collocated with Plant TLD #161	0.1	NNE
SFDR4	Collocated with Plant TLD #162	<0.1	NE
SFDR5	Collocated with Plant TLD #163	<0.1	E
SFDR6	Collocated with Plant TLD #164	0.1	ESE
SFDR7	CCNPP Visitor's Center	0.7	NNE
SFDR8	North Northwest of ISFSI	0.1	NNW
SFDR9	South of ISFSI	0.1	S
SFDR10	NNW of ISFSI	0.1	NNW
SFDR11	WNW of ISFSI	0.1	WNW
SFDR12	West of ISFSI	<0.1	W
SFDR13	SSW of ISFSI	<0.1	SSW
SFDR14	SSE of ISFSI	0.1	SSE
SFDR15	ENE of ISFSI	<0.1	ENE
SFDR16	WSW of ISFSI	<0.1	WSW
DR7 ²	On Site before Entrance to Camp Conoy	0.7	SE
DR30 ³	Meteorological Station	0.4	NW
SFb1	Meteorological Station	0.4	NW
SFb2	CCNPP Visitor's Center	0.7	NNE
SFb3	NNW of ISFSI	0.1	NNW
SFb4	South of ISFSI	0.1	S
SFb5	On Site before Entrance to Camp Conoy	0.7	SE
SFS1	Meteorological Station	0.4	NW
SFS2	CCNPP Visitor's Center	0.7	NNE
SFS3	NNW of ISFSI	0.1	NNW
SFS4	South of ISFSI	0.1	S
SFS5	On Site before Entrance to Camp Conoy	0.7	SE

¹ Distance and direction from the central point of the Independent Spent Fuel Storage Installation.

² Common to both the REMP and ISFSI monitoring program

³ Formerly part of the historical non-Technical Specification monitoring program. DR30 became a Tech Spec location when it was designated part of the ISFSI monitoring program.

FIGURE A-4
Independent Spent Fuel Storage Installation Sampling Locations

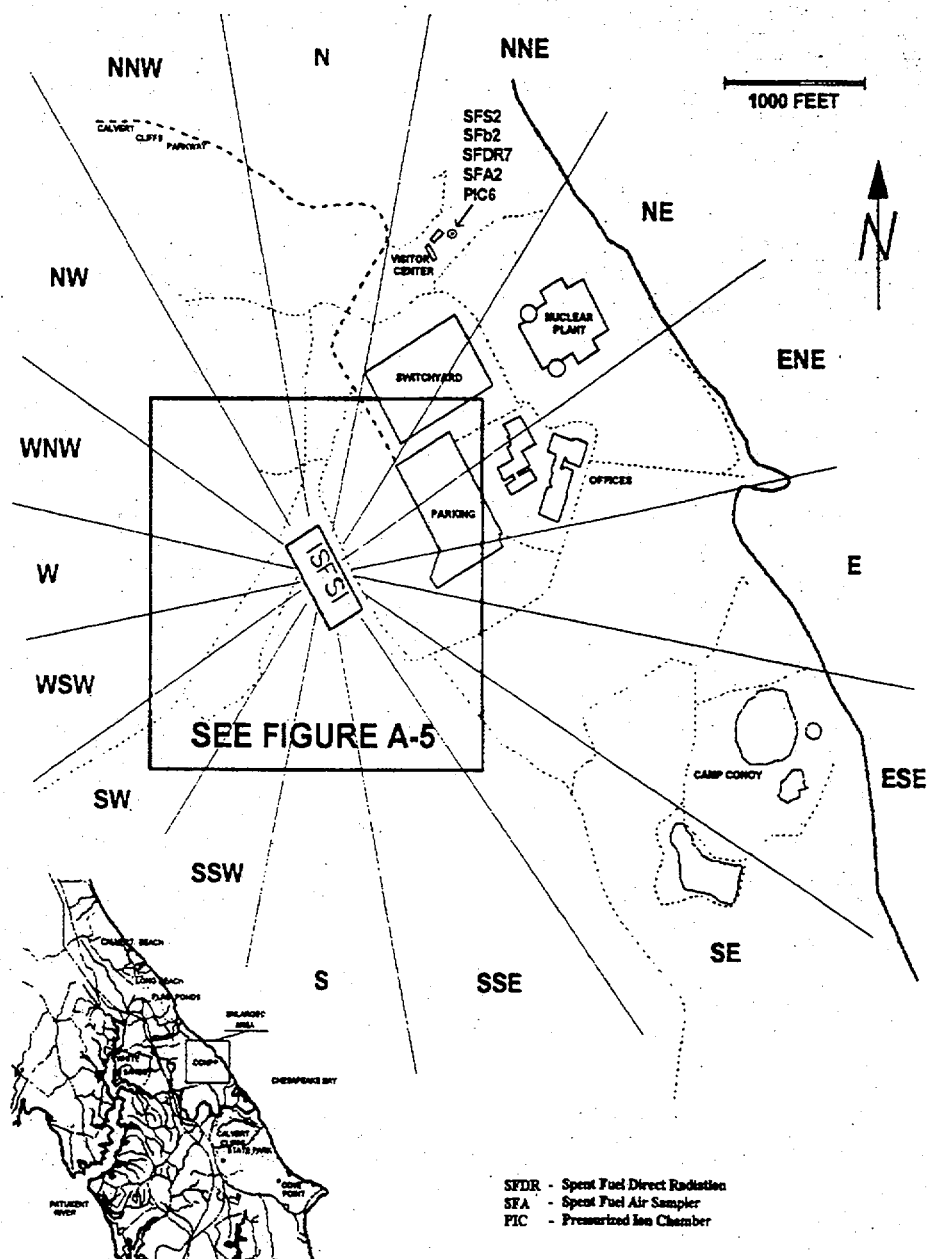
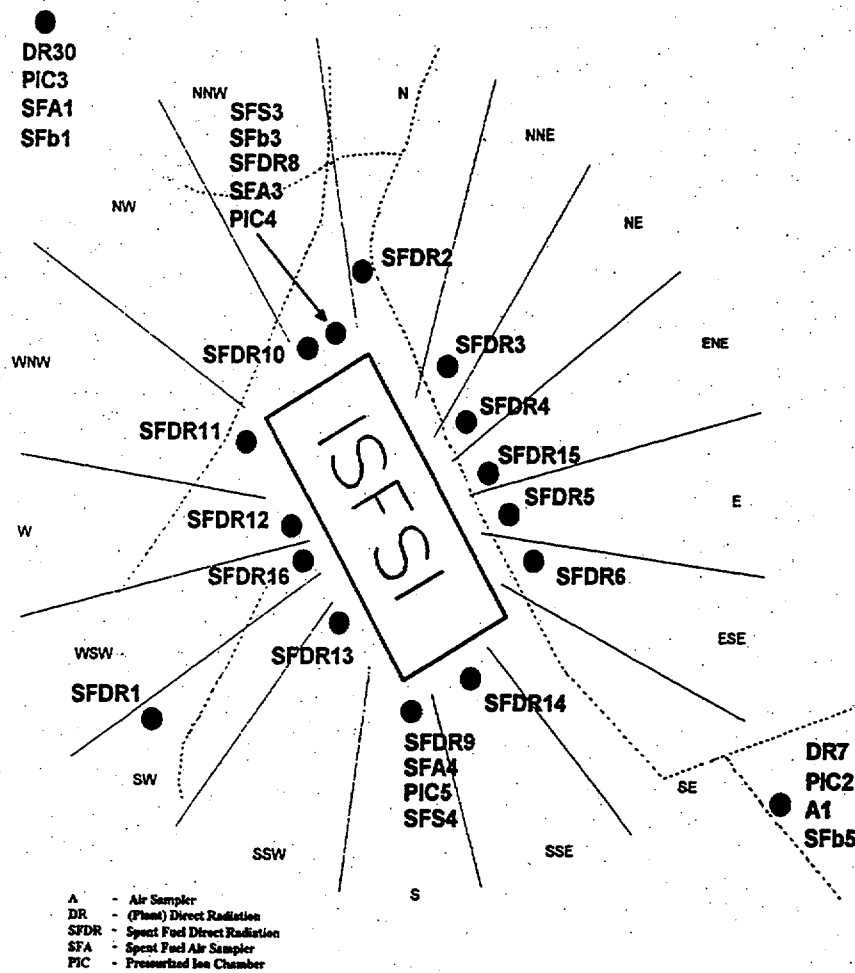


FIGURE A-5
Enlarged Map of the Independent Spent Fuel Storage Installation
Sampling Locations



(LEFT BLANK)

APPENDIX B

Appendix B is a presentation of the analytical results of the 1999 Calvert Cliffs Nuclear Power Plant and the Independent Spent Fuel Storage Installation environmental monitoring programs.

(LEFT BLANK)

TABLE OF CONTENTS - ANALYTICAL RESULTS

Table	Title	Page
B-1	Concentration of Tritium and Gamma Emitters in Bay Water.....	50
B-2	Concentration of Gamma Emitters in the Flesh of Edible Fish.....	51
B-3	Concentration of Gamma Emitters in Oyster Samples	52
B-4	Concentration of Gamma Emitters in Shoreline Sediment	53
B-5	Concentration of Iodine-131 in Filtered Air	54
B-6	Concentration of Beta Emitters in Air Particulates.....	56
B-7	Concentration of Gamma Emitters in Air Particulates.....	60
B-8a	Concentration of Gamma Emitters in Vegetation Samples.....	61
B-8b	Concentration of Gamma Emitters in Vegetation From Locations Around the IFSFI.....	63
B-9	Concentration of Gamma Emitters in Soil Samples From Locations Around the ISFSI	64
B-10	Typical MDA Ranges for Gamma Spectrometry.....	65
B-11	Typical LLDs for Gamma Spectrometry	66
B-12	Direct Radiation	67

Table B-1

Concentration of Tritium and Gamma Emitters in Bay Water
(Results in units of pCi/L +/- 2σ)

Sample Code	Sample Date	H-3 ¹	Gamma Emitters
Wa1 Intake Vicinity	01/15/1999		*
	02/15/1999		*
	03/15/1999		*
	03/31/1999	<42	
	04/15/1999		*
	05/15/1999		*
	06/15/1999		*
	06/30/1999	<39	
	07/15/1999		*
	08/15/1999		*
	09/15/1999		*
	09/30/1999	<41	
	10/15/1999		*
	11/15/1999		*
	12/15/1999		*
	12/31/1999	<60	
Wa2 Discharge Vicinity	01/15/1999		*
	02/15/1999		*
	03/15/1999		*
	03/31/1999	103 +/- 40	
	04/15/1999		*
	05/15/1999		*
	06/15/1999		*
	06/30/1999	616 +/- 43	
	07/15/1999		*
	08/15/1999		*
	09/15/1999		*
	09/30/1999	291 +/- 41	
	10/15/1999		*
	11/15/1999		*
	12/15/1999		*
	12/31/1999	356 +/- 61	

* Non-Natural Gamma Emitters < MDA

¹ Quarterly composite of monthly samples

Table B-2

Concentration of Gamma Emitters in the Flesh of Edible Fish
(Results in units of pCi/kg (wet) \pm 2 σ)

Sample Code	Sample Date	Sample Type	Gamma Emitters
1a1 Discharge Area	08/03/1999	Spot	*
1a2 Discharge Area	08/04/1999	Striped bass	*
1a4 ¹ Patuxent River	08/03/1999	Spot	*
1a5 ¹ Patuxent River	08/04/1999	Striped bass	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table B-3

Concentration of Gamma Emitters in Oyster Samples
(Results in units of pCi/kg (wet) \pm 2 σ)

Sample Code	Sample Date	Ag110m	Gamma Emitters
Ia10 ¹	03/25/1999	12 \pm 6	*
Hog Island	06/16/1999	6 \pm 2	*
	08/03/1999	14 \pm 8	*
	10/06/1999	²	*
Ia3	03/25/1999	35 \pm 9	*
Camp Conoy	06/28/1999	58 \pm 10	*
	08/05/1999	101 \pm 13	*
	10/06/1999	86 \pm 14	*

* Non-Natural Gamma Emitters < MDA

¹ Substitute (or alternate) control location

² This Isotope < MDA

Table B-4

**Concentration of Gamma Emitters in Shoreline Sediment
(Results in units of pCi/kg (dry) $\pm 2\sigma$)**

Sample Code	Sample Date	Gamma Emitters
Wb1 Shoreline at Barge Rd.	05/26/1999	¹
	09/20/1999	¹

¹ Non-Natural Gamma Emitters <MDA

Table B-5

Concentration of Iodine-131 in Filtered Air
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 ¹ EOF
12/28/1998	01/04/1999	*	*	*	*	*
01/04/1999	01/11/1999	*	*	*	*	*
01/11/1999	01/18/1999	*	*	*	*	*
01/18/1999	01/25/1999	*	*	*	*	*
01/25/1999	02/01/1999	*	*	*	*	*
02/01/1999	02/08/1999	*	*	*	*	*
02/08/1999	02/16/1999	*	*	*	*	*
02/16/1999	02/23/1999	*	*	2	*	*
02/23/1999	03/01/1999	*	*	*	*	*
03/01/1999	03/08/1999	*	*	*	*	*
03/08/1999	03/15/1999	*	*	*	*	*
03/15/1999	03/22/1999	*	*	*	*	*
03/22/1999	03/29/1999	*	*	*	*	*
03/29/1999	04/05/1999	*	*	*	*	*
04/05/1999	04/12/1999	*	*	*	*	*
04/12/1999	04/19/1999	*	*	*	*	*
04/19/1999	04/26/1999	*	*	*	*	*
04/26/1999	05/03/1999	*	*	*	*	*
05/03/1999	05/10/1999	*	*	*	*	*
05/10/1999	05/17/1999	*	*	*	*	*
05/17/1999	05/24/1999	*	*	*	*	*
05/24/1999	06/01/1999	*	*	*	*	*
06/01/1999	06/07/1999	*	*	*	*	*
06/07/1999	06/14/1999	*	*	*	*	*
06/14/1999	06/21/1999	*	*	*	*	*
06/21/1999	06/28/1999	*	*	*	*	*
06/28/1999	07/06/1999	*	*	*	*	*
07/06/1999	07/12/1999	*	*	*	*	*
07/12/1999	07/19/1999	*	*	*	*	*
07/19/1999	07/26/1999	*	*	*	*	*
07/26/1999	08/02/1999	*	*	*	*	*

* < MDA

¹ Control Location² Sampler malfunction/low flow

Table B-5

Concentration of Iodine-131 in Filtered Air
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 ¹ EOF
08/02/1999	08/09/1999	*	*	*	*	*
08/09/1999	08/16/1999	*	*	*	*	*
08/16/1999	08/23/1999	*	*	*	*	*
08/23/1999	08/30/1999	1	*	*	*	*
08/30/1999	09/07/1999	*	*	*	*	*
09/07/1999	09/13/1999	*	*	*	*	*
09/13/1999	09/20/1999	1	*	*	2	*
09/20/1999	09/27/1999	*	*	*	*	*
09/27/1999	10/04/1999	*	*	*	*	*
10/04/1999	10/11/1999	*	*	*	*	*
10/11/1999	10/18/1999	*	*	*	*	*
10/18/1999	10/25/1999	*	*	*	*	*
10/25/1999	11/01/1999	*	*	*	*	*
11/01/1999	11/08/1999	*	*	*	*	*
11/08/1999	11/15/1999	*	*	*	*	*
11/15/1999	11/22/1999	*	*	*	*	*
11/22/1999	11/29/1999	*	*	*	*	*
11/29/1999	12/06/1999	*	*	*	*	*
12/06/1999	12/13/1999	*	*	*	*	*
12/13/1999	12/20/1999	*	*	*	*	*
12/20/1999	12/28/1999	*	*	*	*	*
12/28/1999	01/03/2000	*	*	*	*	*

* < MDA

¹ Sampler malfunction/low flow

² Iodine cartridge missing

Table B-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 ¹ EOF
12/28/1998	01/04/1999	1.7 +/- 0.2	1.4 +/- 0.2	1.6 +/- 0.2	1.8 +/- 0.2	1.8 +/- 0.3
01/04/1999	01/11/1999	1.8 +/- 0.2	1.9 +/- 0.3	1.9 +/- 0.2	1.9 +/- 0.2	2.1 +/- 0.3
01/11/1999	01/18/1999	1.3 +/- 0.2	1.4 +/- 0.2	1.0 +/- 0.2	1.4 +/- 0.2	1.8 +/- 0.3
01/18/1999	01/25/1999	0.9 +/- 0.1	0.8 +/- 0.2	0.9 +/- 0.2	1.2 +/- 0.2	1.2 +/- 0.2
01/25/1999	02/01/1999	1.3 +/- 0.2	1.5 +/- 0.2	1.4 +/- 0.2	1.5 +/- 0.2	1.7 +/- 0.2
02/01/1999	02/08/1999	1.0 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2	1.7 +/- 0.2
02/08/1999	02/16/1999	1.8 +/- 0.2	1.5 +/- 0.2	1.3 +/- 0.2	1.7 +/- 0.2	1.8 +/- 0.2
02/16/1999	02/23/1999	2.0 +/- 0.2	2.2 +/- 0.2	²	1.8 +/- 0.2	2.2 +/- 0.2
02/23/1999	03/01/1999	1.1 +/- 0.2	1.1 +/- 0.2	0.8 +/- 0.2	1.5 +/- 0.2	1.8 +/- 0.3
03/01/1999	03/08/1999	1.1 +/- 0.2	1.2 +/- 0.2	1.1 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2
03/08/1999	03/15/1999	0.6 +/- 0.2	0.8 +/- 0.2	0.7 +/- 0.2	0.8 +/- 0.2	1.2 +/- 0.2
03/15/1999	03/22/1999	0.9 +/- 0.2	1.0 +/- 0.2	1.2 +/- 0.2	1.0 +/- 0.2	1.6 +/- 0.2
03/22/1999	03/29/1999	1.0 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2	1.6 +/- 0.2
03/29/1999	04/05/1999	1.1 +/- 0.2	0.9 +/- 0.2	0.9 +/- 0.2	1.2 +/- 0.2	1.6 +/- 0.2
04/05/1999	04/12/1999	1.2 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2	1.2 +/- 0.2	1.7 +/- 0.2
04/12/1999	04/19/1999	1.3 +/- 0.2	1.6 +/- 0.2	1.5 +/- 0.2	1.3 +/- 0.2	1.6 +/- 0.2
04/19/1999	04/26/1999	1.4 +/- 0.2	1.2 +/- 0.2	1.5 +/- 0.2	1.4 +/- 0.2	1.5 +/- 0.2
04/26/1999	05/03/1999	1.2 +/- 0.2	1.0 +/- 0.2	1.4 +/- 0.2	1.4 +/- 0.2	1.2 +/- 0.2
05/03/1999	05/10/1999	1.1 +/- 0.2	1.0 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2
05/10/1999	05/17/1999	1.0 +/- 0.2	0.9 +/- 0.2	1.2 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2
05/17/1999	05/24/1999	1.1 +/- 0.2	0.8 +/- 0.2	1.4 +/- 0.2	0.9 +/- 0.2	0.9 +/- 0.2
05/24/1999	06/01/1999	1.8 +/- 0.2	1.4 +/- 0.2	1.6 +/- 0.2	1.9 +/- 0.2	1.7 +/- 0.2
06/01/1999	06/07/1999	1.6 +/- 0.2	1.5 +/- 0.2	1.6 +/- 0.3	1.0 +/- 0.2	1.6 +/- 0.2
06/07/1999	06/14/1999	1.0 +/- 0.2	1.0 +/- 0.2	1.7 +/- 0.3	1.4 +/- 0.2	1.3 +/- 0.2
06/14/1999	06/21/1999	0.9 +/- 0.2	1.0 +/- 0.2	1.2 +/- 0.3	1.0 +/- 0.2	1.1 +/- 0.2
06/21/1999	06/28/1999	1.3 +/- 0.3	1.1 +/- 0.2	1.1 +/- 0.3	1.3 +/- 0.2	1.3 +/- 0.2
06/28/1999	07/06/1999	1.1 +/- 0.2	0.7 +/- 0.2	1.0 +/- 0.2	1.3 +/- 0.2	1.5 +/- 0.2
07/06/1999	07/12/1999	1.3 +/- 0.2	1.1 +/- 0.2	1.1 +/- 0.3	1.1 +/- 0.3	1.6 +/- 0.3
07/12/1999	07/19/1999	1.2 +/- 0.2	1.3 +/- 0.2	1.3 +/- 0.2	1.3 +/- 0.2	1.2 +/- 0.2
07/19/1999	07/26/1999	1.5 +/- 0.2	1.3 +/- 0.2	1.8 +/- 0.2	2.1 +/- 0.2	1.6 +/- 0.2
07/26/1999	08/02/1999	2.0 +/- 0.3	2.5 +/- 0.3	1.8 +/- 0.3	1.5 +/- 0.2	2.1 +/- 0.2

¹ Control Location² Sampler malfunction/low flow

Table B-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 ¹ EOF
08/02/1999	08/09/1999	1.3 +/- 0.2	1.3 +/- 0.2	1.8 +/- 0.2	1.8 +/- 0.2	1.9 +/- 0.3
08/09/1999	08/16/1999	1.4 +/- 0.2	1.6 +/- 0.2	1.2 +/- 0.2	2.1 +/- 0.2	1.9 +/- 0.2
08/16/1999	08/23/1999	1.6 +/- 0.2	1.4 +/- 0.2	1.4 +/- 0.2	1.9 +/- 0.2	1.4 +/- 0.2
08/23/1999	08/30/1999	²	1.5 +/- 0.2	1.8 +/- 0.3	1.7 +/- 0.2	2.2 +/- 0.2
08/30/1999	09/07/1999	1.1 +/- 0.2	0.9 +/- 0.1	1.0 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2
09/07/1999	09/13/1999	1.8 +/- 0.2	1.7 +/- 0.2	1.8 +/- 0.2	2.1 +/- 0.3	2.5 +/- 0.3
09/13/1999	09/20/1999	²	2.7 +/- 0.3	2.5 +/- 0.4	2.4 +/- 0.3	1.8 +/- 0.2
09/20/1999	09/27/1999	2.2 +/- 0.2	1.8 +/- 0.2	2.4 +/- 0.3	2.4 +/- 0.2	2.2 +/- 0.2
09/27/1999	10/04/1999	2.1 +/- 0.2	1.5 +/- 0.2	2.6 +/- 0.2	2.9 +/- 0.3	2.8 +/- 0.2
10/04/1999	10/11/1999	2.0 +/- 0.2	1.5 +/- 0.2	1.5 +/- 0.2	1.8 +/- 0.3	1.9 +/- 0.2
10/11/1999	10/18/1999	1.1 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2	1.3 +/- 0.2	1.5 +/- 0.2
10/18/1999	10/25/1999	1.4 +/- 0.2	1.5 +/- 0.2	1.2 +/- 0.2	1.6 +/- 0.2	1.6 +/- 0.2
10/25/1999	11/01/1999	2.5 +/- 0.2	2.8 +/- 0.3	2.2 +/- 0.2	2.5 +/- 0.2	2.4 +/- 0.2
11/01/1999	11/08/1999	2.4 +/- 0.3	1.8 +/- 0.2	1.9 +/- 0.2	2.4 +/- 0.2	2.5 +/- 0.3
11/08/1999	11/15/1999	3.9 +/- 0.3	3.3 +/- 0.2	3.1 +/- 0.2	3.2 +/- 0.3	3.9 +/- 0.3
11/15/1999	11/22/1999	1.2 +/- 0.2	1.3 +/- 0.2	1.2 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2
11/22/1999	11/29/1999	1.4 +/- 0.2	1.2 +/- 0.2	1.2 +/- 0.2	1.1 +/- 0.2	1.4 +/- 0.2
11/29/1999	12/06/1999	2.1 +/- 0.3	2.0 +/- 0.2	1.6 +/- 0.2	1.9 +/- 0.2	2.0 +/- 0.2
12/06/1999	12/13/1999	2.1 +/- 0.2	1.7 +/- 0.2	1.4 +/- 0.2	1.8 +/- 0.2	1.5 +/- 0.2
12/13/1999	12/20/1999	1.7 +/- 0.2	1.6 +/- 0.2	1.3 +/- 0.2	1.7 +/- 0.2	1.7 +/- 0.2
12/20/1999	12/28/1999	2.6 +/- 0.2	2.0 +/- 0.2	1.9 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.2
12/28/1999	01/03/2000	3.0 +/- 0.3	2.5 +/- 0.3	2.7 +/- 0.2	2.7 +/- 0.3	2.8 +/- 0.3

¹ Control location² Sampler malfunction/low flow

Table B-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2σ)

Start Date	Stop Date	SFA1 MET Station	SFA2 ¹ Visitors Center	SFA3 NNW of ISFSI	SFA4 South of ISFSI
12/28/1998	01/04/1999	2.1 +/- 0.3	1.7 +/- 0.3	1.8 +/- 0.2	2.1 +/- 0.2
01/04/1999	01/11/1999	3.1 +/- 0.4	2.4 +/- 0.3	2.5 +/- 0.3	2.1 +/- 0.2
01/11/1999	01/18/1999	2.3 +/- 0.3	1.2 +/- 0.2	1.7 +/- 0.2	1.7 +/- 0.2
01/18/1999	01/25/1999	1.7 +/- 0.3	1.0 +/- 0.2	1.4 +/- 0.2	1.1 +/- 0.2
01/25/1999	02/01/1999	2.4 +/- 0.3	1.6 +/- 0.2	1.8 +/- 0.2	1.5 +/- 0.2
02/01/1999	02/08/1999	1.3 +/- 0.2	1.2 +/- 0.2	1.5 +/- 0.2	1.4 +/- 0.2
02/08/1999	02/16/1999	1.4 +/- 0.2	1.5 +/- 0.2	2.0 +/- 0.2	1.5 +/- 0.2
02/16/1999	02/23/1999	1.9 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.2
02/23/1999	03/01/1999	1.3 +/- 0.3	1.2 +/- 0.2	1.5 +/- 0.2	0.9 +/- 0.2
03/01/1999	03/08/1999	1.1 +/- 0.2	1.2 +/- 0.2	1.4 +/- 0.2	1.3 +/- 0.2
03/08/1999	03/15/1999	0.7 +/- 0.2	0.7 +/- 0.2	0.8 +/- 0.3	0.8 +/- 0.2
03/15/1999	03/22/1999	1.0 +/- 0.1	0.9 +/- 0.2	1.3 +/- 0.2	1.0 +/- 0.2
03/22/1999	03/29/1999	1.4 +/- 0.2	1.5 +/- 0.2	1.7 +/- 0.3	1.4 +/- 0.2
03/29/1999	04/05/1999	0.9 +/- 0.2	1.0 +/- 0.2	1.4 +/- 0.2	1.2 +/- 0.2
04/05/1999	04/12/1999	1.2 +/- 0.2	1.2 +/- 0.2	1.6 +/- 0.2	1.4 +/- 0.2
04/12/1999	04/19/1999	1.4 +/- 0.2	1.3 +/- 0.2	1.6 +/- 0.2	1.6 +/- 0.2
04/19/1999	04/26/1999	1.3 +/- 0.2	²	1.6 +/- 0.2	1.5 +/- 0.2
04/26/1999	05/03/1999	1.2 +/- 0.2	1.4 +/- 0.2	1.1 +/- 0.2	1.2 +/- 0.2
05/03/1999	05/10/1999	1.1 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2	1.1 +/- 0.2
05/10/1999	05/17/1999	1.1 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2	1.0 +/- 0.2
05/17/1999	05/24/1999	0.9 +/- 0.2	0.9 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2
05/24/1999	06/01/1999	1.9 +/- 0.2	1.9 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.2
06/01/1999	06/07/1999	1.7 +/- 0.3	1.6 +/- 0.3	1.6 +/- 0.2	1.3 +/- 0.2
06/07/1999	06/14/1999	1.3 +/- 0.2	1.3 +/- 0.2	1.5 +/- 0.2	1.4 +/- 0.2
06/14/1999	06/21/1999	1.0 +/- 0.2	0.8 +/- 0.2	1.1 +/- 0.2	0.7 +/- 0.2
06/21/1999	06/28/1999	1.6 +/- 0.3	1.3 +/- 0.3	1.5 +/- 0.3	1.3 +/- 0.3
06/28/1999	07/06/1999	1.5 +/- 0.2	1.4 +/- 0.2	1.6 +/- 0.2	1.3 +/- 0.2
07/06/1999	07/12/1999	1.9 +/- 0.3	1.9 +/- 0.3	1.8 +/- 0.3	1.5 +/- 0.3
07/12/1999	07/19/1999	1.5 +/- 0.2	1.4 +/- 0.2	1.3 +/- 0.2	1.0 +/- 0.2
07/19/1999	07/26/1999	1.6 +/- 0.2	2.1 +/- 0.2	2.1 +/- 0.2	1.5 +/- 0.2
07/26/1999	08/02/1999	2.8 +/- 0.3	2.4 +/- 0.3	2.3 +/- 0.3	2.0 +/- 0.2
08/02/1999	08/09/1999	2.0 +/- 0.3	1.9 +/- 0.2	1.9 +/- 0.2	1.3 +/- 0.2
08/09/1999	08/16/1999	1.5 +/- 0.2	2.2 +/- 0.2	2.1 +/- 0.2	1.6 +/- 0.2
08/16/1999	08/23/1999	1.5 +/- 0.3	1.7 +/- 0.2	1.8 +/- 0.2	1.3 +/- 0.2
08/23/1999	08/30/1999	2.3 +/- 0.3	2.2 +/- 0.3	2.5 +/- 0.3	1.9 +/- 0.2

¹ Control location² Sampler malfunction/low flow

Table B-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2 σ)

Start Date	Stop Date	SFA1 MET Station	SFA2 ¹ Visitors Center	SFA3 NNW of ISFSI	SFA4 South of ISFSI
08/30/1999	09/07/1999	1.5 +/- 0.2	1.3 +/- 0.2	1.2 +/- 0.2	1.1 +/- 0.1
09/07/1999	09/13/1999	2.5 +/- 0.3	2.4 +/- 0.3	2.3 +/- 0.2	2.1 +/- 0.2
09/13/1999	09/20/1999	1.8 +/- 0.2	2.4 +/- 0.3	2.2 +/- 0.3	2.2 +/- 0.2
09/20/1999	09/27/1999	2.5 +/- 0.2	2.3 +/- 0.3	2.5 +/- 0.3	2.1 +/- 0.2
09/27/1999	10/04/1999	2.7 +/- 0.2	2.8 +/- 0.2	2.7 +/- 0.3	2.2 +/- 0.2
10/04/1999	10/11/1999	1.9 +/- 0.2	1.8 +/- 0.2	1.8 +/- 0.2	1.3 +/- 0.1
10/11/1999	10/18/1999	1.4 +/- 0.2	1.3 +/- 0.2	1.2 +/- 0.2	1.4 +/- 0.2
10/18/1999	10/25/1999	1.5 +/- 0.2	1.4 +/- 0.2	1.9 +/- 0.2	1.4 +/- 0.2
10/25/1999	11/01/1999	2.5 +/- 0.2	2.6 +/- 0.3	2.8 +/- 0.3	2.8 +/- 0.2
11/01/1999	11/08/1999	2.5 +/- 0.2	2.2 +/- 0.2	2.6 +/- 0.3	2.9 +/- 0.3
11/08/1999	11/15/1999	4.0 +/- 0.3	3.4 +/- 0.3	3.6 +/- 0.3	4.2 +/- 0.3
11/15/1999	11/22/1999	1.3 +/- 0.2	1.4 +/- 0.2	1.2 +/- 0.2	1.8 +/- 0.3
11/22/1999	11/29/1999	1.4 +/- 0.2	1.3 +/- 0.2	1.4 +/- 0.2	²
11/29/1999	12/06/1999	2.0 +/- 0.2	1.9 +/- 0.2	2.0 +/- 0.2	2.3 +/- 0.2
12/06/1999	12/13/1999	1.8 +/- 0.3	1.8 +/- 0.2	1.7 +/- 0.2	1.6 +/- 0.2
12/13/1999	12/20/1999	2.1 +/- 0.3	1.6 +/- 0.2	1.5 +/- 0.2	1.6 +/- 0.2
12/20/1999	12/28/1999	2.5 +/- 0.2	2.4 +/- 0.2	2.0 +/- 0.2	2.9 +/- 0.3
12/28/1999	01/03/2000	3.2 +/- 0.3	3.0 +/- 0.3	2.8 +/- 0.2	3.2 +/- 0.3

¹ Control location² Sampler malfunction/low flow

Table B-7

Concentration of Gamma Emitters in Air Particulates
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Sample Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 ¹ EOF
01/15/1999	*	*	*	*	*
02/15/1999	*	*	*	*	*
03/15/1999	*	*	*	*	*
04/15/1999	*	*	*	*	*
05/15/1999	*	*	*	*	*
06/15/1999	*	*	*	*	*
07/15/1999	*	*	*	*	*
08/15/1999	*	*	*	*	*
09/15/1999	*	*	*	*	*
10/15/1999	*	*	*	*	*
11/15/1999	*	*	*	*	*
12/15/1999	*	*	*	*	*

Sample Date	SFA1 MET Station	SFA2 ¹ Visitors Center	SFA3 NNW of ISFSI	SFA4 South of ISFSI
01/15/1999	*	*	*	*
02/15/1999	*	*	*	*
03/15/1999	*	*	*	*
04/15/1999	*	*	*	*
05/15/1999	*	*	*	*
06/15/1999	*	*	*	*
07/15/1999	*	*	*	*
08/15/1999	*	*	*	*
09/15/1999	*	*	*	*
10/15/1999	*	*	*	*
11/15/1999	*	*	*	*
12/15/1999	*	*	*	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table B-8a

Concentration of Gamma Emitters in Vegetation Samples
(Results in units of pCi/kg (wet) \pm 2 σ)

Sample Code	Sample Date	Sample Type	Gamma Emitters
Ib1 Bay Breeze Rd	06/28/1999	Collards	*
	07/26/1999	Collards	*
	08/30/1999	Collards	*
	09/27/1999	Collards	*
	10/25/1999	Collards	*
Ib2 Bay Breeze Rd	06/28/1999	Cabbage	*
	07/26/1999	Cabbage	*
	08/30/1999	Cabbage	*
	09/27/1999	Cabbage	*
	10/25/1999	Cabbage	*
Ib3 Bay Breeze Rd	06/28/1999	Cauliflower	*
	07/26/1999	Cauliflower	*
	08/30/1999	Cauliflower	*
	09/27/1999	Broccoli	*
	10/25/1999	Brussels sprouts	*
Ib4 Camp Conoy Entrance	06/28/1999	Collards	*
	07/26/1999	Collards	*
	08/30/1999	Collards	*
	09/27/1999	Collards	*
	10/25/1999	Collards	*
Ib5 Camp Conoy Entrance	06/28/1999	Cabbage	*
	07/26/1999	Cabbage	*
	08/30/1999	Cabbage	*
	09/27/1999	Cabbage	*
	10/25/1999	Cabbage	*
Ib6 Camp Conoy Entrance	06/28/1999	Cauliflower	*
	07/26/1999	Cauliflower	*
	08/30/1999	Cauliflower	*
	09/27/1999	Broccoli	*
	10/25/1999	Brussels sprouts	*
Ib7 ¹ EOF	06/28/1999	Collards	*
	07/26/1999	Collards	*
	08/30/1999	Collards	*
	09/27/1999	Collards	*
	10/25/1999	Collards	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table B-8a

Concentration of Gamma Emitters in Vegetation Samples
(Results in units of pCi/kg (wet) \pm 2 σ)

Sample Code	Sample Date	Sample Type	Gamma Emitters
lb8 ¹ EOF	06/28/1999	Cabbage	*
	07/26/1999	Cabbage	*
	08/30/1999	Cabbage	*
	09/27/1999	Cabbage	*
	10/25/1999	Cabbage	*
lb9 ¹ EOF	06/28/1999	Cauliflower	*
	07/26/1999	Cauliflower	*
	08/30/1999	Cauliflower	*
	09/27/1999	Broccoli	*
	10/25/1999	Brussels sprouts	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table B-8b

**Concentration of Gamma Emitters in Vegetation
From Locations Around the IFSFI
(Results in units of pCi/kg (wet) \pm 2 σ)**

Sample Code	Sample Date	Gamma Emitters
SFb1	02/16/1999	*
MET Station	06/14/1999	*
	09/13/1999	*
	11/08/1999	*
SFb2 ¹	02/16/1999	*
Visitor's Center	06/14/1999	*
	09/13/1999	*
	11/08/1999	*
SFb3	02/16/1999	*
NNW of ISFSI	06/14/1999	*
	09/13/1999	*
	11/08/1999	*
SFb4	02/16/1999	*
South of ISFSI	06/14/1999	*
	09/13/1999	*
	11/08/1999	*
SFb5	02/16/1999	*
On Site before Entrance to Camp Conoy	06/14/1999	*
	09/13/1999	*
	11/08/1999	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table B-9

**Concentration of Gamma Emitters in Soil Samples
From Locations Around the ISFSI
(Results in units of pCi/kg (dry) \pm 2 σ)**

Sample Code	Sample Date	Cs-137	Gamma Emitters
SFS1	02/16/1999	¹	*
MET station	06/14/1999	¹	*
	09/13/1999	¹	*
	11/08/1999	¹	*
SFS2 ²	02/16/1999	103 \pm 45	*
Visitors Center	06/14/1999	107 \pm 36	*
	09/13/1999	99 \pm 37	*
	11/08/1999	229 \pm 63	*
SFS3	02/16/1999	787 \pm 99	*
NNW of ISFSI	06/14/1999	655 \pm 74	*
	09/13/1999	718 \pm 91	*
	11/08/1999	920 \pm 86	*
SFS4	02/16/1999	48 \pm 49	*
South of ISFSI	06/14/1999	38 \pm 42	*
	09/13/1999	¹	*
	11/08/1999	¹	*
SFS5	02/16/1999	419 \pm 56	*
Entrance to Camp	06/14/1999	205 \pm 39	*
Conoy	09/13/1999	700 \pm 69	*
	11/08/1999	720 \pm 83	*

* Non-Natural Gamma Emitters < MDA

¹ This Isotope < MDA

² Control Location

TABLE B-10
Typical MDA Ranges for Gamma Spectrometry

Selected Nuclides	Bay Water pCi/l	Fish pCi/kg	Shellfish pCi/kg	Shoreline pCi/kg	Vegetation pCi/kg	Soil pCi/kg	Particulates 10 ⁻³ pCi/m ³
Na-22	1.8 - 4.0	22 - 34	11 - 36	18 - 56	18 - 51	19 - 98	1.2 - 7.7
Cr-51	13 - 35	110 - 155	81 - 269	106 - 252	97 - 194	117 - 634	13 - 98
Mn-54	1.6 - 3.2	13 - 22	10 - 30	16 - 49	15 - 36	17 - 106	1.2 - 9.2
Co-58	1.5 - 3.5	17 - 24	10 - 33	15 - 43	14 - 35	16 - 94	1.4 - 9.7
Fe-59	3.6 - 9.4	47 - 69	27 - 76	31 - 90	31 - 88	12 - 203	3.6 - 24.9
Co-60	1.7 - 3.6	18 - 28	11 - 33	17 - 44	18 - 45	19 - 114	1.1 - 7.3
Zn-65	3.2 - 8.0	23 - 51	24 - 69	43 - 134	34 - 92	47 - 256	2.2 - 16.7
Nb-95	1.7 - 4.3	19 - 28	12 - 40	20 - 49	15 - 34	19 - 109	1.9 - 13.7
Zr-95	2.8 - 6.0	29 - 41	22 - 59	28 - 78	27 - 58	27 - 180	2.5 - 15.8
Ru-106	13 - 26	116-177	74 - 254	123 - 384	117 - 284	127 - 851	8.0 - 56.4
Ag-110m	1.5 - 2.8	14 - 18	9 - 27	14 - 39	12 - 33	16 - 121	0.9 - 16.6
Te-129m	20 - 49	175 - 280	123 - 425	174 - 422	142 - 345	203 - 1160	2.2 - 133
I-131	2 - 23	28 - 84	18 - 117	14 - 34	14 - 38	21 - 137	*
Cs-134	1.8 - 2.6	12 - 16	10 - 25	19 - 52	16 - 36	19 - 88	1.2 - 8.6
Cs-137	1.5 - 2.7	13 - 18	8 - 27	16 - 43	14 - 35	12 - 99	0.9 - 6.0
Ba-140	6 - 34	90 - 183	58 - 242	49 - 135	44 - 125	70 - 339	13.2 - 105
Ce-144	9 - 14	34 - 51	29 - 120	74 - 138	59 - 119	71 - 342	3.2 - 49.1

*The MDA range for I-131 measured on silver zeolite cartridge is typically 2.5×10^{-3} to 9.7×10^{-3} pCi/m³.

TABLE B-11
Typical LLDs for Gamma Spectrometry

Selected Nuclides	Bay Water pCi/l	Fish pCi/kg	Shellfish pCi/kg	Sediment pCi/kg	Particulate 10 ⁻³ pCi/m ³	Precipitation pCi/l	Vegetation pCi/Kg	Soil pCi/Kg	Well Water pCi/l
Na-22	2.9	22	22	24	2.9	2.9	35	24	2.9
Cr-51	17	88	88	110	12	17	162	110	17
Mn-54	2.4	17	17	18	2.1	2.4	27	18	2.4
Co-58	2.4	16	16	17	2.0	2.4	25	17	2.4
Fe-59	5.2	37	37	38	4.6	5.2	60	38	5.2
Co-60	2.8	22	22	21	2.7	2.8	33	21	2.8
Zn-65	5.6	23	23	54	2.8	5.6	66	54	5.6
Nb-95	2.2	15	15	18	1.9	2.2	25	18	2.2
Zr-95	3.8	27	27	29	3.3	3.8	44	29	3.8
Ru-106	20	135	135	146	17	20	223	146	20
Ag-110m	2.1	14	14	16	1.8	2.1	25	16	2.1
Te-129m	26	149	149	180	20	26	265	180	26
I-131	2.0	11	11	14	1.5*	2.0	20	14	2.0
Cs-134	2.2	15	15	20	1.9	2.2	24	20	2.2
Cs-137	2.3	15	15	17	1.8	2.3	27	17	2.3
Ba-140	7.3	48	48	54	6.1	7.3	80	54	7.3
La-140	4.1	26	26	25	3.4	4.1	41	25	4.1
Ce-144	12	43	43	75	5.5	12	101	75	12

*The LLD for I-131 measured on silver zeolite cartridge is 7.9x10⁻³ pCi/m³ for NaI1 Detector and 5.3 x10⁻³ pCi/m³ for NaI2 Detector

Table B-12

Direct Radiation
(Results in Units of mR/90 days +/- 2σ)

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
DR01	On Site, along Cliffs	12.91 +/- 1.52	14.40 +/- 0.96	12.98 +/- 1.70	13.44 +/- 1.53
DR02	Route 765, Auto Dump	10.59 +/- 1.13	10.69 +/- 1.47	10.39 +/- 1.45	¹
DR03	Route 765, Giovanni's Tavern	11.04 +/- 0.92	11.02 +/- 2.01	10.78 +/- 1.39	10.64 +/- 0.99
DR04	Route 765, across from White Sands Drive.	12.10 +/- 1.20	13.44 +/- 0.96	11.74 +/- 0.94	12.23 +/- 1.08
DR05	Route 765, St. John's Creek	11.67 +/- 0.89	12.27 +/- 1.55	11.61 +/- 0.98	11.84 +/- 0.83
DR06	Route 765 at Lusby	10.11 +/- 1.70	10.87 +/- 1.05	9.91 +/- 1.36	10.26 +/- 0.82
DR07	Entrance to Camp Conoy	10.23 +/- 0.96	10.44 +/- 0.77	9.91 +/- 1.51	9.94 +/- 0.95
DR08	Camp Conoy Rd at Emergency Siren	15.36 +/- 1.36	15.83 +/- 2.66	15.18 +/- 1.85	14.32 +/- 1.21
DR09	Bay Breeze Rd	11.15 +/- 1.42	12.25 +/- 1.08	10.45 +/- 2.46	10.98 +/- 0.95
DR10	Decatur St. and Calvert Beach Rd.	10.84 +/- 0.96	10.90 +/- 1.09	10.73 +/- 1.34	9.79 +/- 0.23
DR11	Dirt road off Mackall & Parran Rd	10.74 +/- 0.90	10.48 +/- 1.47	11.01 +/- 0.45	10.98 +/- 1.29
DR12	Mackall & Bowen Rds	10.49 +/- 0.59	9.77 +/- 1.10	10.53 +/- 1.06	9.98 +/- 1.22
DR13	Mackall Rd, near Wallville	10.97 +/- 1.70	10.59 +/- 1.22	10.97 +/- 1.11	11.13 +/- 0.69
DR14	Rodney Point	12.84 +/- 0.13	12.35 +/- 0.89	13.32 +/- 0.66	12.93 +/- 0.35
DR15	Mill Bridge & Turner Rds	11.90 +/- 0.53	11.48 +/- 0.48	11.70 +/- 0.74	12.13 +/- 0.39

¹ Missing Data

Table B-12

Direct Radiation
(Results in Units of mR/90 days +/- 2σ)

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
DR16	Across from Appeal School	10.31 +/- 0.71	10.52 +/- 0.96	10.73 +/- 1.90	11.14 +/- 1.27
DR17	Cove Point & Little Cove Point Rds	11.44 +/- 1.17	11.71 +/- 1.31	12.31 +/- 1.33	12.64 +/- 1.10
DR18	Cove Point	9.13 +/- 0.66	8.96 +/- 0.67	9.10 +/- 1.01	9.63 +/- 0.34
DR19	Long Beach	10.25 +/- 1.38	10.05 +/- 0.79	10.36 +/- 0.95	10.24 +/- 0.74
DR20	On site, near Shore	12.95 +/- 1.70	12.85 +/- 1.91	13.68 +/- 1.68	13.47 +/- 1.72
DR21 ¹	EOF	12.26 +/- 1.80	11.78 +/- 0.86	12.17 +/- 1.82	12.20 +/- 0.97
DR22 ¹	Solomons Island	9.07 +/- 0.58	9.76 +/- 0.62	10.08 +/- 1.72	²
DR23 ¹	Taylor's Island	15.16 +/- 1.65	14.72 +/- 1.89	16.32 +/- 2.08	15.14 +/- 1.68
DR30	MET Station	12.22 +/- 1.28	12.05 +/- 1.15	12.31 +/- 0.89	13.42 +/- 2.45
SFDR01	Collocated w/ Plant TLD #159	15.51 +/- 0.89	14.77 +/- 1.66	15.72 +/- 1.00	17.22 +/- 0.92
SFDR02	Collocated w/ plant TLD # 160	19.14 +/- 1.71	18.31 +/- 3.78	18.32 +/- 2.19	19.23 +/- 1.11
SFDR03	Collocated w/ plant TLD #161	22.75 +/- 3.52	24.44 +/- 3.40	27.53 +/- 1.76	25.56 +/- 2.38
SFDR04	Collocated w/ plant TLD #162	16.17 +/- 1.74	18.74 +/- 1.96	16.35 +/- 1.49	18.41 +/- 3.16
SFDR05	Collocated w/ plant TLD #163	13.41 +/- 1.71	13.03 +/- 0.85	12.92 +/- 0.78	12.81 +/- 0.64
SFDR06	Collocated w/ plant TLD #164	13.86 +/- 0.92	15.16 +/- 1.66	14.69 +/- 0.85	14.38 +/- 1.30

¹ Control Location

² Missing Data

Table B-12

Direct Radiation
(Results in Units of mR/90 days +/- 2σ)

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
SFDR07 ¹	Visitor's Center	12.55 +/- 1.17	15.32 +/- 0.43	13.38 +/- 1.16	12.55 +/- 0.82
SFDR08	NNW of ISFSI	24.65 +/- 4.48	22.50 +/- 2.87	21.79 +/- 3.25	28.74 +/- 1.51
SFDR09	South of ISFSI	11.77 +/- 0.86	11.44 +/- 0.98	11.05 +/- 1.32	11.70 +/- 0.91
SFDR10	NNW of ISFSI	36.24 +/- 8.63	41.01 +/- 4.50	38.89 +/- 3.83	42.99 +/- 4.35
SFDR11	WNW ISFSI	24.22 +/- 4.55	23.85 +/- 2.98	22.10 +/- 4.42	24.31 +/- 3.15
SFDR12	W of ISFSI	20.77 +/- 3.52	20.94 +/- 4.48	21.54 +/- 3.21	28.18 +/- 3.57
SFDR13	SSW of ISFSI	12.69 +/- 1.19	12.63 +/- 1.59	13.62 +/- 1.07	13.74 +/- 1.70
SFDR14	SSE of ISFSI	11.45 +/- 1.27	11.42 +/- 1.02	10.94 +/- 1.11	12.07 +/- 0.72
SFDR15	ENE of ISFSI	15.36 +/- 1.83	14.85 +/- 1.00	14.50 +/- 1.91	15.68 +/- 2.01
SFDR16	WSW of ISFSI	20.69 +/- 1.95	21.29 +/- 1.98	18.49 +/- 0.55	21.18 +/- 4.47

¹ Control Location

(LEFT BLANK)

APPENDIX C

Appendix C is a summary of BGE laboratory's quality assurance program. It consists of Table C-1 which is a compilation of the results of the laboratory's participation in the Analytics Radiological Environmental Cross-Check Program during the period January 1, 1999 to December 31, 1999. It also consists of Table C-2 and Table C-3 that together form a compilation of the results of the laboratory's participation in a quality assurance program with Teledyne Brown Engineering's Environmental Services during the same period. The Teledyne Brown Engineering operating procedures pertinent to these analyses are described in Reference 43.

All the BGE results contained in Table C-1 agree with Analytics results with the exception of two isotopes for the filter sample type on 6/24/99 and tritium for 9/23/99. Reanalysis of the filter did not result in agreement within the 3 sigma control limit, however, the original results are in agreement when using the NRC Resolution Test Criteria¹. Reanalysis of the Analytics tritium cross check sample gave a result of 4194 ± 150 pCi/l which was within the 3 sigma acceptability criteria.

All the results contained in Table C-2 agree with the laboratory replicates and split samples submitted to Teledyne Brown Engineering, where appropriate. Samples whose nature precludes splitting them with Teledyne Brown Engineering are marked "***" in the Split Analysis column.

¹ NRC Inspection Manual, Inspection Procedure 84750, March 15, 1994

(LEFT BLANK)

TABLE OF CONTENTS - ANALYTICAL RESULTS

Table	Title	Page
C-1	Results of Participation in Analytics Cross Check Program	75
C-2	Results of Quality Assurance Program for 1999	77
C-3	Teledyne Brown Engineering's Typical MDAs for Gamma Spectrometry.....	86

(LEFT BLANK)

TABLE C-1

Results of Participation in Analytics Cross Check Program for 1999

Sample Date	Sample Type and Units	Isotope Observed	Reported Laboratory ¹ Results ¹	Analytics Results ¹
3/18/99	Water-pCi/L	H-3	2552±90	2698±135
3/18/99	Water-pCi/L	Cs-134	93±20	114±6
		Cs-137	231±38	240±12
		Ce-141	185±38	177±9
		Zn-65	209±62	195±10
		Cr-51	412±210	398±20
		Mn-54	164±34	152±8
		Fe-59	84±38	79±4
		Co-60	184±17	181±9
		I-131	88±28	91±5
6/24/99	Water-pCi/L	I-131	48±42	68±3
		Ce-141	134±39	134±7
		Cr-51	162±192	172±9
		Cs-134	77±15	92±5
		Cs-137	145±27	151±8
		Mn-54	66±20	68±3
		Fe-59	34±38	38±2
		Zn-65	105±44	98±5
		Co-60	184±22	171±9
6/24/99	Filter-pCi/filter	Beta	35±2	41±2
6/24/99	Filter-pCi/filter	Ce-141 ²	178±14	150±8
		Cr-51	231±81	192±10
		Cs-134	99±6	103±5
		Cs-137	186±14	168±8
		Mn-54	88±11	76±4
		Fe-59	55±14	43±2
		Zn-65	130±21	109±5
		Co-60 ²	218±11	191±10

¹ Laboratory precision (3 sigma)

² See discussion at the beginning of this Appendix

TABLE C-1 - Continued

Results of Participation in Analytics Cross Check Program for 1999

Sample Date	Sample Type and Units	Isotope Observed	Reported Laboratory's Results ¹	Analytics Results ¹
9/23/99	Water-pCi/L	H-3 ²	3912±99	4534±227
9/23/99	Water-pCi/L	Cs-134	112±21	119±6
		Cs-137	259±38	268±13
		Ce-141	251±34	244±12
		Zn-65	207±63	202±10
		Cr-51	177±135	184±9
		Mn-54	223±38	210±11
		Fe-59	96±34	94±5
		Co-60	165±26	159±8
		I-131	77±27	77±4
12/09/99	Water-pCi/L	Cs-134	111±18	125±6
		Cs-137	90±26	96±5
		Ce-141	101±33	105±5
		Zn-65	193±62	186±9
		Cr-51	301±172	290±15
		Mn-54	105±27	100±5
		Fe-59	99±38	94±5
		Co-60	144±24	132±7
		I-131	110±50	96±5
		Co-58	112±32	110±6

¹ Laboratory precision (3 sigma)

² See discussion at the beginning of this Appendix

TABLE C-2

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split*
			10^{-2} pCi/m ³		
Air Iodine-A1	1/11/99	I-131	<0.3	<0.3	**
Air Iodine-A2	1/11/99	I-131	<0.6	<0.6	**
Air Filter -A1	1/18/99	Beta	1.3±0.2	1.2±0.2	**
Air Filter -A2	1/18/99	Beta	1.4±0.2	1.0±0.2	**
Air Filter -A3	1/18/99	Beta	1.0±0.2	1.3±0.2	**
Air Filter -A4	1/18/99	Beta	1.4±0.2	1.3±0.2	**
Air Filter -A5	1/18/99	Beta	1.8±0.2	2.0±0.3	**
Air Filter -SFA1	1/18/99	Beta	2.2±0.3	2.2±0.3	**
Air Filter -SFA2	1/18/99	Beta	1.2±0.2	1.2±0.2	**
Air Filter -SFA3	1/18/99	Beta	1.7±0.2	1.8±0.2	**
Air Filter -SFA4	1/18/99	Beta	1.7±0.2	1.7±0.2	**
			pCi/L		
Bay Water-Wa2	1/15/99	Gamma	<MDA	<MDA	<MDA
Bay Water-Wa2	2/15/99	Tritium	103±40	157±41	300±110
			10^{-2} pCi/m ³		
Air Filter-A1	2/8/99	Beta	1.0±0.2	1.0±0.2	**
Air Filter-A2	2/8/99	Beta	1.2±0.2	1.3±0.2	**
Air Filter-A3	2/8/99	Beta	1.3±0.2	1.2±0.2	**
Air Filter-A4	2/8/99	Beta	1.1±0.2	1.2±0.2	**
Air Filter-A5	2/8/99	Beta	1.7±0.2	1.8±0.2	**
Air Filter-SFA1	2/8/99	Beta	1.3±0.2	1.4±0.2	**
Air Filter-SFA2	2/8/99	Beta	1.2±0.2	1.3±0.2	**
Air Filter-SFA3	2/8/99	Beta	1.5±0.2	1.6±0.2	**
Air Filter-SFA4	2/8/99	Beta	1.4±0.2	1.6±0.2	**
Air Iodine-A3	2/8/99	I-131	<0.2	<0.2	**
Air Iodine-A4	2/8/99	I-131	<0.4	<0.4	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
				pCi/kg	
Soil-SFS1	2/16/99	Gamma	<MDA	<MDA	<MDA
Soil-SFS2	2/16/99	Cs-137	103±44	164±44	169±26
Vegetation-SFb2	2/16/99	Gamma	<MDA	<MDA	<MDA
Vegetation-SFb3	2/16/99	Gamma	<MDA	<MDA	<MDA
				10 ⁻² pCi/m ³	
Air Filter-A1	3/8/99	Beta	1.1±0.2	1.1±0.2	**
Air Filter-A2	3/8/99	Beta	1.2±0.2	1.3±0.2	**
Air Filter-A3	3/8/99	Beta	1.1±0.2	1.1±0.2	**
Air Filter-A4	3/8/99	Beta	1.2±0.2	1.2±0.2	**
Air Filter-A5	3/8/99	Beta	1.3±0.2	1.4±0.2	**
Air Filter-SFA1	3/8/99	Beta	1.2±0.2	1.1±0.2	**
Air Filter-SFA2	3/8/99	Beta	1.2±0.2	1.3±0.2	**
Air Filter-SFA3	3/8/99	Beta	1.4±0.2	1.3±0.2	**
Air Filter-SFA4	3/8/99	Beta	1.3±0.2	1.3±0.2	**
Air Iodine-A2	3/8/99	I-131	<0.3	<0.3	**
Air Iodine-A3	3/8/99	I-131	<0.4	<0.4	**
				pCi/kg	
Oysters-Ia3	3/25/99	Ag-110m	35±8	40±9	<30

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
			10^{-2} pCi/m ³		
Air Filter-A1	4/12/99	Beta	1.2±0.2	1.1±0.2	**
Air Filter-A2	4/12/99	Beta	1.3±0.2	1.3±0.2	**
Air Filter-A3	4/12/99	Beta	1.1±0.2	1.0±0.2	**
Air Filter-A4	4/12/99	Beta	1.2±0.2	1.3±0.2	**
Air Filter-A5	4/12/99	Beta	1.7±0.2	1.6±0.2	**
Air Filter-SFA1	4/12/99	Beta	1.2±0.2	1.0±0.2	**
Air Filter-SFA2	4/12/99	Beta	1.2±0.2	1.1±0.2	**
Air Filter-SFA3	4/12/99	Beta	1.6±0.2	1.6±0.2	**
Air Filter-SFA4	4/12/99	Beta	1.4±0.2	1.4±0.2	**
Air Iodine-A4	4/12/99	I-131	<0.3	<0.3	**
Air Iodine-A5	4/12/99	I-131	<0.4	<0.4	**
			pCi/L		
Bay Water-Wa2	4/15/99	Gamma	<MDA	<MDA	<MDA
			10^{-2} pCi/m ³		
Air Filter-A1	5/10/99	Beta	1.1±0.2	1.0±0.2	**
Air Filter-A2	5/10/99	Beta	1.0±0.2	1.0±0.2	**
Air Filter-A3	5/10/99	Beta	1.3±0.2	1.2±0.2	**
Air Filter-A4	5/10/99	Beta	1.1±0.2	1.2±0.2	**
Air Filter-A5	5/10/99	Beta	1.0±0.2	1.0±0.2	**
Air Filter-SFA1	5/10/99	Beta	1.1±0.2	1.2±0.2	**
Air Filter-SFA2	5/10/99	Beta	1.1±0.2	1.1±0.2	**
Air Filter-SFA3	5/10/99	Beta	1.0±0.2	1.0±0.2	**
Air Filter-SFA4	5/10/99	Beta	1.1±0.2	1.2±0.2	**
Air Iodine-A1	5/10/99	I-131	<0.3	<0.3	**
Air Iodine-A4	5/10/99	I-131	<0.6	<0.6	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split*
			pCi/kg		
Shoreline-Wb1	5/26/99	Gamma	<MDA	<MDA	<MDA
Soil-SFS1	6/14/99	Cs-137	<49	<48	29±15
Soil-SFS5	6/14/99	Cs-137	205±38	190±41	161±19
Vegetation-SFb1	6/14/99	Gamma	<MDA	<MDA	<MDA
Vegetation-SFb2	6/14/99	Gamma	<MDA	<MDA	<MDA
			10 ⁻² pCi/m ³		
Air Filter-A1	6/7/99	Beta	1.6±0.2	1.5±0.2	**
Air Filter-A2	6/7/99	Beta	1.5±0.2	1.3±0.2	**
Air Filter-A3	6/7/99	Beta	1.6±0.3	1.4±0.3	**
Air Filter-A4	6/7/99	Beta	1.0±0.2	1.1±0.2	**
Air Filter-A5	6/7/99	Beta	1.6±0.2	1.5±0.2	**
Air Filter-SFA1	6/7/99	Beta	1.7±0.2	1.5±0.2	**
Air Filter-SFA2	6/7/99	Beta	1.6±0.2	1.7±0.2	**
Air Filter-SFA3	6/7/99	Beta	1.6±0.2	1.5±0.2	**
Air Filter-SFA4	6/7/99	Beta	1.3±0.2	1.3±0.2	**
Air Iodine-A2	6/7/99	I-131	<0.4	<0.4	**
Air Iodine-A3	6/7/99	I-131	<0.8	<0.8	**
			10 ⁻³ pCi/m ³		
Air Filters-A1	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A2	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A3	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A4	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A5	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA1	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA2	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA3	6/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA4	6/15/99	Gamma	<MDA	<MDA	<MDA

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
<hr/>					
				10 ⁻² pCi/m ³	
<hr/>					
Air Filter-A1	7/12/99	Beta	1.3±0.2	1.4±0.2	**
Air Filter-A2	7/12/99	Beta	1.1±0.2	1.2±0.2	**
Air Filter-A3	7/12/99	Beta	1.1±0.3	1.9±0.3	**
Air Filter-A4	7/12/99	Beta	1.1±0.3	1.2±0.3	**
Air Filter-A5	7/12/99	Beta	1.6±0.2	1.7±0.2	**
Air Filter-SFA1	7/12/99	Beta	1.9±0.3	2.1±0.3	**
Air Filter-SFA2	7/12/99	Beta	1.9±0.3	1.9±0.3	**
Air Filter-SFA3	7/12/99	Beta	1.8±0.3	1.8±0.3	**
Air Filter-SFA4	7/12/99	Beta	1.5±0.3	1.5±0.2	**
<hr/>					
Air Iodine-A1	7/12/99	I-131	<0.4	<0.4	**
Air Iodine-A2	7/12/99	I-131	<0.5	<0.5	**
<hr/>					
				pCi/L	
<hr/>					
Bay Water-Wa1	7/15/99	Gamma	<MDA	<MDA	<MDA
<hr/>					
				pCi/kg	
<hr/>					
Fish-Ia1	8/3/99	Gamma	<MDA	<MDA	<MDA
Oysters-Ia10	8/3/99	Ag-110	14±8	<17	<30
<hr/>					
				10 ⁻² pCi/m ³	
<hr/>					
Air Filter-A1	8/9/99	Beta	1.3±0.2	1.4±0.2	**
Air Filter-A2	8/9/99	Beta	1.3±0.2	1.3±0.2	**
Air Filter-A3	8/9/99	Beta	1.8±0.2	1.9±0.2	**
Air Filter-A4	8/9/99	Beta	1.8±0.2	1.8±0.2	**
Air Filter-A5	8/9/99	Beta	2.0±0.2	2.1±0.3	**
Air Filter-SFA1	8/9/99	Beta	2.0±0.3	1.9±0.2	**
Air Filter-SFA2	8/9/99	Beta	1.9±0.2	1.9±0.2	**
Air Filter-SFA3	8/9/99	Beta	1.9±0.2	1.9±0.2	**
Air Filter-SFA4	8/9/99	Beta	1.3±0.2	1.4±0.2	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
				10 ⁻² pCi/m ³	
Air Iodine-A2	8/9/99	I-131	<0.3	<0.3	**
Air Iodine-A5	8/9/99	I-131	<0.5	<0.6	**
				pCi/L	
Bay Water-Wa2	8/15/99	Tritium	291±41	313±41	300±100
				pCi/kg	
Vegetation-Ib4	9/27/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib5	9/27/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib6	9/27/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib7	9/27/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib8	9/27/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib9	9/27/99	Gamma	<MDA	<MDA	<MDA
				10 ⁻² pCi/m ³	
Air Filter-A1	9/20/99	Beta	2.8±0.4	2.9±0.4	**
Air Filter-A2	9/20/99	Beta	2.7±0.3	2.7±0.3	**
Air Filter-A3	9/20/99	Beta	2.6±0.4	2.6±0.4	**
Air Filter-A4	9/20/99	Beta	2.4±0.3	2.5±0.3	**
Air Filter-A5	9/20/99	Beta	1.8±0.2	1.9±0.2	**
Air Filter-SFA1	9/20/99	Beta	1.8±0.2	1.8±0.2	**
Air Filter-SFA2	9/20/99	Beta	2.4±0.3	2.5±0.3	**
Air Filter-SFA3	9/20/99	Beta	2.2±0.3	2.2±0.3	**
Air Filter-SFA4	9/20/99	Beta	2.2±0.2	2.2±0.2	**
Air Iodine-A1	9/13/99	I-131	<0.3	<0.3	**
Air Iodine-A3	9/13/99	I-131	<0.5	<0.5	**
				mR/90 Days	
DR03	9/30/99	TLD	10.78±1.39	9.97±0.77	**
DR04	9/30/99	TLD	12.06±1.78	11.74±1.43	**
DR05	9/30/99	TLD	11.61±0.98	11.14±1.11	**
DR06	9/30/99	TLD	9.91±1.36	9.44±1.13	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split*
			mR/90 Days		
DR07	9/30/99	TLD	9.91±1.51	9.30±1.21	**
DR08	9/30/99	TLD	15.18±1.85	13.64±1.42	**
DR32	9/30/99	TLD	9.57±0.78	9.40±0.75	**
DR33	9/30/99	TLD	15.80±2.27	15.28±1.31	**
SFDR04	9/30/99	TLD	16.35±1.49	16.10±1.42	**
SFDR05	9/30/99	TLD	12.92±0.78	12.51±1.60	**
RPDR10	9/30/99	TLD	48.80±4.72	50.08±8.55	**
			10 ⁻² pCi/m ³		
Air Filter-A1	10/11/99	Beta	1.9±0.2	1.9±0.2	**
Air Filter-A2	10/11/99	Beta	1.5±0.2	1.4±0.2	**
Air Filter-A3	10/11/99	Beta	1.5±0.2	1.6±0.2	**
Air Filter-A4	10/11/99	Beta	1.8±0.3	1.8±0.2	**
Air Filter-A5	10/11/99	Beta	2.0±0.2	1.8±0.2	**
Air Filter-SFA1	10/11/99	Beta	1.9±0.2	1.8±0.2	**
Air Filter-SFA2	10/11/99	Beta	1.8±0.2	1.9±0.2	**
Air Filter-SFA3	10/11/99	Beta	1.8±0.2	1.6±0.2	**
Air Filter-SFA4	10/11/99	Beta	1.3±0.2	1.4±0.1	**
Air Iodine-A1	10/11/99	I-131	<0.3	<0.3	**
Air Iodine-A2	10/11/99	I-131	<0.4	<0.4	**
			pCi/kg		
Vegetation-Ib4	10/25/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib5	10/25/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib6	10/25/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib7	10/25/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib8	10/25/99	Gamma	<MDA	<MDA	<MDA
Vegetation-Ib9	10/25/99	Gamma	<MDA	<MDA	<MDA

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
			<hr/> 10 ⁻² pCi/m ³ <hr/>		
Air Filter-A1	11/8/99	Beta	2.4±0.2	2.4±0.2	**
Air Filter-A2	11/8/99	Beta	1.8±0.2	1.8±0.2	**
Air Filter-A3	11/8/99	Beta	1.9±0.2	2.0±0.2	**
Air Filter-A4	11/8/99	Beta	2.4±0.2	2.6±0.2	**
Air Filter-A5	11/8/99	Beta	2.5±0.2	2.4±0.2	**
Air Filter-SFA1	11/8/99	Beta	2.5±0.2	2.6±0.2	**
Air Filter-SFA2	11/8/99	Beta	2.2±0.2	2.3±0.2	**
Air Filter-SFA3	11/8/99	Beta	2.6±0.3	2.6±0.3	**
Air Filter-SFA4	11/8/99	Beta	2.9±0.3	3.1±0.3	**
			<hr/> 10 ⁻² pCi/m ³ <hr/>		
Air Iodine-A3	11/8/99	I-131	<0.3	<0.3	**
Air Iodine-A4	11/8/99	I-131	<0.4	<0.4	**
			<hr/> pCi/L <hr/>		
Bay Water-Wa2	11/15/99	Gamma	<MDA	<MDA	<MDA
			<hr/> 10 ⁻² pCi/m ³ <hr/>		
Air Filter-A1	12/13/99	Beta	2.1±0.2	2.2±0.2	**
Air Filter-A2	12/13/99	Beta	1.7±0.2	2.0±0.2	**
Air Filter-A3	12/13/99	Beta	1.4±0.2	1.7±0.2	**
Air Filter-A4	12/13/99	Beta	1.8±0.2	2.0±0.2	**
Air Filter-A5	12/13/99	Beta	1.5±0.2	1.7±0.2	**
Air Filter-SFA1	12/13/99	Beta	1.8±0.2	2.0±0.2	**
Air Filter-SFA2	12/13/99	Beta	1.7±0.2	2.2±0.2	**
Air Filter-SFA3	12/13/99	Beta	1.7±0.2	2.0±0.2	**
Air Filter-SFA4	12/13/99	Beta	1.6±0.2	1.9±0.2	**
			<hr/>		
Air Iodine-A2	12/13/99	I-131	<0.3	<0.3	**
Air Iodine-A4	12/13/99	I-131	<0.4	<0.4	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-2 - Continued

Results of Quality Assurance Program for 1999

Sample Type And Location	Sample Date	Type of Analysis	Original Analysis	Replicate Analysis	Split* Analysis
			10^{-3} pCi/m ³		
Air Filters-A1	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A2	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A3	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A4	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-A5	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA1	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA2	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA3	12/15/99	Gamma	<MDA	<MDA	<MDA
Air Filters-SFA4	12/15/99	Gamma	<MDA	<MDA	<MDA
			pCi/L		
Bay Water-Wa2	12/31/99	Tritium	356±61	348±61	310±110
			mR/90 Days		
DR09	12/31/99	TLD	10.98±0.95	11.37±1.06	**
DR10	12/31/99	TLD	9.79±0.23	10.30±1.07	**
DR11	12/31/99	TLD	10.98±1.29	10.23±0.95	**
DR12	12/31/99	TLD	9.98±1.22	10.34±1.06	**
DR13	12/31/99	TLD	11.13±0.69	10.85±0.69	**
DR14	12/31/99	TLD	12.93±0.35	12.57±0.86	**
DR23	12/31/99	TLD	15.14±1.68	14.40±1.01	**
DR28	12/31/99	TLD	13.61±1.02	13.79±2.21	**
SFDR06	12/31/99	TLD	14.38±1.30	13.92±1.33	**
SFDR07	12/31/99	TLD	12.55±0.82	13.43±1.44	**
RPDR11	12/31/99	TLD	30.31±1.66	29.48±8.04	**

*Samples split with Teledyne Brown Engineering, Environmental Services, Westwood, NJ. On the following table is a list of their typical MDAs.

**The nature of these samples precluded splitting them with Teledyne Brown Engineering.

TABLE C-3

Teledyne Brown Engineering's Typical MDAs for Gamma Spectrometry

Selected Nuclides	Bay Water pCi/l	Fish pCi/kg	Shellfish pCi/kg	Sediment pCi/kg	Vegetation pCi/kg	Particulates 10 ⁻³ pCi/m ³
H-3	150	--	--	--	--	--
Na-22	3	30	9	20	9	2
Cr-51	40	400	100	200	75	26
Mn-54	3	30	10	20	8	2
Co-58	3	30	10	15	8	2
Fe-59	8	75	25	35	21	5
Co-60	3	30	10	17	8	2
Zn-65	7	60	18	35	20	4
Nb-95	4	30	10	17	8	2
Zr-95	7	60	18	40	18	5
Ru-106	30	200	90	100	70	16
Ag-110m	4	30	20	17	9	2
Te-129m	4	40	11	17	9	3
I-131	16	300	50	50	26	20
Cs-134	3	30	10	17	9	2
Cs-137	4	30	10	17	9	2
BaLa-140	20	300	60	80	43	21
Ce-144	27	200	60	90	48	10

APPENDIX D

Appendix D contains the results of a Land Use Survey conducted around Calvert Cliffs Nuclear Power Plant during July 1999. A table listing the raw data of this survey and a discussion of the results are included in this appendix.

Discussion

A Land Use Survey was conducted during July 1999 to identify, within a distance of 8 km, the location of the nearest milk animal, the nearest residence, and the nearest garden greater than 50 m² in each of the nine sectors over land. A detailed description of the Land Use Survey is given in a separate document (48). The position of the nearest residence and garden in each sector out to 8 km are given in the adjacent table. No dairy animal was found within 8 km in any direction. There has not been any significant change in the use of local lands in the last few years.

Table D-1
Land Use Survey

Sector	Distance From Plant (km)	
	Residence	Garden
SE	2.7	2.7
SSE	2.9	2.9
S	3.1	3.1
SSW	2.6	2.9
SW	2.1	2.6
WSW	1.9	1.9
W	2.1	2.4
WNW	2.6	2.6
NW	2.9	2.9

The closest residence and garden are situated in the WSW sector, which is one of the least prevalent wind directions. In the S, SSE, and SE sectors, there is the highest probability of wind blowing from the direction of the plant. The two gardens used for vegetable samples by the Radiological Environmental Monitoring Program have been placed in the sectors with the highest X/Q. One sampling garden is located in the S sector at a distance of 0.7 km, and another is situated near the site boundary between the SSE and SE sectors at a distance of 2.6 km from the plant. These two sampling sites are considered good indicator locations for radioactive depositions around the plant.

The dose assessment using 1999 meteorological data was performed, and no significant impact from the plant was found.

(LEFT BLANK)

APPENDIX E

Appendix E is a presentation of the analytical results for additional samples collected in the environs of Calvert Cliffs Nuclear Power Plant during the year 1999. These extra samples are not required by the Off Site Dose Calculation Manual (41). They were collected and analyzed to maintain the historical continuity for samples and sampling pathways discontinued when the Environmental Technical Specifications were changed in March, 1985. Additionally, they include the Pressurized Ion Chambers added for the Independent Spent Fuel Storage Installation.

Table E-9 shows the average monthly direct radiation as measured by the pressurized ion chambers at five locations. During December several events occurred as a result of waste resin transfer. PIC4 located NNW of the ISFSI was closest to these events and, as expected, shows a slightly higher average in December as compared to other months in 1999.

Table E-11 shows the direct radiation readings from TLDs placed at the perimeter of the resin storage area located to the west of the ISFSI. The TLD values are higher than those in the REMP program due to their proximity to the source of the radiation. However, when the direct radiation readings for the ISFSI and Site Boundary TLDs are reviewed, it is apparent that storage of the spent resin is having no significant, measurable effect on the environs surrounding Calvert Cliffs Nuclear Power Plant.

(LEFT BLANK)

TABLE OF CONTENTS - ANALYTICAL RESULTS

Table	Title	Page
E-1	Locations of Non-ODCM Environmental Sampling Stations for Calvert Cliffs Nuclear Power Plant	92
E-2	Synopsis of 1999 Calvert Cliffs Nuclear Power Plant Non-ODCM Radiological Environmental Monitoring Program	93
E-3	Annual Summary for Calvert Cliffs Nuclear Power Plant Units 1 & 2 Non-ODCM Radiological Environmental Monitoring Program	94
E-4	Concentration of Gamma Emitters in Bottom Sediment	95
E-5	Concentration of Iodine-131 in Filtered Air	96
E-6	Concentration of Beta Emitters in Air Particulates.....	98
E-7	Concentration of Gamma Emitters in Air Particulates	100
E-8	Concentration of Tritium and Gamma Emitters in Taylors Island Well Water.....	101
E-9	Direct Radiation as Measured in Pressurized Ion Chamber	102
E-10	Direct Radiation	103
E-11	Direct Radiation from Resin Storage Area	104

TABLE E-1

**Locations of Non-ODCM Environmental Sampling Stations
for Calvert Cliffs Nuclear Power Plant**

Station	Description	Distance* (Kilometers)	Direction* (Sector)
A6	Long Beach	4.4	NW
A7	Taylors Island, Carpenter's Property	12.6	ENE
A8	Cambridge, U of MD Estuarine Center	32.0	NE
DR24	Route 4 and Parran Road	3.0	SW
DR25	Camp Conoy Guard House	1.0	S
DR26	Route 235 & Clarks Landing Rd.	20.5	SW
DR27	Route 231 & Route 4	23.0	NW
DR28	Taylors Island Emergency Siren #35	12.3	ENE
DR29	Taylors Island Emergency Siren #38	12.5	E
DR31	Cambridge, U of MD Estuarine Center	32.0	NE
DR32	Twining Property, Taylors Island	12.3	NE
DR33	P.A. Ransome Property, Taylors Island	14.8	ESE
DR34	Shoreline at Barge Road	0.2	NE
PIC1	Taylors Island, Carpenter's Property	12.6	ENE
PIC2	On Site before Entrance to Camp Conoy	0.7	S
PIC3	Meteorological Station	0.8	WSW
PIC4	NNW of ISFSI	0.6	SW
PIC5	South of ISFSI	0.6	SW
PIC8	CCNPP Visitor's Center	0.3	NW
Wbs1	Intake Area	0.2	NE
Wbs2	Discharge Area	0.3	N
Wbs3	Long Beach	4.4	NW
Wbs4	Camp Conoy/Rocky Point	3.0	SE
Ww1	Taylors Island, Carpenter's Property	12.6	ENE

*Distance and direction from the central point between the two containment buildings.

Table E-2

**Synopsis of 1999 Calvert Cliffs Nuclear Power Plant
Non-ODCM Radiological Environmental Monitoring Program**

Sample Type	Sampling Frequency ¹	Number of Locations	Number Collected	Analysis	Analysis Frequency ¹	Number Analyzed
Aquatic Environment						
Bottom Sediment	Q	4	16	Gamma	Q	16
Atmospheric Environment						
Air Iodine ²	W	7	367	I-131	W	367
Air Particulates ³	W	3	155	Gross Beta	W	155
				Gamma	MC	36
Direct Radiation						
Pressurized Ion Chamber	M	6	72	Gamma	M	72
Ambient Radiation	Q	18	426	TLD	Q	426
Terrestrial Environment						
Ground water	M	2	12	Gamma	M	12
				H-3	M	12

¹ W-weekly, M-monthly, Q-quarterly, SA-semiannual, A-annual, C-composite

² The collection device contains silver zeolite

³ Beta counting is performed after ≥ 72 hour decay. Gamma spectroscopy performed on monthly composites of weekly samples

Table E-3

**Annual Summary for Calvert Cliffs Nuclear Power Plant Units 1 & 2
Non-ODCM Radiological Environmental Monitoring Program**

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	Indicator Locations Mean (F)/Range ¹	Location with Highest Annual Mean Name/Distance & Direction ²	Highest Annual Mean (F) / Range ¹	Control Locations Mean (F)/Range ¹
Aquatic Environment Bottom Sediment (pCi/kg)	Gamma (16) Cs-137	33	177 (11/12) (33-269)	Discharge Area Wbs2 0.3 km N	236 (4/4) (196-269)	124 (4/4) (31-201)
Atmospheric Environment Air Particulates (10 ⁻² pCi/m ³)	Gross Beta (155)	0.5	1.6 (106/106) (0.7-3.5)	Long Beach A6 4.4 km NW	1.7 (53/53) (0.8-3.5)	1.6 (49/49) (0.6-2.8)
Direct Radiation Ambient Radiation (mR/90 days)	TLD (426)	--	22.25 (426/426) (6.22-53.44)	East Fence Left RPDR11 km	39.67 (24/24) (30.31-53.44)	-- --
Pressurized Ion Chamber (mR/30 days)	Ionization Chamber (72)	--	5.70 (60/60) (3.94-10.78)	NNW of ISFSI PIC4 0.6 km SW	9.15 (12/12) (8.76-10.78)	6.00 (12/12) (5.60-6.59)

¹ Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.

² From the centerpoint between the two containment buildings.

Table E-4

Concentration of Gamma Emitters in Bottom Sediment
(Results in units of pCi/kg (dry) \pm 2 σ)

Sample Code	Sample Date	Cs-137	Gamma Emitters
Wbs1	03/25/1999	43 \pm 31	*
Intake Area	06/16/1999	56 \pm 29	*
	08/03/1999	¹	*
	10/06/1999	33 \pm 32	*
Wbs2	03/25/1999	249 \pm 59	*
Discharge Area	06/16/1999	269 \pm 77	*
	08/03/1999	231 \pm 52	*
	10/06/1999	196 \pm 52	*
Wbs3	03/25/1999	231 \pm 64	*
Long Beach	06/16/1999	221 \pm 82	*
	08/03/1999	211 \pm 71	*
	10/06/1999	211 \pm 64	*
Wbs4 ²	03/25/1999	80 \pm 37	*
Camp Conoy/ Rocky Point	06/16/1999	201 \pm 55	*
	08/03/1999	182 \pm 66	*
	10/06/1999	31 \pm 24	*

* Non-Natural Gamma Emitters < MDA

¹ This Isotope < MDA² Control Location

Table E-5

Concentration of Iodine-131 in Filtered Air
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A6 Long Beach	A7 ¹ Taylors Island	CAM Cambridge	SFA1 MET Station	SFA2 ¹ Visitors Center	SFA3 NNW of ISFSI	SFA4 South of ISFSI
12/28/1998	01/04/1999	*	*	2	*	*	*	*
01/04/1999	01/11/1999	*	*	*	*	*	*	*
01/11/1999	01/18/1999	*	*	*	*	*	*	*
01/18/1999	01/25/1999	*	*	*	*	*	*	*
01/25/1999	02/01/1999	*	*	*	*	*	*	*
02/01/1999	02/08/1999	*	*	*	*	*	*	*
02/08/1999	02/16/1999	*	*	*	*	*	*	*
02/16/1999	02/23/1999	*	*	*	*	*	*	*
02/23/1999	03/01/1999	*	*	*	*	*	*	*
03/01/1999	03/08/1999	*	*	*	*	*	*	*
03/08/1999	03/15/1999	*	*	*	*	*	*	*
03/15/1999	03/22/1999	*	*	*	*	*	*	*
03/22/1999	03/29/1999	*	*	*	*	*	*	*
03/29/1999	04/05/1999	*	*	*	*	*	*	*
04/05/1999	04/12/1999	*	*	*	*	*	*	*
04/12/1999	04/19/1999	*	*	*	*	*	*	*
04/19/1999	04/26/1999	*	*	*	*	2	*	*
04/26/1999	05/03/1999	*	*	*	*	*	*	*
05/03/1999	05/10/1999	*	*	*	*	*	*	*
05/10/1999	05/17/1999	*	*	*	*	*	*	*
05/17/1999	05/24/1999	*	*	*	*	*	*	*
05/24/1999	06/01/1999	*	*	*	*	*	*	*
06/01/1999	06/07/1999	*	*	*	*	*	*	*
06/07/1999	06/14/1999	*	2	*	*	*	*	*
06/14/1999	06/21/1999	*	*	*	*	*	*	*
06/21/1999	06/28/1999	*	*	*	*	*	*	*
06/28/1999	07/06/1999	*	*	*	*	*	*	*
07/06/1999	07/12/1999	*	*	*	*	*	*	*
07/12/1999	07/19/1999	*	*	*	*	*	*	*
07/19/1999	07/26/1999	*	*	*	*	*	*	*
07/26/1999	08/02/1999	*	*	*	*	*	*	*

* < MDA

¹ Control Location² Sampler malfunction/low flow

Table E-5

Concentration of Iodine-131 in Filtered Air
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A6 Long Beach	A7 ¹ Taylors Island	CAM Cambridge	SFA1 MET Station	SFA2 ¹ Visitors Center	SFA3 NNW of ISFSI	SFA4 South of ISFSI
08/02/1999	08/09/1999	*	*	*	*	*	*	*
08/09/1999	08/16/1999	*	*	*	*	*	*	*
08/16/1999	08/23/1999	*	*	*	*	*	*	*
08/23/1999	08/30/1999	*	*	*	*	*	*	*
08/30/1999	09/07/1999	*	*	*	*	*	*	*
09/07/1999	09/13/1999	*	*	*	*	*	*	*
09/13/1999	09/20/1999	*	*	*	*	*	*	*
09/20/1999	09/27/1999	*	*	*	*	*	*	*
09/27/1999	10/04/1999	*	*	*	*	*	*	*
10/04/1999	10/11/1999	*	*	*	*	*	*	*
10/11/1999	10/18/1999	*	*	*	*	*	*	*
10/18/1999	10/25/1999	*	*	*	*	*	*	*
10/25/1999	11/01/1999	*	*	*	*	*	*	*
11/01/1999	11/08/1999	*	*	*	*	*	*	*
11/08/1999	11/15/1999	*	*	*	*	*	*	*
11/15/1999	11/22/1999	*	*	*	*	*	*	*
11/22/1999	11/29/1999	*	*	*	*	*	*	1
11/29/1999	12/06/1999	*	*	*	*	*	*	*
12/06/1999	12/13/1999	*	*	*	*	*	*	*
12/13/1999	12/20/1999	*	*	*	*	*	*	*
12/20/1999	12/28/1999	*	*	*	*	*	*	*
12/28/1999	01/03/2000	*	*	*	*	*	*	*

* < MDA

¹ Sampler malfunction/low flow

Table E-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A6 Long Beach	A7 ¹ Taylors Island	CAM Cambridge
12/28/1998	01/04/1999	2.3 +/- 0.2	²	1.2 +/- 0.2
01/04/1999	01/11/1999	2.3 +/- 0.3	2.3 +/- 0.3	2.4 +/- 0.3
01/11/1999	01/18/1999	1.7 +/- 0.2	1.6 +/- 0.2	1.2 +/- 0.2
01/18/1999	01/25/1999	1.4 +/- 0.2	1.2 +/- 0.2	1.1 +/- 0.2
01/25/1999	02/01/1999	1.7 +/- 0.2	1.5 +/- 0.2	1.6 +/- 0.2
02/01/1999	02/08/1999	1.7 +/- 0.2	1.5 +/- 0.2	1.3 +/- 0.2
02/08/1999	02/16/1999	2.0 +/- 0.2	1.8 +/- 0.2	1.7 +/- 0.2
02/16/1999	02/23/1999	2.2 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.2
02/23/1999	03/01/1999	1.1 +/- 0.2	1.0 +/- 0.2	0.8 +/- 0.2
03/01/1999	03/08/1999	1.4 +/- 0.2	1.5 +/- 0.2	1.1 +/- 0.2
03/08/1999	03/15/1999	0.8 +/- 0.2	1.0 +/- 0.2	0.9 +/- 0.2
03/15/1999	03/22/1999	1.1 +/- 0.2	1.1 +/- 0.2	1.1 +/- 0.2
03/22/1999	03/29/1999	1.6 +/- 0.2	1.6 +/- 0.2	1.6 +/- 0.2
03/29/1999	04/05/1999	1.7 +/- 0.3	1.1 +/- 0.2	1.1 +/- 0.2
04/05/1999	04/12/1999	1.5 +/- 0.2	1.5 +/- 0.2	1.2 +/- 0.2
04/12/1999	04/19/1999	1.5 +/- 0.3	1.6 +/- 0.2	1.4 +/- 0.2
04/19/1999	04/26/1999	1.5 +/- 0.2	1.5 +/- 0.2	1.3 +/- 0.2
04/26/1999	05/03/1999	1.1 +/- 0.2	1.2 +/- 0.2	1.0 +/- 0.2
05/03/1999	05/10/1999	1.2 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2
05/10/1999	05/17/1999	1.0 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2
05/17/1999	05/24/1999	0.9 +/- 0.2	1.0 +/- 0.2	1.1 +/- 0.2
05/24/1999	06/01/1999	1.5 +/- 0.2	2.0 +/- 0.2	1.8 +/- 0.2
06/01/1999	06/07/1999	1.4 +/- 0.2	2.0 +/- 0.6	1.6 +/- 0.2
06/07/1999	06/14/1999	1.1 +/- 0.2	²	1.0 +/- 0.2
06/14/1999	06/21/1999	0.9 +/- 0.2	1.0 +/- 0.2	0.7 +/- 0.1
06/21/1999	06/28/1999	1.3 +/- 0.3	1.3 +/- 0.2	1.1 +/- 0.2
06/28/1999	07/06/1999	1.3 +/- 0.2	1.7 +/- 0.3	1.5 +/- 0.2
07/06/1999	07/12/1999	1.5 +/- 0.2	0.6 +/- 0.2	2.6 +/- 0.3
07/12/1999	07/19/1999	1.3 +/- 0.2	1.6 +/- 0.2	1.4 +/- 0.2
07/19/1999	07/26/1999	1.3 +/- 0.2	2.1 +/- 0.2	2.1 +/- 0.2
07/26/1999	08/02/1999	2.1 +/- 0.3	1.3 +/- 0.2	1.9 +/- 0.3
08/02/1999	08/09/1999	2.1 +/- 0.3	1.5 +/- 0.2	1.7 +/- 0.2
08/09/1999	08/16/1999	2.0 +/- 0.2	1.8 +/- 0.2	1.9 +/- 0.2
08/16/1999	08/23/1999	1.2 +/- 0.2	1.0 +/- 0.2	0.9 +/- 0.2
08/23/1999	08/30/1999	2.2 +/- 0.2	1.8 +/- 0.2	1.3 +/- 0.2

¹ Control Location² Sampler malfunction/low flow

Table E-6

Concentration of Beta Emitters in Air Particulates
(Results in units of 10^{-2} pCi/m³ +/- 2 σ)

Start Date	Stop Date	A6 Long Beach	A7 ¹ Taylors Island	CAM Cambridge
08/30/1999	09/07/1999	1.3 +/- 0.2	1.3 +/- 0.2	1.0 +/- 0.2
09/07/1999	09/13/1999	2.5 +/- 0.3	2.1 +/- 0.2	1.7 +/- 0.2
09/13/1999	09/20/1999	1.8 +/- 0.2	1.7 +/- 0.2	1.9 +/- 0.2
09/20/1999	09/27/1999	2.1 +/- 0.2	²	2.8 +/- 0.2
09/27/1999	10/04/1999	2.7 +/- 0.2	²	2.1 +/- 0.3
10/04/1999	10/11/1999	1.3 +/- 0.2	2.0 +/- 0.2	2.0 +/- 0.3
10/11/1999	10/18/1999	1.5 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2
10/18/1999	10/25/1999	1.7 +/- 0.2	1.6 +/- 0.2	1.7 +/- 0.2
10/25/1999	11/01/1999	2.4 +/- 0.2	2.4 +/- 0.2	2.8 +/- 0.3
11/01/1999	11/08/1999	2.2 +/- 0.2	1.8 +/- 0.2	2.3 +/- 0.2
11/08/1999	11/15/1999	3.5 +/- 0.3	2.7 +/- 0.3	3.4 +/- 0.3
11/15/1999	11/22/1999	1.3 +/- 0.2	0.8 +/- 0.2	1.3 +/- 0.2
11/22/1999	11/29/1999	1.3 +/- 0.2	1.6 +/- 0.2	1.8 +/- 0.2
11/29/1999	12/06/1999	1.7 +/- 0.2	1.5 +/- 0.2	1.5 +/- 0.2
12/06/1999	12/13/1999	2.0 +/- 0.3	1.0 +/- 0.2	1.3 +/- 0.2
12/13/1999	12/20/1999	1.7 +/- 0.2	1.5 +/- 0.2	0.7 +/- 0.2
12/20/1999	12/28/1999	2.3 +/- 0.2	2.6 +/- 0.2	2.7 +/- 0.2
12/28/1999	01/03/2000	2.6 +/- 0.3	2.8 +/- 0.3	2.8 +/- 0.3

¹ Control Location² Sampler malfunction/low flow

Table E-7

Concentration of Gamma Emitters in Air Particulates
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)

Sample Date	A6 Long Beach	A7 ¹ Taylors Island	CAM Cambridge
01/15/1999	*	*	*
02/15/1999	*	*	*
03/15/1999	*	*	*
04/15/1999	*	*	*
05/15/1999	*	*	*
06/15/1999	*	*	*
07/15/1999	*	*	*
08/15/1999	*	*	*
09/15/1999	*	*	*
10/15/1999	*	*	*
11/15/1999	*	*	*
12/15/1999	*	*	*

* Non-Natural Gamma Emitters < MDA

¹ Control Location

Table E-8

**Concentration of Tritium and Gamma Emitters
in Taylors Island Well Water
(Results in units of 10^{-3} pCi/m³ +/- 2 σ)**

Sample Date	H-3	Gamma Emitters
02/02/1999	<41	1
03/02/1999	<41	1
03/31/1999	<41	1
04/27/1999	<38	1
06/02/1999	<38	1
06/30/1999	<38	1
07/27/1999	<40	1
08/31/1999	<41	1
09/29/1999	<40	1
10/26/1999	<59	1
11/30/1999	<60	1
12/29/1999	<59	1

¹ Non-Natural Gamma Emitters <MDA

Table E-9

Direct Radiation as Measured in Pressurized Ion Chamber
(Results in units of mR/30 days +/- 10%)

Sample Code	Month		Month	
PIC1 ¹ Taylor's Island	JAN	5.86 +/- 0.59	FEB	5.76 +/- 0.58
	MAR	5.60 +/- 0.56	APR	5.65 +/- 0.57
	MAY	5.91 +/- 0.59	JUN	6.46 +/- 0.65
	JUL	6.59 +/- 0.66	AUG	6.37 +/- 0.64
	SEP	5.97 +/- 0.60	OCT	5.94 +/- 0.59
	NOV	5.95 +/- 0.60	DEC	5.98 +/- 0.60
PIC2 Entrance to Camp Conoy	JAN	4.25 +/- 0.43	FEB	4.24 +/- 0.42
	MAR	4.21 +/- 0.42	APR	4.25 +/- 0.43
	MAY	4.19 +/- 0.42	JUN	4.02 +/- 0.40
	JUL	4.07 +/- 0.41	AUG	4.07 +/- 0.41
	SEP	3.94 +/- 0.39	OCT	3.94 +/- 0.39
	NOV	3.97 +/- 0.40	DEC	4.01 +/- 0.40
PIC3 MET Station	JAN	4.55 +/- 0.45	FEB	4.67 +/- 0.47
	MAR	4.52 +/- 0.45	APR	4.51 +/- 0.45
	MAY	4.57 +/- 0.46	JUN	4.77 +/- 0.48
	JUL	4.95 +/- 0.50	AUG	4.76 +/- 0.48
	SEP	4.68 +/- 0.47	OCT	4.69 +/- 0.47
	NOV	4.83 +/- 0.48	DEC	5.87 +/- 0.59
PIC4 NNW of ISFSI	JAN	9.05 +/- 0.91	FEB	9.14 +/- 0.91
	MAR	8.96 +/- 0.90	APR	8.91 +/- 0.89
	MAY	8.97 +/- 0.90	JUN	9.19 +/- 0.92
	JUL	9.35 +/- 0.94	AUG	9.03 +/- 0.90
	SEP	8.80 +/- 0.88	OCT	8.76 +/- 0.88
	NOV	8.87 +/- 0.89	DEC	10.78 +/- 1.08
PIC5 S of ISFSI	JAN	5.07 +/- 0.51	FEB	5.12 +/- 0.51
	MAR	5.01 +/- 0.51	APR	5.01 +/- 0.50
	MAY	4.94 +/- 0.49	JUN	4.94 +/- 0.49
	JUL	4.99 +/- 0.50	AUG	4.95 +/- 0.50
	SEP	4.79 +/- 0.48	OCT	4.81 +/- 0.48
	NOV	4.86 +/- 0.49	DEC	5.28 +/- 0.53
PIC8 Visitor's Center	JAN	5.12 +/- 0.51	FEB	5.12 +/- 0.51
	MAR	5.27 +/- 0.53	APR	6.19 +/- 0.62
	MAY	5.74 +/- 0.57	JUN	5.93 +/- 0.59
	JUL	5.60 +/- 0.56	AUG	5.58 +/- 0.56
	SEP	5.44 +/- 0.54	OCT	5.45 +/- 0.55
	NOV	5.36 +/- 0.54	DEC	5.23 +/- 0.52

¹ Control Location

Table E-10

Direct Radiation
(Results in units of mR/90 days +/- 2σ)

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
DR24	Rt. 4 and Parran Rd.	11.81 +/- 0.62	11.61 +/- 0.96	12.13 +/- 1.31	11.63 +/- 1.60
DR25	Camp Conoy Guard House	12.85 +/- 0.88	12.34 +/- 1.61	13.02 +/- 2.17	13.16 +/- 1.23
DR26	Rt. 234 and Clark's Landing Road	10.44 +/- 0.44	11.08 +/- 0.62	10.70 +/- 0.98	10.20 +/- 0.81
DR27	Rt. 231 and Rt. 4	11.08 +/- 0.31	10.69 +/- 0.91	11.50 +/- 1.20	10.81 +/- 1.11
DR28	Taylor's Is. Siren #35	14.16 +/- 2.01	14.28 +/- 0.88	15.43 +/- 2.13	13.61 +/- 1.02
DR29	Taylor's Is. Siren #38	14.64 +/- 1.27	13.75 +/- 0.82	14.56 +/- 0.94	13.32 +/- 1.21
DR31	Cambridge	14.97 +/- 1.84	14.29 +/- 2.21	14.49 +/- 1.86	14.43 +/- 0.86
DR32	Twining Property, Taylor's Island	9.84 +/- 1.13	9.61 +/- 0.64	9.67 +/- 0.78	9.65 +/- 0.29
DR33	P. A. Ransome Property	15.28 +/- 3.04	14.92 +/- 1.57	15.80 +/- 2.27	15.01 +/- 0.47
DR34	Shoreline at Barge Rd.	9.43 +/- 1.04	9.34 +/- 0.66	¹	9.66 +/- 0.92

¹ Missing Data

Table E-11

Direct Radiation from Resin Storage Area
(Results in units of mR/90 days +/- 2 σ)

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
RPDR05	North Fence Lower	29.92 +/- 3.14	30.95 +/- 1.48	36.58 +/- 3.54	49.83 +/- 5.64
RPDR06	North Fence Upper	30.78 +/- 2.12	39.98 +/- 2.62	44.17 +/- 6.43	37.72 +/- 6.62
RPDR07	West Fence Right	44.67 +/- 4.49	28.72 +/- 3.15	26.88 +/- 3.51	29.17 +/- 1.78
RPDR08	West Fence Left	7.30 +/- 0.59	36.55 +/- 1.14	36.45 +/- 4.68	26.28 +/- 3.77
RPDR09	South Fence Lower	27.40 +/- 1.91	6.22 +/- 0.58	42.30 +/- 55.99	39.66 +/- 2.22
RPDR10	South Fence Upper	33.73 +/- 3.50	37.65 +/- 2.67	48.80 +/- 4.72	11.28 +/- 2.12
RPDR11	East Fence Left	53.44 +/- 8.08	39.15 +/- 2.06	35.79 +/- 4.77	30.31 +/- 1.66
RPDR12	East Fence Right	52.53 +/- 9.79	40.18 +/- 3.94	33.72 +/- 3.99	26.27 +/- 4.12