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May 13, 2011

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  
Independent Spent Fuel Storage Installation; Docket No. 72-8  
Annual Radiological Environmental Operating 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), Calvert Cliffs Nuclear Power Plant is submitting the Annual Radiological Environmental Operating Report, for the calendar year 2010 (Attachment 1).

Should you have questions regarding this matter, please contact me at (410) 495-5219 or Ms. Brenda Nuse at (410) 495-4913.

Very truly yours,

Douglas E. Lauer  
Director-Licensing

DEL/PSF/bjd

**Attachment:** (1) Annual Radiological Environmental Operating Report for the Calvert Cliffs Nuclear Power Plant Units 1 and 2 and the Independent Spent Fuel Storage Installation

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**ATTACHMENT (1)**

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**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
FOR THE CALVERT CLIFFS NUCLEAR POWER PLANT**

**UNITS 1 AND 2**

**AND THE INDEPENDENT SPENT FUEL STORAGE INSTALLATION**

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**ANNUAL RADIOLOGICAL ENVIRONMENTAL  
OPERATING REPORT  
FOR THE  
CALVERT CLIFFS NUCLEAR POWER PLANT  
UNITS 1 AND 2  
AND THE  
INDEPENDENT SPENT FUEL STORAGE INSTALLATION**

January 1 - December 31, 2010

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B. D. Nuse

CONSTELLATION ENERGY  
CONSTELLATION ENERGY NUCLEAR GROUP, LLC

APRIL 2011

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## I. SUMMARY

During this operating period for Calvert Cliffs Nuclear Power Plant (CCNPP) Units 1 and 2, a total of 3483 radiological analyses were performed and the analytical results reviewed. Most of these analyses were performed to satisfy the requirements of the Offsite Dose Calculation Manual (ODCM) (Ref. 6) and the Environmental and Independent Spent Fuel Storage Installation (ISFSI) Technical Specifications (Ref. 10). Some of these samples, although not required by either the ODCM or the Technical Specifications, were collected to maintain our commitments to the surrounding community and to maintain historical continuity of the CCNPP Radiological Environmental Monitoring Program (REMP) that started in 1970. The entire monitoring program in place around CCNPP is divided into three parts: the original REMP, the ISFSI monitoring program, and the Non-ODCM Radiological Environmental Monitoring. The following paragraphs describe each of these parts in more detail.

A total of 651 radiochemical analyses were performed on 583 environmental samples and 540 thermoluminescent dosimeters (TLDs) were analyzed for ambient radiation exposure rates as part of the original REMP. These analyses were performed to satisfy the requirements of the ODCM (Ref. 6) and the Environmental Technical Specifications (Ref. 5).

For the ISFSI monitoring program, 348 radiochemical analyses were performed on 300 environmental samples, 52 of which were in common with the original REMP. In addition, 480 TLDs, 24 in common with the original REMP, were analyzed for ambient radiation exposure rates. These analyses were performed to satisfy the requirements of the ODCM (Ref. 6) and the ISFSI Technical Specifications (Ref. 10).

In addition, 580 analyses were performed on 632 additional environmental samples, and 480 additional TLDs were analyzed for ambient radiation exposure rates. Also, six pressurized ion chambers continuously monitored the environs around the plant for ambient radiation levels resulting in 72 monthly measurements. As mentioned earlier, these 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 monitoring commitments made to the surrounding community.

And lastly, 200 radiochemical analyses were performed on 200 quality assurance samples and 132 quality assurance TLDs were analyzed as part of an internal and external quality assurance program associated with Teledyne Brown Engineering. Laboratory intercomparison samples obtained from Environmental Resource Associates (ERA) and Analytics' Inc. were also analyzed.

Samples collected from the aquatic environment included bay water, fish, oysters, and shoreline sediment. 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, charcoal and silver zeolite molecular sieve cartridges, respectively. The particulate filters were analyzed for beta activity and gamma emitting nuclides. The charcoal and 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 original 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.

Natural radioactivity was detected in essentially all 3483 radiological analyses performed. Low levels of man-made fission products were also observed in 20 of these analyses. All of these observations were attributed to fallout from past atmospheric weapons testing. Detailed discussions about the results of these analyses are contained in the body of this report.

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  $1.60 \times 10^{-2}$  mrem via liquid and gaseous pathways, which is less than 0.1% of the acceptable limit of 75 mrem/yr as specified in 40CFR190;
- b. a maximum whole body dose of  $1.47 \times 10^{-3}$  mrem via liquid and gaseous pathways, which is less than 0.02% of the acceptable limit of 25 mrem/yr as specified in 40CFR190;
- c. a maximum calculated dose to all other organs via liquid and gaseous pathways was equal to  $1.48 \times 10^{-3}$  mrem to GI-Tract. This dose is less than 0.06% of the allowable limit of 25 mrem/yr as specified in 40CFR190.

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

## **II. CALVERT CLIFFS NUCLEAR POWER PLANT RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

### **II.A. INTRODUCTION**

Constellation Energy (CE), previously known as Baltimore Gas and Electric Company (BGE), has been conducting a REMP in the environs of the CCNPP 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. The location of the plant in relation to local metropolitan areas is shown on Figure A-1.

Results of the monitoring program for the pre-operational period have been reported in a series of documents (Ref. 1-4). The results from previous operational periods are contained in annual reports submitted to the NRC as required.

Results of the monitoring program for the current operational period are included in this report. The report presents the content of the REMP (Table 1), the sampling locations (Appendix A), the summary of the analytical results (Table 2), a compilation of the analytical data (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 (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 CCNPP Units 1 and 2.

### **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 (Ref. 6) 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 Constellation Energy according to CCNPP Procedures (Ref. 7,12,13).

### **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**

There were no program exceptions during this operating period.

## **II.C. RESULTS AND DISCUSSIONS**

All the environmental samples collected during the year were analyzed using Constellation Energy laboratory procedures (Ref. 8). 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). Composite samples were obtained from 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 WA1 Intake Area sample at 294 +/- 174 pCi/L for Quarter 3 and in the Discharge (WA2) samples in all four quarters. The detectable concentrations observed in the WA2 Discharge Area samples ranged from 298 +/- 43 pCi/L to 494 +/- 174 pCi/L, which is similar to the ranges observed in previous years.

Figure 1 compares tritium observed in the plant discharge and intake with annual effluent releases 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**

Twelve samples of aquatic organisms were obtained from four locations during the year. Samples of fish, when in season, are normally collected from the 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 discharge and the control point in the Patuxent River. Oyster samples were obtained quarterly from Camp Conoy (sample code Ia3) and Kenwood Beach (Ia6).

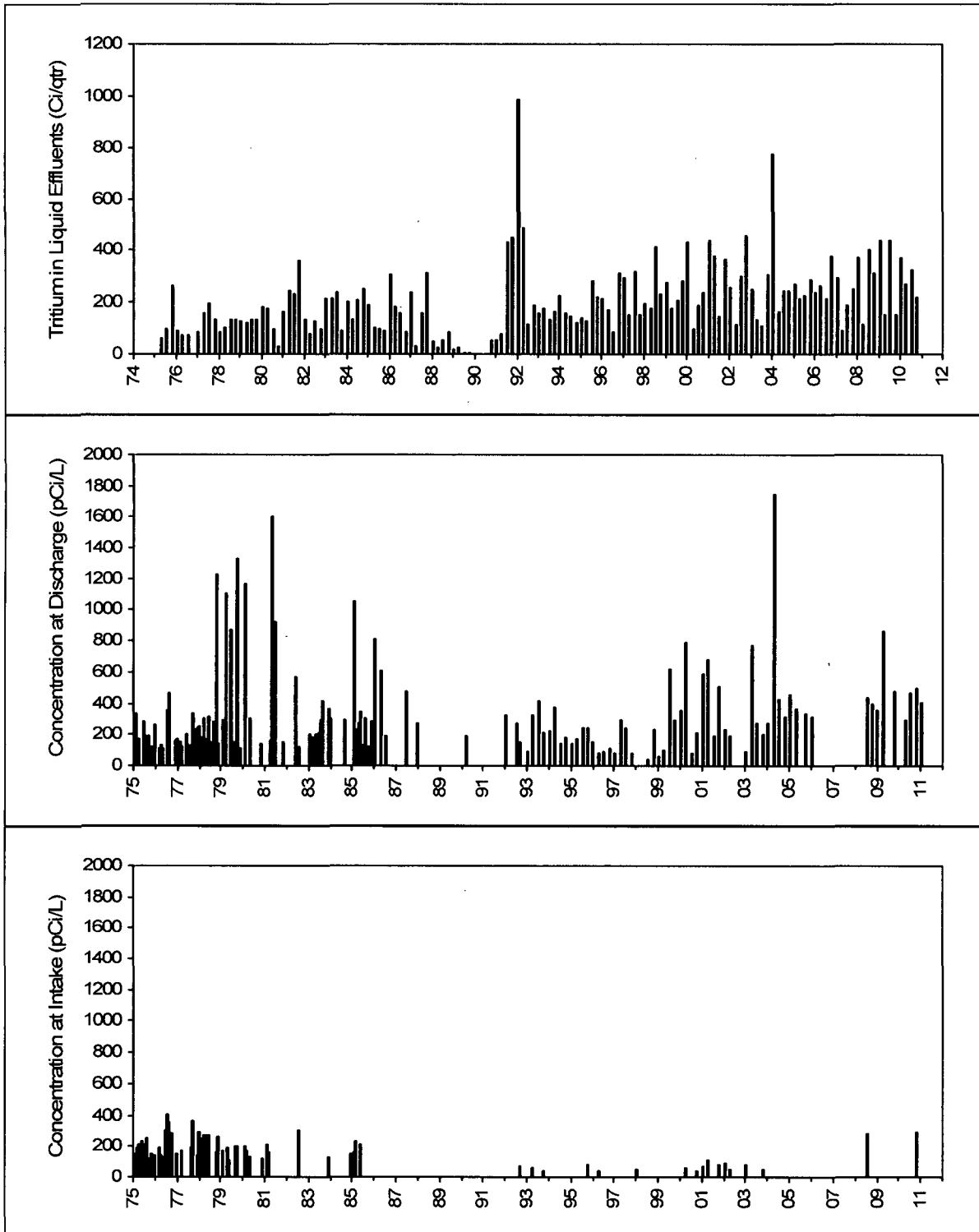
Edible portion of the fish and oyster samples were analyzed for gamma emitters. Gamma spectrometric analyses of the fish exhibited naturally occurring K-40, but no detectable concentrations of any plant-related radionuclides. Oyster samples likewise exhibited naturally occurring K-40, but no detectable concentrations of any plant related radionuclides.

#### **II.C.1.c Shoreline Sediment**

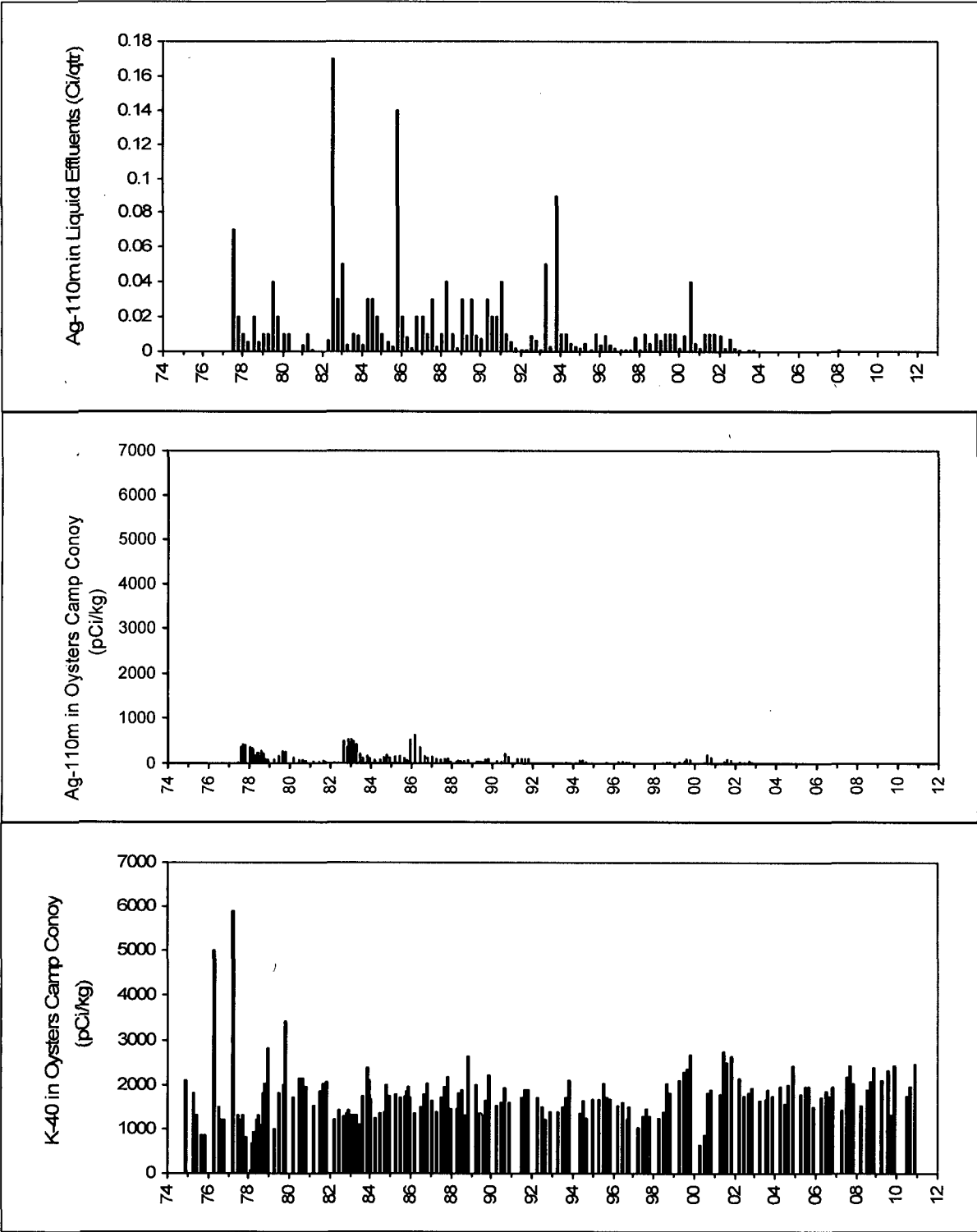
Semiannual shoreline sediment samples were taken from one location during the year. This location is Shoreline at Barge Road (sample code Wb1). The samples obtained from this location were analyzed for gamma emitters.

Gamma spectrometric analyses of these samples exhibited naturally occurring radionuclides, but no detectable concentration 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, charcoal 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. The values ranged from  $0.7 \times 10^{-2}$  to  $4.5 \times 10^{-2}$  pCi/m<sup>3</sup> for the indicator locations and  $0.9 \times 10^{-2}$  to  $4.1 \times 10^{-2}$  pCi/m<sup>3</sup> at the control location. The location with the highest overall mean of  $2.3 \times 10^{-2}$  pCi/m<sup>3</sup> was A4, Lusby.

Gamma spectrometric analyses of monthly composited air particulate samples exhibited no detectable concentrations of any plant-related radionuclides in any of these samples. Naturally occurring radionuclides, such as Be-7, were detected in nearly all samples.

Figure 3 depicts the historical trends of beta activity.

### **II.C.2.b Air Iodine**

Weekly composited charcoal and silver zeolite cartridges (for trapping radioiodine species) were collected from the five locations during the year. These samples were analyzed for radioiodine species.

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

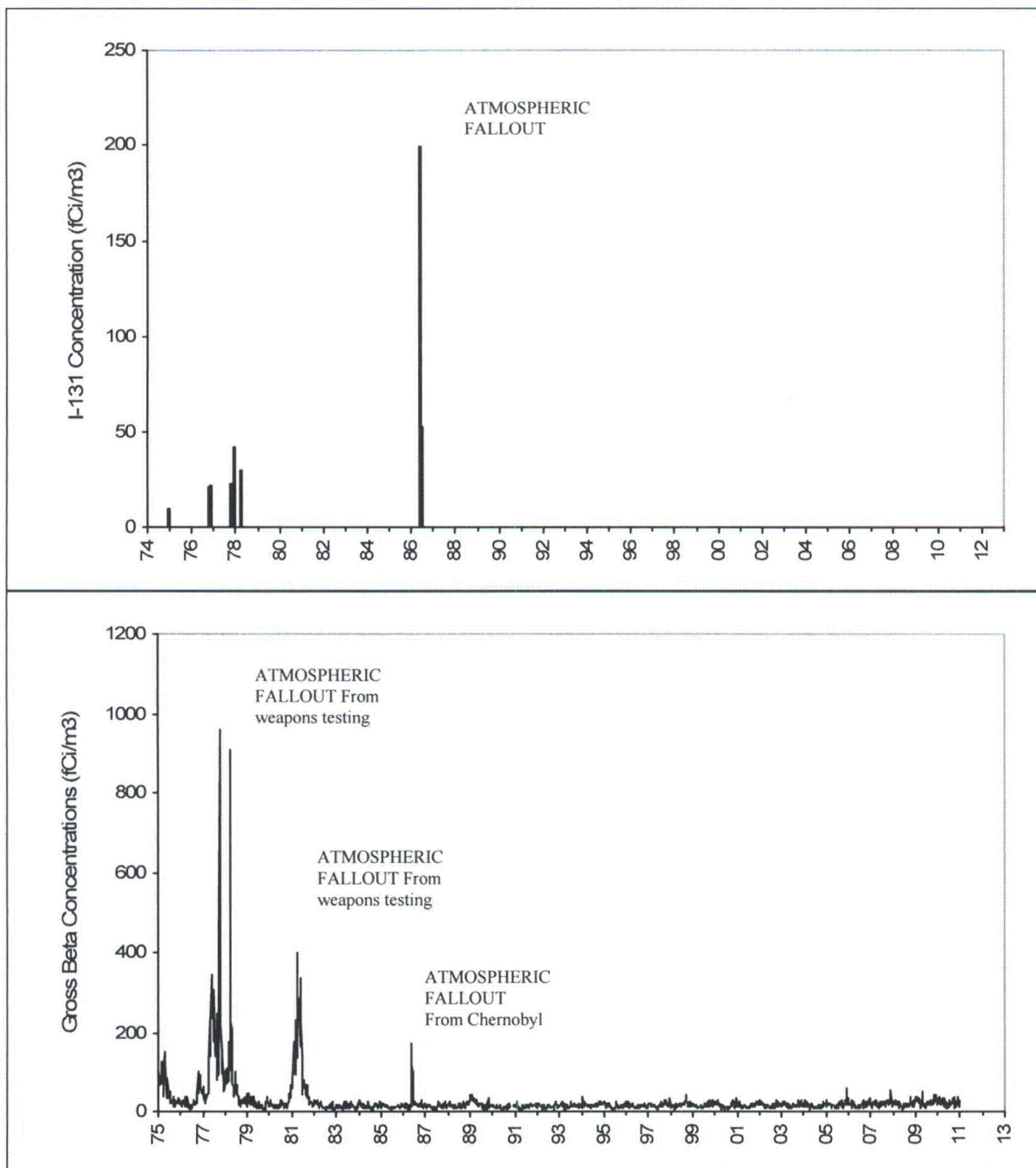
Figure 3 depicts the historical trends of radioiodine.

## **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.

All samples showed detectable amounts of naturally occurring K-40 and Be-7. No plant related radionuclides were found in any of these samples.

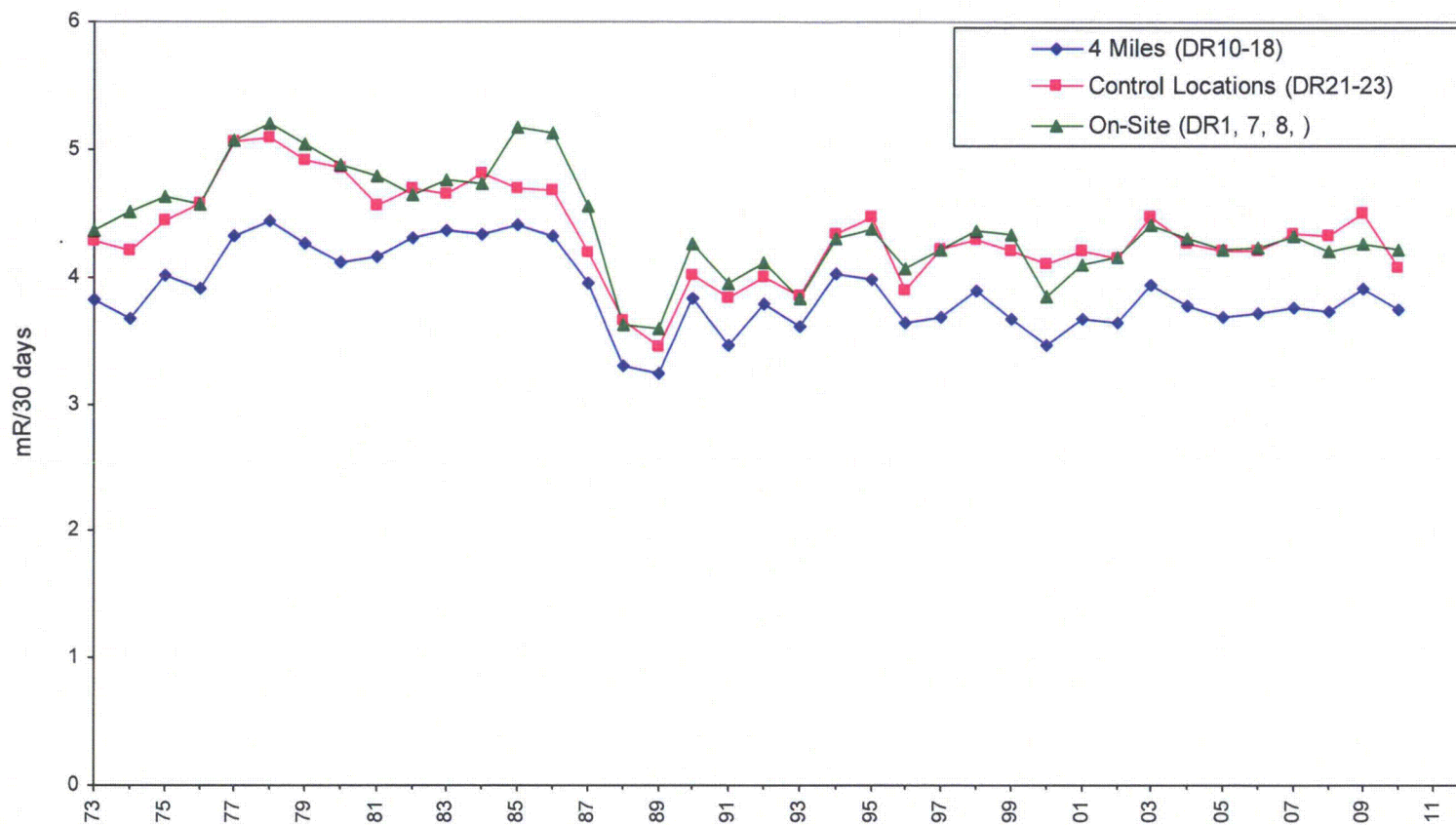
### **II.C.4 Direct Radiation**

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.

TLDs 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, Anderson's Property (sample code DR23).

The mean 90 day ambient radiation measured at the indicator locations was 11.47 mR and ranged from 8.69 to 15.41 mR as reported in Table 2. The control locations showed a 90 day mean of 13.32 mR with ranges from 10.93 to 17.35 mR. The location with the highest overall mean of 15.85 was DR23, Taylors Island, which ranged from 14.49 to 17.35 mR. A comparison of the means and ranges of the current TLD data with those of both the historical data and the regional data shows no plant-related contribution to the measured direct radiation exposure. 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**

No man-made fission or activation by-products attributable to plant operations were observed in the environment surrounding the plant during the year.

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.

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  $1.50 \times 10^{-2}$  mrem to a child via the plume, ground, vegetable, meat, and inhalation pathways at 2.1 km S of the containments at Calvert Cliffs. This is less than 0.1% of the acceptable limit of 75 mrem/yr as specified in 40CFR190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

A maximum whole body gamma dose of  $4.4 \times 10^{-4}$  mrem to a child at 2.1 km SE of the containments at Calvert Cliffs. This is less than 0.02% of the acceptable dose limit of 25 mrem/yr as specified in 40CFR190.

A maximum dose to any other organ, in this case the skin, of  $2.2 \times 10^{-3}$  mrem to an adult at 1.8 km SSW of the containments at Calvert Cliffs. This is less than 0.05% of the acceptable dose limit of 25 mrem/yr as specified in 40CFR190.

### **Liquid Pathways**

A maximum thyroid dose of  $1.0 \times 10^{-3}$  mrem to an adult for all liquid pathways, which is less than 0.002% of the acceptable dose limit of 75 mrem/yr as specified in 40CFR190.

A maximum whole body dose of  $1.03 \times 10^{-3}$  mrem to an adult via all liquid pathways, which is less than 0.01% of the acceptable dose limit of 25 mrem/yr as stated in 40CFR190.

A maximum dose to any other organ, in this case GI Tract, of  $1.06 \times 10^{-3}$  mR to a child for all pathways, which is less than 0.02% of the acceptable dose limit of 25 mrem/yr specified in 40CFR190.

**Gaseous and Liquid Pathways Combined**

A maximum thyroid dose of  $1.6 \times 10^{-2}$  mrem via liquid and gaseous pathways, which is less than 0.1% of the acceptable limit of 75 mrem/yr as specified in 40CFR190;

A maximum whole body dose of  $1.47 \times 10^{-3}$  mrem via liquid and gaseous pathways, which is less than 0.02% of the acceptable limit of 25 mrem/yr as specified in 40CFR190;

A maximum calculated dose to all other organs via liquid and gaseous pathways was equal to  $1.48 \times 10^{-2}$  mrem to the GI Tract. This dose was less than 0.06% of the allowable limit of 25 mrem/yr as specified in 40CFR190.

In all cases, the calculated doses are a small fraction of the applicable limits specified in 40 CFR Part 190.

Therefore, it is concluded that the operation of Calvert Cliffs Units 1 and 2 produced radioactivity and ambient radiation levels significantly below the limits of the ODCM and 40 CFR Part 190, and there was no significant buildup of plant-related radionuclides in the environment due to the operation of the CCNPP.

Figure 5

Atmospheric Dispersion Around CCNPP Average Relative Air Concentrations

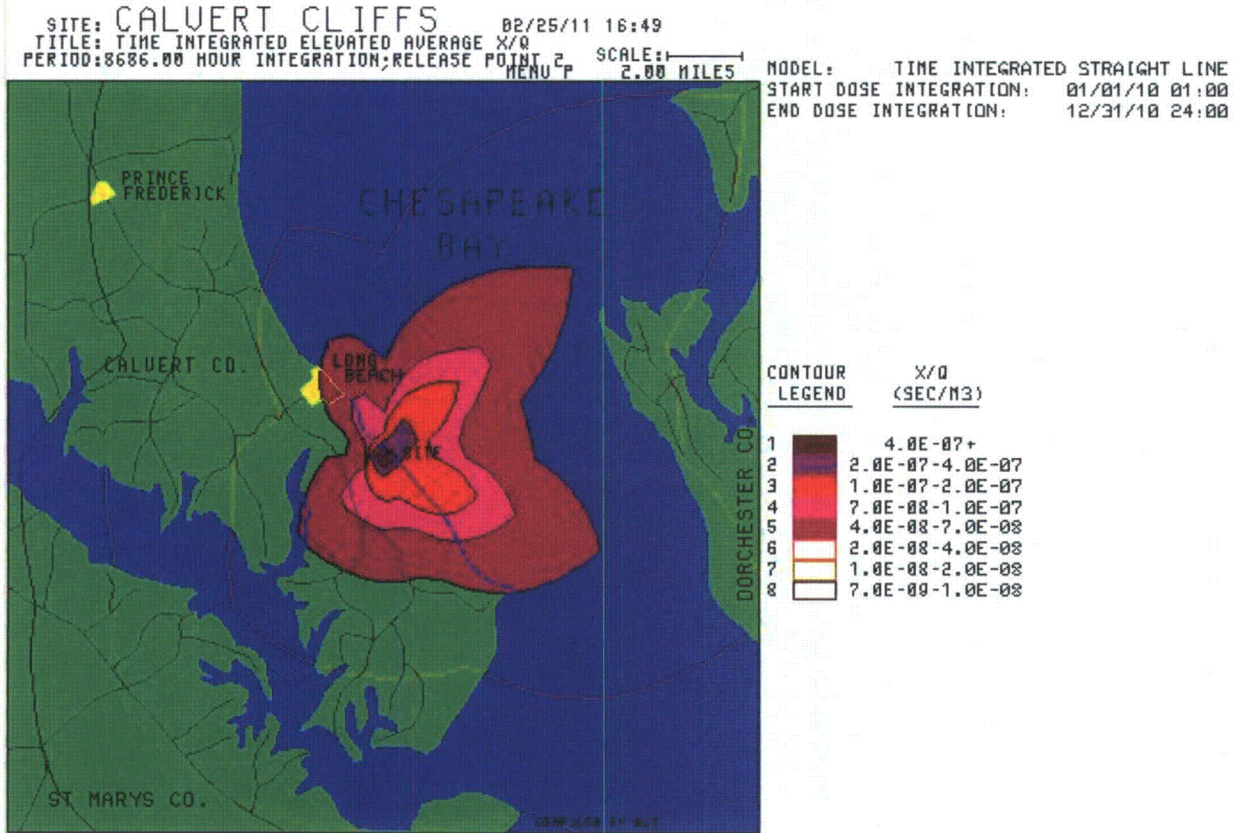
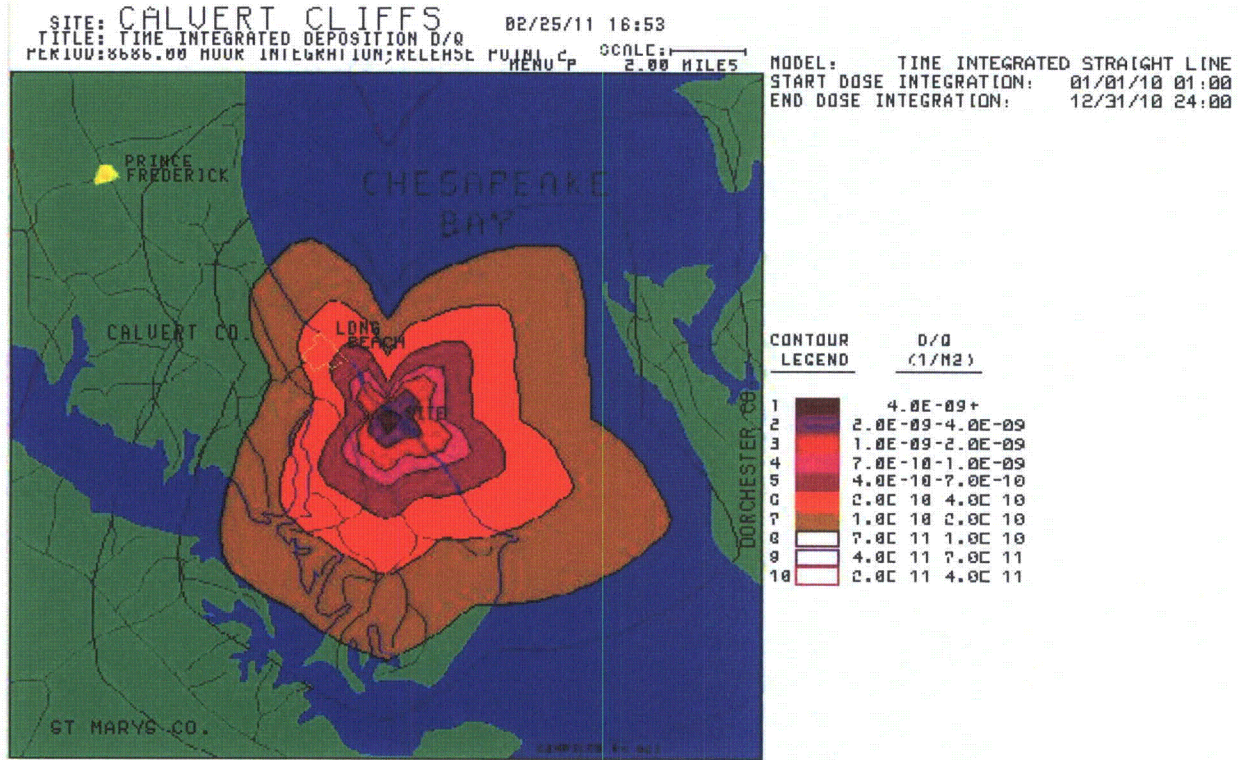


Figure 6

Atmospheric Dispersion Around CCNPP Average Relative Ground Deposition



**Table 1**

**Synopsis of 2010 Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program**

Sample Type	Sampling Frequency <sup>1</sup>	Number of Locations	Number Collected	Analysis	Analysis Frequency <sup>1</sup>	Number Analyzed
<b>Aquatic Environment</b>						
Bay Water	MC	2	24	Gamma H3	MC	24
	QC	2	8		QC	8
Fish <sup>2</sup>	A	4	4	Gamma	A	4
Oysters	Q	2	8	Gamma	Q	8
Shoreline Sediment	SA	1	2	Gamma	SA	2
<b>Atmospheric Environment</b>						
Air Iodine <sup>3</sup>	W	5	259	I-131	W	259
Air Particulates <sup>4</sup>	W	5	259	Gross Beta Gamma	W MC	259 60
<b>Direct Radiation</b>						
Ambient Radiation	Q	23	540	TLD	Q	540
<b>Terrestrial Environment</b>						
Vegetation <sup>5</sup>	M	3	27	Gamma	M	27

<sup>1</sup> W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite

<sup>2</sup> Once in Season, July through September

<sup>3</sup> The collection device contains silver Zeolite

<sup>4</sup> Beta counting is performed after >72 hour decay, Gamma spectroscopy performed on monthly composites of weekly samples

<sup>5</sup> Monthly during growing season when available

**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 <sup>1</sup>	Location with Highest Annual Mean Name/Distance & Direction <sup>2</sup>	Highest Annual Mean (F) / Range <sup>1</sup>	Control Locations Mean (F)/Range
<b>Aquatic Environment</b>						
Bay Water (pCi/L)	H-3	202	417 (4/4) (298-494)	Intake Vicinity WA2 0.2 km NNE	417 (4/4) (298-494)	294 (1/4) (294)
Oysters (pCi/kg)	Gamma (8) Cs-137	15	14 (1/4) --	Camp Conoy IA3 0.9 km E	14 (1/4) --	<sup>2</sup> --
<b>Atmospheric Environment</b>						
Air Particulates (10 <sup>-2</sup> pCi/m <sup>3</sup> )	Gross Beta (254)	0.5	2.1 (207/208) (0.7-4.5)	Route 765 at Lusby A4 2.9 km SSW	2.3 (52/52) (0.9-4.0)	2.2 (51/52) (0.9-4.1)
<b>Direct Radiation</b>						
Ambient Radiation (mR/90 days)	TLD (540)	--	11.47 (474/474) (8.69-15.41)	Taylor's Island DR23 12.6 km ENE	15.85 (24/24) (14.49-17.35)	13.32 (66/66) (10.93-17.35)

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

<sup>2</sup> There was no detectable activity at the control location, IA6



### **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 Installation (ISFSI). The first dry fuel storage canister was loaded into the ISFSI in November of 1993, with more canisters being loaded in subsequent years. During this operating period, three additional canisters of spent fuel were transferred to the ISFSI. The area was also used as a temporary storage area for additional radioactive material.

Results of the monitoring program for the ISFSI for the current period are included in this report.

This report presents the content of the ISFSI REMP (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. Pressurized Ion Chambers (PICs), because they duplicate direct surveillance by TLDs and because they experience problems with reliability, were excluded from the Technical Specification portion of the ISFSI monitoring program. PIC results, however, are given in Table E-9 and will continue to be Non-ODCM surveillance.

The results were compared with that generated during the previous ISFSI pre-operational periods (Ref.11) and the current and previous CCNPP REMP periods. These comparisons show little deviations from these periods and are very close to the natural background levels for the region with the exception of TLDs around the north end of the ISFSI. More detailed discussions of these results are given in Section III. C.

#### **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 contractors to, or personnel of, Constellation Energy personnel according to Constellation Energy Laboratory Procedures (Ref. 8).

### **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**

There were no program exceptions during this operating period

## **III.C. RESULTS AND DISCUSSIONS**

All the environmental samples collected were analyzed using Constellation Energy laboratory procedures (Ref. 8). 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.

No source of airborne radioiodine exists for the ISFSI. Airborne radioiodine is, therefore, not considered in assessing the radiological impact of the ISFSI.

#### **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 SSE 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. These values ranged from  $0.7 \times 10^{-2}$  to  $7.4 \times 10^{-2}$  pCi/m<sup>3</sup> for the indicator locations and  $0.8 \times 10^{-2}$  to  $4.1 \times 10^{-2}$  pCi/m<sup>3</sup> for the control location. The location with the highest overall mean of  $2.4 \times 10^{-2}$  pCi/m<sup>3</sup> was SFA1, MET Station.

Gamma spectrometric analyses of monthly composited air particulate samples exhibited no detectable concentrations of any plant-related radionuclides in any of these samples. Naturally occurring radionuclides, such as Be-7, were detected in nearly all 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), SSE 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.

No detectable concentration of plant-related radionuclides were found in any of these samples. Naturally occurring radionuclides such as K-40 were detected in all 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), SSE 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 twelve quarterly samples from both indicator and control locations. The Cs-137 concentrations ranged from  $41 \pm 31$  to  $498 \pm 57$  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 Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations" and are comparable to those observed in previous annual reporting periods for the CCNPP REMP and in the earlier pre-operational data for the ISFSI. No other detectable concentrations of plant-related radionuclides were found in any of these samples. Naturally occurring radionuclides such as K-40, were also detected in all these samples.

### **III.C.3 Direct Radiation**

Direct radiation is measured by a network of TLDs surrounding the ISFSI. These TLDs are collected quarterly from nineteen 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, (sample code SFDR1); NNW of ISFSI, (sample code SFDR2); North of ISFSI, (sample code SFDR3); NE of ISFSI, (sample code SFDR4); East of ISFSI, (sample code SFDR5); ESE of ISFSI, (sample code SFDR6); NNW of ISFSI, (sample code SFDR8); SSE of ISFSI, (sample code SFDR9); NW of ISFSI, (sample code SFDR10); WNW of ISFSI, (sample code SFDR11); WSW of ISFSI, (sample code SFDR12); South of ISFSI, (sample code SFDR13); SE of ISFSI, (sample code SFDR14); ENE of ISFSI, (sample code SFDR15); SSW of ISFSI, (sample code SFDR16); NNE of ISFSI, (sample code SFDR17) and West of ISFSI, (sample code SFDR18). Sampling locations are shown on Figures A-4 and A-5.

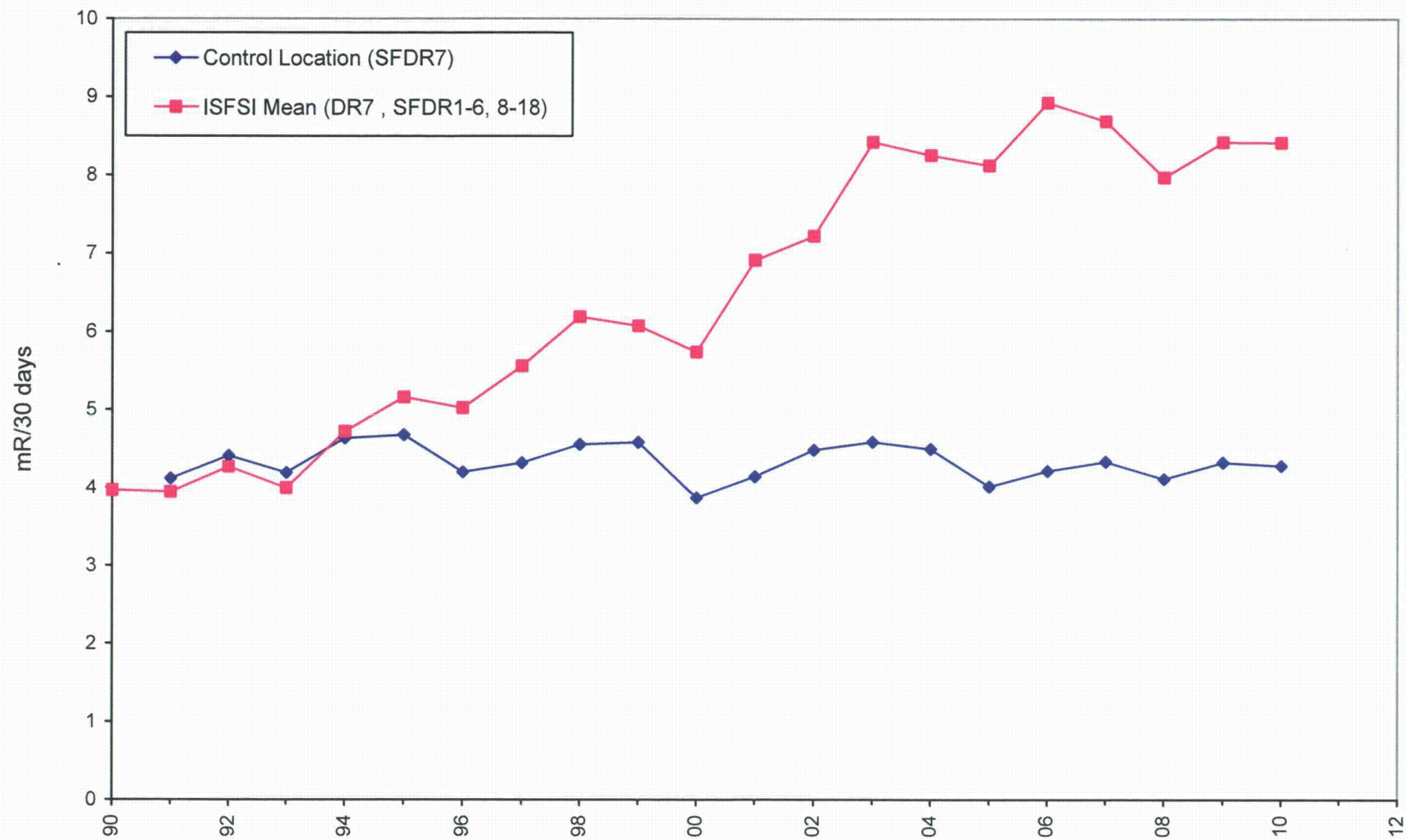
The mean 90 day ambient radiation measured at the ISFSI indicator locations was 25.25 mR and ranged from 9.49 to 51.45 mR as reported in Table 4. The control location showed a 90 day mean of 12.84 mR and ranged from 11.63 to 13.56 mR. The location with the highest overall mean of 46.61 mR with a range of 40.54 to 51.45 mR was SFDR18, West of ISFSI. These readings are consistent with those expected from the storage of spent fuel in the ISFSI. 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. No other plant-related radionuclide was observed in the environs of the ISFSI.

In general, the results in the following tables continue the historical trends previously observed at the official sites of the CCNPP REMP.

**FIGURE 7**  
**Mean TLD Gamma Dose, ISFSI**



**Table 3**

**Synopsis of 2010 Calvert Cliffs Nuclear Power Plant  
Independent Spent Fuel Storage Installation  
Radiological Environmental Monitoring Program**

Sample Type	Sampling Frequency <sup>1</sup>	Number of Locations	Number Collected	Analysis	Analysis Frequency <sup>1</sup>	Number Analyzed
<b>Atmospheric Environment</b>						
Air Particulates <sup>2</sup>	W	5	260	Gross Beta Gamma	W MC	260 60
<b>Direct Radiation</b>						
Ambient Radiation	Q	20	480	TLD	Q	480
<b>Terrestrial Environment</b>						
Vegetation	Q	5	20	Gamma	Q	20
Soil	Q	5	20	Gamma	Q	20

<sup>1</sup> W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite

<sup>2</sup> 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 <sup>1</sup>	Location with Highest Annual Mean Name/Distance & Direction <sup>2</sup>	Highest Annual Mean (F) / Range <sup>1</sup>	Control Locations Mean (F)/Range
<b>Atmospheric Environment</b>						
Air Particulates (10 <sup>-2</sup> pCi/m <sup>3</sup> )	Gross Beta (260)	0.5	2.2 (208/208) (0.7-7.4)	MET Station SFA1 0.4 km NW	2.4 (52/52) (0.9-7.4)	2.0 (52/52) (0.8-4.1)
<b>Direct Radiation</b>						
Ambient Radiation (mR/90 days)	TLD (480)	--	25.25 (456/456) (9.49-51.45)	West of ISFSI SFDR18 0.1 km W	46.61 (24/24) (40.54-51.45)	12.84 (24/24) (11.63-13.56)
<b>Terrestrial Environment</b>						
Vegetation (pCi/L)	Gamma (20) Cs-137	27	20 (3/16) (10-40)	On Site before Entrance to Camp Conoy SFB5 0.7 km ESE	25 (2/4) (10-40)	-- --
Soil (pCi/kg)	Gamma (20) Cs-137	17	233 (8/16) (78-498)	Entrance to Camp Conoy SFS5 0.7 km ESE	318 (4/4) (168-498)	63 (4/4) (41-80)

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

<sup>2</sup> 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) 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
- (5) Calvert Cliffs Nuclear Power Plant, Units 1 and 2, License Nos. DPR-53 and DPR-69, Technical Specification 5.6.2; Annual Radiological Environmental Operating Report.
- (6) Offsite Dose Calculation Manual for the Calvert Cliffs Nuclear Power Plant.
- (7) CP-234, Specification and Surveillance for the Radiological Environmental Monitoring Program.
- (8) Constellation Energy Laboratory Procedures Manual, General Services Department.
- (9) Constellation Energy, "Land Use Survey Around Calvert Cliffs Nuclear Power Plant, August 2010."
- (10) Calvert Cliffs Independent Spent Fuel Storage Installation Technical Specifications, Appendix A to Materials License SNM-2505
- (11) 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.
- (12) CP-501, Liquid and Steam Sampling Techniques
- (13) CNG-EV-1.01-1000, Radiological Environmental Monitoring Program (REMP)



## **APPENDIX A**

### **Sample Locations for the REMP and the ISFSI**

Appendix A contains information concerning the environmental samples which were collected during this operating period.

Sample locations and specific information about individual locations for the CCNPP REMP are given in Table A-1. Figure A-1 shows the location of the CCNPP 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.

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

Station	Description	Distance <sup>1</sup>		Direction <sup>1</sup>
		(KM)	(Miles)	(Sector)
A1 <sup>2</sup>	On Site Before Entrance to Camp Conoy	0.7	0.4	S
A2	Camp Conoy Rd, at emergency siren	2.5	1.6	SSE
A3	Bay Breeze Rd	2.6	1.6	SE
A4	Route 765, Lusby	2.9	1.8	SSW
A5	Emergency Operations Facility	19.3	12.0	WNW
DR01	On Site, along Cliffs	0.6	0.4	NW
DR02	Route 765, Auto Dump	2.7	1.7	WNW
DR03	Route 765, Giovanni's Tavern (Knotty Pine)	2.3	1.4	W
DR04	Route 765, across from White Sands Drive	2.0	1.2	WSW
DR05	Route 765, John's Creek	2.4	1.5	SW
DR06	Route 765, Lusby	2.9	1.8	SSW
DR07 <sup>2</sup>	On Site before Entrance to Camp Conoy	0.7	0.4	S
DR08	Camp Conoy Rd at Emergency Siren	2.5	1.6	SSE
DR09	Bay Breeze Rd	2.6	1.6	SE
DR10	Calvert Beach Rd and Decatur Street	6.4	4.0	NW
DR11	Dirt road off Mackall & Parren Rd	6.6	4.1	WNW
DR12	Mackall & Bowen Rds	6.7	4.2	W
DR13	Mackall Rd, near Wallville	6.1	3.8	WSW
DR14	Rodney Point	6.4	4.0	SW
DR15	Mill Bridge & Turner Rds	6.2	3.9	SSW
DR16	Across from Appeal School	6.5	4.0	S
DR17	Cove Point & Little Cove Point Rds	5.9	3.7	SSE
DR18	Cove Point	7.1	4.4	SE
DR19	Long Beach	4.4	2.7	NW
DR20	On site, near shore	0.4	0.2	NNW
DR21	Emergency Operations Facility (EOF)	19.3	12.0	WNW
DR22	Solomons Island	12.5	7.8	S
DR23	Taylor's Island, Anderson's Property	12.4	7.7	ENE
IA1	Discharge Area	0.3	0.2	N
IA10	Hog Island	15.3	9.5	SSE
IA2	Discharge Vicinity	0.3	0.2	N
IA3	Camp Conoy	0.9	0.6	E
IA4	Patuxent River	-	-	VARIOUS
IA5	Patuxent River	-	-	VARIOUS
IA6	Kenwood Beach	10.7	6.7	NNW
IB1	Garden Off Bay Breeze Rd	2.6	1.6	SSE
IB2	Garden Off Bay Breeze Rd	2.6	1.6	SSE
IB3	Garden Off Bay Breeze Rd	2.6	1.6	SSE
IB4	On site, before entrance to Camp Conoy	0.7	0.4	S
IB5	On site, before entrance to Camp Conoy	0.7	0.4	S
IB6	On site, before entrance to Camp Conoy	0.7	0.4	S
IB7	Emergency offsite facility	19.3	12.0	WNW
IB8	Emergency offsite facility	19.3	12.0	WNW
IB9	Emergency offsite facility	19.3	12.0	WNW
WA1	Intake area	0.2	0.1	NNE
WA2	Discharge area	0.3	0.2	N
WB1	Shoreline at Barge Rd.	0.6	0.4	ESE

<sup>1</sup> Distance and direction from the central point between the two containment buildings

<sup>2</sup> Common to both the REMP and ISFSI monitoring program

Figure A-1

Map of Southern Maryland and Chesapeake Bay Showing Location of Calvert Cliffs Nuclear Power Plant

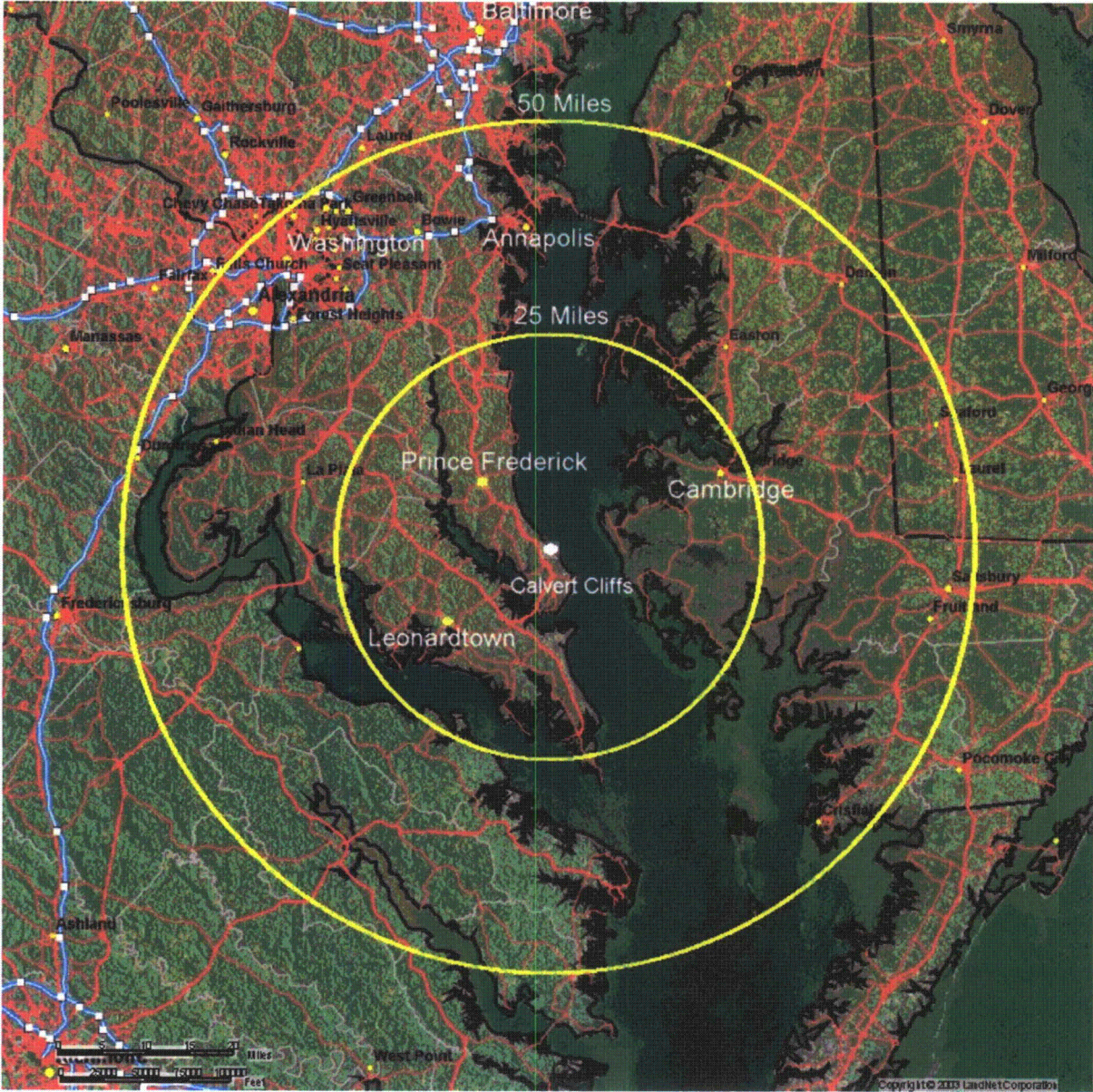


Figure A-2  
Calvert Cliffs Nuclear Power Plant Sampling Locations  
0-2 Miles

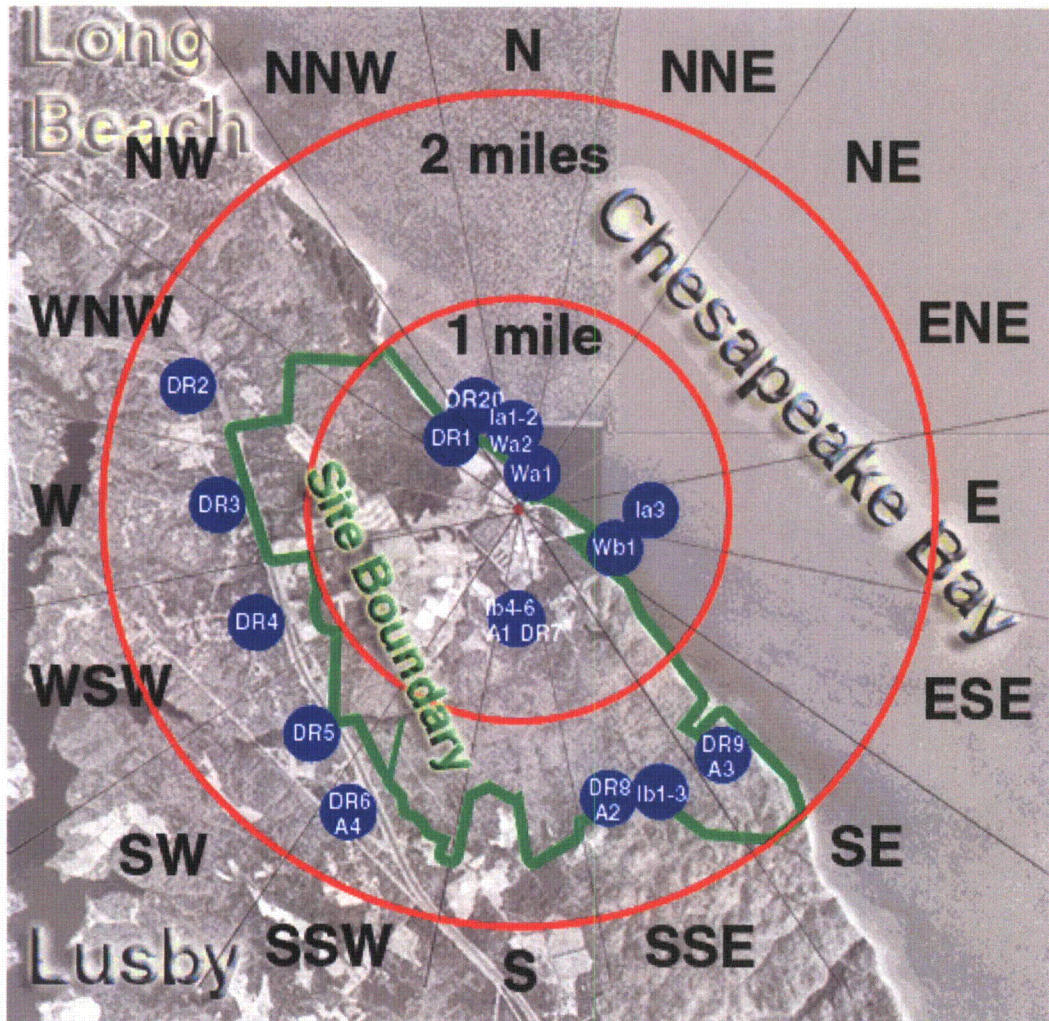
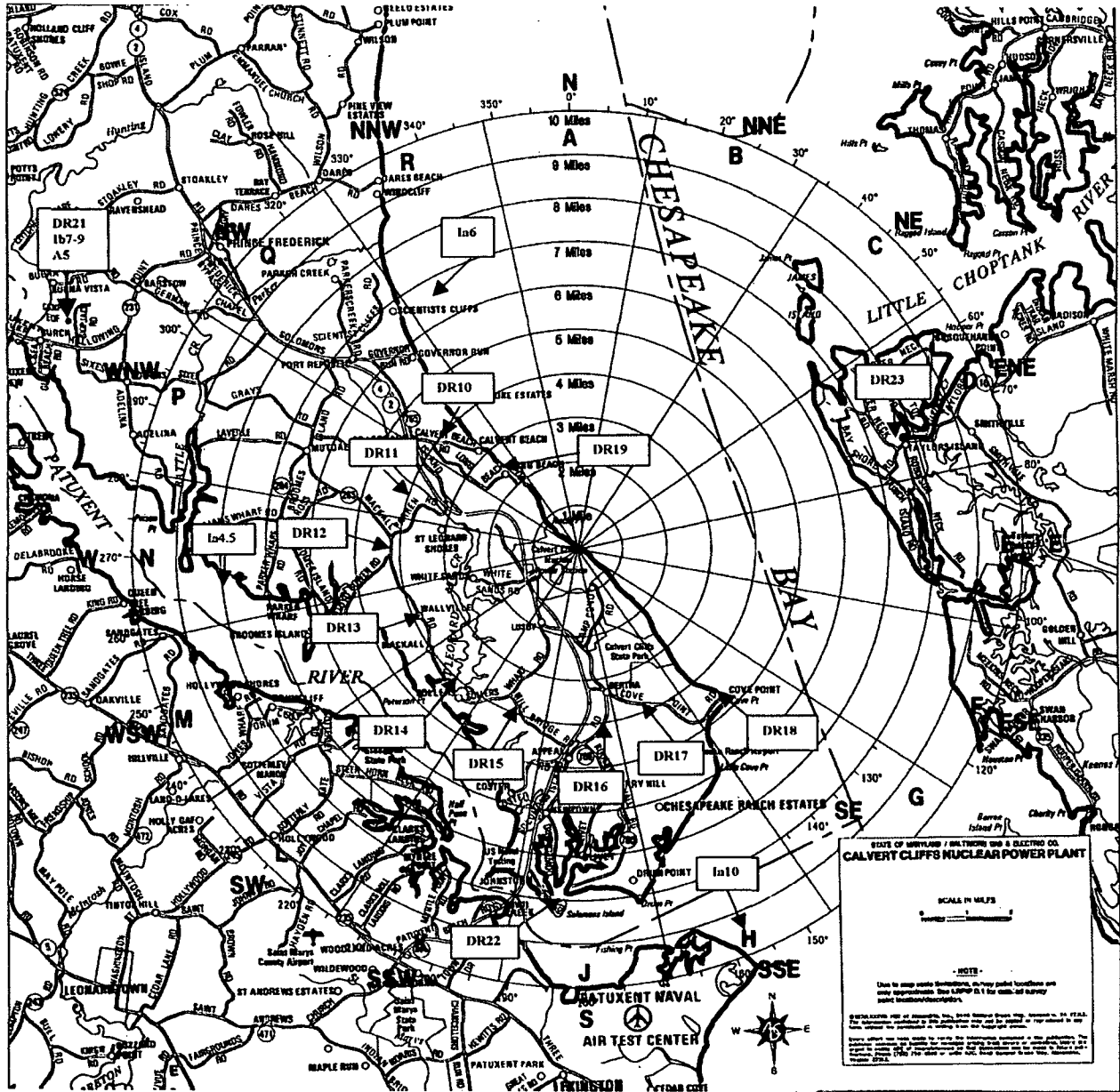


Figure A-3  
Calvert Cliffs Nuclear Power Plant Sampling Locations  
0-10 Miles



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

Station	Description	Distance <sup>1</sup>	Direction <sup>1</sup>
		(KM)	(Sector)
<b>Air Particulate</b>			
A1 <sup>2</sup>	On Site Before Entrance to Camp Conoy	0.7	S
SFA1	Meteorological Station	0.4	NW
SFA2	CCNPP Visitor's Center	0.7	NNE
SFA3	NNW of ISFSI	0.1	NNW
SFA4	SSE of ISFSI	0.1	SSE
<b>Direct Radiation</b>			
DR07 <sup>2</sup>	On Site before Entrance to Camp Conoy	0.7	S
DR30	Meteorological Station	0.4	NW
SFDR01	SW of ISFSI	0.1	SW
SFDR02	NNW of ISFSI	0.1	N
SFDR03	North of ISFSI	0.1	N
SFDR04	NE of ISFSI	0.1	NE
SFDR05	East of ISFSI	0.1	E
SFDR06	ESE of ISFSI	0.1	ESE
SFDR07	CCNPP Visitor's Center	0.7	NNE
SFDR08	NNW of ISFSI	0.1	NNW
SFDR09	SSE of ISFSI	0.1	SSE
SFDR10	NW of ISFSI	0.1	NW
SFDR11	WNW ISFSI	0.1	WNW
SFDR12	WSW of ISFSI	0.1	WSW
SFDR13	South of ISFSI	0.1	S
SFDR14	SE of ISFSI	0.1	SE
SFDR15	ENE of ISFSI	0.1	ENE
SFDR16	SSW of ISFSI	0.1	SW
SFDR17	NNE of ISFSI	0.1	NNE
SFDR18	West of ISFSI	0.1	W
<b>Vegetation</b>			
SFB1	ISFSI Vegetation Met Station	0.4	NW
SFB2	ISFSI Vegetation Visitors Center	0.7	NNE
SFB3	ISFSI Vegetation NNW of ISFSI	0.1	NNW
SFB4	ISFSI vegetation SSE of ISFSI	0.1	SSE
SFB5	On Site before Entrance to Camp Conoy	0.7	ESE
<b>Soil</b>			
SFS1	ISFSI Soil Meteorological Station	0.4	NW
SFS2	ISFSI Soil CCNPP Visitors Center	0.7	NNE
SFS3	ISFSI Soil NNW of ISFSI	0.1	NNW
SFS4	ISFSI Soil SSE of ISFSI	0.1	SSE
SFS5	ISFSI Soil On Site before entrance to Camp Conoy	0.7	ESE

<sup>1</sup> Distance and direction from the central point of the ISFSI

<sup>2</sup> Common to both the REMP and ISFSI monitoring program

Figure A-4

Independent Spent Fuel Storage Installation Sampling Locations

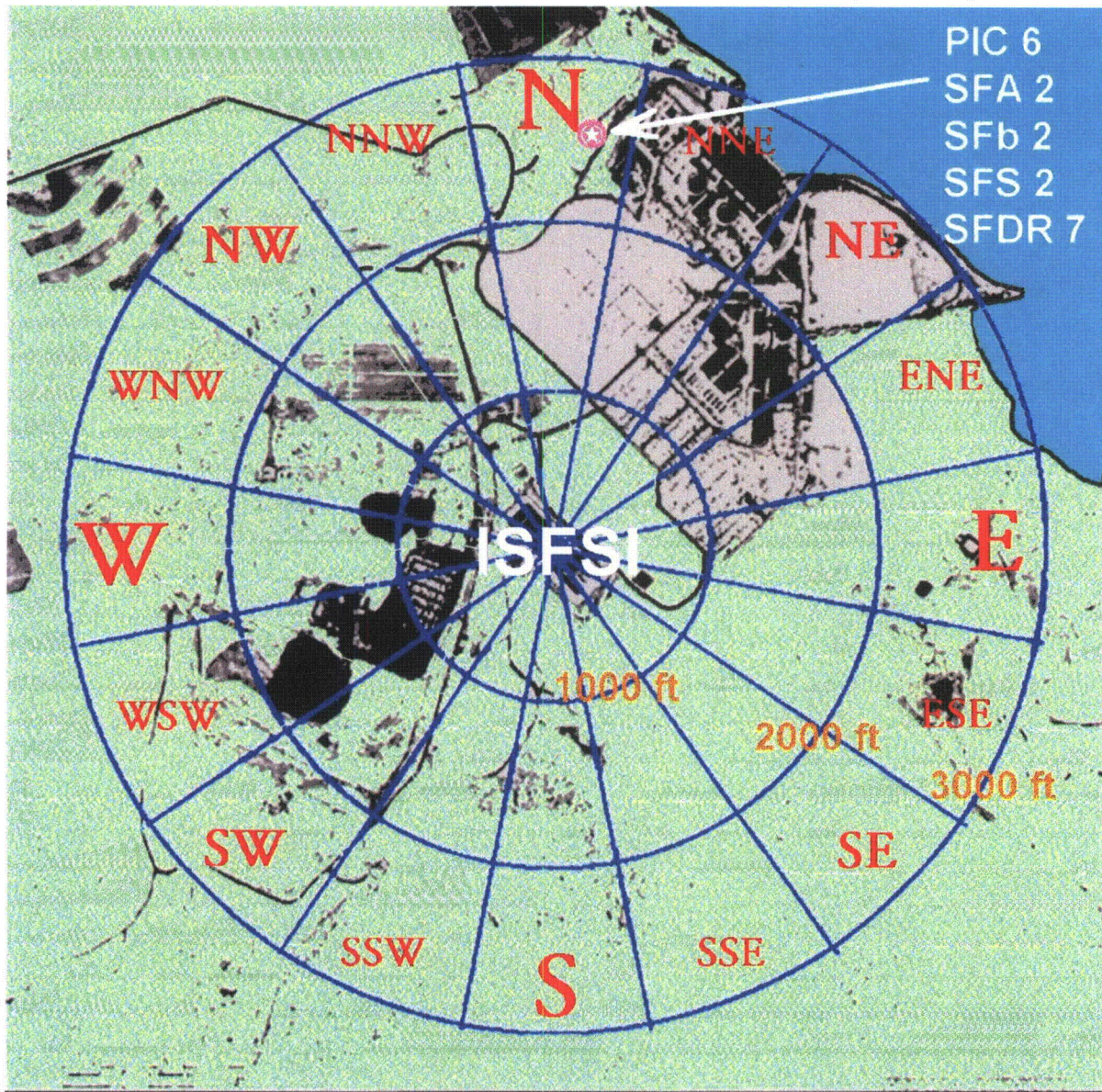
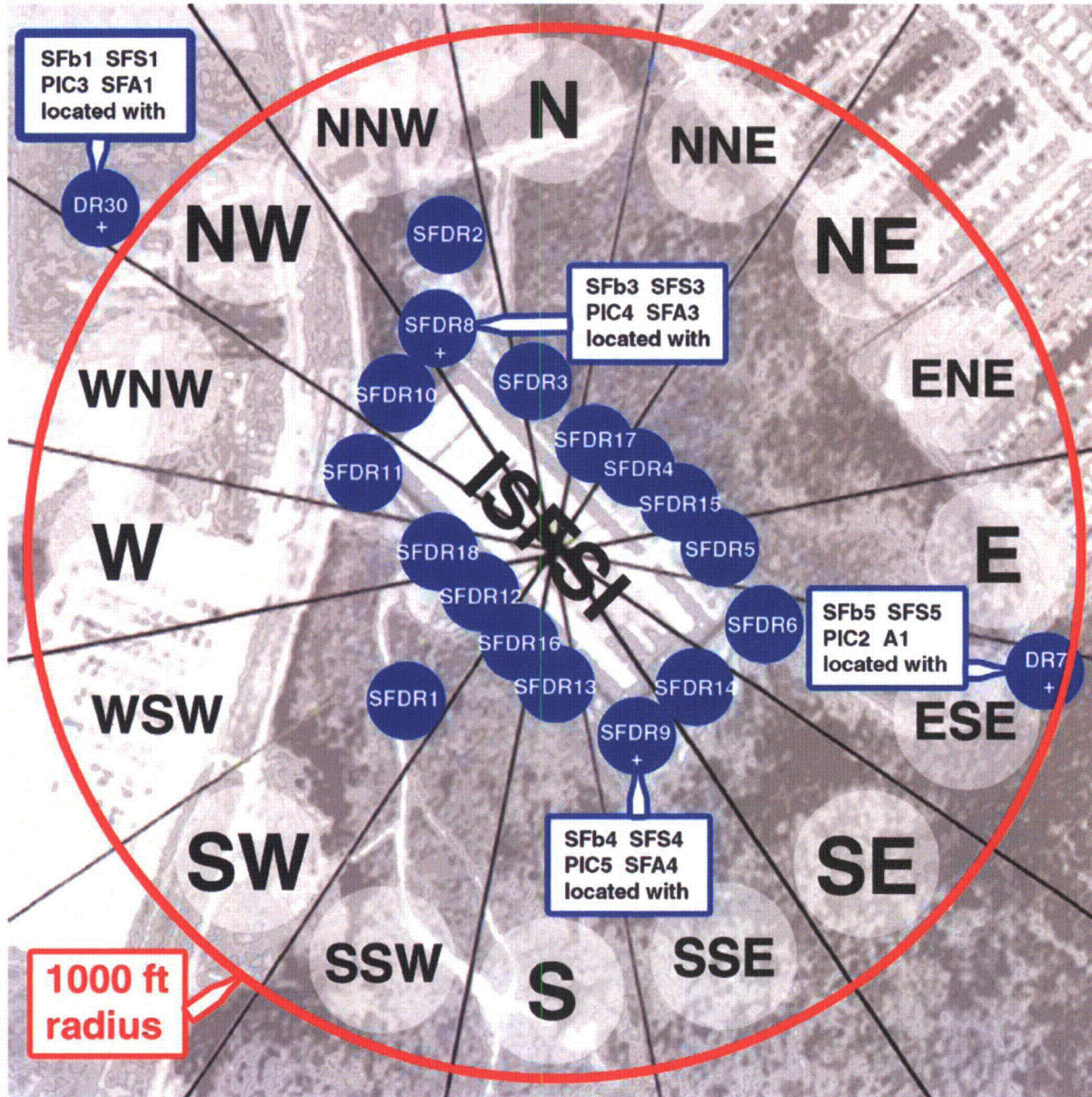




Figure A-5

Enlarged Map of the Independent Spent Fuel Storage Installation  
Sampling Locations



**APPENDIX B**  
**Analysis Results for the REMP and the ISFSI**

Appendix B is a presentation of the analytical results for the CCNPP and the ISFSI radiological environmental monitoring programs.

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**Table B-1**  
**Concentration of Tritium and Gamma Emitters in Bay Water**  
**(Results in units of pCi/L +/- 2σ)**

Sample Code	Sample Date	Gamma Emitters	H-3 <sup>1</sup>
WA1 Intake Vicinity	2/1/2010	*	
	2/28/2010	*	
	4/1/2010		<202
	4/2/2010	*	
	4/30/2010	*	
	6/1/2010	*	
	6/30/2010	*	<202
	7/30/2010	*	
	8/30/2010	*	
	10/1/2010	*	294 +/- 174
	11/1/2010	*	
	12/2/2010	*	
	12/30/2010	*	<284
WA2 Discharge Vicinity	2/1/2010	*	
	2/28/2010	*	
	4/1/2010		298 +/- 43
	4/2/2010	*	
	4/30/2010	*	
	6/1/2010	*	
	6/30/2010	*	472 +/- 174
	7/30/2010	*	
	8/30/2010	*	
	10/1/2010	*	494 +/- 174
	11/1/2010	*	
	12/2/2010	*	
	12/30/2010	*	404 +/- 174

<sup>1</sup> Quarterly composite of monthly samples.

\* All Non-Natural Gamma Emitters <MDA

**Table B-2**

**Concentration of Gamma Emitters in the Flesh of Edible Fish  
(Results in units of pCi/kg (wet) +/- 2σ)**

Sample Code	Sample Date	Sample Type	Gamma Emitters
IA1 Discharge Area	8/17/2010	Spot	*
IA2 Discharge Area	8/17/2010	Perch	*
IA4 <sup>1</sup> Patuxent River	8/17/2010	Spot	*
IA5 <sup>1</sup> Patuxent River	8/18/2010	Perch	*

<sup>1</sup> Control Location

\* All Non-Natural Gamma Emitters <MDA

**Table B-3**

**Concentration of Gamma Emitters in Oyster Samples  
(Results in units of pCi/kg (wet) +/- 2σ)**

Sample Code	Sample Date	Cs-137	Gamma Emitters
IA3			
Camp Conoy	3/23/2010	2	*
	6/22/2010	14 +/- 9	*
	8/18/2010	2	*
	10/20/2010	2	*
IA6 <sup>1</sup>			
Kenwood Beach	3/23/2010	2	*
	6/22/2010	2	*
	8/18/2010	2	*
	10/20/2010	2	*

<sup>1</sup> Control Location

<sup>2</sup> This Isotope < MDA

\* All Non-Natural Gamma Emitters <MDA

**Table B-4**

**Concentration of Gamma Emitters in Shoreline Sediment  
(Results in units of pCi/kg (dry) +/- 2σ)**

Sample Code	Sample Date	Gamma Emitters
WB1		
Shoreline at Barge Rd.	7/8/2010	*
	12/7/2010	*

\* All Non-Natural Gamma Emitters <MDA

Table B-5

**Concentration of Iodine-131 in Filtered Air**  
**(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 <sup>1</sup> EOF
12/28/2009	1/4/2010	*	*	*	*	*
1/4/2010	1/11/2010	*	*	*	*	*
1/11/2010	1/18/2010	*	*	*	*	*
1/18/2010	1/25/2010	*	*	*	*	*
1/25/2010	2/1/2010	*	*	*	*	*
2/1/2010	2/15/2010	*	*	*	*	*
2/15/2010	2/22/2010	*	*	*	*	*
2/22/2010	3/1/2010	*	*	*	*	*
3/1/2010	3/8/2010	*	*	*	*	*
3/8/2010	3/15/2010	*	*	*	*	*
3/15/2010	3/22/2010	*	*	*	*	*
3/22/2010	3/29/2010	*	*	*	*	*
3/29/2010	4/5/2010	*	*	*	*	*
4/5/2010	4/12/2010	*	*	*	*	*
4/12/2010	4/19/2010	*	*	*	*	*
4/19/2010	4/26/2010	*	*	*	*	*
4/26/2010	5/3/2010	*	*	*	*	*
5/3/2010	5/10/2010	*	*	*	*	*
5/10/2010	5/17/2010	*	*	*	*	*
5/17/2010	5/24/2010	*	*	*	*	*
5/24/2010	5/31/2010	*	2	*	*	*
5/31/2010	6/7/2010	*	*	*	*	*
6/7/2010	6/14/2010	*	*	*	*	*
6/14/2010	6/21/2010	*	*	*	*	*
6/21/2010	6/28/2010	*	*	*	*	*
6/28/2010	7/5/2010	*	*	*	*	*
7/5/2010	7/12/2010	*	*	*	*	*
7/12/2010	7/19/2010	*	*	*	*	*
7/19/2010	7/26/2010	*	*	*	*	*
7/26/2010	8/2/2010	*	*	*	*	*
8/2/2010	8/9/2010	*	*	*	*	*
8/9/2010	8/16/2010	*	*	*	*	*
8/16/2010	8/23/2010	*	*	*	*	*
8/23/2010	8/30/2010	*	*	*	*	*
8/30/2010	9/6/2010	*	*	*	*	*
9/6/2010	9/13/2010	*	*	*	*	*
9/13/2010	9/20/2010	*	*	*	*	*
9/20/2010	9/27/2010	*	*	*	*	*



**Table B-5**

**Concentration of Iodine-131 in Filtered Air  
(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2σ)**

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 <sup>1</sup> EOF
9/27/2010	10/4/2010	*	*	*	*	*
10/4/2010	10/11/2010	*	*	*	*	*
10/11/2010	10/18/2010	*	*	*	*	*
10/18/2010	10/25/2010	*	*	*	*	*
10/25/2010	11/1/2010	*	*	*	*	*
11/1/2010	11/8/2010	*	*	*	*	*
11/8/2010	11/15/2010	*	*	*	*	*
11/15/2010	11/22/2010	*	*	*	*	*
11/22/2010	11/29/2010	*	*	*	*	*
11/29/2010	12/6/2010	*	*	*	*	*
12/6/2010	12/13/2010	*	*	*	*	*
12/13/2010	12/20/2010	*	*	*	*	*
12/20/2010	12/27/2010	*	*	*	*	*
12/27/2010	1/3/2011	*	*	*	*	*

<sup>1</sup> Control Location

<sup>2</sup> Sampler malfunction/low flow

\* All Non-Natural Gamma Emitters <MDA

**Table B-6**

**Concentration of Beta Emitters in Air Particulates  
(Results in units of  $10^{-2}$  pCi/m<sup>3</sup> +/- 2σ)**

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 <sup>1</sup> EOF
12/28/2009	1/4/2010	3.2 +/- 0.3	2.8 +/- 0.3	2.6 +/- 0.3	2.9 +/- 0.3	2.2 +/- 0.2
1/4/2010	1/11/2010	2.0 +/- 0.3	1.5 +/- 0.2	2.1 +/- 0.3	2.5 +/- 0.4	1.9 +/- 0.2
1/11/2010	1/18/2010	2.3 +/- 0.2	2.1 +/- 0.3	3.3 +/- 0.3	3.5 +/- 0.4	3.3 +/- 0.2
1/18/2010	1/25/2010	1.7 +/- 0.2	1.6 +/- 0.2	2.7 +/- 0.4	2.3 +/- 0.3	1.9 +/- 0.1
1/25/2010	2/1/2010	2.6 +/- 0.3	2.2 +/- 0.2	2.2 +/- 0.2	3.6 +/- 0.4	2.5 +/- 0.2
2/1/2010	2/15/2010	1.4 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1	3.0 +/- 0.3	1.8 +/- 0.1
2/15/2010	2/22/2010	1.9 +/- 0.3	1.5 +/- 0.2	1.5 +/- 0.2	2.6 +/- 0.3	1.7 +/- 0.1
2/22/2010	3/1/2010	1.2 +/- 0.2	1.0 +/- 0.2	1.1 +/- 0.2	1.7 +/- 0.3	1.4 +/- 0.1
3/1/2010	3/8/2010	1.7 +/- 0.2	1.4 +/- 0.2	1.3 +/- 0.2	2.1 +/- 0.3	1.3 +/- 0.1
3/8/2010	3/15/2010	1.5 +/- 0.3	1.6 +/- 0.2	1.4 +/- 0.3	3.2 +/- 0.4	*
3/15/2010	3/22/2010	1.8 +/- 0.2	1.6 +/- 0.2	1.7 +/- 0.2	2.4 +/- 0.4	1.8 +/- 0.1
3/22/2010	3/29/2010	1.7 +/- 0.3	1.7 +/- 0.2	1.7 +/- 0.2	2.4 +/- 0.4	1.8 +/- 0.1
3/29/2010	4/5/2010	0.7 +/- 0.2	0.8 +/- 0.2	0.9 +/- 0.2	1.2 +/- 0.3	0.9 +/- 0.1
4/5/2010	4/12/2010	2.2 +/- 0.3	2.1 +/- 0.2	2.0 +/- 0.2	3.2 +/- 0.4	2.0 +/- 0.1
4/12/2010	4/19/2010	2.0 +/- 0.2	1.9 +/- 0.2	1.9 +/- 0.2	3.1 +/- 0.4	1.9 +/- 0.1
4/19/2010	4/26/2010	1.7 +/- 0.2	2.3 +/- 0.3	1.6 +/- 0.2	1.7 +/- 0.3	2.1 +/- 0.2
4/26/2010	5/3/2010	1.4 +/- 0.2	1.6 +/- 0.3	1.6 +/- 0.3	1.9 +/- 0.3	1.6 +/- 0.1
5/3/2010	5/10/2010	1.3 +/- 0.2	1.7 +/- 0.2	1.5 +/- 0.3	2.4 +/- 0.3	1.8 +/- 0.1
5/10/2010	5/17/2010	1.0 +/- 0.2	2.1 +/- 0.3	1.5 +/- 0.3	1.1 +/- 0.2	1.4 +/- 0.1
5/17/2010	5/24/2010	0.9 +/- 0.2	0.9 +/- 0.3	1.0 +/- 0.3	0.9 +/- 0.2	1.1 +/- 0.1
5/24/2010	5/31/2010	1.0 +/- 0.2	<sup>2</sup>	1.1 +/- 0.3	1.0 +/- 0.2	1.5 +/- 0.2
5/31/2010	6/7/2010	1.9 +/- 0.1	1.7 +/- 0.3	1.5 +/- 0.3	1.4 +/- 0.2	1.7 +/- 0.1
6/7/2010	6/14/2010	1.9 +/- 0.1	1.3 +/- 0.2	1.7 +/- 0.3	1.4 +/- 0.2	1.9 +/- 0.1
6/14/2010	6/21/2010	2.1 +/- 0.1	1.4 +/- 0.2	1.6 +/- 0.3	1.7 +/- 0.2	2.3 +/- 0.1
6/21/2010	6/28/2010	2.9 +/- 0.2	2.4 +/- 0.2	2.7 +/- 0.3	2.5 +/- 0.3	2.7 +/- 0.2
6/28/2010	7/5/2010	1.3 +/- 0.1	1.4 +/- 0.2	1.4 +/- 0.3	1.1 +/- 0.2	1.3 +/- 0.1
7/5/2010	7/12/2010	3.4 +/- 0.2	1.9 +/- 0.2	2.2 +/- 0.3	2.9 +/- 0.3	3.4 +/- 0.2
7/12/2010	7/19/2010	2.8 +/- 0.2	2.6 +/- 0.3	2.8 +/- 0.3	2.6 +/- 0.3	2.8 +/- 0.2
7/19/2010	7/26/2010	2.8 +/- 0.2	1.7 +/- 0.2	1.8 +/- 0.3	1.8 +/- 0.2	2.5 +/- 0.1
7/26/2010	8/2/2010	1.9 +/- 0.2	1.6 +/- 0.3	2.0 +/- 0.4	1.6 +/- 0.2	1.7 +/- 0.1
8/2/2010	8/9/2010	2.4 +/- 0.1	1.4 +/- 0.2	2.0 +/- 0.3	1.9 +/- 0.2	2.2 +/- 0.1
8/9/2010	8/16/2010	2.4 +/- 0.2	1.7 +/- 0.3	2.2 +/- 0.4	2.1 +/- 0.3	2.4 +/- 0.2
8/16/2010	8/23/2010	3.4 +/- 0.2	2.1 +/- 0.3	2.6 +/- 0.3	2.9 +/- 0.3	3.3 +/- 0.2
8/23/2010	8/30/2010	2.4 +/- 0.1	1.6 +/- 0.2	1.4 +/- 0.3	1.9 +/- 0.2	2.1 +/- 0.1
8/30/2010	9/6/2010	4.3 +/- 0.2	2.3 +/- 0.2	3.0 +/- 0.4	3.4 +/- 0.3	3.7 +/- 0.2
9/6/2010	9/13/2010	2.3 +/- 0.1	1.8 +/- 0.3	2.0 +/- 0.3	2.0 +/- 0.2	2.0 +/- 0.1
9/13/2010	9/20/2010	3.1 +/- 0.2	2.6 +/- 0.3	2.9 +/- 0.4	2.9 +/- 0.3	2.8 +/- 0.2
9/20/2010	9/27/2010	4.4 +/- 0.2	2.9 +/- 0.3	3.5 +/- 0.4	3.9 +/- 0.3	4.1 +/- 0.2

**Table B-6**

**Concentration of Beta Emitters in Air Particulates  
(Results in units of  $10^{-2}$  pCi/m<sup>3</sup> +/- 2σ)**

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 <sup>1</sup> EOF
9/27/2010	10/4/2010	1.0 +/- 0.1	1.0 +/- 0.2	1.6 +/- 0.3	0.9 +/- 0.2	1.1 +/- 0.1
10/4/2010	10/11/2010	3.7 +/- 0.2	2.7 +/- 0.2	3.4 +/- 0.3	2.8 +/- 0.2	3.1 +/- 0.2
10/11/2010	10/18/2010	2.8 +/- 0.2	2.5 +/- 0.2	2.6 +/- 0.4	2.4 +/- 0.3	2.4 +/- 0.1
10/18/2010	10/25/2010	2.6 +/- 0.2	2.3 +/- 0.2	2.8 +/- 0.3	2.2 +/- 0.2	2.3 +/- 0.1
10/25/2010	11/1/2010	1.9 +/- 0.2	2.4 +/- 0.3	2.3 +/- 0.3	1.7 +/- 0.3	1.5 +/- 0.1
11/1/2010	11/8/2010	1.2 +/- 0.2	0.9 +/- 0.2	1.3 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.1
11/8/2010	11/15/2010	2.5 +/- 0.2	1.9 +/- 0.2	1.9 +/- 0.2	2.1 +/- 0.2	2.4 +/- 0.2
11/15/2010	11/22/2010	4.5 +/- 0.2	2.9 +/- 0.3	2.8 +/- 0.3	4.0 +/- 0.4	3.8 +/- 0.2
11/22/2010	11/29/2010	3.0 +/- 0.2	2.2 +/- 0.3	2.3 +/- 0.3	2.3 +/- 0.3	2.7 +/- 0.2
11/29/2010	12/6/2010	2.4 +/- 0.1	1.7 +/- 0.2	1.7 +/- 0.2	2.2 +/- 0.3	2.0 +/- 0.1
12/6/2010	12/13/2010	2.4 +/- 0.2	2.3 +/- 0.3	3.3 +/- 0.3	2.3 +/- 0.3	2.4 +/- 0.2
12/13/2010	12/20/2010	2.7 +/- 0.2	2.5 +/- 0.3	2.9 +/- 0.3	2.9 +/- 0.3	2.3 +/- 0.1
12/20/2010	12/27/2010	1.5 +/- 0.1	1.6 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2	1.3 +/- 0.1
12/27/2010	1/3/2011	3.4 +/- 0.2	2.8 +/- 0.3	2.8 +/- 0.3	2.9 +/- 0.3	3.1 +/- 0.2

<sup>1</sup> Control Location

<sup>2</sup> Sampler malfunction/low flow

\* <MDA

**Table B-6 - Continued**

<b>Concentration of Beta Emitters in Air Particulates</b>					
<b>(Results in units of <math>10^{-2}</math> pCi/m<sup>3</sup> +/- 2σ)</b>					
Start Date	Stop Date	SFA1 MET Station	SFA2 <sup>1</sup> Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
12/28/2009	1/4/2010	2.2 +/- 0.2	2.0 +/- 0.2	2.7 +/- 0.3	2.9 +/- 0.3
1/4/2010	1/11/2010	1.9 +/- 0.2	1.9 +/- 0.2	2.1 +/- 0.3	2.1 +/- 0.3
1/11/2010	1/18/2010	3.6 +/- 0.2	2.9 +/- 0.2	2.9 +/- 0.3	2.5 +/- 0.3
1/18/2010	1/25/2010	1.8 +/- 0.1	1.5 +/- 0.1	1.8 +/- 0.3	1.9 +/- 0.2
1/25/2010	2/1/2010	2.4 +/- 0.1	2.1 +/- 0.1	2.9 +/- 0.3	2.6 +/- 0.3
2/1/2010	2/15/2010	1.7 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.2	1.4 +/- 0.2
2/15/2010	2/22/2010	2.0 +/- 0.1	1.6 +/- 0.1	1.7 +/- 0.2	1.9 +/- 0.3
2/22/2010	3/1/2010	1.1 +/- 0.1	1.3 +/- 0.1	1.1 +/- 0.3	1.4 +/- 0.2
3/1/2010	3/8/2010	1.4 +/- 0.1	1.2 +/- 0.1	1.5 +/- 0.2	1.5 +/- 0.2
3/8/2010	3/15/2010	2.0 +/- 0.1	1.9 +/- 0.1	2.2 +/- 0.4	1.7 +/- 0.3
3/15/2010	3/22/2010	1.9 +/- 0.1	1.7 +/- 0.1	1.9 +/- 0.3	1.9 +/- 0.3
3/22/2010	3/29/2010	1.5 +/- 0.1	1.5 +/- 0.1	2.0 +/- 0.2	1.7 +/- 0.2
3/29/2010	4/5/2010	0.9 +/- 0.1	0.8 +/- 0.1	1.2 +/- 0.2	0.8 +/- 0.2
4/5/2010	4/12/2010	1.7 +/- 0.1	1.6 +/- 0.1	2.3 +/- 0.3	2.1 +/- 0.3
4/12/2010	4/19/2010	2.0 +/- 0.1	1.8 +/- 0.1	2.1 +/- 0.3	2.1 +/- 0.3
4/19/2010	4/26/2010	2.0 +/- 0.1	1.7 +/- 0.1	2.0 +/- 0.3	1.5 +/- 0.2
4/26/2010	5/3/2010	1.7 +/- 0.1	1.5 +/- 0.1	1.9 +/- 0.3	1.7 +/- 0.2
5/3/2010	5/10/2010	1.8 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.2	1.3 +/- 0.2
5/10/2010	5/17/2010	1.4 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.2	1.0 +/- 0.2
5/17/2010	5/24/2010	1.0 +/- 0.1	1.0 +/- 0.1	1.2 +/- 0.2	0.8 +/- 0.2
5/24/2010	5/31/2010	1.9 +/- 0.3	1.1 +/- 0.2	1.3 +/- 0.2	0.9 +/- 0.2
5/31/2010	6/7/2010	2.1 +/- 0.1	1.9 +/- 0.2	1.6 +/- 0.2	1.1 +/- 0.2
6/7/2010	6/14/2010	2.2 +/- 0.1	1.7 +/- 0.1	2.0 +/- 0.3	1.4 +/- 0.2
6/14/2010	6/21/2010	1.9 +/- 0.1	1.9 +/- 0.1	1.8 +/- 0.2	1.5 +/- 0.2
6/21/2010	6/28/2010	3.1 +/- 0.2	2.7 +/- 0.2	2.6 +/- 0.2	2.4 +/- 0.2
6/28/2010	7/5/2010	1.6 +/- 0.1	1.1 +/- 0.1	1.3 +/- 0.2	1.1 +/- 0.2
7/5/2010	7/12/2010	3.4 +/- 0.2	2.7 +/- 0.1	2.5 +/- 0.2	2.2 +/- 0.2
7/12/2010	7/19/2010	3.2 +/- 0.2	2.4 +/- 0.1	2.6 +/- 0.3	2.4 +/- 0.2
7/19/2010	7/26/2010	2.8 +/- 0.2	2.2 +/- 0.1	2.1 +/- 0.3	1.9 +/- 0.2
7/26/2010	8/2/2010	1.7 +/- 0.1	1.5 +/- 0.1	1.6 +/- 0.3	1.8 +/- 0.3
8/2/2010	8/9/2010	2.6 +/- 0.1	2.0 +/- 0.1	2.3 +/- 0.2	1.9 +/- 0.2
8/9/2010	8/16/2010	2.6 +/- 0.2	2.2 +/- 0.1	2.1 +/- 0.3	1.7 +/- 0.2
8/16/2010	8/23/2010	3.4 +/- 0.2	2.8 +/- 0.1	3.1 +/- 0.3	2.6 +/- 0.2
8/23/2010	8/30/2010	7.4 +/- 0.4	2.1 +/- 0.1	2.0 +/- 0.2	2.0 +/- 0.2
8/30/2010	9/6/2010	4.6 +/- 0.2	3.7 +/- 0.2	3.7 +/- 0.3	3.3 +/- 0.3
9/6/2010	9/13/2010	2.8 +/- 0.2	1.9 +/- 0.1	1.9 +/- 0.2	1.7 +/- 0.2
9/13/2010	9/20/2010	3.4 +/- 0.2	2.8 +/- 0.2	2.8 +/- 0.3	2.4 +/- 0.3
9/20/2010	9/27/2010	4.6 +/- 0.2	3.5 +/- 0.2	4.0 +/- 0.4	3.8 +/- 0.3

**Table B-6 - Continued**

**Concentration of Beta Emitters in Air Particulates**  
**(Results in units of  $10^{-2}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

Start Date	Stop Date	SFA1 MET Station	SFA2 <sup>1</sup> Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
9/27/2010	10/4/2010	1.1 +/- 0.1	0.9 +/- 0.1	1.3 +/- 0.2	1.1 +/- 0.2
10/4/2010	10/11/2010	4.0 +/- 0.2	3.0 +/- 0.1	3.4 +/- 0.3	2.9 +/- 0.2
10/11/2010	10/18/2010	2.8 +/- 0.2	2.3 +/- 0.1	2.5 +/- 0.3	2.3 +/- 0.2
10/18/2010	10/25/2010	2.8 +/- 0.2	2.1 +/- 0.1	2.3 +/- 0.3	2.0 +/- 0.2
10/25/2010	11/1/2010	2.0 +/- 0.1	1.6 +/- 0.1	1.7 +/- 0.3	1.6 +/- 0.2
11/1/2010	11/8/2010	1.3 +/- 0.1	1.0 +/- 0.1	1.3 +/- 0.2	0.9 +/- 0.2
11/8/2010	11/15/2010	2.7 +/- 0.2	2.2 +/- 0.2	1.9 +/- 0.2	1.9 +/- 0.2
11/15/2010	11/22/2010	4.3 +/- 0.2	4.1 +/- 0.2	3.7 +/- 0.3	3.4 +/- 0.3
11/22/2010	11/29/2010	2.9 +/- 0.2	2.9 +/- 0.2	2.2 +/- 0.2	2.4 +/- 0.2
11/29/2010	12/6/2010	2.2 +/- 0.1	2.1 +/- 0.1	2.0 +/- 0.2	1.9 +/- 0.2
12/6/2010	12/13/2010	2.3 +/- 0.2	2.2 +/- 0.2	2.0 +/- 0.3	1.8 +/- 0.3
12/13/2010	12/20/2010	2.7 +/- 0.1	2.6 +/- 0.2	2.6 +/- 0.3	2.3 +/- 0.2
12/20/2010	12/27/2010	1.6 +/- 0.1	1.3 +/- 0.1	1.6 +/- 0.2	1.5 +/- 0.2
12/27/2010	1/3/2011	3.3 +/- 0.2	3.2 +/- 0.2	3.1 +/- 0.3	2.8 +/- 0.3

<sup>1</sup> Control Location

**Table B-7**

**Concentration of Gamma Emitters in Air Particulates  
(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

Sample Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5 <sup>1</sup> EOF
2/1/2010	*	*	*	*	*
3/1/2010	*	*	*	*	*
3/29/2010	*	*	*	*	*
5/3/2010	*	*	*	*	*
5/31/2010	*	*	*	*	*
6/28/2010	*	*	*	*	*
8/2/2010	*	*	*	*	*
8/30/2010	*	*	*	*	*
9/27/2010	*	*	*	*	*
11/1/2010	*	*	*	*	*
11/29/2010	*	*	*	*	*
1/3/2011	*	*	*	*	*

Sample Date	SFA1 MET Station	SFA2 <sup>1</sup> Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
2/1/2010	*	*	*	*
3/1/2010	*	*	*	*
3/29/2010	*	*	*	*
5/3/2010	*	*	*	*
5/31/2010	*	*	*	*
6/28/2010	*	*	*	*
8/2/2010	*	*	*	*
8/30/2010	*	*	*	*
9/27/2010	*	*	*	*
11/1/2010	*	*	*	*
11/29/2010	*	*	*	*
1/3/2011	*	*	*	*

<sup>1</sup> Control Location

\* All Non-Natural Gamma Emitters <MDA

**Table B-8a**

**Concentration of Gamma Emitters in Vegetation Samples  
(Results in units of pCi/kg (wet) +/- 2σ)**

Sample Code	Sample Date	Sample Type	Gamma Emitters
IB1			
Bay Breeze Rd	7/27/2010	Greens	*
	8/31/2010	Green Peppers	*
	9/29/2010	Green Peppers	*
IB2			
Bay Breeze Rd	7/27/2010	Green Peppers	*
	8/31/2010	Eggplant Leaves	*
	9/29/2010	Tree Leaves	*
IB3			
Bay Breeze Rd	7/27/2010	Greens	*
	8/31/2010	Tree Leaves	*
	9/29/2010	Tree Leaves	*
IB4			
Camp Conoy Entrance	7/27/2010	Eggplant Leaves	*
	8/31/2010	Green Peppers	*
	9/29/2010	Green Peppers	*
IB5			
Camp Conoy Entrance	7/27/2010	Green Peppers	2
	8/31/2010	Eggplant Leaves	*
	9/29/2010	Eggplant Leaves	*
IB6			
Camp Conoy Entrance	7/27/2010	Greens	*
	8/31/2010	Greens	*
	9/29/2010	Tree Leaves	*
IB7 <sup>1</sup>			
EOF	7/27/2010	Eggplant Leaves	*
	8/31/2010	Green Peppers	*
	9/29/2010	Green Peppers	*
IB8 <sup>1</sup>			
EOF	7/27/2010	Green Peppers	*
	8/31/2010	Eggplant Leaves	*
	9/29/2010	Eggplant Leaves	*
IB9 <sup>1</sup>			
EOF	7/27/2010	Squash	*
	8/31/2010	Squash	*
	9/29/2010	Greens	*

<sup>1</sup> Control Location

<sup>2</sup> Reject Results, bad data file

\* All Non-Natural Gamma Emitters <MDA

**Table B-8b**

**Concentration of Gamma Emitters in Vegetation  
From Locations Around the ISFSI  
(Results in units of pCi/kg (wet) +/- 2σ)**

Sample Code	Sample Date	Cs-137	Gamma Emitters
SFB1			
MET Station	3/14/2010	2	*
	5/28/2010	2	*
	9/14/2010	2	*
	12/7/2010	2	*
SFB2 <sup>1</sup>			
Visitor's Center	3/14/2010	2	*
	5/28/2010	2	*
	9/14/2010	2	*
	12/7/2010	2	*
SFB3			
NNW of ISFSI	3/14/2010	2	*
	5/28/2010	2	*
	9/14/2010	2	*
	12/7/2010	2	*
SFB4			
SSE of ISFSI	3/14/2010	2	*
	5/28/2010	10 +/- 4	*
	9/14/2010	2	*
	12/7/2010	2	*
SFB5			
On Site before Entrance to Camp Conoy	3/14/2010	2	*
	5/28/2010	2	*
	9/14/2010	10 +/- 7	*
	12/7/2010	40 +/- 22	*

<sup>1</sup> Control Location

<sup>2</sup> This Isotope <MDA

\* All Non-Natural Gamma Emitters <MDA



**Table B-9**

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

Sample Code	Sample Date	Cs-137	Gamma Emitters
SFS1 MET station	3/14/2010	1	*
	5/28/2010	1	*
	9/14/2010	1	*
	12/7/2010	1	*
SFS2 <sup>2</sup> Visitors Center	3/14/2010	80 +/- 35	*
	5/28/2010	66 +/- 35	*
	9/14/2010	64 +/- 36	*
	12/7/2010	41 +/- 31	*
SFS3 NNW of ISFSI	3/14/2010	195 +/- 47	*
	5/28/2010	137 +/- 55	*
	9/14/2010	183 +/- 43	*
	12/7/2010	78 +/- 23	*
SFS4 SSE of ISFSI	3/14/2010	1	*
	5/28/2010	1	*
	9/14/2010	1	*
	12/7/2010	1	*
SFS5 Entrance to Camp Conoy	3/14/2010	404 +/- 85	*
	5/28/2010	498 +/- 57	*
	9/14/2010	168 +/- 35	*
	12/7/2010	203 +/- 40	*

<sup>1</sup> This isotope <MDA

<sup>2</sup> Control Location

\* All Non-Natural Gamma Emitters <MDA

**Table B-10**  
**Typical MDA Ranges for Gamma Spectrometry**

Selected Nuclides	Air Particulates (10 <sup>-2</sup> pCi/m <sup>3</sup> )	Bay Water, Surface Water, Drinking Water (pCi/L)	Fish pCi/kg (wet)	Ground water pCi/L	Milk pCi/L	Oysters (pCi/kg)	Shoreline Sediment pCi/kg (dry)	Soil pCi/kg (dry)	Vegetation (pCi/kg)
Na-22	0 - 0	3 - 7	25 - 43	3 - 7	4 - 8	16 - 33	36 - 86	34 - 98	14 - 55
K-40	0 - .1	32 - 73	193 - 327	35 - 84	37 - 69	134 - 234	375 - 699	257 - 838	136 - 412
Cr-51	.1 - 1	23 - 45	348 - 710	25 - 42	18 - 45	148 - 314	433 - 1481	290 - 1048	78 - 291
Mn-54	0 - 0	3 - 6	20 - 30	3 - 6	2 - 6	14 - 24	36 - 69	31 - 82	11 - 40
Co-58	0 - 0	3 - 6	27 - 46	3 - 6	2 - 6	16 - 27	41 - 97	35 - 98	11 - 40
Fe-59	0 - .1	6 - 13	92 - 160	6 - 13	6 - 15	45 - 81	88 - 341	84 - 248	28 - 98
Co-60	0 - 0	3 - 7	23 - 36	3 - 7	3 - 8	16 - 27	34 - 74	33 - 90	14 - 49
Zn-65	0 - 0	6 - 14	54 - 91	7 - 14	6 - 16	35 - 65	107 - 196	82 - 230	30 - 100
Nb-95	0 - .1	3 - 6	45 - 83	3 - 6	3 - 6	23 - 44	67 - 183	42 - 144	12 - 43
Zr-95	0 - 0	5 - 10	51 - 83	5 - 10	5 - 10	29 - 56	76 - 183	60.8 - 175	18 - 70
Ru-106	0 - 0	23 - 51	153 - 260	23 - 56	25 - 51	107 - 195	269 - 543	248 - 675	91 - 330
Ag-110m	0 - 0	3 - 6	19 - 30	3 - 6	3 - 6	12 - 23	30 - 62	29 - 98	10 - 37
I-131	<sup>1</sup>	0 - 7	119 - 13898	3.7 - 6.5	.4 - .8	112 - 440	69 - 11396	0 - 1650	15 - 62
Cs-134	0 - 0	2 - 5	16 - 26	3 - 6	2 - 5	11 - 21	30 - 65	39 - 85	9 - 37
Cs-137	0 - 0	3 - 6	16 - 30	3 - 6	2 - 6	12 - 23	35 - 60	34 - 73	11 - 41
Ba-140	0 - 194	6 - 12	91 - 1396	5 - 10	4 - 10	79 - 260	3 - 2360	49 - 709	18 - 80
La-140	0 - 194	6 - 12	91 - 1396	5 - 10	4 - 10	79 - 260	3 - 2360	49 - 709	18 - 80
Ce-144	0 - 0	14 - 29	51 - 101	16 - 29	16 - 29	38 - 62	149 - 223	120 - 322	40 - 142

<sup>1</sup> This MDA range for I-131 on a silver zeolite cartridge is typically 4.16 x 10E-3 to 3.40 x 10E-2

**Table B-11**

**Typical LLDs for Gamma Spectrometry**

Selected Nuclides	Air Particulates 10-3 pCi/m <sup>3</sup>	Bay Water, Surface Water, Drinking Water pCi/L	Fish pCi/kg (wet)	Ground water pCi/L	Oysters pCi/kg (wet)	Precipitation pCi/L	Soil pCi/kg (dry)	Vegetation (pCi/kg)
Na-22	2.9	2.9	22	2.9	22	2.9	24	35
Cr-51	12	17	88	17	88	17	110	162
Mn-54	2.1	2.4	17	2.4	17	2.4	18	27
Co-58	2	2.4	16	2.4	16	2.4	17	25
Fe-59	4.6	5.2	37	5.2	37	5.2	38	60
Co-60	2.7	2.8	22	2.8	22	2.8	21	33
Zn-65	2.8	5.6	23	5.6	23	5.6	54	66
Nb-95	1.9	2.2	15	2.2	15	2.2	18	25
Zr-95	3.3	3.8	27	3.8	27	3.8	29	44
Ru-106	17	20	135	20	135	20	146	223
Ag-110m	1.8	2.1	14	2.1	14	2.1	16	25
Te-129m	20	26	149	26	149	26	180	265
I-131	1.5	2	11	2	11	2	14	20
Cs-134	1.9	2.2	15	2.2	15	2.2	20	24
Cs-137	1.8	2.3	15	2.3	15	2.3	17	27
Ba-140	6.1	7.3	48	7.3	48	7.3	54	80
La-140	3.4	4.1	26	4.1	26	4.1	25	41
Ce-144	5.5	12	43	12	43	12	75	101

\* The LLD for I-131 measured on a silver zeolite cartridge is 2.0 x10E-3 pCi/m<sup>3</sup>

**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	12.41 +/- 1.94	10.87 +/- 2.65	13.00 +/- 1.32	13.61 +/- 1.48
DR02	Route 765, Auto Dump	10.35 +/- 0.40	10.15 +/- 1.07	11.21 +/- 1.21	11.26 +/- 0.51
DR03	Route 765, Giovanni's Tavern	10.51 +/- 1.24	9.74 +/- 0.60	11.38 +/- 0.98	11.06 +/- 1.54
DR04	Route 765, across from White Sands Drive.	12.25 +/- 0.46	11.10 +/- 0.58	12.97 +/- 0.89	12.59 +/- 1.98
DR05	Route 765, John's Creek	11.83 +/- 0.89	10.90 +/- 0.91	12.38 +/- 1.27	12.56 +/- 0.84
DR06	Route 765 at Lusby	9.65 +/- 1.40	8.95 +/- 0.88	10.34 +/- 0.73	10.75 +/- 0.70
DR07	Entrance to Camp Conoy	10.50 +/- 0.44	9.49 +/- 1.08	10.88 +/- 1.22	11.14 +/- 0.99
DR08	Camp Conoy Rd at Emergency Siren	13.97 +/- 1.30	13.36 +/- 0.39	14.75 +/- 1.59	15.41 +/- 0.92
DR09	Bay Breeze Rd	10.80 +/- 0.59	10.52 +/- 1.24	12.11 +/- 1.53	11.70 +/- 1.06
DR10	Calvert Beach Rd and Decatur Street	10.12 +/- 1.44	9.35 +/- 0.97	10.92 +/- 0.54	10.76 +/- 0.90
DR11	Dirt road off Mackall & Parren Rd	10.92 +/- 1.12	9.83 +/- 1.30	11.57 +/- 0.16	11.39 +/- 0.60
DR12	Mackall & Bowen Rds	10.22 +/- 0.74	9.55 +/- 1.28	10.92 +/- 1.44	11.32 +/- 1.07
DR13	Mackall Rd, near Wallville	11.24 +/- 0.59	11.06 +/- 0.73	12.28 +/- 1.84	12.35 +/- 0.57

**Table B-12**

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

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
DR14	Rodney Point	12.76 +/- 0.99	12.57 +/- 0.82	13.99 +/- 1.26	13.60 +/- 0.98
DR15	Mill Bridge & Turner Rds	11.31 +/- 0.29	10.88 +/- 1.05	12.60 +/- 0.54	12.22 +/- 1.18
DR16	Across from Appeal School	10.27 +/- 1.21	9.73 +/- 0.15	11.07 +/- 1.00	10.84 +/- 0.68
DR17	Cove Point & Little Cove Point Rds	12.16 +/- 1.21	11.32 +/- 1.16	12.78 +/- 0.18	12.57 +/- 0.75
DR18	Cove Point	9.87 +/- 0.76	8.69 +/- 0.83	10.52 +/- 0.19	10.43 +/- 0.64
DR19	Long Beach	10.64 +/- 0.94	10.51 +/- 0.69	11.13 +/- 0.69	11.78 +/- 0.33
DR20	On site, near shore	12.90 +/- 0.83	12.31 +/- 0.71	13.88 +/- 1.14	13.71 +/- 2.19
DR21 <sup>1</sup>	EOF	12.00 +/- 1.12	11.26 +/- 1.14	12.89 +/- 0.98	12.60 +/- 1.60
DR22 <sup>1</sup>	Solomons Island	10.93 +/- 0.71	*	11.65 +/- 0.79	11.74 +/- 1.23
DR23 <sup>1</sup>	Taylors Island	14.49 +/- 1.19	15.37 +/- 1.95	17.35 +/- 1.60	16.19 +/- 1.08
DR30	MET Station	11.75 +/- 0.66	10.94 +/- 0.63	12.23 +/- 0.49	11.73 +/- 0.67
SFDR01	SW of ISFSI	17.36 +/- 0.48	15.26 +/- 1.30	17.79 +/- 2.03	17.60 +/- 1.95
SFDR02	NNW of ISFSI	18.76 +/- 2.29	17.87 +/- 2.21	19.91 +/- 1.25	19.83 +/- 2.06
SFDR03	North of ISFSI	37.75 +/- 5.60	31.73 +/- 2.97	36.04 +/- 2.75	34.45 +/- 5.16
SFDR04	NE of ISFSI	32.17 +/- 3.65	26.40 +/- 4.57	31.97 +/- 4.33	32.16 +/- 2.76

**Table B-12**

**Direct Radiation**  
**(Results in Units of mR/90 days +/- 2 $\sigma$ )**

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
SFDR05	East of ISFSI	20.36 +/- 2.95	15.26 +/- 1.10	19.05 +/- 3.82	19.80 +/- 3.63
SFDR06	ESE of ISFSI	16.40 +/- 1.15	14.37 +/- 1.40	16.68 +/- 1.95	16.68 +/- 1.22
SFDR07 <sup>1</sup>	Visitor's Center	12.83 +/- 1.35	11.63 +/- 0.72	13.56 +/- 0.77	13.34 +/- 1.42
SFDR08	NNW of ISFSI	27.28 +/- 5.15	24.65 +/- 1.82	29.31 +/- 2.52	29.52 +/- 4.50
SFDR09	SSE of ISFSI	14.44 +/- 1.40	14.34 +/- 1.51	15.30 +/- 1.19	15.56 +/- 1.91
SFDR10	NW of ISFSI	30.67 +/- 12.01	26.78 +/- 10.25	31.14 +/- 10.94	34.61 +/- 9.75
SFDR11	WNW ISFSI	31.06 +/- 4.33	26.04 +/- 1.16	27.40 +/- 3.18	27.88 +/- 7.25
SFDR12	WSW of ISFSI	47.80 +/- 17.52	42.99 +/- 10.14	42.38 +/- 8.41	45.12 +/- 10.16
SFDR13	South of ISFSI	23.38 +/- 6.65	20.86 +/- 6.56	23.44 +/- 4.64	24.84 +/- 7.54
SFDR14	SE of ISFSI	15.66 +/- 1.97	13.23 +/- 1.61	15.83 +/- 1.66	16.16 +/- 2.08
SFDR15	ENE of ISFSI	21.58 +/- 2.80	17.81 +/- 3.44	20.17 +/- 4.02	23.57 +/- 3.12
SFDR16	SSW of ISFSI	35.13 +/- 5.37	29.29 +/- 4.23	33.28 +/- 5.74	36.17 +/- 4.76
SFDR17	NNE of ISFSI	37.59 +/- 6.03	32.60 +/- 8.22	35.85 +/- 2.15	37.29 +/- 8.00
SFDR18	West of ISFSI	48.18 +/- 8.82	40.54 +/- 5.88	46.27 +/- 9.80	51.45 +/- 12.58

<sup>1</sup> Control Location

\* Missing Data

## APPENDIX C

### Quality Assurance Program

Appendix C is a summary of Constellation Energy laboratory's quality assurance program. It consists of Table C-1 which is a compilation of the results of the Constellation Energy Laboratory's participation in an intercomparison program with Environmental Resource Associates (ERA) located in Arvada, Colorado and Analytics, Inc. located in Atlanta, Georgia. It also includes Table C-2 which is a compilation of the results of the Constellation Energy Laboratory's participation in a split sample program with Teledyne Brown Engineering located in Knoxville, Tennessee and Table C-3 which is a list of typical MDAs achieved by Teledyne Brown for Gamma Spectroscopy.

All the Constellation Energy Laboratory's results contained in Table C-1 generally agree with the intercomparison laboratories' results within the range of  $\pm 2 \sigma$  of each other. In addition, all the sets of intercomparison results in the table are in full agreement when they were further evaluated using the NRC Resolution Test Criteria<sup>1</sup>. The uncertainties for the Constellation Energy Laboratory's results and Analytics' results are  $\pm 2\sigma$  while the ERA laboratory's uncertainty is based on USEPA guidelines<sup>2</sup>.

All the results contained in Table C-2 agree within the range of  $\pm 2 \sigma$  of each other with their respective Constellation Energy Laboratory original, replicate and/or Teledyne Brown Engineering's split laboratory samples, except for the comparisons of one soil sample and a bottom sediment sample involving Cs-137 results: The original analysis of the soil sample from SFS2 collected on 5/28/2010 and bottom sediment sample from WBS2 collected on 10/20/10 do not agree within the range of  $\pm 2\sigma$  of their respective QC comparison soil samples analyzed. These minor discrepancies, occurring very close to or below the analyses MDA's, are most probably due to counting statistics and/or the non-homogeneous nature of the sample-splitting process. Other samples whose nature generally precludes sample splitting are marked "\*\*\*" in the Split Analysis column.

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<sup>1</sup> NRC Inspection Manual, Inspection Procedure 84750, March 15, 1994

<sup>2</sup> National Standards for Water Proficiency Testing Studies Criteria Document, December 1998

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**Table C-1**

**Results of Participation in Cross Check Programs**

Sample Date	Sample Type and Units	Isotope Observed	Reported Laboratory's Results	Cross Check Lab Results
03/18/10	Air Iodine- pCi Charcoal	I-131	107.0 +/- 6.0	88.5 +/- 1.4
03/18/10	Milk- pCi/L	Co-58	131.0 +/- 11.7	143.0 +/- 2.4
		Co-60	166.0 +/- 9.8	183.0 +/- 3.1
		Zn-65	225.0 +/- 26.8	254.0 +/- 4.2
		I-131	66.0 +/- 12.3	74.0 +/- 1.2
		Cs-134	142.0 +/- 6.8	178.0 +/- 3.0
		Cs-137	146.0 +/- 11.2	158.0 +/- 2.6
		Ce-141	227.0 +/- 13.7	261.0 +/- 4.4
		Cr-51	326.0 +/- 76.9	361.0 +/- 6.0
		Mn-54	189.0 +/- 13.7	207.0 +/- 3.5
		Fe-59	129.0 +/- 15.8	137.0 +/- 2.3
03/18/10	Water - pCi/L	Gross Beta	266 +/- 3.08	293 +/- 4.89
04/05/10	Water - pCi/L	Co-60	85.0 +/- 6.3	84.5
		Ba-133	53.9 +/- 7.0	65.9
		Cs-137	139.0 +/- 10.2	146.0
		Cs-134	64.3 +/- 5.0	71.6
		Zn-65	202.0 +/- 7.0	186.0
06/17/10	Air particulates on filter - pCi	Mn-54	119.0 +/- 8.5	111.0 +/- 1.9
		Cr-51	254.0 +/- 31.9	222.0 +/- 3.7
		Ce-141	80.0 +/- 5.0	72.0 +/- 1.2
		Cs-137	103.0 +/- 8.0	98.0 +/- 1.6
		Cs-134	67.0 +/- 6.0	82.2 +/- 1.4
		Zn-65	146.0 +/- 16.0	135.0 +/- 2.3
		Co-60	133.0 +/- 7.0	129.0 +/- 2.2
		Co-58	66.5 +/- 6.4	66.1 +/- 1.1
		Fe-59	89.0 +/- 9.0	77.6 +/- 1.3

**Table C-1**

**Results of Participation in Cross Check Programs**

Sample Date	Sample Type and Units	Isotope Observed	Reported Laboratory's Results	Cross Check Lab Results
06/17/10	Water – pCi/L	Fe-59	182.0 +/- 17.9	173.0 +/- 2.9
		Cs-134	157.0 +/- 7.0	183.0 +/- 3.1
		Cs-137	221.0 +/- 13.6	218.0 +/- 3.7
		Ce-141	154.0 +/- 14.2	161.0 +/- 2.7
		Cr-51	459.0 +/- 88.0	494.0 +/- 8.3
		Mn-54	247.0 +/- 14.5	246.0 +/- 4.1
		I-131	75.9 +/- 16.4	78.9 +/- 1.3
		Co-58	137.0 +/- 12.2	147.0 +/- 2.5
		Co-60	292.0 +/- 12.1	286.0 +/- 4.8
		Zn-65	314.0 +/- 29.0	300.0 +/- 5.0
06/17/10	Water – 10 <sup>-2</sup> pCi/L	Gross Beta	237.0 +/- 3.0	266.0 +/- 4.4
06/17/10	Water – pCi/L	H3	256	256
07/06/10	Water – pCi/L	Zn-65	110.0 +/- 9.1	110.0
		Co-60	73.1 +/- 3.6	72.8
		I-131	27.9 +/- 6.0	28.4
		Cs-137	203.0 +/- 7.0	210.0
		Cs-134	81.0 +/- 3.0	88.3
		Ba-133	88.7 +/- 4.6	89.1
07/06/10	Water – 10 <sup>-2</sup> pCi/L	Gross Beta	45.4 +/- 1.8	56.4
07/06/10	Water – uCi/L	H3	1.55	1.55
10/04/10	Water – pCi/L	I-131	29.1 +/- 5.0	27.5

**Table C-1**

**Results of Participation in Cross Check Programs**

Sample Date	Sample Type and Units	Isotope Observed	Reported Laboratory's Results	Cross Check Lab Results
12/09/10	Water – pCi/L	Gross Beta	117 +/- 2.00	122 +/- 2.04
12/09/10	Air Iodine– pCi Charcoal	I-131	97.0 +/- 8.00	84.2 +/- 1.41
12/09/10	Milk– pCi/L	Co-58	94.0 +/- 16.0	90.2 +/- 1.51
		Co-60	321 +/- 19.0	301 +/- 5.02
		Fe-59	165 +/- 25.0	131 +/- 2.19
		I-131	101 +/- 24.0	96.9 +/- 1.62
		Cs-134	140 +/- 11.0	157 +/- 2.62
		Cs-137	188 +/- 21.0	186 +/- 3.11
		Cr-51	490 +/- 123	456 +/- 7.61
		Mn-54	126 +/- 17.0	120.0 +/- 2.00
		Zn-65	193 +/- 36.0	174 +/- 2.91
12/09/10	Air particulates on filter – pCi	Mn-54	129 +/- 9.00	114 +/- 1.91
		Cr-51	505 +/- 52.0	435 +/- 7.26
		Cs-137	190 +/- 10.0	178 +/- 2.97
		Cs-134	130 +/- 8.00	150 +/- 2.50
		Zn-65	202 +/- 21.0	166 +/- 2.77
		Co-60	304 +/- 11.0	287 +/- 4.79
		Co-58	89.0 +/- 9.00	86.1 +/- 1.44
		Fe-59	147 +/- 13.0	125 +/- 2.09

<sup>1</sup> See discussion at the beginning of the Appendix

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Air Filter - A1	01/11/10	Gross Beta	1.9 +/- 0.2	1.5 +/- 0.2	**
Air Filter - A2	01/11/10	Gross Beta	1.5 +/- 0.2	1.5 +/- 0.2	**
Air Filter - A3	01/11/10	Gross Beta	2.1 +/- 0.3	1.9 +/- 0.3	**
Air Filter - A4	01/11/10	Gross Beta	2.4 +/- 0.4	2.5 +/- 0.4	**
Air Filter - A5	01/11/10	Gross Beta	1.8 +/- 0.2	1.7 +/- 0.1	**
Air Filter - SFA1	01/11/10	Gross Beta	1.7 +/- 0.1	1.7 +/- 0.1	**
Air Filter - SFA2	01/11/10	Gross Beta	1.9 +/- 0.2	1.7 +/- 0.2	**
Air Filter - SFA3	01/11/10	Gross Beta	2.1 +/- 0.3	2.3 +/- 0.3	**
Air Filter - SFA4	01/11/10	Gross Beta	2.0 +/- 0.3	2.0 +/- 0.3	**
Air Iodine - A1	01/11/10	I-131	<MDA	<MDA	**
Air Iodine - A2	01/11/10	I-131	<MDA	<MDA	**
Air Filter - A1	03/01/10	Gross Beta	1.1 +/- 0.2	1.1 +/- 0.2	**
Air Filter - A2	03/01/10	Gross Beta	1.0 +/- 0.2	1.1 +/- 0.2	**
Air Filter - A3	03/01/10	Gross Beta	1.1 +/- 0.2	1.1 +/- 0.2	**
Air Filter - A4	03/01/10	Gross Beta	1.7 +/- 0.3	1.7 +/- 0.3	**
Air Filter - A5	03/01/10	Gross Beta	1.3 +/- 0.1	1.4 +/- 0.1	**
Air Filter - SFA1	03/01/10	Gross Beta	1.0 +/- 0.1	1.0 +/- 0.1	**
Air Filter - SFA2	03/01/10	Gross Beta	1.3 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA3	03/01/10	Gross Beta	1.1 +/- 0.3	1.3 +/- 0.3	**
Air Filter - SFA4	03/01/10	Gross Beta	1.4 +/- 0.2	1.3 +/- 0.2	**
Air Iodine - A3	03/01/10	I-131	<MDA	<MDA	**
Air Iodine - A4	03/01/10	I-131	<MDA	<MDA	**
Air Filter - A1	03/08/10	Gross Beta	1.6 +/- 0.2	1.5 +/- 0.2	**
Air Filter - A2	03/08/10	Gross Beta	1.4 +/- 0.2	1.6 +/- 0.2	**
Air Filter - A3	03/08/10	Gross Beta	1.3 +/- 0.2	1.4 +/- 0.2	**
Air Filter - A4	03/08/10	Gross Beta	2.1 +/- 0.3	2.3 +/- 0.3	**
Air Filter - A5	03/08/10	Gross Beta	1.3 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA1	03/08/10	Gross Beta	1.3 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA2	03/08/10	Gross Beta	1.2 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA3	03/08/10	Gross Beta	1.6 +/- 0.2	1.5 +/- 0.3	**
Air Filter - SFA4	03/08/10	Gross Beta	1.4 +/- 0.2	1.5 +/- 0.2	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Air Iodine - A1	03/08/10	I-131	<MDA	<MDA	**
Air Iodine - A2	03/08/10	I-131	<MDA	<MDA	**
Oysters - IA3	03/23/10	Gamma	<MDA	<MDA	**
Air Filters – A1	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – A2	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – A3	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – A4	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – A5	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – SFA1	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – SFA2	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – SFA3	05/03/10	Gamma	<MDA	**	<MDA
Air Filters – SFA4	05/03/10	Gamma	<MDA	**	<MDA
Air Iodine - LB	05/17/10	I-131	<MDA	<MDA	**
Air Iodine - T1	05/17/10	I-131	<MDA	<MDA	**
Vegetation – SFB1	05/28/10	Gamma	<MDA	<MDA	<MDA
Vegetation – SFB2	05/28/10	Gamma	<MDA	<MDA	<MDA
Vegetation – SFB3	05/28/10	Gamma	<MDA	<MDA	<MDA
Soil – SFS1	05/28/10	Cs-137	<MDA	<MDA	<MDA
Soil – SFS2	05/28/10	Cs-137	662 +/- 35	92.3 +/- 29.4	43.1 +/- 29.4
Soil – SFS3	05/28/10	Cs-137	137 +/- 55	152 +/- 40.3	115 +/- 43.1
Air Filter - A1	06/07/10	Gross Beta	1.8 +/- 0.1	1.8 +/- 0.1	**
Air Filter - A2	06/07/10	Gross Beta	1.7 +/- 0.3	1.7 +/- 0.3	**
Air Filter - A3	06/07/10	Gross Beta	1.5 +/- 0.3	1.5 +/- 0.3	**
Air Filter - A4	06/07/10	Gross Beta	1.4 +/- 0.2	1.5 +/- 0.2	**
Air Filter - A5	06/07/10	Gross Beta	1.6 +/- 0.1	1.6 +/- 0.1	**
Air Filter - SFA1	06/07/10	Gross Beta	1.9 +/- 0.1	1.9 +/- 0.1	**
Air Filter - SFA2	06/07/10	Gross Beta	1.9 +/- 0.2	1.8 +/- 0.2	**
Air Filter - SFA3	06/07/10	Gross Beta	1.6 +/- 0.2	1.6 +/- 0.2	**
Air Filter - SFA4	06/07/10	Gross Beta	1.1 +/- 0.2	1.1 +/- 0.2	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Air Iodine – A2	06/14/10	I-131	<MDA	<MDA	**
Air Iodine – A3	06/14/10	I-131	<MDA	<MDA	**
Air Filter - A1	07/05/10	Gross Beta	1.3 +/- 0.1	1.3 +/- 0.1	**
Air Filter - A2	07/05/10	Gross Beta	1.4 +/- 0.2	1.3 +/- 0.2	**
Air Filter - A3	07/05/10	Gross Beta	1.4 +/- 0.3	1.2 +/- 0.3	**
Air Filter - A4	07/05/10	Gross Beta	1.1 +/- 0.2	1.1 +/- 0.2	**
Air Filter - A5	07/05/10	Gross Beta	1.3 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA1	07/05/10	Gross Beta	1.4 +/- 0.1	1.4 +/- 0.1	**
Air Filter - SFA2	07/05/10	Gross Beta	1.1 +/- 0.1	1.0 +/- 0.1	**
Air Filter - SFA3	07/05/10	Gross Beta	1.4 +/- 0.2	1.0 +/- 0.2	**
Air Filter - SFA4	07/05/10	Gross Beta	1.1 +/- 0.2	1.1 +/- 0.2	**
Shoreline Sediment – WB1	07/08/10	Gamma	<MDA	**	<MDA
DR05	07/08/10	TLD	11.50 +/- 0.97	10.90 +/- 1.51	**
DR06	07/08/10	TLD	9.44 +/- 0.92	9.99 +/- 0.53	**
DR07	07/08/10	TLD	10.01 +/- 1.12	10.30 +/- 1.37	**
DR08	07/08/10	TLD	14.24 +/- 0.75	13.96 +/- 2.10	**
DR09	07/08/10	TLD	11.10 +/- 1.32	11.19 +/- 1.21	**
DR10	07/08/10	TLD	9.86 +/- 1.00	10.41 +/- 1.07	**
DR11	07/08/10	TLD	10.37 +/- 1.34	10.34 +/- 1.41	**
DR29	07/08/10	TLD	14.44 +/- 1.78	14.55 +/- 1.81	**
DR31	07/08/10	TLD	15.64 +/- 0.85	15.04 +/- 1.24	**
SFDR14	07/08/10	TLD	13.95 +/- 1.66	14.84 +/- 1.83	**
SFDR15	07/08/10	TLD	18.79 +/- 3.57	18.60 +/- 2.07	**
Air Iodine – A5	07/26/10	I-131	<MDA	<MDA	**
Air Iodine – SFA1	07/26/10	I-131	<MDA	<MDA	**
Air Iodine – SFA2	07/26/10	I-131	<MDA	<MDA	**
Oysters – IA3	08/18/10	Gamma	<MDA	<MDA	<MDA
Oysters – IA6	08/18/10	Gamma	<MDA	<MDA	<MDA

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Fish – IA4	08/18/10	Gamma	<MDA	<MDA	**
Water– WA2	8/30/10	Gamma	<MDA	<MDA	<MDA
Vegetation – IB3	08/31/10	Gamma	<MDA	<MDA	<MDA
Vegetation – IB4	08/31/10	Gamma	<MDA	<MDA	<MDA
Vegetation – IB7	08/31/10	Gamma	<MDA	<MDA	<MDA
Air Iodine – A1	08/31/10	I-131	<MDA	<MDA	**
Air Iodine – A4	08/31/10	I-131	<MDA	<MDA	**
Air Filter - A1	08/30/10	Gross Beta	2.3 +/- 0.1	2.3 +/- 0.1	**
Air Filter - A2	08/30/10	Gross Beta	1.6 +/- 0.2	1.6 +/- 0.2	**
Air Filter - A3	08/30/10	Gross Beta	1.4 +/- 0.3	1.3 +/- 0.3	**
Air Filter - A4	08/30/10	Gross Beta	1.8 +/- 0.2	1.9 +/- 0.2	**
Air Filter - A5	08/30/10	Gross Beta	2.1 +/- 0.1	2.2 +/- 0.1	**
Air Filter - SFA1	08/30/10	Gross Beta	6.7 +/- 0.4	6.9 +/- 0.4	**
Air Filter - SFA2	08/30/10	Gross Beta	2.1 +/- 0.1	2.1 +/- 0.1	**
Air Filter - SFA3	08/30/10	Gross Beta	2.1 +/- 0.2	2.2 +/- 0.2	**
Air Filter - SFA4	08/30/10	Gross Beta	2.0 +/- 0.2	1.8 +/- 0.2	**
Air Iodine – A5	09/06/10	I-131	<MDA	<MDA	**
Air Iodine – SF1	09/06/10	I-131	<MDA	<MDA	**
Air Filter - A1	09/07/10	Gross Beta	4.1 +/- 0.2	4.1 +/- 0.2	**
Air Filter - A2	09/07/10	Gross Beta	2.3 +/- 0.2	2.7 +/- 0.3	**
Air Filter - A3	09/07/10	Gross Beta	3.0 +/- 0.3	3.2 +/- 0.4	**
Air Filter - A4	09/07/10	Gross Beta	3.3 +/- 0.3	3.3 +/- 0.3	**
Air Filter - A5	09/07/10	Gross Beta	3.6 +/- 0.2	3.6 +/- 0.2	**
Air Filter - SFA1	09/07/10	Gross Beta	4.2 +/- 0.1	4.0 +/- 0.2	**
Air Filter - SFA2	09/07/10	Gross Beta	3.8 +/- 0.2	3.7 +/- 0.2	**
Air Filter - SFA3	09/07/10	Gross Beta	3.9 +/- 0.3	3.6 +/- 0.3	**
Air Filter - SFA4	09/07/10	Gross Beta	3.3 +/- 0.3	3.0 +/- 0.3	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Air Filters – A1	09/27/10	Gamma	<MDA	<MDA	<MDA
Air Filters – A2	09/27/10	Gamma	<MDA	<MDA	<MDA
Air Filters – A3	09/27/10	Gamma	<MDA	<MDA	<MDA
Air Filters – A4	09/27/10	Gamma	<MDA	**	<MDA
Air Filters – A5	09/27/10	Gamma	<MDA	**	<MDA
Air Filters – SFA1	09/27/10	Gamma	<MDA	**	<MDA
Air Filters – SFA2	09/27/10	Gamma	<MDA	**	<MDA
Air Filters – SFA3	09/27/10	Gamma	<MDA	<MDA	<MDA
Air Filters – SFA4	09/27/10	Gamma	<MDA	<MDA	<MDA
DR05	10/07/10	TLD	12.47 +/- 0.95	12.94 +/- 1.93	**
DR06	10/07/10	TLD	10.69 +/- 0.76	11.11 +/- 0.94	**
DR07	10/07/10	TLD	10.46 +/- 1.16	11.63 +/- 0.39	**
DR08	10/07/10	TLD	15.83 +/- 1.56	16.71 +/- 1.92	**
DR09	10/07/10	TLD	11.90 +/- 0.77	12.36 +/- 1.20	**
DR10	10/07/10	TLD	10.98 +/- 0.97	11.85 +/- 1.35	**
DR11	10/07/10	TLD	11.17 +/- 0.74	11.57 +/- 1.20	**
DR29	10/07/10	TLD	15.17 +/- 1.35	15.63 +/- 1.18	**
DR31	10/07/10	TLD	15.75 +/- 0.93	16.75 +/- 1.40	**
SFDR14	10/07/10	TLD	16.61 +/- 1.87	16.96 +/- 1.32	**
SFDR15	10/07/10	TLD	21.09 +/- 5.39	22.13 +/- 5.45	**
Air Filter - A1	10/11/10	Gross Beta	3.5 +/- 0.2	3.5 +/- 0.2	**
Air Filter - A2	10/11/10	Gross Beta	2.7 +/- 0.2	2.6 +/- 0.2	**
Air Filter - A3	10/11/10	Gross Beta	3.3 +/- 0.3	3.0 +/- 0.3	**
Air Filter - A4	10/11/10	Gross Beta	2.8 +/- 0.2	2.4 +/- 0.2	**
Air Filter - A5	10/11/10	Gross Beta	3.0 +/- 0.2	3.1 +/- 0.2	**
Air Filter - SFA1	10/11/10	Gross Beta	3.6 +/- 0.2	3.4 +/- 0.2	**
Air Filter - SFA2	10/11/10	Gross Beta	3.0 +/- 0.2	2.9 +/- 0.2	**
Air Filter - SFA3	10/11/10	Gross Beta	3.5 +/- 0.3	3.2 +/- 0.3	**
Air Filter - SFA4	10/11/10	Gross Beta	2.8 +/- 0.2	2.8 +/- 0.2	**
Bottom Sediment – WBS2	10/20/10	Cs-137	<MDA	**	121 +/- 6



Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis *	Original Analysis	Replicate Analysis	Split Analysis
Bottom Sediment – WBS4	10/20/10	Gamma	<MDA	**	<MDA
Fish - N	11/13/10	Gamma	<MDA	**	<MDA
Fish - N	11/13/10	Gamma	<MDA	**	<MDA
Intake – WA1	12/02/10	Gamma	<MDA	<MDA	
Discharge – WA2	12/02/10	Gamma	<MDA	<MDA	
Shoreline Sediment - WB1	12/07/10	Gamma	<MDA	<MDA	<MDA
Soil – SFS2	12/07/10	Gamma	<MDA	<MDA	**
Soil – SFS3	12/07/10	Gamma	<MDA	<MDA	**
Air Iodine – A1	12/13/10	I-131	<MDA	<MDA	**
Air Iodine – A5	12/13/10	I-131	<MDA	<MDA	**
Air Filter - A1	12/20/10	Gross Beta	2.7 +/- 0.2	2.6 +/- 0.2	**
Air Filter - A2	12/20/10	Gross Beta	2.4 +/- 0.3	2.3 +/- 0.3	**
Air Filter - A3	12/20/10	Gross Beta	2.8 +/- 0.3	2.6 +/- 0.3	**
Air Filter - A4	12/20/10	Gross Beta	2.8 +/- 0.3	3.0 +/- 0.3	**
Air Filter - A5	12/20/10	Gross Beta	2.3 +/- 0.1	2.4 +/- 0.2	**
Air Filter - SFA1	12/20/10	Gross Beta	2.7 +/- 0.2	2.6 +/- 0.1	**
Air Filter - SFA2	12/20/10	Gross Beta	2.6 +/- 0.2	2.5 +/- 0.2	**
Air Filter - SFA3	12/20/10	Gross Beta	2.6 +/- 0.3	2.8 +/- 0.3	**
Air Filter - SFA4	12/20/10	Gross Beta	2.2 +/- 0.2	2.0 +/- 0.2	**
Intake – WA1	12/30/10	Gamma	<MDA	<MDA	<MDA
Discharge – WA2	12/30/10	Gamma	<MDA	<MDA	<MDA

<sup>1</sup> See discussion at the beginning of the Appendix

\*Units for Gross Beta results are  $10^{-2}$ pCi/m<sup>3</sup>

\*\* The nature of these samples precluded splitting them with an independent laboratory.

**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 <sup>-3</sup> pCi/m <sup>3</sup>
H-3	175	--	--	--	--	--
Na-22	1	8	3	12	6	5
Cr-51	12	105	4	104	50	63
Mn-54	1	9	3	12	5	4
Co-58	1	9	4	9	4	5
Fe-59	3	28	9	24	10	12
Co-60	1	9	4	12	5	6
Zn-65	2	20	8	25	10	9
Nb-95	1	12	7	14	6	9
Zr-95	2	18	8	20	9	9
Ru-106	9	75	30	90	41	40
Ag-110m	1	10	10	10	5	4
Te-129m	16	131	60	162	79	95
I-131	4	65	30	35	22	74
Cs-134	1	8	4	10	5	4
Cs-137	1	9	4	10	5	4
BaLa-140	3	32	15	25	14	36
Ce-144	7	40	16	54	26	18

**APPENDIX D**  
**Land Use Survey**

Appendix D contains the results of a Land Use Survey conducted around Calvert Cliffs Nuclear Power Plant during this operating period. 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 to identify, within a distance of 5 miles, the location of the nearest milk animal, the nearest residence, and the nearest garden greater than 50 m<sup>2</sup> in each of the nine sectors over land. A detailed description of the Land Use Survey is given in a separate document (Ref. 9). The position of the nearest residence and garden in each sector out to 5 miles is given in the adjacent table. There are no animals producing milk for human consumption within the 5 mile radius. \*The nearest garden/resident location has changed since 2009. The use of GPS was used to determine distances from the centerline of containment.

<b>Land Use Survey</b>		
Sector	Distance From Plant (miles)	
	Residence	Garden
SE	1.5	1.5
SSE	1.6	2.4*
S	1.6	1.6
SSW	1.5	1.8
SW	1.1	1.1
WSW	1.3	1.4*
W	1.3	1.3
WNW	2.7	2.7
NW	2.0	2.1

The closest residence is situated in the SW sector and the nearest garden is also in the SW 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 REMP have been placed in the sectors with the highest X/Q. One sampling garden is located in the S sector at a distance of 0.4 miles, and another is situated near the site boundary in the SSE sector at a distance of 1.6 miles from the plant. These two sampling sites are considered good indicator locations for radioactive depositions around the plant.

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

## APPENDIX E

### **Additional Samples and Analysis Results**

Appendix E is a presentation of the analytical results for additional samples collected in the environs of CCNPP. These extra samples are not required by the ODCM (Ref. 6). Table E-1 lists the locations of all the additional samples and the remaining tables in this appendix provide the results. Some of these samples 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 PICs added for the ISFSI.

Table E-4 through E-10 contain analytical results for samples taken from the various radiological pathways (i.e., aquatic, atmospheric, terrestrial, and direct radiation) surrounding the plant. In general these results continue the historical trends previously observed in the official sites of the CCNPP REMP and ISFSI.

Table E-11 shows the direct radiation readings from TLDs placed at the perimeter of the Resin Storage Area which is temporary waste resin storage and cask transfer area located to the west of the ISFSI facility. The TLD values are somewhat higher than those in the REMP program due to their proximity to this source of the radiation. However, when the direct radiation readings for the Resin Storage Area are compared with those from the ISFSI and Site Boundary TLDs, it is apparent that temporary storage of spent resin and cask transfers are having no significant, measurable effect on the environs surrounding CCNPP.

The NEI Industry Groundwater Protection Initiative was established to determine the potential impact nuclear power plants may have on the surrounding environment due to unplanned releases of radioactive liquids. Under the Groundwater Protection Initiative, groundwater monitoring is accomplished through routine sampling of the water table around the plant and analysis for gamma and tritium.

In 2010 a deer population control program was initiated on the Calvert Cliffs site. 24 deer were harvested by Calvert Cliffs employees for consumption. Venison samples were collected from deer harvested on-site and deer harvested outside of the 10 mile radius, and the analysis results were similar. Thus it was concluded that this meat consumption pathway is not a significant source of dose.

Groundwater samples were collected from six on-site piezometer tubes in 2010. A piezometer tube is a shallow monitoring well which allows access to groundwater at a depth of approximately 40 feet beneath the site. Number 19 piezometer tube was added to the program in 2010, 3 additional wells were installed in December of 2010 and will be included in 2011 monitoring. Of the piezometer tubes sampled, only # 11 piezometer tube showed any plant related activity. This activity was previously identified and evaluated in December of 2005. The activity consists of tritium originating from normal rad waste discharges and was previously reported in the Annual Radioactive Release Reports. The tritium contamination is contained on site. No drinking water has been affected; the groundwater at this location does not impact any drinking water pathway. The 2010 analysis results for Tritium are shown in Table E-12 and analysis results for gamma emitting radionuclides are shown in Table E-13.

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TABLE E-1

Locations of Non-Tech Spec Environmental Sampling Stations  
for Calvert Cliffs Nuclear Power Plant

Station	Description	Distance <sup>1</sup>		Direction <sup>1</sup>
		(KM)	(Miles)	(Sector)
A6	Long Beach	4.4	2.7	NW
A7	Taylor's Island, Anderson's Property	12.4	7.7	ENE
A8	Cambridge, U of MD Estuarine Center	32.0	19.9	NE
DR24	Route 4 and Parran Road	3.0	1.9	SW
DR25	Camp Conoy Guard House	1.0	0.6	S
DR26	Route 235 & Clarks Landing Rd.	20.5	12.7	SW
DR27	Route 231 & Route 4	23.0	14.3	NW
DR28	Taylor's Island Emergency Siren #35	12.3	7.6	ENE
DR29	Taylor's Island Emergency Siren #38	12.5	7.8	E
DR31	Cambridge, U of MD Estuarine Center	32.0	19.9	NE
DR32	Twining Property, Taylor's Island	12.3	7.6	NE
DR33	P.A. Ransome Property, Taylor's Island	14.8	9.2	ESE
DR34	Shoreline at Barge Road	0.2	0.1	NE
OSGDR1	North of Old Steam Generator Storage Facility	0.3	0.2	SW
OSGDR2	West of Old Steam Generator Storage Facility	0.3	0.2	SW
PIC1	Taylor's Island, Anderson's Property	12.4	7.7	ENE
PIC2	On Site before Entrance to Camp Conoy	0.7	0.4	S
PIC3	Meteorological Station	0.8	0.5	WSW
PIC4	NNW of ISFSI	0.6	0.4	SW
PIC5	SSE of ISFSI	0.6	0.4	SSW
PIC8	CCNPP Visitor's Center	0.3	0.2	NW
RPDR5	Resin Storage Area – North Fence Lower	0.7	0.4	SW
RPDR6	Resin Storage Area – North Fence Upper	0.7	0.4	SW
RPDR7	Resin Storage Area – West Fence Right	0.7	0.4	SW
RPDR8	Resin Storage Area – West Fence Left	0.7	0.4	SW
RPDR9	Resin Storage Area – South Fence Upper	0.7	0.4	SW
RPDR10	Resin Storage Area – South Fence Lower	0.7	0.4	SW
RPDR11	Resin Storage Area – East Fence Left	0.7	0.4	SW
RPDR12	Resin Storage Area – East Fence Right	0.7	0.4	SW
WBS2	Discharge Area	0.3	0.2	N
WBS4	Camp Conoy/Rocky Point	3.0	1.9	SE
WW1	Taylor's Island, Anderson's Property	12.4	7.7	ENE

<sup>1</sup> Distance and direction from the central point between the two containment buildings.

**Table E-2**

**Synopsis of 2010 Calvert Cliffs Nuclear Power Plant  
Non-Tech Spec Radiological Environmental Monitoring Program**

Sample Type	Sampling Frequency <sup>1</sup>	Number of Locations	Number Collected	Analysis	Analysis Frequency <sup>1</sup>	Number Analyzed
<b>Aquatic Environment</b>						
Bottom Sediment	Q	2	4	Gamma	SA	4
<b>Atmospheric Environment</b>						
Air Iodine <sup>2</sup>	W	7	362	I-131	W	362
Air Particulates <sup>3</sup>	W	3	154	Gross Beta Gamma	W MC	154 36
<b>Direct Radiation</b>						
Pressurized Ion Chamber	M	6	72	Gamma	M	72
Ambient Radiation	Q	20	480	TLD	Q	480
<b>Terrestrial Environment</b>						
Ground water	M	1	12	Gamma H-3	M M	12 12

<sup>1</sup> W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite

<sup>2</sup> The collection device contains silver Zeolite

<sup>3</sup> 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-Tech Spec 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 <sup>1</sup>	Location with Highest Annual Mean Name/Distance & Direction <sup>2</sup>	Highest Annual Mean (F) / Range <sup>1</sup>	Control Locations Mean (F)/Range
<b>Aquatic Environment</b>						
Bottom Sediment (pCi/kg)	Gamma (4) Cs-137	17	115 (2/2) (113-118)	Camp Conoy/ Rocky Point WBS4 3.0 km SE	147 (2/2) (124-171)	147 (2/2) (124-171)
<b>Atmospheric Environment</b>						
Air Particulates (10 <sup>-2</sup> pCi/m <sup>3</sup> )	Gross Beta (156)	0.5	2.1 (102/104) (0.8-5.0)	Long Beach LB 4.4 km NW	2.2 (52/52) (1.1-4.0)	1.8 (51/52) (0.8-3.1)
<b>Direct Radiation</b>						
Pressurized Ion Chamber (mR/30 days)	Ionization Chamber (72)	--	6.64 (60/60) (4.45-16.95)	NNW of ISFSI PIC4 0.6 km SW	11.48 (12/12) (9.93-16.95)	5.93 (12/12) (5.46-6.29)
Ambient Radiation (mR/90 days)	TLD (474)	--	22.51 (474/474) (8.73-107.06)	South Fence Lower RPDR10 km	55.94 (24/24) (48.60-67.22)	-- --

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

<sup>2</sup> From the centerpoint of the ISFSI facility



**Table E-4**

**Concentration of Gamma Emitters in Bottom Sediment  
(Results in units of pCi/kg (dry) +/- 2σ)**

Sample Code	Sample Date	Cs-137	Gamma Emitters
WBS2 Discharge Area	6/22/2010	113 +/- 54	*
	10/20/2010	118 +/- 30	*
WBS4 <sup>1</sup> Camp Conoy/ Rocky Point	6/22/2010	171 +/- 59	*
	10/20/2010	124 +/- 32	*

<sup>1</sup> Control Location

\* All Non-Natural Gamma Emitters <MDA

Table E-5

Concentration of Iodine-131 in Filtered Air  
(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2σ)

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	SFA1 MET Station	SFA2 <sup>1</sup> Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI	TI <sup>1</sup> TAYLOR'S ISLAND
12/28/2009	1/4/2010	*	*	*	*	*	*	*
1/4/2010	1/11/2010	*	*	*	*	*	*	*
1/11/2010	1/18/2010	*	*	*	*	*	*	*
1/18/2010	1/25/2010	*	*	*	*	*	*	*
1/25/2010	2/1/2010	*	*	*	*	*	*	*
2/1/2010	2/15/2010	*	*	*	*	*	*	*
2/15/2010	2/22/2010	*	*	*	*	*	*	*
2/22/2010	3/1/2010	*	*	*	*	*	*	*
3/1/2010	3/8/2010	*	*	*	*	*	*	*
3/8/2010	3/15/2010	*	*	*	*	*	*	*
3/15/2010	3/22/2010	*	*	*	*	*	*	*
3/22/2010	3/29/2010	*	*	*	*	*	*	*
3/29/2010	4/5/2010	*	*	*	*	*	*	*
4/5/2010	4/12/2010	*	*	*	*	*	*	*
4/12/2010	4/19/2010	*	*	*	*	*	*	*
4/19/2010	4/26/2010	*	*	*	*	*	*	2
4/26/2010	5/3/2010	*	*	*	*	*	*	*
5/3/2010	5/10/2010	*	*	*	*	*	*	*
5/10/2010	5/17/2010	*	*	*	*	*	*	*
5/17/2010	5/24/2010	*	*	*	*	*	*	*
5/24/2010	5/31/2010	*	*	*	*	*	*	*
5/31/2010	6/7/2010	*	*	*	*	*	*	*
6/7/2010	6/14/2010	*	*	*	*	*	*	*
6/14/2010	6/21/2010	*	*	*	*	*	*	*
6/21/2010	6/28/2010	*	*	*	*	*	*	*
6/28/2010	7/5/2010	*	*	*	*	*	*	*
7/5/2010	7/12/2010	*	*	*	*	*	*	*

Table E-5

**Concentration of Iodine-131 in Filtered Air**  
**(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2σ)**

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	SFA1 MET Station	SFA2 <sup>1</sup> Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI	TI <sup>1</sup> TAYLOR'S ISLAND
7/12/2010	7/19/2010	*	*	*	*	*	*	*
7/19/2010	7/26/2010	*	*	*	*	*	*	*
7/26/2010	8/2/2010	*	*	*	*	*	*	*
8/2/2010	8/9/2010	*	*	*	*	*	*	*
8/9/2010	8/16/2010	2	*	*	*	*	*	*
8/16/2010	8/23/2010	*	*	*	*	*	*	*
8/23/2010	8/30/2010	3	*	*	*	*	*	*
8/30/2010	9/6/2010	*	*	*	*	*	*	*
9/6/2010	9/13/2010	*	*	*	*	*	*	*
9/13/2010	9/20/2010	*	*	*	*	*	*	*
9/20/2010	9/27/2010	*	*	*	*	*	*	*
9/27/2010	10/4/2010	*	*	*	*	*	*	*
10/4/2010	10/11/2010	*	*	*	*	*	*	*
10/11/2010	10/18/2010	*	*	*	*	*	*	*
10/18/2010	10/25/2010	*	*	*	*	*	*	*
10/25/2010	11/1/2010	*	*	*	*	*	*	*
11/1/2010	11/8/2010	*	*	*	*	*	*	*
11/8/2010	11/15/2010	*	*	*	*	*	*	*
11/15/2010	11/22/2010	*	*	*	*	*	*	*
11/22/2010	11/29/2010	*	*	*	*	*	*	*
11/29/2010	12/6/2010	*	*	*	*	*	*	*
12/6/2010	12/13/2010	*	*	*	*	*	*	*
12/13/2010	12/20/2010	*	*	*	*	*	*	*
12/20/2010	12/27/2010	*	*	*	*	*	*	*
12/27/2010	1/3/2011	*	*	*	*	*	*	*

<sup>1</sup> Control Location

<sup>2</sup> Power outage

<sup>3</sup> Sampler malfunction/low flow

\* <MDA

**Table E-6**

**Concentration of Beta Emitters in Air Particulates  
(Results in units of  $10^{-2}$  pCi/m<sup>3</sup> +/- 2σ)**

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	TI <sup>1</sup> TAYLOR'S ISLAND
12/28/2009	1/4/2010	2.7 +/- 0.4	2.6 +/- 0.3	2.4 +/- 0.3
1/4/2010	1/11/2010	1.8 +/- 0.2	2.1 +/- 0.2	2.3 +/- 0.2
1/11/2010	1/18/2010	2.3 +/- 0.3	3.3 +/- 0.3	3.1 +/- 0.3
1/18/2010	1/25/2010	1.8 +/- 0.2	2.0 +/- 0.3	1.6 +/- 0.3
1/25/2010	2/1/2010	2.6 +/- 0.3	3.8 +/- 0.4	2.5 +/- 0.3
2/1/2010	2/15/2010	1.6 +/- 0.2	2.2 +/- 0.2	1.5 +/- 0.2
2/15/2010	2/22/2010	2.3 +/- 0.3	2.2 +/- 0.3	2.0 +/- 0.2
2/22/2010	3/1/2010	1.1 +/- 0.2	1.5 +/- 0.2	1.0 +/- 0.2
3/1/2010	3/8/2010	1.9 +/- 0.2	1.8 +/- 0.2	2.0 +/- 0.2
3/8/2010	3/15/2010	2.0 +/- 0.3	3.2 +/- 0.5	1.7 +/- 0.2
3/15/2010	3/22/2010	2.0 +/- 0.3	2.0 +/- 0.3	1.9 +/- 0.2
3/22/2010	3/29/2010	1.0 +/- 0.2	1.9 +/- 0.2	1.3 +/- 0.2
3/29/2010	4/5/2010	1.2 +/- 0.2	1.1 +/- 0.2	1.0 +/- 0.2
4/5/2010	4/12/2010	2.3 +/- 0.3	2.4 +/- 0.3	1.9 +/- 0.3
4/12/2010	4/19/2010	1.7 +/- 0.2	2.2 +/- 0.2	1.8 +/- 0.2
4/19/2010	4/26/2010	1.8 +/- 0.2	1.8 +/- 0.2	2
4/26/2010	5/3/2010	1.8 +/- 0.3	1.6 +/- 0.2	1.5 +/- 0.2
5/3/2010	5/10/2010	1.4 +/- 0.2	1.4 +/- 0.2	1.4 +/- 0.2
5/10/2010	5/17/2010	1.4 +/- 0.2	1.1 +/- 0.2	1.3 +/- 0.2
5/17/2010	5/24/2010	0.8 +/- 0.2	1.1 +/- 0.3	0.8 +/- 0.2
5/24/2010	5/31/2010	1.1 +/- 0.2	1.6 +/- 0.3	1.1 +/- 0.2
5/31/2010	6/7/2010	1.6 +/- 0.3	1.5 +/- 0.2	1.3 +/- 0.2
6/7/2010	6/14/2010	1.7 +/- 0.2	1.5 +/- 0.2	1.5 +/- 0.2
6/14/2010	6/21/2010	1.5 +/- 0.2	1.5 +/- 0.2	1.5 +/- 0.2
6/21/2010	6/28/2010	2.1 +/- 0.2	2.4 +/- 0.3	1.7 +/- 0.2
6/28/2010	7/5/2010	1.5 +/- 0.2	1.3 +/- 0.2	1.1 +/- 0.2
7/5/2010	7/12/2010	1.9 +/- 0.3	2.6 +/- 0.3	2.4 +/- 0.3
7/12/2010	7/19/2010	2.2 +/- 0.2	2.4 +/- 0.3	2.1 +/- 0.2
7/19/2010	7/26/2010	1.4 +/- 0.2	1.7 +/- 0.3	2.0 +/- 0.2
7/26/2010	8/2/2010	1.8 +/- 0.2	2.1 +/- 0.3	1.6 +/- 0.2
8/2/2010	8/9/2010	2.2 +/- 0.2	1.8 +/- 0.2	2.5 +/- 0.2
8/9/2010	8/16/2010	2	2.2 +/- 0.3	1.8 +/- 0.2
8/16/2010	8/23/2010	2.8 +/- 0.3	3.0 +/- 0.3	2.9 +/- 0.3
8/23/2010	8/30/2010	3	2.0 +/- 0.3	1.4 +/- 0.2
8/30/2010	9/6/2010	4.6 +/- 0.3	3.4 +/- 0.3	3.1 +/- 0.3
9/6/2010	9/13/2010	2.1 +/- 0.3	2.1 +/- 0.3	1.2 +/- 0.2
9/13/2010	9/20/2010	3.1 +/- 0.3	3.3 +/- 0.3	2.0 +/- 0.2
9/20/2010	9/27/2010	2.7 +/- 0.3	4.0 +/- 0.4	1.5 +/- 0.2
9/27/2010	10/4/2010	2.9 +/- 0.4	1.6 +/- 0.2	1.1 +/- 0.2
10/4/2010	10/11/2010	3.9 +/- 0.4	3.2 +/- 0.3	2.4 +/- 0.3
10/11/2010	10/18/2010	5.0 +/- 0.5	2.9 +/- 0.3	2.5 +/- 0.3

**Table E-6**

**Concentration of Beta Emitters in Air Particulates  
(Results in units of  $10^{-2}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	TI <sup>1</sup> TAYLOR'S ISLAND
10/18/2010	10/25/2010	1.8 +/- 0.2	2.5 +/- 0.3	1.9 +/- 0.2
10/25/2010	11/1/2010	2.0 +/- 0.2	2.0 +/- 0.3	1.2 +/- 0.2
11/1/2010	11/8/2010	1.2 +/- 0.2	1.1 +/- 0.2	1.2 +/- 0.2
11/8/2010	11/15/2010	1.6 +/- 0.2	2.0 +/- 0.2	1.3 +/- 0.3
11/15/2010	11/22/2010	3.2 +/- 0.3	3.5 +/- 0.3	2.0 +/- 0.3
11/22/2010	11/29/2010	2.5 +/- 0.2	2.7 +/- 0.3	1.8 +/- 0.2
11/29/2010	12/6/2010	2.1 +/- 0.3	1.9 +/- 0.2	1.7 +/- 0.3
12/6/2010	12/13/2010	1.2 +/- 0.2	2.1 +/- 0.3	1.6 +/- 0.2
12/13/2010	12/20/2010	2.2 +/- 0.3	2.7 +/- 0.2	2.1 +/- 0.3
12/20/2010	12/27/2010	1.3 +/- 0.2	1.4 +/- 0.2	1.2 +/- 0.2
12/27/2010	1/3/2011	2.5 +/- 0.4	3.0 +/- 0.3	2.5 +/- 0.4

<sup>1</sup> Control Location

<sup>2</sup> Power outage

<sup>3</sup> Sampler malfunction/low flow

\* <MDA

**Table E-7**

**Concentration of Gamma Emitters in Air Particulates  
(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

Sample Date	CA Cambridge	LB LONG BEACH	TI <sup>1</sup> TAYLOR'S ISLAND
2/1/2010	*	*	*
3/1/2010	*	*	*
3/29/2010	*	*	*
5/3/2010	*	*	*
5/31/2010	*	*	*
6/28/2010	*	*	*
8/2/2010	*	*	*
8/30/2010	*	*	*
9/27/2010	*	*	*
11/1/2010	*	*	*
11/29/2010	*	*	*
1/3/2011	*	*	*

<sup>1</sup> Control Location

\* All Non-Natural Gamma Emitters <MDA

Table E-8

**Concentration of Tritium and Gamma Emitters  
in Taylors Island Well Water  
(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/-  $2\sigma$ )**

Sample Date	Gamma Emitters	H-3
1/19/2010	*	<200
2/22/2010	*	<200
3/22/2010	*	<200
4/26/2010	*	<200
5/17/2010	*	<204
6/21/2010	*	<200
7/8/2010	*	<291
8/23/2010	*	<291
9/20/2010	*	<291
10/18/2010	*	<303
11/22/2010	*	<303
12/20/2010	*	<303

\* 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 <sup>1</sup> Taylor's Island	JAN	5.82 +/- 0.58	FEB	5.46 +/- 0.55
	MAR	5.91 +/- 0.59	APR	5.97 +/- 0.60
	MAY	5.92 +/- 0.59 <sup>2</sup>	JUN	6.22 +/- 0.62
	JUL	6.18 +/- 0.62	AUG	6.11 +/- 0.61 <sup>2</sup>
	SEP	6.29 +/- 0.63	OCT	5.74 +/- 0.57
	NOV	5.76 +/- 0.58	DEC	5.93 +/- 0.59
	PIC2 Entrance to Camp Conoy	JAN	4.95 +/- 0.50	FEB
MAR		5.15 +/- 0.52	APR	5.85 +/- 0.59
MAY		4.57 +/- 0.46 <sup>2</sup>	JUN	4.59 +/- 0.46
JUL		4.70 +/- 0.47	AUG	4.62 +/- 0.46
SEP		4.67 +/- 0.47	OCT	4.71 +/- 0.47
NOV		4.45 +/- 0.45	DEC	4.46 +/- 0.45
PIC3 MET Station		JAN	5.39 +/- 0.54	FEB
	MAR	5.41 +/- 0.54	APR	5.19 +/- 0.52
	MAY	5.04 +/- 0.50 <sup>2</sup>	JUN	5.07 +/- 0.51
	JUL	5.88 +/- 0.59	AUG	5.12 +/- 0.51
	SEP	5.20 +/- 0.52	OCT	5.25 +/- 0.52
	NOV	5.12 +/- 0.51	DEC	5.33 +/- 0.53
	PIC4 NNW of ISFSI	JAN	10.35 +/- 1.04	FEB
MAR		10.32 +/- 1.03	APR	10.27 +/- 1.03
MAY		10.77 +/- 1.08 <sup>2</sup>	JUN	10.76 +/- 1.08
JUL		10.91 +/- 1.09	AUG	16.95 +/- 1.70
SEP		11.17 +/- 1.12	OCT	13.95 +/- 1.40 <sup>2</sup>
NOV		11.75 +/- 1.18	DEC	12.42 +/- 1.24
PIC5 SSE of ISFSI		JAN	6.50 +/- 0.65	FEB
	MAR	6.40 +/- 0.64 <sup>3</sup>	APR	6.38 +/- 0.64
	MAY	6.49 +/- 0.65 <sup>2</sup>	JUN	6.21 +/- 0.62
	JUL	6.48 +/- 0.65	AUG	6.39 +/- 0.64
	SEP	6.50 +/- 0.65	OCT	6.60 +/- 0.66
	NOV	6.56 +/- 0.66	DEC	7.14 +/- 0.71
	PIC8 Visitor's Center	JAN	5.23 +/- 0.52	FEB
MAR		5.42 +/- 0.54	APR	5.04 +/- 0.50
MAY		5.59 +/- 0.56 <sup>2</sup>	JUN	5.23 +/- 0.52
JUL		5.26 +/- 0.53 <sup>2</sup>	AUG	5.23 +/- 0.52 <sup>2</sup>
SEP		5.30 +/- 0.53	OCT	5.20 +/- 0.52
NOV		5.19 +/- 0.52 <sup>2</sup>	DEC	5.26 +/- 0.53

<sup>1</sup> Control Location

<sup>2</sup> Instrument being serviced

<sup>3</sup> Power outage



**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.	11.40 +/- 1.71	10.86 +/- 1.03	12.18 +/- 0.97	12.06 +/- 0.57
DR25	Camp Conoy Guard House	13.17 +/- 1.70	11.49 +/- 1.42	14.04 +/- 0.59	13.07 +/- 0.28
DR26	Rt. 235 and Clark's Landing Road	10.56 +/- 0.79	10.08 +/- 0.83	11.22 +/- 0.94	11.38 +/- 1.36
DR27	Rt. 231 and Rt. 4	11.37 +/- 0.25	9.87 +/- 1.152	11.25 +/- 0.64	11.15 +/- 1.22
DR28	Taylors Is. Siren #35	13.59 +/- 1.11	12.93 +/- 0.95	15.05 +/- 1.28	14.64 +/- 1.58
DR29	Taylors Is. Siren #38	14.36 +/- 0.39	13.69 +/- 1.71	15.00 +/- 0.95	15.52 +/- 2.05
DR31	Cambridge	14.47 +/- 1.61	14.83 +/- 0.85	15.42 +/- 1.96	16.26 +/- 1.15
DR32	Twining Property, Taylors Island	13.86 +/- 1.08	13.88 +/- 1.40	16.25 +/- 1.31	15.25 +/- 1.49
DR33	P. A. Ransome Property	14.79 +/- 0.88	13.82 +/- 2.06	16.96 +/- 1.48	16.05 +/- 0.90
DR34	Shoreline at Barge Rd.	9.78 +/- 1.07	8.73 +/- 0.38	10.10 +/- 1.19	10.20 +/- 1.40
OSG1	North of Old Steam Generator Storage Facility	18.43 +/- 1.80	17.69 +/- 1.18	19.48 +/- 1.24	18.64 +/- 1.00
OSG2	West of Old Steam Generator Storage Facility	16.23 +/- 2.52	15.04 +/- 1.75	15.89 +/- 1.33	16.51 +/- 2.88

**Table E-11**

**Direct Radiation from Resin Storage Area  
(Results in units of mR/90 days +/- 2 $\sigma$ )**

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
RPDR05	North Fence Lower	37.47 +/- 6.98	22.18 +/- 3.28	16.08 +/- 2.24	16.95 +/- 2.60
RPDR06	North Fence Upper	48.75 +/- 5.99	37.60 +/- 2.26	26.00 +/- 2.27	26.32 +/- 1.60
RPDR07	West Fence Right	107.1 +/- 9.17	33.86 +/- 2.89	34.02 +/- 2.64	33.90 +/- 2.43
RPDR08	West Fence Left	22.73 +/- 1.91	16.87 +/- 1.19	19.28 +/- 1.31	20.80 +/- 1.90
RPDR09	South Fence Upper	22.97 +/- 3.46	18.58 +/- 1.81	20.14 +/- 1.19	24.26 +/- 0.88
RPDR10	South Fence Lower	67.22 +/- 5.99	48.60 +/- 7.01	50.11 +/- 12.10	57.82 +/- 11.24
RPDR11	East Fence Left	42.81 +/- 1.48	33.15 +/- 3.80	43.39 +/- 6.74	51.23 +/- 5.79
RPDR12	East Fence Right	36.29 +/- 3.15	30.10 +/- 1.88	34.60 +/- 3.91	35.74 +/- 6.86

**Table E-12**  
**Concentration of Tritium in Groundwater**  
**(Results in units of  $10^{-3}$  pCi/m<sup>3</sup> +/- 2 $\sigma$ )**

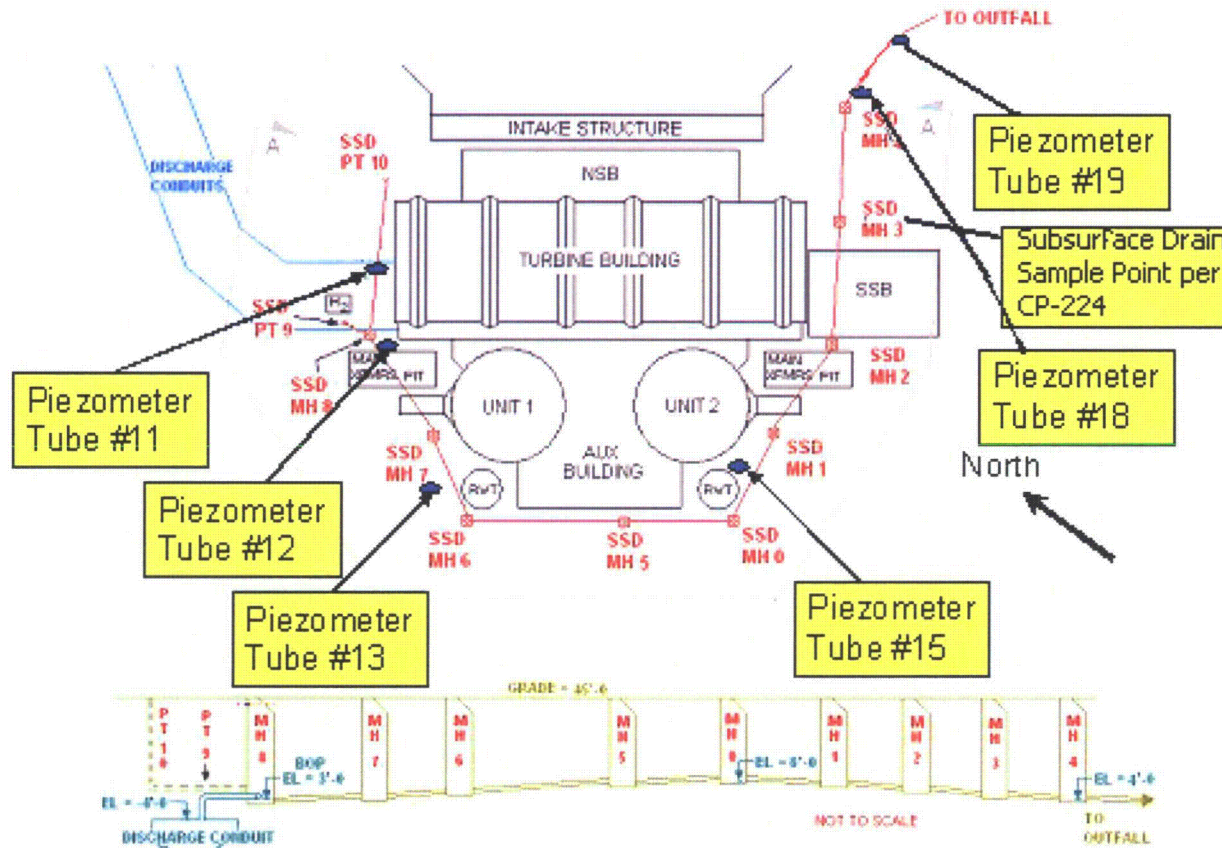
Sample Date	Piezometer Tube #s					
	11	12	13	15	18	19
03/06/2010	<202	<203	<203	<203	<202	--
04/09/2010	<203	<220	<220	<220	<220	--
07/30/2010	412 +/- 67.9	<178	<176	<179	<181	--
10/25/2010	739 +/-180	<295	<289	<289	<293	<293

**Table E-13**  
**Gross Concentration of Gamma Emitters**  
**(Results in units of pCi/L +/- 2σ)**  
E-13 Gross Concentration of Gamma Emitters

Sample Date	Piezometer Tube #s					
	11	12	13	15	18	19
03/06/2010	*	*	*	*	*	--
04/09/2010	*	*	*	*	*	--
07/30/2010	*	*	*	*	*	--
10/25/2010	*	*	*	*	*	*

\*All Non-Natural Gamma Emitters < MDA

**Figure E-1**  
**Site Map Groundwater Monitoring Wells**



Original drawing by J. Gies  
Modified by P. Conner