Exelon Generation®

Larry D. Smith
Manager-Regulatory Assurance

Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657

410-495-5219 Office
www.exeloncorp.com
Larry.smith2@exeloncorp.com

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

Calvert Cliffs Nuclear Power Plant; Unit Nos. 1 & 2;
Renewed Facility Operating License Nos. DPR-53 and DPR-69
Docket Nos. 50-317 & 50-318

Independent Spent Fuel Storage Installation;
Material License No. SNM-2505
NRC Docket No. 72-8

Subject: Annual Radiological Environmental Operating Report

References:
1. Calvert Cliffs Nuclear Power Plant Technical Specification 5.6.2
2. Calvert Cliffs Independent Spent Fuel Storage Installation Technical Specification 6.2

In accordance with References 1 and 2, Calvert Cliffs Nuclear Power Plant is submitting the Annual Radiological Environmental Operating Report (Attachment 1).

There are no regulatory commitments contained in this correspondence.

Should you have questions regarding this matter, please contact me at (410) 495-5219 or Mr. Ed Schinner at (410) 495-5210.

Respectfully,

Larry D. Smith
Manager-Regulatory Assurance

LDS/PSF/bjm

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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

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR

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

Calvert Cliffs Nuclear Power Plant
May 14, 2018

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, 2017

A. M. Barnett
R. V. Ihnacik

EXELON GENERATION, LLC

MAY 2018

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I. SUMMARY

During 2017, Calvert Cliffs Nuclear Power Plant (CCNPP) Units 1 and 2, a total of 3429 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), the Environmental Technical Specifications (Ref. 5) and the 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 653 radiochemical analyses were performed on 585 environmental samples and 546 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, 359 radiochemical analyses were performed on 299 environmental samples, 64 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, 678 analyses were performed on 609 additional environmental samples, and 480 additional TLDs were analyzed for ambient radiation exposure rates.

And lastly, 189 radiochemical analyses were performed on 189 quality assurance samples and 126 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 and charcoal cartridges, respectively. The particulate filters were analyzed for beta activity and gamma emitting nuclides. The charcoal 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 3429 radiological analyses performed. Low levels of man-made fission products were also observed in 9 of these analyses for the CCNPP REMP. All of these observations were within the expected range and attributed to fallout from past atmospheric weapons testing (Ref.16). 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 2017 data from the plant's effluent releases, 2017 on-site meteorological data, and appropriate pathways. Carbon 14 dose is not included here and is instead reported in the Annual Radiological Effluents Release Report. The results of these dose calculations indicate:

a. a maximum thyroid dose of 1.13×10^{-3} mrem via liquid and gaseous pathways, which is about 0.002% of the acceptable limit of 75 mrem/yr as specified in 40CFR190 "Environmental Radiation Protection Standards for Nuclear Power Operations" and 10CFR72.104, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste";

b. a maximum whole body gamma dose of 2.40×10^{-3} mrem via liquid and gaseous pathways, which is about 0.010% of the acceptable limit of 25 mrem/yr as specified in both 40CFR190 and 10CFR72.104; and

c. a maximum calculated dose to all other organs via liquid and gaseous pathways was equal to 5.30×10^{-4} mrem to the GI tract. This dose is about 0.002% of the allowable limit of 25 mrem/yr as specified in both 40CFR190 and 10CFR72.104.

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

The REMP has been conducted in the vicinity of 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 Nuclear Regulatory Commission (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 Interlaboratory Comparison 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 40CFR190,

b. To detect any measurable buildup of long-lived radionuclides in the environment,

c. To monitor and evaluate ambient radiation levels, and

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 Exelon Generation according to CCNPP Procedures (Ref. 7, 8 and 12).

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. Positive results which include natural and manmade activity are those that are "greater than" the MDA with good precision and accuracy. Trending and detailed discussions for positive results are provided in section II.C in their respective sections by sample type, i.e. aquatic, atmospheric, terrestrial.

II.B.4 Program Exceptions

There was a of a loss of sample collection at WA2 between 6/23/17 and 6/27/17. The sample compositor on the Unit 1 side of Outfall 001 was found knocked over on the morning of 6/27/17. The compositor was likely knocked over by a surge of water rising up through the metal grating over Outfall 001. These surges occur upon starting Circulating Water Pumps. There was no loss of sample collected up to that point. A new compositor was put in service on 6/27/17. Sufficient sample volume collected for the month. The compositors at WA2 were moved to a secure location that is out of the way of such surges. The compositors have also been tied to a rigid structure.

Vegetation samples were not collected in June. This is discussed further in section II.C.3.a

II.C. RESULTS AND DISCUSSIONS

All the environmental samples collected during the year were analyzed using Exelon Industrial Services laboratory procedures (Ref. 8) with the exception of Tritium analyzed by GEL Laboratories LLC. (Ref. 14) and Teledyne Brown Engineering (Ref. 15). 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

Continuously composited bay water samples are taken from two locations during the year. These locations are the Intake Area (sample code WA1) and the Discharge Area (sample code WA2). The composite samples are collected monthly.

These samples were analyzed for tritium and gamma emitters. The tritium analyses, performed on quarterly composites of the monthly bay water samples, revealed no evidence of tritium in any of the samples taken from either site throughout the year.

Figure 1 compares tritium activity in three ways. The first graph shows the amount of tritium released from the plant. The units used to describe these releases are Curies per quarter. It can be noted that tritium releases from the plant are fairly constant over the 40-year operation of the facility.

The second graph depicts the concentration of tritium at the plant discharge (WA2), and the third graph depicts the concentration at the intake (WA1). The units for these graphs are in picocuries per Liter. A picocurie is equivalent to 0.00000000001 curies.

It can be noted that there is a change in the detection frequency of tritium at the intake starting in 1985. The 1985 Annual Radiological Effluent Operating Report states that there was a change in sampling methodology: the program shifted from monthly grab sampling to quarterly continuous composite sampling.

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).

Figure 2 compares K-40 and Ag-110m observed in oysters from Camp Conoy (IA3) with annual effluent releases of Ag-110m as reported in the Radioactive Effluent Release Report.

As seen in Figure 2, Ag-110m has not been detected in oysters for over ten years. Ag-110m is produced in the reactor through neutron activation of elemental silver that is present in some components of the reactor system. These components include control rods, in-core instrumentation, reactor vessel head o-rings, and the nuclear fuel. Through corrosion and wear, activated Ag-110m particles become suspended in the reactor coolant, and subsequently enter the facility's liquid radwaste processing system.

Over the years, CCNPP has significantly improved the chemistry control program of the reactor coolant system to reduce corrosion and wear. Additionally, CCNPP has made significant improvements to the liquid radwaste processing system. In 2005, CCNPP retired its reactor coolant waste evaporation system and installed an ultra-filtration system with additional ion-exchangers. In 2015, the ultra-filtration system was replaced by a new Advanced Liquid Processing System to capture suspended particles. These improvements have significantly reduced the amount of Ag-110m that appears in plant effluents. Ag-110m now only appears in plant effluents infrequently, and at extremely low concentrations.

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 are taken from one location during the year. This location is Shoreline at Barge Road (sample code WB1). The semiannual shoreline sediment 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

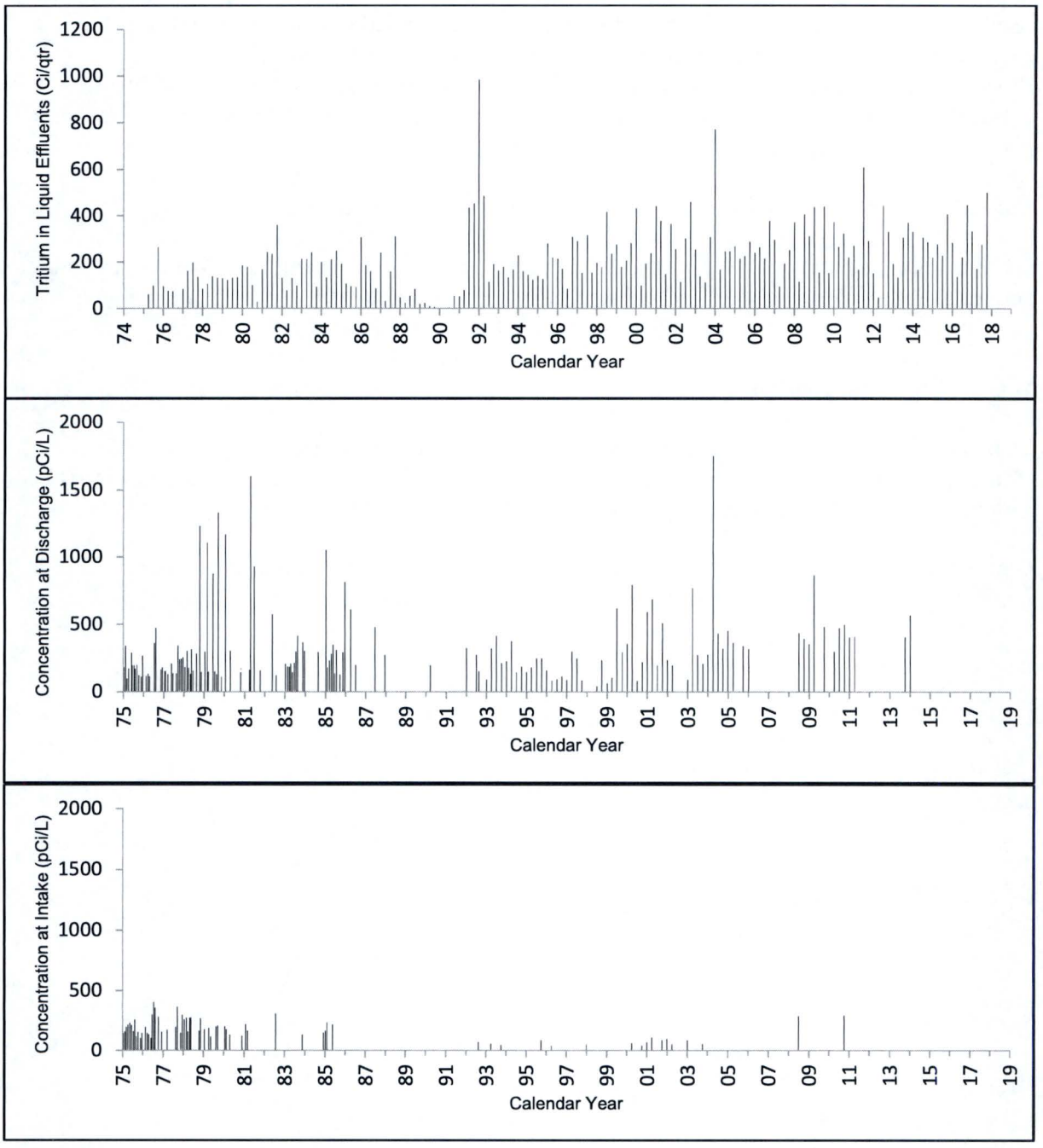
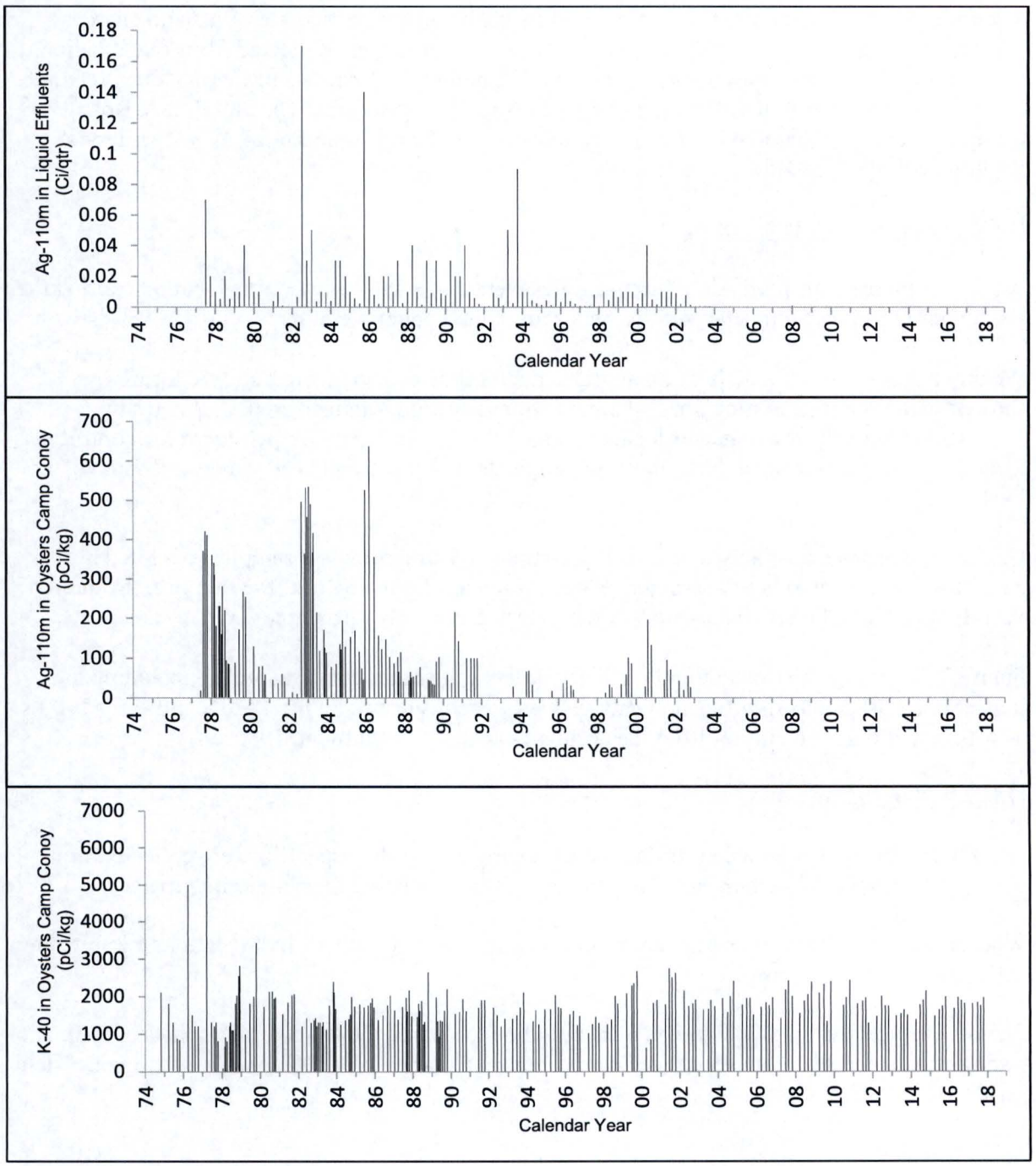


FIGURE 2
Silver-110m and Potassium-40 in Chesapeake Bay Oysters



II.C.2 Atmospheric Environment

The atmospheric environment was monitored by analyzing air particulate filters and charcoal 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 0.7×10^{-2} to 3.4×10^{-2} pCi/m^3 for the indicator locations and 0.8×10^{-2} to 3.5×10^{-2} pCi/m^3 at the control location. The location with the highest overall mean of 2.0×10^{-2} pCi/m^3 was A4, Route 765 at 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 both natural and manmade including the impact of Sr-90 due to significant events such as weapons testing in the 1970's and early 1980's as well as the fallout resulting from the accident event at Chernobyl in 1986.

II.C.2.b Air Iodine

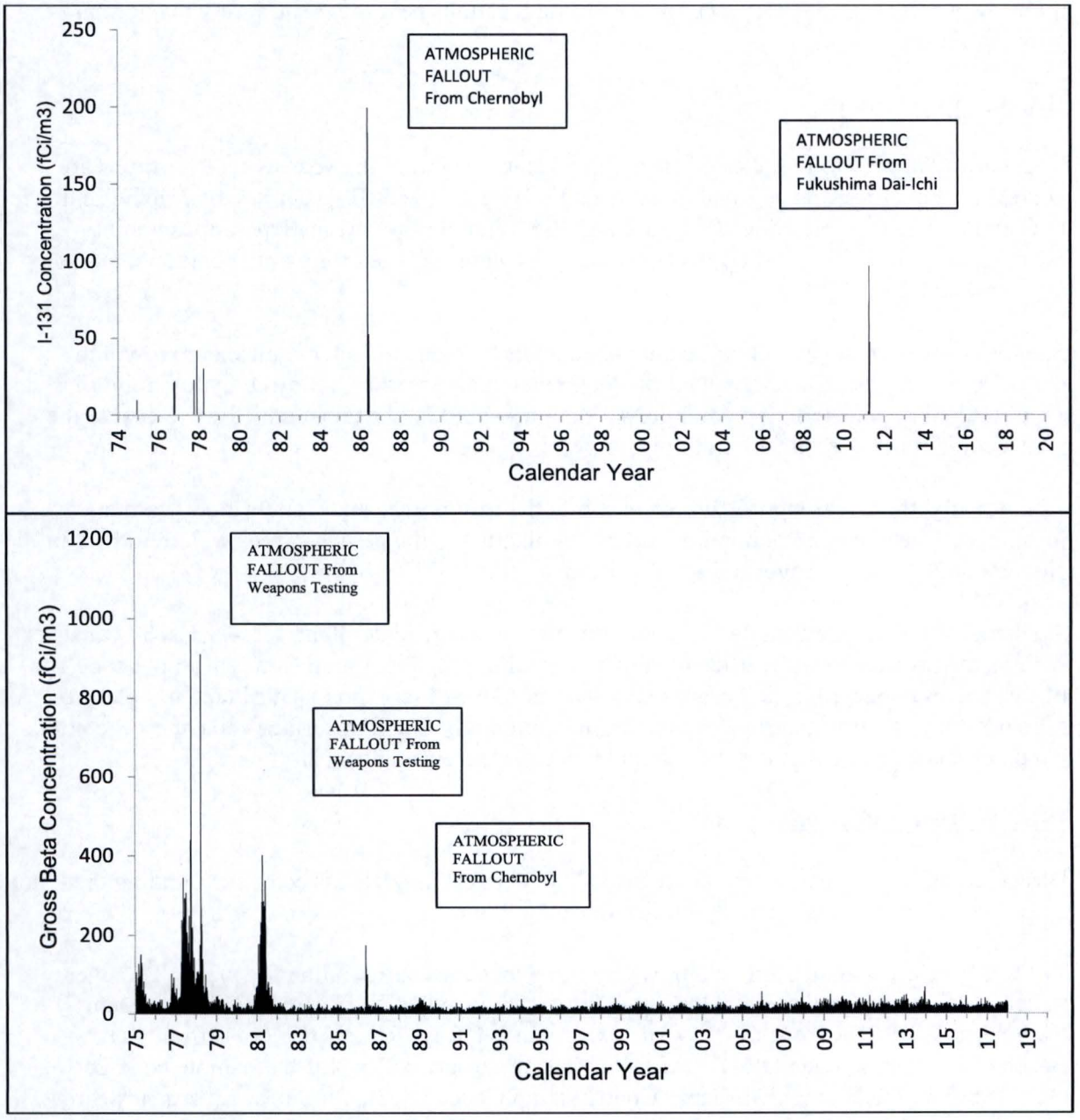
Weekly composited charcoal cartridges (for trapping radioiodine species) were collected from the five locations during the year. These samples were analyzed for radioiodine species.

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

Figure 3 depicts the historical trends of radioiodine including the short-term impacts of weapons testing events and the more recent accident events at Chernobyl in 1986 and Fukushima Dai-Ichi in 2011.

FIGURE 3
Nuclear Fallout in the Calvert Cliffs Area

SURFACE AIR VAPORS, LUSBY, MD (A4)



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.

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.

Samples of garden vegetation were not collected in June due to lack of sufficient growth to collect any samples. Untimely planting due to inclement weather, followed by low rainfall in June resulted in poor growing conditions. Samples could not be taken until July to ensure the plants could remain viable after culling.

Additionally, there was significant tree cover at the Bay Breeze and Camp Conoy garden locations. To enhance likelihood of successful planting at the gardens, trees were removed in November 2017 to improve sunlight exposure.

All samples showed detectable amounts of naturally occurring K-40 and Be-7. Cs137 consistent with historical data was identified at 80pCi/kg in one sample at Camp Conoy (sample code IB6) of tree leaves collected in lieu of a garden species. This observation is attributed to uptake of fallout from past atmospheric weapons testing commonly found in surface soils and vegetation. 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 Vera's Beach Club (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 11.35 mR and ranged from 8.98 to 14.66 mR as reported in Table 2. The control locations showed a 90 day mean of 13.02 mR with ranges from 10.76 to 16.38 mR. The location with the highest overall mean of 15.20 was Taylors Island, Anderson's Property (sample code DR23) which ranged from 13.94 to 16.38 mR. 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. The four-mile group has historically been lower than the on-site and control group; this is likely due to variability in background between the groups. 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-a
Mean TLD Gamma Dose, Calvert Cliffs Nuclear Power Plant

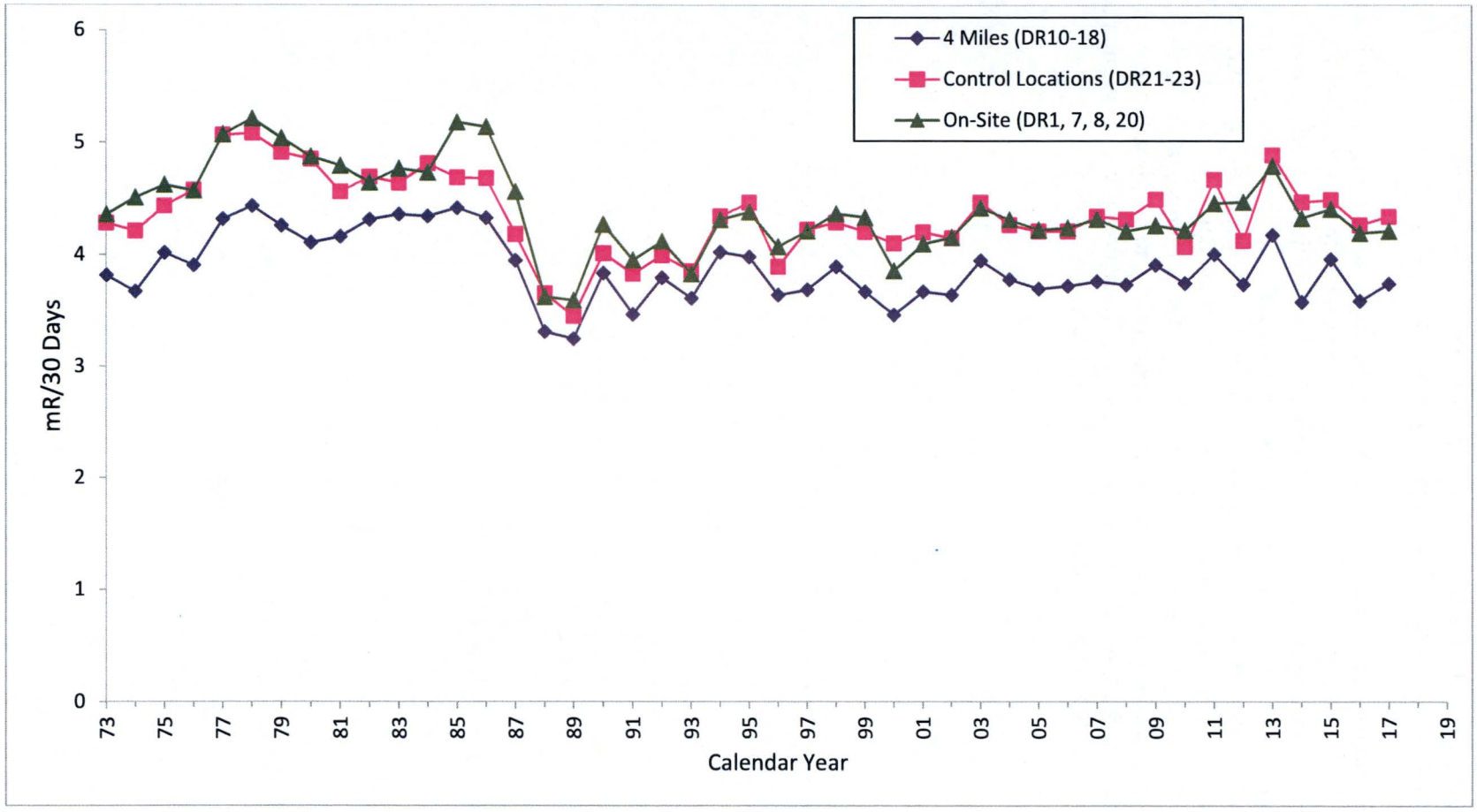
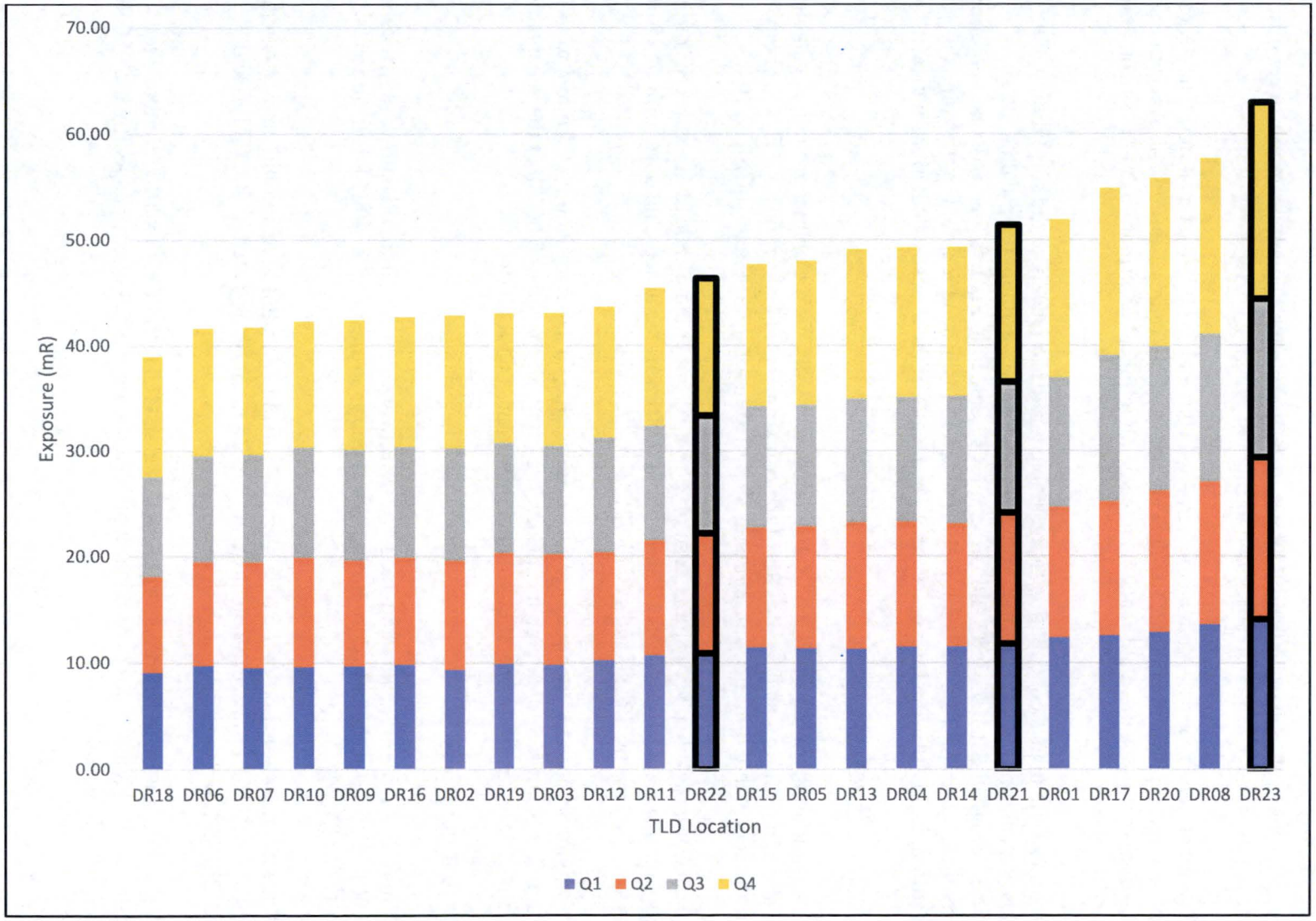


FIGURE 4-b
2017 Quarterly TLD Gamma Dose per Location, Calvert Cliffs Nuclear Power Plant



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 2017 effluent release data, on site meteorological data (see X/Q and D/Q values presented in Figures 5 and 6), and appropriate pathways. Carbon 14 dose is not included here and is instead reported in the Annual Radiological Effluents Release Report. The results of these dose calculations indicate:

Gaseous Pathways

A maximum thyroid dose of 2.58×10^{-4} mrem to a child via the plume, ground, vegetable, and inhalation pathways at 1.5 miles SE of the containments at Calvert Cliffs. This is about 0.0003% of the acceptable limit of 75 mrem/yr as specified in 40CFR190 and 10CFR72.104.

A maximum whole body gamma dose of 2.63×10^{-4} mrem to a child at 1.5 miles SE of the containments at Calvert Cliffs. This is about 0.001% of the acceptable dose limit of 25 mrem/yr as specified in 40CFR190 and 10CFR72.104.

A maximum dose to any other organ, in this case the GI Tract, of 2.60×10^{-4} mrem to a child at 1.5 miles SE of the containments at Calvert Cliffs. This is about 0.001% of the acceptable dose limit of 25 mrem/yr as specified in 40CFR190 and 10CFR72.104.

Liquid Pathways

A maximum thyroid dose of 8.67×10^{-4} mrem to an adult for all liquid pathways, which is about 0.001 % of the acceptable dose limit of 75 mrem/yr as specified in 40CFR190 and 10CFR72.104.

A maximum whole body dose of 2.14×10^{-3} mrem to an adult via all liquid pathways, which is about 0.003 % of the acceptable dose limit of 25 mrem/yr as stated in 40CFR190 and 10CFR72.104.

A maximum dose to any other organ, in this case GI Tract, of 2.70×10^{-4} mrem to a teen for all pathways, which is 0.001% of the acceptable dose limit of 25 mrem/yr specified in 40CFR190 and 10CFR72.104.

Gaseous and Liquid Pathways Combined

A maximum thyroid dose of 1.13×10^{-3} mrem via liquid and gaseous pathways, which is about 0.002% of the acceptable limit of 75 mrem/yr as specified in 40CFR190 and 10CFR72.104.

A maximum whole body dose of 2.40×10^{-3} mrem via liquid and gaseous pathways, which is about 0.010% of the acceptable limit of 25 mrem/yr as specified in 40CFR190 and 10CFR72.104.

A maximum calculated dose to all other organs via liquid and gaseous pathways is equal to 5.30×10^{-4}mrem to the GI Tract. This dose was about 0.002% of the allowable limit of 25 mrem/yr as specified in 40CFR190 and 10CFR72.104.

In all cases, the calculated doses are a small fraction of the applicable limits specified in 40CFR190 and 10CFR72.104.

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, 40CFR190, and 10CFR72.104. There was no significant buildup of plant-related radionuclides in the environment due to the operation of the CCNPP in 2017.

FIGURE 5

Atmospheric Dispersion Around CCNPP Average Relative Air Concentrations (X/Q)

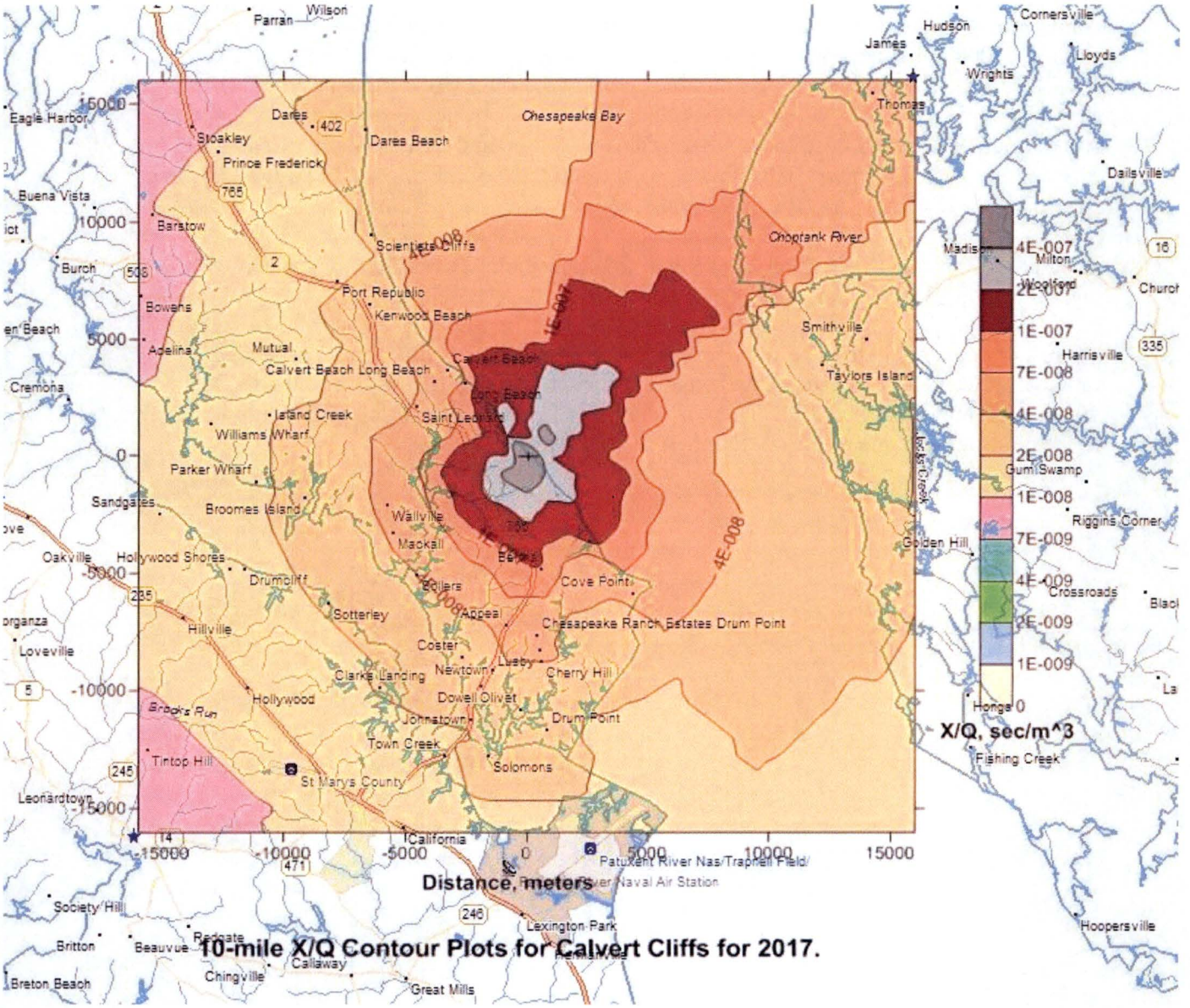


FIGURE 6

Atmospheric Dispersion Around CCNPP Average Relative Ground Deposition (D/Q)

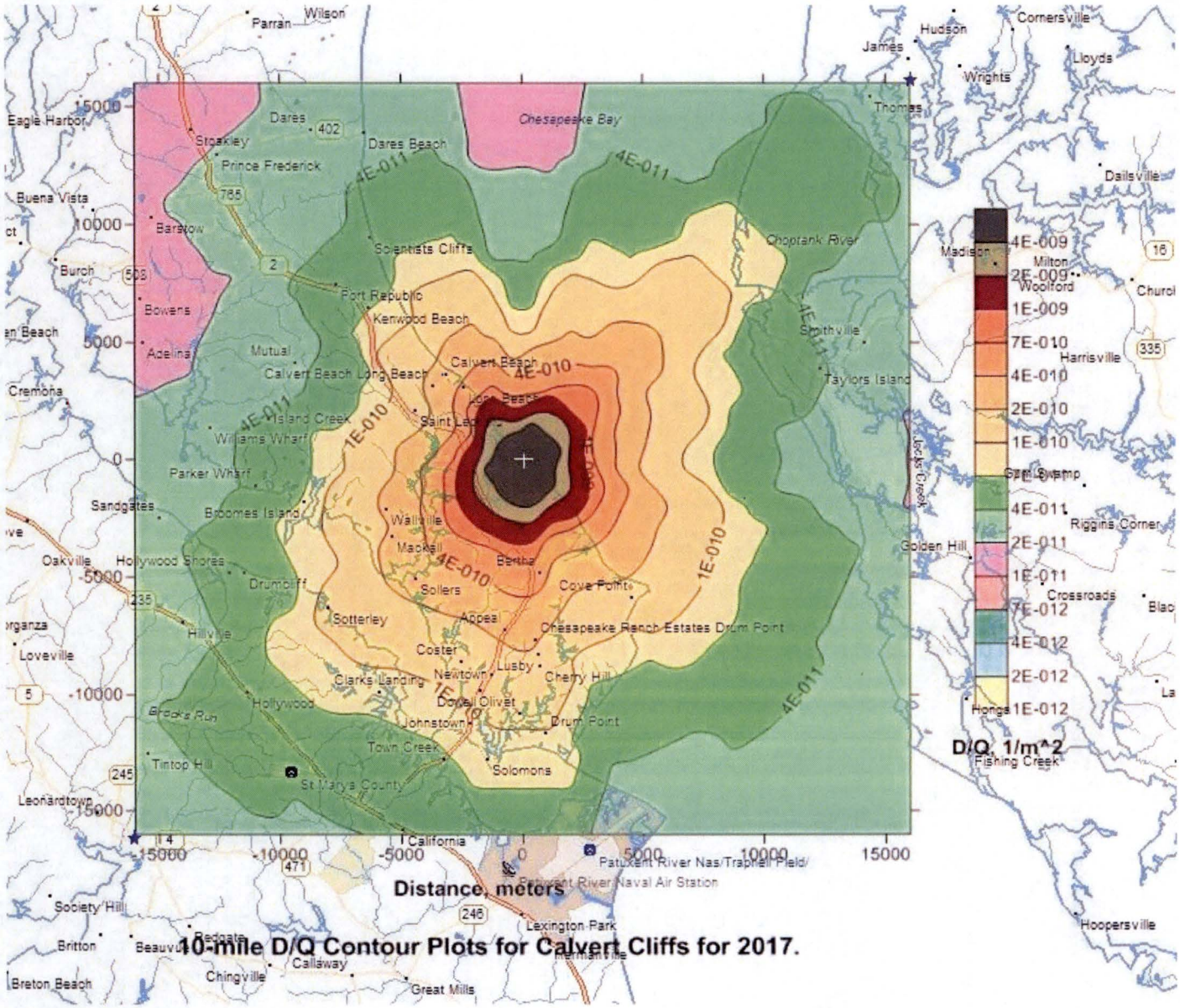


Table 1

Synopsis of 2017 Calvert Cliffs Nuclear Power Plant Radiological Environmental Monitoring Program

Sample Type	Sampling Frequency[1]	Number of Locations	Number Collected	Analysis	Analysis Frequency[1]	Number Analyzed
Aquatic Environment						
Bay Water, Surface Water, Drinking Water	MC	2	24	Gamma	MC	24
				H-3	QC	8
Fish[2]	A	4	4	Gamma	A	4
Oysters	Q	2	8	Gamma	Q	8
Shoreline Sediment	SA	1	2	Gamma	SA	2
Atmospheric Environment						
Air Iodine[3]	W	5	260	I-131	W	260
Air Particulates[4]	W	5	260	Gross Beta	W	260
				Gamma	MC	60
Direct Radiation						
Ambient Radiation	Q	23	552	TLD	Q	552
Terrestrial Environment						
Vegetation[5]	M	3	27	Gamma	M	27

[1] W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite
[2] Once in Season, July through September
[3] The collection device contains charcoal
[4] Beta counting is performed after >72 hour decay, Gamma spectroscopy performed on monthly composites of weekly samples
[5] 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[1]	Location with Highest Annual Mean Name/Distance & Direction[2]	Highest Annual Mean (F) / Range[1]	Control Locations Mean (F)/Range
Atmospheric Environment						
Air Particulates (10^{-2} pCi/m^3)	Gross Beta (260)	0.5	1.9 (208/208) (0.7-3.4)	Route 765 at Lusby A4 2.9 km SSW	2.0 (52/52) (0.8-3.3)	2.0 (52 /52) (0.8-3.5)
Direct Radiation						
Ambient Radiation (mR/90 days)	TLD (552)	--	11.35 (480/480) (8.98-14.66)	Taylors Island DR23 12.6 km ENE	15.20 (24/24) (13.94-16.38)	13.02 (72/72) (10.76-16.38)
Terrestrial Environment						
Vegetation (pCi/L)	Gamma (27) Cs-137	27	81 (1/18) (81)	Camp Conoy Entrance IB6 0.7 km S	81 (1/3) (81)	-- --

[1] Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.
[2] Distance and direction from the central point between the two containment buildings.

III. INDEPENDENT SPENT FUEL STORAGE INSTALLATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

III.A. INTRODUCTION

In August 1990 BGE initiated a program of additional radiological environmental monitoring around the site for the Independent Spent Fuel Storage 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 2017, four additional canisters of spent fuel were transferred to the ISFSI.

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.

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 results are discussed in more detail 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 40CFRPart190 and 10CFR72.104,

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, and

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, Exelon Industrial Services personnel according to Exelon Industrial Services Laboratory Procedures (Ref. 7, 8, 12).

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

A loss of sample occurred at CCNPP Visitors Center (sample code SFA2) between December 11th and December 18th due to a loss of power at the site during a construction project. This program exception has been entered into the site's Corrective Action Program to ensure it does not recur. Normal sampling operation resumed with no further loss of data in the following week when the construction at the site concluded.

III.C. RESULTS AND DISCUSSIONS

All the environmental samples collected were analyzed using Exelon Industrial Services 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 0.8×10^{-2} to 3.0×10^{-2} pCi/m^3 for the indicator locations and $0.9 \times 10^{-2}$to 2.9×10^{-2} pCi/m^3 for the control location. The location with the highest overall mean of 2.0×10^{-2} pCi/m^3 was SFA1, Meteorological 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).

Vegetation samples were analyzed for gamma emitting radionuclides. Cesium-137 was detected in one sample at an indicator location. The Cs-137 concentration was 16 ± 8 pCi/kg. While the presence of Cs 137 in this sample 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 40CFR190 and 10CFR72.104. These 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 detectable concentrations 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 five quarterly samples from indicator locations. The Cs-137 concentrations ranged from 49 ± 29 to 158 ± 40 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 40CFR190 and 10CFR72.104. These 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

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 28.61 mR and ranged from 9.41 to 62.15 mR as reported in Table 4. The control location showed a 90 day mean of 11.80 mR and ranged from 10.94 to 12.44 mR. The location with the highest overall mean of 50.29 mR with a range of 29.90 to 62.15 mR was SFDR14, SE of 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.

It can be noted there is an increasing trend in ISFSI TLD radiation exposure (Figure 7). This is expected as additional spent fuel casks are installed at the ISFSI each year. The ISFSI TLDs are located directly around the perimeter of the ISFSI. Due to the proximity of these TLDs to the spent fuel storage structures, they detect the small increase in radiation exposure each year. However, it is clear from Figure 4 that there is no observable direct radiation exposure of the public from the ISFSI, as the other REMP TLDs (on-site, 4 miles, and beyond) show no observable increase in exposure when compared to control TLDs.

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. Although much of this fallout has decayed over the years it remains a low level contributor to the background level manmade radionuclides in soil and vegetation around the world. No plant-related radionuclides were 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 represented in Figure 3.

FIGURE 7
Mean TLD Gamma Dose, ISFSI

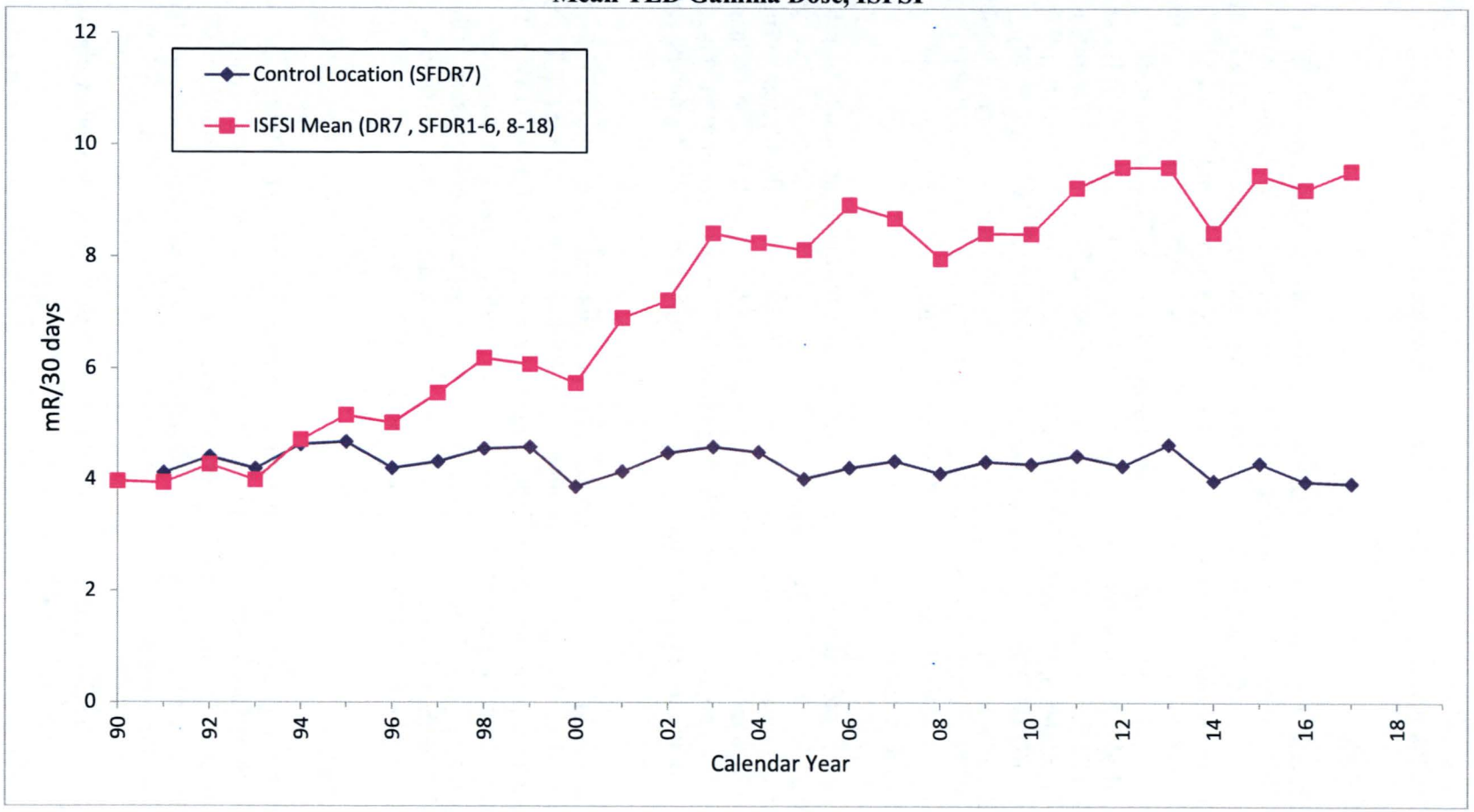


Table 3

Synopsis of 2017 Calvert Cliffs Nuclear Power Plant Independent Spent Fuel Storage Installation Radiological Environmental Monitoring Program

Sample Type	Sampling Frequency[1]	Number of Locations	Number Collected	Analysis	Analysis Frequency[1]	Number Analyzed
Atmospheric Environment						
Air Particulates[2]	W	5	259	Gross Beta	W	259
				Gamma	MC	60
Direct Radiation						
Ambient Radiation	Q	20	480	TLD	Q	480
Terrestrial Environment						
Vegetation	Q	5	20	Gamma	Q	20
Soil	Q	5	20	Gamma	Q	20

[1] W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite
[2] Beta counting is performed after >72 hour decay, Gamma spectroscopy performed on monthly composites of weekly samples

Table 4

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

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	Indicator Locations Mean (F)/Range[1]	Location with Highest Annual Mean Name/Distance & Direction[2]	Highest Annual Mean (F) / Range[1]	Control Locations Mean (F)/Range
Atmospheric Environment						
Air Particulates (10^{-2} pCi/m^3)	Gross Beta (259)	0.5	1.9 (208/208) (0.8-3.0)	MET Station SFA1 0.4 km NW	2.0 (52/51) (0.8-3.0)	1.9 (51/51) (0.9-2.9)
Direct Radiation						
Ambient Radiation (mR/90 days)	TLD (480)	--	28.61 (456/456) (9.41-62.15)	SE of ISFSI SFDR14 0.1 km SE	50.29 (24/24) (29.90-62.15)	11.80 (24/24) (10.94-12.44)
Terrestrial Environment						
Vegetation (pCi/L)	Gamma (20) Cs-137	27	16 (1/16) (16)	On Site Before Entrance to Camp Conoy SFB5 0.7 km ESE	16 (1/4) (16)	-- --
Soil (pCi/kg)	Gamma (20) Cs-137	17	107 (5/16) (49-158)	Entrance to Camp Conoy SFS5 0.7 km ESE	129 (3/4) (75-158)	-- --

[1] Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.
[2] Distance and direction from the center point of the ISFSI.

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) CY-CA-170-301 Current Revision, Offsite Dose Calculation Manual for the Calvert Cliffs Nuclear Power Plant.

(7) CP-234, Specification and Surveillance for the Radiological Environmental Monitoring Program.

(8) Exelon Industrial Services Quality Assurance Program Manual

(9) Land Use Census Around Calvert Cliffs Nuclear Power Plant, August 2017

(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) CY-AA-170-1000, Radiological Environmental Monitoring Program (REMP) and Meteorological Program Implementation.

(14) GEL 2017 Annual Quality Assurance Report for the Radiological Environmental Monitoring Program (REMP)

(15) Teledyne Browne Engineering Services, 2017 Annual Quality Assurance Report

(16) Cesium-137 in the environment: Radioecology and Approaches to Assessment and Management, NCRP Report No.154. (2007) Bethesda, MD: National Council on Radiation Protection and Measurement.

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.

TABLE OF CONTENTS - SAMPLING LOCATIONS

TABLE A-1

Locations of Environmental Sampling Stations for the Calvert Cliffs Nuclear Power Plant

Station	Description	Distance[1] (KM)	Distance[1] (Miles)	Direction[1] (Sector)
A1[2]	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 Vera's Beach Club	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[2]	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 & Parran 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	Taylors Island, Anderson's Property	12.6	7.8	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	0.0	0.0	Various
IA5	Patuxent river	0.0	0.0	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

[1] Distance and direction from the central point between the two containment buildings
[2] 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

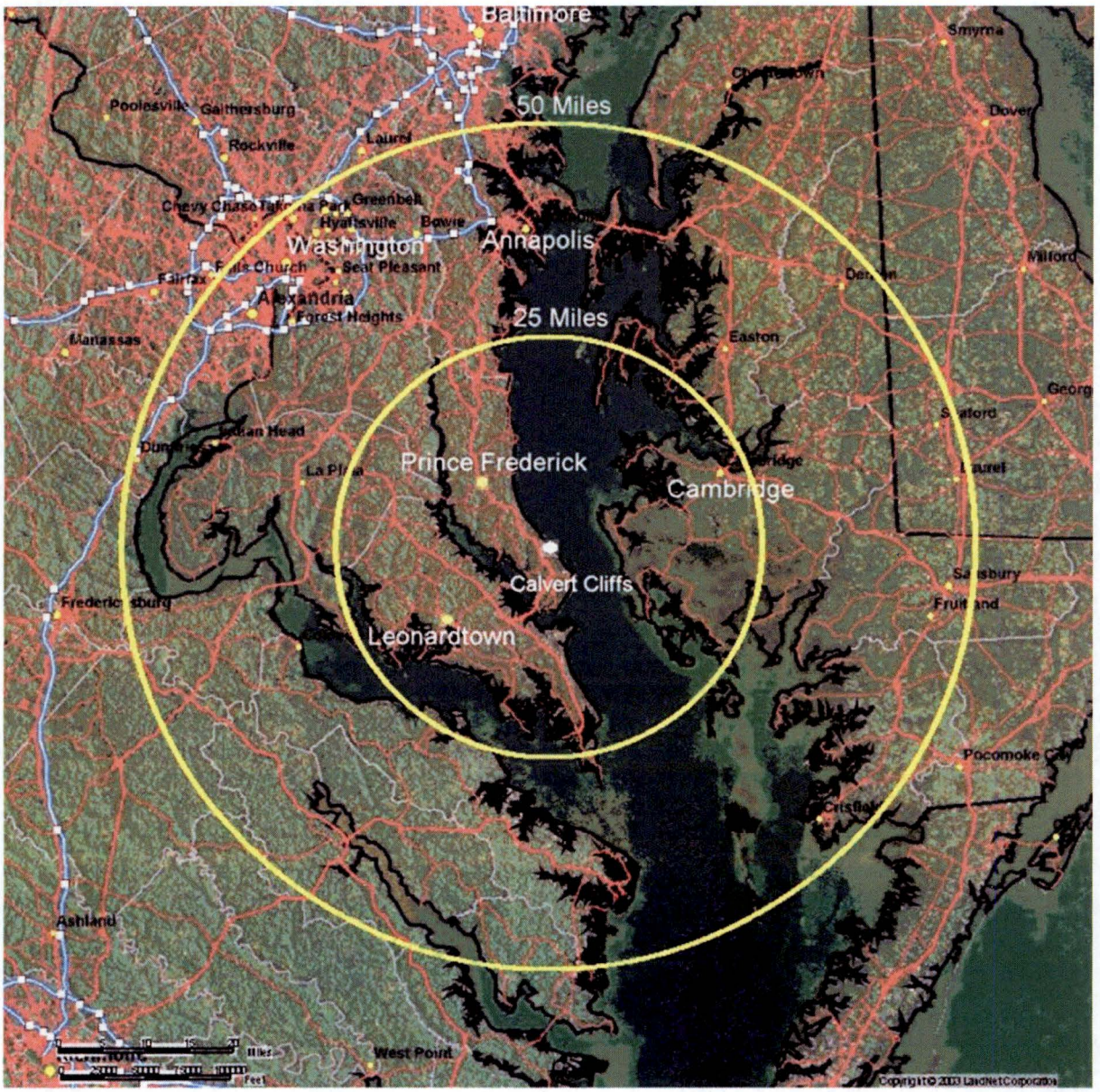


Figure A-2

Calvert Cliffs Nuclear Power Plant Sampling Locations
0-2 Miles

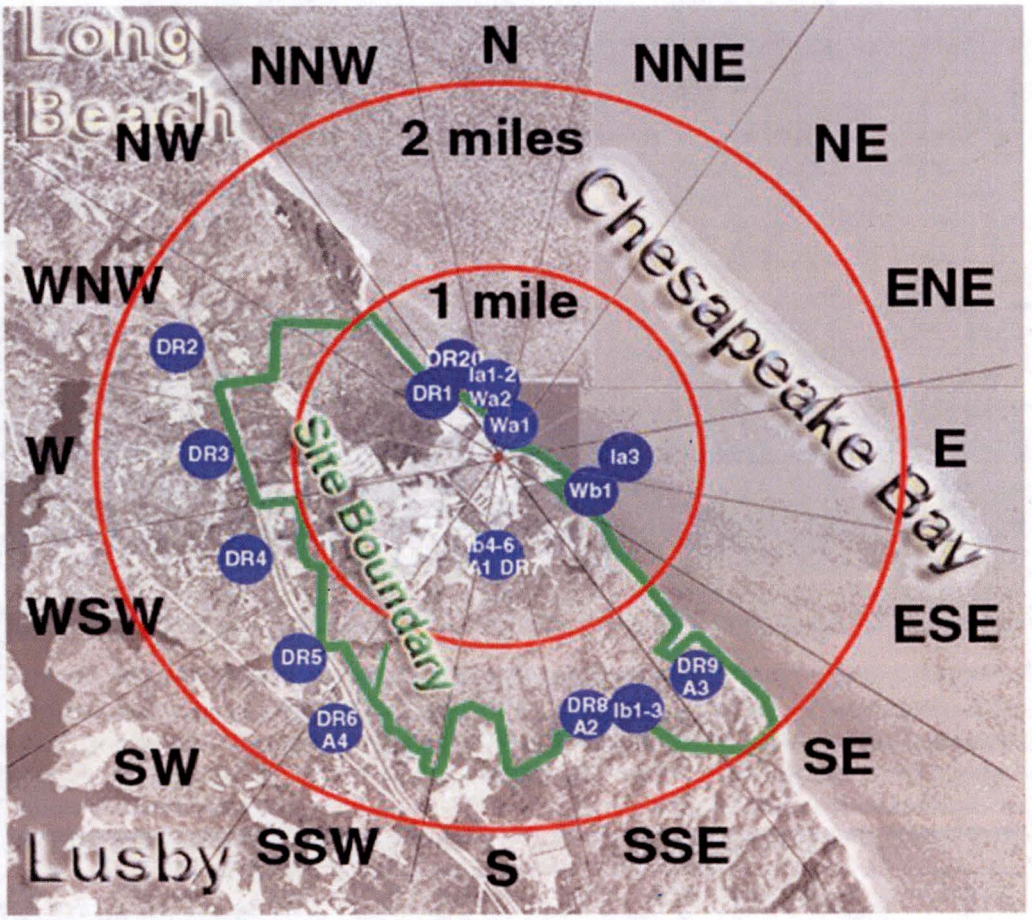


Figure A-3

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[1] (KM)	Direction[1] (Sector)
	Air Particulate		
A1[2]	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 ISFSF	0.1	SSE
	Direct Radiation		
DR07[2]	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
	Vegetation		
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
	Soil		
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

[1] Distance and direction from the central point of the ISFSI
[2] Common to both the REMP and ISFSI monitoring program

Figure A-4

Independent Spent Fuel Storage Installation Sampling Locations

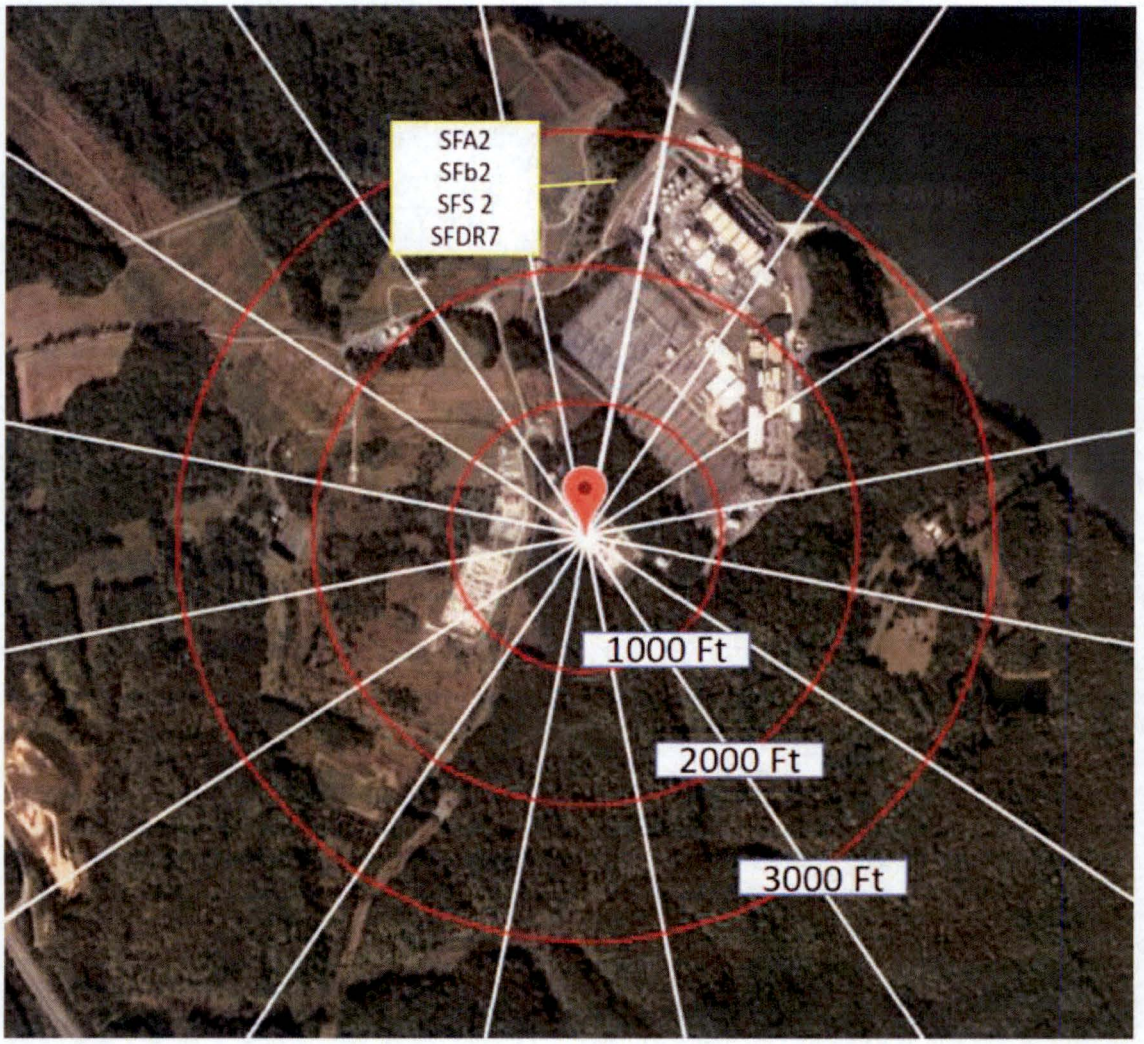
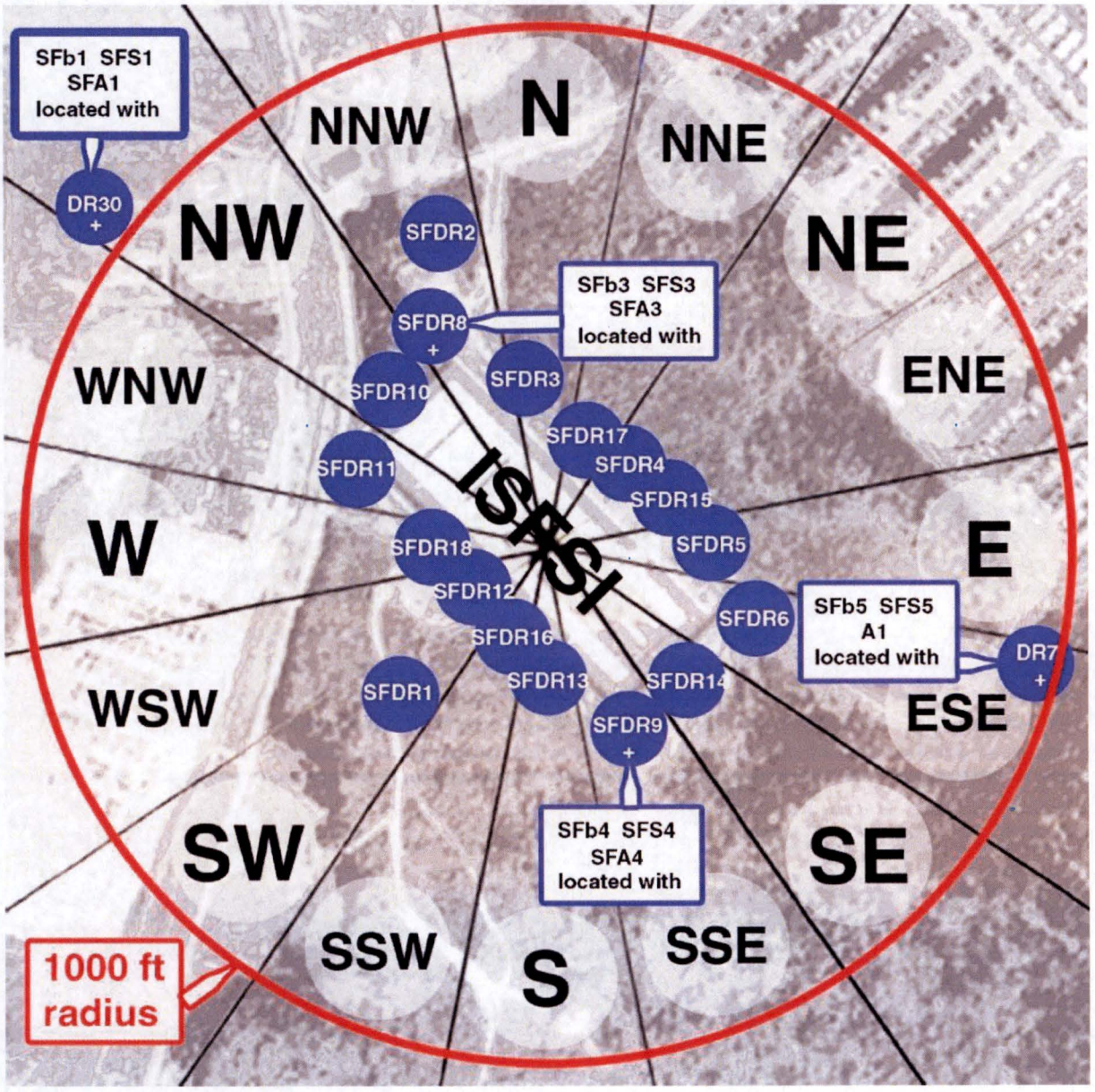


Figure A-5

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.

TABLE OF CONTENTS - ANALYTICAL RESULTS

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[1]
WA1			
Intake Vicinity	2/3/2017	*	
	3/3/2017	*	
	3/30/2017	*	<185
	5/2/2017	*	
	5/31/2017	*	
	6/30/2017	*	<184
	7/31/2017	*	
	9/1/2017	*	
	10/2/2017	*	<167
	10/31/2017	*	
	12/1/2017	*	
	12/29/2017	*	<190
WA2			
Discharge Vicinity	2/3/2017	*	
	3/3/2017	*	
	3/30/2017	*	<182
	5/2/2017	*	
	5/31/2017	*	
	6/30/2017	*	<183
	7/31/2017	*	
	9/1/2017	*	
	10/2/2017	*	<165
	10/31/2017	*	
	12/1/2017	*	
	12/29/2017	*	<191

[1] 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	8/22/2017	Striped bass	*
IA2 Discharge Area	8/22/2017	Spanish Mackeral	*
IA4[1] Patuxent River	8/22/2017	Striped bass	*
IA5[1] Patuxent River	8/22/2017	Spanish Mackeral	*

[1] 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	Gamma Emitters
IA3		
Camp Conoy	3/21/2017	*
	6/29/2017	*
	8/22/2017	*
	10/17/2017	*
IA6[1]		
Kenwood Beach	3/21/2017	*
	6/29/2017	*
	8/22/2017	*
	10/17/2017	*

[1] Control Location
* 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.	4/5/2017	*
	10/3/2017	*

* All Non-Natural Gamma Emitters <MDA

Table B-5

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

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5[1] EOF
1/2/2017	1/9/2017	*	*	*	*	*
1/9/2017	1/16/2017	*	*	*	*	*
1/16/2017	1/23/2017	*	*	*	*	*
1/23/2017	1/30/2017	*	*	*	*	*
1/30/2017	2/6/2017	*	*	*	*	*
2/6/2017	2/13/2017	*	*	*	*	*
2/13/2017	2/20/2017	*	*	*	*	*
2/20/2017	2/27/2017	*	*	*	*	*
2/27/2017	3/6/2017	*	*	*	*	*
3/6/2017	3/13/2017	*	*	*	*	*
3/13/2017	3/20/2017	*	*	*	*	*
3/20/2017	3/27/2017	*	*	*	*	*
3/27/2017	4/3/2017	*	*	*	*	*
4/3/2017	4/10/2017	*	*	*	*	*
4/10/2017	4/17/2017	*	*	*	*	*
4/17/2017	4/24/2017	*	*	*	*	*
4/24/2017	5/1/2017	*	*	*	*	*
5/1/2017	5/8/2017	*	*	*	*	*
5/8/2017	5/15/2017	*	*	*	*	*
5/15/2017	5/22/2017	*	*	*	*	*
5/22/2017	5/29/2017	*	*	*	*	*
5/29/2017	6/5/2017	*	*	*	*	*
6/5/2017	6/12/2017	*	*	*	*	*
6/12/2017	6/19/2017	*	*	*	*	*
6/19/2017	6/26/2017	*	*	*	*	*
6/26/2017	7/3/2017	*	*	*	*	*
7/3/2017	7/10/2017	*	*	*	*	*
7/10/2017	7/17/2017	*	*	*	*	*
7/17/2017	7/24/2017	*	*	*	*	*
7/24/2017	7/31/2017	*	*	*	*	*
7/31/2017	8/7/2017	*	*	*	*	*
8/7/2017	8/14/2017	*	*	*	*	*
8/14/2017	8/21/2017	*	*	*	*	*
8/21/2017	8/28/2017	*	*	*	*	*
8/28/2017	9/4/2017	*	*	*	*	*
9/4/2017	9/11/2017	*	*	*	*	*
9/11/2017	9/18/2017	*	*	*	*	*
9/18/2017	9/25/2017	*	*	*	*	*
9/25/2017	10/2/2017	*	*	*	*	*

Table B-5

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

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5[1] EOF
10/2/2017	10/9/2017	*	*	*	*	*
10/9/2017	10/16/2017	*	*	*	*	*
10/16/2017	10/23/2017	*	*	*	*	*
10/23/2017	10/30/2017	*	*	*	*	*
10/30/2017	11/6/2017	*	*	*	*	*
11/6/2017	11/13/2017	*	*	*	*	*
11/13/2017	11/20/2017	*	*	*	*	*
11/20/2017	11/27/2017	*	*	*	*	*
11/27/2017	12/4/2017	*	*	*	*	*
12/4/2017	12/11/2017	*	*	*	*	*
12/11/2017	12/18/2017	*	*	*	*	*
12/18/2017	12/25/2017	*	*	*	*	*
12/25/2017	1/1/2018	*	*	*	*	*

[1] Control Location
* All Non-Natural Gamma Emitters <MDA

Table B-6

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

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5[1] EOF
1/2/2017	1/9/2017	1.8 +/- 0.2	1.8 +/- 0.2	1.8 +/- 0.2	2.0 +/- 0.2	1.9 +/- 0.2
1/9/2017	1/16/2017	2.0 +/- 0.1	2.0 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1	1.8 +/- 0.1
1/16/2017	1/23/2017	1.2 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1
1/23/2017	1/30/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.4 +/- 0.1	1.5 +/- 0.1
1/30/2017	2/6/2017	2.3 +/- 0.2	2.3 +/- 0.2	2.3 +/- 0.2	2.5 +/- 0.2	2.6 +/- 0.2
2/6/2017	2/13/2017	2.6 +/- 0.1	2.4 +/- 0.1	2.3 +/- 0.1	2.7 +/- 0.1	2.3 +/- 0.1
2/13/2017	2/20/2017	2.0 +/- 0.1	2.1 +/- 0.1	1.8 +/- 0.1	2.2 +/- 0.1	2.0 +/- 0.1
2/20/2017	2/27/2017	1.5 +/- 0.1	1.4 +/- 0.1	1.4 +/- 0.1	1.5 +/- 0.1	1.2 +/- 0.1
2/27/2017	3/6/2017	1.7 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1
3/6/2017	3/13/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.4 +/- 0.1
3/13/2017	3/20/2017	1.5 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1
3/20/2017	3/27/2017	1.9 +/- 0.1	1.9 +/- 0.1	2.1 +/- 0.1	2.1 +/- 0.1	2.0 +/- 0.1
3/27/2017	4/3/2017	1.0 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.1	1.0 +/- 0.1
4/3/2017	4/10/2017	1.4 +/- 0.1	1.5 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1	1.3 +/- 0.1
4/10/2017	4/17/2017	1.7 +/- 0.1	1.6 +/- 0.1	1.5 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1
4/17/2017	4/24/2017	0.9 +/- 0.1	1.0 +/- 0.1	0.9 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.1
4/24/2017	5/1/2017	1.3 +/- 0.1	1.4 +/- 0.1	1.3 +/- 0.1	1.5 +/- 0.1	1.3 +/- 0.1
5/1/2017	5/8/2017	0.8 +/- 0.1	0.9 +/- 0.1	0.7 +/- 0.1	1.0 +/- 0.1	0.8 +/- 0.1
5/8/2017	5/15/2017	1.0 +/- 0.1	1.1 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1	1.2 +/- 0.1
5/15/2017	5/22/2017	1.9 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1	2.0 +/- 0.1	2.0 +/- 0.1
5/22/2017	5/29/2017	0.8 +/- 0.1	1.0 +/- 0.1	0.9 +/- 0.1	0.8 +/- 0.1	1.0 +/- 0.1
5/29/2017	6/5/2017	1.7 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1	2.0 +/- 0.1	1.8 +/- 0.1
6/5/2017	6/12/2017	2.2 +/- 0.1	2.2 +/- 0.1	2.1 +/- 0.1	2.4 +/- 0.1	2.2 +/- 0.1
6/12/2017	6/19/2017	1.5 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1	1.5 +/- 0.1	1.7 +/- 0.1
6/19/2017	6/26/2017	2.1 +/- 0.1	2.0 +/- 0.1	1.9 +/- 0.1	2.3 +/- 0.1	2.2 +/- 0.1
6/26/2017	7/3/2017	1.8 +/- 0.1	2.0 +/- 0.1	2.2 +/- 0.2	2.2 +/- 0.2	2.1 +/- 0.1
7/3/2017	7/10/2017	2.5 +/- 0.1	2.5 +/- 0.1	2.3 +/- 0.1	2.6 +/- 0.1	2.6 +/- 0.1
7/10/2017	7/17/2017	2.2 +/- 0.1	2.5 +/- 0.1	2.4 +/- 0.1	2.6 +/- 0.1	2.5 +/- 0.1
7/17/2017	7/24/2017	2.5 +/- 0.1	2.7 +/- 0.1	2.5 +/- 0.1	2.8 +/- 0.2	2.8 +/- 0.1
7/24/2017	7/31/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1
7/31/2017	8/7/2017	1.7 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1	2.0 +/- 0.1	2.0 +/- 0.1
8/7/2017	8/14/2017	1.8 +/- 0.1	1.9 +/- 0.2	2.0 +/- 0.1	2.1 +/- 0.1	2.2 +/- 0.1
8/14/2017	8/21/2017	2.5 +/- 0.2	2.6 +/- 0.2	2.4 +/- 0.2	2.7 +/- 0.2	2.7 +/- 0.2
8/21/2017	8/28/2017	1.9 +/- 0.1	2.0 +/- 0.1	1.8 +/- 0.1	2.1 +/- 0.1	2.1 +/- 0.1
8/28/2017	9/4/2017	1.7 +/- 0.1	1.8 +/- 0.1	1.7 +/- 0.1	2.0 +/- 0.1	2.0 +/- 0.1
9/4/2017	9/11/2017	1.7 +/- 0.1	1.8 +/- 0.1	1.7 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1
9/11/2017	9/18/2017	1.8 +/- 0.1	2.0 +/- 0.1	2.1 +/- 0.1	2.2 +/- 0.1	2.3 +/- 0.1
9/18/2017	9/25/2017	2.4 +/- 0.1	2.6 +/- 0.1	2.4 +/- 0.1	2.9 +/- 0.2	2.8 +/- 0.1
9/25/2017	10/2/2017	1.4 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1

Table B-6

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

Start Date	Stop Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5[1] EOF
10/2/2017	10/9/2017	1.7 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.1	1.9 +/- 0.1
10/9/2017	10/16/2017	1.2 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1
10/16/2017	10/23/2017	2.6 +/- 0.1	2.6 +/- 0.2	2.5 +/- 0.1	2.7 +/- 0.1	2.9 +/- 0.2
10/23/2017	10/30/2017	1.8 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1
10/30/2017	11/6/2017	2.4 +/- 0.1	2.7 +/- 0.2	2.8 +/- 0.2	2.6 +/- 0.1	2.6 +/- 0.1
11/6/2017	11/13/2017	1.7 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1	2.0 +/- 0.1	2.1 +/- 0.1
11/13/2017	11/20/2017	2.7 +/- 0.2	2.7 +/- 0.2	2.6 +/- 0.2	2.8 +/- 0.2	2.7 +/- 0.2
11/20/2017	11/27/2017	2.7 +/- 0.1	2.5 +/- 0.1	2.5 +/- 0.1	2.7 +/- 0.1	2.8 +/- 0.1
11/27/2017	12/4/2017	3.0 +/- 0.2	3.3 +/- 0.2	3.4 +/- 0.2	3.3 +/- 0.2	3.5 +/- 0.2
12/4/2017	12/11/2017	2.8 +/- 0.2	2.8 +/- 0.2	2.9 +/- 0.2	2.7 +/- 0.2	2.9 +/- 0.2
12/11/2017	12/18/2017	2.9 +/- 0.1	2.9 +/- 0.2	2.9 +/- 0.1	3.1 +/- 0.1	3.0 +/- 0.1
12/18/2017	12/25/2017	2.9 +/- 0.1	2.9 +/- 0.2	2.9 +/- 0.1	2.9 +/- 0.1	3.0 +/- 0.1
12/25/2017	1/1/2018	2.7 +/- 0.2	2.8 +/- 0.2	2.3 +/- 0.2	2.5 +/- 0.2	3.0 +/- 0.2

[1] Control Location

Table B-6 - Continued

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

Start Date	Stop Date	SFA1 MET Station	SFA2[1] Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
1/2/2017	1/9/2017	1.9 +/- 0.1	1.9 +/- 0.2	1.8 +/- 0.2	1.8 +/- 0.2
1/9/2017	1/16/2017	2.2 +/- 0.1	2.0 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1
1/16/2017	1/23/2017	1.2 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.1	1.3 +/- 0.1
1/23/2017	1/30/2017	1.6 +/- 0.1	1.5 +/- 0.1	1.4 +/- 0.1	1.5 +/- 0.1
1/30/2017	2/6/2017	2.4 +/- 0.2	2.4 +/- 0.2	2.3 +/- 0.2	2.5 +/- 0.2
2/6/2017	2/13/2017	2.6 +/- 0.1	2.6 +/- 0.1	2.4 +/- 0.1	2.6 +/- 0.1
2/13/2017	2/20/2017	2.1 +/- 0.1	2.1 +/- 0.1	2.0 +/- 0.1	2.1 +/- 0.1
2/20/2017	2/27/2017	1.4 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1	1.5 +/- 0.1
2/27/2017	3/6/2017	1.9 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.1
3/6/2017	3/13/2017	1.4 +/- 0.1	1.5 +/- 0.1	1.4 +/- 0.1	1.5 +/- 0.1
3/13/2017	3/20/2017	1.7 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1
3/20/2017	3/27/2017	2.1 +/- 0.1	1.8 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.1
3/27/2017	4/3/2017	1.2 +/- 0.1	1.1 +/- 0.1	1.0 +/- 0.1	1.1 +/- 0.1
4/3/2017	4/10/2017	1.2 +/- 0.1	1.4 +/- 0.1	1.4 +/- 0.1	1.2 +/- 0.1
4/10/2017	4/17/2017	1.8 +/- 0.1	1.8 +/- 0.1	1.5 +/- 0.1	1.6 +/- 0.1
4/17/2017	4/24/2017	1.0 +/- 0.1	0.9 +/- 0.1	1.0 +/- 0.1	1.0 +/- 0.1
4/24/2017	5/1/2017	1.4 +/- 0.1	1.4 +/- 0.1	1.4 +/- 0.1	1.3 +/- 0.1
5/1/2017	5/8/2017	0.8 +/- 0.1	0.9 +/- 0.1	0.9 +/- 0.1	1.0 +/- 0.1
5/8/2017	5/15/2017	1.1 +/- 0.1	1.0 +/- 0.1	1.0 +/- 0.1	1.0 +/- 0.1
5/15/2017	5/22/2017	2.0 +/- 0.1	2.1 +/- 0.2	2.0 +/- 0.1	1.8 +/- 0.1
5/22/2017	5/29/2017	1.0 +/- 0.1	0.9 +/- 0.1	0.8 +/- 0.1	0.9 +/- 0.1
5/29/2017	6/5/2017	1.8 +/- 0.1	1.5 +/- 0.1	1.8 +/- 0.1	1.6 +/- 0.1
6/5/2017	6/12/2017	2.2 +/- 0.1	2.4 +/- 0.1	2.1 +/- 0.1	2.1 +/- 0.1
6/12/2017	6/19/2017	1.6 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1	1.4 +/- 0.1
6/19/2017	6/26/2017	2.2 +/- 0.1	2.0 +/- 0.1	2.1 +/- 0.1	1.9 +/- 0.1
6/26/2017	7/3/2017	2.0 +/- 0.1	1.9 +/- 0.1	2.0 +/- 0.1	1.9 +/- 0.1
7/3/2017	7/10/2017	2.5 +/- 0.1	2.2 +/- 0.1	2.3 +/- 0.1	2.3 +/- 0.1
7/10/2017	7/17/2017	2.4 +/- 0.1	2.4 +/- 0.1	2.4 +/- 0.1	2.2 +/- 0.1
7/17/2017	7/24/2017	2.8 +/- 0.1	2.6 +/- 0.1	2.6 +/- 0.1	2.5 +/- 0.1
7/24/2017	7/31/2017	1.6 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1
7/31/2017	8/7/2017	1.7 +/- 0.1	2.0 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1
8/7/2017	8/14/2017	2.1 +/- 0.1	2.1 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1
8/14/2017	8/21/2017	2.8 +/- 0.2	2.4 +/- 0.2	2.7 +/- 0.2	2.4 +/- 0.2
8/21/2017	8/28/2017	1.9 +/- 0.1	1.8 +/- 0.1	1.9 +/- 0.1	1.8 +/- 0.1
8/28/2017	9/4/2017	2.0 +/- 0.1	1.7 +/- 0.1	1.9 +/- 0.1	1.7 +/- 0.1
9/4/2017	9/11/2017	1.7 +/- 0.1	1.5 +/- 0.1	1.8 +/- 0.1	1.6 +/- 0.1
9/11/2017	9/18/2017	2.0 +/- 0.1	2.0 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1
9/18/2017	9/25/2017	2.7 +/- 0.1	2.5 +/- 0.1	2.7 +/- 0.1	2.5 +/- 0.1
9/25/2017	10/2/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1

Table B-6 - Continued

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

Start Date	Stop Date	SFA1 MET Station	SFA2[1] Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
10/2/2017	10/9/2017	1.8 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1
10/9/2017	10/16/2017	1.2 +/- 0.1	1.2 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.1
10/16/2017	10/23/2017	2.8 +/- 0.2	2.4 +/- 0.1	2.6 +/- 0.1	2.5 +/- 0.1
10/23/2017	10/30/2017	1.8 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1
10/30/2017	11/6/2017	2.6 +/- 0.2	2.4 +/- 0.1	2.4 +/- 0.1	2.5 +/- 0.1
11/6/2017	11/13/2017	1.8 +/- 0.1	1.8 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1
11/13/2017	11/20/2017	2.6 +/- 0.2	2.9 +/- 0.4	2.6 +/- 0.2	2.6 +/- 0.2
11/20/2017	11/27/2017	2.7 +/- 0.1	2.6 +/- 0.1	2.6 +/- 0.1	2.5 +/- 0.1
11/27/2017	12/4/2017	2.9 +/- 0.2	2.8 +/- 0.1	2.8 +/- 0.1	2.9 +/- 0.2
12/4/2017	12/11/2017	2.7 +/- 0.2	2.5 +/- 0.1	2.7 +/- 0.2	2.6 +/- 0.2
12/11/2017	12/18/2017	3.0 +/- 0.1	[2]	2.9 +/- 0.1	2.8 +/- 0.1
12/18/2017	12/25/2017	2.9 +/- 0.2	2.7 +/- 0.1	2.8 +/- 0.1	2.7 +/- 0.1
12/25/2017	1/1/2018	2.6 +/- 0.2	2.7 +/- 0.2	2.8 +/- 0.2	2.7 +/- 0.2

[1] Control Location
[2] Power Outage

Table B-7

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

Sample Date	A1 Entrance to Camp Conoy	A2 Camp Conoy Siren	A3 Bay Breeze Rd	A4 Route 765 at Lusby	A5[1] EOF
1/30/2017	*	*	*	*	*
2/27/2017	*	*	*	*	*
4/3/2017	*	*	*	*	*
5/1/2017	*	*	*	*	*
5/29/2017	*	*	*	*	*
7/3/2017	*	*	*	*	*
7/31/2017	*	*	*	*	*
8/29/2017	*	*	*	*	*
10/2/2017	*	*	*	*	*
10/30/2017	*	*	*	*	*
11/28/2017	*	*	*	*	*
1/2/2018	*	*	*	*	*

Sample Date	SFA1 MET Station	SFA2[1] Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI
1/30/2017	*	*	*	*
2/27/2017	*	*	*	*
4/3/2017	*	*	*	*
5/1/2017	*	*	*	*
5/29/2017	*	*	*	*
7/3/2017	*	*	*	*
7/31/2017	*	*	*	*
8/29/2017	*	*	*	*
10/2/2017	*	*	*	*
10/30/2017	*	*	*	*
11/28/2017	*	*	*	*
1/2/2018	*	*	*	*

[1] 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	Cs-137	Gamma Emitters
IB1				
Bay Breeze Rd	7/31/2017	Tree Leaves	2	*
	8/21/2017	Collards	2	*
	9/20/2017	Eggplant Leaves	2	*
IB2				
Bay Breeze Rd	7/31/2017	Tree Leaves	2	*
	8/21/2017	Tree Leaves	2	*
	9/20/2017	Leafy portion of Peppers	2	*
IB3				
Bay Breeze Rd	7/31/2017	Tree Leaves	2	*
	8/21/2017	Tree Leaves	2	*
	9/20/2017	Tree Leaves	2	*
IB4				
Camp Conoy				
Entrance	7/31/2017	Tree Leaves	2	*
	8/21/2017	Tree Leaves	2	*
	9/20/2017	Eggplant Leaves	2	*
IB5				
Camp Conoy				
Entrance	7/31/2017	Tree Leaves	2	*
	8/21/2017	Collards	2	*
	9/20/2017	Tree Leaves	2	*
IB6				
Camp Conoy				
Entrance	7/31/2017	Tree Leaves	81 +/- 20	*
	8/21/2017	Kale	*	*
	9/20/2017	Leafy portion of Peppers	*	*
IB7[1]				
EOF	7/25/2017	Cabbage	2	*
	8/21/2017	Cabbage	2	*
	9/20/2017	Leafy portion of Peppers	2	*
IB8[1]				
EOF	7/25/2017	Kale	2	*
	8/21/2017	Eggplant Leaves	2	*
	9/20/2017	Eggplant Leaves	2	*
IB9[1]				
EOF	7/25/2017	Collards	2	*
	8/21/2017	Leafy portion of Peppers	2	*
	9/20/2017	Tree Leaves	2	*

[1] Control Location
[2] This Isotope <MDA
* 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	3/20/2017	[2]	*
	5/22/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFB2[1]			
Visitor's Center	3/20/2017	[2]	*
	5/22/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFB3			
NNW of ISFSI	3/20/2017	[2]	*
	5/22/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFB4			
SSE of ISFSI	3/20/2017	[2]	*
	5/22/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFB5			
On Site Before Entrance to Camp			
Conoy	3/20/2017	16 +/- 8	*
	5/22/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*

[1] Control Location
[2] 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	3/20/2017	[2]	*
	6/14/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFS2[1]			
Visitors Center	3/20/2017	[2]	*
	6/14/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFS3			
NNW of ISFSI	3/20/2017	101 +/- 38	*
	6/14/2017	[2]	*
	9/11/2017	49 +/- 29	*
	10/31/2017	[2]	*
SFS4			
SSE of ISFSI	3/20/2017	[2]	*
	6/14/2017	[2]	*
	9/11/2017	[2]	*
	10/31/2017	[2]	*
SFS5			
Entrance to Camp			
Conoy	3/20/2017	158 +/- 40	*
	6/14/2017	152 +/- 31	*
	9/11/2017	[2]	*
	10/31/2017	75 +/- 30	*

[1] Control Location
[2] This Isotope <MDA
* All Non-Natural Gamma Emitters <MDA

Table B-10

Typical MDA Ranges for Gamma Spectrometry

Selected Nuclides	Air Particulates (10^{-2} pCi/m^3)	Bay Water, Surface Water, Drinking Water (pCi/L)	Fish (pCi/kg) Wet	Groundwater (pCi/L)	Milk (pCi/L)	Oysters (pCi/kg)Wet	Shoreline Sediment (pCi/kg)Dry	Soil (pCi/kg)Dry	Vegetation (pCi/Kg)Wet
Na-22	0.04 - 0.3	3.1 - 5.1	6.4 - 50.5	3.5 - 5.6	5.2 - 7.8	14.6 - 22.5	43.6 - 68.2	45.9 - 89.8	13.9 - 36.1
K-40	0.2 – 5.0	33.4 - 58.8	54.3 - 338	38.6 - 63.4	42 - 58.9	127 - 180	300 - 597	333 - 786	109 - 284
Cr-51	1.0 – 15.3	26.1 - 41	67.2 - 886	28 - 38.4	36.5 – 49.0	110 - 222	669 - 2723	522 - 2374	86.8 - 246
Mn-54	0.04 – 0.3	2.8 - 4.5	2.7 - 42.2	3.3 - 4.9	3.9 - 5.7	12.0 - 18.8	40.7 - 63.2	44.6 - 90.5	11.3 - 28.9
Co-58	0.07 – 0.6	2.9 - 4.8	6.2 - 56.5	3.4 - 4.9	4.2 - 5.9	12.7 - 22.6	54.3 - 120	56.5 - 128	11.4 - 29.9
Fe-59	0.26 – 2.1	6.8 - 10.7	21.7 - 192	7.6 - 10.7	11 - 14.7	33.7 - 61.6	137 - 437	136 - 400	30.2 - 71
Co-60	0.03 – 0.3	2.9 - 4.8	4.1 - 45.7	3.5 - 5.3	4.7 - 6.9	14.0 - 21.1	38.1 - 66.6	42.8 - 85.7	13.2 - 32.7
Zn-65	0.09 – 0.8	6.3 - 10	3.0 - 124	6.7 - 11.4	10.3 - 16.1	29.9 - 46.8	121 - 187	117 - 251	29.3 - 70.3
Nb-95	0.1 – 1.4	3.4 - 5.3	6.5 - 105	3.8 - 5.6	4.6 - 6.5	14.9 - 29.8	91.8 - 291	81.3 - 282	13.0 - 33.7
Zr-95	0.1 – 1.1	5.2 - 8	5.7 - 111	5.9 - 8.4	7.3 - 9.9	21.6 - 37.8	102 - 216	91.8 - 244	20.4 - 52.8
Ru-106	0.3 – 2.3	24.9 - 38.9	20.9 - 355	29.1 - 41.4	35.4 - 46.5	105 - 156	346 - 498	345 - 719	98.5 - 242
Ag-110m	0.03 – 0.3	2.7 - 4.3	3.8 - 39.1	3.1 - 4.3	3.9 - 5.1	11.6 - 16.5	39 - 59.7	45.6 - 92.8	10.9 - 26.9
I-131[1]	0.3 – 6.1	1.5 - 11.6	22 - 21660	5.2 - 9.8	.3 - 9.5	33.6 - 178	2180 - 79943	180 - 39606	7.3 - 89.6
Cs-134	0.03 – 0.2	2.7 - 4.2	2.9 - 35.2	3 - 4.5	3.7 - 5.1	11.3 - 16.4	40.7 - 52.3	40.3 - 80.2	10.7 - 26.8
Cs-137	0.03 – 0.2	3 - 4.7	7.9 - 44.8	3.4 - 4.9	4.1 - 5.7	12.1 - 17.1	36.3 - 56.7	39.7 - 87.8	11.4 - 30.2
Ba-140	0.4 - 196	6.5 - 11.6	25.2 - 1718	6.6 - 10.6	6.9 - 10.9	27.6 - 98.8	696 - 7088	151 - 4732	16.7 - 70.1
La-140	0.4 - 196	6.5 - 11.6	25.2 - 1718	6.6 - 10.6	6.9 - 10.9	27.6 - 98.8	696 - 7088	151 - 4732	16.7 - 70.1
Ce-144	0.1 – 1.1	14.2 - 23.3	6.1 - 159	16.4 - 23.4	20.3 - 28.3	45.4 - 73.2	168 - 231	145 - 360	40.8 - 102

[1] This MDA range for I-131 on a charcoal cartridge is typically 3.94 x 10^{-3} to 6.10 x 10^{-2} pCi/m^3

Table B-11

Typical LLDs for Gamma Spectrometry

Selected Nuclides	Air Particulates 10^{-3} pCi/m^3	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 (wet)
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 charcoal cartridge is 2.0 x10^{-3} pCi/m^3

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	12.22 +/- 0.73	13.18 +/- 1.44	12.03 +/- 1.41	13.19 +/- 1.22
DR02	Route 765, Auto Dump	9.25 +/- 1.61	11.01 +/- 0.52	10.39 +/- 0.69	11.11 +/- 0.71
DR03	Route 765, Giovanni's Tavern	9.70 +/- 0.88	11.15 +/- 0.49	10.03 +/- 0.54	11.11 +/- 0.79
DR04	Route 765, across from Vera's Beach Club	11.36 +/- 0.76	12.64 +/- 0.80	11.56 +/- 0.49	12.50 +/- 1.29
DR05	Route 765, John's Creek	11.21 +/- 0.62	12.31 +/- 0.71	11.30 +/- 1.10	12.04 +/- 1.14
DR06	Route 765 at Lusby	9.62 +/- 0.75	10.46 +/- 1.22	9.85 +/- 0.88	10.65 +/- 1.03
DR07	Entrance to Camp Conoy	9.41 +/- 0.91	10.66 +/- 1.02	9.97 +/- 0.89	10.64 +/- 1.65
DR08	Camp Conoy Rd at Emergency Siren	13.46 +/- 0.92	14.42 +/- 1.73	13.71 +/- 1.24	14.66 +/- 1.08
DR09	Bay Breeze Rd	9.56 +/- 0.44	10.71 +/- 0.81	10.25 +/- 1.17	10.82 +/- 1.22
DR10	Calvert Beach Rd and Decatur Street	9.49 +/- 0.83	11.06 +/- 0.77	10.20 +/- 1.12	10.52 +/- 1.35
DR11	Dirt road off Mackall & Parran Rd	10.58 +/- 0.93	11.35 +/- 0.33	10.66 +/- 0.97	11.52 +/- 1.00
DR12	Mackall & Bowen Rds	10.13 +/- 0.79	10.89 +/- 0.75	10.62 +/- 0.90	10.79 +/- 0.27
DR13	Mackall Rd, near Wallville	11.18 +/- 0.45	12.75 +/- 0.46	11.52 +/- 1.37	12.46 +/- 1.03
DR14	Rodney Point	11.40 +/- 0.84	12.41 +/- 1.91	12.09 +/- 0.52	12.45 +/- 0.73
DR15	Mill Bridge & Turner Rds	11.29 +/- 0.55	12.10 +/- 1.02	11.31 +/- 0.57	11.85 +/- 1.06

Table B-12

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

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
DR16	Across from Appeal School	9.86 +/- 0.33	10.79 +/- 0.74	10.27 +/- 1.10	10.85 +/- 0.85
DR17	Cove Point & Little Cove Point Rds	12.43 +/- 0.87	13.53 +/- 1.18	13.57 +/- 1.11	13.96 +/- 1.11
DR18	Cove Point	8.98 +/- 0.49	9.69 +/- 0.71	9.25 +/- 0.91	10.03 +/- 1.40
DR19	Long Beach	9.81 +/- 0.84	11.19 +/- 0.90	10.20 +/- 0.73	10.81 +/- 0.66
DR20	On site, near shore	12.73 +/- 0.69	14.32 +/- 1.29	13.39 +/- 1.09	14.02 +/- 0.87
DR21[1]	EOF	11.63 +/- 0.95	13.24 +/- 1.17	12.16 +/- 1.10	13.10 +/- 0.97
DR22[1]	Solomons Island	10.76 +/- 0.93	12.10 +/- 0.77	10.94 +/- 0.81	11.47 +/- 1.29
DR23[1]	Taylors Island	13.94 +/- 1.44	16.38 +/- 0.58	14.69 +/- 1.61	15.80 +/- 1.05
DR30	MET Station	11.09 +/- 1.11	11.56 +/- 0.70	10.96 +/- 0.58	12.06 +/- 0.75
SFDR01	SW of ISFSI	15.34 +/- 0.69	17.31 +/- 0.64	16.06 +/- 1.37	19.56 +/- 1.93
SFDR02	NNW of ISFSI	17.51 +/- 2.24	18.84 +/- 2.02	18.86 +/- 1.56	18.63 +/- 2.67
SFDR03	North of ISFSI	31.10 +/- 6.90	34.62 +/- 4.90	33.11 +/- 4.52	37.89 +/- 5.21
SFDR04	NE of ISFSI	31.87 +/- 5.29	33.89 +/- 4.73	31.45 +/- 5.29	35.19 +/- 6.99
SFDR05	East of ISFSI	21.20 +/- 3.85	24.66 +/- 4.35	20.20 +/- 2.70	26.28 +/- 4.25
SFDR06	ESE of ISFSI	18.46 +/- 1.98	21.49 +/- 2.05	18.24 +/- 2.63	20.95 +/- 2.33

Table B-12

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

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
SFDR07[1]	Visitor's Center	10.94 +/- 0.71	12.37 +/- 0.93	11.46 +/- 1.20	12.44 +/- 0.97
SFDR08	NNW of ISFSI	23.25 +/- 1.94	24.67 +/- 2.97	22.73 +/- 5.46	23.84 +/- 3.40
SFDR09	SSE of ISFSI	27.31 +/- 1.98	29.91 +/- 9.03	31.59 +/- 14.56	61.60 +/- 4.68
SFDR10	NW of ISFSI	25.41 +/- 6.72	28.16 +/- 7.80	31.63 +/- 1.16	27.52 +/- 4.31
SFDR11	WNW ISFSI	23.03 +/- 3.45	23.56 +/- 2.06	21.35 +/- 2.19	22.37 +/- 2.61
SFDR12	WSW of ISFSI	39.39 +/- 7.60	42.43 +/- 8.51	36.01 +/- 8.18	39.82 +/- 8.50
SFDR13	South of ISFSI	28.40 +/- 7.12	36.25 +/- 3.44	31.16 +/- 6.79	27.28 +/- 5.28
SFDR14	SE of ISFSI	62.15 +/- 6.70	29.90 +/- 1.93	51.75 +/- 15.72	57.37 +/- 7.10
SFDR15	ENE of ISFSI	22.84 +/- 6.50	27.70 +/- 6.43	22.34 +/- 3.68	26.04 +/- 4.27
SFDR16	SSW of ISFSI	36.35 +/- 4.64	39.84 +/- 5.87	42.84 +/- 5.75	44.76 +/- 8.59
SFDR17	NNE of ISFSI	37.71 +/- 6.45	43.58 +/- 5.84	39.41 +/- 4.15	39.63 +/- 6.04
SFDR18	West of ISFSI	38.89 +/- 5.18	41.74 +/- 9.96	35.09 +/- 7.92	36.45 +/- 8.08

[1] Control Location

APPENDIX C

Quality Assurance Program

Appendix C is a summary of Exelon Industrial Services (EIS) laboratory's quality assurance program. It consists of Table C-1 which is a compilation of the results of the EIS laboratory's participation in an interlaboratory comparison program with Environmental Resource Associates (ERA) located in Arvada, Colorado and Eckert and Ziegler Analytics, Inc. (EZA) located in Atlanta, Georgia. It also includes Table C-2, which is a compilation of the results of the EIS 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.

The EIS laboratory's results contained in Table C-1 generally agree with the interlaboratory's comparison results within the range of $\pm 2\sigma$ of each other One analysis did not meet the specified acceptance criteria and is recorded in the EIS Corrective Action program. The Analytics Gross Beta in Water study for March 2017 was low and did not meet NRC Resolution Test Criteria while other crosschecks analyzed in the same batch were acceptable. The beaker used to concentrate the sample was rinsed again with 1M Nitric acid and the residue was captured and analyzed indicating presence of additional Beta emitters, confirming the low result was directly due to insufficient transfer of concentrated sample to the planchet being analyzed. Subsequent to this event, the procedure was updated to include that sample glassware is given a thorough rinse with 1M Nitric acid to insure any residue dried on the beaker during the evaporation step is completely dissolved and transferred to the planchet. All crosscheck study results since have had improved recovery and pass NRC Resolution Test Criteria without further issue. 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[1]. The uncertainties for the EIS laboratory's results and Analytics' results are $\pm 2\sigma$ while the ERA laboratory's uncertainty is based on USEPA guidelines[2].

All the results contained in Table C-2 agree within the range of $\pm 2\sigma$ of each other with their respective EIS laboratory original, replicate and/or Teledyne Brown Engineering's split laboratory samples, except for the comparisons of one sample involving Cs-137 results: a tree leaves sample at IB6 Camp Conoy Entrance collected on 7/31/17. The original, 81.1±19.9 pCi/kg, and replicate analysis, 43.2 ±15.6 pCi/kg, of the tree leaves sample from IB6 did not agree within $\pm 2\ \sigma$ of each other while the replicate and the split lab results, 48.2 ± 12.3 pCi/kg, did agree within ±2 of each other. These minor discrepancies, which have been observed in previous reporting periods, are most probably due to counting statistics and/or the heterogeneous nature of this type of sample. Other samples whose nature generally preclude sample splitting are marked "**" in the Split Analysis column.

[1] NRC Inspection Manual, Inspection Procedure 84750, March 15, 1994
[2] National Standards for Water Proficiency Testing Studies Criteria Document, December 1998

TABLE OF CONTENTS - ANALYTICAL RESULTS

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
3/16/2017	Water-pCi/L	Beta	217 [1]	279
3/16/2017	Cartridge- pCi	I-131	87.0	96.4
3/16/2017	Water-pCi/L	H3	9860	9980
3/16/2017	Milk-pCi/l	I-131	103	97.9
		Ce-141	165	145
		Cr-51	299	290
		Cs-134	118	120
		Cs-137	165	140
		Co-58	148	150
		Mn-54	176	164
		Fe-59	136	129
		Zn-65	215	199
		Co-60	192	183
4/10/2017	Water-pCi/L	Ba-133	50.2	49.7
		Cs-134	88.3	90.1
		Cs-137	225.7	206
		Co-60	59.5	54.7
		Zn-65	66.2	53.8
4/10/2017	Water-pCi/l	I-131	29.1	29.9
4/10/2017	Water-pCi/l	Beta	32.4	38.5
4/10/2017	Water-pCi/l	H3	7347	6850

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
6/8/2017	Filter-pCi/Filter	Ce-141	122	118
		Cr-51	238	246
		Cs-134	129	147
		Cs-137	121	117
		Co-58	116	121
		Mn-54	140	134
		Fe-59	99.0	89.9
		Zn-65	175	159
		Co-60	144	149
6/8/2017	Water-pCi/L	I-131	99.0	96.7
		Ce-141	220	199
		Cr-51	503	413
		Cs-134	242	247
		Cs-137	218	197
		Co-58	222	204
		Mn-54	255	225
		Fe-59	170	151
		Zn-65	307	267
		Co-60	278	250
6/8/2017	Water-pCi/l	Beta	242	249
7/10/2017	Water-pCi/l	H3	5305	5060
9/14/2017	Water-pCi/l	H3	14900	14200
9/14/2017	Water-pCi/l	Beta	64.2	67.2

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
9/18/2017	Filter-pCi/Filter	Cs-134	1334	1440
		Cs-137	1050	954
		Co-60	309	271
		Zn-65	153	123
10/6/2017	Water-pCi/L	Ba-133	76.2	73.7
		Cs-134	54.3	53.0
		Cs-137	58.5	52.9
		Co-60	74.9	69.5
		Zn-65	411.5	348
10/6/2017	Water-pCi/L	I-131	25.9	24.2
12/7/2017	Water-pCi/l	Beta	284	265
12/7/2017	Cartridge- pCi	I-131	44.0	47.5
12/7/2017	Filter-pCi/Filter	Ce-141	61.9	59.4
		Cr-51	123	146
		Cs-134	62.8	75.4
		Cs-137	82.8	85.3
		Co-58	50.1	54.3
		Mn-54	97.0	97.1
		Fe-59	69.6	68.5
		Zn-65	124	127
		Co-60	95.7	104

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
12/7/2017	Milk-pCi/l	I-131	71.4	57.8
		Ce-141	113	98.3
		Cr-51	254	242
		Cs-134	129	125
		Cs-137	163	141
		Co-58	89.5	89.9
		Mn-54	184	161
		Fe-59	127	113
		Zn-65	218	211
		Co-60	185	173

[1] 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	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Filter - A1	01/09/17	Gross Beta	pCi/m^3	1.8 +/- 0.2	1.8 +/- 0.2	**
Air Filter - A2	01/09/17	Gross Beta	pCi/m^3	1.8 +/- 0.2	2.0 +/- 0.2	**
Air Filter - A3	01/09/17	Gross Beta	pCi/m^3	1.8 +/- 0.2	1.8 +/- 0.2	**
Air Filter - A4	01/09/17	Gross Beta	pCi/m^3	2.0 +/- 0.2	2.1 +/- 0.2	**
Air Filter - A5	01/09/17	Gross Beta	pCi/m^3	1.9 +/- 0.2	2.0 +/- 0.2	**
Air Filter - SFA1	01/09/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	2.0 +/- 0.2	**
Air Filter - SFA2	01/09/17	Gross Beta	pCi/m^3	1.9 +/- 0.2	2.1 +/- 0.2	**
Air Filter - SFA3	01/09/17	Gross Beta	pCi/m^3	1.8 +/- 0.2	2.1 +/- 0.2	**
Air Filter - SFA4	01/09/17	Gross Beta	pCi/m^3	1.8 +/- 0.2	2.0 +/- 0.2	**
Air Iodine - A1	01/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	01/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	01/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Filter - A1	02/13/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.5 +/- 0.1	**
Air Filter - A2	02/13/17	Gross Beta	pCi/m^3	2.4 +/- 0.1	2.5 +/- 0.1	**
Air Filter - A3	02/13/17	Gross Beta	pCi/m^3	2.3 +/- 0.1	2.3 +/- 0.1	**
Air Filter - A4	02/13/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.6 +/- 0.1	**
Air Filter - A5	02/13/17	Gross Beta	pCi/m^3	2.4 +/- 0.1	2.4 +/- 0.1	**
Air Filter - SFA1	02/13/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.8 +/- 0.1	**
Air Filter - SFA2	02/13/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.6 +/- 0.1	**
Air Filter - SFA3	02/13/17	Gross Beta	pCi/m^3	2.4 +/- 0.1	2.4 +/- 0.1	**
Air Filter - SFA4	02/13/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.4 +/- 0.1	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Filter - A1	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A2	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A3	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A4	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A5	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA1	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA2	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA4	02/27/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Iodine - A1	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A4	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A5	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - SFA1	02/27/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Filter - A1	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A2	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A3	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A4	03/06/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	2.0 +/- 0.1	**
Air Filter - A5	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.7 +/- 0.1	**
Air Filter - SFA1	03/06/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	1.9 +/- 0.1	**
Air Filter - SFA2	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA3	03/06/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA4	03/06/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.8 +/- 0.1	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Iodine - A1	04/03/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	04/03/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	04/03/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Filter - A1	04/10/17	Gross Beta	pCi/m^3	1.4 +/- 0.1	1.3 +/- 0.1	**
Air Filter - A2	04/10/17	Gross Beta	pCi/m^3	1.5 +/- 0.1	1.3 +/- 0.1	**
Air Filter - A3	04/10/17	Gross Beta	pCi/m^3	1.3 +/- 0.1	1.3 +/- 0.1	**
Air Filter - A4	04/10/17	Gross Beta	pCi/m^3	1.2 +/- 0.1	1.4 +/- 0.1	**
Air Filter - A5	04/10/17	Gross Beta	pCi/m^3	1.3 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA1	04/10/17	Gross Beta	pCi/m^3	1.2 +/- 0.1	1.3 +/- 0.1	**
Air Filter - SFA2	04/10/17	Gross Beta	pCi/m^3	1.4 +/- 0.1	1.5 +/- 0.1	**
Air Filter - SFA3	04/10/17	Gross Beta	pCi/m^3	1.4 +/- 0.1	1.2 +/- 0.1	**
Air Filter - SFA4	04/10/17	Gross Beta	pCi/m^3	1.2 +/- 0.1	1.3 +/- 0.1	**
Air Filter - A1	05/22/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A2	05/22/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	1.9 +/- 0.1	**
Air Filter - A3	05/22/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A4	05/22/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	1.8 +/- 0.1	**
Air Filter - A5	05/22/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA1	05/22/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.0 +/- 0.1	**
Air Filter - SFA2	05/22/17	Gross Beta	pCi/m^3	2.1 +/- 0.2	2.0 +/- 0.2	**
Air Filter - SFA3	05/22/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	1.9 +/- 0.1	**
Air Filter - SFA4	05/22/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.7 +/- 0.1	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Iodine - A1	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A4	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A5	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - SFA1	06/12/17	I-131	pCi/m^3	<MDA	<MDA	**
Bottom sediment - WBS2	06/29/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Bottom sediment - WBS4	06/29/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Oysters - IA3	06/29/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Oysters - IA6	06/29/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Air Filter - A1	07/03/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.9 +/- 0.1	**
Air Filter - A2	07/03/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.0 +/- 0.1	**
Air Filter - A3	07/03/17	Gross Beta	pCi/m^3	2.2 +/- 0.2	2.1 +/- 0.2	**
Air Filter - A4	07/03/17	Gross Beta	pCi/m^3	2.2 +/- 0.2	2.3 +/- 0.2	**
Air Filter - A5	07/03/17	Gross Beta	pCi/m^3	2.1 +/- 0.1	2.3 +/- 0.2	**
Air Filter - SFA1	07/03/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.0 +/- 0.1	**
Air Filter - SFA2	07/03/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	2.0 +/- 0.1	**
Air Filter - SFA3	07/03/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.0 +/- 0.1	**
Air Filter - SFA4	07/03/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	2.0 +/- 0.1	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Cabbage - IB7	07/25/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Collards - IB9	07/25/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Kale - IB8	07/25/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Bay Water - WA1	07/31/17	Gamma	pCi/L	<MDA	<MDA	<MDA
Bay Water - WA2	07/31/17	Gamma	pCi/L	<MDA	<MDA	<MDA
Tree Leaves - IB4	07/31/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Tree Leaves - IB5	07/31/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Tree Leaves - IB6 [1]	07/31/17	Cs-137	pCi/kg	81.1 +/- 19.9	43.2 +/- 15.6	48.3 +/- 12.3
Air Filter - A1	08/14/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.8 +/- 0.1	**
Air Filter - A2	08/14/17	Gross Beta	pCi/m^3	1.9 +/- 0.2	2.0 +/- 0.2	**
Air Filter - A3	08/14/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.0 +/- 0.1	**
Air Filter - A4	08/14/17	Gross Beta	pCi/m^3	2.1 +/- 0.1	2.1 +/- 0.1	**
Air Filter - A5	08/14/17	Gross Beta	pCi/m^3	2.2 +/- 0.1	2.1 +/- 0.1	**
Air Filter - SFA1	08/14/17	Gross Beta	pCi/m^3	2.0 +/- 0.1	2.1 +/- 0.1	**
Air Filter - SFA2	08/14/17	Gross Beta	pCi/m^3	2.1 +/- 0.1	2.1 +/- 0.1	**
Air Filter - SFA3	08/14/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.9 +/- 0.1	**
Air Filter - SFA4	08/14/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.9 +/- 0.1	**
Oysters - IA3	08/22/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Oysters - IA6	08/22/17	Gamma	pCi/kg	<MDA	<MDA	<MDA

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Spanish Mackeral - IA2	08/22/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Spanish Mackeral - IA5	08/22/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Air Iodine - A1	09/11/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	09/11/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	09/11/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A4	09/11/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A5	09/11/17	I-131	pCi/m^3	<MDA	<MDA	**
Misc ground coverage - SFB4	09/11/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Misc ground coverage - SFB5	09/11/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Soil - SFS4	09/11/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Soil - SFS5	09/11/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A1	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A2	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A3	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A4	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - A5	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA1	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA2	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Filter - SFA3	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Air Filter - SFA4	10/02/17	Gamma	pCi/m^3	<MDA	<MDA	<MDA
Shoreline sediment - WB1	10/03/17	Gamma	pCi/kg	<MDA	<MDA	<MDA
Air Iodine - A1	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A4	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A5	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - SFA1	10/09/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Filter - A1	10/30/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.7 +/- 0.1	**
Air Filter - A2	10/30/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.8 +/- 0.1	**
Air Filter - A3	10/30/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.8 +/- 0.1	**
Air Filter - A4	10/30/17	Gross Beta	pCi/m^3	1.9 +/- 0.1	1.9 +/- 0.1	**
Air Filter - A5	10/30/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA1	10/30/17	Gross Beta	pCi/m^3	1.8 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA2	10/30/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.6 +/- 0.1	**
Air Filter - SFA3	10/30/17	Gross Beta	pCi/m^3	1.7 +/- 0.1	1.8 +/- 0.1	**
Air Filter - SFA4	10/30/17	Gross Beta	pCi/m^3	1.6 +/- 0.1	1.6 +/- 0.1	**
Bay Water - WA1	10/31/17	Gamma	pCi/L	<MDA	<MDA	<MDA
Bay Water - WA2	10/31/17	Gamma	pCi/L	<MDA	<MDA	<MDA

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Iodine - A1	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A1	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A2	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A3	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A4	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - A5	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Iodine - SFA1	11/06/17	I-131	pCi/m^3	<MDA	<MDA	**
Air Filter - A1	11/27/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.6 +/- 0.1	**
Air Filter - A2	11/27/17	Gross Beta	pCi/m^3	2.5 +/- 0.1	2.6 +/- 0.1	**
Air Filter - A3	11/27/17	Gross Beta	pCi/m^3	2.5 +/- 0.1	2.6 +/- 0.1	**
Air Filter - A4	11/27/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.8 +/- 0.1	**
Air Filter - A5	11/27/17	Gross Beta	pCi/m^3	2.8 +/- 0.1	2.7 +/- 0.1	**
Air Filter - SFA1	11/27/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.6 +/- 0.1	**
Air Filter - SFA2	11/27/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.7 +/- 0.1	**
Air Filter - SFA3	11/27/17	Gross Beta	pCi/m^3	2.6 +/- 0.1	2.6 +/- 0.1	**
Air Filter - SFA4	11/27/17	Gross Beta	pCi/m^3	2.5 +/- 0.1	2.6 +/- 0.1	**
Air Filter - A1	12/25/17	Gross Beta	pCi/m^3	2.9 +/- 0.1	3.0 +/- 0.1	**
Air Filter - A2	12/25/17	Gross Beta	pCi/m^3	2.9 +/- 0.2	3.1 +/- 0.2	**
Air Filter - A3	12/25/17	Gross Beta	pCi/m^3	2.9 +/- 0.1	3.0 +/- 0.1	**
Air Filter - A4	12/25/17	Gross Beta	pCi/m^3	2.9 +/- 0.1	3.0 +/- 0.1	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Air Filter - A5	12/25/17	Gross Beta	pCi/m^3	3.0 +/- 0.1	3.1 +/- 0.1	**
Air Filter - SFA1	12/25/17	Gross Beta	pCi/m^3	2.9 +/- 0.2	3.0 +/- 0.2	**
Air Filter - SFA2	12/25/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.8 +/- 0.1	**
Air Filter - SFA3	12/25/17	Gross Beta	pCi/m^3	2.8 +/- 0.1	2.8 +/- 0.1	**
Air Filter - SFA4	12/25/17	Gross Beta	pCi/m^3	2.7 +/- 0.1	2.6 +/- 0.1	**
Gamma field - DR05	06/27/17	TLD	mR/90 days	12.3 +/- 0.7	11.3 +/- 0.4	**
Gamma field - DR06	06/27/17	TLD	mR/90 days	10.5 +/- 1.2	9.6 +/- 0.8	**
Gamma field - DR07	06/27/17	TLD	mR/90 days	10.7 +/- 1.0	9.6 +/- 0.8	**
Gamma field - DR08	06/27/17	TLD	mR/90 days	14.4 +/- 2.0	13.7 +/- 0.4	**
Gamma field - DR09	06/27/17	TLD	mR/90 days	10.7 +/- 0.8	9.9 +/- 0.8	**
Gamma field - DR10	06/27/17	TLD	mR/90 days	11.1 +/- 0.8	10.3 +/- 1.1	**
Gamma field - DR11	06/27/17	TLD	mR/90 days	11.6 +/- 1.2	10.2 +/- 1.3	**
Gamma field - SFDR14	06/27/17	TLD	mR/90 days	29.0 +/- 7.6	24.7 +/- 3.5	**
Gamma field - SFDR15	06/27/17	TLD	mR/90 days	26.2 +/- 7.6	23.3 +/- 5.9	**
Gamma field - DR29	06/27/17	TLD	mR/90 days	15.7 +/- 0.7	13.5 +/- 1.0	**
Gamma field - DR31	06/27/17	TLD	mR/90 days	17.3 +/- 0.8	14.7 +/- 1.4	**
Gamma field - DR05	01/05/18	TLD	mR/90 days	12.0 +/- 1.1	12.4 +/- 1.9	**
Gamma field - DR06	01/05/18	TLD	mR/90 days	10.6 +/- 1.0	10.8 +/- 1.0	**
Gamma field - DR07	01/05/18	TLD	mR/90 days	10.6 +/- 1.6	12.1 +/- 1.0	**
Gamma field - DR08	01/05/18	TLD	mR/90 days	14.7 +/- 1.1	16.0 +/- 1.9	**
Gamma field - DR09	01/05/18	TLD	mR/90 days	10.8 +/- 1.2	11.8 +/- 1.7	**
Gamma field - DR10	01/05/18	TLD	mR/90 days	10.5 +/- 1.0	12.0 +/- 1.6	**
Gamma field - DR11	01/05/18	TLD	mR/90 days	11.5 +/- 1.0	12.5 +/- 1.0	**

Table C-2

Results of Quality Assurance Program

Sample Type and Location	Sample Date	Type of Analysis	Result Units	Original Analysis	Replicate Analysis	Split Analysis
Gamma field - SFDR14	01/05/18	TLD	mR/90 days	57.37 +/- 7.1	48.8 +/- 18.0	**
Gamma field - SFDR15	01/05/18	TLD	mR/90 days	26.0 +/- 4.3	27.8 +/- 7.1	**
Gamma field - DR29	01/05/18	TLD	mR/90 days	14.6 +/- 1.1	16.6 +/- 3.0	**
Gamma field - DR31	01/05/18	TLD	mR/90 days	16.0 +/- 0.8	17.8 +/- 0.8	**

[1] See discussion at the beginning of the Appendix
** 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^{-3}pCi/m^3
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^2 in each of the nine sectors over land. A detailed description of the Land Use Survey is given in a separate document (Ref. 9).

There are no animals producing milk for human consumption within the 5 mile radius. Beef cattle are pasture-finished at farm 3.9 miles away that spans the W and WNW sector boundary.

The position of the nearest residence and garden in each sector out to 5 miles is given in the table below. The nearest garden location has changed in the SSW, SW, WSW, and W, sectors since 2016.

The closest residence is situated in the WSW and SW sectors and the nearest garden is in the WSW sector.

Discussions with a local waterman indicate that oysters are still harvested in the vicinity of CCNPP.

Sector	NW	WNW	W	WSW	SW	SSW	S	SSE	SE
Nearest Residence (Miles from CCNPP)	2.0*	2.7	1.3*	1.1	1.1	1.5	1.6	1.6	1.5
Nearest Garden (Miles from CCNPP)	2.1	2.7	2.0*	1.4*	2.4*	4.3*	1.6	4.2	1.5

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.

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-10 shows the direct radiation readings from TLDs placed at the perimeter of the Resin Storage Area which is a 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 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.

Groundwater samples were collected from 17 on-site piezometer tubes and three subsurface manholes in 2017. These were identified as Piezometers 11 – 30 on Figure E-1, Site Map Groundwater Monitoring Wells. Figure E-2, Site Map RW Locations, shows precipitation collection sites. A piezometer tube is a shallow monitoring well which allows access to groundwater at a depth of approximately 40 feet beneath the site. Of the piezometer tubes sampled, only # 11 piezometer, MH28 and MH30 showed any plant-related activity. This activity was previously identified and evaluated in December of 2005. The activity consists of tritium originating from normal radiological 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 2017 analysis results for tritium are shown in Table E-11, and analysis results for gamma emitting radionuclides are shown in Table E-12.

TABLE OF CONTENTS - ANALYTICAL RESULTS

TABLE E-1

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

Station	Description	Distance[1]		Direction[1]
		(KM)	(Miles	(Sector)
A6	Long Beach	4.4	2.7	NW
A7	Taylors Island, Anderson's Property	12.6	7.8	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	Taylors Island Emergency Siren #35	12.3	7.6	ENE
DR29	Taylors Island Emergency Siren #38	12.5	7.8	E
DR31	Cambridge, U of MD Estuarine Center	32.0	19.9	NE
DR32	Twining Property, Taylors Island	12.3	7.6	NE
DR33	P.A. Ransome Property, Taylors 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
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	Taylors Island, Anderson's Property	12.6	7.8	ENE

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

Table E-2

Synopsis of 2017 Calvert Cliffs Nuclear Power Plant
Non-Tech Spec Radiological Environmental Monitoring Program

Sample Type	Sampling Frequency[1]	Number of Locations	Number Collected	Analysis	Analysis Frequency[1]	Number Analyzed
Aquatic Environment						
Bottom Sediment	Q	2	4	Gamma	Q	4
Atmospheric Environment						
Air Iodine[2]	W	7	362	I-131	W	362
Air Particulates[3]	W	3	155	Gross Beta	W	155
				Gamma	MC	36
Direct Radiation						
Ambient Radiation	Q	20	480	TLD	Q	480
Terrestrial Environment						
Ground water	M	1	11	Gamma	M	11
				H-3	M	11

[1] W=weekly, M=monthly, Q=quarterly, SA=semiannual, A=annual, C=composite
[2] The collection device contains Charcoal
[3] Beta counting is performed after >72 hour decay, Gamma spectroscopy performed on monthly composites of weekly samples

Table E-3

Annual Summary for Calvert Cliffs Nuclear Power Plant Units 1 & 2
Non-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[1]	Location with Highest Annual Mean Name/Distance & Direction[2]	Highest Annual Mean (F) / Range[1]	Control Locations Mean (F)/Range
Aquatic Environment						
Bottom Sediment (pCi/kg)	Gamma (4) Cs-137	17	142 (2/2) (85-198)	Discharge Area WBS2 0.3 km N	142 (2/2) (85-198)	-- --
Atmospheric Environment						
Air Particulates (10^{-2} pCi/m^3)	Gross Beta (155)	0.5	1.9 (104/104) (0.8-3.0)	Cambridge CA 32.0 km NE	1.9 (51/51) (0.8-2.9)	1.8 (51/51) (0.9-2.9)
Direct Radiation						
Ambient Radiation (mR/90 days)	TLD (480)	--	16.24 (480/480) (9.22-51.58)	West Fence Left RPDR08 km	27.84 (24/24) (18.13-51.58)	-- --

[1] Mean and range based upon detectable measurements only. Fraction (F) of detectable measurements at specified location is indicated in parentheses.
[2] Distance and direction from the central point between the two containment buildings.

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	6/29/2017	85 +/- 65	*
	10/17/2017	198 +/- 58	*
WBS4[1]			
Camp Conoy/ Rocky Point	6/29/2017	[2]	*
	10/17/2017	[2]	*

[1] Control Location
[2] This Isotope <MDA
* All Non-Natural Gamma Emitters <MDA

Table E-5

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

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	SFA1 MET Station	SFA2[1] Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI	TI[1] TAYLOR'S ISLAND
1/2/2017	1/9/2017	*	*	*	*	*	*	*
1/9/2017	1/16/2017	*	*	*	*	*	*	*
1/16/2017	1/23/2017	*	*	*	*	*	*	*
1/23/2017	1/30/2017	*	*	*	*	*	*	*
1/30/2017	2/6/2017	*	*	*	*	*	*	*
2/6/2017	2/13/2017	*	*	*	*	*	*	*
2/13/2017	2/20/2017	*	*	*	*	*	*	*
2/20/2017	2/27/2017	*	*	*	*	*	*	*
2/27/2017	3/6/2017	*	*	*	*	*	*	*
3/6/2017	3/13/2017	*	*	*	*	*	*	*
3/13/2017	3/20/2017	*	*	*	*	*	*	*
3/20/2017	3/27/2017	*	*	*	*	*	*	*
3/27/2017	4/3/2017	*	*	*	*	*	*	*
4/3/2017	4/10/2017	*	*	*	*	*	*	*
4/10/2017	4/17/2017	*	*	*	*	*	*	*
4/17/2017	4/24/2017	*	*	*	*	*	*	*
4/24/2017	5/1/2017	*	*	*	*	*	*	*
5/1/2017	5/8/2017	*	*	*	*	*	*	*
5/8/2017	5/15/2017	*	*	*	*	*	*	*
5/15/2017	5/22/2017	*	*	*	*	*	*	*
5/22/2017	5/29/2017	*	*	*	*	*	*	*
5/29/2017	6/5/2017	*	*	*	*	*	*	*
6/5/2017	6/12/2017	*	*	*	*	*	*	*
6/12/2017	6/19/2017	*	*	*	*	*	*	*
6/19/2017	6/26/2017	*	*	*	*	*	*	*
6/26/2017	7/3/2017	*	*	*	*	*	*	*

Table E-5

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

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	SFA1 MET Station	SFA2[1] Visitors Center	SFA3 NNW of ISFSI	SFA4 SSE of ISFSI	TI[1] TAYLOR'S ISLAND
7/3/2017	7/10/2017	*	*	*	*	*	*	*
7/10/2017	7/17/2017	*	*	*	*	*	*	*
7/17/2017	7/24/2017	*	*	*	*	*	*	*
7/24/2017	7/31/2017	*	*	*	*	*	*	*
7/31/2017	8/7/2017	*	*	*	*	*	*	*
8/7/2017	8/14/2017	*	*	*	*	*	*	*
8/14/2017	8/21/2017	*	*	*	*	*	*	3
8/21/2017	8/28/2017	*	*	*	*	*	*	*
8/28/2017	9/4/2017	*	*	*	*	*	*	*
9/4/2017	9/11/2017	*	*	*	*	*	*	*
9/11/2017	9/18/2017	*	*	*	*	*	*	*
9/18/2017	9/25/2017	*	*	*	*	*	*	*
9/25/2017	10/2/2017	*	*	*	*	*	*	*
10/2/2017	10/9/2017	*	*	*	*	*	*	*
10/9/2017	10/16/2017	*	*	*	*	*	*	*
10/16/2017	10/23/2017	*	*	*	*	*	*	*
10/23/2017	10/30/2017	*	*	*	*	*	*	*
10/30/2017	11/6/2017	*	*	*	*	*	*	*
11/6/2017	11/13/2017	*	*	*	*	*	*	*
11/13/2017	11/20/2017	*	*	*	*	*	*	*
11/20/2017	11/27/2017	*	*	*	*	*	*	*
11/27/2017	12/4/2017	*	*	*	*	*	*	*
12/4/2017	12/11/2017	*	*	*	*	*	*	*
12/11/2017	12/18/2017	*	*	*	2	*	*	*
12/18/2017	12/25/2017	*	*	*	*	*	*	*
12/25/2017	1/1/2018	*	*	*	*	*	*	*

[1] Control Location
[2] Power outage
[3] Sampler malfunction/low flow
* <MDA

Table E-6

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

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	TI[1] TAYLOR'S ISLAND
1/2/2017	1/9/2017	2.0 +/- 0.2	2.0 +/- 0.2	1.8 +/- 0.2
1/9/2017	1/16/2017	2.0 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1
1/16/2017	1/23/2017	1.4 +/- 0.1	1.3 +/- 0.1	1.1 +/- 0.1
1/23/2017	1/30/2017	1.5 +/- 0.1	1.4 +/- 0.1	1.3 +/- 0.1
1/30/2017	2/6/2017	2.1 +/- 0.1	2.4 +/- 0.2	2.1 +/- 0.1
2/6/2017	2/13/2017	2.6 +/- 0.1	2.7 +/- 0.1	2.4 +/- 0.1
2/13/2017	2/20/2017	2.1 +/- 0.1	2.1 +/- 0.1	1.9 +/- 0.1
2/20/2017	2/27/2017	1.3 +/- 0.1	1.3 +/- 0.1	1.3 +/- 0.1
2/27/2017	3/6/2017	1.8 +/- 0.1	1.7 +/- 0.1	1.5 +/- 0.1
3/6/2017	3/13/2017	1.5 +/- 0.1	1.4 +/- 0.1	1.4 +/- 0.1
3/13/2017	3/20/2017	1.7 +/- 0.1	1.6 +/- 0.1	1.5 +/- 0.1
3/20/2017	3/27/2017	1.9 +/- 0.1	1.9 +/- 0.1	1.9 +/- 0.1
3/27/2017	4/3/2017	1.1 +/- 0.1	1.1 +/- 0.1	1.0 +/- 0.1
4/3/2017	4/10/2017	1.2 +/- 0.1	1.3 +/- 0.1	1.2 +/- 0.1
4/10/2017	4/17/2017	1.5 +/- 0.1	1.7 +/- 0.1	1.3 +/- 0.1
4/17/2017	4/24/2017	1.1 +/- 0.1	1.0 +/- 0.1	1.0 +/- 0.1
4/24/2017	5/1/2017	1.3 +/- 0.1	1.4 +/- 0.1	1.3 +/- 0.1
5/1/2017	5/8/2017	0.8 +/- 0.1	0.8 +/- 0.1	0.9 +/- 0.1
5/8/2017	5/15/2017	1.0 +/- 0.1	1.1 +/- 0.1	1.4 +/- 0.1
5/15/2017	5/22/2017	2.1 +/- 0.1	1.8 +/- 0.1	2.0 +/- 0.1
5/22/2017	5/29/2017	0.8 +/- 0.1	0.9 +/- 0.1	0.9 +/- 0.1
5/29/2017	6/5/2017	1.9 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1
6/5/2017	6/12/2017	2.1 +/- 0.1	2.3 +/- 0.1	2.2 +/- 0.1
6/12/2017	6/19/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1
6/19/2017	6/26/2017	2.3 +/- 0.1	2.0 +/- 0.1	2.0 +/- 0.1
6/26/2017	7/3/2017	2.0 +/- 0.1	2.1 +/- 0.2	2.0 +/- 0.1
7/3/2017	7/10/2017	2.4 +/- 0.1	2.3 +/- 0.1	2.4 +/- 0.1
7/10/2017	7/17/2017	2.2 +/- 0.1	2.3 +/- 0.1	2.4 +/- 0.1
7/17/2017	7/24/2017	2.6 +/- 0.1	2.5 +/- 0.1	2.5 +/- 0.1
7/24/2017	7/31/2017	1.6 +/- 0.1	1.5 +/- 0.1	1.6 +/- 0.1
7/31/2017	8/7/2017	1.9 +/- 0.1	1.8 +/- 0.1	1.8 +/- 0.1
8/7/2017	8/14/2017	2.1 +/- 0.1	1.8 +/- 0.1	1.9 +/- 0.1
8/14/2017	8/21/2017	2.5 +/- 0.2	2.4 +/- 0.2	[2]
8/21/2017	8/28/2017	1.9 +/- 0.1	1.7 +/- 0.1	1.9 +/- 0.1
8/28/2017	9/4/2017	1.9 +/- 0.1	1.7 +/- 0.1	1.8 +/- 0.1
9/4/2017	9/11/2017	1.8 +/- 0.1	1.7 +/- 0.1	1.7 +/- 0.1
9/11/2017	9/18/2017	2.0 +/- 0.1	2.1 +/- 0.1	1.9 +/- 0.1
9/18/2017	9/25/2017	2.7 +/- 0.1	2.6 +/- 0.1	2.5 +/- 0.1
9/25/2017	10/2/2017	1.5 +/- 0.1	1.5 +/- 0.1	1.5 +/- 0.1

Table E-6

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

Start Date	Stop Date	CA Cambridge	LB LONG BEACH	TI[1] TAYLOR'S ISLAND
10/2/2017	10/9/2017	1.7 +/- 0.1	1.6 +/- 0.1	1.6 +/- 0.1
10/9/2017	10/16/2017	1.1 +/- 0.1	1.1 +/- 0.1	1.1 +/- 0.1
10/16/2017	10/23/2017	2.4 +/- 0.1	2.5 +/- 0.1	2.3 +/- 0.1
10/23/2017	10/30/2017	1.7 +/- 0.1	1.7 +/- 0.1	1.6 +/- 0.1
10/30/2017	11/6/2017	2.6 +/- 0.1	2.3 +/- 0.1	2.4 +/- 0.1
11/6/2017	11/13/2017	1.8 +/- 0.1	1.6 +/- 0.1	1.7 +/- 0.1
11/13/2017	11/20/2017	2.4 +/- 0.2	2.5 +/- 0.2	2.6 +/- 0.2
11/20/2017	11/27/2017	2.3 +/- 0.1	2.4 +/- 0.1	2.4 +/- 0.1
11/27/2017	12/4/2017	2.9 +/- 0.1	3.0 +/- 0.1	2.9 +/- 0.1
12/4/2017	12/11/2017	2.6 +/- 0.2	2.6 +/- 0.2	2.4 +/- 0.2
12/11/2017	12/18/2017	2.8 +/- 0.1	2.9 +/- 0.1	2.9 +/- 0.1
12/18/2017	12/25/2017	2.7 +/- 0.1	2.5 +/- 0.1	2.8 +/- 0.1
12/25/2017	1/1/2018	2.8 +/- 0.2	2.4 +/- 0.1	2.8 +/- 0.2

[1] Control Location
[2] Sampler Malfunction; Loss of Data

Table E-7

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

Sample Date	CA Cambridge	LB LONG BEACH	TI[1] TAYLOR'S ISLAND
1/30/2017	*	*	*
2/27/2017	*	*	*
4/3/2017	*	*	*
5/1/2017	*	*	*
5/29/2017	*	*	*
7/3/2017	*	*	*
7/31/2017	*	*	*
8/29/2017	*	*	*
10/2/2017	*	*	*
10/30/2017	*	*	*
11/28/2017	*	*	*
1/2/2018	*	*	*

[1] 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 pCi/L +/- 2σ)

Sample Date	Gamma Emitters	H-3
1/31/2017	*	<186
2/21/2017	*	<182
3/20/2017	*	<182
5/16/2017	*	<186
6/14/2017	*	<184
7/10/2017	*	<165
8/15/2017	*	<171
9/19/2017	*	<167
10/23/2017	*	<197
11/7/2017	*	<197
12/11/2017	*	<191

* Non-Natural Gamma Emitters <MDA

Table E-9

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.	10.91 +/- 0.91	11.75 +/- 0.42	11.70 +/- 1.08	12.09 +/- 1.02
DR25	Camp Conoy Guard House	12.00 +/- 0.76	13.71 +/- 0.93	12.92 +/- 1.16	14.16 +/- 1.30
DR26	Rt. 235 and Clark's Landing Road	10.03 +/- 1.04	12.29 +/- 0.81	11.12 +/- 0.75	11.16 +/- 0.90
DR27	Rt. 231 and Rt. 4	11.03 +/- 0.37	12.05 +/- 0.65	11.21 +/- 0.80	11.96 +/- 1.02
DR28	Taylors Is. Siren #35	12.42 +/- 0.53	15.08 +/- 0.94	13.37 +/- 1.07	14.86 +/- 1.61
DR29	Taylors Is. Siren #38	12.80 +/- 0.96	15.72 +/- 0.72	13.39 +/- 1.32	14.65 +/- 1.11
DR31	Cambridge	14.17 +/- 0.96	17.29 +/- 0.83	15.36 +/- 0.56	16.04 +/- 0.85
DR32	Twining Property, Taylors Island	13.97 +/- 0.91	16.36 +/- 0.59	15.58 +/- 1.63	16.93 +/- 0.42
DR33	P. A. Ransome Property	13.93 +/- 1.07	16.30 +/- 0.74	14.35 +/- 0.73	15.67 +/- 1.01
DR34	Shoreline at Barge Rd.	9.22 +/- 0.97	10.13 +/- 0.72	9.23 +/- 0.97	10.64 +/- 1.69
OSG1	North of Old Steam Generator Storage Facility	15.37 +/- 2.18	19.04 +/- 1.92	16.85 +/- 1.86	18.23 +/- 1.53
OSG2	West of Old Steam Generator Storage Facility	13.11 +/- 1.09	16.48 +/- 1.41	14.63 +/- 1.80	15.82 +/- 2.01

Table E-10

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

Site Code	Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
RPDR05	North Fence Lower	22.32 +/- 2.83	25.77 +/- 3.16	24.03 +/- 1.95	26.93 +/- 2.27
RPDR06	North Fence Upper	12.42 +/- 1.38	15.66 +/- 1.90	21.98 +/- 2.65	24.39 +/- 2.42
RPDR07	West Fence Right	17.25 +/- 1.22	16.95 +/- 1.65	17.10 +/- 1.60	18.46 +/- 2.16
RPDR08	West Fence Left	19.27 +/- 1.83	51.58 +/- 1.54	22.39 +/- 0.87	18.13 +/- 1.83
RPDR09	South Fence Upper	15.32 +/- 0.97	28.87 +/- 2.03	15.24 +/- 1.30	15.04 +/- 1.41
RPDR10	South Fence Lower	15.95 +/- 0.82	21.30 +/- 1.59	16.27 +/- 0.93	16.85 +/- 1.97
RPDR11	East Fence Left	18.91 +/- 0.71	23.99 +/- 2.74	19.80 +/- 0.75	16.81 +/- 2.02
RPDR12	East Fence Right	14.10 +/- 2.24	17.72 +/- 1.58	15.44 +/- 1.25	15.54 +/- 0.82

Table E-11

Concentration of Tritium in Groundwater
(Results in units of pCi/L +/- 2σ)

By Piezometer Tube Locations

Sample Date	11	12	13	15	18	19	20	21	22	23	24	25	26	27	28	29	30
01/31/2017	1740+/-89.3	#	#	#	ND	#	#	#	#	ND	#	#	ND	ND	ND	#	#
05/01/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	#	#	ND	ND	ND
05/02/2017	ND	#	#	#	ND	#	ND	ND	ND	#	#	#	ND	ND	#	#	#
05/03/2017	473+/-140	ND	ND	ND	ND	ND	#	#	#	ND	ND	ND	ND	ND	ND	ND	ND
07/31/2017	ND	ND	ND	ND	ND	#	#	#	#	ND	ND	ND	ND	ND	ND	ND	ND
08/01/2017	1810+/-481	#	#	#	ND	ND	ND	ND	ND	ND	#	#	ND	ND	ND	#	#
09/20/2017	931+/-160	#	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	#	#
10/23/2017	663+/-61.1	ND	ND	ND	ND	#	#	#	#	ND	ND	#	ND	ND	ND	ND	ND
10/24/2017	1980+/-254	#	#	#	ND	ND	ND	ND	ND	ND	#	ND	ND	ND	ND	#	#
11/29/2017	2380+/-302	#	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	#	#

ND

[#] Tritium Less than minimum Detectable Activity(<MDA)

[ND] No Data - Quarterly sample obtained as required.

Table E-11 (Continued)
Concentration of Tritium in Surface Water, Precipitation, and Subsurface Drainage
(Results in units of pCi/L +/- 2σ)

Sample Date	MH24	MH28	MH30	RW1	RW2	RW3	RW4	SW003	SW004
01/31/2017	#	ND	ND	ND	ND	ND	ND	ND	ND
02/01/2017	ND	2940+/-118	2340+/-939	ND	ND	ND	ND	#	#
03/20/2017	ND	ND	ND	#	#	#	#	ND	ND
05/02/2017	#	ND	ND	ND	ND	ND	ND	ND	ND
05/09/2017	ND	2350 +/-283	4330+/-478	ND	ND	ND	ND	ND	ND
08/01/2017	ND	2330+/-492	3190+/-378	ND	ND	ND	ND	ND	ND
11/16/2017	ND	4490+/-502	2960+/-351	ND	ND	ND	ND	ND	ND

Tritium Less than minimum Detectable Activity(<MDA)
ND No Data - Quarterly sample obtained as required.

Table E-12

Gross Concentration of Gamma Emitters in Groundwater
(Results in units of pCi/L +/- 2σ)

By Piezometer Tube Locations

Sample Date	11	12	13	15	18	19	20	21	22	23	24	25	26	27	28	29	30
05/01/2017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	*	ND	ND	ND
05/02/2017	ND	*	*	*	ND	*	ND	ND	ND	*	*	*	ND	ND	*	*	*
05/03/2017	*	ND	ND	ND	ND	ND	*	*	*	ND	ND	ND	ND	ND	ND	ND	ND
10/24/2017	*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

* All Non-Natural Gamma Emitters <MDA

ND No Data - Quarterly sample obtained as required.

Table E-12 (CONTINUED)

Gross Concentration of Gamma Emitters in Surface Water, Precipitation, and Subsurface Drainage (Results in units of pCi/L +/- 2σ)

Sample Date	MH24	MH28	MH30	RW1	RW2	RW3	RW4	SW003	SW004
05/02/2017	*	ND	ND	ND	ND	ND	ND	*	*
05/09/2017	ND	*	*	ND	ND	ND	ND	ND	ND

* All Non-Natural Gamma Emitters <MDA
ND No Data - Quarterly sample obtained as required.

Figure E-1

Site Map Groundwater Monitoring Wells

Figure 1
RGPP Monitoring Locations
Overburden Aquifer
Exelon Corporation
Clavert Cliffs Generating Station

Figure E-2

Site Map Rainwater Locations

APPENDIX F

Errata for 2016 AREOR Report

This Appendix is provided as errata to the Program Exception in Section II.B.4 of the 2016 Annual Radiological Environmental Operating Report (AREOR) dated May 15, 2017.

In the 2016 AREOR, Program Exceptions for REMP were provided in Appendix B, Analysis Results for the REMP and ISFSI. To correct the 2016 AREOR report for the REMP, this appendix is provided as errata. Program exceptions were discussed in II.B.4 but did not include an exception for analysis of Tritium performed outside the quarterly requirement. The section should also include the following:

> **A program exception for the 2016 operating period was noted and entered into the site Corrective Action Program for the analysis frequency of water samples collected quarterly as required but not analyzed for Tritium until the end of the year. Although this hold time is consistent with EPA method requirements for analyzing Tritium in Drinking water, it is not in compliance with the CCNPP ODCM Table 3.12-1 requirements for analysis frequency. Site personnel did not ensure the analyses were being performed at the specified frequency by the vendor. To prevent a recurrence, site personnel track the required sampling and analyses for REMP and perform quarterly reviews. Water samples for Tritium were analyzed quarterly as required in 2017.**