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U. S. Nuclear Regulatory Commission
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SUSQUEHANNA STEAM ELECTRIC STATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL
OPERATING REPORT
PLA-7985

Docket No. 50-387
50-388

In accordance with the Susquehanna Steam Electric Station (SSES) Units 1 and 2 Technical Specification 5.6.2, the SSES Annual Radiological Environmental Operating Report is hereby submitted for the 2021 calendar year.

There are no new or revised regulatory commitments contained in this submittal.

If you have any questions regarding this report, please contact Ms. Melisa Krick, Manager – Nuclear Regulatory Affairs, at (570) 542-1818.

Kevin Cimorelli

Attachment: 2021 Annual Radiological Environmental Operating Report

Copy: NRC Region I
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Attachment to PLA-7985

2021 Annual Radiological Environmental Operating Report

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 and 2

Annual Radiological
Environmental Operating Report

2021

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SUSQUEHANNA STEAM ELECTRIC STATION

Units 1 & 2

2021 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

JANUARY 1 TO DECEMBER 31, 2021

Susquehanna Nuclear, LLC
Berwick, PA
April, 2022

TABLE OF CONTENTS

I. Summary 1

II. The Radiological Environmental Monitoring Program 5
- A. Objectives of the Operational REMP 8
- B. Implementation of the Objectives 9

III. Program Description 10
- A. Data Interpretation 10
- B. Program Exceptions 12
- C. Program Changes 12
- D. Quality Assurance Program 22
- E. Summary of Results – Inter-Laboratory Comparison Program 22

IV. Results and Discussion 26
- A. Atmospheric 26
  1. Air Particulates 26
  2. Air Iodine 28
- B. Direct Radiation 28
- C. Terrestrial 30
  1. Milk 30
  2. Groundwater 31
  3. Drinking Water 33
  4. Food Products 34
- D. Aquatic 35
  1. Surface Water 35
  2. Fish 36
  3. Shoreline Sediment 37
- E. Land Use Census 39

V. Annotations to Previous AREOR 40

VI. Conclusions 40

VII. References 41

TABLE OF CONTENTS (cont'd)

Appendix A – Program Summary A-1

Appendix B – Sample Designation and Locations B-1

Appendix C – Data Tables C-1

Appendix D – Summary of Results from Analytics, Environmental Resource Associates (ERA) and Department of Energy (DOE) – Mixed Analyte Performance Evaluation Program (MAPEP) D-1

Appendix E – REMP Sample Equipment Operability Trending E-1

LIST OF TABLES

Exceptions Table..... 13

Appendix A Tables

Table A Summary of Data for SSES A-2

Appendix B Tables

Table B-1 Sampling Locations B-3

Table B-2 Susquehanna Steam Electric Station Radiological Environmental Monitoring Program B-8

Appendix C Tables

Table C-1 Gross Beta Analyses of Air Particulate Filters Susquehanna Steam Electric Station C-2

Table C-2 Gamma Spectroscopic Analyses of Composited Air Particulate Filters Susquehanna Steam Electric Station.....C-4

Table C-3 Iodine-131 Analyses of Air Iodine Samples Susquehanna Steam Electric Station C-5

Table C-4 Environmental Optically Stimulated Luminescence Dosimetry Results Susquehanna Steam Electric Station.....C-7

Table C-5 Iodine-131 and Gamma Spectroscopic Analyses of Milk Susquehanna Steam Electric Station.....C-10

Table C-6 Tritium and Gamma Spectroscopic Analyses of Groundwater Susquehanna Steam Electric Station.....C-12

LIST OF TABLES (cont'd)

Table C-7 Annual Average Tritium Concentration in Precipitation, Monitoring Wells and Lake Took-a-While (LTAW) Surface Water Data Susquehanna Steam Electric Station C-14

Table C-8 Gross Beta, Tritium and Gamma Spectroscopic Analyses of Drinking Water Susquehanna Steam Electric Station C-15

Table C-9 Gamma Spectroscopic Analyses of Food Products (Fruits, Vegetables, and Broadleaf) Susquehanna Steam Electric Station C-16

Table C-10 Tritium and Gamma Spectroscopic Analyses of Surface Water Susquehanna Steam Electric Station C-17

Table C-11 Gamma Spectroscopic Analyses of Fish Susquehanna Steam Electric Station C-19

Table C-12 Gamma Spectroscopic Analyses of Shoreline Sediment Susquehanna Steam Electric Station C-20

Appendix D Tables

Table D-1 Analytics Environmental Radioactivity Cross Check Program Teledyne Brown Engineering Environmental Services D-2

Table D-2 DOE's Mixed Analyte Performance Evaluation Program (MAPEP) Teledyne Brown Engineering Environmental Services D-4

Table D-3 ERA Environmental Radioactivity Cross Check Program Teledyne Brown Engineering Environmental Services D-5

Appendix E Table

Table E-1 REMP Sample Equipment Operability Trending Susquehanna Steam Electric Station E-2

LIST OF MAPS

Map B-1 Direct Radiation Monitoring Locations Within One Mile B-10

Map B-2 Direct Radiation Monitoring Locations From One to Five Miles B-11

Map B-3 Direct Radiation Monitoring Locations Greater than Five Miles B-12

Map B-4 Environmental Sampling Locations Within One Mile B-13

Map B-5 Environmental Sampling Locations From One to Five Miles B-14

Map B-6 Environmental Sampling Locations Greater than Five Miles B-15

LIST OF FIGURES

Figure 1 Radiation Pathways 7

Figure 2 Sources of Radiation Exposure in the U.S. 8

Figure C-1 Gross Beta Activity in Air Particulates C-21

Figure C-2 Ambient Radiation Levels Based on Environmental Dosimetry Data C-22

Figure C-3 Iodine-131 Activity in Milk C-23

Figure C-4 Annual Average Tritium Activity in Precipitation and Surface Water Versus Ground Water C-24

Figure C-5 Gross Beta Activity in Drinking Water C-25

Figure C-6 Tritium Activity in Surface Water C-26

I. Summary

During normal operations of a nuclear power generating station there are permitted releases of small amounts of radioactive material to the environment. To monitor and determine the effects of these releases a Radiological Environmental Monitoring Program (REMP) has been established around the Susquehanna Steam Electric Station (SSES). The results of the REMP are published annually, providing a summary and interpretation of the data collected.

Applied Ecoscience, Inc. was responsible for the collection of environmental samples during 2021. Teledyne Brown Engineering (TBE) was responsible for the analysis of environmental samples during 2021. The results are discussed in this report. Landauer provided the dosimetry services for SSES during 2021.

This Annual Radiological Environmental Operating Report (AREOR) conducted for SSES covers the period January 1, 2021 through December 31, 2021. During that time period, 1341 analyses were performed on 1144 samples.

Tritium (H-3) is the only man-made radionuclide detected in the environment by the Susquehanna Steam Electric Station (SSES) Radiological Environmental Monitoring Program (REMP) that is attributable to station operations. The whole body and organ dose to members of the public attributable to tritium identified in REMP cooling tower blowdown samples was 2.54E-04 mRem. Tritium was included in the dose calculation because it was identified in the REMP samples of permitted water being discharged to the Susquehanna River. The 2021 average concentration of tritium in the cooling tower blowdown water and the 2021 average cooling tower blowdown flow were used to determine the amount of tritium released. The presumed exposure pathways to the public from this radionuclide were drinking water taken from the Susquehanna River at Danville, PA and eating

fish caught near the SSES discharge to the river. Dose from ground plane deposition (shoreline exposure) is not applicable because tritium does not emit gamma radiation and the beta radiation emitted by tritium is not sufficiently penetrating to reach an individual on the shore.

Based on the above outlined methodology, the total tritium activity released from the SSES to the Susquehanna River in 2021 was 22.9 curies.

The 2021 average dilution factor for the Susquehanna River was 833, based on the annual average river flow of 8.52E+06 gpm and the annual average cooling tower blowdown flow of 1.023E+04 gpm.

The REMP Sample Equipment Operability and year-to-year trend comparison is located in Appendix E, Table E-1.

The REMP was conducted in accordance with the SSES Technical Requirements Manual (TRM) and the respective station Offsite Dose Calculation Manual (ODCM) which are based on the design objectives in 10CFR Part 50, Appendix I, Sections IV.B.2, IV.B.3 and IV.C. The Lower Limit of Detection (LLD) values required by the TRM and SSES ODCM were achieved for the 2021 reporting period. The REMP objectives were also met during this period. The concentration of radioactive material in the environment that could be attributable to SSES operations was only a small fraction of the concentration of naturally occurring and man-made radioactivity. Since these results were comparable to the results obtained during the preoperational phase of the program and combined with historical results collected since commercial operation, it can be concluded that the levels and fluctuations were as expected and that the operation of the SSES had no significant radiological impact on the environment. Additionally, the REMP sample results for 2021 verify the adequacy of the SSES radioactive effluent control systems.

Samples of air particulates, air iodine, milk, groundwater, drinking water, vegetation, surface water, fish and sediment were collected and analyzed.

External radiation dose measurements were also made in the vicinity of SSES using passive dosimeters.

Air particulate samples were analyzed for concentrations of gross beta weekly and gamma emitting nuclides quarterly. Gross beta and cosmogenically produced beryllium-7 (Be-7) were detected at levels consistent with those detected in previous years. No fission or activation products were detected.

Air charcoal cartridge samples were analyzed for iodine-131 (I-131). All results were less than the minimum detectable concentration.

Environmental gamma radiation measurements were performed quarterly using optically stimulated luminescent dosimeters (OSLD). The levels of radiation detected were consistent with those observed in previous years.

Cow milk samples were analyzed for gamma emitting nuclides. High sensitivity I-131 analyses were performed on cow milk samples. All I-131 results were below the minimum detectable concentration. Naturally occurring potassium-40 (K-40) was detected at levels consistent with those detected in previous years. No fission or activation products were detected.

Groundwater samples were analyzed for concentrations of tritium and gamma emitting nuclides. Tritium activities were detected at levels consistent with those detected in previous years. No fission or activation products were detected.

Drinking water samples were analyzed for concentrations of tritium, gross beta and gamma emitting nuclides. Gross beta activities detected were consistent with those detected in previous years. No fission or activation products were detected.

Food product (fruits, vegetables and broadleaf vegetation) samples were analyzed for concentrations of gamma emitting nuclides. Naturally occurring

Be-7 and K-40 were detected at levels consistent with those detected in previous years. No fission or activation products were detected.

Surface water samples were analyzed for concentrations of tritium and gamma emitting nuclides. Tritium activities detected were consistent with those detected in previous years. No fission or activation products were detected.

Fish and shoreline sediment samples were analyzed for concentrations of gamma emitting nuclides. Naturally occurring K-40 was detected at levels consistent with those detected in previous years. Naturally occurring radium-226 (Ra-226), actinium-228 (Ac-228), cesium-137 (Cs-137), and thorium-228 (Th-228) were detected in shoreline sediment at levels consistent with results in previous years. No fission or activation products were detected in fish or sediment samples.

II. The Radiological Environmental Monitoring Program

The Susquehanna Steam Electric Station (SSES) is a nuclear electrical generating station located approximately 5 miles northeast of Berwick, in Luzerne County, Pennsylvania. The station consists of two boiling-water reactor generating units. The SSES is located on approximately a 1,087-acre tract just west of the Susquehanna River. The station was constructed in the 1970's, with Unit 1 beginning commercial operation on June 8, 1983, and Unit 2 beginning commercial operation on February 12, 1985. Units 1 and 2 each generate a net 1,350 megawatts (MWe), for a total station output of 2,700 MWe.

In the 4th quarter of 2021, Susquehanna Nuclear, LLC land ownership was reduced due to land transfers to other Talen Energy entities. Impacts to the SSES REMP resulting from the above referenced land ownership changes are being implemented as appropriate by SSES Chemistry personnel. REMP changes resulting from the land transfers shall be documented in future Radiological Environmental Operating Reports.

In total Susquehanna Nuclear, LLC presently owns 1,152 acres of land. Generally, this land is characterized by open deciduous woodlands interspersed with grasslands. The area around the site is primarily rural, consisting predominately of forest and agricultural lands.

Approximately 1,087 acres of land is jointly owned between Susquehanna Nuclear, LLC (90%) and Allegheny Electric Cooperative (10%). The land use includes generation and associated maintenance facilities, laydown areas, parking lots, roads, a nature preserve (the Susquehanna Riverlands), and agricultural leases to local farmers.

To the north of the station along the Susquehanna River, Susquehanna Nuclear, LLC owns 100% of the 65-acre Gould Island.

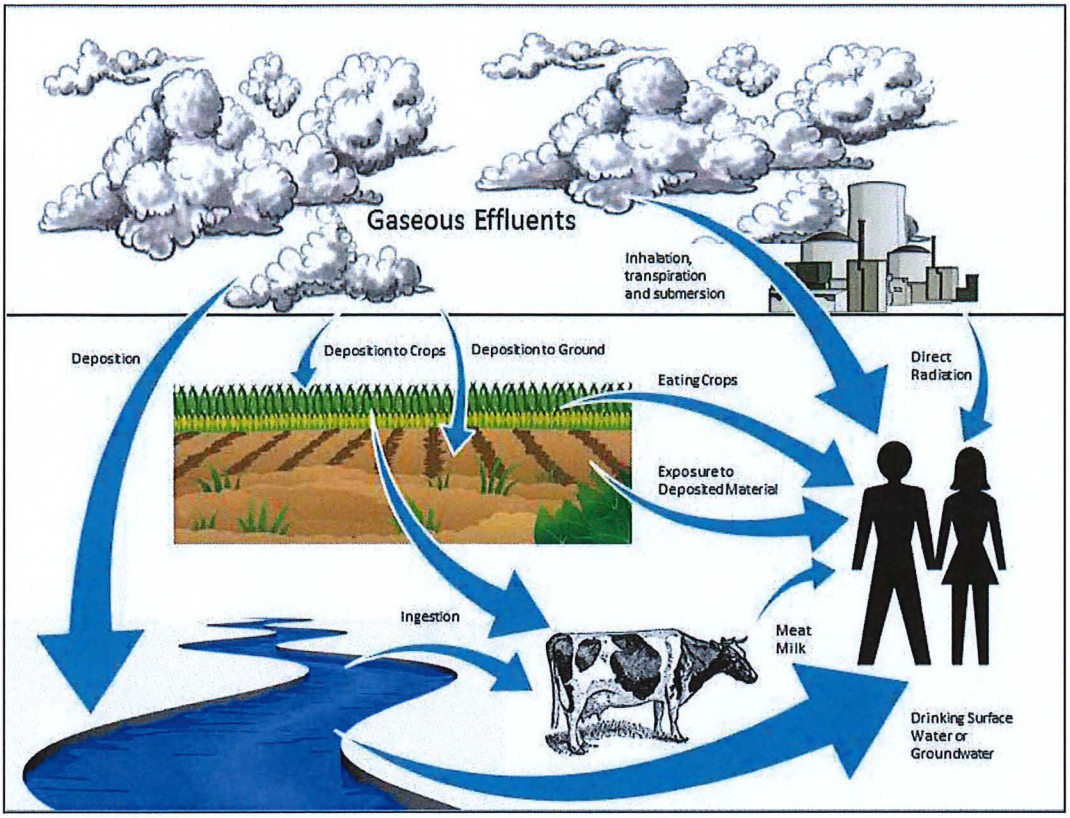
More specific information on the demography, hydrology, meteorology, and land use characteristics of the area in the vicinity of the SSES can be found in the Environmental Report [Reference 1], the Final Safety Analysis Report [Reference 2] and the Final Environmental Statement [Reference 3] for the SSES.

The SSES has maintained a Radiological Environmental Monitoring Program (REMP) since April 1972, prior to construction of both units and ten years prior to the initial operation of Unit 1 in September 1982. The purpose of the preoperational REMP (April,1972 to September 1982) was to establish a baseline for radioactivity in the local environment that could be compared with the radioactivity levels observed in various environmental media throughout the operational lifetime of the SSES. This comparison facilitates assessments of the radiological impact of the SSES operation.

The REMP supplements the results of the radioactive effluent-monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than expected based on the effluent measurements and modeling of the environment in the vicinity of the SSES.

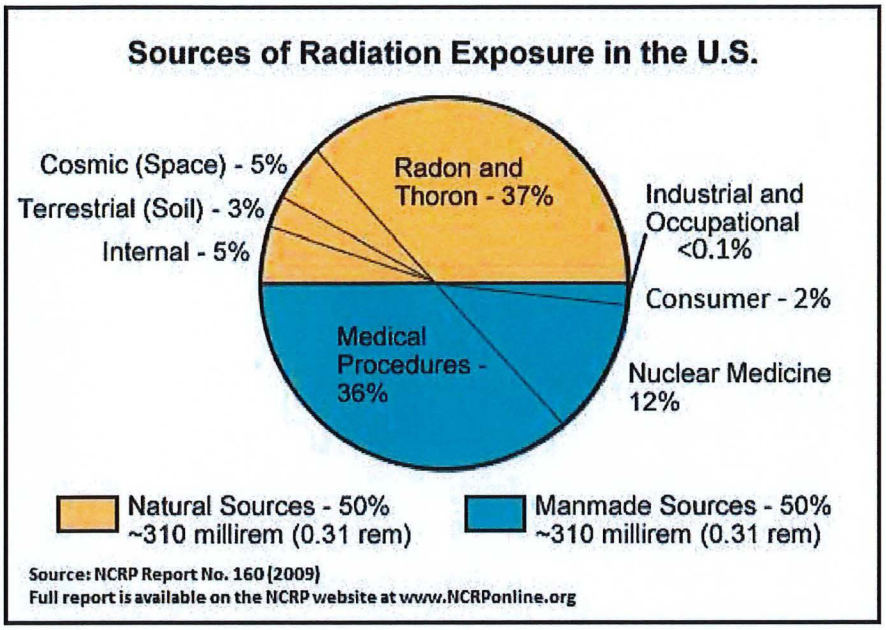
The pathways through which radiation or radioactive material may reach the public from nuclear power plants are direct exposure from the station, atmospheric, terrestrial, and aquatic pathways. (Figure 1 depicts these pathways)

Figure 1 – Radiation Pathways



People are exposed to radiation every day of their lives and have been since the dawn of mankind. Some of this radiation is naturally occurring while some is manmade. There are many factors that will determine the amount of radiation individuals will be exposed to such as where they live, medical treatments, etc. The average person in the United States is exposed to approximately 620 mrem each year. 310 mrem comes from natural sources and 310 from man-made sources. Figure 2 shows what the typical sources of radiation in the U.S.:

Figure 2 – Sources of Radiation Exposure in the U.S.



Radioanalytical data from samples collected under the REMP were compared with results from the preoperational phase and historical results during operations. Differences between these periods were examined statistically to determine the effects of station operations. This report presents the results from January 1 through December 31, 2021, for the SSES Radiological Environmental Monitoring Program (REMP).

A. Objectives of the Operational REMP

The objectives of the Operational REMP are to:

1. Document compliance with SSES REMP Technical Requirements and radiological environmental surveillances.

2. Verify proper implementation of SSES radiological effluent controls.

3. Identify, measure and evaluate trends of radionuclide concentrations in environmental pathways near SSES.

4. Assess impact of SSES Effluents on the Environment and the public.

5. Verify that SSES operations have no detrimental effects on the health and safety of the public or on the environment.

B. Implementation of the Objectives

1. In order to meet the objectives, an operational REMP was developed. Samples of various media were selected for monitoring due to the radiological dose impact to humans and other organisms. The selection of samples was based on:

   (a) Established critical pathways for the transfer of radionuclides through the environment to man, and

   (b) Experience gained during the preoperational phase. Sampling locations were determined based on local meteorology, Susquehanna River hydrology, local demography, and land uses.

2. Sampling locations were divided into two classes, indicator and control. Indicator locations were sited where it is expected that radiation and radioactive material that might originate from the station would be detectable. Control locations were selected in areas where they would be unaffected by station operations (i.e. Susquehanna River upstream from the station, >10 miles from the station in least prevalent wind directions). Fluctuations in the levels of radionuclides and direct radiation at indicator locations were evaluated with respect to analogous fluctuations at control locations. Indicator and control location data were also evaluated relative to preoperational data.

3. Appendix A, Program Summary, describes and summarizes the

analytical results in accordance with the SSES Technical Specifications.

4. Appendix B, Sample Designation and Locations, describes the coding system which identifies sample type and location. Table B-1 lists the location codes, locations, latitude, longitude, and the types of samples collected at each location. Table B-2 contains sample medium, analysis and sampling details.

5. The sampling locations are indicated on the following maps:

   Map B-1, Direct Radiation Monitoring Locations Within One Mile
   Map B-2, Direct Radiation Monitoring Locations From One to Five Miles
   Map B-3, Direct Radiation Monitoring Locations Greater Than Five Miles
   Map B-4, Environmental Sampling Locations Within One Mile
   Map B-5, Environmental Sampling Locations From One to Five Miles
   Map B-6, Environmental Sampling Locations Greater Than Five Miles

II. Program Description

A. Data Interpretation

Results of analyses are grouped according to sample type and presented in Appendix C, Data Tables. All results above the Lower Limit of Detection (LLD) are at a confidence level of ± 2 sigma. This represents the range of values into which 95% of repeated analyses of the same sample should fall. As defined in U.S. Nuclear Regulatory Commission Regulatory Guide 4.8, LLD is the smallest concentration of radioactive material in a sample that will yield a net count (above

system background) that will be detected with 95% probability, with only 5% probability of falsely concluding that a blank observation represents a "real signal." LLD is normally calculated as 4.66 times the standard deviation of the background counting rate, or of the blank sample count, as appropriate, divided by counting efficiency, sample size, 2.22 (dpm per picocurie), the radiochemical yield when applicable, the radioactive decay constant and the elapsed time between sample collection and time of counting. LLD represents the capability of the measurement system.

The Minimum Detectable Concentration (MDC) is defined as the smallest concentration of radioactive material that can be detected at a given confidence level. The MDC differs from the LLD in that the MDC takes into consideration the interference caused by the presence of other nuclides while the LLD does not. MDC is an indicator of the performance of the measurement system. The MDC is set to be below the LLD.

Summaries of the radionuclide average picocurie activities and ranges are included in Table A. If a radionuclide was not detected, zero was used for that isotope in dose calculations and the activity is listed as “<MDC” (less than the minimum detectable concentration) in Table A. <MDC indicates that no activity was positively detected in any sample when samples were analyzed with techniques which achieved the required Lower Limits of Detection (LLD). The following are typical measurement laboratory MDCs for airborne and waterborne REMP samples.

Airborne REMP Typical MDCs

Radionuclide	MDC (pCi/cu.m.)
Mn-54	1.2 E-03
Fe-59	6.9 E-03
Co-58	1.8 E-03
Co-60	1.1 E-03
Zn-65	2.9 E-03
Cs-134	1.1 E-03
Cs-137	1.0 E-03
I-131	2.3 E-01

Waterborne REMP Typical MDCs

Radionuclide	MDC (pCi/L.)
H-3 (DIST)	1.6 E+02
Mn-54	3.6 E+00
Fe-59	1.0 E+01
Co-58	3.8 E+00
Co-60	4.0 E+00
Zn-65	7.3 E+00
Cs-134	3.5 E+00
Cs-137	3.8 E+00
I-131	1.0 E+01
H-3	1.6 E+02
Gross Beta	1.3 E+00

The grouped data were averaged and standard deviations calculated. Thus, the ± 2 sigma of the averaged data represent sample and not analytical variability. For reporting and calculation of averages, any result occurring at or below the LLD is considered to be at the LLD level.

B. Program Exceptions

See Exceptions Table 2021 REMP Atypical Sampling Occurrences

C. Program Changes

There were no program changes in 2021.

2021 REMP Atypical Sampling Occurrences

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
JAN	Surface Water	6S6	12/29/20 to 01/04/21 (week 1 Jan composite) Air accumulation in line of REMP ACS at River Intake (0C564). No effect on sampling.	CA #21-02 CR 2021-00327 01/04/21: Requested I&C perform maintenance. 01/25/21: I&C performed monthly preventative maintenance on sampler. 01/26/21: Operability verified @ 1119 hours. *Ideal sample collected for sample period.*
FEB	Surface Water	2S7	02/03/21 to 02/11/21 (weeks 1 & 2 February composite) ACS sample line blocked after week 1 sample collection and will not draw liquid. Three of the four lines are blocked. Calibration/volume verification not possible due to lack of available water line. REMP sampler shut off on 02/03/21 @ 1030 hours. All four lines scheduled to be replaced as per AR 2021-01902.	CA #21-03 CR 2021-01822 02/04/21: FIN partially cleared two sample lines. REMP sampler placed on one of the lines. 02/10/21: Grab sample collected at 2S7 @ 1030 hours for week 2 February. 02/11/21: Operability verified @ 1552 hours. *Ideal sample collected for week 1 sample period, and grab sample collected for week 2 sample period.*
	Surface Water	2S7	01/26/21 to 02/03/21 (week 1 February composite) ACS automatically shut off on 01/31/21 @ approximately 1709 hours when the float weight was tripped. Greater than normal volume of water collected for week, possibly due to malfunctioning liquid detector. When placed on new supply line on 02/03/21 (CR 2021-01822) sampler could not detect liquid.	CA #21-04 CR 2021-01831 02/10/21: Grab sample collected at 2S7 @ 1030 hours for week 2 February. 02/11/21: New liquid detector installed. Sampler was calibrated to within procedural range. 02/11/21: Operability verified @ 1552 hours. *Ideal sample collected for week 1 sample period, and grab sample collected for week 2.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
FEB (cont.)	Air	3S2	01/27/21 to 02/04/21 Pump providing inadequate flow rate upon arrival (<2.0 cfm), below the procedural range of 2.0-2.4 cfm. Adequate flow could not be achieved with maximum flow settings. Continuous sampling during sample period.	CA #21-05 CR 2021-01882 02/04/21: Pump was replaced, and air flow restored to 2.3 cfm. 02/04/21: Operability verified @ 1230 hours. *Less than ideal sample collected for sample period:* *14,900 cf (01/27/21 to 02/04/21).* *Volume adequate to support required analysis.*
	Air	9B1	02/17/21 to 02/24/21 Pump providing inadequate flow rate upon arrival (<2.0 cfm), below the procedural range of 2.0-2.4 cfm. Adequate flow could not be achieved with maximum flow settings. Continuous sampling during sample period.	CA #21-06 CR 2021-02777 02/24/21: Pump was replaced, and air flow restored to 2.3 cfm. 02/24/21: Operability verified @ 1027 hours. *Ideal sample collected for sample period:* *17,700 cf.*
MAR	Air	12S1	03/10/21 to 03/17/21 (momentary loss of 12kV power) Momentary loss of power on 03/11/21 @ 2200 hours. No loss of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-07 CR 2021-03566 03/11/21: No action required. Air monitor resumed normal operation when power was restored. 03/12/21: Operability verified @ 0904 hours. *Ideal sample collected for sample period:* *22,100 cf.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
MAR (cont.)	Air	12S1	03/10/21 to 03/17/21 (momentary loss of 12kV power) Momentary loss of power on 03/14/21 @ 0800 hours. No loss of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-08 CR 2021-03407 03/14/21: No action required. Air monitor resumed normal operation when power was restored. 03/14/21: Operability verified @ 1505 hours. *Ideal sample collected for sample period: 22,100 cf.*
	Air	3S2, 13S6, 9B1	03/10/21 to 03/17/21 Power outages- dates and times unknown. Loss of 1.3 hours at 3S2, 1.6 hours at 13S6, and 1.3 hours at 9B1, as determined by timer boxes during weekly collection. Non-continuous sampler operation.	CA #21-09 CR 2021-03836 03/17/21: No action required. Air monitors resumed normal operation when power was restored. 03/17/21: Operability verified @ 0916 hours for 3S2, 0928 hours for 13S6, and 0959 hours for 9B1. *Ideal samples collected for sample period: 21,500 cf (3S2), 20,100 cf (13S6), 22,900 cf (9B1).*
	Air	12S1	03/24/21 to 03/31/21 (momentary loss of 12kV power) Momentary loss of power on 03/26/21 @ 1430 hours. No loss of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-10 CR 2021-04517 03/26/21: No action required. Air monitor resumed normal operation when power was restored. 03/27/21: Operability verified @ 0738 hours. *Ideal sample collected for sample period: 21,500 cf.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
APR	Air	12E1	04/07/21 to 04/14/21 Pump providing inadequate flow rate upon arrival (<2.0 cfm), below the procedural range of 2.0-2.4 cfm. Adequate flow could not be achieved with maximum flow settings. Continuous sampling during sample period.	CA #21-11 CR 2021-06278 04/14/21: Pump was replaced, and air flow restored to 2.2 cfm. 04/14/21: Operability verified @ 1010 hours. *Less than ideal sample collected for sample period:* *12,300 cf (04/07/21 to 04/14/21).* *Volume adequate to support required analysis.*
	Surface Water	6S6	04/20/21 to 04/27/21 (week 4 April composite through week 3 May composite) While I&C was performing monthly preventative maintenance, tubing to the composite sampler broke, rendering it nonoperational. Grab sample collected for week 4 April, as well as weeks' 1-3 May.	CA #21-12 CR 2021-07116 04/26/21: Week 4 April sample stopped @ 1356 hours. 05/17/21: I&C restored the sampler to service @ 1423 hours. 05/18/21: Operability verified @ 1415 hours. *Grab samples collected for sample periods @ location 5S9.*
MAY	Air	10S3	05/12/21 to 05/19/21 (loss of 1.2 hours) Power outage- date and time unknown. Loss of 1.2 hours, as determined by timer box during weekly collection. Non-continuous sampler operation.	CA #21-13 CR 2021-08289 05/19/21: No action required. Air monitor resumed normal operation when power was restored. 05/19/21: Operability verified @ 0930 hours. *Ideal sample collected for sample period:* *22,300 cf.*

4

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
MAY (cont.)	Air	12E1	05/12/21 to 05/19/21 Timer box malfunction. Timer box not advancing on pace. Only 112.0 hours recorded for the week. No effect on monitoring. Continuous sampler operation.	CA #21-14 CR 2021-08292 05/19/21: Timer box #5 replaced with timer box #10. Equipment restored to service @ 1148 hours. 05/19/21: Operability verified @ 1148 hours. *Ideal sample collected for sample period: 21,900 cf.*
	Surface Water	2S7	05/18/21 to 05/25/21 (week 4 May composite) ACS sample line became blocked after flushing out the line during week 4 sample collection. Two of the four lines are blocked. Sufficient sample volume collected for week 4 sample.	CA #21-15 CR 2021-08502 05/25/21: REMP sampler placed on backup line. 08/18/21: Mechanical Maintenance cleared bottom right sample line. 09/07/21: REMP sampler placed on bottom right line after issues with current line. 09/07/21: Operability verified @ 1026 hours. *Ideal samples collected for sample periods.*
JUN	Surface Water	2S7	06/01/21 to 06/08/21 – week 1 Jun composite 06/08/21 to 06/15/21 – week 2 Jun composite CTBD secured for planned work associated with the blowdown line sparger inspection. CTBD secured each day from 06/07/21 to 06/09/21. No water available to collect comparative grab samples during inspection period. Sufficient sample volume collected for weeks 1 & 2 June composite.	CA #21-16 CR 2021-08984 06/07/21: REMP sampler turned off @ 1424 hours due to lack of water. 06/09/21: Inspection completed. Sampler returned to service and operability verified @ 1455. *Ideal samples collected for sample periods.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
JUN (cont.)	Air	12S1	06/09/21 to 06/16/21 (momentary loss of 12kV power) Momentary loss of power on 06/11/21. No loss of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-17 CR 2021-09223 06/11/21: No action required. Air monitor resumed normal operation when power was restored. 06/11/21: Operability verified @ 0831 hours. *Ideal sample collected for sample period: 22,000 cf.*
JUL	Surface Water	2S7	07/13/21 to 07/20/21 (week 3 July composite) Non-representative sample caused by overflowing collection tank at time of sample collection on 07/20/21. Reason unknown. Ideal aliquots measured at time of collection.	CA #21-18 CR 2021-10921 07/20/21: Grab sample collected @ 2S7 @ 1130 hours. 07/20/21: Equipment restored to service with aliquots of 20mL and 15mL. 07/27/21: Operability verified @ 0939 hours. *Grab sample collected for sample period.*
	Drinking Water	12H2	07/13/21 to 07/20/21 (week 3 July composite) No water flow to REMP sampler during maintenance activities at the Danville Water Company. Maintenance lasted from 0830 hours to 1100 hours on 07/20/21.	CA #21-19 CR 2021-10925 07/20/21: Adequate sample volume collected during sample period. Sampler resumed normal operation when flow was restored. 07/20/21: Operability verified @ 1100 hours. *Ideal sample collected for sample periods.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
AUG	Air	12S1	07/28/21 to 08/04/21 Pump providing inadequate flow rate upon arrival (<2.0 cfm), below the procedural range of 2.0-2.4 cfm. Adequate flow could not be achieved with maximum flow settings. Continuous sampling during sample period.	CA #21-20 CR 2021-11662 08/04/21: Pump was replaced, and air flow restored to 2.2 cfm. 08/04/21: Operability verified @ 0943 hours. *Less than ideal sample collected for sample period:* *14,500 cf (07/28/21 to 08/04/21).* *Volume adequate to support required analysis.*
	Air	3S2, 13S6, 12S1, 10S3, 9B1	08/04/21 to 08/11/21 Power outages- dates and times unknown. Loss of 0.4 hours at 3S2, 13S6, and 12S1, loss of 3.0 hours at 10S3, and 0.3 hours at 9B1, as determined by timer boxes during weekly collection. Non-continuous sampler operation.	CA #21-21 CR 2021-12041 08/11/21: No action required. Air monitors resumed normal operation when power was restored. 08/11/21: Operability verified @ 0834 hours for 3S2, 0848 hours for 13S6, 0859 hours for 12S1, 0915 hours for 10S3, and 0934 hours for 9B1. *Ideal samples collected for sample period:* *22,100 cf (3S2), 21,100 cf (13S6), 22,300 cf (12S1), 21,500 cf (10S3), and 22,200 cf (9B1).*
	Direct Radiation	14S5	2nd Quarter (8/5/21) Analysis results were missing for one of the dosimeters from location 14S5 on the 2nd quarter analysis report from the vendor analysis lab.	CR 2021-11728 All 2nd quarter 2021 dosimeters accounted for and shipped to the analysis vendor. Analysis vendor indicated they did not receive the missing dosimeter.

7

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
SEP	Air	12S1	08/31/21 to 09/08/21 (momentary loss of 12kV power) Momentary loss of power on 09/01/21. No loss of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-22 CR 2021-13057 09/01/21: No action required. Air monitor resumed normal operation when power was restored. 09/02/21: Operability verified @ 1104 hours. *Ideal sample collected for sample period: 26,100 cf.*
OCT	Air	8G1	10/06/21 to 10/13/21 (loss of 0.3 hours) Power outage on 10/07/21 @ approximately 1030 hours. Loss of 0.3 hours, as determined by timer box during weekly collection and PPL maintenance personnel. Non-continuous sampler operation.	CA #21-23 CR 2021-14862 10/07/21: No action required. Air monitor resumed normal operation when power was restored. 10/13/21: Operability verified @ 1041 hours. *Ideal sample collected for sample period: 20,800 cf.*
	Surface Water	6S6	10/19/21 to 10/26/21 (week 4 October composite) Automatic composite sampler would not sample after being returned to service following monthly preventative maintenance performed by I&C.	CA #21-24 CR 2021-15292 & CR 2021-15297 10/25/21: Week 4 October sample stopped @ 1328 hours. 10/26/21: I&C restored the sampler to service at 1130 hours. 10/26/21: Operability verified @ 1304 hours. *Ideal sample collected for sample period.*

2021 REMP Atypical Sampling Occurrences (continued)

Date	Sample Type	Location Code(s)	Sample Period Reason for Occurrence(s)	Corrective Action
OCT (cont.)	Air	12S1	10/20/21 to 10/27/21 (momentary losses of 12kV power) Multiple momentary losses of power on 10/26/21. No losses of sampling time as determined by timer box. Non-continuous sampler operation.	CA #21-25 CR 2021-15327 & CR 2021-15342 10/26/21: No action required. Air monitor resumed normal operation each time power was restored. 10/26/21: Operability verified @ 1422 hours. *Ideal sample collected for sample period: 22,400 cf.*
	Direct Radiation	3S3	3rd Quarter (10/12/21) Dosimeters at location 3S3 were unable to be located during quarterly exchange. Dosimeter holder was in place, but dosimeters were missing.	CR 2021-14804 4th quarter dosimeters deployed into existing dosimeter holder.
NOV	Air	12S1	10/27/21 to 11/03/21 Pump providing inadequate flow rate upon arrival (<2.0 cfm), below the procedural range of 2.0-2.4 cfm. Adequate flow could not be achieved with maximum flow settings. Continuous sampling during sample period.	CA #21-26 CR 2021-15781 11/03/21: Pump was replaced, and air flow restored to 2.2 cfm. 11/03/21: Operability verified @ 1006 hours. *Ideal sample collected for sample period: 22,300 cf.*
	Surface Water	2S7	11/02/21 to 11/08/21 (week 2 Nov composite) Less than adequate sample volume collected for week 2 November composite. Sample line appeared to be blocked and unable to pull water.	CA #21-27 CR 2021-15981 11/08/21: Grab sample collected at 2S7 @ 1225 hours for week 2 November. Sampler moved to bottom left line in cabinet. Sampler recalibrated. 11/08/21: Operability verified @ 1451 hours. *Grab sample collected for sample period.*

D. Quality Assurance Program

Teledyne Brown Engineering

The quality of the results obtained by TBE is ensured by the implementation of the Quality Assurance Program as described in the Teledyne Brown Engineering Quality Assurance Manual and the Teledyne Brown Engineering Procedure Manual.

E. Summary of Results – Inter-Laboratory Comparison Program

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes. The PE samples supplied by Analytics Inc., Environmental Resource Associates (ERA) and Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

1. Analytics Evaluation Criteria

   Analytics' evaluation report provides a ratio of TBE's result and Analytics' known value. Since flag values are not assigned by Analytics, TBE evaluates the reported ratios based on internal QC requirements based on the DOE MAPEP criteria.

2. ERA Evaluation Criteria

   ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the USEPA, National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (PT) program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression

equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

3. DOE Evaluation Criteria

MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

- Acceptable (flag = "A") - result within ± 20% of the reference value
- Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
- Not Acceptable (flag = "N") – bias is greater than 30% of the reference value

Note: The Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

Teledyne Brown Engineering

For the TBE laboratory, 146 out of 154 analyses performed met the specified acceptance criteria. Seven analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program. NOTE: One analysis (soil for Tc-99) that did not meet acceptance criteria was performed for TBE information and is not on the list of required ICP analyses. A summary is found below:

1. The ERA MRAD March 2021 Water Fe-55 result was evaluated as Not Acceptable. The reported value for Fe-55 was 579 pCi/L and the known result was 275 pCi/L (acceptance range 162 - 400). When reviewing the original sample data, it was found

that the carrier yield was 52.6% (lower than typical water samples). Looking at the etched plate that was counted, it appeared that some loss of sample could have occurred. The sample was logged for reanalysis and used as the workgroup duplicate. The results were acceptable at 197 and 221 respectively. Yields were 97.4% and 105.7% and the plated samples were centered with no apparent loss of sample. The loss of sample during plating resulted in a low yield which produced an artificially high sample result. (NCR 21-01)

2. The MAPEP February 2021 AP Gross Alpha result was evaluated as Not Acceptable. The reported value was 0.371 Bq/sample and the known result was 1.77 Bq/sample (acceptance range 0.53 - 3.01). A similar failure had occurred several years prior due to the filter being placed with the wrong side up on the detector. At that time, a small dot was placed on the top of the filter prior to removal from the package to indicate the correct side for counting. The current sample was still in the detector when the result was received (dot side facing the detector). The sample was recounted with a similar result and was flipped and recounted. The flipped result was 0.661 Bq/sample, within the acceptable range. Because TBE cannot rely on receiving correct packaging from the provider, MAPEP AP cross-checks will be counted on both sides going forward. NOTE: The August sample had the same packaging issue (upside down). (NCR 21-02)

3. The MAPEP February 2021 soil Ni-63 was evaluated as Not Acceptable. The reported value was 310 Bq/kg and the known result was 689 (acceptance range 482 - 896). All workgroup QC was reviewed with no anomalies. The analytical procedure had been revised prior to this analysis to eliminate added interferences. The sample yield was >100%, indicative of

incomplete separation from interferences, leading to a lower result. The procedure was again revised after acceptable results were obtained. (NCR 21-03)

4. The ERA October 2021 water Gross Beta result was evaluated as Not Acceptable. The reported value was 63.0 pCi/L and the known was 55.7 (acceptance range 38.1 - 62.6) or 113% of the known. The 2-sigma error was 6.8, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. A follow-up Quick Response cross-check was analyzed with a 120% ratio (see item 7). (NCR 21-10)

5. The ERA October 2021 water Tritium result was evaluated as Not Acceptable. The reported value was 13,800 pCi/L and the known was 17,200 (acceptance range 15,000 - 18,900). The 2-sigma error was 1,430, placing the result within the acceptable range. TBE's internal QC acceptance is 70% - 130%, while ERA's for this sample was 87% - 110%. All QA was reviewed with no anomalies. A Quick Response follow-up cross-check was analyzed with a result of 17,500 pCi/L (known 17,800 pCi/L). (NCR 21-11)

6. The MAPEP August 2021 soil Ni-63 result was evaluated as Not Acceptable. The reported value was 546 Bq/kg and the known result was 1,280 Bq/kg (acceptance range 896 - 1,664). All QC was reviewed and no anomalies found. The procedure revision to remove added MAPAP interferences was ineffective for this sample. No client soil matrix samples were analyzed for Ni-63 in 2020 or 2021. The root cause investigation is still ongoing at this time. (NCR 21-13)

7. The ERA December 2021 Quick Response water Gross Beta result was evaluated as Not Acceptable. The reported value

was 47.6 pCi/L and the known was 39.8 pCi/L or 120% of the known (acceptance range of 26.4 - 47.3). The 2-sigma error was 6.1, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. The original sample was recounted on a different detector with a result of 40.3 ± 6.27 pCi/L. The “failure” of this sample and the RAD-127 was due to the narrow upper acceptance ranges assigned (119% and 112%) (NCR 21-14)

The Inter-Laboratory Comparison Program provides evidence of “in control” counting systems and methods, and that the laboratories are producing accurate and reliable data.

IV. Results and Discussion

The analytical results of the 2021 REMP samples are divided into categories based on exposure pathways: atmospheric, direct radiation, terrestrial, and aquatic. The analytical results for the 2021 REMP are summarized in Appendix A, Program Summary. The data for individual samples are presented in Appendix C, Data Tables. The data are compared to the formal preoperational environmental monitoring program data (April 1972 to September 1982) and to data during operations. The data collected demonstrates that the SSES REMP was conducted in compliance with the TRM and the SSES ODCM.

A. Atmospheric

Atmospheric REMP sampling included the collection of air particulates, air iodine and direct radiation samples.

1. Air Particulates

Air particulate samples were collected weekly at six indicator locations (3S2, 9B1, 10S3, 12E1, 12S1 and 13S6) and one

control locations (8G1). Each of the samples collected for the year were analyzed for gross beta. Quarterly composites of the weekly samples from each location were analyzed for specific gamma emitters.

Gross Beta

Gross beta activity was detected in 312 of 312 of the indicator location samples at concentrations ranging from 6 to 26 E-3 pCi/m^3 with an average concentration of 15 E-3 pCi/m^3, and in 52 of 52 of the control location samples at concentrations ranging from 6 to 24 E-3 pCi/m^3 with an average of 14 E-3 pCi/m^3. The maximum preoperational level detected was 102 E-3 pCi/m^3 with an average concentration of 62 E-3 pCi/m^3. (Table C–1, Appendix C); Historical levels of gross beta are shown in Figure C-1. Results for gross beta analysis from 1974 to current year are plotted.

Gamma Spectrometry

Gamma spectrometry was performed on each of the 28 quarterly composite samples. Beryllium-7, attributed to cosmic ray activity in the atmosphere, was detected in all 24 indicator location composites at concentrations ranging from 89 E-3 to 141 E-3 pCi/m^3 with an average concentration of 113 E-3 pCi/m^3, and in the four control location composites ranging in concentration from 110 to 118 E-3 pCi/m^3 with an average concentration of 114 E-3 pCi/m^3.

The maximum preoperational level detected was 85 E-3 pCi/m^3 with an average concentration of 74 E-3 pCi/m^3. (Table C–2, Appendix C)

All other gamma emitters were less than the LLD.

2. Air Iodine

Filtered air iodine samples were collected weekly at six indicator locations (3S2, 9B1, 10S3, 12E1, 12S1, and 13S6) and one control locations (8G1). Each of the samples collected for the year were analyzed for I-131.

Iodine-131

Iodine-131 was not detected in any indicator location samples or control location samples. Preoperational data is not available for comparison. (Table C–3, Appendix C)

B. Direct Radiation

Ambient radiation levels in the environs were measured at each monitoring location with a pair of optically stimulated luminescent dosimeters (OSLD) composed of aluminum oxide crystals supplied and processed by Landauer. The Landauer OSLD is designed to meet the ANSI N545 Standard and ANSI/HPS Standard N13.37-2014. Packets containing OSLDs for quarterly exposure were placed in the owner-controlled area and around the site at various distances and in each land-based meteorological sector. Emphasis was placed on special interest areas such as population centers, nearby residences, and schools.

A total of 57 locations were monitored for direct radiation during 2021, including 32 site boundary locations, 14 outer distant locations, six special interest locations and five control locations.

Environmental monitoring of ambient radiation levels began prior to the commencement of SSES operation. The preoperational monitoring period data used in the calculation of dose attributable the SSES

operation is from 1980-1981. The availability of preoperational direct radiation monitoring data and data for control direct radiation monitoring locations provides a basis for distinguishing between the portions of dose received from exposure to sources of natural radiation and that which might have been from man-made sources of radiation.

Pre-operational and operational data are compared for the purpose of determining if dosimeter data may indicate a dose contribution from SSES operation. Ratios of doses for specific indicator locations to the average of the doses for control locations from operational periods are compared to their counterparts from the preoperational period. Comparison of these ratios is performed in lieu of comparing the actual operational and preoperational doses. All indicator-to-control-average dose ratios for operational periods are compared to expected ranges from 1980-81 data for indicator-to-control-average dose ratios from the same locations. If preoperational data does not exist for the location of interest, indicator-to-control-average dose ratios for operational periods are compared to data for control locations monitored during 1980-81. The purpose for these comparisons is to flag possible SSES direct radiation dose contributions and to provide input, if appropriate, for the calculation of SSES direct radiation dose contributions.

Additional details on the statistical method used for determination of direct radiation dose to a member of the public due to SSES operation (based on environmental dosimeter data) can be found in Engineering Calculation EC-ENVR-1012, Interpretation of Environmental Direct Radiation Monitoring Results – Estimation of Direct Radiation Dose to Members of the Public Attributable to SSES Fuel Cycle Operations Rev. 2.

The indicator locations annual average dose rate was 15.8

milliroentgen per standard quarter. The annual average dose rate for the control locations was 14.1 milliroentgen per standard quarter. The preoperational average for the quarterly direct radiation readings was 17.6 milliroentgen per standard quarter.

In 2021, the maximum direct radiation dose to a member of the public calculated using the methodology in EC-ENVR-1012 was 0.538 mrem.

The results of the direct radiation measurements for 2021 confirmed that the radiation levels in the vicinity of the SSES were similar to previous years. (Table C–4, Appendix C); Figure C-2 – Ambient Radiation Levels Based on Environmental Dosimetry Data from 1973 to current year are plotted as quarterly averages.

C. Terrestrial

Terrestrial REMP sampling included the collection of milk, groundwater, drinking water, and vegetation.

1. Milk

Milk samples were collected biweekly when cows were on pasture and monthly when cows were not grazing on pasture. Animals are considered on pasture from April to October of each year. Samples were collected in new polyethylene containers and transported in ice chests with preservatives added to the milk.

Milk samples were collected at local dairy farms from 2 indicator locations (5E2 and 13E3) and one control location (10G1). Each sample was analyzed for I-131 and gamma emitters.

Iodine-131

Iodine-131 was not detected above minimum detectable concentration in any of the 60 samples analyzed. Preoperational data is not available for comparison. (Table C-5, Appendix C); Figure C-3 – Iodine-131 Activity in Milk results from 1976 to 2021 are plotted.

Gamma Spectrometry

Naturally occurring K-40 was detected in all 60 samples with concentrations for the 40 indicator location samples ranging from 1,072 to 1,572 pCi/L with an average concentration of 1,261 pCi/L, and the 20 control location sample concentrations ranging from 989 to 1,529 pCi/L with an average concentration of 1,267 pCi/L. The maximum preoperational level detected was 1,500 pCi/L with an average concentration of 1,358 pCi/L. (Table C-5, Appendix C).
All other gamma emitters were less than the LLD.

2. Groundwater

An expanded groundwater monitoring network was initiated in 2006 for the SSES as part of a site-wide hydrogeological investigation in accordance with the Nuclear Energy Institute (NEI) Groundwater Protection Initiative (GPI). The additional groundwater monitoring wells are sampled as part of the Radiological Environmental Monitoring Program (REMP) to regularly assess groundwater quality and provide early detection of any inadvertent leaks or spills of radioactive materials that could reach groundwater. Groundwater is sampled quarterly and analyzed for H-3 and gamma activity. Additionally, precipitation sampling was initiated in 2007 and analyzed for H-3 activity to assess the influence of station

airborne H-3 emissions on groundwater H-3 activities.

Precipitation washout monitoring data is not used in dose calculations; however, the data does give a gross indication of H-3 which makes its way into surface water and soil where it eventually seeps into shallow groundwater. The annual average H-3 concentrations in precipitation, groundwater monitoring wells and surface water are summarized in Table C-7 and graphically depicted in Figure C-4 - Annual Average Tritium Activity (pCi/L) in Precipitation and Surface Water Versus Groundwater.

Groundwater samples were collected quarterly at 10 indicator locations (1S3, 1S4, 4S8, 4S9, 8S4, 7S10, 2S8, 6S11A, 6S12 and 7S11) and one control station (13S7). Each sample was analyzed for H-3 and gamma emitters.

Tritium

Tritium activity was detected above the minimum detectable concentration in 8 of the 40 indicator location samples with concentrations ranging from 148 to 252 pCi/L with an average concentration of 197 pCi/L. One of the four control location samples had tritium activity above the minimum detectable concentration at of 190 pCi/L. The maximum preoperational level detected was 119 pCi/L. (Table C–6, Appendix C); Figure C-4 – Annual Average Tritium Activity (pCi/L) in Precipitation and Surface Water Versus Groundwater results from 2007 to 2021 are plotted.

Gamma Spectrometry

Naturally occurring K-40 was not detected in any of the indicator or control samples. Preoperational data is not

available for comparison. (Table C-6, Appendix C)
All other gamma emitters were less than the LLD.

3. Drinking Water

Drinking water samples were collected monthly from one location (12H2). Each sample was analyzed for gross beta, H-3 and gamma emitters.

Gross Beta

Gross beta activity was detected in four of the 12 drinking water samples. Sample concentrations ranged from 2.2 to 3.0 pCi/L with an average concentration of 2.5 pCi/L. The maximum preoperational level detected was 2.8 pCi/L with an average concentration of 1.8 pCi/L. (Table C–8, Appendix C); Figure C-5 – Gross Beta Activity in Drinking Water results from 1977 to 2021 are plotted.

Tritium

Tritium activity was not detected in any of the samples. The maximum preoperational level detected was 194 pCi/L with an average of 132 pCi/L. (Table C–8, Appendix C)

Gamma Spectrometry

Naturally occurring K-40 was not detected in any of the samples. Preoperational data is not available for comparison. (Table C–8, Appendix C)

All other gamma emitters were less than the LLD.

4. Food Products

Food products from two indicator locations (11D1 and 11S6) were collected throughout the growing season. All samples (fruit, vegetable, and broadleaf) were analyzed for gamma emitters and included soy beans, pumpkin, swiss chard and collards.

Gamma Spectrometry

Naturally occurring Be-7, attributed to cosmic ray activity in the atmosphere, was detected in eight of the 12 indicator location samples with concentrations ranging from 180 to 751 pCi/kg wet with an average concentration of 497 pCi/kg wet. Preoperational data is not available for comparison.

Naturally occurring K-40 was detected in all 12 indicator location samples with concentrations ranging from 2,407 to 15,440 pCi/kg wet with an average concentration of 4,247 pCi/kg wet. The maximum preoperational level detected was 4,800 pCi/kg wet with an average concentration of 2,140 pCi/kg wet.

Naturally occurring Ac-228 was not detected in any of the indicator or control locations. Preoperational data is not available for comparison.

Naturally occurring Th-228 was not detected in any of the indicator or control locations. Preoperational data is not available for comparison. (Table C-9, Appendix C)

All other gamma emitters were less than the LLD.

D. Aquatic

Aquatic samples include surface water, fish, and sediment samples.

1. Surface Water

Surface water samples were collected routinely at two indicator locations (6S5 and 2S7) and two control locations (5S9 and 6S6). Each sample was analyzed for H-3 and gamma emitters.

Tritium

Tritium activity was detected in 15 of 29 indicator location samples with concentrations ranging from 153 to 3,810 pCi/L with an average concentration of 937 pCi/L. The range of H-3 levels in surface water are biased high due to inclusion of samples from the cooling tower blowdown line (CTBD; location 2S7). Routine station operation includes infrequent batch releases of slightly radioactive water which are discharged into the CTBD. When the H-3 concentration from CTBD samples is averaged with those obtained from Susquehanna River downstream monitoring locations, the result is an overall indicator location average that is higher than the actual average H-3 levels of the downstream river water. No radioactivity attributable to station operations was identified above analysis detection levels in any samples from the Susquehanna River in 2021. Tritium was not detected in any of the 12 control location samples.The maximum preoperational level detected was 319 pCi/L, with an average concentration of 140 pCi/L. (Table C-10, Appendix C) Figure C-6 – Tritium Activity in Surface Water, results from 1972 to 2021 are plotted.

Gamma Spectrometry

Naturally occurring K-40 was not detected in any of the indicator location or control location samples. Preoperational data is not available for comparison.
Iodine-131 was not detected in any of the indicator or control samples. The maximum preoperational level detected was 0.43 pCi/L, with an average concentration of 0.33 pCi/L. (Table C-10, Appendix C)

All other gamma emitters were less than the LLD.

2. Fish

Edible species of fish were collected in the spring and fall of 2021 at two indicator locations (IND [Susquehanna River] and LTAW (only collected in the fall)) and one control location (2H [Susquehanna River]). Each sample was analyzed for gamma emitters.

Gamma Spectrometry

Naturally occurring K-40 was detected in all indicator location samples at concentrations ranging from 2,932 to 4,324 pCi/kg wet with an average concentration of 3,643 pCi/kg wet, and in all control location samples at concentrations ranging from 2,190 to 4,019 pCi/kg wet with an average concentration of 3,450 pCi/kg wet. The maximum preoperational level detected was 3,600 pCi/kg dry with an average concentration of 3,871 pCi/kg dry. (Table C–11, Appendix C)

All other gamma emitters were less than the LLD.

3. Shoreline Sediment

Sediment samples were collected from the Susquehanna River in the spring and fall at two indicator locations (7B and 12F) and one control location (2B). Each sample was analyzed for gamma emitters.

Gamma Spectroscopy

Naturally occurring K-40 was detected in all four of the indicator location samples at concentrations ranging from 7,539 to 15,590 pCi/kg dry with an average concentration of 10,940 pCi/kg dry, and in all of the control location samples with concentrations ranging from 10,020 to 20,000 pCi/kg dry with an average concentration of 15,010 pCi/kg dry. The maximum preoperational level detected was 11,000 pCi/kg dry with an average concentration of 8,500 pCi/kg dry.

Cesium-137 was detected in one of the control location samples with a concentration of 78.3 pCi/kg dry. The maximum preoperational level detected was 210 pCi/kg dry with an average concentration of 110 pCi/kg dry.

Naturally occurring Ra-226 was detected in one of the indicator location samples with a concentration of 1,618 pCi/kg dry and one of the control location samples with a concentration of 3,315 pCi/kg dry. The maximum preoperational level detected was 1,900 pCi/kg dry with an average concentration of 700 pCi/kg dry.

Naturally occurring Ac-228 was detected in all four indicator location samples at concentrations ranging from 636 to 1,264 pCi/kg dry with an average concentration of 902 pCi/kg dry, and in both of the control location samples at concentrations

ranging from 1,005 to 1,520 pCi/kg dry with an average concentration of 1,263 pCi/kg dry. Preoperational data is not available for comparison.

Naturally occurring Th-228 was detected in all of the four indicator location samples at concentrations ranging from 622 to 1,138 pCi/kg dry with an average concentration of 943 pCi/kg dry, and in both of the control location samples at concentrations ranging from 785 and 1,604 pCi/kg dry with an average concentration of 1,194 pCi/kg dry. The maximum preoperational level detected was 3,200 pCi/kg dry with an average concentration of 1,300 pCi/kg dry. (Table C 12, Appendix C)

All other gamma emitters were less than the LLD.

E. Land Use Census

SYNOPSIS OF 2021 LAND USE CENSUS

Applied Ecoscience, Inc. conducted a Land Use Census during the 2021 growing season around SSES to comply with the ODCM. The purpose of the survey was to document the nearest milk animal, residence and garden greater than 50 m^2 (approximately 500 ft^2) producing broad leaf vegetation within a distance of 8 km (approximately 5 miles) in each of the 16 meteorological sectors surrounding the SSES.

Distance in Miles from the SUSQUEHANNA NUCLEAR Reactor Buildings				
Meteorological Sector		Nearest Residence July-Aug, 2021 miles	Nearest Garden July-Sept, 2021 miles	Nearest Dairy Farm July-Aug, 2021 miles
1	N	1.3	3.2	>5.0
2	NNE	1.0	2.3 [a,c,e]	>5.0
3	NE	0.9	2.7	>5.0
4	ENE	2.1	2.4 [a,c]	>5.0
5	E	1.6	4.9	4.5 [d]
6	ESE	0.5	3.1	>5.0
7	SE	0.6	0.6	>5.0
8	SSE	0.7	2.9	>5.0
9	S	1.0	3.5	>5.0
10	SSW	0.9	1.3 [a,c]	>5.0 [d]
11	SW	1.5	4.2	>5.0
12	WSW	1.3	1.3	1.7
13	W	1.4	3.2	5.0
14	WNW	1.1	3.6	>5.0
15	NW	0.8	2.3	>5.0
16	NNW	0.7	4.0	>5.0

a Chickens raised for consumption at this location
b Ducks raised for consumption at this location
c Eggs consumed from chickens at this location
d Fruits/vegetables raised for consumption at this location
e Beef cattle raised for consumption at this location
f Rabbits raised for consumption at this location.

The 2021 Land Use Census results are summarized in the above table.

V. Annotations to Previous AREOR

There are no annotations to the previous AREOR.

VI. Conclusions

The Radiological Environmental Monitoring Program for SSES was conducted during 2021 in accordance with the SSES TRM and ODCM. The LLD values required by the TRM and ODCM were achieved for this reporting period (See Appendix A and Appendix C). The objectives of the program were also met during this period. The data collected assists in demonstrating that SSES was operated in compliance with TRM and ODCM requirements.

The concentration of radioactive material in the environment that could be attributable to SSES operations was only a small fraction of the concentration of naturally occurring and man-made radioactivity. Since these results were comparable to the results obtained during the preoperational phase of the program, which ran from 1972 to 1982, and with results collected since commercial operation, it is concluded that operation of the SSES had no significant radiological impact on the health and safety of the public or the environment.

From the results obtained, it can be concluded that the levels and fluctuations of radioactivity in environmental samples were as expected for the environment surrounding the SSES.

VII. References

[1] Annual Radiological Environmental Operating Report, January 1 to December 31, 2021, prepared by Teledyne Brown Engineering, Knoxville TN.

[2] Final Safety Analysis Report

[3] Final Environmental Statement

[4] Susquehanna Steam Electric Station, 2021 Land Use Census. Prepared for Susquehanna Nuclear, LLC, Berwick, PA. December 2021. Applied Ecoscience, Inc. Berwick, PA.

[5] Google Earth. 2016. Website: http://earth.google.com.

[6] Pennsylvania Department of Transportation. 1990. Columbia County General Highway Map. PA DOT, Harrisburg, PA.

[7] Pennsylvania Department of Transportation. 1990. Luzerne County General Highway Map. PA DOT, Harrisburg, PA.

[8] Susquehanna Nuclear, LLC. Radiological Environmental Monitoring Program, ODCM-QA-008, Rev. 20.

[9] Susquehanna Steam Electric Station, 5-mile radius aerial photograph, REMPE-182244-0. Susquehanna Nuclear, Berwick, PA

[10] United States Geological Survey. 1976. Berwick Quadrangle Topographic Map. 7.5 minute series. USGS, Reston, VA.

[11] United States Geological Survey. 1977. Sybertsville Quadrangle Topographic Map. 7.5 minute series. USGS, Reston, VA.

[12] United States Nuclear Regulatory Commission. “An Acceptable Radiological Environmental Monitoring Program.” Radiological Assessment Branch Technical Position. November 1979, Revision 1. USNRC, Washington, DC.

[13] Susquehanna Nuclear, Tritium Release REMP Calculation (RETDAS) V.3.6.6) – March 2022.

[14] NCRP Report No. 160, “Ionizing Radiation Exposure of the Population of the United States”, (2009).

[15] Engineering Calculation EC-ENVR-1012, Interpretation of Environmental Direct Radiation Monitoring Results – Estimation of Direct Radiation Dose to Members of the Public Attributable to SSES Fuel Cycle Operations, Rev. 2. May 2013

APPENDIX A

PROGRAM SUMMARY

TABLE A
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA

Reporting Period: December 30, 2020 to January 20, 2022

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSIS PERFORMED (1)		LOWER LIMIT OF DETECTION (LLD) (2)	ALL INDICATOR LOCATIONS MEAN (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASURMENTS (4)
Air Particulates (E-3 pCi/m^3)	GR-B	364	10	1.527E+01 (312/312) (6.340E+00 - 2.590E+01)	12E1 4.7 MILES WSW	1.581E+01 (52/52) (6.440E+00 - 2.470E+01)	1.427E+01 (52/52) (6.380E+00 - 2.430E+01)	0
	GAMMA	28						
	BE-7	28	N/A	1.129E+02 (24/24) (8.887E+01 - 1.408E+02)	13S6 0.4 MILES W	1.217E+02 (4/4) (1.095E+02 - 1.408E+02)	1.138E+02 (4/4) (1.098E+02 - 1.181E+02)	0
	K-40	28	N/A	<MDC (0/24)		<MDC	<MDC (0/4)	0
	CS-134	28	50	<MDC (0/24)		<MDC	<MDC (0/4)	0
	CS-137	28	60	<MDC (0/24)		<MDC	<MDC (0/4)	0
Charcoal (E-3 pCi/m^3)	GAMMA	364						
	I-131	364	70	<MDC (0/312)		<MDC	<MDC (0/52)	0
Ambient Radiation (mR/std. qtr.)	OSLD	227	N/A	1.578E+01 (207/207) (7.449E+00 - 3.477E+01)	9S2 0.2 MILES S	3.195E+01 (4/4) (2.955E+01 - 3.477E+01)	1.409E+01 (20/20) (1.096E+01 - 1.914E+01)	0
Milk (pCi/Liter)	I-131	60	1	<MDC (0/40)		<MDC	<MDC (0/20)	0
	GAMMA	60						
	K-40	60	N/A	1.261E+03 (40/40) (1.072E+03 - 1.572E+03)	13E3 5.0 MILES W	1.291E+03 (20/20) (1.072E+03 - 1.572E+03)	1.266E+03 (20/20) (9.887E+02 - 1.529E+03)	0
	CS-134	60	15	<MDC (0/40)		<MDC	<MDC (0/20)	0

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Milk (cont'd) (pCi/Liter)	CS-137	60	18	<MDC	(0/40)	<MDC			<MDC	(0/20)	0
	BA-140	60	60	<MDC	(0/40)	<MDC			<MDC	(0/20)	0
	LA-140	60	15	<MDC	(0/40)	<MDC			<MDC	(0/20)	0
	TH-228	60	N/A	<MDC	(0/40)	<MDC			<MDC	(0/20)	0
Ground Water (pCi/Liter)	H-3	44	2000	1.970E+02 (1.480E+02 - 2.520E+02)	(8/40)	1S3 0.1 MILES N	2.163E+02 (1.750E+02 - 2.520E+02)	(3/4)	1.900E+02 (1.900E+02)	(1/4)	0
	GAMMA	44									
	K-40	44	N/A	<MDC	(0/40)	<MDC			<MDC	(0/4)	0
	MN-54	44	15	<MDC	(0/40)	<MDC			<MDC	(0/4)	0
	CO-58	44	15	<MDC	(0/40)	<MDC			<MDC	(0/4)	0
	FE-59	44	30	<MDC	(0/40)	<MDC			<MDC	(0/4)	0
	CO-60	44	15	<MDC	(0/40)	<MDC			<MDC	(0/4)	0

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Ground Water (cont'd) (pCi/Liter)	ZN-65	44	30	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	NB-95	44	15	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	ZR-95	44	30	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	I-131	44	15	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	CS-134	44	15	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	CS-137	44	18	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	BA-140	44	60	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	LA-140	44	15	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
	TH-228	44	N/A	<MDC	(0/40)	<MDC		<MDC	(0/4)	0
Drinking Water (pCi/Liter)	GR-B	12	4	2.540E+00 (2.220E+00 - 2.990E+00)	(4/12)	12H2 26 MILES WSW	2.540E+00 (2.220E+00 - 2.990E+00)	N/A		0
	H-3	12	2000	<MDC	(0/12)	<MDC		N/A		0

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Drinking Water (cont'd)	GAMMA	12							
(pCi/Liter)	K-40	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	MN-54	12	15	<MDC	(0/12)	<MDC		N/A	0
	CO-58	12	15	<MDC	(0/12)	<MDC		N/A	0
	FE-59	12	30	<MDC	(0/12)	<MDC		N/A	0
	CO-60	12	15	<MDC	(0/12)	<MDC		N/A	0
	ZN-65	12	30	<MDC	(0/12)	<MDC		N/A	0
	NB-95	12	15	<MDC	(0/12)	<MDC		N/A	0
	ZR-95	12	30	<MDC	(0/12)	<MDC		N/A	0
	I-131	12	15	<MDC	(0/12)	<MDC		N/A	0
	CS-134	12	15	<MDC	(0/12)	<MDC		N/A	0

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Drinking Water (cont'd) (pCi/Liter)	CS-137	12	18	<MDC	(0/12)	<MDC			N/A	0
	BA-140	12	60	<MDC	(0/12)	<MDC			N/A	0
	LA-140	12	15	<MDC	(0/12)	<MDC			N/A	0
Food/Garden Crops (pCi/kg wet)	GAMMA	12								
	BE-7	12	N/A	4.973E+02 (1.803E+02 - 7.512E+02)	(8/12)	11S6 0.5 MILES SW	4.973E+02 (1.803E+02 - 7.512E+02)	(8/10)	N/A	0
	K-40	12	N/A	4.247E+03 (2.407E+03 - 1.544E+04)	(12/12)	11D1 3.3 MILES SW	9.266E+03 (3.091E+03 - 1.544E+04)	(2/2)	N/A	0
	MN-54	12	N/A	<MDC	(0/12)	<MDC			N/A	0
	CO-58	12	N/A	<MDC	(0/12)	<MDC			N/A	0
	FE-59	12	N/A	<MDC	(0/12)	<MDC			N/A	0
	CO-60	12	N/A	<MDC	(0/12)	<MDC			N/A	0
	ZN-65	12	N/A	<MDC	(0/12)	<MDC			N/A	0

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Food/Garden Crops (cont'd) (pCi/kg wet)	NB-95	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	ZR-95	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	I-131	12	60	<MDC	(0/12)	<MDC		N/A	0
	CS-134	12	60	<MDC	(0/12)	<MDC		N/A	0
	CS-137	12	80	<MDC	(0/12)	<MDC		N/A	0
	BA-140	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	LA-140	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	AC-228	12	N/A	<MDC	(0/12)	<MDC		N/A	0
	TH-228	12	N/A	<MDC	(0/12)	<MDC		N/A	0

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Surface Water (pCi/Liter)	H-3	41	2000	9.365E+02 (1.530E+02 - 3.810E+03)	(15/29)	2S7 0.1 MILES NNE	1.056E+03 (1.600E+02 - 3.810E+03)	(13/15)	<MDC	(0/12)	0
	GAMMA	41									
	K-40	41	N/A	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	MN-54	41	15	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	CO-58	41	15	<MDC	(0/26)	<MDC			<MDC	(0/12)	0
	FE-59	41	30	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	CO-60	41	15	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	ZN-65	41	30	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	NB-95	41	15	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	ZR-95	41	30	<MDC	(0/29)	<MDC			<MDC	(0/12)	0
	I-131	41	15	<MDC	(0/29)	<MDC			<MDC	(0/12)	0

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Surface Water (cont'd) (pCi/Liter)	CS-134	41	15	<MDC	(0/29)	<MDC		<MDC	(0/12)	0
	CS-137	41	18	<MDC	(0/29)	<MDC		<MDC	(0/12)	0
	BA-140	41	60	<MDC	(0/29)	<MDC		<MDC	(0/12)	0
	LA-140	41	15	<MDC	(0/29)	<MDC		<MDC	(0/12)	0
	TH-228	41	N/A	<MDC	(0/29)	<MDC		<MDC	(0/12)	0
Fish (pCi/kg wet)	GAMMA	14								
	K-40	14	N/A	3.643E+03 (2.932E+03 - 4.324E+03)	(8/8)	LTAW 0.7 MILES NE-ESE	3.724E+03 (3.466E+03 - 3.982E+03)	3.450E+03 (2.190E+03 - 4.019E+03)	(6/6)	0
	MN-54	14	130	<MDC	(0/8)	<MDC		<MDC	(0/6)	0
	CO-58	14	130	<MDC	(0/8)	<MDC		<MDC	(0/6)	0
	FE-59	14	260	<MDC	(0/8)	<MDC		<MDC	(0/6)	0
	CO-60	14	130	<MDC	(0/8)	<MDC		<MDC	(0/6)	0

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Fish (cont'd) (pCi/kg wet)	ZN-65	14	260	<MDC (0/8)	<MDC		<MDC (0/6)	0
	CS-134	14	130	<MDC (0/8)	<MDC		<MDC (0/6)	0
	CS-137	14	150	<MDC (0/8)	<MDC		<MDC (0/6)	0
Sediment (pCi/kg dry)	GAMMA	6						
	K-40	6	N/A	1.094E+04 (4/4) (7.539E+03 - 1.559E+04)	2B 1.6 MILES NNE	1.501E+04 (2/2) (1.002E+04 - 2.000E+04)	1.501E+04 (2/2) (1.002E+04 - 2.000E+04)	0
	CS-134	6	150	<MDC (0/4)	<MDC		<MDC (0/2)	0
	CS-137	6	180	<MDC (0/4)	2B 1.6 MILES NNE	7.831E+01 (1/2) (7.831E+01)	7.831E+01 (1/2) (7.831E+01)	0
	RA-226	6	N/A	1.618E+03 (1/4) (1.618E+03)	2B 1.6 MILES NNE	3.315E+03 (1/2) (3.315E+03)	3.315E+03 (1/2) (3.315E+03)	0
	AC-228	6	N/A	9.022E+02 (4/4) (6.361E+02 - 1.264E+03)	2B 1.6 MILES NNE	1.263E+03 (2/2) (1.005E+03 - 1.520E+03)	1.263E+03 (2/2) (1.005E+03 - 1.520E+03)	0
	TH-228	6	N/A	9.427E+02 (4/4) (6.222E+02 - 1.138E+03)	2B 1.6 MILES NNE	1.194E+03 (2/2) (7.848E+02 - 1.604E+03)	1.194E+03 (2/2) (7.848E+02 - 1.604E+03)	0

1. The total number of analyses does not include duplicates, splits or repeated analyses.
2. The Technical Requirement LLDs are shown when applicable.
3. The mean and range are based on all results above MDC. The ratio indicated in parentheses is the total number of results used to calculate the mean to the total number of samples.
4. USNRC Reporting Levels are specified in the Technical Requirements (i.e., when Reporting Levels in Technical Requirements are exceeded).

APPENDIX B

SAMPLE DESIGNATION
AND
LOCATIONS

SAMPLE DESIGNATION

All distances from the SSES to monitoring locations are measured from the standby gas treatment vent at 44200/N34117 (Pa. Grid System). The location codes are based on both distance and direction from the SSES. The letters in the location codes indicate if the monitoring locations are on site (within the site boundary) or, if they are not on site, the approximate distances of the location from the SSES as described below:

S	=	On site	E	=	4 – 5 miles
A	=	< 1 mile	F	=	5 – 10 miles
B	=	1 – 2 miles	G	=	10 – 20 miles
C	=	2 – 3 miles	H	=	> 20 miles
D	=	3 – 4 miles			

The numbers preceding the letters in the location codes provide the direction of the monitoring locations from the SSES by indicating the sectors in which they are located. A total number of 16 sectors (numbered one through 16) equally divide an imaginary circle on a map of the SSES and its vicinity, with the SSES at the center of the circle. The middle of sector one is directed due North (N). Moving clockwise from sector one, the sector immediately adjacent to sector one is sector two, the middle of which is directed due north, north east (NNE). Continuing to move clockwise the sector number increases to 16, which is the north northwest sector (NNW).

TABLE B-1

SAMPLING LOCATIONS

Specific information about the individual sampling locations are given in Table B-1. Maps B-1 through B-6 show the locations of sampling stations with respect to the Site. A Portable Global Positioning System (GPS) was used to provide the coordinates of sampling locations.

STATION CODE	STATION LOCATION	LATITUDINAL	LONGITUDINAL	SAMPLE TYPE
LESS THAN ONE MILE FROM THE SSES		DEG.	DEG.	
2S7	0.1 mi.NNE	41.093540	-76.144773	Surface water
6S5	0.9 mi.ESE;	41.084639	-76.130642	Surface water
6S6 **	0.8 mi.ESE;	41.088115	-76.131637	Surface water
LTAW	0.7 mi.NE-ESE;	41.098356	-76.135401	Fish
10S3	0.6 mi. SSW;	41.085264	-76.152128	Air
12S1	0.4 mi.WSW;	41.088436	-76.154314	Air
13S6	0.4 mi.W;	41.091771	-76.153869	Air
3S2	0.5 mi NE;	41.095716	-76.140207	Air
1S4	0.1 mi N;	41.093302	-76.145853	Ground water
2S8	0.1 mi.NNE;	41.094991	-76..044207	Ground water
6S11A	0.4 mi.ESE;	41.083448	-76.133412	Ground water
6S12	0.8 mi.ESE;	41.083411	-76.116935	Ground water
7S11	0.3 mi.SE;	41.083527	-76.133513	Ground water
1S3	0.1 mi N;	41.093640	-76.146076	Ground water
4S8	0.1 mi.ENE;	41.092306	-76.144283	Ground water
4S9	0.3 mi.E;	41.093369	-76.141644	Ground water
8S4	0.1 mi.SSE;	41.091424	-76.145531	Ground water
7S10	0.3 mi.SE;	41.089736	-76.142783	Ground water
13S7	0.2 mi.W;	41.091236	-76.149647	Ground water
11S6	0.5 mi.SW;	41.085305	-76.152022	Broadleaf
Site 1	0.1 mi.ESE;	41.092275	-76.145022	Precipitation
Site 2	0.1 mi.SSE;	41.091309	-76.145708	Precipitation
Site 3	0.1 mi.WSW;	41.091243	-76.147345	Precipitation
Site 4	0.1 mi.NW;	41.093321	-76.147316	Precipitation

**** Control Location**

TABLE B-1 (cont'd)

SAMPLING LOCATIONS

STATION CODE	STATION LOCATION	LATITUDINAL	LONGITUDINAL	SAMPLE TYPE
FROM ONE to FIVE MILES FROM THE SSES		DEG.	DEG.	
IND	0.9 mi.ESE;	41.085141	-76.130174	Fish
IND	1.4 mi.ESE;	41.075618	-76.132682	Fish
2B **	1.6 mi.NNE;	41.112441	-76.134758	Sediment
7B	1.2 mi.SE;	41.078924	-76.131548	Sediment
9B1	1.3 mi. SSW;	41.085264	-76.152128	Air
12E1	4.7 mi.WSW;	41.072418	-76.230554	Air
5E2	4.5 mi.E;	41.085184	-76.061099	Milk
13E3	5.0 mi.W;	41.100259	-76.241102	Milk
11D1	3.3 mi.SW;	41.055212	-76.186797	Food Products
** Control Location				
GREATER THAN FIVE MILES FROM THE SSES				
12H2	26 mi.WSW;	40.947192	-76.604524	Drinking water
2H **	30 mi.NNE;	41.459508	-75.853096	Fish
12F	6.9 mi.WSW;	41.041323	-76.255396	Sediment
8G1 **	12 mi.SSE;	40.928886	-76.055092	Air
10G1 **	14 mi.SSW;	40.934847	-76.284449	Milk

TABLE B-1 (cont'd)

SAMPLING LOCATIONS

STATION CODE	STATION LOCATION	LATITUDINAL	LONGITUDINAL	SAMPLE TYPE
OSLD LOCATIONS				
LESS THAN ONE MILE FROM THE SSES		DEG.	DEG.	
1S2	0.2 mi.N;	41.09566	-76.146121	OSLD
2S2	0.9 mi.NNE;	41.10207	-76.141192	OSLD
2S3	0.2 mi.NNE;	41.09486	-76.144101	OSLD
3S2	0.5 mi.NE;	41.09574	-76.140086	OSLD
3S3	0.9 mi.NE;	41.10183	-76.133127	OSLD
4S3	0.2 mi.ENE;	41.09322	-76.141934	OSLD
4S6	0.7 mi.ENE;	41.09687	-76.133807	OSLD
5S4	0.8 mi.E;	41.09286	-76.131604	OSLD
5S7	0.3 mi.E;	41.09199	-76.141165	OSLD
6S4	0.2 mi.ESE;	41.09132	-76.142616	OSLD
6S9	0.2 mi.ESE;	41.09067	-76.142966	OSLD
7S6	0.2 mi.SE;	41.08972	-76.14359	OSLD
7S7	0.4 mi.SE;	41.08745	-76.142033	OSLD
8S2	0.2 mi.SSE;	41.08907	-76.14437	OSLD
9S2	0.2 mi.S;	41.08952	-76.14322	OSLD
10S1	0.4 mi.SSW;	41.08663	-76.150082	OSLD
10S2	0.2 mi.SSW;	41.08894	-76.147881	OSLD
11S7	0.4 mi.SWN;	41.08832	-76.15297	OSLD
12S1	0.4 mi.WSW;	41.0887	-76.154112	OSLD
12S3	0.4 mi.WSW;	41.08968	-76.153192	OSLD
13S2	0.4 mi.W;	41.09223	-76.153320	OSLD
13S5	0.4 mi.W;	41.09176	-76.153292	OSLD
13S6	0.4 mi.W;	41.09177	-76.153869	OSLD
14S5	0.5 mi.WNW;	41.09503	-76.153787	OSLD
15S5	0.4 mi.NW;	41.09576	-76.15103	OSLD
16S1	0.3 mi.NNW;	41.09611	-76.147388	OSLD
16S2	0.3 mi.NNW;	41.09599	-76.148922	OSLD
6A4 *	0.6 mi.ESE;	41.08791	-76.136795	OSLD

TABLE B-1 (cont'd)

SAMPLING LOCATIONS

STATION CODE	STATION LOCATION	LATITUDINAL	LONGITUDINAL	SAMPLE TYPE
LESS THAN ONE MILE FROM THE SSES		DEG.	DEG.	
8A3	0.9 mi.SSE;	41.07982	-76.1139078	OSLD
15A3 *	0.9 mi.NW;	41.10003	-76.1585	OSLD
16A2 *	0.8 mi.NNW;	41.1025	-76.151595	OSLD
FROM ONE to FIVE MILES FROM THE SSES				
12S7	1.1 mi.WSW;	41.08621	-76.165914	OSLD
8B2 *	1.4 mi.SSE;	41.07483	-76.130724	OSLD
9B1	1.3 mi.S;	41.07356	-76.147874	OSLD
10B3 *	1.7 mi.SSW;	41.07064	-76.156646	OSLD
1D5	4.0 mi.N;	41.14936	-76.144346	OSLD
8D3	4.0 mi.SSE;	41.03824	-76.121683	OSLD
9D4	3.6 mi.S;	41.04015	-76.144529	OSLD
10D1	3.0 mi.SSW;	41.05446	-76.175026	OSLD
12D2	3.7 mi.WSW;	41.07363	-76.213306	OSLD
14D1	3.6 mi.WNW;	41.10706	-76.211891	OSLD
3E1	4.7 mi NE;	41.13953	-76.082398	OSLD
4E2	4.7 mi.ENE;	41.12157	-76.064115	OSLD
5E2	4.5 mi. E;	41.08539	-76.060486	OSLD
6E1	4.7 mi.ESE;	41.07275	-76.059529	OSLD
7E1	4.2 mi.SE;	41.04891	-76.090309	OSLD
11E1	4.7 mi. SW;	41.05188	-76.218713	OSLD
12E1 *	4.7 mi.WSW;	41.0725	-76.230331	OSLD
13E4	4.1 mi.W;	41.08962	-76.223726	OSLD

* Special Interest Area (other than controls)

TABLE B-1 (cont'd)

SAMPLING LOCATIONS

STATION CODE	STATION LOCATION	LATITUDINAL	LONGITUDINAL	SAMPLE TYPE
GREATER THAN FIVE MILES FROM THE SSES		DEG.	DEG.	
2F1	5.9 mi.NNE;	41.16796	-76.09146	OSLD
15F1	5.4 mi.NW;	41.15595	-76.202506	OSLD
16F1	7.8 mi.NNW;	41.18985	-76.229283	OSLD
3G4 **	17 mi.NE;	41.23431	-76.869061	OSLD
4G1 **	14 mi.ENE;	41.13898	-75.885121	OSLD
7G1 **	14 mi.SE;	40.94636	-76.974184	OSLD
12G1 **	15 mi.WSW;	41.0262	-76.411566	OSLD
12G4 **	10 mi. WSW;	40.03868	-76.327731	OSLD

* Special Interest Area (other than controls)

** Control Location

TABLE B-2

SUSQUEHANNA STEAM ELECTRIC STATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Analytical Procedure Number
Ambient Radiation	Dosimeter	Quarterly	SSES, HP-TP-205	Landauer Procedure L313, Inlight Dosimeter Analysis
Air	Gross Beta	Weekly	Applied Ecoscience, Appendix 2	TBE-2008 Gross Alpha and/or Gross Beta Activity in Various Matrices.
Air	I-131	Weekly	Applied Ecoscience, Appendix 2	TBE-2012 Radioiodine in Various Matrices
Air	Gamma	Quarterly	Applied Ecoscience, Appendix 2	TBE-2007 Gamma Emitting Radioisotope Analysis
Drinking Water	Gross Beta	Monthly	Applied Ecoscience, Appendix 5	TBE-2008 Gross Alpha and/or Gross Beta Activity in Various Matrices.
Surface & Drinking Water	Tritium	Monthly	Applied Ecoscience, Appendix 3, 4, 5, 6, & 7	TBE-2010 Tritium and Carbon-14 Analysis by Liquid Scintillation.
Surface & Drinking Water	Gamma	Monthly	Applied Ecoscience, Appendix 3, 4, 5, 6, & 7	TBE-2007 Gamma Emitting Radioisotope Analysis.
Ground Water	Tritium	Quarterly	Applied Ecoscience, Appendix 8	TBE-2010 Tritium and Carbon-14 Analysis by Liquid Scintillation
Ground Water	Gamma	Quarterly	Applied Ecoscience, Appendix 8	TBE-2007 Gamma Emitting Radioisotope Analysis

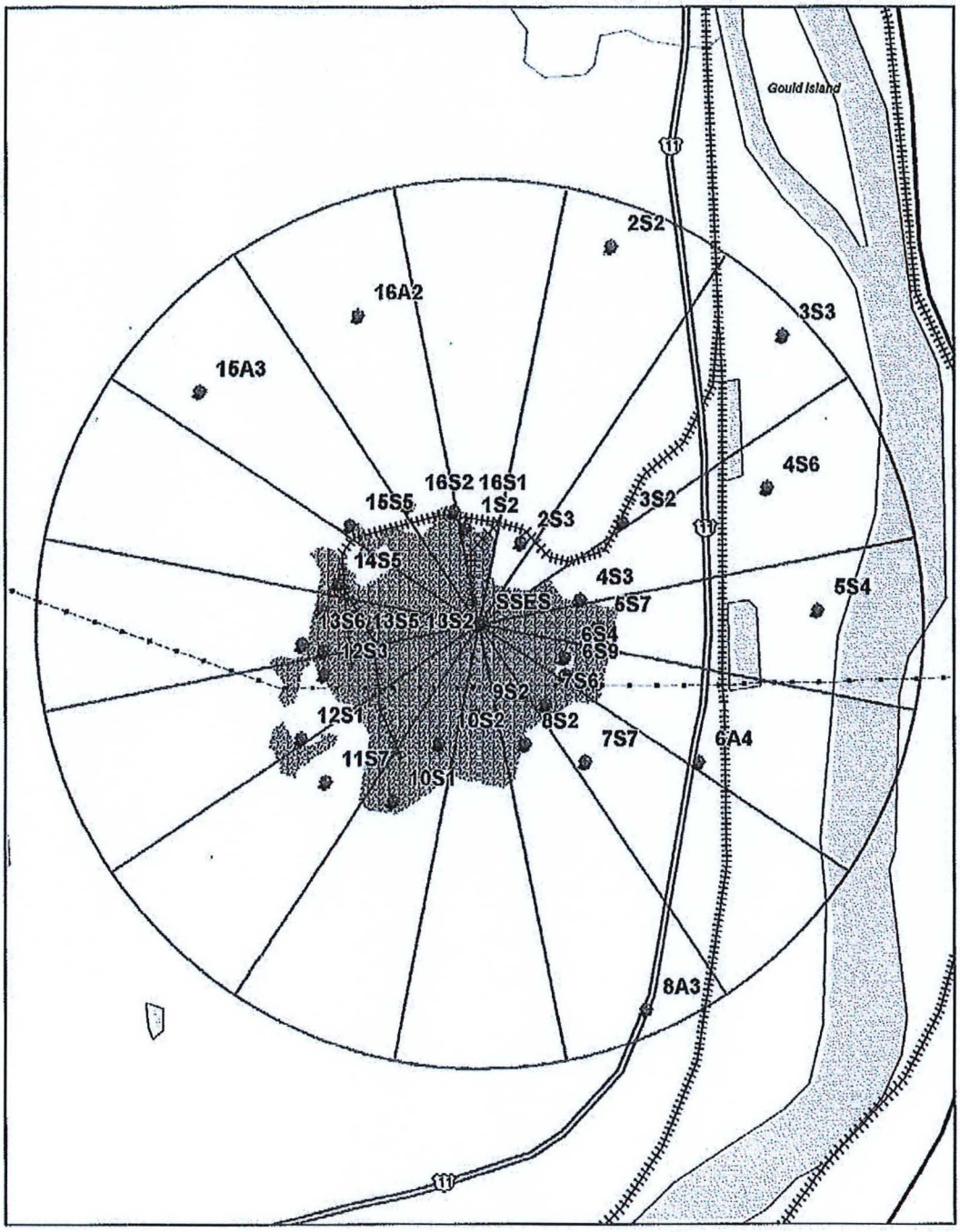
TABLE B-2 (cont'd)

SUSQUEHANNA STEAM ELECTRIC STATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Analytical Procedure Number
Precipitation	Tritium	Monthly (Apr – Nov) / Quarterly	Applied Ecoscience, Appendix 10	TBE-2010 Tritium and Carbon-14 Analysis by Liquid Scintillation
Milk	Gamma	Monthly/Bi-Weekly	Applied Ecoscience, Appendix 9	TBE-2007 Gamma Emitting Radioisotope Analysis
Milk	I-131	Monthly/Bi-Weekly	Applied Ecoscience, Appendix 9	TBE-2012 Radioiodine in Various Matrices
Fish	Gamma	Semi-Annually (Spring/Fall)	Applied Ecoscience, Appendix 11	TBE-2007 Gamma Emitting Radioisotope Analysis
Sediment	Gamma	Semi-Annually (Spring/Fall)	Applied Ecoscience, Appendix 12	TBE-2007 Gamma Emitting Radioisotope Analysis
Fruits & Vegetables	Gamma	In Season (When available)	Applied Ecoscience, Appendix 13 Applied Ecoscience, Appendix 15	TBE-2007 Gamma Emitting Radioisotope Analysis

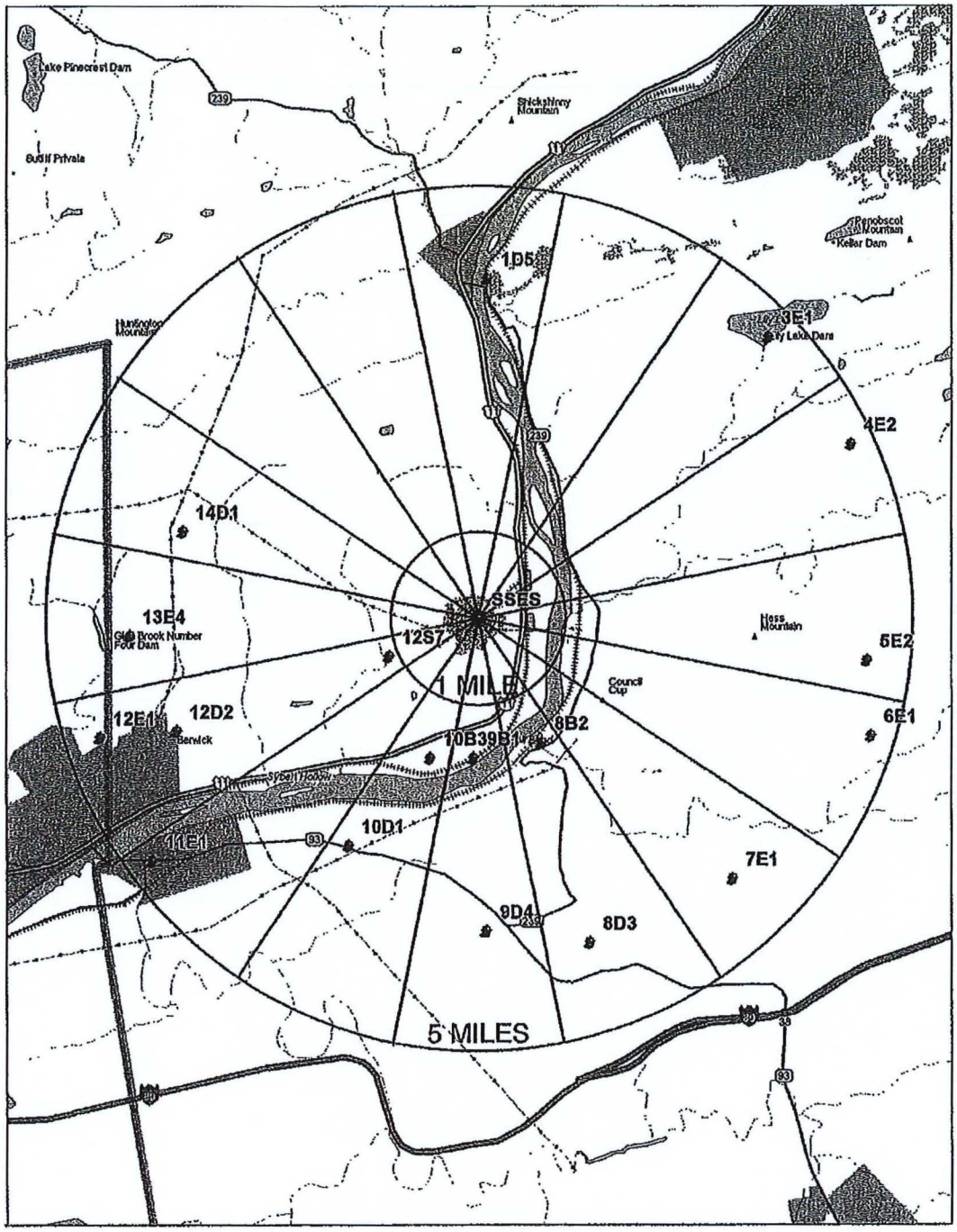
MAP B-1

Direct Radiation Monitoring Locations Within One Mile



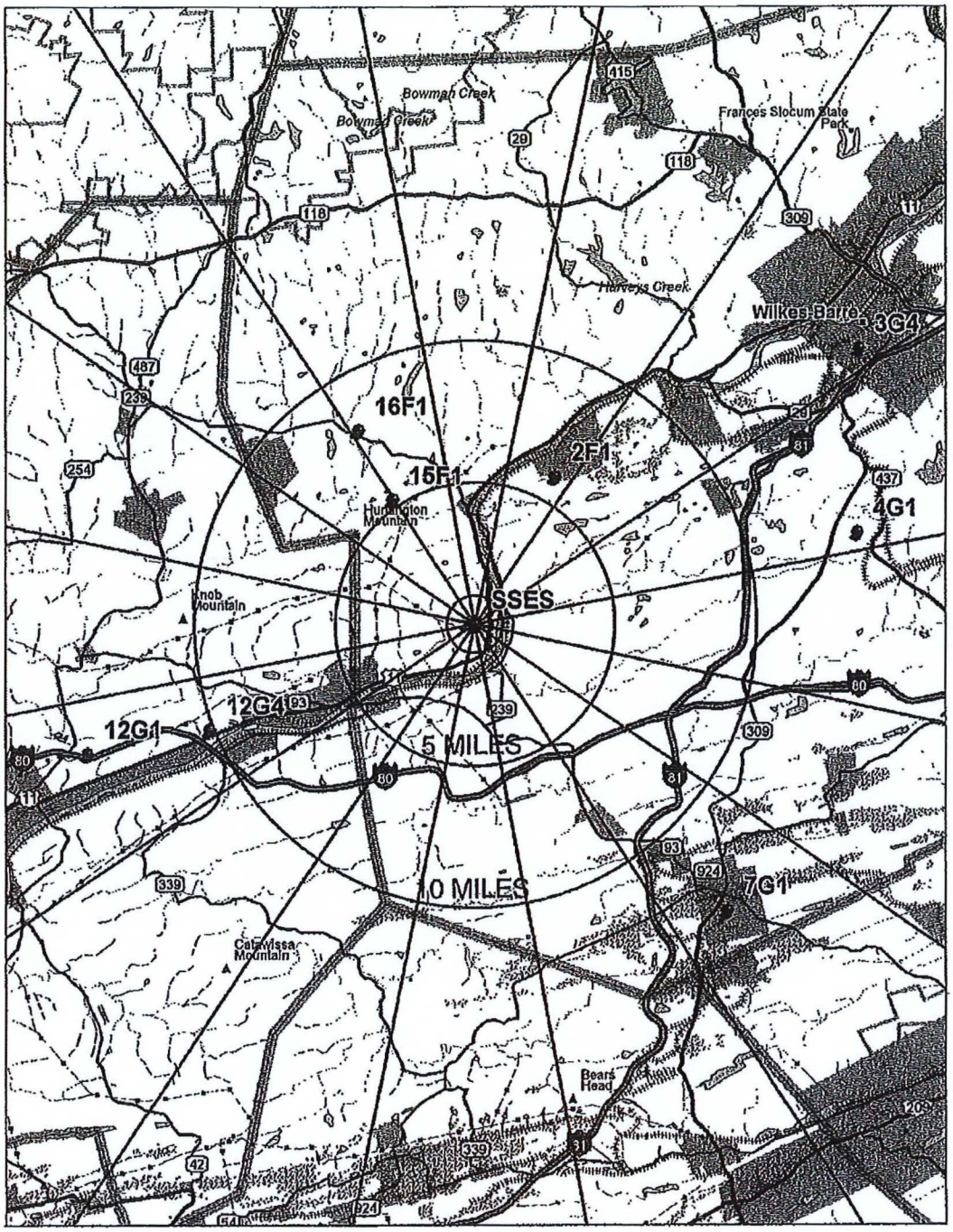
MAP B-2

Direct Radiation Monitoring Locations From One to Five Miles



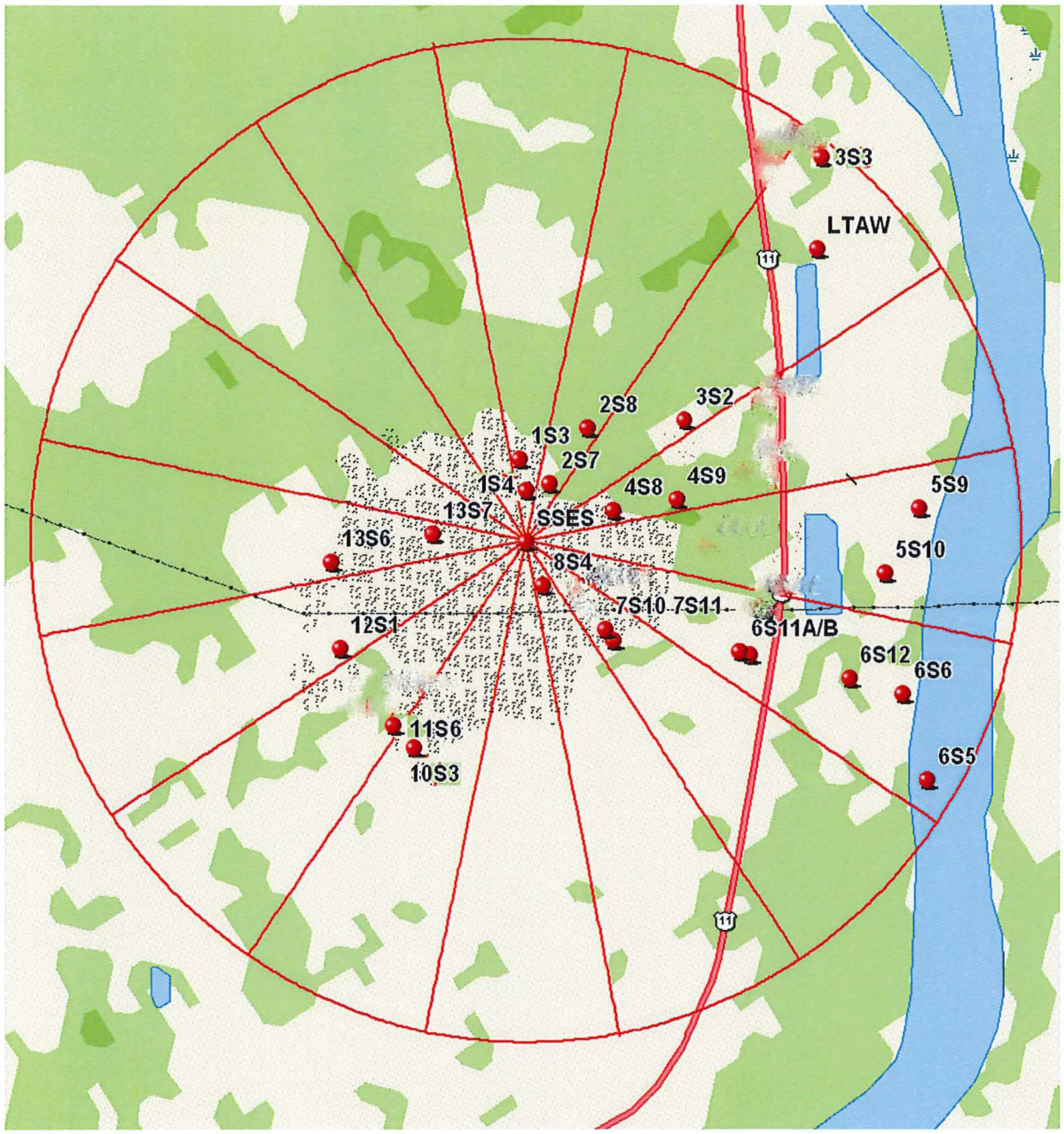
MAP B-3

Direct Radiation Monitoring Locations Greater Than Five Miles



MAP B-4

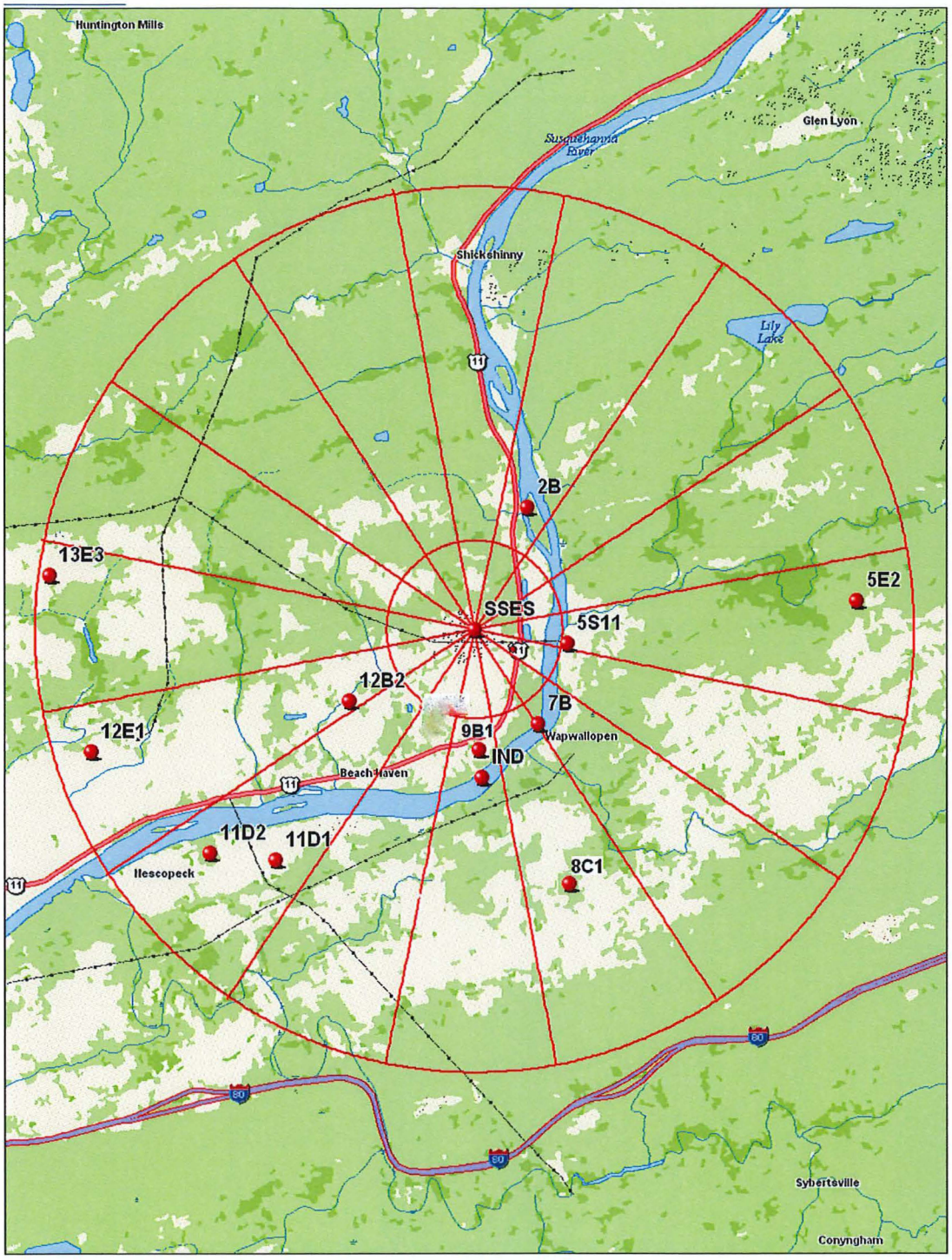
Environmental Sampling Locations Within One Mile



MAP B-5

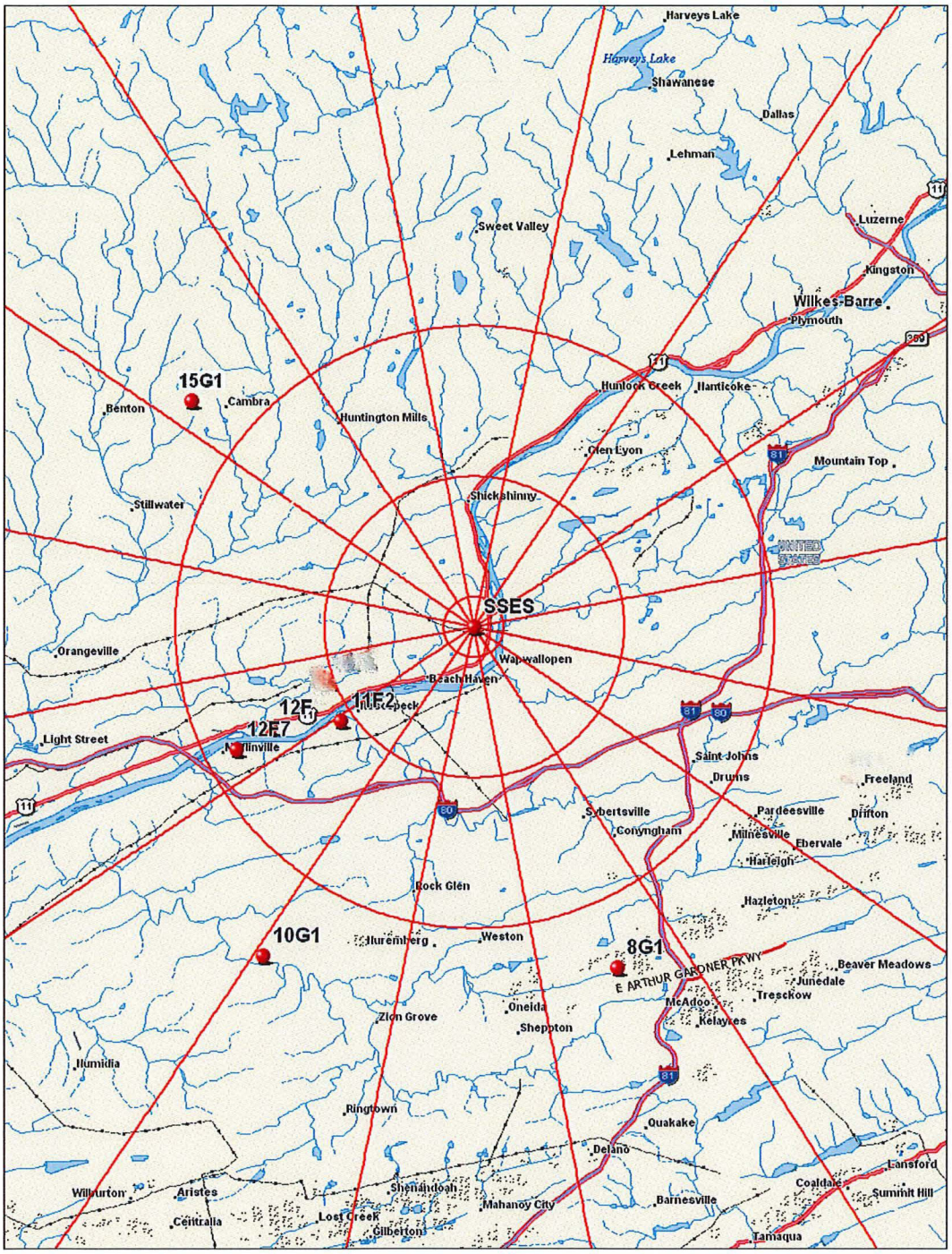
Environmental Sampling Locations

From One to Five Miles



MAP B-6

Environmental Sampling Locations Greater Than Five Miles



APPENDIX C

DATA TABLES

TABLE C-1 **GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in units of E-03 pCi/cu.m. ± 2 sigma

COLLECTION PERIOD	3S2	8G1	12E1	12S1	13S6	9B1
12/30/20 - 01/06/21	8 ± 2	6 ± 2	9 ± 2	9 ± 2	10 ± 2	11 ± 2
01/06/21 - 01/13/21	14 ± 2	15 ± 2	16 ± 2	16 ± 2	17 ± 2	16 ± 2
01/13/21 - 01/20/21	19 ± 3	17 ± 2	24 ± 3	20 ± 3	21 ± 3	23 ± 3
01/20/21 - 01/27/21	8 ± 2	8 ± 2	8 ± 2	8 ± 2	9 ± 2	10 ± 2
01/27/21 - 02/04/21	9 ± 2	6 ± 1	7 ± 1	7 ± 1	7 ± 2	8 ± 2
02/04/21 - 02/11/21	21 ± 3	21 ± 3	22 ± 3	21 ± 3	20 ± 3	20 ± 3
02/11/21 - 02/17/21	14 ± 2	13 ± 2	16 ± 2	14 ± 2	14 ± 2	14 ± 2
02/17/21 - 02/24/21	15 ± 2	16 ± 2	19 ± 2	19 ± 2	17 ± 2	21 ± 3
02/24/21 - 03/03/21	10 ± 2	11 ± 2	12 ± 2	10 ± 2	12 ± 2	11 ± 2
03/03/21 - 03/10/21	14 ± 2	13 ± 2	17 ± 2	13 ± 2	14 ± 2	15 ± 2
03/10/21 - 03/17/21	16 ± 2	14 ± 2	20 ± 3	18 ± 2	18 ± 3	17 ± 2
03/17/21 - 03/24/21	13 ± 2	13 ± 2	15 ± 2	14 ± 2	15 ± 2	14 ± 2
03/24/21 - 03/31/21	10 ± 2	10 ± 2	11 ± 2	9 ± 2	10 ± 2	8 ± 2
03/31/21 - 04/07/21	17 ± 2	15 ± 2	17 ± 2	16 ± 2	17 ± 2	19 ± 2
04/07/21 - 04/14/21	9 ± 2	7 ± 2	13 ± 3	8 ± 2	9 ± 2	9 ± 2
04/14/21 - 04/21/21	12 ± 2	9 ± 2	12 ± 2	9 ± 2	12 ± 2	10 ± 2
04/21/21 - 04/28/21	17 ± 2	17 ± 2	20 ± 3	20 ± 3	18 ± 2	21 ± 3
04/28/21 - 05/05/21	14 ± 2	14 ± 2	14 ± 2	15 ± 2	15 ± 2	15 ± 2
05/05/21 - 05/12/21	7 ± 2	7 ± 2	6 ± 2	6 ± 2	9 ± 2	7 ± 2
05/12/21 - 05/19/21	19 ± 3	16 ± 3	18 ± 3	14 ± 2	19 ± 3	15 ± 2
05/19/21 - 05/26/21	17 ± 3	17 ± 3	20 ± 3	17 ± 2	18 ± 3	19 ± 3
05/26/21 - 06/02/21	11 ± 2	8 ± 2	12 ± 2	10 ± 2	11 ± 2	11 ± 2
06/02/21 - 06/09/21	17 ± 3	14 ± 2	15 ± 2	13 ± 2	17 ± 2	16 ± 2
06/09/21 - 06/16/21	8 ± 2	10 ± 2	11 ± 2	8 ± 2	9 ± 2	8 ± 2
06/16/21 - 06/23/21	16 ± 2	16 ± 2	19 ± 3	15 ± 2	13 ± 2	16 ± 2
06/23/21 - 06/30/21	12 ± 2	12 ± 2	15 ± 2	12 ± 2	10 ± 2	12 ± 2
06/30/21 - 07/07/21	11 ± 2	13 ± 2	14 ± 2	10 ± 2	12 ± 2	12 ± 2
07/07/21 - 07/14/21	14 ± 2	13 ± 2	14 ± 2	13 ± 2	14 ± 2	14 ± 2
07/14/21 - 07/21/21	16 ± 2	16 ± 2	18 ± 3	16 ± 2	18 ± 3	16 ± 2
07/21/21 - 07/28/21	16 ± 3	14 ± 3	17 ± 3	14 ± 2	15 ± 3	16 ± 3
07/28/21 - 08/04/21	14 ± 2	13 ± 2	13 ± 2	16 ± 3	15 ± 2	15 ± 2
08/04/21 - 08/11/21	22 ± 3	20 ± 3	21 ± 3	20 ± 3	21 ± 3	24 ± 3
08/11/21 - 08/18/21	13 ± 2	13 ± 2	13 ± 2	12 ± 2	14 ± 2	13 ± 2
08/18/21 - 08/25/21	13 ± 2	12 ± 2	13 ± 2	12 ± 2	13 ± 2	12 ± 2
08/25/21 - 08/31/21	20 ± 3	19 ± 3	25 ± 3	20 ± 3	20 ± 3	22 ± 3
08/31/21 - 09/08/21	13 ± 2	14 ± 2	15 ± 2	14 ± 2	12 ± 2	15 ± 2
09/08/21 - 09/15/21	26 ± 3	23 ± 3	24 ± 3	21 ± 3	24 ± 3	24 ± 3
09/15/21 - 09/22/21	17 ± 2	16 ± 2	18 ± 3	17 ± 2	20 ± 3	17 ± 2
09/22/21 - 09/29/21	16 ± 2	12 ± 2	16 ± 2	14 ± 2	14 ± 2	14 ± 2
09/29/21 - 10/06/21	10 ± 2	12 ± 2	11 ± 2	13 ± 2	11 ± 2	11 ± 2
10/06/21 - 10/13/21	13 ± 2	13 ± 2	11 ± 2	13 ± 2	14 ± 2	13 ± 2
10/13/21 - 10/20/21	22 ± 3	21 ± 3	22 ± 3	20 ± 3	23 ± 3	21 ± 3
10/20/21 - 10/27/21	20 ± 3	18 ± 3	19 ± 3	19 ± 3	22 ± 3	18 ± 3
10/27/21 - 11/03/21	16 ± 2	14 ± 2	16 ± 2	13 ± 2	13 ± 2	15 ± 2
11/03/21 - 11/09/21	18 ± 3	21 ± 3	17 ± 2	19 ± 3	18 ± 3	17 ± 3
11/09/21 - 11/17/21	20 ± 2	18 ± 2	19 ± 2	19 ± 2	23 ± 3	22 ± 2
11/17/21 - 11/23/21	13 ± 2	15 ± 3	16 ± 2	14 ± 3	16 ± 3	15 ± 2
11/23/21 - 12/01/21	14 ± 2	11 ± 2	13 ± 2	13 ± 2	13 ± 2	12 ± 2
12/01/21 - 12/08/21	16 ± 2	14 ± 2	16 ± 2	17 ± 2	18 ± 2	16 ± 2
12/08/21 - 12/15/21	21 ± 3	22 ± 3	17 ± 2	21 ± 3	26 ± 3	20 ± 2
12/15/21 - 12/22/21	18 ± 3	17 ± 2	16 ± 2	16 ± 2	17 ± 2	14 ± 2
12/22/21 - 12/29/21	25 ± 3	24 ± 3	24 ± 3	24 ± 3	25 ± 3	23 ± 3
AVERAGE	15 ± 9	14 ± 8	16 ± 9	15 ± 8	16 ± 9	15 ± 9

TABLE C-1 **GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in units of E-03 pCi/cu.m. ± 2 sigma

COLLECTION PERIOD	10S3
12/30/20 - 01/06/21	10 ± 2
01/06/21 - 01/13/21	16 ± 2
01/13/21 - 01/20/21	21 ± 3
01/20/21 - 01/27/21	7 ± 2
01/27/21 - 02/04/21	8 ± 2
02/04/21 - 02/11/21	22 ± 3
02/11/21 - 02/17/21	15 ± 2
02/17/21 - 02/24/21	18 ± 2
02/24/21 - 03/03/21	12 ± 2
03/03/21 - 03/10/21	15 ± 2
03/10/21 - 03/17/21	18 ± 2
03/17/21 - 03/24/21	16 ± 2
03/24/21 - 03/31/21	11 ± 2
03/31/21 - 04/07/21	16 ± 2
04/07/21 - 04/14/21	9 ± 2
04/14/21 - 04/21/21	11 ± 2
04/21/21 - 04/28/21	22 ± 3
04/28/21 - 05/05/21	18 ± 3
05/05/21 - 05/12/21	8 ± 2
05/12/21 - 05/19/21	14 ± 2
05/19/21 - 05/26/21	17 ± 2
05/26/21 - 06/02/21	15 ± 2
06/02/21 - 06/09/21	16 ± 2
06/09/21 - 06/16/21	10 ± 2
06/16/21 - 06/23/21	12 ± 2
06/23/21 - 06/30/21	11 ± 2
06/30/21 - 07/07/21	12 ± 2
07/07/21 - 07/14/21	13 ± 2
07/14/21 - 07/21/21	18 ± 2
07/21/21 - 07/28/21	14 ± 2
07/28/21 - 08/04/21	14 ± 2
08/04/21 - 08/11/21	20 ± 3
08/11/21 - 08/18/21	12 ± 2
08/18/21 - 08/25/21	11 ± 2
08/25/21 - 08/31/21	20 ± 3
08/31/21 - 09/08/21	17 ± 2
09/08/21 - 09/15/21	22 ± 3
09/15/21 - 09/22/21	18 ± 3
09/22/21 - 09/29/21	16 ± 2
09/29/21 - 10/06/21	13 ± 2
10/06/21 - 10/13/21	14 ± 2
10/13/21 - 10/20/21	18 ± 2
10/20/21 - 10/27/21	21 ± 3
10/27/21 - 11/03/21	13 ± 2
11/03/21 - 11/09/21	17 ± 3
11/09/21 - 11/17/21	18 ± 2
11/17/21 - 11/23/21	15 ± 3
11/23/21 - 12/01/21	14 ± 2
12/01/21 - 12/08/21	15 ± 2
12/08/21 - 12/15/21	23 ± 3
12/15/21 - 12/22/21	17 ± 2
12/22/21 - 12/29/21	24 ± 3
AVERAGE	15 ± 8

TABLE C-2 GAMMA SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in units of E-03 pCi/cu.m. ± 2 sigma

SITE	COLLECTION PERIOD	Be-7	K-40	Cs-134	Cs-137
8G1	12/30/20 - 03/31/21	110 ± 18	< 16	< 1	< 1
	03/31/21 - 06/30/21	115 ± 19	< 11	< 1	< 0
	06/30/21 - 09/29/21	112 ± 22	< 25	< 1	< 2
	09/29/21 - 12/29/21	118 ± 18	< 17	< 2	< 1
	AVERAGE	114 ± 7	-	-	-
3S2	12/30/20 - 03/31/21	98 ± 22	< 22	< 1	< 1
	03/31/21 - 06/30/21	138 ± 24	< 19	< 1	< 1
	06/30/21 - 09/29/21	105 ± 22	< 25	< 1	< 1
	09/29/21 - 12/29/21	106 ± 19	< 14	< 1	< 1
	AVERAGE	112 ± 35	-	-	-
12E1	12/30/20 - 03/31/21	108 ± 17	< 14	< 1	< 1
	03/31/21 - 06/30/21	138 ± 22	< 13	< 1	< 1
	06/30/21 - 09/29/21	119 ± 20	< 15	< 1	< 1
	09/29/21 - 12/29/21	102 ± 15	< 14	< 1	< 1
	AVERAGE	117 ± 31	-	-	-
12S1	12/30/20 - 03/31/21	109 ± 25	< 22	< 2	< 2
	03/31/21 - 06/30/21	111 ± 18	< 14	< 1	< 1
	06/30/21 - 09/29/21	116 ± 18	< 15	< 1	< 1
	09/29/21 - 12/29/21	100 ± 22	< 16	< 2	< 1
	AVERAGE	109 ± 13	-	-	-
13S6	12/30/20 - 03/31/21	114 ± 18	< 14	< 1	< 1
	03/31/21 - 06/30/21	141 ± 25	< 23	< 1	< 1
	06/30/21 - 09/29/21	122 ± 20	< 18	< 1	< 1
	09/29/21 - 12/29/21	110 ± 19	< 14	< 2	< 1
	AVERAGE	122 + 28	-	-	-
9B1	12/30/20 - 03/31/21	122 ± 21	< 16	< 1	< 1
	03/31/21 - 06/30/21	134 ± 22	< 20	< 1	< 1
	06/30/21 - 09/29/21	109 ± 22	< 18	< 1	< 1
	09/29/21 - 12/29/21	89 ± 19	< 14	< 1	< 1
	AVERAGE	114 ± 39	-	-	-
10S3	12/30/20 - 03/31/21	90 ± 16	< 14	< 1	< 1
	03/31/21 - 06/30/21	136 ± 17	< 14	< 1	< 1
	06/30/21 - 09/29/21	93 ± 26	< 19	< 1	< 1
	09/29/21 - 12/29/21	100 ± 24	< 25	< 2	< 1
	AVERAGE	105 ± 42	-	-	-

TABLE C-3 **IODINE-131 ANALYSES OF AIR IODINE SAMPLES**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in units of E-03 pCi/cu.m. ± 2 sigma

COLLECTION PERIOD	3S2	8G1	12E1	12S1	13S6	9B1
12/30/20 - 01/06/21	< 10	< 14	< 14	< 15	< 9	< 6
01/06/21 - 01/13/21	< 9	< 8	< 8	< 9	< 4	< 6
01/13/21 - 01/20/21	< 17	< 19	< 19	< 20	< 10	< 14
01/20/21 - 01/27/21	< 8	< 9	< 9	< 9	< 4	< 4
01/27/21 - 02/04/21	< 13	< 14	< 14	< 15	< 17	< 11
02/04/21 - 02/11/21	< 15	< 17	< 15	< 16	< 10	< 9
02/11/21 - 02/17/21	< 12	< 18	< 19	< 20	< 7	< 12
02/17/21 - 02/24/21	< 11	< 5	< 11	< 11	< 5	< 7
02/24/21 - 03/03/21	< 16	< 15	< 15	< 16	< 8	< 10
03/03/21 - 03/10/21	< 8	< 7	< 7	< 4	< 4	< 7
03/10/21 - 03/17/21	< 8	< 18	< 7	< 7	< 3	< 8
03/17/21 - 03/24/21	< 20	< 11	< 20	< 19	< 9	< 5
03/24/21 - 03/31/21	< 13	< 15	< 8	< 17	< 19	< 16
03/31/21 - 04/07/21	< 10	< 18	< 4	< 9	< 10	< 9
04/07/21 - 04/14/21	< 7	< 5	< 5	< 7	< 7	< 4
04/14/21 - 04/21/21	< 5	< 8	< 8	< 4	< 7	< 8
04/21/21 - 04/28/21	< 10	< 13	< 19	< 19	< 19	< 18
04/28/21 - 05/05/21	< 13	< 12	< 17	< 17	< 19	< 17
05/05/21 - 05/12/21	< 4	< 4	< 10	< 9	< 9	< 9
05/12/21 - 05/19/21	< 9	< 9	< 15	< 14	< 18	< 15
05/19/21 - 05/26/21	< 8	< 9	< 13	< 13	< 14	< 17
05/26/21 - 06/02/21	< 11	< 8	< 13	< 13	< 17	< 13
06/02/21 - 06/09/21	< 9	< 16	< 8	< 8	< 8	< 16
06/09/21 - 06/16/21	< 8	< 3	< 6	< 6	< 13	< 5
06/16/21 - 06/23/21	< 8	< 18	< 17	< 9	< 18	< 17
06/23/21 - 06/30/21	< 19	< 10	< 17	< 17	< 8	< 17
06/30/21 - 07/07/21	< 7	< 14	< 16	< 16	< 15	< 16
07/07/21 - 07/14/21	< 7	< 8	< 17	< 17	< 12	< 16
07/14/21 - 07/21/21	< 7	< 14	< 16	< 16	< 13	< 16
07/21/21 - 07/28/21	< 19	< 3	< 7	< 7	< 9	< 7
07/28/21 - 08/04/21	< 13	< 6	< 14	< 12	< 14	< 12
08/04/21 - 08/11/21	< 18	< 12	< 17	< 16	< 9	< 16
08/11/21 - 08/18/21	< 13	< 3	< 13	< 13	< 6	< 7
08/18/21 - 08/25/21	< 9	< 9	< 10	< 9	< 4	< 14
08/25/21 - 08/31/21	< 12	< 8	< 12	< 12	< 7	< 17
08/31/21 - 09/08/21	< 12	< 9	< 6	< 9	< 6	< 9
09/08/21 - 09/15/21	< 18	< 12	< 19	< 18	< 9	< 18
09/15/21 - 09/22/21	< 6	< 9	< 4	< 9	< 4	< 9
09/22/21 - 09/29/21	< 13	< 18	< 19	< 18	< 9	< 9
09/29/21 - 10/06/21	< 5	< 3	< 7	< 8	< 4	< 7
10/06/21 - 10/13/21	< 4	< 7	< 5	< 5	< 5	< 7
10/13/21 - 10/20/21	< 9	< 14	< 8	< 9	< 4	< 19
10/20/21 - 10/27/21	< 9	< 9	< 8	< 9	< 4	< 19
10/27/21 - 11/03/21	< 11	< 8	< 16	< 17	< 7	< 16
11/03/21 - 11/09/21	< 19	< 4	< 8	< 9	< 13	< 9
11/09/21 - 11/17/21	< 7	< 4	< 6	< 7	< 3	< 9
11/17/21 - 11/23/21	< 15	< 7	< 14	< 15	< 9	< 12
11/23/21 - 12/01/21	< 12	< 10	< 11	< 12	< 7	< 11
12/01/21 - 12/08/21	< 14	< 11	< 13	< 14	< 7	< 13
12/08/21 - 12/15/21	< 4	< 8	< 8	< 9	< 9	< 8
12/15/21 - 12/22/21	< 7	< 13	< 8	< 12	< 14	< 12
12/22/21 - 12/29/21	< 5	< 9	< 11	< 11	< 11	< 20
AVERAGE	-	-	-	-	-	-

TABLE C-3 **IODINE-131 ANALYSES OF AIR IODINE SAMPLES**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in units of E-03 pCi/cu.m. ± 2 sigma

COLLECTION PERIOD	10S3
12/30/20 - 01/06/21	< 14
01/06/21 - 01/13/21	< 8
01/13/21 - 01/20/21	< 19
01/20/21 - 01/27/21	< 9
01/27/21 - 02/04/21	< 14
02/04/21 - 02/11/21	< 15
02/11/21 - 02/17/21	< 19
02/17/21 - 02/24/21	< 11
02/24/21 - 03/03/21	< 15
03/03/21 - 03/10/21	< 7
03/10/21 - 03/17/21	< 7
03/17/21 - 03/24/21	< 19
03/24/21 - 03/31/21	< 16
03/31/21 - 04/07/21	< 10
04/07/21 - 04/14/21	< 7
04/14/21 - 04/21/21	< 8
04/21/21 - 04/28/21	< 19
04/28/21 - 05/05/21	< 17
05/05/21 - 05/12/21	< 10
05/12/21 - 05/19/21	< 15
05/19/21 - 05/26/21	< 13
05/26/21 - 06/02/21	< 13
06/02/21 - 06/09/21	< 3
06/09/21 - 06/16/21	< 6
06/16/21 - 06/23/21	< 17
06/23/21 - 06/30/21	< 17
06/30/21 - 07/07/21	< 16
07/07/21 - 07/14/21	< 16
07/14/21 - 07/21/21	< 16
07/21/21 - 07/28/21	< 7
07/28/21 - 08/04/21	< 14
08/04/21 - 08/11/21	< 17
08/11/21 - 08/18/21	< 13
08/18/21 - 08/25/21	< 10
08/25/21 - 08/31/21	< 12
08/31/21 - 09/08/21	< 10
09/08/21 - 09/15/21	< 19
09/15/21 - 09/22/21	< 9
09/22/21 - 09/29/21	< 19
09/29/21 - 10/06/21	< 8
10/06/21 - 10/13/21	< 5
10/13/21 - 10/20/21	< 9
10/20/21 - 10/27/21	< 9
10/27/21 - 11/03/21	< 17
11/03/21 - 11/09/21	< 9
11/09/21 - 11/17/21	< 7
11/17/21 - 11/23/21	< 15
11/23/21 - 12/01/21	< 12
12/01/21 - 12/08/21	< 14
12/08/21 - 12/15/21	< 9
12/15/21 - 12/22/21	< 12
12/22/21 - 12/29/21	< 10
AVERAGE	-

TABLE C-4 ENVIRONMENTAL OPTICALLY STIMULATED LUMINESCENCE DOSIMETRY RESULTS SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results (1) are in mR/std. qtr (2) ± 2 sigma (3)

LOCATION	First Quarter 1/7/2021 to 4/21/2021	Second Quarter 4/21/2021 to 7/1/2021	Third Quarter 7/1/2021 to 10/5/2021	Fourth Quarter 10/5/2021 to 1/20/2022
ONSITE				
1S2	19.7 ± 2.3	23.6 ± 0.9	19.9 ± 1.0	20.8 ± 1.0
2S2	11.7 ± 1.2	12.7 ± 1.2	10.5 ± 0.7	13.6 ± 0.6
2S3	18.3 ± 3.4	19.4 ± 4.3	18.6 ± 3.6	20.7 ± 1.1
3S2	12.9 ± 1.4	15.8 ± 0.4	11.7 ± 2.4	12.7 ± 1.4
3S3	12.5 ± 1.0	14.1 ± 0.9	(4) (4)	11.7 ± 0.1
4S3	18.1 ± 1.8	21.9 ± 0.8	18.0 ± 1.1	18.8 ± 0.7
4S6	13.9 ± 0.2	13.6 ± 2.6	10.6 ± 0.3	12.9 ± 0.1
5S4	11.1 ± 0.2	12.7 ± 2.1	7.4 ± 2.5	10.7 ± 0.3
5S7	14.4 ± 1.4	17.2 ± 2.2	15.5 ± 2.9	15.5 ± 1.4
6S4	18.9 ± 1.8	23.4 ± 2.1	18.1 ± 0.3	19.9 ± 2.4
6S9	17.8 ± 2.8	23.9 ± 3.1	21.5 ± 1.4	22.1 ± 0.0
7S6	18.4 ± 0.1	23.8 ± 2.6	20.1 ± 0.0	20.5 ± 1.1
7S7	12.7 ± 0.9	13.1 ± 0.2	9.1 ± 3.1	11.6 ± 1.3
8S2	16.3 ± 3.8	22.4 ± 2.8	22.7 ± 3.0	22.0 ± 0.7
9S2	29.5 ± 1.2	31.1 ± 2.1	32.4 ± 7.8	34.8 ± 4.0
10S1	12.2 ± 2.3	13.5 ± 0.1	10.8 ± 2.6	14.8 ± 1.4
10S2	21.8 ± 0.2	23.4 ± 0.4	20.6 ± 0.7	23.1 ± 1.6
11S7	12.8 ± 0.4	13.4 ± 2.2	11.1 ± 0.0	13.4 ± 0.8
12S1	13.6 ± 2.1	13.4 ± 1.2	11.7 ± 0.2	13.9 ± 2.7
12S3	16.2 ± 2.5	19.8 ± 0.4	16.9 ± 1.9	15.9 ± 1.0
12S7	14.1 ± 0.2	14.1 ± 3.1	11.8 ± 2.2	14.3 ± 0.4
13S2	21.0 ± 0.6	21.9 ± 1.0	25.7 ± 12.2	20.0 ± 2.9
13S5	17.4 ± 1.4	17.4 ± 1.6	18.4 ± 3.0	22.6 ± 1.5
13S6	20.7 ± 1.0	20.7 ± 1.1	17.0 ± 1.1	17.1 ± 0.9
14S5	15.9 ± 0.8	10.2 ± 9.1	16.5 ± 1.4	14.5 ± 0.9
15S5	15.0 ± 0.5	15.9 ± 3.5	14.2 ± 1.1	14.4 ± 0.6
16S1	22.2 ± 1.1	24.8 ± 2.1	16.6 ± 0.5	18.7 ± 1.8
16S2	17.6 ± 0.4	22.4 ± 0.9	15.8 ± 2.3	19.0 ± 0.5

See the comments at the end of this table.

TABLE C-4 ENVIRONMENTAL OPTICALLY STIMULATED LUMINESCENCE DOSIMETRY RESULTS SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results (1) are in mR/std. qtr (2) ± 2 sigma (3)

LOCATION	First Quarter 1/7/2021 to 4/21/2021	Second Quarter 4/21/2021 to 7/1/2021	Third Quarter 7/1/2021 to 10/5/2021	Fourth Quarter 10/5/2021 to 1/20/2022
0-1 MILE OFFSITE				
6A4	14.9 ± 0.9	15.1 ± 1.1	13.2 ± 0.8	16.1 ± 0.1
8A3	14.3 ± 1.4	14.6 ± 1.7	10.9 ± 0.5	15.4 ± 1.6
15A3	11.7 ± 0.3	14.6 ± 1.1	9.2 ± 0.7	10.4 ± 1.4
16A2	12.4 ± 0.2	14.9 ± 0.4	9.7 ± 1.2	11.6 ± 1.2
1-2 MILES OFFSITE				
8B2	12.4 ± 1.5	13.4 ± 1.0	14.6 ± 1.1	13.4 ± 1.4
9B1	17.4 ± 2.1	18.5 ± 0.7	13.7 ± 0.5	16.3 ± 3.3
10B3	13.3 ± 1.0	15.5 ± 0.5	9.8 ± 0.5	13.3 ± 1.0
3-4 MILES OFFSITE				
1D5	14.6 ± 0.4	15.4 ± 0.8	15.2 ± 2.7	14.4 ± 0.4
8D3	13.8 ± 0.2	13.2 ± 0.2	15.7 ± 0.1	12.5 ± 0.8
9D4	13.7 ± 0.1	14.7 ± 1.4	15.1 ± 0.9	14.4 ± 0.9
10D1	12.1 ± 0.6	14.8 ± 0.1	15.2 ± 1.8	12.3 ± 0.5
12D2	19.1 ± 5.2	18.3 ± 0.9	15.3 ± 0.0	16.8 ± 0.1
14D1	14.6 ± 0.4	15.5 ± 2.1	12.2 ± 1.4	12.2 ± 3.2
4-5 MILES OFFSITE				
3E1	10.2 ± 0.2	10.5 ± 0.4	11.9 ± 1.5	10.4 ± 1.1
4E2	13.6 ± 0.7	12.8 ± 4.8	15.4 ± 0.7	12.9 ± 1.2
5E2	15.5 ± 0.9	14.8 ± 1.2	15.3 ± 0.9	13.8 ± 0.7
6E1	15.3 ± 0.1	15.3 ± 2.1	18.4 ± 0.1	14.8 ± 2.3
7E1	15.1 ± 1.1	14.6 ± 0.4	14.8 ± 1.6	13.2 ± 1.7
11E1	9.1 ± 2.2	11.5 ± 0.1	11.8 ± 0.3	10.5 ± 0.1
12E1	13.3 ± 0.2	13.9 ± 1.2	8.6 ± 3.0	13.2 ± 0.2
13E4	16.1 ± 0.7	18.6 ± 0.2	13.4 ± 0.5	17.4 ± 1.2

See the comments at the end of this table.

TABLE C-4 ENVIRONMENTAL OPTICALLY STIMULATED LUMINESCENCE DOSIMETRY RESULTS SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results (1) are in mR/std. qtr (2) ± 2 sigma (3)

LOCATION	First Quarter 1/7/2021 to 4/21/2021	Second Quarter 4/21/2021 to 7/1/2021	Third Quarter 7/1/2021 to 10/5/2021	Fourth Quarter 10/5/2021 to 1/20/2022
5-10 MILES OFFSITE				
2F1	13.9 ± 0.3	15.2 ± 0.5	15.1 ± 0.0	12.7 ± 0.7
15F1	14.9 ± 0.4	16.5 ± 0.0	12.2 ± 2.2	16.1 ± 0.7
16F1	16.4 ± 0.2	16.5 ± 3.8	12.9 ± 1.0	17.2 ± 2.4
10-20 MILES OFFSITE				
3G4	16.1 ± 0.0	19.1 ± 2.3	17.0 ± 0.1	16.0 ± 0.4
4G1	15.4 ± 1.4	13.1 ± 0.6	16.8 ± 1.4	15.1 ± 0.7
7G1	12.8 ± 0.1	11.0 ± 0.3	14.7 ± 0.7	12.7 ± 1.1
12G1	11.8 ± 0.2	14.1 ± 4.3	12.6 ± 0.4	11.7 ± 1.9
12G4	13.3 ± 0.1	11.6 ± 3.9	14.4 ± 0.8	12.7 ± 0.6

See the comments at the end of this table.

LOCATION				
INDICATOR Average (5)	15.5 ± 7.1	16.9 ± 8.7	15.0 ± 9.2	15.8 ± 8.7
CONTROL Average (5)	13.9 ± 3.6	13.8 ± 6.5	15.1 ± 3.7	13.6 ± 3.6

COMMENTS

(1) Individual monitor location results are normally the average of the elemental doses of four elements from the two dosimeters assigned to each monitoring location.

(2) A standard (std.) quarter (qtr.) is considered to be 91.25 days. Results obtained for monitoring periods of other durations are normalized by multiplying them by 91.25/x, where x is the actual duration in days of the period.

(3) Uncertainties for individual monitoring location results are two standard deviations of the elemental doses of four elements from the two dosimeters assigned to each monitoring location, representing the variability between the elemental doses of each of the four dosimeter elements.

(4) No measurement could be made at this location because the dosimeters were lost, stolen, or damaged. Refer to Appendix A of the Annual Radiological Environmental Operating Report for an explanation of program exceptions to REMP.

(5) Uncertainties associated with quarterly indicator and control averages are two standard deviations, representing the variability between the results of the individual monitoring locations.

TABLE C-5 IODINE-131 AND GAMMA SPECTROSCOPIC ANALYSES OF MILK SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION DATE	I-131	<----------GAMMA EMITTERS----------> K-40	Cs-134	Cs-137	Ba-140	La-140	Th-228
10G1	01/04/21	< 0.9	1263 ± 214	< 7	< 9	< 29	< 7	< 13
	02/03/21	< 0.8	989 ± 184	< 9	< 8	< 30	< 8	< 13
	03/08/21	< 0.8	1482 ± 171	< 7	< 7	< 25	< 8	< 14
	04/12/21	< 0.9	1492 ± 204	< 7	< 9	< 40	< 10	< 17
	04/26/21	< 0.8	1246 ± 181	< 8	< 8	< 32	< 5	< 16
	05/10/21	< 0.9	1366 ± 185	< 9	< 8	< 37	< 8	< 17
	05/24/21	< 0.7	1153 ± 159	< 7	< 8	< 24	< 10	< 12
	06/07/21	< 0.8	1367 ± 174	< 7	< 7	< 33	< 11	< 15
	06/21/21	< 0.6	1224 ± 146	< 6	< 7	< 26	< 8	< 11
	07/06/21	< 0.7	1208 ± 219	< 6	< 10	< 22	< 10	< 14
	07/19/21	< 0.8	1162 ± 170	< 7	< 8	< 28	< 6	< 15
	08/02/21	< 0.7	1237 ± 150	< 6	< 7	< 26	< 8	< 14
	08/16/21	< 0.6	1202 ± 137	< 5	< 6	< 18	< 6	< 11
	08/30/21	< 0.9	1095 ± 177	< 7	< 8	< 27	< 9	< 16
	09/13/21	< 0.7	1258 ± 187	< 7	< 11	< 33	< 10	< 17
	09/27/21	< 0.6	1112 ± 144	< 6	< 6	< 31	< 8	< 12
	10/11/21	< 0.9	1157 ± 117	< 5	< 5	< 21	< 7	< 10
	10/25/21	< 1.0	1349 ± 158	< 6	< 7	< 30	< 9	< 14
	11/08/21	< 0.6	1529 ± 204	< 7	< 8	< 35	< 10	< 16
	12/06/21	< 0.8	1428 ± 212	< 8	< 10	< 35	< 10	< 13
	AVERAGE	-	1266 ± 289	-	-	-	-	-
13E3	01/04/21	< 0.9	1271 ± 163	< 7	< 9	< 30	< 10	< 13
	02/03/21	< 0.9	1324 ± 204	< 8	< 8	< 30	< 11	< 15
	03/09/21	< 0.9	1139 ± 175	< 7	< 8	< 28	< 8	< 12
	04/12/21	< 0.9	1072 ± 175	< 9	< 8	< 25	< 8	< 17
	04/26/21	< 0.8	1309 ± 190	< 7	< 8	< 25	< 9	< 14
	05/10/21	< 0.8	1344 ± 179	< 7	< 9	< 30	< 7	< 15
	05/24/21	< 0.9	1126 ± 156	< 7	< 7	< 30	< 10	< 13
	06/07/21	< 0.9	1204 ± 164	< 7	< 6	< 25	< 9	< 14
	06/21/21	< 0.6	1255 ± 162	< 7	< 9	< 25	< 8	< 14
	07/06/21	< 0.8	1209 ± 153	< 6	< 8	< 25	< 8	< 11
	07/19/21	< 0.8	1260 ± 151	< 6	< 6	< 24	< 6	< 12
	08/02/21	< 0.8	1434 ± 178	< 7	< 8	< 24	< 8	< 13
	08/16/21	< 0.7	1248 ± 151	< 6	< 7	< 25	< 7	< 13
	08/30/21	< 0.8	1405 ± 194	< 6	< 7	< 29	< 8	< 15
	09/13/21	< 0.8	1315 ± 192	< 8	< 8	< 29	< 7	< 15
	09/27/21	< 0.9	1431 ± 193	< 7	< 9	< 36	< 9	< 15
	10/11/21	< 0.9	1301 ± 120	< 4	< 5	< 19	< 5	< 10
	10/25/21	< 0.6	1385 ± 157	< 7	< 8	< 27	< 8	< 13
	11/08/21	< 0.5	1212 ± 168	< 7	< 8	< 27	< 9	< 13
	12/06/21	< 0.6	1572 ± 198	< 7	< 8	< 30	< 7	< 16
	AVERAGE	-	1291 ± 238	-	-	-	-	-

TABLE C-5 IODINE-131 AND GAMMA SPECTROSCOPIC ANALYSES OF MILK SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION DATE	I-131	<----------GAMMA EMITTERS---------->					
			K-40	Cs-134	Cs-137	Ba-140	La-140	Th-228
5E2	01/04/21	< 0.8	1272 ± 182	< 7	< 8	< 27	< 10	< 16
	02/04/21	< 0.9	1096 ± 175	< 7	< 8	< 30	< 10	< 15
	03/08/21	< 0.9	1340 ± 178	< 8	< 7	< 34	< 7	< 16
	04/12/21	< 0.9	1087 ± 199	< 8	< 9	< 32	< 9	< 16
	04/26/21	< 0.7	1107 ± 172	< 7	< 8	< 27	< 9	< 16
	05/10/21	< 0.9	1208 ± 181	< 7	< 9	< 29	< 7	< 18
	05/24/21	< 0.7	1169 ± 164	< 7	< 8	< 27	< 7	< 14
	06/07/21	< 0.9	1366 ± 200	< 8	< 9	< 34	< 9	< 15
	06/21/21	< 0.8	1219 ± 168	< 5	< 7	< 25	< 8	< 12
	07/06/21	< 0.9	1356 ± 184	< 6	< 7	< 24	< 9	< 11
	07/19/21	< 0.6	1353 ± 182	< 8	< 9	< 34	< 10	< 16
	08/02/21	< 0.8	1274 ± 199	< 8	< 10	< 30	< 9	< 16
	08/16/21	< 0.7	1266 ± 163	< 6	< 7	< 22	< 7	< 12
	08/30/21	< 0.4	1200 ± 178	< 7	< 8	< 31	< 11	< 13
	09/13/21	< 0.8	1272 ± 182	< 8	< 8	< 41	< 8	< 15
	09/27/21	< 0.5	1110 ± 173	< 8	< 9	< 34	< 10	< 17
	10/11/21	< 0.8	1150 ± 135	< 4	< 5	< 19	< 4	< 9
	10/25/21	< 0.6	1261 ± 191	< 7	< 9	< 25	< 9	< 15
	11/08/21	< 0.7	1213 ± 205	< 8	< 10	< 34	< 12	< 16
	12/06/21	< 0.6	1308 ± 188	< 6	< 8	< 31	< 7	< 16
	AVERAGE	-	1231 ± 181	-	-	-	-	-

TABLE C-6 TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF GROUNDWATER SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION DATE	H-3	<----------GAMMA EMITTERS---------->													
			K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Th-228
2S8	01/21/21	< 143	< 115	< 7	< 6	< 20	< 7	< 15	< 7	< 10	< 11	< 6	< 6	< 29	< 11	< 13
	04/27/21	< 141	< 150	< 8	< 8	< 18	< 7	< 17	< 11	< 15	< 11	< 8	< 9	< 32	< 12	< 18
	07/28/21	< 141	< 120	< 7	< 8	< 18	< 6	< 14	< 7	< 11	< 11	< 6	< 6	< 32	< 14	< 12
	10/22/21	< 148	< 65	< 4	< 4	< 14	< 4	< 9	< 5	< 8	< 12	< 4	< 4	< 27	< 12	< 8
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13S7	01/25/21	< 144	< 116	< 7	< 7	< 19	< 5	< 12	< 8	< 12	< 9	< 6	< 7	< 25	< 6	< 14
	04/20/21	190 ± 94	< 132	< 5	< 7	< 19	< 8	< 12	< 5	< 9	< 12	< 6	< 7	< 33	< 8	< 11
	07/27/21	< 148	< 113	< 8	< 5	< 12	< 7	< 10	< 5	< 10	< 9	< 6	< 6	< 29	< 11	< 11
	10/27/21	< 148	< 95	< 5	< 5	< 16	< 5	< 12	< 6	< 10	< 13	< 6	< 6	< 30	< 10	< 11
	AVERAGE	190 ± 0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1S3	01/25/21	< 146	< 111	< 6	< 7	< 19	< 9	< 10	< 6	< 15	< 10	< 6	< 8	< 27	< 6	< 13
	04/20/21	252 ± 97	< 95	< 4	< 6	< 17	< 6	< 6	< 7	< 9	< 12	< 5	< 6	< 29	< 7	< 10
	07/27/21	175 ± 93	< 113	< 6	< 6	< 16	< 7	< 16	< 8	< 12	< 9	< 7	< 7	< 30	< 7	< 17
	10/27/21	222 ± 100	< 94	< 5	< 6	< 20	< 6	< 10	< 8	< 10	< 13	< 5	< 5	< 32	< 10	< 11
	AVERAGE	216 ± 78	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4S8	01/25/21	156 ± 94	< 78	< 6	< 6	< 15	< 6	< 12	< 7	< 10	< 7	< 5	< 6	< 21	< 9	< 13
	04/20/21	247 ± 98	< 124	< 5	< 6	< 14	< 5	< 11	< 7	< 11	< 9	< 4	< 7	< 37	< 8	< 11
	07/27/21	225 ± 100	< 137	< 7	< 8	< 17	< 11	< 17	< 7	< 9	< 11	< 8	< 7	< 32	< 13	< 14
	10/27/21	148 ± 94	< 120	< 7	< 6	< 19	< 7	< 15	< 9	< 13	< 12	< 6	< 8	< 34	< 13	< 14
	AVERAGE	194 + 99	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4S9	01/28/21	< 140	< 105	< 5	< 6	< 13	< 8	< 10	< 5	< 10	< 11	< 5	< 7	< 32	< 8	< 11
	04/26/21	< 141	< 61	< 6	< 7	< 15	< 7	< 8	< 6	< 13	< 8	< 6	< 7	< 24	< 9	< 13
	08/02/21	< 144	< 148	< 5	< 8	< 21	< 6	< 9	< 5	< 10	< 10	< 7	< 9	< 31	< 7	< 16
	10/28/21	< 145	< 147	< 5	< 7	< 16	< 7	< 14	< 8	< 10	< 13	< 6	< 7	< 33	< 10	< 15
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6S11A	01/28/21	< 137	< 103	< 9	< 7	< 25	< 8	< 15	< 9	< 16	< 12	< 8	< 6	< 38	< 14	< 10
	04/26/21	< 142	< 180	< 11	< 8	< 24	< 11	< 23	< 11	< 17	< 11	< 10	< 10	< 38	< 12	< 16
	08/02/21	< 148	< 162	< 8	< 8	< 19	< 9	< 16	< 9	< 14	< 10	< 6	< 9	< 35	< 13	< 16
	10/28/21	< 149	< 135	< 9	< 9	< 25	< 8	< 14	< 6	< 13	< 14	< 7	< 8	< 41	< 13	< 14
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-6 TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF GROUNDWATER SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION DATE	H-3	<----------GAMMA EMITTERS----------> K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Th-228
6S12	01/28/21	< 134	< 130	< 6	< 7	< 14	< 6	< 12	< 6	< 9	< 13	< 6	< 6	< 32	< 12	< 13
	04/19/21	< 138	< 87	< 5	< 4	< 11	< 5	< 11	< 6	< 6	< 11	< 5	< 5	< 28	< 11	< 10
	07/26/21	< 145	< 132	< 6	< 5	< 9	< 8	< 8	< 6	< 11	< 9	< 5	< 7	< 25	< 10	< 13
	10/25/21	< 150	< 91	< 4	< 6	< 12	< 6	< 9	< 4	< 9	< 11	< 4	< 6	< 25	< 12	< 9
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7S10	01/21/21	< 143	< 100	< 7	< 5	< 14	< 4	< 14	< 7	< 10	< 13	< 7	< 7	< 30	< 11	< 12
	04/19/21	< 140	< 63	< 4	< 3	< 9	< 3	< 8	< 4	< 8	< 10	< 4	< 3	< 26	< 10	< 7
	07/26/21	< 141	< 147	< 7	< 7	< 17	< 7	< 17	< 9	< 11	< 10	< 7	< 6	< 30	< 9	< 16
	10/25/21	< 146	< 72	< 5	< 4	< 14	< 7	< 11	< 7	< 9	< 13	< 6	< 6	< 26	< 8	< 13
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7S11	01/21/21	< 143	< 68	< 6	< 6	< 13	< 7	< 14	< 5	< 11	< 11	< 5	< 6	< 32	< 12	< 12
	04/19/21	< 137	< 118	< 5	< 4	< 16	< 7	< 12	< 6	< 9	< 11	< 5	< 6	< 31	< 12	< 13
	07/26/21	< 145	< 75	< 6	< 5	< 12	< 7	< 11	< 5	< 11	< 8	< 6	< 6	< 21	< 9	< 11
	10/25/21	< 148	< 82	< 6	< 5	< 18	< 5	< 11	< 8	< 7	< 13	< 6	< 7	< 34	< 10	< 13
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8S4	01/25/21	< 146	< 141	< 5	< 5	< 19	< 10	< 13	< 9	< 13	< 11	< 6	< 7	< 32	< 12	< 12
	04/20/21	< 146	< 86	< 6	< 6	< 22	< 4	< 11	< 7	< 6	< 11	< 7	< 7	< 38	< 10	< 13
	07/27/21	151 ± 93	< 119	< 7	< 7	< 21	< 7	< 14	< 6	< 10	< 9	< 7	< 6	< 26	< 10	< 12
	10/27/21	< 148	< 140	< 7	< 5	< 16	< 5	< 12	< 6	< 9	< 13	< 6	< 6	< 28	< 12	< 14
	AVERAGE	151 ± 0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1S4	02/16/21	< 142	< 145	< 7	< 8	< 12	< 7	< 12	< 7	< 11	< 11	< 8	< 7	< 28	< 7	< 14
	05/11/21	< 146	< 104	< 7	< 7	< 16	< 6	< 10	< 6	< 12	< 9	< 6	< 6	< 30	< 9	< 13
	07/27/21	< 144	< 117	< 5	< 6	< 16	< 5	< 10	< 5	< 8	< 8	< 5	< 6	< 25	< 10	< 10
	11/08/21	< 141	< 63	< 5	< 4	< 9	< 7	< 12	< 5	< 9	< 6	< 5	< 5	< 19	< 7	< 10
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-7

ANNUAL AVERAGE TRITIUM CONCENTRATION IN PRECIPITATION, MONITORING WELLS AND LAKE TOOK-A-WHILE (LTAW) SURFACE WATER DATA SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Precip Sites 3S2**, 12S1**, 8G1** (offsite, controls)	62*	49	40	38	82	63	51	39	45	32	45	**	**	**
Precip Sites 1 and 2 (onsite, East of Station Reactor Bldgs)	370	230*	193	216	242	182	142	250	206	251	325	333	252	336
Precipitation Sites 3 and 4 (onsite, West of Station Reactor Bldgs)	414	404*	350	233	169	151	231	258	197	383	494	355	350	382
1S3 - MW-1 (43')	248	150	252	131	164	197	115	169	175	130	218	253	200	187
1S4 - Tap Water Sample	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	28	44
4S8 - MW-2 (45')	292	154	190	173	137	202	187	138	154	138	191	196	239	194
4S9 - MW-3 (94')	127	54	150	64	80	135	94	180	125	55	109	92	77	86
8S4 - MW-4 (111')	172	66	105	68	81	109	60	162	145	91	102	155	96	109
7S10 - MW-5 (36')	171	69	96	-6	74	106	68	70	73	51	93	125	86	82
13S7 - MW-6 (16')	142	134	143	34	80	111	71	79	111	107	122	120	150	110
2S8 - MW-7 (85')	Not installed	Not installed	Not installed	22	54	72	70	70	74	56	37	71	63	35
6S11A - MW-8A (14')	177	82	165	58	15	72	103	110	63	38	50	83	72	48
6S11B - MW-8B (19')	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well	Dry well
6S12 - MW-9 (28')	30	-44	45	18	6	60	21	57	70	5	27	50	47	41
7S11 - MW-10 (132')	3	-27	-9	1	-1	23	29	55	13	1	33	16	3	7
**12F3 - Groundwater Control	26	-53	-2	5	-6	45	-26	20	41	61	82	**	**	**
**LTAW- Surface Water	179	104	110	132	132	145	27	73	89	77	135	**	**	**

* Revised values to reflect full scope of precipitation data.

** Stations were discontinued after 5/30/18.

TABLE C-8 GROSS BETA, TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF DRINKING WATER SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

	COLLECTION PERIOD				<----------GAMMA EMITTERS---------->												
SITE	START	STOP	Gr-B	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
12H2	12/29/20	01/26/21	< 1.9	< 144	< 31	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 7	< 2	< 2	< 13	< 5
12H2	01/26/21	02/23/21	2.3 ± 1.2	< 133	< 17	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 14	< 5
12H2	02/23/21	03/30/21	< 1.5	< 139	< 25	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 10	< 1	< 2	< 17	< 6
12H2	03/30/21	04/27/21	< 2.0	< 131	< 17	< 2	< 2	< 6	< 2	< 4	< 2	< 3	< 11	< 2	< 2	< 18	< 6
12H2	04/27/21	06/01/21	2.2 ± 1.3	< 147	< 34	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 11	< 1	< 2	< 19	< 7
12H2	06/01/21	06/29/21	< 1.9	< 134	< 15	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 9	< 1	< 2	< 16	< 7
12H2	06/29/21	07/27/21	< 2.1	< 147	< 38	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 9	< 2	< 2	< 17	< 5
12H2	07/27/21	08/31/21	3.0 ± 1.4	< 133	< 29	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 14	< 2	< 2	< 21	< 7
12H2	08/31/21	09/28/21	< 2.0	< 120	< 25	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 9	< 1	< 2	< 15	< 5
12H2	09/28/21	10/26/21	< 1.9	< 132	< 18	< 2	< 2	< 6	< 2	< 4	< 2	< 3	< 10	< 2	< 2	< 18	< 7
12H2	10/26/21	11/30/21	2.7 ± 1.3	< 135	< 30	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 12	< 1	< 2	< 19	< 7
12H2	11/30/21	12/28/21	< 1.9	< 128	< 19	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 8	< 1	< 2	< 17	< 6
		AVERAGE	2.5 ± 0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-9 **GAMMA SPECTROSCOPIC ANALYSES OF FOOD PRODUCTS (FRUITS, VEGETABLES AND BROADLEAF)**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/kg (wet) ± 2 sigma

SITE	COLLECTION DATE	SAMPLE TYPE	Be-7	K-40	I-131	Cs-134	Cs-137	Ac-228	Th-228
11D1	12/09/21	Soybeans	< 220	15440 ± 952	< 37	< 21	< 21	< 113	< 39
	12/09/21	Pumpkin	< 171	3091 ± 437	< 36	< 21	< 17	< 72	< 36
	AVERAGE		-	9266 ± 17464	-	-	-	-	-
11S6	06/28/21	Swiss Chard	431 ± 221	3527 ± 442	< 20	< 19	< 18	< 72	< 38
	06/28/21	Collard	< 235	3017 ± 538	< 21	< 20	< 26	< 92	< 41
	07/26/21	Swiss Chard	380 ± 203	3495 ± 615	< 27	< 21	< 25	< 125	< 48
	07/26/21	Collard	405 ± 167	3587 ± 554	< 22	< 17	< 25	< 82	< 39
	08/30/21	Swiss Chard	720 ± 266	2916 ± 521	< 28	< 20	< 23	< 110	< 48
	08/30/21	Collard	751 ± 256	3780 ± 573	< 25	< 25	< 26	< 108	< 45
	09/27/21	Swiss Chard	525 ± 237	2990 ± 465	< 26	< 21	< 19	< 116	< 42
	09/27/21	Collard	587 ± 169	3361 ± 462	< 25	< 24	< 24	< 83	< 39
	10/18/21	Swiss Chard	180 ± 116	2407 ± 320	< 18	< 15	< 17	< 57	< 31
	10/18/21	Collard	< 254	3357 ± 596	< 32	< 30	< 29	< 109	< 52
	AVERAGE		497 ± 378	3244 ± 816	-	-	-	-	-

TABLE C-10 **TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF SURFACE WATER**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION PERIOD	H-3	<----------GAMMA EMITTERS---------->													
			K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Th-228
6S6	12/29/20 - 01/26/21	< 147	< 27	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 7	< 2	< 2	< 14	< 5	< 3
	01/26/21 - 02/23/21	< 132	< 20	< 1	< 2	< 4	< 1	< 3	< 1	< 3	< 6	< 1	< 1	< 12	< 4	< 4
	02/23/21 - 03/30/21	< 144	< 29	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 12	< 2	< 2	< 19	< 6	< 3
	03/30/21 - 04/26/21	< 149	< 16	< 2	< 2	< 5	< 2	< 3	< 2	< 4	< 10	< 2	< 2	< 18	< 6	< 3
	05/17/21 - 06/01/21	< 146	< 15	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 5	< 2	< 2	< 11	< 4	< 3
	06/01/21 - 06/29/21	< 144	< 35	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 20	< 7	< 3
	06/29/21 - 07/27/21	< 149	< 17	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 5	< 1	< 1	< 10	< 3	< 3
	07/27/21 - 08/31/21	< 141	< 16	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 14	< 2	< 2	< 21	< 7	< 3
	08/31/21 - 09/28/21	< 127	< 16	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 8	< 2	< 2	< 16	< 6	< 3
	09/28/21 - 10/26/21	< 139	< 34	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 8	< 1	< 2	< 15	< 5	< 3
	10/26/21 - 11/30/21	< 131	< 14	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 11	< 1	< 2	< 19	< 6	< 3
	11/30/21 - 12/28/21	< 141	< 32	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 9	< 1	< 2	< 15	< 5	< 3
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2S7	12/29/20 - 01/26/21	752 ± 150	< 17	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 4	< 1	< 1	< 9	< 3	< 3
	01/26/21 - 02/23/21	1990 ± 255	< 27	< 1	< 2	< 5	< 2	< 3	< 2	< 3	< 6	< 1	< 2	< 13	< 5	< 3
	02/10/21 - 02/10/21	236 ± 94	< 15	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 7	< 2	< 2	< 13	< 4	< 3
	02/23/21 - 03/30/21	1310 ± 194	< 32	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 12	< 2	< 2	< 20	< 6	< 4
	03/30/21 - 04/27/21	1140 ± 181	< 33	< 2	< 2	< 7	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 21	< 7	< 4
	04/27/21 - 06/01/21	195 ± 106	< 16	< 1	< 2	< 5	< 2	< 3	< 2	< 3	< 11	< 1	< 2	< 19	< 6	< 3
	06/01/21 - 06/29/21	172 ± 95	< 28	< 2	< 2	< 6	< 2	< 3	< 2	< 3	< 10	< 2	< 2	< 17	< 6	< 3
	06/29/21 - 07/27/21	2570 ± 322	< 25	< 1	< 2	< 5	< 2	< 3	< 2	< 3	< 7	< 1	< 2	< 13	< 4	< 3
	07/20/21 - 07/20/21	< 144	< 43	< 2	< 2	< 7	< 3	< 5	< 2	< 5	< 7	< 2	< 2	< 15	< 5	< 5
	07/27/21 - 08/31/21	3810 ± 436	< 15	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 13	< 1	< 2	< 20	< 6	< 3
	08/31/21 - 09/28/21	306 ± 92	< 11	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 6	< 1	< 1	< 11	< 4	< 3
	09/28/21 - 10/26/21	231 ± 94	< 31	< 2	< 2	< 5	< 2	< 3	< 2	< 3	< 9	< 1	< 2	< 16	< 5	< 3
	10/26/21 - 11/30/21	160 ± 93	< 34	< 2	< 2	< 6	< 2	< 4	< 2	< 3	< 11	< 2	< 2	< 19	< 7	< 3
	11/08/21 - 11/08/21	< 137	< 12	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 12	< 1	< 1	< 16	< 6	< 3
	11/30/21 - 12/28/21	852 ± 152	< 35	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 9	< 2	< 2	< 18	< 6	< 3
	AVERAGE	1056 ± 2251	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-10 **TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF SURFACE WATER**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/Liter ± 2 sigma

SITE	COLLECTION PERIOD	H-3	<----------GAMMA EMITTERS---------->													
			K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Th-228
6S5	01/05/21 - 01/26/21	< 147	< 27	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 5	< 2	< 2	< 12	< 4	< 3
	02/03/21 - 02/23/21	< 132	< 39	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 6	< 2	< 2	< 13	< 4	< 3
	03/02/21 - 03/30/21	< 141	< 21	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 9	< 2	< 2	< 18	< 6	< 3
	04/06/21 - 04/27/21	< 144	< 46	< 3	< 4	< 9	< 3	< 6	< 4	< 7	< 13	< 3	< 4	< 24	< 9	< 9
	05/04/21 - 06/01/21	170 ± 98	< 39	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 20	< 6	< 4
	06/08/21 - 06/29/21	< 137	< 40	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 16	< 5	< 4
	07/06/21 - 07/27/21	< 148	< 41	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 6	< 2	< 2	< 13	< 4	< 4
	08/03/21 - 08/31/21	153 ± 94	< 17	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 9	< 1	< 2	< 16	< 6	< 3
	09/07/21 - 09/28/21	< 120	< 18	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 15	< 5	< 3
	10/05/21 - 10/26/21	< 143	< 41	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 15	< 5	< 4
	11/02/21 - 11/30/21	< 139	< 35	< 2	< 2	< 6	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 19	< 7	< 3
	12/07/21 - 12/28/21	< 143	< 11	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 4	< 1	< 1	< 9	< 2	< 3
	AVERAGE	162 ± 24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5S9	04/27/21 - 04/27/21	< 146	< 136	< 7	< 6	< 14	< 6	< 10	< 6	< 10	< 9	< 5	< 6	< 24	< 11	< 11
	05/04/21 - 05/18/21	< 146	< 10	< 1	< 1	< 4	< 1	< 2	< 1	< 2	< 11	< 1	< 1	< 16	< 5	< 3
	AVERAGE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-11 **GAMMA SPECTROSCOPIC ANALYSIS OF FISH**
SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/kg (wet) ± 2 sigma

SITE	COLLECTION DATE	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137
2H									
Shorthead Redhorse	04/23/21	2190 ± 824	< 58	< 47	< 153	< 61	< 114	< 51	< 52
Walleye	04/23/21	3927 ± 1059	< 58	< 40	< 173	< 62	< 116	< 63	< 60
Smallmouth Bass	04/23/21	3707 ± 1010	< 39	< 47	< 187	< 55	< 106	< 50	< 55
Smallmouth Bass	10/15/21	4019 ± 1086	< 79	< 46	< 176	< 78	< 99	< 52	< 53
Common Carp	10/15/21	2986 ± 1119	< 52	< 55	< 205	< 120	< 127	< 54	< 69
Quillback	10/15/21	3869 ± 978	< 56	< 63	< 157	< 76	< 135	< 55	< 55
	AVERAGE	3450 ± 1441	-	-	-	-	-	-	-
IND									
Walleye	04/22/21	3847 ± 1013	< 46	< 58	< 120	< 58	< 116	< 54	< 61
Shorthead Redhorse	04/22/21	3317 ± 676	< 44	< 44	< 115	< 40	< 84	< 46	< 50
Smallmouth Bass	04/22/21	4324 ± 849	< 44	< 38	< 134	< 40	< 83	< 39	< 47
Smallmouth Bass	10/14/21	3493 ± 1215	< 86	< 80	< 217	< 86	< 179	< 84	< 64
Common Carp	10/14/21	2932 ± 1005	< 67	< 86	< 179	< 71	< 147	< 72	< 69
Quillback	10/14/21	3779 ± 841	< 58	< 63	< 153	< 59	< 126	< 58	< 58
	AVERAGE	3615 ± 961	-	-	-	-	-	-	-
LTAW									
Gizzard Shad	10/15/21	3466 ± 897	< 49	< 46	< 166	< 76	< 121	< 56	< 65
Rainbow Trout	10/15/21	3982 ± 1042	< 51	< 52	< 124	< 69	< 90	< 46	< 46
	AVERAGE	3724 ± 730	-	-	-	-	-	-	-

TABLE C-12 GAMMA SPECTROSCOPIC ANALYSES OF SHORELINE SEDIMENT SUSQUEHANNA STEAM ELECTRIC STATION, 2021

Results in pCi/kg (dry) ± 2 sigma

SITE	COLLECTION DATE	K-40	Cs-134	Cs-137	Ra-226	Ac-228	Th-228
2B	03/25/21	10020 ± 1370	< 57	< 65	< 1436	1005 ± 243	785 ± 94
	09/21/21	20000 ± 1270	< 48	78 ± 47	3315 ± 1068	1520 ± 261	1604 ± 91
	AVERAGE	15010 ± 14114	-	78 ± 0	3315 ± 0	1263 ± 728	1194 ± 1159
7B	03/25/21	12060 ± 1578	< 83	< 91	< 1946	1049 ± 404	1124 ± 131
	09/21/21	15590 ± 1128	< 38	< 50	1618 ± 805	1264 ± 220	1138 ± 88
	AVERAGE	13825 ± 4992	-	-	1618 ± 0	1157 ± 304	1131 ± 20
12F	03/25/21	7539 ± 1263	< 50	< 59	< 1231	660 ± 230	622 ± 85
	09/21/21	8554 ± 765	< 41	< 50	< 843	636 ± 190	887 ± 70
	AVERAGE	8047 ± 1435	-	-	-	648 ± 34	754 ± 374

FIGURE C-1 - GROSS BETA ACTIVITY IN AIR PARTICULATES

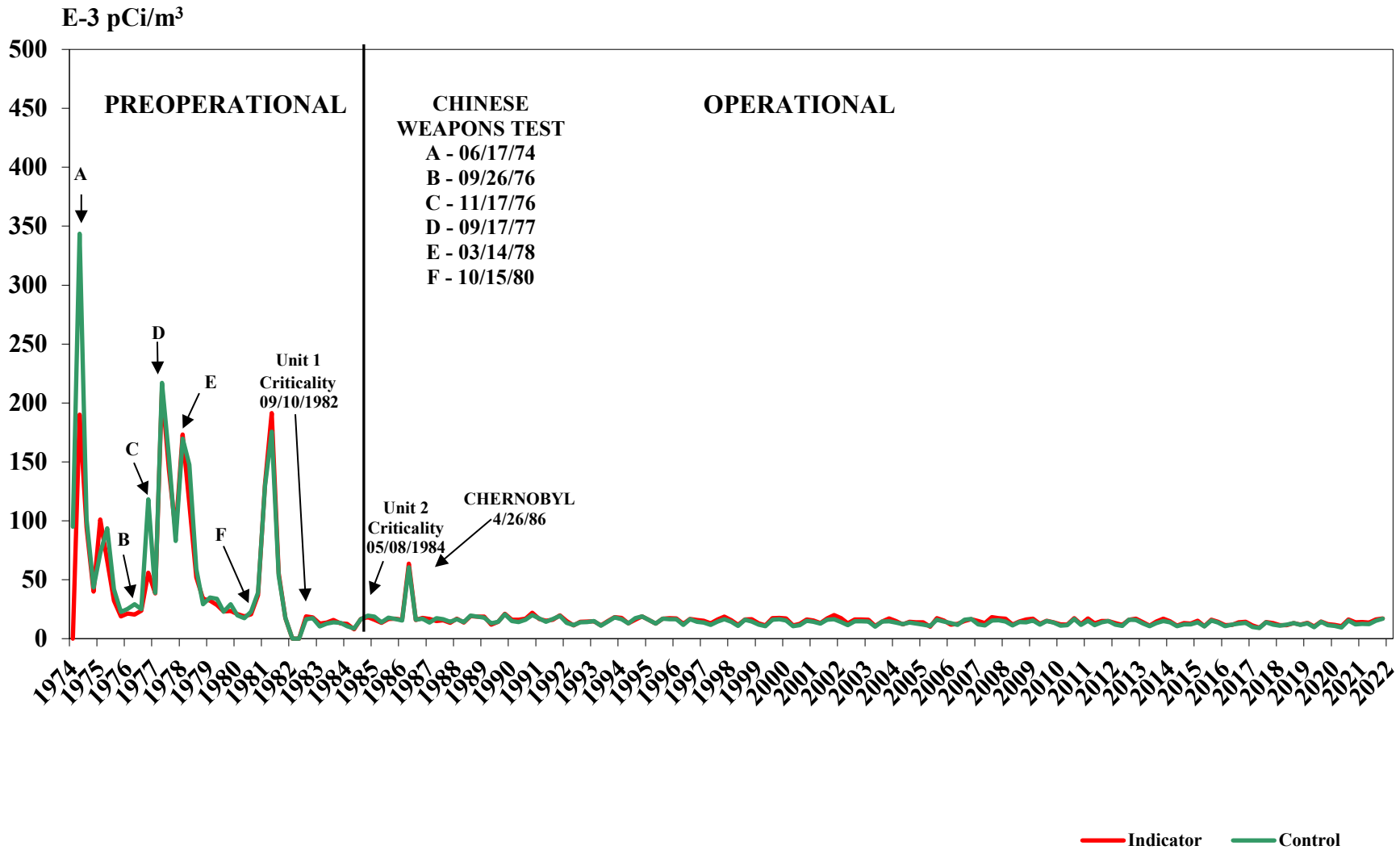


FIGURE C-2 - AMBIENT RADIATION LEVELS BASED ON ENVIRONMENTAL DOSIMETRY DATA

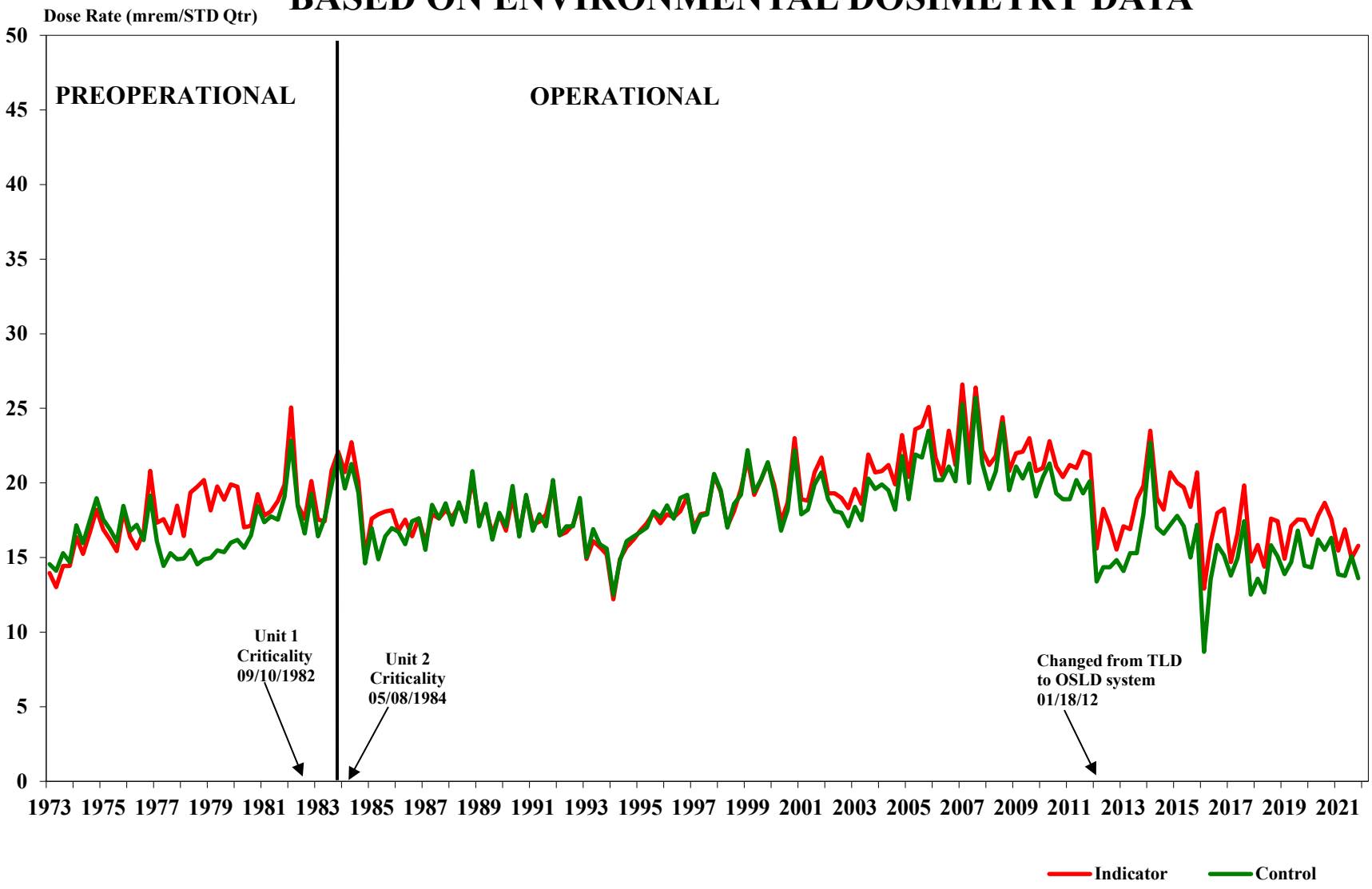


FIGURE C-3 - IODINE-131 ACTIVITY IN MILK

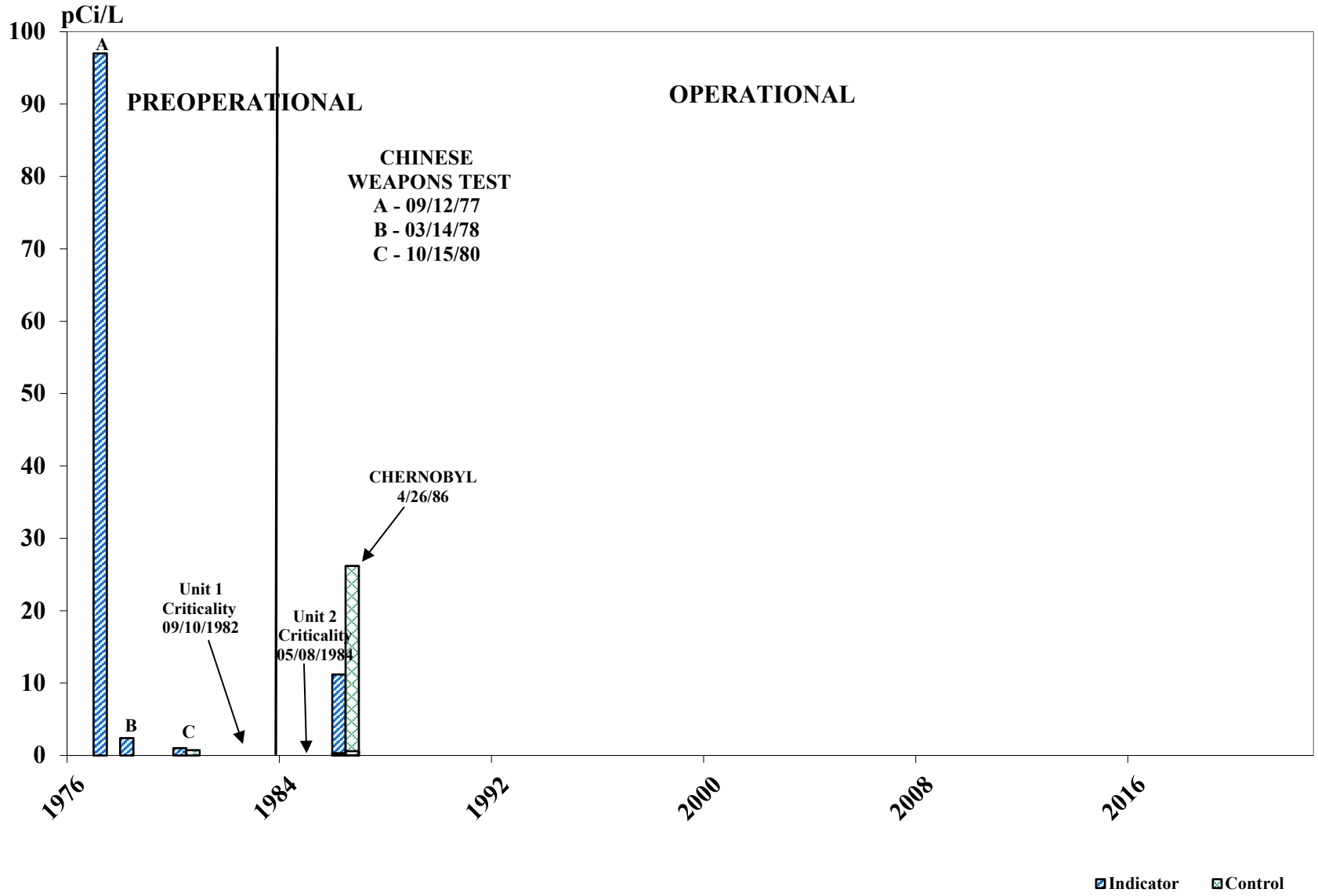


FIGURE C-4 - ANNUAL AVERAGE TRITIUM ACTIVITY IN PRECIPITATION AND SURFACE WATER VERSUS GROUND WATER

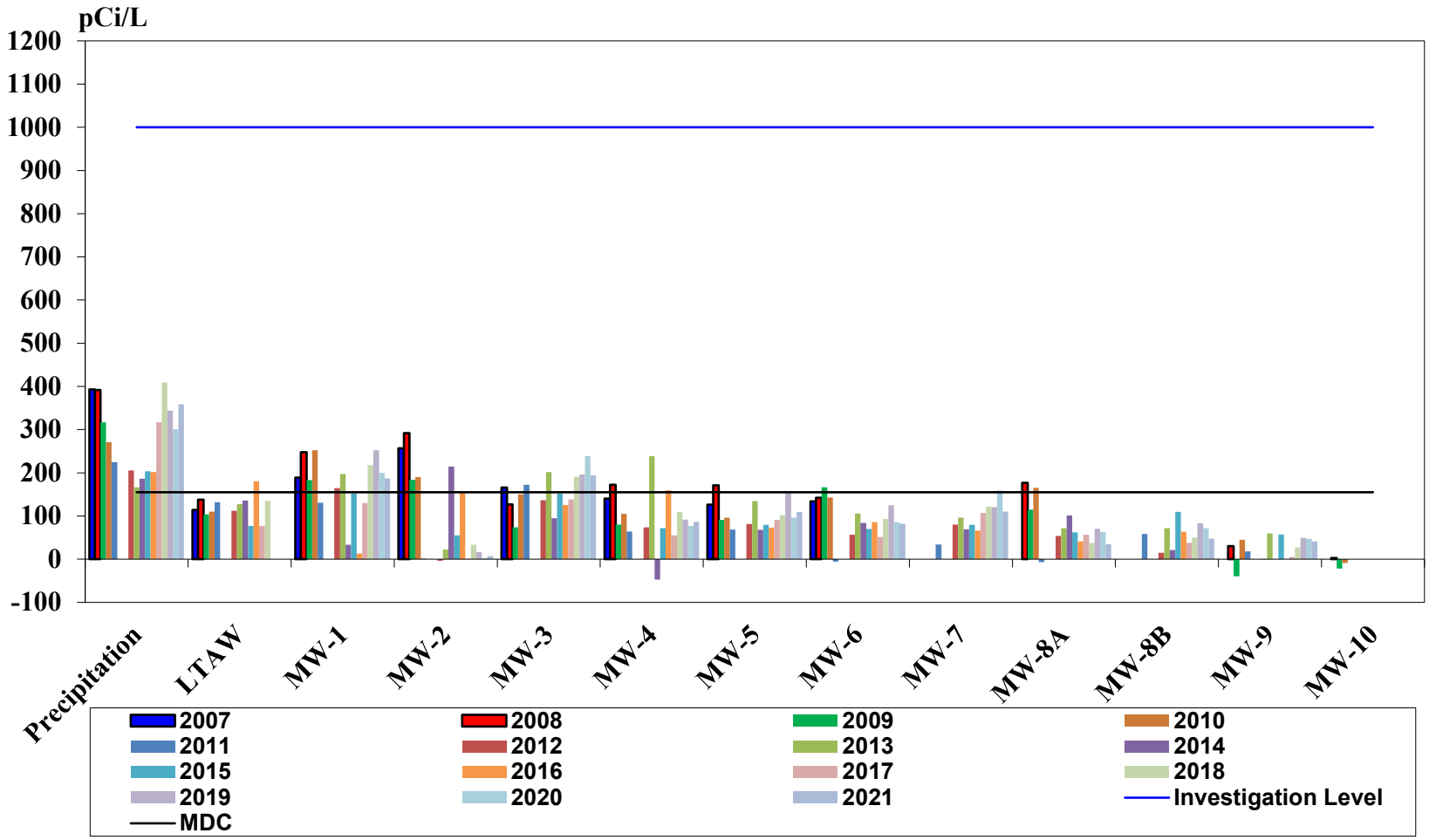


FIGURE C-5 - GROSS BETA ACTIVITY IN DRINKING WATER

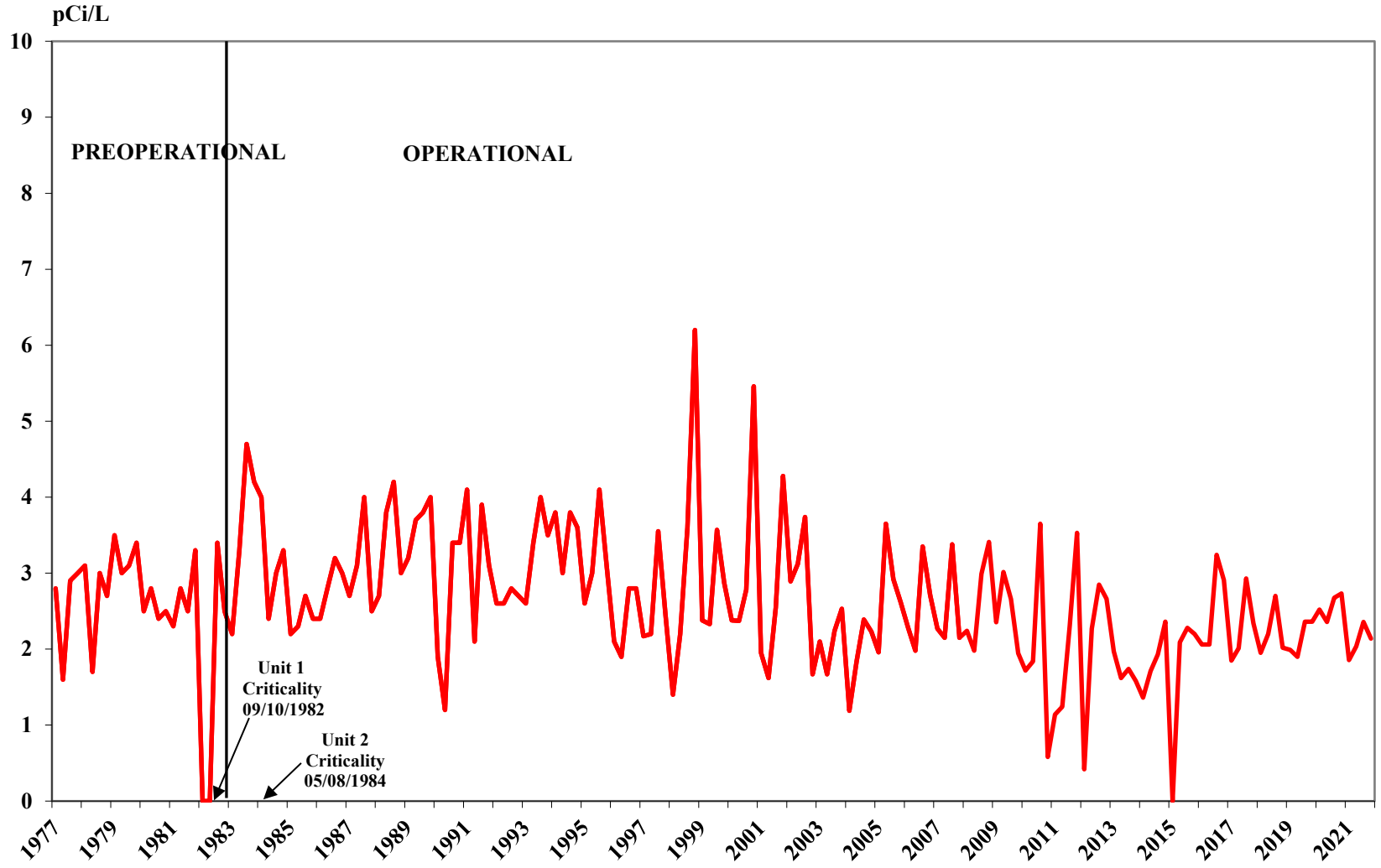
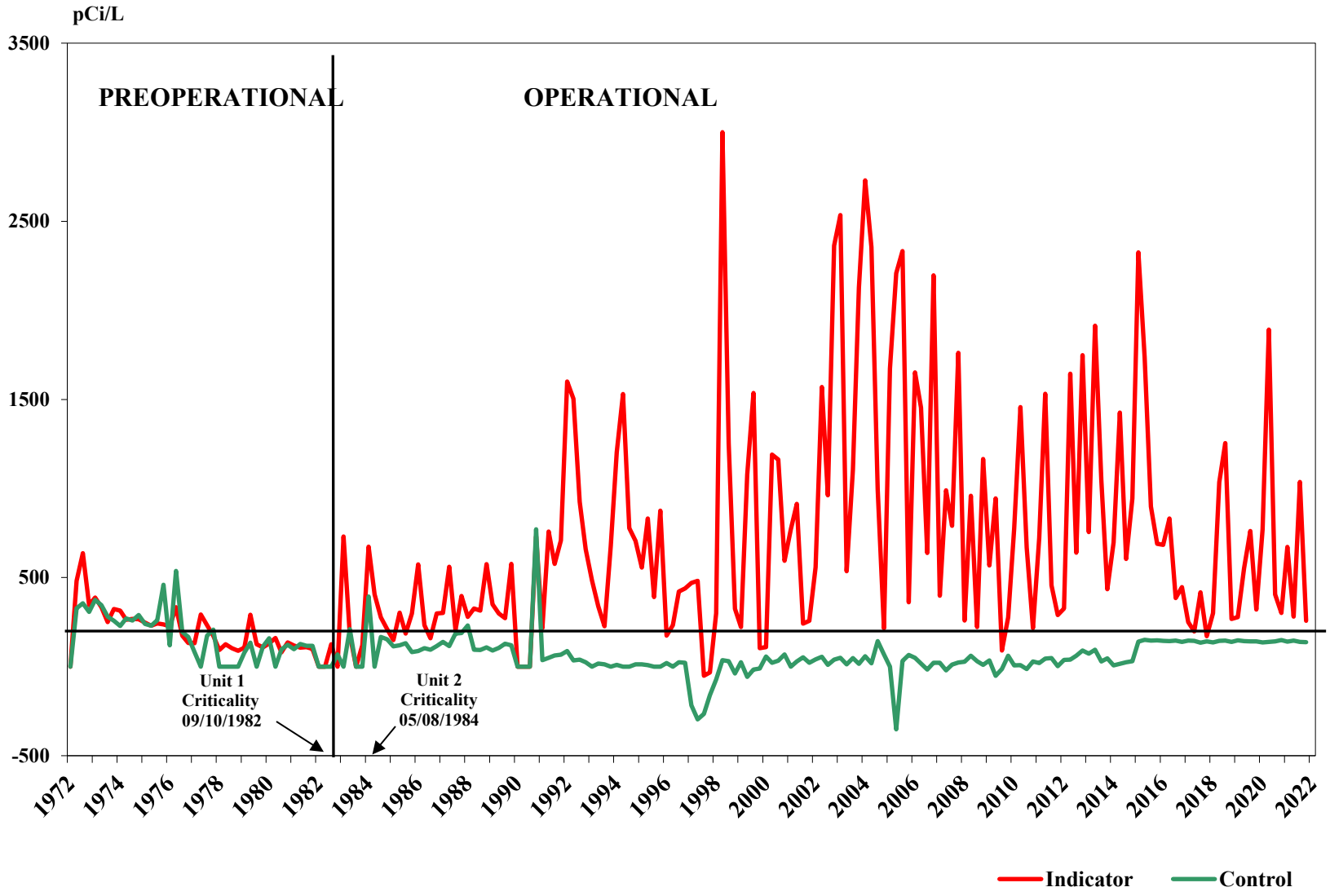


FIGURE C-6 - TRITIUM ACTIVITY IN SURFACE WATER



APPENDIX D

SUMMARY OF RESULTS FROM ANALYTICS, ENVIRONMENTAL RESOURCE ASSOCIATES (ERA), AND DEPARTMENT OF ENERGY (DOE) – MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)

Table D-1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
March 2021	E13466	Milk	Sr-89	pCi/L	84.6	87.1	0.97	A
			Sr-90	pCi/L	11.5	12.6	0.91	A
	E13467	Milk	Ce-141	pCi/L	111	125	0.89	A
			Co-58	pCi/L	123	128	0.96	A
			Co-60	pCi/L	140	154	0.91	A
			Cr-51	pCi/L	252	242	1.04	A
			Cs-134	pCi/L	130	151	0.86	A
			Cs-137	pCi/L	110	110	1.00	A
			Fe-59	pCi/L	105	109	0.96	A
			I-131	pCi/L	77.6	86.9	0.89	A
			Mn-54	pCi/L	111	112	0.99	A
			Zn-65	pCi/L	200	211	0.95	A
	E13468	Charcoal	I-131	pCi	83.5	88.5	0.94	A
	E13469	AP	Ce-141	pCi	103.0	103	1.00	A
			Co-58	pCi	93.3	105	0.89	A
			Co-60	pCi	136	126	1.08	A
			Cr-51	pCi	213	198	1.07	A
			Cs-134	pCi	123.0	124	0.99	A
			Cs-137	pCi	86.3	90.1	0.96	A
			Fe-59	pCi	81.3	89.6	0.91	A
			Mn-54	pCi	93.5	92.0	1.02	A
			Zn-65	pCi	166	173	0.96	A
	E13470	Soil	Ce-141	pCi/g	0.232	0.262	0.89	A
			Co-58	pCi/g	0.251	0.268	0.94	A
			Co-60	pCi/g	0.306	0.322	0.95	A
			Cr-51	pCi/g	0.517	0.506	1.02	A
			Cs-134	pCi/g	0.263	0.317	0.83	A
			Cs-137	pCi/g	0.278	0.301	0.92	A
			Fe-59	pCi/g	0.228	0.229	1.00	A
			Mn-54	pCi/g	0.221	0.235	0.94	A
			Zn-65	pCi/g	0.448	0.441	1.02	A
	E13471	AP	Sr-89	pCi	92.2	95.5	0.97	A
			Sr-90	pCi	11.7	13.9	0.84	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table D-1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
September 2021	E13472	Milk	Sr-89	pCi/L	66.4	85.4	0.78	W
			Sr-90	pCi/L	11.9	14.0	0.85	A
	E13473	Milk	Ce-141	pCi/L	118	114	1.03	A
			Co-58	pCi/L	116	118	0.98	A
			Co-60	pCi/L	142	145	0.98	A
			Cr-51	pCi/L	244	236	1.03	A
			Cs-134	pCi/L	81	93.1	0.87	A
			Cs-137	pCi/L	105	112	0.94	A
			Fe-59	pCi/L	105	102	1.03	A
			I-131	pCi/L	65.1	85.6	0.76	W
			Mn-54	pCi/L	128	128	1.00	A
			Zn-65	pCi/L	158	153	1.03	A
	E13474	Charcoal	I-131	pCi	85.2	90.9	0.94	A
	E13475	AP	Ce-141	pCi	126	135	0.94	A
			Co-58	pCi	148	139	1.07	A
			Co-60	pCi	183	171	1.07	A
			Cr-51	pCi	322	278	1.16	A
			Cs-134	pCi	118	110	1.08	A
			Cs-137	pCi	147	132	1.12	A
			Fe-59	pCi	131	120	1.09	A
			Mn-54	pCi	161	151	1.06	A
			Zn-65	pCi	202	180	1.12	A
	E13476	Soil	Ce-141	pCi/g	0.215	0.219	0.98	A
			Co-58	pCi/g	0.208	0.226	0.92	A
			Co-60	pCi/g	0.277	0.277	1.00	A
			Cr-51	pCi/g	0.388	0.452	0.86	A
			Cs-134	pCi/g	0.157	0.178	0.88	A
			Cs-137	pCi/g	0.270	0.284	0.95	A
			Fe-59	pCi/g	0.218	0.195	1.12	A
			Mn-54	pCi/g	0.239	0.246	0.97	A
			Zn-65	pCi/g	0.312	0.293	1.06	A
	E13477	AP	Sr-89	pCi	85.6	68.3	1.25	W
			Sr-90	pCi	12.6	11.2	1.13	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table D-2 DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Range	Evaluation [b]
February 2021	21-GrF44	AP	Gross Alpha	Bq/sample	0.371	1.77	0.53 - 3.01	N[3]
			Gross Beta	Bq/sample	0.731	0.65	0.325 - 0.974	A
	21-MaS44	Soil	Ni-63	Bq/kg	310	689.0	482 - 896	N[4]
			Tc-99	Bq/kg	457	638	447 - 829	W
	21-MaSU44	Urine	Cs-134	Bq/L	2.34	2.73	1.91 - 3.55	A
			Cs-137	Bq/L	2.54	2.71	1.90 - 3.52	A
			Co-57	Bq/L	0.4100		*(1)*	A
			Co-60	Bq/L	2.24	2.44	1.71 - 3.17	A
			Mn-54	Bq/L	2.03	2.03	1.42 - 2.64	A
			K-40	Bq/L	52.8	54.0	38 - 70	A
			U-234	Bq/L	0.108	0.0877	0.0614 - 0.114	W
			U-238	Bq/L	0.101	0.091	0.064 - 0.118	A
			Zn-65	Bq/L	1.06	1.34	*(2)*	A
	21-MaW44	Water	Ni-63	Bq/L	6.7	8.2	5.7 - 10.7	A
			Tc-99	Bq/L	3.850	4.01	2.81 - 5.21	A
	21-RdV44	Vegetation	Cs-134	Bq/sample	3.13	3.60	2.5 - 4.7	A
			Cs-137	Bq/sample	4.64	4.69	3.28 - 6.10	A
			Co-57	Bq/sample	5.25	5.05	3.54 - 6.57	A
			Co-60	Bq/sample	2.86	2.99	2.09 - 3.89	A
			Mn-54	Bq/sample	5.02	5.25	3.68 - 6.83	A
			Sr-90	Bq/sample	0.631	0.673	0.471 - 0.875	A
			Zn-65	Bq/sample	-0.233		*(1)*	A
August 2021	21-GrF45	AP	Gross Alpha	Bq/sample	0.368	0.960	0.288 - 1.632	A
			Gross Beta	Bq/sample	0.595	0.553	0.277 - 0.830	A
	21-MaS45	Soil	Ni-63	Bq/kg	546	1280	896 - 1664	N[5]
			Tc-99	Bq/kg	453	777	544 - 1010	N[6]
	21-MaSU45	Urine	Cs-134	Bq/L	3.10	3.62	2.53 - 4.71	A
			Cs-137	Bq/L	0.083		*(1)*	A
			Co-57	Bq/L	0.844	0.87	0.606 - 1.125	A
			Co-60	Bq/L	0.0535		*(1)*	A
			Mn-54	Bq/L	0.459	0.417	*(2)*	A
			K-40	Bq/L	48.8	54.0	38 - 70	A
			U-234	Bq/L	0.133	0.116	0.081 - 0.151	A
			U-238	Bq/L	0.137	0.121	0.085 - 0.157	A
			Zn-65	Bq/L	0.339	0.420	*(2)*	A
	21-MaW45	Water	Ni-63	Bq/L	33.5	39.5	27.7 - 51.4	A
			Tc-99	Bq/L	3.5	3.7	2.60 - 4.82	A
	21-RdV45	Vegetation	Cs-134	Bq/sample	3.42	4.34	3.04 - 5.64	W
			Cs-137	Bq/sample	2.14	2.21	1.55 - 2.87	A
			Co-57	Bq/sample	4.08	4.66	3.26 - 6.06	A
			Co-60	Bq/sample	2.81	3.51	2.46 - 4.56	A
			Mn-54	Bq/sample	0.035		*(1)*	A
			Sr-90	Bq/sample	1.15	1.320	0.92 - 1.72	A
			Zn-65	Bq/sample	2.05	2.43	1.70 - 3.16	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test
(2) Sensitivity evaluation
*(3) See **NCR 21-02***
*(4) See **NCR 21-03***
*(5) See **NCR 21-13***
(6) Tc-99 cross-checks done for TBE information only - not required

Table D-3 ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Limits	Evaluation [b]
March 2021	MRAD-34	Water	Am-241	pCi/L	175	157	108 - 201	A
			Fe-55	pCi/L	579	275	162 - 400	N(1)
			Pu-238	pCi/L	181	171	103 - 222	A
			Pu-239	pCi/L	153	142	87.9 - 175	A
		Soil	Sr-90	pCi/kg	6570	9190	2860 - 14,300	A
		AP	Fe-55	pCi/filter	107	121	44.2 - 193	A
			U-234	pCi/filter	25.99	25.5	18.9 - 29.9	A
			U-238	pCi/filter	24.7	25.3	19.1 - 30.2	A
April 2021	RAD-125	Water	Ba-133	pCi/L	92.3	90.5	76.2 - 99.6	A
			Cs-134	pCi/L	62.9	70.5	57.5 - 77.6	A
			Cs-137	pCi/L	161	168	151 - 187	A
			Co-60	pCi/L	22.5	20.9	17.7 - 25.8	A
			Zn-65	pCi/L	183	177.0	159 - 208	A
			GR-A	pCi/L	30.8	30.2	15.4 - 39.4	A
			GR-B	pCi/L	60.1	67.5	46.8 - 74.2	A
			U-Nat	pCi/L	36.45	36.9	30.0 - 40.8	A
			H-3	pCi/L	13,400	14,600	12,800 - 16,100	A
			Sr-89	pCi/L	64.5	63.5	51.4 - 71.5	A
			Sr-90	pCi/L	22.8	23.0	16.5 - 27.0	A
			I-131	pCi/L	28.2	26.7	22.2 - 31.4	A
September 2021	MRAD-35	Water	Am-241	pCi/L	68	63.7	43.7 - 81.5	A
			Fe-55	pCi/L	179	246	145 - 358	A
			Pu-238	pCi/L	102	114	68.5 - 148	A
			Pu-239	pCi/L	32	34.3	21.2 - 42.3	A
		Soil	Sr-90	pCi/kg	6160	6090	1,900 - 9,490	A
		AP	Fe-55	pCi/filter	493	548	200 - 874	A
			Pu-238	pCi/filter	28	28.5	21.5 - 35.0	A
			Pu-239	pCi/filter	21	21.6	16.1 - 26.1	A
			U-234	pCi/filter	7.95	7.76	5.75 - 9.09	A
			U-238	pCi/filter	8.0	7.69	5.81 - 9.17	A
October 2021	RAD-127	Water	Ba-133	pCi/L	82.8	87.5	73.6 - 96.2	A
			Cs-134	pCi/L	64.0	70.1	57.1 - 77.1	A
			Cs-137	pCi/L	145	156	140 - 174	A
			Co-60	pCi/L	83.2	85.9	77.3 - 96.8	A
			Zn-65	pCi/L	133	145	130 - 171	A
			GR-A	pCi/L	76.0	66.7	35.0 - 82.5	A
			GR-B	pCi/L	63.0	55.7	38.1 - 62.6	N(2)
			U-Nat	pCi/L	52.88	55.5	45.3 - 61.1	A
			H-3	pCi/L	13,800	17,200	15,000 - 18,900	N(3)
			Sr-89	pCi/L	54.9	61.0	49.1 - 68.9	A
			Sr-90	pCi/L	24.8	29.3	21.3 - 34.0	A
			I-131	pCi/L	27.4	26.4	21.9 - 31.1	A
December 2021	QR 120121Y	Water	GR-B	pCi/L	47.6	39.8	26.4 - 47.3	N(4)
			H-3	pCi/L	17,500	17,800	15,600 - 19,600	A

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation:
A = Acceptable - Reported value falls within the Acceptance Limits
N = Not Acceptable - Reported value falls outside of the Acceptance Limits

*(1) See **NCR 21-01***
*(2) See **NCR 21-10***
*(3) See **NCR 21-11***
*(4) See **NCR 21-14***

APPENDIX E

REMP SAMPLE EQUIPMENT OPERABILITY TRENDING

TABLE E-1
REMP SAMPLING EQUIPMENT OPERABILITY TRENDING
SUSQUEHANNA STEAM ELECTRIC STATION

Percent (%) Operability

SAMPLING MEDIA	SAMPLE LOCATION	DESCRIPTION	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Air Particulate	3S2	SSES Backup Met. Tower	99.9	99.3	98.9	99.9	100	99	100	99.9	99.9	100.0	99.4	99.9
& Charcoal	12S1	West Building	99.9	100	99.9	99.9	100	100	100	99.1	99.7	99.9	99.9	99.9
	13S6	Former Laydown Area, West of Confers Lane	100	99.7	99.1	99.9	100	97	100	100	99.9	99.9	99.9	99.9
	12E1	Berwick Hospital	100	100	99.9	100.0	100	98	99.1	100	100	100	100.0	100
	6G1	Freeland Substation	100	100	99.9	99.9	100	90*	100	100	100	No longer in service	No longer in service	No longer in service
	8G1	PPL System Facilities Center, Humboldt Industrial Park	99.7	100	99.8	99.9	100	100	99.2	99.9	99.9	99.9	99.9	99.9
	10S3	E of Confers Lane, S of Towers Club	-	-	-	-	-	-	100	99.5	99.9	99.2	98.9	99.9
	9B1	Transmission Line, E of Route 11	-	-	-	-	-	-	100	99.9	99.9	99.9	100.0	99.9
Drinking Water	12H2	Danville Water Company	100	100	100	100.0	100	100	100	100	100	98.1	100.0	100
Surface Water	2S7	Cooling Tower Blowdown Discharge Line	98.0	99.1	98.1	98.1	69**	100	99.1	100	100	99.9	99.9	93.0
	6S6	River Water Intake Line	100	95.5	93.4	93.2	93	98	99.7	99.9	99.9	99.9	88.1***	94.0

* Planned power outage by Electric Utilities
** Auto- Compsite sampler problems, March through June. New Auto- Compsite sampler installed in July.
*** Auto- Compsite sampler taken OOS 8/30/20. New Auto- Compsite sampler installed, placed in service 10/13/20.