Exelon Generation

TS 6.9.1.7

LG-18-053

April 30, 2018

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: 2017 Annual Radiological Environmental Operating Report

In accordance with the requirements of Section 6.9.1.7 of Limerick Generating Station (LGS) Unit 1 and Unit 2 Technical Specifications (TS), and Section 6.1 of the LGS Units 1 and 2 Offsite Dose Calculation Manual (ODCM), this letter submits the 2017 Annual Radiological Environmental Operating Report. This report provides the 2017 results for the Radiological Environmental Monitoring Program (REMP) as called for in the ODCM.

In assessing the data collected for the REMP, it has been concluded that the operation of LGS, Units 1 and 2 had no adverse impact on the environment. No plant-produced fission or activation products, with the exception of CS-137 and I-131, were found in any pathway modeled by the REMP. Neither CS-137 nor I-131 was concluded to be from LGS. The results of the groundwater protection program are also included in this report. Positive tritium was found in 3 of 13 groundwater monitoring locations that ranged from non-detectable to 770 pCi/L; which is below the EPA limit of 20,000 pCi/L.

There are no commitments contained in this letter.

If you have any questions or require additional information, please contact Aaron Briggs at 610-718-2701.

Respectfully,

Richard W. Libra
Vice President-Limerick Generating Station
Exelon Generation Company, LLC

Attachment: 2017 Annual Radiological Environmental Operating Report

cc: D. Dorman, Administrator, Region I, USNRC (w/attachment)
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ATTACHMENT

2017 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Docket No: 50-352
50-353

LIMERICK GENERATING STATION
UNITS 1 AND 2

Annual Radiological Environmental Operating Report

1 January through 31 December 2017

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

Limerick Power Station
Pottstown, PA 19464

April 2018

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Appendices

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I. Preface

The following sections of the preface are meant to help define key concepts, provide clarity, and give context to the readers of this report.

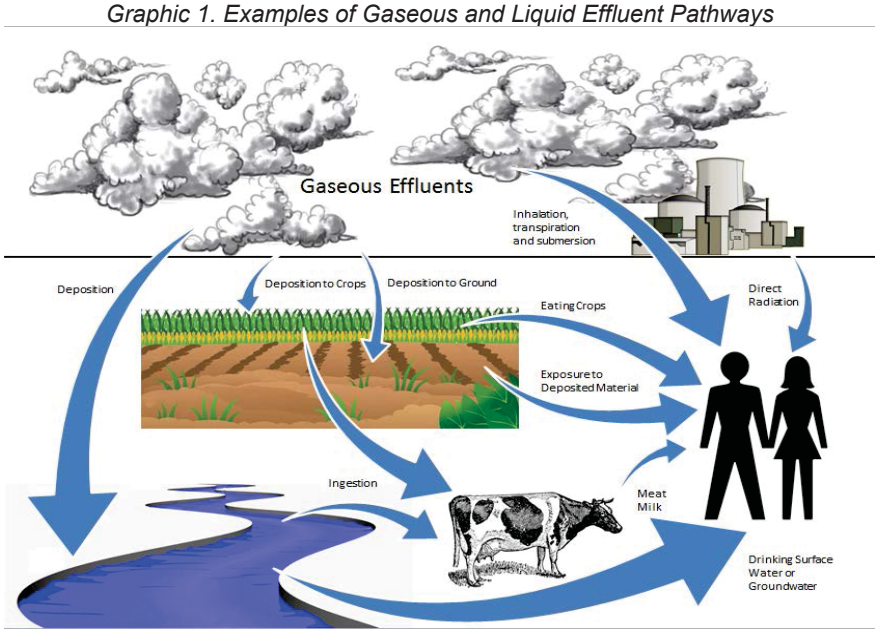
Annual Reports

The Nuclear Regulatory Commission (NRC) is the federal agency who has the role to protect public health and safety related to nuclear energy. Nuclear Power Plants have made many commitments to the NRC to ensure the safety of the public. As part of these commitments, they provide two reports annually to specifically address how the station's operation impacts the environment of the local communities. The NRC then reviews these reports and makes them available to the public. The names of the reports are the Annual Radioactive Effluent Release Report (ARERR) and the Annual Radiological Environmental Operating Report (AREOR).

The ARERR reports the results of the sampling from the effluent release paths at the station and analyzed for radioactivity. An effluent is a liquid or gaseous waste containing plant-related radioactive material emitted at the boundary of the facility.

The AREOR reports the results of the samples obtained in the environment surrounding the station and analyzed for radioactivity. Environmental samples include air, water, vegetation, and other sample types that are identified as potential pathways radioactivity can reach humans.

Graphic 1. Examples of Gaseous and Liquid Effluent Pathways



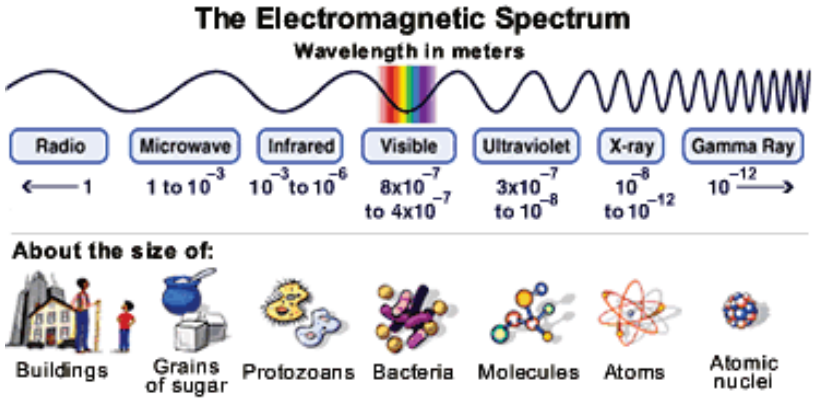
Graphic 1 demonstrates some potential exposure pathways from Limerick Generating Station. The ARERR and AREOR together ensure Nuclear Power

Plants are operating in a manner that is within established regulatory commitments meant to adequately protect the public.

Understanding Radiation

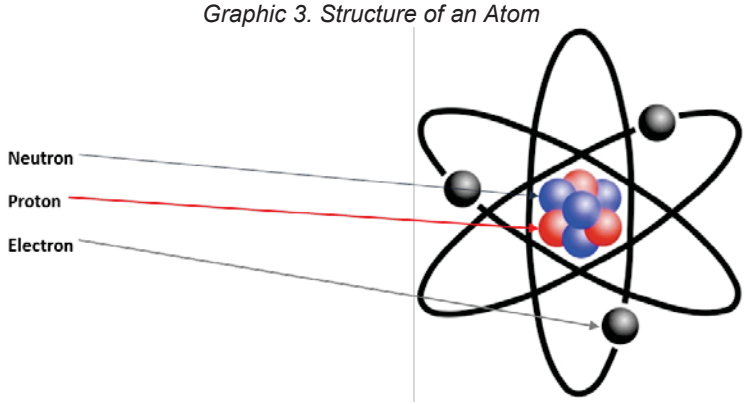
Generally radiation is defined as emitted energy in the form of waves or particles. If radiation has enough energy to displace electrons from an atom it is termed "ionizing", otherwise it is "non-ionizing". Non-Ionizing radiation includes light, heat given off from a stove, radiowaves and microwaves. Ionizing radiation occurs in atoms, particles too small for the eye to see. So, what are atoms and how does radiation come from them?

Graphic 2. Types of Radiation, from NASA Hubblesite



An atom is the smallest part of an element that maintains the characteristics of that element. Atoms are made up of three parts: protons, neutrons, and electrons.

Graphic 3. Structure of an Atom



The number of protons in an atom determines the element. For example, a hydrogen atom will always have one proton while an oxygen atom will always have eight protons. The protons are clustered with the neutrons forming the nucleus at the center of the atom. Orbiting around the nucleus are the relatively small electrons.

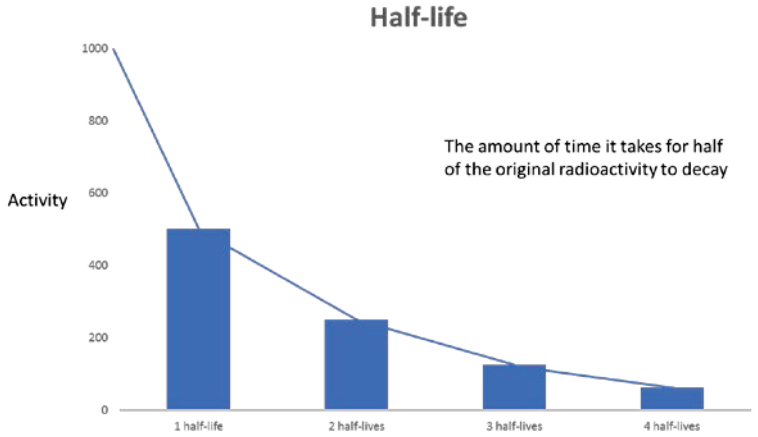
Isotopes are atoms that have the same number of protons but different numbers

of neutrons. Different isotopes of an element will all have the same chemical properties and many isotopes are radioactive while other isotopes are not radioactive. A radioactive isotope can emit radiation because it contains excess energy in its nucleus. Radioactive atoms and isotopes are also referred to as radionuclides and radioisotopes.
There are two basic ways that radionuclides are produced at a nuclear power plant. The first is fission, which creates radionucides that are called *fission products*. Fission occurs when a very large atom, such as uranium-235 (U-235) or plutonium-239 (Pu-239), absorbs a neutron into its nucleus making the atom unstable. The unstable atom can then split into smaller atoms. When fission occurs there is a large amount of energy released in the form of heat. A nuclear power plant uses the heat generated to boil water that spins turbines to produce electricity.

The second way a radionuclide is produced at a nuclear power plant is through a process called activation and the radionuclides produced in this method are termed *activation products*. Pure water that passes over the fissioning atoms is used to cool the reactor and also produce steam to turn the turbines. Although this water is considered to be very pure, there are always some contaminiants within the water from material used in the plant's construction and operation. These contaminants are exposed to the fission process and may become activation products. The atoms in the water itself can also become activated and create radionuclides.

Over time, radioactive atoms will reach a stable state and no longer be radioactive. To do this they must release their excess energy. This release of excess energy is called radioactive decay. The time it takes for a radionuclide to become stable is measured in units called half-lives. A half-life is the amount of time it takes for half of the original radioactivity to decay. Each radionuclide has a specific half-life. Some half-lives can be very long and measured in years while others may be very short and measured in seconds.

Graphic 4. Radioactive Decay Half-Life



In the annual reports you will see both man made and naturally ocurring

radionuclides listed, for example potassium-40 (K-40, natural) and cobalt-60 (Co-60, man-made). We are mostly concerned about man-made radionuclides because they can be produced as by-products when generating electricity at a nuclear power plant. It is important to note that there are also other ways man-made radionuclides are produced, such as detonating nuclear weapons. Weapons testing has deposited some of the same man-made radionuclides into the environment as those generated by nuclear power, and some are still present today because of long half-lives.

Measuring Radiation

There are four different but interrelated units for measuring radioactivity, exposure, absorbed dose, and dose equivalent. Together, they are used to scientifically report the amount of radiation and its effects on humans.

- Radioactivity refers to the amount of ionizing radiation released by a material. The units of measure for radioactivity used within the AREOR and ARERR are the Curie (Ci). Small fractions of the Ci often have a prefix, such as the microCurie (μCi), which means 1/1,000,000 of a Curie.

- Exposure describes the amount of radiation traveling through the air. The units of measure for exposure used within the AREOR and ARERR are the Roentgen (R). Traditionally direct radiation monitors placed around the site are measured milliRoentgen (mR), 1/1,000 of one R.

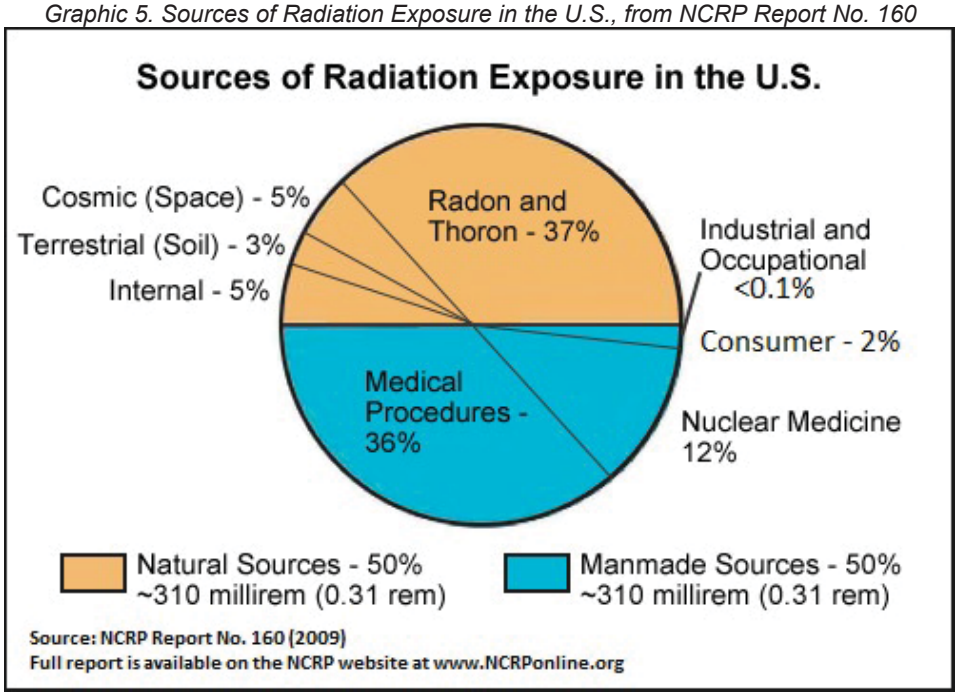
- Absorbed dose describes the amount of radiation absorbed by an object or person. The units of measure for absorbed dose used within the AREOR and ARERR are the rad. Noble gas air doses are reported by the site are measured in millirad (mrad), 1/1,000 of one rad.

- Dose equivalent (or effective dose) combines the amount of radiation absorbed and the health effects of that type of radiation. The units used within the AREOR and ARERR are the Roentgen equivalent man (rem). Regulations require doses to the whole body, specific organ, and direct radiation to be reported in millirem (mrem), 1/1,000 of one rem.

Sources of Radiation

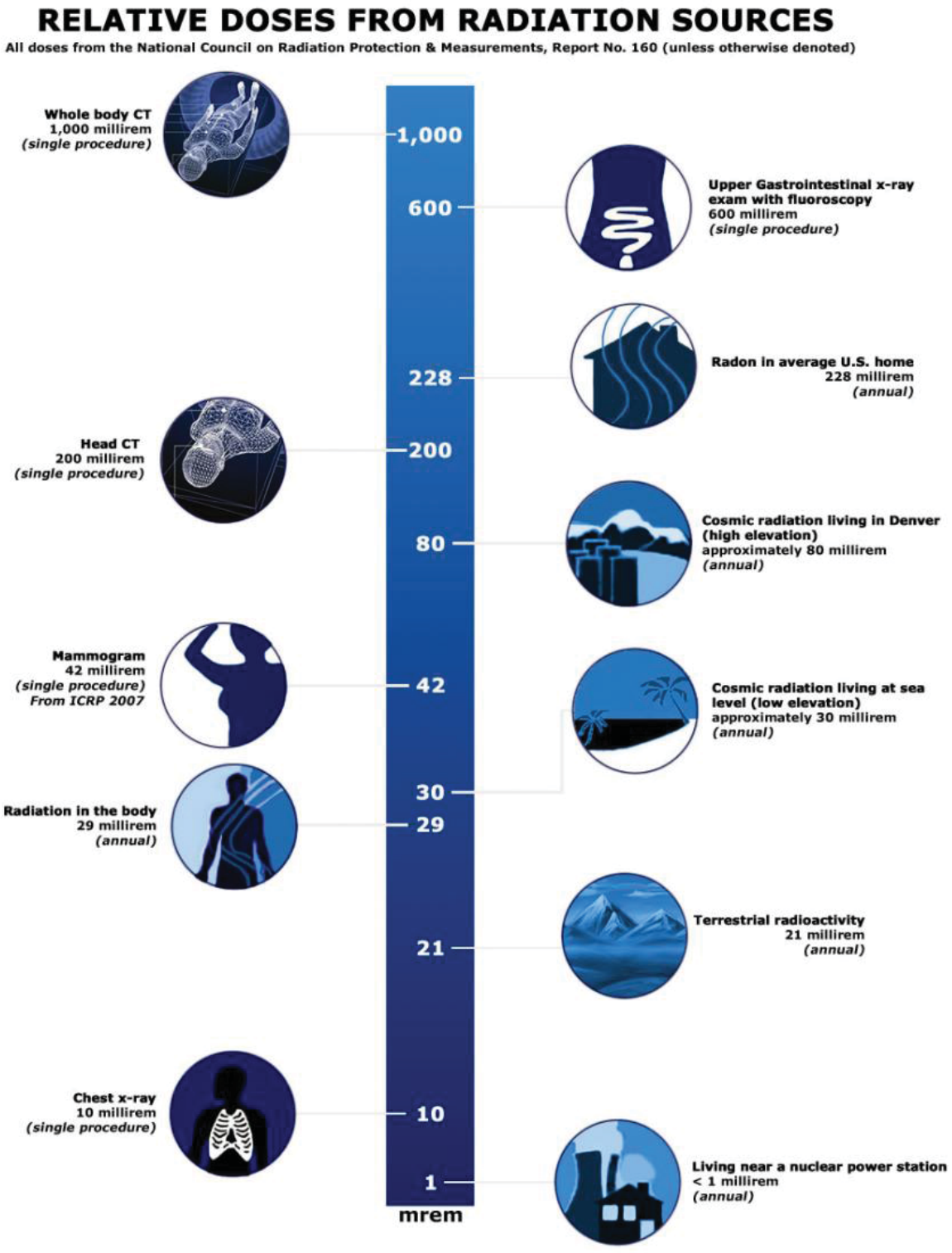
People are exposed to radiation every day of their lives and have been since the dawn of mankind. Some of this radiation is naturally occurring while some is man-made. There are many factors that will determine the amount of radiation individuals will be exposed to such as where they live, medical treatments, 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. The Graphic 5 shows what the typical sources of radiation are for an individual over a calendar year:

Graphic 5. Sources of Radiation Exposure in the U.S., from NCRP Report No. 160



The radiation from a nuclear power plant is included in the chart as part of the "Industrial and Occupational" fraction, <0.1%. The largest natural source of radiation is from radon, because radon gas travels in the air we breathe. Perhaps you know someone who had a CT scan at a hospital to check his or her bones, brain, or heart. CT scans are included in the chart as "Medical Procedures", which make up the next largest fraction. Graphic 6 on the following page shows some of the common doses humans receive from radiation every year.

Graphic 6 .Relative Doses from Radiation Sources, from EPA Radiation Doses and Sources

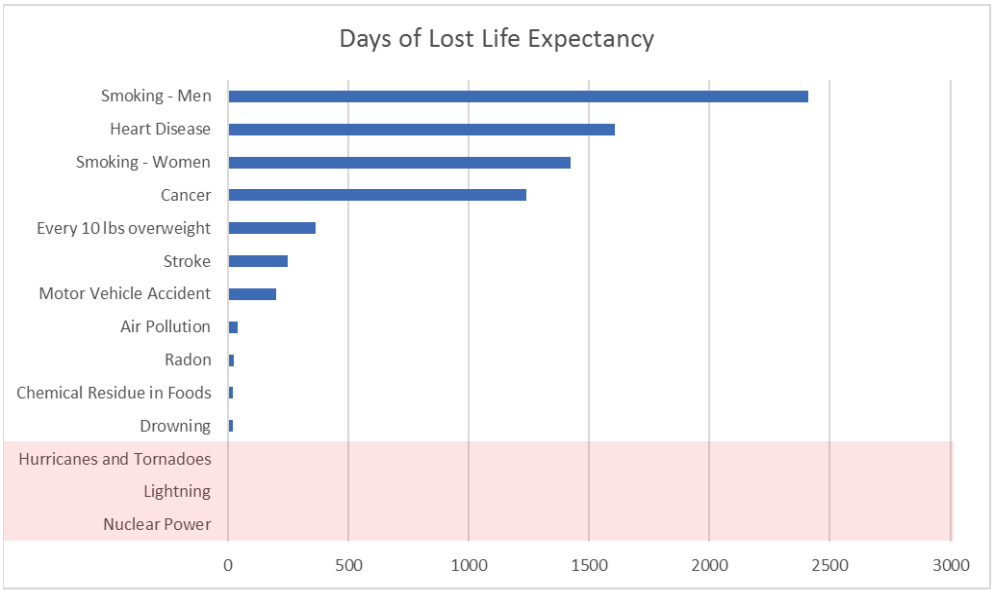


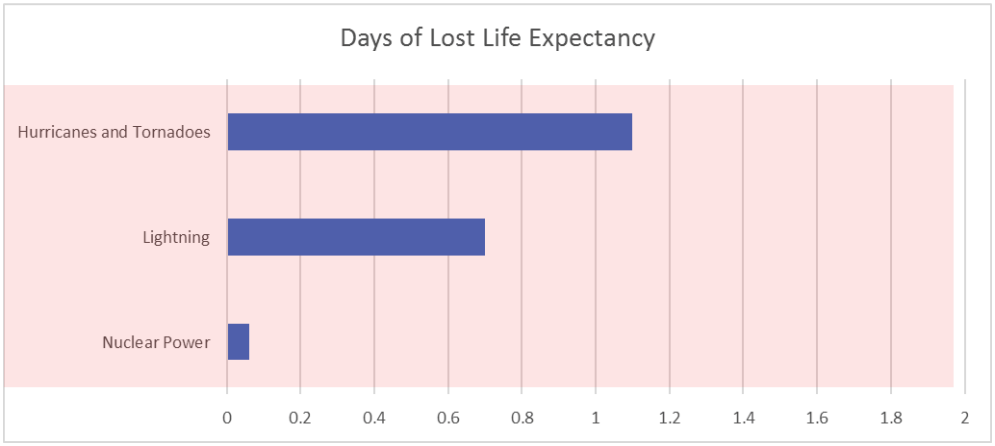
Radiation Risk

Current science suggests there is some risk from any exposure to radiation. However, it is very hard to tell whether cancers or deaths can be attributed to very low doses of radiation or by something else. U.S. radiation protection standards are based on the premise that any radiation exposure carries some risk.

The following graph is an example of one study that tries to relate risk from many different factors. This graph represents risk as “Days of Lost Life Expectancy”. All the categories are averaged over the entire population except Male Smokers, Female Smokers, and individuals that are overweight. Those risks are only for people that fall into those categories. The category for Nuclear Power is a government estimate based on all radioactivity releases from nuclear power, including accidents and wastes.

Graphic 7. Days of Lost Life Expectancy, Adapted from the Journal of American Physicians and Surgeons Volume 8 Number 2 Summer 2003





II. Summary and Conclusions

In 2017, the Limerick Generating Station released to the environment through the radioactive effluent liquid and gaseous pathways approximately 70 curies of noble gas, fission and activation products and approximately 67 curies of tritium. The dose from both liquid and gaseous effluents was conservatively calculated for the Maximum Exposed Member of the Public. The results of those calculations and their comparison to the allowable limits were as follows:

Gaseous and liquid radiation doses to members of the public at the highest dose receptor							
Effluent	Applicable Organ	Estimated Dose	Age Group	Location	% of Applicable Limit	Limit	Unit
Noble Gas	Gamma - Air Dose	2.42E-03	All	Nearest Residence	1.21E-02	20	mRad
Noble Gas	Beta – Air Dose	1.45E-03	All	Nearest Residence	3.62E-03	40	mRad
Noble Gas	Total Body (Gamma)	2.29E-03	All	Nearest Residence	2.29E-02	10	mrem
Noble Gas	Skin (Beta)	3.78E-03	All	Nearest Residence	1.26E-02	30	mrem
Iodine, Particulate, Tritium & C-14	Bone	1.24E+00	Child	Vegetation	4.13E+00	30	mrem
Liquid	Total Body	5.43E-02	Child	Phoenixville, PA	9.05E-01	6	mrem
Liquid	Liver	5.48E-02	Child	Phoenixville, PA	2.74E-01	20	mrem

The calculated doses, from the radiological effluents released from Limerick, were a very small percentage of the allowable limits.

This report on the Radiological Environmental Monitoring Program conducted for the Limerick Generating Station (LGS) by Exelon covers the period 1 January 2017 through 31 December 2017. During that time period, 1,496 analyses were performed on 1,246 samples.

Surface and drinking water samples were analyzed for concentrations of tritium, low level Iodine-131 (I-131) and gamma-emitting nuclides. Drinking water samples were also analyzed for concentrations of total gross beta. Iodine-131 was not detected in primary laboratory samples nor in the secondary laboratory for drinking water. Samples taken in December from the onsite settling basin showed low levels of I-131 due to an upstream hospital. For results, discussion, and dose to member of the public calculation see Section IV.A.2. Gross beta activities detected were consistent with those detected in previous years. No other fission or activation products were detected.

Fish (predator and bottom feeder) samples were analyzed for concentrations of gamma-emitting nuclides. Concentrations of naturally-occurring Potassium-40 (K-40) were consistent with those detected in previous years. No fission or activation products were detected in fish.

Sediment samples were analyzed for concentrations of gamma-emitting nuclides. Samples collected upstream of the discharge had Cesium-137 (Cs-137) concentrations that were consistent with those detected in previous years. No

other station-produced fission or activation products were found in sediment. For results, discussion and dose to member of the public calculation see Section IV.A.4.

Air particulate samples were analyzed for concentrations of gross beta and gamma-emitting nuclides. Gross beta and cosmogenic, naturally-occurring Beryllium-7 (Be-7) were detected at levels consistent with those detected in previous years. No fission or activation products were detected.

High-sensitivity I-131 analyses were performed on weekly air samples. All results were less than the minimum detectable concentration.

Cow milk samples were analyzed for concentrations of I-131 and gamma-emitting nuclides. Concentrations of naturally-occurring Potassium-40 (K-40) were consistent with those detected in previous years. No fission or activation products were found.

Broad leaf vegetation samples were analyzed for gamma-emitting nuclides. Concentrations of naturally-occurring Be-7 and K-40 were detected. Radium-226 (Ra-226) was found in 6 of 32 samples. Thorium-228 (Th-228) was found in 10 of 32 samples. Naturally-occurring Ra-226 and Th-228 were detected in low concentrations, which are consistent with historical values.

Review of the gamma spectroscopy results from the surface water samples located at the Limerick intake (24S1) and downstream of the 10 CFR 20.2002 permitted storage area showed no evidence of offsite radionuclide transport from the 2002 permitted storage area.

Environmental ambient gamma radiation measurements were performed quarterly using Dosimeters of Legal Record (DLR). Levels detected were consistent with those observed in previous years.

A review of the dosimetry data for the nearest residence to the Independent Spent Fuel Storage Installation (ISFSI) indicates no direct dose was received.

A Radiological Groundwater Protection Program (RGPP) was established in 2006 as part of an Exelon Nuclear fleetwide assessment of potential groundwater intrusion from the operation of the Station. In 2017, well water samples were analyzed for tritium, Strontium-89 (Sr-89), Strontium-90 (Sr-90), gross alpha, gross beta, and gamma emitters. Surface water samples were analyzed for tritium, Sr-89, Sr-90 and gamma emitters. Precipitation water samples were analyzed for tritium. Most of the tritium values for well water, surface water and precipitation water were less than the lower limit of detection of 200 pCi/L. Results and Discussion of groundwater samples are covered in Appendix G.

In assessing the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of LGS had no adverse radiological impact on the environment.

III. Introduction

The Limerick Generating Station (LGS), consisting of two 3,515 MW boiling water reactors owned and operated by Exelon Corporation, is located adjacent to the Schuylkill River in Montgomery County, Pennsylvania. Unit No. 1 went critical on 22 December 1984. Unit No. 2 went critical on 11 August 1989. The site is located in Piedmont countryside, transversed by numerous valleys containing small tributaries that feed into the Schuylkill River. On the eastern river bank, elevation rises from approximately 110 to 300 feet mean sea level (MSL). On the western river bank elevation rises to approximately 50 feet MSL to the western site boundary.

A Radiological Environmental Monitoring Program (REMP) for LGS was initiated in 1971. Review of the 1971 through 1977 REMP data resulted in the modification of the program to comply with changes in the Environmental Report Operating License Stage (EROL) and the Branch Technical Position Paper (Rev. 1, 1979). The preoperational period for most media covers the periods 1 January 1982 through 21 December 1984 and was summarized in a separate report. This report covers those analyses performed by Teledyne Brown Engineering (TBE), Mirion Technologies, and Environmental Inc., Midwest Laboratory (EIML) on samples collected during the period 1 January 2017 through 31 December 2017.

On 6 July 1996 a 10 CFR 20.2002 permit was issued to Limerick for storage of slightly contaminated soils, sediments and sludges obtained from the holding pond, cooling tower and spray pond systems. These materials will decay to background while in storage. Final disposition will be determined at Station decommissioning.

On 21 July 2008 an ISFSI pad was put into service. The ISFSI is dry cask storage, where spent nuclear fuel is stored.

A. Objective of the REMP

The objectives of the REMP are to:

1. Provide data on measurable levels of radiation and radioactive materials in the site environs

2. Evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure

B. Implementation of the Objectives

The implementation of the objectives is accomplished by:

1. Identifying significant exposure pathways
2. Establishing baseline radiological data of media within those pathways
3. Continuously monitoring those media before and during station operation to assess station radiological effects (if any) on man and the environment

IV. Program Description

A. Sample Collection

Samples for the LGS REMP were collected for Exelon Nuclear by Normandeau Associates, Inc. (NAI). This section describes the general collection methods used by NAI to obtain environmental samples for the LGS REMP in 2017. Sample locations and descriptions can be found in Tables B–1 and B–2, and Figures B–1 through B–3, Appendix B. The collection procedures used by NAI are listed in Table B-3.

Aquatic Environment

The aquatic environment was evaluated by performing radiological analyses on samples of surface water, drinking water, fish, and sediment. Two-gallon water samples were collected monthly from composite samplers located at two surface water locations (13B1 and 24S1) and four drinking water locations (15F4, 15F7, 16C2, and 28F3). Control locations were 24S1, and 28F3. All samples were collected in new unused plastic bottles, which were rinsed at least twice with source water prior to collection. Fish samples comprising of the flesh of two groups, bottom feeder (white sucker/carp/catfish) and predator (sunfish/bass/rock bass/catfish), were collected semiannually at two locations, 16C5 and 29C1 (control). Sediment samples composed of recently deposited substrate were collected at three locations semiannually, 16B2, 16C4, and 33A2 (control).

Atmospheric Environment

The atmospheric environment was evaluated by performing radiological analyses on samples of air particulate, airborne iodine, and milk. Airborne iodine and particulate samples were collected and analyzed weekly at seven locations (6C1, 10S3, 11S1, 13S4, 14S1, 15D1, and 22G1). The control location was 22G1. Airborne iodine and particulate samples were obtained at each location, using a vacuum pump with charcoal and glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The filters were replaced weekly and sent to the laboratory for analysis.

Terrestrial Environment

Milk samples were collected biweekly at four locations (18E1, 19B1, 23F1, and 25C1) from April through November, and monthly from December through March. One additional location (36E1) was sampled quarterly. Locations 36E1 and 23F1 were controls. All samples were collected in new unused two gallon plastic bottles from the bulk tank at each location, preserved with sodium bisulfite, and shipped promptly to the laboratory.

Broad leaf vegetation was collected monthly, during the growing season, at three locations (11S3, 13S3, and 31G1). The control location was 31G1. Nine different kinds of vegetation samples were collected and placed in new unused plastic bags, and sent to the laboratory for analysis.

Ambient Gamma Radiation

Direct Radiation measurements were made using thermoluminescent dosimeters. The DLR locations were placed on and around the LGS site as follows:

A site boundary ring consisting of 16 locations (36S2, 3S1, 5S1, 7S1, 10S3, 11S1, 13S2, 14S1, 18S2, 21S2, 23S2, 25S2, 26S3, 29S1, 31S1, and 34S2) near and within the site perimeter representing fence post doses (i.e., at locations where the doses will be potentially greater than maximum annual off–site doses) from LGS releases.

An intermediate distance ring consisting of 16 locations (36D1, 2E1, 4E1, 7E1, 10E1, 10F3, 13E1, 16F1, 19D1, 20F1, 24D1, 25D1, 28D2, 29E1, 31D2, and 34E1) extending to approximately 5 miles from the site designed to measure possible exposures to close-in population.

The balance of eight locations (5H1, 6C1, 9C1, 13C1, 15D1, 17B1, 20D1, and 31D1) representing control and special interests areas such as population centers, schools, etc.

The specific dosimetry locations were determined by the following criteria:

1. The presence of relatively dense population;
2. Site meteorological data taking into account distance and elevation for each of the sixteen–22 1/2 degree sectors around the site, where estimated annual dose from LGS, if any, would be most significant;
3. On hills free from local obstructions and within sight of the vents (where practical);
4. And near the closest dwelling to the vents in the prevailing downwind direction.

Two dosimeters were placed at each location in a PVC conduit located approximately three feet above ground level. The dosimeters were exchanged quarterly and sent to Mirion Technologies for analysis.

10 CFR 20.2002 Permit Storage Area

In 1996, the Limerick Generating Station received NRC approval to store slightly contaminated soils, sludges and sediments on site per the requirements of 10 CFR 20.2002. These materials will be stored until end of the site's renewed operating license. At that time the material will be evaluated along with the site for decommissioning. The area is approximately 1.5 acres in size and was evaluated to hold a maximum of 1.12E+06 cubic feet with no more than 7E+04 cubic feet added to the area in any single year. After each material placement on the storage area, the area is graded and seeded to prevent erosion. Since all groundwater movement is to the river, the use of the REMP surface water sampling program is used as a check on potential groundwater movement from the pad. In 2017, no material was placed on the permitted storage area.

Independent Spent Fuel Storage Installation (ISFSI)

The results from the dosimeter locations 36S2 and 3S1 were used to determine the direct radiation exposure to the nearest residence from the ISFSI pad.

B. Sample Analysis

This section lists the analyses performed by the primary laboratory (TBE) and the secondary laboratory (EIML) on environmental samples for the LGS REMP in 2017. The analytical procedures used by the laboratories are listed in Appendix B Table B-3. Analysis results from TBE are provided in Appendix C. Analysis results from Environmental Inc., Midwest Laboratory are provided in Appendix D of this report.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of beta emitters in drinking water and air particulates
2. Concentrations of gamma emitters in surface and drinking water, air particulates, milk, fish, broad leaf vegetation, and sediment
3. Concentrations of tritium in surface and drinking water
4. Concentrations of I-131 in air, milk, and drinking water
5. Ambient gamma radiation levels at various site environs

C. Data Interpretation

The radiological and direct radiation data collected prior to LGS becoming operational was used as a baseline with which these operational data were compared. For the purpose of this report, LGS was considered operational at initial criticality. In addition, data were compared to

previous years' operational data for consistency and trending. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

   The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as a before the fact estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact criteria for the presence of activity. All analyses are designed to achieve the required LGS detection limits for environmental sample analysis.

   The minimum detectable concentration (MDC) is defined as above with the exception that the measurement is an after the fact estimate of the presence of activity.

2. Net Activity Calculation and Reporting of Results

   Net activity for a sample was calculated by subtracting background activity from the sample activity. Since the REMP measures extremely small changes in radioactivity in the environment, background variations may result in sample activity being lower than the background activity affecting a negative number. An MDC was reported in all cases where positive activity was not detected.

   Gamma spectroscopy results for each type of sample were grouped as follows:

   For surface and drinking water, twelve nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140, and La-140 were reported

   For broad leaf vegetation, eleven nuclides, Be-7, K-40, Mn-54, Co-58, Co-60, I-131, Cs-134, Cs-137, Ra-226, Th-228, and Th-232 were reported

   For fish, nine nuclides, K-40, Mn-54, Co-58, Fe-59, Co-60, Zn-65, I-131, Cs-134, and Cs-137 were reported

   For sediment, eight nuclides, Be-7, K-40, Mn-54, Co-58, Co-60, I-131, Cs-134, and Cs-137 were reported

   For air particulates, six nuclides, Be-7, Mn-54, Co-58, Co-60, Cs-134, and Cs-137 were reported

   For milk, five nuclides, K-40, Cs-134, Cs-137, Ba-140, and

La-140 were reported

Means and standard deviations of positive results were calculated. The standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

For 2017 the LGS REMP had a sample recovery rate of greater than 99%. Exceptions are listed below:

1. Air sample from location 11S2 for the week of 01/17/17 – 01/24/17 was not available due to the pump not running. The pump was replaced on 01/26/17 (IR 3968583).

2. Air sample from location 10S3 for the week of 06/05/17 – 06/12/17 was not available due to the pump not running. The pump and fuse were replaced on 06/12/17 (IR 4037354).

3. Air sample from location 13S4 for the week of 6/27/17 – 7/4/17 was not available since the GFI breaker was tripped. The GFI was replaced on 7/6/17 (IR 4029563).

4. Air sample from location 6C1 for the week of 7/24/17 – 7/31/17 was not available due to an equipment issue (IR 4053146).

5. DLR data from location 36S2 was not reported for 3rd quarter of 2017 due to the TLD not being received by the vendor upon shipment. Data from 36S2 is normally used to calculate dose to the public to verify that the dose commitments of ODCM control 3.2.3 have been met. In lieu of this data, TLD location 3S1, a location closer to the plant, was used to show compliance. (IR 4097481).

6. Milk samples for location 18E1 for 10/31/17, 11/14/17, 11/28/17, and 12/12/17 were not available due to a fire at the farm (IR 4070461).

Each program exception was reviewed to understand the causes of the program exception. Occasional equipment breakdowns were unavoidable. The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

E. Program Changes

There were no program changes in 2017.

F. Compliance to 40 CFR 190 Limits

1. Dose to Members of the Public at or Beyond Site Boundary

Per ODCM Control 6.2, the Annual Radioactive Effluent Release Report shall include an assessment of the radiation doses to the hypothetically highest exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources. The ODCM does not require population doses to be calculated. For purposes of this calculation the following assumptions were made:

- Long term annual average meteorology X/Q and D/Q and actual gaseous effluent releases were used.
- Gamma air dose, Beta air dose, Total Body and Skin doses were attributed to noble gas releases.
- Critical organ and age group dose attributed to iodine, particulate, Carbon-14 and tritium releases.
- 100 percent occupancy factor was assumed.
- Dosimetry measurements (minus background levels) obtained from the Radiological Environmental Monitoring Program for the nearest residence to the Independent Spent Fuel Storage Installation (ISFSI) was used to determine direct radiation exposure.
- The highest doses from the critical organ and critical age group for each release pathway was summed and added to the net dosimetry measurement from nearest residence to the ISFSI for 40 CFR 190 compliance.

<u>40 CFR 190 Compliance</u>:
The maximum calculated dose to a real individual would not exceed 3.06E-01 mRem (total body), 1.30E+00 mRem (organ), or 3.05E-01 mRem (thyroid).

All doses calculated were below all ODCM and 40 CFR Part 190 limits to a real individual.

Table 1: 40 CFR 190 Compliance

40 CFR 190 Compliance								
	Gaseous Effluents		Liquid Effluents	Net Direct Radiation	Total	% of Applicable Limit	Limit	Unit
	Noble Gas	Particulate, Iodine, C-14 & Tritium						
Total Body Dose	2.29E-03	2.49E-01	5.43E-02	0.00E+00	3.06E-01	1.22E+00	25	mRem
Organ Dose	3.78E-03	1.24E+00	5.48E-02	0.00E+00	1.30E+00	5.19E+00	25	mRem
Thyroid Dose	2.29E-03	2.49E-01	5.41E-02	0.00E+00	3.05E-01	4.07E-01	75	mRem

V. Results and Discussion

A. Aquatic Environment

1. Surface Water

Samples were taken from a continuous sampler at two locations (13B1 and 24S1) on a monthly schedule. Of these locations only 13B1 located downstream, could be affected by Limerick's effluent releases. The following analyses were performed:

Tritium

Monthly samples from all locations were composited quarterly and analyzed for tritium activity (Appendix C, Table C–I.1). All results were below the required LLD.

Iodine-131

Monthly samples were taken from location 24S1 and analyzed for low level I-131 activity (Appendix C, Table C–I.2). All results were below the required LLD. A non-routine sample was taken in December from surface water location 13B1 and analyzed for low level I-131. I-131 was detected at 1.8 pCi/L. Coinciding with the positive I-131 identified at 13B1 during 4th quarter of 2017, a sample taken from the onsite settling basin also showed positive I-131 (IR 4083746). However, there were no radiological releases from the station during this period. After thorough evaluation, the I-131 is determined to be from an upstream hospital where the radiation emitted from I-131 is used to treat many types of cancer and non-malignant diseases. However, the dose to an infant's thyroid was conservatively calculated at 2.06E+00 mRem. This dose represents 1.03E+01% of the 10 CFR Part 50 Appendix I dose limits.

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Appendix C, Table C–I.3). All nuclides were below the required LLDs.

2. Drinking Water

Monthly samples were collected from continuous water samplers at four locations (15F4, 15F7, 16C2, and 28F3). Three locations (15F4, 15F7, and 16C2) could be affected by Limerick's effluent releases. The following analyses were performed:

Gross Beta

Samples from all locations were analyzed for concentrations of total gross beta (Appendix C, Tables C–II.1). The values ranged from 2.1 to 5.1 pCi/L. Concentrations detected were consistent with those detected in previous years (Appendix C, Figure C–1).

Tritium

Monthly samples from all locations were composited quarterly and analyzed for tritium activity. All results were below required LLD (Appendix C, Table C–II.2).

Iodine-131

Monthly samples were taken from all locations and analyzed for I-131 activity (Appendix C, Table C–II.3). All results were below the required LLD.

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Appendix C, Table C–II.4). All results were below the required LLDs.

3. Fish

Fish samples comprised of bottom feeder (white sucker/carp/catfish) and predator (sunfish/bass/rock bass/catfish), were collected at two locations (16C5 and 29C1) in the spring and fall season. Location 16C5 could be affected by Limerick's effluent releases. The following analysis was performed:

Gamma Spectrometry

The edible portion of fish samples from both locations was analyzed for gamma-emitting nuclides (Appendix C, Table C–III.1). Naturally-occurring K-40 was found at all stations and ranged from 2,691 to 3,973 pCi/kg wet and was consistent with levels detected in previous years. No other activity was detected and the required LLD was met.

4. Sediment

Aquatic sediment samples were collected at three locations (16B2, 16C4 and 33A2) semiannually. Two of these locations (16B2 and 16C4) could be affected by Limerick's effluent releases. The following analysis was performed:

Gamma Spectrometry

Sediment samples from all three locations were analyzed for gamma-emitting nuclides (Appendix C, Table C–IV.1). Nuclides detected were naturally-occurring Be-7 and K-40, as well as the fission product Cs-137.

Be-7 was found at a two locations and ranged from 1,492 to 3,561 pCi/kg dry. K-40 was found at all locations and ranged from 8,645 to 15,390 pCi/kg dry. The fission product Cs-137 was found at location 16B2 with a concentration of 120 pCi/kg dry (IR 4037366).

The Cs-137 activity detected was consistent with those detected in the pre–operational years. The control location, 33A2, and a downstream location, 16C4, both showed no activity. Therefore, at 16B2, the Cs-137 activity found is not attributed to LGS radioactive effluent releases. However, the dose to a teenager's skin and whole body was conservatively calculated at 3.15E-04 mRem and 2.70E-04 mRem, respectively. This dose represents 1.58E-03% and 4.50E-03%, of the Appendix I to 10 CFR Part 50 dose limits, respectively. No other Limerick fission or activation products were found.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from seven locations on a weekly basis. The seven locations were separated into three groups: Group I represents locations within the LGS site boundary (10S3, 11S1, 13S4, and 14S1), Group II represents the locations at an intermediate distance from the LGS site (6C1 and 15D1), and Group III represents the control location at a remote distance from LGS (22G1). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Appendix C, Table C–V.1 and C–V.2).Detectable gross beta activity was observed at all locations. The results from the on-site locations (Group I) ranged from 5E–3 to 29E–3 pCi/m^3 with a mean of 14E–3 pCi/m^3. The results from the intermediate distance location (Group II) ranged from 7E–3 to 29E–3 pCi/m^3 with a mean of 15E–3 pCi/m^3. The results from the remote distance locations (Group III)

ranged from 7E–3 to 29E–3 pCi/m^3 with a mean of 15E–3 pCi/m^3. Comparison of the 2017 air particulate data with previous year's data indicates no effects from the operation of LGS (Appendix C, Figure C–2). In addition, a comparison of the weekly mean values for 2017 indicates no notable differences among the three groups.
(Appendix C, Figure C–3).

Gamma Spectrometry

Weekly samples were composited quarterly and analyzed for gamma-emitting nuclides (Appendix C, Table C–V.3). Naturally-occurring Be-7 was detected in all 28 samples and is contributed to cosmic ray activity. These values ranged from 46E–3 to 105E–3 pCi/m^3. All other nuclides were below the required LLDs.

b. Airborne Iodine

Continuous air samples were collected from seven locations (6C1, 10S3, 11S1, 13S4, 14S1, 15D1, and 22G1) and analyzed weekly for I-131 (Appendix C, Table C–VI.1). All results were below the required LLD.

2. Terrestrial

a. Milk

Samples were collected from four locations (18E1, 19B1, 23F1, and 25C1) biweekly April through November and monthly December through March. Samples from one additional location (36E1) were taken quarterly. The following analyses were performed:

Iodine-131

Milk samples from all locations were analyzed for concentrations of I-131 (Appendix C, Table C–VII.1). All results were below the required LLD.

Gamma Spectrometry

Each milk sample was analyzed for concentrations of gamma-emitting nuclides (Appendix C, Table C–VII.2).

Naturally-occurring K-40 activity was found in all samples and ranged from 956 to 1,509 pCi/L. All other nuclides were below the required LLDs.

b. Broad Leaf Vegetation

Eight types of broadleaf vegetation samples were collected from three locations (11S3, 13S3, and 31G1) monthly from June through October. The following analysis was performed:

Gamma Spectrometry

Each broad leaf vegetation sample was analyzed for concentrations of gamma-emitting nuclides (Appendix C, Table C-VIII.1).

Cosmogenic, naturally-occurring Be-7 was found in 13 of 32 samples and ranged from 219 to 874 pCi/kg wet. Naturally-occurring K-40 was found in all samples and ranged from 1,219 to 7,356 pCi/kg wet. Naturally-occurring Ra-226 was found in 6 of 32 samples and ranged from 1,008 to 1,792 pCi/kg wet. Naturally-occurring Th-228 was found in 10 of 32 samples and ranged from 38 to 163 pCi/kg wet. All other nuclides were below the required LLDs.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing Panasonic 814 ($CaSO_4$) thermoluminescent dosimeters. Forty dosimeter locations were established around the site. Results of dosimeter measurements are listed in Appendix C, Tables C–IX.1 and C–IX.2, Figure C–4. Dosimeter measurements were reported in mR/standard month. All dosimeter measurements were below 10 mR/standard month, with a range of 3.7 to 8.3 mR/standard month. A comparison of the Site Boundary and Intermediate Distance data to the Control Location (5H1) data indicate that the ambient gamma radiation levels from the Control Location were consistently higher than all other locations, except 13S2. Location 13S2 historically shows higher ambient gamma radiation, which is due to the rock substrate. The area that this dosimeter is located in has been determined to emanate radon prodigy.

D. 10 CFR 20.2002 Permit Storage Area

The results of the surface water aquatic monitoring program from Location 24S1 were used to determine if radioactivity from the permit storage area had made it to the Schuylkill River. The data obtained from the gamma analysis program did not detect any migration of radioactivity from the permit storage area.

E. Independent Spent Fuel Storage Installation

The results of the ambient gamma radiation level at dosimeter locations 36S2 and 3S1 were used to determine the direct radiation exposure to the nearest residence from the ISFSI pad. The data, after subtracting background, shows the net direct radiation exposure to the nearest residence was 0.0 mRem for the year.

F. Land Use Survey

A Land Use Survey conducted in September 2017 around Limerick Generating Station (LGS) was performed by Normandeau Associates, Inc. for Exelon Nuclear to comply with Bases 3.3.2 of the Limerick's Offsite Dose Calculation Manual. The purpose of the survey was to document the nearest resident, milk-producing animal and garden of greater than 500 ft^2 in each of the sixteen 22 ½ degree sectors out to five miles around the site. The distance and direction of all locations from the LGS reactor buildings were positioned using Global Positioning System (GPS) technology. The 2017 Land Use Survey identified differences in locations for gardens and meat animals between 2016 and 2017. The gardens identified in sectors ENE, E, ESE, SE, and WNW are newly identified and closer than in 2016. The location for meat animals in sectors NNE, SE, and NNW are closer than in 2016 and location for meat animals in sectors NE and SSW are farther away than in 2016. There were no changes required to the LGS REMP as a result of this survey. The results of this survey are summarized below:

Distance in feet from the LGS Reactor Buildings (Out to 26,400 feet)					
Sector		Residence Feet	Garden Feet	Milk Farm Feet	Meat Animal Feet
1	N	3,109	3,333	24,775	24,775
2	NNE	2,706	12,399	-	25,067
3	NE	3,469	16,718	-	16,044
4	ENE	3,231	8,241	-	7,451
5	E	2,864	7,868	-	-
6	ESE	3,434	3,434	-	12,385
7	SE	3,945	7,139	-	10,903
8	SSE	5,403	6,912	-	-
9	S	4,347	6,103	22,114	12,210
10	SSW	5,063	5,732	10,390	10,390
11	SW	3,251	6,544	-	23,145
12	WSW	3,799	4,507	14,177	14,177
13	W	3,627	8,886	-	17,137
14	WNW	3,685	12.022	-	-
15	NW	3,619	8,200	-	-
16	NNW	5,050	6,473	-	12,065

G. Summary of Results – Inter-laboratory Comparison Program

The primary and secondary laboratories analyzed Performance Evaluation

(PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes (Appendix E). 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:

A. 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.

B. 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.

C. 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.

For the TBE laboratory, 168 out of 173 analyses performed met the specified acceptance criteria. Five analyses did not meet the specified

acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program.

1. The Analytics September 2017 soil Cr-51 result was evaluated as *Not Acceptable* (Ratio of TBE to known result at 0.65). The reported value was 0.230 ± 0.144 pCi/g and the known value was 0.355 ± 0.00592 pCi/g. The sample was counted overnight for 14 hours, however the Cr-51 was spiked at a very low level and had a counting error of 65%. Cr-51 has a 27-day half-life, making low-level quantification even more difficult. The error does not appear to have been taken into consideration for this result. If it had been evaluated with the error, the highest result would have been 105% of the reference value, which is acceptable. Also, the known value is significantly lower than TBE's typical MDC for this nuclide in a soil matrix and would typically not be reported to clients (unless specified). The results of all of the previous cross-checks have been in the acceptable (80 – 120%) range. TBE will evaluate further upon completion of the next ICP sample. (NCR 17-16)

2. The DOE MAPEP August 2017 air particulate U-238 result of 0.115 ± 0.025 Bq/sample was higher than the known value of 0.087 ± 0.002 with a ratio of 1.32, therefore the upper ratio of 1.30 (acceptable with warning) was exceeded. TBE's result with error easily overlaps with the acceptable range. MAPEP does not evaluate results with any associated error. Also, the spike level for this sample was very low (2.35 pCi) compared to TBE's normal LCS of 6 pCi. TBE considers this result as passing. (NCR 17-15)

3. The ERA April 2017 two nuclides in water were evaluated as *Not Acceptable*. (NCR 17-09)

    a. The Zn-65 result of 39.3 pCi/L, exceeded the lower acceptance limit of 47.2. The known value was unusually low for this study. The sample was run in duplicate on two different detectors. The results of each were 39.3 ± 18.2 pCi/L (46% error and lower efficiency) and 59.3 ± 8.23 pCi/L (13.9% error and higher efficiency). The result from the 2nd detector would have been well within the acceptable range (47.2 – 65.9) and 110.2% of the known value of 53.8 pCi/L.

    b. The Sr-89 result of 40.7 pCi/L exceeded the lower acceptance limit of 53.8. All associated QC and recoveries were reviewed and no apparent cause could be determined for the failure. The prior three cross-check results were from 99 – 115% of the known values and the one that followed this sample (November, 2017) was 114% of the known value.

4. The ERA November 2017 water Sr-90 sample was evaluated as *Not Acceptable*. TBE's result of 27.1 pCi/L exceeded the lower acceptance range (30.8 – 48.0 pCi/L). After reviewing the associated QC data for this sample, it was determined that although the spike recovery for Sr-90 was within our laboratory guidelines (70% -130%), both the spike result and our ERA result were biased low. The original cross-check sample was completely consumed and we were unable to reanalyze before submitting the result. We have modified our preparation process to avoid this situation for future cross-check samples. We also have enhanced LIMS programming to force a LCSD when a workgroup includes cross-check samples (as opposed to running a DUP). (NCR 17-19)

For the EIML laboratory, 181 of 189 analyses met the specified acceptance criteria. Eight analyses did not meet the specified acceptance criteria for the following reasons:

1. The ERA March 2017 MRAD air filter Fe-55 result of 590 pCi/filter was higher than the known value of 256 pCi/filter, exceeding the upper control limit of 500 pCi/filter. The 1000-minute recount result of 254 pCi/filter fell within acceptance criteria.

2. The ERA March 2017 MRAD air filter Gross Beta result of 67.6 pCi/filter was higher than the known value of 45.2 pCi/filter, exceeding the lower control limit of 65.9 pCi/filter. ERA appears to have applied the standard material to the filter in a pattern closer to the center of the filter compared to previous studies and different from the filter efficiency utilized by the lab, causing the efficiency calculation to be understated and the lab result to be overstated. Associated QC was acceptable.

3. The ERA March 2017 MRAD soil Pu-239/240 result of 252 pCi/kg was lower than the known value of 484 pCi/kg, exceeding the lower control limit of 316 pCi/kg. The sample was reanalyzed in duplicate with acceptable results. Suspected poor electroplating for low original analysis result.

4. The ERA March 2017 MRAD soil U-233/234 result of 1,030 pCi/kg was lower than the known value of 1,950 pCi/kg, exceeding the lower control limit of 1,190 pCi/kg. The sample was reanalyzed in duplicate with acceptable results. Suspected poor electroplating for low original analysis result.

5. The ERA March 2017 MRAD water Fe-55 result of 1,400 pCi/L was higher than the known value of 984 pCi/L, exceeding the upper

control limit of 1,340 pCi/L. The sample was recounted with results in the acceptable range.

6. The MAPEP February 2017 water Co-57 result of 2.7 Bq/L sample was lower than the known value of 28.5 Bq/L sample. The decimal point was misplaced while performing a unit conversion. The result is within control limits when the proper unit conversion is performed.

7. The MAPEP February 2017 air filter Am-241 result of 0.0540 Bq/total sample was higher than the known value of 0.0376 Bq/total sample. The sample was reanalyzed in duplicate with acceptable results. Original plating was inferior to plating obtained during reanalysis. It is believed that isotopic tracer was not accurately quantified due to poor resolution of its peak.

8. The MAPEP August 2017 air filter Am-241 result of 0.0400 Bq/total sample was lower than the known value of 0.0612 Bq/total sample. The laboratory is not currently offering analysis for air particulate Am-241.

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

VI. References

A. Environmental Report Operating License Stage, Limerick Generating Station, Units 1 and 2, Volumes 1–5 Philadelphia Electric Company

B. NUREG-1302 Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors

C. Branch Technical Position Paper, Regulatory Guide 4.8, Revision 1, November 1979

D. Pre-operational Radiological Environmental Monitoring Program Report, Limerick Generating Station Units 1 and 2, 1 January 1982 through 21 December 1984, Teledyne Isotopes and Radiation Management Corporation

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APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2017

NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353

LOCATION OF FACILITY: MONTGOMERY, PA | **REPORTING PERIOD:** 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) *RANGE*	CONTROL LOCATION MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER *(PCI/LITER)*	**H-3**	8	**200**	<LLD	<LLD	-		0
	GAMMA	24						
	MN-54		**15**	<LLD	<LLD	-		0
	CO-58		**15**	<LLD	<LLD	-		0
	FE-59		**30**	<LLD	<LLD	-		0
	CO-60		**15**	<LLD	<LLD	-		0
	ZN-65		**30**	<LLD	<LLD	-		0
	NB-95		**15**	<LLD	<LLD	-		0
	ZR-95		**30**	<LLD	<LLD	-		0
	I-131		**15**	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		**60**	<LLD	<LLD	-		0
	LA-140		**15**	<LLD	<LLD	-		0
	I-131 (LOW LVL)	14	**1**	1.8 (1/1)	<LLD	1.8 (1/1)	13B1 INDICATOR VINCENT DAM 1.75 MILES SE OF SITE	0
DRINKING WATER *(PCI/LITER)*	**GR-B**	48	**4**	3.6 (31/36) *2.1 - 5.1*	3.3 (9/12) *2.5 - 4.8*	4 (12/12) *2.4 - 5.1*	15F4 INDICATOR AQUA WATER COMPANY	0
	H-3	16	**200**	<LLD	<LLD	-		0
	I-131 (LOW LVL)	48	**1**	<LLD	<LLD	-		0

(M) The Mean Values are calculated using the positive values. **(F)** Fraction of dectectable measurements at specified locations are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2017

NAME OF FACILITY:	**LIMERICK GENERATING STATION**			**DOCKET NUMBER:**		**50-352 & 50-353**		
LOCATION OF FACILITY:	**MONTGOMERY, PA**			**REPORTING PERIOD:**		**2017**		
				INDICATOR LOCATIONS	**CONTROL LOCATION**	**LOCATION WITH HIGHEST ANNUAL MEAN (M)**		
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	MEAN (M) (F) *RANGE*	MEAN (M) (F) *RANGE*	MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DRINKING WATER	**GAMMA**	48						
(PCI/LITER)	*MN-54*		**15**	<LLD	<LLD	-		0
	CO-58		**15**	<LLD	<LLD	-		0
	FE-59		**30**	<LLD	<LLD	-		0
	CO-60		**15**	<LLD	<LLD	-		0
	ZN-65		**30**	<LLD	<LLD	-		0
	NB-95		**15**	<LLD	<LLD	-		0
	ZR-95		**30**	<LLD	<LLD	-		0
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		**60**	<LLD	<LLD	-		0
	LA-140		**15**	<LLD	<LLD	-		0
FISH - BOTTOM FEEDER	**GAMMA**	4						
(PCI/KG WET)	*K-40*		*NA*	3520 (2/2) *3067 - 3973*	3462 (2/2) *3442 - 3482*	3520 (2/2) *3067 - 3973*	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0
	MN-54		**130**	<LLD	<LLD	-		0
	CO-58		**130**	<LLD	<LLD	-		0
	FE-59		**260**	<LLD	<LLD	-		0
	CO-60		**130**	<LLD	<LLD	-		0
	ZN-65		**260**	<LLD	<LLD	-		0
	I-131		*NA*	<LLD	<LLD	-		0
	CS-134		**130**	<LLD	<LLD	-		0
	CS-137		**150**	<LLD	<LLD	-		0

(M) The Mean Values are calculated using the positive values. **(F)** Fraction of dectectable measurements at specified locations are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2017

NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353

LOCATION OF FACILITY: MONTGOMERY, PA | **REPORTING PERIOD:** 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) *RANGE*	CONTROL LOCATION MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
FISH - PREDATOR	**GAMMA**	4						
(PCI/KG WET)	*K-40*		*NA*	3086.5 (2/2) *2736 - 3437*	3001.5 (2/2) *2691 - 3312*	3086.5 (2/2) *2736 - 3437*	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0
	MN-54		**130**	<LLD	<LLD	-		0
	CO-58		**130**	<LLD	<LLD	-		0
	FE-59		**260**	<LLD	<LLD	-		0
	CO-60		**130**	<LLD	<LLD	-		0
	ZN-65		**260**	<LLD	<LLD	-		0
	I-131		*NA*	<LLD	<LLD	-		0
	CS-134		**130**	<LLD	<LLD	-		0
	CS-137		**150**	<LLD	<LLD	-		0
SEDIMENT	**GAMMA**	6						
(PCI/KG DRY)	*BE-7*		*NA*	2194 (4/4) 1492 - 3561	<LLD	2600 (2/2) 1638 - 3561	16B2 INDICATOR LINFIELD BRIDGE 7128 FEET SSE OF SITE	0
	K-40		*NA*	14113 (4/4) *11380 - 15390*	9478 (2/2) *8645 - 10310*	14940 (2/2) *14490 - 15390*	16B2 INDICATOR LINFIELD BRIDGE 7128 FEET SSE OF SITE	0
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	I-131		*NA*	<LLD	<LLD	-		0
	CS-134		**150**	<LLD	<LLD	-		0
	CS-137		**180**	120 (1/4)	<LLD	120 (1/2)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0

(M) The Mean Values are calculated using the positive values. **(F)** Fraction of dectectable measurements at specified locations are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2017

NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353

LOCATION OF FACILITY: MONTGOMERY, PA | **REPORTING PERIOD:** 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) *RANGE*	CONTROL LOCATION MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE	**GR-B**	361	**10**	14	15	15	14S1 INDICATOR	0
(E-3 PCI/CU.METER)				(304/309)	(52/52)	(50/52)	LONGVIEW ROAD	
				5 - 29	*7 - 29*	*7 - 28*	3319 FEET SSE OF SITE	
	GAMMA	28						
	BE-7		*NA*	69.9	70.1	77.1	6C1 INDICATOR	0
				(24/24)	(4/4)	(4/4)	LIMERICK AIRPORT	
				46.4 - 105.4	*55.7 - 81*	*51.7 - 105.4*	11305 FEET NE OF SITE	
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	CS-134		**50**	<LLD	<LLD	-		0
	CS-137		**60**	<LLD	<LLD	-		0
AIR IODINE	**GAMMA**	361						
(E-3 PCI/CU.METER)	*I-131 (GELI)*		**70**	<LLD	<LLD	-		0
MILK	**I-131 (LOW LVL)**	88	**1**	<LLD	<LLD	-		0
(PCI/LITER)								
	GAMMA	88						
	K-40		*NA*	1241	1259	1288	23F1 CONTROL	0
				(62/62)	(26/26)	(22/22)		
				1021 - 1509	*956 - 1456*	*1200 - 1456*	26505 FEET SW OF SITE	
	CS-134		**15**	<LLD	<LLD	-		0
	CS-137		**18**	<LLD	<LLD	-		0
	BA-140		**60**	<LLD	<LLD	-		0
	LA-140		**15**	<LLD	<LLD	-		0

(M) The Mean Values are calculated using the positive values. **(F)** Fraction of dectectable measurements at specified locations are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2017

NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353

LOCATION OF FACILITY: MONTGOMERY, PA | **REPORTING PERIOD:** 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) *RANGE*	CONTROL LOCATION MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) *RANGE*	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
VEGETATION	**GAMMA**	32						
(PCI/KG WET)	*BE-7*		*NA*	514	457.7	537.5	13S3 INDICATOR	0
				(5/21)	(8/11)	(3/10)	LGS 500 KV YARD	
				328.2 - 873.5	*219.3 - 695.7*	*328.2 - 873.5*	1267 FEET SE OF SITE	
	K-40		*NA*	4512	4640.2	4640.2	31G1 CONTROL	0
				(21/21)	(11/11)	(11/11)	PROUT'S JOLLYVIEW FARM	
				1219 - 7356	*2319 - 6607*	*2319 - 6607*	71,808 FEET NW OF SITE	
	MN-54		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	I-131		**60**	<LLD	<LLD	-		0
	CS-134		**60**	<LLD	<LLD	-		0
	CS-137		**80**	<LLD	<LLD	-		0
	RA-226		*NA*	1382.2	<LLD	1382.2	13S3 INDICATOR	0
				(6/21)		(6/10)	LGS 500 KV YARD	
				1008 - 1991		*1008 - 1991*	1267 FEET SE OF SITE	
	TH-228		*NA*	90.9	103.7	103.7	31G1 CONTROL	0
				(7/21)	(3/11)	(3/11)	PROUT'S JOLLYVIEW FARM	
				38 - 163	55.3 - 148.3	55.3 - 148.3	71,808 FEET NW OF SITE	
	TH-232		*NA*	<LLD	<LLD	-		0
DIRECT RADIATION	**OSLD-QUARTERLY**	318	*NA*	5.6	6.8	7.7	13S2 INDICATOR	0
(MILLI-ROENTGEN/STD.MO.)				(156/156)	(4/4)	(4/4)	500 KV SUBSTATION	
				3.6 - 9.8	*6.2 - 7.3*	*7.5 - 8*	0.41 MILES SE	

(M) The Mean Values are calculated using the positive values. **(F)** Fraction of dectectable measurements at specified locations are indicated in parentheses.

APPENDIX B

LOCATION DESIGNATION, DISTANCE & DIRECTION, AND SAMPLE COLLECTION & ANALYTICAL METHODS

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TABLE B-1: Location Designation and Identification System for the Limerick Generating Station

XXYZ - General code for identification of locations, where:

XX - Angular Sector of Sampling Location. The compass is divided into 36 sectors of 10 degrees each with center at Limerick's Units 1 and 2 off-gas vents. Sector 36 is centered due North, and others are numbered in a clockwise direction.

Y - Radial Zone of Sampling Location (in this report, the radial distance from the Limerick vent for all regional stations).

S : on-site location
A : 0-5,280 feet off-site
B : 5,280-10,560 feet off-site
C : 10,560-15,840 feet off-site
D : 15,840-21,120 feet off-site
E : 21,120-26,400 feet off-site
F : 26,400-52,800 feet off-site
G : 52,800-105,600 feet off-site
H : 105,600-528,000 feet off-site

Z - Station's Numerical Designation within sector and zone, using 1, 2, 3... in each sector and zone.

TABLE B-2: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction
Limerick Generating Station, 2017

Location	Location Description	Distance & Direction From Site
A.	Surface Water	
13B1	Vincent Dam	9,225 feet SE
24S1	Limerick Intake (control)	1,058 feet SW
B.	Drinking (Potable) Water	
15F4	AQUA Water Company	45,514 feet SE
15F7	Phoenixville Water Works	33,400 feet SSE
16C2	PA American	14,034 feet SSE
28F3	Pottstown Borough Authority, Water Distribution Division (control)	30,811 feet WNW
C.	Milk - bi-weekly / monthly	
10F4		34,848 feet ESE
18E1		22,229 feet S
19B1		10,317 feet SSW
23F1	Control	26,505 feet SW
25C1		14,224 feet WSW
D.	Milk - quarterly	
36E1	Control	24,816 feet N
E.	Air Particulates / Air Iodine	
10S3	Keen Road	2,648 feet E
11S1	LGS Information Center	2,017 feet ESE
11S2	LGS Information Center (quality control)	2,017 feet ESE
13S4	Longview Road, near 500 kv Yard	1,186 feet SE
14S1	Longview Road	3,319 feet SSE
15D1	Spring City Substation	16,877 feet SE
22G1	Manor Substation (control)	93,619 feet SW
6C1	Limerick Airport	11,305 feet NE
F .	Fish	
16C5	Vincent Pool	Downstream of Discharge
29C1	Pottstown Vicinity (control)	Upstream of Intake
G.	Sediment	
16B2	Linfield Bridge	7,128 feet SSE
16C4	Vincent Dam	11,510 feet SSE
33A2	Upstream of Intake (control)	4,435 feet NNW
H.	Broad Leaf Vegetation	
11S3	LGS Information Center	1,848 feet ESE
13S3	LGS 500 KV Yard	1,267 feet SE
31G1	Prout's Jollyview Farm (control)	71,808 feet NW

TABLE B-2: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction
Limerick Generating Station, 2017

Location	Location Description	Distance & Direction From Site
I.	Environmental Dosimetry - DLR	
Site Boundary		
36S2	Evergreen & Sanatoga Road	3,183 feet N
3S1	Sanatoga Road	2,301 feet NNE
5S1	Possum Hollow Road	2,350 feet NE
7S1	LGS Training Center	3,099 feet ENE
10S3	Keen Road	2,648 feet E
11S1	LGS Information Center	2,017 feet ESE
13S2	500 KV Substation	2,149 feet SE
14S1	Longview Road	3,319 feet SSE
18S2	Rail Line along Longview Road	1,390 feet S
21S2	Near Intake Building	977 feet SSW
23S2	Transmission Tower	2,793 feet SW
25S2	Sector Site Boundary	2,445 feet WSW
26S3	Met. Tower #2	2,088 feet W
29S1	Sector Site Boundary	2,886 feet WNW
31S1	Sector Site Boundary	1,395 feet NW
34S2	Met. Tower #1	3,071 feet NNW
	Intermediate Distance	
36D1	Siren Tower No. 147	18,527 feet N
2E1	Laughing Waters GSC	25,112 feet NNE
4E1	Neiffer Road	25,221 feet NE
7E1	Pheasant Road	22,489 feet ENE
10E1	Royersford Road	20,826 feet E
10F3	Trappe Substation	29,442 feet ESE
13E1	Vaughn Substation	22,772 feet SE
16F1	Pikeland Substation	26,608 feet SSE
19D1	Snowden Substation	18,439 feet S
20F1	Sheeder Substation	27,648 feet SSW
24D1	Porters Mill Substation	20,972 feet SW
25D1	Hoffecker & Keim Streets	21,044 feet WSW
28D2	W. Cedarville Road	20,231 feet W
29E1	Prince Street	26,110 feet WNW
31D2	Poplar Substation	20,446 feet NW
34E1	Varnell Road	24,243 feet NNW
	Control and Special Interest	
5H1	Birch Substation (control)	130,742 feet NE
6C1	Limerick Airport	11,305 feet NE
9C1	Reed Road	11,377 feet E
13C1	King Road	14,980 feet SE
15D1	Spring City Substation	16,877 feet SE
17B1	Linfield Substation	8,462 feet S
20D1	Ellis Woods Road	16,157 feet SSW
31D1	Lincoln Substation	15,853 feet WNW

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Limerick Generating Station, 2017

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Sample Size	Analytical Procedure Number
Surface Water	Gamma Spectroscopy	Monthly composite from a continuous water compositor	RMC-ER5 Collection of water samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Surface Water	Tritium	Quarterly composite from a continuous water compositor	RMC-ER5 Collection of water samples for radiological analysis (Limerick Generating Station)	500 ml	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., T-02 Determination of tritium in water (direct method)
Drinking Water	Gross Beta	Monthly composite from a continuous water compositor	RMC-ER5 Collection of water samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., W(DS)-01 Determination of gross alpha and/or gross beta in water (dissolved solids or total residue) Env. Inc., W(SS)-02 Determination of gross alpha and/or gross beta in water (suspended solids)
Drinking Water	I-131	Monthly composite from a continuous water compositor	RMC-ER10 Collection of water samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2012 Radioiodine in various matrices Env. Inc., I-131-01 Determination of I-131 in water by an ion exchange
Drinking Water	Gamma Spectroscopy	Monthly composite from a continuous water compositor	RMC-ER5 Collection of water samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Drinking Water	Tritium	Quarterly composite from a continuous water compositor	RMC-ER5 Collection of water samples for radiological analysis (Limerick Generating Station)	500 ml	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., T-02 Determination of tritium in water (direct method)
Fish	Gamma Spectroscopy	Semi-annual samples collected via electroshocking or other techniques	RMC-ER6 Collection of fish samples for radiological analysis (Limerick Generating Station)	1000 grams (wet)	TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Sediment	Gamma Spectroscopy	Semi-annual grab samples	RMC-ER7 Collection of sediment samples for radiological analysis (Limerick Generating Station)	500 grams (dry)	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Limerick Generating Station, 2017

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Sample Size	Analytical Procedure Number
Air Particulates	Gross Beta	One-week composite of continuous air sampling through glass fiber filter paper	RMC-ER8 Collection of air particulate and air iodine samples for radiological analysis (Limerick Generating Station)	1 filter (approximately 280 cubic meters weekly)	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., AP-02 Determination of gross alpha and/or gross beta in air particulate filters
Air Particulates	Gamma Spectroscopy	Quarterly composite of each station	TBE, TBE-2023 Compositing of samples Env. Inc., AP-03 Procedure for compositing air particulate filters for gamma spectroscopic analysis	13 filters (approximately 3600 cubic meters)	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Air Iodine	Gamma Spectroscopy	One-week composite of continuous air sampling through charcoal filter	RMC-ER8 Collection of air particulate and air iodine samples for radiological analysis (Limerick Generating Station)	1 filter (approximately 280 cubic meters weekly)	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., I-131-02 Determination of I-131 in charcoal canisters by gamma spectroscopy (batch method)
Milk	I-131	Bi-weekly grab sample when cows are on pasture; Monthly all other times	RMC-ER10 Collection of milk samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2012 Radioiodine in various matrices Env. Inc., I-131-01 Determination of I-131 in milk by anion exchange
Milk	Gamma Spectroscopy	Bi-weekly grab sample when cows are on pasture; Monthly all other times	RMC-ER10 Collection of milk samples for radiological analysis (Limerick Generating Station)	2 gallon	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
DLR	Thermoluminescent Dosimetry	Quarterly DLRs comprised of two dosimeter elements	RMC-ER9 Collection of dosimetry samples for radiological analysis (Limerick Generating Station)	2 dosimeters	Mirion Technologies

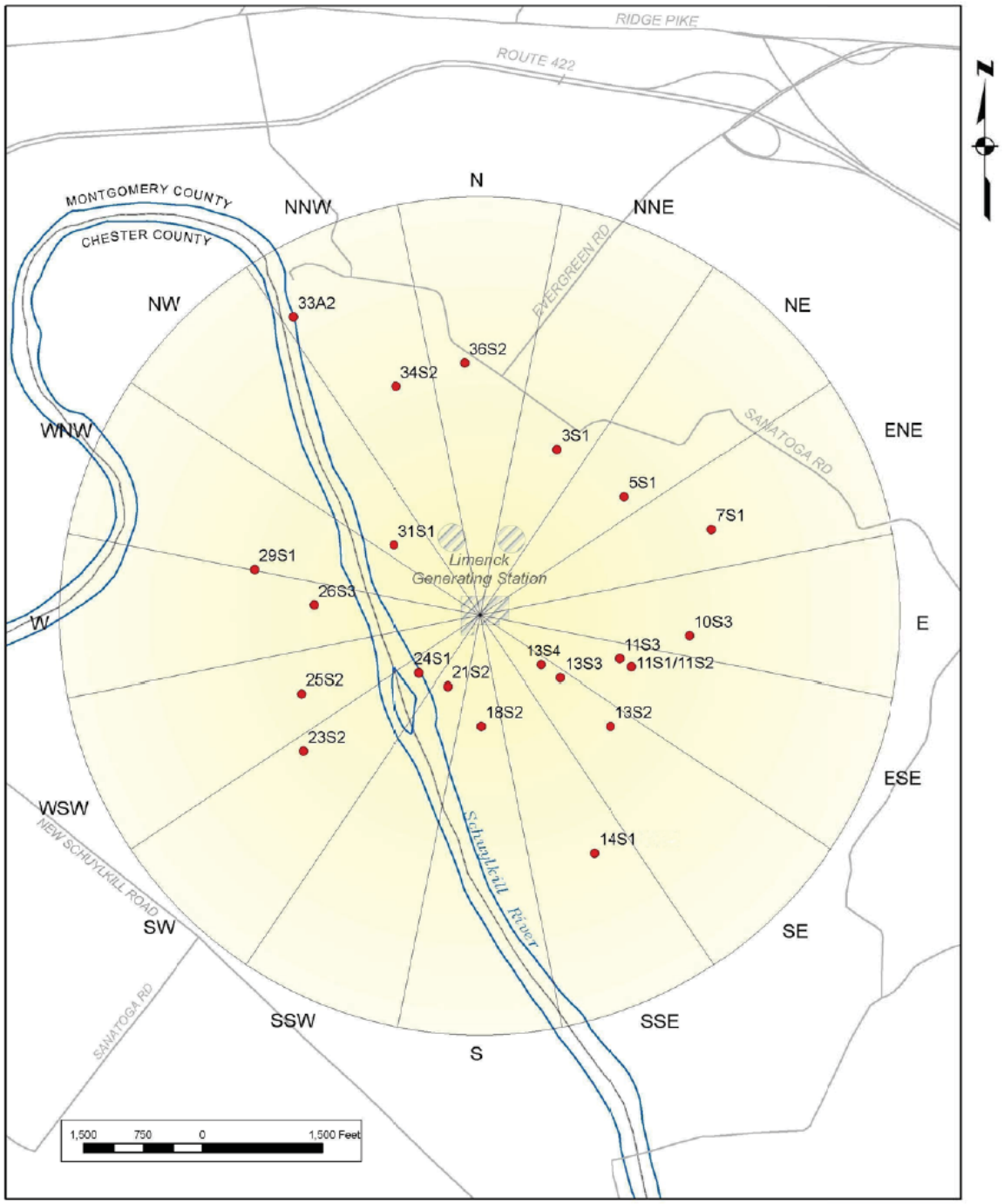

Figure B-1
Environmental Sampling Locations Within 5,280 Feet
of the Limerick Generating Station, 2017

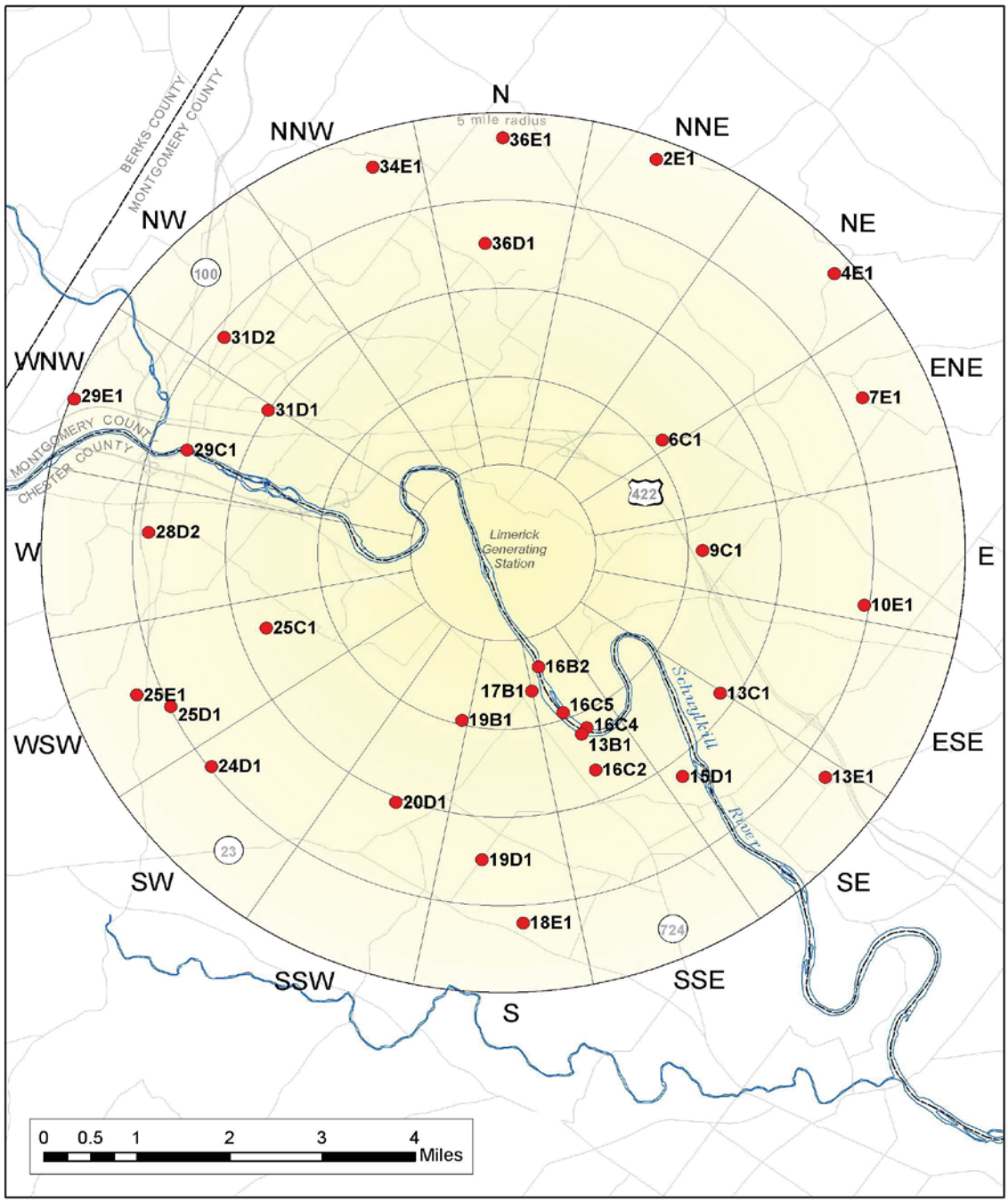

Figure B-2
Environmental Sampling Locations Between 5,280 and 26,400 Feet
from the Limerick Generating Station, 2017

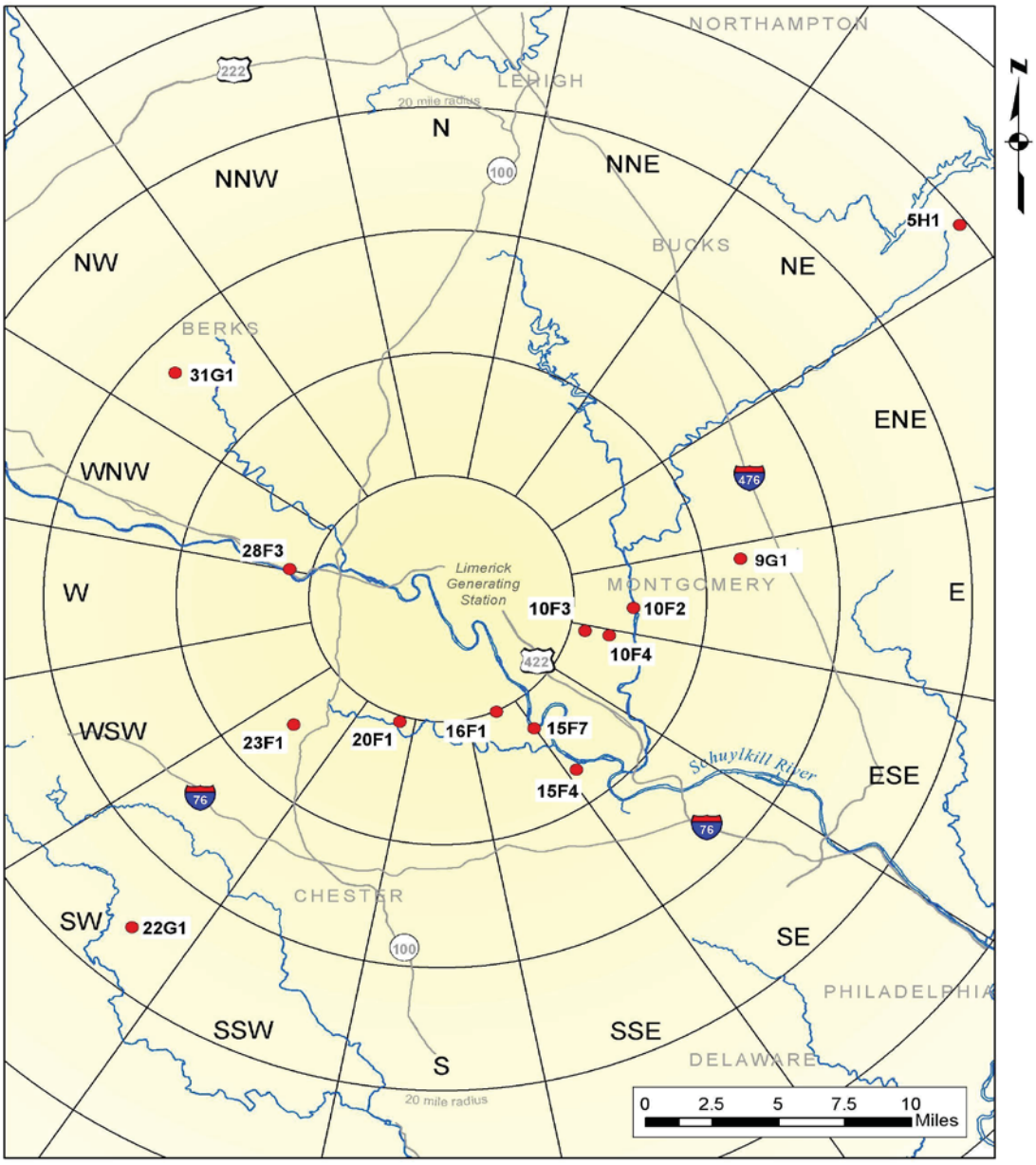

Figure B-3
Environmental Sampling Locations Greater than 26,400 Feet
from the Limerick Generating Station, 2017

APPENDIX C

DATA TABLES AND FIGURES
PRIMARY LABORATORY

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Table C-I.1 **CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	13B1	24S1
12/27/16 - 03/28/17	< 193	< 197
03/28/17 - 06/26/17	< 189	< 195
06/26/17 - 10/03/17	< 173	< 180
10/03/17 - 01/02/18	< 192	< 194
MEAN	-	-

Table C-I.2 **CONCENTRATIONS OF I-131 IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	13B1	24S1
01/30/17 - 02/28/17		< 0.5
02/28/17 - 03/28/17		< 0.4
03/28/17 - 05/01/17		< 0.5
05/01/17 - 05/31/17		< 0.8
05/31/17 - 06/26/17		< 0.6
06/26/17 - 08/01/17		< 0.5
08/01/17 - 08/29/17		< 0.3
08/29/17 - 10/03/17		< 0.4
10/03/17 - 10/31/17		< 0.5
10/31/17 - 11/28/17		< 0.8
11/28/17 - 01/02/18		< 0.6
12/12/17 - 12/19/17	1.8 ± 0.4	< 0.6
12/13/17 - 12/13/17		< 0.5
MEAN ± 2 STD DEV	1.8 ± 0	-

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-I.3 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
13B1	12/27/16 - 01/30/17	< 7	< 7	< 13	< 7	< 14	< 6	< 9	< 6	< 6	< 7	< 22	< 9
	01/30/17 - 02/28/17	< 7	< 9	< 18	< 8	< 23	< 9	< 15	< 9	< 8	< 9	< 28	< 8
	02/28/17 - 03/28/17	< 5	< 4	< 9	< 5	< 10	< 5	< 7	< 6	< 5	< 5	< 17	< 6
	03/28/17 - 05/01/17	< 7	< 6	< 14	< 8	< 12	< 7	< 12	< 10	< 6	< 8	< 24	< 9
	05/01/17 - 05/31/17	< 8	< 7	< 15	< 7	< 16	< 8	< 11	< 13	< 10	< 8	< 32	< 10
	05/31/17 - 06/26/17	< 9	< 8	< 18	< 8	< 21	< 8	< 16	< 10	< 8	< 10	< 36	< 14
	06/26/17 - 08/01/17	< 8	< 9	< 19	< 10	< 16	< 9	< 16	< 10	< 9	< 7	< 40	< 11
	08/01/17 - 08/29/17	< 8	< 5	< 13	< 8	< 13	< 7	< 11	< 12	< 6	< 7	< 33	< 14
	08/29/17 - 10/03/17	< 7	< 7	< 16	< 8	< 13	< 7	< 12	< 14	< 5	< 7	< 36	< 9
	10/03/17 - 10/31/17	< 8	< 7	< 17	< 8	< 16	< 9	< 11	< 9	< 7	< 7	< 30	< 11
	10/31/17 - 11/28/17	< 8	< 6	< 9	< 5	< 16	< 6	< 8	< 6	< 5	< 7	< 26	< 4
	11/28/17 - 01/02/18	< 9	< 10	< 18	< 12	< 19	< 11	< 15	< 10	< 9	< 12	< 34	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
24S1	12/27/16 - 01/30/17	< 4	< 4	< 9	< 5	< 8	< 5	< 8	< 5	< 4	< 5	< 15	< 6
	01/30/17 - 02/28/17	< 8	< 6	< 15	< 8	< 16	< 7	< 10	< 8	< 7	< 7	< 25	< 7
	02/28/17 - 03/28/17	< 6	< 6	< 11	< 7	< 12	< 6	< 9	< 7	< 5	< 6	< 17	< 7
	03/28/17 - 05/01/17	< 7	< 7	< 15	< 7	< 16	< 7	< 12	< 9	< 7	< 8	< 28	< 8
	05/01/17 - 05/31/17	< 9	< 7	< 18	< 8	< 14	< 9	< 16	< 14	< 8	< 8	< 36	< 11
	05/31/17 - 06/26/17	< 4	< 5	< 11	< 5	< 9	< 5	< 9	< 6	< 5	< 5	< 18	< 5
	06/26/17 - 08/01/17	< 9	< 8	< 16	< 8	< 17	< 9	< 17	< 11	< 10	< 10	< 33	< 10
	08/01/17 - 08/29/17	< 5	< 5	< 12	< 5	< 12	< 5	< 9	< 9	< 4	< 5	< 21	< 7
	08/29/17 - 10/03/17	< 8	< 8	< 16	< 8	< 15	< 7	< 14	< 15	< 7	< 7	< 37	< 10
	10/03/17 - 10/31/17	< 6	< 6	< 11	< 7	< 10	< 6	< 11	< 7	< 6	< 7	< 20	< 8
	10/31/17 - 11/28/17	< 6	< 6	< 16	< 8	< 10	< 6	< 13	< 8	< 6	< 9	< 27	< 9
	11/28/17 - 01/02/18	< 7	< 6	< 13	< 7	< 14	< 7	< 13	< 6	< 6	< 7	< 24	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-II.1 **CONCENTRATIONS OF GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/27/16 - 01/30/17	3.9 ± 1.6	3.0 ± 1.5	3.7 ± 1.6	3.2 ± 1.5
01/30/17 - 02/28/17	4.6 ± 1.8	2.4 ± 1.5	3.2 ± 1.6	3.8 ± 1.6
02/28/17 - 03/28/17	3.1 ± 1.8	< 2.6	< 2.7	< 2.6
03/28/17 - 05/01/17	3.5 ± 1.5	3.0 ± 1.4	2.4 ± 1.3	2.5 ± 1.3
05/01/17 - 05/31/17	3.5 ± 1.5	< 2.0	2.1 ± 1.4	< 2.0
05/31/17 - 06/26/17	2.4 ± 1.6	< 2.2	< 2.3	< 2.2
06/26/17 - 08/01/17	5.1 ± 1.8	3.3 ± 1.5	2.8 ± 1.6	2.7 ± 1.5
08/01/17 - 08/29/17	3.7 ± 1.5	4.4 ± 1.5	2.2 ± 1.5	2.8 ± 1.4
08/29/17 - 10/03/17	4.9 ± 1.7	4.5 ± 1.7	3.0 ± 1.6	4.8 ± 1.7
10/03/17 - 10/31/17	5.1 ± 1.7	3.6 ± 1.7	4.6 ± 1.8	4.8 ± 1.7
10/31/17 - 11/28/17	4.3 ± 1.6	4.0 ± 1.5	3.5 ± 1.6	2.9 ± 1.5
11/28/17 - 01/02/18	4.3 ± 1.7	5.0 ± 1.8	2.4 ± 1.6	2.6 ± 1.6
MEAN ± 2 STD DEV	4.0 ± 1.7	3.7 ± 1.7	3.0 ± 1.6	3.3 ± 1.8

Table C-II.2 **CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/27/16 - 03/28/17	< 191	< 195	< 190	< 193
03/28/17 - 06/26/17	< 190	< 193	< 190	< 188
06/26/17 - 10/03/17	< 178	< 178	< 178	< 178
10/03/17 - 01/02/18	< 192	< 192	< 190	< 190
MEAN	-	-	-	-

Table C-II.3 **CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/27/16 - 01/30/17	< 0.7	< 0.6	< 0.8	< 0.7
01/30/17 - 02/28/17	< 0.5	< 0.7	< 0.7	< 0.5
02/28/17 - 03/28/17	< 0.3	< 0.3	< 0.4	< 0.4
03/28/17 - 05/01/17	< 0.5	< 0.6	< 0.5	< 0.4
05/01/17 - 05/31/17	< 0.7	< 0.7	< 0.7	< 0.7
05/31/17 - 06/26/17	< 0.7	< 0.6	< 0.7	< 0.7
06/26/17 - 08/01/17	< 0.6	< 0.5	< 0.5	< 0.4
08/01/17 - 08/29/17	< 0.4	< 0.6	< 0.5	< 0.3
08/29/17 - 10/03/17	< 0.7	< 0.8	< 0.4	< 0.4
10/03/17 - 10/31/17	< 0.5	< 0.6	< 0.5	< 0.5
10/31/17 - 11/28/17	< 0.7	< 0.6	< 0.6	< 0.8
11/28/17 - 01/02/18	< 0.6	< 0.7	< 0.6	< 0.8
MEAN	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-II.4 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
15F4	12/27/16 - 01/30/17	< 5	< 5	< 10	< 5	< 9	< 5	< 9	< 5	< 5	< 19	< 5
	01/30/17 - 02/28/17	< 7	< 5	< 13	< 7	< 14	< 7	< 13	< 6	< 8	< 27	< 8
	02/28/17 - 03/28/17	< 4	< 4	< 7	< 5	< 10	< 5	< 8	< 4	< 5	< 18	< 4
	03/28/17 - 05/01/17	< 7	< 7	< 14	< 6	< 13	< 5	< 11	< 6	< 7	< 23	< 7
	05/01/17 - 05/31/17	< 7	< 6	< 17	< 8	< 13	< 8	< 13	< 7	< 7	< 38	< 11
	05/31/17 - 06/26/17	< 6	< 7	< 12	< 8	< 12	< 7	< 13	< 7	< 6	< 22	< 9
	06/26/17 - 08/01/17	< 7	< 8	< 15	< 8	< 16	< 10	< 12	< 8	< 8	< 32	< 12
	08/01/17 - 08/29/17	< 7	< 5	< 14	< 8	< 8	< 6	< 12	< 6	< 6	< 30	< 6
	08/29/17 - 10/03/17	< 7	< 8	< 12	< 7	< 15	< 6	< 13	< 6	< 8	< 34	< 15
	10/03/17 - 10/31/17	< 7	< 7	< 13	< 5	< 18	< 7	< 13	< 7	< 7	< 30	< 11
	10/31/17 - 11/28/17	< 6	< 7	< 12	< 8	< 13	< 6	< 9	< 6	< 7	< 27	< 8
	11/28/17 - 01/02/18	< 7	< 6	< 11	< 9	< 18	< 7	< 11	< 6	< 9	< 30	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-
15F7	12/27/16 - 01/30/17	< 8	< 7	< 15	< 8	< 18	< 8	< 14	< 8	< 8	< 32	< 10
	01/30/17 - 02/28/17	< 7	< 6	< 14	< 8	< 17	< 7	< 13	< 7	< 7	< 29	< 7
	02/28/17 - 03/28/17	< 6	< 6	< 11	< 6	< 9	< 4	< 9	< 6	< 6	< 21	< 6
	03/28/17 - 05/01/17	< 6	< 8	< 10	< 8	< 17	< 7	< 13	< 8	< 9	< 27	< 11
	05/01/17 - 05/31/17	< 7	< 8	< 15	< 9	< 18	< 8	< 14	< 7	< 7	< 36	< 13
	05/31/17 - 06/26/17	< 8	< 7	< 23	< 10	< 14	< 7	< 15	< 8	< 10	< 28	< 10
	06/26/17 - 08/01/17	< 8	< 8	< 20	< 10	< 18	< 10	< 15	< 10	< 12	< 37	< 11
	08/01/17 - 08/29/17	< 7	< 6	< 13	< 7	< 15	< 8	< 13	< 7	< 8	< 36	< 11
	08/29/17 - 10/03/17	< 5	< 5	< 11	< 4	< 10	< 5	< 8	< 4	< 5	< 25	< 10
	10/03/17 - 10/31/17	< 7	< 7	< 16	< 9	< 15	< 9	< 10	< 10	< 10	< 32	< 6
	10/31/17 - 11/28/17	< 8	< 8	< 18	< 8	< 21	< 8	< 12	< 10	< 9	< 32	< 9
	11/28/17 - 01/02/18	< 4	< 5	< 7	< 6	< 10	< 5	< 9	< 5	< 6	< 18	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-II.4 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
16C2	12/27/16 - 01/30/17	< 6	< 6	< 9	< 5	< 11	< 5	< 9	< 5	< 6	< 23	< 6
	01/30/17 - 02/28/17	< 6	< 6	< 12	< 7	< 12	< 7	< 12	< 7	< 8	< 26	< 11
	02/28/17 - 03/28/17	< 5	< 4	< 10	< 5	< 11	< 5	< 9	< 5	< 5	< 20	< 8
	03/28/17 - 05/01/17	< 6	< 5	< 15	< 6	< 16	< 7	< 16	< 8	< 8	< 28	< 6
	05/01/17 - 05/31/17	< 7	< 6	< 13	< 7	< 16	< 6	< 10	< 6	< 7	< 29	< 7
	05/31/17 - 06/26/17	< 6	< 7	< 11	< 5	< 12	< 7	< 12	< 6	< 7	< 25	< 8
	06/26/17 - 08/01/17	< 9	< 7	< 18	< 10	< 20	< 8	< 17	< 11	< 9	< 34	< 12
	08/01/17 - 08/29/17	< 6	< 7	< 17	< 8	< 13	< 5	< 13	< 6	< 7	< 34	< 14
	08/29/17 - 10/03/17	< 7	< 6	< 14	< 5	< 14	< 6	< 12	< 7	< 6	< 34	< 10
	10/03/17 - 10/31/17	< 10	< 10	< 18	< 9	< 18	< 9	< 16	< 13	< 9	< 31	< 12
	10/31/17 - 11/28/17	< 6	< 7	< 15	< 8	< 15	< 8	< 12	< 8	< 7	< 28	< 9
	11/28/17 - 01/02/18	< 6	< 6	< 14	< 6	< 10	< 7	< 12	< 6	< 6	< 25	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-
28F3	12/27/16 - 01/30/17	< 5	< 5	< 9	< 5	< 10	< 4	< 7	< 4	< 5	< 20	< 5
	01/30/17 - 02/28/17	< 7	< 6	< 9	< 7	< 14	< 6	< 11	< 5	< 7	< 21	< 7
	02/28/17 - 03/28/17	< 6	< 7	< 13	< 7	< 13	< 7	< 14	< 6	< 7	< 26	< 10
	03/28/17 - 05/01/17	< 6	< 7	< 16	< 6	< 15	< 7	< 13	< 7	< 9	< 24	< 12
	05/01/17 - 05/31/17	< 8	< 8	< 16	< 8	< 14	< 10	< 13	< 7	< 7	< 35	< 13
	05/31/17 - 06/26/17	< 7	< 6	< 15	< 8	< 16	< 7	< 12	< 6	< 8	< 28	< 10
	06/26/17 - 08/01/17	< 8	< 9	< 19	< 10	< 18	< 8	< 13	< 9	< 10	< 33	< 12
	08/01/17 - 08/29/17	< 7	< 6	< 12	< 6	< 13	< 5	< 12	< 6	< 6	< 26	< 9
	08/29/17 - 10/03/17	< 7	< 8	< 14	< 8	< 11	< 7	< 13	< 6	< 7	< 31	< 12
	10/03/17 - 10/31/17	< 5	< 7	< 14	< 8	< 14	< 7	< 13	< 6	< 7	< 25	< 8
	10/31/17 - 11/28/17	< 7	< 8	< 12	< 8	< 15	< 8	< 14	< 7	< 10	< 30	< 5
	11/28/17 - 01/02/18	< 8	< 8	< 16	< 7	< 20	< 9	< 11	< 8	< 9	< 28	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1 **CONCENTRATIONS OF GAMMA EMITTERS IN PREDATOR AND BOTTOM FEEDER (FISH) SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	I-131	Cs-134	Cs-137
16C5	PREDATOR									
	06/08/17	3437 ± 765	< 40	< 41	< 88	< 55	< 123	< 67	< 51	< 48
	10/10/17	2736 ± 1032	< 77	< 65	< 128	< 68	< 193	< 114	< 64	< 72
	MEAN ± 2 STD DEV	3087 ± 991	-	-	-	-	-	-	-	-
16C5	BOTTOM FEEDER									
	06/08/17	3067 ± 1063	< 60	< 75	< 125	< 56	< 148	< 76	< 67	< 78
	10/10/17	3973 ± 1044	< 50	< 54	< 113	< 62	< 121	< 97	< 48	< 55
	MEAN ± 2 STD DEV	3520 ± 1281	-	-	-	-	-	-	-	-
29C1	PREDATOR									
	06/15/17	2691 ± 928	< 68	< 54	< 140	< 59	< 126	< 85	< 65	< 60
	10/11/17	3312 ± 1074	< 77	< 70	< 123	< 86	< 135	< 101	< 70	< 82
	MEAN ± 2 STD DEV	3002 ± 878	-	-	-	-	-	-	-	-
29C1	BOTTOM FEEDER									
	06/15/17	3482 ± 863	< 44	< 52	< 115	< 62	< 107	< 62	< 46	< 45
	10/11/17	3442 ± 745	< 62	< 53	< 126	< 65	< 135	< 91	< 67	< 62
	MEAN ± 2 STD DEV	3462 ± 57	-	-	-	-	-	-	-	-

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-IV.1 **CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/KG DRY ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	K-40	Mn-54	Co-58	Co-60	I-131	Cs-134	Cs-137
16B2	06/14/17	3561 ± 858	14490 ± 1924	< 106	< 66	< 108	< 93	< 64	120 ± 84
	12/06/17	1638 ± 810	15390 ± 2163	< 102	< 101	< 151	< 145	< 101	< 160
	MEAN ± 2 STD DEV	2600 ± 2720	14940 ± 1273	-	-	-	-	-	120 ± 0
16C4	06/14/17	2083 ± 817	11380 ± 1477	< 82	< 51	< 98	< 98	< 77	< 103
	12/06/17	1492 ± 786	15190 ± 2201	< 107	< 99	< 126	< 150	< 96	< 139
	MEAN ± 2 STD DEV	1788 ± 836	13285 ± 5388	-	-	-	-	-	-
33A2	06/14/17	< 882	10310 ± 1976	< 113	< 93	< 94	< 100	< 98	< 131
	12/06/17	< 951	8645 ± 1966	< 118	< 109	< 143	< 175	< 111	< 124
	MEAN ± 2 STD DEV	-	9478 ± 2355	-	-	-	-	-	-

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-V.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION	GROUP I				GROUP II		GROUP III
PERIOD	10S3	11S1	13S4	14S1	6C1	15D1	22G1
01/03/17 - 01/09/17	14 ± 6	9 ± 5	8 ± 3	11 ± 5	9 ± 5	12 ± 5	10 ± 5
01/09/17 - 01/17/17	17 ± 4	18 ± 5	11 ± 3	16 ± 4	17 ± 4	15 ± 4	18 ± 4
01/17/17 - 01/24/17	< 6	8 ± 5	12 ± 3	7 ± 4	< 6	10 ± 5	12 ± 5
01/24/17 - 01/30/17	13 ± 5	11 ± 5	9 ± 3	12 ± 5	14 ± 6	12 ± 5	16 ± 6
01/30/17 - 02/06/17	16 ± 5	15 ± 5	17 ± 3	17 ± 5	17 ± 5	22 ± 5	17 ± 5
02/06/17 - 02/13/17	22 ± 5	24 ± 5	19 ± 3	22 ± 5	21 ± 5	23 ± 5	25 ± 5
02/13/17 - 02/21/17	19 ± 5	21 ± 5	15 ± 3	18 ± 4	18 ± 4	18 ± 5	18 ± 5
02/21/17 - 02/27/17	15 ± 5	14 ± 5	13 ± 3	14 ± 5	14 ± 5	12 ± 5	15 ± 5
02/27/17 - 03/06/17	17 ± 5	16 ± 5	15 ± 3	15 ± 5	13 ± 5	13 ± 5	17 ± 5
03/06/17 - 03/13/17	12 ± 5	11 ± 5	10 ± 3	11 ± 5	18 ± 5	11 ± 5	12 ± 5
03/13/17 - 03/20/17	24 ± 5	13 ± 5	13 ± 3	16 ± 5	16 ± 5	19 ± 5	17 ± 5
03/20/17 - 03/27/17	19 ± 5	21 ± 5	16 ± 3	19 ± 5	19 ± 5	17 ± 5	22 ± 5
03/27/17 - 04/03/17	< 6	8 ± 4	8 ± 3	< 6	9 ± 4	8 ± 4	7 ± 4
04/03/17 - 04/10/17	8 ± 4	14 ± 5	7 ± 3	9 ± 4	11 ± 4	8 ± 4	10 ± 4
04/10/17 - 04/17/17	13 ± 5	13 ± 5	12 ± 3	12 ± 5	14 ± 5	12 ± 5	18 ± 5
04/17/17 - 04/24/17	13 ± 5	8 ± 4	6 ± 3	7 ± 4	9 ± 4	8 ± 4	11 ± 5
04/24/17 - 05/02/17	10 ± 4	10 ± 4	7 ± 2	10 ± 4	8 ± 4	10 ± 4	10 ± 4
05/02/17 - 05/08/17	7 ± 5	10 ± 5	8 ± 3	12 ± 5	12 ± 5	11 ± 5	8 ± 5
05/08/17 - 05/15/17	9 ± 4	11 ± 4	7 ± 2	12 ± 4	11 ± 4	14 ± 4	9 ± 4
05/15/17 - 05/22/17	12 ± 5	17 ± 5	11 ± 3	15 ± 5	13 ± 5	11 ± 5	9 ± 5
05/22/17 - 05/30/17	6 ± 4	6 ± 4	5 ± 3	< 6	9 ± 4	7 ± 4	7 ± 4
05/30/17 - 06/05/17	14 ± 5	16 ± 5	10 ± 3	11 ± 5	10 ± 5	15 ± 5	15 ± 5
06/05/17 - 06/12/17	*(1)*	10 ± 5	12 ± 3	11 ± 5	14 ± 5	10 ± 5	11 ± 5
06/12/17 - 06/19/17	13 ± 4	19 ± 5	15 ± 3	19 ± 5	17 ± 5	15 ± 4	14 ± 4
06/19/17 - 06/27/17	12 ± 4	17 ± 4	15 ± 5	15 ± 4	16 ± 4	20 ± 5	13 ± 4
06/27/17 - 07/03/17	14 ± 5	15 ± 5	*(1)*	16 ± 6	19 ± 6	22 ± 6	20 ± 5
07/03/17 - 07/11/17	11 ± 4	15 ± 4	14 ± 4	15 ± 4	12 ± 4	14 ± 4	17 ± 4
07/11/17 - 07/17/17	17 ± 6	19 ± 6	16 ± 4	15 ± 6	15 ± 6	14 ± 6	19 ± 6
07/17/17 - 07/24/17	20 ± 5	12 ± 5	14 ± 3	18 ± 5	21 ± 5	17 ± 5	20 ± 5
07/24/17 - 07/31/17	9 ± 4	8 ± 4	6 ± 3	8 ± 4	*(1)*	10 ± 4	7 ± 4
07/31/17 - 08/08/17	13 ± 4	11 ± 4	18 ± 5	16 ± 4	9 ± 4	11 ± 4	17 ± 4
08/08/17 - 08/14/17	22 ± 6	15 ± 7	17 ± 4	18 ± 6	16 ± 5	16 ± 5	17 ± 5
08/14/17 - 08/22/17	23 ± 5	18 ± 4	18 ± 3	20 ± 5	16 ± 4	23 ± 5	20 ± 4
08/22/17 - 08/28/17	9 ± 5	11 ± 5	12 ± 4	14 ± 6	10 ± 5	10 ± 5	15 ± 5
08/28/17 - 09/05/17	11 ± 4	14 ± 4	12 ± 3	13 ± 4	15 ± 4	15 ± 4	15 ± 4
09/05/17 - 09/11/17	9 ± 5	10 ± 5	10 ± 3	11 ± 5	13 ± 5	11 ± 5	10 ± 5
09/11/17 - 09/19/17	15 ± 4	19 ± 5	19 ± 3	18 ± 5	20 ± 5	18 ± 4	20 ± 4
09/19/17 - 09/25/17	26 ± 6	26 ± 6	20 ± 4	25 ± 6	23 ± 5	29 ± 6	24 ± 5
09/25/17 - 10/02/17	10 ± 4	11 ± 4	13 ± 3	19 ± 5	14 ± 5	13 ± 5	11 ± 4
10/02/17 - 10/10/17	12 ± 4	16 ± 4	13 ± 3	14 ± 4	14 ± 4	14 ± 4	13 ± 4
10/10/17 - 10/16/17	11 ± 5	8 ± 5	10 ± 4	10 ± 5	11 ± 5	15 ± 5	7 ± 4
10/16/17 - 10/23/17	22 ± 5	20 ± 5	17 ± 4	27 ± 6	20 ± 5	24 ± 5	21 ± 5
10/23/17 - 10/30/17	12 ± 5	15 ± 5	13 ± 3	15 ± 5	15 ± 5	15 ± 5	12 ± 4
10/30/17 - 11/06/17	14 ± 5	13 ± 5	10 ± 3	12 ± 5	15 ± 5	12 ± 4	16 ± 4
11/06/17 - 11/13/17	16 ± 4	15 ± 4	15 ± 3	19 ± 5	17 ± 4	14 ± 4	15 ± 4
11/13/17 - 11/20/17	16 ± 5	15 ± 5	12 ± 3	15 ± 5	13 ± 5	12 ± 5	14 ± 5
11/20/17 - 11/27/17	23 ± 5	20 ± 5	19 ± 4	24 ± 5	24 ± 5	18 ± 5	29 ± 5
11/27/17 - 12/04/17	22 ± 5	16 ± 5	17 ± 4	19 ± 5	22 ± 5	23 ± 6	22 ± 5
12/04/17 - 12/11/17	29 ± 5	19 ± 5	20 ± 4	28 ± 5	24 ± 5	22 ± 5	23 ± 5
12/11/17 - 12/18/17	12 ± 4	12 ± 4	10 ± 3	15 ± 5	13 ± 4	11 ± 4	15 ± 4
12/18/17 - 12/26/17	16 ± 4	15 ± 4	14 ± 3	15 ± 4	9 ± 4	16 ± 4	17 ± 4
12/26/17 - 01/02/18	14 ± 5	15 ± 5	13 ± 3	13 ± 5	12 ± 5	14 ± 5	11 ± 4
MEAN ± 2 STD DEV	15 ± 10	14 ± 9	13 ± 8	15 ± 9	15 ± 8	15 ± 9.6	15 ± 10

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-V.2

MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

GROUP I - ON-SITE LOCATIONS				GROUP II - INTERMEDIATE DISTANCE LOCATIONS				GROUP III - CONTROL LOCATIONS			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
01/03/17 - 01/30/17	7	18	12 ± 7	01/03/17 - 01/30/17	9	17	13 ± 6	01/03/17 - 01/30/17	10	18	14 ± 7
01/30/17 - 02/27/17	13	24	18 ± 7	01/30/17 - 02/27/17	12	23	18 ± 8	01/30/17 - 02/27/17	15	25	19 ± 8
02/27/17 - 04/03/17	8	24	15 ± 9	02/27/17 - 04/03/17	8	19	14 ± 8	02/27/17 - 04/03/17	7	22	15 ± 11
04/03/17 - 05/02/17	6	14	10 ± 5	04/03/17 - 05/02/17	8	14	10 ± 5	04/03/17 - 05/02/17	10	18	12 ± 7
05/02/17 - 05/30/17	5	17	10 ± 7	05/02/17 - 05/30/17	7	14	11 ± 5	05/02/17 - 05/30/17	7	9	8 ± 2
05/30/17 - 07/03/17	10	19	14 ± 5	05/30/17 - 07/03/17	10	22	16 ± 8	05/30/17 - 07/03/17	11	20	14 ± 7
07/03/17 - 07/31/17	6	20	14 ± 8	07/03/17 - 07/31/17	10	21	15 ± 7	07/03/17 - 07/31/17	7	20	16 ± 11
07/31/17 - 08/28/17	9	23	16 ± 8	07/31/17 - 08/28/17	9	23	14 ± 10	07/31/17 - 08/28/17	15	20	17 ± 4
08/28/17 - 10/02/17	9	26	16 ± 11	08/28/17 - 10/02/17	11	29	17 ± 11	08/28/17 - 10/02/17	10	24	16 ± 12
10/02/17 - 10/30/17	8	27	15 ± 10	10/02/17 - 10/30/17	11	24	16 ± 8	10/02/17 - 10/30/17	7	21	13 ± 12
10/30/17 - 12/04/17	10	24	17 ± 7	10/30/17 - 12/04/17	12	24	17 ± 9	10/30/17 - 12/04/17	14	29	19 ± 13
12/04/17 - 01/02/18	10	29	16 ± 11	12/04/17 - 01/02/18	9	24	15 ± 11	12/04/17 - 01/02/18	11	23	17 ± 10
01/03/17 - 01/02/18	5	29	14 ± 9	01/03/17 - 01/02/18	7	29	15 ± 9	01/03/17 - 01/02/18	7	29	15 ± 10

Table C-V.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	Mn-54	Co-58	Co-60	Cs-134	Cs-137
10S3	01/03/17 - 04/03/17	55 ± 20	< 3	< 2	< 3	< 2	< 2
	04/03/17 - 07/03/17	69 ± 22	< 3	< 3	< 3	< 2	< 2
	07/03/17 - 10/02/17	63 ± 18	< 3	< 3	< 3	< 3	< 2
	10/02/17 - 01/02/18	64 ± 16	< 3	< 3	< 3	< 3	< 3
	MEAN ± 2 STD DEV	63 ± 12	-	-	-	-	-
11S1	01/03/17 - 04/03/17	68 ± 25	< 4	< 2	< 3	< 2	< 2
	04/03/17 - 07/03/17	73 ± 27	< 4	< 4	< 4	< 4	< 4
	07/03/17 - 10/02/17	83 ± 40	< 3	< 5	< 4	< 4	< 4
	10/02/17 - 01/02/18	58 ± 15	< 2	< 2	< 2	< 2	< 2
	MEAN ± 2 STD DEV	71 ± 21	-	-	-	-	-
13S4	01/03/17 - 04/03/17	69 ± 17	< 2	< 2	< 2	< 2	< 2
	04/03/17 - 06/27/17	78 ± 17	< 2	< 2	< 1	< 2	< 1
	07/06/17 - 10/02/17	62 ± 16	< 2	< 2	< 2	< 1	< 2
	10/02/17 - 01/02/18	46 ± 12	< 2	< 2	< 1	< 2	< 1
	MEAN ± 2 STD DEV	64 ± 27	-	-	-	-	-
14S1	01/03/17 - 04/03/17	84 ± 31	< 4	< 3	< 3	< 4	< 4
	04/03/17 - 07/03/17	75 ± 19	< 3	< 2	< 2	< 2	< 2
	07/03/17 - 10/02/17	68 ± 24	< 2	< 3	< 3	< 3	< 2
	10/02/17 - 01/02/18	72 ± 21	< 3	< 3	< 2	< 3	< 2
	MEAN ± 2 STD DEV	75 ± 13	-	-	-	-	-
15D1	01/03/17 - 04/03/17	75 ± 19	< 3	< 3	< 2	< 2	< 2
	04/03/17 - 07/03/17	81 ± 22	< 2	< 3	< 3	< 3	< 3
	07/03/17 - 10/02/17	76 ± 23	< 3	< 3	< 1	< 3	< 3
	10/02/17 - 01/02/18	50 ± 17	< 3	< 3	< 2	< 2	< 2
	MEAN ± 2 STD DEV	70 ± 28	-	-	-	-	-
22G1	01/03/17 - 04/03/17	77 ± 32	< 3	< 3	< 2	< 3	< 3
	04/03/17 - 07/03/17	81 ± 16	< 3	< 3	< 4	< 3	< 3
	07/03/17 - 10/02/17	66 ± 31	< 4	< 4	< 3	< 3	< 3
	10/02/17 - 01/02/18	56 ± 25	< 3	< 4	< 5	< 3	< 4
	MEAN ± 2 STD DEV	70 ± 23	-	-	-	-	-
6C1	01/03/17 - 04/03/17	52 ± 31	< 4	< 4	< 4	< 4	< 4
	04/03/17 - 07/03/17	77 ± 26	< 3	< 3	< 4	< 4	< 4
	07/03/17 - 10/02/17	105 ± 27	< 2	< 3	< 3	< 2	< 3
	10/02/17 - 01/02/18	74 ± 20	< 2	< 3	< 2	< 3	< 2
	MEAN ± 2 STD DEV	77 ± 44	-	-	-	-	-

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-VI.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF E-3 PCI/CU METER + 2 SIGMA

COLLECTION	GROUP I				GROUP II		GROUP III
PERIOD	10S3	11S1	13S4	14S1	6C1	15D1	22G1
01/03/17 - 01/09/17	< 28	< 28	< 20	< 32	< 28	< 33	< 33
01/09/17 - 01/17/17	< 23	< 23	< 15	< 23	< 23	< 26	< 26
01/17/17 - 01/24/17	< 36	< 36	< 22	< 36	< 36	< 38	< 38
01/24/17 - 01/30/17	< 47	< 47	< 24	< 47	< 46	< 40	< 39
01/30/17 - 02/06/17	< 40	< 40	< 25	< 42	< 40	< 43	< 43
02/06/17 - 02/13/17	< 33	< 33	< 9	< 33	< 14	< 38	< 37
02/13/17 - 02/21/17	< 22	< 22	< 17	< 22	< 22	< 28	< 28
02/21/17 - 02/27/17	< 47	< 47	< 10	< 44	< 46	< 44	< 42
02/27/17 - 03/06/17	< 30	< 30	< 10	< 30	< 12	< 44	< 44
03/06/17 - 03/13/17	< 36	< 36	< 20	< 36	< 35	< 35	< 33
03/13/17 - 03/20/17	< 29	< 29	< 29	< 47	< 29	< 47	< 48
03/20/17 - 03/27/17	< 43	< 44	< 15	< 44	< 43	< 49	< 46
03/27/17 - 04/03/17	< 32	< 33	< 15	< 32	< 32	< 26	< 26
04/03/17 - 04/10/17	< 23	< 23	< 12	< 23	< 22	< 20	< 19
04/10/17 - 04/17/17	< 35	< 35	< 19	< 31	< 34	< 31	< 31
04/17/17 - 04/24/17	< 40	< 40	< 10	< 40	< 39	< 37	< 36
04/24/17 - 05/02/17	< 31	< 31	< 18	< 29	< 31	< 29	< 28
05/02/17 - 05/08/17	< 40	< 40	< 9	< 38	< 40	< 39	< 41
05/08/17 - 05/15/17	< 39	< 39	< 7	< 28	< 38	< 29	< 29
05/15/17 - 05/22/17	< 59	< 59	< 14	< 59	< 58	< 58	< 57
05/22/17 - 05/30/17	< 34	< 34	< 26	< 41	< 34	< 42	< 40
05/30/17 - 06/05/17	< 38	< 38	< 19	< 29	< 37	< 30	< 30
06/05/17 - 06/12/17	*(1)*	< 24	< 6	< 24	< 23	< 24	< 24
06/12/17 - 06/19/17	< 41	< 40	< 14	< 41	< 40	< 41	< 38
06/19/17 - 06/27/17	< 20	< 20	< 26	< 20	< 20	< 23	< 21
06/27/17 - 07/03/17	< 40	< 40	*(1)*	< 40	< 15	< 40	< 38
07/03/17 - 07/11/17	< 20	< 20	< 19	< 20	< 20	< 19	< 17
07/11/17 - 07/17/17	< 46	< 46	< 17	< 47	< 46	< 61	< 58
07/17/17 - 07/24/17	< 35	< 36	< 19	< 36	< 35	< 31	< 29
07/24/17 - 07/31/17	< 29	< 12	< 19	< 30	*(1)*	< 30	< 27
07/31/17 - 08/08/17	< 35	< 36	< 9	< 22	< 35	< 22	< 19
08/08/17 - 08/14/17	< 18	< 63	< 12	< 42	< 42	< 41	< 40
08/14/17 - 08/22/17	< 30	< 30	< 11	< 39	< 30	< 38	< 34
08/22/17 - 08/28/17	< 39	< 40	< 19	< 31	< 39	< 30	< 29
08/28/17 - 09/05/17	< 25	< 25	< 7	< 26	< 25	< 31	< 29
09/05/17 - 09/11/17	< 45	< 45	< 20	< 46	< 45	< 32	< 30
09/11/17 - 09/19/17	< 35	< 35	< 10	< 36	< 35	< 27	< 25
09/19/17 - 09/25/17	< 36	< 36	< 22	< 34	< 36	< 34	< 32
09/25/17 - 10/02/17	< 34	< 34	< 19	< 30	< 34	< 29	< 27
10/02/17 - 10/10/17	< 30	< 30	< 11	< 31	< 30	< 20	< 18
10/10/17 - 10/16/17	< 34	< 35	< 16	< 29	< 34	< 29	< 27
10/16/17 - 10/23/17	< 40	< 40	< 20	< 31	< 40	< 31	< 28
10/23/17 - 10/30/17	< 49	< 50	< 27	< 41	< 49	< 41	< 39
10/30/17 - 11/06/17	< 41	< 42	< 24	< 37	< 41	< 36	< 34
11/06/17 - 11/13/17	< 35	< 35	< 18	< 27	< 35	< 27	< 25
11/13/17 - 11/20/17	< 40	< 40	< 16	< 46	< 40	< 46	< 43
11/20/17 - 11/27/17	< 36	< 37	< 9	< 39	< 36	< 38	< 36
11/27/17 - 12/04/17	< 32	< 33	< 14	< 21	< 32	< 20	< 19
12/04/17 - 12/11/17	< 40	< 41	< 12	< 20	< 40	< 20	< 19
12/11/17 - 12/18/17	< 32	< 33	< 27	< 45	< 32	< 44	< 41
12/18/17 - 12/26/17	< 37	< 38	< 23	< 38	< 37	< 38	< 35
12/26/17 - 01/02/18	< 40	< 41	< 11	< 21	< 40	< 21	< 19
MEAN	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.1 **CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION	CONTROL FARM		INDICATOR FARM		
PERIOD	23F1	36E1	18E1	19B1	25C1
01/10/17	< 0.7	< 0.7	< 0.8	< 0.6	< 0.7
02/07/17	< 0.3		< 0.4	< 0.3	< 0.4
03/07/17	< 0.9		< 0.9	< 0.8	< 0.5
04/04/17	< 0.7	< 0.7	< 0.9	< 0.8	< 0.8
04/18/17	< 0.9		< 0.8	< 0.6	< 0.6
05/02/17	< 0.5		< 0.8	< 0.8	< 1.0
05/16/17	< 0.9		< 0.9	< 0.9	< 0.9
05/30/17	< 0.4		< 0.4	< 0.3	< 0.3
06/13/17	< 0.8		< 0.7	< 0.5	< 0.5
06/27/17	< 0.6		< 0.7	< 0.6	< 0.6
07/11/17	< 0.5	< 0.7	< 0.7	< 0.5	< 0.6
07/25/17	< 0.7		< 0.5	< 0.7	< 0.6
08/08/17	< 0.8		< 0.8	< 0.8	< 0.8
08/22/17	< 0.5		< 0.4	< 0.4	< 0.7
09/05/17	< 0.7		< 0.7	< 0.7	< 1.0
09/19/17	< 0.5		< 0.5	< 0.8	< 1.0
10/03/17	< 0.6	< 0.7	< 0.4	< 0.3	< 0.6
10/17/17	< 0.4		< 0.3	< 0.6	< 0.4
10/31/17	< 0.6		*(1)*	< 0.8	< 0.5
11/14/17	< 0.6		*(1)*	< 0.8	< 0.8
11/28/17	< 0.7		*(1)*	< 0.5	< 0.5
12/12/17	< 0.4		*(1)*	< 0.8	< 0.8
MEAN	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
18E1	01/10/17	1034 ± 189	< 9	< 9	< 29	< 11
	02/07/17	1276 ± 187	< 6	< 5	< 31	< 8
	03/07/17	1307 ± 215	< 11	< 10	< 40	< 10
	04/04/17	1344 ± 228	< 13	< 13	< 43	< 10
	04/18/17	1137 ± 135	< 7	< 6	< 21	< 9
	05/02/17	1054 ± 182	< 7	< 8	< 30	< 9
	05/16/17	1296 ± 128	< 5	< 5	< 14	< 7
	05/30/17	1282 ± 173	< 7	< 8	< 32	< 11
	06/13/17	1130 ± 160	< 15	< 12	< 40	< 11
	06/27/17	1338 ± 170	< 10	< 10	< 40	< 12
	07/11/17	1285 ± 146	< 5	< 7	< 34	< 9
	07/25/17	1021 ± 195	< 8	< 9	< 35	< 10
	08/08/17	1272 ± 158	< 6	< 7	< 27	< 7
	08/22/17	1105 ± 201	< 9	< 9	< 44	< 9
	09/05/17	1079 ± 139	< 6	< 6	< 23	< 9
	09/19/17	1231 ± 143	< 5	< 6	< 30	< 9
	10/03/17	1376 ± 156	< 5	< 7	< 32	< 8
	10/17/17	1377 ± 188	< 6	< 7	< 27	< 7
	MEAN ± 2 STD DEV	1219 ± 245	-	-	-	-
19B1	01/10/17	1324 ± 153	< 6	< 7	< 20	< 7
	02/07/17	1159 ± 150	< 5	< 7	< 24	< 6
	03/07/17	1190 ± 216	< 10	< 10	< 34	< 13
	04/04/17	1118 ± 172	< 9	< 9	< 31	< 9
	04/18/17	1328 ± 118	< 5	< 5	< 19	< 5
	05/02/17	1117 ± 188	< 7	< 9	< 29	< 8
	05/16/17	1145 ± 183	< 7	< 11	< 39	< 12
	05/30/17	1161 ± 218	< 9	< 9	< 46	< 15
	06/13/17	1201 ± 183	< 11	< 9	< 42	< 14
	06/27/17	1047 ± 202	< 9	< 11	< 34	< 9
	07/11/17	1171 ± 190	< 7	< 7	< 41	< 12
	07/25/17	1351 ± 168	< 10	< 8	< 33	< 10
	08/08/17	1249 ± 185	< 6	< 8	< 22	< 9
	08/22/17	1280 ± 155	< 10	< 10	< 49	< 13
	09/05/17	1366 ± 197	< 8	< 10	< 28	< 7
	09/19/17	1140 ± 151	< 6	< 6	< 32	< 10
	10/03/17	1175 ± 189	< 7	< 9	< 42	< 8
	10/17/17	1214 ± 199	< 9	< 9	< 33	< 8
	10/31/17	1100 ± 153	< 6	< 7	< 26	< 7
	11/14/17	1502 ± 153	< 6	< 6	< 23	< 6
	11/28/17	1154 ± 161	< 8	< 9	< 26	< 5
	12/12/17	1270 ± 173	< 8	< 10	< 26	< 9
	MEAN ± 2 STD DEV	1216 ± 215	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
23F1	01/10/17	1347 ± 161	< 8	< 10	< 31	< 9
	02/07/17	1327 ± 208	< 8	< 8	< 36	< 9
	03/07/17	1200 ± 175	< 8	< 8	< 36	< 10
	04/04/17	1456 ± 182	< 7	< 8	< 28	< 10
	04/18/17	1224 ± 125	< 8	< 8	< 28	< 8
	05/02/17	1268 ± 171	< 7	< 9	< 29	< 11
	05/16/17	1304 ± 158	< 5	< 6	< 23	< 7
	05/30/17	1361 ± 199	< 6	< 8	< 36	< 11
	06/13/17	1206 ± 198	< 9	< 11	< 35	< 10
	06/27/17	1274 ± 186	< 10	< 10	< 33	< 12
	07/11/17	1212 ± 166	< 7	< 7	< 34	< 9
	07/25/17	1391 ± 212	< 8	< 10	< 31	< 8
	08/08/17	1234 ± 184	< 6	< 7	< 25	< 10
	08/22/17	1370 ± 157	< 7	< 7	< 29	< 11
	09/05/17	1209 ± 177	< 7	< 8	< 22	< 9
	09/19/17	1308 ± 174	< 7	< 8	< 36	< 9
	10/03/17	1299 ± 193	< 7	< 8	< 39	< 9
	10/17/17	1202 ± 174	< 8	< 8	< 33	< 8
	10/31/17	1444 ± 191	< 7	< 8	< 27	< 7
	11/14/17	1239 ± 156	< 5	< 6	< 18	< 8
	11/28/17	1266 ± 154	< 6	< 8	< 25	< 9
	12/12/17	1203 ± 158	< 8	< 10	< 32	< 8
	MEAN ± 2 STD DEV	1288 ± 159	-	-	-	-
25C1	01/10/17	1328 ± 185	< 7	< 9	< 29	< 10
	02/07/17	1213 ± 183	< 7	< 8	< 30	< 8
	03/07/17	1342 ± 169	< 10	< 9	< 32	< 6
	04/04/17	1211 ± 142	< 10	< 10	< 30	< 8
	04/18/17	1250 ± 138	< 4	< 5	< 20	< 4
	05/02/17	1363 ± 181	< 7	< 9	< 31	< 9
	05/16/17	1283 ± 158	< 6	< 7	< 28	< 7
	05/30/17	1360 ± 185	< 8	< 10	< 50	< 14
	06/13/17	1462 ± 230	< 8	< 11	< 38	< 9
	06/27/17	1430 ± 215	< 9	< 11	< 35	< 10
	07/11/17	1509 ± 171	< 11	< 11	< 49	< 15
	07/25/17	1233 ± 186	< 10	< 9	< 37	< 11
	08/08/17	1173 ± 199	< 9	< 9	< 31	< 11
	08/22/17	1235 ± 193	< 8	< 9	< 34	< 12
	09/05/17	1205 ± 221	< 9	< 11	< 31	< 12
	09/19/17	1162 ± 203	< 8	< 8	< 42	< 11
	10/03/17	1274 ± 171	< 6	< 8	< 33	< 8
	10/17/17	1297 ± 174	< 9	< 9	< 24	< 9
	10/31/17	1282 ± 155	< 11	< 10	< 36	< 8
	11/14/17	1096 ± 140	< 5	< 6	< 25	< 6
	11/28/17	1204 ± 170	< 6	< 8	< 22	< 7
	12/12/17	1332 ± 196	< 8	< 9	< 29	< 9
	MEAN ± 2 STD DEV	1284 ± 202	-	-	-	-
36E1	01/10/17	956 ± 172	< 8	< 9	< 27	< 8
	04/04/17	1050 ± 182	< 8	< 9	< 31	< 9
	07/13/17	1101 ± 194	< 9	< 11	< 47	< 13
	10/03/17	1287 ± 111	< 7	< 8	< 34	< 8
	MEAN ± 2 STD DEV	1098 ± 279	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

TABLE C-VIII.1

CONCENTRATIONS OF GAMMA EMITTERS IN BROAD LEAFY VEGETATION SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD		Be-7	K-40	Mn-54	Co-58	Co-60	I-131	Cs-134	Cs-137	Ra-226	Th-228	Th-232
11S3	06/26/17	Cabbage	< 278	1898 ± 596	< 39	< 41	< 48	< 35	< 33	< 40	< 746	< 61	< 162
	06/26/17	Collards	< 226	4206 ± 688	< 28	< 26	< 41	< 28	< 27	< 29	< 689	163 ± 51	< 117
	06/26/17	Swiss Chard	< 359	6867 ± 885	< 30	< 31	< 47	< 33	< 24	< 28	< 756	74 ± 61	< 136
	07/20/17	Cabbage	< 336	1503 ± 508	< 41	< 43	< 45	< 55	< 42	< 41	< 999	< 72	< 174
	07/20/17	Collards	< 319	3590 ± 532	< 33	< 31	< 41	< 49	< 36	< 37	< 877	< 65	< 141
	07/20/17	Swiss Chard	< 336	7293 ± 887	< 28	< 32	< 47	< 38	< 29	< 31	< 683	< 51	< 124
	08/24/17	Cabbage	< 227	2907 ± 581	< 28	< 29	< 31	< 42	< 25	< 32	< 709	< 57	< 93
	08/24/17	Collards	< 333	3287 ± 527	< 36	< 32	< 36	< 49	< 35	< 37	< 829	< 63	< 122
	08/24/17	Swiss Chard	380 ± 218	4862 ± 632	< 30	< 30	< 32	< 39	< 31	< 34	< 646	< 47	< 115
	09/26/17	Swiss Chard	< 269	7356 ± 718	< 30	< 29	< 42	< 50	< 28	< 31	< 740	< 58	< 114
	10/31/17	Swiss Chard	577 ± 156	7176 ± 498	< 17	< 18	< 23	< 18	< 17	< 17	< 401	38 ± 25	< 74
		MEAN ± 2 STD DEV	479 ± 278	4631 ± 4442	-	-	-	-	-	-	-	92 ± 129	-
13S3	06/26/17	Cabbage	< 234	5733 ± 641	< 22	< 23	< 26	< 27	< 23	< 20	1991 ± 566	101 ± 39	< 95
	06/26/17	Collards	< 263	3931 ± 673	< 24	< 25	< 33	< 25	< 22	< 29	< 645	144 ± 43	< 128
	06/26/17	Swiss Chard	< 263	5097 ± 567	< 21	< 21	< 27	< 23	< 21	< 24	< 665	65 ± 35	< 85
	07/20/17	Cabbage	< 294	1219 ± 574	< 31	< 31	< 36	< 39	< 27	< 37	< 713	< 58	< 145
	07/20/17	Collards	< 274	2701 ± 507	< 29	< 29	< 38	< 34	< 27	< 24	< 691	< 54	< 95
	07/20/17	Swiss Chard	328 ± 248	5224 ± 685	< 36	< 30	< 31	< 38	< 31	< 36	1213 ± 806	< 57	< 141
	08/24/17	Swiss Chard	< 239	4989 ± 660	< 25	< 34	< 35	< 47	< 31	< 29	1008 ± 658	< 61	< 124
	08/24/17	Wild Grape Leaves	874 ± 256	4852 ± 555	< 24	< 18	< 30	< 30	< 22	< 26	1792 ± 509	< 44	< 87
	09/26/17	Swiss Chard	< 287	4230 ± 674	< 33	< 32	< 36	< 56	< 31	< 33	1191 ± 685	< 53	< 123
	10/31/17	Swiss Chard	411 ± 113	5832 ± 378	< 14	< 12	< 18	< 16	< 14	< 15	1098 ± 352	52 ± 21	< 64
		MEAN ± 2 STD DEV	538 ± 588	4381 ± 2890	-	-	-	-	-	-	1382 ± 812	90 ± 83	-
31G1	06/26/17	Broccoli Leaves	491 ± 228	4291 ± 606	< 19	< 27	< 32	< 23	< 20	< 28	< 646	148 ± 59	< 102
	06/26/17	Cabbage	< 229	2319 ± 486	< 25	< 23	< 32	< 28	< 28	< 30	< 742	55 ± 46	< 127
	06/26/17	Swiss Chard	583 ± 221	6607 ± 787	< 30	< 30	< 39	< 30	< 31	< 34	< 747	108 ± 52	< 139
	07/20/17	Cabbage	502 ± 215	3981 ± 629	< 27	< 21	< 33	< 34	< 23	< 23	< 529	< 44	< 116
	07/20/17	Kale	472 ± 306	5091 ± 600	< 33	< 34	< 40	< 44	< 38	< 35	< 864	< 63	< 140
	07/20/17	Swiss Chard	347 ± 221	4774 ± 723	< 27	< 26	< 30	< 34	< 26	< 29	< 651	< 50	< 109
	08/24/17	Kale	350 ± 212	5979 ± 772	< 27	< 29	< 39	< 38	< 22	< 30	< 554	< 49	< 108
	08/24/17	Squash Leaves	696 ± 264	4684 ± 715	< 39	< 30	< 42	< 41	< 32	< 35	< 618	< 51	< 136
	08/24/17	Swiss Chard	219 ± 180	4256 ± 558	< 26	< 21	< 30	< 29	< 20	< 24	< 479	< 33	< 98
	09/26/17	Red Beet Leaves	< 229	4048 ± 406	< 28	< 26	< 31	< 45	< 30	< 26	< 618	< 47	< 100
	09/26/17	Swiss Chard	< 221	5012 ± 416	< 27	< 23	< 29	< 44	< 30	< 28	< 627	< 47	< 98
		MEAN ± 2 STD DEV	458 ± 299	4640 ± 2233	-	-	-	-	-	-	-	104 ± 93	-

THE MEAN AND 2-STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-IX.1 **QUARTERLY DLR RESULTS FOR LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF MILLIROENTGEN/STANDARD MONTH ± 2 STANDARD DEVIATIONS

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
2E1	5.7 ± 0.5	5.9 ± 0.7	5.4 ± 0.0	5.9 ± 0.2	5.7 ± 0.4
3S1	5.5 ± 0.6	5.7 ± 0.5	5.2 ± 0.2	5.8 ± 0.0	5.4 ± 0.9
4E1	4.1 ± 0.4	4.3 ± 0.0	3.9 ± 0.3	4.2 ± 0.7	3.9 ± 0.8
5H1	7.0 ± 0.4	7.1 ± 0.5	6.7 ± 0.2	7.0 ± 0.8	7.1 ± 0.2
5S1	6.3 ± 0.6	6.4 ± 0.3	5.9 ± 0.2	6.6 ± 0.0	6.2 ± 1.4
6C1	5.7 ± 0.7	5.7 ± 0.5	5.3 ± 0.2	6.1 ± 0.6	5.5 ± 1.4
7E1	5.8 ± 0.6	6.1 ± 0.0	5.4 ± 0.5	5.9 ± 0.5	5.9 ± 0.2
7S1	5.7 ± 0.6	5.8 ± 0.5	5.2 ± 1.3	5.9 ± 0.3	5.8 ± 0.2
9C1	5.3 ± 0.2	5.4 ± 0.1	5.2 ± 0.3	5.4 ± 0.8	5.2 ± 0.4
10E1	5.6 ± 0.5	5.7 ± 0.6	5.3 ± 0.1	5.9 ± 0.6	5.6 ± 0.5
10F3	5.5 ± 0.6	5.5 ± 0.6	5.1 ± 0.0	5.8 ± 0.0	5.4 ± 0.3
10S3	5.6 ± 0.7	5.5 ± 0.2	5.1 ± 0.0	5.9 ± 0.3	5.7 ± 0.7
11S1	6.4 ± 0.4	6.3 ± 0.3	6.1 ± 0.4	6.5 ± 1.2	6.6 ± 0.3
13C1	3.9 ± 0.3	3.9 ± 0.3	3.7 ± 0.6	4.1 ± 0.3	3.8 ± 0.8
13E1	5.6 ± 0.4	5.6 ± 0.0	5.4 ± 0.2	5.9 ± 0.5	5.6 ± 0.1
13S2	8.0 ± 0.8	7.8 ± 1.1	7.5 ± 0.5	8.3 ± 0.0	8.3 ± 0.1
14S1	4.8 ± 0.6	4.7 ± 0.9	4.5 ± 0.1	5.2 ± 0.3	4.9 ± 0.6
15D1	5.8 ± 0.4	5.6 ± 0.5	5.6 ± 0.1	6.0 ± 0.7	5.9 ± 0.4
16F1	5.4 ± 0.7	5.3 ± 0.1	5.1 ± 0.1	5.9 ± 0.5	5.2 ± 0.7
17B1	5.3 ± 0.4	5.2 ± 0.7	5.0 ± 0.1	5.3 ± 0.1	5.5 ± 0.1
18S2	6.1 ± 0.3	6.1 ± 0.3	5.9 ± 0.2	6.2 ± 1.0	6.3 ± 0.4
19D1	5.0 ± 0.4	4.9 ± 1.4	4.8 ± 0.7	5.2 ± 0.4	5.1 ± 1.0
20D1	4.9 ± 0.5	4.9 ± 0.1	4.5 ± 0.0	5.1 ± 0.9	5.0 ± 0.8
20F1	5.3 ± 0.8	4.9 ± 2.0	4.9 ± 0.1	5.6 ± 1.2	5.6 ± 0.9
21S2	5.0 ± 0.8	4.6 ± 2.1	4.7 ± 0.1	5.2 ± 0.4	5.4 ± 0.9
23S2	5.1 ± 0.4	5.1 ± 0.3	4.8 ± 0.2	5.3 ± 0.1	5.2 ± 0.0
24D1	4.6 ± 0.4	4.9 ± 0.9	4.4 ± 0.5	4.6 ± 1.1	4.6 ± 0.1
25D1	4.4 ± 0.3	4.5 ± 0.4	4.2 ± 0.6	4.4 ± 0.1	4.5 ± 0.1
25S2	4.6 ± 0.8	4.8 ± 0.3	4.0 ± 0.3	4.9 ± 0.4	4.7 ± 0.9
26S3	4.8 ± 0.6	5.0 ± 0.2	4.4 ± 1.0	5.0 ± 0.1	4.9 ± 1.0
28D2	5.0 ± 0.4	4.9 ± 0.2	4.7 ± 0.4	5.1 ± 0.8	5.1 ± 1.6
29E1	5.1 ± 0.7	4.8 ± 1.7	4.7 ± 0.1	5.2 ± 0.5	5.5 ± 0.9
29S1	4.9 ± 0.5	4.9 ± 0.6	4.5 ± 0.1	5.1 ± 0.3	4.9 ± 0.5
31D1	6.8 ± 0.6	6.9 ± 0.7	6.4 ± 0.6	6.7 ± 1.2	7.1 ± 1.7
31D2	5.7 ± 0.7	6.0 ± 0.0	5.4 ± 1.2	6.0 ± 0.5	5.4 ± 1.0
31S1	5.8 ± 0.6	6.0 ± 0.1	5.4 ± 0.2	6.0 ± 1.0	5.6 ± 0.9
34E1	5.4 ± 0.3	5.5 ± 0.3	5.2 ± 0.1	5.5 ± 0.7	5.3 ± 0.3
34S2	5.4 ± 0.4	5.6 ± 0.5	5.2 ± 0.4	5.4 ± 0.5	5.2 ± 0.1
36D1	4.9 ± 0.5	5.1 ± 0.4	4.6 ± 0.6	5.0 ± 0.2	4.7 ± 0.1
36S2	5.7 ± 0.7	6.1 ± 1.0	5.4 ± 0.5	*(1)*	5.7 ± 0.2

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-IX.2 **MEAN QUARTERLY DLR RESULTS FOR THE SITE BOUNDARY, MIDDLE AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF MILLIROENTGEN/STANDARD MONTH
± 2 STANDARD DEVIATIONS OF THE STATION DATA

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	MIDDLE ± 2 S.D.	CONTROL ± 2 S.D.
JAN-MAR	5.7 ± 1.6	5.2 ± 1.3	7.1 ± 0
APR-JUN	5.2 ± 1.7	4.9 ± 1.2	6.7 ± 0
JUL-SEP	5.8 ± 1.7	5.4 ± 1.4	7.0 ± 0
OCT-DEC	5.7 ± 1.8	5.2 ± 1.4	7.1 ± 0

Table C-IX.3 **SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF MILLIROENTGEN/STANDARD MONTH
± 2 STANDARD DEVIATIONS OF THE STATION DATA

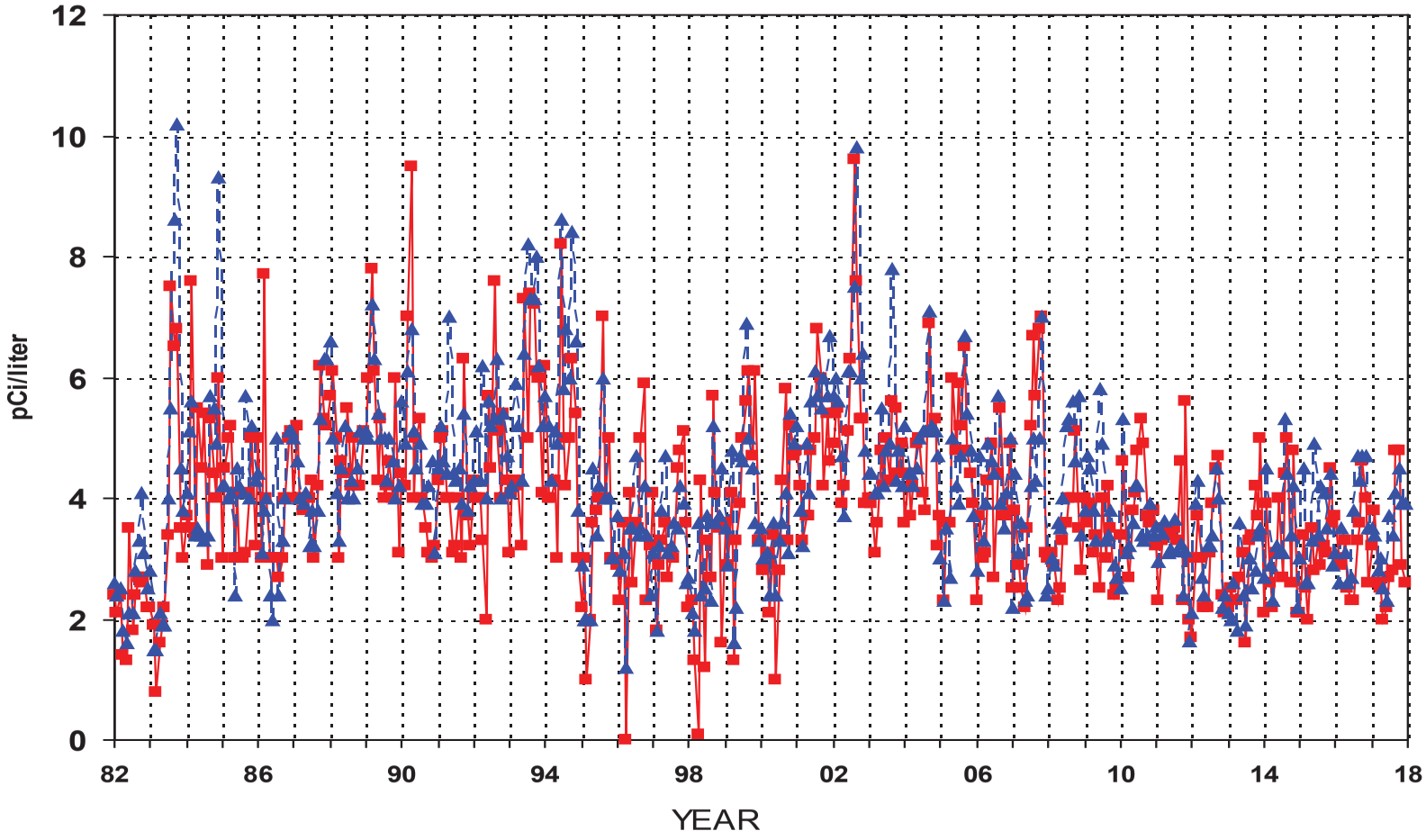
LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
SITE BOUNDARY	126	4	8.3	5.6 ± 1.7
MIDDLE	184	3.7	7.1	5.2 ± 1.3
CONTROL	8	6.7	7.1	7.0 ± 0.4

SITE BOUNDARY STATIONS - 10S3, 11S1, 13S2, 14S1, 18S2, 21S2, 23S2, 25S2, 26S3, 29S1, 31S1, 34S2, 36S2, 3S1, 5S1, 7S1

MIDDLE STATIONS - 10E1, 10F3, 13C1, 13E1, 15D1, 16F1, 17B1, 19D1, 20D1, 20F1, 24D1, 25D1 28D2, 29E1, 2E1, 31D1, 31D2, 34E1, 36D1, 4E1, 6C1, 7E1, 9C1

CONTROL STATIONS - 5H1

FIGURE C-1
MEAN MONTHLY TOTAL GROSS BETA CONCENTRATIONS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 - 2017



Note: 2005 analysis changed from Insoluble & Soluble to Total Gross Beta

LGS CRITICALITY
UNIT NO. 1: 12/22/84
UNIT NO. 2: 08/11/89

LGS CHANGED TO TOTAL GROSS BETA AT THE BEGINNING OF 2005.
PREVIOUS DATA INCLUDED SUMMATION OF LESS THAN VALUES.

FIGURE C-2
MEAN MONTHLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 – 2017

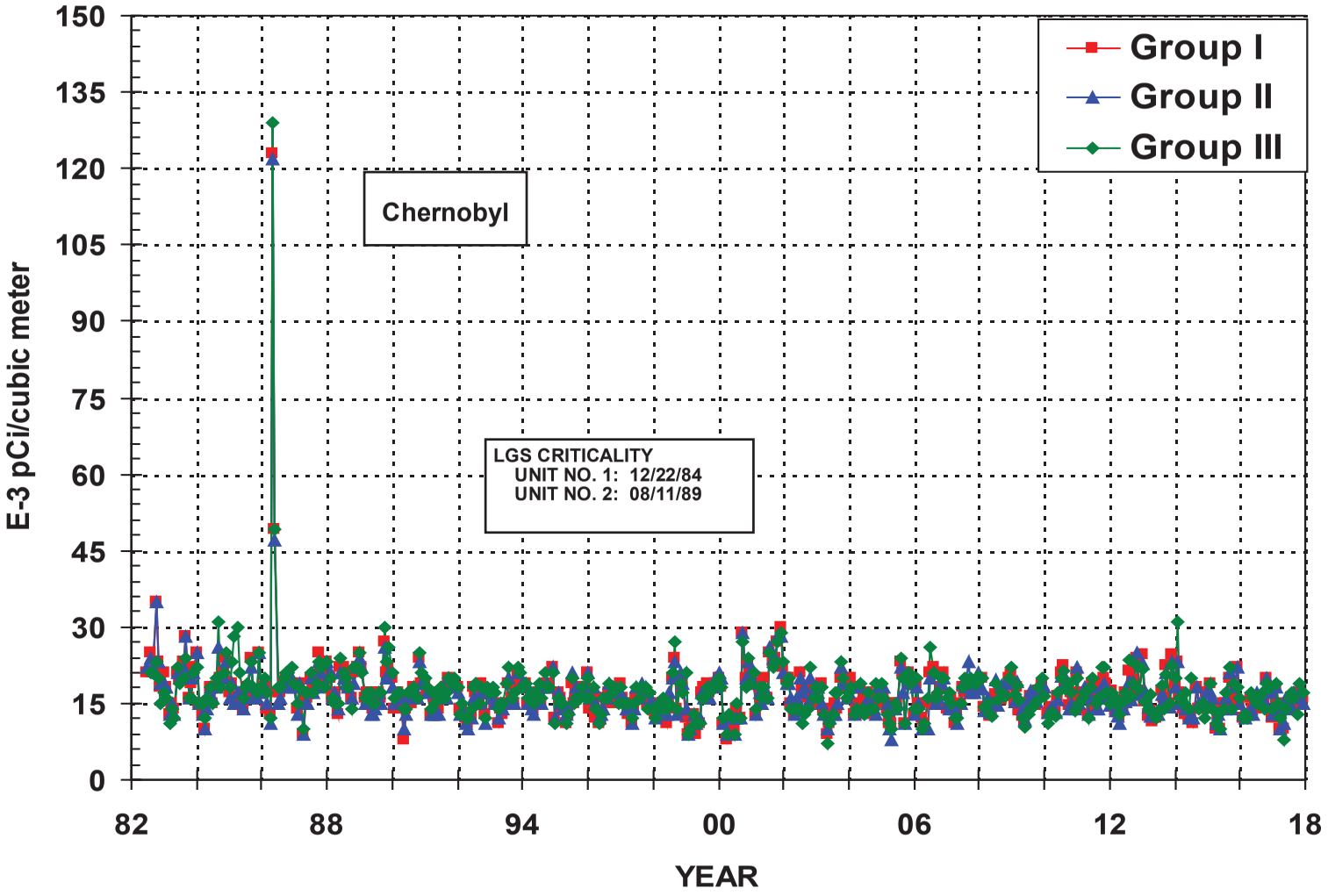


FIGURE C-3
MEAN WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 2017

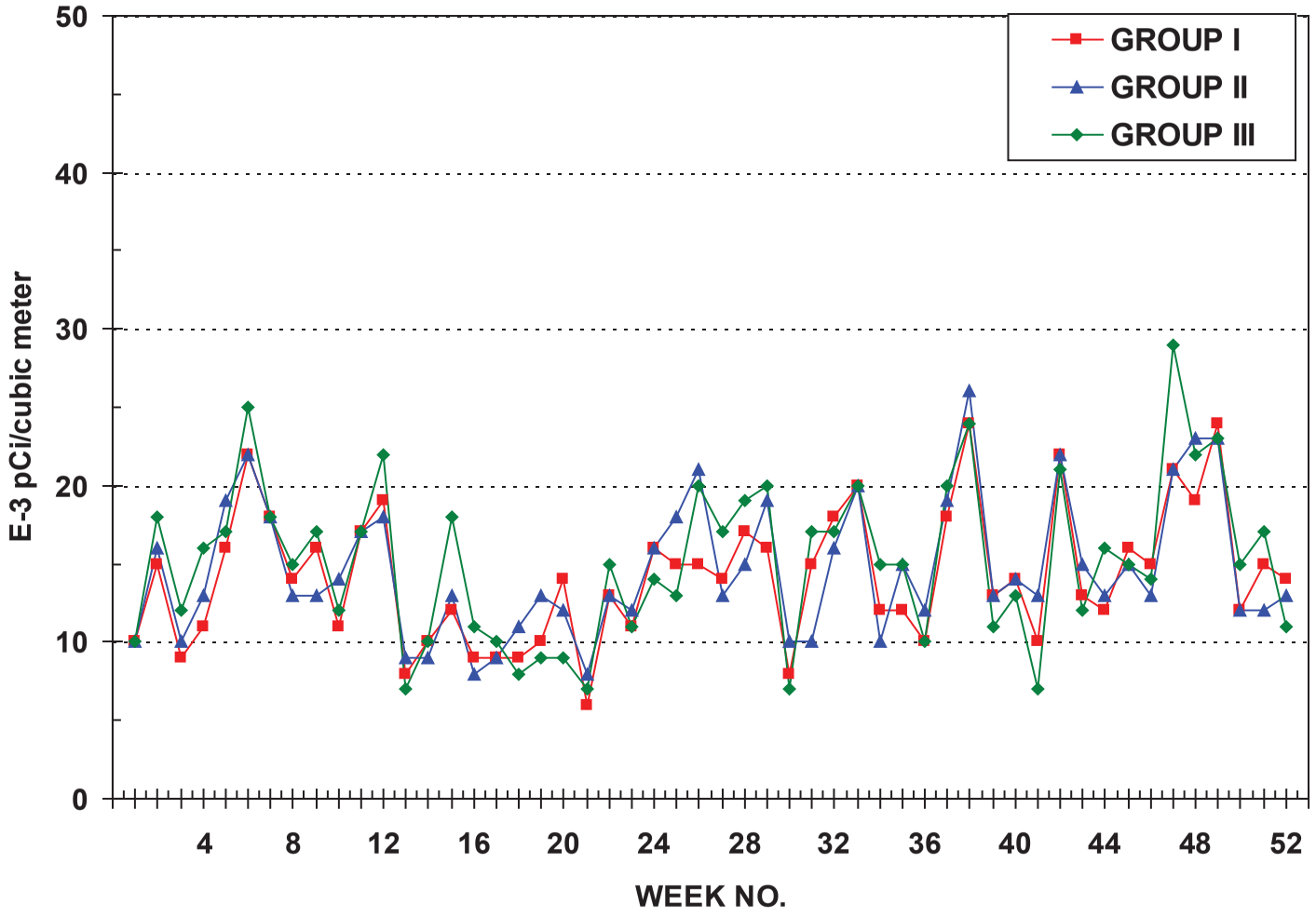
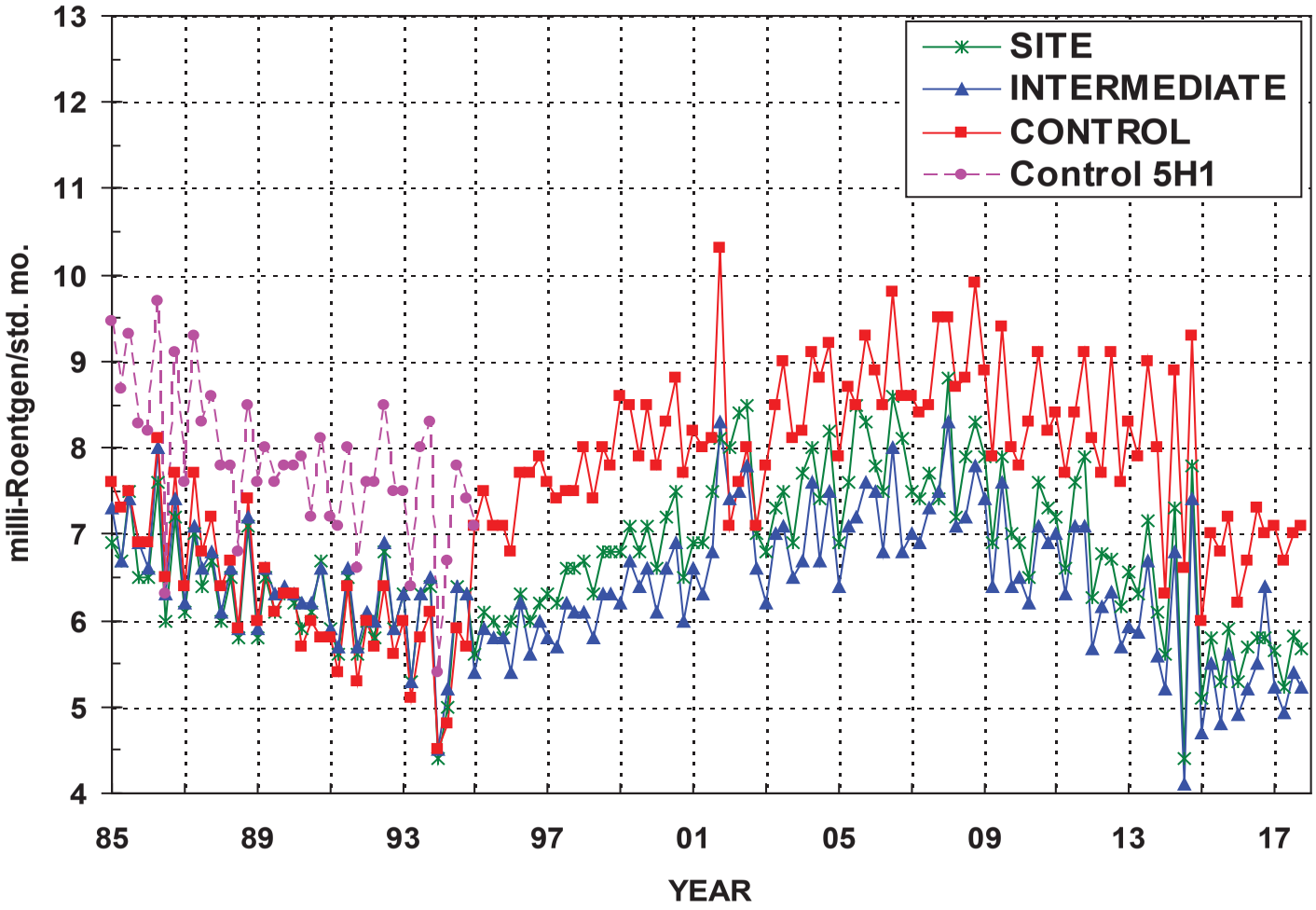


FIGURE C-4
MEAN QUARTERLY AMBIENT GAMMA RADIATION LEVELS (DLR) IN THE VICINITY OF LGS, 1985 – 2017

NOTE: Control Station 5H1 became the only distant location beginning in 1995



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APPENDIX D

DATA TABLES AND FIGURES
COMPARISON LABORATORY

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TABLE D-I.1 CONCENTRATIONS OF TOTAL GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/27/16 - 01/30/17	2.6 ± 0.8
01/30/17 - 02/28/17	0.9 ± 0.5
02/28/17 - 03/28/17	2.1 ± 0.7
03/28/17 - 05/01/17	1.4 ± 0.6
05/01/17 - 05/31/17	1.0 ± 0.5
05/31/17 - 06/26/17	1.9 ± 1.0
06/26/17 - 08/01/17	1.0 ± 0.5
08/01/17 - 08/29/17	1.3 ± 0.6
08/29/17 - 10/03/17	0.5 ± 0.5
10/03/17 - 10/31/17	1.6 ± 0.6
10/31/17 - 11/28/17	1.3 ± 0.6
11/28/17 - 01/02/18	1.6 ± 0.6
MEAN ± 2 STD DEV	1.4 ± 1.2

TABLE D-I.2 CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/27/16 - 01/30/17	< 0.2
01/30/17 - 02/28/17	< 0.3
02/28/17 - 03/28/17	< 0.4
03/28/17 - 05/01/17	< 0.3
05/01/17 - 05/31/17	< 0.3
05/31/17 - 06/26/17	< 0.2
06/26/17 - 08/01/17	< 0.4
08/01/17 - 08/29/17	< 0.1
08/29/17 - 10/03/17	< 0.2
10/03/17 - 10/31/17	< 0.2
10/31/17 - 11/28/17	< 0.2
11/28/17 - 01/02/18	< 0.3
MEAN	-

TABLE D-I.3 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/27/16 - 03/28/17	< 150
03/28/17 - 06/26/17	< 148
06/26/17 - 10/03/17	< 144
10/03/17 - 01/02/18	< 158
MEAN	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

TABLE D-I.4 **CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
16C2	12/27/16 - 01/30/17	< 2	< 2	< 5	< 3	< 4	< 3	< 3	< 3	< 3	< 3	< 11	< 2
	01/30/17 - 02/28/17	< 3	< 2	< 4	< 1	< 3	< 5	< 2	< 6	< 2	< 3	< 12	< 2
	02/28/17 - 03/28/17	< 1	< 2	< 3	< 3	< 4	< 3	< 3	< 4	< 2	< 2	< 13	< 2
	03/28/17 - 05/01/17	< 2	< 3	< 5	< 3	< 6	< 4	< 3	< 11	< 3	< 2	< 22	< 5
	05/01/17 - 05/31/17	< 3	< 2	< 4	< 2	< 4	< 3	< 4	< 4	< 3	< 3	< 11	< 2
	05/31/17 - 06/26/17	< 3	< 2	< 3	< 2	< 5	< 3	< 3	< 6	< 2	< 2	< 12	< 5
	06/26/17 - 08/01/17	< 2	< 3	< 3	< 1	< 4	< 2	< 2	< 11	< 2	< 3	< 23	< 3
	08/01/17 - 08/29/17	< 2	< 2	< 3	< 2	< 3	< 5	< 2	< 6	< 2	< 2	< 14	< 2
	08/29/17 - 10/03/17	< 3	< 2	< 4	< 3	< 5	< 4	< 3	< 5	< 2	< 2	< 14	< 3
	10/03/17 - 10/31/17	< 2	< 4	< 4	< 2	< 5	< 4	< 3	< 7	< 4	< 2	< 10	< 2
	10/31/17 - 11/28/17	< 3	< 3	< 4	< 2	< 6	< 5	< 3	< 3	< 2	< 3	< 9	< 2
	11/28/17 - 01/02/18	< 1	< 3	< 3	< 3	< 5	< 5	< 4	< 4	< 2	< 2	< 14	< 3
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

TABLE D-II.1 CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE AND I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION PERIOD	11S2 GROSS BETA	11S2 I-131
01/03/17 - 01/09/17	18 ± 5	< 15
01/09/17 - 01/17/17	23 ± 4	< 14
01/17/17 - 01/24/17	*(1)*	*(1)*
01/24/17 - 01/30/17	26 ± 7	< 10
01/30/17 - 02/06/17	25 ± 5	< 19
02/06/17 - 02/13/17	26 ± 5	< 14
02/13/17 - 02/21/17	27 ± 4	< 13
02/21/17 - 02/27/17	23 ± 5	< 17
02/27/17 - 03/06/17	27 ± 5	< 20
03/06/17 - 03/13/17	20 ± 4	< 10
03/13/17 - 03/20/17	24 ± 5	< 10
03/20/17 - 03/27/17	25 ± 5	< 14
03/27/17 - 04/03/17	10 ± 4	< 14
04/03/17 - 04/10/17	14 ± 4	< 16
04/10/17 - 04/17/17	22 ± 5	< 11
04/17/17 - 04/24/17	10 ± 4	< 20
04/24/17 - 05/02/17	10 ± 4	< 18
05/02/17 - 05/08/17	13 ± 4	< 14
05/08/17 - 05/15/17	8 ± 4	< 19
05/15/17 - 05/22/17	22 ± 5	< 13
05/22/17 - 05/30/17	9 ± 4	< 17
05/30/17 - 06/05/17	20 ± 5	< 14
06/05/17 - 06/12/17	25 ± 4	< 21
06/12/17 - 06/19/17	25 ± 5	< 18
06/19/17 - 06/27/17	26 ± 4	< 14
06/27/17 - 07/03/17	25 ± 5	< 26
07/03/17 - 07/11/17	22 ± 4	< 14
07/11/17 - 07/17/17	25 ± 5	< 21
07/17/17 - 07/24/17	31 ± 5	< 23
07/24/17 - 07/31/17	16 ± 4	< 16
07/31/17 - 08/08/17	23 ± 4	< 11
08/08/17 - 08/14/17	38 ± 7	< 19
08/14/17 - 08/22/17	33 ± 5	< 22
08/22/17 - 08/28/17	26 ± 5	< 21
08/28/17 - 09/05/17	21 ± 4	< 8
09/05/17 - 09/11/17	21 ± 5	< 21
09/11/17 - 09/19/17	31 ± 4	< 9
09/19/17 - 09/25/17	36 ± 6	< 11
09/25/17 - 10/02/17	19 ± 4	< 16
10/02/17 - 10/10/17	22 ± 4	< 18
10/10/17 - 10/16/17	21 ± 5	< 15
10/16/17 - 10/23/17	32 ± 5	< 21
10/23/17 - 10/30/17	24 ± 4	< 14
10/30/17 - 11/06/17	21 ± 5	< 10
11/06/17 - 11/13/17	21 ± 5	< 14
11/13/17 - 11/20/17	22 ± 5	< 17
11/20/17 - 11/27/17	34 ± 5	< 21
11/27/17 - 12/04/17	35 ± 5	< 11
12/04/17 - 12/11/17	41 ± 5	< 16
12/11/17 - 12/18/17	18 ± 4	< 13
12/18/17 - 12/26/17	31 ± 4	< 14
12/26/17 - 01/02/18	30 ± 5	< 25
MEAN ± 2 STD DEV	23 ± 15	-

(1) Invalid sample due to pump malfunction

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUE

TABLE D-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Be-7	Mn-54	Co-58	Co-60	Cs-134	Cs-137
11S2	01/03/17 - 04/03/17	94 ± 18	< 1.1	< 1.0	< 0.8	< 1.2	< 1.1
	04/03/17 - 07/03/17	87 ± 17	< 1.0	< 1.0	< 1.2	< 0.4	< 0.6
	07/03/17 - 10/02/17	87 ± 18	< 0.9	< 1.2	< 0.9	< 0.8	< 0.5
	10/02/17 - 01/02/18	79 ± 16	< 0.7	< 0.4	< 0.7	< 1.1	< 0.5
	MEAN ± 2 STD DEV	87 ± 12	-	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

TABLE D-III.1 CONCENTRATIONS OF I-131 BY CHEMICAL SEPARATION AND GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
19B1	01/10/17	< 0.3	1392 ± 117	< 3	< 4	< 24	< 4
	04/04/17	< 0.3	1310 ± 100	< 2	< 3	< 29	< 3
	07/11/17	< 0.3	1415 ± 104	< 3	< 3	< 27	< 5
	10/03/17	< 0.4	1395 ± 93	< 3	< 3	< 30	< 4
MEAN ± 2 STD DEV		-	1378 ± 93	-	-	-	-
25C1	01/10/17	< 0.3	1445 ± 112	< 2	< 3	< 20	< 7
	04/04/17	< 0.3	1284 ± 119	< 4	< 4	< 25	< 7
	07/11/17	< 0.3	1435 ± 95	< 3	< 2	< 26	< 3
	10/03/17	< 0.4	1456 ± 103	< 3	< 3	< 38	< 9
MEAN ± 2 STD DEV		-	1405 ± 162	-	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

FIGURE D-1
COMPARISON OF MONTHLY TOTAL GROSS BETA CONCENTRATIONS IN DRINKING WATER SAMPLES SPLIT BETWEEN ENV AND TBE, 2017

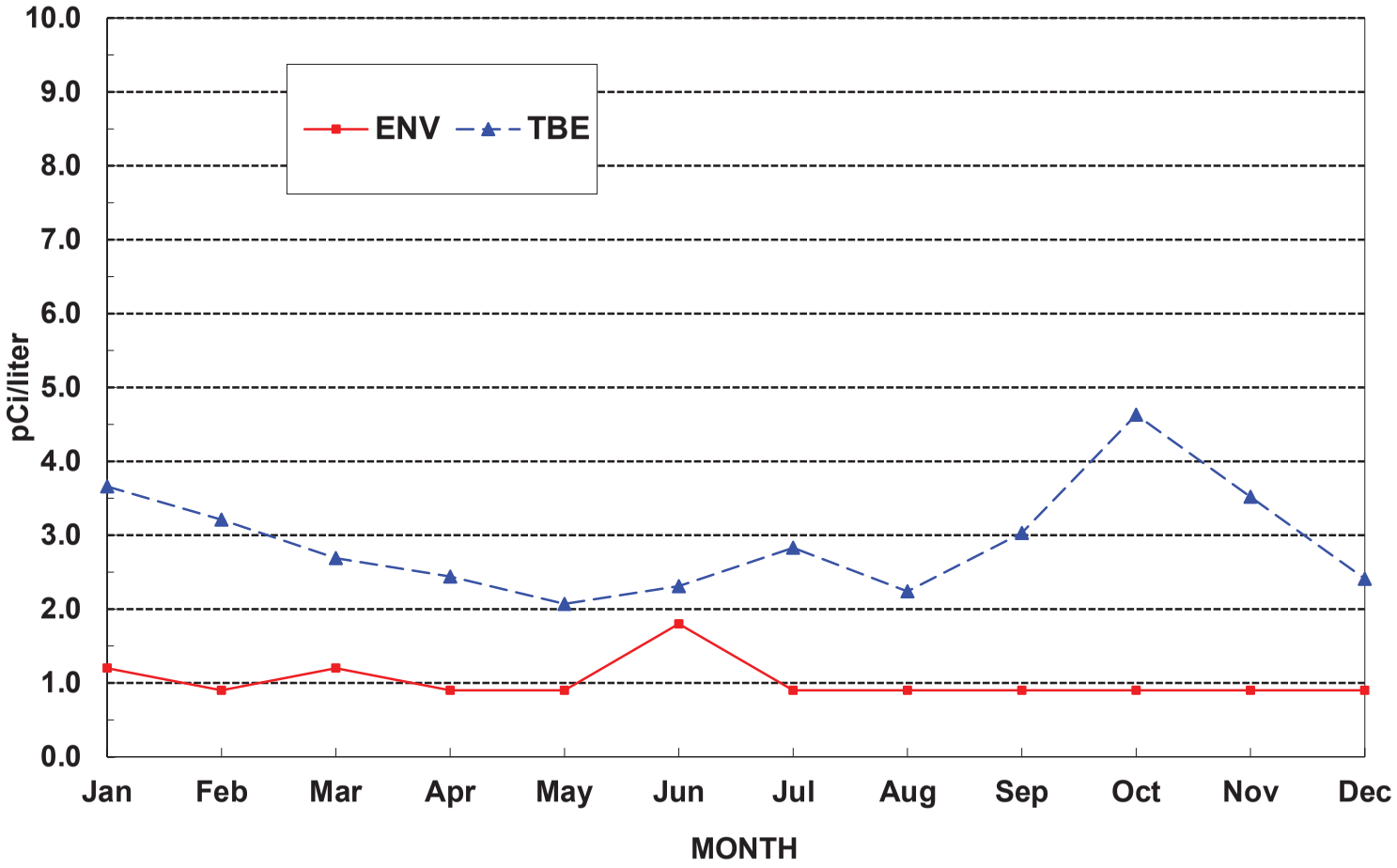
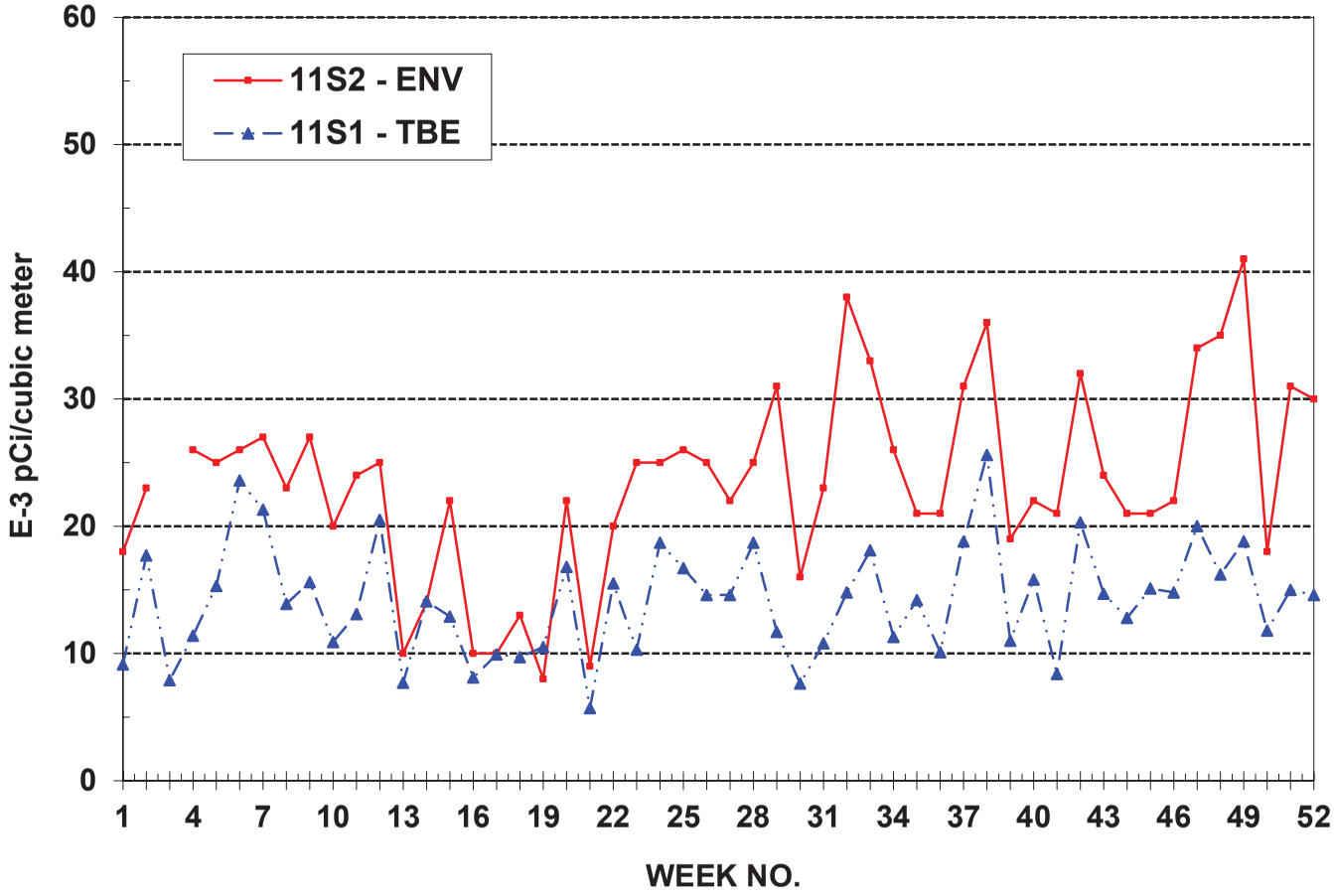


FIGURE D-2
COMPARISON OF WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED FROM LGS COLLOCATED LOCATIONS 11S1 AND 11S2, 2017



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APPENDIX E

INTER-LABORATORY COMPARISON PROGRAM

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TABLE E.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 2017	E11811	Milk	Sr-89	pCi/L	87	97.7	0.89	A
			Sr-90	pCi/L	12.4	16.2	0.77	A
	E11812	Milk	Ce-141	pCi/L	135	145	0.93	A
			Co-58	pCi/L	153	150	1.02	A
			Co-60	pCi/L	182	183	1.00	A
			Cr-51	pCi/L	258	290	0.89	A
			Cs-134	pCi/L	104	120	0.87	A
			Cs-137	pCi/L	142	140	1.02	A
			Fe-59	pCi/L	135	129	1.05	A
			I-131	pCi/L	92.6	97.9	0.95	A
			Mn-54	pCi/L	173	164	1.05	A
			Zn-65	pCi/L	208	199	1.04	A
	E11813	Charcoal	I-131	pCi	92	93.9	0.98	A
	E11814	AP	Ce-141	pCi	99.9	101	0.99	A
			Co-58	pCi	95.4	104	0.92	A
			Co-60	pCi	140	127	1.10	A
			Cr-51	pCi	211	201	1.05	A
			Cs-134	pCi	82.1	83.2	0.99	A
			Cs-137	pCi	92.8	97.0	0.96	A
			Fe-59	pCi	107	89.3	1.20	A
			Mn-54	pCi	106	114	0.93	A
			Zn-65	pCi	137	138	0.99	A
	E11816	Soil	Ce-141	pCi/g	0.258	0.250	1.03	A
			Co-58	pCi/g	0.241	0.258	0.93	A
			Co-60	pCi/g	0.312	0.315	0.99	A
			Cr-51	pCi/g	0.439	0.500	0.88	A
			Cs-134	pCi/g	0.176	0.207	0.85	A
			Cs-137	pCi/g	0.304	0.317	0.96	A
			Fe-59	pCi/g	0.210	0.222	0.95	A
			Mn-54	pCi/g	0.292	0.283	1.03	A
			Zn-65	pCi/g	0.353	0.344	1.03	A
	E11815	Water	Fe-55	pCi/L	1600	1890	0.85	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 E.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)]
June 2017	E11844	Milk	Sr-89	pCi/L	81.3	92.6	0.88	A
			Sr-90	pCi/L	12.1	13.5	0.90	A
	E11846	Milk	Ce-141	pCi/L	142	151	0.94	A
			Co-58	pCi/L	147	155	0.95	A
			Co-60	pCi/L	185	191	0.97	A
			Cr-51	pCi/L	321	315	1.02	A
			Cs-134	pCi/L	168	188	0.89	A
			Cs-137	pCi/L	148	150	0.99	A
			Fe-59	pCi/L	116	115	1.01	A
			I-131	pCi/L	102	93.6	1.09	A
			Mn-54	pCi/L	168	172	0.98	A
			Zn-65	pCi/L	195	204	0.96	A
	E11847	Charcoal	I-131	pCi	87.9	84.8	1.04	A
	E11845	AP	Sr-89	pCi	70.8	79.1	0.90	A
			Sr-90	pCi	9.10	11.5	0.79	W
	E11848	AP	Ce-141	pCi	112	116	0.96	A
			Co-58	pCi	119	119	1.00	A
			Co-60	pCi	171	146	1.17	A
			Cr-51	pCi	270	241	1.12	A
			Cs-134	pCi	152	144	1.05	A
			Cs-137	pCi	114	115	0.99	A
			Fe-59	pCi	94.1	88.3	1.07	A
			Mn-54	pCi	139	132	1.06	A
			Zn-65	pCi	141	156	0.90	A
	E11849	Water	Fe-55	pCi/L	1840	1890	0.97	A
July 2017	E11901	AP	GR-A	pCi	50.1	44.2	1.13	A
			GR-B	pCi	218	233	0.93	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 E.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 2017	E11914	Milk	Sr-89	pCi/L	84.3	82.7	1.02	A
			Sr-90	pCi/L	12.6	12.1	1.04	A
	E11915	Milk	Ce-141	pCi/L	93.9	87.0	1.08	A
			Co-58	pCi/L	115	117	0.98	A
			Co-60	pCi/L	265	262	1.01	A
			Cr-51	pCi/L	273	217	1.26	W
			Cs-134	pCi/L	186	201	0.93	A
			Cs-137	pCi/L	175	172	1.02	A
			Fe-59	pCi/L	137	125	1.09	A
			I-131	pCi/L	78.0	71.0	1.10	A
			Mn-54	pCi/L	128	123	1.04	A
			Zn-65	pCi/L	206	184	1.12	A
	E11916	Charcoal	I-131	pCi	71.9	64.4	1.12	A
	E11917	AP	Ce-141	pCi	80.1	86.3	0.93	A
			Co-58	pCi	110	116	0.95	A
			Co-60	pCi	277	260	1.07	A
			Cr-51	pCi	275	215	1.28	W
			Cs-134	pCi	192	199	0.96	A
			Cs-137	pCi	165	170	0.97	A
			Fe-59	pCi	122	124	0.98	A
			Mn-54	pCi	120	122	0.99	A
			Zn-65	pCi	175	183	0.96	A
	E11918	Water	Fe-55	pCi/L	1630	1630	1.00	A
	E11919	Soil	Ce-141	pCi/g	0.136	0.142	0.96	A
			Co-58	pCi/g	0.179	0.191	0.94	A
			Co-60	pCi/g	0.405	0.429	0.94	A
			Cr-51	pCi/g	0.230	0.355	0.65	N [1]
			Cs-134	pCi/g	0.272	0.328	0.83	A
			Cs-137	pCi/g	0.336	0.356	0.94	A
			Fe-59	pCi/g	0.210	0.205	1.02	A
			Mn-54	pCi/g	0.210	0.201	1.05	A
			Zn-65	pCi/g	0.301	0.301	1.00	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

(1) See NCR 17-16

TABLE E.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)]
December 2017	E12054	Milk	Sr-89	pCi/L	92.1	92.3	1.00	A
			Sr-90	pCi/L	18.3	16.9	1.09	A
	E12055	Milk	Ce-141	pCi/L	97.8	98.3	0.99	A
			Co-58	pCi/L	92.3	89.9	1.03	A
			Co-60	pCi/L	176	173	1.02	A
			Cr-51	pCi/L	226	242	0.93	A
			Cs-134	pCi/L	118	125	0.95	A
			Cs-137	pCi/L	148	141	1.05	A
			Fe-59	pCi/L	123	113	1.08	A
			I-131	pCi/L	66.0	57.8	1.14	A
			Mn-54	pCi/L	173	161	1.08	A
			Zn-65	pCi/L	233	211	1.10	A
	E12056	Charcoal	I-131	pCi	48.1	47.5	1.01	A
	E12057A	AP	Ce-141	pCi	108	111	0.97	A
			Co-58	pCi	89.5	102	0.88	A
			Co-60	pCi	223	196	1.14	A
			Cr-51	pCi	311	274	1.13	A
			Cs-134	pCi	141	142	1.00	A
			Cs-137	pCi	162	160	1.01	A
			Fe-59	pCi	121	129	0.94	A
			Mn-54	pCi	177	182	0.97	A
			Zn-65	pCi	203	239	0.85	A
	E12058	Water	Fe-55	pCi/L	1970	1740	1.13	A
	E12059	AP	Sr-89	pCi	71.2	87.4	0.81	A
			Sr-90	pCi	12.9	16.0	0.81	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 E.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 2017	17-MaS36	Soil	Ni-63	Bq/kg	-5.512		*(1)*	A
			Sr-90	Bq/kg	571	624	437 - 811	A
	17-MaW36	Water	Am-241	Bq/L	0.693	0.846	0.592 - 1.100	A
			Ni-63	Bq/L	13.4	12.2	8.5 - 15.9	A
			Pu-238	Bq/L	0.7217	0.703	0.492 - 0.914	A
			Pu-239/240	Bq/L	0.9277	0.934	0.654 - 1.214	A
	17-RdF36	AP	U-234/233	Bq/sample	0.0911	0.104	0.073 - 0.135	A
			U-238	Bq/sample	0.0967	0.107	0.075 - 0.139	A
	17-RdV36	Vegetation	Cs-134	Bq/sample	6.44	6.95	4.87 - 9.04	A
			Cs-137	Bq/sample	4.61	4.60	3.22 - 5.98	A
			Co-57	Bq/sample	-0.0229		*(1)*	A
			Co-60	Bq/sample	8.52	8.75	6.13 - 11.38	A
			Mn-54	Bq/sample	3.30	3.28	2.30 - 4.26	A
			Sr-90	Bq/sample	1.30	1.75	1.23 - 2.28	W
			Zn-65	Bq/sample	5.45	5.39	3.77 - 7.01	A
August 2017	17-MaS37	Soil	Ni-63	Bq/kg	1130	1220	854 - 1586	A
			Sr-90	Bq/kg	296	289	202 - 376	A
	17-MaW37	Water	Am-241	Bq/L	0.838	0.892	0.624 - 1.160	A
			Ni-63	Bq/L	-0.096		*(1)*	A
			Pu-238	Bq/L	0.572	0.603	0.422 - 0.784	A
			Pu-239/240	Bq/L	0.863	0.781	0.547 - 1.015	A
	17-RdF37	AP	U-234/233	Bq/sample	0.103	0.084	0.059 - 0.109	W
			U-238	Bq/sample	0.115	0.087	0.061 - 0.113	N [2]
	17-RdV37	Vegetation	Cs-134	Bq/sample	2.34	2.32	1.62 - 3.02	A
			Cs-137	Bq/sample	0.05		*(1)*	A
			Co-57	Bq/sample	3.32	2.8	2.0 - 3.6	A
			Co-60	Bq/sample	2.09	2.07	1.45 - 2.69	A
			Mn-54	Bq/sample	2.90	2.62	1.83 - 3.41	A
			Sr-90	Bq/sample	1.17	1.23	0.86 - 1.60	A
			Zn-65	Bq/sample	6.07	5.37	3.76 - 6.98	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) See NCR 17-15

TABLE E.3 **ERA Environmental Radioactivity Cross Check Program**
Teledyne Brown Engineering Environmental Services

Month/Year	Identrification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Limits	Evaluation [b]
March 2017	MRAD-26	AP	GR-A	pCi/sample	76.3	85.5	28.6 - 133	A
April 2017	RAD-109	Water	Ba-133	pCi/L	49.2	49.7	40.8 - 55.1	A
			Cs-134	pCi/L	83.2	90.1	74.0 - 99.1	A
			Cs-137	pCi/L	202	206	185 - 228	A
			Co-60	pCi/L	51.2	54.7	49.2 - 62.7	A
			Zn-65	pCi/L	39.3	53.8	47.2 - 65.9	N [1]
			GR-A	pCi/L	53.6	75.0	39.5 - 92.3	A
			GR-B	pCi/L	42.7	38.5	25.5 - 46.0	A
			U-Nat	pCi/L	50.1	55.6	45.2 - 61.7	A
			H-3	pCi/L	7080	6850	5920 - 7540	A
			Sr-89	pCi/L	40.7	66.2	53.8 - 74.3	N [1]
			Sr-90	pCi/L	26.9	26.7	19.3 - 31.1	A
			I-131	pCi/L	26.7	29.9	24.9 - 34.9	A
September 2017	MRAD-27	AP	GR-A	pCi/sample	40.9	50.1	16.8 - 77.8	A
		AP	GR-B	pCi/sample	58.0	61.8	39.1 - 90.1	A
October 2017	RAD-111	Water	Ba-133	pCi/L	71.3	73.7	61.7 - 81.1	A
			Cs-134	pCi/L	43.0	53.0	42.8 - 58.3	A
			Cs-137	pCi/L	48.2	52.9	47.6 - 61.1	A
			Co-60	pCi/L	69.0	69.5	62.6 - 78.9	A
			Zn-65	pCi/L	335	348	313 - 406	A
			GR-A	pCi/L	32.5	35.6	18.3 - 45.8	A
			GR-B	pCi/L	24.3	25.6	16.0 - 33.6	A
			U-Nat	pCi/L	36.6	37.0	30.0 - 40.9	A
			H-3	pCi/L	6270	6250	5390 - 6880	A
			I-131	pCi/L	26.4	24.2	20.1 - 28.7	A
November 2017	111317O	Water	Sr-89	pCi/L	57.1	50.0	39.4 - 57.5	A
			Sr-90	pCi/L	27.1	41.8	30.8 - 48.0	N [2]

(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 17-09
(2) See NCR 17-19

TABLE E.4

Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)[a] MRAD Study
Environmental, Inc., Midwest Laboratory

			Concentration [b]			
Lab Code [b]	Date	Analysis	Laboratory Result	ERA Result	Control Limits [c]	Acceptance
ERAP-1112	3/20/2017	Am-241	55.3 ± 2.8	76.4	47.1 - 103.0	Pass
ERAP-1112	3/20/2017	Co-60	1,230 ± 8	1030	797 - 1290	Pass
ERAP-1112	3/20/2017	Cs-134	1,110 ± 9	1100.0	700 - 1360	Pass
ERAP-1112	3/20/2017	Cs-137	1,810 ± 12	1390	1,040 - 1,830	Pass
ERAP-1112 [d]	3/20/2017	Fe-55	590 ± 385	256	79.4 - 500	Fail
ERAP-1112	3/20/2017	Mn-54	< 5.14	< 50.0	0.00 - 50.0	Pass
ERAP-1112	3/20/2017	Pu-238	54.6 ± 2.8	54.3	37.2 - 71.4	Pass
ERAP-1112	3/20/2017	Pu-239/240	63.6 ± 3.0	62.0	44.9 - 81.0	Pass
ERAP-1112	3/20/2017	Sr-90	55.3 ± 8.3	52.4	25.6 - 78.5	Pass
ERAP-1112	3/20/2017	U-233/234	65.7 ± 3.0	73.1	45.3 - 110	Pass
ERAP-1112	3/20/2017	U-238	67.3 ± 3.0	72.4	46.8 - 100	Pass
ERAP-1112	3/20/2017	Zn-65	1,355 ± 16	984.0	705 - 1,360	Pass
ERAP-1114	3/20/2017	Gr. Alpha	106 ± 5	85.5	28.6 - 133	Pass
ERAP-1114 [e]	3/20/2017	Gr. Beta	67.6 ± 3.0	45.2	28.6 - 65.9	Fail
ERSO-1116	3/20/2017	Am-241	418 ± 98	448	262 - 582	Pass
ERSO-1116	3/20/2017	Ac-228	1,540 ± 260	1240	795 - 1,720	Pass
ERSO-1116	3/20/2017	Bi-212	1,550 ± 90	1240.0	330 - 1,820	Pass
ERSO-1116	3/20/2017	Bi-214	2,560 ± 20	2750	1,660 - 3,960	Pass
ERSO-1116	3/20/2017	Co-60	4,620 ± 100	4430.0	3,000 - 6,100	Pass
ERSO-1116	3/20/2017	Cs-134	8,340 ± 100	8860.0	5,790 - 10,600	Pass
ERSO-1116	3/20/2017	Cs-137	8,420 ± 100	7500.0	5,750 - 9,650	Pass
ERSO-1116	3/20/2017	K-40	13,600 ± 900	10600.0	7,740 - 14,200	Pass
ERSO-1116	3/20/2017	Mn-54	< 68.1	< 1000	0.00 - 1,000	Pass
ERSO-1116	3/20/2017	Pb-212	1,060 ± 70	1240.0	812 - 1,730	Pass
ERSO-1116	3/20/2017	Pb-214	2,620 ± 160	2890.0	1,690 - 4,310	Pass
ERSO-1116	3/20/2017	Pu-238	424 ± 154	648.0	390 - 894	Pass
ERSO-1116 [f]	3/20/2017	Pu-239/240	252 ± 112	484	316 - 669	Fail
ERSO-1116 [g]	3/20/2017	Pu-239/240	436 ± 106	484	316 - 669	Pass
ERSO-1116	3/20/2017	Sr-90	7,930 ± 250	9150	3,490 - 14,500	Pass
ERSO-1116	3/20/2017	Th-234	1,820 ± 200	1940	614 - 3,650	Pass

[a] *Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurements Laboratory Quality Assurance Program (EIML)*

[b] *Laboratory codes as follows: ERW (water), ERAP (air filter), ERSO (soil), ERVE (vegetation). Results are reported in units of pCi/, except for air filters (pCi/Filter), vegetation and soil (pCi/kg.*

[c] *Results are presented as the known values, expected laboratory precision (2 sigma, 1 determination) and control limits as provided by ERA*

[d] *Fe-55 analysis result was outside the acceptable range. Recounting the sample disk for 1000 minutes resulted in 254 ± 364 with an LLD calculation of < 342. Insufficient sample was available after performing other required analyses on the sample to quantify the activity with a uncertainty less than the activity.*

[e] *ERA appears to have applied the standard material to the filter in a pattern closer to the center of the filter compared to previous studies an different from the filter efficiency utilized by the laboratory. This likely caused the efficency used the calculation to be understated and the result obtained by the laboratory to be overstated. For comparison, the AP gross beta in-house spike had a ratio of 0.94 of lab result to kno*

[f] *Analysis result for Plutonium-239/240 was below the lower limit of acceptance.*

[g] *Samples were reanalyzed in duplicate with acceptable results for each. Original analysis had poor resolution possibly due to a poor* elctroplating and is suspected in contributing to poor results.

TABLE E.4

Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)[a] MRAD Study
Environmental, Inc., Midwest Laboratory

			Concentration [b]			
Lab Code [b]	Date	Analysis	Laboratory Result	ERA Result	Control Limits [c]	Acceptance
ERSO-1116 [h]	3/20/2017	U-233/234	1,030 ± 130	1950	1,190 - 2,500	Fail
ERSO-1116 [i]	3/20/2017	U-233/234	1,820 ± 200	1950	1,190 - 2,500	Pass
ERSO-1116	3/20/2017	U-238	1,240 ± 140	1940	1,200 - 2,460	Pass
ERSO-1116 [i]	3/20/2017	U-238	1,930 ± 200	1940	1,200 - 2,460	Pass
ERSO-1116	3/20/2017	Zn-65	7,190 ± 240	6090	4,850 - 8,090	Pass
ERW-1122	3/20/2017	Gr. Alpha	65.3 ± 2.4	89.5	31.8 - 139	Pass
ERW-1122	3/20/2017	Gr. Beta	54.8 ± 1.5	61	34.9 - 90.4	Pass
ERW-1124	3/20/2017	H-3	19,000 ± 410	19400	13,000 - 27,700	Pass
ERVE-1118	42814	Am-241	1,560 ± 140	1860	1,140 - 2,470	Pass
ERVE-1118	42814	Cm-244	530 ± 80	734	360 - 1,140	Pass
ERVE-1118	42814	Co-60	1,400 ± 350	1390	959 - 1,940	Pass
ERVE-1118	42814	Cs-134	1,650 ± 460	1830	1,180 - 2,380	Pass
ERVE-1118	42814	Cs-137	2,580 ± 540	2500	1,810 - 3,480	Pass
ERVE-1118	42814	K-40	32,100 ± 700	30900	22,300 - 43,400	Pass
ERVE-1118	42814	Mn-54	< 27.3	< 300	0.00 - 300	Pass
ERVE-1118	42814	Zn-65	889 ± 64	853	615 - 1,200	Pass
ERVE-1118	42814	Pu-238	3,250 ± 210	3250	1,940 - 4,450	Pass
ERVE-1118	42814	Pu-239/240	2,180 ± 170	2150	1,320 - 2,960	Pass
ERVE-1118	42814	Sr-90	665 ± 135	726	414 - 963	Pass
ERVE-1118	42814	U-233/234	2,840 ± 200	3090	2,030 - 3,970	Pass
ERVE-1118	42814	U-238	2,990 ± 200	3060	2,040 - 3,890	Pass
ERW-1120	42814	Am-241	108 ± 7	140	94.3 - 188	Pass
ERW-1120	42814	Co-60	2,600 ± 198	2540	2,210 - 2,970	Pass
ERW-1120	42814	Cs-134	2,380 ± 250	2510	1,840 - 2880	Pass
ERW-1120	42814	Cs-137	1,470 ± 243	1400	1,190 - 1,680	Pass
ERW-1120	42814	Mn-54	< 12.3	< 100	0.00 - 100	Pass
ERW-1120	42814	Pu-238	117 ± 4	128	94.7 - 159	Pass
ERW-1120	42814	Pu-239/240	74.8 ± 3.3	85.8	66.6 - 108	Pass
ERW-1120	42814	U-233/234	75.3 ± 3.2	90.3	67.8 - 116	Pass
ERW-1120	42814	U-238	76.4 ± 3.2	89.5	68.2 - 110	Pass
ERW-1120	42814	Zn-65	2,130 ± 378	1960	1630 - 2,470	Pass
ERW-1120 [j]	42814	Fe-55	1,400 ± 403	984	587 - 1,340	Fail
ERW-1120 [k]	42814	Fe-55	1,081 ± 383	984	587 - 1,340	Pass
ERW-1120	42814	Sr-90	652 ± 12	714	465 - 944	Pass

[a] *Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurements Laboratory Quality Assurance Program (EIML)*

[b] *Laboratory codes as follows: ERW (water), ERAP (air filter), ERSO (soil), ERVE (vegetation). Results are reported in units of pCi/, except for air filters (pCi/Filter), vegetation and soil (pCi/kg).*

[c] *Results are presented as the known values, expected laboratory precision (2 sigma, 1 determination) and control limits as provided by ERA*

[h] *Analysis result for Uranium-233/234 was below the lower limit of acceptance*

i Samples were reanalyzed in duplicate with acceptable results for each. Original analysis had poor resolution possibly due to a poor elctroplating and is suspected in contributing to poor results.

j Iron -55 analysis result was outside acceptable range

i Result of recounting was acceptable. Using available aliquot after dividing sample for other analyses leaves insufficient sample to reliably determine the activity present in sample.

TABLE E.5

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Environmental, Inc., Midwest Laboratory

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory Result	Known Activity	Control Limits [c]	Acceptance
MASO-903	2/1/2017	Am-241	60.9 ± 6.9	67	46.9 - 87.1	Pass
MASO-903	2/1/2017	Cs-134	1360 ± 14	1550	1085 - 2015	Pass
MASO-903	2/1/2017	Cs-137	678 ± 13	611	428 - 794	Pass
MASO-903	2/1/2017	Co-57	1.63 ± 1.69	0.000	NA [c]	Pass
MASO-903	2/1/2017	Co-60	909 ± 12	891.0	624 - 1158	Pass
MASO-903	2/1/2017	Mn-54	1052 ± 17	967.0000	677 - 1257	Pass
MASO-903	2/1/2017	K-40	657 ± 68	607.0000	425 - 789	Pass
MASO-903	2/1/2017	Zn-65	-0.52 ± 7.40	0.0	NA [c]	Pass
MASO-903	2/1/2017	Ni-63	3.25 ± 7.17	0.0000	NA [c]	Pass
MASO-903	2/1/2017	Pu-238	0.46 ± 0.69	0.4100	NA [e]	Pass
MASO-903	2/1/2017	Pu-239/240	56.8 ± 5.9	59.8	41.9 - 77.7	Pass
MASO-903	2/1/2017	Sr-90	501 ± 17	624.00	437 - 811	Pass
MASO-903	2/1/2017	Tc-99	748 ± 16	656.00	459 - 853	Pass
MAW-849	2/1/2017	I-129	-0.05 ± 0.12	0.0000	NA [c]	Pass
MAVE-905	2/1/2017	Cs-134	6.61 ± 0.16	6.95	4.87 - 9.04	Pass
MAVE-905	2/1/2017	Cs-137	4.97 ± 0.18	4.60	3.22 - 5.98	Pass
MAVE-905	2/1/2017	Co-57	-0.01 ± 0.03	0.00	NA [c]	Pass
MAVE-905	2/1/2017	Co-60	9.51 ± 0.17	8.75	6.13 - 11.38	Pass
MAVE-905	2/1/2017	Mn-54	3.67 ± 0.17	3.28	2.30 - 4.26	Pass
MAVE-905	2/1/2017	Zn-65	6.12 ± 0.44	5.39	3.77 - 7.01	Pass
MAW-847	2/1/2017	Am-241	0.679 ± 0.079	0.846	0.592 - 1.100	Pass
MAW-847	2/1/2017	Cs-134	0.03 ± 0.10	0	NA [c]	Pass
MAW-847	2/1/2017	Cs-137	12.7 ± 0.4	11.100	7.8 - 14.4	Pass
MAW-847 [d]	2/1/2017	Co-57	2.7 ± 0.3	28.500	20.0 - 37.1	Fail
MAW-847	2/1/2017	Co-60	13.5 ± 0.3	12.300	8.6 - 16.0	Pass
MAW-847	2/1/2017	Mn-54	16.5 ± 0.4	14.900	10.4 - 19.4	Pass
MAW-847	2/1/2017	K-40	287 ± 6	254.0	178 - 330	Pass
MAW-847	2/1/2017	Zn-65	-0.15 ± 0.23	0.000	NA [c]	Pass
MAW-847	2/1/2017	H-3	275 ± 10	249.000	174 - 324	Pass
MAW-847	2/1/2017	Fe-55	2.4 ± 13.6	1.7	NA [e]	Pass
MAW-847	2/1/2017	Ni-63	10.1 ± 2.8	12.20	8.5 - 15.9	Pass
MAW-847	2/1/2017	Pu-238	0.729 ± 0.097	0.70	0.492 - 0.914	Pass
MAW-847	2/1/2017	Pu-239/240	0.866 ± 0.102	0.934	0.654 - 1.214	Pass
MAW-847	2/1/2017	Ra-226	0.506 ± 0.053	0.504	0.353 - 0.655	Pass
MAW-847	2/1/2017	Sr-90	10.0 ± 0.8	10.10	7.1 - 13.1	Pass

[a] Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation)

[b] Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil), MAVE (vegetation)

[c] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing serie as a "false positive". MAPEP does not provide control limits.

[d] Decimal point was misplaced while performing a unit conversion. The result is within control limits when the proper un conversion is performed.

[e] Provided in the series for "sensitivity evaluation". MAPEP does not provide control limits.

TABLE E.5

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Environmental, Inc., Midwest Laboratory

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory Result	Known Activity	Control Limits [c]	Acceptance
MAW-847	2/1/2017	Tc-99	4.77 ± 0.62	6.25	4.38 - 8.13	Pass
MAW-847	2/1/2017	U-234/233	1.19 ± 0.10	1.16	0.81 - 1.51	Pass
MAW-847	2/1/2017	U-238	1.15 ± 0.10	1.20	0.84 - 1.56	Pass
MAAP-907 [f]	2/1/2017	Am-241	0.0540 ± 0.0140	0.0376	0.0263 - 0.0489	Fail
MAAP-907	2/1/2017	Cs-134	1.31 ± 0.06	1.42	0.99 - 1.85	Pass
MAAP-907	2/1/2017	Cs-137	0.797 ± 0.080	0.685	0.480 - 0.891	Pass
MAAP-907	2/1/2017	Co-57	1.86 ± 0.06	1.70	1.19 - 2.21	Pass
MAAP-907	2/1/2017	Co-60	0.86 ± 0.05	0.78	0.55 - 1.01	Pass
MAAP-907	2/1/2017	Mn-54	0.01 ± 0.03	0.00	NA [c]	Pass
MAAP-907	2/1/2017	Zn-65	1.62 ± 0.13	1.29	0.90 - 1.68	Pass
MAAP-907	2/1/2017	Pu-238	0.0530 ± 0.0190	0.0598	0.0419 - 0.0777	Pass
MAAP-907	2/1/2017	Pu-239/240	0.0490 ± 0.0160	0.0460	0.0322 - 0.0598	Pass
MAAP-907	2/1/2017	Sr-90	0.648 ± 0.120	0.651	0.456 - 0.846	Pass
MAAP-907	2/1/2017	U-234/233	0.086 ± 0.024	0.104	0.073 - 0.135	Pass
MAAP-907	2/1/2017	U-238	0.097 ± 0.024	0.107	0.075 - 0.139	Pass
MASO-4515	8/1/2017	Am-241	45.9 ± 7.0	58.8	41.2 - 76.4	Pass [g]
MASO-4515	8/1/2017	Cs-134	409 ± 7	448	314 - 582	Pass [g]
MASO-4515	8/1/2017	Cs-137	798 ± 12	722	505 - 939	Pass [g]
MASO-4515	8/1/2017	Co-57	1572 ± 10	1458	1021 - 1895	Pass [g]
MASO-4515	8/1/2017	Co-60	0.2 ± 1.4	0.00	NA [c]	Pass [g]
MASO-4515	8/1/2017	Mn-54	934 ± 13	825	578 - 1073	Pass [g]
MASO-4515	8/1/2017	K-40	704 ± 53	592	414 - 770	Pass [g]
MASO-4515	8/1/2017	Zn-65	667 ± 17	559	391 - 727	Pass [g]
MASO-4515	8/1/2017	Pu-238	101 ± 9	92	64 - 120	Pass [g]
MASO-4515	8/1/2017	Pu-239/240	74.8 ± 7.7	68.8	48.2 - 89.4	Pass [g]
MASO-4515	8/1/2017	Sr-90	252 ± 7	289	202 - 376	Pass [g]
MAW-4494	8/1/2017	I-129	2.31 ± 0.10	2.31	1.62 - 3.00	Pass
MAVE-4517	8/1/2017	Cs-134	2.40 ± 0.10	2.32	1.62 - 3.02	Pass
MAVE-4517	8/1/2017	Cs-137	-0.002 ± 0.048	0.000	NA [c]	Pass
MAVE-4517	8/1/2017	Co-57	3.3 ± 0.1	2.8	2.0 - 3.6	Pass
MAVE-4517	8/1/2017	Co-60	2.10 ± 0.10	2.07	1.45 - 2.69	Pass
MAVE-4517	8/1/2017	Mn-54	3.00 ± 0.20	2.62	1.83 - 3.41	Pass
MAVE-4517	8/1/2017	Zn-65	5.90 ± 0.30	5.37	3.76 - 6.98	Pass

[a] Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation)

[b] Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil), MAVE (vegetation)

[c] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing serie as a "false positive". MAPEP does not provide control limits.

[f] Sample was reanalyzed in duplicate with acceptable results. Original plating was inferior to platings obtained during reanalysis. It is believed that isotopic tracer was not accurately quantified due to poor resolution of its peak.

[g] Data were erroneously submitted in units of Bq/g. All results pass MAPEP criteria when evaluated in units of Bq/Kg.

TABLE E.5

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Environmental, Inc., Midwest Laboratory

		Concentration [a]				
Lab Code [b]	Reference Date	Analysis	Laboratory Result	Known Activity	Control Limits [c]	Acceptance
MAW-4513	8/1/2017	Am-241	0.820 ± 0.220	0.89	0.624 - 1.160	Pass
MAW-4513	8/1/2017	Cs-134	10.3 ± 0.3	11.50	8.1 - 15.0	Pass
MAW-4513	8/1/2017	Cs-137	17.2 ± 0.5	16.30	11.4 - 21.2	Pass
MAW-4513	8/1/2017	Co-57	12.7 ± 0.4	12.1000	8.5 - 15.7	Pass
MAW-4513	8/1/2017	Co-60	10.6 ± 0.3	10.70	7.5 - 13.9	Pass
MAW-4513	8/1/2017	Mn-54	15.6 ± 0.4	14.900	10.4 - 19.4	Pass
MAW-4513	8/1/2017	Zn-65	15.9 ± 0.7	15.50	10.9 - 20.2	Pass
MAW-4513	8/1/2017	H-3	255 ± 9	258.00	181 - 335	Pass
MAW-4513	8/1/2017	Fe-55	21.6 ± 6.6	19.40	13.6 - 25.2	Pass
MAW-4513	8/1/2017	Ni-63	-0.1 ± 2.0	0.00	NA [c]	Pass
MAW-4513	8/1/2017	Pu-238	0.590 ± 0.080	0.6030	0.422 - 0.784	Pass
MAW-4513	8/1/2017	Pu-239/240	0.740 ± 0.090	0.7810	0.547 - 1.015	Pass
MAW-4513	8/1/2017	Ra-226	1.000 ± 0.100	0.858	0.601 - 1.115	Pass
MAW-4513	8/1/2017	Sr-90	7.80 ± 0.60	7.770	5.44 - 10.10	Pass
MAW-4513	8/1/2017	Tc-99	6.70 ± 0.40	6.730	4.71 - 8.75	Pass
MAW-4513	8/1/2017	U-2344/233	0.94 ± 0.06	1.0	0.71 - 1.31	Pass
MAW-4513	8/1/2017	U-238	0.97 ± 0.07	1	0.73 - 1.35	Pass
MAAP-4519 [h]	8/1/2017	Am-241	0.0400 ± 0.0100	0	0.0428 - 0.0796	Fail
MAAP-4519	8/1/2017	Cs-134	0.90 ± 0.10	1	0.70 - 1.30	Pass
MAAP-4519	8/1/2017	Cs-137	0.90 ± 0.10	0.82	0.57 - 1.07	Pass
MAAP-4519	8/1/2017	Co-57	0.01 ± 0.01	0	NA [c]	Pass
MAAP-4519	8/1/2017	Co-60	0.70 ± 0.10	1	0.48 - 0.88	Pass
MAAP-4519	8/1/2017	Mn-54	1.50 ± 0.10	1	0.91 - 1.69	Pass
MAAP-4519	8/1/2017	Zn-65	1.30 ± 0.10	1	0.76 - 1.40	Pass
MAAP-4519	8/1/2017	Pu-238	0.0300 ± 0.0100	0.0	0.0209 - 0.0387	Pass
MAAP-4519	8/1/2017	Pu-239/240	0.0400 ± 0.0200	0	0.0328 - 0.0608	Pass
MAAP-4519	8/1/2017	Sr-90	0.800 ± 0.100	0.80	0.561 - 1.041	Pass
MAAP-4519	8/1/2017	U-234/233	0.070 ± 0.010	0.08	0.059 - 0.109	Pass
MAAP-4519	8/1/2017	U-238	0.090 ± 0.010	0.087	0.061 - 0.113	Pass

[a] *Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation)*

[b] *Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil), MAVE (vegetation)*

[c] *MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing serie as a "false positive". MAPEP does not provide control limits.*

[h] *Laboratory is not currently offering analysis for Am-241 in Air Particulate samples*

TABLE E.6

Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a] RAD Study
Environmental, Inc., Midwest Laboratory

Lab Code	Date	Analysis	Laboratory Result	ERA Result	Control Limits	Acceptance
ERW-95	1/9/2017	Sr-89	51.9 ± 4.6	55.5	44.3 - 63.2	Pass
ERW-95	1/9/2017	Sr-90	43.6 ± 2.4	43.1	31.8 - 49.5	Pass
ERW-97	1/9/2017	Ba-133	78.2 ± 4.1	85.6	72.0 - 94.2	Pass
ERW-97	1/9/2017	Cs-134	53.9 ± 3.8	52.6	42.4 - 57.9	Pass
ERW-97	1/9/2017	Cs-137	122 ± 6	112	101 - 126	Pass
ERW-97	1/9/2017	Co-60	117 ± 4	113.0	102 - 126	Pass
ERW-97	1/9/2017	Zn-65	208 ± 13	189.0	170 - 222	Pass
ERW-99	1/9/2017	Gr. Alpha	48.9 ± 2.4	52.3	27.3 - 65.5	Pass
ERW-99	1/9/2017	Gr. Beta	37.1 ± 1.3	41.6	27.7 - 49.0	Pass
ERW-101	1/9/2017	I-131	22.3 ± 0.6	24.3	20.2 - 28.8	Pass
ERW-103	1/9/2017	Ra-226	11.3 ± 0.4	12.7	9.5 - 14.7	Pass
ERW-103	1/9/2017	Ra-228	6.10 ± 0.90	6.2	3.8 - 8.1	Pass
ERW-103	1/9/2017	Uranium	11.8 ± 0.8	12.6	9.9 - 14.4	Pass
ERW-106	1/9/2017	H-3	12,600 ± 300	12500	10,900 - 13,800	Pass
ERW-3344	7/10/2017	Sr-89	29.0 ± 10.0	26.4	18.4 - 32.9	Pass
ERW-3344	7/10/2017	Sr-90	33.8 ± 3.3	36	26.4 - 41.5	Pass
ERW-3346	7/10/2017	Ba-133	66.4 ± 4.1	66.3	55.2 - 72.9	Pass
ERW-3346	7/10/2017	Cs-134	27.0 ± 4.3	24.4	18.7 - 27.2	Pass
ERW-3346	7/10/2017	Cs-137	57.4 ± 4.5	51.6	46.4 - 59.6	Pass
ERW-3346	7/10/2017	Co-60	92.6 ± 4.4	88.6	79.7 - 99.8	Pass
ERW-3346	7/10/2017	Zn-65	32.4 ± 6.0	32.7	27.3 - 41.6	Pass
ERW-3348	7/10/2017	Gr. Alpha	23.7 ± 1.9	25.7	13.0 - 34.1	Pass
ERW-3348	7/10/2017	Gr. Beta	54.6 ± 1.6	63	43.5 - 69.6	Pass
ERW-3350	7/10/2017	I-131	25.4 ± 1.3	25.5	21.2 - 30.1	Pass
ERW-3352	7/10/2017	Ra-226	1.38 ± 0.15	1.3	1.07 - 1.95	Pass
ERW-3352	7/10/2017	Ra-228	6.70 ± 0.93	5.7	3.45 - 7.47	Pass
ERW-3352	7/10/2017	Uranium	58.4 ± 0.9	66.7	54.3 - 73.9	Pass
ERW-3354	7/10/2017	H-3	5,254 ± 224	5060	4,340 - 5,570	Pass

[a] *Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resources Associates (ERA).*

APPENDIX F

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

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Docket No: 50-352
50-353

LIMERICK GENERATING STATION
UNITS 1 AND 2

Annual Radiological Groundwater Protection Program Report

1 January through 31 December 2017

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

Limerick Power Station
Pottstown, PA 19464

April 2018

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Appendices

I. Summary and Conclusions

This report on the Radiological Groundwater Protection Program (RGPP) conducted for the Limerick Generating Station (LGS) by Exelon Nuclear covers the period 01 January 2017 through 31 December 2017. During that time period, 274 analyses were performed on 141 samples from 13 groundwater, 7 surface water and 4 precipitation water locations collected from the environment, both on and off station property in 2017.

Groundwater and surface water was analyzed for tritium. All sample results were at concentrations less than the United States Environmental Protection Agency (USEPA) drinking water standard (and the Nuclear Regulatory Commission Reporting Limit) of 20,000 pCi/L. Low levels of tritium were detected at 3 of the 13 groundwater monitoring locations and at 1 of the 7 surface water monitoring locations. All other results were less than the required Exelon-specified LLD of 200 pCi/L.

Groundwater and surface water was analyzed for Strontium-89 (Sr-89) and Strontium-90 (Sr-90). All Sr-89 and Sr-90 results were less than the MDC.

Groundwater was analyzed for gross alpha and gross beta in dissolved and suspended fractions. Gross alpha (dissolved) was detected at 1 of 13 groundwater locations sampled. All gross alpha (suspended) results were less than the MDC. Gross beta (dissolved) was detected at 10 of 13 groundwater locations sampled. All gross beta (suspended) results were less than the MDC.

Groundwater and surface water was analyzed for gamma-emitting radionuclides associated with the renewed licensed plant operation. Naturally-occurring Potassium-40 (K-40) was detected in 1 of 7 surface water locations. All other gamma isotopic results were less than the MDC.

Hard-To-Detect (HTD) analyses are routinely performed on a once per five year frequency for all groundwater monitoring locations. No HTD analyses were performed in 2017.

Precipitation water samples were analyzed for tritium. Tritium was detected at 2 of 4 precipitation locations sampled.

In assessing all the data gathered for this report, it was concluded that the operation of Limerick Generating Station had no adverse radiological impact on the environment offsite of LGS. Additionally, there does not appear to be an active source of tritium to groundwater at the Station.

II. Introduction

The Limerick Generating Station (LGS), consisting of two 3515 MWt boiling water reactors owned and operated by Exelon Corporation, is located adjacent to the Schuylkill River in Montgomery County, Pennsylvania. Unit No. 1 went critical on 22 December 1984. Unit No. 2 went critical on 11 August 1989. The site is located in Piedmont countryside, transversed by numerous valleys containing small tributaries that feed into the Schuylkill River. On the eastern river bank elevation rises from approximately 110 to 300 feet mean sea level (MSL). On the western river bank elevation rises to approximately 50 feet MSL.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) on samples collected in 2017.

In 2006, Exelon instituted a comprehensive program to evaluate the impact of station operations on groundwater and surface water in the vicinity of Limerick Generating Station. This evaluation involved numerous station personnel and contractor support personnel.

A. Objective of the RGPP

The long-term objectives of the RGPP are as follows:

1. Identify suitable locations to monitor and evaluate potential impacts from station operations before significant radiological impact to the environment and potential drinking water sources.

2. Understand the local hydrogeologic regime in the vicinity of the station and maintain up-to-date knowledge of flow patterns on the surface and shallow subsurface.

3. Perform routine water sampling and radiological analysis of water from selected locations.

4. Report new leaks, spills, or other detections with potential radiological significance to stakeholders in a timely manner.

5. Regularly assess analytical results to identify adverse trends.

6. Take necessary corrective actions to protect groundwater resources.

B. Implementation of the Objectives

The objectives identified have been implemented at Limerick Generating Station as discussed below:

1. Exelon and its consultant identified locations as described in the 2006 Phase 1 study. The Phase 1 study results and conclusions were made available to state and federal regulators in station specific reports.

2. The Limerick Generating Station reports describe the local hydrogeologic regime. Periodically, the flow patterns on the surface and shallow subsurface are updated based on ongoing measurements.

3. Limerick Generating Station will continue to perform routine sampling and radiological analysis of water from selected locations.

4. Limerick Generating Station has procedures to identify and report new leaks, spills, or other detections with potential radiological significance in a timely manner.

5. Limerick Generating Station staff and consulting hydrogeologist assess analytical results on an ongoing basis to identify adverse trends.

C. Program Description

Samples for the ongoing ground water monitoring program were collected for Exelon Nuclear by Normandeau Associates, Inc. (NAI). This section describes the general collection methods used to obtain environmental samples for the LGS RGPP in 2017. Sample locations can be found in Table A–1, Appendix A.

1. Sample Collection

<u>Groundwater and Surface Water</u>

Samples of both groundwater and surface water were collected, managed, transported and analyzed in accordance with approved procedures following EPA methods. Sample locations, sample collection frequencies and analytical frequencies were controlled in accordance with approved station procedures. Contractor and/or station personnel were trained in the collection, preservation management, and shipment of samples, as well as in documentation of sampling events. Analytical laboratories were subject to internal quality assurance programs, industry cross-check programs, as well as nuclear industry audits. Station personnel reviewed and evaluated all analytical data deliverables as data were received. Both station personnel and an independent hydrogeologist reviewed analytical data results for adverse trends or changes to hydrogeological conditions.

Precipitation

A five-gallon precipitation collection bucket fitted with a funnel was installed at four locations around the Limerick Generating Station. Three collection buckets were located on site in the highest prevalent wind sectors and one located on site in the least prevalent wind sector.

D. Characteristics of Tritium (H-3)

Tritium (chemical symbol H-3) is a radioactive isotope of hydrogen. The most common form of tritium is tritium oxide, which is also called "tritiated water." The chemical properties of tritium are essentially those of ordinary hydrogen.

Tritiated water behaves the same as ordinary water in both the environment and the body. Tritium can be taken into the body by drinking water, breathing air, eating food, or absorption through skin. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted primarily through urine with a clearance rate characterized by an effective biological half-life of about 14 days. Within one month or so after ingestion, essentially all tritium is cleared. Organically bound tritium (tritium that is incorporated in organic compounds) can remain in the body for a longer period.

Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Tritium is also produced during nuclear weapons explosions, as a by-product in reactors producing electricity, and in special production reactors, where the isotopes lithium-7 and/or boron-10 are activated to produce tritium. Like normal water, tritiated water is colorless and odorless. Tritiated water behaves chemically and physically like non-tritiated water in the subsurface, and therefore tritiated water will travel at the same velocity as the average groundwater velocity.

Tritium has a half-life of approximately 12.3 years. It decays spontaneously to Helium-3 (^{3}He). This radioactive decay releases a beta particle (low-energy electron). The radioactive decay of tritium is the source of the health risk from exposure to tritium. Tritium is one of the least dangerous radionuclides because it emits very weak radiation and leaves the body relatively quickly. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues is generally uniform and is dependent on the water content of the specific tissue.

III. Program Description

A. Sample Analysis

This section lists the analyses performed by TBE and EIML on environmental samples for the LGS RGPP in 2017. The analytical procedures used by the laboratories are listed in the AREOR Appendix B Table B-3.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of tritium in groundwater, surface water and precipitation water

2. Concentrations of Gross Alpha, Dissolved and Suspended and Gross Beta, Dissolved and Suspended in groundwater

3. Concentrations of gamma-emitters (Be-7, K-40, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140, and La-140) in groundwater and surface water

4. Concentrations of Strontium (Sr-89 and Sr-90) in groundwater and surface water

B. Data Interpretation

The radiological data collected prior to Limerick Generating Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Limerick Generating Station was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. <u>Lower Limit of Detection and Minimum Detectable Concentration</u>

   The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as a before the fact estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact criterion for the presence of activity. All analyses were designed to achieve the required LGS detection capabilities for environmental sample analysis.

   The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an after the fact estimate of the presence of activity.

2. Laboratory Measurements Uncertainty

The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value.

Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. Exelon reports the uncertainty of a measurement created by statistical process (counting error) as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. Exelon reports the TPU by following the result with plus or minus (±) the estimated sample standard deviation, as TPU, that is obtained by propagating all sources of analytical uncertainty in measurements.

Analytical uncertainties are reported at the 95% confidence level in this report for reporting consistency with the AREOR.

C. Background Analysis

A pre-operational radiological environmental monitoring program (pre-operational REMP) was conducted to establish background radioactivity levels prior to operation of the Station. The environmental media sampled and analyzed during the pre-operational REMP were atmospheric radiation, fall-out, domestic water, surface water, aquatic life, and foodstuffs. The results of the monitoring were detailed in the report entitled *Pre-operational Radiological Environmental Monitoring Program Report, Limerick Generating Station Units 1 and 2, 1 January 1982 through 21 December 1984, Teledyne Isotopes and Radiation Management Corporation*.

The pre-operational REMP contained analytical results from samples collected from both surface water and groundwater.

Monthly surface water sampling began in 1982, and the samples were analyzed for tritium as well as other radioactive analytes. During the preoperational program tritium was detected at a maximum concentration of 420 pCi/L, indicating that these preoperational results were from nuclear weapons testing and is radioactively decaying as predicted. Gamma isotopic results from the preoperational program were all less than or at the minimum detectable concentration (MDC) level.

1. Background Concentrations of Tritium

The purpose of the following discussion is to summarize background measurements of tritium in various media performed by others. Additional detail may be found by consulting references.

a. Tritium Production

Tritium is created in the environment from naturally occurring processes both cosmic and subterranean, as well as from anthropogenic (i.e., man-made) sources. In the upper atmosphere, “Cosmogenic” tritium is produced from the bombardment of stable nuclides and combines with oxygen to form tritiated water, which will then enter the hydrologic cycle. Below ground, “lithogenic” tritium is produced by the bombardment of natural lithium present in crystalline rocks by neutrons produced by the radioactive decay of naturally abundant uranium and thorium. Lithogenic production of tritium is usually negligible compared to other sources due to the limited abundance of lithium in rock. The lithogenic tritium is introduced directly to groundwater.

A major anthropogenic source of tritium and Sr-90 comes from the former atmospheric testing of thermonuclear weapons. Levels of tritium in precipitation increased significantly during the 1950s and early 1960s, and later with additional testing, resulting in the release of significant amounts of tritium to the atmosphere. The Canadian heavy water nuclear power reactors, other commercial power reactors, nuclear research and weapons production continue to influence tritium concentrations in the environment.

b. Precipitation Data

Precipitation samples are routinely collected at stations around the world for the analysis of tritium and other radionuclides. Two publicly available databases that provide tritium concentrations in precipitation are Global Network of Isotopes in Precipitation (GNIP) and USEPA’s RadNet database. GNIP provides tritium precipitation concentration data for samples collected worldwide since 1960. RadNet provides tritium precipitation concentration data for samples collected at stations throughout the U.S. Based on GNIP data for sample stations located in the U.S. Midwest, tritium concentrations peaked around 1963. This peak, which approached 10,000 pCi/L for some stations, coincided with the atmospheric testing of thermonuclear weapons. Tritium

concentrations in surface water showed a sharp decline up until 1975 followed by a gradual decline since that time. Tritium concentrations have typically been below 100 pCi/L since approximately 1980. Tritium concentrations in wells may still be above the 200 pCi/L detection limit from the external causes described above.

Water from previous years was naturally captured in groundwater. As a result, some well water sources today are affected by the surface water from the 1960s that contained elevated tritium activity.

c. Surface Water Data

Tritium concentrations are routinely measured in the Schuylkill and Delaware Rivers. Pennsylvania surface water data are typically less than 100 pCi/L.

The USEPA RadNet surface water data typically has a reported 'Combined Standard Uncertainty' of 35 to 50 pCi/L. According to USEPA, this corresponds to a ±70 to 100 pCi/L 95% confidence bound on each given measurement. Therefore, the typical background data provided may be subject to measurement uncertainty of approximately ± 70 to 100 pCi/L.

The radioanalytical laboratory is counting tritium results to an Exelon specified LLD of 200 pCi/L. Typically, the lowest positive measurement will be reported within a range of 40 – 240 pCi/L or 140 ± 100 pCi/L. Clearly, these sample results cannot be distinguished as different from background at this concentration. The surface water data ends in 1999 as the USEPA RadNet surface water program was terminated in March 1999.

IV. Results and Discussion

A. Groundwater Results

Samples were collected from onsite wells throughout the year in accordance with the station Radiological Groundwater Protection Program. Analytical results and anomalies are discussed below:

Tritium

Samples from 13 locations were analyzed for tritium activity. (Appendix B, Table B–I.1) Tritium values ranged from non-detectable to 770 pCi/L.

Although no drinking water pathway is available from groundwater, the theoretical dose via the drinking water pathway was calculated at 4.56E-02 mrem to a child (total body), which represents 7.59E-01% of the 10 CFR 50, Appendix I dose limit of 6 mrem.

Strontium

Samples were analyzed for Sr-89 and Sr-90. All results were below the required LLDs. (Appendix B, Table B–I.1)

Gross Alpha and Gross Beta (dissolved and suspended)

All samples were analyzed for gross alpha and gross beta in the dissolved and suspended fractions once in April 2017. Gross alpha (dissolved) was detected in 1 of 13 groundwater locations sampled at a concentration of 2.2 pCi/L. Gross alpha (suspended) results were below the required LLDs. Gross beta (dissolved) was detected in 10 of 13 groundwater locations sampled. The concentrations ranged from 2.3 to 15.9 pCi/L. Gross beta (suspended) results were below the required LLDs.
(Appendix B, Table B-I.1)

Gamma Emitters

Samples were analyzed for gamma-emitting nuclides. All gamma results were below the required LLDs. (Appendix B, Table B-I.2)

Hard-To-Detect

No HTD analyses were performed in 2017. (Appendix B, Table B-I.3)

B. Surface Water Results

In accordance with the Station's Radiological Groundwater Protection Program surface water samples were collected from streams that transverses the site, as well as, from other water bodies that could influence the tritium concentration at Limerick. Analytical results and anomalies are discussed below.

Tritium

Samples from 7 locations were analyzed for tritium activity (Appendix B, Table B-II.1). Tritium was detected in 1 of the 7 locations, sampled at a concentration of 245 pCi/L. The theoretical dose via the drinking water pathway was calculated at 1.45E-02 mrem to a child (total body), which represents 2.42E-01% of the 10 CFR 50, Appendix I dose limit of 6 mrem.

Strontium

Samples were analyzed for Sr-89 and Sr-90. All results were below the required LLDs. (Appendix B, Table B-II.1)

Gamma Emitters

Samples were analyzed for gamma-emitting nuclides. Naturally-occurring K-40 was detected in 1 of 7 locations at a concentration of 103 pCi/L. All other gamma results were below the required LLDs.
(Appendix B, Table B–II.2)

C. Precipitation Sample Results

Tritium

Tritium activity was detected in 2 of 4 precipitation water locations analyzed. The concentrations ranged from 190 - 347 pCi/L. These concentrations are consistent with historical values observed. (Appendix B, Table B-III.1)

D. Drinking Water Well Survey

A drinking water well survey was conducted during the summer 2006 by CRA (CRA 2006) around the Limerick Generating Station. CRA reviewed the Pennsylvania Groundwater Information System database to identify wells within a 1-mile radius from the center of the Station. Forty-six domestic withdrawal wells, two industrial wells, two commercial wells, and one institutional well were identified within the specified radius. The well depths range from 78 to 345 feet below ground surface (BGS), and they yield between 8 and 100 gallons per minute (gpm). All wells are completed in the Brunswick Formation.

The Station has one potable supply well and one fire water well. The potable supply well is constructed as an open-rock borehole. Groundwater was measured at a depth 102 feet bgs during a well pump replacement in 2014. The pump was placed at a depth of approximately 294 feet BGS. The total well depth and the depth of the steel casing are approximately 310 feet BGS. The well is located approximately 175 feet east of the Reactor Building. The potable supply well is sampled as part of the RGPP and designated as DW-LR-1. The fire water well is constructed as an open-rock borehole. Groundwater was encountered at 121 feet BGS during a well pump replacement in 2004. The well pump was placed at a depth of approximately 399 feet BGS. The total well depth and the depth of the steel casing are unknown. The well is located approximately 500 feet east of the cooling towers. The well is used in an emergency fire situation and for system testing and flushing. In 2017, approximately 1.4 million gallons were pumped from the well.

E. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE are presented in the Annual Radiological Environmental Operating Report.

F. Leaks, Spills, and Releases

There were no spills to groundwater in 2017.

G. Trends

No trends were identified.

H. Investigations

Currently no investigations are ongoing.

I. Actions Taken

1. Compensatory Actions

   There have been no station events requiring compensatory actions at the Limerick Generating Station.

2. Installation of Monitoring Wells

   No New monitoring well

3. Actions to Recover/Reverse Plumes

   No actions were required to recover or reverse groundwater plumes.

V. References

1. Conestoga Rovers and Associates, Fleetwide Assessment, Limerick Generating Station, Sanatoga, Pennsylvania, Ref. No. 045136(17), September 2006

2. Pre-operational Radiological Environmental Monitoring Program Report, Limerick Generating Station Units 1 and 2, 1 January 1982 through 21 December 1984, Teledyne Isotopes and Radiation Management Corporation

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APPENDIX A

LOCATION DESIGNATION

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TABLE A-1: Radiological Groundwater Protection Program – Sampling Locations for the Limerick Generating Station, 2017

Location	Type	Distance
MW-LR-1	Monitoring Well	Onsite
MW-LR-2	Monitoring Well	Onsite
MW-LR-3	Monitoring Well	Onsite
MW-LR-4	Monitoring Well	Onsite
MW-LR-5	Monitoring Well	Onsite
MW-LR-6	Monitoring Well	Onsite
MW-LR-7	Monitoring Well	Onsite
MW-LR-8	Monitoring Well	Onsite
MW-LR-9	Monitoring Well	Onsite
MW-LR-10	Monitoring Well	Onsite
P11	Monitoring Well	Onsite
P14	Monitoring Well	Onsite
P17	Monitoring Well	Onsite
P3	Monitoring Well	Onsite
SP22	Monitoring Well	Onsite
DW-LR-1	Monitoring Well	Onsite
SW-LR-2	Surface Water	Offsite
SW-LR-4	Surface Water	Offsite
SW-LR-6	Surface Water	Offsite
SW-LR-7	Surface Water	Onsite
SW-LR-8 (Hold Pond)	Surface Water	Onsite
SW-LR-9 (Spray Pond)	Surface Water	Onsite
SW-LR-10	Surface Water	Onsite
36S3	Precipitation Water	Onsite
E-5	Precipitation Water	Onsite
ESE-6	Precipitation Water	Onsite
SE-7	Precipitation Water	Onsite

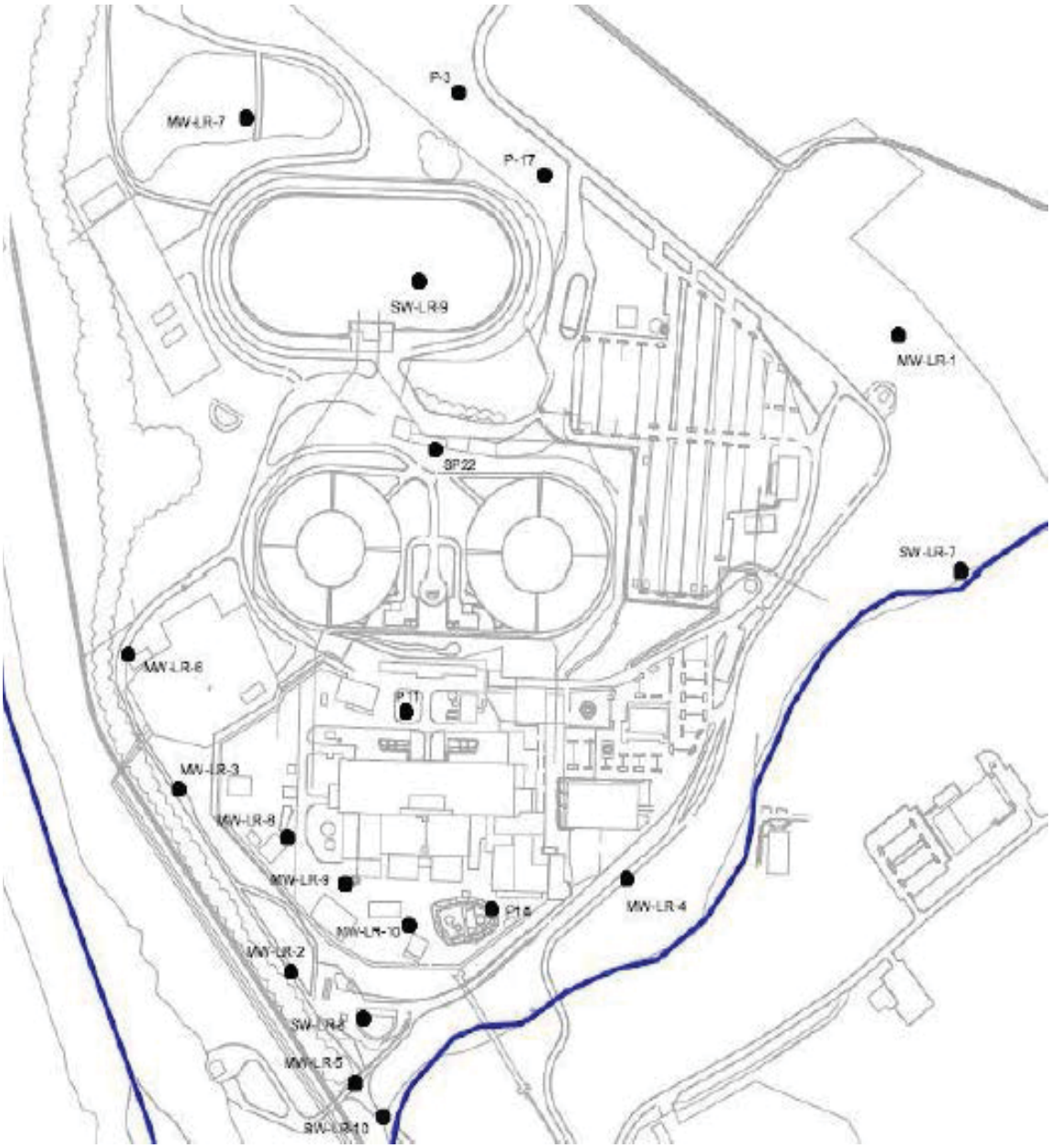

Figure 1 Routine Well Water and Surface Water Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2017

Figure 2 Routine Surface Water Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2017

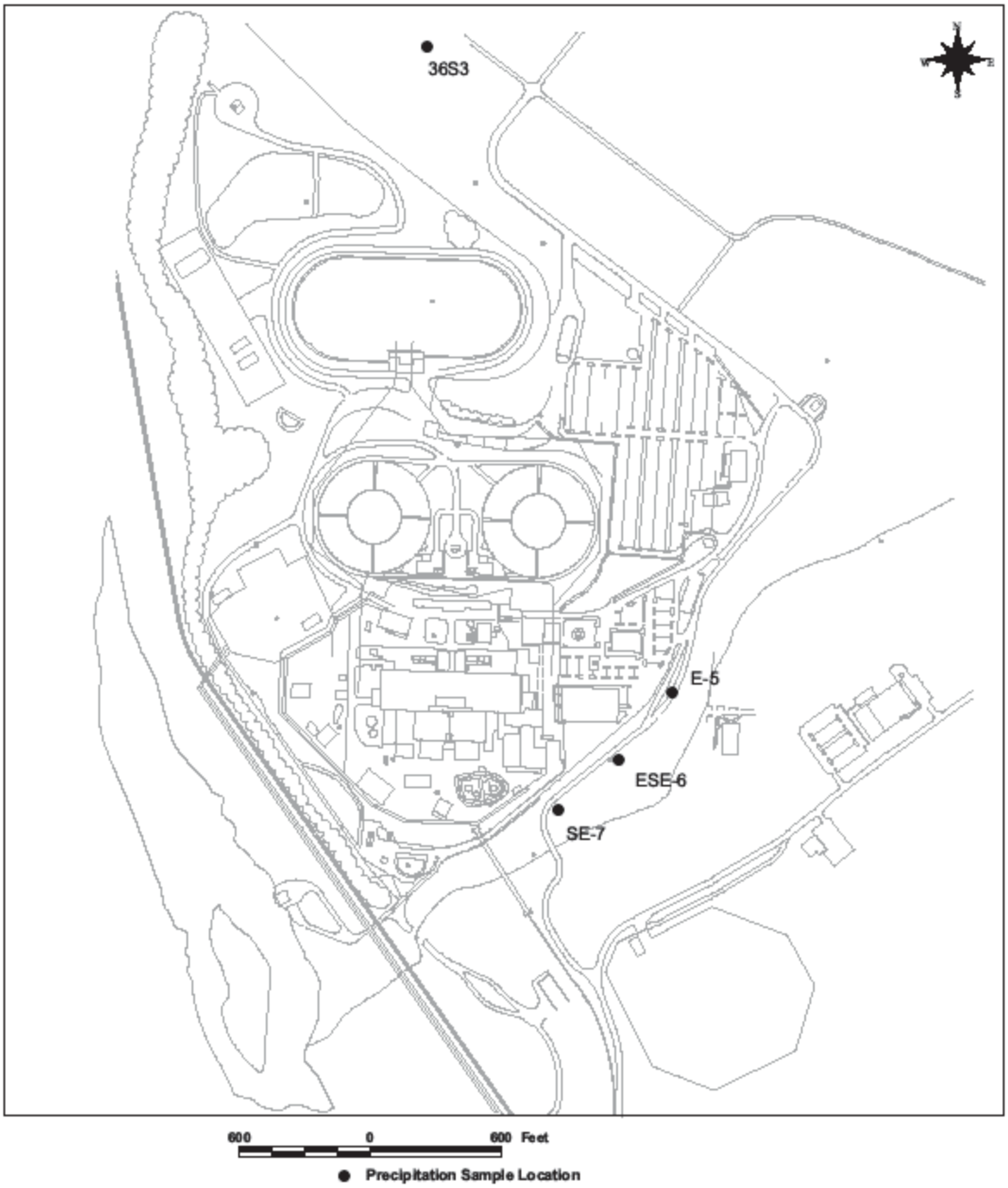

Figure 3 Routine Precipitation Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2017

APPENDIX B

DATA TABLES

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TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
DW-LR-1	01/05/17		< 194						
DW-LR-1	04/05/17		< 192	< 3.5	< 0.5	2.2 ± 1.3	< 1.0	< 1.8	< 1.5
DW-LR-1	07/10/17		< 180						
DW-LR-1	10/03/17		< 180						
MW-LR-1	04/11/17		< 194	< 4.6	< 0.6	< 1.1	< 1.0	4.4 ± 1.0	< 1.5
MW-LR-2	01/05/17		< 199						
MW-LR-2	04/11/17		< 194	< 4.5	< 0.6	< 1.4	< 0.6	2.9 ± 0.9	< 1.4
MW-LR-2	07/07/17		< 187						
MW-LR-2	10/04/17		< 178						
MW-LR-3	01/05/17		< 197						
MW-LR-3	04/11/17		< 191	< 6.3	< 0.8	< 1.9	< 0.6	3.7 ± 1.2	< 1.4
MW-LR-3	07/06/17		< 190						
MW-LR-3	10/04/17		< 176						
MW-LR-4	01/05/17		< 197						
MW-LR-4	04/11/17		< 192	< 4.7	< 0.7	**< 4.3**	< 0.6	6.4 ± 1.5	< 1.4
MW-LR-4	07/07/17		< 186						
MW-LR-4	10/04/17		< 177						
MW-LR-5	01/05/17	*TBE*	< 198						
MW-LR-5	01/05/17	*TBE*	< 194						
MW-LR-5	01/04/17	*EIML*	< 151						
MW-LR-5	04/11/17	*TBE*	< 193	< 5.2	< 0.6	< 1.3	< 1.0	8.1 ± 1.3	< 1.5
MW-LR-5	04/11/17	*TBE*	< 194	< 4.4	< 0.6	< 1.7	< 0.6	7.3 ± 1.2	< 1.4
MW-LR-5	04/11/17	*EIML*	222 ± 83	< 0.6	< 0.5	< 0.0 *(1)*		7.6 ± 0.9 *(1)*	
MW-LR-5	07/07/17	*TBE*	312 ± 129						
MW-LR-5	07/07/17	*TBE*	335 ± 131						
MW-LR-5	07/07/17	*EIML*	269 ± 96						
MW-LR-5	10/04/17	*TBE*	736 ± 143						
MW-LR-5	10/04/17	*TBE Original*	654 ± 137						
MW-LR-5	10/04/17	*TBE Reanalysis*	770 ± 144						
MW-LR-5	10/04/17	*EIML*	710 ± 102						
MW-LR-7	01/05/17		< 199						
MW-LR-7	04/11/17		< 194	< 3.7	< 0.6	< 0.7	< 0.6	2.6 ± 0.8	< 1.4
MW-LR-7	07/06/17		< 185						
MW-LR-7	10/03/17		< 173						
MW-LR-8	01/04/17	*TBE*	266 ± 137						
MW-LR-8	01/04/17	*TBE*	365 ± 139						
MW-LR-8	01/04/17	*EIML*	356 ± 91						
MW-LR-8	04/12/17	*TBE*	247 ± 130	< 3.8	< 0.5	< 2.7	< 0.5	4.8 ± 1.5	< 1.5
MW-LR-8	04/12/17	*TBE*	491 ± 142	< 5.2	< 0.6	< 2.5	< 0.6	2.3 ± 1.5	< 1.4
MW-LR-8	04/12/17	*EIML*	416 ± 93	< 0.6	< 0.5	< 0.0 *(1)*		2.3 ± 1.2 *(1)*	
MW-LR-8	07/06/17	*TBE*	448 ± 135						
MW-LR-8	07/06/17	*TBE*	506 ± 134						
MW-LR-8	07/06/17	*EIML*	440 ± 102						
MW-LR-8	10/03/17	*TBE*	514 ± 133						
MW-LR-8	10/03/17	*TBE*	558 ± 136						
MW-LR-8	10/03/17	*EIML*	594 ± 98						

(1) Total Gross Alpha & Gross Beta results reported (not Dissolved)

Bolded values indicate LLD was not met due to high solid content in the sample

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-LR-9	01/04/17	*TBE*	520 ± 151						
MW-LR-9	01/04/17	*TBE*	622 ± 156						
MW-LR-9	01/04/17	*EIML*	631 ± 103						
MW-LR-9	01/25/17		636 ± 154						
MW-LR-9	02/06/17		431 ± 143						
MW-LR-9	04/12/17	*TBE*	278 ± 133	< 4.0	< 0.6	< 1.3	< 0.5	14.5 ± 1.6	< 1.6
MW-LR-9	04/12/17	*TBE*	400 ± 139	< 4.6	< 0.6	< 1.4	< 0.6	9.5 ± 1.6	< 1.4
MW-LR-9	04/12/17	*EIML*	519 ± 97	< 0.7	< 0.5	< 0.0 *(1)*		3.1 ± 1.2 *(1)*	
MW-LR-9	07/06/17	*TBE*	278 ± 125						
MW-LR-9	07/06/17	*TBE*	277 ± 130						
MW-LR-9	07/06/17	*EIML*	342 ± 98						
MW-LR-9	10/03/17	*TBE*	299 ± 127						
MW-LR-9	10/03/17	*EIML*	344 ± 86						
MW-LR-10	01/04/17		< 198						
MW-LR-10	04/12/17		< 191	< 5.2	< 0.8	**< 6.0**	< 1.0	6.4 ± 1.9	< 1.5
MW-LR-10	07/06/17		< 188						
MW-LR-10	10/03/17		< 178						
P11	01/04/17		< 193						
P11	04/12/17		< 191	< 4.2	< 0.5	< 2.4	< 1.0	15.9 ± 1.9	< 1.5
P11	07/06/17		< 190						
P11	10/03/17		< 185						
P14	01/04/17		< 196						
P14	04/12/17		< 195	< 4.4	< 0.6	**< 5.9**	< 1.0	< 2.8	< 1.5
P14	07/06/17		< 186						
P14	10/03/17		< 187						
P17	04/11/17		< 190	< 4.6	< 0.9	**< 5.4**	< 1.0	< 2.7	< 1.5

(1) Total Gross Alpha & Gross Beta results reported (not Dissolved)

Bolded values indicate LLD was not met due to high solid content in the sample

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		Be-7	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
DW-LR-1	04/05/17		< 43	< 36	< 4	< 5	< 10	< 4	< 10	< 5	< 6	< 13	< 5	< 5	< 30	< 9
MW-LR-1	04/11/17		< 58	< 144	< 6	< 5	< 14	< 7	< 11	< 5	< 9	< 11	< 6	< 6	< 30	< 7
MW-LR-2	04/11/17		< 52	< 154	< 6	< 6	< 14	< 6	< 13	< 7	< 12	< 11	< 5	< 7	< 33	< 10
MW-LR-3	04/11/17		< 53	< 62	< 7	< 5	< 10	< 7	< 12	< 7	< 12	< 14	< 7	< 7	< 32	< 11
MW-LR-4	04/11/17		< 44	< 44	< 5	< 5	< 9	< 6	< 9	< 6	< 9	< 10	< 5	< 5	< 21	< 9
MW-LR-5	04/11/17	*TBE*	< 61	< 68	< 6	< 7	< 13	< 6	< 10	< 7	< 12	< 14	< 6	< 7	< 34	< 10
MW-LR-5	04/11/17	*TBE*	< 77	< 156	< 7	< 7	< 17	< 7	< 17	< 9	< 14	< 13	< 8	< 9	< 40	< 12
MW-LR-5	04/11/17	*EIML*	< 48	< 72	< 4	< 3	< 3	< 4	< 8	< 4	< 6	< 8	< 4	< 3	< 25	< 5
MW-LR-7	04/11/17		< 45	< 94	< 4	< 5	< 9	< 5	< 9	< 5	< 9	< 9	< 5	< 5	< 25	< 7
MW-LR-8	04/12/17	*TBE*	< 65	< 120	< 8	< 8	< 14	< 6	< 16	< 8	< 11	< 12	< 7	< 6	< 35	< 6
MW-LR-8	04/12/17	*TBE*	< 81	< 121	< 9	< 7	< 16	< 7	< 13	< 9	< 11	< 11	< 7	< 8	< 36	< 12
MW-LR-8	04/12/17	*EIML*	< 21	< 52	< 2	< 2	< 4	< 2	< 4	< 2	< 5	< 6	< 2	< 2	< 15	< 2
MW-LR-9	04/12/17	*TBE*	< 62	< 139	< 7	< 7	< 13	< 9	< 14	< 7	< 13	< 14	< 7	< 9	< 30	< 9
MW-LR-9	04/12/17	*TBE*	< 55	< 143	< 7	< 6	< 13	< 6	< 11	< 7	< 11	< 12	< 6	< 7	< 30	< 11
MW-LR-9	04/12/17	*EIML*	< 23	< 44	< 2	< 2	< 3	< 2	< 4	< 3	< 4	< 5	< 2	< 2	< 16	< 4
MW-LR-10	04/12/17		< 38	< 44	< 4	< 4	< 11	< 4	< 11	< 6	< 8	< 9	< 5	< 6	< 21	< 9
P11	04/12/17		< 53	< 117	< 6	< 7	< 14	< 8	< 17	< 9	< 9	< 12	< 8	< 8	< 29	< 8
P14	04/12/17		< 52	< 182	< 7	< 6	< 16	< 7	< 17	< 7	< 16	< 15	< 7	< 8	< 35	< 14
P17	04/11/17		< 49	< 47	< 5	< 5	< 10	< 4	< 10	< 5	< 9	< 8	< 4	< 6	< 22	< 6

TABLE B-I.3 **CONCENTRATIONS OF HARD TO DETECTS IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	AM-241	CM-242	CM-243/244	PU-238	PU-239	U-233/234	U-235	U-238	FE-55	NI-63

There were no HTD's Analyzed in 2017

TABLE B-II.1 CONCENTRATIONS OF TRITIUM AND STRONTIUM IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90
SW-LR-2	01/03/17		< 199		
SW-LR-2	04/10/17		< 196	< 3.5	< 0.9
SW-LR-2	07/05/17		< 186		
SW-LR-2	10/02/17		< 177		
SW-LR-4	01/03/17		< 196		
SW-LR-4	04/10/17		< 197	< 5.1	< 0.7
SW-LR-4	07/05/17		< 188		
SW-LR-4	10/02/17		< 175		
SW-LR-6	01/03/17		< 195		
SW-LR-6	04/10/17		< 196	< 4.9	< 0.6
SW-LR-6	07/05/17		< 186		
SW-LR-6	10/02/17		< 175		
SW-LR-7	01/03/17		< 195		
SW-LR-7	04/11/17		< 192	< 3.8	< 0.5
SW-LR-7	07/05/17		< 188		
SW-LR-7	10/02/17		< 178		
SW-LR-8	01/04/17		228 ± 133		
SW-LR-8	01/04/17	*Reanlaysis*	245 ± 135		
SW-LR-8	04/05/17		< 195	< 5.2	< 0.6
SW-LR-8	07/11/17		< 182		
SW-LR-8	10/03/17		< 179		
SW-LR-9	01/06/17		< 192		
SW-LR-9	04/05/17		< 190	< 3.9	< 0.5
SW-LR-9	07/12/17		< 178		
SW-LR-9	10/03/17		< 177		
SW-LR-10	01/03/17		< 199		
SW-LR-10	04/11/17		< 197	< 4.7	< 0.5
SW-LR-10	07/05/17		< 190		
SW-LR-10	10/02/17		< 178		

TABLE B-II.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Be-7	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
SW-LR-2	04/10/17	< 59	< 69	< 7	< 6	< 13	< 6	< 13	< 7	< 11	< 13	< 6	< 7	< 33	< 10
SW-LR-4	04/10/17	< 49	< 104	< 5	< 6	< 11	< 5	< 9	< 6	< 10	< 12	< 5	< 7	< 26	< 10
SW-LR-6	04/10/17	< 61	< 110	< 4	< 6	< 12	< 4	< 13	< 5	< 8	< 10	< 6	< 6	< 30	< 6
SW-LR-7	04/11/17	< 57	< 97	< 5	< 5	< 14	< 8	< 12	< 6	< 12	< 8	< 6	< 6	< 26	< 7
SW-LR-8	04/05/17	< 50	103 ± 63	< 5	< 5	< 11	< 6	< 8	< 5	< 8	< 15	< 5	< 5	< 32	< 13
SW-LR-9	04/05/17	< 40	< 87	< 5	< 5	< 13	< 6	< 11	< 5	< 8	< 15	< 4	< 4	< 32	< 8
SW-LR-10	04/11/17	< 46	< 119	< 5	< 6	< 15	< 6	< 13	< 7	< 11	< 10	< 6	< 6	< 26	< 11

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2017

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
36S3	12/29/16 - 01/30/17	< 199
36S3	01/30/17 - 02/27/17	< 195
36S3	02/27/17 - 03/27/17	< 193
36S3	03/27/17 - 04/28/17	< 174
36S3	04/28/17 - 05/26/17	< 181
36S3	05/26/17 - 06/29/17	< 180
36S3	06/29/17 - 07/28/17	< 181
36S3	07/28/17 - 08/24/17	< 174
36S3	08/24/17 - 09/26/17	< 187
36S3	09/26/17 - 10/30/17	< 177
36S3	10/30/17 - 12/07/17	< 182
36S3	12/07/17 - 12/29/17	< 187
E-5	12/29/16 - 01/30/17	< 191
E-5	01/30/17 - 02/27/17	< 192
E-5	02/27/17 - 03/27/17	< 192
E-5	03/27/17 - 04/28/17	< 174
E-5	04/28/17 - 05/26/17	< 180
E-5	05/26/17 - 06/29/17	< 186
E-5	06/29/17 - 07/28/17	< 179
E-5	07/28/17 - 08/24/17	< 174
E-5	08/24/17 - 09/26/17	< 180
E-5	09/26/17 - 10/30/17	< 175
E-5	10/30/17 - 12/07/17	< 182
E-5	12/07/17 - 12/29/17	< 184
ESE-6	12/29/16 - 01/30/17	< 195
ESE-6	01/30/17 - 02/27/17	< 192
ESE-6	02/27/17 - 03/27/17	190 ± 124
ESE-6	03/27/17 - 04/28/17	< 169
ESE-6	04/28/17 - 05/26/17	< 178
ESE-6	05/26/17 - 06/29/17	< 183
ESE-6	06/29/17 - 07/28/17	< 181
ESE-6	07/28/17 - 08/24/17	< 174
ESE-6	08/24/17 - 09/26/17	< 181
ESE-6	09/26/17 - 10/30/17	< 181
ESE-6	10/30/17 - 12/07/17	< 182
ESE-6	12/07/17 - 12/29/17	< 196
SE-7	12/29/16 - 01/30/17	< 198
SE-7	01/30/17 - 02/27/17	< 190
SE-7	02/27/17 - 03/27/17	< 188
SE-7	03/27/17 - 04/28/17	< 175
SE-7	04/28/17 - 05/26/17	< 181
SE-7	05/26/17 - 06/29/17	347 ± 129
SE-7	06/29/17 - 07/28/17	< 179
SE-7	07/28/17 - 08/24/17	< 173
SE-7	08/24/17 - 09/26/17	227 ± 122
SE-7	09/26/17 - 10/30/17	< 180
SE-7	10/30/17 - 12/07/17	< 187
SE-7	12/07/17 - 12/29/17	< 187