Exelon Generation

TS 6.9.1.7

LG-16-057

April 28, 2016

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

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: 2015 Annual Radiological Environmental Operating Report

Dear Sir:
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 2015 Annual Radiological Environmental Operating Report. This report provides the 2015 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 discharged by LGS during 2015. The results of the groundwater protection program are also included in this report. Positive tritium was found in 2 of 14 groundwater monitoring locations that ranged up to 432 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: 2015 Annual Radiological Environmental Operating Report

cc: D. Dorman, Administrator, Region I, USNRC (w/attachment)
S. Rutenkroger, LGS USNRC Senior Resident Inspector (w/attachment)
R. Nimitz, Inspector Region I, USNRC (w/attachment)
R. Ennis, Senior Project Manager-NRR, USNRC (w/attachment)

ATTACHMENT

2015 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 2015

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

April 2016

Intentionally left blank

Table Of Contents

Appendices

Figures

Intentionally Left Blank

I. Summary and Conclusions

In 2015, the Limerick Generating Station released to the environment through the radioactive effluent liquid and gaseous pathways approximately 119 curies of noble gas, fission and activation products and approximately 48 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	4.30E-03	All	Nearest Residence	2.15E-02	20	mRad
Noble Gas	Beta – Air Dose	2.59E-03	All	Nearest Residence	6.46E-03	40	mRad
Noble Gas	Total Body (Gamma)	4.07E-03	All	Nearest Residence	4.07E-02	10	mrem
Noble Gas	Skin (Beta)	6.73E-03	All	Nearest Residence	2.24E-02	30	mrem
Iodine, Particulate, Tritium & C-14	Bone	1.29E-00	Child	Vegetation	4.30E-00	30	mrem
Liquid	Total Body	2.36E-04	Child	Aqua PA	3.94E-03	6	mrem
Liquid	Bone	6.20E-04	Child	LGS Outfall	3.10E-03	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 2015 through 31 December 2015. During that time period, 1330 analyses were performed on 1094 samples.

Surface and drinking water samples were analyzed for concentrations of tritium and gamma emitting nuclides. Drinking water samples were also analyzed for concentrations of I-131 and total gross betaIodine-131 was not detected in primary laboratory samples, however, one sample from the secondary laboratory indicated I-131 in drinking water. 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) and sediment samples were analyzed for concentrations of gamma emitting nuclides. No fission or activation products were detected in fish.

Sediment samples collected below the discharge had Cesium-137 concentrations that were consistent to those from 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 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 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. Naturally occurring Radium-226 and Thorium-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 10CFR20.2002 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 2015, well water samples were analyzed for tritium, Sr-89, 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.

II. Introduction

The Limerick Generating Station (LGS), consisting of two 3,515 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 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 Labs) on samples collected during the period 1 January 2015 through 31 December 2015.

On 6 July 1996 a 10CFR20.2002 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.

III. 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 2015. 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 at three locations (11S3, 13S3, and 31G1). The control location was 31G1. Four 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.

10CFR20.2002 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 10CFR20.2002. 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 2002 pad, 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.

Independent Spent Fuel Storage Installation (ISFSI)

The results from the dosimeter location 36S2 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 TBE and Midwest Labs on environmental samples for the LGS REMP in 2015. The analytical procedures used by the laboratories are listed in Appendix B Table B-3.

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.

   If no positive activity was detected, then gamma spectroscopy MDC 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, Zr-95, Nb-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 particulate 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 2015 the LGS REMP had a sample recovery rate of 99%. Exceptions are listed below:

1. Air particulate sample from location 15D1 for the week of 01/05/15 – 01/13/15 was not available due to the filter being found out of place, potentially allowing air to bypass the filter (IR 2440275).

2. Air sample from location 13S4 for the week of 03/23/15 – 03/30/15 was not available since the FGI breaker tripped due to PECO maintenance (IR 2489296).

3. Air sample from location 11S1 for the week of 04/06/15 – 04/13/15 was not available due to pump failure; the pump was replaced 04/14/15 (IR 2489339).

4. Air sample from location 14S1 for the week of 04/20/15 – 04/27/15 was not available due to inadequate volume from a blown fuse. The pump and the fuse were replaced on 04/27/15 (IR 2497669).

5. Air sample from location 22G1 for the week of 10/05/15 – 10/12/15 was not available due to pump failure; the pump was replaced on 10/12/15 (IR 2575550).

Each program exception was reviewed to understand the causes of the program exception. Sampling and maintenance errors were reviewed with the personnel involved to prevent recurrence. Occasional equipment breakdowns and freezing temperatures 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 changes to the program in 2015.

F. Compliance to 40CFR190 Limits

A. 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 40CFR190 compliance.

<u>40 CFR 190 Compliance</u>:
The maximum calculated dose to a real individual would not exceed 2.62E-01 mrem (total body), 1.30E+00 mrem (organ), or 2.62E-01 mrem (thyroid).

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

Table 1: 40CFR190 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	4.07E-03	2.58E-01	2.36E-04	0.00E+00	2.62E-01	1.05E+00	25	mrem
Organ Dose	6.73E-03	1.29E+00	6.20E-04	0.00E+00	1.30E+00	5.19E+00	25	mrem
Thyroid Dose	4.07E-03	2.58E-01	2.21E-04	0.00E+00	2.62E-01	3.50E-01	75	mrem

IV. 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.

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Appendix C, Table C–I.2). 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 2.0 to 5.9 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 Iodine-131 activity (Appendix C, Table C–II.3). All results were below the required LLD from TBE; however, Midwest Labs indicated I-131 was present at 0.9 pCi/L in November 2015.

There were no liquid discharges containing I-131 from LGS during 2015, therefore, the I-131 found in drinking water is not from LGS radioactive effluent releases. However, the dose to an infant's thyroid and whole body was conservatively calculated at 3.49E-01 mrem and 4.67E-04 mrem, respectively. This dose represents 1.75E+00% and 7.78E-03%, respectively, of the Appendix I to 10 CFR Part 50 dose limits.

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 2,031 to 3,355 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. Of these locations two, 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.

Beryllium-7 was found at three locations and ranged from 1,211 to 3,624 pCi/kg dry. Potassium-40 was found at all locations and ranged from 10,010 to 16,330 pCi/kg dry. The fission product

Cs-137 was found at locations 16B2 and 16C4. The concentration ranged from 137 to 205 pCi/kg dry.

The activity detected was consistent with those detected in the pre–operational years. There was no release of Cs-137 from LGS, therefore, the Cs-137 activity found at 16C4 is not attributed to LGS radioactive effluent releases. However, the dose to a teenager's skin and whole body was conservatively calculated at 5.38E-04 mrem and 4.61E-04 mrem, respectively. This dose represents 2.69E-03% and 7.69E-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 6 E–3 to 55 E–3 pCi/m^3 with a mean of 16 E–3 pCi/m^3. The results from the intermediate distance location (Group II) ranged from 6 E–3 to 49 E–3 pCi/m^3 with a mean of 16 E–3 pCi/m^3. The results from the remote distance locations (Group III) ranged from 8 E–3 to 36 E–3 pCi/m^3 with a mean of 15 E–3 pCi/m^3. Comparison of the 2015 air particulate data with previous year’s data indicate no effects from the operation of LGS (Appendix C, Figure C–2). In addition, a comparison of the weekly mean values for 2015 indicate 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 43 E–3 to 115 E–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 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 met 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 994 to 1,566 pCi/L. All other nuclides were below the required LLDs.

b. Broad Leaf Vegetation

Four types of broad leaf 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 Be-7 was found in eight of 41 samples and ranged from 157 to 776 pCi/kg wet. Naturally occurring K-40 was found in all samples and ranged from 1,945 to 8,693 pCi/kg wet. Naturally occurring Ra-226 was found in seven of 41 samples and ranged from 321 to 2,242 pCi/kg wet. Naturally occurring Th-228 was found in one of 41 samples at a concentration of 149 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 3.1 to 8.8 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 result of the ambient gamma radiation level at dosimeter location 36S2 was 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 and October 2015 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 2015 Land Use Survey identified differences in locations for residences, gardens, and meat animals between 2014 and 2015. New residences in sectors SE and WNW were identified closer to LGS than in 2014. The nearest gardens in 2014 in sectors NE, E, SE, and WNW are no longer in existence. The gardens identified in sectors NE, E, and SE are farther away than in 2014 and there is no garden present in the WNW sector. Meat animals (beef, dairy cows, pigs, poultry, etc.) found in sectors NE, ENE, and SSW are closer to LGS than in 2014. New meat animals were found in sectors SW and NNW in 2015. 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	Garden	Milk Farm	Meat Animal
		Feet	Feet	Feet	Feet
1	N	3,109	3,333	24,775	24,775
2	NNE	2,706	9,611	-	26,297
3	NE	3,469	14,297	-	14,064
4	ENE	3,231	14,208	-	7,451
5	E	2,864	11,723	-	-
6	ESE	3,434	4,498	-	12,385
7	SE	3,945	23,335	-	25,246
8	SSE	5,403	6,912	-	-
9	S	4,347	6,103	22,114	12,210
10	SSW	5,063	5,321	10,390	7,620
11	SW	3,251	4,558	-	23,145
12	WSW	3,799	4,507	14,177	14,177
13	W	3,627	4,321	-	17,137
14	WNW	3,685	-	-	-
15	NW	3,619	8,200	-	-
16	NNW	5,050	5,586	-	20,930

G. Errata Data

1. Dosimetry data was documented in units of milliroentgen/quarter in Tables C-IX.1, C-IX.2, and C-1X.3 in the 2014 AREOR. Upon review, these units are inconsistent with the information reported on page 14 Section C Ambient Gamma Radiation, that state the data is reported in mR/standard month. The data in the data

tables are in units of mR/standard month and the data table units should be reported as “Results in units of milliroentgen/standard month ± 2 Standard Deviation”. This change impacts Tables C-IX.1, C-IX.2, and C-IX.3 of the 2014 AREOR and the revised tables can be found in Appendix F

2. In the 2014 AREOR Appendix F, which presents corrections to the 2013 AREOR, the 40CFR190 Compliance Values in the text of Appendix F, Section III does not match the table following the text. The numbers in the text are incorrect and should reflect the 40CFR190 compliance values in Table 1. The revised text can be found in Appendix F of this document. This change impacts the following:

   Section III of the 2013 AREOR

   Appendix F of the 2014 AREOR

3. The 2014 AREOR states TLD Panasonic 814 type dosimeters were used for dosimetry data, but does not clearly depict that Landauer OSL type dosimeters were used in 1st quarter 2014. The 2014 AREOR should state that Landauer OSL type dosimeters were used in 1st quarter 2014 and Panasonic 814 (CaSO4) Thermoluminescent dosimeters were used in 2nd – 4th quarter 2014 for ambient gamma radiation level measurements. This change impacts Section IV, C of the 2014 AREOR and the revised text, which can be found in Appendix F.

4. The 2014 AREOR incorrectly reports the sample recovery rate of 90% which is low as only 30 samples were missed out of 1005 samples. This would indicate a recovery rate of 97%. The revised text for this section can be found in Appendix F.

H. 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:

1. Analytics Evaluation Criteria

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

2. ERA Evaluation Criteria

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

3. DOE Evaluation Criteria

   MAPEP's evaluation report provides an acceptance range with associated flag values.

   The MAPEP defines three levels of performance: Acceptable (flag = "A"), Acceptable with Warning (flag = "W"), and Not Acceptable (flag = "N"). Performance is considered acceptable when a mean result for the specified analyte is ± 20% of the reference value. Performance is acceptable with warning when a mean result falls in the range from ± 20% to ± 30% of the reference value. If the bias is greater than 30%, the results are deemed not acceptable.

For the TBE laboratory, 129 out of 139 analyses performed met the specified acceptance criteria. Ten analyses (AP - Cr-51, U-234/233, Gr A, Sr-90; Soil Sr-90; Water – Ni-63, Sr-89, Sr-90, Natural U; Vegetation Sr-90 samples) did not meet the specified acceptance criteria for the following reasons:

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.

1. Teledyne Brown Engineering's Analytics' June 2015 air particulate Cr-51 result of 323 ± 45.5 pCi was higher than the known value of 233 pCi with a ratio of 1.39. The upper ratio of 1.30 (acceptable

with warning) was exceeded. The air particulate sample is counted at a distance above the surface of the detector to avoid detector summing which could alter the results. Chromium-51 has the shortest half-life (27.7 days) and the lowest gamma energy (320.08 keV) of this mixed nuclide sample. Additionally, Cr-51 has only one gamma energy and also has a low intensity (9.38 gamma photons produced per 100 disintegrations). This geometry produces a larger error for the Cr-51 and other gamma emitters as any distance from the detector decreases the counting rate and the probability of accurately detecting the nuclide energy. Taking into consideration the uncertainty, the activity of Cr-51 overlaps with the known value at a ratio of 1.19, which would statistically be considered acceptable. NCR 15-18

2. Teledyne Brown Engineering's MAPEP March 2015 soil Sr-90 result of 286 Total Bq/kg was lower than the known value of 653 Bq/kg, exceeding the lower acceptance range of 487 Bq/kg. The failure was due to incomplete digestion of the sample. Incomplete digestion of samples causes some of the sample to be left behind and is not present in the digested sample utilized for analysis. The procedure has been updated to include a more robust digestion using stirring during the heating phase. The MAPEP September 2014 soil Sr-90 series prior to this study was evaluated as acceptable with a result of 694 and an acceptance range of 601 – 1115 Bq/kg. The MAPEP September 2015 series soil Sr-90 after this study was evaluated as acceptable with a result of 429 and an acceptance range of 298 – 553 Bq/kg. We feel the issue is specific to the March 2015 MAPEP sample. NCR 15-13

3. Teledyne Brown Engineering's MAPEP March 2015 air particulate U-234/233 result of 0.0211 ± 0.0120 Bq/sample was higher than the known value of 0.0155 Bq/sample, exceeding the upper acceptance range of 0.0202 Bq/sample. Although evaluated as a failure, taking into consideration the uncertainty, TBE's result would overlap with the known value, which is statistically considered acceptable. MAPEP spiked the sample with significantly more U-238 activity (a found to known ratio of 0.96) than the normal U-234/233. Due to the extremely low activity, it was difficult to quantify the U-234/233. NCR 15-13

4. Teledyne Brown Engineering's MAPEP March 2015 air particulate gross alpha result of 0.448 Bq/sample was lower than the known value of 1.77 Bq/sample, exceeding the lower acceptance range of 0.53 Bq/sample. The instrument efficiency used for gross alpha is determined using a non-attenuated alpha standard. The MAPEP filter has the alphas embedded in the filter, requiring an attenuated efficiency. When samples contain alpha particles that are

embedded in the sample media, due to the size of the alpha particle, some of the alpha particles are absorbed by the media and cannot escape to be counted. When the sample media absorbs the alpha particles this is known as self-absorption or attenuation. The calibration must include a similar configuration/media to correct for the attenuation. In order to correct the low bias, TBE will create an attenuated efficiency for MAPEP air particulate filters. The MAPEP September series air particulate gross alpha result of 0.47 Bq/sample was evaluated as acceptable with a range of 0.24 – 1.53 Bq/sample. Unlike the MAPEP samples, air particulate Gross alpha analyses for power plants are not evaluated as a direct count sample. Power plant air particulate filters for gross alpha go through an acid digestion process prior to counting and the digested material is analyzed. NCR 15-13

5. Teledyne Brown Engineering's MAPEP September water Ni-63 result of 11.8 ± 10.8 Bq/L was higher than the known value of 8.55 Bq/L, exceeding the upper acceptance range of 11.12 Bq/L. The Ni-63 half-life is approximately 100 years. Nickel-63 is considered to be a "soft" or low energy beta emitter, which means that the beta energy is very low. The maximum beta energy for Ni-63 is approximately 65 keV, much lower than other more common nuclides such as Co-60 (maximum beta energy of 1549 keV). The original sample was run with a 10 mL aliquot which was not sufficient for the low level of Ni-63 in the sample. The rerun aliquot of 30 mL produced an acceptable result of 8.81 Bq/L. NCR 15-21

6. Teledyne Brown Engineering's MAPEP September air particulate Sr-90 result of 1.48 Bq/sample was lower than the known value of 2.18 Bq/sample, exceeding the lower acceptance range of 1.53 Bq/sample. In the past, MAPEP has added substances (unusual compounds found in DOE complexes) to various matrices that have resulted in incomplete removal of the isotope of interest for the laboratories analyzing the cross checks. TBE suspects that this may be the cause of this error. Many compounds, if not properly accounted for or removed in the sample matrix, can cause interferences to either indicate lower activity or higher activity. TBE will no longer analyze the air particulate Sr-90 through MAPEP but will participate in the Analytics cross check program to perform both Sr-89 and Sr-90 in the air particulate matrix. NCR 15-21

7. Teledyne Brown Engineering's MAPEP September vegetation Sr-90 result of 0.386 Bq/sample was lower than the known value of 1.30 Bq/sample, exceeding the lower acceptance range of 0.91 Bq/sample. In the past, MAPEP has added substances (unusual compounds found in DOE complexes) to various matrices that have resulted in incomplete removal of the isotope of interest for

the laboratories analyzing the cross checks. TBE suspects that this maybe the cause of this error. Many compounds, if not properly accounted for or removed in the sample matrix, can cause interferences to either indicate lower activity or higher activity. Results from previous performance evaluations were reviewed and shown to be acceptable. NCR 15-21

8. & 9. Teledyne Brown Engineering's ERA May water Sr-89/90 results of 45.2 and 28.0 pCi/L, respectively were lower than the known values of 63.2 and 41.9 pCi/L, respectively, exceeding the lower acceptance limits of 51.1 and 30.8 pCi/L, respectively. The yields were on the high side of the TBE acceptance range, which indicates the present of excess calcium contributed to the yield, resulting in low results. NCR 15-09

10. Teledyne Brown Engineering's ERA November water Uranium natural result of 146.9 pCi/L was higher than the known value of 56.2 pCi/L, exceeding the upper acceptance limit of 62.4 pCi/L. The technician failed to dilute the original sample, but used the entire 12 mL sample. When the results were recalculated without the dilution and using the 12 mL aliquot, the result of 57.16 agreed with the assigned value of 56.2. NCR 15-19.

For the EIML laboratory, 90 of 94 analyses met the specified acceptance criteria. Four analyses (Water – Co-57, Fe-55; AP – Co-57; Soil – Sr-90) did not meet the specified acceptance criteria for the following reasons:

1. The Environmental Inc., Midwest Laboratory's MAPEP February 2015 water Co-57 result of 10.2 Bq/L was lower than the known value of 29.9 Bq/L, exceeding the lower control limit of 20.9 Bq/L. The reported value should have been 27.84, which would have been evaluated as acceptable. A data entry error resulted in a non-acceptable result.

2. The Environmental Inc., Midwest Laboratory's MAPEP February 2015 AP Co-57 result of 0.04 Total Bq was lower than the known value of 1.51 Bq/L, exceeding the lower control limit of 1.06 Total Bq. The reported value should have been 1.58, which would have been evaluated as acceptable. A data entry error resulted in a non-acceptable result.

3. The Environmental Inc., Midwest Laboratory's MAPEP August 2015 soil Sr-90 result of 231 Bq/kg was lower than the known value of 425 Bq/kg, exceeding the lower control limit of 298 Bq/kg. The incomplete separation of calcium from strontium caused a failed low result. The reanalysis result of 352 Bq/kg fell within acceptance criteria.

4. The Environmental Inc., Midwest Laboratory's MAPEP August 2015 water Fe-55 result of 4.2 Bq/L was lower than the known value of 13.1 Bq/L, exceeding the lower control limit of 9.2 Bq/L. The known activity was below the routine laboratory detection limits for the available aliquot fraction.

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

V. 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

Intentionally Left Blank

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

Intentionally left blank

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	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

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER (PCI/LITER)	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
DRINKING WATER (PCI/LITER)	GR-B	48	4	3.7 (33/36) (2.0/5.9)	3.3 (10/12) (2.5/4.5)	4.3 (12/12) (2.4/5.9)	15F4 INDICATOR AQUA AMERICA 8.62 MILES SE OF SITE	0
	H-3	16	200	<LLD	<LLD	-		0
	I-131	48	1	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DRINKING WATER (PCI/LITER)	GAMMA MN-54	48	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
DRINKING WATER (PCI/LITER)	NB-95		15	<LLD	<LLD	-		0
	ZR-95		30	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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
DRINKING WATER (PCI/LITER)	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0
BOTTOM FEEDER (PCI/KG WET)	GAMMA	4						
	K-40		NA	3230 (2/2) (3122/3337)	2346 (2/2) (2031/2661)	3230 (2/2) (3122/3337)	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

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
BOTTOM FEEDER (PCI/KG WET)	ZN-65		260	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0
	CS-137		150	<LLD	<LLD	-		0
PREDATOR (PCI/KG WET)	GAMMA	4						
	K-40		NA	3194 (2/2) (3102/3286)	3113 (2/2) (2871/3355)	3194 (2/2) (3102/3286)	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0
	MN-54		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
PREDATOR (PCI/KG WET)	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 (PCI/KG DRY)	GAMMA BE-7	6	NA	2298 (3/4) (1211/3624)	2047 (1/2)	2418 (2/2) (1211/3624)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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
SEDIMENT (PCI/KG DRY)	K-40		NA	14213 (4/4) (12160/16330)	12715 (2/2) (10010/15420)	15345 (2/2) (14360/16330)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES 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	179 (3/4) (137/205)	<LLD	205 (1/2)	16C4 INDICATOR VINCENT DAM 2.18 MILES SSE OF SITE	0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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 (E-3 PCI/CU.METER)	GR-B	359	10	16 (303/308) (6/55)	15 (50/51) (8/36)	17 (50/51) (7/55)	14S1 INDICATOR LONGVIEW ROAD 0.63 MILES SSE OF SITE	0
	GAMMA	28						
	BE-7		NA	73 (24/24) (49/115)	80 (4/4) (43/113)	85 (4/4) (65/108)	6C1 INDICATOR 11305 FEET NE OF SITE	0
	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

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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 IODINE (E-3 PCI/CU.METER)	GAMMA I-131	360	70	<LLD	<LLD	-		0
MILK (PCI/LITER)	I-131	88	1	<LLD	<LLD	-		0
	GAMMA K-40	88	NA	1275 (63/63) (1035/1566)	1273 (25/25) (994/1465)	1333 (21/21) (1164/1465)	19B1 INDICATOR 1.95 MILES SSW OF SITE	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

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
VEGETATION (PCI/KG WET)	GAMMA	41						
	BE-7		NA	396 (5/28) (157/665)	582 (3/13) (333/776)	582 (3/13) (333/776)	31G1 CONTROL	0
	K-40		NA	5048 (28/28) (1945/7746)	5588 (13/13) (2661/8693)	5588 (13/13) (2661/8693)	31G1 CONTROL	0
	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

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2015

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

LOCATION OF FACILITY: MONTGOMERY, PA **REPORTING PERIOD: 2015**

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 (PCI/KG WET)	RA-226		NA	1534 (6/28) (321/2242)	994 (1/13)	1534 (6/14) (321/2242)	13S3 INDICATOR VINCENT DAM 0.24 MILES SE OF SITE	0
	TH-228		NA	149 (1/28)	<LLD	149 (1/14)	13S3 INDICATOR VINCENT DAM 0.24 MILES SE OF SITE	0
	TH-232		NA	<LLD	<LLD	-		0
DIRECT RADIATION (MILLI-ROENTGEN/STD.MO.)	OSLD-QUARTERLY	160	NA	5.3 (156/156) (3.1/8.8)	6.8 (4/4) (6.0/7.2)	8.1 (4/4) (7.3/8.8)	13S2 INDICATOR 500 KV SUBSTATION 0.41 MILES SE	0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESIS (F)

Intentionally left blank

APPENDIX B

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

Intentionally left blank

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, 2015

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 Water Authority (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, 2015

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, 2015

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
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

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Limerick Generating Station, 2015

Sample Medium	Analysis	Sampling Method	Collection Procedure Number	Sample Size	Analytical Procedure Number
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

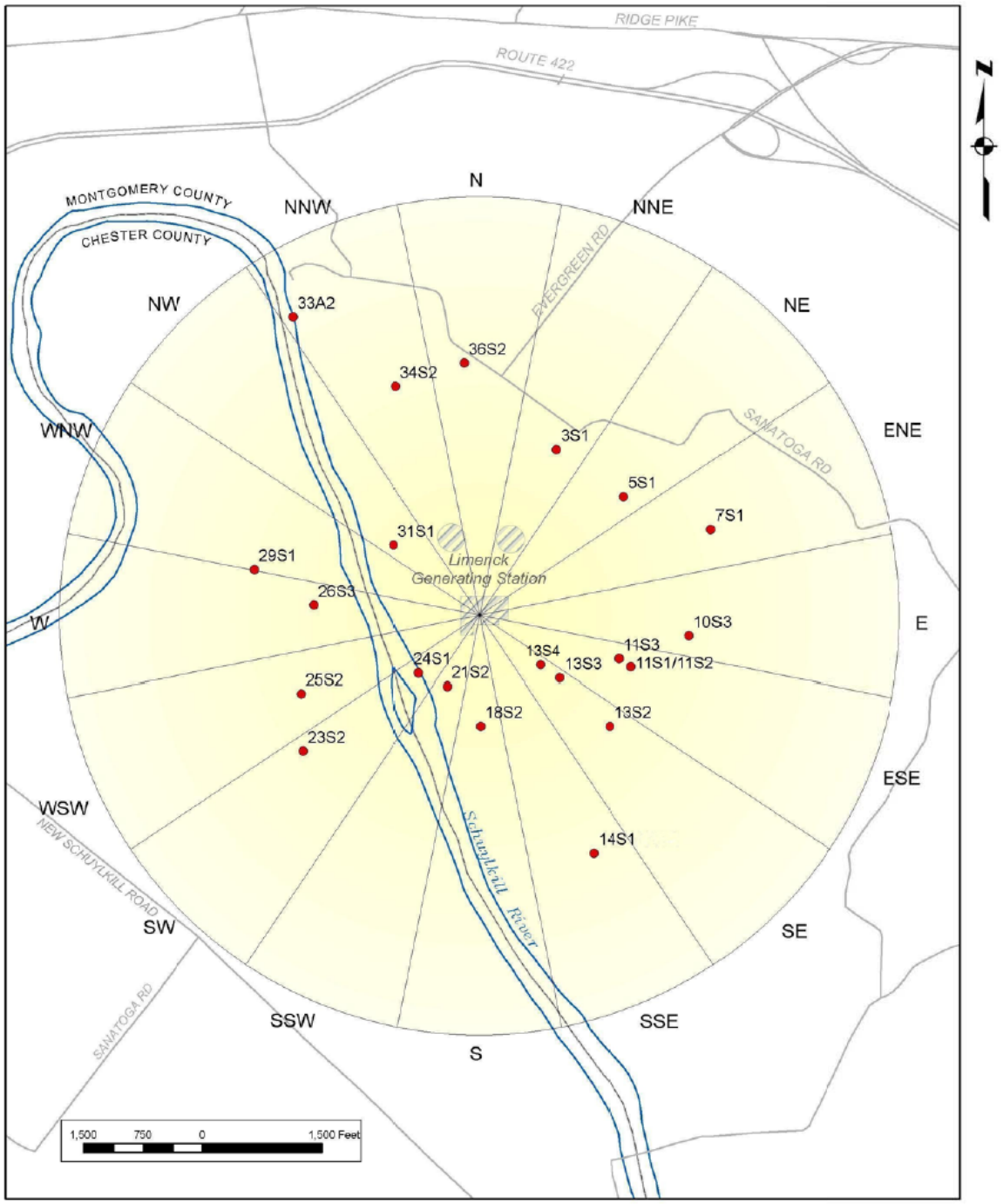


Figure B-1
Environmental Sampling Locations Within 5,280 Feet
of the Limerick Generating Station, 2015

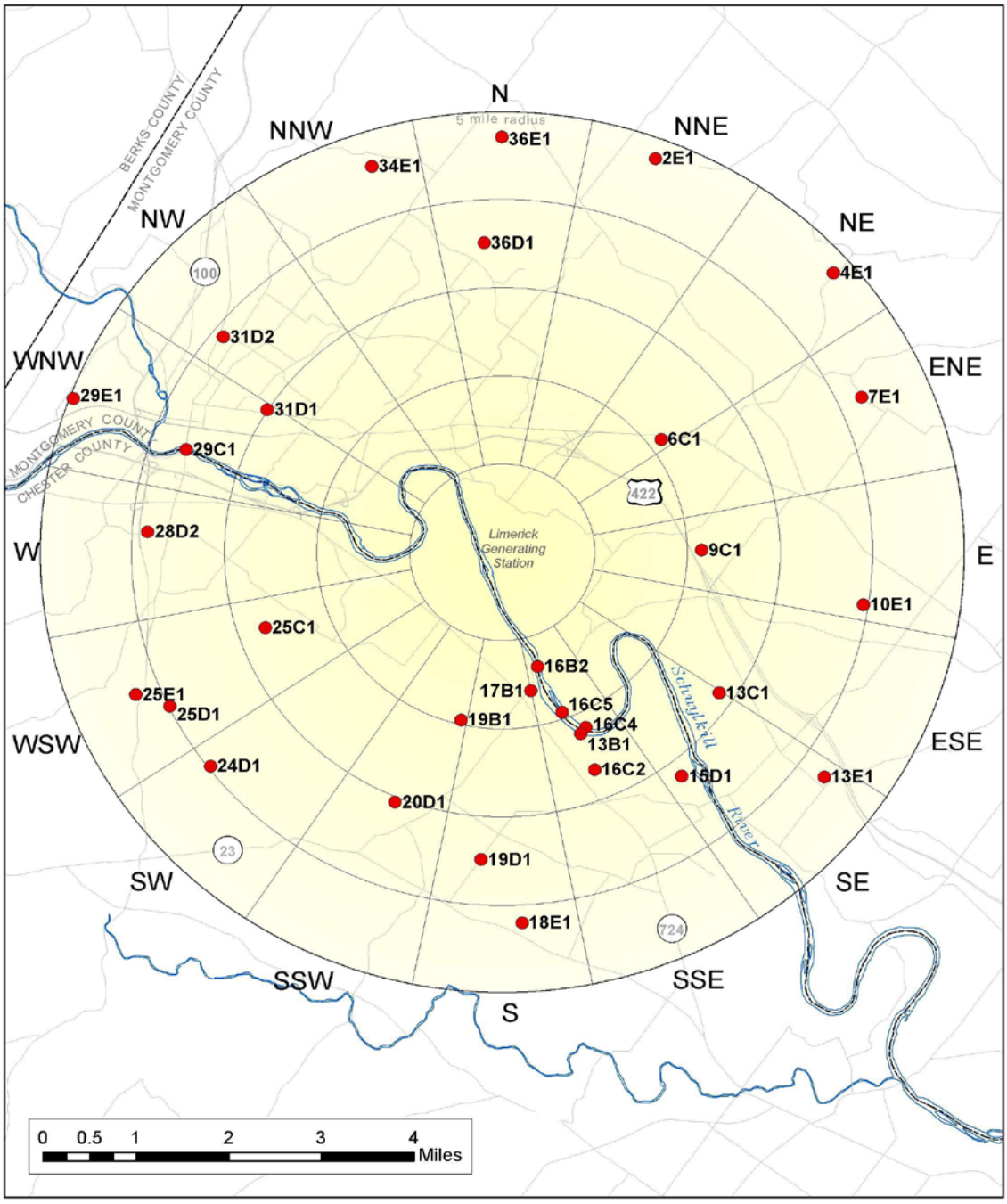


Figure B-2
Environmental Sampling Locations Between 5,280 and 26,400 Feet
from the Limerick Generating Station, 2015

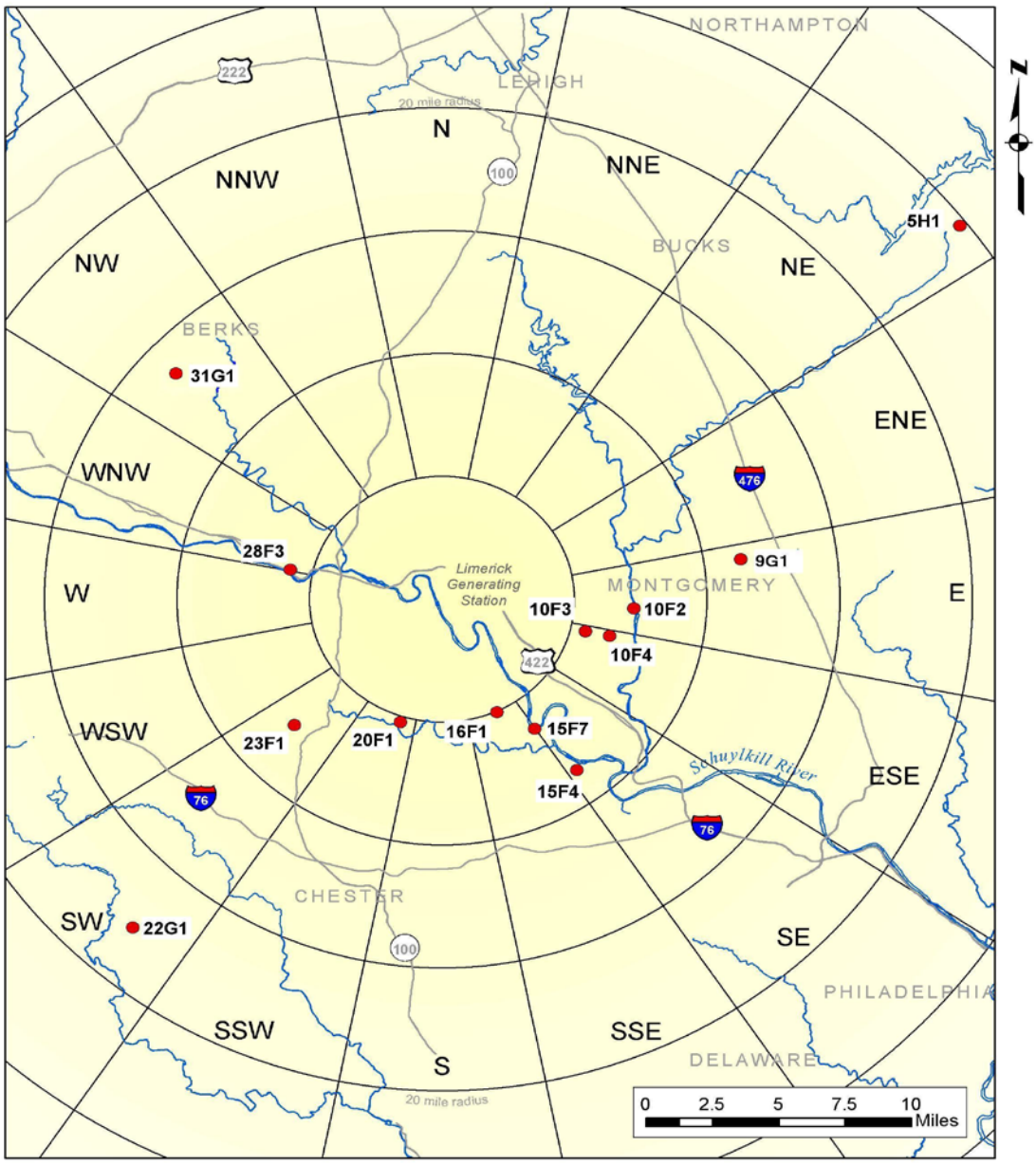


Figure B-3
Environmental Sampling Locations Greater than 26,400 Feet
from the Limerick Generating Station, 2015

APPENDIX C

DATA TABLES AND FIGURES
PRIMARY LABORATORY

Intentionally left blank

Table C-I.1 **CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	13B1	24S1
12/31/14 - 03/31/15	< 197	< 195
03/31/15 - 06/29/15	< 186	< 190
06/29/15 - 09/29/15	< 198	< 196
09/29/15 - 12/28/15	< 166	< 163
MEAN	-	-

Table C-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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	12/29/14 - 02/03/15	< 5	< 6	< 15	< 5	< 15	< 6	< 10	< 12	< 5	< 5	< 28	< 10
	02/03/15 - 03/02/15	< 5	< 7	< 16	< 6	< 14	< 7	< 13	< 13	< 6	< 7	< 31	< 12
	03/02/15 - 03/31/15	< 5	< 5	< 11	< 5	< 12	< 5	< 8	< 10	< 5	< 5	< 26	< 9
	03/31/15 - 04/28/15	< 6	< 6	< 13	< 6	< 10	< 5	< 9	< 8	< 6	< 6	< 19	< 10
	04/28/15 - 06/02/15	< 5	< 4	< 10	< 4	< 8	< 5	< 9	< 15	< 5	< 5	< 33	< 11
	06/02/15 - 06/29/15	< 7	< 7	< 11	< 7	< 16	< 7	< 11	< 11	< 6	< 7	< 36	< 11
	06/29/15 - 08/04/15	< 6	< 6	< 13	< 5	< 12	< 6	< 10	< 11	< 5	< 5	< 32	< 9
	08/04/15 - 08/31/15	< 10	< 8	< 17	< 9	< 18	< 9	< 17	< 13	< 8	< 9	< 41	< 10
	08/31/15 - 09/29/15	< 11	< 9	< 18	< 8	< 21	< 10	< 16	< 12	< 9	< 11	< 31	< 12
	09/29/15 - 11/03/15	< 5	< 5	< 12	< 5	< 10	< 6	< 9	< 13	< 5	< 6	< 27	< 10
	11/03/15 - 12/01/15	< 5	< 5	< 8	< 5	< 13	< 6	< 8	< 7	< 5	< 6	< 22	< 7
	12/01/15 - 12/28/15	< 7	< 7	< 15	< 8	< 10	< 6	< 12	< 13	< 6	< 7	< 33	< 13
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
24S1	12/29/14 - 02/03/15	< 7	< 6	< 16	< 7	< 14	< 8	< 11	< 15	< 6	< 7	< 40	< 13
	02/03/15 - 03/02/15	< 5	< 6	< 12	< 5	< 9	< 5	< 9	< 12	< 6	< 6	< 32	< 11
	03/02/15 - 03/31/15	< 4	< 3	< 8	< 3	< 7	< 4	< 7	< 9	< 4	< 4	< 21	< 6
	03/31/15 - 04/28/15	< 8	< 10	< 16	< 7	< 15	< 7	< 13	< 14	< 8	< 8	< 40	< 14
	04/28/15 - 06/02/15	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 8	< 3	< 3	< 20	< 7
	06/02/15 - 06/29/15	< 6	< 7	< 9	< 7	< 14	< 8	< 13	< 12	< 6	< 5	< 38	< 12
	06/29/15 - 08/04/15	< 7	< 8	< 21	< 7	< 17	< 7	< 12	< 15	< 8	< 8	< 46	< 14
	08/04/15 - 08/31/15	< 6	< 6	< 17	< 7	< 19	< 9	< 12	< 12	< 7	< 7	< 40	< 9
	08/31/15 - 09/29/15	< 11	< 7	< 19	< 8	< 17	< 10	< 17	< 11	< 9	< 10	< 31	< 4
	09/29/15 - 11/03/15	< 5	< 6	< 12	< 7	< 12	< 8	< 11	< 13	< 6	< 7	< 32	< 8
	11/03/15 - 12/01/15	< 6	< 7	< 11	< 8	< 12	< 8	< 13	< 10	< 6	< 6	< 39	< 8
	12/01/15 - 12/28/15	< 7	< 7	< 14	< 8	< 16	< 9	< 13	< 14	< 8	< 9	< 44	< 14
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-II.1 **CONCENTRATIONS OF GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/29/14 - 02/03/15	4.2 ± 1.8	< 2.4	< 2.4	< 2.1
02/03/15 - 03/02/15	4.6 ± 2.1	4.7 ± 1.9	4.1 ± 1.8	3.4 ± 1.8
03/02/15 - 03/31/15	3.1 ± 1.8	2.4 ± 1.6	2.1 ± 1.3	2.5 ± 1.6
03/31/15 - 04/28/15	2.4 ± 1.5	3.5 ± 1.5	2.0 ± 1.4	< 2.0
04/28/15 - 06/02/15	3.5 ± 1.7	3.3 ± 1.7	3.2 ± 1.7	3.5 ± 1.7
06/02/15 - 06/29/15	5.9 ± 1.8	4.9 ± 1.7	3.8 ± 1.7	2.8 ± 1.5
06/29/15 - 08/04/15	5.5 ± 1.7	2.4 ± 1.3	2.5 ± 1.4	3.3 ± 1.4
08/04/15 - 08/31/15	4.9 ± 1.9	4.8 ± 1.9	2.9 ± 1.8	2.9 ± 1.7
08/31/15 - 09/29/15	5.2 ± 1.8	4.3 ± 1.7	2.6 ± 1.6	3.2 ± 1.6
09/29/15 - 11/03/15	4.1 ± 1.7	3.0 ± 1.6	3.3 ± 1.6	3.1 ± 1.6
11/03/15 - 12/01/15	5.1 ± 1.7	4.2 ± 1.6	3.8 ± 1.6	4.5 ± 1.7
12/01/15 - 12/28/15	3.4 ± 1.5	< 1.9	3.4 ± 1.5	3.6 ± 1.5
MEAN	4.3 ± 2.1	3.8 ± 1.9	3.1 ± 1.4	3.3 ± 1.1

Table C-II.2 **CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/31/14 - 03/31/15	< 197	< 198	< 163	< 195
03/31/15 - 06/29/15	< 188	< 193	< 187	< 188
06/29/15 - 09/29/15	< 183	< 182	< 184	< 184
09/29/15 - 12/28/15	< 179	< 181	< 180	< 180
MEAN	-	-	-	-

Table C-II.3 **CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/29/14 - 02/03/15	< 0.5	< 0.5	< 0.5	< 0.5
02/03/15 - 03/02/15	< 0.4	< 0.4	< 0.3	< 0.4
03/02/15 - 03/31/15	< 0.4	< 0.2	< 0.3	< 0.4
03/31/15 - 04/28/15	< 0.2	< 0.2	< 0.2	< 0.3
04/28/15 - 06/02/15	< 0.8	< 0.8	< 0.6	< 1.0
06/02/15 - 06/29/15	< 0.4	< 0.3	< 0.3	< 0.4
06/29/15 - 08/04/15	< 0.4	< 0.6	< 0.3	< 0.4
08/04/15 - 08/31/15	< 0.4	< 0.4	< 0.4	< 0.4
08/31/15 - 09/29/15	< 0.6	< 0.7	< 0.6	< 0.8
09/29/15 - 11/03/15	< 0.6	< 0.6	< 0.6	< 0.7
11/03/15 - 12/01/15	< 0.7	< 0.6	< 0.8	< 0.7
12/01/15 - 12/28/15	< 0.4	< 0.5	< 0.5	< 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, 2015**

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	12/29/14 - 02/03/15	< 6	< 7	< 10	< 6	< 12	< 7	< 10	< 5	< 6	< 29	< 12
	02/03/15 - 03/02/15	< 5	< 5	< 11	< 6	< 11	< 5	< 12	< 6	< 6	< 31	< 10
	03/02/15 - 03/31/15	< 4	< 5	< 9	< 5	< 9	< 5	< 9	< 5	< 5	< 26	< 7
	03/31/15 - 04/28/15	< 6	< 5	< 12	< 6	< 15	< 7	< 12	< 7	< 7	< 32	< 11
	04/28/15 - 06/02/15	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 12	< 4
	06/02/15 - 06/29/15	< 7	< 6	< 16	< 7	< 14	< 8	< 12	< 6	< 7	< 39	< 10
	06/29/15 - 08/04/15	< 4	< 4	< 7	< 4	< 8	< 5	< 9	< 4	< 5	< 23	< 5
	08/04/15 - 08/31/15	< 8	< 7	< 18	< 5	< 16	< 7	< 13	< 6	< 6	< 23	< 9
	08/31/15 - 09/29/15	< 8	< 8	< 16	< 8	< 14	< 8	< 14	< 7	< 7	< 28	< 9
	09/29/15 - 11/03/15	< 6	< 6	< 11	< 5	< 12	< 7	< 9	< 6	< 6	< 33	< 7
	11/03/15 - 12/01/15	< 5	< 4	< 12	< 6	< 12	< 7	< 9	< 5	< 6	< 19	< 5
	12/01/15 - 12/28/15	< 6	< 6	< 13	< 5	< 11	< 5	< 9	< 6	< 7	< 38	< 10
	MEAN	-	-	-	-	-	-	-	-	-	-	-
15F7	12/29/14 - 02/03/15	< 7	< 6	< 10	< 7	< 14	< 6	< 13	< 7	< 7	< 36	< 10
	02/03/15 - 03/02/15	< 5	< 6	< 13	< 6	< 12	< 6	< 11	< 7	< 6	< 34	< 10
	03/02/15 - 03/31/15	< 4	< 4	< 8	< 4	< 8	< 5	< 7	< 4	< 4	< 23	< 5
	03/31/15 - 04/28/15	< 7	< 8	< 18	< 7	< 15	< 8	< 14	< 8	< 8	< 35	< 11
	04/28/15 - 06/02/15	< 4	< 5	< 11	< 5	< 8	< 5	< 8	< 4	< 5	< 31	< 11
	06/02/15 - 06/29/15	< 6	< 6	< 16	< 7	< 14	< 7	< 11	< 6	< 6	< 32	< 12
	06/29/15 - 08/04/15	< 5	< 5	< 11	< 6	< 12	< 5	< 10	< 5	< 6	< 27	< 9
	08/04/15 - 08/31/15	< 7	< 6	< 18	< 6	< 14	< 7	< 9	< 8	< 7	< 29	< 6
	08/31/15 - 09/29/15	< 7	< 5	< 15	< 7	< 13	< 6	< 13	< 7	< 5	< 24	< 9
	09/29/15 - 11/03/15	< 5	< 5	< 9	< 6	< 10	< 6	< 10	< 7	< 6	< 33	< 6
	11/03/15 - 12/01/15	< 7	< 9	< 14	< 9	< 15	< 8	< 11	< 7	< 8	< 29	< 7
	12/01/15 - 12/28/15	< 7	< 6	< 14	< 7	< 13	< 9	< 12	< 6	< 8	< 38	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-II.4 **CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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	12/29/14 - 02/03/15	< 8	< 7	< 17	< 6	< 14	< 7	< 10	< 7	< 7	< 28	< 14
	02/03/15 - 03/02/15	< 7	< 6	< 9	< 7	< 11	< 8	< 11	< 6	< 6	< 38	< 12
	03/02/15 - 03/31/15	< 6	< 6	< 13	< 7	< 13	< 5	< 11	< 5	< 6	< 35	< 11
	03/31/15 - 04/28/15	< 7	< 7	< 9	< 6	< 14	< 5	< 11	< 6	< 7	< 25	< 10
	04/28/15 - 06/02/15	< 4	< 5	< 8	< 4	< 9	< 5	< 8	< 4	< 5	< 32	< 9
	06/02/15 - 06/29/15	< 8	< 7	< 17	< 8	< 15	< 7	< 14	< 6	< 8	< 38	< 12
	06/29/15 - 08/04/15	< 5	< 6	< 12	< 5	< 10	< 7	< 11	< 6	< 6	< 35	< 8
	08/04/15 - 08/31/15	< 8	< 7	< 15	< 7	< 15	< 9	< 16	< 7	< 9	< 30	< 12
	08/31/15 - 09/29/15	< 7	< 6	< 14	< 5	< 9	< 10	< 11	< 8	< 8	< 32	< 12
	09/29/15 - 11/03/15	< 7	< 5	< 14	< 5	< 13	< 5	< 9	< 7	< 7	< 34	< 15
	11/03/15 - 12/01/15	< 7	< 8	< 16	< 6	< 17	< 7	< 12	< 6	< 8	< 24	< 8
	12/01/15 - 12/28/15	< 5	< 5	< 13	< 6	< 10	< 6	< 9	< 5	< 4	< 32	< 9
	MEAN	-	-	-	-	-	-	-	-	-	-	-
28F3	12/29/14 - 02/03/15	< 9	< 8	< 17	< 8	< 16	< 9	< 15	< 6	< 7	< 39	< 15
	02/03/15 - 03/02/15	< 5	< 5	< 10	< 4	< 10	< 5	< 8	< 4	< 5	< 25	< 9
	03/02/15 - 03/31/15	< 6	< 4	< 11	< 5	< 10	< 6	< 10	< 5	< 6	< 24	< 7
	03/31/15 - 04/28/15	< 7	< 7	< 15	< 7	< 13	< 8	< 12	< 7	< 8	< 34	< 10
	04/28/15 - 06/02/15	< 5	< 5	< 11	< 6	< 10	< 6	< 9	< 4	< 6	< 33	< 9
	06/02/15 - 06/29/15	< 7	< 8	< 14	< 7	< 16	< 6	< 13	< 8	< 8	< 35	< 12
	06/29/15 - 08/04/15	< 6	< 5	< 9	< 4	< 12	< 6	< 11	< 6	< 6	< 34	< 9
	08/04/15 - 08/31/15	< 7	< 7	< 13	< 7	< 19	< 7	< 12	< 7	< 7	< 27	< 7
	08/31/15 - 09/29/15	< 7	< 7	< 14	< 8	< 13	< 6	< 14	< 6	< 7	< 27	< 7
	09/29/15 - 11/03/15	< 6	< 6	< 13	< 6	< 14	< 6	< 12	< 7	< 6	< 32	< 12
	11/03/15 - 12/01/15	< 8	< 9	< 13	< 8	< 17	< 7	< 13	< 10	< 8	< 35	< 9
	12/01/15 - 12/28/15	< 5	< 7	< 13	< 4	< 10	< 7	< 10	< 6	< 4	< 29	< 15
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1 **CONCENTRATIONS OF GAMMA EMITTERS IN PREDATOR AND BOTTOM FEEDER (FISH) SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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									
	05/22/15	3102 ± 587	< 32	< 30	< 76	< 36	< 68	< 123	< 34	< 42
	11/17/15	3286 ± 960	< 55	< 52	< 125	< 60	< 103	< 76.7	< 56	< 62
	MEAN	3194 ± 260	-	-	-	-	-	-	-	-
16C5	BOTTOM FEEDER									
	05/22/15	3122 ± 898	< 39	< 41	< 92	< 26	< 89	< 145	< 36	< 23
	11/17/15	3337 ± 560	< 43	< 43	< 82	< 49	< 101	< 52.3	< 46	< 45
	MEAN	3230 ± 304	-	-	-	-	-	-	-	-
29C1	PREDATOR									
	05/15/15	3355 ± 1149	< 56	< 45	< 115	< 54	< 109	< 175	< 66	< 59
	10/27/15	2871 ± 1020	< 58	< 45	< 113	< 58	< 127	< 111	< 53	< 65
	MEAN	3113 ± 684	-	-	-	-	-	-	-	-
29C1	BOTTOM FEEDER									
	05/15/15	2031 ± 901	< 54	< 49	< 78	< 47	< 68	< 156	< 51	< 53
	10/27/15	2661 ± 1292	< 72	< 81	< 187	< 100	< 161	< 154	< 80	< 87
	MEAN	2346 ± 891	-	-	-	-	-	-	-	-

Table C-IV.1 **CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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	06/23/15	3624 ± 1023	16330 ± 1893	< 106	< 87	< 95	< 346	< 89	137 ± 95
	11/30/15	1211 ± 1121	14360 ± 2502	< 120	< 146	< 125	< 159	< 120	196 ± 159
	MEAN	2418 ± 3412	15345 ± 2786	-	-	-	-	-	166 ± 84
16C4	06/23/15	< 799	12160 ± 1566	< 79	< 88	< 82	< 315	< 83	< 98
	11/30/15	2058 ± 993	14000 ± 2547	< 146	< 113	< 138	< 167	< 126	205 ± 155
	MEAN	2058 ± 0	13080 ± 2602	-	-	-	-	-	205 ± 0
33A2	06/23/15	2047 ± 938	15420 ± 2013	< 111	< 110	< 112	< 326	< 101	< 123
	11/30/15	< 886	10010 ± 1534	< 108	< 96	< 102	< 135	< 142	< 124
	MEAN	2047 ± 0	12715 ± 7651	-	-	-	-	-	-

Table C-V.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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
12/29/14 - 01/05/15	18 ± 5	13 ± 5	19 ± 5	15 ± 5	21 ± 6	15 ± 5	16 ± 5
01/05/15 - 01/13/15	22 ± 5	22 ± 5	18 ± 4	24 ± 5	21 ± 5	(1)	17 ± 4
01/13/15 - 01/20/15	14 ± 5	14 ± 5	13 ± 4	14 ± 5	14 ± 5	16 ± 5	10 ± 5
01/20/15 - 01/26/15	19 ± 5	20 ± 5	13 ± 4	21 ± 5	19 ± 5	22 ± 5	16 ± 5
01/26/15 - 02/01/15	20 ± 6	14 ± 5	14 ± 5	14 ± 5	14 ± 5	12 ± 5	11 ± 5
02/01/15 - 02/08/15	17 ± 5	18 ± 5	9 ± 4	18 ± 5	16 ± 5	17 ± 5	16 ± 5
02/08/15 - 02/16/15	23 ± 5	17 ± 5	16 ± 4	18 ± 5	15 ± 5	14 ± 5	20 ± 5
02/16/15 - 02/23/15	22 ± 5	16 ± 5	18 ± 5	23 ± 5	13 ± 5	19 ± 5	21 ± 5
02/23/15 - 03/03/15	23 ± 5	24 ± 5	21 ± 4	22 ± 5	19 ± 5	21 ± 5	18 ± 5
03/03/15 - 03/10/15	17 ± 5	16 ± 5	16 ± 4	18 ± 5	22 ± 5	19 ± 5	16 ± 5
03/10/15 - 03/17/15	12 ± 4	6 ± 4	7 ± 4	11 ± 4	11 ± 5	10 ± 5	9 ± 4
03/17/15 - 03/23/15	18 ± 5	16 ± 5	12 ± 5	18 ± 5	18 ± 6	18 ± 5	15 ± 5
03/23/15 - 03/30/15	14 ± 4	17 ± 5	(1)	17 ± 4	16 ± 4	14 ± 4	15 ± 4
03/30/15 - 04/06/15	< 7	10 ± 5	10 ± 4	9 ± 5	11 ± 5	12 ± 5	10 ± 5
04/06/15 - 04/13/15	13 ± 4	(1)	10 ± 4	8 ± 4	12 ± 4	13 ± 4	11 ± 4
04/13/15 - 04/20/15	10 ± 5	8 ± 5	9 ± 4	12 ± 5	9 ± 5	13 ± 5	13 ± 5
04/20/15 - 04/27/15	9 ± 4	< 9	9 ± 4	(1)	< 6	9 ± 4	9 ± 4
04/27/15 - 05/04/15	6 ± 4	7 ± 4	8 ± 4	< 8	9 ± 5	7 ± 4	< 6
05/04/15 - 05/11/15	14 ± 5	17 ± 5	14 ± 4	21 ± 6	17 ± 5	15 ± 5	15 ± 5
05/11/15 - 05/18/15	18 ± 5	23 ± 5	13 ± 4	12 ± 5	15 ± 5	16 ± 5	15 ± 5
05/18/15 - 05/26/15	14 ± 4	16 ± 4	14 ± 4	10 ± 4	13 ± 4	16 ± 4	12 ± 4
05/26/15 - 06/01/15	12 ± 5	10 ± 5	14 ± 5	10 ± 5	12 ± 5	13 ± 6	13 ± 5
06/01/15 - 06/08/15	< 5	8 ± 4	6 ± 3	7 ± 4	6 ± 4	8 ± 4	9 ± 4
06/08/15 - 06/15/15	11 ± 4	16 ± 5	11 ± 4	14 ± 5	13 ± 5	13 ± 5	11 ± 4
06/15/15 - 06/22/15	6 ± 4	10 ± 4	8 ± 4	10 ± 4	9 ± 4	13 ± 4	10 ± 4
06/22/15 - 06/29/15	9 ± 4	12 ± 4	6 ± 3	11 ± 4	12 ± 4	11 ± 4	12 ± 5
06/29/15 - 07/07/15	15 ± 4	12 ± 4	16 ± 4	14 ± 4	15 ± 4	11 ± 4	15 ± 4
07/07/15 - 07/13/15	10 ± 6	11 ± 6	18 ± 6	16 ± 6	12 ± 6	11 ± 5	11 ± 6
07/13/15 - 07/20/15	10 ± 4	14 ± 5	11 ± 3	11 ± 4	13 ± 5	14 ± 4	11 ± 5
07/20/15 - 07/27/15	14 ± 4	15 ± 5	12 ± 3	16 ± 5	12 ± 4	13 ± 4	16 ± 5
07/27/15 - 08/03/15	16 ± 5	22 ± 5	21 ± 4	24 ± 6	23 ± 6	19 ± 5	19 ± 5
08/03/15 - 08/10/15	14 ± 5	13 ± 5	11 ± 3	11 ± 5	17 ± 5	8 ± 4	20 ± 5
08/10/15 - 08/17/15	17 ± 5	14 ± 5	11 ± 3	18 ± 5	20 ± 5	17 ± 5	13 ± 5
08/17/15 - 08/24/15	15 ± 5	15 ± 5	14 ± 3	14 ± 5	14 ± 5	20 ± 5	18 ± 5
08/24/15 - 08/31/15	17 ± 5	16 ± 5	17 ± 3	23 ± 6	17 ± 5	19 ± 5	17 ± 5
08/31/15 - 09/08/15	28 ± 5	30 ± 5	26 ± 3	34 ± 5	35 ± 5	31 ± 5	35 ± 6
09/08/15 - 09/14/15	17 ± 6	17 ± 6	14 ± 4	14 ± 6	16 ± 6	15 ± 5	12 ± 5
09/14/15 - 09/21/15	19 ± 5	26 ± 5	22 ± 3	27 ± 5	25 ± 5	26 ± 5	25 ± 5
09/21/15 - 09/28/15	11 ± 4	11 ± 4	12 ± 3	12 ± 5	12 ± 4	14 ± 4	14 ± 5
09/28/15 - 10/05/15	10 ± 4	10 ± 4	8 ± 3	14 ± 5	14 ± 5	9 ± 4	9 ± 4
10/05/15 - 10/12/15	17 ± 5	14 ± 5	13 ± 3	14 ± 5	15 ± 5	13 ± 4	(1)
10/12/15 - 10/19/15	12 ± 4	16 ± 5	10 ± 3	9 ± 4	13 ± 5	11 ± 4	12 ± 5
10/19/15 - 10/26/15	21 ± 5	22 ± 6	20 ± 4	22 ± 6	17 ± 5	19 ± 5	22 ± 6
10/26/15 - 11/02/15	15 ± 5	17 ± 5	12 ± 3	16 ± 5	17 ± 5	15 ± 5	13 ± 5
11/02/15 - 11/08/15	14 ± 5	18 ± 6	15 ± 4	20 ± 6	27 ± 6	22 ± 6	25 ± 6
11/08/15 - 11/16/15	24 ± 5	18 ± 5	15 ± 3	17 ± 5	20 ± 5	16 ± 4	17 ± 5
11/16/15 - 11/23/15	16 ± 5	12 ± 4	12 ± 3	11 ± 4	12 ± 4	13 ± 4	16 ± 5
11/23/15 - 11/30/15	18 ± 5	17 ± 5	16 ± 3	20 ± 5	18 ± 5	16 ± 4	18 ± 5
11/30/15 - 12/07/15	30 ± 6	27 ± 6	25 ± 4	27 ± 6	31 ± 6	29 ± 5	22 ± 5
12/07/15 - 12/14/15	48 ± 8	46 ± 6	39 ± 4	55 ± 7	48 ± 7	49 ± 6	36 ± 6
12/14/15 - 12/21/15	13 ± 6	9 ± 5	11 ± 3	11 ± 5	13 ± 5	9 ± 4	8 ± 5
12/21/15 - 12/28/15	12 ± 5	15 ± 5	14 ± 3	15 ± 5	10 ± 5	11 ± 4	10 ± 5
MEAN	16 ± 13	16 ± 13	14 ± 12	17 ± 16	16 ± 14	16 ± 14	15 ± 12

THE MEAN AND TWO 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, 2015**

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
12/29/14 - 02/01/15	13	24	17 ± 7	12/29/14 - 02/01/15	12	22	17 ± 7	12/29/14 - 02/01/15	10	17	14 ± 7
02/01/15 - 03/03/15	9	24	19 ± 8	02/01/15 - 03/03/15	13	21	17 ± 5	02/01/15 - 03/03/15	16	21	19 ± 4
03/03/15 - 03/30/15	6	18	14 ± 8	03/03/15 - 03/30/15	10	22	16 ± 8	03/03/15 - 03/30/15	9	16	14 ± 6
03/30/15 - 04/27/15	8	13	10 ± 3	03/30/15 - 04/27/15	9	13	11 ± 3	03/30/15 - 04/27/15	9	13	11 ± 3
04/27/15 - 06/01/15	6	23	13 ± 9	04/27/15 - 06/01/15	7	17	13 ± 6	05/04/15 - 06/01/15	12	15	13 ± 3
06/01/15 - 06/29/15	6	16	10 ± 6	06/01/15 - 06/29/15	6	13	10 ± 5	06/01/15 - 06/29/15	9	12	10 ± 3
06/29/15 - 08/03/15	10	24	15 ± 8	06/29/15 - 08/03/15	11	23	14 ± 8	06/29/15 - 08/03/15	11	19	14 ± 7
08/03/15 - 08/31/15	11	23	15 ± 6	08/03/15 - 08/31/15	8	20	16 ± 8	08/03/15 - 08/31/15	13	20	17 ± 6
08/31/15 - 09/28/15	11	34	20 ± 15	08/31/15 - 09/28/15	12	35	21 ± 17	08/31/15 - 09/28/15	12	35	22 ± 21
09/28/15 - 11/02/15	8	22	15 ± 9	09/28/15 - 11/02/15	9	19	14 ± 6	09/28/15 - 11/02/15	9	22	14 ± 11
11/02/15 - 11/30/15	11	24	16 ± 7	11/02/15 - 11/30/15	12	27	18 ± 10	11/02/15 - 11/30/15	16	25	19 ± 8
11/30/15 - 12/28/15	9	55	24 ± 29	11/30/15 - 12/28/15	9	49	25 ± 34	11/30/15 - 12/28/15	8	36	19 ± 26
12/29/14 - 12/28/15	6	55	16 ± 13	12/29/14 - 12/28/15	6	49	16 ± 14	12/29/14 - 12/28/15	8	36	15 ± 12

Table C-V.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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	12/29/14 - 03/30/15	59 ± 29	< 3	< 4	< 4	< 3	< 2
	03/30/15 - 06/29/15	77 ± 21	< 3	< 3	< 2	< 2	< 2
	06/29/15 - 09/28/15	115 ± 50	< 5	< 5	< 4	< 5	< 5
	09/28/15 - 12/28/15	48 ± 19	< 2	< 3	< 3	< 3	< 3
	MEAN	75 ± 59	-	-	-	-	-
11S1	12/29/14 - 03/30/15	84 ± 39	< 3	< 6	< 5	< 4	< 3
	03/30/15 - 06/29/15	76 ± 25	< 4	< 5	< 5	< 4	< 4
	06/29/15 - 09/28/15	96 ± 32	< 3	< 3	< 2	< 4	< 2
	09/28/15 - 12/28/15	67 ± 18	< 2	< 2	< 1	< 2	< 2
	MEAN	81 ± 25	-	-	-	-	-
13S4	12/29/14 - 03/23/15	58 ± 30	< 3	< 6	< 4	< 3	< 3
	03/30/15 - 06/29/15	65 ± 22	< 3	< 4	< 2	< 3	< 2
	06/29/15 - 09/28/15	74 ± 20	< 2	< 3	< 2	< 2	< 2
	09/28/15 - 12/28/15	53 ± 15	< 2	< 3	< 2	< 1	< 1
	MEAN	62 ± 18	-	-	-	-	-
14S1	12/29/14 - 03/30/15	69 ± 35	< 3	< 7	< 6	< 4	< 3
	03/30/15 - 06/29/15	62 ± 31	< 3	< 5	< 3	< 4	< 4
	06/29/15 - 09/28/15	85 ± 29	< 3	< 5	< 4	< 3	< 2
	09/28/15 - 12/28/15	60 ± 30	< 5	< 6	< 5	< 4	< 4
	MEAN	69 ± 23	-	-	-	-	-
15D1	12/29/14 - 03/30/15	81 ± 33	< 4	< 4	< 3	< 3	< 4
	03/30/15 - 06/29/15	65 ± 22	< 2	< 3	< 3	< 3	< 2
	06/29/15 - 09/28/15	85 ± 19	< 2	< 3	< 2	< 2	< 2
	09/28/15 - 12/28/15	45 ± 19	< 2	< 3	< 2	< 2	< 2
	MEAN	69 ± 36	-	-	-	-	-
22G1	12/29/14 - 03/30/15	86 ± 39	< 4	< 4	< 3	< 3	< 2
	03/30/15 - 06/29/15	80 ± 19	< 2	< 3	< 2	< 2	< 2
	06/29/15 - 09/28/15	113 ± 27	< 3	< 4	< 3	< 3	< 3
	09/28/15 - 12/28/15	43 ± 26	< 2	< 3	< 3	< 2	< 2
	MEAN	80 ± 58	-	-	-	-	-
6C1	12/29/14 - 03/30/15	99 ± 38	< 3	< 5	< 4	< 3	< 3
	03/30/15 - 06/29/15	65 ± 25	< 3	< 4	< 4	< 3	< 4
	06/29/15 - 09/28/15	108 ± 33	< 2	< 4	< 2	< 3	< 3
	09/28/15 - 12/28/15	66 ± 30	< 4	< 4	< 3	< 4	< 4
	MEAN	85 ± 45	-	-	-	-	-

Table C-VI.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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
12/29/14 - 01/05/15	< 43	< 43	< 17	< 43	< 43	< 49	< 49
01/05/15 - 01/13/15	< 53	< 53	< 51	< 53	< 54	< 59	< 59
01/13/15 - 01/20/15	< 41	< 41	< 40	< 41	< 17	< 48	< 48
01/20/15 - 01/26/15	< 56	< 57	< 59	< 56	< 57	< 68	< 67
01/26/15 - 02/01/15	< 20	< 52	< 34	< 51	< 52	< 39	< 39
02/01/15 - 02/08/15	< 60	< 60	< 37	< 60	< 62	< 42	< 41
02/08/15 - 02/16/15	< 31	< 12	< 26	< 31	< 31	< 30	< 30
02/16/15 - 02/23/15	< 48	< 49	< 44	< 48	< 49	< 51	< 50
02/23/15 - 03/03/15	< 45	< 45	< 27	< 20	< 46	< 32	< 32
03/03/15 - 03/10/15	< 47	< 47	< 42	< 47	< 47	< 52	< 49
03/10/15 - 03/17/15	< 39	< 39	< 52	< 60	< 40	< 30	< 61
03/17/15 - 03/23/15	< 54	< 55	< 53	< 54	< 55	< 60	< 57
03/23/15 - 03/30/15	< 48	< 48	(1)	< 54	< 49	< 54	< 56
03/30/15 - 04/06/15	< 61	< 62	< 64	< 61	< 34	< 62	< 70
04/06/15 - 04/13/15	< 30	(1)	< 25	< 29	< 30	< 28	< 28
04/13/15 - 04/20/15	< 57	< 66	< 62	< 66	< 67	< 69	< 69
04/20/15 - 04/27/15	< 39	< 65	< 56	(1)	< 15	< 63	< 62
04/27/15 - 05/04/15	< 34	< 34	< 54	< 45	< 34	< 61	< 61
05/04/15 - 05/11/15	< 24	< 58	< 29	< 66	< 59	< 34	< 34
05/11/15 - 05/18/15	< 68	< 69	< 56	< 68	< 69	< 66	< 65
05/18/15 - 05/26/15	< 63	< 26	< 56	< 62	< 64	< 66	< 66
05/26/15 - 06/01/15	< 60	< 61	< 49	< 60	< 36	< 56	< 55
06/01/15 - 06/08/15	< 48	< 48	< 45	< 26	< 48	< 48	< 52
06/08/15 - 06/15/15	< 32	< 33	< 30	< 32	< 33	< 35	< 35
06/15/15 - 06/22/15	< 54	< 55	< 65	< 55	< 55	< 22	< 27
06/22/15 - 06/29/15	< 58	< 58	< 49	< 23	< 60	< 49	< 69
06/29/15 - 07/07/15	< 59	< 60	< 54	< 61	< 61	< 59	< 67
07/07/15 - 07/13/15	< 41	< 42	< 26	< 43	< 54	< 35	< 42
07/13/15 - 07/20/15	< 62	< 62	< 38	< 62	< 64	< 56	< 62
07/20/15 - 07/27/15	< 38	< 39	< 15	< 39	< 39	< 24	< 27
07/27/15 - 08/03/15	< 45	< 45	< 38	< 46	< 47	< 59	< 66
08/03/15 - 08/10/15	< 54	< 54	< 39	< 56	< 56	< 61	< 69
08/10/15 - 08/17/15	< 26	< 26	< 6	< 27	< 27	< 24	< 27
08/17/15 - 08/24/15	< 40	< 40	< 24	< 41	< 41	< 38	< 42
08/24/15 - 08/31/15	< 46	< 47	< 36	< 63	< 48	< 24	< 63
08/31/15 - 09/08/15	< 46	< 46	< 25	< 47	< 48	< 39	< 44
09/08/15 - 09/14/15	< 50	< 51	< 21	< 52	< 51	< 33	< 36
09/14/15 - 09/21/15	< 34	< 34	< 17	< 35	< 35	< 27	< 31
09/21/15 - 09/28/15	< 21	< 22	< 17	< 22	< 22	< 27	< 31
09/28/15 - 10/05/15	< 54	< 54	< 14	< 55	< 55	< 59	< 66
10/05/15 - 10/12/15	< 57	< 57	< 36	< 63	< 58	< 56	(1)
10/12/15 - 10/19/15	< 54	< 54	< 38	< 55	< 55	< 59	< 67
10/19/15 - 10/26/15	< 53	< 54	< 38	< 55	< 55	< 60	< 67
10/26/15 - 11/02/15	< 40	< 40	< 14	< 57	< 41	< 51	< 58
11/02/15 - 11/08/15	< 49	< 49	< 35	< 50	< 50	< 54	< 59
11/08/15 - 11/16/15	< 53	< 53	< 34	< 54	< 54	< 53	< 60
11/16/15 - 11/23/15	< 67	< 68	< 31	< 69	< 69	< 48	< 54
11/23/15 - 11/30/15	< 67	< 67	< 39	< 67	< 68	< 60	< 67
11/30/15 - 12/07/15	< 53	< 53	< 33	< 54	< 54	< 50	< 56
12/07/15 - 12/14/15	< 56	< 43	< 9	< 39	< 44	< 34	< 39
12/14/15 - 12/21/15	< 51	< 43	< 33	< 44	< 44	< 49	< 56
12/21/15 - 12/28/15	< 58	< 58	< 42	< 60	< 59	< 62	< 70
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, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

	CONTROL FARM		INDICATOR FARM		
COLLECTION PERIOD	23F1	36E1	18E1	19B1	25C1
01/13/15	< 0.4	< 0.3	< 0.4	< 0.3	< 0.4
02/17/15	< 0.4		< 0.4	< 0.4	< 0.3
03/10/15	< 0.5		< 0.6	< 0.4	< 0.6
04/07/15	< 0.6	< 0.5	< 0.6	< 0.7	< 0.6
04/21/15	< 0.5		< 0.4	< 0.6	< 0.5
05/06/15	< 0.5		< 0.9	< 0.5	< 0.6
05/20/15	< 0.7		< 0.9	< 0.7	< 0.5
06/02/15	< 0.5		< 0.4	< 0.5	< 0.4
06/17/15	< 0.7		< 0.5	< 0.6	< 0.9
06/30/15	< 0.6		< 0.6	< 0.6	< 0.9
07/14/15	< 0.4	< 0.8	< 0.5	< 0.5	< 0.4
07/29/15	< 0.3		< 0.8	< 0.4	< 0.5
08/11/15	< 0.3		< 0.3	< 0.3	< 0.3
08/25/15	< 0.7		< 0.9	< 0.9	< 1.0
09/09/15	< 0.6		< 0.4	< 0.6	< 0.7
09/22/15	< 0.3		< 0.5	< 0.3	< 0.4
10/06/15	< 0.4	< 0.7	< 0.6	< 0.6	< 0.5
10/20/15	< 0.6		< 0.4	< 0.5	< 0.4
11/04/15	< 0.4		< 0.6	< 0.5	< 0.6
11/17/15	< 0.9		< 0.8	< 0.7	< 0.9
12/08/15	< 0.5		< 0.3	< 0.4	< 0.4
MEAN	-	-	-	-	-

Table C-VII.2 CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
18E1	01/13/15	1566 ± 193	< 8	< 10	< 42	< 13
	02/17/15	1236 ± 175	< 7	< 6	< 33	< 8
	03/10/15	1179 ± 121	< 4	< 5	< 25	< 6
	04/07/15	1259 ± 134	< 6	< 6	< 32	< 4
	04/21/15	1122 ± 159	< 6	< 6	< 25	< 8
	05/06/15	1175 ± 189	< 7	< 9	< 32	< 6
	05/20/15	1075 ± 178	< 7	< 8	< 43	< 15
	06/02/15	1035 ± 140	< 5	< 6	< 26	< 7
	06/17/15	1278 ± 179	< 7	< 7	< 37	< 12
	06/29/15	1190 ± 154	< 6	< 6	< 28	< 6
	07/13/15	1092 ± 137	< 5	< 5	< 36	< 11
	07/29/15	1157 ± 159	< 7	< 8	< 34	< 7
	08/10/15	1209 ± 145	< 5	< 6	< 36	< 8
	08/24/15	1346 ± 199	< 9	< 9	< 32	< 14
	09/09/15	1220 ± 172	< 5	< 9	< 29	< 10
	09/21/15	1276 ± 212	< 6	< 8	< 32	< 8
	10/05/15	1467 ± 226	< 7	< 11	< 39	< 8
	10/19/15	1317 ± 186	< 8	< 8	< 39	< 8
	11/02/15	1147 ± 188	< 9	< 7	< 39	< 8
	11/16/15	1154 ± 158	< 7	< 7	< 31	< 11
	12/08/15	1422 ± 259	< 9	< 12	< 31	< 12
	MEAN	1234 ± 265	-	-	-	-
19B1	01/13/15	1452 ± 214	< 7	< 7	< 53	< 14
	02/17/15	1276 ± 167	< 6	< 8	< 30	< 8
	03/10/15	1240 ± 170	< 7	< 7	< 42	< 14
	04/07/15	1457 ± 191	< 7	< 9	< 44	< 12
	04/21/15	1213 ± 133	< 7	< 6	< 25	< 8
	05/05/15	1356 ± 189	< 6	< 8	< 37	< 12
	05/19/15	1403 ± 162	< 6	< 5	< 34	< 9
	06/02/15	1448 ± 168	< 5	< 5	< 32	< 10
	06/16/15	1355 ± 163	< 6	< 6	< 39	< 13
	06/30/15	1248 ± 160	< 6	< 7	< 35	< 10
	07/14/15	1465 ± 154	< 6	< 7	< 48	< 10
	07/28/15	1353 ± 158	< 6	< 5	< 24	< 6
	08/11/15	1417 ± 227	< 7	< 9	< 43	< 11
	08/25/15	1164 ± 195	< 9	< 10	< 37	< 9
	09/08/15	1391 ± 164	< 6	< 8	< 35	< 7
	09/22/15	1354 ± 199	< 9	< 9	< 36	< 10
	10/06/15	1346 ± 240	< 10	< 10	< 39	< 12
	10/20/15	1288 ± 227	< 10	< 11	< 42	< 14
	11/03/15	1321 ± 215	< 8	< 10	< 45	< 13
	11/17/15	1193 ± 170	< 4	< 5	< 17	< 3
	12/08/15	1245 ± 238	< 9	< 11	< 35	< 6
	MEAN	1333 ± 184	-	-	-	-

Table C-VII.2 CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
23F1	01/13/15	1319 ± 193	< 7	< 9	< 52	< 14
	02/17/15	1294 ± 150	< 5	< 7	< 29	< 10
	03/10/15	1184 ± 166	< 7	< 7	< 44	< 13
	04/07/15	1416 ± 195	< 7	< 9	< 52	< 14
	04/21/15	1212 ± 145	< 5	< 6	< 25	< 6
	05/05/15	1174 ± 169	< 8	< 8	< 39	< 12
	05/19/15	1238 ± 167	< 7	< 9	< 36	< 14
	06/02/15	1384 ± 171	< 8	< 9	< 35	< 15
	06/16/15	1465 ± 143	< 7	< 8	< 46	< 13
	06/30/15	1140 ± 177	< 8	< 9	< 38	< 12
	07/14/15	1346 ± 149	< 7	< 7	< 49	< 9
	07/28/15	1452 ± 190	< 7	< 9	< 35	< 12
	08/11/15	1290 ± 179	< 5	< 7	< 29	< 10
	08/25/15	1287 ± 227	< 9	< 10	< 37	< 15
	09/09/15	1324 ± 167	< 7	< 8	< 40	< 12
	09/22/15	1399 ± 216	< 7	< 9	< 26	< 11
	10/06/15	1052 ± 210	< 8	< 13	< 41	< 14
	10/20/15	1316 ± 248	< 7	< 8	< 30	< 15
	11/04/15	1222 ± 196	< 9	< 10	< 49	< 11
	11/17/15	1441 ± 152	< 6	< 7	< 28	< 6
	12/08/15	1252 ± 257	< 8	< 8	< 31	< 6
	MEAN	1296 ± 219	-	-	-	-
25C1	01/13/15	1315 ± 186	< 6	< 7	< 39	< 8
	02/17/15	1306 ± 142	< 6	< 7	< 26	< 9
	03/10/15	1157 ± 147	< 5	< 7	< 40	< 8
	04/07/15	1182 ± 171	< 7	< 7	< 40	< 7
	04/21/15	1155 ± 170	< 7	< 9	< 30	< 11
	05/05/15	1226 ± 165	< 6	< 9	< 41	< 9
	05/19/15	1105 ± 160	< 5	< 7	< 34	< 11
	06/02/15	1119 ± 173	< 5	< 7	< 26	< 11
	06/16/15	1202 ± 133	< 5	< 6	< 39	< 13
	06/30/15	1199 ± 152	< 6	< 6	< 29	< 8
	07/14/15	1313 ± 186	< 8	< 10	< 53	< 14
	07/28/15	1350 ± 160	< 6	< 7	< 33	< 7
	08/11/15	1367 ± 176	< 8	< 10	< 40	< 12
	08/25/15	1325 ± 200	< 9	< 12	< 40	< 9
	09/08/15	1278 ± 167	< 6	< 7	< 34	< 8
	09/22/15	1459 ± 185	< 8	< 11	< 34	< 9
	10/06/15	1227 ± 239	< 9	< 10	< 35	< 11
	10/20/15	1322 ± 154	< 6	< 6	< 26	< 10
	11/04/15	1247 ± 225	< 9	< 11	< 37	< 11
	11/17/15	1258 ± 139	< 9	< 8	< 33	< 7
	12/08/15	1276 ± 194	< 6	< 8	< 29	< 4
	MEAN	1257 ± 177	-	-	-	-

Table C-VII.2 CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
36E1	01/13/15	1201 ± 127	< 5	< 4	< 22	< 6
	04/07/15	994 ± 171	< 6	< 9	< 38	< 11
	07/14/15	1190 ± 150	< 6	< 7	< 28	< 8
	10/06/15	1229 ± 250	< 10	< 12	< 31	< 10
	MEAN	1154 ± 215	-	-	-	-

TABLE C-VIII.1 **CONCENTRATIONS OF GAMMA EMITTERS IN BROAD LEAFY VEGETATION SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015**

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	06/23/15	Cabbage	< 230	1945 ± 425	< 25	< 26	< 31	< 43	< 22	< 24	< 553	< 47	< 115
	06/23/15	Kale	< 315	6172 ± 784	< 34	< 35	< 27	< 54	< 32	< 28	< 578	< 56	< 114
	06/23/15	Swiss Chard	< 302	4953 ± 668	< 23	< 30	< 23	< 47	< 24	< 23	< 532	< 45	< 121
	07/23/15	Cabbage	< 110	2450 ± 278	< 11	< 13	< 14	< 55	< 10	< 12	< 226	< 18	< 47
	07/23/15	Kale	347 ± 151	7370 ± 396	< 8	< 11	< 11	< 52	< 8	< 8	< 218	< 18	< 45
	07/23/15	Swiss Chard	211 ± 104	7175 ± 377	< 9	< 12	< 13	< 54	< 9	< 11	< 184	< 15	< 43
	08/17/15	Cabbage	< 301	3575 ± 732	< 30	< 40	< 35	< 47	< 40	< 31	< 834	< 63	< 150
	08/17/15	Collards	< 300	4702 ± 782	< 30	< 27	< 38	< 44	< 32	< 32	< 771	< 59	< 132
	08/17/15	Swiss Chard	< 348	5344 ± 909	< 47	< 36	< 43	< 45	< 39	< 39	< 672	< 56	< 155
	09/14/15	Cabbage	< 261	2511 ± 589	< 30	< 28	< 36	< 35	< 34	< 31	< 749	< 60	< 105
	09/14/15	Collards	< 373	5261 ± 877	< 47	< 36	< 55	< 46	< 40	< 44	< 1030	< 87	< 209
	09/14/15	Swiss Chard	< 351	6654 ± 861	< 28	< 28	< 35	< 37	< 33	< 38	< 656	< 56	< 126
	10/26/15	Collards	< 244	4244 ± 704	< 30	< 30	< 36	< 42	< 28	< 29	< 716	< 55	< 128
	10/26/15	Swiss Chard	665 ± 269	7746 ± 1183	< 37	< 36	< 52	< 52	< 32	< 29	< 790	< 67	< 131
	MEAN		408 ± 466	5007 ± 3799	-	-	-	-	-	-	-	-	-
13S3	06/23/15	Collards	< 196	5749 ± 517	< 21	< 22	< 33	< 36	< 18	< 19	< 376	< 31	< 84
	06/23/15	Kale	< 209	6247 ± 551	< 19	< 24	< 26	< 44	< 22	< 22	1673 ± 547	< 42	< 102
	06/23/15	Swiss Chard	< 339	7366 ± 711	< 35	< 26	< 34	< 59	< 28	< 30	2242 ± 811	< 53	< 133
	07/23/15	Cabbage	< 119	3190 ± 303	< 10	< 11	< 13	< 59	< 11	< 13	321 ± 313	< 22	< 52
	07/23/15	Collards	157 ± 130	4467 ± 366	< 9	< 13	< 15	< 54	< 11	< 10	< 303	< 23	< 53
	07/23/15	Swiss Chard	< 149	5197 ± 345	< 12	< 12	< 12	< 57	< 12	< 13	2160 ± 369	< 24	< 53
	08/17/15	Cabbage	< 294	3379 ± 760	< 34	< 29	< 48	< 43	< 28	< 33	< 925	< 57	< 162
	08/17/15	Collards	< 383	3086 ± 870	< 25	< 34	< 42	< 42	< 34	< 42	< 929	< 72	< 153
	08/17/15	Swiss Chard	< 384	6489 ± 1045	< 43	< 36	< 56	< 47	< 33	< 40	< 1143	< 79	< 67
	09/14/15	Cabbage	< 506	4954 ± 1030	< 53	< 49	< 54	< 60	< 47	< 45	1400 ± 939	< 92	< 271
	09/14/15	Collards	< 306	4599 ± 726	< 36	< 30	< 37	< 38	< 33	< 36	< 1007	149 ± 80	< 131
	09/14/15	Swiss Chard	< 388	6257 ± 738	< 37	< 38	< 40	< 49	< 34	< 39	1407 ± 953	< 67	< 137
	10/26/15	Collards	< 224	3788 ± 532	< 23	< 21	< 23	< 34	< 27	< 24	< 531	< 48	< 92
	10/26/15	Swiss Chard	602 ± 193	6478 ± 754	< 32	< 30	< 38	< 36	< 33	< 29	< 935	< 53	< 114
	MEAN		379 ± 629	5089 ± 2779	-	-	-	-	-	-	1534 ± 1391	149 ± 0	-

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, 2015**

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
31G1	06/23/15	Cabbage	< 282	4605 ± 715	< 29	< 31	< 40	< 51	< 30	< 32	< 584	< 47	< 111
	06/23/15	Kale	< 261	5673 ± 583	< 26	< 27	< 27	< 48	< 20	< 25	< 542	< 45	< 111
	06/23/15	Swiss Chard	< 265	7813 ± 773	< 23	< 25	< 37	< 45	< 21	< 24	< 500	< 42	< 90
	07/23/15	Cabbage	< 102	2661 ± 251	< 12	< 12	< 12	< 59	< 10	< 11	< 250	< 22	< 48
	07/23/15	Kale	< 98	5422 ± 318	< 9	< 11	< 12	< 52	< 9	< 10	< 164	< 13	< 45
	07/23/15	Swiss Chard	333 ± 193	8693 ± 509	< 11	< 12	< 12	< 57	< 8	< 8	< 256	< 21	< 45
	08/17/15	Kale	< 340	4875 ± 843	< 31	< 36	< 51	< 46	< 37	< 45	< 934	< 75	< 163
	08/17/15	Squash Leaves	636 ± 264	5600 ± 1113	< 39	< 39	< 58	< 47	< 39	< 52	< 902	< 94	< 154
	08/17/15	Swiss Chard	< 355	6560 ± 883	< 45	< 40	< 54	< 38	< 33	< 37	< 789	< 59	< 166
	09/14/15	Cabbage	< 312	4677 ± 643	< 35	< 33	< 40	< 38	< 38	< 38	< 859	< 61	< 126
	09/14/15	Kale	776 ± 264	7017 ± 939	< 33	< 36	< 44	< 43	< 37	< 36	994 ± 986	< 75	< 136
	09/14/15	Swiss Chard	< 415	6122 ± 951	< 39	< 33	< 52	< 46	< 31	< 40	< 885	< 74	< 114
	10/26/15	Cabbage	< 219	2921 ± 577	< 28	< 25	< 29	< 34	< 25	< 26	< 663	< 45	< 114
	MEAN		582 ± 452	5588 ± 3458	-	-	-	-	-	-	994 ± 0	-	-

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

Table C-IX.1 QUARTERLY DLR RESULTS FOR LIMERICK GENERATING STATION, 2015

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	5.6 ± 0.8	5.1 ± 2.3	5.9 ± 1.5	5.4 ± 0.8	5.9 ± 1.7
3S1	5.4 ± 0.6	5.1 ± 1.3	5.7 ± 2.0	5.3 ± 2.5	5.6 ± 2.6
4E1	3.9 ± 0.6	3.7 ± 1.0	4.1 ± 1.2	3.5 ± 1.0	4.1 ± 1.5
5H1	6.8 ± 1.1	6.0 ± 1.5	7.0 ± 0.6	6.8 ± 1.9	7.2 ± 1.2
5S1	6.3 ± 1.0	5.5 ± 1.6	6.5 ± 2.7	6.6 ± 1.4	6.4 ± 1.9
6C1	5.3 ± 1.0	4.6 ± 0.7	5.5 ± 0.9	5.7 ± 3.4	5.5 ± 1.5
7E1	5.9 ± 0.8	5.3 ± 1.4	6.0 ± 1.5	6.3 ± 0.9	5.9 ± 1.5
7S1	5.5 ± 1.0	4.8 ± 3.5	5.7 ± 1.2	6.0 ± 1.5	5.6 ± 2.3
9C1	5.4 ± 0.9	4.7 ± 1.2	5.7 ± 0.6	5.7 ± 1.1	5.3 ± 2.0
10E1	5.7 ± 1.2	5.2 ± 1.4	5.8 ± 2.0	5.2 ± 1.5	6.5 ± 1.9
10F3	5.5 ± 1.6	4.7 ± 0.6	5.9 ± 1.4	4.9 ± 1.1	6.4 ± 2.3
10S3	5.5 ± 1.3	4.9 ± 0.8	5.6 ± 1.1	5.2 ± 2.3	6.4 ± 0.7
11S1	6.6 ± 1.1	6.2 ± 2.2	6.8 ± 2.1	6.0 ± 1.0	7.2 ± 1.5
13C1	3.9 ± 1.3	3.8 ± 1.3	4.0 ± 1.1	3.1 ± 1.3	4.7 ± 0.8
13E1	5.7 ± 1.4	5.3 ± 1.2	6.0 ± 1.3	4.9 ± 1.9	6.4 ± 2.1
13S2	8.1 ± 1.2	8.2 ± 2.4	8.2 ± 1.6	7.3 ± 1.2	8.8 ± 3.2
14S1	5.0 ± 1.3	4.7 ± 1.1	5.0 ± 1.7	4.3 ± 1.5	5.8 ± 2.0
15D1	5.9 ± 1.5	5.1 ± 1.0	6.0 ± 1.5	5.5 ± 1.1	6.8 ± 1.9
16F1	5.6 ± 1.5	4.8 ± 1.0	6.0 ± 1.3	5.0 ± 1.7	6.4 ± 0.4
17B1	5.1 ± 1.4	4.5 ± 0.7	5.4 ± 1.3	4.6 ± 1.4	6.0 ± 1.7
18S2	5.9 ± 1.7	5.1 ± 1.5	6.2 ± 0.3	5.4 ± 1.4	7.0 ± 2.9
19D1	4.9 ± 1.0	4.4 ± 2.1	5.5 ± 1.1	4.6 ± 1.1	5.2 ± 2.6
20D1	4.8 ± 1.2	4.3 ± 1.6	5.4 ± 1.4	4.3 ± 1.0	5.2 ± 1.7
20F1	5.1 ± 1.0	5.1 ± 2.9	5.5 ± 1.0	4.4 ± 1.5	5.4 ± 1.6
21S2	4.9 ± 0.9	4.8 ± 2.0	5.4 ± 1.3	4.3 ± 1.4	5.0 ± 2.4
23S2	4.8 ± 1.1	4.3 ± 1.7	5.3 ± 1.0	4.3 ± 1.7	5.2 ± 2.0
24D1	4.4 ± 0.7	4.3 ± 2.8	4.5 ± 0.6	3.9 ± 0.9	4.7 ± 0.4
25D1	4.1 ± 0.6	4.1 ± 1.3	4.4 ± 1.2	3.7 ± 0.4	4.3 ± 1.0
25S2	4.5 ± 0.6	4.4 ± 2.2	4.8 ± 1.3	4.2 ± 0.4	4.7 ± 2.7
26S3	4.6 ± 0.8	4.0 ± 1.5	4.9 ± 1.2	4.5 ± 1.3	4.8 ± 1.4
28D2	4.8 ± 0.6	4.5 ± 1.9	5.1 ± 1.9	4.5 ± 0.9	5.0 ± 0.5
29E1	5.0 ± 1.0	5.2 ± 0.6	5.4 ± 1.5	4.3 ± 0.8	5.2 ± 1.9
29S1	4.5 ± 1.0	4.1 ± 2.1	4.9 ± 1.2	4.0 ± 1.0	5.0 ± 2.3
31D1	6.3 ± 1.2	5.6 ± 1.4	6.9 ± 0.7	5.9 ± 1.4	6.7 ± 1.7
31D2	5.6 ± 0.9	5.3 ± 2.2	6.0 ± 1.4	5.1 ± 1.7	5.9 ± 2.0
31S1	5.8 ± 0.6	5.6 ± 1.5	5.9 ± 1.5	5.4 ± 1.3	6.1 ± 2.0
34E1	5.1 ± 1.1	4.5 ± 2.2	5.7 ± 1.2	4.8 ± 1.2	5.5 ± 2.1
34S2	5.2 ± 0.8	4.9 ± 2.3	5.7 ± 0.9	4.9 ± 2.6	5.3 ± 1.3
36D1	4.5 ± 0.6	4.1 ± 1.5	4.7 ± 1.0	4.3 ± 1.4	4.7 ± 1.3
36S2	5.8 ± 1.0	5.2 ± 1.5	5.9 ± 1.6	6.4 ± 3.9	5.8 ± 0.9

Table C-IX.2 MEAN QUARTERLY DLR RESULTS FOR THE SITE BOUNDARY, MIDDLE AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2015

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

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	MIDDLE	CONTROL
JAN-MAR	5.1 ± 2.0	4.7 ± 1.0	6.0 ± 0
APR-JUN	5.8 ± 1.7	5.5 ± 1.4	7.0 ± 0
JUL-SEP	5.3 ± 2.0	4.8 ± 1.6	6.8 ± 0
OCT-DEC	5.9 ± 2.1	5.6 ± 1.5	7.2 ± 0

Table C-IX.3 SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR LIMERICK GENERATING STATION, 2015

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

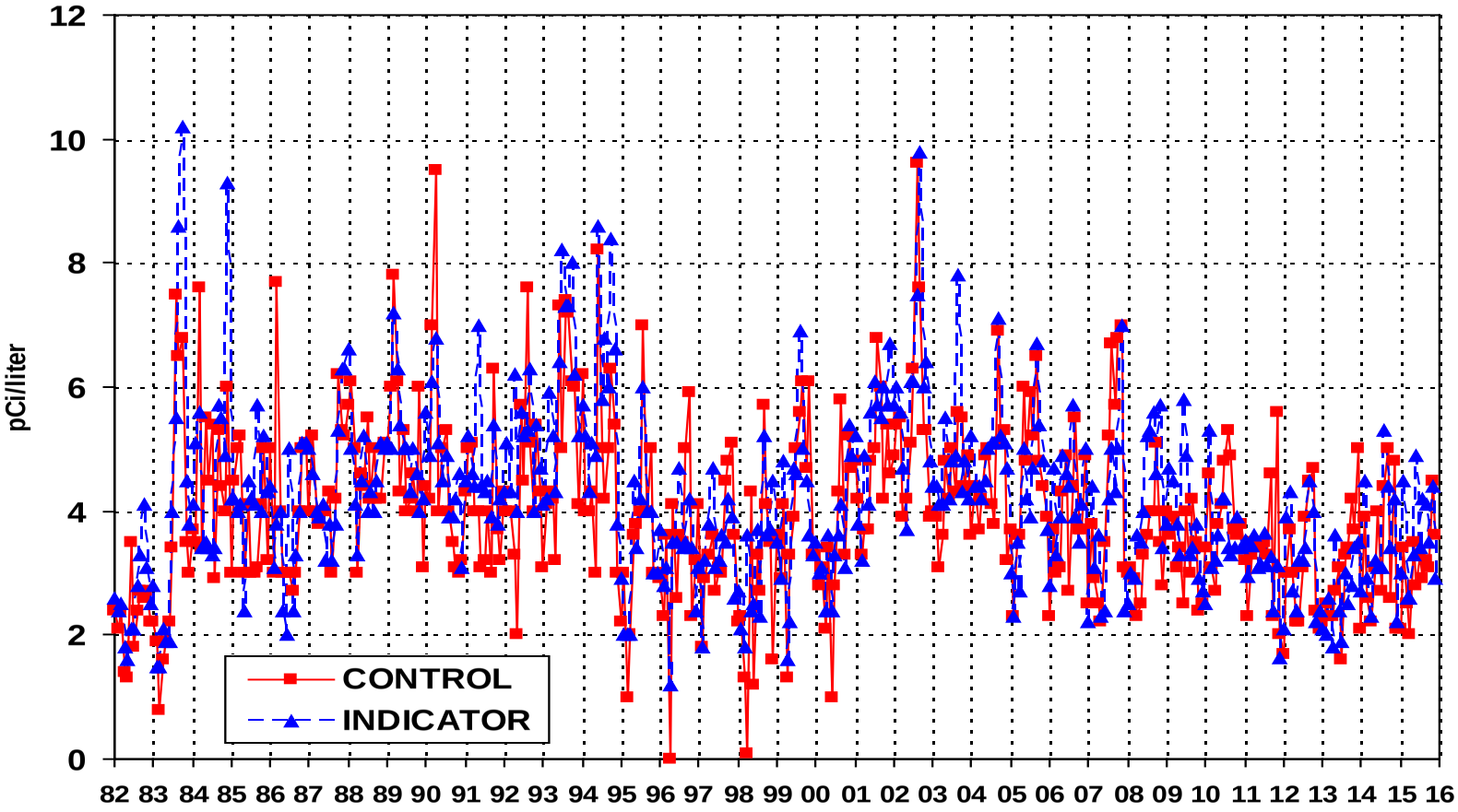
LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
SITE BOUNDARY	64	4.0	8.8	5.5 ± 2.0
MIDDLE	92	3.1	6.9	5.1 ± 1.6
CONTROL	4	6.0	7.2	6.8 ± 1.1

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 - 2015



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 – 2015

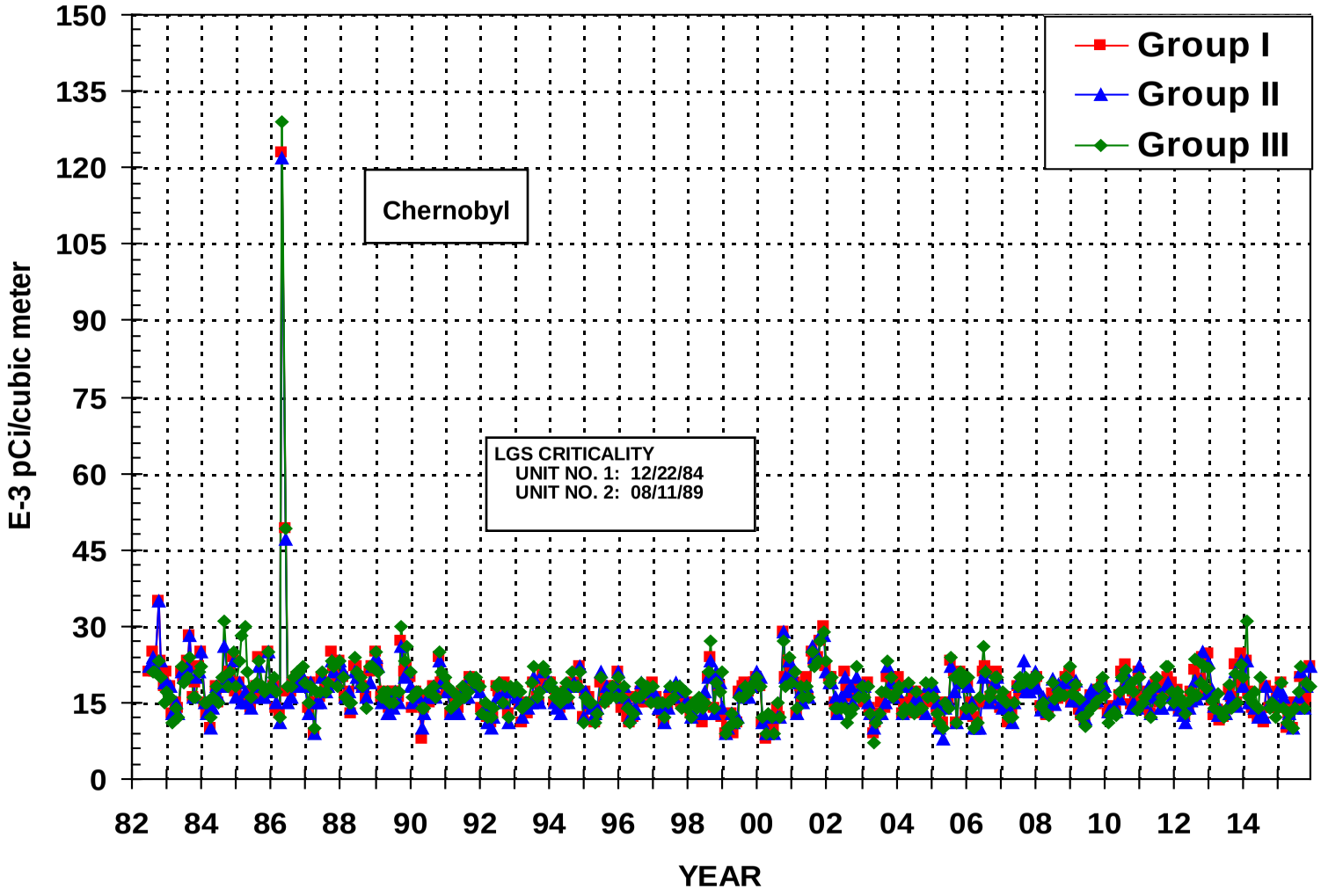


FIGURE C-3
MEAN WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 2015

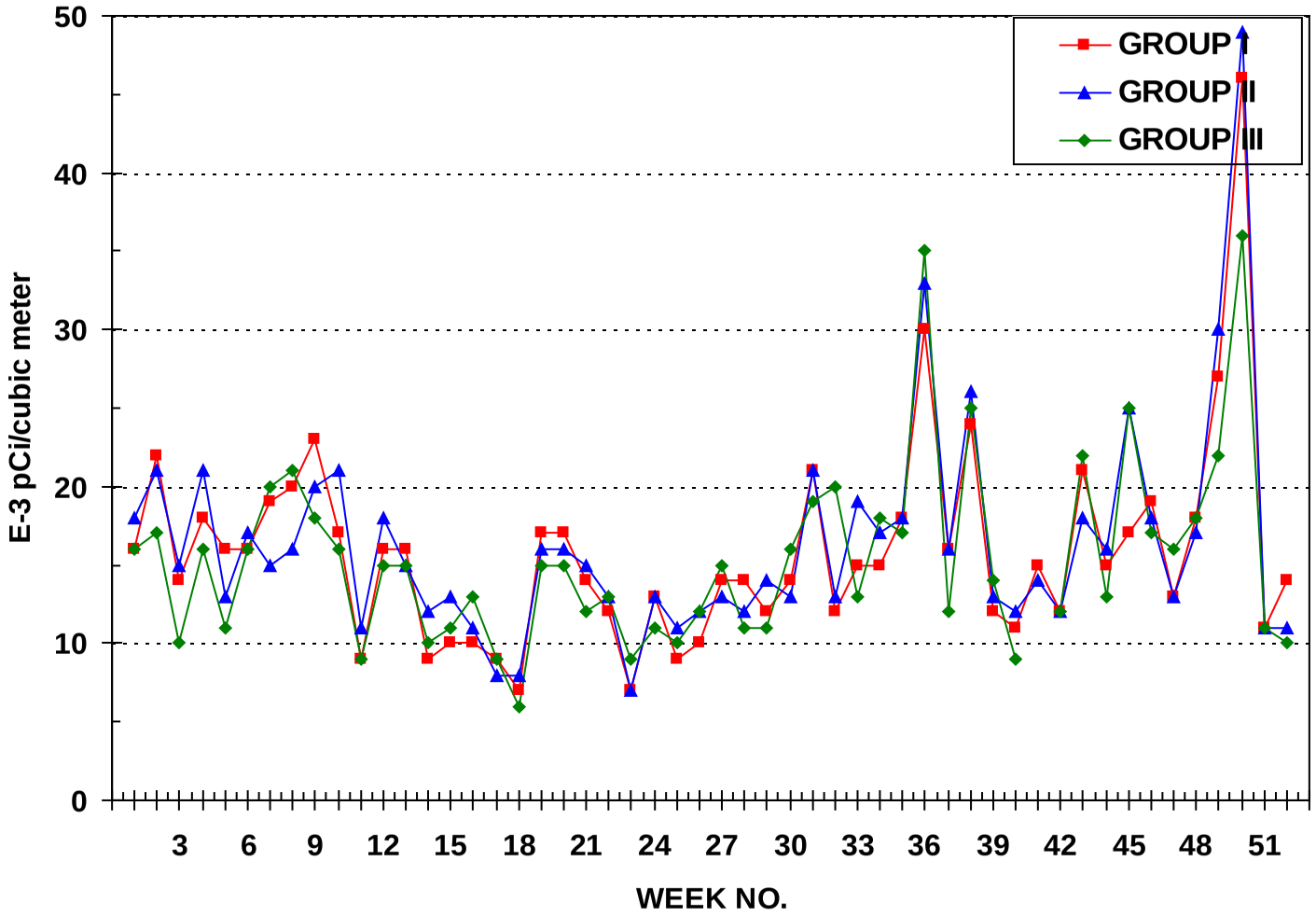
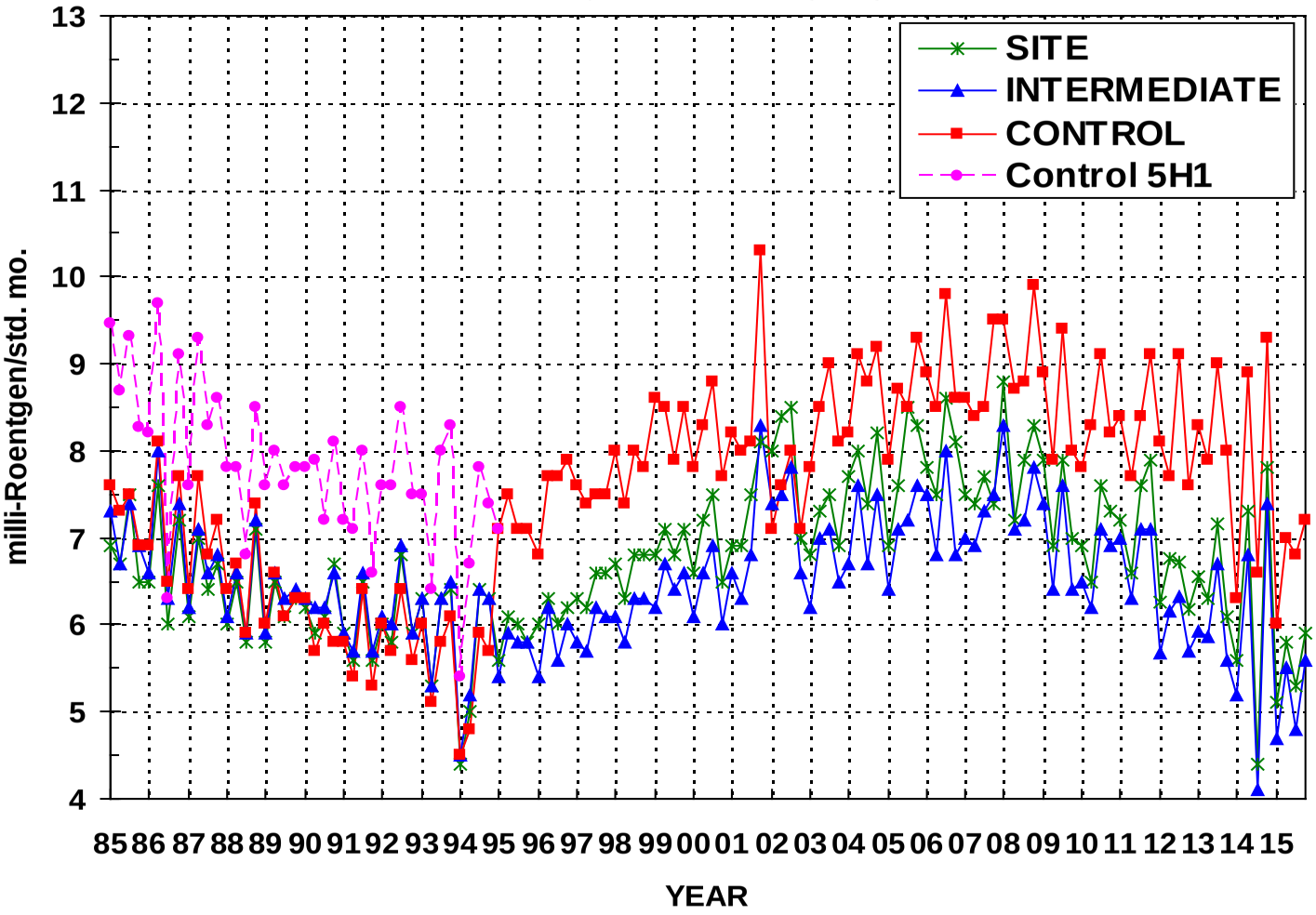


FIGURE C-4
MEAN QUARTERLY AMBIENT GAMMA RADIATION LEVELS (DLR) IN THE VICINITY OF LGS, 1985 – 2015

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



Intentionally left blank

APPENDIX D

DATA TABLES AND FIGURES
COMPARISON LABORATORY

Intentionally left blank

TABLE D-I.1 CONCENTRATIONS OF TOTAL GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/29/14 - 02/03/15	2.3 ± 0.7
02/03/15 - 03/02/15	1.0 ± 0.4
03/02/15 - 03/31/15	< 1.8
03/31/15 - 04/28/15	2.1 ± 0.9
04/28/15 - 06/02/15	< 0.9
06/02/15 - 06/29/15	1.3 ± 0.6
06/29/15 - 08/04/15	1.2 ± 0.6
08/04/15 - 08/31/15	1.4 ± 0.6
08/31/15 - 09/29/15	1.6 ± 0.6
09/29/15 - 11/03/15	3.6 ± 1.1
11/03/15 - 12/01/15	4.1 ± 1.1
12/01/15 - 12/28/15	2.3 ± 1.0
MEAN	2.1 ± 2.1

TABLE D-I.2 CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/29/14 - 02/03/15	< 0.3
02/03/15 - 03/02/15	< 0.2
03/02/15 - 03/31/15	< 0.2
03/31/15 - 04/28/15	< 0.5
04/28/15 - 06/02/15	< 0.2
06/02/15 - 06/29/15	< 0.2
06/29/15 - 08/04/15	< 0.3
08/04/15 - 08/31/15	< 0.3
08/31/15 - 09/29/15	< 0.5
09/29/15 - 11/03/15	< 0.5
11/03/15 - 12/01/15	0.9 ± 0.1
12/01/15 - 12/28/15	< 0.5
MEAN	0.9 ± 0.0

TABLE D-I.3 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/29/15 - 03/30/15	< 147
03/31/15 - 06/29/15	< 150
06/29/15 - 09/29/15	< 150
09/29/15 - 12/28/15	< 144
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, 2015**

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	12/29/14 - 02/03/15	< 1	< 1	< 2	< 1	< 2	< 2	< 1	< 4	< 1	< 1	< 7	< 2
	02/03/15 - 03/02/15	< 6	< 5	< 11	< 4	< 6	< 11	< 3	< 10	< 5	< 6	< 27	< 5
	03/02/15 - 03/31/15	< 1	< 2	< 2	< 1	< 2	< 2	< 2	< 7	< 1	< 1	< 13	< 2
	03/31/15 - 04/28/15	< 2	< 2	< 2	< 2	< 4	< 3	< 2	< 9	< 2	< 2	< 13	< 3
	04/28/15 - 06/02/15	< 2	< 2	< 5	< 2	< 4	< 3	< 3	< 8	< 2	< 2	< 17	< 2
	06/02/15 - 06/29/15	< 3	< 2	< 5	< 2	< 4	< 4	< 3	< 9	< 3	< 4	< 22	< 4
	06/29/15 - 08/04/15	< 3	< 5	< 2	< 2	< 4	< 5	< 4	< 10	< 3	< 4	< 16	< 6
	08/04/15 - 08/31/15	< 1	< 2	< 5	< 2	< 5	< 6	< 3	< 11	< 2	< 3	< 15	< 8
	08/31/15 - 09/29/15	< 1	< 3	< 3	< 2	< 6	< 4	< 4	< 8	< 3	< 2	< 15	< 6
	09/29/15 - 11/03/15	< 1	< 1	< 3	< 1	< 3	< 3	< 2	< 5	< 1	< 1	< 11	< 4
	11/03/15 - 12/01/15	< 3	< 4	< 6	< 3	< 4	< 7	< 3	< 6	< 5	< 4	< 19	< 3
	12/01/15 - 12/28/15	< 2	< 2	< 5	< 3	< 5	< 5	< 2	< 6	< 3	< 3	< 22	< 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, 2015

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

COLLECTION PERIOD	11S2 GROSS BETA	11S2 I-131
12/29/14 - 01/05/15	26 ± 4	< 16
01/05/15 - 01/13/15	25 ± 4	< 10
01/13/15 - 01/20/15	25 ± 4	< 9
01/20/15 - 01/26/15	21 ± 5	< 12
02/16/15 - 02/01/15	24 ± 5	< 10
02/01/15 - 02/08/15	26 ± 4	< 13
02/08/15 - 02/16/15	27 ± 4	< 17
02/16/15 - 02/23/15	37 ± 5	< 18
02/23/15 - 03/03/15	32 ± 5	< 12
03/03/15 - 03/10/15	31 ± 5	< 11
03/10/15 - 03/17/15	18 ± 4	< 19
03/17/15 - 03/23/15	25 ± 5	< 14
03/23/15 - 03/30/15	24 ± 5	< 16
03/30/15 - 04/06/15	18 ± 5	< 10
04/06/15 - 04/13/15	20 ± 4	< 7
04/13/15 - 04/20/15	16 ± 4	< 8
04/20/15 - 04/27/15	14 ± 4	< 16
04/24/15 - 05/04/15	13 ± 4	< 13
05/04/15 - 05/11/15	31 ± 5	< 14
05/11/15 - 05/15/15	21 ± 4	< 19
05/18/15 - 05/26/15	21 ± 4	< 10
05/26/15 - 06/01/15	14 ± 5	< 22
06/01/15 - 06/08/15	12 ± 4	< 11
06/08/15 - 06/15/15	20 ± 5	< 14
06/15/15 - 06/22/15	17 ± 4	< 19
06/22/15 - 06/29/15	17 ± 4	< 10
06/29/15 - 07/07/15	21 ± 4	< 11
07/07/15 - 07/13/15	22 ± 5	< 15
07/13/15 - 07/20/15	26 ± 5	< 11
07/20/15 - 07/27/15	28 ± 5	< 17
07/27/15 - 08/03/15	28 ± 5	< 19
08/03/15 - 08/10/15	23 ± 5	< 16
08/10/15 - 08/17/15	30 ± 5	< 19
08/17/15 - 08/24/15	30 ± 5	< 16
08/24/15 - 08/31/15	31 ± 5	< 15
08/31/15 - 09/08/15	64 ± 6	< 2
09/08/15 - 09/14/15	24 ± 6	< 18
09/14/15 - 09/21/15	40 ± 5	< 8
09/21/15 - 09/28/15	23 ± 5	< 18
09/28/15 - 10/05/15	11 ± 4	< 16
10/05/15 - 10/12/15	24 ± 5	< 15
10/12/15 - 10/19/15	17 ± 4	< 13
10/19/15 - 10/26/15	36 ± 5	< 13
10/26/15 - 11/02/15	25 ± 5	< 19
11/02/15 - 11/08/15	35 ± 6	< 14
11/08/15 - 11/16/15	25 ± 4	< 22
11/16/15 - 11/23/15	22 ± 5	< 17
11/23/15 - 11/30/15	33 ± 5	< 16
11/30/15 - 12/07/15	39 ± 5	< 15
12/07/15 - 12/14/15	68 ± 7	< 16
12/14/15 - 12/21/15	16 ± 5	< 18
12/21/15 - 12/28/15	21 ± 5	< 16
MEAN	26 ± 21	-

TABLE D-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2015

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	12/29/14 - 03/30/15	79 ± 22	< 0.7	< 0.9	< 1.1	< 0.5	< 0.8
	03/30/15 - 06/29/15	70 ± 12	< 0.7	< 0.7	< 0.4	< 0.8	< 0.8
	06/29/15 - 09/28/15	99 ± 21	< 0.7	< 1.2	< 0.6	< 0.9	< 0.9
	09/28/15 - 12/28/15	59 ± 16	< 0.6	< 1.4	< 1.0	< 0.7	< 1.0
	MEAN	77 ± 34	-	-	-	-	-

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, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
19B1	01/13/15	< 0.2	1305 ± 105	< 3	< 4	< 17	< 6
	04/07/15	< 0.4	1304 ± 93	< 2	< 3	< 19	< 4
	07/14/15	< 0.2	1425 ± 122	< 4	< 4	< 24	< 5
	10/06/15	< 0.4	1346 ± 96	< 4	< 4	< 29	< 13
	MEAN	-	1345 ± 113	-	-	-	-
25C1	01/13/15	< 0.2	1272 ± 101	< 3	< 2	< 24	< 6
	04/07/15	< 0.3	1349 ± 90	< 3	< 3	< 34	< 6
	07/14/15	< 0.2	1508 ± 123	< 4	< 4	< 27	< 7
	10/06/15	< 0.3	1364 ± 95	< 3	< 2	< 41	< 8
	MEAN	-	1373 ± 197	-	-	-	-

FIGURE D-1
COMPARISON OF MONTHLY TOTAL GROSS BETA CONCENTRATIONS IN DRINKING WATER SAMPLES SPLIT BETWEEN ENV AND TBE, 2015

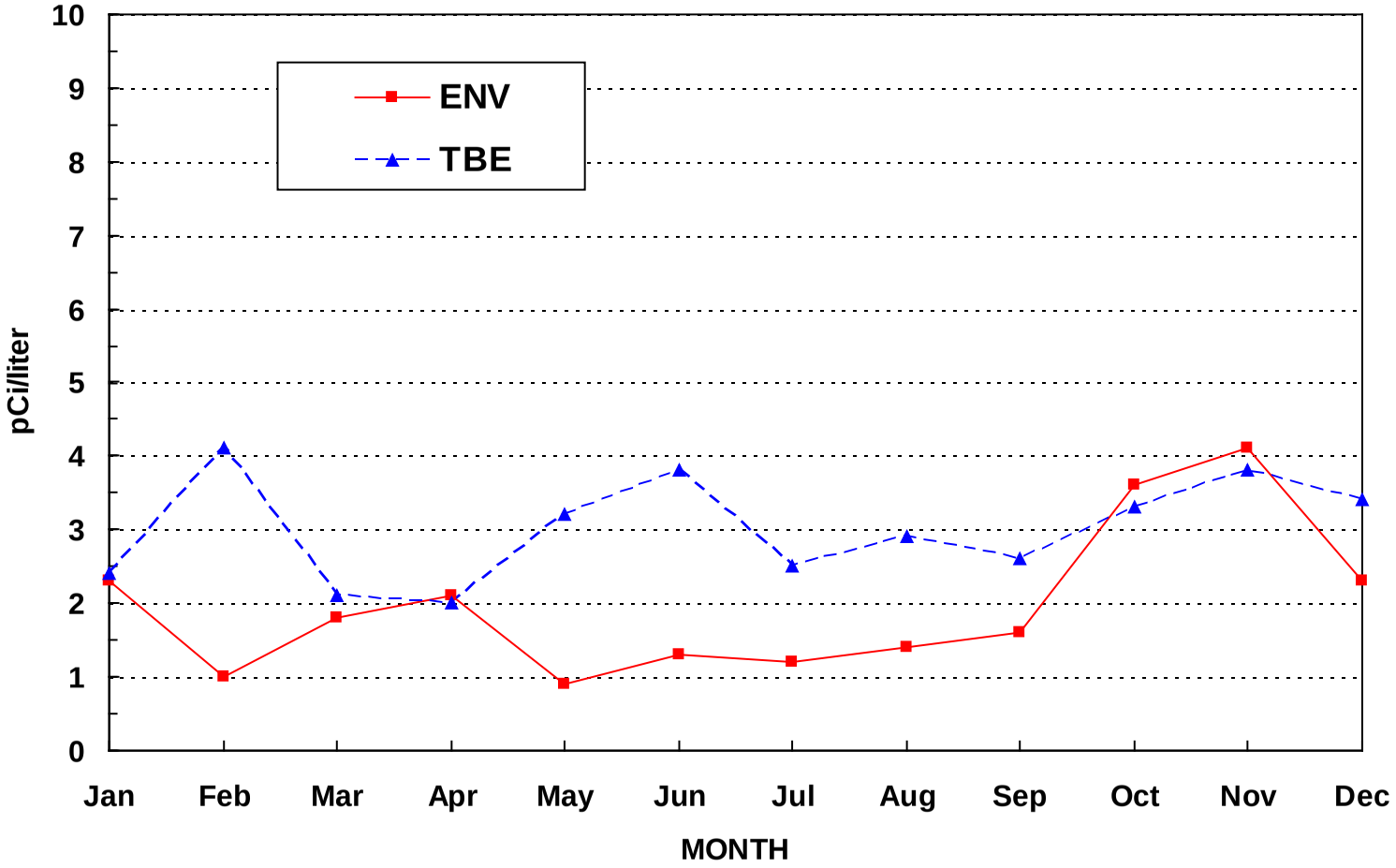
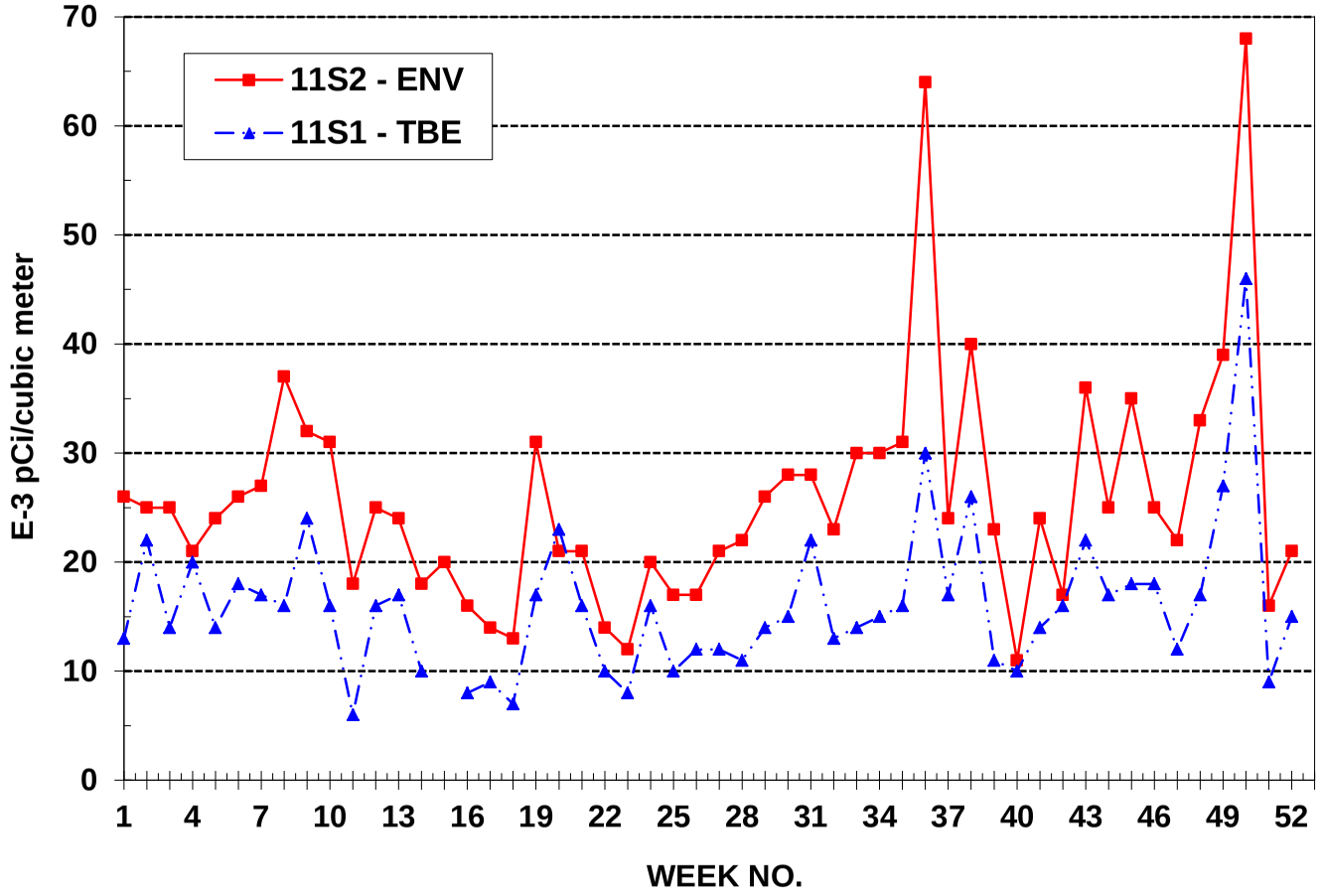


FIGURE D-2
COMPARISON OF WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED FROM LGS COLLOCATED LOCATIONS 11S1 AND 11S2, 2015



Intentionally left blank

APPENDIX E

INTER-LABORATORY COMPARISON PROGRAM

Intentionally left blank

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2015

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2015	E11181	Milk	Sr-89	pCi/L	88.9	97.2	0.91	A
			Sr-90	pCi/L	12.2	17.4	0.70	W
	E11182	Milk	I-131	pCi/L	61.3	65.1	0.94	A
			Ce-141	pCi/L	104	113	0.92	A
			Cr-51	pCi/L	265	276	0.96	A
			Cs-134	pCi/L	138	154	0.90	A
			Cs-137	pCi/L	205	207	0.99	A
			Co-58	pCi/L	178	183	0.97	A
			Mn-54	pCi/L	187	188	0.99	A
			Fe-59	pCi/L	182	177	1.03	A
			Zn-65	pCi/L	345	351	0.98	A
			Co-60	pCi/L	379	405	0.94	A
	E11184	AP	Ce-141	pCi	107	85.0	1.26	W
			Cr-51	pCi	261	224	1.17	A
			Cs-134	pCi	74.6	77.0	0.97	A
			Cs-137	pCi	99.6	102	0.98	A
			Co-58	pCi	99.8	110	0.91	A
			Mn-54	pCi	99.2	96.9	1.02	A
			Fe-59	pCi	109	119	0.92	A
			Zn-65	pCi	188	183	1.03	A
			Co-60	pCi	200	201	1.00	A
	E11183	Charcoal	I-131	pCi	82.9	85.4	0.97	A
	E11185	Water	Fe-55	pCi/L	1950	1900	1.03	A
June 2015	E11234	Milk	Sr-89	pCi/L	94.9	92.6	1.02	A
			Sr-90	pCi/L	14.3	12.7	1.13	A
	E11238	Milk	I-131	pCi/L	93.2	95.9	0.97	A
			Ce-141	pCi/L	Not provided for this study			
			Cr-51	pCi/L	349	276	1.26	W
			Cs-134	pCi/L	165	163	1.01	A
			Cs-137	pCi/L	143	125	1.14	A
			Co-58	pCi/L	82.0	68.4	1.20	A
			Mn-54	pCi/L	113	101	1.12	A
			Fe-59	pCi/L	184	151	1.22	W
			Zn-65	pCi/L	269	248	1.08	A
			Co-60	pCi/L	208	193	1.08	A
	E11237	AP	Ce-141	pCi	Not provided for this study			
			Cr-51	pCi	323	233	1.39	N (1)
			Cs-134	pCi	139	138	1.01	A
			Cs-137	pCi	111	106	1.05	A
			Co-58	pCi	54.0	57.8	0.93	A
			Mn-54	pCi	96.8	84.9	1.14	A
			Fe-59	pCi	162	128	1.27	W
			Zn-65	pCi	198	210	0.94	A
			Co-60	pCi	178	163	1.09	A
	E11236	Charcoal	I-131	pCi	93.9	80	1.17	A
June 2015	E11238	Water	Fe-55	pCi/L	1890	1790	1.06	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2015
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
September 2015	E11289	Milk	Sr-89	pCi/L	95.7	99.1	0.97	A
			Sr-90	pCi/L	15.4	16.4	0.94	A
	E11290	Milk	I-131	pCi/L	94.9	99.9	0.95	A
			Ce-141	pCi/L	228	213	1.07	A
			Cr-51	pCi/L	499	538	0.93	A
			Cs-134	pCi/L	208	212	0.98	A
			Cs-137	pCi/L	270	255	1.06	A
			Co-58	pCi/L	275	263	1.05	A
			Mn-54	pCi/L	320	290	1.10	A
			Fe-59	pCi/L	255	226	1.13	A
			Zn-65	pCi/L	392	353	1.11	A
			Co-60	pCi/L	350	330	1.06	A
	E11292	AP	Ce-141	pCi	104	85.1	1.22	W
			Cr-51	pCi	262	215	1.22	W
			Cs-134	pCi	86.1	84.6	1.02	A
			Cs-137	pCi	93	102	0.91	A
			Co-58	pCi	106	105	1.01	A
			Mn-54	pCi	117	116	1.01	A
			Fe-59	pCi	94.8	90.2	1.05	A
			Zn-65	pCi	160	141	1.13	A
			Co-60	pCi	146	132	1.11	A
	E11291	Charcoal	I-131	pCi	85.9	81.7	1.05	A
	E11293	Water	Fe-55	pCi/L	2090	1800	1.16	A
	E11294	Soil	Ce-141	pCi/kg	209	222	0.94	A
			Cr-51	pCi/kg	463	560	0.83	A
			Cs-134	pCi/kg	231	221	1.05	A
			Cs-137	pCi/kg	311	344	0.90	A
			Co-58	pCi/kg	245	274	0.89	A
			Mn-54	pCi/kg	297	302	0.98	A
			Fe-59	pCi/kg	248	235	1.06	A
			Zn-65	pCi/kg	347	368	0.94	A
			Co-60	pCi/kg	328	344	0.95	A
December 2015	E11354	Milk	Sr-89	pCi/L	96.2	86.8	1.11	A
			Sr-90	pCi/L	14.8	12.5	1.18	A
	E11355	Milk	I-131	pCi/L	95.1	91.2	1.04	A
			Ce-141	pCi/L	117	129	0.91	A
			Cr-51	pCi/L	265	281	0.94	A
			Cs-134	pCi/L	153	160	0.96	A
			Cs-137	pCi/L	119	115	1.03	A
			Co-58	pCi/L	107	110	0.97	A
			Mn-54	pCi/L	153	145	1.06	A
			Fe-59	pCi/L	117	108	1.08	A
			Zn-65	pCi/L	261	248	1.05	A
			Co-60	pCi/L	212	213	1.00	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2015
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2015	E11357	AP	Ce-141	pCi	89.9	84.0	1.07	A
			Cr-51	pCi	215	184	1.17	A
			Cs-134	pCi	103	105	0.98	A
			Cs-137	pCi	76.6	74.8	1.02	A
			Co-58	pCi	76.2	71.9	1.06	A
			Mn-54	pCi	91.4	94.4	0.97	A
			Fe-59	pCi	78.6	70.3	1.12	A
			Zn-65	pCi	173	162	1.07	A
			Co-60	pCi	138	139	0.99	A
	E11422	AP	Sr-89	pCi	98.0	96.9	1.01	A
			Sr-90	pCi	10.0	14.0	0.71	W
	E11356	Charcoal	I-131	pCi	74.9	75.2	1.00	A
	E11358	Water	Fe-55	pCi/L	2160	1710	1.26	W
	E11353	Soil	Ce-141	pCi/kg	252	222	1.14	A
			Cr-51	pCi/kg	485	485	1.00	A
			Cs-134	pCi/kg	319	277	1.15	A
			Cs-137	pCi/kg	292	276	1.06	A
			Co-58	pCi/kg	193	190	1.02	A
			Mn-54	pCi/kg	258	250	1.03	A
			Fe-59	pCi/kg	218	186	1.17	A
			Zn-65	pCi/kg	457	429	1.07	A
			Co-60	pCi/kg	381	368	1.04	A

(1) AP Cr-51 - Cr-51 has the shortest half-life and the weakest gamma energy of the mixed nuclide sample, which produces a large error. Taking into account the error, the lowest value would be 119% of the reference value, which would be considered acceptable. NCR 15-18 See Section H for summary of results.

(a) Teledyne Brown Engineering reported result.

(b) 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.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) 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, 2015

Month/Year	Identification Number	Media	Nuclide*	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2015	15-MaW32	Water	Am-241	Bq/L	0.632	0.654	0.458 - 0.850	A
			Ni-63	Bq/L	2.5		(1)	A
			Pu-238	Bq/L	0.0204	0.0089	(2)	A
			Pu-239/240	Bq/L	0.9	0.8	0.582 - 1.082	A
	15-MaS32	Soil	Ni-63	Bq/kg	392	448.0	314 - 582	A
			Sr-90	Bq/kg	286	653	487 - 849	N (3)
	15-RdF32	AP	Sr-90	Bq/sample	-0.0991		(1)	A
			U-234/233	Bq/sample	0.0211	0.0155	0.0109 - 0.0202	N (3)
			U-238	Bq/sample	0.095	0.099	0.069 - 0.129	A
	15-GrF32	AP	Gr-A	Bq/sample	0.448	1.77	0.53 - 3.01	N (3)
			Gr-B	Bq/sample	0.7580	0.75	0.38 - 1.13	A
	15-RdV32	Vegetation	Cs-134	Bq/sample	8.08	7.32	5.12 - 9.52	A
			Cs-137	Bq/sample	11.6	9.18	6.43 - 11.93	W
			Co-57	Bq/sample	-0.0096		(1)	A
			Co-60	Bq/sample	6.53	5.55	3.89 - 7.22	A
			Mn-54	Bq/sample	0.0058		(1)	A
			Sr-90	Bq/sample	0.999	1.08	0.76 - 1.40	A
			Zn-65	Bq/sample	-0.108		(1)	A
September 2015	15-MaW33	Water	Am-241	Bq/L	1.012	1.055	0.739 - 1.372	A
			Ni-63	Bq/L	11.8	8.55	5.99 - 11.12	N (4)
			Pu-238	Bq/L	0.727	0.681	0.477 - 0.885	A
			Pu-239/240	Bq/L	0.830	0.900	0.630 - 1.170	A
	15-MaS33	Soil	Ni-63	Bq/kg	635	682	477 - 887	A
			Sr-90	Bq/kg	429	425	298 - 553	A
	15-RdF33	AP	Sr-90	Bq/sample	1.48	2.18	1.53 - 2.83	N (4)
			U-234/233	Bq/sample	0.143	0.143	0.100 - 0.186	A
			U-238	Bq/sample	0.149	0.148	0.104 - 0.192	A
	15-GrF33	AP	Gr-A	Bq/sample	0.497	0.90	0.27 - 1.53	A
			Gr-B	Bq/sample	1.34	1.56	0.78 - 2.34	A
	15-RdV33	Vegetation	Cs-134	Bq/sample	6.10	5.80	4.06 - 7.54	A
			Cs-137	Bq/sample	0.0002		(1)	A
			Co-57	Bq/sample	8.01	6.62	4.63 - 8.61	W
			Co-60	Bq/sample	4.97	4.56	3.19 - 5.93	A
			Mn-54	Bq/sample	8.33	7.68	5.38 - 9.98	A
			Sr-90	Bq/sample	0.386	1.30	0.91 - 1.69	N (4)
			Zn-65	Bq/sample	6.07	5.46	3.82 - 7.10	A

(1) False positive test.

(2) Sensitivity evaluation.

(3) Soil Sr-90 - incomplete digestion of the sample resulted in low results; AP U-234/233 - extremely low activity was difficult to quantify AP Gr-A - the MAPEP filter has the activity embedded in the filter. To corrected the low bias, TBE will create an attenuated efficiency for MAPEP samples. NCR 15-13 See Section H for summary of results.
See Section H for summary of results.

(4) Water Ni-63 extremely low activity was difficult to quantify; AP & Vegetation Sr-90 was lost during separation, possible from substance added by MAPEP NCR 15-21.
See Section H for summary of results.

(a) Teledyne Brown Engineering reported result.

(b) 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.

(c) DOE/MAPEP evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

TABLE E-3 ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2015

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2015	RAD-101	Water	Sr-89	pCi/L	45.2	63.2	51.1 - 71.2	N (1)
			Sr-90	pCi/L	28.0	41.9	30.8 - 48.1	N (1)
			Ba-133	pCi/L	80.6	82.5	63.9 - 90.8	A
			Cs-134	pCi/L	71.7	75.7	61.8 - 83.3	A
			Cs-137	pCi/L	187	189	170 - 210	A
			Co-60	pCi/L	85.7	84.5	76.0 - 95.3	A
			Zn-65	pCi/L	197	203	183 - 238	A
			Gr-A	pCi/L	26.1	42.6	22.1 - 54.0	A
			Gr-B	pCi/L	28.8	32.9	21.3 - 40.6	A
			I-131	pCi/L	23.5	23.8	19.7 - 28.3	A
			U-Nat	pCi/L	6.19	6.59	4.99 - 7.83	A
			H-3	pCi/L	3145	3280	2770 - 3620	A
November 2015	RAD-103	Water	Sr-89	pCi/L	40.9	35.7	26.7 - 42.5	A
			Sr-90	pCi/L	29.3	31.1	22.7 - 36.1	A
			Ba-133	pCi/L	31.5	32.5	25.9 - 36.7	A
			Cs-134	pCi/L	59.65	62.3	50.6 - 68.5	A
			Cs-137	pCi/L	156	157	141 - 175	A
			Co-60	pCi/L	70.6	71.1	64.0 - 80.7	A
			Zn-65	pCi/L	145	126	113 - 149	A
			Gr-A	pCi/L	38.2	51.6	26.9 - 64.7	A
			Gr-B	pCi/L	42.0	36.6	24.1 - 44.2	A
			I-131	pCi/L	24.8	26.3	21.9 - 31.0	A
			U-Nat	pCi/L	146.90	56.2	45.7 - 62.4	N (2)
			H-3	pCi/L	21100	21300	18700 - 23400	A

(1) Yield on the high side of our acceptance range indicates possibility of calcium interference. NCR 15-09

(2) Technician failed to dilute original sample. If dilulted, the result would have been 57.1, which fell within the acceptance limits. NCR 15-19 See Section H for summary of Results.

(a) Teledyne Brown Engineering reported result.

(b) 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.

(c) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

TABLE E-4 **ERA (a) STATISTICAL SUMMARY PROFICIENCY TESTING PROGRAM[a]**
ENVIRONMENTAL, INC., 2015

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result [b]	ERA Result [c]	Control Limits	Acceptance
ERW-1444	04/06/15	Sr-89	59.71 ± 5.44	63.20	51.10 - 71.20	Pass
ERW-1444	04/06/15	Sr-90	43.41 ± 2.43	41.90	30.80 - 48.10	Pass
ERW-1448	04/06/15	Ba-133	77.75 ± 4.69	82.50	69.30 - 90.80	Pass
ERW-1448	04/06/15	Cs-134	68.82 ± 3.08	75.70	61.80 - 83.30	Pass
ERW-1448	04/06/15	Cs-137	- 191.92 ± 5.9	189	- 170.00 - 210.0	Pass
ERW-1448	04/06/15	Co-60	85.05 ± 4.59	84.50	76.00 - 95.30	Pass
ERW-1448	04/06/15	Zn-65	- 195.97 ± 12.0	203	- 183.00 - 238.0	Pass
ERW-1450	04/06/15	Gr. Alpha	34.05 ± 1.90	42.60	22.10 - 54.00	Pass
ERW-1450	04/06/15	G. Beta	26.93 ± 1.12	32.90	21.30 - 40.60	Pass
ERW-1453	04/06/15	I-131	22.47 ± 0.83	23.80	19.70 - 28.30	Pass
ERW-1456	04/06/15	Uranium	5.98 ± 0.31	6.59	4.99 - 7.83	Pass
ERW-1461	04/06/15	H-3	3,254 ± 180	3280	2,770 - 3620	Pass
ERW-5528	10/05/15	Sr-89	34.76 ± 0.06	35.70	26.70 - 42.50	Pass
ERW-5528	10/05/15	Sr-90	29.23 ± 0.06	31.10	22.70 - 36.10	Pass
ERW-5531	10/05/15	Ba-133	30.91 ± 0.53	32.50	25.90 - 36.70	Pass
ERW-5531	10/05/15	Cs-134	57.40 ± 2.57	62.30	50.69 - 68.50	Pass
ERW-5531	10/05/15	Cs-137	- 163.12 ± 4.8	157	- 141.00 - 175.0	Pass
ERW-5531	10/05/15	Co-60	73.41 ± 1.72	71.10	64.00 - 80.70	Pass
ERW-5531	10/05/15	Zn-65	- 138.94 ± 5.7	126	- 113.00 - 149.0	Pass
ERW-5534	10/05/15	Gr. Alpha	29.99 ± 0.08	51.60	26.90 - 64.70	Pass
ERW-5534	10/05/15	G. Beta	27.52 ± 0.04	36.60	24.10 - 44.20	Pass
ERW-5537	10/05/15	I-131	25.54 ± 0.60	26.30	21.90 - 31.00	Pass
ERW-5540	10/05/15	Uranium	53.30 ± 0.55	56.20	45.70 - 62.40	Pass
ERW-5543	10/05/15	H-3	21,260 ± 351	21,300	18,700 - 23400.0	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).

[b] Unless otherwise indicated, the laboratory result is given as the mean ± standard deviation for three determinations.

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

TABLE E-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
ENVIRONMENTAL, INC., 2015
(Page 1 of 2)

			Concentration [a]			
Lab Code [b]	Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MASO-975	02/01/15	Ni-63	341 ± 18	448	314 - 582	Pass
MASO-975	02/01/15	Sr-90	523 ± 12	653	457 - 849	Pass
MASO-975	02/01/15	Cs-134	533 ± 6	678	475 - 881	Pass
MASO-975	02/01/15	Cs-137	0.8 ± 2.5	0.0	NA [c]	Pass
MASO-975	02/01/15	Co-57	0.5 ± 1	0.0	NA [c]	Pass
MASO-975	02/01/15	Co-60	741 ± 8	817	572 - 1062	Pass
MASO-975	02/01/15	Mn-54	1,153 ± 9	1,198	839 - 1557	Pass
MASO-975	02/01/15	Zn-65	892 ± 18	1064	745 - 1383	Pass
MAW-969	02/01/15	Am-241	0.650 ± 0.078	0.654	0.458 - 0.850	Pass
MAW-969	02/01/15	Cs-134	21.09 ± 0.25	23.5	16.5 - 30.6	Pass
MAW-969	02/01/15	Cs-137	19.63 ± 0.34	19.1	13.4 - 24.8	Pass
MAW-969 [d]	02/01/15	Co-57	10.2 ± 0.4	29.9	20.9 - 38.9	Fail
MAW-969	02/01/15	Co-60	0.02 ± 0.05	0.00	NA [c]	Pass
MAW-969	02/01/15	H-3	569 ± 13	563	394 - 732	Pass
MAW-969	02/01/15	Fe-55	6.00 ± 6.60	6.88	4.82 - 8.94	Pass
MAW-969	02/01/15	Mn-54	0.02 ± 0.07	0.00	NA [c]	Pass
MAW-969	02/01/15	Ni-63	2.9 ± 3	0.00	NA [c]	Pass
MAW-969	02/01/15	Zn-65	16.54 ± 0.85	18.3	12.8 - 23.8	Pass
MAW-969	02/01/15	Pu-238	0.02 ± 0.03	0.01	NA [e]	Pass
MAW-969	02/01/15	Pu-239/240	0.81 ± 0.10	0.83	0.58 - 1.08	Pass
MAW-969	02/01/15	Sr-90	9.40 ± 1.30	9.48	6.64 - 12.32	Pass
MAW-950	02/01/15	Gr. Alpha	0.66 ± 0.05	1.07	0.32 - 1.81	Pass
MAW-950	02/01/15	Gr. Beta	2.72 ± 0.06	2.79	1.40 - 4.19	Pass
MAAP-978	02/01/15	Cs-134	1.00 ± 0.04	1.15	0.81 - 1.50	Pass
MAAP-978	02/01/15	Cs-137	0.004 ± 0.023	0.00	NA [c]	Pass
MAAP-978 [e]	02/01/15	Co-57	0.04 ± 0.04	1.51	1.06 - 1.96	Fail
MAAP-978	02/01/15	Co-60	0.01 ± 0.02	0.00	NA [c]	Pass
MAAP-978	02/01/15	Mn-54	1.11 ± 0.08	1.02	0.71 - 1.33	Pass
MAAP-978	02/01/15	Zn-65	0.83 ± 0.10	0.83	0.58 - 1.08	Pass
MAAP-981	02/01/15	Sr-89	38.12 ± 1.01	47.5	33.3 - 61.8	Pass
MAAP-981	02/01/15	Sr-90	1.22 ± 0.13	1.06	0.74 - 1.38	Pass
MAAP-984	02/01/15	Gr. Alpha	0.59 ± 0.06	1.77	0.53 - 3.01	Pass
MAAP-984	02/01/15	Gr. Beta	0.95 ± 0.07	0.75	0.38 - 1.13	Pass
MAVE-972	02/01/15	Cs-134	6.98 ± 0.13	7.32	5.12 - 9.52	Pass
MAVE-972	02/01/15	Cs-137	9.73 ± 0.21	9.18	6.43 - 11.93	Pass
MAVE-972	02/01/15	Co-57	0.01 ± 0.04	0.00	NA [c]	Pass
MAVE-972	02/01/15	Co-60	3.89 ± 0.20	5.55	3.89 - 7.22	Pass
MAVE-972	02/01/15	Mn-54	0.04 ± 0.07	0.00	NA [c]	Pass
MAVE-972	02/01/15	Zn-65	0.09 ± 0.12	0.00	NA [c]	Pass

TABLE E-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
ENVIRONMENTAL, INC., 2015
(Page 2 of 2)

			Concentration [a]			
Lab Code [b]	Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MASO-4903	08/01/15	Ni-63	556 ± 18	682	477 - 887	Pass
MASO-4903 [f]	08/01/15	Sr-90	231 ± 7	425	298 - 553	Fail
MASO-4903 [f]	08/01/15	Sr-90	352 ± 10	425	298 - 553	Pass
MASO-4903	08/01/15	Cs-134	833 ± 10	1,010	707 - 1313	Pass
MASO-4903	08/01/15	Cs-137	808 ± 11	809.00	566 - 1052	Pass
MASO-4903	08/01/15	Co-57	1,052 ± 10	1,180	826 - 1534	Pass
MASO-4903	08/01/15	Co-60	2 ± 2	1.3	NA [e]	Pass
MASO-4903	08/01/15	Mn-54	1,331 ± 13	1,340	938 - 1742	Pass
MASO-4903	08/01/15	Zn-65	686 ± 15	662	463 - 861	Pass
MAW-5007	08/01/15	Cs-134	16.7 ± 0.4	23.1	16.2 - 30	Pass
MAW-5007	08/01/15	Cs-137	-0.36 ± 0.13	0	NA [c]	Pass
MAW-5007	08/01/15	Co-57	21.8 ± 0.4	20.8	14.6 - 27	Pass
MAW-5007	08/01/15	Co-60	17.3 ± 0.3	17.1	12 - 22.2	Pass
MAW-5007	08/01/15	H-3	227.5 ± 8.9	216	151 - 281	Pass
MAW-5007 [g]	08/01/15	Fe-55	4.2 ± 14.1	13.1	9.2 - 17	Fail
MAW-5007	08/01/15	Mn-54	16.6 ± 0.5	15.6	10.9 - 20.3	Pass
MAW-5007	08/01/15	Ni-63	9.1 ± 2.6	8.55	5.99 - 11.12	Pass
MAW-5007	08/01/15	Zn-65	15.5 ± 0.9	13.9	9.7 - 18.1	Pass
MAW-5007	08/01/15	Sr-90	4.80 ± 0.50	4.80	3.36 - 6.24	Pass
MAW-5007	08/01/15	Gr. Alpha	0.41 ± 0.04	0.43	0.13 - 0.73	Pass
MAW-5007	08/01/15	Gr. Beta	3.45 ± 0.07	3.52	1.76 - 5.28	Pass
MAAP-4911	08/01/15	Sr-89	3.55 ± 0.67	3.98	2.79 - 5.17	Pass
MAAP-4911	08/01/15	Sr-90	0.94 ± 0.16	1.05	0.74 - 1.37	Pass
MAAP-4907	08/01/15	Gr. Alpha	0.30 ± 0.04	0.90	0.27 - 1.53	Pass
MAAP-4907	08/01/15	Gr. Beta	1.85 ± 0.09	1.56	0.78 - 2.34	Pass
MAVE-4901	08/01/15	Cs-134	5.56 ± 0.16	5.80	4.06 - 7.54	Pass
MAVE-4901	08/01/15	Cs-137	-0.02 ± 0.06	0.00	NA [c]	Pass
MAVE-4901	08/01/15	Co-57	7.74 ± 0.18	6.62	4.63 - 8.61	Pass
MAVE-4901	08/01/15	Co-60	4.84 ± 0.15	4.56	3.19 - 5.93	Pass
MAVE-4901	08/01/15	Mn-54	8.25 ± 0.25	7.68	5.38 - 9.98	Pass
MAVE-4901	08/01/15	Zn-65	5.78 ± 0.29	5.46	3.82 - 7.10	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 series as a "false positive". MAPEP does not provide control limits.

[d] Lab result was 27.84. Data entry error resulted in a non-acceptable result. See Section H for summary of results.

[e] Lab result was 1.58. Data entry error resulted in a non-acceptable result. See Section H for summary of results.

f The incomplete separation of calcium from strontium caused a failed low result. The result of reanalysis acceptable. See Section H for summary of results.

g The known activity was below the routine laboratory detection limits for the available aliquot fraction. See Section H for summary of results.

APPENDIX F

ERRATA DATA

Intentionally left blank

There are four corrections to the 2014 AREOR.

1. Dosimetry data was documented in units of milliRoentgen/quarter in Tables C-IX.1, C-IX.2, and C-IX.3 in the 2014 AREOR. Upon review, these units are inconsistent with the information reported on page 14 section C Ambient Gamma Radiation, that state the data is reported in mR/standard month. The data in the data tables are in units of milliRoentgen/standard month and the data table units should be reported as "Results in Units of milliRoentgen/standard month ± 2 Standard Deviation". This change impacts Tables C-IX.1, C-IX.2, and C-IX.3 of the 2014 AREOR and Section III of the 2013 AREOR and the revised section can be found in this appendix, pages F-2 through F-3.

2. In the 2014 AREOR Appendix F, which presents corrections to the 2013 AREOR, the 40CFR190 Compliance Values in the text of Appendix F, Section III does not match the table following the text. The numbers in the text are incorrect and should reflect the 40CFR190 compliance values in Table 1. This change affects Appendix F of the 2014 AREOR and Section III of the 2013 AREOR and the revised section can be found in this appendix, pages F-4 through F-5.

3. The 2014 AREOR states TLD Panasonic 814 type dosimeters were used for dosimetry data, but does not clearly depict that Landauer OSL type dosimeters were used in 1st quarter 2014. The 2014 AREOR should state that Landauer OSL type dosimeters were used in 1st quarter 2014 and Panasonic 814 ($CaSO_4$) thermoluminescent dosimeters were used in 2nd – 4th quarter 2014 for ambient gamma radiation level measurements. This change impacts Section IV, C of the 2014 AREOR and the revised text can be found in this Appendix, page F-6.

4. The 2014 AREOR incorrectly reports the sample recovery rate in Section D, Program Exemption. It states a recovery rate of 90% which is low as only 30 samples were missed out of 1005 samples. This would indicate a recovery rate of 97%. The revised text for this section can be found in this Appendix, page F-7.

Table C-IX.1 QUARTERLY DLR RESULTS FOR LIMERICK GENERATING STATION, 2014

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	6.3 ± 2.5	5.5 ± 2.4	7.0 ± 1.7	5.1 ± 2.7	7.7 ± 1.8
3S1	6.1 ± 3.4	5.1 ± 2.0	7.4 ± 1.0	4.2 ± 4.2	7.6 ± 1.8
4E1	4.3 ± 3.1	3.8 ± 0.4	5.1 ± 0.8	2.4 ± 1.2	6.0 ± 0.4
5H1	7.8 ± 3.1	6.3 ± 0.6	8.9 ± 1.0	6.6 ± 2.4	9.3 ± 0.9
5S1	7.1 ± 3.6	5.9 ± 1.6	8.9 ± 1.2	5.2 ± 2.1	8.4 ± 1.7
6C1	6.1 ± 2.5	5.2 ± 0.6	6.7 ± 2.1	4.8 ± 2.8	7.5 ± 1.5
7E1	6.5 ± 2.8	5.7 ± 0.3	7.3 ± 1.1	5.0 ± 3.0	8.1 ± 1.3
7S1	6.5 ± 2.6	5.7 ± 0.2	7.5 ± 1.1	5.1 ± 3.0	7.7 ± 1.2
9C1	6.1 ± 2.9	5.1 ± 0.6	7.5 ± 1.6	4.6 ± 1.1	7.2 ± 1.8
10E1	6.7 ± 3.0	6.0 ± 1.2	7.5 ± 1.1	4.9 ± 2.3	8.2 ± 1.3
10F3	5.9 ± 3.9	4.3 ± 1.2	7.0 ± 1.7	4.2 ± 1.6	8.1 ± 1.6
10S3	6.4 ± 3.0	5.8 ± 1.0	7.2 ± 2.1	4.5 ± 1.4	7.9 ± 1.3
11S1	7.5 ± 2.9	6.5 ± 0.3	8.5 ± 1.1	5.9 ± 1.4	8.9 ± 2.7
13C1	4.5 ± 3.5	4.3 ± 1.0	5.3 ± 1.4	2.1 ± 1.3	6.1 ± 0.3
13E1	6.4 ± 3.0	5.7 ± 0.1	7.5 ± 1.4	4.7 ± 1.4	7.8 ± 1.4
13S2	9.3 ± 3.7	8.8 ± 1.9	10.6 ± 1.9	6.9 ± 3.1	10.9 ± 1.5
14S1	5.7 ± 3.1	5.0 ± 0.3	6.6 ± 1.6	3.8 ± 2.2	7.2 ± 1.4
15D1	6.8 ± 2.7	6.3 ± 1.4	7.6 ± 1.3	5.1 ± 1.4	8.1 ± 1.2
16F1	6.4 ± 3.2	5.4 ± 0.9	7.2 ± 1.4	4.7 ± 2.1	8.2 ± 1.1
17B1	5.9 ± 3.5	5.4 ± 0.2	6.6 ± 1.4	3.7 ± 2.3	7.8 ± 2.1
18S2	6.7 ± 2.9	5.8 ± 0.4	7.7 ± 1.4	5.1 ± 1.2	8.1 ± 2.3
19D1	5.8 ± 2.8	5.4 ± 1.0	6.4 ± 1.0	4.0 ± 1.4	7.2 ± 0.8
20D1	5.4 ± 3.6	4.5 ± 0.3	6.6 ± 1.2	3.3 ± 1.6	7.1 ± 2.3
20F1	6.0 ± 3.1	5.4 ± 0.5	6.9 ± 1.5	4.0 ± 2.2	7.5 ± 1.2
21S2	5.0 ± 3.4	4.4 ± 0.5	5.1 ± 1.2	3.2 ± 3.8	7.2 ± 1.6
23S2	5.8 ± 3.1	5.6 ± 2.8	6.7 ± 1.6	3.7 ± 1.1	7.2 ± 0.9
24D1	5.0 ± 3.6	4.5 ± 1.4	6.0 ± 1.2	2.6 ± 2.1	6.7 ± 0.7
25D1	5.0 ± 3.0	4.8 ± 0.4	5.8 ± 0.9	3.0 ± 4.0	6.5 ± 1.3
25S2	5.3 ± 3.5	4.8 ± 1.3	6.4 ± 1.2	3.0 ± 2.3	6.8 ± 1.0
26S3	5.1 ± 3.4	4.3 ± 0.1	6.3 ± 1.4	3.1 ± 2.8	6.7 ± 1.1
28D2	5.6 ± 2.8	5.2 ± 1.6	6.4 ± 1.9	3.8 ± 3.3	7.0 ± 1.3
29E1	5.8 ± 2.9	5.0 ± 1.1	6.7 ± 1.2	4.1 ± 2.8	7.2 ± 1.0
29S1	5.1 ± 3.6	4.2 ± 0.5	6.4 ± 4.4	3.0 ± 3.0	6.7 ± 1.4
31D1	7.3 ± 2.8	6.7 ± 0.7	8.2 ± 0.7	5.6 ± 3.2	8.7 ± 0.9
31D2	6.2 ± 3.6	5.2 ± 0.0	7.7 ± 0.8	4.2 ± 2.2	7.7 ± 0.6
31S1	6.6 ± 3.0	6.0 ± 0.0	7.7 ± 1.2	4.8 ± 2.9	8.0 ± 1.6
34E1	5.7 ± 3.2	4.7 ± 0.4	6.7 ± 0.8	4.0 ± 3.4	7.4 ± 1.3
34S2	6.0 ± 2.8	5.5 ± 1.5	6.7 ± 0.9	4.2 ± 2.8	7.4 ± 1.9
36D1	5.1 ± 3.0	4.4 ± 0.3	5.8 ± 3.4	3.3 ± 3.4	6.7 ± 1.3
36S2	6.4 ± 3.0	6.0 ± 0.4	7.3 ± 1.1	4.5 ± 2.8	7.9 ± 1.6

Table C-IX.2 MEAN QUARTERLY DLR RESULTS FOR THE SITE BOUNDARY, MIDDLE AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2014

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

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	MIDDLE	CONTROL
JAN-MAR	5.6 ± 2.2	5.2 ± 1.4	6.3 ± 0
APR-JUN	7.3 ± 2.5	6.8 ± 1.6	8.9 ± 0
JUL-SEP	4.4 ± 2.2	4.1 ± 1.9	6.6 ± 0
OCT-DEC	7.8 ± 2.1	7.4 ± 1.4	9.3 ± 0

Table C-IX.3 SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR LIMERICK GENERATING STATION, 2014

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	64	3.0	10.9	6.3 ± 3.5
MIDDLE	92	2.1	8.7	5.8 ± 3.1
CONTROL	4	6.3	9.3	7.8 ± 3.1

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

III. Program Description

F. Compliance to 40CFR190 Limits

A. 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 40CFR190 compliance.

<u>40 CFR 190 Compliance</u>:

The maximum calculated dose to a real individual would not exceed 3.19E-01 mrem (total body), 1.56E+00 mrem (organ), or 3.19E-01 mrem (thyroid).

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

Table 1 40CFR190 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	6.76E-03	3.12E-01	1.79E-04	0.00E+00	3.19E-01	1.28E+00%	25	mrem
Organ Dose	6.76E-03	1.55E+00	1.79E-04	0.00E+00	1.56E+00	6.23E+00%	25	mrem
Thyroid Dose	6.76E-03	3.12E-01	1.78E-04	0.00E+00	3.19E-01	4.25E-01%	75	mrem

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing Landauer (Al_2O_3:C) optically stimulated luminescence dosimeters in 1st quarter 2014 and Panasonic 814 ($CaSO_4$) thermoluminescent type dosimeters in 2nd-4th quarter 2014. 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–6.

Dosimeter measurements were reported in mR/standard month. Most dosimeter measurements were below 10 mR/standard month, with a range of 2.1 to 10.9 mR/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. Program Exceptions

For 2014 the LGS REMP had a sample recovery rate of 97%. Exceptions are listed below.

1. Air sample from location 22G1 for the week of 02/24/14 – 03/2/14 was not available due to inadequate volume from a blown fuse (IR 1640093).

2. Air sample from location 15D1 for the week of 06/16/14 – 06/23/14 was not available due to equipment malfunction (IR 2400170).

3. Air sample from location 10S3 for the week of 10/13/14 – 10/20/14 was not available due to equipment malfunction (IR 2422722).

4. Air samples from location 22G1 for the time frame of 07/07/14 – 09/29/14 was not available due to loss of power of underground wiring (IR 1689430). During this period of time another location was used, located in a least prevalent wind direction, to satisfy the requirements of a control location in the ODCM.

Each program exception was reviewed to understand the causes of the program exception. Sampling and maintenance errors were reviewed with the personnel involved to prevent recurrence. Occasional equipment breakdowns and freezing temperatures were unavoidable.

The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

Intentionally left blank

APPENDIX G

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally left blank

Docket No: 50-352
50-353

LIMERICK GENERATING STATION
UNITS 1 and 2

Annual Radiological
Groundwater Protection Program Report

1 January Through 31 December 2015

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

April 2016

Intentionally Left Blank

Table of Contents

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 2015 through 31 December 2015. During that time period, 284 analyses were performed on 113 samples from 14 groundwater, 7 surface water and 4 precipitation water locations collected from the environment, both on and off station property in 2015.

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 two of the fourteen groundwater monitoring locations. Tritium was not detected at any of the seven 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 and Strontium-90. All Sr-89 and Sr-90 results were less than the MDA.

Groundwater and surface water was analyzed for gross alpha and gross beta in dissolved and suspended fractions. Gross alpha (dissolved) was detected at four of 13 groundwater locations sampled. Gross alpha (suspended) was detected at two of 13 groundwater locations sampled. Gross beta (dissolved) was detected at 13 of 13 groundwater locations sampled. Gross beta (suspended) was detected at two of 13 groundwater locations.

Groundwater and surface water was analyzed for gamma emitting radionuclides associated with the renewed licensed plant operation. Naturally occurring potassium-40 was detected in two of 13 groundwater locations sampled and one of seven surface water locations. All other gamma isotopic results were less than the MDA.

Hard-To-Detect analyses were performed on a select group of groundwater locations to establish background levels. The analyses included Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-233/234, U-235 and U-238. The isotopes of U-233/234 and U-238 were detected in one of one groundwater monitoring locations. The U-233/234 concentrations was 6.4 pCi/L and the U-238 concentration was 3.1 pCi/L. The levels detected are considered background.

All other hard-to-detect nuclides were not detected at concentrations greater than their respective MDCs.

Precipitation water samples were analyzed for tritium. Tritium was detected at two of four 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. Results are consistent with previous years.

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 2015.

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 2015. 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 hydrogeologic conditions.

<u>Precipitation</u>

A five gallon precipitation collection bucket fitted with a funnel was installed a four locations around the Limerick Generating Station. Three collection buckets were located on site boundary 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 Midwest Labs on environmental samples for the LGS RGPP in 2015. 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. 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 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 strontium-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 fourteen locations were analyzed for tritium activity (Appendix B, Table B–I.1). Tritium values ranged from non-detectable to 432 pCi/L. Although no drinking water pathway is available from groundwater, the theoretical dose via the drinking water pathway was calculated at 2.17E-03 mrem to a child (total body), which represents 3.62E-02% 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)

Samples were analyzed for gross alpha and gross beta in the dissolved and suspended fractions. Gross alpha (dissolved) was detected in four of 13 groundwater locations sampled. The concentrations ranged from 2.1 to 4.3 pCi/L. Gross alpha (suspended) was detected in two of 13 groundwater locations sampled. The concentrations ranged from 3.6 to 21.2 pCi/L. Gross beta (dissolved) was detected in 13 of 13 groundwater locations sampled. The concentrations ranged from 2.1 to 34.9 pCi/L. Gross beta (suspended) was detected in two of 13 groundwater locations sampled. The concentrations ranged from 3.8 to 27.6 pCi/L (Appendix B, Table B-I.1).

Gamma Emitters

Samples were analyzed for gamma emitting nuclides. Naturally occurring potassium-40 was detected in two of 13 locations. All other gamma results were below the required LLDs (Appendix B, Table B-I.2).

Hard-To-Detect

Hard-To-Detect analyses are performed on a select group of groundwater locations to establish background levels. The analyses include Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-233/234, U-235 and U-238. The isotopes of U-233/234 and U-238 were detected in one of 14 groundwater monitoring locations. The U-233/234 concentration was 6.4 pCi/L and the U-238 concentration was 3.1 pCi/L (Table B-I.3, Appendix B). The concentrations detected are considered background.

All other hard-to-detect nuclides were not detected at concentrations greater than their respective MDCs.

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 seven locations were analyzed for tritium activity (Appendix B, Table B-II.1). Tritium was not detected in any of the seven locations sampled.

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 potassium-40 was detected in one of seven locations at a concentration of 57 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 two of four precipitation water locations analyzed. The concentrations ranged from 225 pCi/L to 311 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 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 only in an emergency fire situation; therefore, water use is estimated to be zero.

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 2015.

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

   New monitoring well MW-LR-10 was installed in the 3rd quarter of 2015 and the first samples taken were in 4th quarter of 2015.

3. Abandonment of Monitoring Wells

   Well P-16 was abandoned in 3rd quarter 2015. The new monitoring well MW-LR-10 ensures the same vicinity is covered by the RGPP.

4. 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

APPENDIX A

LOCATION DESIGNATION

Intentionally left blank

TABLE A-1: Radiological Groundwater Protection Program – Sampling Locations for the Limerick Generating Station, 2015

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
P16	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

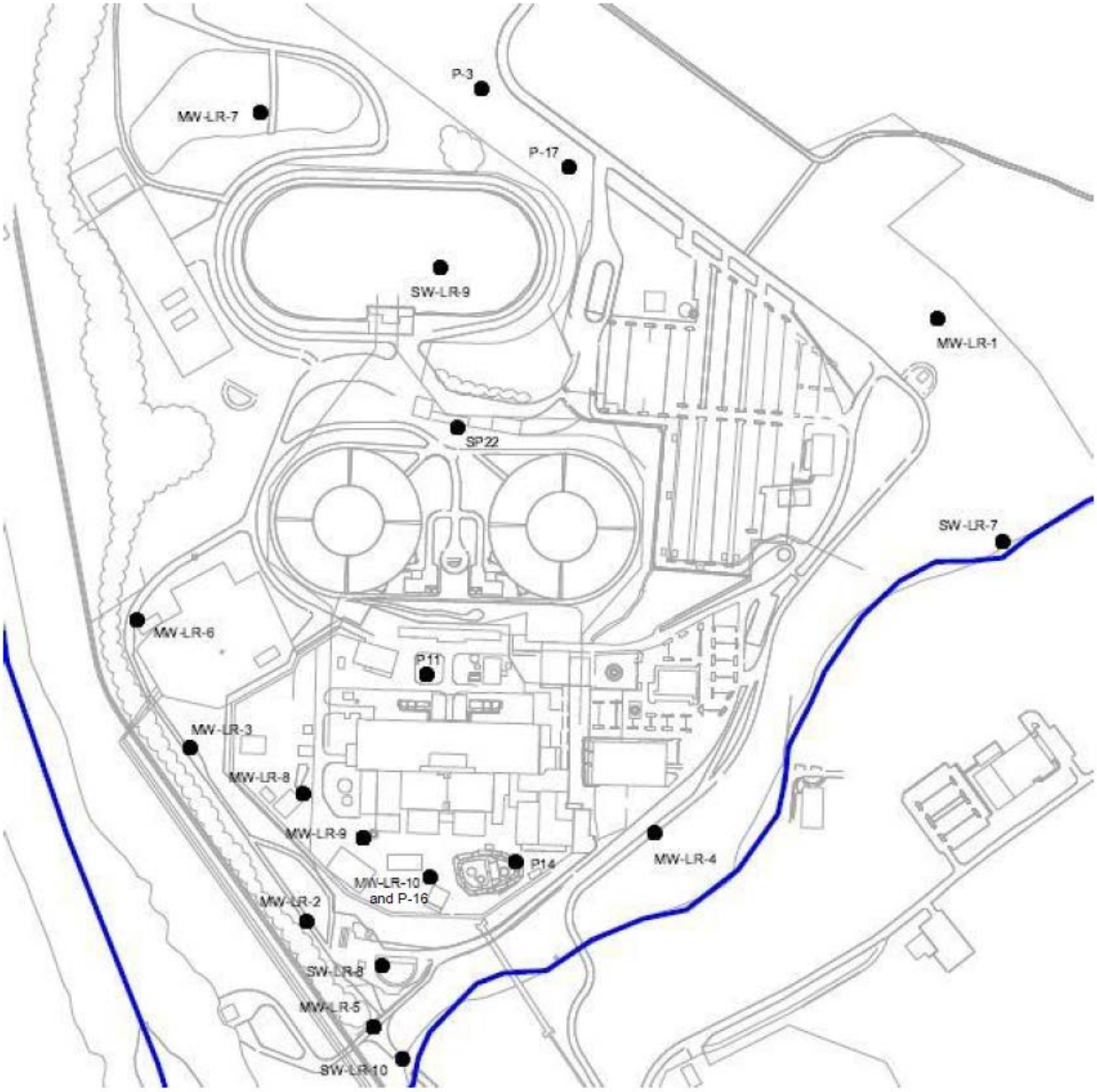


Figure 1 Routine Well Water and Surface Water Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2015.

Figure 2 Routine Surface Water Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2015.

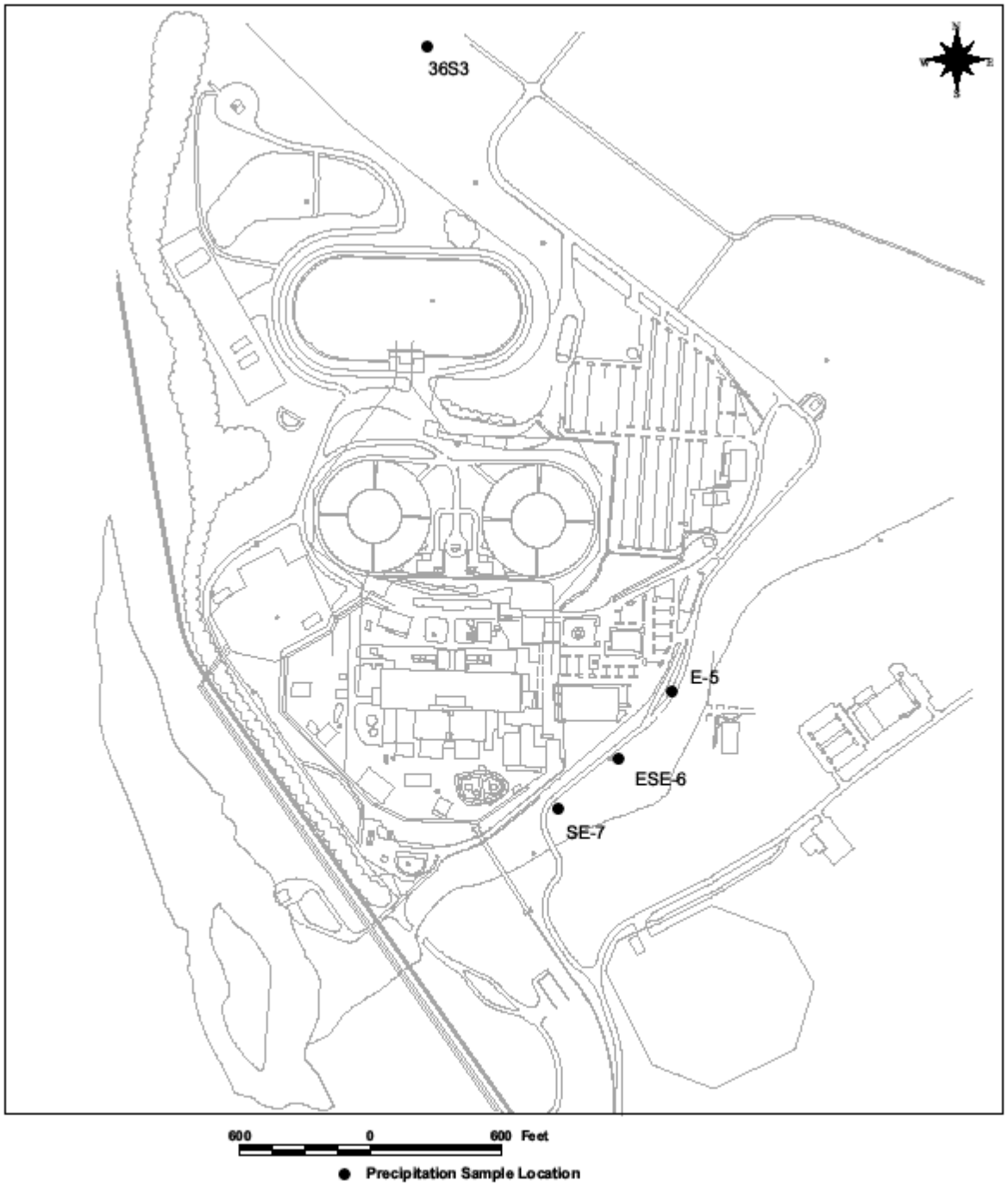


Figure 3 Routine Precipitation Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2015.

APPENDIX B

DATA TABLES

Intentionally left blank

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, 2015

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	02/02/15		< 165						
DW-LR-1	05/12/15		< 198	< 5.0	< 0.7	2.1 ± 1.0	< 0.4	2.3 ± 1.0	< 1.5
DW-LR-1	08/04/15		< 188						
DW-LR-1	10/20/15		< 182						
MW-LR-1	05/12/15		< 197	< 5.8	< 0.6	< 3.4	< 0.4	19.2 ± 2.0	< 1.5
MW-LR-2	02/03/15		< 170						
MW-LR-2	05/12/15		< 193	< 5.2	< 0.5	< 2.2	< 0.5	2.7 ± 1.2	< 1.4
MW-LR-2	08/05/15		< 188						
MW-LR-2	10/22/15		< 184						
MW-LR-3	02/05/15		< 171						
MW-LR-3	05/13/15		< 190	< 5.6	< 0.6	< 2.6	< 0.9	3.1 ± 1.3	< 2.1
MW-LR-3	08/05/15		< 188						
MW-LR-3	10/22/15		< 185						
MW-LR-4	02/03/15		< 164						
MW-LR-4	05/12/15		< 191	< 5.3	< 0.6	< 6.7	< 1.4	7.3 ± 1.9	< 2.0
MW-LR-4	08/04/15		< 189						
MW-LR-4	10/21/15		< 183						
MW-LR-5	02/03/15		< 169						
MW-LR-5	05/12/15		< 191	< 5.2	< 0.7	< 4.4	< 1.4	7.9 ± 1.6	< 2.1
MW-LR-5	08/04/15		< 189						
MW-LR-5	10/21/15		< 183						
MW-LR-7	02/03/15		< 191						
MW-LR-7	05/12/15		< 192	< 5.6	< 0.7	< 1.2	< 0.5	3.1 ± 0.8	< 1.4
MW-LR-7	08/04/15		< 189						
MW-LR-7	10/21/15		< 181						
MW-LR-8	02/04/15	TBE	< 166						
MW-LR-8	02/04/15	TBE	< 168						
MW-LR-8	02/04/15	EIML	< 195						
MW-LR-8	05/13/15	TBE	326 ± 140	< 4.4	< 0.5	< 3.4	< 1.4	4.6 ± 1.6	< 2.1
MW-LR-8	05/13/15	TBE	307 ± 133	< 4.2	< 0.6	< 4.7	< 1.4	2.8 ± 1.5	< 2.1
MW-LR-8	05/13/15	EIML	240 ± 89		0.7	0.4			
MW-LR-8	08/04/15	TBE	273 ± 127						
MW-LR-8	08/04/15	TBE	231 ± 125						
MW-LR-8	08/04/15	EIML	294 ± 88						
MW-LR-8	10/21/15	TBE	319 ± 131						
MW-LR-8	10/21/15	TBE	353 ± 131						
MW-LR-8	10/21/15	EIML	229 ± 92						
MW-LR-9	02/04/15	TBE	380 ± 123						
MW-LR-9	02/04/15	TBE	382 ± 123						
MW-LR-9	02/04/15	EIML	432 ± 122						
MW-LR-9	05/13/15		< 192	< 5.1	< 0.8	2.2 ± 1.4	< 0.4	10.6 ± 1.6	< 1.5
MW-LR-9	05/13/15		< 191	< 5.3	< 0.6	< 2.2	< 1.5	8.4 ± 1.4	< 2.1
MW-LR-9	08/04/15	TBE	323 ± 132						
MW-LR-9	08/04/15	TBE	266 ± 128						
MW-LR-9	08/04/15	EIML	354 ± 91						
MW-LR-9	10/21/15	TBE	193 ± 125						
MW-LR-9	10/21/15	TBE	234 ± 125						
MW-LR-9	10/21/15	EIML	< 149						

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, 2015

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-10	10/21/15	Original	< 181	< 7.2	< 1.0	3.0 ± 0.9	21.2 ± 2.8	2.1 ± 1.0	27.6 ± 2.4
MW-LR-10	10/21/15	Recount				4.3 ± 2.1	20.2 ± 2.7	4.1 ± 1.6	27.6 ± 2.5
P-11	02/04/15		< 170						
P-11	05/13/15		< 198	< 4.2	< 0.5	< 6.6	< 0.4	34.9 ± 3.5	< 1.5
P-11	08/04/15		< 187						
P-11	10/21/15		< 186						
P-14	02/05/15		< 165						
P-14	05/13/15		< 196	< 6.2	< 0.8	< 3.5	3.6 ± 1.2	4.8 ± 1.8	3.8 ± 1.3
P-14	08/04/15		< 187						
P-14	10/21/15		< 184						
P-16	02/05/15		< 168						
P-17	05/12/15		< 200	< 3.3	< 0.6	< 3.8	< 0.4	3.5 ± 1.5	< 1.5

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2015**

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	05/12/15	< 13	< 12	< 1	< 1	< 3	< 1	< 3	< 2	< 3	< 5	< 1	< 1	< 10	< 3
MW-LR-1	05/12/15	< 22	< 18	< 2	< 2	< 5	< 2	< 5	< 2	< 4	< 8	< 2	< 2	< 17	< 5
MW-LR-2	05/12/15	< 19	< 28	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 19	< 6
MW-LR-3	05/13/15	< 20	< 17	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 20	< 7
MW-LR-4	05/12/15	< 19	< 15	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 19	< 5
MW-LR-5	05/12/15	< 22	< 21	< 2	< 3	< 6	< 2	< 5	< 3	< 5	< 12	< 2	< 2	< 22	< 8
MW-LR-7	05/12/15	< 22	< 47	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 13	< 2	< 2	< 21	< 7
MW-LR-8	05/13/15	< 23	< 48	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 13	< 2	< 2	< 22	< 7
MW-LR-8	05/13/15	< 16	< 18	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 9	< 2	< 2	< 16	< 6
MW-LR-9	05/13/15	< 23	< 23	< 2	< 3	< 6	< 3	< 5	< 3	< 5	< 12	< 2	< 3	< 23	< 8
MW-LR-9	05/13/15	< 19	< 35	< 2	< 2	< 4	< 2	< 4	< 2	< 3	< 9	< 2	< 2	< 17	< 5
MW-LR-10	10/21/15	< 43	111 ± 66	< 5	< 4	< 9	< 5	< 10	< 6	< 8	< 9	< 5	< 5	< 22	< 7
P-11	05/13/15	< 20	46 ± 25	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 10	< 2	< 2	< 19	< 5
P-14	05/13/15	< 19	< 31	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 11	< 2	< 2	< 17	< 6
P-17	05/12/15	< 21	< 17	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 13	< 2	< 2	< 23	< 6

TABLE B-I.3 CONCENTRATIONS OF HARD TO DETECTS IN GROUNDWATER SAMPLES COLLECTED A
RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STA

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	AM-241	CM-242	CM-243/244	PU-238	PU-239/240	U-233/234	U-235
DW-LR-1	05/12/15							
MW-LR-1	05/12/15							
MW-LR-2	05/12/15							
MW-LR-3	05/13/15							
MW-LR-4	05/12/15							
MW-LR-5	05/12/15							
MW-LR-7	05/12/15							
MW-LR-8	05/13/15							
MW-LR-8	05/13/15							
MW-LR-9	05/13/15							
MW-LR-9	05/13/15							
MW-LR-10	10/21/15	< 0.2	< 0.02	< 0.1	< 0.1	< 0.1	6.4 ± 1.3	< 0.03
P-11	05/13/15							
P-14	05/13/15							
P-17	05/12/15							

TABLE B-II.1 CONCENTRATIONS OF TRITIUM AND STRONTIUM IN SURFACE WATER SAMPLE COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	Sr-89	Sr-90
SW-LR-2	05/11/15	< 196	< 5.9	< 0.8
SW-LR-2	10/20/15	< 182		
SW-LR-4	05/11/15	< 197	< 6.1	< 0.6
SW-LR-4	10/20/15	< 183		
SW-LR-6	05/11/15	< 191	< 6.3	< 0.8
SW-LR-6	10/20/15	< 182		
SW-LR-7	05/11/15	< 198	< 5.8	< 0.7
SW-LR-7	10/20/15	< 184		
SW-LR-8	05/12/15	< 200	< 5.8	< 0.7
SW-LR-8	10/20/15	< 186		
SW-LR-9	05/11/15	< 196	< 6.6	< 0.8
SW-LR-9	10/20/15	< 188		
SW-LR-10	05/11/15	< 194	< 5.0	< 0.6
SW-LR-10	10/20/15	< 182		

TABLE B-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2015

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	05/11/15	< 16	< 14	< 1	< 2	< 4	< 1	< 3	< 2	< 3	< 6	< 1	< 2	< 11	< 3
SW-LR-4	05/11/15	< 18	< 18	< 2	< 2	< 4	< 2	< 3	< 2	< 4	< 7	< 2	< 2	< 14	< 4
SW-LR-6	05/11/15	< 25	< 54	< 3	< 3	< 6	< 3	< 6	< 3	< 5	< 9	< 2	< 3	< 20	< 7
SW-LR-7	05/11/15	< 25	< 57	< 2	< 3	< 5	< 2	< 5	< 3	< 5	< 10	< 2	< 2	< 18	< 7
SW-LR-8	05/12/15	< 21	< 37	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 15	< 5
SW-LR-9	05/11/15	< 21	57 ± 31	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 16	< 6
SW-LR-10	05/11/15	< 18	< 16	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 14	< 5

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2015

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3
36S3	12/29/14	- 01/26/15	< 149
36S3	02/26/15	- 03/25/15	< 197
36S3	03/25/15	- 04/27/15	< 185
36S3	04/27/15	- 05/28/15	< 181
36S3	05/28/15	- 06/25/15	< 191
36S3	06/25/15	- 07/27/15	< 186
36S3	07/27/15	- 09/01/15	< 181
36S3	09/01/15	- 09/24/15	< 190
36S3	09/24/15	- 10/26/15	< 185
36S3	10/26/15	- 11/25/15	< 194
36S3	11/25/15	- 12/28/15	225 ± 117
E-5	12/29/14	- 01/26/15	< 171
E-5	01/26/15	- 02/26/15	< 165
E-5	02/26/15	- 03/25/15	< 184
E-5	03/25/15	- 04/27/15	< 183
E-5	04/27/15	- 05/28/15	< 189
E-5	05/28/15	- 06/25/15	< 192
E-5	06/25/15	- 07/27/15	< 187
E-5	07/27/15	- 09/01/15	< 190
E-5	09/01/15	- 09/24/15	< 186
E-5	09/24/15	- 10/26/15	< 176
E-5	10/26/15	- 11/25/15	< 193
E-5	11/25/15	- 12/28/15	< 163
ESE-6	12/29/14	- 01/26/15	< 169
ESE-6	01/26/15	- 02/26/15	< 166
ESE-6	02/26/15	- 03/25/15	< 187
ESE-6	03/25/15	- 04/27/15	< 199
ESE-6	04/27/15	- 05/28/15	< 182
ESE-6	05/28/15	- 06/25/15	< 194
ESE-6	06/25/15	- 07/27/15	< 185
ESE-6	07/27/15	- 09/01/15	< 180
ESE-6	09/01/15	- 09/24/15	< 191
ESE-6	09/24/15	- 10/26/15	< 183
ESE-6	10/26/15	- 11/25/15	< 195
ESE-6	11/25/15	- 12/28/15	< 162
SE-7	12/29/14	- 01/26/15	< 168
SE-7	01/26/15	- 02/26/15	< 163
SE-7	02/26/15	- 03/25/15	< 185
SE-7	03/25/15	- 04/27/15	< 197
SE-7	04/27/15	- 05/28/15	< 181
SE-7	05/28/15	- 06/25/15	< 193
SE-7	06/25/15	- 07/27/15	< 186
SE-7	07/27/15	- 09/01/15	< 183
SE-7	09/01/15	- 09/24/15	< 188
SE-7	09/24/15	- 10/26/15	< 187
SE-7	10/26/15	- 11/25/15	< 195
SE-7	11/25/15	- 12/28/15	311 ± 119