Exelon Generation

TS 6.9.1.7
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April 30, 2014

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

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

Subject: 2013 Annual Radiological Environmental Operating Report

Dear Sir:
In accordance with the requirements of Section 6.9.17 of Limerick Generating Station (LGS) Unit 1 and Unit 2 Tech. Specs., and Section 6.1 of the LGS Units 1 and 2 Offsite Dose Calculation Manual (ODCM), this letter submits the 2013 Annual Radiological Environmental Operating Report. This report provides the 2013 results for the Radiological Environmental Monitoring Program (REMP) as called for in the Offsite Dose Calculation Manual.

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, were found in any pathway modeled by the REMP. Cesium-137 levels detected in sediment were consistent with levels found in previous years and were attributable to LGS liquid releases. Results of the groundwater protection program are also included in this report. Positive tritium was found in 3 of 13 groundwater monitoring locations that ranged up to 477 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, please do not hesitate to contact us.

Sincerely,

Thomas J. Dougherty
Vice President -LGS
Exelon Generation Company, LLC

Attachment: 2013 Annual Radiological Environmental Operating Report

cc: W. Dean, Administrator, Region I, USNRC (w/Attachment)
E. DiPaolo, USNRC Senior Resident Inspector, LGS (w/Attachment)
R. Ennis -Senior Project Manager-NRR, USNRC (w/Attachment)
R. Nimitz, Inspector, Region I, USNRC (w/Attachment)

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ATTACHMENT 1

2013 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 2013

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

April 2014

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Appendices

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I. Summary and Conclusions

In 2013, the Limerick Generating Station released to the environment through the radioactive effluent liquid and gaseous pathways approximately 151 curies of noble gas, fission and activation products and approximately 40 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	6.22E-03	All	Nearest Residence	3.11E-02	20	mRad
Noble Gas	Beta – Air Dose	3.83E-03	All	Nearest Residence	9.58E-03	40	mRad
Noble Gas	Total Body (Gamma)	5.85E-03	All	Nearest Residence	5.85E-02	10	mrem
Noble Gas	Skin (Beta)	9.64E-03	All	Nearest Residence	3.21E-02	30	mrem
Iodine, Particulate, Tritium & C-14	Bone	1.55E-00	Child	Vegetation	5.17E-00	30	mrem
Liquid	Total Body	1.79E-04	Child	AQUA PA	2.98E-03	6	mrem
Liquid	GI-Lli	1.79E-04	Child	AQUA PA	8.95E-04	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 2013 through 31 December 2013. During that time period, 1265 analyses were performed on 1025 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 total gross beta and I-131. No I-131 was detected. No fission or activation products were detected. Gross beta activities detected were consistent with those detected in previous years.

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. The calculated dose to a teenager's skin and whole body was 4.54E-04 mrem and 3.89E-04 mrem, respectively. This dose represents 2.27E-03% and 6.48E-03%, respectively of the 10 CFR Part 50, Appendix I dose limits.

Air particulate samples were analyzed for concentrations of gross beta and gamma emitting nuclides. Gross beta and cosmogenic Be-7 was 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. All I-131 results were below the minimum detectable concentration. 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. Radium-226 was found in 11 of 43 samples. Thorium-228 was found in 2 of 43 samples. Radium-226 and Thorium-228 were detected in low concentration just above the MDC (minimum detectable concentration). No activation or fission products were detected.

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. Levels detected were slightly higher than what has been detected in previous years. This step change in data is attributed to the change in methodology used to calculate the ambient gamma dose in 2013.

A review of the dosimetry data for the nearest residence to the Independent Spent Fuel Storage Installation (ISFSI) indicates 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 2013, 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. Most of the tritium values for well water and surface water were less than the lower limit of detection of 200 pCi/L. Results and Discussion of groundwater samples are covered in Appendix G. Precipitation water samples were also analyzed for tritium. No tritium was detected in any precipitation samples.

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), Landauer Incorporated and Environmental Inc. (Midwest Labs) on samples collected during the period 1 January 2013 through 31 December 2013.

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 2011. 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 (catfish/carp/white suckers) and predator (sunfish/bass/rock bass), 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, 13C1, 14S1, 15D1 and 22G). 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 five locations (10F4, 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. Seven different kinds of vegetation samples were collected and placed in new unused plastic bags, and sent to the laboratory for analysis.

Ambient Gamma Radiation

Beginning in 2012, Exelon changed the type of dosimetry used for the Radiological Environmental Monitoring Program (REMP). Optically Stimulated Luminescent Dosimetry (OSLD) were deployed and Thermoluminescent Dosimetry (TLD) were discontinued. A step change of increased readings was observed. Side by side comparison of the OLSDs and the TLDs was performed during second, third and fourth quarters of 2012, with an average 2 standard deviation of 5.55. The relative comparison to control locations remains valid. OSLD technology is different than that used in a TLD but has the same purpose (to measure direct radiation).The dosimeter 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 Landauer 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 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 describes the general analytical methodologies used by TBE and Midwest Labs to analyze the environmental samples for radioactivity for the LGS REMP in 2011. 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 2013 the LGS REMP had a sample recovery rate of 99%. Exceptions are listed below:

1. Air sample from location 11S1 for the week of 02/4/13 – 02/11/13 was not available due to loss of power (IR 1494664).

2. Air sample from location 6C1 for the week of 03/18/13 – 03/26/13 was not available due to equipment malfunction (IR 1494671).

3. Air particulate sample from location 15D1 for the week of 07/15/13 – 07/22/13 was not available due to invalid particulate filter. Deviation memorandum dated 7/25/13. (IR 1541267).

4. Air sample from location 22G1 for the week of 09/09/13 – 09/16/13 was not available due to loss of power (IR 1561512).

5. Grab samples were taken for the composite surface water sampler at location 13B1 during the following periods due to frozen sample line and loss of power due to landscaping:
   10/29/13 – 11/05/13 (IR 1609841)
   12/10/13 – 12/17/13 (IR 1609834)

6. Grab samples were taken for the composite drinking water sampler at location 15F7 during the following periods due to loss of power:
   07/01/13 – 07/09/13 (IR 1609833)

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

1. In March 2013, the air station 13C1 located in the SE sector was shut down due to its inconvenient location. Air station 15D1 in the SE sector was started up as its replacement. See Appendix B for detailed location information.
2. In April 2013, sampling at milk station 10F4 was discontinued.

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 1.07E+01 mrem (total body), 1.20E+01 mrem (organ), or 1.07 E+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, Iodone, C-14 & Tritium						
Total Body Dose	6.76E-03	3.12E-01	1.79E-04	1.04E+01	1.07E+01	4.28E+01%	25	mrem
Organ Dose	6.76E-03	1.55E+00	1.79E-04	1.04E+01	1.20E+01	4.80E+01%	25	mrem
Thryoid Dose	6.76E-03	3.12E-01	1.78E-04	1.04E+01	1.07E+01	1.43E+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 met the required LLD.

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Appendix C, Table C–I.2). All nuclides met 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 1.9 to 8.8 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 met the 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 met the required LLD.

Gamma Spectrometry

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

3. Fish

Fish samples comprised of bottom feeder (catfish/carp/white suckers) and predator (sunfish/bass/rock bass), 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 3,061 to 4,824 pCi/kg wet and was consistent with levels detected in previous years. No other activity was detected and the required LLD was met. Though Cs-137 was not detected in 2013, historical levels of Cs-137 are shown in Appendix C, Figure C–2.

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-7and K-40, as well as the fission product Cs-137.

Beryllium-7 was found at all locations and ranged from 2,736 to 5,637 pCi/kg dry. Potassium-40 was found at all locations and ranged from 14,370 to 19,190 pCi/kg dry. The fission product Cs-137 was found at location 16C4 at a concentration of 173 pCi/kg dry (Appendix C, Figure C–4).

The activity detected was consistent with those detected in the pre–operational years. Due to the control location, 33A2, not showing positive activity, the Cs-137 activity found at 16C4 is attributed to LGS radioactive effluent releases. The dose to a teenager's skin and whole body was conservatively calculated at 4.54E-04 mrem and 3.89E-04 mrem, respectively. This dose represents 2.27E-03% and 6.48E-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 six locations on a weekly basis. The six locations were separated into three groups: Group I represents locations within the LGS site boundary (10S3, 11S1, and 14S1), Group II represents the locations at an intermediate distance from the LGS site (6C1, 13C1, 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 7 E–3 to 36 E–3 pCi/m^3 with a mean of 17 E–3 pCi/m^3. The results from the intermediate distance location (Group II) ranged from 8 E–3 to 35 E–3 pCi/m^3 with a mean of 17 E–3 pCi/m^3. The results from the remote distance locations (Group III) ranged from 7 E–3 to 31 E–3 pCi/m^3 with a mean of 16 E–3 pCi/m^3. Comparison of the 2013 air particulate data with previous year's data indicate no effects from the operation of LGS (Appendix C, Figure C–4). In addition, a comparison of the weekly mean values for 2013 indicate no notable differences among the three groups (Appendix C, Figure C–5).

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 24 out of 25 samples and is contributed to cosmic ray activity. These values ranged from 42 E–3 to 95 E–3 pCi/m^3. All other nuclides met the required LLDs.

b. Airborne Iodine

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

2. Terrestrial

a. Milk

Samples were collected from five locations (10F4, 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 1,107 to 1,515 pCi/L. All other nuclides met the required LLDs.

b. Broad Leaf Vegetation

Seven 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 28 of 43 samples and ranged from 122 to 6,680 pCi/kg wet. Naturally occurring K-40 was found in all samples and ranged from 2,039 to 8,809 pCi/kg wet. All other nuclides met the required LLDs.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing Al_2O_3:C optically stimulated luminescence 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,.

Dosimeter measurements were reported in mrem/standard month. Most dosimeter measurements were below 10 mrem/standard month, with a range of 7.7 to 13.7 mrem/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 10.4 mrem for the year.

F. Land Use Survey

A Land Use Survey conducted in August 2013 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 around the site. The distance and direction of all locations from the LGS reactor buildings were positioned using Global Positioning System (GPS) technology. 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					
Sector		Residence Feet	Garden Feet	Milk Farm Feet	Meat Animal Feet
1	N	3,109	3,335	24,775	24,775
2	NNE	2,706	9,610	-	-
3	NE	3,469	3,494	-	21,274
4	ENE	3,231	14,266	-	20,552
5	E	2,864	7,776	-	25,739
6	ESE	3,434	5,780	-	-
7	SE	5,108	6,470	-	10,927
8	SSE	5,403	6,898	-	-
9	S	4,347	6,103	22,115	12,211
10	SSW	5,063	5,320	10,390	10,390
11	SW	3,251	4,562	-	18,547
12	WSW	3,799	12,013	14,175	14,175
13	W	3,627	4,208	14,654	14,654
14	WNW	3,932	3,932	-	-
15	NW	3,619	8,169	-	-
16	NNW	5,051	5,586	-	-

G. Errata Data

1. Teledyne Brown Engineering (TBE) provides data results [activity, uncertainty and minimum detectable concentration {MDC}]. The MDC is calculated using a multiplier of 4.66.

$$MDA = \frac{4.66\sqrt{\frac{\beta}{\Delta t}}}{2.22\,(v)(y)\,(a)(\varepsilon)}$$

Where:

Δt = counting time for sample (minutes)

β = background rate of instrument blank (cpm)

2.22 = dpm/pCi or : 2.22×10^6 dpm/μCi

v = volume or mass of sample analyzed

y = chemical yield

ε = efficiency of the counter

The formulas for calculating the activity, uncertainty and MDC are contained in the software of the counting equipment. For the gamma system, when the new detector number 08 was added to the system in January 2012, the default value of 3.29 was used to calculated the MDCs on detector 08. The activity and uncertainty were not affected. The multiplier has been changed from 3.29 to the required 4.66.

When the MDCs were recalculated using 4.66, the MDC values increased by 41.6%. The greatest impact is on the short-lived nuclides which have an LLD requirement, e.g. I-131, Ba-140 and La-140. The missed LLDs are identified in the Errata Data Appendix F table of the 2013 annual report.

2. Total body and organ dose for liquid releases in 2010, 2011, and 2012 were recalculated due to a software error identified (IR 1613017). Due to the software error, dose calculations were being performed without the inclusion of the Schuylkill River dilution factor as required by the ODCM dose methodology. The corrected data in Appendix F includes the dose calculations post dilution and the updated 40 CFR 190 Compliance table. No limits have been exceeded.

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, 178 out of 185 analyses performed met the specified acceptance criteria. Seven analyses (Sr-89 and Sr-90 in milk, Co-57, Zn-65 and Sr-90 in soil, Cs-134 in air particulate and Sr-90 in vegetation [two low warning in a row]) did not meet the specified acceptance criteria or internal QA requirements for the following reason:

1. Teledyne Brown Engineering's Analytics September 2013 Sr-89 in milk result of 63.9 pCi/L was lower than the known value of 96.0 pCi/L. The failure was a result of analyst error and was specific to the Analytics sample. Client samples for the associated time period were evaluated and no client samples were affected by this failure. NCR 13-15

2. Teledyne Brown Engineering's Analytics September 2013 Sr-90 in milk result of 8.88 pCi/L was lower than the known value of 13.2 pCi/L. The failure was a result of analyst error and was specific to the Analytics sample. Client samples for the associated time period were evaluated and no client samples were affected by this failure. NCR 13-15

3. & 4. Teledyne Brown Engineering's MAPEP September 2013 Co-57 and Zn-65 in soil were evaluated as failing the false positive test. While MAPEP evaluated the results as failures, the gamma software listed the results as non identified nuclides. The two nuclides would never have been reported as detected nuclides to a client. MAPEP does not allow laboratories to put in qualifiers for the submitted data nor "less than" results. MAPEP evaluates results based on the relationship between the activity and the

uncertainty. MAPEP spiked the soil sample with an extremely large concentration of Eu-152, which was identified by the gamma software as an interfering nuclide, resulting in forced activity results that were evaluated by MAPEP as detected Co-57 and Zn-65. No client samples were affected by these failures. NCR 13-14

5. Teledyne Brown Engineering's MAPEP September 2013 Sr-90 in soil result of 664 Bq/kg was higher than the known value of 460 Bq/kg, exceeding the upper control limit of 598 Bq/kg. An incorrect Sr-90 result was entered into the MAPEP database. The correct Sr-90 activity of 322 Bq/kg would have been evaluated as acceptable with warning. No client samples were affected by this failure. NCR 13-14

6. Teledyne Brown Engineering's MAPEP September 2013 Cs-134 in air particulate activity of -0.570 Bq/sample was evaluated as a failed false positive test, based on MAPEP's evaluation of the result as a significant negative value at 3 standard deviations. A negative number would never have been reported as a detected nuclide to a client, therefore no client samples were affected by this failure. NCR 13-14

7. Teledyne Brown Engineering's MAPEP September 2013 Sr-90 in vegetation result was investigated due to two low warnings in a row. It appears the September sample was double spiked with carrier, resulting in a low activity. With a recovery of around 50% lower, the Sr-90 result would have fallen within the acceptance range. No client samples were affected by this issue. NCR 13-14

For the EIML laboratory, 89 of 92 analyses met the specified acceptance criteria. Three analyses (AP - Gross Alpha, Soil - Sr-90 and Co-57) did not meet the specified acceptance criteria for the following reasons:

1. Environmental Inc., Midwest Laboratory's MAPEP February 2013 air particulate gross alpha result of 0.14 Bq/total sample was lower than the known value of 1.20 Bq/total sample, exceeding the lower control limit of 0.36 Bq/total sample. The filter was recounted overnight. No significant activity could be detected.

2. Environmental Inc., Midwest Laboratory's MAPEP February 2013 soil Co-57 result of 408.40 Bq/kg was lower than the known value of 628.0 Bq/kg, exceeding the lower control limit of 440.0 Bq/kg. The sample was reanalyzed using additional fuming nitric separations. The reanalysis result of 574.4 fell within the control limits.

3. Environmental Inc., Midwest Laboratory's MAPEP August 2013 soil Co-57 result of 699.60 Bq/kg was higher than the known value of 0.00 Bq/kg, exceeding the upper control limit

of 5.00 Bq/kg. Interference from Eu-152 resulted in misidentification of Co-57.

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.

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APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

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TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2013

NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353 2013

LOCATION OF FACILITY: MONTGOMERY PA | **REPORTING PERIOD:** 2013

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER (PCI/LITER)	H-3	8	200	<LLD	<LLD	-		0
	GAMMA	24						
	MN-54		15	<LLD	<LLD	-		0
	CO-58		15	<LLD	<LLD	-		0
	FE-59		30	<LLD	<LLD	-		0
	CO-60		15	<LLD	<LLD	-		0
	ZN-65		30	<LLD	<LLD	-		0
	NB-95		15	<LLD	<LLD	-		0

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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, 2013

NAME OF FACILITY: LIMERICK GENERATING STATION **DOCKET NUMBER: 50-352 & 50-353 2013**

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

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)	ZR-95		30	<LLD	<LLD	-		0
	I-131		15	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0
DRINKING WATER (PCI/LITER)	GR-B	48	4	3.8 (31/36) (1.9/8.8)	3.2 (10/12) (2.3/5.0)	4.7 (11/12) (2.4/8.8)	15F4 INDICATOR PHILADELPHIA SUBURBAN WATER COMPANY 8.62 MILES SE OF SITE	0

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LOCATION OF FACILITY: MONTGOMERY PA | **REPORTING PERIOD:** 2013

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)	H-3	16	200	<LLD	<LLD	-		0
	I-131	48	1	<LLD	<LLD	-		0
	GAMMA	48						
	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

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LOCATION OF FACILITY: MONTGOMERY PA **REPORTING PERIOD: 2013**

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DRINKING WATER (PCI/LITER)	NB-95		15	<LLD	<LLD	-		0
	ZR-95		30	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0
BOTTOM FEEDER (PCI/KG WET)	GAMMA K-40	4	NA	4203 (2/2) (3871/4535)	3672 (2/2) (3096/4247)	4203 (2/2) (3871/4535)	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0

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LOCATION OF FACILITY: MONTGOMERY PA | **REPORTING PERIOD:** 2013

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BOTTOM FEEDER (PCI/KG WET)	MN-54		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0
	FE-59		260	<LLD	<LLD	-		0
	CO-60		130	<LLD	<LLD	-		0
	ZN-65		260	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0

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LOCATION OF FACILITY: MONTGOMERY PA **REPORTING PERIOD: 2013**

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BOTTOM FEEDER (PCI/KG WET)	CS-137		150	<LLD	<LLD	-		0
PREDATOR (PCI/KG WET)	GAMMA	4						
	K-40		NA	4426 (2/2) (4028/4824)	3509 (2/2) (3061/3957)	4426 (2/2) (4028/4824)	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0
	MN-54		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0
	FE-59		260	<LLD	<LLD	-		0
	CO-60		130	<LLD	<LLD	-		0
	ZN-65		260	<LLD	<LLD	-		0

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PREDATOR (PCI/KG WET)	I-131		NA	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0
	CS-137		150	<LLD	<LLD	-		0
SEDIMENT (PCI/KG DRY)	GAMMA	6						
	BE-7		NA	5097 (3/4) (4701/5637)	2736 (1/2)	5637 (1/2)	16C4 INDICATOR VINCENT DAM 2.18 MILES SSE OF SITE	0
	K-40		NA	17848 (4/4) (16840/19190)	15475 (2/2) (14370/16580)	18015 (2/2) (16840/19190)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0
	MN-54		NA	<LLD	<LLD	-		0
	CO-58		NA	<LLD	<LLD	-		0

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SEDIMENT (PCI/KG DRY)	CO-60		NA	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		150	<LLD	<LLD	-		0
	CS-137		180	173 (1/4)	<LLD	173 (1/2)	16C4 INDICATOR VINCENT DAM 2.18 MILES SSE OF SITE	0
AIR PARTICULATE (E-3 PCI/CU.METER)	GR-B	320	10	17 (263/269) (7/36)	16 (51/51) (7/31)	19 (10/12) (13/28)	13C1 INDICATOR KING ROAD 2.84 MILES SE OF SITE	0
	GAMMA BE-7	25	NA	77 (20/21) (61/95)	71 (4/4) (42/85)	81 (4/4) (71/93)	6C1 INDICATOR 11305 FEET NE OF SITE	0
	MN-54		NA	<LLD	<LLD	-		0

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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
AIR PARTICULATE (E-3 PCI/CU.METER)	CO-58		NA	<LLD	<LLD	-		0
	CO-60		NA	<LLD	<LLD	-		0
	CS-134		50	<LLD	<LLD	-		0
	CS-137		60	<LLD	<LLD	-		0
AIR IODINE (E-3 PCI/CU.METER)	GAMMA I-131	321	70	<LLD	<LLD	-		0
MILK (PCI/LITER)	I-131	95	1	<LLD	<LLD	-		0

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MILK	GAMMA	95						
(PCI/LITER)	K-40		NA	1284 (69/69) (1108/1515)	1281 (26/26) (1107/1422)	1302 (22/22) (1146/1457)	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
VEGETATION	GAMMA	43						
(PCI/KG WET)	BE-7		NA	681 (19/28) (122/2384)	1095 (9/15) (255/6680)	1095 (9/15) (255/6680)	31G1 CONTROL	0

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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)	K-40		NA	5008 (28/28) (2039/7354)	5635 (15/15) (3624/8809)	5635 (15/15) (3624/8809)	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

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NAME OF FACILITY: LIMERICK GENERATING STATION | **DOCKET NUMBER:** 50-352 & 50-353
LOCATION OF FACILITY: MONTGOMERY PA | **REPORTING PERIOD:** 2013

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	982 (11/28) (198/2099)	<LLD	1061 (10/15) (223/2099)	13S3 INDICATOR VINCENT DAM 0.24 MILES SE OF SITE	0
	TH-228		NA	35 (2/28) (17/53)	<LLD	35 (2/13) (17/53)	11S3 INDICATOR LGS INFORMATION CENTER 0.35 MILES ESE OF SITE	0
	TH-232		NA	<LLD	<LLD	-		0
DIRECT RADIATION (MILLI-ROENTGEN/STD.MO.)	OSLD-QUARTERLY	160	NA	10 (156/156) (7.7/13.7)	11.6 (4/4) (11.0/12.3)	13.4 (4/4) (13.0/13.7)	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)

APPENDIX B

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

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

XXYZ - General code for identification of locations, where:

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

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

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

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

TABLE B-2: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Limerick Generating Station, 2013

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	Citizens Home Water Company	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
13C1	King Road	14,980 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, 2013

Location	Location Description	Distance & Direction From Site
I. Environmental Dosimetry - OSLD		
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, 2013

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, 2013

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
OSLD	Optically Stimulated Luminescence Dosimetry	Quarterly OSLDs comprised of two Al_2O_3:C Landauer Incorporated elements.	RMC-ER9 Collection of dosimetry samples for radiological analysis (Limerick Generating Station)	2 dosimeters	Landauer Incorporated

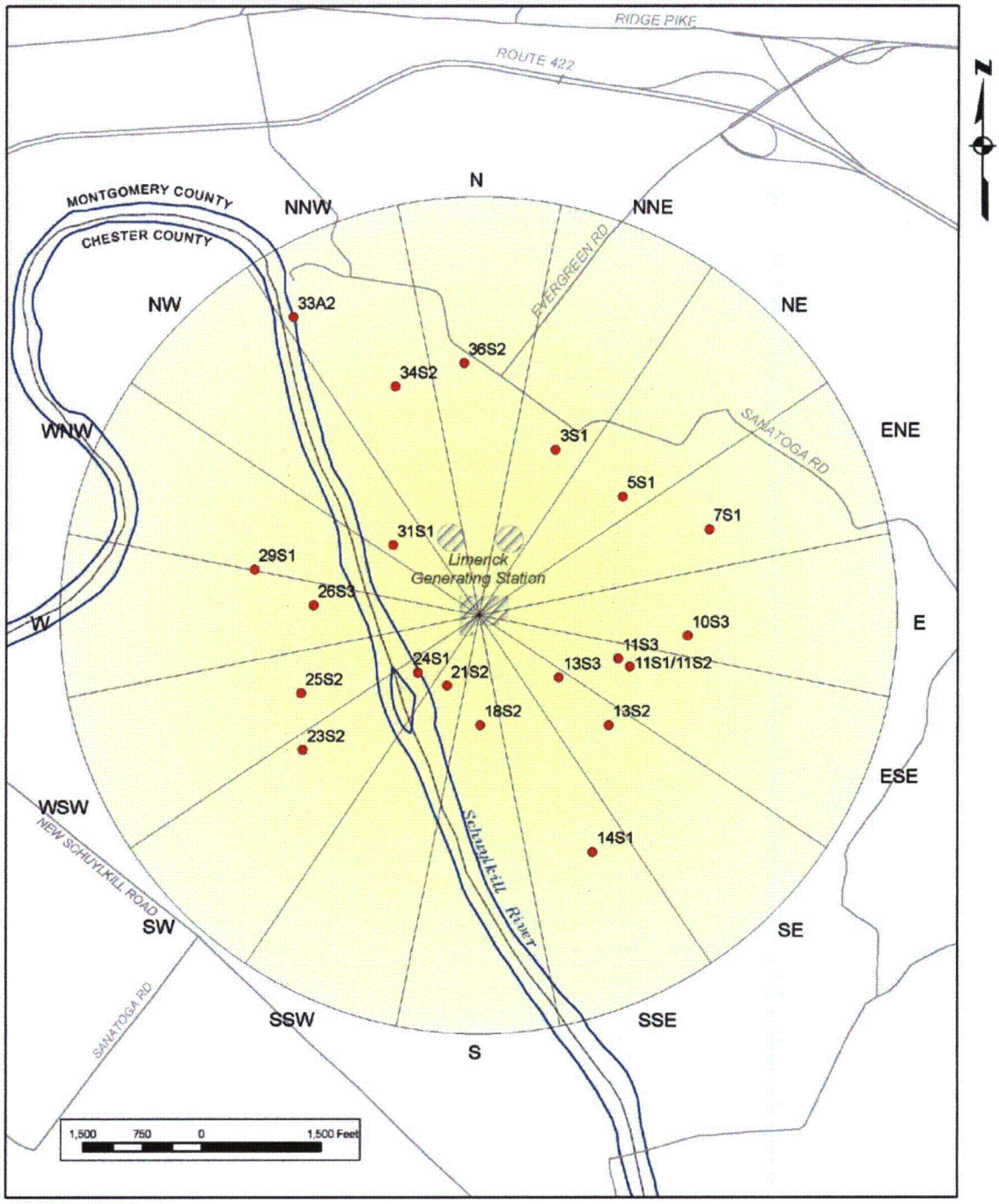

Figure B-1
Environmental Sampling Locations Within 5,280 Feet
of the Limerick Generating Station, 2013

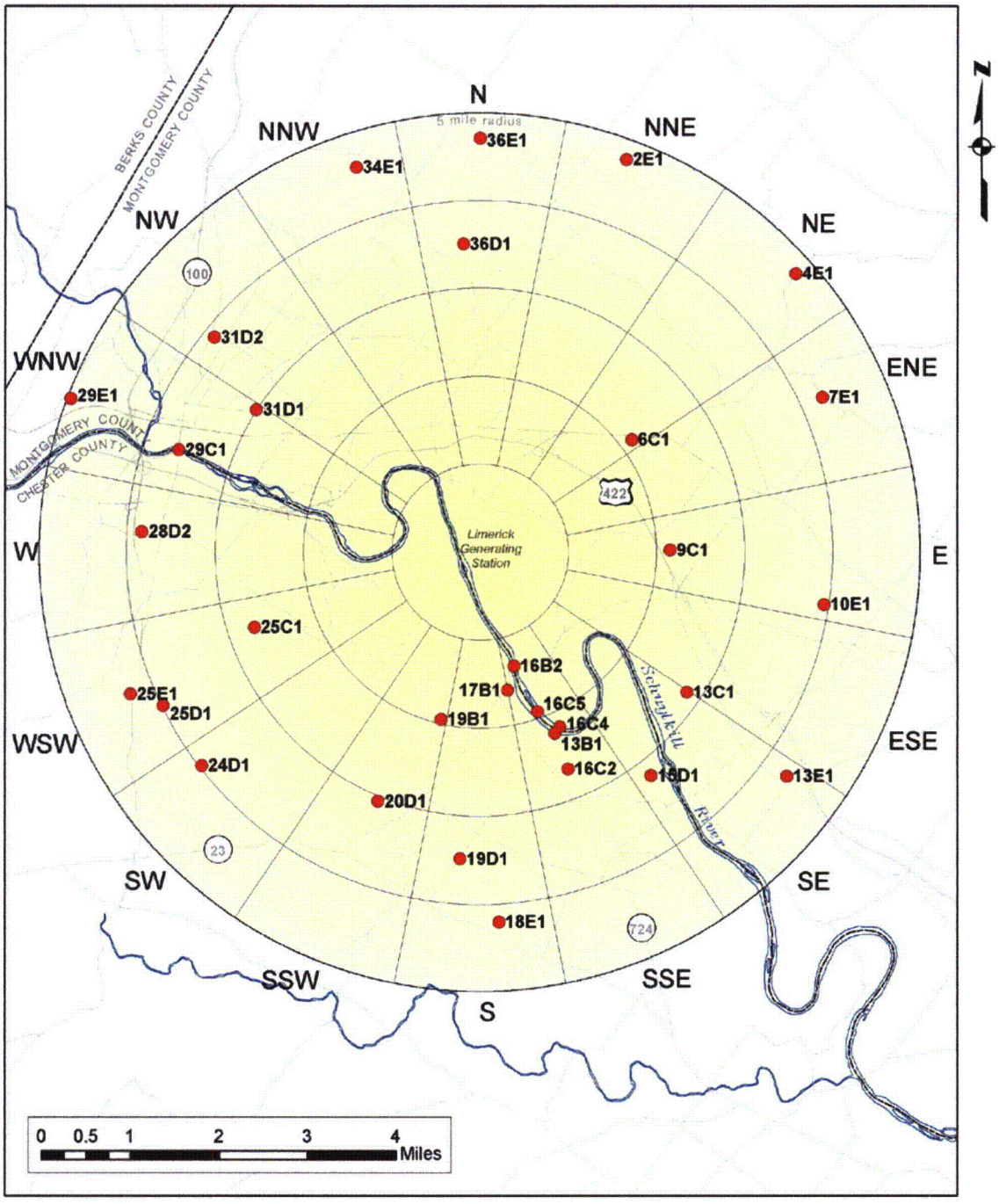

Figure B-2
Environmental Sampling Locations Between 5,280 and 26,400 Feet
from the Limerick Generating Station, 2013

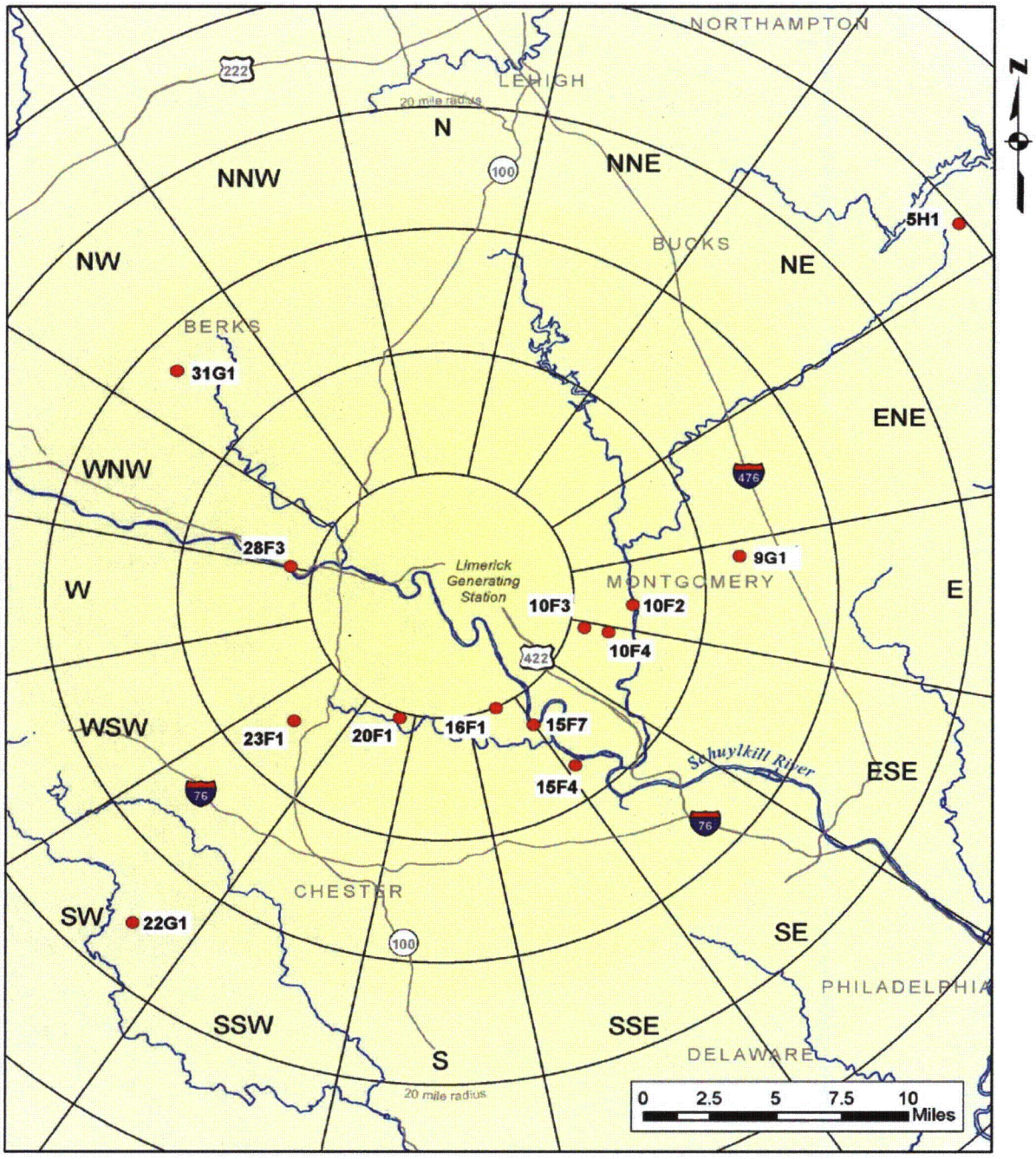

Figure B-3
Environmental Sampling Locations Greater than 26,400 Feet
from the Limerick Generating Station, 2013

APPENDIX C

DATA TABLES AND FIGURES
PRIMARY LABORATORY

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Table C-I.1 **CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	13B1	24S1
12/31/12 - 04/01/13	< 194	< 192
04/01/13 - 07/01/13	< 191	< 190
07/01/13 - 09/30/13	< 195	< 191
09/30/13 - 12/30/13	< 176 (1)	< 164
MEAN	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	12/31/12 - 01/29/13	< 4	< 5	< 9	< 5	< 10	< 6	< 8	< 8	< 3	< 5	< 27	< 9
	01/29/13 - 02/26/13	< 4	< 4	< 8	< 4	< 9	< 4	< 7	< 6	< 4	< 4	< 16	< 5
	02/26/13 - 04/01/13	< 5	< 4	< 11	< 5	< 10	< 5	< 9	< 8	< 4	< 5	< 21	< 7
	04/01/13 - 04/29/13	< 5	< 7	< 11	< 7	< 13	< 6	< 11	< 14	< 6	< 7	< 32	< 11
	04/29/13 - 06/04/13	< 5	< 6	< 10	< 7	< 12	< 6	< 11	< 9	< 5	< 6	< 27	< 12
	06/04/13 - 07/01/13	< 5	< 4	< 10	< 5	< 10	< 4	< 8	< 9	< 4	< 5	< 21	< 9
	07/01/13 - 07/30/13	< 4	< 4	< 11	< 4	< 10	< 5	< 7	< 7	< 4	< 4	< 21	< 7
	07/30/13 - 08/27/13	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 3	< 2	< 2	< 8	< 3
	08/27/13 - 09/30/13	< 5	< 5	< 8	< 5	< 10	< 5	< 8	< 12	< 4	< 4	< 25	< 6
	09/30/13 - 10/29/13	< 5	< 5	< 10	< 6	< 10	< 7	< 9	< 10	< 4	< 5	< 19	< 9
	10/29/13 - 12/03/13 (1)	< 7	< 8	< 15	< 7	< 15	< 7	< 15	< 13	< 7	< 8	< 39	< 12
	12/03/13 - 12/30/13 (1)	< 4	< 4	< 10	< 5	< 10	< 5	< 7	< 10	< 4	< 5	< 20	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
24S1	12/31/12 - 01/29/13	< 5	< 6	< 11	< 5	< 13	< 6	< 10	< 13	< 7	< 6	< 28	< 9
	01/29/13 - 02/26/13	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 4	< 3	< 3	< 13	< 5
	02/26/13 - 04/01/13	< 3	< 3	< 8	< 4	< 6	< 3	< 5	< 7	< 3	< 4	< 16	< 7
	04/01/13 - 04/29/13	< 6	< 6	< 12	< 5	< 11	< 6	< 11	< 13	< 6	< 6	< 34	< 8
	04/29/13 - 06/04/13	< 5	< 7	< 13	< 6	< 10	< 8	< 12	< 12	< 6	< 8	< 28	< 12
	06/04/13 - 07/01/13	< 3	< 4	< 9	< 3	< 9	< 4	< 8	< 8	< 4	< 4	< 23	< 6
	07/01/13 - 07/30/13	< 3	< 3	< 5	< 3	< 6	< 3	< 5	< 5	< 3	< 3	< 13	< 5
	07/30/13 - 08/27/13	< 5	< 6	< 12	< 6	< 12	< 6	< 10	< 11	< 5	< 6	< 26	< 9
	08/27/13 - 09/30/13	< 5	< 6	< 10	< 4	< 9	< 6	< 9	< 13	< 4	< 5	< 29	< 10
	09/30/13 - 10/29/13	< 7	< 6	< 19	< 7	< 15	< 8	< 13	< 13	< 7	< 7	< 35	< 13
	10/29/13 - 12/03/13	< 6	< 5	< 13	< 5	< 13	< 5	< 11	< 12	< 5	< 6	< 32	< 9
	12/03/13 - 12/30/13	< 5	< 5	< 10	< 5	< 10	< 5	< 9	< 12	< 4	< 5	< 26	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.1 **CONCENTRATIONS OF GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/31/12 - 01/29/13	2.4 ± 1.5	< 2.2	< 2.3	< 2.2
01/29/13 - 02/26/13	4.2 ± 1.2	2.1 ± 1.0	< 1.5	2.5 ± 1.0
02/26/13 - 04/01/13	4.0 ± 1.4	3.2 ± 1.3	3.2 ± 1.4	2.3 ± 1.3
04/01/13 - 04/29/13	2.8 ± 1.1	2.3 ± 1.1	< 1.6	2.3 ± 1.1
04/29/13 - 06/04/13	8.8 ± 1.4	3.9 ± 1.2	2.5 ± 1.3	2.7 ± 1.2
06/04/13 - 07/01/13	4.0 ± 1.1	2.7 ± 1.0	3.3 ± 1.1	3.1 ± 1.0
07/01/13 - 07/30/13	< 1.8	2.4 ± 1.2 (1)	2.1 ± 1.3	< 1.6
07/30/13 - 08/27/13	4.6 ± 1.3	4.2 ± 1.3	3.6 ± 1.4	3.3 ± 1.3
08/27/13 - 09/30/13	3.8 ± 1.3	3.1 ± 1.3	2.9 ± 1.3	3.4 ± 1.3
09/30/13 - 10/29/13	4.3 ± 1.2	4.1 ± 1.2	3.0 ± 1.2	4.2 ± 1.2
10/29/13 - 12/03/13	7.0 ± 1.3	5.7 ± 1.3	1.9 ± 1.3	3.7 ± 1.3
12/03/13 - 12/30/13	5.4 ± 1.4	4.8 ± 1.3	4.8 ± 1.4	5.0 ± 1.3
MEAN	4.7 ± 3.7	3.5 ± 2.3	3.0 ± 1.7	3.2 ± 1.7

Table C-II.2 **CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/31/12 - 04/01/13	< 189	< 192	< 191	< 190
04/01/13 - 07/01/13	< 188	< 172	< 188	< 191
07/01/13 - 09/30/13	< 181	< 182 (1)	< 171	< 187
09/30/13 - 12/30/13	< 193	< 194	< 194	< 192
MEAN	-	-	-	-

Table C-II.3 **CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/31/12 - 01/29/13	< 0.7	< 0.5	< 0.6	< 0.6
01/29/13 - 02/26/13	< 0.6	< 0.6	< 0.7	< 0.6
02/26/13 - 04/01/13	< 0.7	< 0.7	< 0.5	< 0.6
04/01/13 - 04/29/13	< 0.8	< 0.8	< 0.7	< 0.7
04/29/13 - 06/04/13	< 0.7	< 0.7	< 0.5	< 0.6
06/04/13 - 07/01/13	< 0.6	< 0.7	< 1.0	< 1.0
07/01/13 - 07/30/13	< 0.7	< 0.7 (1)	< 0.9	< 0.7
07/30/13 - 08/27/13	< 0.8	< 0.9	< 0.8	< 0.7
08/27/13 - 09/30/13	< 0.6	< 0.7	< 0.7	< 0.7
09/30/13 - 10/29/13	< 0.6	< 0.6	< 0.6	< 0.6
10/29/13 - 12/03/13	< 0.5	< 0.6	< 0.7	< 0.8
12/03/13 - 12/30/13	< 0.6	< 0.7	< 0.6	< 0.6
MEAN	-	-	-	-

THE MEAN AND 2 STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.4 **CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	12/31/12 - 01/29/13	< 9	< 8	< 18	< 8	< 18	< 8	< 15	< 7	< 7	< 32	< 14
	01/29/13 - 02/26/13	< 5	< 4	< 10	< 4	< 9	< 4	< 7	< 4	< 5	< 20	< 7
	02/26/13 - 04/01/13	< 5	< 5	< 11	< 5	< 10	< 5	< 10	< 5	< 6	< 22	< 9
	04/01/13 - 04/29/13	< 6	< 7	< 13	< 6	< 13	< 5	< 11	< 5	< 6	< 30	< 10
	04/29/13 - 06/04/13	< 6	< 6	< 12	< 5	< 10	< 6	< 12	< 6	< 6	< 24	< 8
	06/04/13 - 07/01/13	< 4	< 5	< 5	< 4	< 9	< 4	< 8	< 4	< 5	< 27	< 6
	07/01/13 - 07/30/13	< 5	< 5	< 10	< 5	< 10	< 5	< 9	< 4	< 6	< 23	< 9
	07/30/13 - 08/27/13	< 5	< 5	< 10	< 6	< 8	< 4	< 8	< 4	< 5	< 22	< 8
	08/27/13 - 09/30/13	< 5	< 5	< 9	< 4	< 6	< 5	< 9	< 4	< 5	< 26	< 9
	09/30/13 - 10/29/13	< 7	< 6	< 14	< 7	< 13	< 6	< 9	< 5	< 6	< 28	< 11
	10/29/13 - 12/03/13	< 6	< 5	< 13	< 8	< 14	< 6	< 12	< 6	< 8	< 31	< 10
	12/03/13 - 12/30/13	< 4	< 4	< 9	< 4	< 7	< 5	< 8	< 4	< 4	< 23	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-
15F7	12/31/12 - 01/29/13	< 5	< 5	< 12	< 6	< 10	< 6	< 10	< 6	< 5	< 28	< 9
	01/29/13 - 02/26/13	< 4	< 3	< 6	< 4	< 6	< 4	< 6	< 3	< 4	< 17	< 4
	02/26/13 - 04/01/13	< 3	< 4	< 7	< 4	< 6	< 4	< 6	< 3	< 4	< 21	< 5
	04/01/13 - 04/29/13	< 6	< 6	< 14	< 6	< 11	< 6	< 8	< 5	< 6	< 30	< 10
	04/29/13 - 06/04/13	< 6	< 5	< 13	< 6	< 12	< 5	< 9	< 6	< 6	< 28	< 9
	06/04/13 - 07/01/13	< 5	< 5	< 11	< 5	< 10	< 6	< 9	< 5	< 6	< 30	< 7
	07/01/13 - 07/30/13 (1)	< 3	< 4	< 8	< 4	< 7	< 4	< 6	< 3	< 4	< 17	< 5
	07/30/13 - 08/27/13	< 4	< 5	< 11	< 5	< 10	< 5	< 9	< 5	< 4	< 27	< 9
	08/27/13 - 09/30/13	< 5	< 5	< 13	< 5	< 11	< 6	< 10	< 5	< 6	< 34	< 8
	09/30/13 - 10/29/13	< 6	< 7	< 12	< 5	< 14	< 5	< 13	< 5	< 6	< 32	< 12
	10/29/13 - 12/03/13	< 5	< 7	< 11	< 7	< 9	< 6	< 11	< 5	< 7	< 23	< 10
	12/03/13 - 12/30/13	< 4	< 5	< 8	< 5	< 8	< 4	< 7	< 4	< 5	< 22	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.4 **CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	12/31/12 - 01/29/13	< 5	< 6	< 13	< 6	< 11	< 7	< 9	< 5	< 5	< 32	< 10
	01/29/13 - 02/26/13	< 3	< 3	< 7	< 3	< 6	< 3	< 6	< 3	< 4	< 14	< 5
	02/26/13 - 04/01/13	< 4	< 3	< 8	< 3	< 7	< 3	< 6	< 3	< 4	< 16	< 7
	04/01/13 - 04/29/13	< 5	< 6	< 12	< 6	< 12	< 6	< 10	< 6	< 6	< 34	< 9
	04/29/13 - 06/04/13	< 7	< 8	< 15	< 8	< 17	< 8	< 15	< 8	< 9	< 46	< 13
	06/04/13 - 07/01/13	< 7	< 7	< 17	< 8	< 12	< 7	< 14	< 6	< 7	< 38	< 12
	07/01/13 - 07/30/13	< 4	< 5	< 9	< 4	< 11	< 5	< 9	< 4	< 4	< 20	< 6
	07/30/13 - 08/27/13	< 4	< 4	< 10	< 5	< 10	< 5	< 8	< 4	< 4	< 23	< 6
	08/27/13 - 09/30/13	< 4	< 5	< 11	< 4	< 6	< 5	< 7	< 4	< 5	< 24	< 8
	09/30/13 - 10/29/13	< 5	< 5	< 13	< 5	< 11	< 7	< 9	< 5	< 6	< 29	< 7
	10/29/13 - 12/03/13	< 7	< 9	< 12	< 6	< 17	< 7	< 12	< 5	< 7	< 37	< 13
	12/03/13 - 12/30/13	< 4	< 4	< 9	< 3	< 7	< 4	< 7	< 4	< 4	< 21	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-
28F3	12/31/12 - 01/29/13	< 6	< 7	< 12	< 6	< 12	< 7	< 12	< 6	< 6	< 34	< 14
	01/29/13 - 02/26/13	< 3	< 3	< 7	< 4	< 5	< 3	< 5	< 3	< 3	< 14	< 5
	02/26/13 - 04/01/13	< 4	< 4	< 9	< 4	< 9	< 4	< 7	< 4	< 5	< 21	< 6
	04/01/13 - 04/29/13	< 4	< 6	< 10	< 5	< 9	< 5	< 9	< 5	< 6	< 34	< 6
	04/29/13 - 06/04/13	< 5	< 6	< 10	< 6	< 10	< 6	< 10	< 6	< 6	< 28	< 9
	06/04/13 - 07/01/13	< 5	< 5	< 10	< 5	< 10	< 5	< 8	< 4	< 4	< 26	< 9
	07/01/13 - 07/30/13	< 4	< 4	< 10	< 4	< 9	< 4	< 8	< 4	< 5	< 20	< 6
	07/30/13 - 08/27/13	< 5	< 5	< 10	< 5	< 12	< 5	< 12	< 5	< 5	< 26	< 7
	08/27/13 - 09/30/13	< 6	< 7	< 13	< 6	< 14	< 7	< 12	< 6	< 7	< 30	< 11
	09/30/13 - 10/29/13	< 6	< 5	< 12	< 5	< 8	< 6	< 10	< 5	< 5	< 29	< 10
	10/29/13 - 12/03/13	< 5	< 6	< 12	< 5	< 11	< 6	< 11	< 6	< 5	< 27	< 11
	12/03/13 - 12/30/13	< 6	< 5	< 13	< 4	< 10	< 5	< 9	< 6	< 5	< 31	< 9
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1 **CONCENTRATIONS OF GAMMA EMITTERS IN PREDATOR AND BOTTOM FEEDER (FISH) SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	I-131	Cs-134	Cs-137
16C5	PREDATOR									
	06/06/13	4028 ± 684	< 44	< 37	< 104	< 47	< 95	< 105	< 37	< 45
	10/22/13	4824 ± 1074	< 52	< 59	< 170	< 46	< 87	< 379	< 47	< 61
	MEAN	4426 ± 1126	-	-	-	-	-	-	-	-
16C5	BOTTOM FEEDER									
	06/06/13	3871 ± 952	< 68	< 67	< 137	< 71	< 101	< 148	< 62	< 59
	10/22/13	4535 ± 942	< 73	< 73	< 150	< 67	< 142	< 417	< 55	< 68
	MEAN	4203 ± 939	-	-	-	-	-	-	-	-
29C1	PREDATOR									
	06/05/13	3957 ± 935	< 61	< 61	< 115	< 59	< 148	< 178	< 54	< 58
	10/21/13	3061 ± 908	< 65	< 82	< 182	< 82	< 138	< 427	< 59	< 68
	MEAN	3509 ± 1267	-	-	-	-	-	-	-	-
29C1	BOTTOM FEEDER									
	06/05/13	3096 ± 771	< 41	< 42	< 81	< 45	< 86	< 116	< 37	< 36
	10/21/13	4247 ± 894	< 51	< 64	< 137	< 42	< 112	< 393	< 42	< 40
	MEAN	3672 ± 1628	-	-	-	-	-	-	-	-

Table C-IV.1 **CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	06/06/13	4701 ± 1222	16840 ± 1999	< 111	< 109	< 131	< 340	< 97	< 106
	10/30/13	4952 ± 1377	19190 ± 2737	< 137	< 145	< 109	< 771	< 123	< 169
	MEAN	4827 ± 355	18015 ± 3323	-	-	-	-	-	-
16C4	06/06/13	5637 ± 860	16990 ± 1580	< 90	< 79	< 111	< 261	< 82	173 ± 69
	10/30/13	< 1466	18370 ± 2053	< 120	< 127	< 124	< 744	< 111	< 154
	MEAN	-	17680 ± 1952	-	-	-	-	-	-
33A2	06/06/13	2736 ± 884	16580 ± 2090	< 81	< 86	< 132	< 327	< 84	< 106
	10/30/13	< 1096	14370 ± 1870	< 104	< 115	< 99	< 649	< 99	< 114
	MEAN	-	15475 ± 3125	-	-	-	-	-	-

Table C-V.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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

COLLECTION PERIOD	GROUP I			GROUP II			GROUP III
	10S3	11S1	14S1	6C1	13C1 (2)	15D1	22G1
12/31/12 - 01/06/13	25 ± 7	27 ± 7	30 ± 7	26 ± 7	26 ± 7	26 ± 7	23 ± 7
01/06/13 - 01/14/13	27 ± 5	33 ± 5	31 ± 5	29 ± 5	28 ± 5	29 ± 5	30 ± 5
01/14/13 - 01/22/13	19 ± 5	18 ± 5	21 ± 5	16 ± 5	17 ± 5	19 ± 5	16 ± 5
01/22/13 - 01/29/13	19 ± 5	22 ± 5	24 ± 5	20 ± 5	15 ± 5	21 ± 5	17 ± 5
01/29/13 - 02/04/13	26 ± 6	23 ± 6	23 ± 6	26 ± 6	19 ± 6	27 ± 6	24 ± 6
02/04/13 - 02/11/13	20 ± 5	(1)	22 ± 8	19 ± 5	20 ± 5	22 ± 5	20 ± 5
02/11/13 - 02/19/13	14 ± 5	11 ± 4	13 ± 6	20 ± 5	14 ± 5	14 ± 5	15 ± 5
02/19/13 - 02/25/13	11 ± 6	< 8	11 ± 6	< 8	< 9	10 ± 6	11 ± 6
02/25/13 - 03/04/13	7 ± 5	7 ± 5	7 ± 5	8 ± 5	< 7	12 ± 5	7 ± 5
03/04/13 - 03/11/13	9 ± 5	7 ± 4	8 ± 5	11 ± 5	17 ± 5	16 ± 5	12 ± 5
03/11/13 - 03/18/13	17 ± 5	15 ± 5	17 ± 5	15 ± 5	13 ± 5	17 ± 5	16 ± 5
03/18/13 - 03/26/13	16 ± 3	17 ± 3	14 ± 3	(1)	19 ± 3	20 ± 3	18 ± 3
03/26/13 - 04/01/13	13 ± 5	8 ± 5	10 ± 5	13 ± 5		9 ± 5	11 ± 5
04/01/13 - 04/08/13	15 ± 5	15 ± 5	14 ± 5	14 ± 5		13 ± 5	25 ± 6
04/08/13 - 04/15/13	11 ± 5	11 ± 5	15 ± 5	12 ± 5		12 ± 5	13 ± 5
04/15/13 - 04/22/13	14 ± 5	15 ± 5	13 ± 5	10 ± 5		12 ± 5	17 ± 5
04/22/13 - 04/29/13	12 ± 5	14 ± 5	14 ± 5	14 ± 5		13 ± 5	11 ± 5
04/29/13 - 05/06/13	7 ± 5	7 ± 5	11 ± 5	12 ± 5		12 ± 5	12 ± 5
05/06/13 - 05/13/13	10 ± 5	< 6	7 ± 4	9 ± 4		< 6	11 ± 5
05/13/13 - 05/20/13	11 ± 5	10 ± 6	9 ± 5	15 ± 5		12 ± 5	11 ± 5
05/20/13 - 05/28/13	15 ± 5	11 ± 4	13 ± 4	12 ± 4		16 ± 5	15 ± 5
05/28/13 - 06/03/13	15 ± 6	16 ± 6	17 ± 6	18 ± 6		17 ± 6	17 ± 6
06/03/13 - 06/10/13	9 ± 5	9 ± 4	10 ± 5	13 ± 5		9 ± 5	10 ± 5
06/10/13 - 06/17/13	11 ± 5	8 ± 4	11 ± 5	11 ± 5		13 ± 5	9 ± 5
06/17/13 - 06/24/13	13 ± 5	11 ± 5	15 ± 5	11 ± 5		11 ± 5	12 ± 5
06/24/13 - 07/01/13	16 ± 5	18 ± 6	18 ± 6	13 ± 5		20 ± 6	17 ± 6
07/01/13 - 07/08/13	9 ± 4	9 ± 5	13 ± 5	11 ± 5		10 ± 4	9 ± 5
07/08/13 - 07/15/13	15 ± 4	10 ± 4	11 ± 4	11 ± 4		14 ± 5	13 ± 4
07/15/13 - 07/22/13	20 ± 5	20 ± 5	20 ± 5	22 ± 5		(1)	23 ± 5
07/22/13 - 07/29/13	9 ± 5	10 ± 5	10 ± 5	11 ± 5		11 ± 5	10 ± 5
07/29/13 - 08/05/13	15 ± 5	15 ± 5	21 ± 6	17 ± 5		12 ± 5	16 ± 5
08/05/13 - 08/12/13	17 ± 5	16 ± 5	15 ± 5	11 ± 5		15 ± 5	11 ± 5
08/12/13 - 08/19/13	16 ± 5	14 ± 5	15 ± 5	15 ± 5		15 ± 5	16 ± 5
08/19/13 - 08/26/13	13 ± 5	20 ± 6	16 ± 5	18 ± 5		15 ± 5	20 ± 5
08/26/13 - 09/03/13	21 ± 5	27 ± 5	25 ± 5	26 ± 5		21 ± 5	30 ± 5
09/03/13 - 09/09/13	11 ± 6	9 ± 6	12 ± 6	10 ± 6		10 ± 5	13 ± 6
09/09/13 - 09/16/13	29 ± 6	24 ± 6	23 ± 6	29 ± 6		24 ± 6	(1)
09/16/13 - 09/23/13	15 ± 5	16 ± 5	14 ± 5	13 ± 5		14 ± 5	18 ± 6
09/23/13 - 09/30/13	15 ± 5	12 ± 5	10 ± 5	13 ± 5		14 ± 5	11 ± 5
09/30/13 - 10/07/13	35 ± 6	34 ± 6	36 ± 6	35 ± 6		31 ± 6	31 ± 6
10/07/13 - 10/15/13	16 ± 4	15 ± 4	22 ± 5	17 ± 4		17 ± 5	16 ± 4
10/15/13 - 10/21/13	24 ± 6	17 ± 6	21 ± 6	20 ± 6		17 ± 6	20 ± 6
10/21/13 - 10/28/13	15 ± 5	14 ± 5	16 ± 5	11 ± 5		16 ± 5	13 ± 5
10/28/13 - 11/04/13	24 ± 6	29 ± 6	20 ± 6	22 ± 6		23 ± 6	23 ± 6
11/04/13 - 11/11/13	10 ± 5	12 ± 5	10 ± 5	8 ± 5		13 ± 5	9 ± 5
11/11/13 - 11/18/13	16 ± 5	15 ± 5	15 ± 5	18 ± 5		15 ± 5	17 ± 5
11/18/13 - 11/25/13	15 ± 5	13 ± 5	20 ± 5	11 ± 5		14 ± 5	13 ± 5
11/25/13 - 12/02/13	21 ± 5	20 ± 5	17 ± 5	19 ± 5		16 ± 5	21 ± 5
12/02/13 - 12/09/13	36 ± 6	34 ± 6	33 ± 6	34 ± 6		34 ± 6	30 ± 6
12/09/13 - 12/16/13	23 ± 5	22 ± 5	27 ± 6	25 ± 5		26 ± 6	23 ± 5
12/16/13 - 12/23/13	23 ± 6	22 ± 6	25 ± 6	21 ± 6		21 ± 5	18 ± 5
12/23/13 - 12/30/13	16 ± 5	17 ± 5	20 ± 6	12 ± 5		12 ± 5	19 ± 5
MEAN	17 ± 13	16 ± 14	17 ± 13	17 ± 13	19 ± 10	17 ± 12	16 ± 12

THE MEAN AND 2 STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION
(2) SEE PROGRAM CHANGES 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, 2013**

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
12/31/12 - 01/29/13	18	33	25 ± 10	12/31/12 - 01/29/13	15	29	23 ± 10	12/31/12 - 01/29/13	16	30	22 ± 13
01/29/13 - 03/04/13	7	26	15 ± 13	01/29/13 - 03/04/13	8	27	18 ± 12	01/29/13 - 03/04/13	7	24	15 ± 14
03/04/13 - 04/01/13	7	17	12 ± 8	03/04/13 - 04/01/13	9	20	15 ± 7	03/04/13 - 04/01/13	11	18	14 ± 7
04/01/13 - 04/29/13	11	15	14 ± 3	04/01/13 - 04/29/13	10	14	13 ± 3	04/01/13 - 04/29/13	11	25	17 ± 13
04/29/13 - 06/03/13	7	17	11 ± 6	04/29/13 - 06/03/13	9	18	14 ± 6	04/29/13 - 06/03/13	11	17	13 ± 6
06/03/13 - 07/01/13	8	18	12 ± 7	06/03/13 - 07/01/13	9	20	13 ± 6	06/03/13 - 07/01/13	9	17	12 ± 7
07/01/13 - 07/29/13	9	20	13 ± 9	07/01/13 - 07/29/13	10	22	13 ± 8	07/01/13 - 07/29/13	9	23	14 ± 13
07/29/13 - 09/03/13	13	27	18 ± 8	07/29/13 - 09/03/13	11	26	17 ± 9	07/29/13 - 09/03/13	11	30	19 ± 15
09/03/13 - 09/30/13	9	29	16 ± 13	09/03/13 - 09/30/13	10	29	16 ± 14	09/03/13 - 09/30/13	11	18	14 ± 7
09/30/13 - 11/04/13	14	36	22 ± 15	09/30/13 - 11/04/13	11	35	21 ± 15	09/30/13 - 11/04/13	13	31	21 ± 14
11/04/13 - 12/02/13	10	21	15 ± 7	11/04/13 - 12/02/13	8	19	14 ± 7	11/04/13 - 12/02/13	9	21	15 ± 10
12/02/13 - 12/30/13	16	36	25 ± 13	12/02/13 - 12/30/13	12	34	23 ± 16	12/02/13 - 12/30/13	18	30	23 ± 11
12/31/12 - 12/30/13	7	36	17 ± 13	12/31/12 - 12/30/13	8	35	17 ± 12	12/31/12 - 12/30/13	7	31	16 ± 12

Table C-V.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	12/31/12 - 04/01/13	< 42	< 3	< 4	< 3	< 5	< 4
	04/01/13 - 07/01/13	95 ± 36	< 4	< 5	< 5	< 5	< 5
	07/01/13 - 09/30/13	81 ± 28	< 2	< 4	< 3	< 3	< 2
	09/30/13 - 12/30/13	63 ± 22	< 3	< 3	< 2	< 3	< 3
	MEAN	80 ± 32	-	-	-	-	-
11S1	12/31/12 - 04/01/13	62 ± 29	< 3	< 5	< 3	< 3	< 3
	04/01/13 - 07/01/13	85 ± 31	< 4	< 5	< 4	< 4	< 3
	07/01/13 - 09/30/13	67 ± 22	< 3	< 4	< 3	< 3	< 2
	09/30/13 - 12/30/13	79 ± 30	< 4	< 5	< 4	< 5	< 4
	MEAN	73 ± 21	-	-	-	-	-
13C1	12/31/12 - 03/26/13	64 ± 25	< 3	< 6	< 3	< 3	< 3
	04/01/13 - 07/01/13 (2)	-	-	-	-	-	-
	07/01/13 - 09/30/13 (2)	-	-	-	-	-	-
	09/30/13 - 12/30/13 (2)	-	-	-	-	-	-
	MEAN	-	-	-	-	-	-
14S1	12/31/12 - 04/01/13	80 ± 35	< 4	< 5	< 3	< 4	< 3
	04/01/13 - 07/01/13	87 ± 28	< 3	< 4	< 3	< 3	< 3
	07/01/13 - 09/30/13	72 ± 30	< 5	< 6	< 6	< 6	< 3
	09/30/13 - 12/30/13	61 ± 24	< 3	< 3	< 3	< 3	< 2
	MEAN	75 ± 22	-	-	-	-	-
15D1	12/31/12 - 04/01/13	62 ± 30	< 3	< 6	< 4	< 4	< 4
	04/01/13 - 07/01/13	90 ± 41	< 3	< 4	< 5	< 5	< 4
	07/01/13 - 09/30/13	83 ± 34	< 3	< 4	< 3	< 4	< 3
	09/30/13 - 12/30/13	84 ± 22	< 4	< 4	< 3	< 4	< 3
	MEAN	80 ± 24	-	-	-	-	-
22G1	12/31/12 - 04/01/13	42 ± 24	< 3	< 3	< 3	< 3	< 3
	04/01/13 - 07/01/13	73 ± 22	< 2	< 3	< 2	< 3	< 2
	07/01/13 - 09/30/13	85 ± 31	< 3	< 3	< 3	< 4	< 2
	09/30/13 - 12/30/13	84 ± 31	< 4	< 3	< 3	< 3	< 3
	MEAN	71 ± 40	-	-	-	-	-
6C1	12/31/12 - 04/01/13	93 ± 31	< 4	< 4	< 3	< 4	< 4
	04/01/13 - 07/01/13	73 ± 22	< 4	< 4	< 4	< 3	< 3
	07/01/13 - 09/30/13	71 ± 34	< 3	< 4	< 3	< 3	< 2
	09/30/13 - 12/30/13	85 ± 29	< 2	< 3	< 3	< 2	< 3
	MEAN	81 ± 21	-	-	-	-	-

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

(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

Table C-VI.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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

COLLECTION	GROUP I			GROUP II			GROUP III
PERIOD	10S3	11S1	14S1	6C1	13C1 (2)	15D1	22G1
12/31/12 - 01/06/13	< 58	< 58	< 42	< 24	< 59	< 43	< 43
01/06/13 - 01/14/13	< 23	< 23	< 39	< 23	< 24	< 40	< 40
01/14/13 - 01/22/13	< 21	< 49	< 43	< 48	< 50	< 43	< 43
01/22/13 - 01/29/13	< 26	< 26	< 20	< 26	< 26	< 21	< 21
01/29/13 - 02/04/13	< 36	< 13	< 35	< 36	< 37	< 35	< 35
02/04/13 - 02/11/13	< 45	(1)	< 60	< 44	< 45	< 40	< 40
02/11/13 - 02/19/13	< 26	< 26	< 32	< 25	< 10	< 25	< 25
02/19/13 - 02/25/13	< 49	< 49	< 34	< 49	< 50	< 34	< 34
02/25/13 - 03/04/13	< 24	< 24	< 10	< 24	< 25	< 25	< 25
03/04/13 - 03/11/13	< 27	< 27	< 32	< 26	< 27	< 32	< 32
03/11/13 - 03/18/13	< 21	< 21	< 29	< 21	< 30	< 12	< 29
03/18/13 - 03/26/13	< 25	< 25	< 42	(1)	< 25	< 43	< 43
03/26/13 - 04/01/13	< 32	< 32	< 27	< 32		< 27	< 10
04/01/13 - 04/08/13	< 21	< 21	< 28	< 21		< 28	< 28
04/08/13 - 04/15/13	< 31	< 31	< 31	< 13		< 33	< 32
04/15/13 - 04/22/13	< 18	< 18	< 29	< 18		< 29	< 29
04/22/13 - 04/29/13	< 11	< 30	< 21	< 29		< 21	< 21
04/29/13 - 05/06/13	< 43	< 43	< 43	< 43		< 44	< 44
05/06/13 - 05/13/13	< 23	< 23	< 12	< 23		< 31	< 30
05/13/13 - 05/20/13	< 16	< 19	< 16	< 16		< 16	< 16
05/20/13 - 05/28/13	< 34	< 34	< 59	< 33		< 21	< 59
05/28/13 - 06/03/13	< 44	< 44	< 38	< 43		< 39	< 38
06/03/13 - 06/10/13	< 61	< 61	< 49	< 61		< 50	< 21
06/10/13 - 06/17/13	< 28	< 27	< 32	< 27		< 32	< 32
06/17/13 - 06/24/13	< 33	< 34	< 29	< 15		< 28	< 29
06/24/13 - 07/01/13	< 20	< 21	< 27	< 20		< 26	< 26
07/01/13 - 07/08/13	< 66	< 69	< 65	< 67		< 62	< 65
07/08/13 - 07/15/13	< 58	< 59	< 56	< 59		< 56	< 55
07/15/13 - 07/22/13	< 53	< 54	< 61	< 53		< 58	< 60
07/22/13 - 07/29/13	< 37	< 38	< 43	< 37		< 42	< 42
07/29/13 - 08/05/13	< 41	< 42	< 39	< 42		< 38	< 39
08/05/13 - 08/12/13	< 59	< 61	< 48	< 60		< 46	< 47
08/12/13 - 08/19/13	< 47	< 48	< 47	< 48		< 19	< 47
08/19/13 - 08/26/13	< 62	< 63	< 56	< 62		< 54	< 54
08/26/13 - 09/03/13	< 21	< 21	< 30	< 21		< 29	< 16
09/03/13 - 09/09/13	< 54	< 56	< 49	< 55		< 47	< 48
09/09/13 - 09/16/13	< 18	< 19	< 19	< 6		< 19	(1)
09/16/13 - 09/23/13	< 36	< 37	< 52	< 37		< 50	< 60
09/23/13 - 09/30/13	< 56	< 58	< 53	< 57		< 51	< 52
09/30/13 - 10/07/13	< 55	< 56	< 36	< 55		< 35	< 35
10/07/13 - 10/15/13	< 45	< 46	< 35	< 45		< 35	< 34
10/15/13 - 10/21/13	< 61	< 63	< 48	< 62		< 47	< 49
10/21/13 - 10/28/13	< 48	< 50	< 62	< 49		< 62	< 61
10/28/13 - 11/04/13	< 52	< 53	< 50	< 52		< 48	< 49
11/04/13 - 11/11/13	< 32	< 33	< 29	< 32		< 28	< 28
11/11/13 - 11/18/13	< 52	< 53	< 60	< 52		< 59	< 58
11/18/13 - 11/25/13	< 38	< 39	< 55	< 39		< 60	< 21
11/25/13 - 12/02/13	< 66	< 68	< 70	< 67		< 67	< 68
12/02/13 - 12/09/13	< 51	< 52	< 51	< 20		< 49	< 50
12/09/13 - 12/16/13	< 61	< 63	< 49	< 62		< 48	< 49
12/16/13 - 12/23/13	< 45	< 46	< 43	< 46		< 41	< 42
12/23/13 - 12/30/13	< 57	< 58	< 63	< 57		< 61	< 63
MEAN	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION
(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

Table C-VII.1 **CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

	CONTROL FARM		INDICATOR FARM			
COLLECTION PERIOD	23F1	36E1	10F4	18E1	19B1	25C1
01/08/13	< 0.6	< 0.7	< 0.9	< 0.7	< 0.6	< 0.8
02/12/13	< 0.7		< 0.8	< 0.7	< 0.8	< 0.8
03/13/13	< 0.6		< 0.9	< 0.8	< 0.8	< 0.8
04/03/13	< 0.8	< 0.8	(2)	< 0.5	< 0.6	< 0.7
04/16/13	< 0.7			< 0.4	< 0.7	< 0.8
04/30/13	< 0.6			< 0.7	< 0.7	< 0.7
05/14/13	< 0.6			< 0.6	< 0.6	< 0.8
05/28/13	< 0.6			< 0.7	< 0.8	< 0.9
06/11/13	< 0.7			< 0.7	< 0.8	< 0.8
06/25/13	< 0.7			< 0.6	< 0.7	< 0.7
07/09/13	< 0.5	< 0.7		< 0.5	< 0.4	< 0.7
07/23/13	< 0.8			< 0.7	< 0.8	< 0.7
08/06/13	< 0.6			< 0.7	< 0.8	< 0.8
08/20/13	< 0.6			< 0.7	< 0.6	< 0.8
09/03/13	< 0.5			< 0.6	< 0.6	< 0.6
09/17/13	< 0.5			< 0.6	< 0.6	< 0.8
10/01/13	< 0.6	< 0.7		< 0.7	< 0.6	< 0.7
10/15/13	< 0.5			< 0.8	< 0.6	< 0.6
10/29/13	< 0.5			< 0.5	< 0.5	< 0.6
11/12/13	< 1.0			< 0.6	< 0.6	< 0.9
11/25/13	< 0.6			< 0.7	< 0.6	< 0.5
12/10/13	< 0.5			< 0.7	< 0.7	< 0.6
MEAN	-	-	-	-	-	-

(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD		K-40	Cs-134	Cs-137	Ba-140	La-140
10F4	01/08/13		1168 ± 100	< 4	< 5	< 25	< 7
	02/12/13		1223 ± 175	< 7	< 8	< 36	< 12
	03/12/13		1405 ± 155	< 5	< 5	< 27	< 7
	04/03/13	(2)	-	-	-	-	-
	04/16/13		-	-	-	-	-
	04/30/13		-	-	-	-	-
	05/14/13		-	-	-	-	-
	05/28/13		-	-	-	-	-
	06/11/13		-	-	-	-	-
	06/25/13		-	-	-	-	-
	07/09/13		-	-	-	-	-
	07/23/13		-	-	-	-	-
	08/06/13		-	-	-	-	-
	08/20/13		-	-	-	-	-
	09/03/13		-	-	-	-	-
	09/17/13		-	-	-	-	-
	10/01/13		-	-	-	-	-
	10/15/13		-	-	-	-	-
	10/29/13		-	-	-	-	-
	11/12/13		-	-	-	-	-
	11/25/13		-	-	-	-	-
	12/10/13		-	-	-	-	-
	MEAN		1265 ± 248	-	-	-	-
18E1	01/08/13		1210 ± 152	< 5	< 6	< 31	< 11
	02/12/13		1308 ± 179	< 7	< 7	< 37	< 9
	03/12/13		1198 ± 143	< 6	< 6	< 29	< 11
	04/03/13		1108 ± 151	< 8	< 8	< 43	< 9
	04/16/13		1277 ± 134	< 6	< 6	< 31	< 12
	04/30/13		1170 ± 185	< 8	< 8	< 46	< 13
	05/14/13		1231 ± 116	< 4	< 5	< 36	< 12
	05/28/13		1384 ± 118	< 4	< 5	< 24	< 7
	06/11/13		1199 ± 168	< 7	< 8	< 40	< 11
	06/25/13		1280 ± 166	< 5	< 7	< 34	< 11
	07/09/13		1243 ± 163	< 6	< 7	< 31	< 9
	07/23/13		1199 ± 158	< 6	< 7	< 37	< 12
	08/06/13		1341 ± 123	< 4	< 5	< 30	< 7
	08/20/13		1198 ± 126	< 4	< 5	< 38	< 10
	09/03/13		1328 ± 143	< 5	< 6	< 46	< 14
	09/17/13		1383 ± 173	< 5	< 6	< 27	< 11
	10/01/13		1389 ± 176	< 7	< 7	< 52	< 9
	10/15/13		1379 ± 58	< 2	< 2	< 23	< 7
	10/29/13		1260 ± 138	< 5	< 6	< 23	< 8
	11/12/13		1188 ± 104	< 4	< 4	< 50	< 15
	11/25/13		1350 ± 180	< 6	< 5	< 50	< 13
	12/10/13		1160 ± 124	< 4	< 6	< 25	< 7
	MEAN		1263 ± 168	-	-	-	-

(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
19B1	01/08/13	1253 ± 116	< 4	< 5	< 26	< 8
	02/12/13	1146 ± 161	< 5	< 7	< 32	< 12
	03/12/13	1295 ± 131	< 5	< 5	< 26	< 10
	04/02/13	1387 ± 130	< 5	< 5	< 27	< 9
	04/16/13	1272 ± 153	< 6	< 8	< 42	< 15
	04/30/13	1297 ± 151	< 6	< 7	< 31	< 8
	05/14/13	1276 ± 168	< 7	< 7	< 51	< 15
	05/28/13	1357 ± 150	< 5	< 7	< 31	< 10
	06/11/13	1341 ± 153	< 7	< 7	< 37	< 8
	06/25/13	1437 ± 123	< 4	< 6	< 30	< 9
	07/09/13	1206 ± 155	< 6	< 7	< 33	< 11
	07/23/13	1204 ± 156	< 6	< 7	< 33	< 9
	08/06/13	1457 ± 180	< 6	< 7	< 36	< 12
	08/20/13	1324 ± 158	< 6	< 7	< 47	< 14
	09/03/13	1339 ± 153	< 6	< 7	< 44	< 13
	09/17/13	1315 ± 163	< 7	< 7	< 34	< 10
	10/01/13	1256 ± 117	< 5	< 5	< 34	< 9
	10/15/13	1258 ± 55	< 2	< 2	< 22	< 7
	10/29/13	1257 ± 176	< 8	< 8	< 39	< 13
	11/12/13	1211 ± 91	< 4	< 4	< 44	< 15
	11/25/13	1434 ± 164	< 6	< 8	< 49	< 14
	12/10/13	1314 ± 139	< 5	< 7	< 31	< 12
	MEAN	1302 ± 160	-	-	-	-
23F1	01/08/13	1247 ± 120	< 5	< 5	< 30	< 8
	02/12/13	1189 ± 160	< 7	< 8	< 37	< 10
	03/13/13	1279 ± 145	< 5	< 5	< 28	< 9
	04/02/13	1319 ± 108	< 5	< 6	< 28	< 9
	04/16/13	1212 ± 121	< 4	< 5	< 34	< 10
	04/30/13	1351 ± 158	< 6	< 7	< 36	< 13
	05/14/13	1344 ± 166	< 5	< 6	< 46	< 14
	05/28/13	1389 ± 138	< 6	< 6	< 33	< 9
	06/11/13	1312 ± 133	< 6	< 6	< 29	< 7
	06/25/13	1422 ± 136	< 6	< 6	< 33	< 11
	07/09/13	1204 ± 146	< 5	< 6	< 33	< 10
	07/23/13	1341 ± 151	< 6	< 6	< 32	< 5
	08/06/13	1264 ± 168	< 7	< 8	< 44	< 14
	08/20/13	1318 ± 136	< 6	< 6	< 47	< 13
	09/03/13	1371 ± 140	< 5	< 7	< 45	< 12
	09/17/13	1368 ± 182	< 6	< 8	< 37	< 10
	10/01/13	1370 ± 123	< 4	< 4	< 29	< 9
	10/15/13	1337 ± 51	< 2	< 2	< 19	< 6
	10/29/13	1286 ± 138	< 5	< 7	< 34	< 8
	11/12/13	1253 ± 99	< 4	< 5	< 50	< 15
	11/25/13	1229 ± 162	< 6	< 8	< 47	< 11
	12/10/13	1136 ± 108	< 5	< 5	< 24	< 7
	MEAN	1297 ± 147	-	-	-	-

Table C-VII.2 **CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
25C1	01/08/13	1165 ± 125	< 4	< 5	< 27	< 8
	02/12/13	1243 ± 178	< 6	< 8	< 30	< 10
	03/12/13	1287 ± 135	< 5	< 6	< 28	< 8
	04/02/13	1374 ± 128	< 5	< 5	< 26	< 9
	04/16/13	1269 ± 130	< 5	< 7	< 39	< 11
	04/30/13	1275 ± 135	< 6	< 7	< 36	< 9
	05/14/13	1278 ± 121	< 5	< 5	< 37	< 8
	05/28/13	1290 ± 147	< 5	< 6	< 33	< 8
	06/11/13	1333 ± 146	< 7	< 9	< 41	< 10
	06/25/13	1282 ± 136	< 4	< 6	< 29	< 9
	07/09/13	1515 ± 171	< 6	< 8	< 45	< 9
	07/23/13	1303 ± 140	< 5	< 6	< 32	< 8
	08/06/13	1368 ± 144	< 6	< 7	< 37	< 9
	08/20/13	1169 ± 144	< 7	< 8	< 52	< 12
	09/03/13	1277 ± 145	< 6	< 7	< 51	< 10
	09/17/13	1261 ± 168	< 6	< 8	< 26	< 10
	10/01/13	1330 ± 123	< 4	< 5	< 34	< 6
	10/15/13	1337 ± 52	< 2	< 2	< 21	< 6
	10/29/13	1269 ± 140	< 6	< 6	< 27	< 9
	11/12/13	1228 ± 105	< 4	< 4	< 46	< 15
	11/25/13	1309 ± 159	< 6	< 7	< 49	< 15
	12/10/13	1222 ± 107	< 4	< 5	< 25	< 6
	MEAN	1290 ± 147	-	-	-	-
36E1	01/08/13	1107 ± 119	< 5	< 6	< 26	< 10
	04/02/13	1302 ± 102	< 3	< 4	< 23	< 8
	07/09/13	1239 ± 108	< 4	< 5	< 22	< 7
	10/01/13	1107 ± 146	< 6	< 7	< 35	< 12
	MEAN	1189 ± 196	-	-	-	-

TABLE C-VIII.1 **CONCENTRATIONS OF GAMMA EMITTERS IN BROAD LEAFY VEGETATION SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	06/18/13	Cabbage	139 ± 99	5695 ± 315	< 14	< 12	< 15	< 27	< 13	< 13	< 337	< 26	< 56
	06/18/13	Collards	< 133	5641 ± 379	< 14	< 13	< 20	< 30	< 14	< 16	< 307	< 23	< 71
	06/18/13	Swiss Chard	122 ± 80	3889 ± 254	< 10	< 10	< 12	< 21	< 9	< 11	< 238	< 18	< 45
	07/16/13	Cabbage	< 231	2736 ± 528	< 25	< 26	< 28	< 47	< 22	< 21	< 568	< 43	< 104
	07/16/13	Collards	260 ± 222	5724 ± 699	< 28	< 30	< 35	< 53	< 24	< 33	< 524	< 38	< 120
	07/16/13	Swiss Chard	485 ± 175	7245 ± 619	< 22	< 25	< 31	< 45	< 24	< 25	< 458	53 ± 41	< 96
	08/19/13	Cabbage	< 164	2039 ± 386	< 16	< 18	< 21	< 37	< 18	< 20	< 348	< 29	< 82
	08/19/13	Zucchini Leaves	498 ± 238	4689 ± 486	< 22	< 23	< 24	< 39	< 23	< 24	< 463	< 32	< 106
	08/19/13	Swiss Chard	< 209	7354 ± 567	< 21	< 21	< 28	< 43	< 20	< 26	< 450	< 37	< 94
	09/09/13	Swiss Chard	286 ± 159	5522 ± 497	< 19	< 19	< 25	< 59	< 20	< 21	< 541	< 43	< 83
	09/09/13	Zuchinni Leaves	691 ± 193	5294 ± 537	< 23	< 20	< 30	< 54	< 20	< 24	< 478	< 35	< 87
	10/15/13	Swiss Chard	606 ± 110	5197 ± 226	< 8	< 10	< 10	< 52	< 7	< 8	198 ± 147	17 ± 13	< 33
	10/15/13	Zucchini Leaves	2384 ± 124	5331 ± 195	< 8	< 10	< 10	< 60	< 8	< 9	< 175	< 14	< 38
	MEAN		608 ± 1391	5104 ± 3033	-	-	-	-	-	-	-	35 ± 51	-
13S3	06/18/13	Cabbage	< 200	3459 ± 429	< 22	< 21	< 27	< 46	< 23	< 20	695 ± 491	< 40	< 81
	06/18/13	Collards	< 141	3681 ± 331	< 14	< 13	< 18	< 30	< 13	< 16	272 ± 240	< 21	< 58
	06/18/13	Swiss Chard	311 ± 139	6148 ± 474	< 19	< 18	< 23	< 39	< 17	< 18	875 ± 430	< 33	< 81
	07/16/13	Cabbage	< 254	3505 ± 480	< 18	< 24	< 24	< 43	< 20	< 21	1081 ± 497	< 43	< 76
	07/16/13	Collards	< 216	4000 ± 562	< 20	< 26	< 30	< 52	< 20	< 24	< 614	< 42	< 95
	07/16/13	Swiss Chard	394 ± 298	6507 ± 603	< 27	< 22	< 30	< 56	< 21	< 26	2099 ± 581	< 51	< 115
	08/19/13	Zucchini Leaves	556 ± 233	5392 ± 578	< 23	< 26	< 27	< 52	< 24	< 26	< 467	< 47	< 95
	08/19/13	Collards	314 ± 155	3453 ± 508	< 19	< 21	< 30	< 44	< 21	< 23	< 548	< 39	< 104
	08/19/13	Swiss Chard	309 ± 164	5549 ± 503	< 23	< 22	< 29	< 47	< 19	< 23	1501 ± 522	< 37	< 92
	09/09/13	Collards	< 249	4463 ± 677	< 28	< 23	< 29	< 59	< 23	< 32	< 594	< 49	< 115
	09/09/13	Swiss Chard	255 ± 178	5621 ± 484	< 17	< 18	< 24	< 45	< 17	< 13	1037 ± 545	< 32	< 73
	09/09/13	Zucchini Leaves	813 ± 234	5577 ± 613	< 24	< 26	< 34	< 59	< 24	< 22	< 571	< 43	< 102
	10/15/13	Collards	2099 ± 146	5951 ± 261	< 7	< 8	< 9	< 53	< 7	< 7	1657 ± 275	< 17	< 36
	10/15/13	Swiss Chard	584 ± 99	5536 ± 220	< 8	< 10	< 10	< 54	< 7	< 7	1164 ± 184	< 15	< 33
	10/15/13	Zucchini Leaves	1841 ± 108	5011 ± 193	< 8	< 9	< 10	< 52	< 7	< 8	223 ± 151	< 13	< 32
	MEAN		748 ± 1338	4924 ± 2131	-	-	-	-	-	-	1060 ± 1179	-	-

THE MEAN AND 2 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, 2013**

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	06/18/13	Cabbage	< 147	3934 ± 305	< 12	< 14	< 17	< 33	< 15	< 15	< 350	< 26	< 59
	06/18/13	Broccoli Leaves	436 ± 128	4604 ± 371	< 13	< 15	< 19	< 27	< 12	< 15	< 310	< 25	< 63
	06/18/13	Swiss Chard	259 ± 149	6802 ± 506	< 21	< 18	< 26	< 37	< 19	< 21	< 372	< 27	< 91
	07/16/13	Cabbage	364 ± 143	4128 ± 442	< 20	< 20	< 27	< 44	< 22	< 25	< 564	< 41	< 83
	07/16/13	Brussel Sprout Leaves	< 260	5339 ± 526	< 20	< 20	< 26	< 55	< 25	< 25	< 599	< 49	< 102
	07/16/13	Swiss Chard	284 ± 205	7847 ± 695	< 28	< 24	< 32	< 42	< 24	< 23	< 512	< 43	< 102
	08/19/13	Cabbage	< 181	5270 ± 553	< 19	< 24	< 25	< 46	< 23	< 25	< 537	< 44	< 83
	08/19/13	Zucchini Leaves	820 ± 202	3946 ± 494	< 23	< 23	< 26	< 46	< 21	< 23	< 563	< 47	< 94
	08/19/13	Swiss Chard	< 229	6849 ± 624	< 22	< 21	< 25	< 41	< 20	< 22	< 466	< 36	< 102
	09/09/13	Cabbage	< 188	4900 ± 414	< 18	< 17	< 19	< 40	< 16	< 20	< 431	< 27	< 69
	09/09/13	Kale	368 ± 161	7057 ± 508	< 19	< 19	< 26	< 45	< 18	< 21	< 450	< 32	< 96
	09/09/13	Swiss Chard	255 ± 164	8809 ± 686	< 24	< 30	< 31	< 57	< 21	< 22	< 493	< 40	< 87
	10/15/13	Cabbage	< 63	3624 ± 153	< 6	< 6	< 7	< 39	< 5	< 6	< 124	< 10	< 26
	10/15/13	Kale	386 ± 69	6352 ± 206	< 8	< 9	< 10	< 52	< 7	< 8	< 158	< 14	< 32
	10/15/13	Swiss Chard	6680 ± 171	5059 ± 203	< 7	< 8	< 10	< 56	< 7	< 8	< 200	< 16	< 31
	MEAN		1095 ± 4203	5635 ± 3142	-	-	-	-	-	-	-	-	-

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

Table C-IX.1 QUARTERLY OSLD RESULTS FOR LIMERICK GENERATING STATION, 2013

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

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
2E1	10.9 ± 1.4	9.9 ± 0.4	11.3 ± 1.0	10.9 ± 0.8	11.4 ± 1.6
3S1	9.2 ± 3.0	10.3 ± 0.4	8.0 ± 1.1	10.7 ± 0.7	7.8 ± 1.0
4E1	10.2 ± 3.8	8.4 ± 0.4	11.8 ± 0.8	8.7 ± 2.4	11.9 ± 2.9
5H1	11.6 ± 1.2	12.0 ± 0.1	11.0 ± 0.2	12.3 ± 1.4	11.2 ± 0.6
5S1	10.7 ± 1.4	11.5 ± 0.1	10.1 ± 0.1	11.1 ± 0.0	10.2 ± 0.2
6C1	10.4 ± 0.8	9.8 ± 0.2	10.4 ± 0.9	10.8 ± 2.6	10.4 ± 0.4
7E1	10.6 ± 1.5	10.2 ± 1.1	10.1 ± 0.1	11.7 ± 0.2	10.4 ± 0.5
7S1	10.2 ± 1.2	10.4 ± 1.1	10.3 ± 1.0	10.8 ± 0.1	9.4 ± 0.3
9C1	9.7 ± 0.9	9.8 ± 0.3	9.5 ± 0.4	10.2 ± 0.1	9.2 ± 0.1
10E1	10.4 ± 0.5	10.6 ± 0.1	10.0 ± 0.6	10.5 ± 0.8	10.3 ± 0.7
10F3	9.9 ± 0.7	9.9 ± 0.6	9.9 ± 1.2	10.2 ± 0.1	9.4 ± 2.3
10S3	10.1 ± 0.3	10.2 ± 0.6	9.9 ± 0.8	10.2 ± 0.4	10.0 ± 2.1
11S1	11.4 ± 0.3	11.2 ± 0.6	11.3 ± 2.0	11.5 ± 1.1	11.4 ± 0.4
13C1	8.0 ± 0.4	8.1 ± 0.1	7.7 ± 0.4	8.2 ± 0.1	8.0 ± 0.6
13E1	10.1 ± 0.4	10.0 ± 0.8	10.2 ± 1.4	10.3 ± 1.6	9.9 ± 0.1
13S2	13.4 ± 0.6	13.6 ± 0.7	13.0 ± 2.3	13.7 ± 1.4	13.3 ± 1.2
14S1	9.3 ± 0.3	9.2 ± 0.5	9.4 ± 1.6	9.1 ± 0.3	9.3 ± 0.9
15D1	10.7 ± 0.8	10.4 ± 0.4	10.6 ± 1.0	11.3 ± 1.1	10.5 ± 0.4
16F1	10.4 ± 0.7	10.3 ± 0.8	10.4 ± 0.3	10.9 ± 0.8	10.0 ± 0.7
17B1	9.7 ± 0.4	9.9 ± 0.6	9.4 ± 0.2	9.6 ± 0.2	9.8 ± 0.5
18S2	10.8 ± 0.6	11.0 ± 0.1	10.4 ± 0.6	11.0 ± 0.8	10.7 ± 0.2
19D1	9.8 ± 0.9	9.6 ± 1.3	10.4 ± 2.3	9.4 ± 1.1	9.7 ± 0.1
20D1	9.3 ± 0.6	9.6 ± 0.1	9.3 ± 0.6	9.3 ± 0.1	8.9 ± 0.4
20F1	9.8 ± 0.6	9.6 ± 0.3	10.1 ± 0.8	10.0 ± 0.4	9.5 ± 0.1
21S2	9.5 ± 0.6	9.6 ± 0.0	9.8 ± 1.5	9.1 ± 1.9	9.5 ± 1.1
23S2	9.5 ± 0.5	9.8 ± 0.1	9.6 ± 0.3	9.3 ± 0.3	9.3 ± 0.3
24D1	9.0 ± 0.7	8.8 ± 0.7	9.5 ± 2.1	8.8 ± 0.4	8.8 ± 1.3
25D1	8.7 ± 0.4	8.5 ± 0.0	8.5 ± 1.5	8.9 ± 0.5	8.7 ± 1.3
25S2	9.0 ± 0.4	8.9 ± 0.8	9.1 ± 1.1	9.2 ± 0.1	8.7 ± 0.5
26S3	9.2 ± 0.2	9.3 ± 0.2	9.1 ± 0.5	9.3 ± 0.8	9.2 ± 0.0
28D2	9.3 ± 0.3	9.2 ± 0.7	9.4 ± 0.1	9.4 ± 0.4	9.1 ± 1.0
29E1	9.2 ± 1.3	8.8 ± 0.1	8.9 ± 0.4	10.1 ± 0.2	8.8 ± 0.3
29S1	9.8 ± 1.2	9.3 ± 0.3	10.4 ± 1.2	9.3 ± 1.3	10.2 ± 0.3
31D1	11.0 ± 2.1	12.0 ± 0.4	10.3 ± 3.0	11.7 ± 0.6	9.9 ± 1.6
31D2	10.3 ± 0.3	10.2 ± 0.7	10.1 ± 0.1	10.5 ± 0.1	10.2 ± 0.6
31S1	10.0 ± 1.2	10.3 ± 0.0	9.4 ± 2.3	10.7 ± 0.1	9.7 ± 0.4
34E1	10.0 ± 0.6	9.9 ± 0.1	10.4 ± 0.8	10.0 ± 0.6	9.7 ± 0.1
34S2	9.7 ± 1.3	10.6 ± 1.6	9.2 ± 2.5	9.9 ± 1.3	9.2 ± 0.9
36D1	9.5 ± 1.1	9.1 ± 0.2	10.2 ± 0.0	9.0 ± 0.1	9.6 ± 1.3
36S2	10.2 ± 0.8	10.3 ± 0.6	10.3 ± 3.1	10.6 ± 0.3	9.7 ± 1.0

TABLE C-IX.2 MEAN QUARTERLY OSLD RESULTS FOR THE SITE BOUNDARY, MIDDLE, AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2013

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

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	MIDDLE	CONTROL
JAN-MAR	10.3 ± 2.3	9.7 ± 1.7	12.0 ± 0
APR-JUN	10.0 ± 2.2	9.9 ± 1.7	11.0 ± 0
JUL-SEP	10.3 ± 2.4	10.0 ± 1.9	12.3 ± 0
OCT-DEC	9.9 ± 2.5	9.7 ± 1.8	11.2 ± 0

TABLE C-IX.2 MEAN QUARTERLY OSLD RESULTS FOR THE SITE BOUNDARY MIDDLE AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2013

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

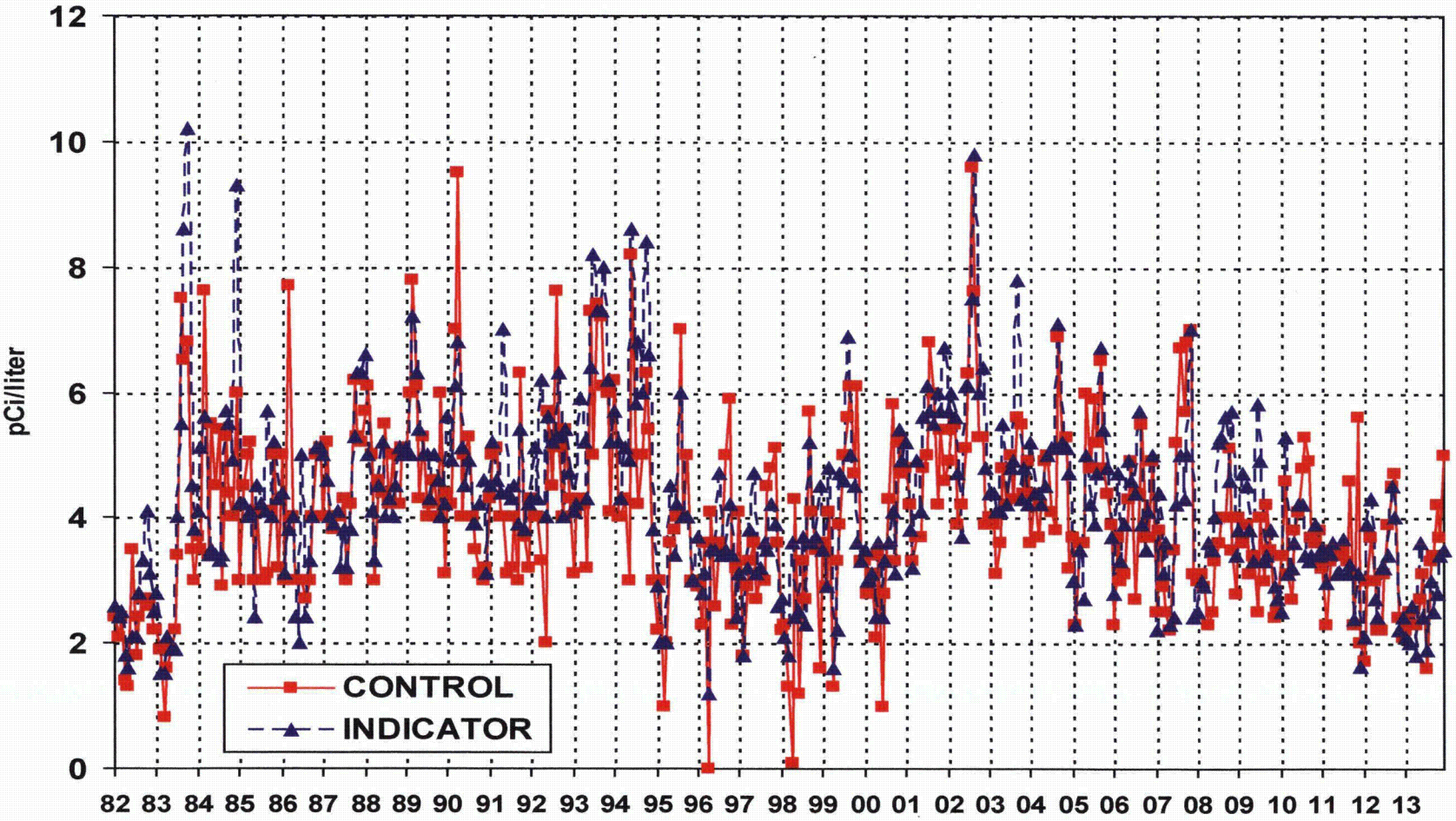
LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
SITE BOUNDARY	64	7.8	13.7	10.1 ± 2.3
MIDDLE	92	7.7	12.0	9.8 ± 1.8
CONTROL	4	11.0	12.3	11.6 ± 1.2

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 - 2013

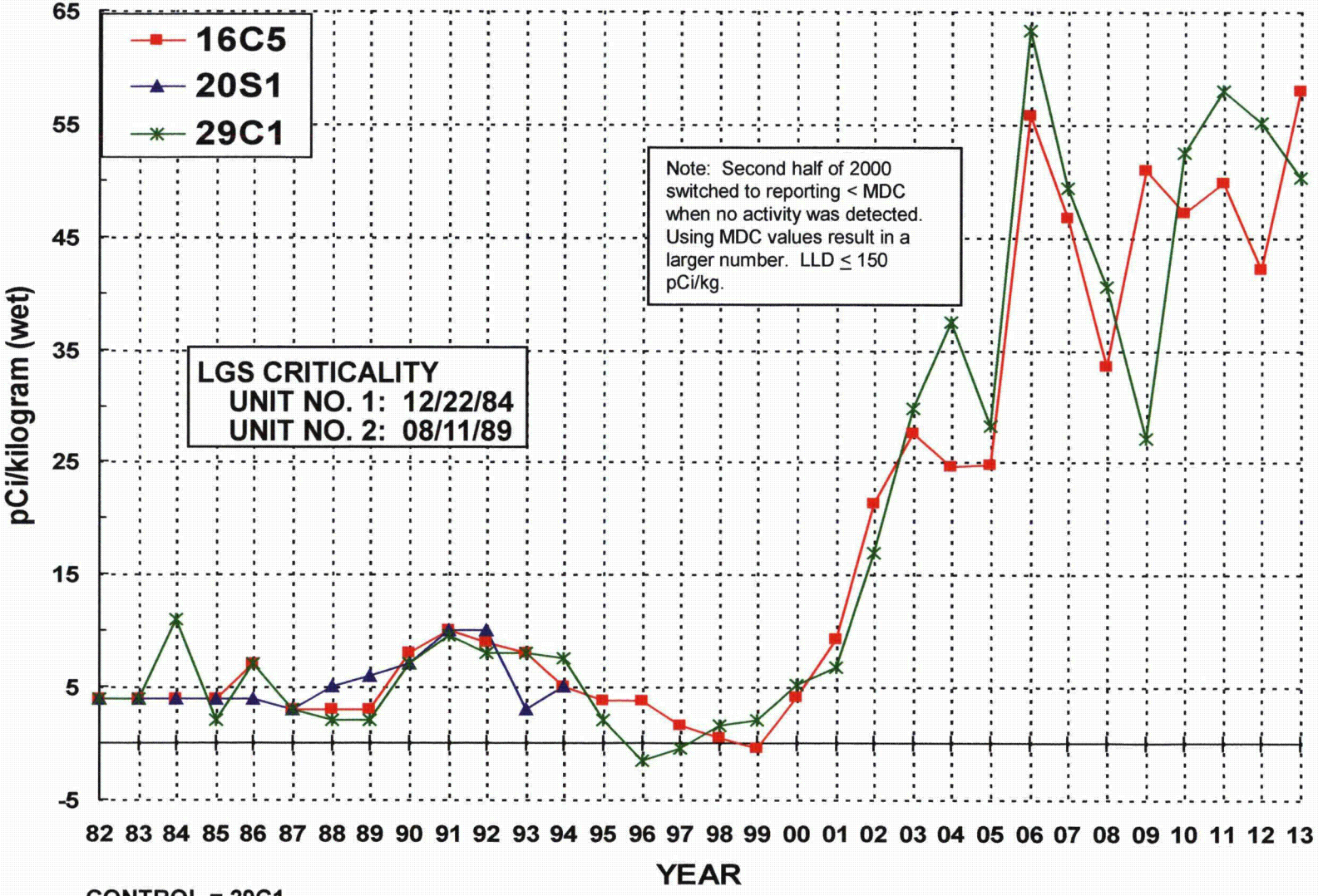


Note: 2005 analysis changed from Insoluble & Soluble to Total Gross Beta

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 ANNUAL CS-137 CONCENTRATIONS IN FISH SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 - 2013



CONTROL = 29C1

Station 20S1 discontinued in 1995

FIGURE C-3
CONCENTRATIONS OF CS-137 IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 – 2013

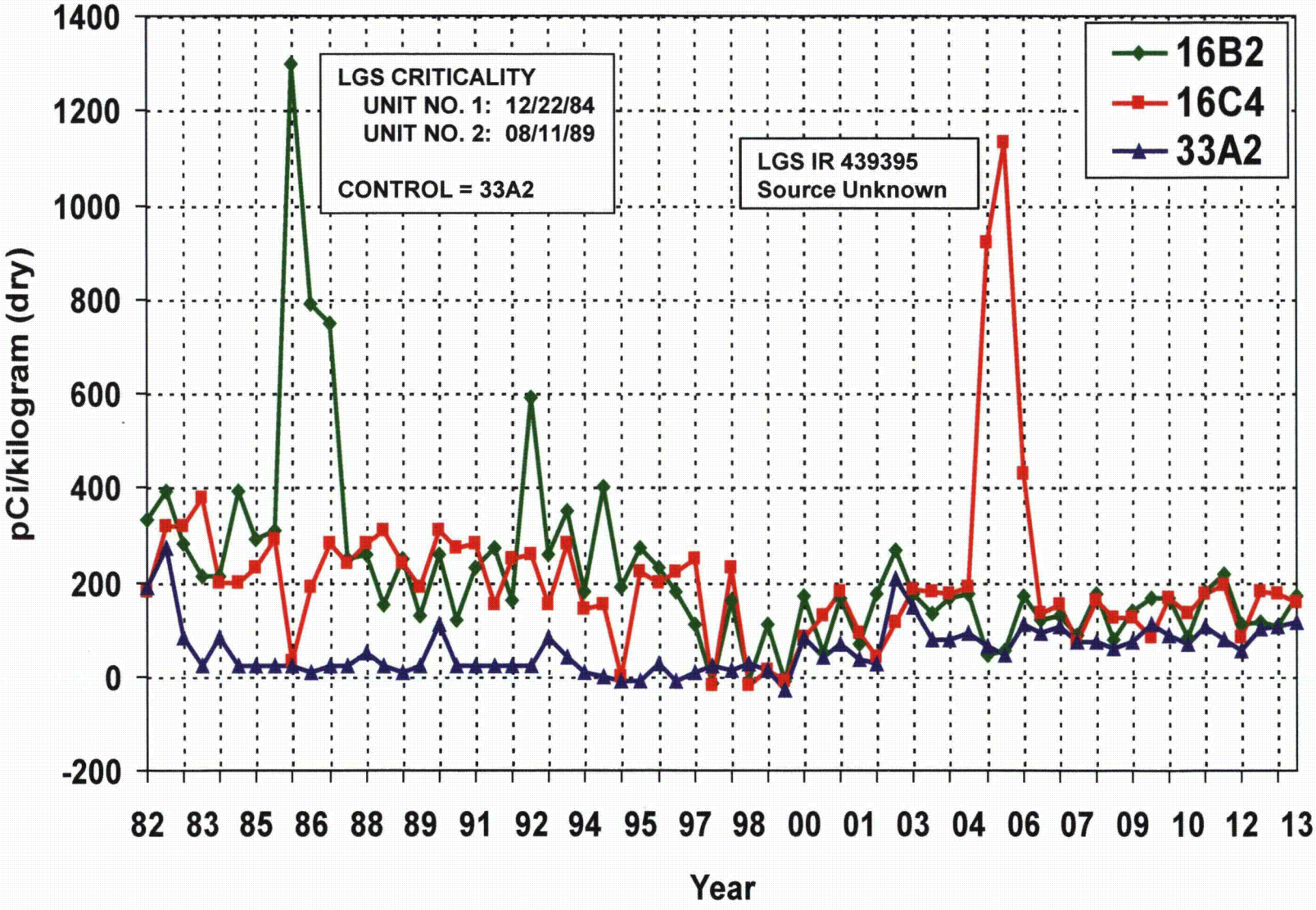


FIGURE C-4
MEAN MONTHLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 – 2013

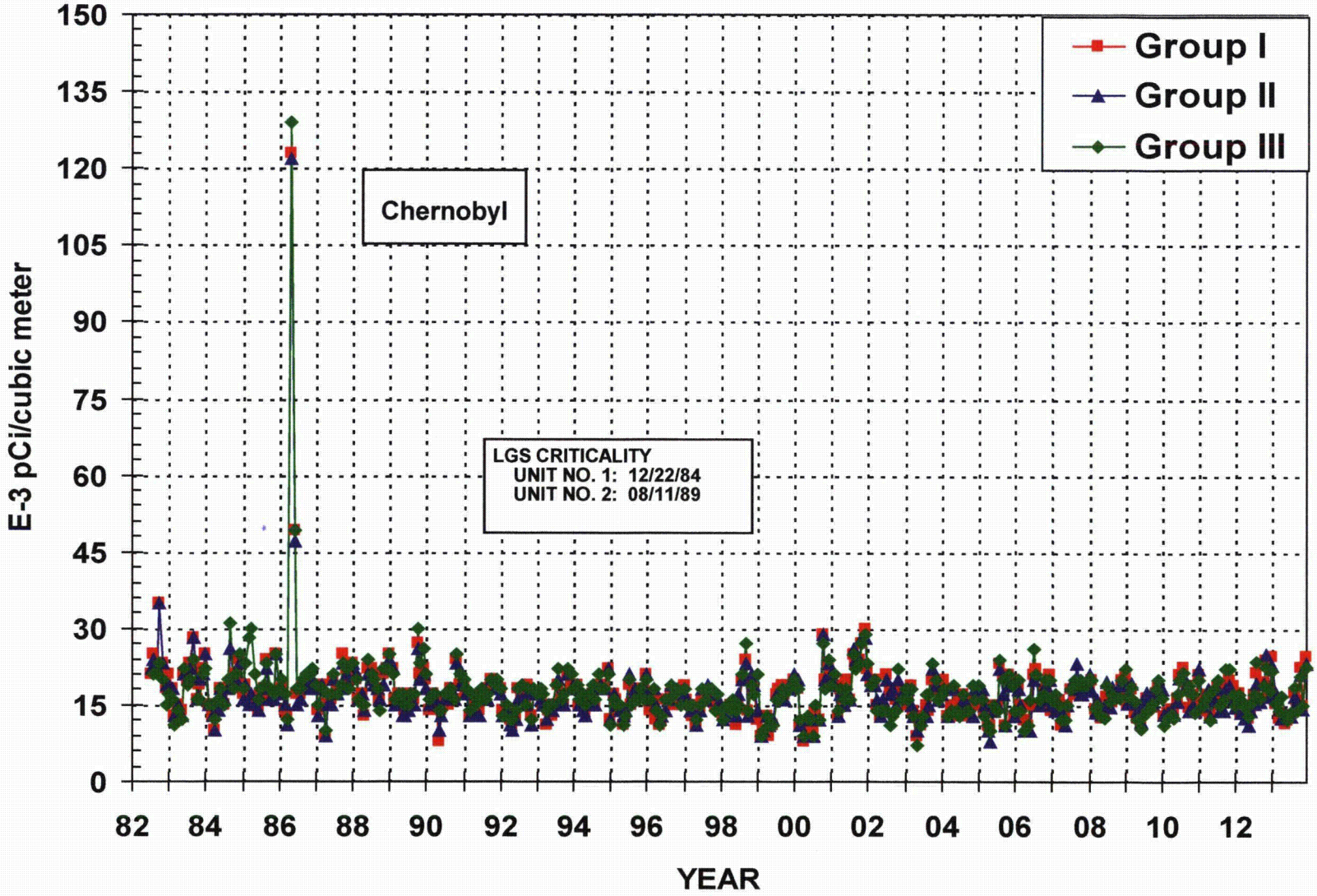


FIGURE C-5
MEAN WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 2013

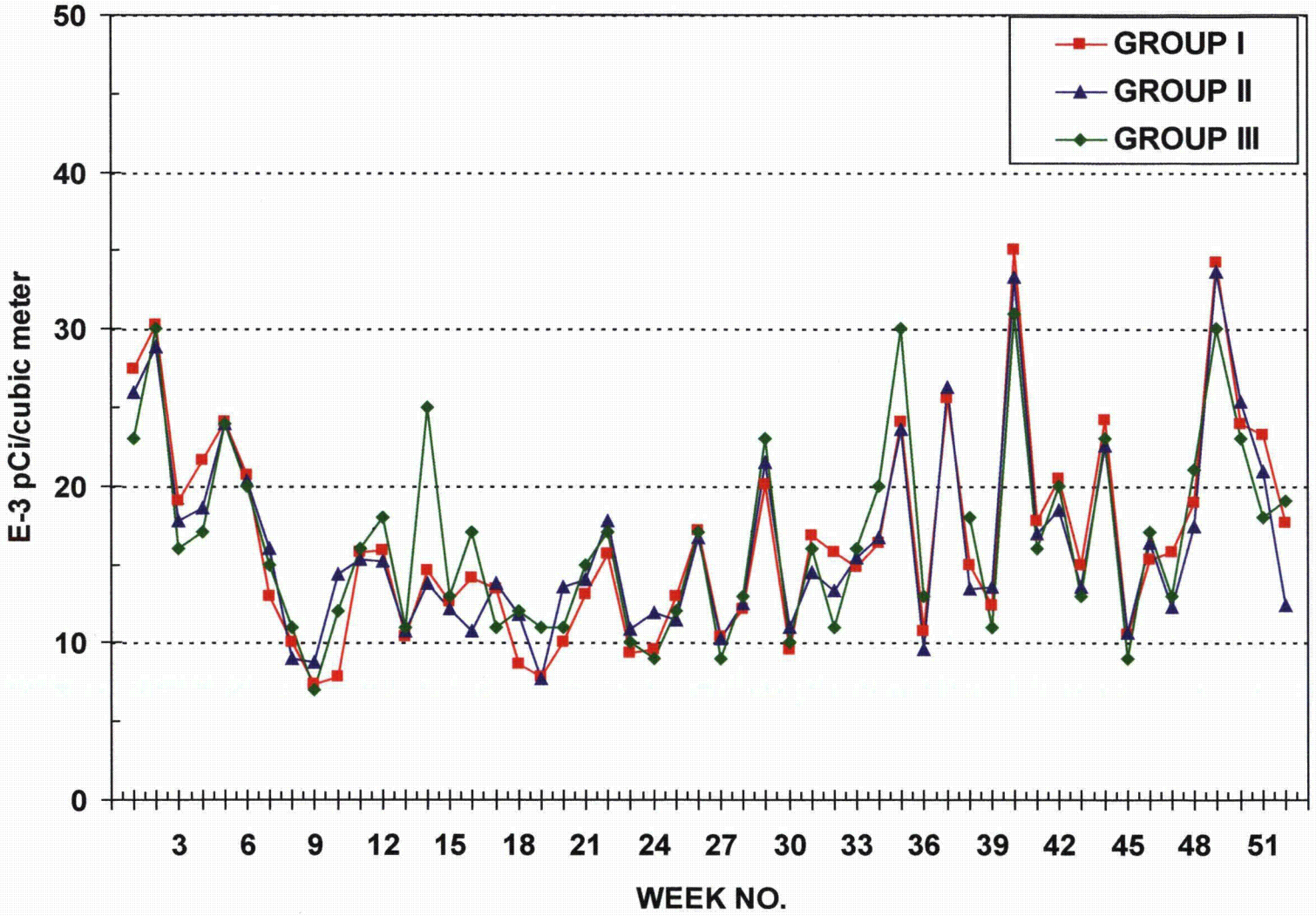
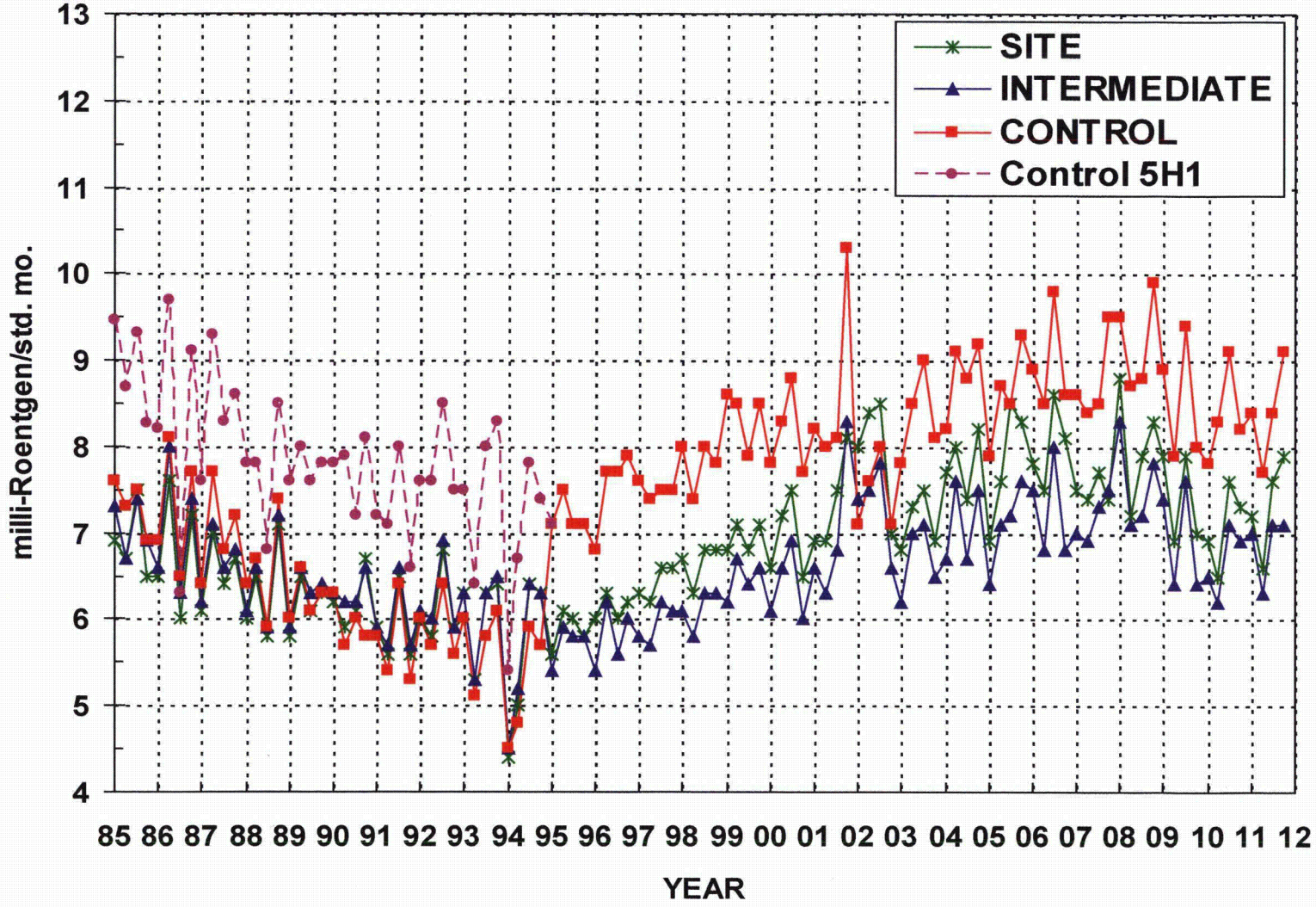


FIGURE C-6
MEAN QUARTERLY AMBIENT GAMMA RADIATION LEVELS (TLD) IN THE VICINITY OF LGS, 1985 – 2011

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



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APPENDIX D

DATA TABLES AND FIGURES
COMPARISON LABORATORY

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TABLE D-I.1 CONCENTRATIONS OF TOTAL GROSS BETA IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/31/12 - 01/29/13	4.7 ± 1.6
01/29/13 - 02/26/13	1.6 ± 0.6
02/26/13 - 04/01/13	< 1.4
04/01/13 - 04/29/13	1.7 ± 0.8
04/29/13 - 06/04/13	< 3.7
06/04/13 - 07/01/13	1.3 ± 0.5
07/01/13 - 07/30/13	2.3 ± 0.7
07/30/13 - 08/27/13	2.6 ± 0.6
08/27/13 - 09/30/13	2.9 ± 1.1
09/30/13 - 10/29/13	< 1.3
10/29/13 - 12/03/13	3.2 ± 0.8
12/03/13 - 12/30/13	1.8 ± 1.0
MEAN	2.4 ± 2.1

TABLE D-I.2 CONCENTRATIONS OF I-131 IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/31/12 - 01/29/13	< 0.5
01/29/13 - 02/26/13	< 0.2
02/26/13 - 04/01/13	< 0.2
04/01/13 - 04/29/13	< 0.5
04/29/13 - 06/04/13	< 0.3
06/04/13 - 07/01/13	< 0.3
07/01/13 - 07/30/13	< 0.5
07/30/13 - 08/27/13	< 0.2
08/27/13 - 09/30/13	< 0.2
09/30/13 - 10/29/13	< 0.4
10/29/13 - 12/03/13	< 0.2
12/03/13 - 12/30/13	< 0.2
MEAN	-

TABLE D-I.3 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/31/12 - 04/01/13	< 150
04/01/13 - 07/01/13	< 156
07/01/13 - 09/30/13	< 148
09/30/13 - 12/30/13	< 149
MEAN	-

TABLE D-I.4 **CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013**

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	12/31/12 - 01/29/13	< 2	< 3	< 7	< 2	< 4	< 4	< 3	< 12	< 3	< 2	< 25	< 5
	01/29/13 - 02/26/13	< 3	< 3	< 6	< 5	< 6	< 7	< 4	< 4	< 3	< 3	< 14	< 4
	02/26/13 - 04/01/13	< 2	< 2	< 6	< 3	< 6	< 4	< 4	< 6	< 3	< 3	< 15	< 4
	04/01/13 - 04/29/13	< 3	< 2	< 10	< 3	< 6	< 6	< 3	< 6	< 3	< 3	< 11	< 2
	04/29/13 - 06/04/13	< 2	< 2	< 7	< 2	< 2	< 3	< 3	< 10	< 3	< 2	< 20	< 3
	06/04/13 - 07/01/13	< 2	< 3	< 3	< 2	< 2	< 4	< 3	< 4	< 3	< 3	< 17	< 2
	07/01/13 - 07/30/13	< 3	< 3	< 3	< 2	< 4	< 4	< 3	< 9	< 2	< 3	< 23	< 5
	07/30/13 - 08/27/13	< 7	< 5	< 8	< 4	< 8	< 9	< 3	< 8	< 6	< 5	< 25	< 4
	08/27/13 - 09/30/13	< 1	< 1	< 2	< 1	< 2	< 2	< 2	< 11	< 1	< 1	< 16	< 3
	09/30/13 - 10/29/13	< 3	< 4	< 4	< 4	< 7	< 5	< 4	< 6	< 5	< 4	< 17	< 3
	10/29/13 - 12/03/13	< 2	< 3	< 5	< 3	< 6	< 6	< 4	< 10	< 3	< 3	< 15	< 3
	12/03/13 - 12/30/13	< 2	< 2	< 3	< 2	< 3	< 4	< 3	< 3	< 3	< 3	< 14	< 4
	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, 2013

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

COLLECTION PERIOD	11S2 GROSS BETA	11S2 I-131
12/31/12 - 01/06/13	41 ± 6	< 22
01/06/13 - 01/14/13	38 ± 5	< 16
01/14/13 - 01/22/13	24 ± 4	< 12
01/22/13 - 01/29/13	28 ± 4	< 9
01/29/13 - 02/04/13	34 ± 5	< 16
02/04/13 - 02/11/13	43 ± 12	< 46
02/11/13 - 02/19/13	22 ± 4	< 10
02/19/13 - 02/25/13	7 ± 4	< 14
02/25/13 - 03/04/13	12 ± 4	< 18
03/04/13 - 03/11/13	9 ± 4	< 17
03/11/13 - 03/18/13	23 ± 4	< 17
03/18/13 - 03/26/13	14 ± 3	< 11
03/26/13 - 04/01/13	12 ± 4	< 19
04/01/13 - 04/08/13	28 ± 4	< 17
04/08/13 - 04/15/13	17 ± 4	< 16
04/15/13 - 04/22/13	18 ± 4	< 18
04/22/13 - 04/29/13	21 ± 4	< 12
04/29/13 - 05/06/13	18 ± 4	< 13
05/06/13 - 05/13/13	9 ± 4	< 14
05/13/13 - 05/20/13	18 ± 4	< 16
05/20/13 - 05/28/13	16 ± 4	< 18
05/28/13 - 06/03/13	24 ± 5	< 21
06/03/13 - 06/10/13	10 ± 4	< 14
06/10/13 - 06/17/13	18 ± 5	< 13
06/17/13 - 06/24/13	14 ± 4	< 18
06/24/13 - 07/01/13	22 ± 5	< 13
07/01/13 - 07/08/13	15 ± 4	< 16
07/08/13 - 07/15/13	22 ± 4	< 18
07/15/13 - 07/22/13	31 ± 5	< 21
07/22/13 - 07/29/13	19 ± 4	< 15
07/29/13 - 08/05/13	21 ± 4	< 18
08/05/13 - 08/12/13	19 ± 5	< 13
08/12/13 - 08/19/13	17 ± 4	< 9
08/19/13 - 08/26/13	23 ± 5	< 15
08/26/13 - 09/03/13	33 ± 4	< 14
09/03/13 - 09/09/13	18 ± 5	< 19
09/09/13 - 09/16/13	29 ± 5	< 13
09/16/13 - 09/23/13	18 ± 5	< 17
09/23/13 - 09/30/13	22 ± 4	< 21
09/30/13 - 10/07/13	40 ± 5	< 11
10/07/13 - 10/15/13	23 ± 4	< 16
10/15/13 - 10/21/13	29 ± 5	< 20
10/21/13 - 10/28/13	23 ± 5	< 16
10/28/13 - 11/04/13	32 ± 5	< 10
11/04/13 - 11/11/13	21 ± 4	< 22
11/11/13 - 11/18/13	26 ± 5	< 12
11/18/13 - 11/25/13	19 ± 5	< 14
11/25/13 - 12/02/13	22 ± 4	< 15
12/02/13 - 12/09/13	44 ± 5	< 16
12/09/13 - 12/16/13	29 ± 5	< 15
12/16/13 - 12/23/13	25 ± 5	< 22
12/23/13 - 12/30/13	31 ± 4	< 25
MEAN	23 ± 17	-

TABLE D-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2013

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	12/31/12 - 04/01/13	59 ± 20	< 0.8	< 1.0	< 0.9	< 1.0	< 1.0
	04/01/13 - 07/01/13	81 ± 19	< 1.1	< 0.7	< 0.5	< 1.2	< 0.7
	07/01/13 - 09/30/13	61 ± 20	< 0.7	< 0.8	< 0.4	< 0.9	< 0.5
	09/30/13 - 12/30/13	69 ± 16	< 1.1	< 0.5	< 0.4	< 0.9	< 0.5
	MEAN	68 ± 20	-	-	-	-	-

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, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
10F4	01/08/13	< 0.5	1318 ± 92	< 3	< 3	< 21	< 3
	04/02/13	-	-	-	-	-	-
	07/09/13	-	-	-	-	-	-
	10/01/13	-	-	-	-	-	-
	MEAN	-	-	-	-	-	-
19B1	01/08/13	< 0.4	1452 ± 104	< 4	< 3	< 29	< 3
	04/02/13	< 0.3	1319 ± 111	< 3	< 2	< 14	< 3
	07/09/13	< 0.2	1397 ± 102	< 4	< 3	< 32	< 6
	10/01/13	< 0.4	1440 ± 103	< 3	< 2	< 42	< 11
	MEAN	-	1402 ± 120	-	-	-	-
25C1	01/08/13	< 0.4	1399 ± 88	< 4	< 4	< 18	< 7
	04/02/13	< 0.3	1377 ± 109	< 3	< 3	< 20	< 3
	07/09/13	< 0.4	1485 ± 96	< 3	< 3	< 17	< 9
	10/01/13	< 0.2	1404 ± 15	< 4	< 4	< 61	< 9
	MEAN	-	1416 ± 95	-	-	-	-

FIGURE D-1
COMPARISON OF MONTHLY TOTAL GROSS BETA CONCENTRATIONS IN DRINKING WATER SAMPLES SPLIT BETWEEN ENV AND TBE, 2013

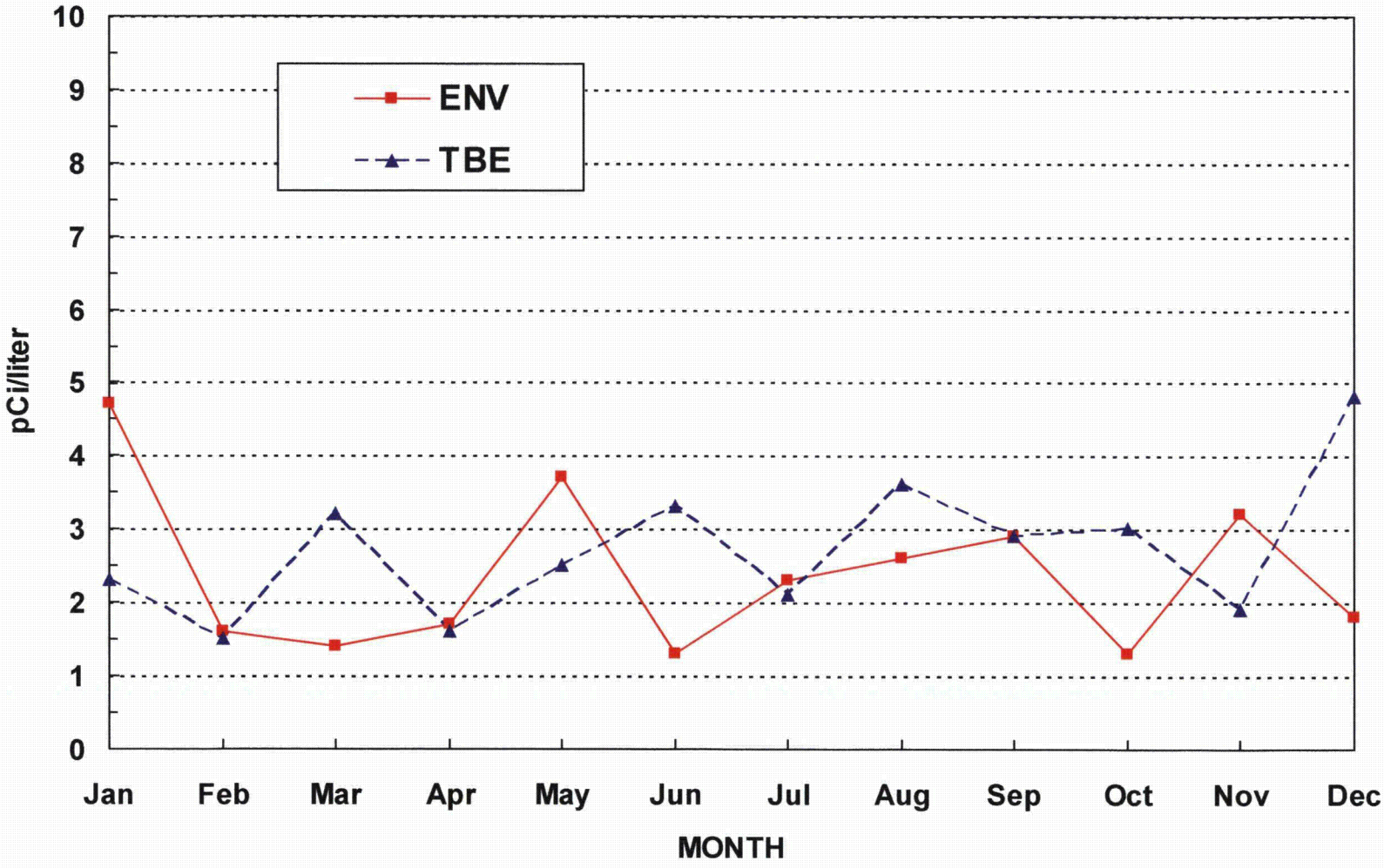
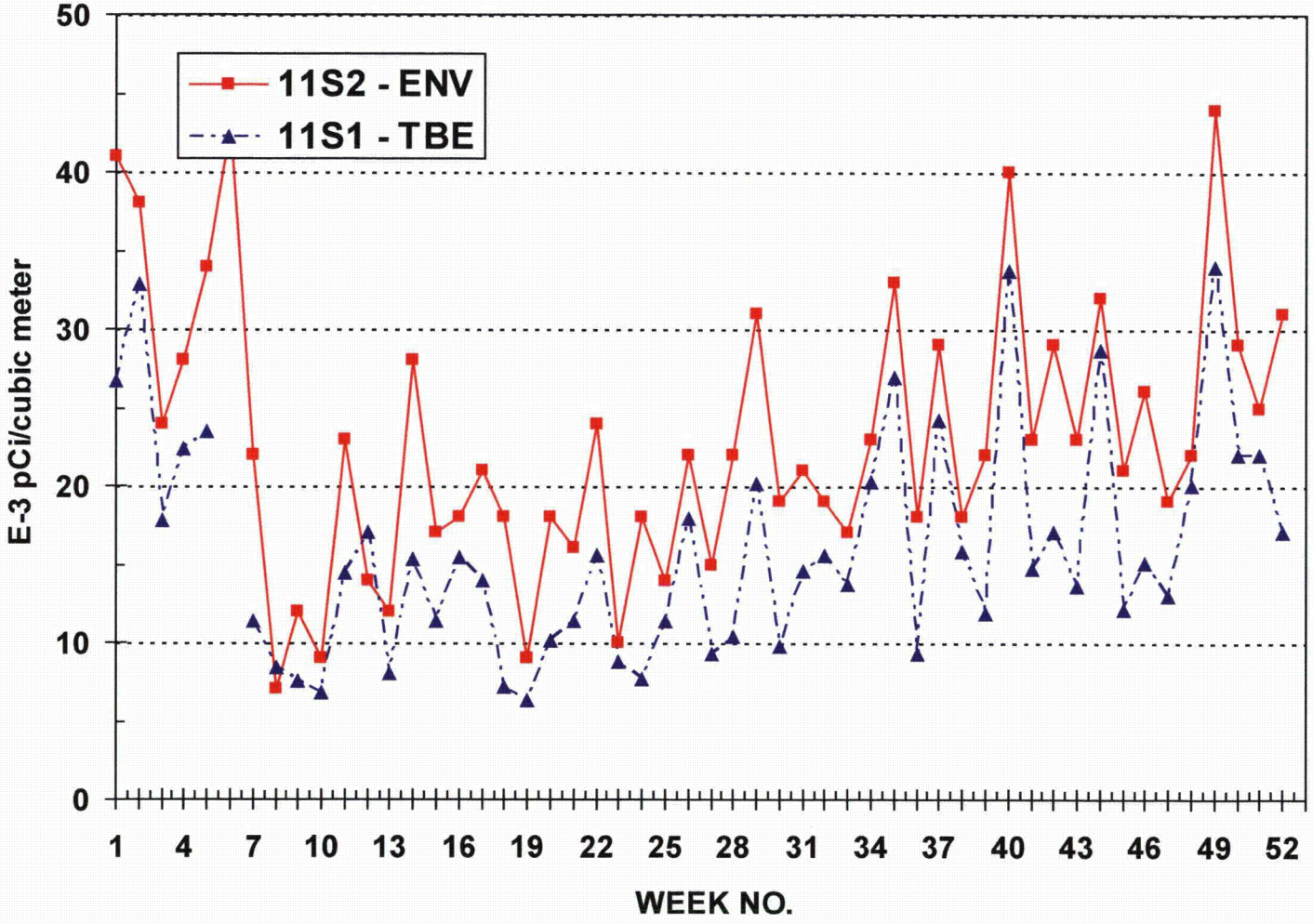


FIGURE D-2
COMPARISON OF WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED FROM LGS COLLOCATED LOCATIONS 11S1 AND 11S2, 2013



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APPENDIX E

INTER-LABORATORY COMPARISON PROGRAM

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TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 1 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2013	E10477	Milk	Sr-89	pCi/L	120	99.7	1.20	A
			Sr-90	pCi/L	9.21	11.0	0.84	A
	E10478	Milk	I-131	pCi/L	87.1	100	0.87	A
			Ce-141	pCi/L	186	187	0.99	A
			Cr-51	pCi/L	463	472	0.98	A
			Cs-134	pCi/L	201	214	0.94	A
			Cs-137	pCi/L	262	266	0.98	A
			Co-58	pCi/L	200	208	0.96	A
			Mn-54	pCi/L	215	208	1.03	A
			Fe-59	pCi/L	266	252	1.06	A
			Zn-65	pCi/L	311	301	1.03	A
			Co-60	pCi/L	384	400	0.96	A
	E10480	AP	Ce-141	pCi	95.3	95.6	1.00	A
			Cr-51	pCi	264	241	1.10	A
			Cs-134	pCi	123	109	1.13	A
			Cs-137	pCi	142	136	1.04	A
			Co-58	pCi	112	106	1.06	A
			Mn-54	pCi	115	106	1.08	A
			Fe-59	pCi	139	129	1.08	A
			Zn-65	pCi	163	153	1.07	A
			Co-60	pCi	212	204	1.04	A
	E10479	Charcoal	I-131	pCi	90.1	92.6	0.97	A
	E10481	Water	Fe-55	pCi/L	1840	1890	0.97	A
June 2013	E10564	Milk	Sr-89	pCi/L	110	95.0	1.16	A
			Sr-90	pCi/L	15.8	17.0	0.93	A
	E10545	Milk	I-131	pCi/L	92.6	95.5	0.97	A
			Ce-141	pCi/L	83.1	90.4	0.92	A
			Cr-51	pCi/L	253	250	1.01	A
			Cs-134	pCi/L	118	125	0.94	A
			Cs-137	pCi/L	143	151	0.95	A
			Co-58	pCi/L	87.1	94.0	0.93	A
			Mn-54	pCi/L	171	172	0.99	A
			Fe-59	pCi/L	125	120	1.04	A
			Zn-65	pCi/L	220	217	1.01	A
			Co-60	pCi/L	169	175	0.97	A
	E10547	AP	Ce-141	pCi	56.8	56.7	1.00	A
			Cr-51	pCi	168	157	1.07	A
			Cs-134	pCi	85.2	78.4	1.09	A
			Cs-137	pCi	101	94.6	1.07	A
			Co-58	pCi	62.7	58.9	1.06	A
			Mn-54	pCi	125	108	1.16	A
			Fe-59	pCi	85.7	75.0	1.14	A
			Zn-65	pCi	169	136	1.24	W
			Co-60	pCi	116	110	1.05	A
	E10546	Charcoal	I-131	pCi	86.5	89.7	0.96	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
June 2013	E10549	Water	Fe-55	pCi/L	1610	1610	1.00	A
September 2013	E10646	Milk	Sr-89	pCi/L	63.9	96.0	0.67	N (1)
			Sr-90	pCi/L	8.88	13.2	0.67	N (1)
	E10647	Milk	I-131	pCi/L	93.9	98.3	0.96	A
			Ce-141	pCi/L				NA (2)
			Cr-51	pCi/L	272	277	0.98	A
			Cs-134	pCi/L	150	172	0.87	A
			Cs-137	pCi/L	125	131	0.95	A
			Co-58	pCi/L	105	108	0.97	A
			Mn-54	pCi/L	138	139	0.99	A
			Fe-59	pCi/L	125	130	0.96	A
			Zn-65	pCi/L	264	266	0.99	A
			Co-60	pCi/L	187	196	0.95	A
	E10672	AP	Ce-141	pCi				NA (2)
			Cr-51	pCi	208	223	0.93	A
			Cs-134	pCi	143	139	1.03	A
			Cs-137	pCi	106	105	1.01	A
			Co-58	pCi	97.0	86.5	1.12	A
			Mn-54	pCi	116	112	1.04	A
			Fe-59	pCi	98.6	105	0.94	A
			Zn-65	pCi	219	214	1.02	A
			Co-60	pCi	166	158	1.05	A
	E10648	Charcoal	I-131	pCi	76.3	71.7	1.06	A
	E10673	Water	Fe-55	pCi/L	1790	1690	1.06	A
December 2013	E10774	Milk	Sr-89	pCi/L	97.3	93.8	1.04	A
			Sr-90	pCi/L	13.3	12.9	1.03	A
	E10775	Milk	I-131	pCi/L	89.7	96.1	0.93	A
			Ce-141	pCi/L	99.8	110	0.91	A
			Cr-51	pCi/L	297	297	1.00	A
			Cs-134	pCi/L	129	142	0.91	A
			Cs-137	pCi/L	126	126	1.00	A
			Co-58	pCi/L	116	112	1.04	A
			Mn-54	pCi/L	167	168	0.99	A
			Fe-59	pCi/L	117	110	1.06	A
			Zn-65	pCi/L	757	741	1.02	A
			Co-60	pCi/L	141	147	0.96	A
	E10777	AP	Ce-141	pCi	85.1	88.0	0.97	A
			Cr-51	pCi	278	238	1.17	A
			Cs-134	pCi	123	114	1.08	A
			Cs-137	pCi	102	101	1.01	A
			Co-58	pCi	84.4	89.9	0.94	A
			Mn-54	pCi	132	135	0.98	A
			Fe-59	pCi	101	88.3	1.14	A
			Zn-65	pCi	506	595	0.85	A
			Co-60	pCi	118	118	1.00	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2013	E10776	Charcoal	I-131	pCi	84.7	80.5	1.05	A
	E10778	Water	Fe-55	pCi/L	2010	1910	1.05	A

(1) Milk, Sr-89/90 - The failure was due to analyst error. No client samples were affected by this failure. NCR 13-15

(2) The sample was not spiked with Ce-141

(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 **ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2013	RAD-93	Water	Sr-89	pCi/L	48.3	41.3	31.6 - 48.4	A
			Sr-90	pCi/L	19.3	23.9	17.2 - 28.0	A
			Ba-133	pCi/L	81.9	82.1	69.0 - 90.3	A
			Cs-134	pCi/L	40.9	42.8	34.2 - 47.1	A
			Cs-137	pCi/L	44.0	41.7	37.0 - 48.8	A
			Co-60	pCi/L	61.9	65.9	59.3 - 75.0	A
			Zn-65	pCi/L	202	189	170 - 222	A
			Gr-A	pCi/L	34.2	40.8	21.1 - 51.9	A
			Gr-B	pCi/L	18.0	21.6	13.0 - 29.7	A
			I-131	pCi/L	23.8	23.8	19.7 - 28.3	A
			U-Nat	pCi/L	60.4	61.2	49.8 - 67.9	A
			H-3	pCi/L	3970	4050	3450 - 4460	A
	MRAD-18	Filter	Gr-A	pCi/filter	Lost during processing			
November 2013	RAD-95	Water	Sr-89	pCi/L	25.5	21.9	14.4 - 28.2	A
			Sr-90	pCi/L	14.3	18.1	12.8 - 21.5	A
			Ba-133	pCi/L	57.2	54.2	44.7 - 59.9	A
			Cs-134	pCi/L	83.3	86.7	71.1 - 95.4	A
			Cs-137	pCi/L	201	206	185 - 228	A
			Co-60	pCi/L	104	102	91.8 - 114	A
			Zn-65	pCi/L	361	333	300 - 389	A
			Gr-A	pCi/L	29.5	42.8	22.2 - 54.3	A
			Gr-B	pCi/L	30.1	32.2	20.8 - 39.9	A
			I-131	pCi/L	23.1	23.6	19.6 - 28.0	A
			U-Nat	pCi/L	5.53	6.24	47.0 - 7.44	A
			H-3	pCi/L	17650	17700	15500 - 19500	A
	MRAD-19	Filter	Gr-A	pCi/filter	33.0	83.0	27.8 - 129	A

(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-3 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2013	13-MaW28	Water	Cs-134	Bq/L	21.0	24.4	17.1 - 31.7	A
			Cs-137	Bq/L	0.0446		(1)	A
			Co-57	Bq/L	28.3	30.9	21.6 - 40.2	A
			Co-60	Bq/L	18.2	19.56	13.69 - 25.43	A
			H-3	Bq/L	506	507	355 - 659	A
			Mn-54	Bq/L	25.7	27.4	19.2 - 35.6	A
			K-40	Bq/L	2.09		(1)	A
			Sr-90	Bq/L	10.5	10.5	7.4 - 13.7	A
			Zn-65	Bq/L	29.2	30.4	21.3 - 39.5	A
	13-GrW28	Water	Gr-A	Bq/L	2.74	2.31	0.69 - 3.93	A
			Gr-B	Bq/L	15.6	13.0	6.5 - 19.5	A
	13-MaS28	Soil	Cs-134	Bq/kg	859	887	621 - 1153	A
			Cs-137	Bq/kg	633	587	411 - 763	A
			Co-57	Bq/kg	0.256		(1)	A
			Co-60	Bq/kg	738	691	484 - 898	A
			Mn-54	Bq/kg	0.671		(1)	A
			K-40	Bq/kg	714	625.3	437.7 - 812.9	A
			Sr-90	Bq/kg	442	628	440 - 816	W
			Zn-65	Bq/kg	1057	995	697 - 1294	A
	13-RdF28	AP	Cs-134	Bq/sample	1.73	1.78	1.25 - 2.31	A
			Cs-137	Bq/sample	2.73	2.60	1.82 - 3.38	A
			Co-57	Bq/sample	2.38	2.36	1.65 - 3.07	A
			Co-60	Bq/sample	0.0302		(1)	A
			Mn-54	Bq/sample	4.36	4.26	2.98 - 5.54	A
			Sr-90	Bq/sample	1.43	1.49	1.04 - 1.94	A
			Zn-65	Bq/sample	3.14	3.13	2.19 - 4.07	A
	13-GrF28	AP	Gr-A	Bq/sample	0.767	1.20	0.36 - 2.04	A
			Gr-B	Bq/sample	0.871	0.85	0.43 - 1.28	A
	13-RdV28	Vegetation	Cs-134	Bq/sample	-0.197		(1)	A
			Cs-137	Bq/sample	7.39	6.87	4.81 - 8.93	A
			Co-57	Bq/sample	9.87	8.68	6.08 - 11.28	A
			Co-60	Bq/sample	6.08	5.85	4.10 - 7.61	A
			Mn-54	Bq/sample	-0.0104		(1)	A
			Sr-90	Bq/sample	1.28	1.64	1.15 - 2.13	W
			Zn-65	Bq/sample	6.84	6.25	4.38 - 8.13	A
September 2013	13-MaW29	Water	Cs-134	Bq/L	29.1	30.0	21.0 - 39.0	A
			Cs-137	Bq/L	34.5	31.6	22.1 - 41.1	A
			Co-57	Bq/L	0.0358		(1)	A
			Co-60	Bq/L	24.6	23.58	16.51 - 30.65	A
			H-3	Bq/L	2.45		(1)	A
			Mn-54	Bq/L	0.0337		(1)	A
			K-40	Bq/L	0.193		(1)	A
			Sr-90	Bq/L	9.12	7.22	5.05 - 9.39	W
			Zn-65	Bq/L	38.1	34.6	24.2 - 45.0	A
	13-GrW29	Water	Gr-A	Bq/L	1.13	0.701	0.210 - 1.192	A
			Gr-B	Bq/L	7.61	5.94	2.97 - 8.91	A

TABLE E-3 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING, 2013
(PAGE 2 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2013	13-MaS29	Soil	Cs-134	Bq/kg	1150	1172	820 - 1524	A
			Cs-137	Bq/kg	1100	977	684 - 1270	A
			Co-57	Bq/kg	670		(1)	N (2)
			Co-60	Bq/kg	502	451	316 - 586	A
			Mn-54	Bq/kg	758	674	472 - 876	A
			K-40	Bq/kg	796	633	443 - 823	W
			Sr-90	Bq/kg	664	460	322 - 598	N (2)
			Zn-65	Bq/kg	210		(1)	N (2)
	13-RdF29	AP	Cs-134	Bq/sample	-0.570		(1)	N (2)
			Cs-137	Bq/sample	2.85	2.7	1.9 - 3.5	A
			Co-57	Bq/sample	3.30	3.4	2.4 - 4.4	A
			Co-60	Bq/sample	2.41	2.3	1.6 - 3.0	A
			Mn-54	Bq/sample	3.65	3.5	2.5 - 4.6	A
			Sr-90	Bq/sample	1.40	1.81	1.27 - 2.35	W
			Zn-65	Bq/sample	2.90	2.7	1.9 - 3.5	A
	13-GrF29	AP	Gr-A	Bq/sample	0.872	0.9	0.3 - 1.5	A
			Gr-B	Bq/sample	1.57	1.63	0.82 - 2.45	A
	13-RdV29	Vegetation	Cs-134	Bq/sample	5.29	5.20	3.64 - 6.76	A
			Cs-137	Bq/sample	7.48	6.60	4.62 - 8.58	A
			Co-57	Bq/sample	0.0129		(1)	A
			Co-60	Bq/sample	0.0523		(1)	A
			Mn-54	Bq/sample	8.78	7.88	5.52 - 10.24	A
			Sr-90	Bq/sample	1.63	2.32	1.62 - 3.02	W (2)
			Zn-65	Bq/sample	3.18	2.63	1.84 - 3.42	W

(1) False positive test.

(2) Soil, Co-57 & Zn-65 identified by gamma software as not detected, MAPEP evaluated as failing the false positive test. A large concentration of Eu-152 was spiked into the sample, causing interference in the analysis. Gamma software recognized the interference and identified them as not detected. MAPEP does not allow clients to enter non-detect designation. NCR 13-04

Soil, Sr-90 - incorrect results were submitted to MAPEP. Actual result was 332 bq/kg, which is within the acceptance range. NCR 13-04

AP, Cs-134 - MAPEP evaluated the -0.570 as a failed false positive test. No client samples were affected by these failures. NCR 13-04

Vegetation, Sr-90 - it appears that the carrier was double spiked into the sample, resulting in the low activity for this sample. NCR 13-04

(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-4 **ERA (a) STATISTICAL SUMMARY PROFICIENCY TESTING PROGRAM[a]**
ENVIRONMENTAL, INC., 2013

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result (b)	ERA Result (c)	Control Limits	Acceptance
ERW-1593	04/08/13	Sr-89	43.6 ± 4.3	41.30	31.6 - 48.4	Pass
ERW-1593	04/08/13	Sr-90	23.2 ± 1.7	23.90	17.2 - 28.0	Pass
ERW-1596	04/08/13	Ba-133	74.80 4.00	82.10	69.00 90.30	Pass
ERW-1596	04/08/13	Co-60	65.50 3.42	65.90	59.30 75.00	Pass
ERW-1596	04/08/13	Cs-134	41.10 3.47	42.80	34.20 47.10	Pass
ERW-1596	04/08/13	Cs-137	42.30 4.03	41.70	37.00 48.80	Pass
ERW-1596	04/08/13	Zn-65	200.3 ± 10.1	189.0	170.0 - 222.0	Pass
ERW-1598	04/08/13	Gr. Alpha	34.30 1.98	40.80	21.10 51.90	Pass
ERW-1598	04/08/13	Gr. Beta	18.70 0.98	21.60	13.00 29.70	Pass
ERW-1600	04/08/13	I-131	23.00 ± 1.10	23.80	19.70 - 28.30	Pass
ERW-1600	04/08/13	I-131(G)	23.48 ± 9.44	23.80	19.70 ± 28.30	Pass
ERW-1606	04/08/13	H-3	4041 ± 194	4050	3450 - 4460	Pass
ERW-6009	10/07/13	Sr-89	22.00 2.80	21.90	14.40 28.20	Pass
ERW-6009	10/07/13	Sr-90	17.10 2.55	18.10	12.80 21.50	Pass
ERW-6012	10/07/13	Ba-133	48.20 4.29	54.20	44.70 59.90	Pass
ERW-6012	10/07/13	Co-60	100.8 ± 4.7	102.0	91.8 - 114.0	Pass
ERW-6012	10/07/13	Cs-134	87.30 4.35	86.70	71.10 95.40	Pass
ERW-6012	10/07/13	Cs-137	199.6 ± 7.4	206.0	185.0 - 228.0	Pass
ERW-6012	10/07/13	Zn-65	356.2 ± 13.2	333.0	300.0 - 389.0	Pass
ERW-6015	10/07/13	Gr. Alpha	30.70 11.90	42.80	22.20 54.30	Pass
ERW-6015	10/07/13	Gr. Beta	25.70 6.48	32.20	20.80 39.90	Pass
ERW-6019	10/07/13	I-131	22.50 1.01	23.60	19.60 28.00	Pass
ERW-6024	10/07/13	H-3	18397 695	17700	15500 19500	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., 2013
(Page 1 of 2)

			Concentration (a)			
Lab Code (b)	Date	Analysis	Laboratory result	Known Activity	Control Limits (c)	Acceptance
MAAP-738	02/01/13	Co-57	2.58 ± 0.06	2.36	1.65 - 3.07	Pass
MAAP-738	02/01/13	Co-60	0.01 ± 0.03	0.00	0.00 - 0.10	Pass
MAAP-738	02/01/13	Cs-134	1.82 ± 0.13	1.78	1.25 - 2.31	Pass
MAAP-738	02/01/13	Cs-137	2.93 ± 0.10	2.60	1.82 - 3.38	Pass
MAAP-738	02/01/13	Mn-54	4.87 ± 0.13	4.26	2.98 - 5.54	Pass
MAAP-738	02/01/13	Sr-90	1.39 ± 0.14	1.49	1.04 - 1.94	Pass
MAAP-738	02/01/13	Zn-65	3.84 ± 0.20	3.13	2.19 - 4.07	Pass
MAAP-738 d	02/01/13	Gr. Alpha	0.14 ± 0.03	1.20	0.36 - 2.04	Fail (1)
MAAP-738	02/01/13	Gr. Beta	0.93 ± 0.06	0.85	0.43 - 1.28	Pass
MAW-806	02/01/13	Co-57	31.20 0.40	30.90	21.60 40.20	Pass
MAW-806	02/01/13	Co-60	19.70 ± 0.30	16.56	13.69 - 25.43	Pass
MAW-806	02/01/13	Cs-134	23.20 ± 0.50	24.40	17.10 - 31.70	Pass
MAW-806	02/01/13	Cs-137	0.03 ± 0.12	0.00	0.00 - 1.00	Pass
MAW-806	02/01/13	Fe-55	34.00 ± 3.30	44.00	30.80 - 57.20	Pass
MAW-806	02/01/13	H-3	511.60 ± 12.50	507.00	355.00 - 659.00	Pass
MAW-806	02/01/13	K-40	2.20 ± 0.90	0.00	0.00 - 5.00	Pass
MAW-806	02/01/13	Mn-54	27.60 ± 0.50	27.40	19.20 - 35.60	Pass
MAW-806	02/01/13	Sr-90	9.30 ± 0.80	10.50	7.40 - 13.70	Pass
MAW-806	02/01/13	Zn-65	31.60 ± 0.80	30.40	21.30 - 39.50	Pass
MAW-811	02/01/13	Gr. Alpha	1.87 ± 0.09	2.31	0.69 - 3.93	Pass
MAW-811	02/01/13	Gr. Beta	13.04 ± 0.13	13.00	6.50 - 19.50	Pass
MASO-739	02/01/13	Co-57	0.60 ± 0.50	0.00	0.00 - 5.00	Pass
MASO-739	02/01/13	Co-60	739.20 ± 28.50	691.00	484.00 - 898.00	Pass
MASO-739	02/01/13	Cs-134	863.30 ± 34.10	887.00	621.00 - 1153.00	Pass
MASO-739	02/01/13	Cs-137	661.80 ± 25.70	587.00	411.00 - 763.00	Pass
MASO-739	02/01/13	K-40	745.80 ± 33.30	625.30	437.70 - 812.90	Pass
MASO-739	02/01/13	Mn-54	1.10 ± 1.00	0.00	0.00 - 5.00	Pass
MASO-739	02/01/13	Zn-65	1109.60 ± 44.10	995.00	697.00 - 1294.00	Pass
MASO-744 e	02/01/13	Sr-90	408.40 ± 14.00	628.00	440.00 - 816.00	Fail (2)
MAVE-747	02/01/13	Co-57	10.37 ± 0.17	8.68	6.08 - 11.28	Pass
MAVE-747	02/01/13	Co-60	6.48 ± 0.17	5.85	4.10 - 7.61	Pass
MAVE-747	02/01/13	Cs-134	0.02 ± 0.04	0.00	0.00 - 0.10	Pass
MAVE-747	02/01/13	Cs-137	7.79 ± 0.21	6.87	4.81 - 8.93	Pass
MAVE-747	02/01/13	Mn-54	0.00 ± 0.05	0.00	0.00 - 0.10	Pass
MAVE-747	02/01/13	Zn-65	7.29 ± 0.33	6.25	4.38 - 8.13	Pass
MASO-5043 f	08/01/13	Co-57	699.60 ± 3.90	0.00	0.00 - 5.00	Fail (3)
MASO-5043	08/01/13	Cs-134	1191.70 ± 23.00	1172.00	820.00 - 1524.00	Pass
MASO-5043	08/01/13	Cs-137	1072.00 ± 5.10	977.00	684.00 - 1270.00	Pass
MASO-5043	08/01/13	K-40	760.00 ± 16.20	633.00	443.00 - 823.00	Pass
MASO-5043	08/01/13	Mn-54	753.80 ± 4.90	674.00	472.000 - 876.000	Pass

TABLE E-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
ENVIRONMENTAL, INC., 2013
(Page 2 of 2)

			Concentration (a)			
Lab Code (b)	Date	Analysis	Laboratory result	Known Activity	Control Limits (c)	Acceptance
MASO-5043	08/01/13	Sr-90	383.90 ± 14.50	460.00	322.00 - 598.00	Pass
MASO-5043	08/01/13	Zn-65	-351.50 ± 5.50	0.00	0.00 - 0.00	Pass
MAW-5094	08/01/13	Co-57	0.01 ± 0.09	0.00	0.00 - 5.00	Pass
MAW-5094	08/01/13	Co-60	23.20 ± 0.32	23.58	16.51 - 30.65	Pass
MAW-5094	08/01/13	Cs-134	27.60 ± 0.58	30.40	21.00 - 39.00	Pass
MAW-5094	08/01/13	Cs-137	32.31 ± 0.52	31.60	22.10 - 41.10	Pass
MAW-5094	08/01/13	Fe-55	39.20 ± 3.50	53.30	37.30 - 69.30	Pass
MAW-5094	08/01/13	Gr. Alpha	0.54 ± 0.05	0.70	0.21 - 1.19	Pass
MAW-5094	08/01/13	Gr. Beta	5.85 ± 0.09	5.94	2.97 - 8.91	Pass
MAW-5094	08/01/13	H-3	1.20 ± 3.00	0.00	0.00 - 5.00	Pass
MAW-5094	08/01/13	K-40	2.22 ± 0.90	0.00	0.00 - 5.00	Pass
MAW-5094	08/01/13	Mn-54	0.010 ± 0.11	0.00	0.00 - 5.00	Pass
MAW-5094	08/01/13	Sr-90	6.40 ± 0.60	7.22	5.05 - 9.39	Pass
MAW-5094	08/01/13	Zn-65	35.30 ± 0.90	34.60	24.20 - 45.00	Pass
MAVE-5046	08/01/13	Co-57	0.01 ± 0.03	0.00	0.00 - 0.00	Pass
MAVE-5046	08/01/13	Co-60	0.00 ± 0.04	0.00	0.00 - 0.00	Pass
MAVE-5046	08/01/13	Cs-134	5.71 ± 0.23	5.20	3.64 - 6.76	Pass
MAVE-5046	08/01/13	Cs-137	7.64 ± 0.20	6.60	4.62 - 8.58	Pass
MAVE-5046	08/01/13	Mn-54	9.08 ± 0.24	7.88	5.52 - 10.24	Pass
MAVE-5046	08/01/13	Zn-65	2.92 ± 0.25	2.63	1.84 - 3.42	Pass
MAAP-5046	08/01/13	Co-57	3.48 ± 0.14	3.40	1.90 - 3.50	Pass
MAAP-5046	08/01/13	Co-60	2.44 ± 0.08	3.40	1.60 - 3.00	Pass
MAAP-5046	08/01/13	Cs-134	0.01 ± 0.03	0.00	0.02 - 0.04	Pass
MAAP-5046	08/01/13	Cs-137	3.09 ± 0.13	2.70	1.90 - 3.50	Pass
MAAP-5046	08/01/13	Gr. Alpha	0.28 ± 0.04	0.90	0.27 - 1.53	Pass
MAAP-5046	08/01/13	Gr. Beta	1.90 ± 0.08	1.63	0.82 - 2.45	Pass
MAAP-5046	08/01/13	Mn-54	3.95 ± 0.12	3.50	2.50 - 4.60	Pass
MAAP-5046	08/01/13	Sr-90	1.69 ± 4.10	1.81	1.27 - 2.35	Pass
MAAP-5046	08/01/13	Zn-65	3.27 ± 0.18	2.70	2.50 - 4.60	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.

(1) The filter was recounted overnight, no significant alpha activity could be detected.

(2) The sample was reanalyzed using additional fuming nitric separations. Result of reanalysis: 574.4 ± 35.2 Bq/kg.

(3) Interference from Eu-152 resulted in misidentification of Co-57.

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APPENDIX F

ERRATA DATA

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Due to an incorrect setting on gamma detector 08, 3.29 rather than 4.66 was used in the MDC calculation. Nonconformance 13-07 was initiated and corrective actions have been implemented to address this issue. All samples counted on detector 08 were reprocessed using the correct calculation. As a result, all MDCs for these samples have increased by 41.6%. The previously reported activities and uncertainties were not affected. In some cases, the increased MDC resulted in missed LLDs. All samples with MDCs affected by this issue are listed below. The samples with missed LLDs are shown in the table for 2012, and 2013. All other required LLDs were met.

2012

CLIENT ID	START DATE	END DATE	MATRIX	NUCLIDE	REQUIRED MDC	REVISED MDC	UNITS
16C2	12/27/11	01/31/12	Drinking Water	*	*	*	*
15F4	02/28/12	04/02/12	Drinking Water	*	*	*	*
25C1	03/13/12	03/13/12	Milk	*	*	*	*
15F4	04/02/12	04/30/12	Drinking Water	I-131	<15	<15.98	pCi/L
15F4	04/02/12	04/30/12	Drinking Water	La-140	<15	<18.2	pCi/L
10F4	04/03/12	04/03/12	Milk	*	*	*	*
MW-LR-3	04/24/12		RGPP	*	*	*	*
SW-LR-4	04/25/12		RGPP	*	*	*	*
25C1	05/29/12	05/29/12	Milk	*	*	*	*
28F3	05/29/12	07/02/12	Drinking Water	*	*	*	*
11S3 (Collards)	06/13/12	06/13/12	Vegetation	*	*	*	*
3Q12 22G1	07/01/12	10/01/12	Air Particulate	*	*	*	*
11S3 (Swiss Chard)	07/17/12		Vegetation	*	*	*	*
23F1	08/07/12	08/07/12	Milk	*	*	*	*
11S3 (Swiss Chard)	08/07/12		Vegetation	*	*	*	*
31G1 (Squash Leaves)	08/07/12		Vegetation	*	*	*	*
10F4	08/21/12	08/21/12	Milk	*	*	*	*
15F4	08/28/12	10/02/12	Drinking Water	*	*	*	*
31G1 (Zucchini Leaves)	09/05/12	09/05/12	Vegetation	*	*	*	*
23F1	09/18/12	09/18/12	Milk	*	*	*	*
4Q12 13C1	10/01/12	12/31/12	Air Particulate	*	*	*	*
13S3 (Collards)	10/09/12	10/09/12	Vegetation	I-131	<60	<71.69	pCi/kg Wet
13S3 (Zucchini Leaves)	10/09/12	10/09/12	Vegetation	I-131	<60	<84.89	pCi/kg Wet
11S3 (Swiss Chard)	10/09/12	10/09/12	Vegetation	*	*	*	*
31G1 (Kale)	10/09/12	10/09/12	Vegetation	*	*	*	*
13B1	10/29/12	12/04/12	Surface Water	*	*	*	*
15F7	10/29/12	12/04/12	Drinking Water	*	*	*	*
25C1	11/27/12	11/27/12	Milk	*	*	*	*
16C2	12/04/12	12/31/12	Drinking Water	*	*	*	*
23F1	12/11/12	12/11/12	Milk	*	*	*	*

* Required LLDs were achieved

2013

CLIENT ID	START DATE	END DATE	MATRIX	NUCLIDE	REQUIRED MDC	REVISED MDC	UNITS
15F4	12/31/12	01/29/13	Drinking Water	I-131	<15	<15.45	pCi/L
18E1	01/08/13	01/08/13	Milk	*	*	*	*
15F4	01/29/13	02/26/13	Drinking Water	*	*	*	*

* Required LLDs were achieved

Correction to 2010 ARERR
Total body and organ dose for liquid releases were recalculated due to a software error identified (IR 1613017). Due to the software error, dose calculations were being performed without the inclusion of the Schuylkill River dilution factor as required by the ODCM dose methodology. The corrected data in this section includes the dose calculations post dilution and the updated 40 CFR 190 Compliance table. No limits have been exceeded.

Correction to 2011 ARERR
Total body and organ dose for liquid releases were recalculated due to a software error identified (IR 1613017). Due to the software error, dose calculations were being performed without the inclusion of the Schuylkill River dilution factor as required by the ODCM dose methodology. The corrected data in this section includes the dose calculations post dilution and the updated 40 CFR 190 Compliance table. No limits have been exceeded.

Correction to 2012 ARERR
Total body and organ dose for liquid releases were recalculated due to a software error identified (IR 1613017). Due to the software error, dose calculations were being performed without the inclusion of the Schuylkill River dilution factor as required by the ODCM dose methodology. The corrected data in this section includes the dose calculations post dilution and the updated 40 CFR 190 Compliance table. No limits have been exceeded.

I. Summary and Conclusion

Gaseous and liquid radiation doses to members of the public at locations							
Effluent	**Applicable Organ**	**Estimated Dose**	**Age Group**	**Location**	**% of Applicable Limit**	**Limit**	**Unit**
Noble Gas	Gamma - Air Dose	4.04E-03	All	Nearest Residence	2.00E-02	20	mRad
Noble Gas	Beta – Air Dose	2.40E-03	All	Nearest Residence	6.00E-03	40	mRad
Noble Gas	Total Body (Gamma)	3.83E-03	All	Nearest Residence	3.80E-02	10	mrem
Noble Gas	Skin (Beta)	6.39E-03	All	Nearest Residence	2.10E-02	30	mrem
Iodine, Particulate & Tritium	Bone	2.06E-01	Child	Cow Milk	6.87E-01	30	mrem
Liquid	Total Body	1.25E-03	Child	Phoenixville, Pa	2.08E-02	6	mrem
Liquid	Liver	1.40E-03	Child	Phoenixville, Pa	7.00E-03	20	mrem

40 CFR 190 Compliance								
	Gaseous Effluents							
	Noble Gas	**Particulate, Iodone, C-14 & Tritium**	**Liquid Effluents**	**Direct Radiation**	**Total**	**% of Applicable Limit**	**Limit**	**Unit**
Total Body Dose	3.84E-03	4.25E-02	1.25E-03	0.00E+00	4.76E-02	1.90E-01	25	mrem
Organ Dose	3.84E-03	2.06E-01	1.40E-03	0.00E+00	2.11E-01	8.44E-01	25	mrem
Thryoid Dose	3.84E-03	4.25E-02	1.18E-03	0.00E+00	4.75E-02	6.33E-02	75	mrem

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

I. Summary and Conclusion

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	1.46E-02	All	Nearest Residence	7.28E-02	20	mRad
Noble Gas	Beta – Air Dose	8.73E-03	All	Nearest Residence	2.18E-02	40	mRad
Noble Gas	Total Body (Gamma)	1.39E-02	All	Nearest Residence	1.39E-02	10	mrem
Noble Gas	Skin (Beta)	2.30E-02	All	Nearest Residence	7.67E-02	30	mrem
Iodine, Particulate, Tritium & C-14	Bone	4.13E-01	Child	Cow Milk	1.38E-00	30	mrem
Liquid	Total Body	5.28E-04	Child	LGS Outfall	8.80E-03	6	mrem
Liquid	GI-Lli	6.00E-04	Child	LGS Outfall	3.00E-03	20	mrem

40 CFR 190 Compliance								
	Gaseous Effluents		**Liquid Effluents**	**Net Direct Radiation**	**Total**	**% of Applicable Limit**	**Limit**	**Unit**
	Noble Gas	**Particulate, Iodone, C-14 & Tritium**						
Total Body Dose	1.39E-02	8.26E-02	5.28E-04	0.00E+00	9.70E-02	3.88E-01	25	mrem
Organ Dose	1.39E-02	4.13E-01	6.00E-04	0.00E+00	4.28E-01	1.71E+00	25	mrem
Thyroid Dose	1.39E-02	8.26E-02	4.77E-04	0.00E+00	9.70E-02	1.29E-01	75	mrem

I. Summary and Conclusions

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	4.69E-03	All	Nearest Residence	2.35E-02	20	mRad
Noble Gas	Beta – Air Dose	3.02E-03	All	Nearest Residence	7.55E-03	40	mRad
Noble Gas	Total Body (Gamma)	4.45E-03	All	Nearest Residence	4.45E-02	10	mrem
Noble Gas	Skin (Beta)	7.47E-03	All	Nearest Residence	2.49E-02	30	mrem
Iodine, Particulate, Tritium & C-14	Bone	6.28E-01	Child	Vegetation	2.09E-00	30	mrem
Liquid	Total Body	9.79E-04	Adult	LGS Outfall	1.63E-02	6	mrem
Liquid	Liver	1.10E-03	Adult	LGS Outfall	5.50E-03	20	mrem

40 CFR 190 Compliance:

The maximum calculated dose to a real individual would not exceed 2.14E-01 mrem (total body), 7.15E-01 mrem (organ), or 2.14 E-01 mrem (thyroid).

All doses calculated were well 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, Iodone, C-14 & Tritium**						
Total Body Dose	4.45E-03	1.27E-01	9.79E-04	0.00E+00	1.32E-01	5.28E-01	25	mrem
Organ Dose	4.45E-03	6.28E-01	1.10E-03	0.00E+00	6.34E-01	2.54E-00	25	mrem
Thryoid Dose	4.45E-03	1.27E-01	7.98E-04	0.00E+00	1.32E-01	1.76E-01	75	mrem

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APPENDIX G

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

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Docket No: 50-352
50-353

LIMERICK GENERATING STATION
UNITS 1 and 2

Annual Radiological
Groundwater Protection Program
Report

1 January Through 31 December 2013

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

April 2014

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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 2013 through 31 December 2013. During that time period, 391 analyses were performed on 136 samples from 13 groundwater, 7 surface water and 4 precipitation water locations collected from the environment, both on and off station property in 2013.

In 2012 there was one known release into the groundwater at the Limerick Generating Station that occurred from an over flow of the cooling tower blowdown line during a radioactive waste tank release. The flow path of the water traveled over a road and into Possum Hollow Creek. One well (LM-MW-5) located in the travel path showed a tritium value as high as 14,200 pCi/L. In 2013, only one of five samples analyzed for tritium was positive at a concentration of 183 pCi/l.

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 three of the thirteen groundwater monitoring locations. All surface water tritium sample 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 8 of 12 groundwater locations sampled. Gross alpha (suspended) was detected at 3 of 12 groundwater locations sampled. Gross beta (dissolved) was detected at 11 of 12 groundwater locations sampled. Gross beta (suspended) was detected at 6 of 12 groundwater locations.

Groundwater and surface water was analyzed for gamma emitting radionuclides associated with the licensed plant operation. All gamma isotopic results were less than the MDA.

Precipitation water samples were analyzed for tritium. All tritium results met the Exelon specified LLD of 200 pCi/L.

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.

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 2013.

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 2013. Sample locations can be found in Table A–1, Appendix A.

1. Sample Collection

Groundwater and Surface Water

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.

Precipitation

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 describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the Limerick Generating Station RGPP in 2013.

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.

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 thirteen locations were analyzed for tritium activity (Appendix B, Table B–I.1). Tritium values ranged from non detectable to 477 pCi/L. Although no drinking water pathway is available from groundwater, the theoretical dose via the drinking water pathway was calculated at 0.03 mrem to a child (total body), which represents 0.47% of the 10 CFR 50, Appendix I dose limit of 6 mrem.

Strontium

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

Gross Alpha and Gross Beta (dissolved and suspended)

All samples were analyzed for gross alpha and gross beta in the dissolved and suspended fractions during all quarters in 2013. Gross alpha (dissolved) was detected in 8 of 12 groundwater locations sampled. The concentrations ranged from 1.1 to 4.0 pCi/L. Gross alpha (suspended) was detected in 3 of 12 groundwater locations sampled. The concentrations ranged from 1.7 to 3.6 pCi/L. Gross beta (dissolved) was detected in 11 of 12 groundwater locations sampled. The concentrations ranged from 2.4 to 23.0 pCi/L. Gross beta (suspended) was detected in 6 of 12 groundwater locations sampled. The concentrations ranged from 1.6 to 10.1 pCi/L (Appendix B, Table B-I.1).

Gamma Emitters

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

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. Tritium activity was not detected in any surface water samples analyzed (Appendix B, Table B-II.1).

Strontium

No Sr-89 or Sr-90 activity was detected in any surface water samples analyzed (Appendix B, Table B–II.1).

Gamma Emitters

Potassium-40 was detected at one surface water location with a concentration of 82 pCi/L. No other gamma emitting nuclides were detected (Appendix B, Table B–II.2).

C. Precipitation Sample Results

Tritium

No tritium activity was detected in any precipitation water samples analyzed. (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 2004 (personal communication with Station, 2006). The pump was placed at a depth of approximately 294 feet bgs. The total well depth and the depth of the steel casing are unknown. The well is located approximately 175 feet east of the Reactor Building. The Station estimates that the well is pumped at approximately 2 gpm. 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 ground containing radioactive material in 2013. However, during the first quarter and fourth quarter of 2013, tritiated water was identified leaking from the expansion joints of the Unit 1 Turbine Building condenser bay. The water was contained and disposed of via the normal radioactive waste processing system. No elevated tritium results were observed in the monitoring wells or the Power Block Foundation Sump in 2013.

G. Trends

No trends were identified.

H. Investigations

Conclusions from the Phase 1 report have been made available to state and federal regulators and to the public. Currently no investigations are on going.

I. Actions Taken

1. Compensatory Actions

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

2. Installation of Monitoring Wells

   No new wells were installed in 2013

3. Actions to Recover/Reverse Plumes

   No actions were required to recover or reverse groundwater plumes.

V. References

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

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

APPENDIX A

LOCATION DESIGNATION

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TABLE A-1: Radiological Groundwater Protection Program – Sampling Locations for the Limerick Generating Station, 2013

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
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

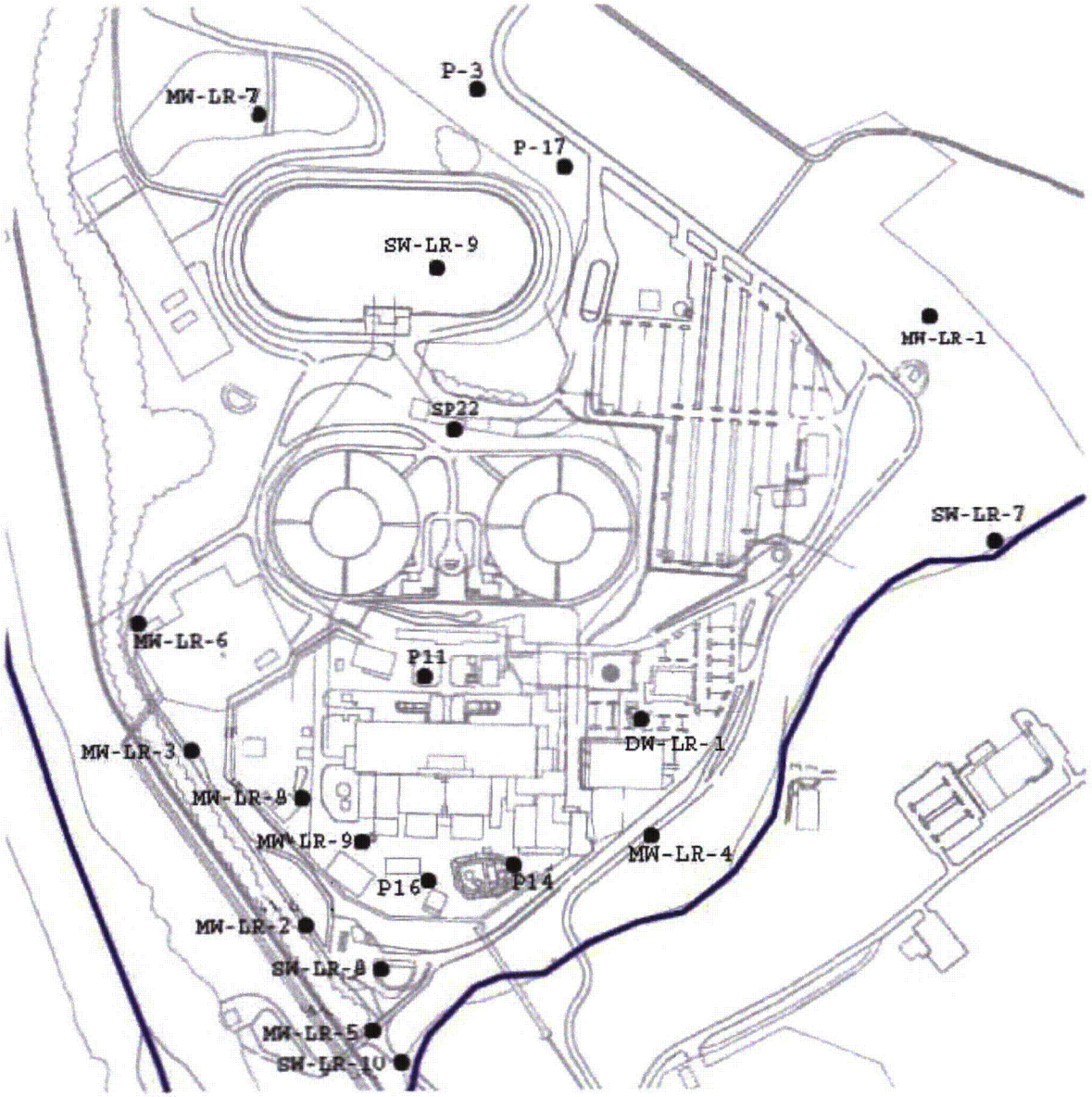

Figure 1 Routine Well Water, Surface Water and Precipitation Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2013.

Figure 1 Routine Well Water, Surface Water and Precipitation Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2013.

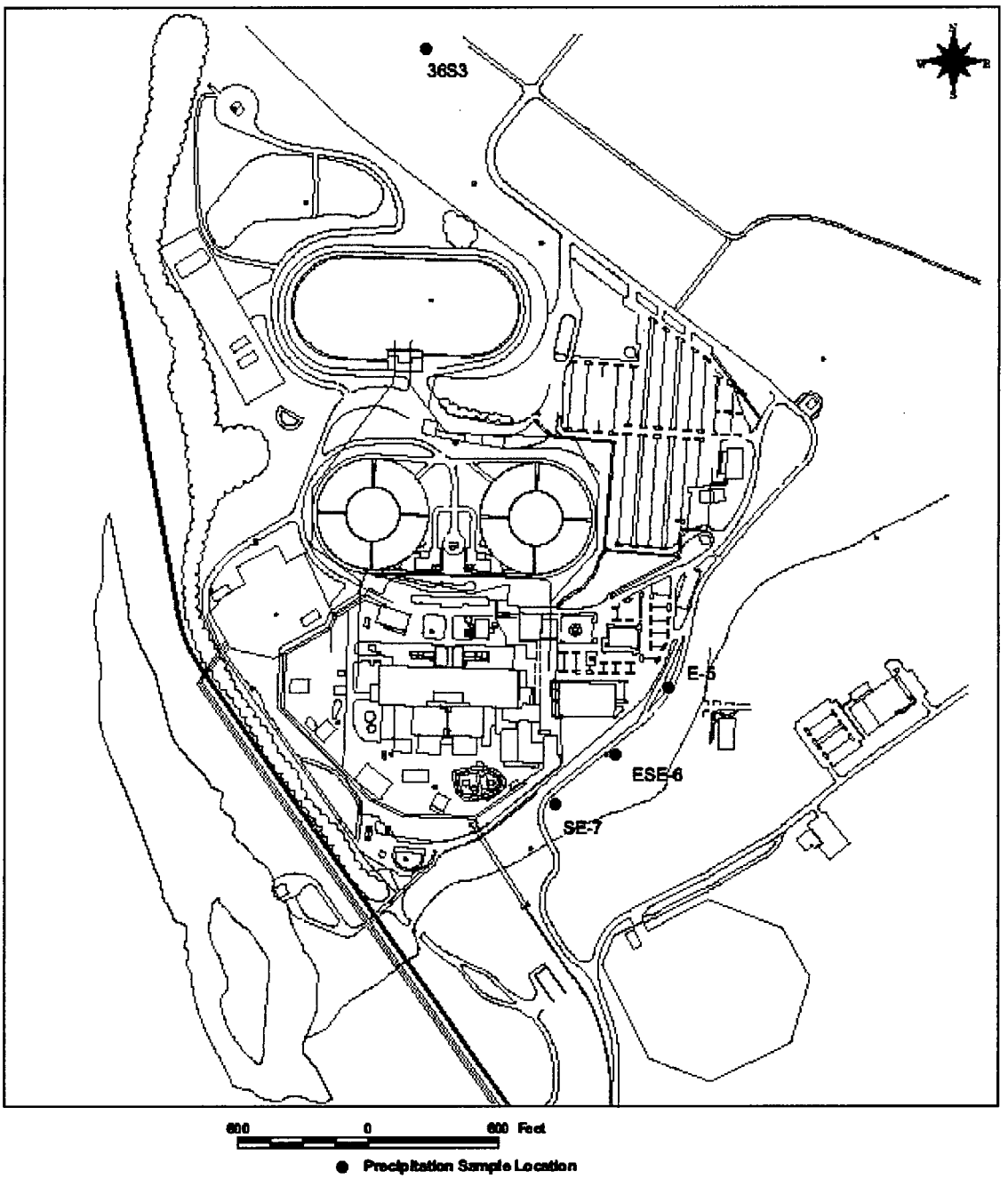

Figure 1 Routine Well Water, Surface Water and Precipitation Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2013.

APPENDIX B

DATA TABLES

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TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2013

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	05/07/13		< 178	< 7.9	< 0.6	2.7 ± 0.9	< 0.5	2.4 ± 1.0	< 1.5
DW-LR-1	07/30/13		< 193			1.8 ± 0.7	< 0.4	2.4 ± 1.0	< 1.6
DW-LR-1	11/07/13		< 161			4.0 ± 1.2	< 0.5	< 2.0	< 1.5
MW-LR-1	05/09/13		< 163	< 7.5	< 0.5	< 2.3	< 0.6	10.4 ± 1.7	< 1.6
MW-LR-2	01/15/13		< 171			1.2 ± 0.7	1.7 ± 0.9	3.2 ± 1.1	< 1.8
MW-LR-2	05/09/13		< 184	< 8.0	< 0.4	< 0.9	< 0.9	2.7 ± 1.0	< 1.6
MW-LR-2	07/30/13		< 185			1.5 ± 0.8	< 0.4	2.7 ± 1.0	< 1.4
MW-LR-2	11/06/13		< 170			< 1.1	< 0.8	3.5 ± 1.1	2.1 ± 1.0
MW-LR-3	01/15/13		< 176			2.2 ± 0.9	< 0.8	3.7 ± 1.2	< 1.8
MW-LR-3	05/09/13		< 186	< 8.5	< 0.5	< 0.9	< 0.9	3.4 ± 1.1	< 1.6
MW-LR-3	07/31/13		< 194			1.6 ± 0.9	< 0.4	3.5 ± 1.1	< 1.4
MW-LR-3	11/06/13		< 170			< 1.1	< 0.8	4.2 ± 1.1	< 1.4
MW-LR-4	01/15/13		< 180			< 1.2	< 0.8	4.7 ± 1.2	< 1.8
MW-LR-4	05/09/13		< 184	< 7.8	< 0.5	< 1.5	< 0.9	4.2 ± 1.2	< 1.6
MW-LR-4	07/30/13		< 193			< 1.7	< 0.4	3.8 ± 1.2	< 1.4
MW-LR-4	11/05/13		< 169			2.2 ± 1.3	< 0.8	5.4 ± 1.2	< 1.4
MW-LR-5	01/15/13		< 181			1.1 ± 0.7	< 0.4	7.0 ± 1.2	< 1.6
MW-LR-5	04/12/13		183 ± 119						
MW-LR-5	05/09/13		< 169	< 7.7	< 0.4	1.1 ± 0.7	< 0.9	5.0 ± 1.0	< 1.6
MW-LR-5	07/30/13		< 183			1.2 ± 0.6	< 0.4	4.5 ± 0.9	< 1.4
MW-LR-5	11/05/13		< 172			1.9 ± 0.8	< 0.8	5.9 ± 1.2	< 1.4
MW-LR-7	01/16/13		< 175			< 0.5	< 0.4	3.5 ± 0.8	< 1.6
MW-LR-7	05/09/13		< 175	< 8.4	< 0.5	< 1.2	< 0.9	< 1.6	< 1.6
MW-LR-7	07/31/13		< 191			< 0.6	< 0.4	3.8 ± 0.8	< 1.4
MW-LR-7	11/06/13		< 165			< 1.0	< 0.5	2.9 ± 1.2	< 1.7
MW-LR-8	01/15/13	TBE	< 175			< 1.4	< 0.4	2.6 ± 1.2	< 1.6
MW-LR-8	01/15/13	TBE	< 176			< 1.6	2.2 ± 0.9	4.1 ± 1.3	2.9 ± 1.3
MW-LR-8	01/15/13	EIML	366 ± 87						
MW-LR-8	01/30/13		< 176						
MW-LR-8	05/07/13	TBE	279 ± 115	< 8.8	< 0.6	< 1.6	< 0.8	5.0 ± 1.2	< 1.5
MW-LR-8	05/07/13	TBE	286 ± 121	< 8.7	< 0.6	2.3 ± 1.0	< 1.0	6.3 ± 1.2	< 1.6
MW-LR-8	05/07/13	EIML	228 ± 82	< 0.6	< 0.6				
MW-LR-8	07/30/13	TBE	319 ± 136			3.5 ± 1.4	< 0.4	3.8 ± 1.2	< 1.6
MW-LR-8	07/30/13	TBE	477 ± 142			1.9 ± 1.2	< 0.4	3.5 ± 1.2	< 1.6
MW-LR-8	07/30/13	EIML	376 ± 95						
MW-LR-8	11/05/13	TBE	226 ± 112			< 1.5	< 0.9	3.6 ± 1.2	< 1.7
MW-LR-8	11/05/13	TBE	248 ± 113			1.4 ± 0.8	< 0.5	3.1 ± 1.1	< 1.7
MW-LR-8	11/05/13	EIML	289 ± 99						
MW-LR-8	11/20/13		< 187						
MW-LR-8	12/27/13		234 ± 128						
MW-LR-9	01/15/13	TBE	181 ± 119			1.7 ± 0.8	< 0.6	6.3 ± 1.1	< 1.5
MW-LR-9	01/15/13	TBE	246 ± 121			< 0.8	< 0.7	6.1 ± 1.1	6.7 ± 1.5
MW-LR-9	01/15/13	EIML	352 ± 86						
MW-LR-9	01/30/13		240 ± 120						
MW-LR-9	05/07/13	TBE	< 162	< 6.6	< 0.5	1.5 ± 0.9	< 0.9	7.3 ± 1.2	3.6 ± 1.3
MW-LR-9	05/07/13	TBE	< 178	< 9.5	< 0.6	< 0.6	< 0.5	2.8 ± 0.9	< 1.5
MW-LR-9	05/07/13	EIML	< 144	< 0.8	< 0.7				
MW-LR-9	07/30/13	TBE	247 ± 132			2.5 ± 0.8	< 0.4	6.4 ± 1.1	< 1.6
MW-LR-9	07/30/13	TBE	255 ± 131			2.1 ± 0.9	< 0.4	5.0 ± 1.1	< 1.6
MW-LR-9	07/30/13	EIML	298 ± 91						
MW-LR-9	11/05/13	TBE	267 ± 114			1.4 ± 0.8	< 0.9	6.6 ± 1.1	< 1.7

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, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	SR-89	SR-90	GR-A (DIS)	GR-A (SUS)	GR-B (DIS)	GR-B (SUS)
MW-LR-9	11/05/13	TBE	223 ± 114			< 0.9	< 0.5	7.2 ± 1.2	< 1.7
MW-LR-9	11/05/13	EIML	349 ± 101						
MW-LR-9	12/27/13		355 ± 136						
P-11	01/15/13		< 182			< 2.6	< 0.6	19.8 ± 2.0	< 1.5
P-11	05/07/13		< 174	< 8.8	< 0.6	< 2.7	< 0.5	13.9 ± 1.9	1.6 ± 1.0
P-11	07/30/13		< 196			1.9 ± 1.1	< 0.4	14.9 ± 1.6	< 1.6
P-11	11/05/13		< 163			< 1.6	< 0.5	23.0 ± 1.8	< 1.7
P-14	01/15/13		< 177			< 2.8	< 0.6	4.2 ± 1.4	< 1.5
P-14	05/07/13		< 177	< 8.8	< 0.7	< 1.3	< 2.3	< 1.7	9.2 ± 2.0
P-14	07/30/13		< 198			< 3.0	< 2.4	2.4 ± 1.4	4.4 ± 1.4
P-14	11/05/13		< 164			< 2.6	3.6 ± 1.5	3.0 ± 1.4	10.1 ± 1.9
P-16	01/15/13		< 173						
P-17	05/09/13		< 175	< 6.9	< 0.7	< 1.3	< 0.5	< 1.7	1.7 ± 1.0

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2013**

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	05/07/13	< 36	< 58	< 3	< 4	< 7	< 4	< 6	< 4	< 6	< 14	< 3	< 4	< 29	< 7
MW-LR-1	05/09/13	< 41	< 81	< 5	< 4	< 10	< 3	< 7	< 5	< 9	< 15	< 4	< 4	< 35	< 11
MW-LR-2	05/09/13	< 32	< 55	< 3	< 3	< 6	< 3	< 6	< 4	< 7	< 10	< 3	< 3	< 22	< 7
MW-LR-3	05/09/13	< 47	< 85	< 4	< 5	< 9	< 5	< 11	< 4	< 8	< 13	< 4	< 5	< 32	< 8
MW-LR-4	05/09/13	< 38	< 45	< 4	< 4	< 10	< 4	< 9	< 4	< 8	< 12	< 4	< 4	< 30	< 11
MW-LR-5	05/09/13	< 35	< 72	< 4	< 3	< 8	< 4	< 7	< 4	< 7	< 11	< 3	< 4	< 23	< 8
MW-LR-7	05/09/13	< 49	< 55	< 5	< 6	< 14	< 6	< 12	< 5	< 8	< 14	< 5	< 5	< 34	< 10
MW-LR-8	05/07/13 TBE	< 30	< 28	< 3	< 4	< 8	< 3	< 5	< 3	< 6	< 13	< 3	< 3	< 28	< 7
MW-LR-8	05/07/13 TBE	< 39	< 74	< 4	< 4	< 9	< 4	< 7	< 4	< 7	< 14	< 4	< 4	< 29	< 9
MW-LR-8	05/07/13 EIML	< 18	< 55	< 2	< 2	< 7	< 3	< 6	< 4	< 5	< 6	< 4	< 4	< 15	< 2
MW-LR-9	05/07/13 TBE	< 29	< 25	< 3	< 3	< 7	< 3	< 6	< 3	< 6	< 13	< 3	< 3	< 25	< 9
MW-LR-9	05/07/13 TBE	< 39	< 32	< 4	< 4	< 9	< 4	< 6	< 5	< 7	< 14	< 3	< 4	< 32	< 9
MW-LR-9	05/07/13 EIML	< 25	< 54	< 2	< 3	< 3	< 3	< 7	< 3	< 4	< 5	< 2	< 2	< 15	< 3
P-11	05/07/13	< 35	< 64	< 3	< 3	< 9	< 4	< 7	< 4	< 7	< 14	< 3	< 4	< 29	< 8
P-14	05/07/13	< 32	< 24	< 3	< 3	< 7	< 3	< 5	< 4	< 6	< 14	< 3	< 3	< 26	< 7
P-17	05/09/13	< 33	< 25	< 4	< 3	< 7	< 4	< 6	< 4	< 6	< 11	< 3	< 4	< 21	< 7

TABLE B-II.1 **CONCENTRATIONS OF TRITIUM, STRONTIUM-89 AND STRONTIUM-90 IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	SR-89	SR-90
SW-LR-10	01/16/13	< 175		
SW-LR-10	05/06/13	< 178	< 9.4	< 0.6
SW-LR-10	07/29/13	< 193		
SW-LR-10	11/04/13	< 163		
SW-LR-2	01/16/13	< 175		
SW-LR-2	05/08/13	< 178	< 7.6	< 0.7
SW-LR-2	07/29/13	< 192		
SW-LR-2	11/04/13	< 162		
SW-LR-4	01/16/13	< 176		
SW-LR-4	05/06/13	< 173	< 7.7	< 0.6
SW-LR-4	07/29/13	< 196		
SW-LR-4	11/04/13	< 163		
SW-LR-6	01/16/13	< 180		
SW-LR-6	05/06/13	< 180	< 7.6	< 0.6
SW-LR-6	07/29/13	< 195		
SW-LR-6	11/04/13	< 162		
SW-LR-7	01/16/13	< 177		
SW-LR-7	05/06/13	< 176	< 7.5	< 0.7
SW-LR-7	07/29/13	< 191		
SW-LR-7	11/04/13	< 166		
SW-LR-8	01/16/13	< 180		
SW-LR-8	05/08/13	< 177	< 8.6	< 0.8
SW-LR-8	07/29/13	< 193		
SW-LR-8	11/06/13	< 160		
SW-LR-9	01/15/13	< 170		
SW-LR-9	05/09/13	< 179	< 7.9	< 0.6
SW-LR-9	07/29/13	< 188		
SW-LR-9	11/05/13	< 160		

TABLE B-II.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2013**

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-10	05/06/13	< 30	< 57	< 3	< 3	< 7	< 3	< 5	< 3	< 6	< 14	< 3	< 3	< 27	< 7
SW-LR-2	05/08/13	< 31	< 52	< 3	< 3	< 7	< 3	< 6	< 3	< 6	< 10	< 3	< 3	< 23	< 7
SW-LR-4	05/06/13	< 34	< 29	< 3	< 4	< 8	< 4	< 7	< 4	< 7	< 15	< 3	< 4	< 30	< 7
SW-LR-6	05/06/13	< 33	82 ± 41	< 3	< 4	< 8	< 3	< 7	< 3	< 6	< 13	< 3	< 4	< 27	< 8
SW-LR-7	05/06/13	< 29	< 22	< 3	< 3	< 6	< 2	< 6	< 3	< 5	< 13	< 3	< 3	< 22	< 7
SW-LR-8	05/08/13	< 32	< 31	< 3	< 3	< 8	< 3	< 6	< 3	< 6	< 13	< 3	< 3	< 23	< 8
SW-LR-9	05/09/13	< 36	< 36	< 4	< 4	< 9	< 4	< 7	< 3	< 7	< 14	< 4	< 4	< 30	< 9

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2013

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
36S3	01/30/13	< 165
36S3	02/26/13	< 198
36S3	03/25/13	< 163
36S3	04/30/13	< 185
36S3	05/29/13	< 183
36S3	06/26/13	< 179
36S3	08/02/13	< 183
36S3	08/28/13	< 192
36S3	09/25/13	< 197
36S3	11/25/13	< 189
36S3	11/25/13	< 182
E-5	01/30/13	< 167
E-5	02/26/13	< 195
E-5	03/25/13	< 180
E-5	04/30/13	< 179
E-5	05/29/13	< 183
E-5	06/26/13	< 184
E-5	08/02/13	< 180
E-5	08/28/13	< 194
E-5	09/25/13	< 196
E-5	11/25/13	< 157
E-5	11/25/13	< 183
ESE-6	01/30/13	< 166
ESE-6	02/26/13	< 200
ESE-6	03/25/13	< 177
ESE-6	04/30/13	< 182
ESE-6	05/29/13	< 183
ESE-6	06/26/13	< 178
ESE-6	08/02/13	< 178
ESE-6	08/28/13	< 195
ESE-6	09/25/13	< 197
ESE-6	11/25/13	< 192
ESE-6	11/25/13	< 183
SE-7	01/30/13	< 177
SE-7	02/26/13	< 197
SE-7	03/25/13	< 160
SE-7	04/30/13	< 181
SE-7	05/29/13	< 182
SE-7	06/26/13	< 179
SE-7	08/02/13	< 175
SE-7	08/28/13	< 179
SE-7	09/25/13	< 196
SE-7	11/25/13	< 191
SE-7	11/25/13	< 184