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Exelon Nuclear

TS 6.9.1.7

April 27, 2010

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: 2009 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 2009 Annual Radiological Environmental Operating Report No. 25. This report provides the 2009 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, we have 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 15 groundwater monitoring locations that ranged up to 1,750 pCi/L.

There are no commitments contained in this letter.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Christopher H. Mudrick
Vice President -LGS
Exelon Generation Company, LLC

Attachment: 2009 Annual Radiological Environmental Operating Report No. 25

cc: S. Collins, Administrator, Region I, USNRC (w/Attachment)
E. DiPaolo, USNRC Senior Resident Inspector, LGS (w/Attachment)
P. Bamford -Senior Project Manager-NRR, USNRC (w/Attachment)
T. Moslak, Inspector, Region I, USNRC (w/Attachment)

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LIMERICK GENERATING STATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
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Docket No: 50 – 352
50 – 353

LIMERICK GENERATING STATION
UNITS 1 and 2

Annual Radiological
Environmental Operating Report

Report No. 25

1 January Through 31 December 2009

Prepared By

Teledyne Brown Engineering
Environmental Services

Exelon
Nuclear

Limerick Generating Station
Sanatoga, PA 19464

April 2010

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Appendices

Figures

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I. Summary and Conclusions

In 2009, the Limerick Generating Station released to the environment through the radioactive effluent liquid and gaseous pathways approximately 28 curies of noble gas, fission and activation products and approximately 56 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 locations								
Effluent	**Applicable Organ**	**Estimated Dose**	**Age Group**	**Location**		**% of Applicable Limit**	**Limit**	**Unit**
				Distance (meters)	**Direction (toward)**			
Noble Gas	**Gamma - Air Dose**	2.17E-03	All	1004	ESE	0.011	**20**	**mRad**
Noble Gas	**Beta – Air Dose**	1.27E-03	All	1004	ESE	0.003	**40**	**mRad**
Noble Gas	**Total Body (Gamma)**	2.06E-03	All	1004	ESE	0.021	**10**	**mrem**
Noble Gas	**Skin (Beta)**	3.42E-03	All	1004	ESE	0.011	**30**	**mrem**
Iodine, Particulate & Tritium	Lung	6.06E-04	Teen	1004	ESE	0.002	**30**	**mrem**
Liquid	Total Body	7.75E-01	Child	Aqua PA		12.917	6	**mrem**
Liquid	Liver	7.75E-01	Child	Aqua PA		3.875	20	**mrem**

The calculated doses, as a result of 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 2009 through 31 December 2009. During that time period, 1088 analyses were performed on 887 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. 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 Plant produced fission or activation products were found in sediment. The calculated dose to a teenager's skin and whole body was 4.36E-04 mrem and 3.74E-04 mrem, respectively. This dose represents 2.18E-03% and 6.23E-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. 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. No activation or fission products were detected.

Environmental gamma radiation measurements were performed quarterly using thermoluminescent dosimeters. Levels detected were consistent with those observed in previous years.

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.

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

A radiological groundwater protection program (RGPP) was established in 2006 as part of an Exelon Nuclear fleetwide assessment of potential groundwater intrusion from the operation of the Station. Well water samples were analyzed for tritium, Sr-90 and gamma emitters. Additionally, a select group of wells had hard-to-detect nuclides and gross alpha and gross beta analyses performed. Most tritium values were less than the lower limit of detection of 200 pCi/L.

However, one well located near the Unit 1 Condensate Storage Tank had a tritium value as high as 1,750 pCi/L. This activity was due to a leak from the exterior walls of both U1 and U2 condenser bays. The condensation was observed dripping directly to open ground and asphalt. Water samples were collected and analyzed for gamma isotopic and tritium. No gamma emitting nuclides were identified; however, tritium was identified at a concentration of 3.90E-3 uCi/ml. Although no drinking water pathway exist, the dose from drinking the water from the well containing 1,750 pCi/L tritium was calculated at 0.18 mrem to a child (total body), which was 3.02% of the 10 CFR 50, Appendix I dose limit. All results for Sr-90 and gamma emitting nuclides were less than MDC.

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 3,458 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), Global Dosimetry, and Environmental Inc. (Midwest Labs) on samples collected during the period 1 January 2009 through 31 December 2009.

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 cast 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 2009. 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 continuous samplers located at three surface water locations (10F2, 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, catfish/bullhead (bottom feeder) and sunfish (predator), 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 five locations (10S3, 11S1, 13C1, 14S1, and 22G1). The control location was 22G1. Airborne iodine and particulate samples were obtained at each location, using a vacuum pump with charcoal and glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The filters were replaced weekly and sent to the laboratory for analysis.

Milk samples were collected biweekly at five locations (10F4, 18E1, 19B1, 23F1, and 25C1) from April through November, and monthly from December through March. Two additional locations (25E1 and 36E1) were 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. Eight different kinds of vegetation samples were collected and placed in new unused plastic bags, and sent to the laboratory for analysis.

Ambient Gamma Radiation

Direct radiation measurements were made using Panasonic 814 calcium sulfate ($CaSO_4$) thermoluminescent dosimeters (TLD). The TLD 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 TLD 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 TLDs – each comprised of three $CaSO_4$ thermoluminescent phosphors enclosed in plastic – were placed at each location in a PVC conduit located approximately three feet above ground level. The TLDs were exchanged quarterly and sent to Global Dosimetry for analysis.

10CFR20.2002 Permit Storage Area

The results of the surface water sampling program were used to determine if radioactive nuclide transport from the storage area into the Schuylkill River had occurred.

Independent Spent Fuel Storage Installation (ISFSI)

The results from the TLD 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 2009. The analytical procedures used by the laboratories are listed in 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 and milk.
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) was 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 was 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 were designed to achieve the required LGS detection limits for environmental sample analysis.

The minimum detectable concentration (MDC) was 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 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 and broad leaf vegetation 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 2009 the LGS REMP had a sample recovery rate in excess of 99%. Exceptions are listed below:

1. Air sample from location 14S1 for the week 3/3/09 – 3/9/09

was not available due to equipment malfunction (IR 00893287).

2. Air sample from location 11S2 for the week 4/20/09 – 4/27/09 was not available due to equipment malfunction (IR 00915359).

3. Air sample from location 10S3 for the week 5/18/09 – 5/26/09 was not available due to equipment malfunction (IR 00925392).

4. Air samples from location 11S1 for the week 7/6/09 – 7/13/09 and 07/20/09 – 07/27/09 were not available due to equipment malfunction (IR 00944071).

5. Air sample results from location 11S2 for the week of 8/3/09 – 8/10/09 were not available due to the loss of sample during processing.

6. Grab samples were taken for the composite surface water sampler at location 13B1 during the following periods due to equipment malfunction or frozen sample line:

   02/01/09 – 02/18/09

   03/01/09 – 03/14/09

   03/29/09 – 04/04/09

   05/17/09 – 05/23/09

   08/30/09 – 09/05/09

   10/11/09 – 10/17/09

7. A grab sample was taken for the composite surface water sampler at location 24S1 during the week of 02/01/09 – 02/07/09 due to equipment malfunction.

8. Grab samples were taken for the composite drinking water sampler at location 16C2 during the following periods due to equipment malfunction:

   03/22/09 – 03/28/09

   12/20/09 – 01/02/10

9. Only two broad leaf vegetation samples were collected at Station 11S3 during the month of September. Collards were not available.

10. Milk sample stations 23F1 and 25C1 showed positive I-131 activity on 11/03/09. The elevated activity can be attributed to a naturally occurring isotope that was not completely separated from the sample. The activity is considered to be a false positive data point (IR 01039780).

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 power outages 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. Milk farm Station 25E1 went out of business in 2009.
2. Surface water Station 10F2 was shut down until further notice. This location is sampled only when LGS draws water from the Delaware River for cooling purposes.

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 (Table C–I.1, Appendix C). All results were less than the MDC.

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C–I.2, Appendix C). All nuclides were less than the MDC.

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 (Tables C–II.1, Appendix C). The values ranged

from 2.3 to 7.4 pCi/L. Concentrations detected were consistent with those detected in previous years (Figure C–1, Appendix C).

Tritium

Monthly samples from all locations were composited quarterly and analyzed for tritium activity (Table C–II.2, Appendix C). One of 16 samples had a value of 168 pCi/L, which is less than the required 200 pCi/L LLD requirement. All other results were less than the MDC.

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C–II.3, Appendix C). All nuclides were less than the MDC.

3. Fish

Fish samples comprised of catfish/bullhead (bottom feeder) and sunfish (predator) 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 (Table C–III.1, Appendix C). Naturally occurring K-40 was found at all stations and ranged from 2,220 to 4,350 pCi/kg wet and was consistent with levels detected in previous years. No other gamma emitting nuclides were found. Historical levels of Cs-137 are shown in Figure C–2, Appendix C.

4. Sediment

Aquatic sediment samples were collected at three locations (16B2, 16C4 and 33A2) semiannually. Of these locations two, 16B2 and 16C4, located downstream, 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 (Table C–IV.1, Appendix C). Nuclides detected were naturally occurring Be-7, K-40 and the fission product Cs-137.

Beryllium-7 was found at locations 16B2 and 16C4 and ranged from 1,660 to 1,990 pCi/kg dry. Potassium-40 was found at all locations and ranged from 11,800 to 17,800 pCi/kg dry. The fission product Cs-137 was found at all locations and ranged from 83 to

166 pCi/kg dry. The Cs-137 activity found at16B2 and 16C4 is attributed to LGS radioactive effluent releases. The dose to a teenager's skin and whole body was conservatively calculated at 4.36E-04 mrem and 3.74E-04 mrem, respectively. This dose represents 2.18E-03% and 6.23E-03%, of the Appendix I to 10 CFR Part 50 dose limits, respectively. The activity detected was consistent with those detected in the pre–operational years. (Figure C–4, Appendix C). No other Limerick fission or activation products were found.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from five locations on a weekly basis. The five locations were separated into three groups: Group I represents locations within the LGS site boundary (10S3, 11S1, and 14S1), Group II represents the location at an intermediate distance from the LGS site (13C1), 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 (Table C–V.1 and C–V.2, Appendix C).

Detectable gross beta activity was observed at all locations. The results from the On-Site locations (Group I) ranged from 8 E–3 to 29 E–3 pCi/m^3 with a mean of 15.8 E–3 pCi/m^3. The results from the Intermediate Distance location (Group II) ranged from 8 E–3 to 34 E–3 pCi/m^3 with a mean of 16.3 E–3 pCi/m^3. The results from the Distant locations (Group III) ranged from 8 E–3 to 31 E–3 pCi/m^3 with a mean of 15.9 E–3 pCi/m^3. Comparison of the 2009 air particulate data with previous year's data indicate no effects from the operation of LGS (Figure C–4, Appendix C). In addition, a comparison of the weekly mean values for 2009 indicate no notable differences among the three groups (Figure C–5, Appendix C).

Gamma Spectrometry

Weekly samples were composited quarterly and analyzed for gamma emitting nuclides (Table C–V.3, Appendix C).

Naturally occurring Be-7 due to cosmic ray activity was detected in all samples. These values ranged from 55 E–3 to 125 E–3 pCi/m^3. All other nuclides were less than the MDC.

b. Airborne Iodine

Continuous air samples were collected from five locations (10S3, 11S1, 14S1, 13C1, and 22G1) and analyzed weekly for I-131 (Table C–VI.1, Appendix C). All results were less than the MDC.

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 (Table C–VII.1, Appendix C). All results were less than the MDC.

Gamma Spectrometry

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

Naturally occurring K-40 activity was found in all samples and ranged from 1,090 to 1,620 pCi/L. All other nuclides were less than the MDC.

b. Broad Leaf Vegetation

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

Gamma Spectrometry

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

Cosmogenic Be-7 was found in 15 of 20 samples and ranged from 157 to 3,000 pCi/kg wet. Naturally occurring K-40 was

found in all samples and ranged from 2,650 to 10,300 pCi/kg wet. All other nuclides were less than the MDC.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing Panasonic 814 ($CaSO_4$) thermoluminescent dosimeters. Forty TLD locations were established around the site. Results of TLD measurements are listed in Tables C–IX.1 to C–IX.3, Appendix C.

Most TLD measurements were below 10 mR/standard month, with a range of 4.8 to 11.5 mR/standard month. A comparison of the Site Boundary and Intermediate Distance data to the Control Location data, indicate that the ambient gamma radiation levels from the Control Location 5H1 were consistently higher to all other locations other than 13S2. Location 13S2 historically shows higher ambient gamma radiation, which is assumed due to the rock substrate. The area that this TLD is located in has been determined to emanate radon prodingy.

The historical ambient gamma radiation data from Location 5H1 were plotted along with similar data from the Site, Intermediate Distance and Outer Ring Locations (Figure C–6, Appendix C). Location 5H1 has a historical high bias, but tracked with the data from all three groups. This bias is most likely due to radon emanating from the ground.

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 TLD 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 zero mrem.

F. Land Use Survey

A Land Use Survey conducted in August 2009 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 gardens in the NE and SSE sectors are further away than 2008. 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 miles from the LGS Reactor Buildings			
Sector	Residence Miles	Garden Miles	Milk Farm Miles
1 N	0.6	1.8	4.7
2 NNE	0.5	1.8	-
3 NE	0.7	3.4	-
4 ENE	0.7	2.7	-
5 E	0.6	2.4	-
6 ESE	0.5	0.3	-
7 SE	0.7	0.2	-
8 SSE	1.0	1.3	-
9 S	1.0	1.2	4.2
10 SSW	0.8	1.0	2.0
11 SW	1.0	1.0	-
12 WSW	0.6	2.3	2.7
13 W	0.7	0.8	2.8
14 WNW	0.7	0.7	-
15 NW	0.7	1.6	-
16 NNW	0.7	1.3	-

G. Summary of Results – Inter-laboratory Comparison Program

The primary and secondary laboratories analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation and water matrices for 18 and 14 analytes, respectively (Appendix E). The PE samples, supplied by Analytics Inc., Environmental Resource Associates (ERA) and DOE's 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, NELAC, state specific 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 (i.e., 20% < bias < 30%). If the bias is greater than 30%, the results are deemed not acceptable.

For the primary laboratory, 17 out of 18 analytes met the specified acceptance criteria. One sample did not meet the specified acceptance criteria for the following reason:

1. Teledyne Brown Engineering's Analytics June 2009 Zn-65 in AP result of 137 pCi/L was higher than the known value of 101 pCi/L, resulting in a found to known ratio of 1.36. NCR 09-23 was initiated to investigate this failure. The failure appears to be a result of a slightly high bias on Detector 7. A recount on Detector 17 resulted in a Zn-65 result of 101 pCi/L. The detector has been tagged out-of-service until a recalibration can be performed. Detector 7 is not used for client samples.

For the secondary laboratory, Environmental, Inc., 11 out of 14 analytes met the specified acceptance criteria. Four samples did not meet the specified acceptance criteria for the following reason:

1. Environmental Inc.'s ERA April 2009 Cs-137 in water result of 147.7 pCi/L exceeded the lower control limit of 151.0 pCi/L. All gamma emitters showed a low bias. A large plastic burr found on the base of the Marinelli kept the beaker from sitting directly on the detector. Recounting in a different beaker gave an acceptable result of 155.33 ± 14.55 pCi/L.
2. Environmental Inc.'s ERA April 2009 H-3 in water result of 22,819 pCi/L exceeded the upper control limit of 22,300 pCi/L. A recount of the original vials averaged 23,009 pCi/L. Reanalysis results were acceptable at 19,170 pCi/L. No cause could be found for the failure.

3. Environmental Inc.'s MAPEP January 2009 Sr-90 in AP result of 0.93 exceeded the upper control limit of 0.83. Reanalysis results were acceptable at 0.54 ± 0.12 Bq/filter. No cause could be found for the failure.
4. Environmental Inc.'s MAPEP July 2009 Sr-90 in soil result of 310.5 Bq/kg exceeded the lower control limit of 319 Bq/kg. Reanalysis results were acceptable at 363.3 Bq/kg. Incomplete separation of strontium from calcium could result in a higher recovery percentage and consequently lower reported activity.

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

1. Environmental Report Operating License Stage, Limerick Generating Station, Units 1 and 2, Volumes 1–5 Philadelphia Electric Company.
2. Branch Technical Position Paper, Regulatory Guide 4.8, Revision 1, November 1979.
3. 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

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2009

Name of Facility: LIMERICK GENERATING STATION **DOCKET NUMBER:** 50-352 & 50-353

Location of Facility: MONTGOMERY COUNTY PA **REPORTING PERIOD:** 2009

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

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FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2009

Name of Facility: LIMERICK GENERATING STATION **DOCKET NUMBER: 50-352 & 50-353**

Location of Facility: MONTGOMERY COUNTY PA **REPORTING PERIOD: 2009**

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)	GR-B	48	4	4 (34/36) (2.3/7.4)	3.6 (9/12) (3.0/4.2)	4.2 (12/12) (2.8/6.3)	15F7 INDICATOR PHOENIXVILLE WATER WORKS 6.33 MILES SSE OF SITE	0
	H-3	16	200	168 (1/12)	<LLD	168 (1/4)	15F7 INDICATOR PHOENIXVILLE WATER WORKS 6.33 MILES SSE OF SITE	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
	NB-95		15	<LLD	<LLD	-		0
	ZR-95		30	<LLD	<LLD	-		0
	I-131		15	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0

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Location of Facility: MONTGOMERY COUNTY PA **REPORTING PERIOD:** 2009

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
BOTTOM FEEDER (PCI/KG WET)	GAMMA	4						
	K-40		NA	3575 (2/2) (3310/3840)	3915 (2/2) (3480/4350)	3915 (2/2) (3480/4350)	29C1 CONTROL POTTSTOWN VICINITY UPSTREAM OF INTAKE	0
	MN-54		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0
	FE-59		260	<LLD	<LLD	-		0
	CO-60		130	<LLD	<LLD	-		0
	ZN-65		260	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0
	CS-137		150	<LLD	<LLD	-		0
PREDATOR (PCI/KG WET)	GAMMA	4						
	K-40		NA	3510 (2/2) (3230/3790)	2785 (2/2) (2220/3350)	3510 (2/2) (3230/3790)	16C5 INDICATOR VINCENT POOL DOWNSTREAM OF DISCHARGE	0
	MN-54		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0
	FE-59		260	<LLD	<LLD	-		0
	CO-60		130	<LLD	<LLD	-		0
	ZN-65		260	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0
	CS-137		150	<LLD	<LLD	-		0

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SEDIMENT (PCI/KG DRY)	GAMMA	6						
	BE-7		NA	1840 (3/4) (1660/1990)	<LLD	1870 (1/2)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0
	K-40		NA	16550 (4/4) (15500/17800)	13350 (2/2) (11800/14900)	17200 (2/2) (16600/17800)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0
	MN-54		NA	<LLD	<LLD	-		0
	CO-58		NA	<LLD	<LLD	-		0
	CO-60		NA	<LLD	<LLD	-		0
	I-131		NA	<LLD	<LLD	-		0
	CS-134		150	<LLD	<LLD	-		0
	CS-137		180	128 (4/4) (83/166)	108 (1/2)	153 (2/2) (139/166)	16B2 INDICATOR LINFIELD BRIDGE 1.35 MILES SSE OF SITE	0

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TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE LIMERICK GENERATING STATION, 2009

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AIR PARTICULATE (E-3 PCI/CU.METER)	GR-B	256	10	16 (200/204) (8/34)	16 (51/52) (8/31)	16 (51/52) (8/34)	13C1 INDICATOR KING ROAD 2.84 MILES SE OF SITE	0
	GAMMA	20						
	BE-7		NA	85 (15/16) (55/125)	95 (3/4) (75/116)	95 (3/4) (75/116)	22G1 CONTROL MANOR SUBSTATION 17.73 MILES SW OF SITE	0
	MN-54		NA	<LLD	<LLD	-		0
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	256	70	<LLD	<LLD	-		0

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FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

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MILK (PCI/LITER)	I-131	109	1	<LLD	<LLD	-		0
	GAMMA	109						
	K-40		NA	1252 (84/84) (1090/1450)	1258 (25/25) (1150/1620)	1271 (21/21) (1170/1450)	10F4 INDICATOR 6.60 MILES ESE 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 (PCI/KG WET)	GAMMA	20						
	BE-7		NA	311 (8/11) (157/519)	1283 (7/9) (308/3000)	1283 (7/9) (308/3000)	31G1 CONTROL	0
	K-40		NA	4991 (11/11) (2650/10300)	4980 (9/9) (3430/5940)	8457 (3/3) (5950/10300)	13S3 INDICATOR VINCENT DAM 0.24 MILES SE OF SITE	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
DIRECT RADIATION (MILLI-ROENTGEN/STD.MO.)	TLD-QUARTERLY	160	NA	7.1 (156/156) (4.8/11.5)	8.5 (4/4) (7.9/9.4)	10.8 (4/4) (9.9/11.5)	13S2 INDICATOR 500 KV SUBSTATION 0.41 MILES SE	0

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FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

APPENDIX B

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

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 : 0-1 mile off-site
B : 1-2 miles off-site
C : 2-3 miles off-site
D : 3-4 miles off-site
E : 4-5 miles off-site
F : 5-10 miles off-site
G : 10-20 miles off-site
H : 20-100 miles 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, 2009

Location	Location Description	Distance & Direction From Site
A.	Surface Water	
13B1	Vincent Dam (indicator)	1.75 miles SE
24S1	Limerick Intake (control)	0.20 miles SW
10F2	Perkiomen Pumping Station (control)	7.25 miles E
B.	Drinking (Potable) Water	
15F4	Philadelphia Suburban Water Company (indicator)	8.62 miles SE
15F7	Phoenixville Water Works (indicator)	6.33 miles SSE
16C2	Citizens Home Water Company (indicator)	2.66 miles SSE
28F3	Pottstown Water Authority (control)	5.84 miles WNW
C.	Milk - bi-weekly / monthly	
10F4		6.60 miles ESE
18E1		4.21 miles S
19B1		1.95 miles SSW
23F1	Control	5.02 miles SW
25C1		2.69 miles WSW
D.	Milk - quarterly	
25E1		4.27 miles WSW
36E1	Control	4.70 miles N
E.	Air Particulates / Air Iodine	
10S3	Keen Road	0.50 miles E
11S1	LGS Information Center	0.38 miles ESE
11S2	LGS Information Center	0.38 miles ESE
13C1	King Road	2.84 miles SE
14S1	Longview Road	0.63 miles SSE
22G1	Manor Substation (control)	17.73 miles SW
F.	Fish	
16C5	Vincent Pool (indicator)	Downstream of Discharge
29C1	Pottstown Vicinity (control)	Upstream of Intake
G.	Sediment	
16B2	Linfield Bridge (indicator)	1.35 miles SSE
16C4	Vincent Dam (indicator)	2.18 miles SSE
33A2	Upstream of Intake (control)	0.84 miles NNW
H.	Broad Leaf Vegetation	
11S3	LGS Information Center	0.35 miles ESE
13S3	LGS 500 KV Yard	0.24 miles SE
31G1	Prout's Jollyview Farm	13.6 miles NW

TABLE B-2: Radioiogical Environmental Monitoring Program - Sampling Locations, Distance and Direction, Limerick Generating Station, 2009

Location	Location Description	Distance & Direction From Site
H.	Environmental Dosimetry - TLD	
Site Boundary		
36S2	Evergreen & Sanatoga Road	0.60 miles N
3S1	Sanatoga Road	0.44 miles NNE
5S1	Possum Hollow Road	0.45 miles NE
7S1	LGS Training Center	0.59 miles ENE
10S3	Keen Road	0.50 miles E
11S1	LGS Information Center	0.38 miles ESE
13S2	500 KV Substation	0.41 miles SE
14S1	Longview Road	0.63 miles SSE
18S2	Rail Line along Longview Road	0.26 miles S
21S2	Near Intake Building	0.19 miles SSW
23S2	Transmission Tower	0.53 miles SW
25S2	Sector Site Boundary	0.46 miles WSW
26S3	Met. Tower #2	0.40 miles W
29S1	Sector Site Boundary	0.55 miles WNW
31S1	Sector Site Boundary	0.26 miles NW
34S2	Met. Tower #1	0.58 miles NNW
Intermediate Distance		
36D1	Siren Tower No. 147	3.51 miles N
2E1	Laughing Waters GSC	4.76 miles NNE
4E1	Neiffer Road	4.78 miles NE
7E1	Pheasant Road	4.26 miles ENE
10E1	Royersford Road	3.94 miles E
10F3	Trappe Substation	5.58 miles ESE
13E1	Vaughn Substation	4.31 miles SE
16F1	Pikeland Substation	5.04 miles SSE
19D1	Snowden Substation	3.49 miles S
20F1	Sheeder Substation	5.24 miles SSW
24D1	Porters Mill Substation	3.97 miles SW
25D1	Hoffecker & Keim Streets	3.99 miles WSW
28D2	W. Cedarville Road	3.83 miles W
29E1	Prince Street	4.95 miles WNW
31D2	Poplar Substation	3.87 miles NW
34E1	Varnell Road	4.59 miles NNW
Control and Special Interest		
5H1	Birch Substation (control)	24.76 miles NE
6C1	Pottstown Landing Field	2.14 miles NE
9C1	Reed Road	2.15 miles E
13C1	King Road	2.84 miles SE
15D1	Spring City Substation	3.20 miles SE
17B1	Linfield Substation	1.60 miles S
20D1	Ellis Woods Road	3.06 miles SSW
31D1	Lincoln Substation	3.00 miles WNW

TABLE B-3: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Limerick Generating Station, 2009

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	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, 2009

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
TLD	Thermoluminescence Dosimetry	Quarterly TLDs comprised of two Panasonic 814 (containing 3 each $CaSO_4$ elements)	RMC-ER9 Collection of TLD samples for radiological analysis (Limerick Generating Station)	2 dosimeters	Global Dosimetry

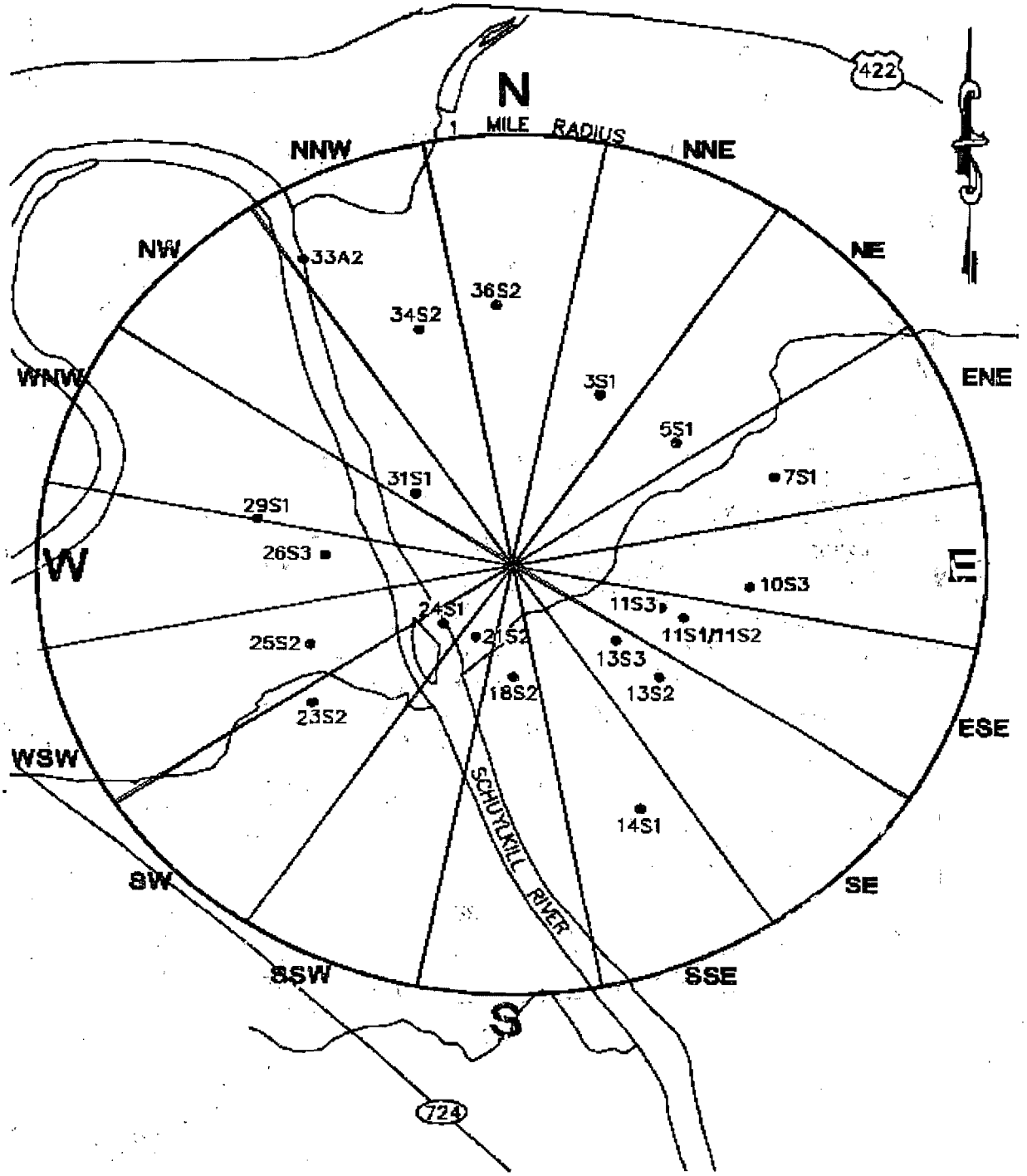


Figure B-1
Environmental Sampling Locations Within One
Mile of the Limerick Generating Station, 2009

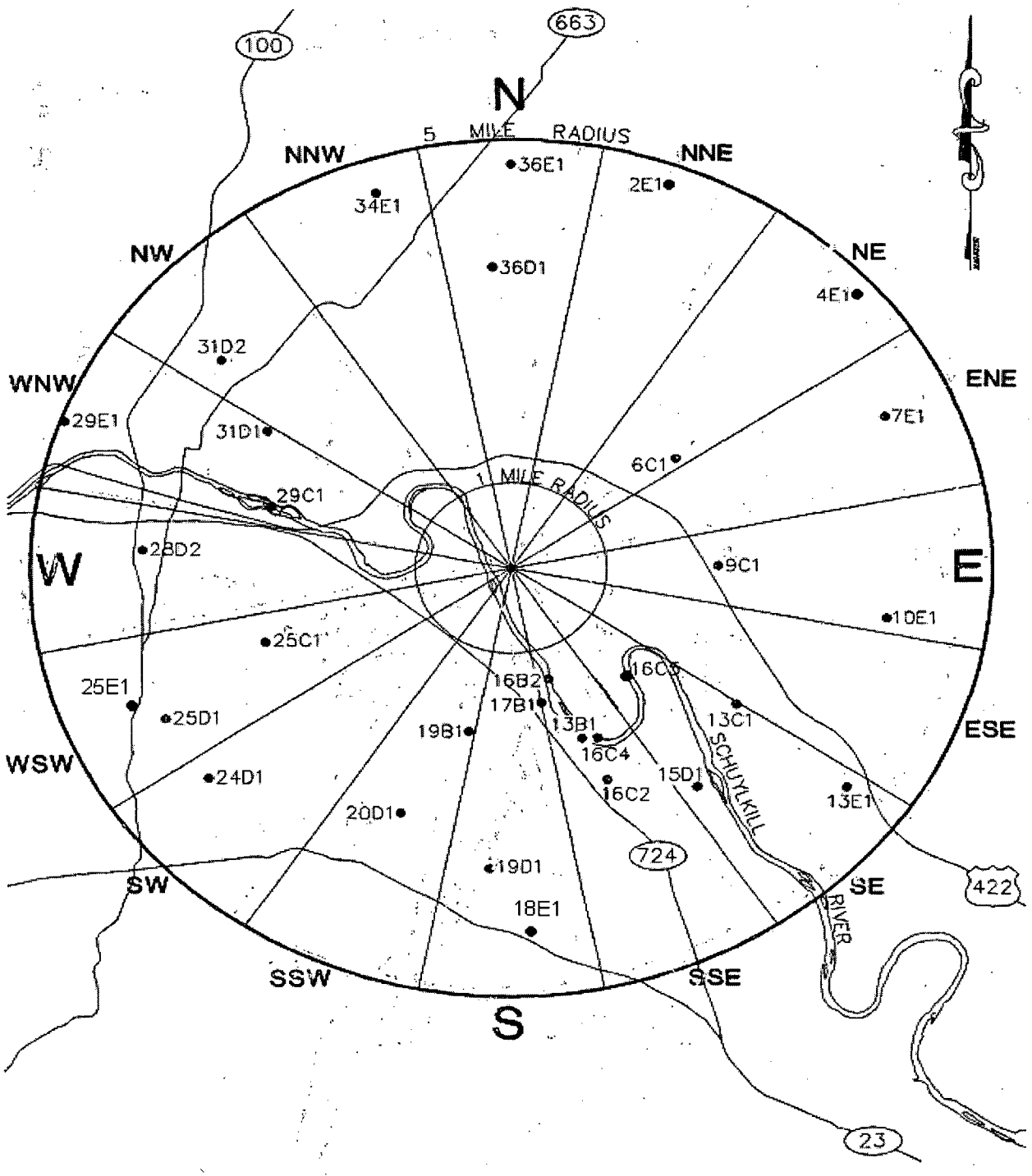


Figure B-2
Environmental Sampling Locations Between One and Five Miles from the Limerick Generating Station, 2009

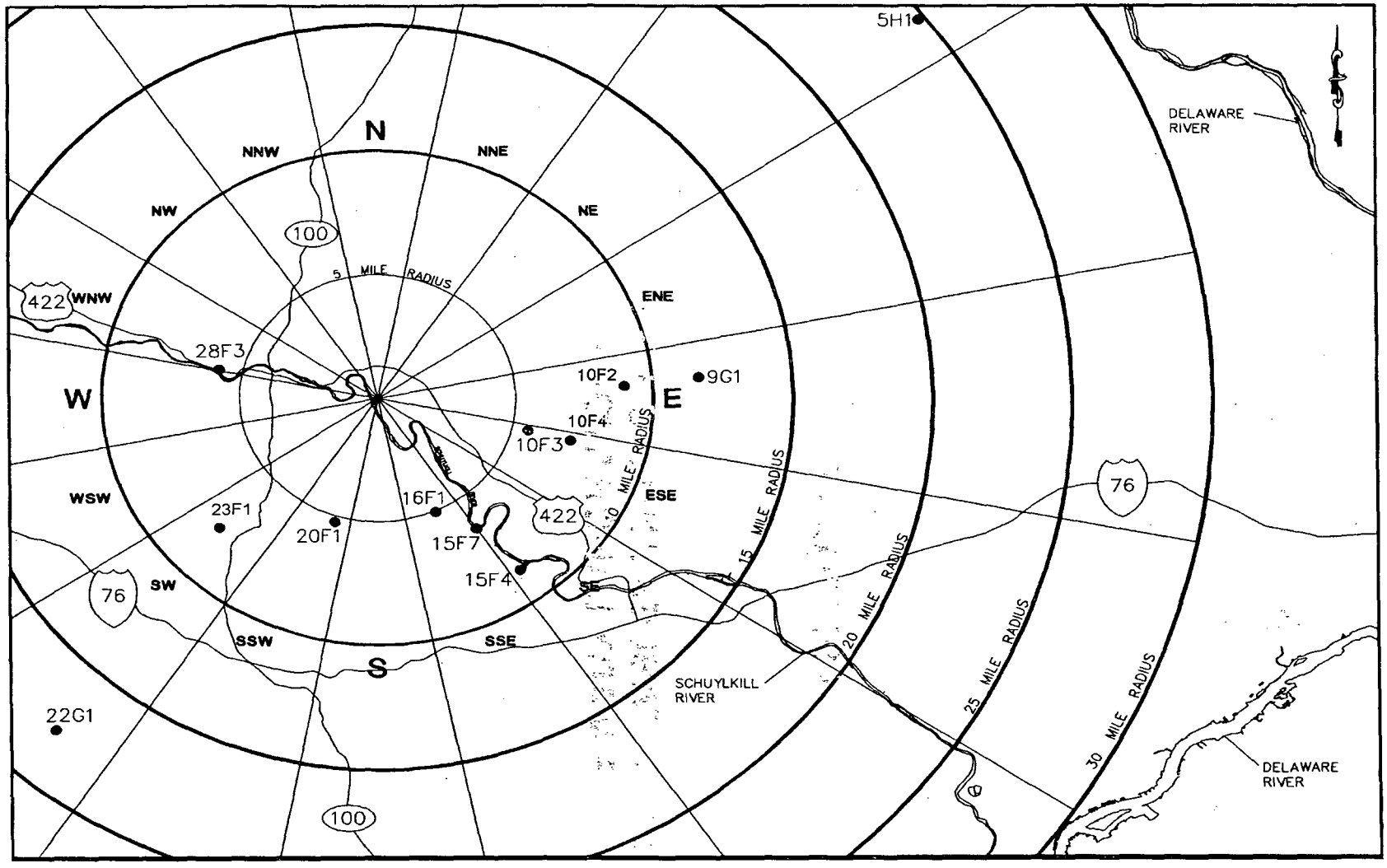


Figure B-3
Environmental Sampling Locations Greater than Five
Miles from the Limerick Generating Station, 2009

APPENDIX C

DATA TABLES AND FIGURES
PRIMARY LABORATORY

TABLE C-I.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	10F2	13B1	24S1
12/29/2008 - 03/31/2009	(1)	< 159	< 162
03/31/2009 - 06/30/2009		< 123	< 129
06/30/2009 - 09/29/2009		< 182	< 185
09/29/2009 - 12/28/2009		< 167	< 168
MEAN		-	-

(1) SEE PROGRAM CHANGES SECTIONS FOR EXPLANATION

TABLE C-I.2 CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	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
10F2	(1)												
13B1	12/29/2008 - 02/03/2009	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 15	< 5
	02/03/2009 - 03/03/2009	< 6	< 7	< 12	< 6	< 11	< 6	< 12	< 15	< 4	< 6	< 37	< 12
	03/03/2009 - 03/31/2009	< 3	< 4	< 8	< 4	< 7	< 4	< 7	< 15	< 4	< 4	< 30	< 9
	03/31/2009 - 04/28/2009	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 12	< 1	< 1	< 18	< 5
	04/28/2009 - 06/02/2009	< 7	< 7	< 14	< 6	< 16	< 6	< 11	< 12	< 5	< 5	< 34	< 12
	06/02/2009 - 06/29/2009	< 4	< 4	< 9	< 4	< 8	< 5	< 7	< 14	< 4	< 4	< 31	< 9
	06/29/2009 - 08/04/2009	< 2	< 3	< 6	< 3	< 6	< 3	< 5	< 15	< 2	< 3	< 25	< 10
	08/04/2009 - 09/01/2009	< 2	< 2	< 6	< 2	< 4	< 3	< 5	< 14	< 2	< 2	< 22	< 8
	09/01/2009 - 09/29/2009	< 6	< 6	< 11	< 5	< 11	< 5	< 8	< 6	< 5	< 6	< 21	< 5
	09/29/2009 - 11/02/2009	< 4	< 4	< 7	< 5	< 8	< 4	< 6	< 5	< 4	< 4	< 16	< 5
	11/02/2009 - 12/01/2009	< 4	< 4	< 9	< 4	< 8	< 5	< 8	< 13	< 4	< 4	< 29	< 10
	12/01/2009 - 12/28/2009	< 3	< 3	< 7	< 2	< 3	< 2	< 4	< 10	< 2	< 2	< 22	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
24S1	12/29/2008 - 02/03/2009	< 1	< 1	< 3	< 1	< 3	< 2	< 3	< 5	< 1	< 1	< 11	< 3
	02/03/2009 - 03/03/2009	< 3	< 4	< 8	< 3	< 8	< 4	< 7	< 11	< 4	< 4	< 25	< 7
	03/03/2009 - 03/31/2009	< 2	< 3	< 5	< 3	< 6	< 4	< 5	< 11	< 2	< 3	< 26	< 7
	03/31/2009 - 04/28/2009	< 1	< 1	< 2	< 1	< 2	< 1	< 2	< 10	< 1	< 1	< 13	< 4
	04/28/2009 - 06/02/2009	< 4	< 4	< 9	< 4	< 8	< 4	< 7	< 10	< 4	< 5	< 22	< 6
	06/02/2009 - 06/30/2009	< 3	< 3	< 8	< 3	< 6	< 4	< 7	< 11	< 3	< 4	< 23	< 5
	06/30/2009 - 08/04/2009	< 2	< 3	< 7	< 2	< 5	< 3	< 5	< 15	< 2	< 3	< 26	< 10
	08/04/2009 - 09/01/2009	< 2	< 2	< 6	< 2	< 4	< 3	< 5	< 15	< 2	< 2	< 25	< 7
	09/01/2009 - 09/29/2009	< 4	< 5	< 9	< 6	< 10	< 6	< 9	< 6	< 5	< 5	< 19	< 5
	09/29/2009 - 11/02/2009	< 4	< 5	< 10	< 4	< 9	< 4	< 7	< 5	< 4	< 4	< 18	< 6
	11/02/2009 - 12/01/2009	< 4	< 4	< 11	< 5	< 9	< 5	< 8	< 15	< 4	< 5	< 31	< 13
	12/01/2009 - 12/28/2009	< 3	< 4	< 7	< 3	< 6	< 4	< 7	< 11	< 3	< 2	< 30	< 6
	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, 2009**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/29/2008 - 02/03/2009	3.8 ± 1.7	4.2 ± 1.7	3.4 ± 1.6	4.0 ± 1.7
02/03/2009 - 03/03/2009	4.8 ± 1.6	4.8 ± 1.6	4.5 ± 1.5	3.6 ± 1.5
03/03/2009 - 03/31/2009	4.9 ± 1.7	5.3 ± 1.8	3.2 ± 1.6	3.9 ± 1.6
03/31/2009 - 04/28/2009	2.3 ± 1.5	4.0 ± 1.6	5.2 ± 1.8	3.1 ± 1.6
04/28/2009 - 06/02/2009	3.9 ± 1.7	3.0 ± 1.6	2.8 ± 1.6	3.4 ± 1.7
06/02/2009 - 06/29/2009	3.7 ± 1.8	6.3 ± 2.1	7.4 ± 2.2	< 2.5
06/30/2009 - 08/04/2009	4.6 ± 1.8	5.2 ± 1.9	4.9 ± 1.9	4.0 ± 1.8
08/04/2009 - 09/01/2009	3.5 ± 1.7	2.9 ± 1.7	3.4 ± 1.8	3.0 ± 1.7
09/01/2009 - 09/29/2009	4.0 ± 1.8	3.5 ± 1.8	< 2.7	4.2 ± 1.9
09/29/2009 - 11/02/2009	2.8 ± 1.7	4.9 ± 1.8	3.6 ± 1.8	3.5 ± 1.8
11/02/2009 - 12/01/2009	2.8 ± 1.7	2.8 ± 1.7	3.2 ± 1.7	< 2.4
12/01/2009 - 12/28/2009	2.6 ± 1.8	2.9 ± 1.7	< 2.5	< 2.5
MEAN	3.6 ± 1.7	4.2 ± 2.3	4.2 ± 2.8	3.6 ± 0.8

TABLE C-II.2 **CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	15F4	15F7	16C2	28F3
12/29/2008 - 03/31/2009	< 163	168 ± 105	< 162	< 156
03/31/2009 - 06/30/2009	< 131	< 133	< 137	< 134
06/30/2009 - 09/29/2009	< 185	< 177	< 185	< 189
09/29/2009 - 12/28/2009	< 167	< 170	< 165	< 167
MEAN	-	168	-	-

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

TABLE C-II.3 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± SIGMA

STC	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
15F4	12/29/2008 - 02/03/2009	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 7	< 2	< 2	< 15	< 4
	02/03/2009 - 03/03/2009	< 4	< 5	< 10	< 4	< 8	< 5	< 8	< 12	< 4	< 4	< 28	< 9
	03/03/2009 - 03/31/2009	< 3	< 3	< 6	< 2	< 5	< 3	< 5	< 15	< 3	< 3	< 26	< 7
	03/31/2009 - 04/28/2009	< 1	< 1	< 2	< 1	< 1	< 1	< 2	< 10	< 1	< 1	< 12	< 3
	04/28/2009 - 06/02/2009	< 6	< 6	< 13	< 6	< 14	< 6	< 9	< 14	< 6	< 6	< 32	< 9
	06/02/2009 - 06/29/2009	< 4	< 3	< 10	< 4	< 8	< 5	< 7	< 15	< 4	< 4	< 27	< 7
	06/29/2009 - 08/04/2009	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 6	< 1	< 1	< 10	< 3
	08/04/2009 - 09/01/2009	< 2	< 2	< 6	< 2	< 4	< 3	< 4	< 14	< 2	< 2	< 26	< 8
	09/01/2009 - 09/29/2009	< 4	< 4	< 7	< 4	< 6	< 5	< 8	< 6	< 4	< 5	< 19	< 5
	09/29/2009 - 11/02/2009	< 3	< 3	< 5	< 3	< 6	< 3	< 5	< 4	< 3	< 3	< 14	< 4
	11/02/2009 - 12/01/2009	< 4	< 4	< 7	< 4	< 8	< 4	< 8	< 12	< 4	< 4	< 26	< 9
	12/01/2009 - 12/28/2009	< 3	< 3	< 7	< 2	< 6	< 3	< 6	< 11	< 3	< 3	< 21	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
15F7	12/29/2008 - 02/03/2009	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 6	< 2	< 2	< 13	< 4
	02/03/2009 - 03/03/2009	< 5	< 5	< 10	< 4	< 8	< 5	< 10	< 15	< 4	< 5	< 35	< 9
	03/03/2009 - 03/31/2009	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 13	< 2	< 2	< 22	< 7
	03/31/2009 - 04/28/2009	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 10	< 1	< 1	< 14	< 3
	04/28/2009 - 06/02/2009	< 5	< 6	< 9	< 4	< 8	< 6	< 8	< 11	< 5	< 4	< 27	< 7
	06/02/2009 - 06/30/2009	< 4	< 4	< 10	< 5	< 9	< 5	< 7	< 15	< 4	< 5	< 32	< 8
	06/30/2009 - 08/04/2009	< 2	< 2	< 5	< 1	< 4	< 2	< 4	< 12	< 2	< 2	< 20	< 7
	08/04/2009 - 09/01/2009	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 12	< 2	< 2	< 21	< 6
	09/01/2009 - 09/29/2009	< 6	< 5	< 10	< 6	< 12	< 6	< 10	< 8	< 6	< 7	< 22	< 7
	09/29/2009 - 11/02/2009	< 3	< 4	< 8	< 4	< 7	< 4	< 6	< 5	< 3	< 3	< 15	< 6
	11/02/2009 - 12/01/2009	< 4	< 4	< 9	< 4	< 9	< 5	< 7	< 11	< 3	< 4	< 28	< 9
	12/01/2009 - 12/28/2009	< 3	< 3	< 7	< 3	< 6	< 4	< 6	< 13	< 3	< 3	< 27	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-II.3 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± SIGMA

STC	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
16C2	12/29/2008 - 02/03/2009	< 2	< 3	< 6	< 2	< 5	< 3	< 4	< 7	< 2	< 2	< 16	< 6
	02/03/2009 - 03/03/2009	< 5	< 6	< 12	< 4	< 11	< 5	< 11	< 15	< 5	< 5	< 36	< 11
	03/03/2009 - 03/31/2009	< 3	< 2	< 7	< 2	< 6	< 3	< 5	< 14	< 2	< 3	< 24	< 8
	03/31/2009 - 04/28/2009	< 1	< 1	< 2	< 1	< 2	< 1	< 2	< 10	< 1	< 1	< 14	< 5
	04/28/2009 - 06/02/2009	< 4	< 4	< 11	< 5	< 10	< 5	< 9	< 10	< 5	< 5	< 20	< 8
	06/02/2009 - 06/29/2009	< 4	< 5	< 8	< 4	< 8	< 5	< 8	< 15	< 4	< 4	< 30	< 12
	06/29/2009 - 08/04/2009	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 10	< 1	< 2	< 17	< 5
	08/04/2009 - 09/01/2009	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 15	< 2	< 3	< 26	< 8
	09/01/2009 - 09/29/2009	< 5	< 5	< 8	< 5	< 9	< 5	< 9	< 6	< 4	< 5	< 20	< 5
	09/29/2009 - 11/02/2009	< 3	< 3	< 6	< 3	< 7	< 3	< 6	< 5	< 4	< 4	< 16	< 4
	11/02/2009 - 12/01/2009	< 4	< 5	< 11	< 5	< 9	< 5	< 10	< 15	< 4	< 5	< 32	< 11
	12/01/2009 - 12/28/2009	< 3	< 4	< 8	< 3	< 7	< 4	< 7	< 13	< 3	< 4	< 27	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
28F3	12/29/2008 - 02/03/2009	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 6	< 2	< 2	< 13	< 5
	02/03/2009 - 03/03/2009	< 4	< 4	< 12	< 5	< 8	< 5	< 8	< 14	< 4	< 4	< 30	< 11
	03/03/2009 - 03/31/2009	< 3	< 3	< 6	< 3	< 5	< 3	< 6	< 12	< 2	< 3	< 23	< 7
	03/31/2009 - 04/28/2009	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 8	< 1	< 1	< 9	< 3
	04/28/2009 - 06/02/2009	< 4	< 6	< 12	< 5	< 11	< 5	< 9	< 10	< 4	< 5	< 22	< 8
	06/02/2009 - 06/29/2009	< 4	< 4	< 9	< 5	< 10	< 5	< 9	< 15	< 4	< 4	< 27	< 11
	06/29/2009 - 08/04/2009	< 1	< 2	< 3	< 1	< 3	< 2	< 3	< 9	< 1	< 1	< 15	< 4
	08/04/2009 - 09/01/2009	< 2	< 2	< 5	< 2	< 4	< 3	< 4	< 14	< 2	< 2	< 22	< 8
	09/01/2009 - 09/29/2009	< 5	< 4	< 9	< 4	< 11	< 6	< 9	< 6	< 4	< 5	< 18	< 7
	09/29/2009 - 11/02/2009	< 3	< 3	< 7	< 4	< 6	< 3	< 6	< 4	< 3	< 3	< 13	< 5
	11/02/2009 - 12/01/2009	< 4	< 5	< 8	< 4	< 9	< 5	< 7	< 15	< 4	< 5	< 29	< 11
	12/01/2009 - 12/28/2009	< 3	< 3	< 7	< 4	< 5	< 3	< 6	< 13	< 3	< 3	< 23	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

TABLE C-III.1 CONCENTRATIONS OF GAMMA EMMITTERS IN PREDATOR AND BOTTOM FEEDER (FISH) SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

STC	COLLECTION PERIOD	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	I-131	Cs-134	Cs-137
16C5	PREDATOR									
	06/25/2009	3230 ± 797	< 50	< 49	< 126	< 46	< 84	< 213	< 47	< 55
	10/21/2009	3790 ± 874	< 60	< 55	< 144	< 58	< 109	< 518	< 52	< 62
	MEAN	3510 ± 792	-	-	-	-	-	-	-	-
16C5	BOTTOM FEEDER									
	06/25/2009	3840 ± 818	< 41	< 51	< 113	< 42	< 92	< 241	< 42	< 47
	10/21/2009	3310 ± 705	< 49	< 44	< 119	< 55	< 96	< 323	< 44	< 40
	MEAN	3575 ± 750	-	-	-	-	-	-	-	-
29C1	PREDATOR									
	05/20/2009	2220 ± 464	< 18	< 17	< 67	< 24	< 44	< 789	< 17	< 16
	12/18/2009	3350 ± 370	< 18	< 20	< 39	< 20	< 42	< 27.5	< 20	< 21
	MEAN	2785 ± 1598	-	-	-	-	-	-	-	-
29C1	BOTTOM FEEDER									
	05/20/2009	4350 ± 919	< 54	< 63	< 186	< 48	< 114	< 3620	< 43	< 46
	12/16/2009	3480 ± 401	< 21	< 21	< 44	< 21	< 44	< 31.8	< 22	< 24
	MEAN	3915 ± 1230	-	-	-	-	-	-	-	-

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

TABLE C-IV.1 CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/KG DRY ± 2 SIGMA

STC	COLLECTION PERIOD	Be-7	K-40	Mn-54	Co-58	Co-60	I-131	Cs-134	Cs-137
16B2	06/10/2009	< 895	17800 ± 1730	< 78	< 89	< 59	< 278	< 77	139 ± 83
	12/16/2009	1870 ± 721	16600 ± 1540	< 76	< 87	< 71	< 745	< 70	166 ± 54
	MEAN	1870	17200 ± 1697	-	-	-	-	-	153 ± 38
16C4	06/10/2009	1990 ± 829	15500 ± 1480	< 57	< 55	< 71	< 152	< 43	123 ± 56
	12/16/2009	1660 ± 967	16300 ± 1690	< 41	< 38	< 34	< 456	< 34	83 ± 65
	MEAN	1825 ± 467	15900 ± 1131	-	-	-	-	-	103 ± 57
33A2	06/10/2009	< 652	11800 ± 1520	< 82	< 76	< 84	< 243	< 66	< 73
	12/16/2009	< 523	14900 ± 1440	< 28	< 32	< 35	< 565	< 22	108 ± 85
	MEAN	-	13350 ± 4384	-	-	-	-	-	108

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

TABLE C-V.1 **CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009**

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

COLLECTION PERIOD	GROUP I			GROUP II	GROUP III
	10S3	11S1	14S1	13C1	22G1
12/29/2008 - 01/05/2009	22 ± 5	21 ± 5	22 ± 5	19 ± 5	27 ± 5
01/05/2009 - 01/12/2009	17 ± 5	17 ± 5	13 ± 5	14 ± 5	22 ± 5
01/12/2009 - 01/19/2009	18 ± 5	16 ± 5	19 ± 5	20 ± 5	19 ± 5
01/19/2009 - 01/26/2009	23 ± 5	28 ± 6	26 ± 6	22 ± 5	22 ± 5
01/26/2009 - 02/02/2009	26 ± 6	22 ± 5	20 ± 5	20 ± 5	21 ± 5
02/02/2009 - 02/09/2009	16 ± 5	20 ± 5	21 ± 5	22 ± 5	20 ± 5
02/09/2009 - 02/17/2009	9 ± 4	10 ± 4	10 ± 4	8 ± 4	16 ± 5
02/17/2009 - 02/23/2009	12 ± 6	14 ± 6	13 ± 6	16 ± 6	12 ± 6
02/23/2009 - 03/03/2009	18 ± 5	17 ± 5	20 ± 5	15 ± 5	19 ± 5
03/03/2009 - 03/09/2009	14 ± 6	15 ± 6	(1)	22 ± 6	23 ± 6
03/09/2009 - 03/16/2009	23 ± 5	23 ± 5	18 ± 5	22 ± 5	19 ± 5
03/16/2009 - 03/23/2009	27 ± 6	20 ± 5	18 ± 5	21 ± 5	17 ± 5
03/23/2009 - 03/30/2009	17 ± 9	15 ± 5	11 ± 5	12 ± 5	16 ± 5
03/30/2009 - 04/06/2009	14 ± 4	9 ± 4	10 ± 4	12 ± 4	12 ± 4
04/06/2009 - 04/13/2009	17 ± 5	18 ± 5	15 ± 5	17 ± 5	21 ± 5
04/13/2009 - 04/20/2009	13 ± 5	19 ± 5	15 ± 5	18 ± 5	16 ± 5
04/20/2009 - 04/27/2009	10 ± 5	10 ± 5	14 ± 5	14 ± 5	13 ± 5
04/27/2009 - 05/04/2009	16 ± 5	15 ± 5	16 ± 5	20 ± 5	17 ± 5
05/04/2009 - 05/11/2009	12 ± 4	12 ± 4	12 ± 4	8 ± 4	10 ± 4
05/11/2009 - 05/18/2009	13 ± 5	11 ± 5	10 ± 5	10 ± 5	11 ± 5
05/18/2009 - 05/26/2009	(1)	15 ± 5	10 ± 4	17 ± 5	11 ± 4
05/26/2009 - 06/01/2009	< 7	12 ± 5	8 ± 5	< 7	11 ± 5
06/01/2009 - 06/08/2009	12 ± 5	10 ± 5	11 ± 5	12 ± 5	8 ± 5
06/08/2009 - 06/16/2009	10 ± 4	14 ± 4	11 ± 4	13 ± 4	11 ± 4
06/16/2009 - 06/22/2009	< 8	8 ± 5	< 8	9 ± 5	< 7
06/22/2009 - 06/29/2009	12 ± 5	14 ± 5	12 ± 5	13 ± 5	11 ± 5
06/29/2009 - 07/06/2009	12 ± 5	12 ± 5	12 ± 5	13 ± 5	10 ± 5
07/06/2009 - 07/13/2009	9 ± 5	(1)	9 ± 5	14 ± 5	10 ± 5
07/13/2009 - 07/20/2009	19 ± 5	21 ± 5	18 ± 5	21 ± 5	17 ± 5
07/20/2009 - 07/27/2009	19 ± 5	(1)	14 ± 5	19 ± 6	9 ± 5
07/27/2009 - 08/03/2009	14 ± 5	17 ± 6	18 ± 5	11 ± 5	19 ± 5
08/03/2009 - 08/10/2009	14 ± 5	18 ± 5	16 ± 5	20 ± 5	12 ± 5
08/10/2009 - 08/17/2009	21 ± 6	19 ± 6	21 ± 6	18 ± 6	16 ± 5
08/17/2009 - 08/24/2009	13 ± 5	17 ± 6	13 ± 5	17 ± 6	14 ± 5
08/24/2009 - 08/31/2009	11 ± 5	13 ± 5	20 ± 5	14 ± 5	13 ± 5
08/31/2009 - 09/07/2009	14 ± 5	12 ± 5	18 ± 5	20 ± 6	18 ± 5
09/07/2009 - 09/15/2009	22 ± 4	16 ± 4	16 ± 4	15 ± 4	13 ± 4
09/15/2009 - 09/21/2009	13 ± 6	10 ± 6	15 ± 6	18 ± 6	12 ± 6
09/21/2009 - 09/28/2009	16 ± 5	13 ± 5	11 ± 5	14 ± 5	14 ± 5
09/28/2009 - 10/05/2009	17 ± 5	13 ± 5	15 ± 5	15 ± 5	10 ± 5
10/05/2009 - 10/12/2009	9 ± 5	15 ± 5	12 ± 5	15 ± 5	20 ± 5
10/12/2009 - 10/19/2009	10 ± 5	11 ± 5	16 ± 5	13 ± 5	10 ± 5
10/19/2009 - 10/26/2009	21 ± 5	16 ± 5	25 ± 6	25 ± 6	24 ± 6
10/26/2009 - 11/02/2009	15 ± 4	13 ± 4	9 ± 4	8 ± 4	13 ± 4
11/02/2009 - 11/09/2009	16 ± 5	20 ± 6	19 ± 6	20 ± 6	21 ± 6
11/09/2009 - 11/16/2009	21 ± 5	14 ± 5	20 ± 5	18 ± 5	19 ± 5
11/16/2009 - 11/23/2009	19 ± 5	16 ± 5	19 ± 5	17 ± 5	20 ± 5
11/23/2009 - 11/30/2009	15 ± 5	15 ± 5	17 ± 5	12 ± 5	13 ± 5
11/30/2009 - 12/07/2009	15 ± 4	18 ± 5	17 ± 5	11 ± 4	12 ± 4
12/07/2009 - 12/14/2009	21 ± 5	29 ± 5	24 ± 5	34 ± 5	31 ± 5
12/14/2009 - 12/21/2009	22 ± 5	17 ± 4	20 ± 5	19 ± 5	22 ± 5
12/21/2009 - 12/28/2009	15 ± 5	13 ± 5	13 ± 5	12 ± 5	16 ± 5
MEAN	16 ± 9	16 ± 9	16 ± 9	16 ± 10	16 ± 10

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

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

TABLE C-V.2 **MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009**

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

GROUP I - ON-SITE LOCATIONS				GROUP II - INTERMEDIATE DISTANCE LOCATIONS				GROUP III - CONTROL LOCATIONS			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
12/29/2008 - 02/02/2009	13	28	20.6 ± 8	12/29/2008 - 02/02/2009	14	22	19.1 ± 6	12/29/2008 - 02/02/2009	19	27	22.1 ± 6
02/02/2009 - 03/03/2009	9	21	15 ± 9	02/02/2009 - 03/03/2009	8	22	15.4 ± 12	02/02/2009 - 03/03/2009	12	20	16.9 ± 8
03/03/2009 - 03/30/2009	11	27	18.3 ± 9	03/03/2009 - 03/30/2009	12	22	19.2 ± 10	03/03/2009 - 03/30/2009	16	23	18.7 ± 6
03/30/2009 - 04/27/2009	9	19	13.7 ± 7	03/30/2009 - 04/27/2009	12	18	15.3 ± 6	03/30/2009 - 04/27/2009	12	21	15.6 ± 8
04/27/2009 - 06/01/2009	8	16	12.3 ± 5	04/27/2009 - 06/01/2009	8	20	13.7 ± 11	04/27/2009 - 06/01/2009	10	17	12 ± 6
06/01/2009 - 06/29/2009	8	14	11.5 ± 3	06/01/2009 - 06/29/2009	9	13	11.6 ± 3	06/01/2009 - 06/29/2009	8	11	10.3 ± 3
06/29/2009 - 08/03/2009	9	21	14.8 ± 8	06/29/2009 - 08/03/2009	11	21	15.6 ± 8	06/29/2009 - 08/03/2009	9	19	13 ± 9
07/28/2009 - 08/31/2009	11	21	16.3 ± 7	07/28/2009 - 08/31/2009	14	20	17.5 ± 5	07/28/2009 - 08/31/2009	12	16	13.7 ± 4
08/31/2009 - 09/28/2009	10	22	14.8 ± 6	08/31/2009 - 09/28/2009	14	20	16.7 ± 5	08/31/2009 - 09/28/2009	12	18	14.1 ± 5
09/28/2009 - 11/02/2009	9	25	14.4 ± 8	09/28/2009 - 11/02/2009	8	25	15.4 ± 12	09/28/2009 - 11/02/2009	10	24	15.4 ± 12
11/02/2009 - 11/30/2009	14	21	17.5 ± 5	11/02/2009 - 11/30/2009	12	20	16.6 ± 7	11/02/2009 - 11/30/2009	13	21	18 ± 7
11/30/2009 - 12/28/2009	13	29	18.7 ± 10	11/30/2009 - 12/28/2009	11	34	18.9 ± 21	11/30/2009 - 12/28/2009	12	31	20.1 ± 16
12/29/2008 - 12/28/2009	8	29	16 ± 9	12/29/2008 - 12/28/2009	8	34	16 ± 10	12/29/2008 - 12/28/2009	8	31	16 ± 10

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

TABLE C-V.3 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

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

STC	COLLECTION PERIOD	Be-7	Mn-54	Co-58	Co-60	Cs-134	Cs-137
10S3	12/29/2008 - 03/30/2009	90 ± 34	< 4	< 4	< 2	< 3	< 4
	03/30/2009 - 06/29/2009	92 ± 44	< 5	< 8	< 5	< 5	< 4
	06/29/2009 - 09/28/2009	72 ± 45	< 3	< 7	< 2	< 4	< 2
	09/28/2009 - 12/28/2009	70 ± 31	< 5	< 4	< 4	< 5	< 4
	MEAN	81 ± 23	-	-	-	-	-
11S1	12/29/2008 - 03/30/2009	70 ± 38	< 3	< 5	< 4	< 3	< 3
	03/30/2009 - 06/29/2009	108 ± 69	< 6	< 11	< 5	< 5	< 3
	06/29/2009 - 09/28/2009	96 ± 47	< 4	< 7	< 5	< 4	< 3
	09/28/2009 - 12/28/2009	71 ± 37	< 3	< 5	< 4	< 5	< 4
	MEAN	86 ± 38	-	-	-	-	-
13C1	12/29/2008 - 03/30/2009	92 ± 34	< 3	< 5	< 3	< 3	< 2
	03/30/2009 - 06/29/2009	125 ± 50	< 4	< 10	< 4	< 5	< 4
	06/29/2009 - 09/28/2009	< 97	< 5	< 9	< 3	< 6	< 4
	09/28/2009 - 12/28/2009	55 ± 37	< 4	< 7	< 5	< 6	< 4
	MEAN	91 ± 70	-	-	-	-	-
14S1	12/29/2008 - 03/30/2009	66 ± 19	< 3	< 3	< 3	< 2	< 2
	03/30/2009 - 06/29/2009	79 ± 36	< 3	< 8	< 3	< 4	< 4
	06/29/2009 - 09/28/2009	102 ± 44	< 3	< 6	< 3	< 3	< 3
	09/28/2009 - 12/28/2009	93 ± 36	< 5	< 5	< 4	< 4	< 4
	MEAN	85 ± 32	-	-	-	-	-
22G1	12/29/2008 - 03/30/2009	75 ± 40	< 3	< 4	< 3	< 3	< 3
	03/30/2009 - 06/29/2009	116 ± 96	< 6	< 11	< 6	< 7	< 4
	06/29/2009 - 09/28/2009	94 ± 38	< 3	< 6	< 3	< 3	< 2
	09/28/2009 - 12/28/2009	< 67	< 4	< 7	< 4	< 5	< 4
	MEAN	95 ± 41	-	-	-	-	-

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

TABLE C-1 CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

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

COLLECTION PERIOD	GROUP I			GROUP II	GROUP III
	10S3	11S1	14S1	13C1	22G1
12/29/2008 - 01/05/2009	< 29	< 53	< 54	< 53	< 54
01/05/2009 - 01/12/2009	< 22	< 39	< 40	< 39	< 40
01/12/2009 - 01/19/2009	< 20	< 36	< 37	< 36	< 37
01/19/2009 - 01/26/2009	< 50	< 27	< 50	< 49	< 50
01/26/2009 - 02/02/2009	< 13	< 23	< 23	< 23	< 23
02/02/2009 - 02/09/2009	< 57	< 57	< 57	< 31	< 57
02/09/2009 - 02/17/2009	< 25	< 47	< 47	< 47	< 48
02/17/2009 - 02/23/2009	< 48	< 48	< 21	< 48	< 49
02/23/2009 - 03/03/2009	< 7	< 17	< 17	< 17	< 17
03/03/2009 - 03/09/2009	< 18	< 18	(1)	< 17	< 14
03/09/2009 - 03/16/2009	< 30	< 44	< 45	< 44	< 45
03/16/2009 - 03/23/2009	< 18	< 41	< 41	< 41	< 42
03/23/2009 - 03/30/2009	< 22	< 27	< 27	< 27	< 27
03/30/2009 - 04/06/2009	< 49	< 27	< 49	< 49	< 50
04/06/2009 - 04/13/2009	< 27	< 63	< 63	< 62	< 63
04/13/2009 - 04/20/2009	< 67	< 67	< 67	< 28	< 68
04/20/2009 - 04/27/2009	< 23	< 41	< 41	< 41	< 41
04/27/2009 - 05/04/2009	< 45	< 45	< 20	< 45	< 46
05/04/2009 - 05/11/2009	< 64	< 64	< 65	< 64	< 66
05/11/2009 - 05/18/2009	< 64	< 64	< 64	< 63	< 32
05/18/2009 - 05/26/2009	(1)	< 69	< 69	< 68	< 70
05/26/2009 - 06/01/2009	< 27	< 48	< 48	< 47	< 48
06/01/2009 - 06/08/2009	< 16	< 30	< 30	< 29	< 30
06/08/2009 - 06/16/2009	< 64	< 35	< 65	< 63	< 66
06/16/2009 - 06/22/2009	< 54	< 54	< 36	< 54	< 54
06/22/2009 - 06/29/2009	< 65	< 66	< 66	< 29	< 64
06/29/2009 - 07/06/2009	< 57	< 58	< 58	< 25	< 56
07/06/2009 - 07/13/2009	< 44	(1)	< 25	< 46	< 45
07/13/2009 - 07/20/2009	< 37	< 39	< 38	< 21	< 37
07/20/2009 - 07/27/2009	< 36	(1)	< 19	< 37	< 36
07/27/2009 - 08/03/2009	< 20	< 12	< 21	< 21	< 20
08/03/2009 - 08/10/2009	< 12	< 22	< 22	< 22	< 21
08/10/2009 - 08/17/2009	< 29	< 30	< 30	< 23	< 29
08/17/2009 - 08/24/2009	< 21	< 9	< 22	< 22	< 21
08/24/2009 - 08/31/2009	< 56	< 57	< 58	< 25	< 56
08/31/2009 - 09/07/2009	< 44	< 44	< 45	< 25	< 43
09/07/2009 - 09/15/2009	< 41	< 42	< 43	< 24	< 42
09/15/2009 - 09/21/2009	< 66	< 67	< 67	< 42	< 66
09/21/2009 - 09/28/2009	< 44	< 45	< 45	< 19	< 43
09/28/2009 - 10/05/2009	< 55	< 57	< 57	< 32	< 56
10/05/2009 - 10/12/2009	< 53	< 55	< 55	< 24	< 53
10/12/2009 - 10/19/2009	< 63	< 64	< 64	< 65	< 62
10/19/2009 - 10/26/2009	< 22	< 23	< 23	< 17	< 22
10/26/2009 - 11/02/2009	< 63	< 28	< 65	< 66	< 63
11/02/2009 - 11/09/2009	< 61	< 63	< 63	< 27	< 61
11/09/2009 - 11/16/2009	< 57	< 59	< 59	< 33	< 58
11/16/2009 - 11/23/2009	< 25	< 25	< 25	< 26	< 15
11/23/2009 - 11/30/2009	< 63	< 65	< 36	< 66	< 63
11/30/2009 - 12/07/2009	< 59	< 60	< 60	< 33	< 59
12/07/2009 - 12/14/2009	< 59	< 60	< 61	< 61	< 25
12/14/2009 - 12/21/2009	< 65	< 66	< 67	< 29	< 65
12/21/2009 - 12/28/2009	< 60	< 61	< 62	< 31	< 59
MEAN	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

TABLE C-VII.1 CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

	CONTROL FARM		INDICATOR FARM				
COLLECTION PERIOD	23F1	36E1	10F4	18E1	19B1	25C1	25E1
01/13/2009	< 0.5	< 0.7	< 0.6	< 0.7	< 0.6	< 0.6	(1)
02/10/2009	< 0.5		< 0.6	< 0.7	< 0.7	< 0.7	
03/10/2009	< 0.5		< 0.7	< 0.7	< 0.7	< 0.7	
04/07/2009	< 0.8	< 0.6	< 0.9	< 0.8	< 1.0	< 1.0	
04/22/2009	< 0.5		< 0.6	< 0.6	< 0.7	< 0.8	
05/05/2009	< 0.3		< 0.5	< 0.5	< 0.5	< 0.5	
05/19/2009	< 0.6		< 0.8	< 0.6	< 0.8	< 0.8	
06/02/2009	< 0.4		< 0.5	< 0.5	< 0.6	< 0.6	
06/16/2009	< 0.6		< 0.9	< 0.7	< 0.7	< 0.7	
06/30/2009	< 0.6		< 0.6	< 0.7	< 0.7	< 0.7	
07/14/2009	< 0.4	< 0.2	< 0.6	< 0.5	< 0.5	< 0.6	
07/28/2009	< 0.6		< 0.7	< 0.7	< 0.6	< 0.8	
08/11/2009	< 0.7		< 0.9	< 0.8	< 0.8	< 0.8	
08/25/2009	< 0.6		< 0.7	< 0.7	< 0.7	< 0.7	
09/08/2009	< 0.6		< 0.7	< 0.6	< 0.5	< 0.6	
09/22/2009	< 0.6		< 0.8	< 0.6	< 0.6	< 0.6	
10/06/2009	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	
10/20/2009	< 0.4		< 0.3	< 0.3	< 0.3	< 0.4	
11/03/2009	< 0.9		< 0.6	< 0.6	< 0.7	< 1.0	
11/17/2009	< 0.6		< 0.7	< 0.6	< 0.6	< 0.5	
12/08/2009	< 0.7		< 0.8	< 0.7	< 0.8	< 0.8	
MEAN	-	-	-	-	-	-	

(1) 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, 2009

RESULTS IN UNITS OF PCI/LITER ±2 SIGMA

STC	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
10F4	01/13/2009	1220 ± 41	< 1	< 2	< 16	< 4
	02/10/2009	1240 ± 122	< 5	< 6	< 52	< 14
	03/10/2009	1220 ± 84	< 3	< 3	< 15	< 4
	04/07/2009	1260 ± 42	< 1	< 2	< 24	< 8
	04/21/2009	1200 ± 37	< 1	< 1	< 22	< 6
	05/05/2009	1190 ± 48	< 2	< 2	< 50	< 14
	05/19/2009	1390 ± 50	< 1	< 1	< 22	< 5
	06/02/2009	1210 ± 100	< 4	< 5	< 44	< 14
	06/16/2009	1200 ± 167	< 7	< 7	< 33	< 7
	06/30/2009	1450 ± 58	< 2	< 2	< 33	< 10
	07/14/2009	1220 ± 142	< 5	< 7	< 39	< 14
	07/28/2009	1370 ± 124	< 2	< 3	< 22	< 8
	08/11/2009	1180 ± 108	< 4	< 5	< 22	< 6
	08/25/2009	1370 ± 163	< 9	< 9	< 43	< 11
	09/08/2009	1210 ± 137	< 6	< 6	< 36	< 10
	09/22/2009	1350 ± 99	< 4	< 5	< 20	< 6
	10/06/2009	1220 ± 115	< 4	< 5	< 22	< 5
	10/20/2009	1170 ± 116	< 5	< 6	< 25	< 7
	11/03/2009	1370 ± 118	< 4	< 5	< 25	< 7
	11/17/2009	1290 ± 76	< 3	< 4	< 16	< 5
	12/08/2009	1370 ± 124	< 5	< 5	< 38	< 14
	MEAN	1271 ± 171	-	-	-	-
18E1	01/13/2009	1270 ± 49	< 2	< 2	< 23	< 6
	02/10/2009	1160 ± 111	< 5	< 5	< 50	< 12
	03/10/2009	1230 ± 108	< 5	< 5	< 24	< 7
	04/07/2009	1170 ± 52	< 2	< 2	< 30	< 10
	04/22/2009	1130 ± 48	< 2	< 2	< 28	< 8
	05/05/2009	1140 ± 49	< 2	< 2	< 47	< 14
	05/19/2009	1240 ± 40	< 1	< 2	< 24	< 7
	06/02/2009	1170 ± 129	< 3	< 4	< 39	< 11
	06/16/2009	1160 ± 157	< 6	< 7	< 25	< 8
	06/30/2009	1260 ± 46	< 2	< 2	< 27	< 8
	07/14/2009	1240 ± 120	< 5	< 6	< 40	< 12
	07/28/2009	1130 ± 69	< 2	< 3	< 20	< 5
	08/11/2009	1240 ± 106	< 3	< 4	< 17	< 5
	08/25/2009	1270 ± 186	< 6	< 8	< 33	< 11
	09/08/2009	1230 ± 130	< 5	< 6	< 32	< 10
	09/22/2009	1170 ± 98	< 4	< 4	< 20	< 4
	10/06/2009	1360 ± 145	< 6	< 8	< 35	< 9
	10/20/2009	1170 ± 144	< 6	< 6	< 29	< 9
	11/03/2009	1120 ± 112	< 4	< 4	< 27	< 8
	11/17/2009	1310 ± 100	< 3	< 4	< 19	< 4
	12/08/2009	1230 ± 117	< 4	< 5	< 41	< 14
	MEAN	1210 ± 129	-	-	-	-

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

TABLE C-VII.2 CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
19B1	01/13/2009	1330 ± 50	< 2	< 2	< 19	< 6
	02/10/2009	1330 ± 101	< 4	< 4	< 43	< 13
	03/10/2009	1270 ± 100	< 4	< 4	< 20	< 7
	04/07/2009	1320 ± 50	< 2	< 2	< 29	< 9
	04/21/2009	1110 ± 47	< 2	< 2	< 27	< 9
	05/05/2009	1180 ± 46	< 2	< 2	< 47	< 14
	05/19/2009	1260 ± 50	< 1	< 1	< 20	< 6
	06/02/2009	1170 ± 112	< 2	< 3	< 32	< 7
	06/16/2009	1130 ± 176	< 7	< 7	< 30	< 10
	06/30/2009	1240 ± 38	< 1	< 1	< 20	< 6
	07/14/2009	1230 ± 140	< 5	< 6	< 36	< 10
	07/28/2009	1210 ± 99	< 3	< 4	< 29	< 6
	08/11/2009	1280 ± 141	< 5	< 6	< 24	< 10
	08/25/2009	1380 ± 154	< 6	< 7	< 33	< 11
	09/08/2009	1220 ± 138	< 5	< 6	< 33	< 10
	09/22/2009	1310 ± 99	< 4	< 4	< 22	< 6
	10/06/2009	1320 ± 112	< 4	< 5	< 24	< 8
	10/20/2009	1120 ± 116	< 5	< 5	< 26	< 6
	11/03/2009	1320 ± 134	< 5	< 6	< 33	< 9
	11/17/2009	1270 ± 69	< 3	< 3	< 13	< 4
	12/08/2009	1340 ± 80	< 5	< 5	< 31	< 11
	MEAN	1254 ± 157	-	-	-	-
23F1	01/13/2009	1320 ± 41	< 1	< 2	< 15	< 4
	02/10/2009	1230 ± 121	< 4	< 5	< 55	< 14
	03/10/2009	1240 ± 112	< 4	< 4	< 22	< 8
	04/07/2009	1280 ± 55	< 2	< 2	< 28	< 8
	04/21/2009	1190 ± 47	< 2	< 2	< 30	< 9
	05/05/2009	1260 ± 46	< 2	< 2	< 41	< 12
	05/19/2009	1310 ± 47	< 1	< 1	< 15	< 4
	06/02/2009	1190 ± 102	< 4	< 4	< 39	< 10
	06/16/2009	1240 ± 133	< 5	< 5	< 22	< 7
	06/30/2009	1240 ± 48	< 2	< 2	< 30	< 9
	07/14/2009	1340 ± 142	< 6	< 7	< 44	< 12
	07/28/2009	1250 ± 130	< 3	< 3	< 23	< 7
	08/11/2009	1300 ± 102	< 3	< 4	< 17	< 6
	08/25/2009	1370 ± 120	< 5	< 6	< 26	< 10
	09/08/2009	1150 ± 171	< 7	< 8	< 38	< 12
	09/22/2009	1150 ± 93	< 3	< 4	< 17	< 5
	10/06/2009	1270 ± 136	< 5	< 5	< 32	< 11
	10/20/2009	1270 ± 123	< 6	< 6	< 30	< 8
	11/03/2009	1190 ± 105	< 4	< 5	< 22	< 8
	11/17/2009	1620 ± 155	< 5	< 6	< 42	< 11
	12/08/2009	1200 ± 92	< 4	< 4	< 30	< 9
	MEAN	1267 ± 200	-	-	-	-

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

TABLE C-VII.2 CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ba-140	La-140
25C1	01/13/2009	1370 ± 52	< 2	< 2	< 21	< 6
	02/10/2009	1260 ± 104	< 4	< 5	< 42	< 11
	03/10/2009	1450 ± 91	< 3	< 4	< 18	< 7
	04/07/2009	1440 ± 58	< 2	< 2	< 35	< 9
	04/21/2009	1230 ± 48	< 2	< 2	< 29	< 8
	05/05/2009	1300 ± 48	< 2	< 2	< 55	< 15
	05/19/2009	1320 ± 53	< 2	< 2	< 37	< 11
	06/02/2009	1090 ± 135	< 5	< 5	< 46	< 10
	06/16/2009	1310 ± 126	< 5	< 4	< 21	< 7
	06/30/2009	1350 ± 49	< 2	< 2	< 28	< 8
	07/14/2009	1290 ± 138	< 6	< 7	< 43	< 13
	07/28/2009	1310 ± 104	< 4	< 5	< 33	< 10
	08/11/2009	1300 ± 123	< 4	< 6	< 29	< 7
	08/25/2009	1240 ± 108	< 4	< 5	< 22	< 6
	09/08/2009	1110 ± 134	< 5	< 6	< 32	< 7
	09/22/2009	1200 ± 123	< 5	< 6	< 27	< 8
	10/06/2009	1290 ± 156	< 4	< 7	< 29	< 8
	10/20/2009	1270 ± 134	< 5	< 6	< 31	< 9
	11/03/2009	1180 ± 137	< 6	< 7	< 30	< 12
	11/17/2009	1180 ± 112	< 5	< 5	< 29	< 8
	12/08/2009	1200 ± 70	< 3	< 3	< 26	< 7
	MEAN	1271 ± 186	-	-	-	-
25E1	01/13/2009	(1)				
	04/07/2009					
	07/14/2009					
	10/06/2009					
36E1	01/13/2009	1270 ± 138	< 6	< 7	< 39	< 12
	04/07/2009	1220 ± 96	< 4	< 4	< 27	< 9
	07/14/2009	1150 ± 127	< 5	< 5	< 34	< 11
	10/06/2009	1190 ± 99	< 4	< 5	< 22	< 6
	MEAN	1208 ± 101	-	-	-	-

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

(1) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

TABLE C-VIII.1 CONCENTRATIONS OF GAMMA EMITTERS IN BROAD LEAFY VEGETATION SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

STC	COLLECTION PERIOD		Be-7	K-40	Mn-54	Co-58	Co-60	I-131	Cs-134	Cs-137
11S3	07/20/2009	Cabbage	157 ± 70	3980 ± 189	< 8	< 8	< 7	< 27	< 7	< 8
	07/20/2009	Collards	211 ± 159	4110 ± 311	< 14	< 13	< 14	< 52	< 13	< 14
	07/20/2009	Kale	326 ± 182	5280 ± 446	< 13	< 13	< 11	< 50	< 12	< 13
	08/12/2009	Cabbage	< 67	2650 ± 141	< 6	< 8	< 7	< 46	< 6	< 7
	08/12/2009	Collards	340 ± 111	2750 ± 197	< 6	< 6	< 6	< 38	< 5	< 5
	08/12/2009	Kale	195 ± 78	3690 ± 202	< 6	< 6	< 7	< 42	< 5	< 6
	09/24/2009	Cabbage	< 190	3540 ± 469	< 21	< 19	< 22	< 32	< 20	< 23
	09/24/2009	Kale	401 ± 337	3530 ± 732	< 42	< 45	< 42	< 58	< 40	< 42
	MEAN		272 ± 194	3691 ± 1656	-	-	-	-	-	-
13S3	07/20/2009	Swiss Chard	342 ± 235	9120 ± 514	< 12	< 12	< 16	< 46	< 12	< 12
	08/12/2009	Swiss Chard	519 ± 122	10300 ± 293	< 7	< 8	< 7	< 53	< 6	< 6
	09/24/2009	Swiss Chard	< 235	5950 ± 581	< 25	< 24	< 30	< 43	< 24	< 26
	MEAN		431 ± 250	8457 ± 4499	-	-	-	-	-	-
31G1	07/20/2009	Cabbage	< 146	5330 ± 382	< 14	< 16	< 17	< 50	< 12	< 14
	07/20/2009	Pickle Leaves	1790 ± 193	3920 ± 315	< 12	< 15	< 14	< 50	< 11	< 12
	07/20/2009	Zucchini Leaves	1000 ± 143	5940 ± 310	< 13	< 12	< 13	< 45	< 11	< 12
	08/12/2009	Cabbage	638 ± 79	5640 ± 176	< 6	< 7	< 6	< 47	< 6	< 6
	08/12/2009	Eggplant Leaves	3000 ± 122	5870 ± 200	< 8	< 9	< 8	< 60	< 7	< 9
	08/12/2009	Zucchini Leaves	1900 ± 96	4440 ± 159	< 6	< 7	< 6	< 48	< 6	< 6
	09/24/2009	Broccoli Leaves	308 ± 204	4620 ± 565	< 22	< 21	< 20	< 32	< 21	< 23
	09/24/2009	Cabbage	< 242	3430 ± 494	< 24	< 30	< 23	< 36	< 23	< 24
	09/24/2009	Lettuce	343 ± 184	5630 ± 646	< 34	< 31	< 26	< 37	< 26	< 34
	MEAN		1283 ± 1986	4980 ± 1822	-	-	-	-	-	-

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

TABLE C-IX.1 QUARTERLY TLD RESULTS FOR LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF MILLI-ROENTGEN/STD. MONTH ± 2 STANDARD DEVIATIONS

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
2E1	7.2 ± 1.9	7.5 ± 0.6	6.3 ± 0.5	8.4 ± 1.5	6.7 ± 0.7
3S1	7.4 ± 0.9	7.6 ± 0.7	7.0 ± 1.7	7.9 ± 1.4	7.1 ± 0.5
4E1	5.4 ± 1.3	5.5 ± 0.5	4.8 ± 0.5	6.3 ± 0.5	5.1 ± 0.4
5H1	8.5 ± 1.5	8.9 ± 2.2	7.9 ± 1.0	9.4 ± 0.8	8.0 ± 0.6
5S1	8.1 ± 1.6	8.0 ± 0.9	7.3 ± 0.9	9.2 ± 0.7	8.1 ± 0.7
6C1	7.0 ± 0.8	7.2 ± 0.8	6.8 ± 0.6	7.5 ± 1.2	6.7 ± 0.7
7E1	7.7 ± 2.0	9.1 ± 0.6	7.0 ± 1.0	7.9 ± 0.4	6.9 ± 0.7
7S1	7.4 ± 1.1	7.7 ± 1.8	7.0 ± 1.1	8.1 ± 1.0	6.9 ± 0.4
9C1	7.1 ± 1.4	7.1 ± 1.1	6.7 ± 0.6	8.1 ± 0.2	6.5 ± 0.4
10E1	7.2 ± 1.6	7.4 ± 0.8	6.2 ± 0.3	8.2 ± 0.6	7.1 ± 0.7
10F3	7.1 ± 1.4	7.5 ± 1.0	6.5 ± 0.2	7.9 ± 0.7	6.5 ± 0.4
10S3	7.1 ± 1.2	7.5 ± 0.4	6.5 ± 0.4	7.7 ± 1.0	6.7 ± 0.3
11S1	8.2 ± 1.6	9.1 ± 1.7	7.2 ± 0.6	8.4 ± 1.3	8.2 ± 0.6
13C1	5.5 ± 1.1	5.8 ± 0.6	5.2 ± 0.5	6.2 ± 0.5	5.0 ± 0.4
13E1	7.2 ± 1.8	8.1 ± 0.5	6.4 ± 0.6	7.8 ± 0.8	6.4 ± 0.6
13S2	10.8 ± 1.5	11.5 ± 0.7	10.5 ± 0.8	11.3 ± 1.2	9.9 ± 1.1
14S1	6.7 ± 0.9	7.2 ± 1.2	6.1 ± 0.4	6.8 ± 1.3	6.6 ± 1.0
15D1	7.7 ± 1.5	8.3 ± 0.9	7.1 ± 0.6	8.3 ± 0.3	7.0 ± 0.7
16F1	7.4 ± 1.3	7.9 ± 0.6	7.0 ± 1.2	8.1 ± 1.1	6.8 ± 0.3
17B1	7.0 ± 1.5	7.7 ± 1.1	6.5 ± 0.7	7.7 ± 0.3	6.3 ± 0.3
18S2	8.1 ± 1.1	8.8 ± 1.0	7.4 ± 1.0	8.1 ± 1.7	8.0 ± 1.7
19D1	7.1 ± 1.3	7.7 ± 0.5	6.6 ± 0.4	7.7 ± 0.4	6.6 ± 0.4
20D1	6.8 ± 1.4	7.5 ± 0.4	6.1 ± 0.6	7.2 ± 1.1	6.3 ± 0.5
20F1	7.1 ± 0.9	7.6 ± 1.7	6.8 ± 1.1	7.4 ± 1.2	6.6 ± 0.4
21S2	6.9 ± 1.3	7.3 ± 1.0	6.5 ± 0.7	7.6 ± 0.5	6.3 ± 0.8
23S2	6.7 ± 1.0	6.9 ± 0.4	6.4 ± 0.3	7.3 ± 0.8	6.2 ± 0.4
24D1	6.6 ± 2.0	6.6 ± 0.8	5.9 ± 0.7	8.0 ± 1.3	5.9 ± 0.5
25D1	5.9 ± 0.9	6.5 ± 0.4	5.6 ± 1.1	6.0 ± 0.7	5.6 ± 0.1
25S2	6.7 ± 1.6	7.6 ± 1.4	6.2 ± 0.4	7.1 ± 0.6	5.9 ± 0.3
26S3	6.5 ± 1.0	7.1 ± 0.5	6.3 ± 0.4	6.7 ± 0.7	6.0 ± 0.7
28D2	6.8 ± 2.0	6.4 ± 0.5	6.7 ± 0.4	8.3 ± 2.7	6.0 ± 0.7
29E1	6.8 ± 1.9	7.6 ± 1.0	5.9 ± 0.5	7.5 ± 0.7	6.0 ± 0.6
29S1	6.4 ± 1.4	7.2 ± 0.9	6.0 ± 0.3	6.8 ± 0.6	5.8 ± 0.7
31D1	8.1 ± 1.3	8.8 ± 0.7	7.4 ± 0.8	8.4 ± 0.7	7.7 ± 0.3
31D2	7.3 ± 1.2	7.9 ± 2.0	6.9 ± 0.7	7.8 ± 0.8	6.7 ± 0.7
31S1	7.3 ± 1.4	8.0 ± 1.5	6.6 ± 0.4	7.9 ± 0.3	6.9 ± 0.5
34E1	7.0 ± 1.2	7.8 ± 1.3	6.7 ± 0.5	7.2 ± 1.0	6.4 ± 0.5
34S2	7.1 ± 1.2	8.0 ± 0.8	6.8 ± 0.4	7.1 ± 0.6	6.6 ± 0.5
36D1	6.7 ± 1.2	7.3 ± 0.6	5.9 ± 0.4	7.0 ± 0.4	6.5 ± 0.5
36S2	7.5 ± 1.0	7.3 ± 0.2	6.9 ± 0.7	8.0 ± 0.7	7.9 ± 1.2

TABLE C-IX.2 **MEAN QUARTERLY TLD RESULTS FOR THE SITE BOUNDARY, MIDDLE AND CONTROL LOCATIONS FOR LIMERICK GENERATING STATION, 2009**

RESULTS IN UNITS OF MILLI-ROENTGEN/STD. MONTH ± 2 STANDARD DEVIATIONS OF THE STATION DATA

COLLECTION PERIOD	SITE BOUNDARY ± 2 S.D.	INTERMEDIATE	CONTROL
JAN-MAR	7.9 ± 2.2	7.4 ± 1.7	8.9 ± 0.0
APR-JUN	6.9 ± 2.1	6.4 ± 1.3	7.9 ± 0.0
JUL-SEP	7.9 ± 2.3	7.6 ± 1.4	9.4 ± 0.0
OCT-DEC	7.0 ± 2.2	6.4 ± 1.2	8.0 ± 0.0

TABLE C-IX.3 **SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR LIMERICK GENERATING STATION, 2009**

RESULTS IN UNITS OF MILLI-ROENTGEN/STD. MONTH

LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
SITE BOUNDARY	64	5.8	11.5	7.4 ± 2.3
INTERMEDIATE	92	4.8	9.1	6.9 ± 1.8
CONTROL	4	7.9	9.4	8.5 ± 1.5

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-3
CONCENTRATIONS OF CS-137 IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 – 2009

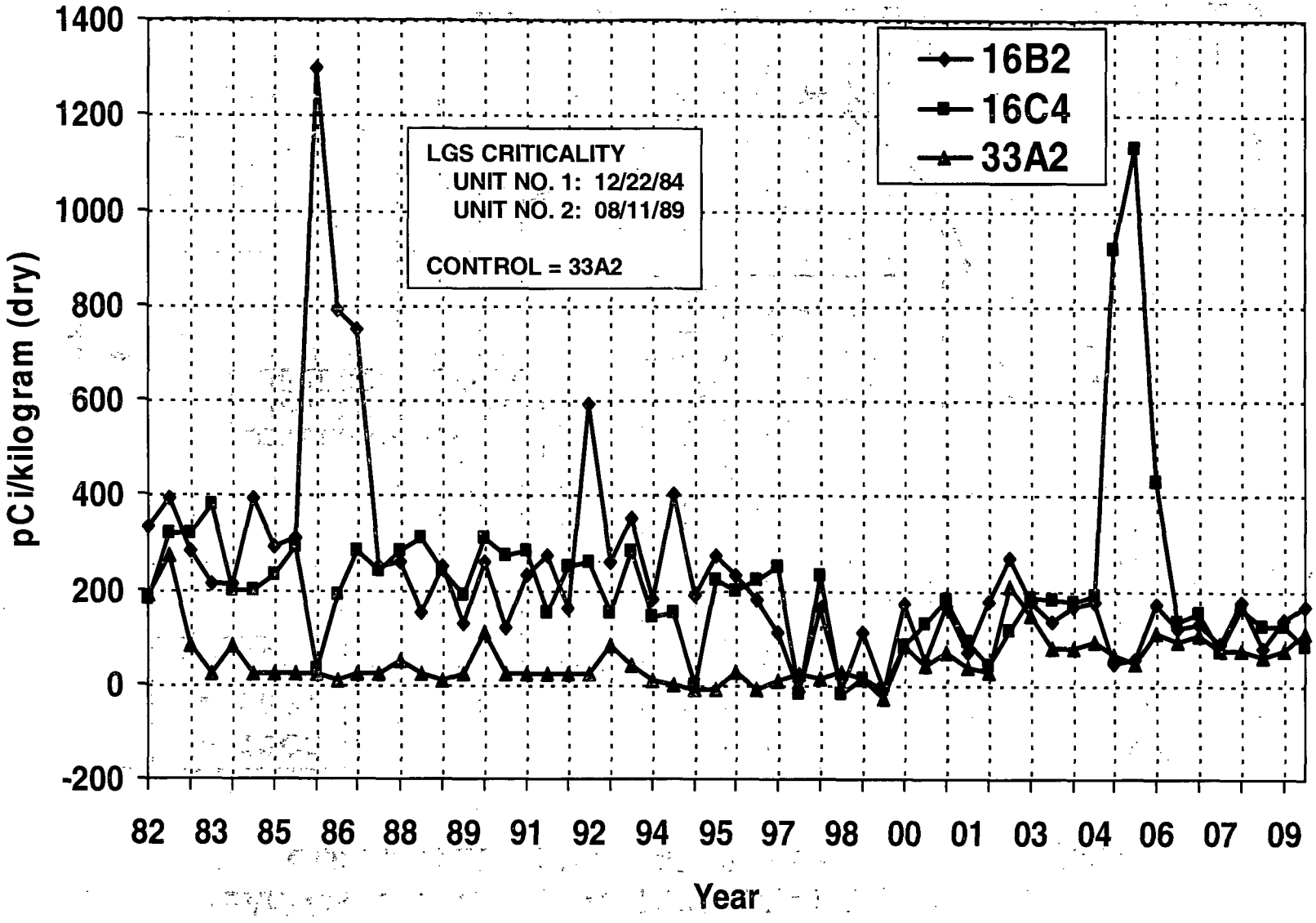


FIGURE C-4
MEAN MONTHLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 1982 – 2009

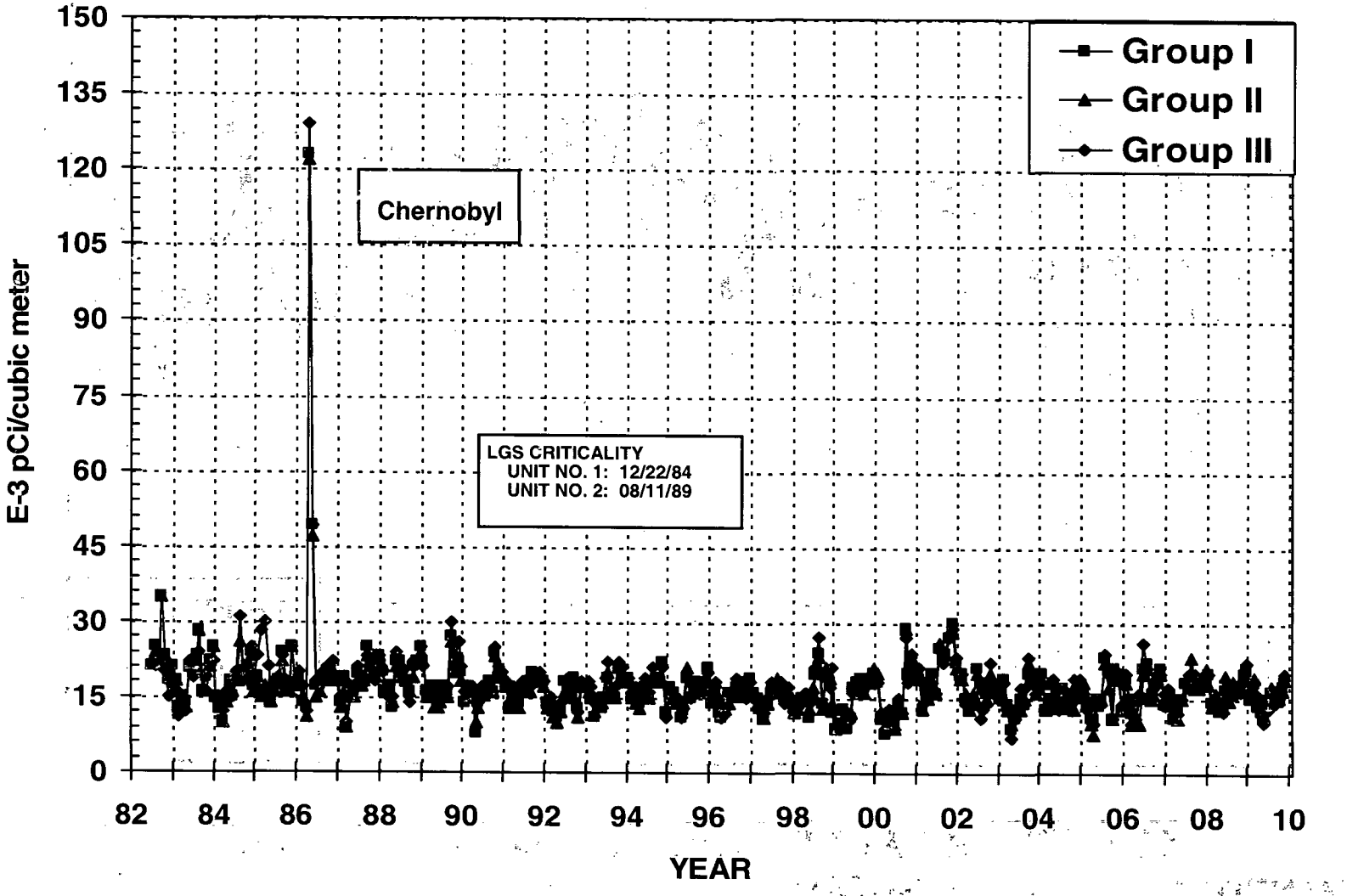


FIGURE C-5
MEAN WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS, 2009

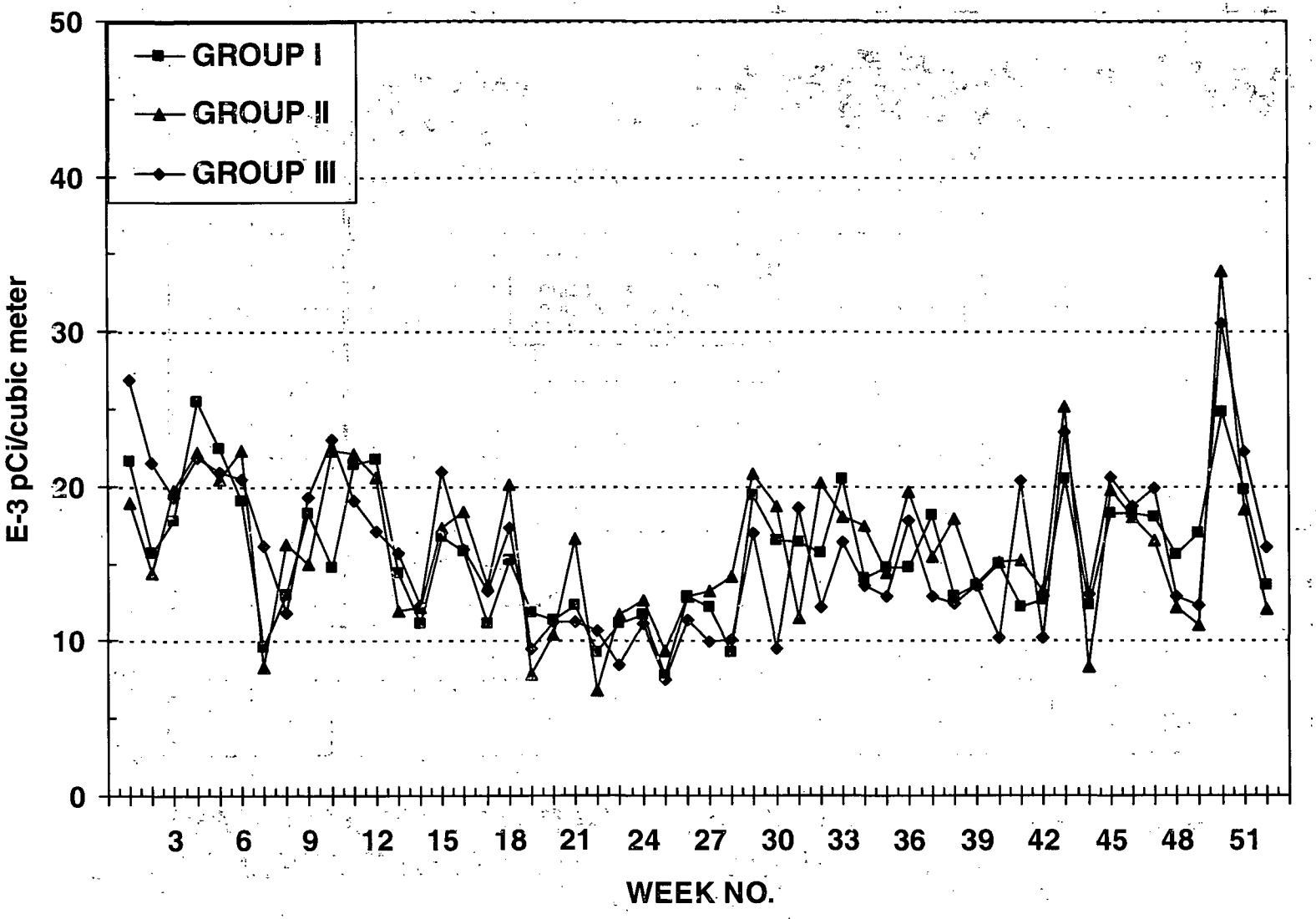
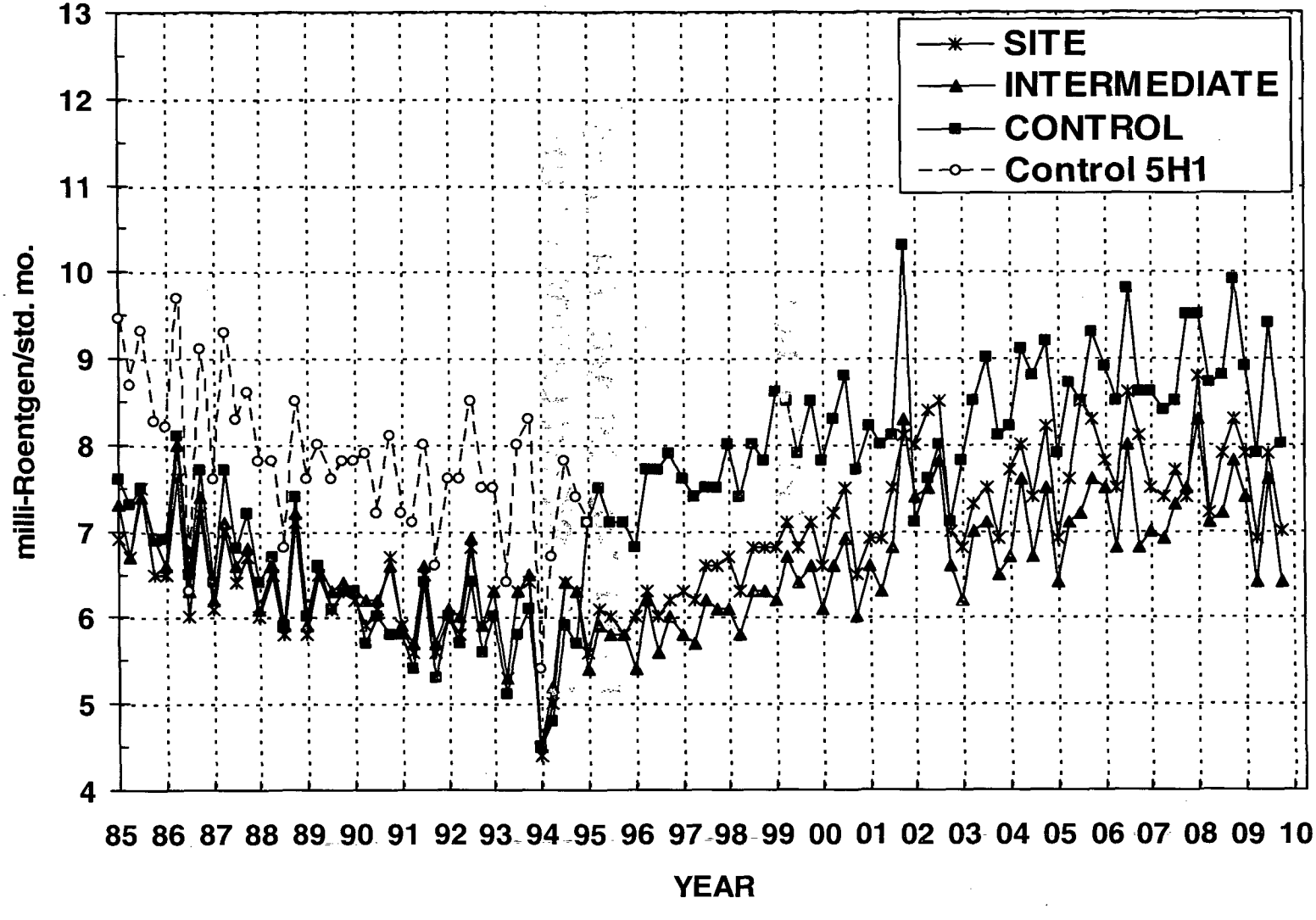


FIGURE C-6
MEAN QUARTERLY AMBIENT GAMMA RADIATION LEVELS (TLD) IN THE VICINITY OF LGS, 1985 – 2009



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

APPENDIX D

DATA TABLES AND FIGURES
COMPARISON LABORATORY

The following section contains data and figures illustrating the analyses performed by the quality control laboratory, Environmental Incorporated (ENV). Duplicate samples were obtained from several locations and media and split between the primary laboratory, Teledyne Brown Engineering (TBE) and ENV. Comparison of the results for most media was within expected ranges.

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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, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/29/08 - 02/03/09	2.3 ± 1.0
02/03/09 - 03/03/09	3.82 ± 1.0
03/03/09 - 03/31/09	0.91 ± 0.5
03/31/09 - 04/28/09	1.82 ± 0.6
04/28/09 - 06/02/09	2.65 ± 1.1
06/02/09 - 06/29/09	1.93 ± 0.8
06/29/09 - 08/04/09	2.95 ± 1.1
08/04/09 - 09/01/09	1.59 ± 0.6
09/01/09 - 09/29/09	2.22 ± 0.8
09/29/09 - 11/02/09	2.24 ± 0.6
11/02/09 - 12/01/09	1.67 ± 0.6
12/01/09 - 12/28/09	1.01 ± 0.6
MEAN	2.1 ± 0.4

TABLE D-I.2 CONCENTRATIONS OF TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	16C2
12/29/08 - 03/31/08	< 148
03/31/08 - 06/29/09	< 148
06/29/09 - 09/29/09	< 148
09/29/09 - 12/28/09	< 150
MEAN	-

TABLE D-I.3 CONCENTRATIONS OF GAMMA EMITTERS IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
16C2	12/29/09 - 02/03/09	< 3	< 3	< 6	< 2	< 5	< 4	< 3	< 5	< 3	< 3	< 17	< 2
	02/03/09 - 03/03/09	< 3	< 1	< 7	< 3	< 5	< 4	< 4	< 3	< 3	< 2	< 12	< 2
	03/03/09 - 03/31/09	< 3	< 3	< 5	< 3	< 4	< 3	< 2	< 3	< 2	< 3	< 11	< 2
	03/31/09 - 04/28/09	< 4	< 3	< 9	< 3	< 8	< 5	< 4	< 4	< 5	< 4	< 11	< 2
	04/28/09 - 06/02/09	< 2	< 2	< 6	< 3	< 5	< 7	< 4	< 7	< 4	< 3	< 19	< 4
	06/02/09 - 06/29/09	< 4	< 3	< 8	< 3	< 8	< 3	< 3	< 6	< 4	< 3	< 14	< 2
	06/29/09 - 08/04/09	< 4	< 2	< 7	< 3	< 4	< 7	< 4	< 8	< 4	< 3	< 16	< 3
	08/04/09 - 09/01/09	< 3	< 2	< 2	< 2	< 3	< 5	< 3	< 4	< 3	< 3	< 12	< 1
	09/01/09 - 09/29/09	< 3	< 2	< 7	< 3	< 7	< 4	< 4	< 4	< 4	< 3	< 14	< 2
	09/29/09 - 11/02/09	< 3	< 4	< 9	< 3	< 5	< 8	< 2	< 5	< 3	< 4	< 19	< 1
	11/02/09 - 12/01/09	< 5	< 4	< 5	< 4	< 6	< 8	< 3	< 4	< 5	< 3	< 14	< 3
	12/01/09 - 12/28/09	< 3	< 3	< 5	< 2	< 4	< 6	< 2	< 6	< 3	< 2	< 16	< 1
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

TABLE D-II.1 CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

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

COLLECTION PERIOD	11S2
12/29/08 - 01/05/09	31 ± 4
01/05/09 - 01/12/09	21 ± 4
01/12/09 - 01/19/09	23 ± 4
01/19/09 - 01/26/09	33 ± 4
01/26/09 - 02/02/09	33 ± 4
02/02/09 - 02/09/09	23 ± 4
02/09/09 - 02/17/09	18 ± 3
02/17/09 - 02/23/09	15 ± 4
02/23/09 - 03/03/09	27 ± 4
03/03/09 - 03/09/09	28 ± 5
03/09/09 - 03/16/09	28 ± 4
03/16/09 - 03/23/09	29 ± 4
03/23/09 - 03/30/09	17 ± 4
03/30/09 - 04/06/09	12 ± 3
04/06/09 - 04/13/09	23 ± 4
04/13/09 - 04/20/09	29 ± 4
04/20/09 - 04/27/09	(1)
04/27/09 - 05/04/09	20 ± 4
05/04/09 - 05/11/09	14 ± 3
05/11/09 - 05/18/09	21 ± 4
05/18/09 - 05/26/09	23 ± 4
05/26/09 - 06/01/09	17 ± 4
06/01/09 - 06/08/09	15 ± 4
06/08/09 - 06/16/09	14 ± 3
06/16/09 - 06/22/09	8 ± 4
06/22/09 - 06/29/09	18 ± 4
06/29/09 - 07/06/09	18 ± 4
07/06/09 - 07/13/09	17 ± 4
07/13/09 - 07/20/09	22 ± 4
07/20/09 - 07/27/09	21 ± 4
07/27/09 - 08/03/09	23 ± 4
08/03/09 - 08/10/09	(1)
08/10/09 - 08/17/09	27 ± 4
08/17/09 - 08/24/09	22 ± 4
08/24/09 - 08/31/09	21 ± 4
08/31/09 - 09/07/09	29 ± 4
09/07/09 - 09/15/09	26 ± 4
09/15/09 - 09/21/09	25 ± 5
09/21/09 - 09/28/09	22 ± 4
09/28/09 - 10/05/09	22 ± 4
10/05/09 - 10/12/09	18 ± 4
10/12/09 - 10/19/09	16 ± 4
10/19/09 - 10/26/09	25 ± 4
10/26/09 - 11/02/09	14 ± 4
11/02/09 - 11/09/09	25 ± 4
11/09/09 - 11/16/09	31 ± 4
11/16/09 - 11/23/09	24 ± 4
11/23/09 - 11/30/09	15 ± 4
11/30/09 - 12/07/09	16 ± 4
12/07/09 - 12/14/09	35 ± 4
12/14/09 - 12/21/09	26 ± 4
12/21/09 - 12/28/09	15 ± 4
MEAN	22 ± 12

(1) See Program Exceptions for Explanation

TABLE D-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

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

STC	COLLECTION PERIOD			Be-7	Mn-54	Co-58	Co-60	Cs-134	Cs-137
11S2	12/29/09	-	03/30/09	84 ± 14	< 0.5	< 0.6	< 0.6	< 0.7	< 0.5
	03/30/09	-	06/29/09	91 ± 17	< 1.1	< 1.1	< 0.8	< 0.9	< 1
	06/29/09	-	09/28/09	103 ± 15	< 0.8	< 0.6	< 0.6	< 0.8	< 0.6
	09/28/09	-	12/28/09	63 ± 14	< 0.5	< 0.9	< 0.9	< 0.6	< 0.5
	MEAN			85 ± 34	-	-	-	-	-

TABLE D-III.1 CONCENTRATIONS OF I-131 BY CHEMICAL SEPARATION AND GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
19B1	01/13/09	< 0.22	1356 ± 126	< 5	< 4	< 19	< 3
	04/07/09	< 0.15	1359 ± 118	< 4	< 4	< 16	< 3
	07/14/09	< 0.15	1290 ± 110	< 3	< 3	< 11	< 2
	10/06/09	< 0.4	1333 ± 120	< 4	< 4	< 13	< 3
	MEAN	-	1335 ± 64	-	-	-	-
10F4	01/13/09	< 0.22	1382 ± 127	< 4	< 3	< 23	< 3
	04/07/09	< 0.16	1398 ± 121	< 5	< 4	< 12	< 4
	07/14/09	< 0.28	1454 ± 43	< 1	< 1	< 6	< 2
	10/06/09	< 0.14	1249 ± 119	< 3	< 3	< 15	< 5
	MEAN	-	1371 ± 173	-	-	-	-
25C1	01/13/09	< 0.21	1419 ± 130	< 4	< 2	< 23	< 3
	04/07/09	< 0.14	1505 ± 105	< 4	< 3	< 16	< 4
	07/14/09	< 0.28	1362 ± 119	< 7	< 6	< 20	< 4
	10/06/09	< 0.25	1459 ± 112	< 4	< 4	< 19	< 3
	MEAN	-	1436 ± 121	-	-	-	-

FIGURE D-1
COMPARISON OF MONTHLY TOTAL GROSS BETA CONCENTRATIONS IN DRINKING WATER SAMPLES SPLIT BETWEEN ENV AND TBE, 2009

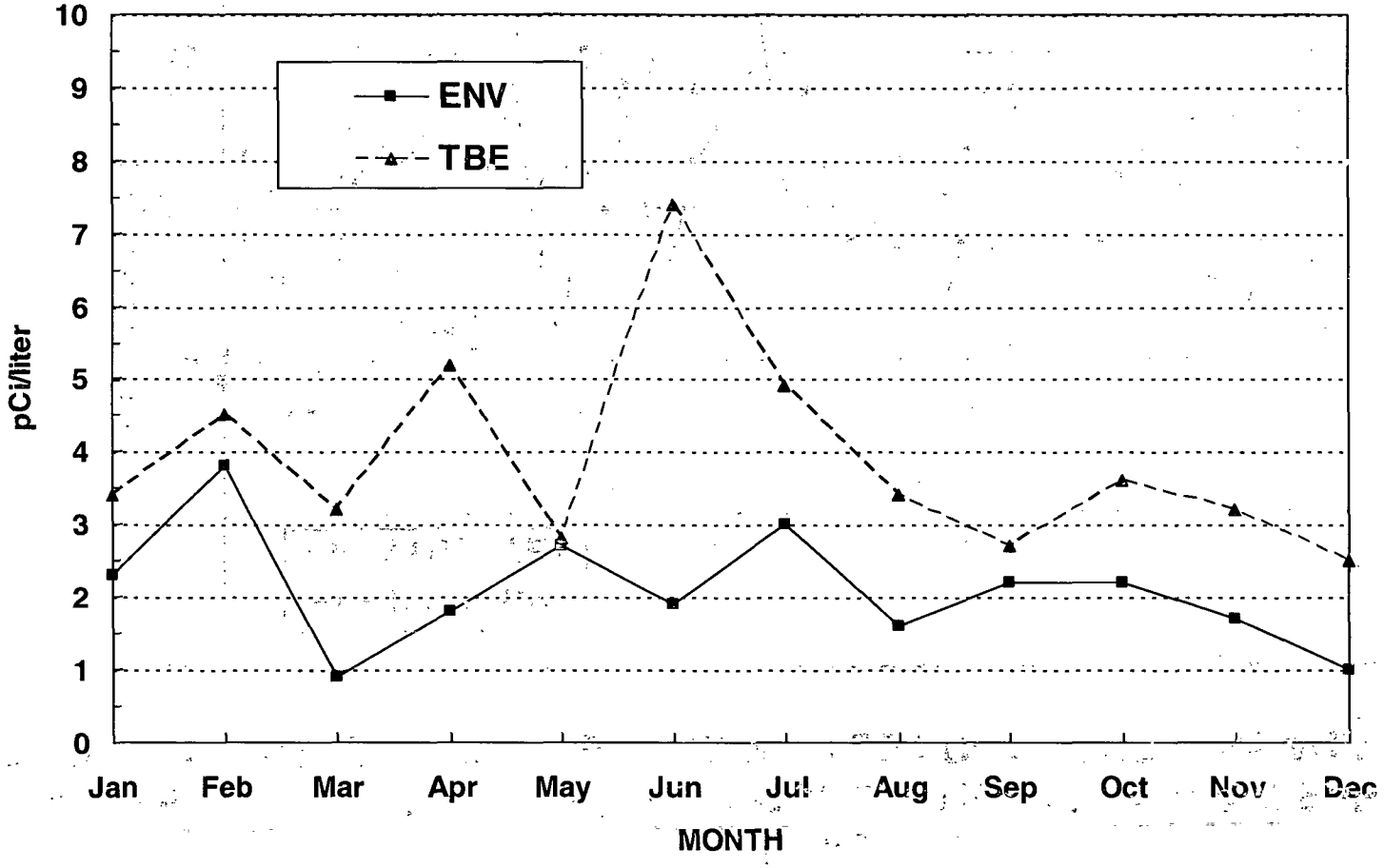
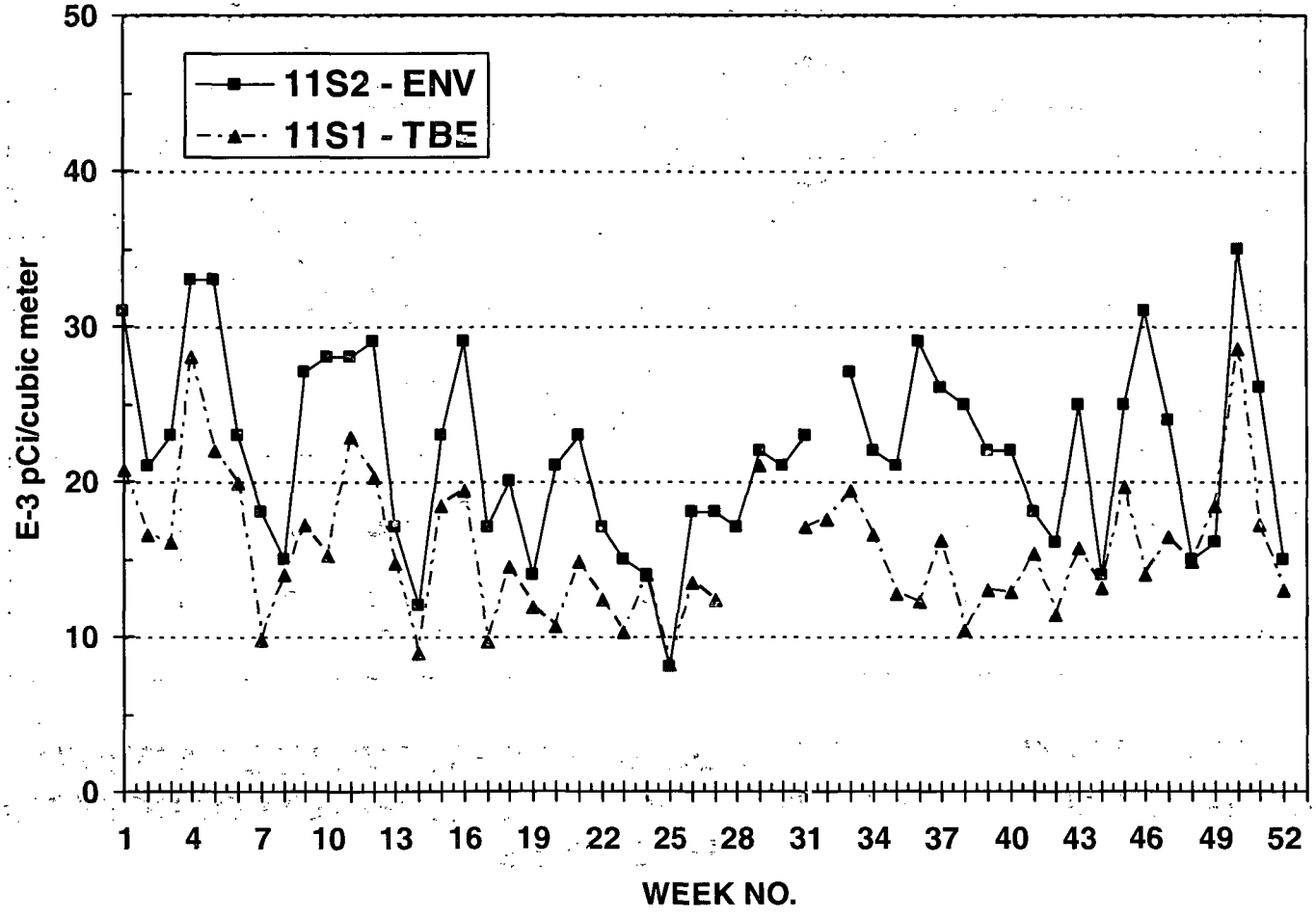


FIGURE D-2
COMPARISON OF WEEKLY GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED FROM LGS COLLOCATED LOCATIONS 11S1 AND 11S2, 2009



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APPENDIX E

INTER-LABORATORY COMPARISON PROGRAM

TABLE E-1 **ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
TELEDYNE BROWN ENGINEERING, 2009
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Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2009	E6533-396	Milk	Sr-89	pCi/L	102	97.7	1.04	A
			Sr-90	pCi/L	14.9	15.6	0.96	A
	E6534-396	Milk	I-131	pCi/L	66.7	79.3	0.84	A
			Ce-141	pCi/L	87.5	94.9	0.92	A
			Cr-51	pCi/L	275	305	0.90	A
			Cs-134	pCi/L	82.0	93.7	0.88	A
			Cs-137	pCi/L	111	111	1.00	A
			Co-58	pCi/L	114	119	0.96	A
			Mn-54	pCi/L	136	128	1.06	A
			Fe-59	pCi/L	112	99.9	1.12	A
			Zn-65	pCi/L	160	156	1.03	A
			Co-60	pCi/L	142	142	1.00	A
	E6536-396	AP	Ce-141	pCi	120	115	1.04	A
			Cr-51	pCi	385	371	1.04	A
			Cs-134	pCi	113	114	0.99	A
			Cs-137	pCi	149	135	1.10	A
			Co-58	pCi	153	145	1.06	A
			Mn-54	pCi	155	155	1.00	A
			Fe-59	pCi	118	121	0.98	A
			Zn-65	pCi	195	189	1.03	A
			Co-60	pCi	190	173	1.10	A
	E6535-396	Charcoal	I-131	pCi	82.8	79.4	1.04	A
June 2009	E6742-396	Milk	Sr-89	pCi/L	107	112	0.96	A
			Sr-90	pCi/L	19.0	16.7	1.14	A
	E6743-396	Milk	I-131	pCi/L	98.1	102.0	0.96	A
			Ce-141	pCi/L	260	284	0.92	A
			Cr-51	pCi/L	389	400	0.97	A
			Cs-134	pCi/L	144	166	0.87	A
			Cs-137	pCi/L	185	192	0.96	A
			Co-58	pCi/L	86.9	91.9	0.95	A
			Mn-54	pCi/L	133	137	0.97	A
			Fe-59	pCi/L	126	122	1.03	A
			Zn-65	pCi/L	173	175	0.99	A
			Co-60	pCi/L	298	312	0.96	A
	E6745-396	AP	Ce-141	pCi	186	163	1.14	A
			Cr-51	pCi	262	231	1.13	A
			Cs-134	pCi	101	95	1.06	A
			Cs-137	pCi	135	111	1.22	W
			Co-58	pCi	61	53	1.16	A
			Mn-54	pCi	83.1	79	1.05	A
			Fe-59	pCi	84	70	1.19	A
			Zn-65	pCi	137	101	1.36	N (1)
			Co-60	pCi	202	180	1.12	A
	E6744-396	Charcoal	I-131	pCi	92.2	95.8	0.96	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2009
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Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
September 2009	E6897-396	Milk	Sr-89	pCi/L	113	107	1.06	A
			Sr-90	pCi/L	17.4	18.8	0.93	A
	E6898-396	Milk	I-131	pCi/L	89.2	98.6	0.90	A
			Ce-141	pCi/L	249	275	0.91	A
			Cr-51	pCi/L	213	221	0.96	A
			Cs-134	pCi/L	104.0	123	0.85	A
			Cs-137	pCi/L	172	185	0.93	A
			Co-58	pCi/L	96.3	99.4	0.97	A
			Mn-54	pCi/L	201	206	0.98	A
			Fe-59	pCi/L	154	147	1.05	A
			Zn-65	pCi/L	213	204	1.04	A
			Co-60	pCi/L	154	160	0.96	A
	E6900-396	AP	Ce-141	pCi	181	161	1.12	A
			Cr-51	pCi	145	130	1.12	A
			Cs-134	pCi	71.8	72	0.99	A
			Cs-137	pCi	115	109	1.06	A
			Co-58	pCi	62	58	1.06	A
			Mn-54	pCi	129	121	1.07	A
			Fe-59	pCi	97	98	0.98	A
			Zn-65	pCi	110	120	0.92	A
			Co-60	pCi	98.7	94.1	1.05	A
	E6899-396	Charcoal	I-131	pCi	89.5	92.3	0.97	A
December 2009	E6946-396	Milk	Sr-89	pCi/L	131	131	1.00	A
			Sr-90	pCi/L	19.3	17.9	1.08	A
	E6947-396	Milk	I-131	pCi/L	79.2	87.3	0.91	A
			Ce-141	pCi/L	193	202	0.96	A
			Cr-51	pCi/L	512	548	0.93	A
			Cs-134	pCi/L	222	253	0.88	A
			Cs-137	pCi/L	163	179	0.91	A
			Co-58	pCi/L	200	211	0.95	A
			Mn-54	pCi/L	178	178	1.00	A
			Fe-59	pCi/L	176	178	0.99	A
			Zn-65	pCi/L	326	345	0.94	A
			Co-60	pCi/L	240	256	0.94	A
	E6949-396	AP	Ce-141	pCi	103	103	1.00	A
			Cr-51	pCi	290	280	1.04	A
			Cs-134	pCi	116	129	0.90	A
			Cs-137	pCi	93.4	91.5	1.02	A
			Co-58	pCi	111	108	1.03	A
			Mn-54	pCi	81.0	90.8	0.89	A
			Fe-59	pCi	106	90.8	1.17	A
			Zn-65	pCi	155	176	0.88	A
			Co-60	pCi	135	131	1.03	A

TABLE E-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2009
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2009	E6948-396	Charcoal	I-131	pCi	93.3	93.9	0.99	A

(1) Detector 7 appears to have a slightly high bias. Detector 7 was removed from service until it can be recalibrated. NCR 09-23

(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, 2009
(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Control Limits	Evaluation (c)
April 2009	RAD 77	Water	Sr-89	pCi/L	57.4	48.3	37.8 - 55.7	N (1)
			Sr-90	pCi/L	30.6	31.4	22.9 - 36.4	A
			Ba-133	pCi/L	55.2	52.7	43.4 - 58.3	A
			Cs-134	pCi/L	65.8	72.9	59.5 - 80.2	A
			Cs-137	pCi/L	157	168	151 - 187	A
			Co-60	pCi/L	86.4	88.9	80.0 - 100	A
			Zn-65	pCi/L	85.5	84.4	76.0 - 101	A
			Gr-A	pCi/L	47.7	54.2	28.3 - 67.7	A
			Gr-B	pCi/L	45.2	43.5	29.1 - 50.8	A
			I-131	pCi/L	25.2	26.1	21.7 - 30.8	A
			H-3	pCi/L	19733	20300	17800 - 22300	A
October 2009	RAD 79	Water	Sr-89	pCi/L	64.75	62.2	50.2 - 70.1	A
			Sr-90	pCi/L	30.30	30.7	22.4 - 35.6	A
			Ba-133	pCi/L	97.9	92.9	78.3 - 102	A
			Cs-134	pCi/L	76.8	79.4	65.0 - 87.3	A
			Cs-137	pCi/L	59.9	54.6	49.1 - 62.9	A
			Co-60	pCi/L	121	117	105 - 131	A
			Zn-65	pCi/L	115	99.5	89.6 - 119	A
			Gr-A	pCi/L	19.6	23.2	11.6 - 31.1	A
			Gr-B	pCi/L	28.5	26.0	16.2 - 33.9	A
			I-131	pCi/L	22.1	22.2	18.4 - 26.5	A
			H-3	pCi/L	16133	16400	14300 - 18000	A

(1) Calculation did not allow for Y-90 ingrowth on the Sr-89 mount. NCR 09-14

(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, 2009
(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2009	09-MaW20	Water	Cs-134	Bq/L	18.8	22.5	18.5 - 29.3	A
			Cs-137	Bq/L	0.06		(1)	A
			Co-57	Bq/L	17.0	18.9	13.2 - 24.6	A
			Co-60	Bq/L	16.1	17.21	12.1 - 22.4	A
			H-3	Bq/L	332	330.9	232 - 430	A
			Mn-54	Bq/L	13.8	14.7	10.3 - 19.1	A
			Sr-90	Bq/L	6.88	7.21	5.05- 9.37	A
			Zn-65	Bq/L	13.2	13.6	9.5 - 17.7	A
	09-GrW20	Water	Gr-A	Bq/L	0.53	0.635	>0.0 - 1.27	A
			Gr-B	Bq/L	1.87	1.27	0.64 - 1.91	A
	09-MaS20	Soil	Cs-134	Bq/kg	433	467	327 - 607	A
			Cs-137	Bq/kg	649	605	424 - 787	A
			Co-57	Bq/kg	-0.120		(1)	A
			Co-60	Bq/kg	3.91	4.11	(2)	A
			Mn-54	Bq/kg	339	307	215 - 399	A
			K-40	Bq/kg	644	570	399 - 741	A
			Sr-90	Bq/kg	245	257	180 - 334	A
			Zn-65	Bq/kg	272	242	169 - 315	A
	09-RdF20	AP	Cs-134	Bq/sample	2.77	2.93	2.05 - 3.81	A
			Cs-137	Bq/sample	1.41	1.52	1.06 - 1.98	A
			Co-57	Bq/sample	1.24	1.30	0.91 - 1.69	A
			Co-60	Bq/sample	1.33	1.22	0.85 - 1.59	A
			Mn-54	Bq/sample	2.42	2.27	1.59 - 2.95	A
			Sr-90	Bq/sample	0.71	0.64	0.45 - 0.83	A
			Zn-65	Bq/sample	1.30	1.36	0.95 - 1.77	A
	09-GrF20	AP	Gr-A	Bq/sample	0.19	0.35	>0.0 - 0.7	A
			Gr-B	Bq/sample	0.31	0.28	0.14 - 0.42	A
March 2009	09-RdV20	Vegetation	Cs-134	Bq/sample	3.48	3.40	2.38 - 4.42	A
			Cs-137	Bq/sample	1.15	0.93	0.65 - 1.21	W
			Co-57	Bq/sample	3.12	2.36	1.65 - 3.07	N (3)
			Co-60	Bq/sample	-0.01		(1)	A
			Mn-54	Bq/sample	2.98	2.30	1.61 - 2.99	W
			K-40	Bq/sample	64.1		(4)	
			Sr-90	Bq/sample	1.09	1.26	0.88 - 1.64	A
			Zn-65	Bq/sample	1.73	1.35	0.95 - 1.76	W
September 2009	09-MaW21	Water	Cs-134	Bq/L	26.5	32.2	22.5 - 41.9	A
			Cs-137	Bq/L	37.2	41.2	28.8 - 53.6	A
			Co-57	Bq/L	32.2	36.6	25.6 - 47.6	A
			Co-60	Bq/L	14.0	15.40	10.8 - 20.0	A
			H-3	Bq/L	705	634.1	443.9 - 824.3	A
			Mn-54	Bq/L	-0.1015		(1)	A
			Sr-90	Bq/L	13.9	12.99	9.09- 16.89	A
			Zn-65	Bq/L	26.2	26.9	18.8 - 35.0	A
	09-GrW21	Water	Gr-A	Bq/L	1.27	1.047	>0.0 - 2.09	A
			Gr-B	Bq/L	9.70	7.53	3.77 - 11.30	A

TABLE E-3 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING, 2009
(PAGE 2 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2009	09-MaS21	Soil	Am-241	Bq/kg	74.7	89.8	62.9 - 116.7	A
			Cs-134	Bq/kg	0.6		(1)	A
			Cs-137	Bq/kg	706	669	468 - 870	A
			Co-57	Bq/kg	606	586	410 - 762	A
			Co-60	Bq/kg	350	327.000	229 - 425	A
			Mn-54	Bq/kg	876	796	557 - 1035	A
			K-40	Bq/kg	425	375	263 - 488	A
			Sr-90	Bq/kg	505	455	319 - 592	A
			Zn-65	Bq/kg	1370	1178	825 - 1531	A
	09-RdF21	AP	Cs-134	Bq/sample	-0.02		(1)	A
			Cs-137	Bq/sample	1.4	1.4	0.98 - 1.82	A
			Co-57	Bq/sample	5.98	6.48	4.54 - 8.42	A
			Co-60	Bq/sample	1.01	1.03	0.72 - 1.34	A
			Mn-54	Bq/sample	5.16	5.49	3.84 - 7.14	A
			Sr-90	Bq/sample	0.93	0.08	0.59 - 1.09	A
			Zn-65	Bq/sample	4.39	3.93	2.75 - 5.11	A
	09-GrF21	AP	Gr-A	Bq/sample	0.36	0.66	>0.0 - 1.32	A
			Gr-B	Bq/sample	1.40	1.32	0.66 - 1.98	A
	09-RdV21	Vegetation	Cs-134	Bq/sample	-0.0027		(1)	A
			Cs-137	Bq/sample	2.36	2.43	1.70 - 3.16	A
			Co-60	Bq/sample	2.58	2.57	1.80 - 3.34	A
			Mn-54	Bq/sample	8.36	7.9	5.5 - 10.3	A
			K-40	Bq/sample	57.8		(4)	
			Sr-90	Bq/sample	1.73	1.78	1.25 - 2.31	A
			Zn-65	Bq/sample	-0.59		(1)	A

(1) False positive test.
(2) Sensitivity evaluation.
(3) Homogeneity problem. MAPEP requires using entire sample but due to geometry limitations we can only use part of the sample. NCR 09-13
(4) Not evaluated by MAPEP.
(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., 2009

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result[b]	ERA Result[c]	Control Limits	Acceptance
STW-1181	04/06/09	Sr-89	41.0 ± 5.8	48.3	37.8 - 55.7	Pass
STW-1181	04/06/09	Sr-90	32.4 ± 2.4	31.4	22.9 - 36.4	Pass
STW-1182	04/06/09	Ba-133	44.6 ± 3.1	52.7	43.4 - 58.3	Pass
STW-1182	04/06/09	Co-60	81.0 ± 3.1	88.9	80.0 - 100.0	Pass
STW-1182	04/06/09	Cs-134	65.6 ± 5.2	72.9	59.5 - 80.2	Pass
STW-1182 [d]	04/06/09	Cs-137	147.7 ± 5.3	168.0	151.0 - 187.0	Fail
STW-1182	04/06/09	Zn-65	79.8 ± 7.5	84.4	76.0 - 101.0	Pass
STW-1183	04/06/09	Gr. Alpha	47.6 ± 2.1	54.2	28.3 - 67.7	Pass
STW-1183	04/06/09	Gr. Beta	38.5 ± 1.3	43.5	29.1 - 50.8	Pass
STW-1184	04/06/09	I-131	24.4 ± 2.5	26.1	21.7 - 30.8	Pass
STW-1186 [e]	04/06/09	H-3	22819.0 ± 453.0	20300.0	17800.0 - 22300.0	Fail
STW-1193	10/05/09	Sr-89	53.0 ± 6.0	62.2	50.2 - 70.1	Pass
STW-1193	10/05/09	Sr-90	31.1 ± 2.2	30.7	22.4 - 35.6	Pass
STW-1194	10/05/09	Ba-133	82.5 ± 3.5	92.9	78.3 - 102.0	Pass
STW-1194	10/05/09	Co-60	116.8 ± 3.3	117.0	105.0 - 131.0	Pass
STW-1194	10/05/09	Cs-134	78.8 ± 5.7	78.8	65.0 - 87.3	Pass
STW-1194	10/05/09	Cs-137	54.2 ± 3.7	54.6	49.1 - 62.9	Pass
STW-1194	10/05/09	Zn-65	102.5 ± 6.2	99.5	89.6 - 119.0	Pass
STW-1195	10/05/09	Gr. Alpha	20.3 ± 2.0	23.2	11.6 - 31.1	Pass
STW-1195	10/05/09	Gr. Beta	23.7 ± 1.4	26.0	16.2 - 33.9	Pass
STW-1196	10/05/09	I-131	22.4 ± 1.4	22.2	18.4 - 26.5	Pass
STW-1198	10/05/09	H-3	17228.0 ± 694.0	16400.0	14300.0 - 18000.0	Pass

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

[d] *All gamma -emitters showed a low bias. A large plastic burr found on the base of the Marinelli kept the beaker from sitting directly on the detector. Result of recount in a different beaker, Cs-137, 155.33 ± 14.55 pCi/L.*

[e] *Samples were recounted and also reanalyzed. A recount of the original vials averaged 23,009 pCi/L. Reanalysis results were acceptable, 19,170 pCi/L.*

TABLE E-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)[a] ENVIRONMENTAL, INC., 2009

			Concentration[b]			
Lab Code[c]	Date	Analysis	Laboratory result	Known Activity	Control Limits[d]	Acceptance
STW-1170	01/01/09	Co-57	19.6 ± 0.4	18.9	13.2 - 24.6	Pass
STW-1170	01/01/09	Co-60	16.6 ± 0.3	17.2	12.1 - 22.4	Pass
STW-1170	01/01/09	Cs-134	20.4 ± 0.5	22.5	15.8 - 29.3	Pass
STW-1170[e]	01/01/09	Cs-137	0.1 ± 0.2	0.0	0.0 - 1.0	Pass
STW-1170	01/01/09	H-3	359.9 ± 33.9	330.9	231.6 - 430.2	Pass
STW-1170	01/01/09	Mn-54	15.0 ± 0.4	14.7	10.3 - 19.1	Pass
STW-1170	01/01/09	Sr-90	7.9 ± 1.4	7.2	5.1 - 9.4	Pass
STW-1170	01/01/09	Zn-65	14.0 ± 0.7	13.6	9.5 - 17.7	Pass
STW-1171	01/01/09	Gr. Alpha	0.56 ± 0.06	0.64	0.00 - 1.27	Pass
STW-1171	01/01/09	Gr. Beta	1.29 ± 0.05	1.27	0.64 - 1.91	Pass
STSO-1172[e]	01/01/09	Co-57	0.0 ± 0.0	0.0	0.0 - 1.0	Pass
STSO-1172	01/01/09	Cs-134	458.6 ± 7.4	467.0	327.0 - 607.0	Pass
STSO-1172	01/01/09	Cs-137	652.3 ± 3.5	605.0	424.0 - 787.0	Pass
STSO-1172	01/01/09	K-40	636.4 ± 9.5	570.0	360.4 - 669.4	Pass
STSO-1172	01/01/09	Mn-54	346.4 ± 3.1	307.0	215.0 - 399.0	Pass
STSO-1172	01/01/09	Sr-90	180.6 ± 12.1	257.0	180.0 - 334.0	Pass
STSO-1172	01/01/09	Zn-65	268.3 ± 4.0	242.0	169.0 - 315.0	Pass
STVE-1173	01/01/09	Co-57	2.75 ± 0.11	2.36	1.65 - 3.07	Pass
STVE-1173[e]	01/01/09	Co-60	0.06 ± 0.09	0.00	0.00 - 1.00	Pass
STVE-1173	01/01/09	Cs-134	3.49 ± 0.22	3.40	2.38 - 4.42	Pass
STVE-1173	01/01/09	Cs-137	1.01 ± 0.11	0.93	0.65 - 1.21	Pass
STVE-1173	01/01/09	Mn-54	2.52 ± 0.14	2.30	1.61 - 2.99	Pass
STVE-1173	01/01/09	Zn-65	1.52 ± 0.18	1.35	0.95 - 1.76	Pass
STAP-1174	01/01/09	Co-57	1.25 ± 0.05	1.30	0.91 - 1.69	Pass
STAP-1174	01/01/09	Co-60	1.17 ± 0.06	1.22	0.85 - 1.59	Pass
STAP-1174	01/01/09	Cs-134	2.67 ± 0.14	2.93	2.05 - 3.81	Pass
STAP-1174	01/01/09	Cs-137	1.53 ± 0.08	1.52	1.06 - 1.98	Pass
STAP-1174	01/01/09	Mn-54	2.34 ± 0.09	2.27	1.59 - 2.95	Pass
STAP-1174[f]	01/01/09	Sr-90	0.93 ± 0.14	0.64	0.45 - 0.83	Fail
STAP-1174	01/01/09	Zn-65	1.44 ± 0.14	1.36	0.95 - 1.77	Pass
STAP-1175	01/01/09	Gr. Alpha	0.22 ± 0.03	0.35	0.00 - 0.70	Pass
STAP-1175	01/01/09	Gr. Beta	0.36 ± 0.04	0.28	0.14 - 0.42	Pass
STW-1192	07/01/09	Co-57	37.2 ± 1.5	36.60	25.6 - 47.6	Pass
STW-1192	07/01/09	Co-60	15.1 ± 0.9	15.40	10.8 - 20.0	Pass
STW-1192	07/01/09	Cs-134	30.3 ± 2.1	32.20	22.5 - 41.9	Pass
STW-1192	07/01/09	Cs-137	41.9 ± 1.8	41.20	28.8 - 53.6	Pass
STW-1192	07/01/09	H-3	680.3 ± 33.6	634.10	443.9 - 824.3	Pass
STW-1192[e]	07/01/09	Mn-54	0.01 ± 0.26	0.00	0.0 - 1.0	Pass
STW-1192	07/01/09	Sr-90	12.9 ± 1.7	12.99	9.1 - 16.9	Pass
STW-1192	07/01/09	Zn-65	28.5 ± 2.4	26.90	18.8 - 35.0	Pass

TABLE E-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)[a] ENVIRONMENTAL, INC., 2009

(Page 2 of 2)

			Concentration [b]			
Lab Code [c]	Date	Analysis	Laboratory result	Known Activity	Control Limits [d]	Acceptance
STW-1191	07/01/09	Gr. Alpha	0.88 ± 0.07	1.05	0 - 2.1	Pass
STW-1191	07/01/09	Gr. Beta	7.29 ± 0.10	7.53	3.77 - 11.3	Pass
STSO-1188	07/01/09	Co-57	674.60 ± 9.00	586	410 - 762	Pass
STSO-1188	07/01/09	Co-60	356.40 ± 6.30	327	229 - 425	Pass
STSO-1188	07/01/09	Cs-134	0.20 ± 1.90	0	0 - 1.0	Pass
STSO-1188	07/01/09	Cs-137	767.50 ± 12.00	669	468 - 870	Pass
STSO-1188	07/01/09	K-40	433.00 ± 37.20	375	263 - 488	Pass
STSO-1188	07/01/09	Mn-54	931.60 ± 14.10	796	557 - 1035	Pass
STSO-1188 [g]	07/01/09	Sr-90	310.50 ± 12.20	455	319 - 592	Fail
STSO-1188	07/01/09	Zn-65	1433.90 ± 25.20	1178	825 - 1531	Pass
STVE-1190	07/01/09	Co-57	8.90 ± 0.60	8.00	5.60 - 10.40	Pass
STVE-1190	07/01/09	Co-60	2.50 ± 0.36	2.57	1.80 - 3.34	Pass
STVE-1190	07/01/09	Cs-134	0.01 ± 0.11	0.00	0 - 0.10	Pass
STVE-1190	07/01/09	Cs-137	2.42 ± 0.16	2.43	1.70 - 3.16	Pass
STVE-1190	07/01/09	Mn-54	8.35 ± 0.70	7.90	5.50 - 10.30	Pass
STVE-1190	07/01/09	Zn-65	0.01 ± 0.26	0.00	0 - 0.10	Pass
STAP-1189	07/01/09	Gr. Alpha	0.33 ± 0.04	0.66	0 - 1.32	Pass
STAP-1189	07/01/09	Gr. Beta	1.57 ± 0.07	1.32	0.66 - 1.98	Pass
STAP-1190	07/01/09	Co-57	6.78 ± 0.27	6.48	4.54 - 8.42	Pass
STAP-1190	07/01/09	Co-60	1.06 ± 0.18	1.03	0.72 - 1.34	Pass
STAP-1190	07/01/09	Cs-134	0.01 ± 0.06	0.00	0.01 - 0.05	Pass
STAP-1190	07/01/09	Cs-137	1.49 ± 0.27	1.40	0.98 - 1.82	Pass
STAP-1190	07/01/09	Mn-54	6.00 ± 0.45	5.49	3.84 - 7.14	Pass
STAP-1190	07/01/09	Sr-90	0.79 ± 0.13	0.84	0.59 - 1.09	Pass
STAP-1190	07/01/09	Zn-65	4.55 ± 0.66	3.93	2.75 - 5.11	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho

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

[c] Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation).

[d] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP.

[e] Included in the testing series as a "false positive".

[f] No reason was determined for the initial high results. The analysis was repeated; result of reanalysis; 0.54 ± 0.12 Bq/filter.

[g] Incomplete separation of strontium from calcium could result in a higher recovery percentage and consequently lower reported activity. The analysis was repeated; result of reanalysis 363.3 ± 28.6 Bq/kg.

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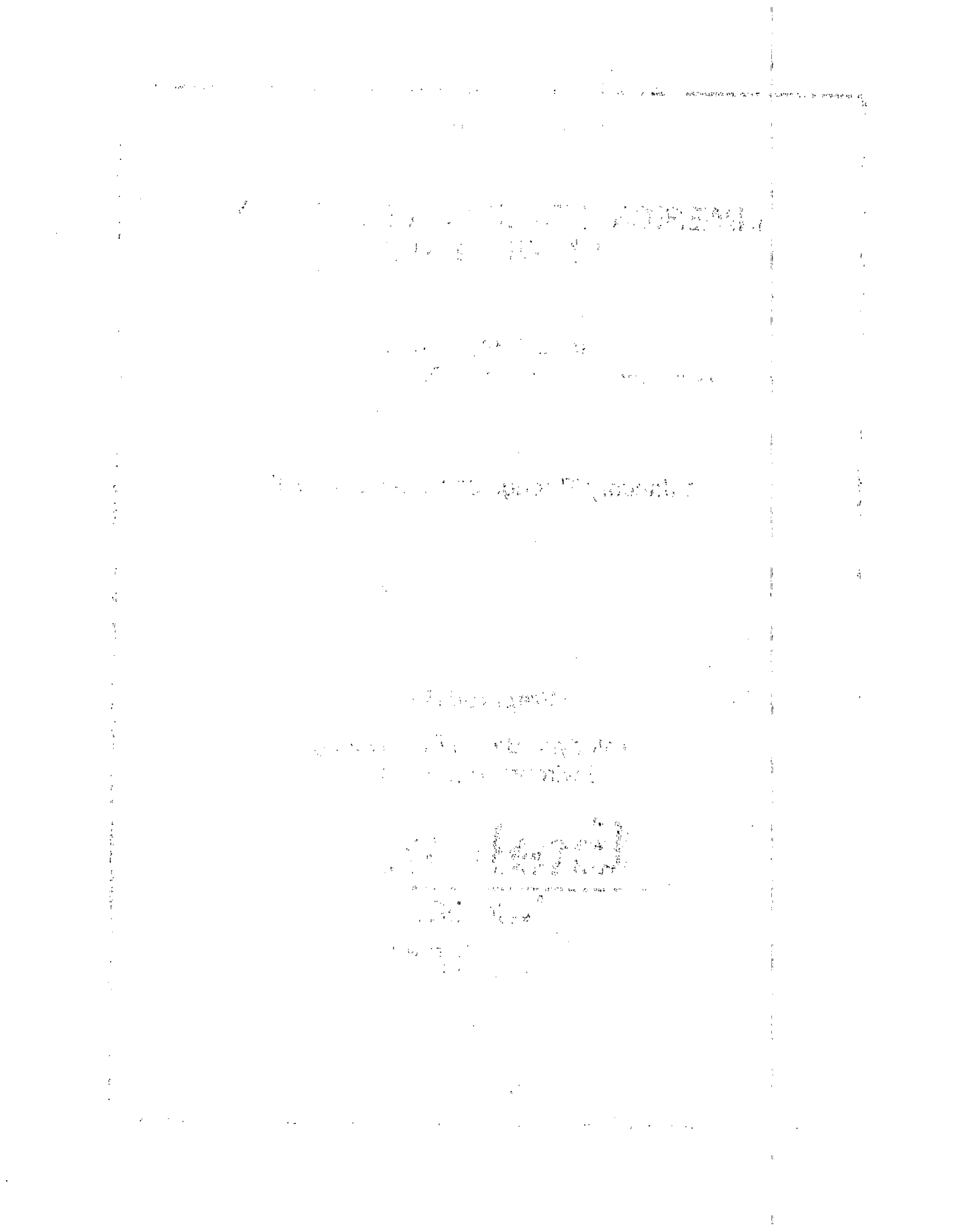
APPENDIX F

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)



Docket No: 50 – 352
50 – 353

LIMERICK GENERATING STATION
UNITS 1 and 2

Annual Radiological
Groundwater Protection Program Report

1 January Through 31 December 2009

Prepared By

Teledyne Brown Engineering
Environmental Services

Exelon SM
Nuclear

Limerick Generating
Sanatoga, PA

April 2010

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Appendices

I. Summary and Conclusions

This report on the Radiological Groundwater Protection Program (RGPP) conducted for the Limerick Generating Station (LGS) by Exelon Nuclear covers the period 01 January 2008 through 31 December 2008. During that time period, 264 analyses were performed on 44 samples from 15 groundwater and 7 surface water locations collected from the environment, both on and off station property in 2009.

There was one known release into the groundwater at the Limerick Generating Station that occurred from a leak from the exterior walls of both U1 and U2 condenser bays. The condensation was observed dripping directly to open ground and asphalt. One well (LM-MW-9) located near the Unit 1 Condensate Storage Tank had a tritium value as high as 1750 pCi/L.

Tritium was not detected in any of the groundwater or surface water samples at concentrations greater 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 15 groundwater monitoring locations. The tritium concentrations ranged from 189 to 1750 pCi/L.

Strontium-90 was not detected in either the groundwater or surface water samples.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions performed on groundwater surface water samples during the second sampling in 2009. Gross Alpha (dissolved) was detected in 9 of 15 groundwater and 1 of 7 surface water locations. The concentrations ranged from 2.1 to 9.1 pCi/L. Gross Alpha (suspended) was detected in 5 of 15 groundwater locations. The concentrations ranged from 1.6 to 7.5 pCi/L. Gross Beta (dissolved) was detected in all 15 groundwater and 6 of 7 surface water locations. The concentrations ranged from 2.6 to 17 pCi/L. Gross Beta (suspended) was detected in 3 of 15 locations. The concentrations ranged from 4.3 to 11 pCi/L.

Gamma-emitting radionuclides associated with licensed plant operations were not detected in either groundwater or surface water samples.

Hard-To-Detect analyses were performed on a select group of groundwater locations to establish background levels. The analyses included Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-233/234, U-235 and U-238. The isotopes of U-233/234 and U-238 were detected in four of five groundwater monitoring locations. The U-233/234 concentrations ranged from 0.9 to 2.3 pCi/L and the U-238 concentrations ranged from 0.5 to 1.8 pCi/L. The levels detected are considered background.

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

Although no drinking water pathway is available from groundwater, the dose via the drinking water pathway was calculated at 0.181 mrem to a child (total body), which was 3.20% of the 10 CFR 50, Appendix I dose limit.

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 3458 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 2009.

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 as well as the public on an Exelon web site in station specific reports. www.exeloncorp.com/ourcompanies/powergen/nuclear/Tritium.htm

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 implemented new 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 2009. 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.

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 2009.

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

1. Concentrations of tritium in groundwater and surface water.

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

3. Concentrations of gamma emitters in groundwater and surface water.

4. Concentrations of strontium in groundwater and surface water.

5. Concentrations of Am-241 in groundwater.

6. Concentrations of Cm-242 and Cm-243/244 in groundwater.

7. Concentrations of Pu-238 and PU-239/240 in groundwater.

8. Concentrations of U-233/234, U-235 and U-238 in groundwater.

9. Concentrations of Fe-55 in groundwater.

10. Concentrations of Ni-63 in groundwater.

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 world wide since 1960. RadNet provides tritium precipitation concentration data for samples collected at stations through out 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

Gamma spectroscopy results for groundwater and surface water sample were reported for twelve nuclides (Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140 and La-140).

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 fifteen locations were analyzed for tritium activity (Table B–I.1, Appendix B). Tritium values ranged from non detectable to 1,750 pCi/L. Well MW-LR-9 had the highest value of 1,750 pCi/L. Although no drinking water pathway is available from groundwater, the theoretical dose via the drinking water pathway was calculated at 0.181 mrem to a child (total body), which represents 3.02% of the 10 CFR 50, Appendix I dose limit of 6 mrem.

Strontium

No Sr-90 activity was detected in any of the ground water samples analyzed (Table B–I.1, Appendix B).

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater surface water samples during the second sampling in 2009. Gross Alpha (dissolved) was detected in 9 of 15 groundwater locations. The concentrations ranged from 2.1 to 9.1 pCi/L. Gross Alpha (suspended) was detected in 5 of 15 groundwater locations. The concentrations ranged from 1.6 to 7.5 pCi/L. Gross Beta (dissolved) was detected in all 15 groundwater locations. The concentrations ranged from 2.6 to 17 pCi/L. Gross Beta (suspended) was detected in 3 of 15 groundwater locations. The concentrations ranged from 4.3 to 11 pCi/L (Table B-I.1, Appendix B).

Gamma Emitters

Potassium-40 was detected on three of 15 groundwater locations with a range of 72 to 120 pCi/L. No other gamma emitting nuclides were detected (Table B-I.2, Appendix B).

Hard-To-Detect

Hard-To-Detect analyses were performed on a select group of groundwater locations to establish background levels. The analyses included Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-233/234, U-235 and U-238. The isotopes of U-233/234 and U-238 were detected in four of five groundwater monitoring locations. The U-233/234 concentrations ranged from 0.9 to 2.3 pCi/L and the U-238 concentrations ranged from 0.5 to 1.8 pCi/L (Table B-I.3, Appendix B). The concentrations detected are considered background.

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

B. Surface Water Results

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

Tritium

Samples from seven locations were analyzed for tritium activity Tritium activity was detected in station SW-LR-8 at a concentration of 198 pCi/Liter (Table B-II.1, Appendix B).

Strontium

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

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on surface water samples during the second sampling in 2009. Gross Alpha (dissolved) was detected in one of seven surface water locations. The concentration was 3.9 pCi/L. Gross Alpha and Gross Beta (suspended) was not detected in any surface water location. Gross Beta (dissolved) was detected in six of seven surface water locations. The concentrations ranged from 2.6 to 17 pCi/L (Table B-II.1, Appendix B).

Gamma Emitters

No gamma emitting nuclides were detected (Table B–II.2, Appendix B).

C. 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 blow 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.

D. Summary of Results – Inter-Laboratory Comparison Program

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

E. Leaks, Spills, and Releases

On February 13, 2009 a leak from the exterior walls of both U1 and U2 condenser bays was discovered via operator rounds (IR880716). The condensation was observed dripping directly to open ground and asphalt. Water samples were collected and analyzed for gamma isotopic and tritium. No gamma emitting nuclides were identified; however, tritium was identified at a concentration of 3.90E-03 uCi/ml (3.90E+06 pCi/L).

Sampling of NPDES outfalls verified that no offsite release of tritium occurred. The release to ground occurred for up to six days until catch containments were installed. The total release of tritium to the ground was conservatively estimated at 1.23E-03 Curies. Groundwater sampling, as part of the radiological groundwater protection program (RGPP), has identified tritium in one down gradient well, MW-LM-9, at a maximum concentration of 1750 pCi/L, which is below the environmental lower limit of detection (LLD) of 2000 pCi/L.

The leaks along the condenser bay joints were sealed with caulk and periodic inspections for future leaking has been added to operator rounds. All data related to this release was added to the Stations 10 CFR 50.75(g) decommissioning file.

On April 3, 2009 the water from the catch containments was released to the station's holding pond. The holding pond releases through the normal liquid effluent release point at outfall 001. The catch containment water contained approximately 747 uCi of tritium.

F. Trends

No trends have been identified.

G. 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.

H. 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 have been installed in 2009

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

TABLE A-1: Radiological Groundwater Protection Program – Sampling Locations for the Limerick Generating Station, 2009

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
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	Surface Water	Onsite
SW-LR-9	Surface Water	Onsite
SW-LR-9	Surface Water	Onsite
SW-LR-10	Surface Water	Onsite

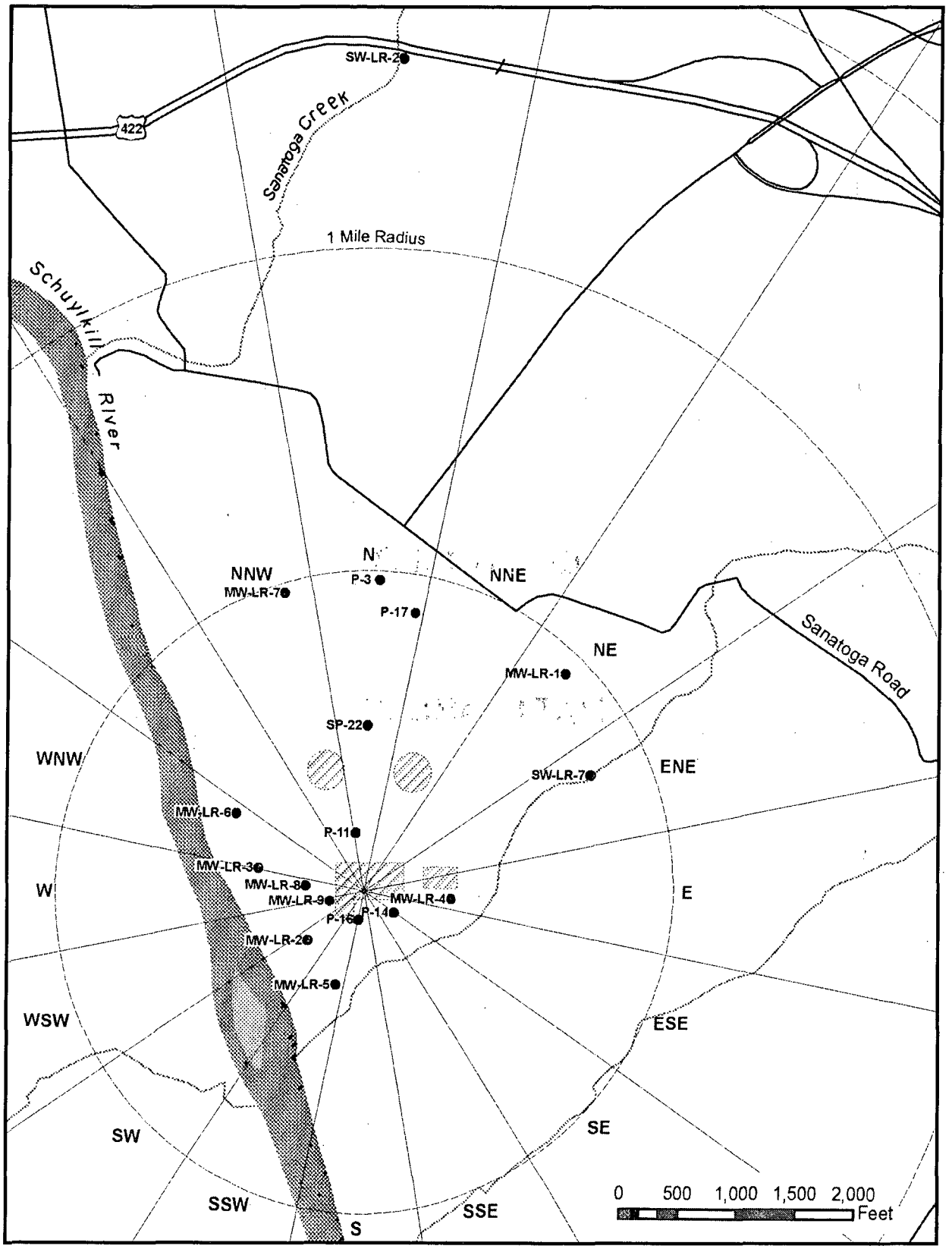

Figure 1 Routine Well Water and Surface Water Sample Locations for the Radiological Groundwater Protection Program, Limerick Generating Station, 2009

APPENDIX B

DATA TABLES

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM-90, GROSS ALPHA, AND GROSS BETA IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE		COLLECTION DATE	H-3	SR-90	GR-A (DIS)	GR-A (SUS)	GR-B (DIS)	GR-B (SUS)
MW-LR-1		04/28/2009	< 139					
MW-LR-1		10/28/2009	< 181	< 0.6	4.2 ± 2.5	< 1.5	3.2 ± 2.1	< 2.4
Mean ± 2 SD			-	-	4.2	-	3.2	-
MW-LR-2		04/30/2009	< 165					
MW-LR-2		10/28/2009	< 185	< 0.7	6.6 ± 2.5	2.8 ± 1.1	8.2 ± 2.3	< 1.9
Mean ± 2 SD			-	-	6.6	2.8	8.2	-
MW-LR-3		04/30/2009	< 168					
MW-LR-3		10/28/2009	< 182	< 0.7	6.2 ± 2.8	< 0.8	4.1 ± 2.4	< 1.8
Mean ± 2 SD			-	-	6.6	-	4.1	-
MW-LR-4		04/28/2009	< 166					
MW-LR-4		10/29/2009	< 185	< 0.6	3.5 ± 1.5	7.5 ± 1.9	17 ± 3.8	5.9 ± 1.6
Mean ± 2 SD			-	-	3.5	7.5	17	5.9
MW-LR-5	TBE	04/30/2009	189 ± 110					
MW-LR-5	TBE	04/30/2009	191 ± 110					
MW-LR-5	EIML	04/30/2009	375 ± 97					
MW-LR-5	TBE	10/29/2009	< 184	< 0.9	6.2 ± 2.8	2.4 ± 1.0	9.0 ± 2.4	< 1.9
MW-LR-5	TBE	10/29/2009	< 178	< 0.8	7.6 ± 3.0	1.6 ± 0.9	8.1 ± 2.3	< 1.7
MW-LR-5	EIML	10/29/2009	< 152	< 0.6				
Mean ± 2 SD			252 ± 214	-	6.9 ± 2.0	2.0 ± 1.1	8.6 ± 1.3	-
MW-LR-6		04/30/2009	< 168					
MW-LR-6		10/28/2009	< 183	< 0.7	2.4 ± 1.2	2.4 ± 1.2	3.5 ± 2.1	< 2.1
Mean ± 2 SD			-	-	2.4	2.4	3.5	-
MW-LR-7		04/30/2009	< 168					
MW-LR-7		10/28/2009	< 182	< 1.0	< 2.9	< 0.8	3.9 ± 1.9	< 1.8
Mean ± 2 SD			-	-	-	-	3.9	-
MW-LR-8		04/28/2009	< 169					
MW-LR-8		10/30/2009	< 182	< 0.4	2.1 ± 1.2	< 0.8	5.6 ± 2.0	< 1.8
Mean ± 2 SD			-	-	2.1	-	5.6	-

Samples are distilled for H-3 analysis

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM-90, GROSS ALPHA, AND GROSS BETA IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE		COLLECTION DATE	H-3	SR-90	GR-A (DIS)	GR-A (SUS)	GR-B (DIS)	GR-B (SUS)
MW-LR-9		02/24/2009	434 ± 138					
MW-LR-9	ORIGINAL	04/28/2009	658 ± 135					
MW-LR-9	RERUN	04/28/2009	821 ± 148					
MW-LR-9	ORIGINAL	04/28/2009	794 ± 147					
MW-LR-9	RERUN	04/28/2009	830 ± 151					
MW-LR-9	EIML	04/28/2009	803 ± 115					
MW-LR-9		06/11/2009	1190 ± 190					
MW-LR-9		07/14/2009	1750 ± 215					
MW-LR-9		08/18/2009	582 ± 161					
MW-LR-9		09/17/2009	545 ± 133					
MW-LR-9		10/30/2009	708 ± 145	< 0.7	4.1 ± 1.5	< 1.2	8.8 ± 2.6	4.3 ± 1.6
MW-LR-9		10/30/2009	864 ± 152	< 0.5	9.1 ± 3.2	< 2.0	9.7 ± 2.4	11 ± 2.1
MW-LR-9	EIML	10/30/2009	961 ± 120	< 0.6				
Mean ± 2 SD			842 ± 668	-	6.6 ± 7.1	-	9.2 ± 1.3	7.4 ± 8.8
P11		02/24/2009	375 ± 136					
P11		04/28/2009	187 ± 110					
P11		04/28/2009	200 ± 110					
P11	EIML	04/28/2009	343 ± 96					
P11		10/28/2009	< 181	< 0.8				
P11		10/28/2009	< 172	< 0.9	4.0 ± 2.3	< 0.8	17 ± 3.0	< 1.7
P11	EIML	10/30/2009	< 152	< 0.6				
Mean ± 2 SD			276 ± 193	-	4.0	-	17	-
P14		02/24/2009	< 180					
P14		04/28/2009	< 165					
P14		10/30/2009	< 181	< 1.0				
Mean ± 2 SD			-	-				
P16		04/28/2009	< 168					
P16		10/30/2009	< 181	< 0.6				
Mean ± 2 SD			-	-				
P17		04/28/2009	< 140					
P17		10/27/2009	< 182	< 0.6				
Mean ± 2 SD			-	-				
P3		04/28/2009	< 167					
P3		10/27/2009	< 180	< 0.7				
Mean ± 2 SD			-	-				
SP22		04/28/2009	< 140					
SP22		10/28/2009	< 181	< 0.7				
Mean ± 2 SD			-	-				

Samples are distilled for H-3 analysis

TABLE B-I.2 CONCENTRATIONS OF GAMMA EMITTERS IN WELL WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC		COLLECTION PERIOD	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
MW-LR-1		10/28/09	< 43	< 45	< 5	< 4	< 9	< 3	< 9	< 6	< 7	< 9	< 4	< 5	< 23	< 9
MW-LR-2		10/28/09	< 60	< 71	< 6	< 7	< 15	< 8	< 15	< 9	< 10	< 13	< 6	< 7	< 35	< 13
MW-LR-3		10/28/09	< 47	< 99	< 5	< 6	< 12	< 7	< 11	< 6	< 10	< 11	< 6	< 6	< 29	< 9
MW-LR-4		10/29/09	< 46	< 36	< 4	< 5	< 9	< 4	< 11	< 6	< 9	< 11	< 5	< 7	< 29	< 8
MW-LR-5	TBE	10/29/09	< 38	< 65	< 4	< 4	< 9	< 5	< 9	< 5	< 8	< 9	< 4	< 4	< 23	< 7
MW-LR-5	TBE	10/29/09	< 52	< 60	< 5	< 5	< 11	< 5	< 11	< 6	< 10	< 11	< 4	< 5	< 26	< 7
MW-LR-5	EIML	10/29/09	< 29	105 ± 27	< 3	< 3	< 8	< 3	< 7	< 5	< 5	< 6	< 4	< 4	< 19	< 6
MW-LR-6		10/28/09	< 50	< 71	< 5	< 5	< 9	< 5	< 9	< 6	< 10	< 9	< 5	< 5	< 25	< 8
MW-LR-7		10/28/09	< 48	< 58	< 7	< 6	< 13	< 6	< 12	< 7	< 10	< 10	< 5	< 5	< 30	< 9
MW-LR-8		10/30/09	< 43	< 92	< 5	< 4	< 12	< 5	< 10	< 6	< 10	< 7	< 5	< 5	< 28	< 9
MW-LR-9		06/11/09	< 36	< 62	< 4	< 3	< 8	< 4	< 7	< 4	< 7	< 7	< 4	< 4	< 22	< 6
MW-LR-9		10/30/09	< 59	< 69	< 6	< 7	< 14	< 7	< 16	< 8	< 13	< 12	< 7	< 8	< 33	< 14
MW-LR-9		10/30/09	< 31	< 111	< 5	< 3	< 4	< 5	< 6	< 5	< 9	< 6	< 4	< 5	< 17	< 5
MW-LR-9	EIML	10/30/09	< 35	120 ± 41	< 3	< 2	< 4	< 3	< 7	< 4	< 8	< 6	< 4	< 4	< 20	< 5
P11		10/28/09	< 56	< 51	< 6	< 6	< 14	< 6	< 13	< 8	< 11	< 14	< 5	< 6	< 35	< 10
P11		10/28/09	< 50	< 110	< 7	< 5	< 10	< 7	< 12	< 5	< 8	< 11	< 4	< 6	< 27	< 8
P11	EIML	10/30/09	< 34	104 ± 35	< 4	< 3	< 4	< 2	< 5	< 5	< 4	< 8	< 3	< 4	< 22	< 6
P14		10/30/09	< 25	72 ± 39	< 3	< 3	< 6	< 3	< 7	< 3	< 5	< 6	< 3	< 3	< 15	< 5
P16		10/30/09	< 20	< 44	< 2	< 2	< 5	< 2	< 5	< 2	< 4	< 4	< 2	< 2	< 12	< 4
P17		10/27/09	< 44	< 41	< 5	< 5	< 10	< 5	< 10	< 5	< 9	< 11	< 5	< 6	< 27	< 7
P3		10/27/09	< 50	< 53	< 5	< 5	< 12	< 6	< 11	< 7	< 10	< 12	< 5	< 5	< 29	< 8
SP22		10/28/09	< 46	< 34	< 4	< 5	< 10	< 4	< 8	< 5	< 8	< 9	< 5	< 5	< 27	< 7

TABLE B-II.3 CONCENTRATIONS OF HARD TO DETECTS IN GROUNDWATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	FE-55	NI-63	AM-241	CM-242	CM-243/244	PU-238	PU-239/240	U-233/234	U-235	U-238
MW-LR-1	10/28/2009	< 199	< 2.9	< 0.1	< 0.05	< 0.02	< 0.1	< 0.1	< 0.03	< 0.2	< 0.2
MW-LR-8	10/30/2009	< 87	< 4.8	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	2.3 ± 0.3	< 0.1	1.3 ± 0.2
MW-LR-9	10/30/2009	< 163	< 4.2	< 0.1	< 0.2	< 0.1	< 0.2	< 0.2	1.3 ± 0.5	< 0.1	0.6 ± 0.3
P11	10/28/2009	< 124	< 3.7	< 0.1	< 0.1	< 0.1	< 0.1	< 0.02	0.9 ± 0.3	< 0.1	0.5 ± 0.2
P14	10/30/2009	< 108	< 4.8	< 0.1	< 0.05	< 0.05	< 0.1	< 0.1	1.9 ± 0.7	< 0.1	1.8 ± 0.7

TABLE B-II.1 CONCENTRATIONS OF TRITIUM, STRONTIUM-90, GROSS ALPHA, AND GROSS BETA IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	SR-90	GR-A (DIS)	GR-A (SUS)	GR-B (DIS)	GR-B (SUS)
SW-LR-2	4/28/2009	< 140					
SW-LR-2	10/27/2009	< 178	< 0.6	< 1.6	< 0.9	3.0 ± 1.7	< 1.9
Mean ± 2 SD		-	-	-	-	3.0	-
SW-LR-4	4/30/2009	< 169					
SW-LR-4	10/27/2009	< 179	< 0.9	< 2.2	< 0.8	4.4 ± 1.9	< 1.8
Mean ± 2 SD		-	-	-	-	4.4	-
SW-LR-6	4/30/2009	< 167					
SW-LR-6	10/27/2009	< 182	< 0.9	< 1.7	< 0.8	< 2.4	< 1.8
Mean ± 2 SD		-	-	-	-	2.4	-
SW-LR-7	4/28/2009	< 138					
SW-LR-7	10/27/2009	< 169	< 1.0	3.9 ± 2.3	< 0.8	6.8 ± 2.1	< 1.7
Mean ± 2 SD		-	-	3.9	-	6.8	-
SW-LR-8	5/1/2009	< 159					
SW-LR-8	10/28/2009	198 ± 119	< 0.8	< 1.6	< 0.9	2.6 ± 1.5	< 1.8
Mean ± 2 SD		198	-	-	-	2.6	-
SW-LR-9	5/1/2009	< 157					
SW-LR-9	10/28/2009	< 166	< 0.6	< 2.9	< 0.8	17 ± 3.1	< 1.7
Mean ± 2 SD		-	-	-	-	17	-
SW-LR-10	2/24/2009	< 186					
SW-LR-10	4/28/2009	< 141					
SW-LR-10	10/27/2009	< 171	< 0.7	< 1.7	1.5 ± 0.9	4.1 ± 1.6	< 1.8
Mean ± 2 SD		-	-	-	-	4	

SAMPLES ARE DISTILLED FOR H-3 ANALYSIS

TABLE B-II.2 CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED AS PART OF THE RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM, LIMERICK GENERATING STATION, 2009

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

STC	COLLECTION PERIOD	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
SW-LR-2	10/27/2009	< 49	< 53	< 5	< 4	< 11	< 5	< 11	< 5	< 8	< 13	< 5	< 6	< 27	< 9
SW-LR-4	10/27/2009	< 44	< 41	< 5	< 6	< 14	< 6	< 11	< 6	< 9	< 12	< 5	< 6	< 29	< 11
SW-LR-6	10/27/2009	< 52	< 65	< 6	< 7	< 13	< 6	< 15	< 6	< 8	< 12	< 6	< 6	< 34	< 12
SW-LR-7	10/27/2009	< 42	< 51	< 5	< 5	< 8	< 5	< 11	< 6	< 9	< 12	< 5	< 5	< 32	< 9
SW-LR-8	10/28/2009	< 58	< 73	< 6	< 5	< 13	< 5	< 11	< 6	< 10	< 13	< 6	< 6	< 32	< 11
SW-LR-9	10/28/2009	< 51	< 50	< 5	< 5	< 12	< 5	< 10	< 6	< 9	< 12	< 5	< 6	< 29	< 7
SW-LR-10	10/27/2009	< 45	< 46	< 4	< 4	< 10	< 5	< 9	< 5	< 10	< 11	< 4	< 5	< 28	< 9