NEXTera ENERGY
DUANE ARNOLD

May 13, 2013

NG-13-0173
TS 5.6.2

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

Duane Arnold Energy Center
Docket No. 50-331
Renewed Op. License No. DPR-49

Subject: 2012 Annual Radiological Environmental Operating Report

Please find as Enclosure 1 to this letter, a copy of NextEra Energy Duane Arnold, LLC's, (hereafter, NextEra Energy Duane Arnold) 2012 Annual Radiological Environmental Operating Report for the Duane Arnold Energy Center, pursuant to the requirements of ODAM Section 8.2.2 and Technical Specification Section 5.6.2.

This letter contains no new commitments nor does it revise any existing commitments.

Should you have any questions regarding this matter, please contact Thomas R. Byrne at (319) 851-7929.

Sincerely,

Richard L. Anderson
Vice President, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosure

cc: Regional Administrator, USNRC, Region III
Resident Inspector, USNRC, Duane Arnold Energy Center
Project Manager, USNRC, Duane Arnold Energy Center

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Enclosure 1 to
NG-13-0173

Duane Arnold Energy Center

2012 Annual Radiological Environmental Operating Report

97 Pages to follow

2012

Annual Radiological Environmental Operating Report

Duane Arnold Energy Center

Primary Contributor: Stunk Date: 07-May-2013

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DUANE ARNOLD ENERGY CENTER
CEDAR RAPIDS, IOWA
DOCKET NO. 50-331

REPORT

to the

UNITED STATES
NUCLEAR REGULATORY COMMISSION

Annual Radiological Environmental Operating Report

January 1 to December 31, 2012

Prepared by

ATI ENVIRONMENTAL, Inc.
Midwest Laboratory

Project No. 8001

Approved : _____ 05/02/2013

Bronia Grob, M.S.
Laboratory Manager

PREFACE

Staff members of the Environmental, Inc., Midwest Laboratory were responsible for the acquisition of data presented in this report, with the exception of Appendices D, E and F which were completed by DAEC personnel. All environmental samples, with the exception of aquatic, were collected by personnel of DAEC. Aquatic samples were collected by the University of Iowa Hygienic Laboratory.

The report was prepared by Environmental, Inc., Midwest Laboratory, with the exception of Appendices D, E and F, which were prepared by DAEC personnel.

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1.0 INTRODUCTION

This report summarizes and interprets results of the Radiological Environmental Monitoring Program conducted by Environmental, Inc., Midwest Laboratory at the Duane Arnold Energy Center, Palo, Iowa, during the period January - December, 2012. This Program monitors the levels of radioactivity in the air, terrestrial, and aquatic environments in order to assess the impact of the plant on its surroundings.

Tabulations of individual analyses made during the year are included in Part II of this report.

The Duane Arnold Energy Center (DAEC) is a boiling water reactor, located in Linn County, Iowa, on the Cedar River, and owned and operated by NextEra Energy Resources. Initial criticality was attained on March 23, 1974. The reactor reached 100% power on August 12, 1974. Commercial operation began on February 1, 1975.

2.0 SUMMARY

The Radiological Environmental Monitoring Program, as required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Duane Arnold Energy Center, is herein described. Results for the year 2012 are summarized and discussed.

Program findings show only background levels of radioactivity in the environmental samples collected in the vicinity of the Duane Arnold Energy Center.

Short-lived radioactive elements released into the environment following the Fukushima Daiichi incident, March 11, 2011, are no longer detectable in the background. It is possible that a slight increase in soil and sediment background activity could be observed, attributable to the release of longer-lived isotopes, e.g. Cs-134 and Cs-137.

No effect on the environment is indicated in the areas surrounding the site of the Duane Arnold Energy Center.

3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

3.1 Program Design and Data Interpretation

The purpose of the Radiological Environmental Monitoring Program at the Duane Arnold Energy Center (DAEC) is to assess the impact of the plant on its environment. For this purpose, samples are collected from the air, terrestrial, and aquatic environments and analyzed for radioactive content. In addition, ambient gamma radiation levels are monitored by thermoluminescent dosimeters (TLDs).

Sources of environmental radiation include the following:

(1) Natural background radiation arising from cosmic rays and primordial radionuclides;

(2) Fallout from atmospheric nuclear detonations;

(3) Releases from nuclear power plants; and

(4) Industrial and medical radioactive waste.

In interpreting the data, effects due to the DAEC operation must be distinguished from those due to other sources.

A major interpretive aid in assessment of these effects is the design of the monitoring program at the DAEC which is based on the indicator-control concept. Most types of samples are collected both at indicator locations (nearby, downwind, or downstream) and at control locations (distant, upwind, or upstream). A station effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other sources.

An additional interpretive technique involves analyses for specific radionuclides present in the environmental samples collected from the DAEC site. The DAEC's monitoring program includes analyses for strontium-90 and iodine-131, which are fission products, and tritium, which is produced by cosmic rays, atmospheric nuclear detonations, and also by nuclear power plants. Most samples are also analyzed for gamma-emitting isotopes with results for the following groups quantified: zirconium-95, cesium-137, and cerium-144. These three gamma-emitting isotopes were selected as radiological impact indicators because of the different characteristic proportions in which they appear in the fission product mix produced by a nuclear reactor and that produced by a nuclear detonation. Each of the three isotopes is produced in roughly equivalent amounts by a reactor: each constitutes about 10% of the total activity of fission products ten (10) days after reactor shutdown. On the other hand, ten (10) days after a nuclear explosion, the contributions of zirconium-95, cerium-144, and cesium-137 to the activity of the resulting debris are in the approximate ratio 4:1:0.03 (Eisenbud,1963). The other group quantified consists of niobium-95, ruthenium-103 and -106, cesium-134, barium-lanthanum-140, and cerium-141. These isotopes are released in small quantities by nuclear power plants, but to date their major source of injection into the general environment has been atmospheric nuclear testing. Nuclides of the next group, manganese-54, cobalt-58 and-60, and zinc-65, are activation products and arise from activation of corrosion products. They are typical components of nuclear power plant effluents, but are not produced in significant quantities by nuclear detonations. Nuclides of the final group, beryllium-7, which is of cosmogenic origin, and potassium-40, a naturally-occurring isotope, were chosen as calibration monitors and provide a comparison between levels of naturally occurring radionuclides and radionuclides that could be attributed to the operation of the plant.

Program Design and Data Interpretation (continued)

Characteristic properties of isotopes quantified in gamma-spectroscopic analysis are presented in Table 5.1. Other means of distinguishing sources of environmental radiation can be employed in interpreting the data. Current radiation levels can be compared with previous levels, including those measured before the Plant became operational. Results of the DAEC's Monitoring Program can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations.

3.2 Program Description

3.2.1 Environmental Monitoring

The sampling and analysis schedule for the Radiological Environmental Monitoring Program (REMP) at the DAEC is summarized in Table 5.2 and is briefly reviewed below. Table 5.3 defines the sampling location codes used in Table 5.2 and specifies for each location its distance, direction, and sector relative to the reactor site. The types of samples collected at each location and the frequency of collections are presented in Table 5.4 using codes defined in Table 5.5.

To monitor the air environment, airborne particulates are collected on membrane filters by continuous pumping at nine locations. Airborne iodine is collected by continuous pumping through charcoal filters. Eight of the nine locations are indicators and one is a control (D-13). Filters are changed and counted weekly. Particulate filters are analyzed for gross beta activity. If gross beta activity exceeds ten times the yearly mean of the control samples, gamma isotopic analysis is performed. Quarterly composites of airborne particulates from each location are analyzed for gamma emitting isotopes. Charcoal filter samples are analyzed weekly for iodine-131.

Ambient gamma radiation is monitored at a total of 50 locations. A TLD is placed at each location and exchanged and analyzed quarterly. The TLD locations are distributed as follows:

- Two on-site locations
- Eighteen in a circle within a 0.5 mi. radius from the DAEC stack.
- Six in 22.5° sectors within 1 mi. from the DAEC stack.
- Ten in 22.5° sectors between 1 and 3 miles from the DAEC stack.
- Ten control locations greater than 3 miles from the DAEC stack.
- Four along sections of the Independent Spent Fuel Storage Installation (ISFSI) fenceline.

Surface water is collected monthly from four river locations, D-49 (Lewis Access, Control, 4 mi. upstream), D-50 (Inlet), D-51 (Discharge) and D-61 (downstream of Discharge) and also from Pleasant Creek Lake (D-99). The monthly samples are analyzed for tritium and gamma-emitting isotopes. Additional analyses are performed on samples collected from the control and indicator locations, D-49 and D-61. Analyses for low-level iodine-131 are performed on monthly collections and quarterly composites are prepared and analyzed for strontium-89 and strontium-90.

The aquatic environment is also monitored by upstream and downstream (D-49 and D-61) semiannual collections of fish. River bottom sediment is collected semiannually at the plant's intake and discharge (D-50 and D-51) and downstream of the sewage plant (D-107a). The samples are analyzed for gamma-emitting isotopes.

Program Description (continued)

Potable ground water is collected quarterly from a treated municipal water system (D-53), the inlet to the municipal water treatment system (D-54), three indicator locations (D-55, D-57, D-58) and one control location (D-72). The samples are analyzed for gross beta and tritium. If gross beta measures greater than 3 pCi/L, or positive tritium is detected, an analysis for gamma emitters is performed. If a gross beta measurement is greater than 7 pCi/L, or reactor by-product gamma emitters are detected, analyses for Fe-55, Sr-89, Sr-90, Ni-63 and alpha emitters are performed.

Milk is collected monthly from one indicator and one control location during the non-grazing season, October through April, and biweekly during the grazing season, May 1 through September 30. The samples are analyzed for iodine-131 and gamma-emitting isotopes.

For additional monitoring of the terrestrial environment, grain, hay and broad leaf vegetation samples are collected annually, as available, from nine locations: one control (D-108) and eight indicators (D-16, D-57, D-58, D-72, D-96, D-109 and D-118). Grain, hay and broad leaf (green leafy) vegetation samples are analyzed for gamma-emitting isotopes and at least two broad leaf vegetation samples are analyzed for iodine-131.

If cattle are slaughtered for home use, a meat sample is collected annually, during or immediately following a grazing period from animals grazing on-site. The sample is analyzed for gamma-emitting isotopes.

3.2.2 Ground Water Protection Program

Environmental, Inc., Midwest Laboratory provides laboratory services for the Duane Arnold Energy Center Ground Water Protection Program. For results from these analyses, refer to the Duane Arnold Energy Center, 2012 Annual Radioactive Effluent Release Report.

3.3 Program Execution

The program was executed as described in the preceding section with the following exceptions:

(1) Airborne Particulates / Airborne Iodine:

Air particulate / air iodine samples were not available at location D-13, for the weeks ending 08/09/12 through 09/06/12. The sampler was out of service due to power pole maintenance.

(2) Milk:

Milk was not available from location D-108 after the May, 22, 2012 collection. The farm went out of the dairy business.

(3) Thermoluminescent Dosimetry

The first quarter, 2012 TLD at location D-36 was missing in the field. The TLD was replaced.
The third quarter, 2012 TLD at location D-41 was missing in the field. The TLD was replaced.
The fourth quarter, 2012 TLD at location D-17 was missing in the field. The TLD was replaced.

Program Execution (continued)

(4) Vegetation

Suitable vegetation samples were not available from locations D-58, D-72, and D-96 in 2012.

(5) Ground Water

Due to human error, well water from the 4th quarter of 2012 was not collected until January 9th, 2013.

3.4 Laboratory Procedures

The Iodine-131 analyses in milk and water were made using a sensitive radiochemical procedure involving separation of iodine using an ion-exchange method, solvent extraction and subsequent beta counting. Levels of iodine-131 in vegetation and concentrations of airborne iodine-131 in charcoal samples were determined by gamma spectroscopy.

Gamma-spectroscopic analyses are performed using high-purity germanium (HPGe) detectors. The gamma isotopic analysis provides a spectrum with an energy range from 80 to 2048 KeV. Specific isotopes included in the gamma library are Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-95, Nb-95, Ru-103, Ru-106, I-131, Ba-La-140, Cs-134, Cs-137, Ce-141, and Ce-144. Naturally occurring gamma-emitters, such as Be-7, K-40 and Ra daughters, are frequently detected but may not be listed.

Tritium was measured by liquid scintillation.

Analytical Procedures used by Environmental, Inc. are on file and are available for inspection. Procedures are based on those prescribed by the Health and Safety Laboratory of the U.S. Dep't of Energy, Edition 28, 1997, U.S. Environmental Protection Agency for Measurement of Radioactivity in Drinking Water, 1980, and the U.S. Environmental Protection Agency, EERF, Radiochemical Procedures Manual, 1984.

Environmental, Inc., Midwest Laboratory has a comprehensive quality control/quality assurance program designed to assure the reliability of data obtained. Details of the QA Program are presented elsewhere (Environmental, Inc., Midwest Laboratory, 2013). The QA Program includes participation in Interlaboratory Comparison (crosscheck) Programs. Results obtained in crosscheck programs are presented in Appendix A.

3.5 Program Modifications

Milk location (D-108, Control) was dropped from the program in June, 2012. The dairy sold off its herd. A replacement dairy (D-138) was located 13.4 miles WSW of the plant. Sampling started with the July 17, 2012 collection.

4.0 RESULTS AND DISCUSSION

All collections and analyses were made as scheduled, except for those listed in Table 5.6.

Results are summarized in Table 5.7 as recommended by the Nuclear Regulatory Commission. For each type of analysis and sample medium, the table lists the mean and range of all indicator and control locations, as well as that location with the highest mean and range.

Tabulated results of measurements are not included in this section, although reference to these results will be made in discussion. A complete tabulation of results for 2012 is contained in Part II of the Annual Report on the Radiological Environmental Monitoring Program for the Duane Arnold Energy Center.

4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no reported accidents involving significant release to the environment at nuclear reactor facilities in 2012. The Fukushima Daiichi nuclear accident occurred March 11, 2011.

There were no reported atmospheric nuclear tests in 2012. The last reported test was conducted on October 16, 1980 by the People's Republic of China.

4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected outside of the Owner Controlled Area in 2012. The trace levels of strontium-90 and cesium-137, still measurable in soil and sediments are attributed to deposition of fallout from previous decades.

Airborne Particulates

The average annual gross beta concentrations in airborne particulates were almost identical at indicator and control locations (0.030 and 0.029 pCi/m^3, respectively) and similar to levels observed from 1995 through 2011. The results are tabulated below.

Year	Indicators	Controls		Year	Indicators	Controls
Concentration (pCi/m^3)				Concentration (pCi/m^3)		
1997	0.023	0.023		2005	0.031	0.031
1998	0.024	0.024		2006	0.029	0.027
1999	0.026	0.027		2007	0.031	0.031
2000	0.026	0.027		2008	0.029	0.029
2001	0.026	0.026		2009	0.031	0.030
2002	0.027	0.027		2010	0.028	0.028
2003	0.029	0.029		2011	0.030	0.029
2004	0.028	0.028		2012	0.030	0.029

Average annual gross beta concentrations in airborne particulates.

4.2 Program Findings, Airborne Particulates (continued)

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, produced continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples, with an average activity of 0.070 pCi/m^3 for all locations. All other gamma-emitting isotopes were below their respective LLD limits.

Airborne Iodine

Weekly levels of airborne iodine-131 measured below the required limit of 0.030 pCi/m^3 for all samples.

Ambient Radiation (TLDs)

At ten control locations, thermoluminescent dosimeter (TLD) readings averaged 17.5 mR/quarter. At locations within a half mile, one mile and three mile radius of the stack, the measurements averaged 19.0, 20.2 and 17.0 mR/quarter, respectively. The two on-site locations D-15 and D-16 averaged 17.2 mR/quarter. The average for these locations was 18.4 mR/quarter. This is similar to the estimated average natural background radiation for Middle America, 19.5 mR/quarter, which is based on data on Pages 71 and 108 of the report, "Natural Background Radiation in the United States" (National Council on Radiation Protection and Measurements, 1975). The terrestrial absorbed dose (uncorrected for structural and body shielding) ranges from 8.8 to 18.8 mrad/quarter and averages 11.5 mrad/quarter for Middle America. Cosmic radiation and cosmogenic radionuclides contribute 8.0 mrad/quarter for a total average of 19.5 mrad/quarter. No plant effect is indicated.

ISFSI Facility Operations Monitoring

Four TLDs, placed directionally along the ISFSI fenceline, averaged 31.7 mR/quarter.

Milk

There was no iodine-131 activity detected in milk samples. Iodine-131 measured below a detection limit of 0.5 pCi/L.

No gamma-emitting isotopes, excepting naturally occurring potassium-40, were detected in any milk samples. This is consistent with findings that most radiocontaminants in feed do not find their way into milk due to the selective metabolism of the cow. The common exceptions are radioisotopes of potassium, cesium, strontium, barium, and iodine (National Center for Radiological Health, 1968).

In summary, milk data for 2012 show no radiological effects of plant operation.

Ground Water (potable)

The annual mean for gross beta activity 1.9 pCi/L, similar to levels observed from 1991 through 2011. The location with the highest mean was D-58, a farm 1.0 mile distant from the plant.

Tritium activity in ground water measured below an LLD of 151 pCi/L.

No effect from plant operation is indicated.

4.2 Program Findings (continued)

Vegetation

Iodine-131 concentrations in broadleaf vegetation were below the LLD level of 0.013 pCi/g wet weight in all samples.

With the exception of potassium-40, which was observed in all vegetation samples (broadleaf, grain, and forage), all other gamma-emitting isotopes were below detection limits. No effect from plant operation is indicated.

Surface Water

Surface water was tested for tritium and gamma emitting isotopes in sixty samples from five locations. No measurable tritium activity was detected above an LLD of 159 pCi/L. Gamma-emitting isotopes were below detection limits.

Analyses for I-131 were performed on samples from locations D-49 (control) and D-61 (0.5 mi. downstream, indicator). Positive iodine-131 above LLD was detected in samples collected March 19, 2012, at both the control and indicator locations and measured 1.9 and 1,6 pCi/L, respectively. Since the iodine was detected at both the upstream and downstream locations, there is no indication of a plant origin.

Quarterly composites were also prepared from the samples collected at locations D-49 and D-61 and tested for strontium-89 and strontium-90. All samples tested below detection limits.

No plant effect on surface water is indicated.

Fish

Fish were collected in May and September, 2012, and analyzed for gamma-emitting isotopes. With the exception of naturally-occurring potassium-40 no gamma-emitting isotopes were identified in edible portions of fish. The potassium-40 level was similar at both the indicator and control locations (3.13 and 3.06 pCi/g wet, respectively). No plant effect on the fish population is indicated.

River Sediments

River sediments were collected in May and November, 2012, and analyzed for gamma-emitting isotopes. Potassium-40 activity ranged from 6.28–8.39 pCi/g dry weight and averaged 7.41 pCi/g dry weight.

Cs-137 was not detected at either the indicator or control locations in 2012. Low levels had been observed from 1991 through 2011, any trace cesium activity is generally attributable to deposition of fallout from previous decades.

Other gamma-emitting isotopes were below detection limits. There is no indication of a plant effect.

Ground Water Protection Program

Environmental, Inc., Midwest Laboratory provides laboratory services for the Duane Arnold Energy Center Ground Water Protection Program. For results from these analyses, refer to the Duane Arnold Energy Center, 2012 Annual Radioactive Effluent Release Report.

5.0 TABLES AND FIGURES

Table 5.1 Characteristic properties of isotopes quantified in gamma-spectroscopic analyses.

Designation	Comment	Isotope	Half-life [a]
Naturally Occurring			
A. Cosmogenic	Produced by interaction of cosmic rays with atmosphere	Be-7	53.2 d
B. Terrestrial	Primordial	K-40	1.26×10^9 y
II. Fission Products [b]	Nuclear accidents and detonations constitute the major environmental source.		
A. Short-lived		I-131	8.04 d
		Ba-140	12.8 d
B. Other than Short-lived		Nb-95	35.15 d
		Zr-95	65 d
		Ru-103	39.35 d
		Ru-106	368.2 d
		Cs-134	2.061 y
		Cs-137	30.174 y
		Ce-141	32.5 d
		Ce-144	284.31 d
III. Activation Products	Typically found in nuclear power plant effluents	Mn-54	312.5 d
		Fe-59	45.0 d
		Co-58	70.78 d
		Co-60	5.26 y
		Zn-65	245 d

[a] Half-lives are taken from Appendix E of Environmental Quarterly, 1 January 1978, EML-334 (U. S. Department of Energy, 1978).

[b] Includes fission-product daughters.

Table 5.2 Sample collection and analysis program.

Sampling Location [a]				
Exposure Pathway and/or Sample Type	Sample Point	Description	Sampling and Collection Frequency	Type and Frequency of Analysis [b]
Airborne Particulates	3 5 6 7 11 13 15 16 40	Hiawatha Palo Center Point Shellsburg Toddville Alburnett (C) On-site North On-site South Wickiup Hill	Continuous operation of sampler with sample collection at least once per week or as required by dust loading.	Analyze for gross beta activity more than 24 hours after filter change. Perform gamma isotopic analysis on each sample having gross beta activity greater than ten times the yearly mean of the control samples. Composite weekly samples to form a quarterly composite (by location). Analyze quarterly composite for gamma isotopic.
Airborne Iodine	3 5 6 7 11 13 15 16 40	Hiawatha Palo Center Point Shellsburg Toddville Alburnett (C) On-site North On-site South Wickiup Hill	Continuous operation of sampler with sample collection at least once per week.	Analyze each cartridge for iodine-131.
Ambient Radiation	1-3, 5-8, 10, 11, 13 15-23, 28-32, 82-86, 91 43-48 33-42 161-164	Controls Indicators ≤ 0.5 mi. of Stack ≤ 1.0 mi. of Stack ≤ 3.0 mi. of Stack ISFSI Fenceline	One dosimeter continuously at each location. Dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly.
Surface Water	49 50 51 61 99	Lewis Acess (C) Plant Intake Plant Discharge 0.5 mi. downstream Pleasant Creek Lake	Once per month.	Tritium and gamma isotopic analyses for each sample (by location). Locations 49 and 61, analyses for low level I-131. Quarterly Composites for Sr-89, Sr-90.

Table 5.2 Sample collection and analysis program, (continued).

Sampling Location [a]				
Exposure Pathway and/or Sample Type	Sample Point	Description	Sampling and Collection Frequency	Type and Frequency of Analysis [b]
Ground Water (potable)	53 54 55 57, 58 72 (C)	Treated Municipal Inlet to Municipal Wate Treatment System On-site well Wells off-site and within 4 km of DAEC	Grab sample at least once per quarter.	Analysis for gross beta and tritium on quarterly samples. If gross beta measures > 3 pCi/L, OR tritium concentration measures > MDA, perform gamma isotopic analyses. If reactor by-product gamma emitters are identified, OR if gross beta measures > 7 pCi/L, analyze for Fe-55, Ni-63, Sr-89, Sr-90 and alpha emitters.
Vegetation	16, 57, 58, 72, 96, 109, 118 108 (C)	Farms that raise food crops.	Annually at harvest time. One sample of each: grain, green leafy, and forage. At least one sample should be broadleaf vegetation.	Gamma isotopic analysis of edible portions. I-131 analysis on broadleaf vegetation.
Fish	49 61	Cedar River upstream of DAEC not influenced by effluent (C) Downstream of DAEC in influence of effluent	One sample per 6 months (once during January through June and once during July through December).	Gamma isotopic analysis on edible portions.
Milk [c]	108 (C) 110 138 (C)	Farm near Watkins, Iowa Farm 7.9 mi. SW Farm 13.4 mi. WSW	At least once per two weeks during the grazing season. At least once per month during the non-grazing season.	Gamma isotopic and iodine-131 analyses of each sample.
River Sediment	50 51 107a	Plant Intake (C) Plant Discharge North Drainage Ditch (on-site)	At least once every six months.	Gamma isotopic analysis of each sample.
Meat [d]		On-site	Annually	Gamma Isotopic

[a] (C) denotes control location. All other locations are indicators.
[b] Gamma isotopic analysis and analysis for gamma-emitting nuclides refer to high resolution gamma ray spectrum analysis.
[c] The grazing season is considered to be May 1 through September 30.
[d] Only sampled when meat is butchered for home use.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

Sampling Location		
Code	Location Description	Distance and Direction from Site Stack
D-1	Cedar Rapids	12.9 mi SE
D-2	Marion	10.5 mi ESE
D-3	Hiawatha	6.7 mi SE
D-5	Palo	2.8 mi SSW
D-6	Center Point	6.0 mi N
D-7	Shellsburg	4.9 mi W
D-8	Urbana	9.3 mi NNW
D-10	Atkins	8.5 mi SSW
D-11	Toddville	3.1 mi E
D-13	Alburnett	9.0 mi ENE
D-15	On-site, North-Northwest	0.7 mi NNW
D-16	On-site, South-Southeast	0.3 mi SSE
D-17	On-site, N	0.7 mi N
D-18	On-site, NNE	0.4 mi NNE
D-19	On-site, NE	0.4 mi NE
D-20	On-site, ENE	0.3 mi ENE
D-21	On-site, ENE	0.3 mi ENE
D-22	On-site, ESE	0.3 mi ESE
D-23	On-site, SE	0.3 mi SE
D-28	On-site, WSW	0.5 mi WSW
D-29	On-site, W	0.4 mi W
D-30	On-site, WNW	0.4 mi WNW
D-31	On-site, NW	0.5 mi NW
D-32	On-site, NNW	0.7 mi NNW
D-33	3 mile ring N	2.7 mi N
D-34	3 mile ring NNE	2.4 mi NNE
D-35	3 mile ring NE	1.7 mi NE
D-36	3 mile ring ENE	2.2 mi ENE
D-37	3 mile ring E	1.8 mi E
D-38	3 mile ring ESE	2.0 mi ESE
D-39	3 mile ring SE	1.6 mi SE
D-40	3 mile ring SSE	1.5 mi SSE
D-41	3 mile ring S	3.5 mi S
D-42	3 mile ring SSE	2.7 mi SSE
D-43	1 mile ring SSW	1.0 mi SSW
D-44	1 mile ring WSW	1.0 mi WSW
D-45	1 mile ring W	0.9 mi W
D-46	1 mile ring WNW	1.0 mi WNW
D-47	1 mile ring NW	1.1 mi NW
D-48	1 mile ring NNW	1.0 mi NNW

Table 5.3 Sampling locations, Duane Arnold Energy Center (continued).

Sampling Location		
Code	Location Description	Distance and Direction from Site Stack
D-49	Lewis Access, upstream of DAEC	4.2 mi NNW
D-50	Plant Intake	0.4 mi SE
D-51	Plant Discharge	0.4 mi SE
D-53	Treated Municipal Water	8.6 mi SE
D-54	Inlet, Municipal Water Treatment System	8.6 mi SE
D-55	Production Well	On-site
D-57	Farm (Off-site Well)	1.0 mi W
D-58	Farm (Off-site Well)	1.0 mi WSW-SW
D-61	Downstream of plant discharge	0.4 mi SSE
D-72	Farm	2.0 mi SSW
D-82	On-site, SSE	0.4 mi SSE
D-83	On-site, SSE	0.4 mi SSE
D-84	On-site, S	0.4 mi S
D-85	On-site, SSW	0.4 mi SSW
D-86	On-site, SW	0.5 mi SW
D-91	On-site, NNW	0.7 mi NNW
D-96	Farm	7.1 mi SSW
D-99	Pleasant Creek Lake	2.4 mi WNW
D-107a	North Drainage Ditch	On-site
D-108	Farm	16.0 mi. SW
D-109	Farm	3.7 mi. SW
D-110	Farm	7.9 mi. SW
D-118	Farm	1.45 mi. NW
D-138	Farm	13.4 mi. WSW
D-161	ISFSI Fence East	On-site
D-162	ISFSI Fence South	On-site
D-163	ISFSI Fence West	On-site
D-164	ISFSI Fence North	On-site

Table 5.4 Type and Frequency of collection.

Location	Weekly	Monthly	Quarterly	Semiannually	Annually
D-1			TLD		
D-2			TLD		
D-3	AP, AI		TLD		
D-5	AP, AI		TLD		
D-6	AP, AI		TLD		
D-7	AP, AI		TLD		
D-8			TLD		
D-10			TLD		
D-11	AP, AI		TLD		
D-13	AP, AI		TLD		
D-15	AP, AI		TLD		
D-16	AP, AI		TLD		G
D-17 to D-23			TLD		
D-28 to D-39			TLD		
D-40	AP, AI		TLD		
D-41 to D-48			TLD		
D-49		SW		F	
D-50		SW		BS	
D-51		SW		BS	
D-53			WW		
D-54			WW		
D-55			WW		
D-57			WW		G
D-58			WW		G
D-61		SW		F	
D-72			WW		G
D-82 to D-86			TLD		
D-91			TLD		
D-96					G
D-99		SW			
D-107A				BS	
D-108		MI*			G
D-109					G
D-110		MI*			
D-118					G
D-138		MI*			
D-161 to D-164			TLD		
On-site					ME

* Biweekly during the grazing season.

Table 5.5. Sample codes used in Table 5.4 and Table 5.6.

Code	Description
AP	Airborne Particulates
AI	Airborne Iodine
TLD	Thermoluminescent Dosimeter
MI	Milk
WW	Well Water
G	Vegetation
ME	Meat
SW	Surface Water
F	Fish
BS	River Sediment

Table 5.6. Program Deviations, Duane Arnold Energy Center.

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
AP/AI	Gross Beta / I-131	D-13	08/09/12 - 09/06/12	Out of service due to power line maintenance.
MI	I-131, Gamma	D-108	06-05-12	Dairy out of business.
TLD	Ambient Gamma	D-36	1st Qtr. 2012	TLD missing in the field, TLD replaced.
TLD	Ambient Gamma	D-41	3rd Qtr. 2012	TLD missing in the field, TLD replaced.
TLD	Ambient Gamma	D-17	4th Qtr. 2012	TLD missing in the field, TLD replaced.
WW	Gross Beta / H-3	D-53, D-54, D-55 D-57, D-58, D-72	4th Qtr. 2012	Samples were collected Jan. 9, 2013.
G	Gamma	D-58, D-72, D-96	2012	Vegetation samples not available.

In no instance did missed analyses affect minimum sampling requirements as specified in the ODAM.

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa (County, State)	Reporting Period	January-December, 2012

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean: Location [d]	Location with Highest Annual Mean: Mean (F) [c] Range [c]	Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
Airborne Pathway							
Airborne Particulates (pCi/m^3)	GB 472	0.003	0.029 (420/424) (0.006-0.083)	D-7, Shellsburg 5 mi. W	0.030 (53/53) (0.012-0.083)	0.025 (47/48) (0.011-0.078)	0
	GS 36						
	Be-7	0.020	0.070 (32/32) (0.037-0.109)	D-7, Shellsburg 5 mi. W	0.076 (4/4) (0.051-0.109)	0.073 (4/4) (0.045-0.105)	0
	Mn-54	0.0013	< LLD			< LLD	0
	Fe-59	0.0035	< LLD			< LLD	0
	Co-58	0.0014	< LLD			< LLD	0
	Co-60	0.0020	< LLD			< LLD	0
	Zn-65	0.0024	< LLD			< LLD	0
	Nb-95	0.0019	< LLD			< LLD	0
	Zr-95	0.0023	< LLD			< LLD	0
	Ru-103	0.0016	< LLD			< LLD	0
	Ru-106	0.0095	< LLD			< LLD	0
	Cs-134	0.0015	< LLD			< LLD	0
	Cs-137	0.0012	< LLD			< LLD	0
	Ce-141	0.0026	< LLD			< LLD	0
	Ce-144	0.0062	< LLD			< LLD	0
Airborne Iodine (pCi/m^3)	I-131 472	0.030	< LLD			< LLD	0
Direct Radiation							
TLDs (mR/quarter)							
Control Locations	Gamma 40	1.0	None	D-8,Urbana 10 mi. NW	21.9 (4/4) (20.6-24.6)	17.5 (40/40) (10.3-24.6)	0
Within 0.5 mi. of Stack	Gamma 79	1.0	19.0 (79/79) (13.3-24.2)	D-29,On-site 0.5 mi. W	23.0 (4/4) (21.2-24.2)	None	0
Within 1.0 mi. of Stack	Gamma 24	1.0	20.2 (24/24) (15.9-23.7)	D-48 1 mi. NNW	21.8 (4/4) (20.5-23.7)	None	0
Within 3.0 mi. of Stack	Gamma 38	1.0	17.0 (38/38) (13.1-20.4)	D-38 2 mi. ESE	18.6 (4/4) (17.2-19.5)	None	0
ISFSI border	Gamma 16	1.0	31.7 (16/16) (11.4-52.3)	D-161 ISFSI Fence	50.6 (4/4) (46.8-52.3)	None	0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa (County, State)	Reporting Period	January-December, 2012

Sample Type (Units)	Type and Number of Analyses [a]		LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean Location [d]	Mean (F) [c] Range [c]	Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
Waterborne Pathway								
Ground Water, potable (pCi/L)	GB	24	0.0	1.9 (18/20) (0.3-4.7)	D-58, Farm 1 mi. WSW-SW	3.7 (4/4) (3.1-4.7)	< LLD	0
	H-3	24	162	< LLD	-	-	< LLD	0
Surface Water (pCi/L)	H-3	60	159	< LLD	-	-	< LLD	0
	I-131	24	0.5	1.6 (1/12)	D-49 Lewis Access, 4.2 mi. NNW	1.9 (1/12)	1.9 (1/12)	0
	Sr-89	8	0.8	< LLD	-	-	< LLD	0
	Sr-90	8	0.6	< LLD	-	-	< LLD	0
	GS	60						
	Mn-54		4.3	< LLD	-	-	< LLD	0
	Fe-59		9.2	< LLD	-	-	< LLD	0
	Co-58		4.3	< LLD	-	-	< LLD	0
	Co-60		4.6	< LLD	-	-	< LLD	0
	Zn-65		11.1	< LLD	-	-	< LLD	0
	Nb-95		7.0	< LLD	-	-	< LLD	0
	Zr-95		9.5	< LLD	-	-	< LLD	0
	I-131		8.6	< LLD	-	-	< LLD	0
	Cs-134		4.4	< LLD	-	-	< LLD	0
	Cs-137		4.9	< LLD	-	-	< LLD	0
	Ba-140		23.0	< LLD	-	-	< LLD	0
	La-140		4.9	< LLD	-	-	< LLD	0
Sediments (pCi/g dry)	GS	6						
	K-40		1.0	7.40 (4/4) (6.28-8.39)	D-51, Plant Discharge	7.86 (2/2) (7.32-8.39)	7.41 (2/2) (7.21-7.62)	0
	Mn-54		0.019	< LLD	-	-	< LLD	0
	Fe-59		0.052	< LLD	-	-	< LLD	0
	Co-58		0.020	< LLD	-	-	< LLD	0
	Co-60		0.016	< LLD	-	-	< LLD	0
	Zn-65		0.036	< LLD	-	-	< LLD	0
	Nb-95		0.032	< LLD	-	-	< LLD	0
	Zr-95		0.032	< LLD	-	-	< LLD	0
	Ru-103		0.028	< LLD	-	-	< LLD	0
	Ru-106		0.15	< LLD	-	-	< LLD	0
	Cs-134		0.014	< LLD	-	-	< LLD	0
	Cs-137		0.016	< LLD	-	-	< LLD	0
	Ce-141		0.054	< LLD	-	-	< LLD	0
	Ce-144		0.13	< LLD	-	-	< LLD	0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility: Duane Arnold Energy Center — Docket No.: 50-331
Location of Facility: Linn, Iowa (County, State) — Reporting Period: January-December, 2012

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean: Location [d]	Location with Highest Annual Mean: Mean (F) [c] Range [c]	Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
Ingestion Pathway							
Milk (pCi/L)	I-131 33	0.5	< LLD	-	-	< LLD	0
	GS 33						
	K-40	100	1396 (18/18) (1283-1517)	D-138, Farm 13.4 mi. WSW	1417 (15/15) (1173-1680)	1417 (15/15) (1173-1680)	0
	Cs-134	5	< LLD	-	-	< LLD	0
	Cs-137	5	< LLD	-	-	< LLD	0
	Ba-140	60	< LLD	-	-	< LLD	0
	La-140	5	< LLD	-	-	< LLD	0
Broadleaf Vegetation (pCi/g wet)	I-131 2	0.013	< LLD	-	-	none	0
	GS 2						
	K-40	0.5	1.89 (2/2) (1.83-1.96)	D-118, Farm 1.45 mi. NW	1.90 (2/2) (1.83-1.96)	none	0
	Mn-54	0.009	< LLD	-	-	none	0
	Co-58	0.006	< LLD	-	-	none	0
	Co-60	0.006	< LLD	-	-	none	0
	Zn-65	0.013	< LLD	-	-	none	0
	Nb-95	0.006	< LLD	-	-	none	0
	Zr-95	0.018	< LLD	-	-	none	0
	Ru-103	0.009	< LLD	-	-	none	0
	Ru-106	0.050	< LLD	-	-	none	0
	Cs-134	0.007	< LLD	-	-	none	0
	Cs-137	0.009	< LLD	-	-	none	0
	Ce-141	0.012	< LLD	-	-	none	0
	Ce-144	0.054	< LLD	-	-	none	0
Vegetation (Grain and Forage) (pCi/g wet)	GS 10						
	K-40	0.5	7.43 (7/7) (2.22-19.33)	D-138, Farm 13.4 mi. WSW	12.64 (1/1)	9.65 (3/3) (2.11-14.20)	0
	Mn-54	0.041	< LLD	-	-	< LLD	0
	Co-58	0.044	< LLD	-	-	< LLD	0
	Co-60	0.034	< LLD	-	-	< LLD	0
	Zn-65	0.053	< LLD	-	-	< LLD	0
	Nb-95	0.045	< LLD	-	-	< LLD	0
	Zr-95	0.065	< LLD	-	-	< LLD	0
	Ru-103	0.038	< LLD	-	-	< LLD	0
	Ru-106	0.45	< LLD	-	-	< LLD	0
	Cs-134	0.039	< LLD	-	-	< LLD	0
	Cs-137	0.041	< LLD	-	-	< LLD	0
	Ce-141	0.062	< LLD	-	-	< LLD	0
	Ce-144	0.28	< LLD	-	-	< LLD	0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa (County, State)	Reporting Period	January-December, 2012

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean Location [d]	Mean (F) [c] Range [c]	Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
Ingestion Pathway (cont.)							
Fish (pCi/g wet)	GS 8						
	K-40	1.0	3.13 (4/4) (2.81-3.35)	D-61, Downstream	3.13 (4/4) (2.81-3.35)	3.06 (4/4) (2.85-3.33)	0
	Mn-54	0.015	< LLD	-	-	< LLD	0
	Fe-59	0.032	< LLD	-	-	< LLD	0
	Co-58	0.017	< LLD	-	-	< LLD	0
	Co-60	0.019	< LLD	-	-	< LLD	0
	Zn-65	0.031	< LLD	-	-	< LLD	0
	Nb-95	0.024	< LLD	-	-	< LLD	0
	Zr-95	0.042	< LLD	-	-	< LLD	0
	Ru-103	0.021	< LLD	-	-	< LLD	0
	Ru-106	0.11	< LLD	-	-	< LLD	0
	Cs-134	0.015	< LLD	-	-	< LLD	0
	Cs-137	0.017	< LLD	-	-	< LLD	0
	Ce-141	0.040	< LLD	-	-	< LLD	0
	Ce-144	0.120	< LLD	-	-	< LLD	0

[a] GB = Gross beta; GS = Gamma spectroscopy

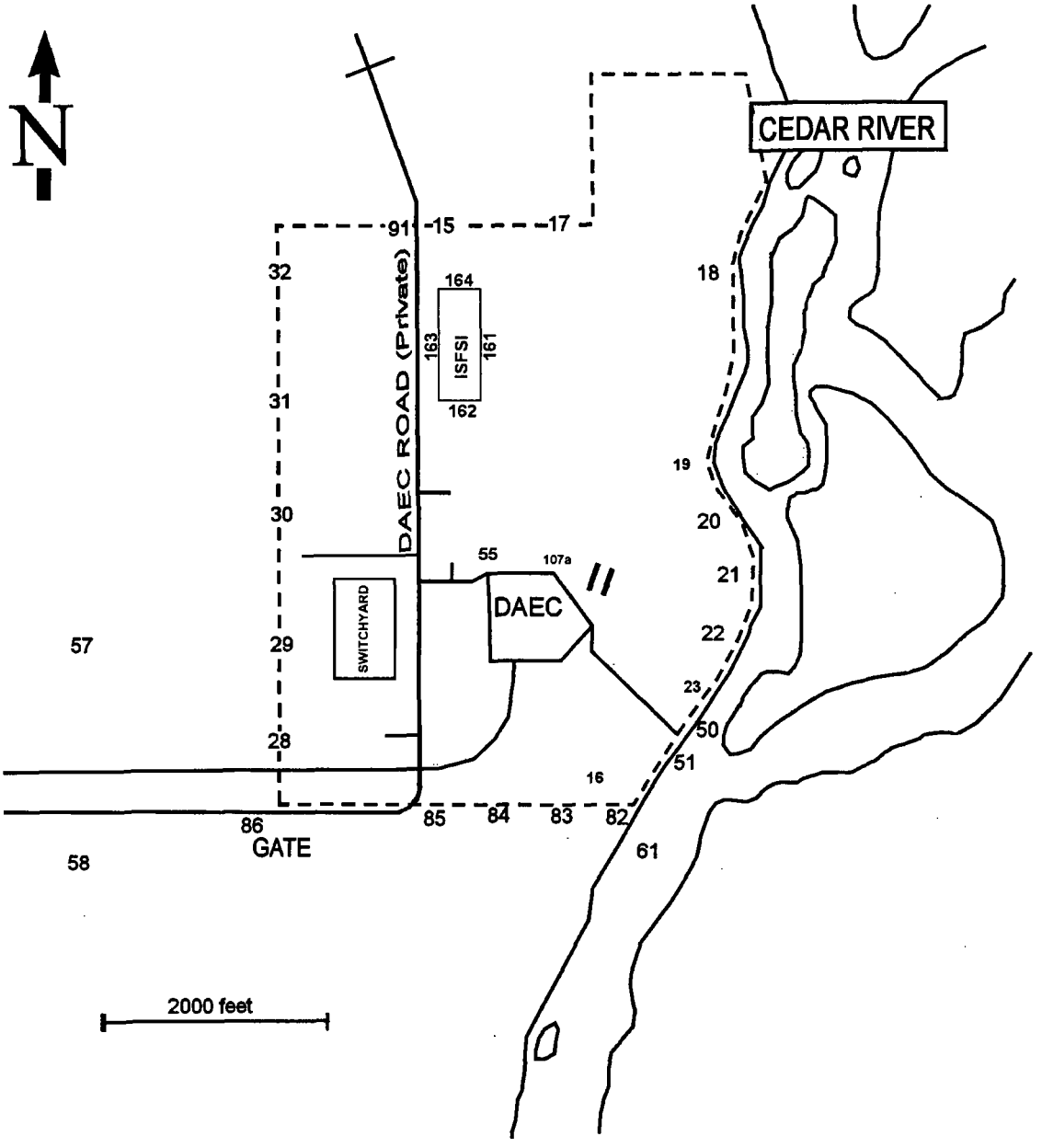
[b] LLD = Nominal lower limit of detection based on 4.66 sigma counting error for the background sample.

[c] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).

[d] Locations are specified by: (1) Name and code (Table 5.3); and (2) distance, direction and sector relative to reactor site.

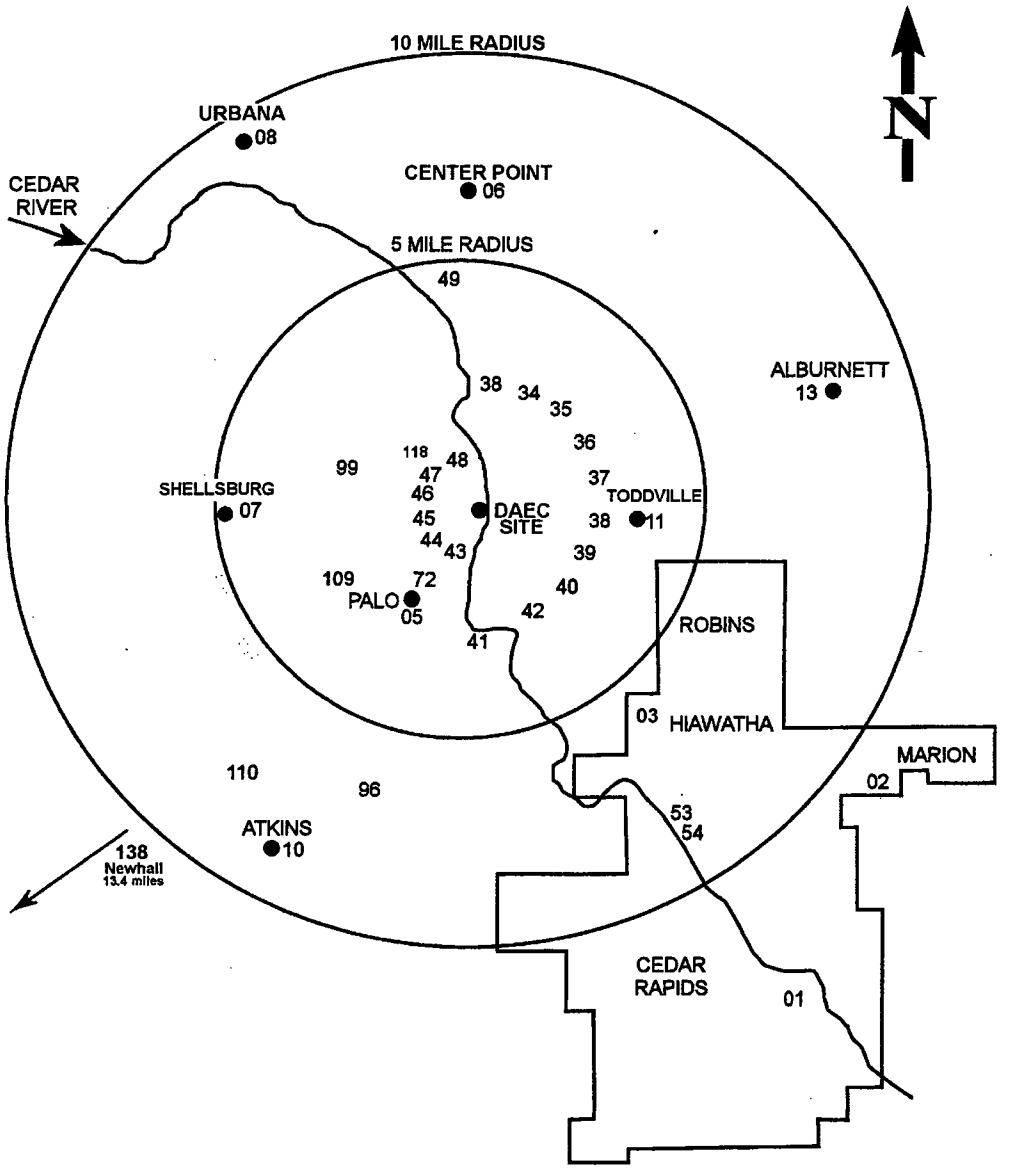
[e] Non-routine results are those which exceed ten times the control station value for the location. If a control station value is not available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

Figure 5.1 Radiological Environmental Monitoring Program
Sampling Stations near the Duane Arnold Energy Center.



See Table 5.3 for sampling locations and Table 5.4 for Type and Frequency of collection.

Figure 5.2. Radiological Environmental Monitoring Program Sampling Stations Outside 0.5 Miles.



See Table 5.3 for sampling locations and Table 5.4 for Type and Frequency of collection.

6.0 REFERENCES CITED

Arnold, J. R. and H. A. Al-Salih. 1955. Beryllium-7 Produced by Cosmic Rays. Science 121: 451-453.

Eisenbud, M. 1963. Environmental Radioactivity, McGraw-Hill, New York, New York, pp. 213, 275-276.

Environmental, Inc., Midwest Laboratory.

_____ 2001 through 2013. Environmental Radiological Monitoring Program for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December, 2001 – 2012.

_____ 1984 to 2000. (formerly Teledyne Brown Engineering, Environmental Services, Midwest Laboratory) Environmental Radiological Monitoring Program for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December, 1983 - 1999.

_____ 1982 to 1984. (formerly Hazleton Environmental Sciences Corporation) Environmental Radiation Monitoring for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December 1981 - 1983.

_____ 2012. Quality Assurance Program Manual, Rev. 3, 14 November 2012.

_____ 2009. Quality Control Procedures Manual, Rev. 2, 08 July 2009.

_____ 2009. Quality Control Program, Rev. 2, 12 November 2009.

Gold, S., H. W. Barkhau, B. Shlein, and B. Kahn, 1964. Measurement of Naturally Occurring Radionuclides in Air, in the Natural Environment, University of Chicago Press, Chicago, Illinois, 369-382.

National Center for Radiological Health, 1968. Radiological Health and Data Reports, Vol. 9, Number 12, 730-746.

U. S. Department of Energy. 1978. Environmental Quarterly, Appendix E. Half-Life Tables, 1 January 1978, EML-334.

U. S. Nuclear Regulatory Commission. 1977. Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I.

Wilson, D. W., G. M. Ward and J. E. Johnson. 1969. In Environmental Contamination by Radioactive Materials, International Atomic Energy Agency. p.125.

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APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Environmental Inc., Midwest Laboratory participates in intercomparison studies administered by Environmental Resources Associates, and serves as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. Results are reported in Appendix A. TLD Intercomparison results, in-house spikes, blanks, duplicates and mixed analyte performance evaluation program results are also reported. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only.

January, 2012 through December, 2012

Appendix A

Interlaboratory Comparison Program Results

Environmental, Inc., Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on a laboratory's analytical procedures and to alert it of any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

Results in Table A-1 were obtained through participation in the environmental sample crosscheck program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Table A-2 lists results for thermoluminescent dosimeters (TLDs), via International Intercomparison of Environmental Dosimeters, when available, and internal laboratory testing.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-5 lists REMP specific analytical results from the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Complete analytical data for duplicate analyses is available upon request.

The results in Table A-6 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

Results in Table A-7 were obtained through participation in the environmental sample crosscheck program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurement Laboratory Quality Assessment Program (EML).

Attachment A lists the laboratory precision at the 1 sigma level for various analyses. The acceptance criteria in Table A-3 is set at ± 2 sigma.

Out-of-limit results are explained directly below the result.

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One standard deviation for single determination
Gamma Emitters	5 to 100 pCi/liter or kg > 100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg > 50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg > 30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium-40	≥ 0.1 g/liter or kg	5% of known value
Gross alpha	≤ 20 pCi/liter > 20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤ 100 pCi/liter > 100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤ 4,000 pCi/liter > 4,000 pCi/liter	$\pm 1\sigma$ = $169.85 \times (\text{known})^{0.0933}$ 10% of known value
Radium-226,-228	≥ 0.1 pCi/liter	15% of known value
Plutonium	≥ 0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤ 55 pCi/liter > 55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63[b] Technetium-99[b]	≤ 35 pCi/liter > 35 pCi/liter	6 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter > 100 pCi/liter	10 pCi/liter 10% of known value
Other Analyses [b]	---	20% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] Laboratory limit.

TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA) [a].

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result [b]	ERA Result [c]	Control Limits	Acceptance
ERW-1783	04/09/12	Sr-89	62.2 ± 6.0	58.5	46.9 - 66.3	Pass
ERW-1783	04/09/12	Sr-90	33.7 ± 2.1	37.4	27.4 - 43.1	Pass
ERW-1786	04/09/12	Ba-133	75.7 ± 4.1	82.3	69.1 - 90.5	Pass
ERW-1786	04/09/12	Co-60	71.9 ± 4.0	72.9	65.6 - 82.6	Pass
ERW-1786	04/09/12	Cs-134	70.0 ± 4.3	74.2	60.6 - 81.6	Pass
ERW-1786	04/09/12	Cs-137	151.5 ± 6.1	155.0	140.0 - 172.0	Pass
ERW-1786	04/09/12	Zn-65	108.3 ± 89.0	105.0	94.5 - 125.0	Pass
ERW-1789	04/09/12	Gr. Alpha	55.0 ± 2.4	62.9	33.0 - 78.0	Pass
ERW-1789 [d]	04/09/12	Gr. Beta	76.2 ± 1.8	44.2	29.6 - 51.5	Fail
ERW-1795	04/09/12	Ra-226	6.4 ± 0.4	5.7	4.3 - 6.9	Pass
ERW-1795	04/09/12	Ra-228	5.4 ± 1.2	4.6	2.7 - 6.3	Pass
ERW-1795	04/09/12	Uranium	56.2 ± 2.6	61.5	50.0 - 68.2	Pass
ERW-1798	04/09/12	H-3	16023 ± 355	15800	13800 - 17400	Pass
ERW-6283	10/05/12	Sr-89	41.5 ± 4.1	39.1	29.7 - 46.1	Pass
ERW-6283	10/05/12	Sr-90	19.7 ± 1.6	20.1	14.4 - 23.8	Pass
ERW-6286	10/05/12	Ba-133	82.7 ± 4.4	84.8	71.3 - 93.3	Pass
ERW-6286	10/05/12	Co-60	77.2 ± 3.7	78.3	70.5 - 88.5	Pass
ERW-6286	10/05/12	Cs-134	74.4 ± 1.5	76.6	62.6 - 84.3	Pass
ERW-6286	10/05/12	Cs-137	183.0 ± 6.2	183.0	165.0 - 203.0	Pass
ERW-6286	10/05/12	Zn-65	211.0 ± 9.9	204.0	184.0 - 240.0	Pass
ERW-6288	10/05/12	Gr. Alpha	47.0 ± 2.3	58.6	30.6 - 72.9	Pass
ERW-6288	10/05/12	Gr. Beta	33.4 ± 1.2	39.2	26.0 - 46.7	Pass
ERW-6290	10/05/12	I-131	23.3 ± 1.0	24.8	20.6 - 29.4	Pass
ERW-6295 [e]	10/05/12	Ra-226	17.5 ± 0.7	15.0	11.2 - 17.2	Fail
ERW-6295 [e]	10/05/12	Ra-228	7.4 ± 1.5	4.6	2.7 - 6.2	Fail
ERW-6295	10/05/12	Uranium	61.2 ± 1.8	62.5	50.8 - 69.3	Pass

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

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

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

[d] Result of reanalysis: 38.3 ± 1.3 pCi/L. Sample dilution problem suspected. A new dilution was prepared.

[e] Results of reanalyses, original submission (pCi/L): Ra-226, 16.5 ± 0.7 Ra-228, 4.9 ± 1.1
A new test was ordered from Environmental Resources Associates, results will be updated for first quarter, 2013.

TABLE A-2. Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards).

Lab Code	Date	Description	mR Known Value	mR Lab Result ± 2 sigma	Control Limits	Acceptance
Environmental, Inc.						
2012-1	2/7/2012	30 cm.	74.87	87.22 ± 2.86	52.41 - 97.33	Pass
2012-1	2/7/2012	40 cm.	42.12	53.70 ± 4.53	29.48 - 54.76	Pass
2012-1	2/7/2012	50 cm.	26.95	33.04 ± 1.96	18.87 - 35.04	Pass
2012-1	2/7/2012	70 cm.	13.75	13.26 ± 1.15	9.63 - 17.88	Pass
2012-1	2/7/2012	75 cm.	11.98	13.38 ± 1.68	8.39 - 15.57	Pass
2012-1	2/7/2012	80 cm.	10.53	11.27 ± 0.95	7.37 - 13.69	Pass
2012-1	2/7/2012	90 cm.	8.32	7.79 ± 0.83	5.82 - 10.82	Pass
2012-1	2/7/2012	100 cm.	6.74	5.91 ± 0.25	4.72 - 8.76	Pass
2012-1	2/7/2012	110 cm.	5.57	4.63 ± 0.83	3.90 - 7.24	Pass
2012-1	2/7/2012	120 cm.	4.68	3.96 ± 1.68	3.28 - 6.08	Pass
2012-1	2/7/2012	150 cm.	2.99	2.41 ± 0.08	2.09 - 3.89	Pass
2012-1	2/7/2012	180 cm.	2.08	2.02 ± 0.25	1.46 - 2.70	Pass
Environmental, Inc.						
2012-2	9/11/2012	40 cm.	33.75	43.74 ± 1.31	23.63 - 43.88	Pass
2012-2	9/11/2012	50 cm.	21.6	25.37 ± 0.82	15.12 - 28.08	Pass
2012-2	9/11/2012	60 cm.	15	16.63 ± 0.45	10.50 - 19.50	Pass
2012-2	9/11/2012	70 cm.	11.02	10.58 ± 0.20	7.71 - 14.33	Pass
2012-2	9/11/2012	80 cm.	8.44	8.55 ± 1.18	5.91 - 10.97	Pass
2012-2	9/11/2012	90 cm.	6.67	5.75 ± 0.33	4.67 - 8.67	Pass
2012-2	9/11/2012	100 cm.	5.4	4.44 ± 0.22	3.78 - 7.02	Pass
2012-2	9/11/2012	110 cm.	4.46	3.85 ± 0.05	3.12 - 5.80	Pass
2012-2	9/11/2012	120 cm.	3.75	3.03 ± 0.71	2.63 - 4.88	Pass
2012-2	9/11/2012	150 cm.	2.4	1.82 ± 0.10	1.68 - 3.12	Pass
2012-2	9/11/2012	180 cm.	1.67	1.19 ± 0.34	1.17 - 2.17	Pass

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration (pCi/L)[a] Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-41824	2/15/2012	Ra-228	24.85 ± 2.14	28.75	20.13 - 37.38	Pass
W-22712	2/27/2012	Gr. Alpha	14.59 ± 0.34	20.00	10.00 - 30.00	Pass
W-22712	2/27/2012	Gr. Alpha	43.57 ± 0.40	41.70	20.85 - 62.55	Pass
SPAP-1032	3/5/2012	Cs-134	7.06 ± 1.71	5.26	0.00 - 15.26	Pass
SPAP-1032	3/5/2012	Cs-137	102.63 ± 3.13	104.24	93.82 - 114.66	Pass
SPAP-1034	3/5/2012	Gr. Beta	44.30 ± 0.11	46.88	28.13 - 65.63	Pass
SPW-1036	3/5/2012	Cs-134	43.23 ± 3.84	39.42	29.42 - 49.42	Pass
SPW-1036	3/5/2012	Cs-137	57.44 ± 4.60	52.12	42.12 - 62.12	Pass
SPW-1036	3/5/2012	Sr-90	60.51 ± 1.93	61.52	49.22 - 73.82	Pass
SPMI-1038	3/5/2012	Cs-134	37.79 ± 4.06	39.42	29.42 - 49.42	Pass
SPMI-1038	3/5/2012	Cs-137	54.75 ± 5.09	52.12	42.12 - 62.12	Pass
SPW-1045	3/5/2012	H-3	68022 ± 746	69048	55238 - 82858	Pass
SPW-1047	3/5/2012	Ni-63	217.10 ± 3.64	206.64	144.65 - 268.63	Pass
SPW-1049	3/5/2012	C-14	3858.90 ± 12.79	4738.80	2843.28 - 6634.32	Pass
W-31412	3/14/2012	Ra-226	13.13 ± 0.36	16.70	11.69 - 21.71	Pass
SPW-1520	3/23/2012	U-238	45.67 ± 2.02	41.70	29.19 - 54.21	Pass
SPW-41825	4/10/2012	Ra-228	28.48 ± 2.51	28.35	19.85 - 36.86	Pass
WW-1547	4/16/2012	Ba-133	18.99 ± 4.67	26.70	16.70 - 36.70	Pass
WW-1547	4/16/2012	Cs-134	9.28 ± 2.82	8.68	0.00 - 18.68	Pass
WW-1547	4/16/2012	Cs-137	27.77 ± 4.49	29.70	19.70 - 39.70	Pass
W-51712	5/17/2012	Ra-226	17.29 ± 0.43	16.70	11.69 - 21.71	Pass
W-61112	6/11/2012	Gr. Alpha	22.16 ± 0.45	20.00	10.00 - 30.00	Pass
W-61112	6/11/2012	Gr. Beta	43.57 ± 0.40	45.20	35.20 - 55.20	Pass
SPAP-4418	7/25/2012	Gr. Beta	43.74 ± 0.11	46.50	27.90 - 65.10	Pass
SPAP-4420	7/25/2012	Cs-134	4.54 ± 0.73	4.60	2.76 - 6.44	Pass
SPAP-4420	7/25/2012	Cs-137	104.70 ± 2.77	103.30	92.97 - 113.63	Pass
SPMI-4422	7/25/2012	Co-60	31.43 ± 2.12	31.62	21.62 - 41.62	Pass
SPMI-4422	7/25/2012	Cs-134	16.50 ± 1.17	16.15	6.15 - 26.15	Pass
SPMI-4422	7/25/2012	Cs-137	29.60 ± 2.61	26.64	16.64 - 36.64	Pass
SPMI-4422	7/25/2012	Sr-90	31.60 ± 1.35	30.47	24.38 - 36.56	Pass
SPW-4424	7/25/2012	Co-60	38.52 ± 1.76	37.95	27.95 - 47.95	Pass
SPW-4424	7/25/2012	Cs-137	33.23 ± 2.27	32.01	22.01 - 42.01	Pass
SPW-4424	7/25/2012	Sr-90	36.56 ± 1.58	40.60	32.48 - 48.72	Pass
SPF-4426	7/25/2012	Cs-134	947.50 ± 42.50	1025.00	922.50 - 1127.50	Pass
SPF-4426	7/25/2012	Cs-137	2692.00 ± 62.40	2480.00	2232.00 - 2728.00	Pass
SPW-4428	7/25/2012	C-14	4325.70 ± 15.80	4738.80	2843.28 - 6634.32	Pass
SPW-4430	7/25/2012	H-3	70119.40 ± 773.40	67570.00	54056.00 - 81084.00	Pass
SPW-4432	7/25/2012	Ni-63	187.20 ± 3.85	206.80	144.76 - 268.84	Pass
W-81712	8/17/2012	Ra-226	14.94 ± 0.40	16.70	11.69 - 21.71	Pass
SPW-5407	8/29/2012	U-238	42.95 ± 0.11	41.70	29.19 - 54.21	Pass
SPW-18022	9/10/2012	Ra-228	29.03 ± 2.80	28.21	19.75 - 36.67	Pass

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration (pCi/L)[a] Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
W-91012	9/10/2012	Gr. Alpha	19.95 ± 0.42	20.00	10.00 - 30.00	Pass
W-91012	9/10/2012	Gr. Beta	43.47 ± 0.40	45.20	35.20 - 55.20	Pass
W-100312	10/3/2012	Gr. Alpha	19.95 ± 0.41	20.00	10.00 - 30.00	Pass
W-100312	10/3/2012	Gr. Beta	44.21 ± 0.40	45.20	35.20 - 55.20	Pass
W-101812	10/18/2012	Ra-226	18.80 ± 0.43	16.70	11.69 - 21.71	Pass
ESO-7235	12/6/2012	Sr-90	138.79 ± 2.67	161.05	128.84 - 193.26	Pass
SPW-7753	12/6/2012	U-238	45.55 ± 5.05	41.70	29.19 - 54.21	Pass
SPW-18023	12/18/2012	Ra-228	31.59 ± 2.99	25.98	18.19 - 33.77	Pass

[a] Liquid sample results are reported in pCi/Liter, air filters(pCi/filter), charcoal (pCi/m^3), and solid samples (pCi/g).

[b] Laboratory codes : W (Water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish), U (urine).

[c] Results are based on single determinations.

[d] Control limits are established from the precision values listed in Attachment A of this report, adjusted to ± 2 σ.

NOTE: For fish, Jello is used for the Spike matrix. For Vegetation, cabbage is used for the Spike matrix.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration (pCi/L)[a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[c]	Criteria (4.66 σ)
SPW-41814	Water	2/15/2012	Ra-228	0.65	0.49 ± 0.36	2
W-22712	Water	2/27/2012	Gr. Alpha	0.42	-0.04 ± 0.29	1
W-22712	Water	2/27/2012	Gr. Beta	0.74	-0.54 ± 0.50	3.2
SPAP-1031	Air Filter	3/5/2012	Cs-134	1.89	-	100
SPAP-1031	Air Filter	3/5/2012	Cs-137	1.16	-	100
SPAP-1033	Air Filter	3/5/2012	Gr. Beta	0.003	0.013 ± 0.003	0.01
SPW-1035	Water	3/5/2012	Cs-134	2.40	-	10
SPW-1035	Water	3/5/2012	Cs-137	2.88	-	10
SPW-1035	Water	3/5/2012	I-131(G)	2.35	-	20
SPW-1035	Water	3/5/2012	Sr-90	0.60	-0.11 ± 0.26	1
SPMI-1037	Milk	3/5/2012	Cs-134	2.85	-	10
SPMI-1037	Milk	3/5/2012	Cs-137	3.73	-	10
SPMI-1037	Milk	3/5/2012	I-131(G)	3.24	-	20
SPW-1044	Water	3/5/2012	H-3	146.10	37.10 ± 74.40	200
SPW-1046	Water	3/5/2012	Ni-63	19.07	8.30 ± 11.79	20
SPW-1048	Water	3/5/2012	C-14	5.70	2.99 ± 3.04	200
SPW-1166	water	3/9/2012	C-14	6.79	1.11	200
W-31412	Water	3/14/2012	Ra-226	0.034	0.043 ± 0.027	1
SPW-1521	Water	3/23/2012	U-238	0.10	0.09 ± 0.11	1
W-51712	Water	4/24/2012	Ra-226	0.04	0.04 ± 0.03	1
W-61112	Water	6/11/2012	Gr. Alpha	0.47	-0.14 ± 0.32	1
W-61112	Water	6/11/2012	Gr. Beta	0.71	0.29 ± 0.51	3.2
SPW-41815	Water	7/7/2011	Ra-228	0.77	0.52 ± 0.42	2
SPAP-4417	Air Filter	7/25/2012	Gr. Beta	0.001	0.021 ± 0.003	0.01
SPMI-4421	Milk	7/25/2012	Co-60	4.29	-	10
SPMI-4421	Milk	7/25/2012	Cs-134	3.58	-	10
SPMI-4421	Milk	7/25/2012	Cs-137	4.60	-	10
SPMI-4421	Milk	7/25/2012	Sr-90	0.45	0.53 ± 0.27	1
SPW-4423	Water	7/25/2012	Co-60	1.88	-	10
SPW-4423	Water	7/25/2012	Cs-134	2.38	-	10
SPW-4423	Water	7/25/2012	Cs-137	2.80	-	10
SPW-4423	water	7/25/2012	Sr-90	0.45	0.08 ± 0.22	1
SPF-4425	Fish	7/25/2012	Co-60	6.74	-	100
SPF-4425	Fish	7/25/2012	Cs-134	7.47	-	100
SPF-4425	Fish	7/25/2012	Cs-137	9.62	-	100
SPW-4427	Water	7/25/2012	C-14	10.93	3.54 ± 5.84	200
SPW-4431	Water	7/25/2012	Ni-63	19.00	5.50 ± 11.70	20
W-81712	Water	8/17/2012	Ra-226	0.038	0.035 ± 0.030	1
SPW-5408	Water	8/29/2012	U-238	0.039	0.015 ± 0.057	1

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration (pCi/L)[a]		
				Laboratory results (4.66σ)		Acceptance Criteria (4.66 σ)
				LLD	Activity[c]	
SPW-18032	Water	9/10/2012	Ra-228	0.78	0.85 ± 0.46	2
W-91012	Water	9/10/2012	Gr. Alpha	0.42	0.027 ± 0.29	1
W-91012	Water	9/10/2012	Gr. Beta	0.75	-0.13 ± 0.52	3.2
W-100312	Water	10/3/2012	Gr. Beta	0.77	-0.32 ± 0.53	3.2
W-100312	Water	10/3/2012	Gr. Beta	0.43	0.06 ± 0.30	3.2
W-101812	Water	10/18/2012	Ra-226	0.04	0.038 ± 0.031	1
SPW-7754	Water	12/6/2012	U-238	0.10	0.022 ± 0.075	1
SPW-18033	Water	12/18/2012	Ra-228	0.98	0.43 ± 0.50	2

[a] Liquid sample results are reported in pCi/Liter, air filters(pCi/filter), charcoal (pCi/charcoal canister), and solid samples (pCi/kg).

[b] I-131(G); iodine-131 as analyzed by gamma spectroscopy.

[c] Activity reported is a net activity result. For gamma spectroscopic analysis, activity detected below the LLD value is not reported.

TABLE A-5. In-House "Duplicate" Samples

Lab Code	Date	Analysis	Concentration (pCi/L)[a] First Result	Second Result	Averaged Result	Acceptance
CF-20, 21	1/3/2012	Gr. Beta	14.50 ± 0.29	15.02 ± 0.30	14.76 ± 0.21	Pass
CF-20, 21	1/3/2012	K-40	12.88 ± 0.55	12.40 ± 0.53	12.64 ± 0.38	Pass
CF-20, 21	1/3/2012	Sr-90	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.00	Pass
P-9133, 9134	1/3/2012	H-3	108.86 ± 83.03	206.60 ± 86.38	157.73 ± 59.91	Pass
U-302, 303	1/17/2012	Beta (-K40)	6.84 ± 2.91	5.24 ± 2.56	6.04 ± 1.94	Pass
S-386, 387	1/23/2012	Ac-228	0.77 ± 0.11	0.79 ± 0.14	0.78 ± 0.09	Pass
S-386, 387	1/23/2012	Bi-214	0.80 ± 0.07	0.73 ± 0.11	0.77 ± 0.07	Pass
S-386, 387	1/23/2012	Pb-214	0.74 ± 0.06	0.75 ± 0.11	0.75 ± 0.06	Pass
S-386, 387	1/23/2012	Tl-208	0.21 ± 0.02	0.21 ± 0.04	0.21 ± 0.02	Pass
S-386, 387	1/23/2012	U-235	0.05 ± 0.02	0.12 ± 0.05	0.09 ± 0.03	Pass
WW-619, 620	1/31/2012	H-3	257.20 ± 86.00	305.80 ± 88.30	281.50 ± 61.63	Pass
MI-702, 703	2/6/2012	K-40	1337.00 ± 123.00	1460.40 ± 102.00	1398.70 ± 79.90	Pass
WW-892, 893	2/17/2012	Gr. Beta	3.46 ± 0.56	3.77 ± 0.59	3.61 ± 0.41	Pass
S-850, 851	2/22/2012	Cs-134	0.14 ± 0.02	0.13 ± 0.02	0.14 ± 0.01	Pass
S-850, 851	2/22/2012	Cs-137	0.21 ± 0.03	0.22 ± 0.03	0.22 ± 0.02	Pass
W-1251, 1252	3/6/2012	Gr. Alpha	1.20 ± 0.62	1.27 ± 0.92	1.24 ± 0.55	Pass
W-1251, 1252	3/6/2012	Gr. Beta	16.86 ± 1.43	15.14 ± 1.34	16.00 ± 0.98	Pass
W-1251, 1252	3/6/2012	H-3	5235.52 ± 230.91	4893.24 ± 224.55	5064.38 ± 161.05	Pass
W-1251, 1252	3/6/2012	Tc-99	19.67 ± 3.60	14.46 ± 3.51	17.07 ± 2.51	Pass
AP-1209, 1210	3/8/2012	Be-7	0.24 ± 0.12	0.20 ± 0.11	0.22 ± 0.08	Pass
XWW-1564, 1565	3/14/2012	H-3	308.00 ± 88.00	293.00 ± 87.00	300.50 ± 61.87	Pass
SG-1438, 1439	3/19/2012	Ac-228	6.01 ± 0.30	6.23 ± 0.31	6.12 ± 0.22	Pass
SG-1438, 1439	3/19/2012	Pb-214	4.69 ± 0.49	5.20 ± 0.54	4.95 ± 0.36	Pass
WW-1585, 1586	3/19/2012	H-3	3124.50 ± 176.96	2982.38 ± 173.62	3053.44 ± 123.96	Pass
AP-2103, 2104	3/28/2012	Be-7	0.080 ± 0.016	0.076 ± 0.013	0.078 ± 0.010	Pass
AP-2166, 2167	3/28/2012	Be-7	0.061 ± 0.020	0.071 ± 0.016	0.066 ± 0.013	Pass
AP-1632, 1633	3/29/2012	Be-7	0.26 ± 0.12	0.24 ± 0.12	0.25 ± 0.08	Pass
E-1653, 1654	4/2/2012	Gr. Beta	1.53 ± 0.05	1.55 ± 0.04	1.54 ± 0.03	Pass
E-1653, 1654	4/2/2012	K-40	1.34 ± 0.13	1.36 ± 0.14	1.35 ± 0.10	Pass
SG-1677, 1678	4/2/2012	Ac-228	6.63 ± 0.37	6.49 ± 0.33	6.56 ± 0.25	Pass
SG-1677, 1678	4/2/2012	Pb-214	4.77 ± 0.16	5.07 ± 0.14	4.92 ± 0.11	Pass
SWU-1719, 1720	4/3/2012	Gr. Beta	1.16 ± 0.41	1.53 ± 0.44	1.35 ± 0.30	Pass
W-1698, 1699	4/5/2012	Gr. Beta	10.86 ± 1.49	9.42 ± 1.32	10.14 ± 1.00	Pass
W-1698, 1699	4/5/2012	Ra-226	0.41 ± 0.15	0.67 ± 0.18	0.54 ± 0.12	Pass
W-1698, 1699	4/5/2012	Ra-228	1.46 ± 0.76	1.48 ± 0.74	1.47 ± 0.53	Pass
SG-1761, 1762	4/10/2012	Ac-228	16.26 ± 0.53	16.55 ± 0.44	16.41 ± 0.34	Pass
SG-1761, 1762	4/10/2012	Pb-214	14.16 ± 1.44	15.40 ± 1.56	14.78 ± 1.06	Pass
AP-2019, 2020	4/12/2012	Be-7	0.17 ± 0.10	0.17 ± 0.08	0.17 ± 0.07	Pass
DW-2272, 2273	4/20/2012	I-131	0.52 ± 0.24	0.49 ± 0.27	0.51 ± 0.18	Pass
DW-2356, 2357	4/24/2012	Gr. Beta	12.82 ± 2.01	9.47 ± 1.74	11.14 ± 1.33	Pass

TABLE A-5. In-House "Duplicate" Samples

Lab Code	Date	Analysis	Concentration (pCi/L)[a] First Result	Second Result	Averaged Result	Acceptance
G-2403, 2404	5/1/2012	Be-7	1.77 ± 0.21	1.55 ± 0.33	1.66 ± 0.20	Pass
G-2403, 2404	5/1/2012	K-40	6.38 ± 0.50	6.93 ± 0.72	6.66 ± 0.44	Pass
BS-2445, 2446	5/1/2012	Gr. Beta	8.92 ± 1.52	9.29 ± 1.63	9.11 ± 1.11	Pass
BS-2445, 2446	5/1/2012	K-40	5.86 ± 0.38	6.22 ± 0.48	6.04 ± 0.31	Pass
SWU-2550, 2551	5/1/2012	Gr. Beta	2.07 ± 0.65	1.59 ± 0.62	1.83 ± 0.45	Pass
WW-2614, 2615	5/1/2012	Gr. Beta	2.03 ± 1.04	2.36 ± 1.14	2.20 ± 0.77	Pass
WW-2614, 2615	5/1/2012	H-3	750.60 ± 106.20	653.20 ± 102.30	701.90 ± 73.73	Pass
BS-2656, 2657	5/2/2012	Cs-137	0.13 ± 0.07	0.07 ± 0.04	0.10 ± 0.04	Pass
BS-2656, 2657	5/2/2012	K-40	10.15 ± 0.97	11.13 ± 0.90	10.64 ± 0.66	Pass
SO-2635, 2636	5/3/2012	Cs-137	0.046 ± 0.024	0.050 ± 0.027	0.048 ± 0.018	Pass
SO-2635, 2636	5/3/2012	K-40	13.20 ± 0.74	14.01 ± 0.67	13.61 ± 0.50	Pass
MI-2677, 2678	5/7/2012	K-40	1415.30 ± 131.40	1348.10 ± 109.00	1381.70 ± 85.36	Pass
VE-2719, 2720	5/7/2012	K-40	4.15 ± 0.36	4.19 ± 0.38	4.17 ± 0.26	Pass
SWU-3221, 3222	5/8/2012	Gr. Beta	1.67 ± 0.47	1.39 ± 0.45	1.53 ± 0.33	Pass
SWU-3221, 3222	5/8/2012	H-3	236.90 ± 101.90	281.90 ± 103.70	259.40 ± 72.69	Pass
WW-3073, 3074	5/14/2012	H-3	339.12 ± 145.45	337.23 ± 98.19	338.18 ± 87.74	Pass
AP-2968, 2969	5/17/2012	Be-7	0.25 ± 0.12	0.21 ± 0.09	0.23 ± 0.07	Pass
F-3031, 3032	5/22/2012	H-3	11291.00 ± 372.80	11167.00 ± 315.00	11229.00 ± 244.03	Pass
F-3031, 3032	5/22/2012	K-40	3528.90 ± 372.80	3677.20 ± 392.40	3603.05 ± 270.63	Pass
G-3094, 3095	5/23/2012	Gr. Beta	7.89 ± 0.16	8.01 ± 0.16	7.95 ± 0.11	Pass
F-3412, 3413	5/23/2012	Gr. Beta	3.46 ± 0.10	3.33 ± 0.10	3.40 ± 0.07	Pass
F-3412, 3413	5/23/2012	K-40	2.40 ± 0.38	2.55 ± 0.43	2.48 ± 0.29	Pass
MI-3067, 3068	5/24/2012	K-40	1267.20 ± 105.00	1305.70 ± 109.80	1286.45 ± 75.96	Pass
SO-3305, 3306	5/30/2012	Cs-137	0.024 ± 0.013	0.030 ± 0.015	0.027 ± 0.010	Pass
SO-3305, 3306	5/30/2012	Gr. Beta	10.95 ± 0.89	10.86 ± 0.89	10.91 ± 0.63	Pass
SO-3305, 3306	5/30/2012	Tl-208	0.068 ± 0.018	0.062 ± 0.017	0.065 ± 0.012	Pass
LW-3454, 3455	5/31/2012	Gr. Beta	2.12 ± 0.86	2.27 ± 0.77	2.20 ± 0.58	Pass
BS-3697, 3698	6/14/2012	Be-7	2.05 ± 0.19	2.27 ± 0.38	2.16 ± 0.21	Pass
BS-3697, 3698	6/14/2012	Cs-137	2.32 ± 0.39	2.26 ± 0.66	2.29 ± 0.38	Pass
BS-3697, 3698	6/14/2012	K-40	6.67 ± 0.28	6.64 ± 0.42	6.66 ± 0.25	Pass
VE-3798, 3799	6/20/2012	K-40	5.93 ± 0.38	6.03 ± 0.37	5.98 ± 0.26	Pass
WW-4790, 4791	6/20/2012	H-3	251.33 ± 86.51	372.48 ± 92.27	311.90 ± 63.24	Pass
DW-30103, 30104	6/27/2012	Ra-226	0.30 ± 0.08	0.42 ± 0.09	0.36 ± 0.06	Pass
DW-30103, 30104	6/27/2012	Ra-228	0.76 ± 0.54	0.78 ± 0.54	0.77 ± 0.38	Pass
LW-3970, 3971	6/28/2012	Gr. Beta	1.49 ± 1.06	0.72 ± 0.53	1.11 ± 0.59	Pass
DW-3949, 3950	6/29/2012	I-131	0.54 ± 0.26	0.25 ± 0.26	0.40 ± 0.18	Pass
SG-4075, 4076	7/2/2012	Ac-228	0.33 ± 0.09	0.34 ± 0.06	0.34 ± 0.05	Pass
SG-4075, 4076	7/2/2012	K-40	6.71 ± 0.58	7.20 ± 0.32	6.96 ± 0.33	Pass
SG-4075, 4076	7/2/2012	Pb-214	0.46 ± 0.05	0.49 ± 0.03	0.48 ± 0.03	Pass
AP-4390, 4391	7/3/2012	Be-7	0.09 ± 0.02	0.09 ± 0.01	0.09 ± 0.01	Pass
AP-4390, 4391	7/3/2012	Be-7	0.11 ± 0.02	0.10 ± 0.01	0.11 ± 0.01	Pass
AP-4012, 4013	7/5/2012	Be-7	0.27 ± 0.09	0.29 ± 0.16	0.28 ± 0.09	Pass
SW-4033, 4034	7/5/2012	H-3	614.99 ± 107.99	512.31 ± 103.83	563.65 ± 74.91	Pass

TABLE A-5. In-House "Duplicate" Samples

Lab Code	Date	Analysis	Concentration (pCi/L)[a] First Result	Second Result	Averaged Result	Acceptance
VE-4054, 4055	7/9/2012	K-40	7.28 ± 0.56	7.42 ± 0.63	7.35 ± 0.42	Pass
VE-4222, 4223	7/13/2012	Be-7	0.16 ± 0.08	0.22 ± 0.09	0.19 ± 0.06	Pass
VE-4222, 4223	7/13/2012	K-40	7.20 ± 0.30	6.60 ± 0.30	6.90 ± 0.21	Pass
DW-30113, 30114	7/13/2012	Ra-228	1.93 ± 0.66	1.03 ± 0.53	1.48 ± 0.42	Pass
DW-30115, 30116	7/13/2012	Gr. Alpha	7.46 ± 1.21	7.02 ± 1.14	7.24 ± 0.83	Pass
DW-30124, 30125	7/13/2012	Ra-226	1.16 ± 0.15	0.90 ± 0.12	1.03 ± 0.10	Pass
DW-30124, 30125	7/13/2012	Ra-228	1.38 ± 0.56	1.72 ± 0.60	1.55 ± 0.41	Pass
DW-30126, 30127	7/13/2012	Gr. Alpha	6.23 ± 1.16	6.75 ± 1.29	6.49 ± 0.87	Pass
AP-4433, 4434	7/19/2012	Be-7	0.17 ± 0.09	0.21 ± 0.10	0.19 ± 0.07	Pass
SG-4475, 4476	7/19/2012	Gr. Alpha	17.03 ± 4.17	15.56 ± 3.96	16.30 ± 2.88	Pass
SG-4475, 4476	7/19/2012	Gr. Beta	13.23 ± 2.61	14.36 ± 2.47	13.80 ± 1.80	Pass
WW-4685, 4686	7/24/2012	H-3	289.00 ± 99.00	375.00 ± 103.00	332.00 ± 71.43	Pass
AP-4706, 4707	7/26/2012	Be-7	0.28 ± 0.14	0.24 ± 0.14	0.26 ± 0.10	Pass
SO-4748, 4749	7/26/2012	Gr. Beta	20.45 ± 1.04	19.22 ± 0.94	19.84 ± 0.70	Pass
SO-4748, 4749	7/26/2012	U-233/4	0.11 ± 0.02	0.10 ± 0.01	0.11 ± 0.01	Pass
SO-4748, 4749	7/26/2012	U-238	0.12 ± 0.02	0.11 ± 0.01	0.12 ± 0.01	Pass
VE-4832, 4833	8/1/2012	K-40	4.06 ± 0.22	4.08 ± 0.24	4.07 ± 0.16	Pass
DW-30149, 30150	8/1/2012	Ra-226	2.69 ± 0.22	2.79 ± 0.22	2.74 ± 0.16	Pass
DW-30149, 30150	8/1/2012	Ra-228	2.77 ± 0.75	1.61 ± 0.57	2.19 ± 0.47	Pass
SG-4916, 4917	8/3/2012	Ac-228	11.03 ± 0.33	11.08 ± 0.44	11.06 ± 0.28	Pass
SG-4916, 4917	8/3/2012	K-40	6.39 ± 0.80	6.98 ± 0.88	6.69 ± 0.59	Pass
F-5313, 5314	8/9/2012	Cs-137	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.01	Pass
F-5313, 5314	8/9/2012	Gr. Beta	4.12 ± 0.08	4.10 ± 0.08	4.11 ± 0.06	Pass
F-5313, 5314	8/9/2012	K-40	3.07 ± 0.42	3.14 ± 0.40	3.11 ± 0.29	Pass
VE-5166, 5167	8/15/2012	K-40	4.26 ± 0.28	3.66 ± 0.47	3.96 ± 0.27	Pass
VE-5376, 5377	8/22/2012	Gr. Beta	7.72 ± 0.17	7.61 ± 0.16	7.67 ± 0.12	Pass
VE-5334, 5335	8/27/2012	K-40	1.65 ± 0.17	1.72 ± 0.15	1.68 ± 0.12	Pass
VE-5481, 5482	8/28/2012	Be-7	2.52 ± 0.19	2.65 ± 0.21	2.59 ± 0.14	Pass
VE-5481, 5482	8/28/2012	K-40	5.05 ± 0.37	4.79 ± 0.39	4.92 ± 0.27	Pass
VE-5481, 5482	8/28/2012	Sr-90	0.01 ± 0.00	0.01 ± 0.01	0.01 ± 0.00	Pass
DW-30164, 30165	8/30/2012	Ra-226	1.33 ± 0.15	1.59 ± 0.17	1.46 ± 0.11	Pass
DW-30164, 30165	8/30/2012	Ra-228	2.76 ± 0.66	1.54 ± 0.56	2.15 ± 0.43	Pass
VE-5166, 5167	9/4/2012	K-40	2.05 ± 0.32	2.53 ± 0.36	2.29 ± 0.24	Pass
ME-5607, 5608	9/4/2012	Gr. Beta	2.92 ± 0.08	2.89 ± 0.08	2.90 ± 0.06	Pass
ME-5607, 5608	9/4/2012	K-40	2.06 ± 0.32	2.53 ± 0.36	2.29 ± 0.24	Pass
SW-5901, 5902	9/17/2012	H-3	10909.00 ± 311.00	10817.00 ± 310.00	10863.00 ± 219.56	Pass
BS-6048, 6049	9/24/2012	K-40	1.24 ± 0.20	1.18 ± 0.21	1.21 ± 0.14	Pass
AP-6482, 6483	9/27/2012	Be-7	0.09 ± 0.02	0.09 ± 0.03	0.09 ± 0.02	Pass

TABLE A-5. In-House "Duplicate" Samples

Lab Code	Date	Analysis	Concentration (pCi/L)[a] First Result	Second Result	Averaged Result	Acceptance
G-6090, 6091	10/1/2012	Be-7	3.74 ± 0.33	3.54 ± 0.30	3.64 ± 0.22	Pass
G-6090, 6091	10/1/2012	Gr. Beta	10.81 ± 0.34	10.72 ± 0.33	10.77 ± 0.24	Pass
G-6090, 6091	10/1/2012	K-40	5.99 ± 0.47	5.45 ± 0.44	5.72 ± 0.32	Pass
SO-6111, 6112	10/1/2012	Cs-137	0.06 ± 0.03	0.04 ± 0.02	0.05 ± 0.02	Pass
SO-6111, 6112	10/1/2012	K-40	19.66 ± 0.84	20.09 ± 0.80	19.88 ± 0.58	Pass
W-6795, 6796	10/1/2012	H-3	215.20 ± 88.00	292.80 ± 91.60	254.00 ± 63.51	Pass
AP-6461, 6462	10/2/2012	Be-7	0.07 ± 0.01	0.07 ± 0.02	0.07 ± 0.01	Pass
WW-6279, 6280	10/3/2012	Gr. Beta	1.54 ± 0.68	1.67 ± 0.75	1.61 ± 0.51	Pass
W-6346, 6347	10/3/2012	Ra-226	0.30 ± 0.10	0.36 ± 0.10	0.33 ± 0.07	Pass
VE-6503, 6504	10/9/2012	K-40	5.23 ± 0.83	6.00 ± 0.45	5.04 ± 0.27	Pass
WW-6606, 6607	10/10/2012	Gr. Beta	3.18 ± 1.31	2.42 ± 1.27	2.80 ± 0.91	Pass
WW-6606, 6607	10/10/2012	H-3	273.10 ± 85.70	219.80 ± 83.10	246.45 ± 59.69	Pass
WW-7237, 7238	10/12/2012	H-3	175.44 ± 99.84	180.75 ± 100.03	178.10 ± 70.66	Pass
F-6627, 6628	10/15/2012	K-40	3.05 ± 0.39	3.23 ± 0.37	3.14 ± 0.27	Pass
VE-6669, 6670	10/16/2012	Be-7	0.48 ± 0.26	0.50 ± 0.13	0.49 ± 0.15	Pass
VE-6669, 6670	10/16/2012	K-40	4.06 ± 0.28	3.68 ± 0.26	3.87 ± 0.19	Pass
SS-6711, 6712	10/16/2012	Ac-228	0.16 ± 0.05	0.17 ± 0.06	0.17 ± 0.04	Pass
SS-6711, 6712	10/16/2012	Bi-214	0.13 ± 0.03	0.16 ± 0.03	0.14 ± 0.02	Pass
SS-6711, 6712	10/16/2012	Gr. Beta	14.20 ± 0.89	12.67 ± 0.88	13.44 ± 0.63	Pass
SS-6711, 6712	10/16/2012	Pb-212	0.15 ± 0.06	0.13 ± 0.02	0.14 ± 0.03	Pass
SS-6711, 6712	10/16/2012	Tl-208	0.06 ± 0.02	0.04 ± 0.02	0.05 ± 0.01	Pass
WW-7258, 7259	10/22/2012	H-3	214.69 ± 85.42	314.60 ± 90.25	264.65 ± 62.13	Pass
WW-7655, 7656	10/25/2012	H-3	159.00 ± 86.10	159.00 ± 86.10	159.00 ± 60.88	Pass
WW-7747, 7748	10/25/2012	H-3	156.50 ± 84.70	170.20 ± 85.30	163.35 ± 60.10	Pass
MI-6963, 6964	10/28/2012	K-40	1384.60 ± 111.70	1421.60 ± 107.60	1403.10 ± 77.55	Pass
MI-7174, 7175	11/5/2012	K-40	1283.60 ± 97.45	1293.20 ± 91.37	1288.40 ± 66.79	Pass
SG-7221, 7222	11/9/2012	Pb-214	31.49 ± 0.70	30.11 ± 0.80	30.80 ± 0.53	Pass
DW-30216, 30217	11/9/2012	Gr. Alpha	2.23 ± 0.86	2.31 ± 0.92	2.27 ± 0.63	Pass
DW-30216, 30217	11/9/2012	Ra-226	0.72 ± 0.12	0.82 ± 0.14	0.77 ± 0.09	Pass
DW-30216, 30217	11/9/2012	Ra-228	0.92 ± 0.52	1.26 ± 0.53	1.09 ± 0.37	Pass
MI-7363, 7364	11/13/2012	K-40	1304.40 ± 103.30	1496.10 ± 121.30	1400.25 ± 79.66	Pass
CF-7384, 7385	11/13/2012	K-40	11.75 ± 0.52	10.94 ± 0.59	11.35 ± 0.39	Pass
VE-7489, 7490	11/16/2012	K-40	2.22 ± 0.23	1.91 ± 0.22	2.06 ± 0.16	Pass
AP-7531, 7532	11/21/2012	Be-7	0.19 ± 0.10	0.29 ± 0.17	0.24 ± 0.10	Pass
BS-7573, 7574	11/24/2012	K-40	7.21 ± 0.41	7.57 ± 0.39	7.39 ± 0.28	Pass
LW-7865, 7866	12/5/2012	Gr. Beta	2.16 ± 0.56	1.64 ± 0.62	1.90 ± 0.42	Pass
SG-8095, 8096	12/19/2012	Ac-228	25.15 ± 0.73	25.47 ± 0.54	25.31 ± 0.45	Pass
SG-8095, 8096	12/19/2012	Gamma	26.98 ± 2.72	28.68 ± 2.89	27.83 ± 1.98	Pass

Note: Duplicate analyses are performed on every twentieth sample received in-house. Results are not listed for those analyses with activities that measure below the LLD.

[a] Results are reported in units of pCi/L, except for air filters (pCi/Filter), food products, vegetation, soil, sediment (pCi/g).

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
STW-1670	02/01/12	I-129	9.31 ± 0.31	12.29	8.60 - 15.98	Pass
STSO-1766 [d]	02/01/12	Am-241	88.50 ± 8.30	159.00	111.00 - 207.00	Fail
STSO-1766	02/01/12	Co-57	1352.10 ± 4.00	1179.00	825.00 - 1533.00	Pass
STSO-1766	02/01/12	Co-60	1.70 ± 0.70	1.56	1.00 - 2.00	Pass
STSO-1766	02/01/12	Cs-134	842.20 ± 4.30	828.00	580.00 - 1076.00	Pass
STSO-1766	02/01/12	Cs-137	0.40 ± 0.90	0.00	0.00 - 1.00	Pass
STSO-1766	02/01/12	K-40	1729.60 ± 22.20	1491.00	1044.00 - 1938.00	Pass
STSO-1766	02/01/12	Mn-54	647.60 ± 4.20	558.00	391.00 - 725.00	Pass
STSO-1766	02/01/12	Ni-63	781.50 ± 9.70	862.00	603.00 - 1121.00	Pass
STSO-1766	02/01/12	Pu-238	142.40 ± 9.70	136.00	97.00 - 177.00	Pass
STSO-1766	02/01/12	Pu-239/40	66.10 ± 6.40	65.80	46.10 - 85.50	Pass
STSO-1766	02/01/12	Sr-90	383.20 ± 15.30	392.00	274.00 - 510.00	Pass
STSO-1766	02/01/12	Tc-99	289.60 ± 10.90	374.00	262.00 - 486.00	Pass
STSO-1766	02/01/12	U-233/4	63.20 ± 5.40	68.10	47.70 - 88.50	Pass
STSO-1766	02/01/12	U-238	310.80 ± 12.10	329.00	230.00 - 428.00	Pass
STSO-1766	02/01/12	Zn-65	766.70 ± 6.70	642.00	449.00 - 835.00	Pass
STAP-1772	02/01/12	Am-241	0.062 ± 0.02	0.073	0.051 - 0.10	Pass
STAP-1772	02/01/12	Co-57	0.010 ± 0.01	0.00	0.000 - 1.00	Pass
STAP-1772	02/01/12	Co-60	2.40 ± 0.08	2.18	1.53 - 2.84	Pass
STAP-1772	02/01/12	Cs-134	2.33 ± 0.13	2.38	1.67 - 3.09	Pass
STAP-1772	02/01/12	Cs-137	2.07 ± 0.10	1.79	1.25 - 2.33	Pass
STAP-1772	02/01/12	Mn-54	3.77 ± 0.14	3.24	2.27 - 4.21	Pass
STAP-1772	02/01/12	Pu-238	0.003 ± 0.004	0.002	0.000 - 0.10	Pass
STAP-1772	02/01/12	Pu-239/40	0.098 ± 0.017	0.097	0.07 - 0.13	Pass
STAP-1772	02/01/12	Sr-90	-0.010 ± 0.060	0.000	-0.10 - 0.13	Pass
STAP-1772 [e]	02/01/12	U-233/4	0.016 ± 0.006	0.019	0.013 - 0.024	Pass
STAP-1772	02/01/12	U-238	0.11 ± 0.02	0.12	0.09 - 0.16	Pass
STAP-1772	02/01/12	Zn-65	3.67 ± 0.20	2.99	2.09 - 3.89	Pass
STAP-1773	02/01/12	Gr. Alpha	0.51 ± 0.05	1.20	0.40 - 2.00	Pass
STAP-1773	02/01/12	Gr. Beta	2.75 ± 0.10	2.40	1.20 - 3.60	Pass
STVE-1776	02/01/12	Co-57	14.57 ± 0.28	12.00	8.40 - 15.60	Pass
STVE-1776	02/01/12	Co-60	6.45 ± 0.23	6.05	4.24 - 7.87	Pass
STVE-1776	02/01/12	Cs-134	8.39 ± 0.29	8.43	5.90 - 10.96	Pass
STVE-1776	02/01/12	Cs-137	0.01 ± 0.09	0.00	0.00 - 0.10	Pass
STVE-1776	02/01/12	Mn-54	0.03 ± 0.08	0.00	0.00 - 0.10	Pass
STVE-1776	02/01/12	Zn-65	10.31 ± 0.67	8.90	6.23 - 11.57	Pass
STW-1960	02/01/12	Gr. Alpha	1.68 ± 0.09	2.14	0.64 - 3.64	Pass
STW-1960	02/01/12	Gr. Beta	6.33 ± 0.10	6.36	3.18 - 9.54	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
STW-1964	02/01/12	Am-241	1.28 ± 0.12	1.63	1.14 - 2.12	Pass
STW-1964	02/01/12	Co-57	33.30 ± 0.40	32.90	23.00 - 42.80	Pass
STW-1964	02/01/12	Co-60	23.20 ± 0.40	23.72	16.60 - 30.84	Pass
STW-1964	02/01/12	Cs-134	0.30 ± 3.00	0.00	0.00 - 1.00	Pass
STW-1964	02/01/12	Cs-137	40.10 ± 0.60	39.90	27.90 - 51.90	Pass
STW-1964 [†]	02/01/12	Fe-55	65.10 ± 9.50	81.90	57.30 - 106.50	Pass
STW-1964	02/01/12	H-3	460.00 ± 12.10	437.00	306.00 - 568.00	Pass
STW-1964	02/01/12	K-40	153.00 ± 4.20	142.00	99.00 - 185.00	Pass
STW-1964	02/01/12	Mn-54	32.70 ± 0.60	31.80	22.30 - 41.30	Pass
STW-1964	02/01/12	Ni-63	49.80 ± 2.90	60.00	42.00 - 78.00	Pass
STW-1964	02/01/12	Pu-238	0.58 ± 0.06	0.63	0.44 - 0.82	Pass
STW-1964	02/01/12	Pu-239/40	1.30 ± 0.15	1.34	0.94 - 1.74	Pass
STW-1964	02/01/12	Sr-90	0.10 ± 0.20	0.00	0.00 - 1.00	Pass
STW-1964	02/01/12	Tc-99	23.70 ± 0.80	27.90	19.50 - 36.30	Pass
STW-1964	02/01/12	U-233/4	0.40 ± 0.05	0.39	0.27 - 0.51	Pass
STW-1964	02/01/12	U-238	2.67 ± 0.13	2.76	1.93 - 3.59	Pass
STW-1964	02/01/12	Zn-65	0.01 ± 0.20	0.00	0.00 - 1.00	Pass
STW-5391	08/01/12	I-129	5.73 ± 0.28	6.82	4.77 - 8.87	Pass
STSO-5392	08/01/12	Am-241	129.30 ± 12.70	111.00	78.00 - 144.00	Pass
STSO-5392	08/01/12	Ni-63	376.20 ± 20.60	406.00	284.00 - 528.00	Pass
STSO-5392	08/01/12	Pu-238	118.70 ± 9.30	105.80	74.10 - 137.50	Pass
STSO-5392	08/01/12	Pu-239/40	140.70 ± 9.90	134.00	94.00 - 174.00	Pass
STSO-5392	08/01/12	Sr-90	483.52 ± 16.47	508.00	356.00 - 660.00	Pass
STSO-5392	08/01/12	Tc-99	432.50 ± 23.10	469.00	328.00 - 610.00	Pass
STSO-5394	08/01/12	Co-57	1528.00 ± 4.10	1316.00	921.00 - 1711.00	Pass
STSO-5394	08/01/12	Co-60	592.00 ± 3.20	531.00	372.00 - 690.00	Pass
STSO-5394	08/01/12	Cs-134	933.60 ± 5.82	939.00	657.00 - 1221.00	Pass
STSO-5394	08/01/12	Cs-137	1319.80 ± 5.50	1150.00	805.00 - 1495.00	Pass
STSO-5394	08/01/12	K-40	737.30 ± 17.70	632.00	442.00 - 822.00	Pass
STSO-5394	08/01/12	Mn-54	1083.20 ± 5.20	920.00	644.00 - 1196.00	Pass
STSO-5394	08/01/12	U-233/4	55.80 ± 4.20	60.30	42.20 - 78.40	Pass
STSO-5394	08/01/12	U-238	231.20 ± 8.60	263.00	184.00 - 342.00	Pass
STSO-5394	08/01/12	Zn-65	696.10 ± 7.00	606.00	424.00 - 788.00	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
STVE-5395 [g]	08/01/12	Co-57	7.44 ± 0.17	5.66	3.96 - 7.36	Fail
STVE-5395	08/01/12	Co-60	5.90 ± 0.15	5.12	3.58 - 6.66	Pass
STVE-5395	08/01/12	Cs-134	7.40 ± 0.31	6.51	4.56 - 8.46	Pass
STVE-5395	08/01/12	Cs-137	5.45 ± 0.18	4.38	3.07 - 5.69	Pass
STVE-5395	08/01/12	Mn-54	4.06 ± 0.21	3.27	2.29 - 4.25	Pass
STAP-5398	08/01/12	Gr. Alpha	0.41 ± 0.05	0.97	0.29 - 1.65	Pass
STAP-5398	08/01/12	Gr. Beta	2.11 ± 0.09	1.92	0.96 - 2.88	Pass
STAP-5401 [h]	08/01/12	Am-241	0.12 ± 0.02	0.08	0.05 - 0.10	Fail
STAP-5403	08/01/12	Co-57	1.96 ± 0.05	1.91	1.34 - 2.48	Pass
STAP-5403	08/01/12	Co-60	1.76 ± 0.07	1.73	1.21 - 2.25	Pass
STAP-5403	08/01/12	Cs-134	2.74 ± 0.18	2.74	1.92 - 3.56	Pass
STAP-5403	08/01/12	Cs-137	0.00 ± 0.03	0.00	-0.01 - 0.01	Pass
STAP-5403	08/01/12	Mn-54	2.52 ± 0.10	2.36	1.65 - 3.07	Pass
STAP-5403	08/01/12	Pu-238	0.050 ± 0.015	0.063	0.044 - 0.081	Pass
STAP-5403	08/01/12	Pu-239/40	0.001 ± 0.004	0.00081	0.000 - 0.010	Pass
STAP-5403 [i]	08/01/12	U-233/4	0.009 ± 0.011	0.014	0.010 - 0.018	Fail
STAP-5403	08/01/12	U-238	0.08 ± 0.02	0.10	0.070 - 0.130	Pass
STAP-5403	08/01/12	Zn-65	0.01 ± 0.06	0.00	-0.010 - 0.010	Pass
STW-5445	08/01/12	Fe-55	79.80 ± 4.10	89.30	62.50 - 116.10	Pass
STW-5445	08/01/12	Ni-63	74.30 ± 3.40	66.30	46.40 - 86.20	Pass
STW-5445	08/01/12	U-233/4	0.46 ± 0.05	0.45	0.32 - 0.59	Pass
STW-5445	08/01/12	U-238	3.14 ± 0.14	3.33	2.33 - 4.33	Pass
STW-5445 [j]	08/01/12	Am-241	0.64 ± 0.04	1.06	0.74 - 1.38	Fail

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

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

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

[d] Investigation was inconclusive, there was not enough sample for reanalysis. ERA results (A-7) for the same matrix were acceptable.

[e] No errors found in calculation or procedure, original analysis result; 0.010 ± 0.010 Bq/filter.

[f] Reanalysis results were within limits, but low. ERA results (A-7) for the same matrix were acceptable. The efficiency factor was recalculated for the second round of MAPEP testing. Original analysis results 55.8 ± 12.6 Bq/L.

[g] Result of reanalysis; 6.74 ± 0.15 Bq/sample. Gamma emitters for the vegetation matrix exhibited a high bias, only Co-57 exceeded acceptance limits. Recounted using a geometry more closely matched to the MAPEP sample size.

[h] Result of reanalysis; 0.070 ± 0.013 Bq/filter.

[i] Result of reanalysis; 0.013 ± 0.005 pCi/filter. A larger sample size was used to reduce the counting error.

[j] Result of reanalysis 1.07 ± 0.06 pCi/L. The analyses of the MAPEP sample matrix resulted in recovery factors greater than 100%. A correction was made using recovery based on analysis of blank samples. A new tracer solution is on order, future samples for MAPEP testing will include batch spike and blank samples.

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA) [a].

Lab Code [b]	Date	Analysis	Concentration (pCi/L) [b] Laboratory Result [c]	ERA Result [d]	Control Limits	Acceptance
ERAP-1393	03/19/12	Co-60	917.5 ± 7.0	880.0	681.0 - 1100.0	Pass
ERAP-1393	03/19/12	Cs-134	586.6 ± 7.4	656.0	417.0 - 814.0	Pass
ERAP-1393	03/19/12	Cs-137	1255.9 ± 9.4	1130.0	849.0 - 1480.0	Pass
ERAP-1393	03/19/12	Mn-54	< 3.4	0.0	-	Pass
ERAP-1393	03/19/12	Zn-65	1085.2 ± 18.0	897.0	642.0 - 1240.0	Pass
ERAP-1394	03/19/12	Am-241	86.9 ± 2.9	68.8	42.4 - 93.1	Pass
ERAP-1394	03/19/12	Pu-238	70.2 ± 3.6	63.2	43.3 - 83.1	Pass
ERAP-1394	03/19/12	Pu-239/40	66.0 ± 1.0	63.0	45.6 - 82.4	Pass
ERAP-1394	03/19/12	Sr-90	112.5 ± 15.4	89.6	43.8 - 134.0	Pass
ERAP-1394	03/19/12	U-233/4	43.4 ± 0.8	47.5	29.4 - 71.6	Pass
ERAP-1394	03/19/12	U-238	44.0 ± 1.2	47.1	30.4 - 65.1	Pass
ERAP-1394	03/19/12	Uranium	89.1 ± 2.2	96.7	53.5 - 147.0	Pass
ERAP-1396	03/19/12	Gr. Alpha	81.1 ± 1.5	77.8	26.1 - 121.0	Pass
ERAP-1396	03/19/12	Gr. Beta	68.4 ± 0.7	52.5	33.2 - 76.5	Pass
ERSO-1397	03/19/12	Ac-228	1303.4 ± 89.3	1570.0	1010.0 - 2180.0	Pass
ERSO-1397	03/19/12	Am-241	856.0 ± 123.7	938.0	549.0 - 1220.0	Pass
ERSO-1397	03/19/12	Bi-212	1379.2 ± 247.2	1550.0	413.0 - 2280.0	Pass
ERSO-1397	03/19/12	Bi-214	965.2 ± 38.4	1100.0	665.0 - 1590.0	Pass
ERSO-1397	03/19/12	Co-60	3693.6 ± 32.1	3500.0	2370.0 - 4820.0	Pass
ERSO-1397	03/19/12	Cs-134	2257.3 ± 45.4	2180.0	1420.0 - 2620.0	Pass
ERSO-1397	03/19/12	Cs-137	9444.5 ± 58.4	8770.0	6720.0 - 11300.0	Pass
ERSO-1397	03/19/12	K-40	11277.0 ± 275.1	11600.0	8470.0 - 15600.0	Pass
ERSO-1397	03/19/12	Mn-54	< 21.0	0.0	-	Pass
ERSO-1397	03/19/12	Pb-212	1208.4 ± 26.3	1510.0	992.0 - 2110.0	Pass
ERSO-1397	03/19/12	Pb-214	1041.6 ± 46.9	1110.0	647.0 - 1650.0	Pass
ERSO-1397	03/19/12	Pu-238	921.0 ± 112.6	984.0	592.0 - 1360.0	Pass
ERSO-1397	03/19/12	Pu-239/40	1028.0 ± 112.6	879.0	575.0 - 1210.0	Pass
ERSO-1397	03/19/12	Sr-90	8128.0 ± 329.0	8800.0	3360.0 - 13900.0	Pass
ERSO-1397	03/19/12	Th-234	2711.3 ± 253.6	2000.0	632.0 - 3760.0	Pass
ERSO-1397	03/19/12	U-233/4	1859.3 ± 126.6	1960.0	1200.0 - 2510.0	Pass
ERSO-1397	03/19/12	U-238	2003.3 ± 130.3	2000.0	1240.0 - 2540.0	Pass
ERSO-1397	03/19/12	Uranium	3939.5 ± 283.8	4030.0	2190.0 - 5320.0	Pass
ERSO-1397	03/19/12	Zn-65	4200.4 ± 65.9	3650.0	2910.0 - 4850.0	Pass

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA) [a].

Lab Code [b]	Date	Analysis	Concentration (pCi/L) [b] Laboratory Result [c]	ERA Result [d]	Control Limits	Acceptance
ERVE-1400	03/19/12	Am-241	4194.8 ± 199.5	4540.0	2780.0 - 6040.0	Pass
ERVE-1400	03/19/12	Cm-244	1471.2 ± 113.1	1590.0	779.0 - 2480.0	Pass
ERVE-1400	03/19/12	Co-60	2347.8 ± 47.9	2210.0	1520.0 - 3090.0	Pass
ERVE-1400	03/19/12	Cs-134	2847.5 ± 64.0	2920.0	1880.0 - 3790.0	Pass
ERVE-1400	03/19/12	Cs-137	1503.5 ± 52.5	1340.0	972.0 - 1860.0	Pass
ERVE-1400	03/19/12	K-40	34105.7 ± 745.3	28600.0	20700.0 - 40100.0	Pass
ERVE-1400	03/19/12	Mn-54	< 26.8	0.0	-	Pass
ERVE-1400	03/19/12	Pu-238	2509.0 ± 213.6	2350.0	1400.0 - 3220.0	Pass
ERVE-1400	03/19/12	Pu-239/40	2690.4 ± 208.9	2570.0	1580.0 - 3540.0	Pass
ERVE-1400	03/19/12	Sr-90	7881.5 ± 470.8	8520.0	4860.0 - 11300.0	Pass
ERVE-1400	03/19/12	U-233/4	3149.6 ± 165.2	3610.0	2370.0 - 4640.0	Pass
ERVE-1400	03/19/12	U-238	3203.6 ± 166.5	3580.0	2390.0 - 4550.0	Pass
ERVE-1400	03/19/12	Uranium	6463.7 ± 363.2	7350.0	4980.0 - 9150.0	Pass
ERVE-1400	03/19/12	Zn-65	2701.9 ± 105.5	2310.0	1670.0 - 3240.0	Pass
ERW-1403	03/19/12	Am-241	119.9 ± 3.2	135.0	91.0 - 181.0	Pass
ERW-1403	03/19/12	Fe-55	713.7 ± 127.4	863.0	514.0 - 1170.0	Pass
ERW-1403	03/19/12	Pu-238	131.9 ± 6.4	135.0	99.9 - 168.0	Pass
ERW-1403	03/19/12	Pu-239/40	108.9 ± 10.2	112.0	86.9 - 141.0	Pass
ERW-1403	03/19/12	U-233/4	93.1 ± 7.9	105.0	78.9 - 135.0	Pass
ERW-1403	03/19/12	U-238	96.9 ± 5.5	104.0	79.3 - 128.0	Pass
ERW-1403	03/19/12	Uranium	190.0 ± 13.8	214.0	157.0 - 277.0	Pass
ERW-1405	03/19/12	Co-60	858.7 ± 5.6	875.0	760.0 - 1020.0	Pass
ERW-1405	03/19/12	Cs-134	560.4 ± 4.4	609.0	447.0 - 700.0	Pass
ERW-1405	03/19/12	Cs-137	1239.9 ± 7.4	1250.0	1060.0 - 1500.0	Pass
ERW-1405	03/19/12	Mn-54	< 7.4	0.0	-	Pass
ERW-1405	03/19/12	Sr-90	944.3 ± 26.2	989.0	644.0 - 1310.0	Pass
ERW-1405	03/19/12	Zn-65	786.9 ± 20.6	749.0	624.0 - 945.0	Pass
ERW-1406	03/19/12	Gr. Alpha	85.9 ± 3.0	103.0	36.6 - 160.0	Pass
ERW-1406	03/19/12	Gr. Beta	45.7 ± 1.6	43.7	25.0 - 64.7	Pass
ERW-1409	03/19/12	H-3	9045.0 ± 284.0	9150.0	6130.0 - 13000.0	Pass

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

[b] Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation). Results are reported in units of pCi/L, except for air filters (pCi/Filter), vegetation and soil (pCi/kg).

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

[d] Results are presented as the known values, expected laboratory precision (1 sigma, 1 determination) and control limits as provided by ERA. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". Control limits are not provided.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows: $x \pm s$

where: x = value of the measurement;

s = 2σ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is less than the lower limit of detection L, it is reported as: < L,
where L = the lower limit of detection based on 4.66σ uncertainty for a background sample.

3.0. Duplicate analyses

If duplicate analyses are reported, the convention is as follows. :

3.1 Individual results: For two analysis results; $x_1 \pm s_1$ and $x_2 \pm s_2$

Reported result: $x \pm s$; where $x = (1/2)(x_1 + x_2)$ and $s = (1/2)\sqrt{s_1^2 + s_2^2}$

3.2. Individual results: $< L_1$, $< L_2$ Reported result: < L, where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$, < L Reported result: $x \pm s$ if $x \geq L$; < L otherwise.

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation "s" of a set of n numbers $x_1, x_2 \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n} \sum x \qquad s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

4.5 In rounding off, the following rules are followed:

4.5.1. If the number following those to be retained is less than 5, the number is dropped, and the retained numbers are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2. If the number following those to be retained is equal to or greater than 5, the number is dropped and the last retained number is raised by 1. As an example, 11.445 is rounded off to 11.45.

APPENDIX C

Maximum Permissible Concentrations

of Radioactivity in Air and Water

Above Background in Unrestricted Areas

Table C-1. Maximum permissible concentrations of radioactivity in air and water above natural background in unrestricted areas[a].

	Air (pCi/m^3)		Water (pCi/L)
Gross alpha	1×10^{-3}	Strontium-89	8,000
Gross beta	1	Strontium-90	500
Iodine-131[b]	2.8×10^{-1}	Cesium-137	1,000
		Barium-140	8,000
		Iodine-131	1,000
		Potassium-40[c]	4,000
		Gross alpha	2
		Gross beta	10
		Tritium	1×10^6

[a] Taken from Table 2 of Appendix B to Code of Federal Regulations Title 10, Part 20, and appropriate footnotes. Concentrations may be averaged over a period not greater than one year.

[b] Value adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-milk-child pathway.

[c] A natural radionuclide.

APPENDIX D

SUMMARY OF THE LAND USE CENSUS

Appendix D

Summary of the 2012 Land Use Census

The Duane Arnold Energy Land Use Census for 2012 was completed during August and September of 2012. All milk animals, residences and gardens greater than 500 square feet were identified within three miles for each of the 16 meteorological sectors. If none were identified within the three mile range, additional surveys were performed out to a distance of five miles.

The Cedar River was surveyed by boat on August 31st of 2012 for water use downstream of the DAEC to Cedar Rapids. This survey identified no new usages of river water from previous surveys. Recreational fishing is the only identified food pathway use of Cedar River water between the DAEC and the City of Cedar Rapids eight miles down-river.

There were 140 vegetable gardens identified during the performance of the 2012 Census. This number is more than the number of gardens found in the 2011 survey by 26. The distance to the nearest vegetation receptor changed in two sectors.

- In the sector towards the northwest, a new garden was identified at 2120 meters. This is compares of a distance of 2160 meters in that sector in 2011.
- In the sector towards the southwest, a new garden was identified at 3320 meters. This is compares of a distance of 4380 meters in that sector in 2011.

There were no other changes to the locations of the nearest vegetable receptors.

There was one new cattle herd observed at 3710 meters towards the north. There were no observed changes in milk cow locations.

No new drinking water wells were identified within a two mile radius of the site.

There was one instance where there was a change in the location of the nearest resident in a sector.

- In the sector towards the southwest, a previously occupied house has been vacant for more than a year. The residence was purchased by a sand mining company in 2010 for commercial use.

In August of 2012, a professional geologist employed by the firm Conestoga-Rovers & Associates evaluated the new sand pit located to the SW of the site for its potential effect on site hydrology. The hydrogeologist observed that during dredging activities, some water is removed from the pit. This water returned to the pit following the sorting process and there is effectively no net addition or subtraction of water from the underlying aquifers.
He concluded that:

> "..current activities at Croell have no significant impact on groundwater flow conditions (e.g. groundwater flow rate and direction) at DAEC."

In accordance with the DAEC's Environmental Sampling Procedure ESP 4.4, "Land Use Census", no changes in land use were identified that would adversely affect the safe operation of the DAEC, or that would warrant an update of the DAEC Updated Final Safety Analysis Report (UFSAR). Examples of land use that would warrant an UFSAR update include new hazards near the DAEC such as new gas pipelines or new installations utilizing toxic gases.

NextEra Energy Resources, Duane Arnold has committed to compliance with NEI 07-07, "Nuclear Energy Institute's Industry Ground Water Protection Initiative". Per NEI 07-07, the following information is presented:

- No radioactive reactor by-product material was identified in samples collected by the DAEC's Radiological Environmental Monitoring Program (REMP) or the site Ground Water Protection Program (GWPP) above the threshold concentration levels for reporting.

APPENDIX E

ANNUAL RADIATION DOSE ASSESSMENT

Appendix E

Annual Radiation Dose Assessment

The annual offsite radiation dose to a member of the public was determined by assessment of environmental dosimetry results and by calculations based on monitored effluent releases.

Section A. Dose Contribution from Direct Radiation

Direct radiation dose from the operation of the DAEC was reported by TLDs placed at locations in the surrounding environment as described in the Offsite Dose Assessment Manual (ODAM).

1. Pre-operational and 2012 TLD results were evaluated with a paired difference statistical test. The evaluation concluded that there were no significant differences in the TLD populations for the 0.5 mile and 1 mile TLD populations.

2. As stated in Part 1 of this report, no plant effect was indicated by the TLDs when dose results were compared to the estimated average natural background for Middle America.

Section B. Estimated Offsite Dose from Effluent Releases

1. The contribution of dose to a member of the public most likely to be exposed from liquid and gaseous effluent releases was calculated using the Meteorological Information and Dose Assessment System (MIDAS) computer program in accordance with the ODAM. The calculation methods follow those prescribed by Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I".

2. Following calculation of offsite doses, the appropriateness of REMP sampling station types and locations was reviewed. The current sampling scheme was determined to be more than adequate for the identified receptors.

Results of the MIDAS dose calculations are displayed below.

1.) The hypothetical maximally exposed organ due to liquid effluents was the liver of a child with an estimated dose equivalent of 0.00000248 mrem.

2.) The whole body dose equivalent to the hypothetical maximally exposed individual due to liquid effluents was 0.00000248 mrem.

3.) The maximum dose to air at the site boundary from noble gases released was 0.00305 mrad from gamma radiation at 695 meters towards the North-East.

4.) The maximum dose to air at the site boundary from noble gases released was 0.00387 mrad beta radiation at 695 meters towards the North-East.

5.) The whole body dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.00110 mrem, at 805 meters towards the West.

6.) The skin dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.00260 mrem, at 805 meters towards the West.

7.) The hypothetical maximally exposed organ due to airborne iodines and particulates with half-lives greater than eight days (excluding carbon-14) was the thyroid of a child at 805 meters to the West, with an estimated dose equivalent of 0.00899 mrem.

8.) The hypothetical maximally exposed organ due to airborne carbon-14 was the bone of a child located 2414 meters to the North of the site. The dose was 0.056 mrem.

Conclusion

No measurable dose due to the operation of the DAEC was detected by environmental TLDs in 2012. The calculated doses are below the regulatory limits stated in Appendix I to 10CFR50 and in 40CFR190.

Estimated Maximum Offsite Individual Doses for 2012

Type	Age Group	Distance (meters)	Direction	Dose or Dose Equivalent (mrem)	Annual 10 CFR 50, Appendix I "Limit"
Direct Radiation (as measured by TLDs)				None	*
Liquid Releases					
Whole Body Dose	Child		S	0.00000248 mrem	3 mrem
Organ Dose	Child - Liver		S	0.00000248 mrem	10 mrem
Noble Gas					
Gamma Air Dose		695	NE	0.00305 mrad	10 mrad
Beta Air Dose		695	NE	0.00387 mrad	20 mrad
Whole Body	All	805	W	0.00110 mrem	5 mrem
Skin	Child	805	W	0.00260 mrem	15 mrem
Particulates & Iodines					
Organ Dose	Child – Thyroid	805	W	0.00899 mrem	15 mrem
Carbon 14					
Organ Dose	Child – Bone	2414	N	0.056 mrem	15 mrem

* There is no Appendix I limit for direct radiation. It is listed here to demonstrate compliance with 40 CFR 190 limits of 25 mrem whole body and 75 mrem thyroid.

APPENDIX F

ERRATA FROM PREVIOUS ANNUAL REPORTS

Appendix F

Errata From Previous Annual Reports

Corrections to the Previous Annual Reports:

1. The opening sentence in Appendix D of the 2009 Annual Radiological Environmental Operation Report (AREOR) incorrectly described the reporting year as 2008 when it should have been 2009.

2. Section 3.3 of the 2011 AREOR described that only partial air sample volumes were collected at three locations on 5/12/11 however, only two of those three incidents were subsequently described in Part I, Table 5.6 and in Part II, Section 2.0. Those sections should have also described the partial sample at D-11, Toddville on 5/12/11.

3. In Attachment One of the 2011 Annual Radioactive Material Release Report, there were three instances where incorrect units of measure were reported for Ground Water Protection Program tritium sampling results. Sample numbers 2_2011-08-24_013 and 2_2011-05-24_009 listed units of pCi/liter when the correct units of measure were uCi/ml Sample number 2_2011-08-19_006 had no unit of measure listed when the units should have been pCi/liter.

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DUANE ARNOLD ENERGY CENTER
CEDAR RAPIDS, IOWA
Docket No. 50-331

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

ANNUAL REPORT - PART II
DATA TABULATIONS AND ANALYSES

January 1 to December 31, 2012

Prepared by

ATI ENVIRONMENTAL, Inc.
Midwest Laboratory

Project No. 8001

Reviewed and Approved

05/02/2013

Bronia Grob, M.S.
Laboratory Manager

TABLE OF CONTENTS

LIST OF TABLES

In addition the following tables may be found in Appendix A.

1.0 INTRODUCTION

The following constitutes a supplement to the Annual Report for the Radiological Environmental Monitoring Program conducted at the Duane Arnold Energy Center, Palo, Iowa in 2012. Results of completed analyses are presented in the attached tables.

For information regarding sampling locations, type and frequency of collection, and sample codes, please refer to Part I, Tables 5.3 - 5.5 and Figures 5.1 and 5.2.

All concentrations, except gross beta and airborne iodine, are decay corrected to the time of collection. Airborne I-131 is decayed to the midpoint of the collection period.

The required values for lower limits of detection (LLD) for gamma emitting isotopes are established through the Offsite Dose Assessment Manual (ODAM). Naturally occurring radioisotopes, such as Be-7, K-40 and Ra daughters, are frequently detected, but may not be listed for every sample medium.

2.0 PROGRAM DEVIATIONS

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
AP/AI	Gross Beta / I-131	D-13	08-09-12 through 09-06-12	Out of service due to power line maintenance.
MI	I-131, Gamma	D-108	06-05-12	Dairy out of business.
TLD	Ambient Gamma	D-36	1st Qtr. 2012	TLD missing in the field, TLD replaced.
TLD	Ambient Gamma	D-41	3rd Qtr. 2012	TLD missing in the field, TLD replaced.
TLD	Ambient Gamma	D-17	4th Qtr. 2012	TLD missing in the field, TLD replaced.
WW	Gross Beta / H-3	D-53, D-54, D-55 D-57, D-58, D-72	4th Qtr. 2012	Samples were collected Jan. 9, 2013.
G	Gamma	D-58, D-72, D-96	2012	Vegetation samples not available.

In no instance did missed analyses affect minimum sampling requirements as specified in the ODAM.

3.0 DATA TABLES

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-3 (Hiawatha)
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	288	0.025 ± 0.004	07-05-12	315	0.041 ± 0.004
01-11-12	253	0.032 ± 0.004	07-12-12	273	0.031 ± 0.004
01-19-12	330	0.031 ± 0.003	07-19-12	274	0.041 ± 0.005
01-26-12	292	0.030 ± 0.004	07-26-12	276	0.036 ± 0.004
02-02-12	285	0.023 ± 0.003	08-02-12	283	0.027 ± 0.004
02-09-12	282	0.024 ± 0.003	08-09-12	283	0.024 ± 0.004
02-15-12	248	0.008 ± 0.003	08-16-12	280	0.019 ± 0.004
02-22-12	280	0.021 ± 0.003	08-24-12	326	0.037 ± 0.004
03-01-12	331	< 0.003 [b]	08-31-12	278	0.050 ± 0.005
03-08-12	283	0.020 ± 0.003	09-06-12	249	0.032 ± 0.004
03-15-12	284	0.018 ± 0.003	09-13-12	276	0.040 ± 0.004
03-22-12	288	0.015 ± 0.003	09-20-12	284	0.034 ± 0.004
03-28-12	244	0.015 ± 0.004	09-27-12	281	0.023 ± 0.003
1st Quarter Mean ± s.d.		0.022 ± 0.007	3rd Quarter Mean ± s.d.		0.034 ± 0.009
04-06-12	367	0.019 ± 0.003	10-05-12	329	0.048 ± 0.004
04-12-12	246	0.017 ± 0.004	10-12-12	278	0.029 ± 0.004
04-20-12	324	0.012 ± 0.003	10-18-12	241	0.031 ± 0.004
04-27-12	290	0.014 ± 0.003	10-26-12	326	0.023 ± 0.003
05-03-12	235	0.016 ± 0.004	11-02-12	276	0.016 ± 0.004
05-10-12	272	0.015 ± 0.003	11-09-12	280	0.028 ± 0.004
05-17-12	275	0.018 ± 0.004	11-16-12	275	0.045 ± 0.005
05-25-12	313	0.020 ± 0.003	11-23-12	283	0.066 ± 0.005
05-31-12	236	0.017 ± 0.004	12-01-12	311	0.041 ± 0.004
06-07-12	274	0.020 ± 0.004	12-07-12	244	0.045 ± 0.005
06-14-12	274	0.018 ± 0.004	12-13-12	240	0.039 ± 0.005
06-20-12	233	0.026 ± 0.004	12-21-12	315	0.062 ± 0.005
06-27-12	272	0.027 ± 0.004	12-28-12	276	0.043 ± 0.004
			01-03-13	240	0.078 ± 0.006
2nd Quarter Mean ± s.d.		0.018 ± 0.004	4th Quarter Mean ± s.d.		0.042 ± 0.017
			Cumulative Average		0.029

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.
[b] Filter light; potential loss of vacuum.

Table 2. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-5 (Palo)
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	281	0.028 ± 0.004	07-05-12	312	0.037 ± 0.004
01-11-12	246	0.037 ± 0.004	07-12-12	275	0.026 ± 0.004
01-19-12	320	0.030 ± 0.003	07-19-12	283	0.029 ± 0.004
01-26-12	283	0.028 ± 0.004	07-26-12	265	0.039 ± 0.005
02-02-12	282	0.022 ± 0.003	08-02-12	267	0.027 ± 0.004
02-09-12	279	0.025 ± 0.004	08-09-12	266	0.019 ± 0.004
02-15-12	244	0.012 ± 0.003	08-16-12	284	0.027 ± 0.004
02-22-12	279	0.024 ± 0.004	08-24-12	321	0.035 ± 0.004
03-01-12	327	0.032 ± 0.003	08-31-12	271	0.041 ± 0.004
03-08-12	284	0.027 ± 0.004	09-06-12	228	0.024 ± 0.004
03-15-12	283	0.021 ± 0.003	09-13-12	261	0.017 ± 0.003
03-22-12	287	0.019 ± 0.003	09-20-12	270	0.024 ± 0.004
03-28-12	245	0.014 ± 0.004	09-27-12	260	0.027 ± 0.004
1st Quarter Mean ± s.d.		0.025 ± 0.007	3rd Quarter Mean ± s.d.		0.029 ± 0.008
04-06-12	374	0.016 ± 0.003	10-05-12	309	0.052 ± 0.005
04-12-12	239	0.016 ± 0.004	10-12-12	262	0.021 ± 0.004
04-20-12	324	0.022 ± 0.003	10-18-12	226	0.030 ± 0.005
04-27-12	289	0.021 ± 0.004	10-26-12	307	0.027 ± 0.004
05-03-12	243	0.017 ± 0.004	11-02-12	264	0.036 ± 0.005
05-10-12	284	0.014 ± 0.003	11-09-12	266	0.029 ± 0.004
05-17-12	288	0.022 ± 0.004	11-16-12	266	0.043 ± 0.005
05-25-12	326	0.026 ± 0.004	11-23-12	269	0.054 ± 0.005
05-31-12	244	0.016 ± 0.004	12-01-12	300	0.042 ± 0.004
06-07-12	282	0.024 ± 0.004	12-07-12	255	0.042 ± 0.005
06-14-12	283	0.019 ± 0.004	12-13-12	259	0.037 ± 0.004
06-20-12	240	0.028 ± 0.004	12-21-12	341	0.058 ± 0.004
06-27-12	154	0.041 ± 0.007 [b]	12-28-12	300	0.044 ± 0.004
			01-03-13	258	0.076 ± 0.006
2nd Quarter Mean ± s.d.		0.022 ± 0.007	4th Quarter Mean ± s.d.		0.042 ± 0.014
			Cumulative Average		0.030

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.
[b] Low volume due to storms in area.

Table 3. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-6 (Center Point)
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	281	0.025 ± 0.004	07-05-12	317	0.034 ± 0.004
01-11-12	246	0.028 ± 0.004	07-12-12	276	0.031 ± 0.004
01-19-12	321	0.028 ± 0.003	07-19-12	277	0.041 ± 0.004
01-26-12	283	0.024 ± 0.003	07-26-12	279	0.024 ± 0.004
02-02-12	290	0.020 ± 0.003	08-02-12	272	0.031 ± 0.004
02-09-12	287	0.028 ± 0.004	08-09-12	269	0.022 ± 0.004
02-15-12	250	0.023 ± 0.004	08-16-12	271	0.025 ± 0.004
02-22-12	285	0.026 ± 0.004	08-24-12	312	0.033 ± 0.004
03-01-12	337	0.027 ± 0.003	08-31-12	267	0.045 ± 0.005
03-08-12	288	0.028 ± 0.004	09-06-12	238	0.031 ± 0.005
03-15-12	289	0.024 ± 0.004	09-13-12	265	0.028 ± 0.004
03-22-12	293	0.019 ± 0.003	09-20-12	273	0.025 ± 0.004
03-28-12	249	0.017 ± 0.004	09-27-12	269	0.027 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.004	3rd Quarter Mean ± s.d.		0.030 ± 0.007
04-06-12	376	0.015 ± 0.003	10-05-12	316	0.049 ± 0.004
04-12-12	249	0.016 ± 0.004	10-12-12	267	0.026 ± 0.004
04-20-12	330	0.022 ± 0.003	10-18-12	227	0.034 ± 0.005
04-27-12	295	0.022 ± 0.004	10-26-12	313	0.024 ± 0.004
05-03-12	234	0.017 ± 0.004	11-02-12	269	0.023 ± 0.004
05-10-12	255	0.014 ± 0.004	11-09-12	277	0.029 ± 0.004
05-17-12	279	0.021 ± 0.004	11-16-12	267	0.035 ± 0.004
05-25-12	316	0.024 ± 0.004	11-23-12	277	0.060 ± 0.005
05-31-12	239	0.016 ± 0.004	12-01-12	305	0.041 ± 0.004
06-07-12	277	0.019 ± 0.004	12-07-12	230	0.051 ± 0.005
06-14-12	277	0.017 ± 0.004	12-13-12	235	0.035 ± 0.005
06-20-12	235	0.026 ± 0.004	12-21-12	305	0.053 ± 0.005
06-27-12	277	0.018 ± 0.004	12-28-12	271	0.038 ± 0.004
			01-03-13	234	0.072 ± 0.006
2nd Quarter Mean ± s.d.		0.019 ± 0.004	4th Quarter Mean ± s.d.		0.041 ± 0.015
			Cumulative Average		0.029

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.

Table 4. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-7 (Shellsburg)
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	293	0.029 ± 0.004	07-05-12	324	0.032 ± 0.004
01-11-12	258	0.035 ± 0.004	07-12-12	281	0.030 ± 0.004
01-19-12	332	0.034 ± 0.003	07-19-12	282	0.038 ± 0.004
01-26-12	300	0.037 ± 0.004	07-26-12	281	0.028 ± 0.004
02-02-12	284	0.018 ± 0.003	08-02-12	282	0.029 ± 0.004
02-09-12	282	0.025 ± 0.004	08-09-12	278	0.021 ± 0.004
02-15-12	246	0.023 ± 0.004	08-16-12	280	0.030 ± 0.004
02-22-12	286	0.029 ± 0.004	08-24-12	322	0.039 ± 0.004
03-01-12	326	0.031 ± 0.003	08-31-12	279	0.051 ± 0.005
03-08-12	284	0.028 ± 0.004	09-06-12	236	0.035 ± 0.005
03-15-12	283	0.023 ± 0.004	09-13-12	268	0.029 ± 0.004
03-22-12	287	0.022 ± 0.004	09-20-12	285	0.031 ± 0.004
03-28-12	245	0.015 ± 0.004	09-27-12	274	0.012 ± 0.003
1st Quarter Mean ± s.d.		0.027 ± 0.007	3rd Quarter Mean ± s.d.		0.031 ± 0.009
04-06-12	373	0.019 ± 0.003	10-05-12	326	0.028 ± 0.004
04-12-12	239	0.014 ± 0.004	10-12-12	276	0.024 ± 0.004
04-20-12	324	0.021 ± 0.003	10-18-12	238	0.025 ± 0.004
04-27-12	288	0.025 ± 0.004	10-26-12	326	0.029 ± 0.004
05-03-12	241	0.018 ± 0.004	11-02-12	281	0.027 ± 0.004
05-10-12	281	0.014 ± 0.003	11-09-12	283	0.027 ± 0.004
05-17-12	285	0.024 ± 0.004	11-16-12	284	0.049 ± 0.005
05-25-12	323	0.022 ± 0.003	11-23-12	286	0.061 ± 0.005
05-31-12	244	0.017 ± 0.004	12-01-12	320	0.043 ± 0.004
06-07-12	281	0.019 ± 0.004	12-07-12	240	0.057 ± 0.006
06-14-12	283	0.018 ± 0.004	12-13-12	245	0.033 ± 0.004
06-20-12	240	0.026 ± 0.004	12-21-12	321	0.048 ± 0.004
06-27-12	283	0.019 ± 0.004	12-28-12	283	0.044 ± 0.004
			01-03-13	243	0.083 ± 0.006
2nd Quarter Mean ± s.d.		0.020 ± 0.004	4th Quarter Mean ± s.d.		0.041 ± 0.017
			Cumulative Average		0.030

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.

Table 5. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: D-11 (Toddville)
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	270	0.025 ± 0.004	07-05-12	314	0.039 ± 0.004
01-11-12	226	0.040 ± 0.005	07-12-12	273	0.026 ± 0.004
01-19-12	278	0.040 ± 0.004	07-19-12	274	0.042 ± 0.005
01-26-12	261	0.040 ± 0.004	07-26-12	276	0.028 ± 0.004
02-02-12	260	0.009 ± 0.003 [b]	08-02-12	274	0.027 ± 0.004
02-09-12	289	0.025 ± 0.003	08-09-12	285	0.014 ± 0.004
02-15-12	254	0.022 ± 0.004	08-16-12	284	0.029 ± 0.004
02-22-12	295	0.023 ± 0.003	08-24-12	328	0.029 ± 0.004
03-01-12	341	0.027 ± 0.003	08-31-12	283	0.050 ± 0.005
03-08-12	292	0.026 ± 0.004	09-06-12	250	0.031 ± 0.004
03-15-12	292	0.020 ± 0.003	09-13-12	279	0.031 ± 0.004
03-22-12	297	0.016 ± 0.003	09-20-12	287	0.023 ± 0.004
03-28-12	251	0.016 ± 0.004	09-27-12	283	0.024 ± 0.003
1st Quarter Mean ± s.d.		0.025 ± 0.010	3rd Quarter Mean ± s.d.		0.030 ± 0.009
04-06-12	383	0.018 ± 0.003	10-05-12	333	0.036 ± 0.004
04-12-12	248	0.006 ± 0.004	10-12-12	281	0.024 ± 0.004
04-20-12	334	0.021 ± 0.003	10-18-12	245	0.031 ± 0.004
04-27-12	299	0.020 ± 0.004	10-26-12	328	0.022 ± 0.003
05-03-12	252	0.019 ± 0.004	11-02-12	284	0.025 ± 0.004
05-10-12	271	0.013 ± 0.003	11-09-12	288	0.025 ± 0.004
05-17-12	276	0.019 ± 0.004	11-16-12	278	0.039 ± 0.004
05-25-12	313	0.024 ± 0.004	11-23-12	289	0.062 ± 0.005
05-31-12	236	0.014 ± 0.004	12-01-12	318	0.043 ± 0.004
06-07-12	274	0.020 ± 0.004	12-07-12	240	0.047 ± 0.005
06-14-12	274	0.016 ± 0.004	12-13-12	245	0.035 ± 0.004
06-20-12	233	0.029 ± 0.004	12-21-12	317	0.062 ± 0.005
06-27-12	274	0.020 ± 0.004	12-28-12	282	0.042 ± 0.004
			01-03-13	245	0.070 ± 0.006
2nd Quarter Mean ± s.d.		0.018 ± 0.005	4th Quarter Mean ± s.d.		0.040 ± 0.015
			Cumulative Average		0.029

[a] Iodine-131 concentrations are < 0.03 pCi/m^3 unless noted otherwise.
[b] Filter light.

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a]
Location: D-13 (Alburnett)
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	295	0.017 ± 0.003	07-05-12	308	0.037 ± 0.004
01-11-12	258	0.012 ± 0.003 [b]	07-12-12	267	0.028 ± 0.004
01-19-12	337	0.037 ± 0.004	07-19-12	268	0.041 ± 0.005
01-26-12	297	0.029 ± 0.004	07-26-12	224	0.028 ± 0.005
02-02-12	295	0.018 ± 0.003	08-02-12	230	0.026 ± 0.004
02-09-12	293	< 0.003 [b]	08-09-12		ND [c]
02-15-12	257	0.025 ± 0.004	08-16-12		ND [c]
02-22-12	293	0.023 ± 0.003	08-24-12		ND [c]
03-01-12	321	0.011 ± 0.002 [b]	08-31-12		ND [c]
03-08-12	275	0.024 ± 0.004	09-06-12		ND [c, d]
03-15-12	275	0.023 ± 0.004	09-13-12	274	0.024 ± 0.004
03-22-12	279	0.012 ± 0.003	09-20-12	270	0.017 ± 0.003
03-28-12	237	0.020 ± 0.004	09-27-12	279	0.019 ± 0.003
1st Quarter Mean ± s.d.		0.021 ± 0.008	3rd Quarter Mean ± s.d.		0.027 ± 0.008
04-06-12	358	0.018 ± 0.003	10-05-12	326	0.027 ± 0.003
04-12-12	236	0.016 ± 0.004	10-12-12	276	0.019 ± 0.004
04-20-12	314	0.023 ± 0.003	10-18-12	238	0.021 ± 0.004
04-27-12	281	0.019 ± 0.004	10-26-12	323	0.020 ± 0.003
05-03-12	237	0.020 ± 0.004	11-02-12	278	0.018 ± 0.004
05-10-12	274	0.014 ± 0.003	11-09-12	286	0.018 ± 0.003
05-17-12	270	0.015 ± 0.004	11-16-12	295	0.041 ± 0.004
05-25-12	306	0.025 ± 0.004	11-23-12	280	0.050 ± 0.005
05-31-12	232	0.015 ± 0.004	12-01-12	308	0.011 ± 0.003 [b]
06-07-12	269	0.018 ± 0.004	12-07-12	234	0.046 ± 0.005
06-14-12	268	0.017 ± 0.004	12-13-12	238	0.030 ± 0.004
06-20-12	228	0.033 ± 0.005	12-21-12	309	0.055 ± 0.005
06-27-12	268	0.019 ± 0.004	12-28-12	274	0.036 ± 0.004
			01-03-13	236	0.078 ± 0.006
2nd Quarter Mean ± s.d.		0.019 ± 0.005	4th Quarter Mean ± s.d.		0.034 ± 0.019
			Cumulative Average		0.025

[a] Iodine-131 concentrations are < 0.03 pCi/m^3 unless noted otherwise.
[b] Filter light.
[c] No data; see Table 2.0, Listing of Missed Samples.
[d] No valid sample, Power restored 9/6/12, approximately two hours run-time.

Table 7. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: D-15 (On-site, north)
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta		Date Collected	Volume (m^3)	Gross Beta	
Required LLD		0.010		Required LLD		0.010	
01-05-12	274	0.025 ± 0.004		07-05-12	327	0.029 ± 0.004	
01-11-12	242	0.036 ± 0.004		07-12-12	293	0.020 ± 0.003	
01-19-12	315	0.026 ± 0.003		07-19-12	294	0.041 ± 0.004	
01-26-12	277	0.039 ± 0.004		07-26-12	295	0.027 ± 0.004	
02-02-12	282	0.022 ± 0.003		08-02-12	297	0.028 ± 0.004	
02-09-12	269	0.024 ± 0.004		08-09-12	292	0.019 ± 0.004	
02-15-12	239	0.025 ± 0.004		08-16-12	284	0.030 ± 0.004	
02-22-12	288	0.013 ± 0.003		08-24-12	283	0.014 ± 0.003	
03-01-12	325	0.015 ± 0.003		08-31-12	282	0.044 ± 0.004	
03-08-12	284	0.015 ± 0.003		09-06-12	249	0.033 ± 0.005	
03-15-12	290	0.012 ± 0.003		09-13-12	281	0.028 ± 0.004	
03-22-12	280	< 0.004	[b]	09-20-12	286	0.025 ± 0.004	
03-28-12	244	0.009 ± 0.003		09-27-12	284	0.023 ± 0.003	
1st Quarter Mean ± s.d.		0.022 ± 0.009		3rd Quarter Mean ± s.d.		0.028 ± 0.008	
04-06-12	371	0.011 ± 0.002		10-05-12	333	0.043 ± 0.004	
04-12-12	242	< 0.006	[b]	10-12-12	281	0.022 ± 0.004	
04-20-12	325	0.017 ± 0.003		10-18-12	244	0.035 ± 0.005	
04-27-12	288	0.017 ± 0.004		10-26-12	331	0.026 ± 0.003	
05-03-12	243	0.011 ± 0.004		11-02-12	283	0.020 ± 0.004	
05-10-12	285	0.009 ± 0.003		11-09-12	202	0.023 ± 0.005	[d]
05-17-12	296	0.017 ± 0.003		11-16-12	281	0.042 ± 0.004	
05-25-12	335	0.018 ± 0.003		11-23-12	295	0.045 ± 0.004	
05-31-12	255	0.019 ± 0.004		12-01-12	330	0.039 ± 0.004	
06-07-12	294	0.017 ± 0.003		12-07-12	259	0.052 ± 0.005	
06-14-12	291	0.015 ± 0.003		12-13-12	241	0.033 ± 0.004	
06-20-12	253	0.024 ± 0.004		12-21-12	331	0.058 ± 0.004	
06-27-12	161	0.036 ± 0.006	[c]	12-28-12	291	0.043 ± 0.004	
				01-03-13	250	0.067 ± 0.005	
2nd Quarter Mean ± s.d.		0.018 ± 0.007		4th Quarter Mean ± s.d.		0.039 ± 0.014	
				Cumulative Average		0.027	

[a] Iodine-131 concentrations are < 0.03 pCi/m^3 unless noted otherwise.
[b] Filter light.
[c] Low volume due to storms in area; GFI reset.
[d] Short run, GFI reset.

Table 8. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-16 (On-site)
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	291	0.032 ± 0.004	07-05-12	307	0.034 ± 0.004
01-11-12	256	0.040 ± 0.004	07-12-12	267	0.023 ± 0.004
01-19-12	334	0.029 ± 0.003	07-19-12	268	0.040 ± 0.005
01-26-12	294	0.038 ± 0.004	07-26-12	269	0.028 ± 0.004
02-02-12	301	0.020 ± 0.003	08-02-12	271	0.026 ± 0.004
02-09-12	282	0.026 ± 0.004	08-09-12	283	0.018 ± 0.004
02-15-12	251	0.020 ± 0.004	08-16-12	285	0.024 ± 0.004
02-22-12	293	0.028 ± 0.004	08-24-12	329	0.032 ± 0.004
03-01-12	330	0.030 ± 0.003	08-31-12	283	0.044 ± 0.004
03-08-12	290	0.021 ± 0.003	09-06-12	251	0.024 ± 0.004
03-15-12	297	0.018 ± 0.003	09-13-12	281	0.029 ± 0.004
03-22-12	284	0.022 ± 0.004	09-20-12	287	0.027 ± 0.004
03-28-12	249	0.017 ± 0.004	09-27-12	284	0.023 ± 0.003
1st Quarter Mean ± s.d.		0.026 ± 0.007	3rd Quarter Mean ± s.d.		0.029 ± 0.007
04-06-12	379	0.016 ± 0.003	10-05-12	332	0.039 ± 0.004
04-12-12	239	0.011 ± 0.004	10-12-12	281	0.025 ± 0.004
04-20-12	331	0.020 ± 0.003	10-18-12	244	0.030 ± 0.004
04-27-12	294	0.017 ± 0.004	10-26-12	330	0.024 ± 0.003
05-03-12	247	0.014 ± 0.004	11-02-12	283	0.022 ± 0.004
05-10-12	268	0.014 ± 0.003	11-09-12	272	0.025 ± 0.004
05-17-12	270	0.016 ± 0.004	11-16-12	272	0.044 ± 0.005
05-25-12	306	0.024 ± 0.004	11-23-12	274	0.066 ± 0.005
05-31-12	233	0.008 ± 0.004	12-01-12	308	0.046 ± 0.004
06-07-12	268	0.022 ± 0.004	12-07-12	241	0.048 ± 0.005
06-14-12	266	0.006 ± 0.003 [b]	12-13-12	224	0.035 ± 0.005
06-20-12	231	0.009 ± 0.004 [b]	12-21-12	308	0.058 ± 0.005
06-27-12	269	0.022 ± 0.004	12-28-12	271	0.046 ± 0.005
			01-03-13	232	0.061 ± 0.006
2nd Quarter Mean ± s.d.		0.015 ± 0.006	4th Quarter Mean ± s.d.		0.041 ± 0.015
			Cumulative Average		0.028

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.
[b] Filter light.

Table 9. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131 [a].
Location: D-40
Units: pCi/m ^{3}
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-05-12	280	0.033 ± 0.004	07-05-12	310	0.035 ± 0.004
01-11-12	246	0.036 ± 0.004	07-12-12	264	0.027 ± 0.004
01-19-12	323	0.038 ± 0.004	07-19-12	272	0.037 ± 0.004
01-26-12	282	0.021 ± 0.003	07-26-12	269	0.030 ± 0.004
02-02-12	282	0.023 ± 0.003	08-02-12	275	0.026 ± 0.004
02-09-12	278	0.027 ± 0.004	08-09-12	273	0.015 ± 0.004
02-15-12	246	0.027 ± 0.004	08-16-12	264	0.023 ± 0.004
02-22-12	271	0.029 ± 0.004	08-24-12	317	0.027 ± 0.003
03-01-12	325	0.032 ± 0.003	08-31-12	267	0.040 ± 0.004
03-08-12	282	0.030 ± 0.004	09-06-12	239	0.025 ± 0.004
03-15-12	278	0.019 ± 0.003	09-13-12	266	0.027 ± 0.004
03-22-12	287	0.017 ± 0.003	09-20-12	271	0.022 ± 0.004
03-28-12	242	0.014 ± 0.004	09-27-12	269	0.020 ± 0.003
1st Quarter Mean ± s.d.		0.027 ± 0.007	3rd Quarter Mean ± s.d.		0.027 ± 0.007
04-06-12	389	0.011 ± 0.002	10-05-12	316	0.039 ± 0.004
04-12-12	248	< 0.005 [b]	10-12-12	267	0.024 ± 0.004
04-20-12	336	0.020 ± 0.003	10-18-12	233	0.032 ± 0.005
04-27-12	300	0.018 ± 0.004	10-26-12	313	0.026 ± 0.004
05-03-12	254	0.020 ± 0.004	11-02-12	270	0.018 ± 0.004
05-10-12	295	0.015 ± 0.003	11-09-12	268	0.022 ± 0.004
05-17-12	293	0.017 ± 0.003	11-16-12	274	0.049 ± 0.005
05-25-12	344	0.023 ± 0.003	11-23-12	278	0.062 ± 0.005
05-31-12	256	0.018 ± 0.004	12-01-12	304	0.037 ± 0.004
06-07-12	297	0.019 ± 0.003	12-07-12	232	0.049 ± 0.005
06-14-12	296	0.020 ± 0.004	12-13-12	235	0.032 ± 0.004
06-20-12	251	0.027 ± 0.004	12-21-12	304	0.058 ± 0.005
06-27-12	298	0.022 ± 0.004	12-28-12	271	0.040 ± 0.004
			01-03-13	258	0.079 ± 0.006
2nd Quarter Mean ± s.d.		0.019 ± 0.004	4th Quarter Mean ± s.d.		0.040 ± 0.017
			Cumulative Average		0.029

[a] Iodine-131 concentrations are < 0.03 pCi/m ^{3} unless noted otherwise.
[b] Filter white; no particulate matter collected.

Table 10. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location	D-3			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 2163	DAP- 4402	DAP- 6477	DAP- 8510
Volume (m^3)	3688	3611	3678	3915
Be-7	0.037 ± 0.013	0.079 ± 0.015	0.092 ± 0.013	0.052 ± 0.016
Mn-54	< 0.0008	< 0.0006	< 0.0007	< 0.0004
Fe-59	< 0.0014	< 0.0027	< 0.0007	< 0.0015
Co-58	< 0.0006	< 0.0008	< 0.0008	< 0.0005
Co-60	< 0.0003	< 0.0008	< 0.0003	< 0.0008
Zn-65	< 0.0010	< 0.0012	< 0.0009	< 0.0007
Nb-95	< 0.0009	< 0.0013	< 0.0006	< 0.0007
Zr-95	< 0.0014	< 0.0017	< 0.0013	< 0.0009
Ru-103	< 0.0009	< 0.0012	< 0.0008	< 0.0008
Ru-106	< 0.0070	< 0.0077	< 0.0056	< 0.0038
Cs-134	< 0.0006	< 0.0008	< 0.0005	< 0.0006
Cs-137	< 0.0008	< 0.0010	< 0.0006	< 0.0006
Ce-141	< 0.0016	< 0.0022	< 0.0010	< 0.0013
Ce-144	< 0.0032	< 0.0062	< 0.0034	< 0.0033
Location	D-5			
Lab Code	DAP- 2164	DAP- 4403	DAP- 6478	DAP- 8511
Volume (m^3)	3641	3569	3564	3882
Be-7	0.060 ± 0.016	0.093 ± 0.018	0.078 ± 0.013	0.052 ± 0.015
Mn-54	< 0.0008	< 0.0007	< 0.0013	< 0.0003
Fe-59	< 0.0019	< 0.0010	< 0.0018	< 0.0011
Co-58	< 0.0008	< 0.0006	< 0.0006	< 0.0006
Co-60	< 0.0004	< 0.0006	< 0.0016	< 0.0007
Zn-65	< 0.0007	< 0.0008	< 0.0014	< 0.0009
Nb-95	< 0.0007	< 0.0008	< 0.0009	< 0.0008
Zr-95	< 0.0014	< 0.0008	< 0.0020	< 0.0008
Ru-103	< 0.0010	< 0.0009	< 0.0016	< 0.0007
Ru-106	< 0.0067	< 0.0078	< 0.0047	< 0.0044
Cs-134	< 0.0004	< 0.0006	< 0.0008	< 0.0005
Cs-137	< 0.0007	< 0.0007	< 0.0011	< 0.0004
Ce-141	< 0.0016	< 0.0019	< 0.0020	< 0.0017
Ce-144	< 0.0053	< 0.0032	< 0.0047	< 0.0044
Location	D-6			
Lab Code	DAP- 2165	DAP- 4404	DAP- 6479	DAP- 8512
Volume (m^3)	3698	3637	3586	3793
Be-7	0.047 ± 0.014	0.088 ± 0.017	0.091 ± 0.017	0.064 ± 0.013
Mn-54	< 0.0007	< 0.0010	< 0.0010	< 0.0004
Fe-59	< 0.0025	< 0.0035	< 0.0021	< 0.0014
Co-58	< 0.0009	< 0.0003	< 0.0007	< 0.0005
Co-60	< 0.0005	< 0.0005	< 0.0007	< 0.0009
Zn-65	< 0.0016	< 0.0008	< 0.0012	< 0.0013
Nb-95	< 0.0009	< 0.0016	< 0.0010	< 0.0007
Zr-95	< 0.0010	< 0.0017	< 0.0016	< 0.0007
Ru-103	< 0.0011	< 0.0012	< 0.0010	< 0.0011
Ru-106	< 0.0095	< 0.0057	< 0.0085	< 0.0060
Cs-134	< 0.0011	< 0.0007	< 0.0009	< 0.0004
Cs-137	< 0.0010	< 0.0007	< 0.0009	< 0.0004
Ce-141	< 0.0019	< 0.0013	< 0.0011	< 0.0016
Ce-144	< 0.0040	< 0.0045	< 0.0047	< 0.0036

Table 10. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location	D-7			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 2166	DAP- 4405	DAP- 6480	DAP- 8513
Volume (m^3)	3706	3684	3670	3952
Be-7	0.061 ± 0.020	0.11 ± 0.020	0.082 ± 0.016	0.051 ± 0.016
Mn-54	< 0.0005	< 0.0009	< 0.0007	< 0.0003
Fe-59	< 0.0019	< 0.0017	< 0.0023	< 0.0011
Co-58	< 0.0007	< 0.0010	< 0.0008	< 0.0007
Co-60	< 0.0004	< 0.0005	< 0.0009	< 0.0008
Zn-65	< 0.0007	< 0.0009	< 0.0012	< 0.0007
Nb-95	< 0.0011	< 0.0013	< 0.0018	< 0.0008
Zr-95	< 0.0011	< 0.0016	< 0.0017	< 0.0009
Ru-103	< 0.0012	< 0.0011	< 0.0011	< 0.0010
Ru-106	< 0.0083	< 0.0073	< 0.0059	< 0.0032
Cs-134	< 0.0004	< 0.0007	< 0.0008	< 0.0004
Cs-137	< 0.0007	< 0.0009	< 0.0010	< 0.0005
Ce-141	< 0.0015	< 0.0015	< 0.0020	< 0.0019
Ce-144	< 0.0059	< 0.0059	< 0.0039	< 0.0052
Location	D-11			
Lab Code	DAP- 2168	DAP- 4406	DAP- 6481	DAP- 8514
Volume (m^3)	3606	3665	3691	3972
Be-7	0.076 ± 0.017	0.080 ± 0.019	0.088 ± 0.016	0.040 ± 0.012
Mn-54	< 0.0009	< 0.0007	< 0.0008	< 0.0010
Fe-59	< 0.0025	< 0.0010	< 0.0019	< 0.0021
Co-58	< 0.0006	< 0.0007	< 0.0014	< 0.0007
Co-60	< 0.0007	< 0.0005	< 0.0009	< 0.0007
Zn-65	< 0.0021	< 0.0007	< 0.0008	< 0.0020
Nb-95	< 0.0009	< 0.0006	< 0.0013	< 0.0012
Zr-95	< 0.0015	< 0.0019	< 0.0012	< 0.0013
Ru-103	< 0.0014	< 0.0009	< 0.0011	< 0.0015
Ru-106	< 0.0073	< 0.0070	< 0.0089	< 0.0092
Cs-134	< 0.0008	< 0.0007	< 0.0009	< 0.0009
Cs-137	< 0.0012	< 0.0008	< 0.0004	< 0.0010
Ce-141	< 0.0014	< 0.0019	< 0.0019	< 0.0018
Ce-144	< 0.0053	< 0.0026	< 0.0045	< 0.0057
Location	D-13			
Lab Code	DAP- 2169	DAP- 4407	DAP- 6482	DAP- 8515
Volume (m^3)	3701	3541	2120	3901
Be-7	0.053 ± 0.012	0.10 ± 0.020	0.089 ± 0.024	0.045 ± 0.014
Mn-54	< 0.0006	< 0.0006	< 0.0008	< 0.0006
Fe-59	< 0.0010	< 0.0010	< 0.0015	< 0.0023
Co-58	< 0.0004	< 0.0006	< 0.0011	< 0.0008
Co-60	< 0.0004	< 0.0005	< 0.0020	< 0.0007
Zn-65	< 0.0009	< 0.0008	< 0.0024	< 0.0010
Nb-95	< 0.0006	< 0.0011	< 0.0016	< 0.0010
Zr-95	< 0.0011	< 0.0015	< 0.0015	< 0.0019
Ru-103	< 0.0011	< 0.0007	< 0.0015	< 0.0015
Ru-106	< 0.0062	< 0.0044	< 0.0048	< 0.0088
Cs-134	< 0.0005	< 0.0004	< 0.0015	< 0.0007
Cs-137	< 0.0006	< 0.0005	< 0.0007	< 0.0009
Ce-141	< 0.0013	< 0.0026	< 0.0015	< 0.0019
Ce-144	< 0.0024	< 0.0041	< 0.0056	< 0.0051

Table 10. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location			D-15	
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 2170	DAP- 4408	DAP- 6484	DAP- 8516
Volume (m^3)	3606	3638	3747	3949
Be-7	0.042 ± 0.015	0.089 ± 0.016	0.096 ± 0.019	0.053 ± 0.013
Mn-54	< 0.0007	< 0.0006	< 0.0009	< 0.0005
Fe-59	< 0.0017	< 0.0018	< 0.0013	< 0.0005
Co-58	< 0.0007	< 0.0009	< 0.0009	< 0.0004
Co-60	< 0.0004	< 0.0004	< 0.0009	< 0.0005
Zn-65	< 0.0007	< 0.0015	< 0.0007	< 0.0004
Nb-95	< 0.0013	< 0.0012	< 0.0016	< 0.0010
Zr-95	< 0.0014	< 0.0021	< 0.0020	< 0.0010
Ru-103	< 0.0008	< 0.0012	< 0.0013	< 0.0011
Ru-106	< 0.0064	< 0.0073	< 0.0079	< 0.0065
Cs-134	< 0.0005	< 0.0007	< 0.0006	< 0.0005
Cs-137	< 0.0006	< 0.0009	< 0.0010	< 0.0006
Ce-141	< 0.0011	< 0.0018	< 0.0019	< 0.0012
Ce-144	< 0.0050	< 0.0056	< 0.0041	< 0.0044
Location			D-16	
Lab Code	DAP- 2171	DAP- 4409	DAP- 6485	DAP- 8517
Volume (m^3)	3753	3599	3665	3873
Be-7	0.065 ± 0.015	0.074 ± 0.016	0.080 ± 0.017	0.051 ± 0.015
Mn-54	< 0.0006	< 0.0006	< 0.0009	< 0.0004
Fe-59	< 0.0014	< 0.0024	< 0.0013	< 0.0016
Co-58	< 0.0010	< 0.0009	< 0.0011	< 0.0004
Co-60	< 0.0006	< 0.0004	< 0.0010	< 0.0010
Zn-65	< 0.0008	< 0.0008	< 0.0012	< 0.0008
Nb-95	< 0.0010	< 0.0019	< 0.0006	< 0.0013
Zr-95	< 0.0010	< 0.0010	< 0.0010	< 0.0012
Ru-103	< 0.0011	< 0.0009	< 0.0013	< 0.0007
Ru-106	< 0.0059	< 0.0091	< 0.0090	< 0.0033
Cs-134	< 0.0008	< 0.0008	< 0.0009	< 0.0005
Cs-137	< 0.0006	< 0.0008	< 0.0006	< 0.0004
Ce-141	< 0.0014	< 0.0013	< 0.0023	< 0.0014
Ce-144	< 0.0047	< 0.0047	< 0.0054	< 0.0037
Location			D-40	
Lab Code	DAP- 2172	DAP- 4410	DAP- 6486	DAP- 8519
Volume (m^3)	3621	3857	3555	3823
Be-7	0.056 ± 0.012	0.088 ± 0.017	0.092 ± 0.017	0.048 ± 0.010
Mn-54	< 0.0005	< 0.0009	< 0.0010	< 0.0005
Fe-59	< 0.0013	< 0.0019	< 0.0018	< 0.0015
Co-58	< 0.0008	< 0.0008	< 0.0006	< 0.0005
Co-60	< 0.0006	< 0.0007	< 0.0007	< 0.0004
Zn-65	< 0.0006	< 0.0007	< 0.0008	< 0.0007
Nb-95	< 0.0012	< 0.0012	< 0.0016	< 0.0009
Zr-95	< 0.0008	< 0.0021	< 0.0023	< 0.0008
Ru-103	< 0.0013	< 0.0007	< 0.0008	< 0.0006
Ru-106	< 0.0065	< 0.0069	< 0.0071	< 0.0021
Cs-134	< 0.0005	< 0.0009	< 0.0009	< 0.0007
Cs-137	< 0.0007	< 0.0005	< 0.0012	< 0.0003
Ce-141	< 0.0016	< 0.0023	< 0.0020	< 0.0009
Ce-144	< 0.0032	< 0.0048	< 0.0056	< 0.0023

DUANE ARNOLD

Table 11. Ambient gamma radiation as measured by thermoluminescent dosimeters (TLD).
Quarterly collection. Units: mR/91 days

Control Locations	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-1	17.5 ± 0.7	12.2 ± 1.5	15.6 ± 1.0	15.5 ± 1.8
D-2	16.4 ± 0.9	10.3 ± 0.8	14.0 ± 1.0	14.4 ± 1.7
D-3	18.0 ± 1.1	13.8 ± 0.8	15.8 ± 1.2	18.5 ± 1.0
D-5	19.5 ± 1.0	17.6 ± 0.7	18.8 ± 1.5	21.8 ± 0.9
D-6	18.4 ± 0.7	16.4 ± 0.7	16.8 ± 1.3	19.9 ± 1.2
D-7	18.1 ± 0.9	15.6 ± 0.9	17.0 ± 1.2	19.8 ± 1.0
D-8	21.5 ± 0.8	20.6 ± 1.2	20.9 ± 0.9	24.6 ± 1.4
D-10	20.3 ± 0.8	14.8 ± 0.8	18.7 ± 1.1	18.0 ± 1.3
D-11	16.9 ± 0.7	15.1 ± 1.5	15.6 ± 0.9	19.2 ± 2.0
D-13	20.0 ± 0.6	16.8 ± 1.3	17.2 ± 1.1	19.6 ± 1.4
Mean ± s.d.	18.7 ± 1.6	15.3 ± 2.9	17.0 ± 2.0	19.1 ± 2.9
Within 0.5 mi. of Stack				
D-15	18.4 ± 1.2	14.9 ± 0.8	17.5 ± 1.1	18.5 ± 1.0
D-16	19.2 ± 0.9	14.4 ± 1.3	17.5 ± 1.0	16.9 ± 1.9
D-17	21.5 ± 0.9	17.1 ± 1.1	20.4 ± 1.1	ND [a]
D-18	18.6 ± 1.2	13.7 ± 0.9	16.4 ± 1.7	15.4 ± 0.9
D-19	17.6 ± 1.0	13.3 ± 0.8	15.5 ± 1.1	14.9 ± 0.9
D-20	20.3 ± 0.9	16.7 ± 1.0	16.9 ± 1.1	18.6 ± 1.9
D-21	21.1 ± 1.0	15.2 ± 0.8	18.4 ± 1.2	16.4 ± 1.0
D-22	20.7 ± 0.7	16.6 ± 0.9	18.1 ± 1.2	17.5 ± 0.9
D-23	18.4 ± 1.2	14.7 ± 0.8	15.2 ± 1.3	16.6 ± 0.9
D-28	22.6 ± 1.2	20.6 ± 0.8	21.5 ± 1.5	22.8 ± 0.9
D-29	24.2 ± 0.7	21.2 ± 1.1	22.8 ± 1.5	23.8 ± 1.4
D-30	22.8 ± 1.0	19.8 ± 1.1	22.2 ± 1.3	21.5 ± 2.3
D-31	23.2 ± 1.2	21.2 ± 1.3	21.5 ± 1.7	23.0 ± 1.5
D-32	24.2 ± 0.7	20.6 ± 1.0	23.6 ± 0.9	22.2 ± 1.0
D-82	18.4 ± 0.8	13.9 ± 1.0	18.6 ± 1.1	17.8 ± 1.0
D-83	18.4 ± 0.7	15.6 ± 0.8	18.9 ± 1.2	19.8 ± 1.1
D-84	18.7 ± 1.1	15.7 ± 0.9	19.1 ± 1.7	19.4 ± 1.2
D-85	20.0 ± 0.7	18.0 ± 1.0	21.5 ± 0.9	20.2 ± 1.2
D-86	20.2 ± 1.6	17.8 ± 1.2	21.7 ± 2.0	21.2 ± 1.6
D-91	18.9 ± 0.8	17.4 ± 1.3	19.9 ± 1.2	20.3 ± 1.8
Mean ± s.d.	20.4 ± 2.1	16.9 ± 2.6	19.4 ± 2.5	19.3 ± 2.7

[a] ND = No data; TLD missing in field.

DUANE ARNOLD

Table 11. Ambient gamma radiation as measured by thermoluminescent dosimeters (TLD). Quarterly collection. Units: mR/91 days

Within 1.0 mi. of Stack	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-43	17.4 ± 0.9	16.6 ± 1.3	17.8 ± 1.3	18.8 ± 1.4
D-44	21.3 ± 0.9	20.3 ± 0.8	22.5 ± 1.1	22.2 ± 0.8
D-45	17.9 ± 0.8	15.9 ± 1.1	18.8 ± 1.3	17.6 ± 1.2
D-46	21.2 ± 1.0	20.3 ± 1.0	23.7 ± 1.2	21.8 ± 1.1
D-47	21.2 ± 0.9	19.3 ± 0.7	22.5 ± 1.0	20.9 ± 1.0
D-48	20.8 ± 0.6	20.5 ± 0.8	23.7 ± 0.9	22.0 ± 0.9
Mean ± s.d.	20.0 ± 1.8	18.8 ± 2.0	21.5 ± 2.5	20.5 ± 1.9
Within 3.0 mi. of Stack				
D-33	17.8 ± 0.7	13.8 ± 0.7	16.1 ± 0.9	16.6 ± 1.0
D-34	17.3 ± 0.8	13.2 ± 1.2	16.1 ± 1.0	16.3 ± 1.1
D-35	17.7 ± 0.7	13.1 ± 0.7	16.0 ± 0.8	15.6 ± 1.1
D-36	ND [a]	14.7 ± 1.0	19.0 ± 1.3	16.8 ± 1.0
D-37	20.4 ± 0.9	14.9 ± 0.8	19.2 ± 1.2	15.6 ± 0.9
D-38	19.5 ± 1.0	17.2 ± 1.5	19.0 ± 1.2	18.8 ± 1.6
D-39	19.6 ± 0.8	16.7 ± 0.7	18.7 ± 0.9	19.2 ± 1.8
D-40	18.1 ± 0.8	15.5 ± 0.9	15.9 ± 1.1	17.8 ± 1.0
D-41	18.2 ± 0.9	15.6 ± 0.9	ND [a]	17.4 ± 1.0
D-42	18.2 ± 0.8	15.5 ± 1.4	15.7 ± 1.0	18.1 ± 1.4
Mean ± s.d.	18.5 ± 1.0	15.0 ± 1.4	17.3 ± 1.6	17.2 ± 1.3
ISFSI Fenceline				
D-161	52.1 ± 1.0	52.3 ± 3.8	51.2 ± 2.4	46.8 ± 3.9
D-162	19.0 ± 0.8	16.3 ± 1.6	19.1 ± 0.9	18.7 ± 1.8
D-163	44.3 ± 0.7	42.4 ± 2.6	42.6 ± 1.2	43.0 ± 1.2
D-164	16.1 ± 0.7	11.4 ± 0.9	16.3 ± 0.8	15.4 ± 1.0
Mean ± s.d.	32.8 ± 18.0	30.6 ± 19.9	32.3 ± 17.3	31.0 ± 16.2

[a] ND = No data; TLD missing in field.

Table 12. Milk samples, analyses for iodine-131 and gamma emitting isotopes. Collection: Monthly during non-grazing season (October 1 through April 30): biweekly during grazing season (May 1 through September 30)

Location		D-108					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-10-12	DMI- 143	< 0.3	1325 ± 118	< 3.7	< 4.3	< 20.4	< 2.5
02-07-12	DMI- 695	< 0.3	1477 ± 107	< 3.0	< 1.8	< 8.5	< 1.9
03-06-12	DMI- 1140	< 0.3	1303 ± 118	< 3.4	< 4.2	< 15.4	< 2.8
04-10-12	DMI- 1834	< 0.4	1338 ± 114	< 3.4	< 3.9	< 14.3	< 2.1
05-08-12	DMI- 2683	< 0.4	1431 ± 118	< 3.1	< 4.3	< 9.0	< 1.4
05-22-12	DMI- 3049	< 0.3	1319 ± 101	< 2.5	< 2.9	< 7.3	< 2.8
06-05-12			ND [a]				
06-19-12			ND				
07-03-12			ND				
Location		D-138 [b]					
07-17-12	DMI- 4263	< 0.5	1419 ± 113	< 3.2	< 2.4	< 9.1	< 2.3
07-31-12	DMI- 4777	< 0.4	1680 ± 115	< 3.9	< 4.9	< 14.7	< 1.4
08-14-12	DMI- 5109	< 0.3	1436 ± 109	< 2.0	< 4.2	< 8.0	< 2.7
08-28-12	DMI- 5427	< 0.3	1466 ± 125	< 2.5	< 4.3	< 15.5	< 2.0
09-06-12	DMI- 5627	< 0.4	1402 ± 106	< 2.4	< 2.8	< 17.9	< 1.7
09-18-12	DMI- 5893	< 0.4	1542 ± 125	< 4.0	< 4.1	< 13.2	< 2.8
10-02-12	DMI- 6160	< 0.3	1390 ± 98	< 2.3	< 2.9	< 13.5	< 2.4
11-06-12	DMI- 7163	< 0.3	1547 ± 94	< 2.5	< 1.9	< 9.0	< 3.1
12-04-12	DMI- 7766	< 0.3	1173 ± 104	< 2.8	< 3.5	< 11.5	< 3.2

Location		D-110					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-10-12	DMI- 144	< 0.3	1358 ± 98	< 2.8	< 3.2	< 13.0	< 2.3
02-07-12	DMI- 696	< 0.3	1399 ± 93	< 2.7	< 3.1	< 11.4	< 3.0
03-06-12	DMI- 1141	< 0.3	1316 ± 112	< 2.1	< 3.4	< 17.3	< 1.3
04-10-12	DMI- 1835	< 0.4	1409 ± 103	< 2.2	< 3.4	< 11.8	< 3.1
05-08-12	DMI- 2684	< 0.4	1517 ± 121	< 3.6	< 4.2	< 10.5	< 1.9
05-22-12	DMI- 3050	< 0.4	1319 ± 93	< 2.9	< 3.3	< 10.8	< 1.3
06-05-12	DMI- 3446	< 0.3	1443 ± 115	< 2.6	< 3.8	< 9.2	< 1.2
06-19-12	DMI- 3723	< 0.3	1405 ± 116	< 2.8	< 3.2	< 11.4	< 1.2
07-03-12	DMI- 3947	< 0.5	1438 ± 101	< 2.5	< 3.9	< 8.9	< 2.2
07-17-12	DMI- 4262	< 0.2	1412 ± 102	< 2.4	< 3.3	< 13.2	< 3.5
07-31-12	DMI- 4776	< 0.4	1420 ± 104	< 3.0	< 2.2	< 17.2	< 3.4
08-14-12	DMI- 5108	< 0.3	1427 ± 102	< 2.6	< 2.7	< 11.7	< 2.4
08-28-12	DMI- 5426	< 0.1	1443 ± 116	< 2.9	< 3.2	< 14.8	< 1.8
09-06-12	DMI- 5626	< 0.5	1290 ± 110	< 3.5	< 3.4	< 11.4	< 2.6
09-18-12	DMI- 5892	< 0.4	1318 ± 104	< 3.2	< 3.3	< 11.7	< 2.6
10-02-12	DMI- 6159	< 0.3	1481 ± 116	< 3.0	< 3.0	< 13.5	< 1.5
11-06-12	DMI- 7162	< 0.3	1283 ± 91	< 3.3	< 3.0	< 11.7	< 1.4
12-04-12	DMI- 7765	< 0.4	1452 ± 115	< 2.9	< 3.3	< 12.6	< 2.4

[a] ND = No data; see Table 2.0, Listing of Missed Samples.
[b] Replacement for D-108 as of 07-17-12.

DUANE ARNOLD

Table 13.1. Well water samples, analyses for gross beta and H3data.
Collection: Quarterly
Units: pCi/L

Location	D-53 Treated Municipal Water			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 888	DWW- 3184	DWW- 5300	DWW- 8339
Gross Beta	1.4 ± 0.4	1.0 ± 0.5	2.5 ± 0.6	-0.3 ± 0.3 [b]
H-3	< 142	< 162	< 153	< 137

Location	D-54 Inlet to Municipal Water			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 889	DWW- 3185	DWW- 5301	DWW- 8340
Gross Beta	1.2 ± 0.4	1.2 ± 0.6	3.4 ± 0.6	1.9 ± 0.4
H-3	< 142	< 162	< 153	< 137

Location	D-55 On-site Well			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 890	DWW- 3186	DWW- 5302	DWW- 8341
Gross Beta	0.4 ± 0.4 [b]	0.9 ± 0.5 [b]	-0.1 ± 0.6 [b]	1.8 ± 0.4
H-3	< 142	< 162	< 153	< 137

Location	D-57 Bull Farm			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 891	DWW- 3187	DWW- 5303	DWW- 8342
Gross Beta	0.3 ± 0.4 [b]	0.7 ± 0.5 [b]	1.0 ± 0.6	0.9 ± 0.3
H-3	< 142	< 162	< 153	< 137

Location	D-58 Franz Farm			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 892	DWW- 3188	DWW- 5304	DWW- 8343
Gross Beta	3.5 ± 0.6	3.1 ± 0.7	4.7 ± 0.6	3.6 ± 0.4
H-3	< 142	< 162	< 153	< 137

Location	D-72 Van Note Farm			
Collection Date	02-17-12	05-25-12	08-21-12	01-09-13
Lab Code	DWW- 894	DWW- 3189	DWW- 5305	DWW- 8344
Gross Beta	0.6 ± 0.8 [b]	-0.2 ± 0.4 [b]	0.5 ± 0.6 [b]	0.4 ± 0.3 [b]
H-3	< 142	< 162	< 153	< 137

[a] Gamma isotopic analysis will be performed if gross beta activity is greater than 3 pCi/L and/or H3 activity exceeds MDA.
[b] Value is less than MDA.

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Table 14. Vegetation (broadleaf), analyses for iodine-131 and other gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-57	D-94
Lab Code	DVE- 4264	DVE- 5337
Date Collected	07-17-12	08-22-12
Sample Type	Cabbage	Cabbage
K-40	1.96 ± 0.20	1.83 ± 0.22
Mn-54	< 0.009	< 0.009
Fe-59	< 0.013	< 0.012
Co-58	< 0.003	< 0.006
Co-60	< 0.006	< 0.004
Zn-65	< 0.012	< 0.013
Nb-95	< 0.006	< 0.006
Zr-95	< 0.010	< 0.018
Ru-103	< 0.009	< 0.008
Ru-106	< 0.050	< 0.031
I-131	< 0.013	< 0.008
Cs-134	< 0.007	< 0.006
Cs-137	< 0.009	< 0.009
Ce-141	< 0.012	< 0.008
Ce-144	< 0.039	< 0.054

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Table 15. Vegetation (hay and grain), analyses for gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-16	D-57	D-57	D-57	D-57
Lab Code	DVE- 3682	DVE- 3007	DVE- 4007	DVE- 7489	DVE- 7491
Date Collected	06-14-12	05-18-12	07-05-12	11-16-12	11-16-12
Sample Type	Wheat grain	Hay	Forage (Hay)	Corn	Beans
K-40	4.82 ± 0.52	19.33 ± 1.36	9.36 ± 0.54	2.22 ± 0.23	10.80 ± 0.49
Mn-54	< 0.013	< 0.041	< 0.018	< 0.008	< 0.008
Fe-59	< 0.035	< 0.060	< 0.036	< 0.012	< 0.042
Co-58	< 0.013	< 0.044	< 0.020	< 0.007	< 0.008
Co-60	< 0.017	< 0.034	< 0.013	< 0.005	< 0.009
Zn-65	< 0.023	< 0.053	< 0.023	< 0.016	< 0.028
Nb-95	< 0.016	< 0.045	< 0.022	< 0.005	< 0.012
Zr-95	< 0.028	< 0.065	< 0.030	< 0.010	< 0.016
Ru-103	< 0.015	< 0.038	< 0.022	< 0.007	< 0.011
Ru-106	< 0.15	< 0.45	< 0.096	< 0.050	< 0.093
I-131	< 0.032	< 0.060	< 0.029	< 0.016	< 0.029
Cs-134	< 0.014	< 0.039	< 0.016	< 0.005	< 0.010
Cs-137	< 0.014	< 0.041	< 0.019	< 0.007	< 0.016
Ce-141	< 0.034	< 0.062	< 0.025	< 0.011	< 0.023
Ce-144	< 0.12	< 0.28	< 0.14	< 0.058	< 0.062

			Control	
Location	D-109	D-110	D-108	D-108
Lab Code	DVE- 7488	DVE- 7494	DVE- 7492	DVE- 7493
Date Collected	11-16-12	11-06-12	11-16-12	11-16-12
Sample Type	Corn	Corn	Corn	Beans
K-40	3.14 ± 0.22	2.37 ± 0.16	2.11 ± 0.20	14.20 ± 0.54
Mn-54	< 0.005	< 0.004	< 0.006	< 0.007
Fe-59	< 0.009	< 0.010	< 0.011	< 0.029
Co-58	< 0.006	< 0.004	< 0.004	< 0.008
Co-60	< 0.005	< 0.006	< 0.006	< 0.008
Zn-65	< 0.018	< 0.006	< 0.014	< 0.029
Nb-95	< 0.010	< 0.007	< 0.006	< 0.011
Zr-95	< 0.014	< 0.012	< 0.013	< 0.016
Ru-103	< 0.009	< 0.005	< 0.006	< 0.014
Ru-106	< 0.074	< 0.037	< 0.05	< 0.086
I-131	< 0.018	< 0.025	< 0.017	< 0.025
Cs-134	< 0.006	< 0.005	< 0.005	< 0.010
Cs-137	< 0.004	< 0.005	< 0.008	< 0.009
Ce-141	< 0.011	< 0.012	< 0.014	< 0.011
Ce-144	< 0.036	< 0.041	< 0.045	< 0.046

Table 16. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-49

Lab Code	DSW- 163	DSW- 808	DSW- 1388	DSW- 2052	DSW- 2763	DSW- 3576
Date Collected	01-11-12	02-16-12	03-19-12	04-16-12	05-11-12	06-11-12
H-3	< 146	< 144	< 143	< 150	< 152	< 140
I-131(Chemistry)	< 0.3	< 0.4	1.9 ± 0.2 [a]	< 0.3	< 0.5	< 0.2
Mn-54	< 1.4	< 3.0	< 2.6	< 2.1	< 3.4	< 2.4
Fe-59	< 6.4	< 5.7	< 4.7	< 3.3	< 2.7	< 3.6
Co-58	< 1.9	< 3.0	< 1.8	< 2.4	< 2.8	< 2.9
Co-60	< 1.4	< 2.8	< 1.5	< 1.9	< 2.2	< 2.0
Zn-65	< 3.2	< 4.8	< 1.6	< 3.6	< 4.8	< 3.2
Nb-95	< 1.7	< 2.1	< 2.3	< 2.3	< 2.5	< 2.9
Zr-95	< 5.3	< 5.9	< 3.4	< 4.3	< 3.6	< 2.5
I-131	< 5.1	< 4.4	< 4.1	< 3.4	< 4.9	< 5.9
Cs-134	< 2.9	< 2.7	< 1.9	< 2.5	< 2.4	< 2.7
Cs-137	< 3.1	< 3.1	< 1.9	< 2.6	< 3.1	< 2.7
Ba-140	< 13.6	< 17.9	< 13.4	< 13.3	< 13.8	< 10.1
La-140	< 2.4	< 4.9	< 1.1	< 1.3	< 2.9	< 2.1

Lab Code	DSW- 4145	DSW- 5048	DSW- 5736	DSW- 6958	DSW- 7483	DSW- 8089
Date Collected	07-12-12	08-09-12	09-12-12	10-26-12	11-17-12	12-14-12
H-3	< 141	< 151	< 148	< 159	< 144	< 143
I-131(Chemistry)	< 0.4	< 0.2	< 0.4	< 0.3	< 0.4	< 0.2
Mn-54	< 3.4	< 3.0	< 2.6	< 3.9	< 3.5	< 2.7
Fe-59	< 5.8	< 3.8	< 5.2	< 6.5	< 7.2	< 3.9
Co-58	< 2.9	< 3.4	< 3.2	< 1.9	< 2.7	< 3.3
Co-60	< 2.4	< 3.3	< 3.2	< 4.6	< 2.1	< 2.0
Zn-65	< 4.1	< 3.3	< 6.5	< 7.2	< 6.4	< 5.0
Nb-95	< 3.3	< 4.1	< 2.7	< 3.2	< 3.9	< 3.1
Zr-95	< 4.5	< 4.1	< 6.9	< 5.0	< 6.2	< 4.7
I-131	< 4.7	< 5.8	< 7.3	< 7.7	< 6.2	< 5.0
Cs-134	< 3.1	< 3.1	< 4.1	< 3.9	< 2.3	< 2.5
Cs-137	< 4.0	< 4.9	< 3.3	< 4.1	< 3.8	< 2.2
Ba-140	< 13.0	< 12.7	< 15.9	< 19.1	< 18.1	< 14.7
La-140	< 1.5	< 3.6	< 4.2	< 2.5	< 2.7	< 2.0

[a] Analysis was repeated. Result of reanalysis: 2.0 ± 0.2 pCi/L.

Table 16. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-50

Lab Code	DSW- 164	DSW- 809	DSW- 1389	DSW- 2053	DSW- 2764	DSW- 3577
Date Collected	01-11-12	02-16-12	03-19-12	04-16-12	05-11-12	06-11-12
H-3	< 146	< 144	< 143	< 150	< 152	< 140
Mn-54	< 3.8	< 2.1	< 2.3	< 2.6	< 2.6	< 3.0
Fe-59	< 3.9	< 5.1	< 2.6	< 7.5	< 4.4	< 3.7
Co-58	< 3.0	< 3.2	< 1.9	< 2.4	< 3.2	< 3.7
Co-60	< 2.5	< 2.6	< 1.4	< 2.7	< 2.1	< 3.4
Zn-65	< 3.0	< 1.5	< 4.2	< 5.1	< 1.7	< 3.9
Nb-95	< 2.2	< 2.3	< 2.2	< 2.0	< 4.0	< 3.2
Zr-95	< 5.3	< 5.2	< 3.7	< 2.8	< 4.5	< 3.5
I-131	< 4.5	< 4.7	< 2.8	< 3.7	< 5.2	< 3.8
Cs-134	< 3.0	< 2.4	< 2.2	< 2.9	< 2.7	< 2.7
Cs-137	< 3.0	< 3.2	< 2.4	< 2.5	< 3.2	< 3.5
Ba-140	< 12.2	< 13.0	< 9.6	< 12.3	< 18.2	< 11.4
La-140	< 1.8	< 2.1	< 2.9	< 1.6	< 3.9	< 1.9

Lab Code	DSW- 4146	DSW- 5049	DSW- 5737	DSW- 6959	DSW- 7484	DSW- 8090
Date Collected	07-12-12	08-09-12	09-12-12	10-26-12	11-17-12	12-14-12
H-3	< 141	< 133	< 148	< 159	< 144	< 143
Mn-54	< 2.0	< 3.1	< 1.9	< 2.4	< 4.3	< 1.8
Fe-59	< 3.9	< 8.0	< 3.0	< 5.9	< 7.9	< 4.9
Co-58	< 1.4	< 2.0	< 1.9	< 1.9	< 3.7	< 2.8
Co-60	< 2.7	< 2.5	< 2.7	< 2.1	< 2.8	< 3.3
Zn-65	< 2.7	< 5.1	< 2.8	< 3.3	< 8.7	< 4.8
Nb-95	< 3.0	< 5.1	< 4.0	< 3.2	< 4.9	< 3.3
Zr-95	< 4.6	< 6.6	< 4.8	< 4.8	< 5.5	< 5.3
I-131	< 4.1	< 8.6	< 5.9	< 7.4	< 8.6	< 5.3
Cs-134	< 2.0	< 3.1	< 3.0	< 3.4	< 4.4	< 2.4
Cs-137	< 2.0	< 3.0	< 3.1	< 2.8	< 2.9	< 3.0
Ba-140	< 11.3	< 23.0	< 16.6	< 9.1	< 11.6	< 14.9
La-140	< 2.9	< 2.1	< 2.0	< 3.4	< 4.0	< 1.6

Table 16. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-51

Lab Code	DSW- 165	DSW- 811	DSW- 1390	DSW- 2054	DSW- 2765	DSW- 3578
Date Collected	01-11-12	02-16-12	03-19-12	04-16-12	05-11-12	06-11-12
H-3	< 146	< 144	< 143	< 150	< 152	< 140
Mn-54	< 1.7	< 3.1	< 2.6	< 1.9	< 2.5	< 2.6
Fe-59	< 5.6	< 4.5	< 5.4	< 3.3	< 5.1	< 3.3
Co-58	< 2.0	< 1.7	< 2.1	< 2.7	< 1.9	< 1.9
Co-60	< 2.1	< 2.4	< 2.3	< 1.7	< 2.6	< 0.9
Zn-65	< 3.4	< 5.1	< 5.6	< 4.1	< 3.3	< 3.9
Nb-95	< 1.8	< 3.0	< 1.9	< 3.1	< 2.6	< 1.9
Zr-95	< 3.6	< 6.7	< 4.5	< 3.7	< 4.9	< 3.2
I-131	< 4.0	< 4.4	< 4.5	< 4.1	< 4.8	< 2.1
Cs-134	< 2.1	< 2.3	< 2.2	< 2.2	< 2.8	< 2.5
Cs-137	< 3.0	< 3.2	< 2.6	< 1.7	< 3.0	< 3.4
Ba-140	< 9.0	< 17.7	< 6.9	< 11.5	< 19.4	< 12.9
La-140	< 2.3	< 3.5	< 2.4	< 1.4	< 2.8	< 2.1

Lab Code	DSW- 4147	DSW- 5050	DSW- 5738	DSW- 6960	DSW- 7485	DSW- 8091
Date Collected	07-12-12	08-09-12	09-12-12	10-26-12	11-17-12	12-14-12
H-3	< 141	< 133	< 148	< 159	< 144	< 143
Mn-54	< 2.2	< 2.5	< 2.3	< 2.0	< 2.1	< 2.7
Fe-59	< 3.9	< 6.3	< 5.2	< 6.8	< 4.2	< 4.6
Co-58	< 1.9	< 1.8	< 2.4	< 2.8	< 1.7	< 2.8
Co-60	< 2.5	< 3.1	< 2.4	< 2.5	< 2.7	< 2.9
Zn-65	< 1.9	< 4.6	< 4.4	< 4.7	< 4.3	< 3.5
Nb-95	< 2.3	< 3.3	< 2.2	< 3.8	< 2.5	< 1.8
Zr-95	< 4.2	< 4.5	< 4.2	< 6.3	< 3.5	< 2.1
I-131	< 5.2	< 7.9	< 4.8	< 6.7	< 6.5	< 8.0
Cs-134	< 2.1	< 2.3	< 2.4	< 3.4	< 2.0	< 3.8
Cs-137	< 3.0	< 1.7	< 4.0	< 3.2	< 2.7	< 2.9
Ba-140	< 10.0	< 17.5	< 18.8	< 16.5	< 12.8	< 12.5
La-140	< 1.3	< 2.4	< 3.7	< 3.0	< 3.9	< 1.5

Table 16. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-61

Lab Code	DSW- 166	DSW- 812	DSW- 1391	DSW- 2055	DSW- 2766	DSW- 3579
Date Collected	01-11-12	02-16-12	03-19-12	04-16-12	05-11-12	06-11-12
H-3	< 146	< 144	< 143	< 150	< 152	< 140
I-131(Chemistry)	< 0.3	< 0.3	1.6 ± 0.2 [a]	< 0.3	< 0.3	< 0.2
Mn-54	< 1.5	< 2.2	< 2.8	< 2.8	< 3.3	< 2.1
Fe-59	< 2.9	< 6.0	< 2.7	< 5.2	< 4.9	< 5.1
Co-58	< 2.0	< 2.3	< 1.7	< 2.3	< 2.1	< 2.5
Co-60	< 1.1	< 1.4	< 1.6	< 1.8	< 2.3	< 2.3
Zn-65	< 2.3	< 4.9	< 4.8	< 2.5	< 3.0	< 3.6
Nb-95	< 2.3	< 2.8	< 2.8	< 2.2	< 3.2	< 2.4
Zr-95	< 2.6	< 5.4	< 4.1	< 5.8	< 7.3	< 5.8
I-131	< 4.5	< 4.0	< 5.2	< 3.7	< 4.8	< 4.1
Cs-134	< 3.6	< 2.3	< 2.4	< 2.4	< 2.0	< 1.9
Cs-137	< 3.0	< 2.8	< 2.6	< 3.0	< 3.2	< 3.5
Ba-140	< 9.8	< 17.0	< 12.8	< 10.2	< 9.0	< 12.9
La-140	< 1.8	< 3.7	< 3.7	< 2.0	< 1.4	< 1.6

Lab Code	DSW- 4148	DSW- 5051	DSW- 5739	DSW- 6961	DSW- 7486	DSW- 8092
Date Collected	07-12-12	08-09-12	09-12-12	10-26-12	11-17-12	12-14-12
H-3	< 141	< 133	< 148	< 159	< 144	< 143
I-131(Chemistry)	< 0.3	< 0.2	< 0.4	< 0.3	< 0.5	< 0.2
Mn-54	< 2.7	< 3.9	< 2.6	< 3.1	< 3.9	< 1.7
Fe-59	< 3.2	< 4.6	< 3.9	< 5.2	< 9.2	< 4.7
Co-58	< 2.1	< 3.0	< 2.5	< 3.4	< 3.5	< 1.2
Co-60	< 3.2	< 2.1	< 1.8	< 3.7	< 3.3	< 3.7
Zn-65	< 4.0	< 4.0	< 5.5	< 4.6	< 11.1	< 4.5
Nb-95	< 3.2	< 4.6	< 3.7	< 3.9	< 7.0	< 2.7
Zr-95	< 4.9	< 3.2	< 3.2	< 7.3	< 9.5	< 2.6
I-131	< 5.5	< 5.8	< 4.2	< 5.0	< 8.1	< 3.8
Cs-134	< 2.2	< 4.1	< 2.5	< 3.6	< 3.3	< 1.8
Cs-137	< 2.7	< 2.5	< 3.2	< 3.3	< 4.6	< 3.3
Ba-140	< 15.7	< 20.6	< 11.4	< 12.6	< 21.1	< 10.9
La-140	< 2.7	< 3.6	< 3.0	< 1.5	< 4.9	< 2.3

[a] Analysis was repeated. Result of reanalysis: 1.5 ± 0.2 pCi/L.

Table 16. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-99

Lab Code	DSW- 167	DSW- 813	DSW- 1392	DSW- 2056	DSW- 2767	DSW- 3580
Date Collected	01-11-12	02-16-12	03-19-12	04-16-12	05-11-12	06-11-12
H-3	< 146	< 144	< 143	< 150	< 152	< 140
Mn-54	< 3.0	< 1.9	< 2.0	< 2.0	< 2.7	< 2.2
Fe-59	< 4.8	< 4.2	< 4.6	< 4.4	< 5.3	< 3.3
Co-58	< 1.9	< 1.9	< 2.7	< 1.8	< 2.2	< 4.3
Co-60	< 2.2	< 1.7	< 2.4	< 0.7	< 2.4	< 3.9
Zn-65	< 4.0	< 2.7	< 3.6	< 4.2	< 7.8	< 6.3
Nb-95	< 3.1	< 1.9	< 2.6	< 2.1	< 2.6	< 3.9
Zr-95	< 4.8	< 3.8	< 5.7	< 2.4	< 4.7	< 5.9
I-131	< 5.1	< 5.2	< 4.9	< 3.7	< 6.0	< 4.6
Cs-134	< 3.7	< 2.0	< 2.1	< 1.9	< 2.8	< 1.7
Cs-137	< 4.0	< 2.2	< 2.7	< 2.7	< 3.1	< 3.4
Ba-140	< 12.0	< 11.8	< 18.9	< 10.1	< 12.5	< 12.9
La-140	< 1.7	< 2.1	< 2.9	< 2.1	< 2.0	< 3.0

Lab Code	DSW- 4149	DSW- 5052	DSW- 5740	DSW- 6962	DSW- 7487	DSW- 8093
Date Collected	07-12-12	08-09-12	09-12-12	10-26-12	11-17-12	12-14-12
H-3	< 141	< 151	< 149	< 159	< 144	< 143
Mn-54	< 1.6	< 2.2	< 2.2	< 3.1	< 2.6	< 1.8
Fe-59	< 3.9	< 4.1	< 4.2	< 6.6	< 3.4	< 5.2
Co-58	< 2.4	< 2.7	< 1.2	< 2.2	< 3.1	< 2.5
Co-60	< 2.9	< 2.0	< 1.9	< 4.0	< 4.2	< 2.1
Zn-65	< 4.4	< 3.8	< 5.4	< 7.9	< 2.2	< 2.5
Nb-95	< 2.2	< 2.7	< 2.2	< 3.0	< 2.1	< 4.1
Zr-95	< 5.8	< 4.9	< 3.7	< 6.4	< 6.9	< 4.2
I-131	< 5.4	< 4.4	< 4.3	< 6.4	< 7.6	< 4.7
Cs-134	< 2.8	< 2.4	< 1.6	< 3.2	< 3.1	< 2.7
Cs-137	< 2.9	< 3.4	< 2.9	< 3.6	< 3.7	< 4.2
Ba-140	< 16.1	< 19.7	< 11.2	< 17.3	< 18.5	< 18.2
La-140	< 2.6	< 1.6	< 2.4	< 2.8	< 2.2	< 1.8

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Table 17. Surface water, analysis for strontium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location	D-49			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1458	DSW-3613	DSW-5822	DSW-8108
Sr-89	< 0.55	< 0.49	< 0.75	< 0.71
Sr-90	< 0.54	< 0.51	< 0.54	< 0.53

Location	D-61			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1459	DSW-3614	DSW-5823	DSW-8109
Sr-89	< 0.67	< 0.50	< 0.63	< 0.67
Sr-90	< 0.59	< 0.51	< 0.48	< 0.46

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Table 18. Fish, analyses of edible portion for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g wet

Location	Upstream, D-49			
Lab Code	DF- 3045	DF- 3046	DF- 6168	DF- 6169
Date Collected	05-11-12	05-11-12	09-28-12	09-28-12
Sample Type	Cyprinus Carpio	Carpiodes Spp.	Cyprinus Carpio	Moxostoma Sp.
K-40	2.85 ± 0.31	3.07 ± 0.32	2.98 ± 0.36	3.33 ± 0.43
Mn-54	< 0.012	< 0.006	< 0.007	< 0.014
Fe-59	< 0.029	< 0.025	< 0.015	< 0.015
Co-58	< 0.009	< 0.013	< 0.010	< 0.016
Co-60	< 0.012	< 0.011	< 0.015	< 0.018
Zn-65	< 0.025	< 0.031	< 0.011	< 0.015
Nb-95	< 0.017	< 0.017	< 0.020	< 0.015
Zr-95	< 0.014	< 0.013	< 0.016	< 0.042
Ru-103	< 0.013	< 0.011	< 0.016	< 0.014
Ru-106	< 0.097	< 0.10	< 0.081	< 0.090
Cs-134	< 0.008	< 0.012	< 0.011	< 0.010
Cs-137	< 0.011	< 0.012	< 0.011	< 0.012
Ce-141	< 0.023	< 0.027	< 0.040	< 0.032
Ce-144	< 0.075	< 0.065	< 0.084	< 0.102

Location	Downstream, D-61			
Lab Code	DF- 3047	DF- 3048	DF- 6170	DF- 6171
Date Collected	05-11-12	05-11-12	09-28-12	09-28-12
Sample Type	Cyprinus Carpio	Carpiodes Spp.	Carp Sucker Sp.	Moxostoma Sp.
K-40	2.81 ± 0.33	3.05 ± 0.35	3.35 ± 0.38	3.30 ± 0.38
Mn-54	< 0.013	< 0.014	< 0.015	< 0.013
Fe-59	< 0.027	< 0.030	< 0.032	< 0.014
Co-58	< 0.011	< 0.009	< 0.017	< 0.011
Co-60	< 0.011	< 0.011	< 0.013	< 0.019
Zn-65	< 0.025	< 0.012	< 0.026	< 0.026
Nb-95	< 0.024	< 0.017	< 0.022	< 0.017
Zr-95	< 0.013	< 0.026	< 0.028	< 0.011
Ru-103	< 0.018	< 0.021	< 0.019	< 0.014
Ru-106	< 0.086	< 0.10	< 0.112	< 0.110
Cs-134	< 0.011	< 0.013	< 0.015	< 0.010
Cs-137	< 0.015	< 0.015	< 0.017	< 0.010
Ce-141	< 0.027	< 0.037	< 0.038	< 0.033
Ce-144	< 0.083	< 0.10	< 0.120	< 0.071

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Table 19. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-50 (Plant Intake, Control)	
Lab Code	DBS- 3002	DBS- 7573
Date Collected	05-17-12	11-24-12
K-40	7.62 ± 0.47	7.21 ± 0.41
Mn-54	< 0.014	< 0.011
Fe-59	< 0.020	< 0.052
Co-58	< 0.011	< 0.013
Co-60	< 0.010	< 0.009
Zn-65	< 0.036	< 0.028
Nb-95	< 0.018	< 0.024
Zr-95	< 0.023	< 0.027
Ru-103	< 0.015	< 0.016
Ru-106	< 0.065	< 0.10
Cs-134	< 0.008	< 0.008
Cs-137	< 0.013	< 0.012
Ce-141	< 0.035	< 0.036
Ce-144	< 0.044	< 0.086

Location	D-51 (Discharge)	
Lab Code	DBS- 3003	DBS- 7575
Date Collected	05-17-12	11-24-12
K-40	8.39 ± 0.51	7.32 ± 0.40
Mn-54	< 0.014	< 0.012
Fe-59	< 0.029	< 0.026
Co-58	< 0.013	< 0.012
Co-60	< 0.005	< 0.010
Zn-65	< 0.031	< 0.024
Nb-95	< 0.016	< 0.012
Zr-95	< 0.020	< 0.027
Ru-103	< 0.018	< 0.014
Ru-106	< 0.11	< 0.084
Cs-134	< 0.009	< 0.007
Cs-137	< 0.015	< 0.009
Ce-141	< 0.031	< 0.031
Ce-144	< 0.084	< 0.083

DUANE ARNOLD

Table 19. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-107A (North Drainage Ditch)	
Lab Code	DBS- 3004	DBS- 7576
Date Collected	05-17-12	11-24-12
K-40	7.61 ± 0.51	6.28 ± 0.41
Mn-54	< 0.019	< 0.014
Fe-59	< 0.044	< 0.026
Co-58	< 0.015	< 0.020
Co-60	< 0.016	< 0.008
Zn-65	< 0.032	< 0.028
Nb-95	< 0.032	< 0.019
Zr-95	< 0.032	< 0.014
Ru-103	< 0.028	< 0.018
Ru-106	< 0.15	< 0.074
Cs-134	< 0.014	< 0.010
Cs-137	< 0.016	< 0.012
Ce-141	< 0.054	< 0.036
Ce-144	< 0.13	< 0.050

APPENDIX A

Supplemental Analyses

A-1. Supplemental Analyses.

Well water samples, conditional analyses for gamma-emitting isotopes [a].

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}La	^{140}Ba
						D-54						
DWW- 5301	8/21/2012	< 1.6	< 3.0	< 1.5	< 1.6	< 3.5	< 3.4	< 3.4	< 2.4	< 2.1	< 26	< 5.7
						D-55 [b]						
DWW- 890	2/17/2012	< 0.8	< 3.0	< 1.6	< 0.6	< 1.9	< 2.8	< 3.2	< 1.0	< 1.3	< 60	< 17.1
DWW- 3186	5/25/2012	< 2.8	< 3.7	< 3.5	< 2.7	< 4.4	< 3.9	< 3.8	< 2.7	< 2.7	< 13	< 4.7
DWW- 5302	8/21/2012	< 1.3	< 3.1	< 0.9	< 1.0	< 1.9	< 1.9	< 2.0	< 1.0	< 1.3	< 33	< 9.6
DWW- 8341	1/9/2013	< 2.7	< 3.8	< 2.0	< 2.4	< 3.4	< 3.8	< 4.4	< 2.5	< 2.5	< 15	< 1.6
						D-58						
DWW- 892	2/17/2012	< 1.5	< 4.0	< 1.9	< 1.2	< 2.0	< 3.0	< 3.3	< 1.1	< 1.1	< 56	< 12.2
DWW- 3188	5/25/2012	< 1.0	< 3.5	< 0.9	< 0.7	< 1.6	< 2.0	< 1.8	< 0.9	< 1.1	< 30	< 6.6
DWW- 5304	8/21/2012	< 1.7	< 3.5	< 1.8	< 1.6	< 2.4	< 2.2	< 2.3	< 1.5	< 1.9	< 22	< 4.2
DWW- 8343	1/9/2013	< 3.1	< 6.4	< 2.7	< 2.5	< 4.4	< 3.0.	< 4.8	< 2.4	< 2.4	< 17	< 2.9

[a] Gamma isotopic analysis is performed when gross beta activity is greater than 3 pCi/L and/or H3 activity exceeds MDA.

[b] Analyses performed at client request.