

2010

Annual Radiological Environmental  
Operating Report

Duane Arnold Energy Center

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DUANE ARNOLD ENERGY CENTER  
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REPORT

to the

UNITED STATES  
NUCLEAR REGULATORY COMMISSION

Annual Radiological Environmental Operating Report

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Prepared by

ATI ENVIRONMENTAL, Inc.  
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Project No. 8001

Approved :

A handwritten signature in black ink, appearing to read 'B. Grob', is written over a horizontal line. Below the signature, the name and title of the signatory are printed: Bronia Grob, M.S. Laboratory Manager.

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 and E, 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 and E, 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, 2010. 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.

Tabulation of the 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 2010 are summarized and discussed.

Trace levels of tritium in groundwater were reported from the sampling of monitoring wells within the Site Protected Area. REMP threshold reporting levels were not exceeded.

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

The sampling and analysis schedule for the environmental radiological monitoring program 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 46 locations. A TLD is placed at each location and is 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.

A precipitation sample is collected monthly from one on-site location and analyzed for gamma-emitting isotopes. A quarterly composite is analyzed for tritium.

Milk samples are 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-94, 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. An alternative site for broadleaf vegetation (D-15, indicator) may be sampled, if available.

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.

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). Non-potable water is collected from six on-site locations (MW-01 to MW-06). Two monitoring wells are sampled from each site, at shallow (A) and intermediate (B) depths, and analyzed for gross beta and tritium. If gross beta activity exceeds ten times the yearly mean of the control samples (or 7 pCi/liter), gamma isotopic, strontium-89 and strontium-90 analyses are performed.

Soil samples are collected annually at the two on-site locations, D-15a and D-16. The samples are analyzed for strontium-90, tritium and gamma-emitting isotopes.

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). In addition, Pleasant Lake (D-99) surface water and sewage effluent from location (D-107) is also monitored. 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.

### 3.3 Program Execution

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

(1) Airborne Particulates / Airborne Iodine:

No air particulate/ air iodine sample was available from location D-15 for the week ending 02/04/10.

There was no particulate matter collected on the filter.

Partial samples were collected at location D-7, for the weeks ending 05/13/10 and 08/12/10. Detection limits for I-131 were not met due to power interruptions, caused by a faulty line cord.

Air particulate / air iodine samples were not available at location D-6, for the weeks ending 08/05/10 through 09/02/10. The sampler site was shut down due to construction.

A partial sample (205 m<sup>3</sup>) was collected at location D-15, for the week ending 09/30/10, due to a power outage.

(2) Surface Water:

Surface water from locations D-50 and D-99 could not be sampled for the December 8, 2010 collection. The water was frozen.

(3) Milk:

Milk samples for locations D-108 and D-110, collected June 15, 2010, were damaged and lost in transit.

(4) Vegetation:

Vegetation samples were not collected at location D-94 in 2010. The sampling station was removed from the program in November, 2010.

(5) Precipitation:

Lower limits of detection could not be reached for the February, 2010 precipitation collection, due to insufficient sample volume (250 ml.).

### 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, 2011). The QA Program includes participation in Interlaboratory Comparison (crosscheck) Programs. Results obtained in crosscheck programs are presented in Appendix A.

### 3.5 Program Modifications

A new revision to the study plan (rev. 22) was issued in November of 2010. The revision included new conditional requirements for analysis of groundwaters:

Groundwater from potable wells is analyzed for gross beta and tritium. A gamma isotopic analysis will be performed if gross beta activity exceeds 3 pCi/L, or tritium activity exceeds MDA. If reactor by-product gamma emitters are identified, OR if gross beta measures > 7 pCi/L, or more than ten times the annual mean of the control samples, then additional analyses for Ni-63, Sr-89, Sr-90 and alpha emitters will be performed.

Samples from the six on-site monitoring wells are analyzed for tritium. If the tritium concentration is greater than 1000 pCi/L, conditional analyses for Ni-63, Sr-89, Sr-90 and alpha and gamma emitters are performed.

Vegetation samples were no longer available from sampling site D-94 in 2010. The station was removed from the program in November, 2010.

## 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 2010 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 atmospheric nuclear tests in 2010.

### 4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected outside of the Site Protected Area in 2010. The trace levels of strontium-90 and cesium-137, still measurable in soil and sediment samples, are attributed to deposition of fallout from previous decades.

Tritium was identified in some groundwater samples collected within the site Protected Area. In no instances were REMP threshold reporting levels exceeded. (ODAM, Table 6.3-3)

#### Airborne Particulates

The average annual gross beta concentrations in airborne particulates were identical at indicator and control locations (0.028 pCi/m<sup>3</sup>) and similar to levels observed from 1995 through 2009. The results are tabulated below.

<u>Year</u>	<u>Indicators</u>	<u>Controls</u>		<u>Year</u>	<u>Indicators</u>	<u>Controls</u>
Concentration ( pCi/m <sup>3</sup> )				Concentration ( pCi/m <sup>3</sup> )		
1995	0.025	0.024		2003	0.029	0.029
1996	0.024	0.023		2004	0.028	0.028
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

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, which is produced continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955) was detected in all samples, with an average activity of 0.081 pCi/m<sup>3</sup> for all locations. All other gamma-emitting isotopes were below their respective LLD limits.

##### Airborne Iodine

Weekly levels of airborne iodine-131 were below the required limit of 0.030 pCi/m<sup>3</sup> in all samples, excepting station D-7 for the weeks ending 05/13/10 and 08/12/10 (Sec. 3.3).

##### Ambient Radiation (TLDs)

At ten control locations, TLD readings averaged 17.3 mR/quarter. At locations within a half mile, one mile and three mile radius of the stack, measurements averaged 19.7 mR/quarter, 19.3 mR/quarter and 17.3 mR/quarter, respectively. The two on-site locations D-15 and D-16 averaged 18.2 mR/quarter. The average for all locations was 18.6 mR/quarter. This is lower than 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.

##### Precipitation

Precipitation from the on-site location D-16 was analyzed for tritium and gamma-emitting isotopes. No tritium activity was measured above the LLD of 159 pCi/L. No gamma-emitting isotopes were detected.

##### Milk

Iodine-131 results were below the detection limit of 0.5 pCi/L in all samples.

No gamma-emitting isotopes, except naturally occurring potassium-40, were detected in any milk samples. This is consistent with the finding of the National Center for Radiological Health 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 2010 show no radiological effects of plant operation.



## 4.2 Program Findings (continued)

### Ground Water (potable)

The annual mean for gross beta activity 2.6 pCi/L, similar to levels observed from 1991 through 2009. The location with the highest mean was D-58, a farm 1.0 mile distant from the plant. Tritium activity measured below the LLD of 164 pCi/L in all samples.

No effect from plant operation is indicated.

### Ground Water (Site Monitoring Wells)

Twelve on-site monitoring wells (six shallow and six intermediate depth) were sampled in 2010 and analyzed for gross beta and tritium.

The annual mean for gross beta activity in six intermediate depth wells measured 2.6 pCi/liter. Measurements for the shallow wells averaged 3.1 pCi/liter. The highest mean (5.0 pCi/L) was observed at shallow well MW-6A. The same pattern of concentration was observed in 2009. The most likely cause of higher beta activity is contribution from naturally-occurring isotopes. No plant effect was indicated.

Tritium activity measured below the LLD of 164 pCi/L in all twenty four samples collected from the intermediate depth wells. Activity was identified in nine of the twenty-nine samples taken from shallow wells and ranged from 169 to 1817 pCi/L. The highest mean (792 pCi/L) was observed at shallow well MW-1A, lower than concentrations measured in 2009. The activity has been attributed to "washout" from gaseous effluents.

### Vegetation

Iodine-131 concentrations in broadleaf vegetation were below the LLD level of 0.018 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.

### Soil

Strontium-90 activity measured below an LLD of 0.023 pCi/g dry weight in both on-site locations. Cesium-137 activity averaged 0.14 pCi/g dry weight. Strontium-90 and cesium-137 activities are similar or less than levels observed from 1991 through 2009, these levels are generally attributable to deposition of fallout from previous decades.

Naturally-occurring potassium-40 averaged 11.82 pCi/g dry weight. No effect from the plant operation is indicated.

The soil was distilled and analyzed for tritium. One of the two samples tested indicated slight activity (176 pCi/L) above the background level of 165 pCi/L and is attributed to rainwater washout of tritium from gaseous effluents.

## Program Findings (continued)

### Surface Water

Surface water was tested for tritium and gamma emitting isotopes in seventy samples from six locations. No measurable tritium activity was detected above an LLD of 179 pCi/L. Gamma-emitting isotopes were below detection limits.

An analysis for I-131 was performed on samples from locations D-49 (control) and D-61 (0.5 mi. downstream, indicator). All samples tested below detection limits.

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, 2010, 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 (2.97 and 3.45 pCi/g wet, respectively). No plant effect on the fish population is indicated.

### River Sediments

River sediments were collected in June and September, 2010, and analyzed for gamma-emitting isotopes. Potassium-40 activity ranged from 6.95 – 11.79 pCi/g dry weight and averaged 9.12 pCi/g dry weight.

Cs-137 activity measured below a detection limit of 0.039 pCi/g dry, less than levels observed from 1991 through 2009, trace cesium activity is generally attributable to deposition of fallout from previous decades.

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

## 4.3 Supplementary Groundwater Testing

There were no REMP sample analyses results that warranted communications to State and Local Stakeholders.

Refer to Part II, Appendix A for results of additional/ancillary samples collected in support of the Nuclear Industry Ground Water Protection Initiative.

## 5.0 TABLES AND FIGURES

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

Designation	Comment	Isotope	Half-life <sup>a</sup>
Naturally Occurring			
A. Cosmogenic	Produced by interaction of cosmic rays with atmosphere	Be-7	53.2 d
B. Terrestrial	Primordial	K-40	1.26 x 10 <sup>9</sup> y
II. Fission Products <sup>b</sup>			
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

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

<sup>b</sup> Includes fission-product daughters.

Table 5.2 Sample collection and analysis program.

Exposure Pathway and/or Sample Type	Sampling Location <sup>a</sup>		Sampling and Collection Frequency	Type and Frequency of Analysis <sup>b</sup>
	Sample Point	Description		
Airborne Particulates	3	Hiawatha	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.
	5	Palo		
	6	Center Point		
	7	Shellsburg		
	11	Toddville		
	13	Alburnett (C)		
	15	On-site North		
	16	On-site South		
40	Wikiup Hill			
Airborne Iodine	3	Hiawatha	Continuous operation of sampler with sample collection at least once per week.	Analyze each cartridge for iodine-131.
	5	Palo		
	6	Center Point		
	7	Shellsburg		
	11	Toddville		
	13	Alburnett (C)		
	15	On-site North		
	16	On-site South		
40	Wikiup Hill			
Ambient Radiation	1-3, 5-8, 10, 11, 1	Controls	One dosimeter continuously at each location.  Dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly .
	15, 16	Indicators		
	17-23, 28-32,	≤ 0.5 mi. of Stack		
	43-48, 82-86, 91	≤ 1.0 mi. of Stack		
	33-42	≤ 3.0 mi. of Stack		
Surface Water	49	Lewis Access (C)	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.
	50	Plant Intake		
	51	Plant Discharge		
	61	0.5 mi. downstream		
	99	Pleasant Creek Lake		
	107	Plant Sewage Discharge		

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

Exposure Pathway and/or Sample Type	Sampling Location <sup>a</sup>		Sampling and Collection Frequency	Type and Frequency of Analysis <sup>b</sup>
	Sample Point	Description		
Ground Water (potable)	53	Treated Municipal Inlet to Municipal Water Treatment System	Grab sample at least once per quarter.	Gross beta and tritium activity analysis on quarterly sample. If gross beta measures greater than ten times the annual mean of the control samples, or 7 pCi/L, perform gamma isotopic and Sr-89 and Sr-90 analyses.
	54			
	55	On-site well		
	57, 58 72 (C)	Wells off-site and within 4 km of DAEC		
On-site Ground Water (Monitoring Wells)	111	On-site wells: MW-01A, B (SSE)		
	112	MW-02A, B (ESE)		
	113	MW-03A, B (NW)		
	114	MW-04A, B (S)		
	115	MW-05A, B (SSW)		
	116	MW-06A, B (NE)		
River Sediment	50	Plant Intake (C)	At least once every six months.	Gamma isotopic analysis of each sample.
	51	Plant Discharge		
	107a	North Drainage Ditch (on-site)		
Vegetation	16, 57, 58 72, 94, 96, 109, 118	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.
	108 (C)			
Fish	49	Cedar River upstream of DAEC not influenced by effluent (C)	One sample per 6 months (once during January through June and once during July through December).	Gamma isotopic analysis on edible portions.
	61	Downstream of DAEC in influence of effluent		
Milk <sup>c</sup>	108 (C)	Control Farm near Watkins, Iowa	At least once per two weeks during the grazing season.	Gamma isotopic and iodine-131 analyses of each sample.
	110	Dairy Farm 7.8 mi. SW	At least once per month during the non-grazing season.	

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

Exposure Pathway and/or Sample Type	Sampling Location <sup>a</sup>		Sampling and Collection Frequency	Type and Frequency of Analysis <sup>b</sup>
	Sample Point	Description		
Precipitation	16	On-site	Monthly	Gamma isotopic on all samples. Tritium on quarterly composites.
Meat <sup>d</sup>		On-site	Annually	Gamma Isotopic
Soil	15a, 16	On-site	Annually	Gamma Isotopic, Sr-90 and tritium

<sup>a</sup> (C) denotes control location. All other locations are indicators.

<sup>b</sup> Gamma isotopic analysis and analysis for gamma-emitting nuclides refer to high resolution gamma ray spectrum analysis.

<sup>c</sup> The grazing season is considered to be May 1 through September 30.

<sup>d</sup> Only sampled when meat is butchered for home use.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

Code	Sampling Location	
	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-15a	On-site, North-Northwest	0.3 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, E	0.3 mi E
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 miles N	2.7 mi N
D-34	3 miles NNE	2.4 mi NNE
D-35	3 miles NE	1.7 mi NE
D-36	3 miles ENE	2.2 mi ENE
D-37	3 miles E	1.8 mi E
D-38	3 miles ESE	2.0 mi ESE
D-39	3 miles SE	1.6 mi SE
D-40	3 miles SSE	1.5 mi SSE
D-41	3 miles S	3.5 mi S
D-42	3 miles SSE	2.7 mi SSE
D-43	1 mile SSW	1.0 mi SSW
D-44	1 mile WSW	1.0 mi WSW
D-45	1 mile W	0.9 mi W



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

Code	Sampling Location	
	Location Description	Distance and Direction from Site Stack
D-46	1 mile WNW	1.0 mi WNW
D-47	1 mile NW	1.1 mi NW
D-48	1 mile NNW	1.0 mi NNW
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-107	Sewage Plant Effluent	On-site
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-111	Monitoring wells, MW-01A, B	On-site, SSE
D-112	Monitoring wells, MW-02A, B	On-site, ESE
D-113	Monitoring wells, MW-03A, B	On-site, NW
D-114	Monitoring wells, MW-04A, B	On-site, S
D-115	Monitoring wells, MW-05A, B	On-site, SSW
D-116	Monitoring wells, MW-06A, B	On-site, NE
D-118	Farm	1.45 mi. NW

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-15A					SO
D-16	AP, AI	P	TLD		SO, 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-94					G
D-96					G
D-99		SW			
D-107		SW			
D-107A				BS	
D-108		MI*			G
D-109					G
D-110		MI*			
D-111 to D-116			WW		
D-118					G
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
P	Precipitation
MI	Milk
WW	Well Water
G	Vegetation
ME	Meat
SO	Soil
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 Gamma	D-15	02-04-10	No particulates found deposited on filter.
P	Gamma	D-16	2-25-10	Required limits of detection not met due to insufficient sample volume.
AP/AI	Gross Beta Gamma	D-7	05-13-10	Partial sample, 77 m3, due to faulty line cord.
MI <sup>a</sup>	I-131, Gamma	D-108	06-15-10	Sample damaged and lost in transit.
MI <sup>a</sup>	I-131, Gamma	D-110	06-15-10	Sample damaged and lost in transit.
AP/AI	Gross Beta Gamma	D-6	08-05-10 to 09-02-10	No sample due to construction
AP/AI	Gross Beta Gamma	D-7	08-12-10	Partial sample, 85 m3, due to faulty line cord.
AP/AI	Gross Beta Gamma	D-15	09-30-10	Partial sample, 205 m3, due to power outage.
SW	H-3 Gamma	D-50	12-08-10	No sample; water frozen.
SW	H-3 Gamma	D-99	12-08-10.	No sample; water frozen.
VE	Gamma	D-94	2010	Location dropped from program.

<sup>a</sup> Constitutes a missed sample per the minimum requirements specified by the ODAM.

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	<u>Duane Arnold Energy Center</u>	Docket No.	<u>50-331</u>
Location of Facility	<u>Linn, Iowa</u>	Reporting Period	<u>January-December, 2010</u>
	(County, State)		

Sample Type (Units)	Type and Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Number Non-Routine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> Range <sup>c</sup>		
Airborne Particulates (pCi/m <sup>3</sup> )	GB 462	0.003	0.028 (409/410) (0.003-0.078)	D-6, Center Point 7 mi. N	0.030 (47/47) (0.012-0.055)	0.028 (52/52) (0.010-0.053)	0
	GS 36						
	Be-7	0.020	0.082 (32/32) (0.056-0.108)	D-7, Shellsburg 5 mi. W	0.092 (4/4) (0.074-0.108)	0.080 (4/4) (0.073-0.084)	0
	Mn-54	0.0011	< LLD			< LLD	0
	Fe-59	0.0029	< LLD			< LLD	0
	Co-58	0.0013	< LLD			< LLD	0
	Co-60	0.0012	< LLD			< LLD	0
	Zn-65	0.0020	< LLD			< LLD	0
	Nb-95	0.0015	< LLD			< LLD	0
	Zr-95	0.0025	< LLD			< LLD	0
	Ru-103	0.0018	< LLD			< LLD	0
	Ru-106	0.0107	< LLD			< LLD	0
	Cs-134	0.0011	< LLD			< LLD	0
	Cs-137	0.0012	< LLD			< LLD	0
Ce-141	0.0028	< LLD			< LLD	0	
Ce-144	0.0062	< LLD			< LLD	0	
Airborne Iodine (pCi/m <sup>3</sup> )	I-131 462	0.030	< LLD	-	-	< LLD	0
TLD, Control Locations (mR/quarter)	Gamma 40	1.0	None	D-8, Urbana 10 mi. NW	21.5 (4/4) (18.4-26.8)	17.7 (40/40) (13.5-26.8)	0
TLD, within 0.5 mi. of Stack (mR/quarter)	Gamma 56	1.0	19.5 (56/56) (13.5-30.4)	D-29, On-site 0.5 mi. W	23.2 (4/4) (20.0-29.0)	None	0
TLD, within 1.0 mi. of Stack (mR/quarter)	Gamma 48	1.0	19.3 (48/48) (12.2-27.1)	D-44 1 mi. WSW	22.3 (4/4) (20.3-27.1)	None	0
TLD, within 3.0 mi. of Stack (mR/quarter)	Gamma 40	1.0	17.3 (40/40) (13.6-26.3)	D-37, 3 mi. E	20.9 (4/4) (17.9-26.3)	None	0
Precipitation (pCi/L)	H-3 4	159	< LLD	-	-	None	0
	GS 12						
	Mn-54	7.3	< LLD	-	-	None	0
	Fe-59	12.6	< LLD	-	-	None	0
	Co-58	8.4	< LLD	-	-	None	0
	Co-60	10.3	< LLD	-	-	None	0
	Zn-65	18.3	< LLD	-	-	None	0
	Nb-95	9.8	< LLD	-	-	None	0
	Zr-95	12.5	< LLD	-	-	None	0
	I-131	17.1	< LLD	-	-	None	0
	Cs-134	6.7	< LLD	-	-	None	0
	Cs-137	8.0	< LLD	-	-	None	0
Ba-140	59.4	< LLD	-	-	None	0	
La-140	11.4	< LLD	-	-	None	0	

Table 5.7 Radiological Environmental Monitoring Program Summary.

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	(County, State)		

Sample Type (Units)	Type and Number of Analyses <sup>a</sup>		LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Number Non-Routine Results <sup>d</sup>
					Location <sup>e</sup>	Mean (F) <sup>c</sup> Range <sup>c</sup>		
Milk (pCi/L)	I-131	34	0.5	< LLD	-	-	< LLD	0
	GS	34						
	K-40		100	1376 (17/17) (1288-1444)	D-108, Farm 17.3 mi. SW	1411 (17/17) (1171-1692)	1411 (17/17) (1171-1692)	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
Ground Water, potable (pCi/L)	GB	23	1.4	2.1 (7/19) (1.4-4.0)	D-58, Farm 1 mi. WSW-SW	2.6 (4/3) (1.6-4.0)	< LLD	0
	H-3	23	164	< LLD	-	-	< LLD	0
Monitoring wells (pCi/L)	GB	53	1.8	3.0 (30/53) (1.8-6.4)	MW-6A, shallow Onsite, NE	5.0 (4/4) (3.1-6.4)	< LLD	0
	H-3	53	164	659 (9/53) (169-1817)	MW-01A (shallow) Onsite, 210m SSE	792 (7/7) (243-1817)	< LLD	1
Broadleaf Vegetation (pCi/g wet)	I-131	4	0.018	< LLD	-	-	< LLD	0
	GS	4						
	K-40		0.5	3.28 (4/4) (2.60-4.04)	D-108, Farm 17.3 mi. SW	4.04 (1/1)	4.04 (1/1)	0
	Mn-54		0.015	< LLD	-	-	< LLD	0
	Co-58		0.012	< LLD	-	-	< LLD	0
	Co-60		0.018	< LLD	-	-	< LLD	0
	Zn-65		0.032	< LLD	-	-	< LLD	0
	Nb-95		0.014	< LLD	-	-	< LLD	0
	Zr-95		0.029	< LLD	-	-	< LLD	0
	Ru-103		0.014	< LLD	-	-	< LLD	0
	Ru-106		0.15	< LLD	-	-	< LLD	0
	Cs-134		0.014	< LLD	-	-	< LLD	0
	Cs-137		0.015	< LLD	-	-	< LLD	0
	Ce-141		0.022	< LLD	-	-	< LLD	0
Ce-144		0.11	< LLD	-	-	< LLD	0	

Table 5.7 Radiological Environmental Monitoring Program Summary.

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 (County, State)

Sample Type (Units)	Type and Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Number Non-Routine Results <sup>a</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> Range <sup>c</sup>		
Vegetation (Grain and Forage) (pCi/g wet)	GS <sup>9</sup>						
	K-40	0.5	6.55 (7/7) (2.58-17.96)	D-58, Farm 1 mi. WSW-SW	12.79 (1/1)	7.53 (2/2) (4.83-10.22)	0
	Mn-54	0.023	< LLD	-	-	< LLD	0
	Co-58	0.025	< LLD	-	-	< LLD	0
	Co-60	0.022	< LLD	-	-	< LLD	0
	Zn-65	0.053	< LLD	-	-	< LLD	0
	Nb-95	0.024	< LLD	-	-	< LLD	0
	Zr-95	0.058	< LLD	-	-	< LLD	0
	Ru-103	0.018	< LLD	-	-	< LLD	0
	Ru-106	0.18	< LLD	-	-	< LLD	0
	Cs-134	0.018	< LLD	-	-	< LLD	0
	Cs-137	0.022	< LLD	-	-	< LLD	0
	Ce-141	0.039	< LLD	-	-	< LLD	0
Ce-144	0.15	< LLD	-	-	< LLD	0	
Soil (pCi/gwet)	Sr-90 <sup>2</sup>	0.023	< LLD	-	-	None	0
	H-3 (pCi/L) <sup>2</sup>	165	176 (1/2)	D-16, On-site 0.5 mi. SSE	176 (1/1)	None	0
	GS <sup>2</sup>						
	K-40	0.5	11.82 (2/2) (9.02-14.62)	D-15, On-site 0.5 mi. NW	14.62 (1/1)	None	0
	Mn-54	0.025	< LLD	-	-	None	0
	Fe-59	0.066	< LLD	-	-	None	0
	Co-58	0.025	< LLD	-	-	None	0
	Co-60	0.015	< LLD	-	-	None	0
	Zn-65	0.065	< LLD	-	-	None	0
	Nb-95	0.033	< LLD	-	-	None	0
	Zr-95	0.021	< LLD	-	-	None	0
	Ru-103	0.029	< LLD	-	-	None	0
	Ru-106	0.25	< LLD	-	-	None	0
	Cs-134	0.017	< LLD	-	-	None	0
	Cs-137	0.060	0.14 (2/2) (0.13-0.15)	D-15, On-site 0.5 mi. NW	0.15 (1/1)	None	0
	Ce-141	0.047	< LLD	-	-	None	0
Ce-144	0.13	< LLD	-	-	None	0	

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				Location <sup>d</sup>	Mean (F) <sup>c</sup> Range <sup>c</sup>			
Surface Water (pCi/L)	H-3	70	179	< LLD	-	< LLD	0	
	I-131	24	0.8	< LLD	-	< LLD	0	
	Sr-89	8	0.9	< LLD	-	< LLD	0	
	Sr-90	8	0.6	< LLD	-	< LLD	0	
	GS	70						
	Mn-54		4.5	< LLD	-	< LLD	0	
	Fe-59		7.9	< LLD	-	< LLD	0	
	Co-58		4.8	< LLD	-	< LLD	0	
	Co-60		5.0	< LLD	-	< LLD	0	
	Zn-65		10.3	< LLD	-	< LLD	0	
	Nb-95		5.3	< LLD	-	< LLD	0	
	Zr-95		10.4	< LLD	-	< LLD	0	
	I-131		9.2	< LLD	-	< LLD	0	
	Cs-134		5.0	< LLD	-	< LLD	0	
	Cs-137		5.8	< LLD	-	< LLD	0	
	Ba-140		24.9	< LLD	-	< LLD	0	
La-140		5.6	< LLD	-	< LLD	0		
Sediments (pCi/g dry)	GS	6						
	K-40		1.0	7.12 (4/4) (5.75-8.21)	D-107, Sewage Effluent Canal	7.25 (2/2) (7.10-7.41)	6.94 (2/2) (6.60-7.29)	0
	Mn-54		0.047	< LLD	-	-	< LLD	0
	Fe-59		0.09	< LLD	-	-	< LLD	0
	Co-58		0.041	< LLD	-	-	< LLD	0
	Co-60		0.030	< LLD	-	-	< LLD	0
	Zn-65		0.080	< LLD	-	-	< LLD	0
	Nb-95		0.069	< LLD	-	-	< LLD	0
	Zr-95		0.073	< LLD	-	-	< LLD	0
	Ru-103		0.045	< LLD	-	-	< LLD	0
	Ru-106		0.28	< LLD	-	-	< LLD	0
	Cs-134		0.034	< LLD	-	-	< LLD	0
	Cs-137		0.039	< LLD	-	-	< LLD	0
	Ce-141		0.087	< LLD	-	-	< LLD	0
Ce-144		0.24	< LLD	-	-	< LLD	0	



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	(County, State)		

Sample Type (Units)	Type and Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> Range <sup>c</sup>	Number Non-Routine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> Range <sup>c</sup>		
Fish (pCi/g wet)	GS 8 K-40	1.0	2.97 (4/4) (2.87-3.14)	D-49, Upstream, 4.0 mi. NNW	3.45 (4/4) (3.34-3.63)	3.45 (4/4) (3.34-3.63)	0
	Mn-54	0.021	< LLD	-	-	< LLD	0
	Fe-59	0.037	< LLD	-	-	< LLD	0
	Co-58	0.018	< LLD	-	-	< LLD	0
	Co-60	0.024	< LLD	-	-	< LLD	0
	Zn-65	0.051	< LLD	-	-	< LLD	0
	Nb-95	0.028	< LLD	-	-	< LLD	0
	Zr-95	0.036	< LLD	-	-	< LLD	0
	Ru-103	0.022	< LLD	-	-	< LLD	0
	Ru-106	0.19	< LLD	-	-	< LLD	0
	Cs-134	0.021	< LLD	-	-	< LLD	0
	Cs-137	0.016	< LLD	-	-	< LLD	0
	Ce-141	0.032	< LLD	-	-	< LLD	0
	Ce-144	0.159	< LLD	-	-	< LLD	0

<sup>a</sup> GB = Gross beta; GS = Gamma spectroscopy

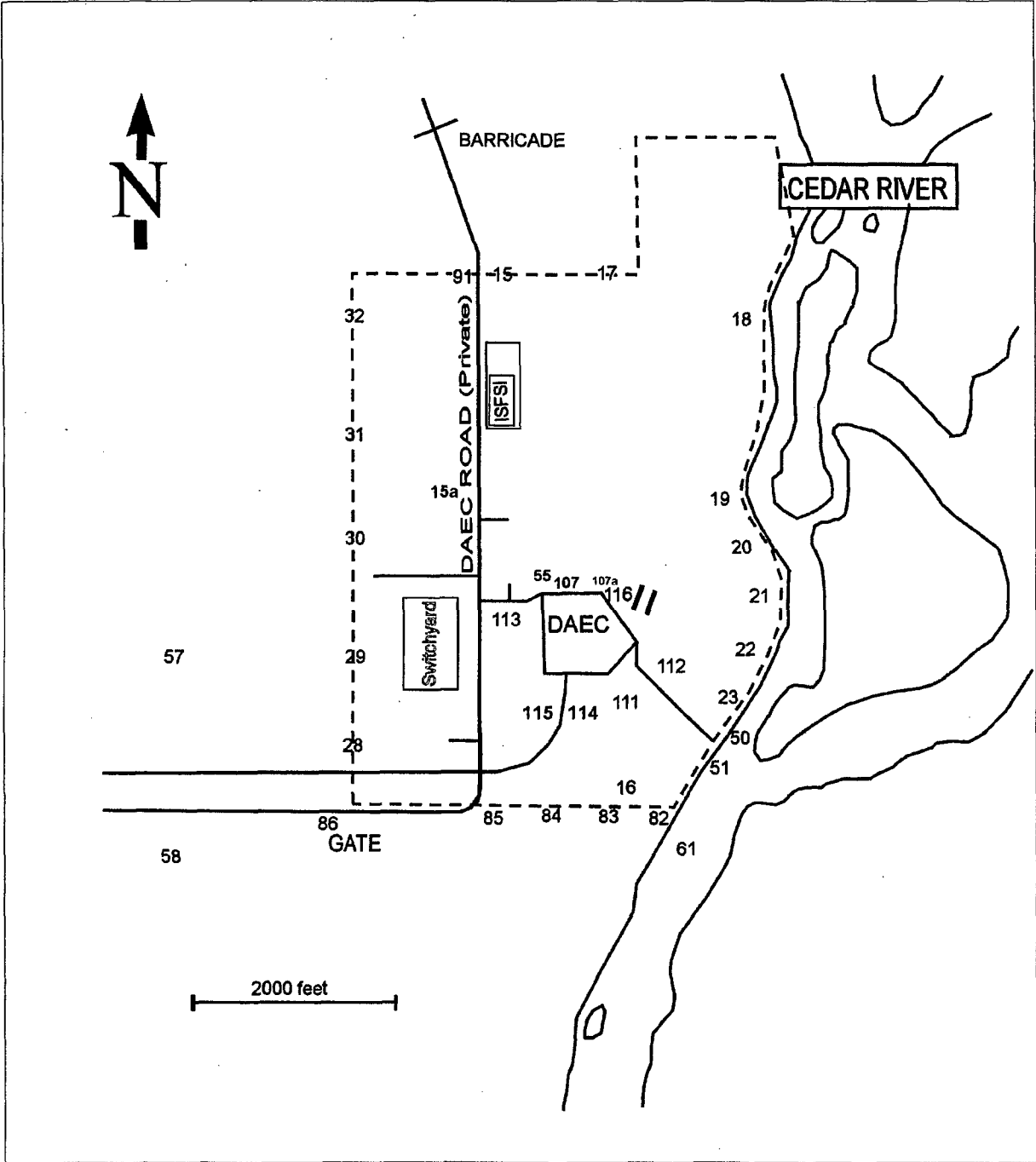
<sup>b</sup> LLD = Nominal lower limit of detection based on 4.66 sigma counting error for the background sample.

<sup>c</sup> Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).

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

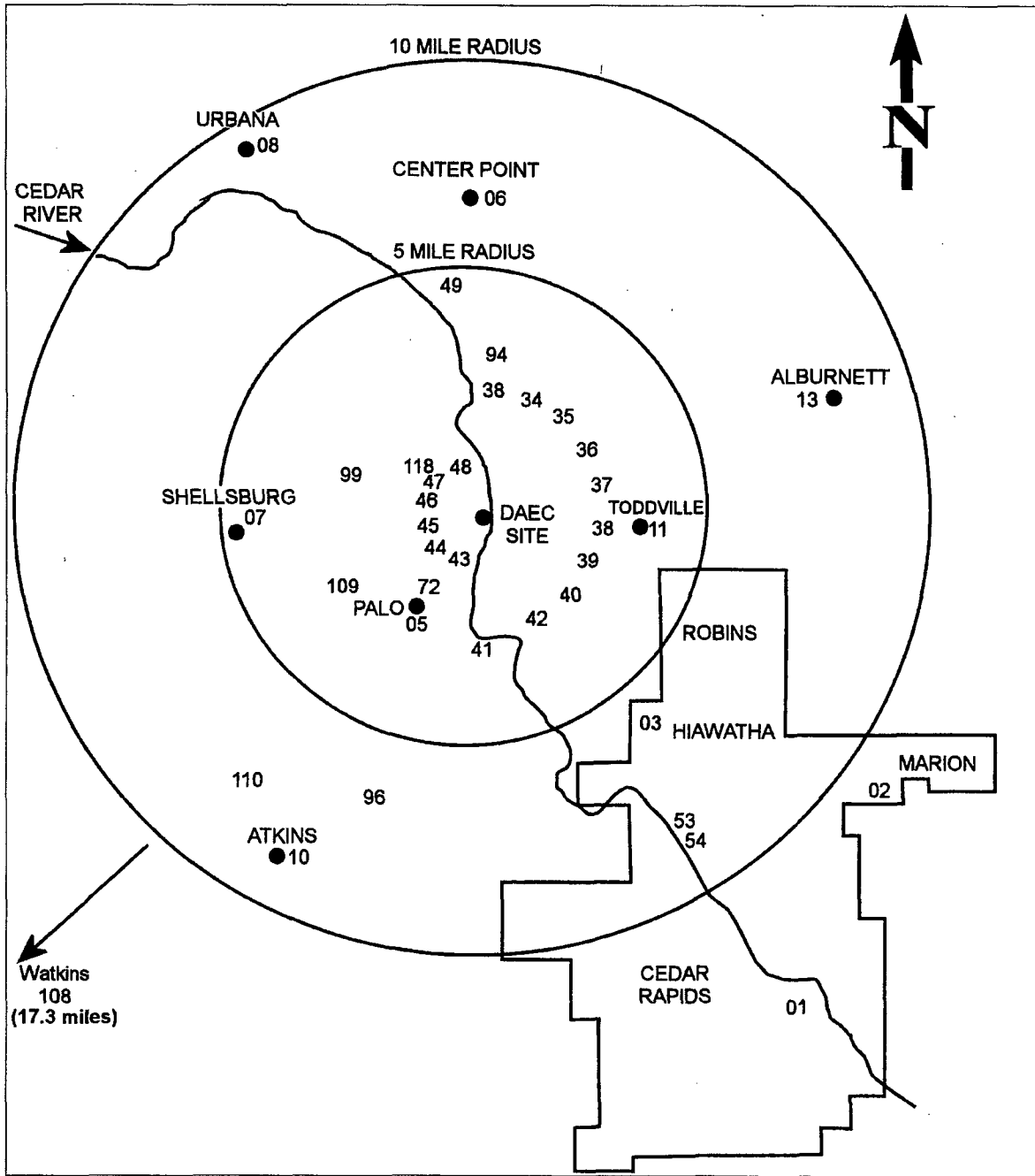
<sup>e</sup> Non-routine results are those which exceed ten times the control station value for the location. If a control station value is not available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

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.

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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, 2010 through December, 2010

## Appendix A

### Interlaboratory Comparison Program Results

Environmental, Inc., Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of its 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  $\pm 2$  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<sup>a</sup>

<u>Analysis</u>	<u>Level</u>	<u>One standard deviation for single determination</u>
Gamma Emitters	5 to 100 pCi/liter or kg > 100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89 <sup>b</sup>	5 to 50 pCi/liter or kg > 50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90 <sup>b</sup>	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	± 1σ = 169.85 x (known) <sup>0.0933</sup> 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 <sup>b</sup>	≤ 55 pCi/liter > 55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63 <sup>b</sup> Technetium-99 <sup>b</sup>	≤ 35 pCi/liter > 35 pCi/liter	6 pCi/liter 15% of known value
Iron-55 <sup>b</sup>	50 to 100 pCi/liter > 100 pCi/liter	10 pCi/liter 10% of known value
Other Analyses <sup>b</sup>	---	20% of known value

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

<sup>b</sup> Laboratory limit.

TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)<sup>a</sup>.

Lab Code	Date	Analysis	Concentration (pCi/L)			Acceptance
			Laboratory Result <sup>b</sup>	ERA Result <sup>c</sup>	Control Limits	
STW-1205	04/05/10	Sr-89	63.0 ± 5.7	60.4	48.6 - 68.2	Pass
STW-1205	04/05/10	Sr-90	37.4 ± 2.4	41.3	30.4 - 47.4	Pass
STW-1206	04/05/10	Ba-133	63.6 ± 3.3	65.9	54.9 - 72.5	Pass
STW-1206	04/05/10	Co-60	83.3 ± 2.9	84.5	76.0 - 95.3	Pass
STW-1206	04/05/10	Cs-134	71.0 ± 3.4	71.6	58.4 - 78.8	Pass
STW-1206	04/05/10	Cs-137	145.5 ± 5.1	146.0	131.0 - 163.0	Pass
STW-1206	04/05/10	Zn-65	194.9 ± 7.8	186.0	167.0 - 219.0	Pass
STW-1207	04/05/10	Gr. Alpha	26.5 ± 1.7	32.9	16.9 - 42.6	Pass
STW-1207	04/05/10	Gr. Beta	34.5 ± 1.6	37.5	24.7 - 45.0	Pass
STW-1208	04/05/10	I-131	22.7 ± 0.8	26.4	21.9 - 31.1	Pass
STW-1209	04/05/10	Ra-226	15.2 ± 0.7	14.6	10.9 - 16.8	Pass
STW-1209	04/05/10	Ra-228	15.6 ± 1.8	15.1	10.1 - 18.3	Pass
STW-1209	04/05/10	Uranium	59.5 ± 0.7	62.3	50.7 - 69.1	Pass
STW-1210	04/05/10	H-3	12955 ± 332	12400.0	10800 - 13600	Pass
STW-1224	10/04/10	Sr-89	65.3 ± 5.7	68.5	55.8 - 76.7	Pass
STW-1224	10/04/10	Sr-90	39.9 ± 2.3	43.0	31.7 - 49.3	Pass
STW-1225	10/04/10	Ba-133	67.2 ± 4.3	68.9	57.5 - 75.8	Pass
STW-1225	10/04/10	Co-60	53.2 ± 3.3	53.4	48.1 - 61.3	Pass
STW-1225	10/04/10	Cs-134	47.3 ± 5.1	43.2	34.5 - 47.5	Pass
STW-1225	10/04/10	Cs-137	118.0 ± 5.9	123.0	111.0 - 138.0	Pass
STW-1225	10/04/10	Zn-65	107.0 ± 8.7	102.0	91.8 - 122.0	Pass
STW-1226	10/04/10	Gr. Alpha	30.7 ± 2.9	42.3	21.9 - 53.7	Pass
STW-1226	10/04/10	Gr. Beta	32.7 ± 0.8	36.6	24.0 - 44.2	Pass
STW-1227	10/04/10	I-131	28.6 ± 1.1	27.5	22.9 - 32.3	Pass
STW-1228	10/04/10	Ra-226	11.8 ± 0.6	11.4	8.5 - 13.2	Pass
STW-1228	10/04/10	Ra-228	12.0 ± 1.8	9.9	6.4 - 12.3	Pass
STW-1228	10/04/10	Uranium	34.8 ± 0.4	36.8	29.8 - 41.0	Pass
STW-1229	10/04/10	H-3	13682 ± 352	12900.0	11200 - 14200	Pass

<sup>a</sup> 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).

<sup>b</sup> Unless otherwise indicated, the laboratory result is given as the mean ± standard deviation for three determinations.

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



TABLE A-2. Crosscheck program results; Thermoluminescent Dosimetry, (TLD, CaSO<sub>4</sub>: Dy Cards).

Lab Code	Date	Description	Known Value	mR		Acceptance
				Lab Result $\pm 2$ sigma	Control Limits	
<u>Environmental, Inc.</u>						
2010-1	6/8/2010	30 cm.	75.07	90.78 $\pm$ 3.60	52.55 - 97.59	Pass
2010-1	6/8/2010	40 cm.	42.23	50.88 $\pm$ 3.59	29.56 - 54.90	Pass
2010-1	6/8/2010	50 cm.	27.03	32.12 $\pm$ 1.90	18.92 - 35.14	Pass
2010-1	6/8/2010	60 cm.	18.77	21.80 $\pm$ 0.90	13.14 - 24.40	Pass
2010-1	6/8/2010	70 cm.	13.79	15.38 $\pm$ 1.39	9.65 - 17.93	Pass
2010-1	6/8/2010	75 cm.	12.01	11.30 $\pm$ 1.07	8.41 - 15.61	Pass
2010-1	6/8/2010	80 cm.	10.56	10.90 $\pm$ 0.61	7.39 - 13.73	Pass
2010-1	6/8/2010	90 cm.	8.34	7.84 $\pm$ 0.83	5.84 - 10.84	Pass
2010-1	6/8/2010	100 cm.	6.76	6.61 $\pm$ 0.52	4.73 - 8.79	Pass
2010-1	6/8/2010	110 cm.	5.58	4.29 $\pm$ 0.55	3.91 - 7.25	Pass
2010-1	6/8/2010	120 cm.	4.69	3.64 $\pm$ 0.33	3.28 - 6.10	Pass
2010-1	6/8/2010	150 cm.	3.00	2.82 $\pm$ 0.84	2.10 - 3.90	Pass
2010-1	6/8/2010	180 cm.	2.09	1.55 $\pm$ 0.23	1.46 - 2.72	Pass

Environmental, Inc.

2010-2	12/13/2010	100 cm.	4.94	4.65 $\pm$ 0.57	3.46 - 6.42	Pass
2010-2	12/13/2010	110 cm.	4.09	3.50 $\pm$ 0.74	2.86 - 5.32	Pass
2010-2	12/13/2010	120 cm.	3.43	2.68 $\pm$ 0.36	2.40 - 4.46	Pass
2010-2	12/13/2010	150 cm.	2.2	1.75 $\pm$ 0.42	1.54 - 2.86	Pass
2010-2	12/13/2010	180 cm.	1.53	1.32 $\pm$ 0.52	1.07 - 1.99	Pass
2010-2	12/13/2010	40 cm.	30.89	38.56 $\pm$ 2.11	21.62 - 40.16	Pass
2010-2	12/13/2010	50 cm.	19.77	23.35 $\pm$ 1.82	13.84 - 25.70	Pass
2010-2	12/13/2010	60 cm.	13.73	14.53 $\pm$ 1.24	9.61 - 17.85	Pass
2010-2	12/13/2010	60 cm.	13.73	15.84 $\pm$ 1.53	9.61 - 17.85	Pass
2010-2	12/13/2010	80 cm.	7.72	8.33 $\pm$ 0.74	5.40 - 10.04	Pass
2010-2	12/13/2010	90 cm.	6.1	5.93 $\pm$ 0.73	4.27 - 7.93	Pass

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

Lab Code <sup>b</sup>	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			Laboratory results 2s, n=1 <sup>c</sup>	Known Activity	Control Limits <sup>d</sup>	
SPW-12648	1/20/2010	Ra-228	40.04 ± 2.99	40.54	28.38 - 52.70	Pass
SPW-279	1/27/2010	U-238	4.52 ± 0.22	4.17	0.00 - 16.17	Pass
SPW-391	2/4/2010	Ni-63	179.70 ± 2.96	209.62	146.73 - 272.51	Pass
W-21210	2/12/2010	Ra-226	16.05 ± 0.39	16.77	11.74 - 21.80	Pass
W-21710	2/17/2010	Gr. Alpha	17.54 ± 0.37	20.00	10.00 - 30.00	Pass
W-21710	2/17/2010	Gr. Beta	42.47 ± 0.39	45.20	35.20 - 55.20	Pass
SPAP-669	2/25/2010	Gr. Beta	45.78 ± 0.11	49.24	29.54 - 68.94	Pass
SPAP-671	2/25/2010	Cs-134	10.56 ± 3.15	10.38	0.38 - 20.38	Pass
SPAP-671	2/25/2010	Cs-137	105.36 ± 3.15	109.20	98.28 - 120.12	Pass
SPMI-674	2/25/2010	Co-60	67.38 ± 5.65	68.79	58.79 - 78.79	Pass
SPMI-674	2/25/2010	Cs-134	60.61 ± 6.28	51.91	41.91 - 61.91	Pass
SPMI-674	2/25/2010	Cs-137	173.80 ± 10.30	163.80	147.42 - 180.18	Pass
SPW-676	2/25/2010	Co-60	66.13 ± 5.22	68.79	58.79 - 78.79	Pass
SPW-676	2/25/2010	Cs-134	51.54 ± 5.97	51.91	41.91 - 61.91	Pass
SPW-676	2/25/2010	Cs-137	179.30 ± 9.95	163.80	147.42 - 180.18	Pass
SPW-678	2/25/2010	H-3	59213.70 ± 709.90	60407.70	48326.16 - 72489.24	Pass
SPF-680	2/25/2010	Cs-134	402.56 ± 22.40	415.00	373.50 - 456.50	Pass
SPF-680	2/25/2010	Cs-137	2267.90 ± 75.60	2180.00	1962.00 - 2398.00	Pass
SPW-682	2/25/2010	Tc-99	29.70 ± 1.51	32.34	20.34 - 44.34	Pass
SPW-2871	4/5/2010	Ra-228	33.91 ± 2.85	36.80	25.76 - 47.84	Pass
W-40510	4/5/2010	Gr. Alpha	20.65 ± 0.42	20.00	10.00 - 30.00	Pass
W-40510	4/5/2010	Gr. Beta	44.72 ± 0.40	45.20	35.20 - 55.20	Pass
SPW-2083	4/28/2010	U-238	4.20 ± 0.32	4.17	0.00 - 16.17	Pass
W-51310	5/13/2010	Ra-226	17.04 ± 0.50	16.77	11.74 - 21.80	Pass
SPW-3181	6/17/2010	Tc-99	29.87 ± 1.09	32.34	20.34 - 44.34	Pass
SPW-3272	6/25/2010	H-3	5489.00 ± 224.00	5928.00	4742.40 - 7113.60	Pass
SPW-3278	6/25/2010	Fe-55	17054.00 ± 348.00	19614.00	15691.20 - 23536.80	Pass
SPW-3280	6/25/2010	C-14	3410.60 ± 9.75	4738.00	2842.80 - 6633.20	Pass
SPAP-3270	6/28/2010	Cs-134	12.24 ± 3.13	10.38	0.38 - 20.38	Pass
SPAP-3270	6/28/2010	Cs-137	103.92 ± 7.14	109.20	98.28 - 120.12	Pass
SPW-3274	6/28/2010	Co-60	67.48 ± 5.53	65.84	55.84 - 75.84	Pass
SPW-3274	6/28/2010	Cs-134	49.55 ± 6.11	46.38	36.38 - 56.38	Pass
SPW-3274	6/28/2010	Cs-137	58.85 ± 6.54	54.17	44.17 - 64.17	Pass
SPW-3274	6/28/2010	Sr-90	41.59 ± 1.83	42.72	34.18 - 51.26	Pass
SPMI-3276	6/28/2010	Co-60	66.80 ± 5.25	65.84	55.84 - 75.84	Pass
SPMI-3276	6/28/2010	Cs-134	48.20 ± 3.88	46.38	36.38 - 56.38	Pass
SPMI-3276	6/28/2010	Cs-137	62.46 ± 6.33	54.17	44.17 - 64.17	Pass
SPMI-3276	6/28/2010	Sr-90	43.32 ± 1.63	42.72	34.18 - 51.26	Pass

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

Lab Code <sup>b</sup>	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			Laboratory results 2s, n=1	Known Activity	Control Limits <sup>c</sup>	
SPW-5081	9/9/2010	Tc-99	30.22 ± 1.06	32.34	20.34 - 44.34	Pass
W-90910	9/9/2010	Gr. Alpha	20.95 ± 0.43	20.00	10.00 - 30.00	Pass
W-90910	9/9/2010	Gr. Beta	45.20 ± 0.41	45.20	35.20 - 55.20	Pass
W-91010	9/10/2010	Ra-226	17.48 ± 0.50	16.77	11.74 - 21.80	Pass
SPW-2874	9/23/2010	Ra-228	34.60 ± 2.68	36.80	25.76 - 47.84	Pass
XWW-5302	10/6/2010	Ba-133	154.13 ± 8.90	155.21	139.69 - 170.73	Pass
XWW-5302	10/6/2010	Co-60	24.65 ± 4.11	23.28	13.28 - 33.28	Pass
XWW-5302	10/6/2010	Cs-134	14.03 ± 3.87	13.95	3.95 - 23.95	Pass
XWW-5302	10/6/2010	Cs-137	61.16 ± 6.08	59.22	49.22 - 69.22	Pass
SPW-6035	10/21/2010	U-238	4.52 ± 0.20	4.17	0.00 - 16.17	Pass
W-120110	12/1/2010	Gr. Alpha	20.27 ± 0.41	20.00	10.00 - 30.00	Pass
W-120110	12/1/2010	Gr. Beta	46.75 ± 0.41	45.20	35.20 - 55.20	Pass
W-121610	12/16/2010	Ra-226	17.99 ± 0.43	16.77	11.74 - 21.80	Pass

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

<sup>b</sup> Laboratory codes as follows: W (water), MI (milk), AP (air filter), SO (soil), VE (vegetation),  
CH (charcoal canister), F (fish).

<sup>c</sup> Results are based on single determinations.

<sup>d</sup> Control limits are established from the precision values listed in Attachment A of this report, adjusted to ± 2σ.

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 <sup>b</sup>	Concentration (pCi/L) <sup>a</sup>		
				Laboratory results (4.66σ)		Acceptance Criteria (4.66 σ)
				LLD	Activity <sup>c</sup>	
SPW-12658	Water	1/20/2010	Ra-228	0.79	0.61 ± 0.44	2
SPW-280	Water	1/27/2010	U-238	0.18	0.07 ± 0.13	1
SPW-392	Water	2/4/2010	Ni-63	15.90	-11.80 ± 9.40	20
W-21210	Water	2/12/2010	Ra-226	0.03	0.06 ± 0.02	1
W-21710	Water	2/17/2010	Gr. Alpha	0.41	0.09 ± 0.30	1
W-21710	Water	2/17/2010	Gr. Beta	0.73	0.23 ± 0.52	3.2
SPAP-668	Air Filter	2/25/2010	Gr. Beta	0.11	0.008 ± 0.002	3.2
SPAP-670	Air Filter	2/25/2010	Cs-134	1.87	-	100
SPAP-670	Air Filter	2/25/2010	Cs-137	2.31	-	100
SPMI-672	Milk	2/25/2010	Cs-137	3.52	-	10
SPMI-672	Milk	2/25/2010	I-131(G)	6.09	-	20
SPW-675	Water	2/25/2010	Co-60	1.55	-	10
SPW-675	Water	2/25/2010	Cs-137	2.69	-	10
SPW-675	Water	2/25/2010	I-131(G)	5.68	-	20
SPF-679	Fish	2/25/2010	Cs-134	10.94	-	100
SPF-679	Fish	2/25/2010	Cs-137	18.37	-	100
SPW-681	Water	2/25/2010	Tc-99	16.11	-10.75 ± 9.53	10
SPW-2881	Water	4/5/2010	Ra-228	0.89	0.22 ± 0.44	2
W-40510	Water	4/5/2010	Gr. Alpha	0.40	-0.20 ± 0.26	1
W-40510	Water	4/5/2010	Gr. Beta	0.75	-0.09 ± 0.52	3.2
SPW-2084	Water	4/28/2010	U-238	0.14	0.03 ± 0.10	1
W-51310	Water	5/13/2010	Ra-226	0.03	0.06 ± 0.02	1
SPW-3271	Water	6/25/2010	H-3	151.60	-58.10 ± 71.90	200
SPW-3278	Water	6/25/2010	Fe-55	634.50	256.80 ± 396.40	1000
SPW-3279	water	6/25/2010	C-14	8.57	-1.84 ± 5.18	200
SPAP-3269	Air Filter	6/28/2010	Cs-134	1.71	-	100
SPAP-3269	Air Filter	6/28/2010	Cs-137	2.42	-	100
SPW-3273	Water	6/28/2010	Co-60	1.64	-	10
SPW-3273	Water	6/28/2010	Cs-134	3.89	-	10
SPW-3273	Water	6/28/2010	Cs-137	4.29	-	10
SPW-3273	water	6/25/2010	Sr-90	0.50	-0.04 ± 0.22	1
SPMI-3275	Milk	6/28/2010	Cs-134	3.33	-	10
SPMI-3275	Milk	6/28/2010	Cs-137	3.82	-	10
SPMI-3275	Milk	6/28/2010	I-131(G)	3.71	-	20
SPMI-3275	Milk	6/28/2010	Sr-90	0.58	0.81 ± 0.36	1

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

Lab Code	Sample Type	Date	Analysis <sup>b</sup>	Concentration (pCi/L) <sup>a</sup>		
				Laboratory results (4.66σ)		Acceptance Criteria (4.66 σ)
				LLD	Activity <sup>c</sup>	
SPW-5080	Water	9/9/2010	Tc-99	2.15	-0.71 ± 1.29	10
W-90910	Water	9/9/2010	Gr. Alpha	0.39	0.10 ± 0.28	1
W-90910	Water	9/9/2010	Gr. Beta	0.78	-0.09 ± 0.55	3.2
W-91010	Water	9/10/2010	Ra-226	0.04	0.07 ± 0.03	1
SPW-2884	Water	9/23/2010	Ra-228	0.71	1.14 ± 0.46	2
SPW-6036	Water	10/21/2010	U-238	0.11	0.07 ± 0.10	1
W-120110	Water	12/1/2010	Gr. Alpha	0.43	-0.05 ± 0.29	1
W-120110	Water	12/1/2010	Gr. Beta	0.75	-0.08 ± 0.53	3.2
W-121610	Water	12/16/2010	Ra-226	0.03	0.04 ± 0.02	1
BKW-120610	water	12/6/2010	Ba-133	5.66	-	10
BKW-120610	water	12/6/2010	Co-60	4.49	-	10
BKW-120610	water	12/6/2010	Cs-134	4.41	-	10
BKW-120610	water	12/6/2010	Cs-137	5.33	-	10
W-121610	Water	12/16/2010	Ra-226	0.03	0.04 ± 0.02	1

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

<sup>b</sup> I-131(G); iodine-131 as analyzed by gamma spectroscopy.

<sup>c</sup> 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) <sup>a</sup>			Acceptance
			First Result	Second Result	Averaged Result	
CF-20, 21	1/4/2010	Gr. Beta	10.96 ± 0.27	11.30 ± 0.28	11.13 ± 0.19	Pass
CF-20, 21	1/4/2010	K-40	8.88 ± 0.48	8.27 ± 0.78	8.58 ± 0.46	Pass
CF-20, 21	1/4/2010	Sr-90	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.00	Pass
CF-41, 42	1/4/2010	Be-7	0.45 ± 0.11	0.41 ± 0.14	0.43 ± 0.09	Pass
CF-41, 42	1/4/2010	Gr. Beta	3.26 ± 0.10	3.33 ± 0.11	3.30 ± 0.07	Pass
CF-41, 42	1/4/2010	K-40	2.85 ± 0.36	3.04 ± 0.22	2.95 ± 0.21	Pass
MI-111, 112	1/12/2010	K-40	1276.00 ± 98.96	1334.80 ± 105.00	1305.40 ± 72.14	Pass
DW-10010, 10011	1/13/2010	Ra-226	0.48 ± 0.10	0.43 ± 0.10	0.46 ± 0.07	Pass
DW-10010, 10011	1/13/2010	Ra-226	1.59 ± 0.61	1.13 ± 0.47	1.36 ± 0.39	Pass
WW-215, 216	1/18/2010	H-3	211.16 ± 87.57	291.90 ± 91.31	251.53 ± 63.26	Pass
DW-10022, 10023	1/21/2010	Ra-226	8.57 ± 0.91	10.20 ± 1.08	9.39 ± 0.71	Pass
DW-10022, 10023	1/21/2010	Ra-228	5.68 ± 1.36	3.59 ± 1.17	4.64 ± 0.90	Pass
WW-424, 425	1/28/2010	H-3	422.30 ± 95.90	484.20 ± 98.50	453.25 ± 68.74	Pass
DW-10034, 10035	1/28/2010	Ra-226	0.93 ± 0.13	0.90 ± 0.11	0.92 ± 0.09	Pass
DW-10034, 10035	1/28/2010	Ra-228	1.16 ± 0.62	1.29 ± 0.62	1.23 ± 0.44	Pass
SW-382, 383	2/1/2010	Gr. Beta	2.22 ± 0.68	1.18 ± 0.71	1.70 ± 0.49	Pass
DW-10046, 10047	2/2/2010	Ra-226	6.11 ± 0.91	7.88 ± 1.17	7.00 ± 0.74	Pass
DW-10046, 10047	2/2/2010	Ra-228	5.84 ± 1.11	6.13 ± 1.14	5.99 ± 0.80	Pass
WW-693, 694	2/23/2010	H-3	1458.00 ± 131.00	1531.00 ± 133.00	1494.50 ± 93.34	Pass
SW-782, 783	3/1/2010	Gr. Beta	1.05 ± 0.42	1.60 ± 0.43	1.33 ± 0.30	Pass
SW-782, 783	3/1/2010	K-40	1.50 ± 0.15	1.52 ± 0.15	1.51 ± 0.11	Pass
MI-946, 947	3/9/2010	K-40	1485.00 ± 109.30	1347.40 ± 108.30	1416.20 ± 76.93	Pass
W-1035, 1036	3/17/2010	Ra-226	11.78 ± 1.51	9.76 ± 1.26	10.77 ± 0.98	Pass
W-1035, 1036	3/17/2010	Ra-228	5.31 ± 2.42	8.45 ± 2.78	6.88 ± 1.84	Pass
SW-1285, 1286	3/17/2010	H-3	377.60 ± 104.50	282.70 ± 100.70	330.15 ± 72.56	Pass
W-1103, 1104	3/18/2010	H-3	12690 ± 333	12679 ± 333	12685 ± 235	Pass
WW-1193, 1194	3/18/2010	H-3	227.38 ± 95.19	251.81 ± 96.15	239.60 ± 67.65	Pass
LW-1909, 1910	3/24/2010	H-3	1529.40 ± 144.60	1404.40 ± 140.80	1466.90 ± 100.91	Pass
LW-1909, 1910	3/25/2010	H-3	2.40 ± 0.97	1.99 ± 1.03	2.20 ± 0.71	Pass
DW-10068, 10069	3/25/2010	Gr. Alpha	1.08 ± 1.02	1.35 ± 1.05	1.22 ± 0.73	Pass
DW-10070, 10071	3/29/2010	Ra-226	1.58 ± 0.17	1.69 ± 0.16	1.64 ± 0.12	Pass
DW-10070, 10071	3/29/2010	Ra-228	1.16 ± 0.47	1.34 ± 0.49	1.25 ± 0.34	Pass
AP-1729, 1730	3/30/2010	Be-7	0.08 ± 0.01	0.08 ± 0.01	0.08 ± 0.01	Pass
AP-1782, 1783	3/30/2010	Be-7	0.08 ± 0.01	0.09 ± 0.01	0.09 ± 0.01	Pass
E-1392, 1393	4/1/2010	Gr. Beta	1.59 ± 0.07	1.66 ± 0.08	1.63 ± 0.05	Pass
E-1392, 1393	4/1/2010	K-40	902.30 ± 179.00	1076.70 ± 202.90	989.50 ± 135.29	Pass
WW-1422, 1423	4/1/2010	Gr. Beta	22.23 ± 1.58	19.42 ± 1.40	20.83 ± 1.06	Pass
SW-1464, 1465	4/1/2010	H-3	262.06 ± 98.96	233.18 ± 97.75	247.62 ± 69.55	Pass
XW-1666, 1667	4/1/2010	Fe-55	7.05 ± 0.71	7.25 ± 0.74	7.15 ± 0.51	Pass
SG-1532, 1533	4/6/2010	Ac-228	19.45 ± 1.14	20.07 ± 1.19	19.76 ± 0.82	Pass
SG-1532, 1533	4/6/2010	Pb-214	12.66 ± 0.52	13.32 ± 0.54	12.99 ± 0.38	Pass

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

Lab Code	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			First Result	Second Result	Averaged Result	
SG-1506, 1507	4/7/2010	Ac-228	1.28 ± 0.15	1.15 ± 0.14	1.22 ± 0.10	Pass
SG-1506, 1507	4/7/2010	Pb-214	1.24 ± 0.10	1.22 ± 0.09	1.23 ± 0.07	Pass
SW-1645, 1646	4/14/2010	H-3	312.00 ± 100.00	352.00 ± 102.00	332.00 ± 71.42	Pass
DW-10095, 10096	4/14/2010	Ra-226	4.87 ± 0.53	5.57 ± 0.61	5.22 ± 0.40	Pass
DW-10095, 10096	4/14/2010	Ra-228	2.49 ± 0.56	2.76 ± 0.60	2.63 ± 0.41	Pass
W-2013, 2014	4/16/2010	Gr. Alpha	33.45 ± 3.98	39.11 ± 4.54	36.28 ± 3.02	Pass
W-2013, 2014	4/16/2010	Gr. Beta	14.83 ± 0.96	16.07 ± 0.96	15.45 ± 0.68	Pass
WW-2431, 2432	4/19/2010	H-3	400.40 ± 98.10	377.70 ± 97.10	389.05 ± 69.01	Pass
SO-2037, 2038	4/22/2010	K-40	2.89 ± 0.40	2.89 ± 0.51	2.89 ± 0.32	Pass
W-2325, 2326	4/26/2010	H-3	399.00 ± 92.00	429.00 ± 94.00	414.00 ± 65.76	Pass
AP-2149, 2150	4/29/2010	Be-7	0.14 ± 0.08	0.26 ± 0.12	0.20 ± 0.07	Pass
LW-2191, 2192	4/29/2010	Gr. Beta	1.16 ± 0.56	0.79 ± 0.52	0.97 ± 0.38	Pass
G-2170, 2171	5/3/2010	Be-7	0.91 ± 0.32	0.86 ± 0.26	0.89 ± 0.21	Pass
G-2170, 2171	5/3/2010	Gr. Beta	8.73 ± 0.22	9.01 ± 0.23	8.87 ± 0.16	Pass
G-2170, 2171	5/3/2010	K-40	7.24 ± 0.44	7.48 ± 0.78	7.36 ± 0.45	Pass
SWT-2282, 2283	5/4/2010	Gr. Beta	0.73 ± 0.52	1.58 ± 0.57	1.16 ± 0.39	Pass
WW-2233, 2234	5/5/2010	Gr. Alpha	1.56 ± 1.47	2.27 ± 1.65	1.92 ± 1.10	Pass
WW-2233, 2234	5/5/2010	Gr. Beta	2.33 ± 1.14	4.08 ± 1.24	3.21 ± 0.84	Pass
TD-2410, 2411	5/10/2010	H-3	431.92 ± 96.50	403.05 ± 95.26	417.48 ± 67.80	Pass
SG-2347, 2348	5/13/2010	Ra-226	37.34 ± 0.42	37.91 ± 0.36	37.63 ± 0.28	Pass
F-2463, 2464	5/17/2010	K-40	2.69 ± 0.56	2.65 ± 0.38	2.67 ± 0.34	Pass
XW-2834, 2835	5/20/2010	H-3	209.53 ± 83.34	263.11 ± 85.95	236.32 ± 59.86	Pass
WW-2597, 2598	5/25/2010	H-3	288.10 ± 98.20	155.80 ± 93.40	221.95 ± 67.76	Pass
MI-2639, 2640	5/25/2010	K-40	1428.80 ± 110.60	1408.60 ± 107.40	1418.70 ± 77.08	Pass
SL-2771, 2772	6/1/2010	Gr. Beta	5.33 ± 0.18	5.30 ± 0.18	5.32 ± 0.13	Pass
SL-2771, 2772	6/1/2010	K-40	4.67 ± 0.46	4.88 ± 0.46	4.78 ± 0.33	Pass
SW-2879, 2880	6/1/2010	H-3	335.60 ± 92.60	356.40 ± 93.60	346.00 ± 65.83	Pass
SG-2904, 2905	6/7/2010	Gamma	5.20 ± 0.20	5.50 ± 0.10	5.35 ± 0.11	Pass
SO-3039, 3040	6/8/2010	Be-7	0.12 ± 0.03	0.13 ± 0.08	0.13 ± 0.04	Pass
SO-3039, 3040	6/8/2010	Cs-137	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	Pass
SO-3039, 3040	6/8/2010	Gr. Beta	22.80 ± 2.05	23.84 ± 2.44	23.32 ± 1.59	Pass
SO-3039, 3040	6/8/2010	K-40	11.30 ± 1.20	11.70 ± 1.20	11.50 ± 0.85	Pass
SO-3039, 3040	6/8/2010	U-233/4	0.12 ± 0.02	0.13 ± 0.01	0.13 ± 0.01	Pass
SO-3039, 3040	6/8/2010	U-238	0.12 ± 0.01	0.13 ± 0.01	0.13 ± 0.01	Pass
WW-3060, 3061	6/14/2010	H-3	199.16 ± 95.13	203.59 ± 95.34	201.38 ± 67.34	Pass
VE-3351, 3352	6/21/2010	Be-7	1.86 ± 0.25	1.85 ± 0.27	1.85 ± 0.18	Pass
VE-3351, 3352	6/21/2010	K-40	6.10 ± 0.52	6.10 ± 0.57	6.10 ± 0.39	Pass
W-3469, 3470	6/25/2010	H-3	573.00 ± 110.00	525.00 ± 108.00	549.00 ± 77.08	Pass
SG-3539, 3540	6/29/2010	Ac-228	14.55 ± 0.51	14.57 ± 0.44	14.56 ± 0.34	Pass
SG-3539, 3540	6/29/2010	Pb-214	15.50 ± 1.56	16.80 ± 1.71	16.15 ± 1.16	Pass
AP-3743, 3744	6/30/2010	Be-7	0.07 ± 0.01	0.07 ± 0.01	0.07 ± 0.01	Pass

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

Lab Code	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			First Result	Second Result	Averaged Result	
G-3427, 3428	7/1/2010	Be-7	1.18 ± 0.29	1.06 ± 0.25	1.12 ± 0.19	Pass
G-3427, 3428	7/1/2010	K-40	8.79 ± 0.64	7.85 ± 0.65	8.32 ± 0.46	Pass
SW-3512, 3513	7/6/2010	H-3	441.00 ± 103.00	423.00 ± 102.00	432.00 ± 72.48	Pass
AP-3680, 3681	7/8/2010	Be-7	0.16 ± 0.08	0.13 ± 0.07	0.15 ± 0.05	Pass
VE-3791, 3792	7/12/2010	K-40	4.37 ± 0.38	4.23 ± 0.35	4.30 ± 0.26	Pass
WW-3934, 3935	7/12/2010	H-3	3091.00 ± 187.00	3242.00 ± 191.00	3166.50 ± 133.65	Pass
DW-10135, 10136	7/13/2010	Ra-226	0.18 ± 0.07	0.26 ± 0.07	0.22 ± 0.05	Pass
DW-10135, 10136	7/13/2010	Ra-228	0.76 ± 0.44	0.81 ± 0.41	0.79 ± 0.30	Pass
W-4063, 4064	7/14/2010	H-3	469.00 ± 104.00	351.00 ± 99.00	410.00 ± 71.79	Pass
DW-10143, 10144	7/19/2010	Gr. Alpha	2.84 ± 0.74	2.49 ± 0.73	2.67 ± 0.52	Pass
DW-10148, 10149	7/23/2010	Ra-226	2.08 ± 0.39	2.97 ± 0.55	2.53 ± 0.34	Pass
DW-10148, 10149	7/23/2010	Ra-228	1.90 ± 0.61	2.00 ± 0.61	1.95 ± 0.43	Pass
DW-10159, 10160	7/23/2010	Ra-226	0.91 ± 0.14	0.79 ± 0.21	0.85 ± 0.13	Pass
DW-10159, 10160	7/23/2010	Ra-228	1.41 ± 0.54	1.30 ± 0.53	1.36 ± 0.38	Pass
SL-4106, 4107	8/2/2010	Be-7	2.05 ± 0.20	2.05 ± 0.18	2.05 ± 0.13	Pass
SL-4106, 4107	8/2/2010	Gr. Beta	5.06 ± 0.32	4.62 ± 0.30	4.84 ± 0.22	Pass
SL-4106, 4107	8/2/2010	K-40	1.89 ± 0.24	1.70 ± 0.17	1.80 ± 0.15	Pass
SG-4085, 4086	8/3/2010	Ra-226	20.23 ± 2.04	21.45 ± 2.16	20.84 ± 1.49	Pass
SG-4085, 4086	8/3/2010	Ra-228	15.88 ± 0.41	16.24 ± 0.36	16.06 ± 0.27	Pass
SWT-4304, 4305	8/3/2010	Gr. Beta	2.08 ± 1.07	2.44 ± 0.98	2.26 ± 0.73	Pass
BS-4398, 4399	8/10/2010	Cs-137	78.80 ± 33.50	94.30 ± 51.90	86.55 ± 30.89	Pass
BS-4398, 4399	8/10/2010	K-40	13708 ± 795	12091 ± 1110	12900 ± 683	Pass
VE-4531, 4532	8/11/2010	Gr. Beta	36.20 ± 0.90	35.80 ± 0.90	36.00 ± 0.64	Pass
VE-4531, 4532	8/11/2010	K-40	27.31 ± 0.70	27.58 ± 0.62	27.45 ± 0.47	Pass
VE-4531, 4532	8/11/2010	U-233/4	0.014 ± 0.003	0.014 ± 0.003	0.014 ± 0.002	Pass
VE-4531, 4532	8/11/2010	U-238	0.012 ± 0.003	0.010 ± 0.002	0.011 ± 0.002	Pass
DW-10170, 10171	8/13/2010	Ra-226	1.32 ± 0.14	1.26 ± 0.14	1.29 ± 0.10	Pass
DW-10170, 10171	8/13/2010	Ra-228	2.55 ± 0.78	1.76 ± 0.71	2.16 ± 0.53	Pass
AP-4766, 4767	8/26/2010	Be-7	0.18 ± 0.09	0.25 ± 0.13	0.22 ± 0.08	Pass
DW-10182, 10183	8/27/2010	Ra-226	0.15 ± 0.08	0.11 ± 0.07	0.13 ± 0.05	Pass
VE-4928, 4929	9/1/2010	K-40	2.99 ± 0.41	3.18 ± 0.28	3.09 ± 0.25	Pass
SL-4883, 4884	9/1/2010	Gr. Beta	6.90 ± 0.20	7.10 ± 0.20	7.00 ± 0.14	Pass
SL-4883, 4884 <sup>b</sup>	9/1/2010	K-40	7.15 ± 0.99	5.07 ± 0.51	6.11 ± 0.56	Fail
W-5135, 5136	9/6/2010	H-3	658.60 ± 110.80	600.90 ± 108.50	629.75 ± 77.54	Pass
SW-5071, 5072	9/13/2010	H-3	186.70 ± 101.10	267.30 ± 104.40	227.00 ± 72.66	Pass
XWW-5246, 5247	9/14/2010	H-3	1990.60 ± 157.70	1986.20 ± 157.60	1988.40 ± 111.48	Pass



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

Lab Code	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			First Result	Second Result	Averaged Result	
VE-5114, 5115	9/9/2010	Be-7	1.14 ± 0.35	1.48 ± 0.26	1.31 ± 0.22	Pass
VE-5114, 5115	9/9/2010	Gr. Beta	34.72 ± 1.29	33.38 ± 1.23	34.05 ± 0.89	Pass
VE-5114, 5115	9/9/2010	H-3	79367 ± 837	79421 ± 837	79394 ± 592	Pass
VE-5114, 5115	9/9/2010	K-40	22.13 ± 0.67	21.93 ± 0.58	22.03 ± 0.44	Pass
VE-5114, 5115	9/9/2010	U-233/4	0.08 ± 0.01	0.06 ± 0.01	0.07 ± 0.01	Pass
MI-5267, 5268	9/20/2010	K-40	1281.10 ± 118.90	1218.60 ± 110.80	1249.85 ± 81.26	Pass
SO-5357, 5358	9/23/2010	K-40	10894.00 ± 560.00	11175.00 ± 760.00	11034.50 ± 472.02	Pass
AP-5357, 5358	9/23/2010	Be-7	0.11 ± 0.02	0.09 ± 0.02	0.10 ± 0.01	Pass
DW-10194, 10195	9/23/2010	Ra-226	0.40 ± 0.10	0.20 ± 0.10	0.30 ± 0.07	Pass
DW-10194, 10195	9/23/2010	Ra-228	1.61 ± 0.65	0.88 ± 0.47	1.25 ± 0.40	Pass
WW-5442, 5443	9/29/2010	H-3	6706.00 ± 252.00	6510.00 ± 249.00	6608.00 ± 177.13	Pass
VE-5469, 5470	9/29/2010	K-40	2.86 ± 0.38	2.57 ± 0.37	2.72 ± 0.26	Pass
BS-5886, 5887	9/29/2010	Cs-137	83.36 ± 23.31	58.97 ± 21.16	71.17 ± 15.74	Pass
BS-5886, 5887	9/29/2010	K-40	13913.00 ± 775.40	13582.00 ± 710.30	13747.50 ± 525.78	Pass
G-5513, 5514	10/4/2010	Be-7	6.73 ± 0.40	6.36 ± 0.41	6.55 ± 0.29	Pass
E-5492, 5493	10/4/2010	Gr. Beta	1.74 ± 0.05	1.77 ± 0.05	1.76 ± 0.04	Pass
E-5492, 5493	10/4/2010	K-40	1.57 ± 0.17	1.55 ± 0.18	1.56 ± 0.12	Pass
G-5512, 5513	10/4/2010	Gr. Beta	10.86 ± 0.44	10.39 ± 0.39	10.63 ± 0.29	Pass
G-5512, 5513	10/4/2010	K-40	7.10 ± 0.54	7.41 ± 0.59	7.26 ± 0.40	Pass
MI-5541, 5542	10/4/2010	K-40	1090.60 ± 106.70	1246.10 ± 102.60	1168.35 ± 74.01	Pass
MI-5541, 5542	10/4/2010	Sr-90	1.44 ± 0.38	1.11 ± 0.35	1.27 ± 0.26	Pass
F-6061, 6062	10/9/2010	H-3	7.64 ± 0.23	7.49 ± 0.23	7.57 ± 0.16	Pass
F-6061, 6062	10/9/2010	K-40	2.81 ± 0.40	2.56 ± 0.50	2.68 ± 0.32	Pass
VE-5740, 5741	10/10/2010	K-40	4.92 ± 0.53	4.61 ± 0.34	4.77 ± 0.32	Pass
VE-5761, 5762	10/12/2010	Be-7	1.05 ± 0.29	0.69 ± 0.15	0.87 ± 0.16	Pass
VE-5761, 5762	10/12/2010	K-40	3.45 ± 0.45	3.34 ± 0.29	3.40 ± 0.27	Pass
AP-5910, 5911	10/14/2010	Be-7	0.23 ± 0.09	0.30 ± 0.12	0.26 ± 0.08	Pass
WW-6294, 6295	10/18/2010	H-3	1681.49 ± 146.32	1637.41 ± 144.98	1659.45 ± 102.99	Pass
P-6038, 6039	10/19/2010	H-3	2131.90 ± 159.50	2212.00 ± 161.70	2171.95 ± 113.56	Pass
AP-6195, 6196	10/21/2010	Be-7	0.27 ± 0.11	0.26 ± 0.13	0.26 ± 0.09	Pass
WW-6366, 6367	10/23/2010	H-3	477.28 ± 102.02	529.99 ± 104.27	503.64 ± 72.94	Pass
SWU-6315, 6316	10/26/2010	Gr. Beta	1.85 ± 1.00	1.40 ± 0.90	1.62 ± 0.67	Pass
SO-6336, 6337	10/28/2010	Cs-137	0.23 ± 0.03	0.23 ± 0.04	0.23 ± 0.02	Pass
SO-6336, 6337	10/28/2010	Gr. Beta	26.36 ± 1.67	24.78 ± 1.52	25.57 ± 1.13	Pass
SO-6336, 6337	10/28/2010	K-40	13.43 ± 0.76	13.73 ± 0.81	13.58 ± 0.56	Pass
AP-6453, 6454	10/28/2010	Be-7	0.23 ± 0.12	0.30 ± 0.15	0.26 ± 0.10	Pass
BS-6475, 6476	11/1/2010	Gr. Beta	13.13 ± 1.83	12.75 ± 1.67	12.94 ± 1.24	Pass
F-6658, 6659	11/3/2010	K-40	2.79 ± 0.40	2.94 ± 0.44	2.86 ± 0.30	Pass
F-6565, 6566	11/4/2010	Cs-137	0.06 ± 0.02	0.04 ± 0.01	0.05 ± 0.01	Pass
F-6565, 6566	11/4/2010	Gr. Beta	3.90 ± 0.10	4.10 ± 0.10	3.96 ± 0.06	Pass
F-6565, 6566	11/4/2010	K-40	2.63 ± 0.45	2.57 ± 0.35	2.60 ± 0.29	Pass
SS-5761, 5762	11/16/2010	K-40	15.42 ± 1.57	15.87 ± 1.21	15.65 ± 0.99	Pass
WW-7056, 7057	11/30/2010	Gr. Beta	2.09 ± 0.84	2.22 ± 0.80	2.16 ± 0.58	Pass

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

Lab Code	Date	Analysis	Concentration (pCi/L) <sup>a</sup>			Acceptance
			First Result	Second Result	Averaged Result	
SO-7166, 7167	11/30/2010	Cs-137	0.12 ± 0.04	0.11 ± 0.03	0.11 ± 0.03	Pass
SO-7166, 7167	11/30/2010	K-40	14.93 ± 0.88	14.49 ± 0.86	14.71 ± 0.61	Pass
WW-7412, 7413	12/6/2010	H-3	469.78 ± 146.32	503.57 ± 93.96	486.68 ± 86.94	Pass
MI-7187, 7188	12/8/2010	K-40	1495.10 ± 129.00	1398.40 ± 109.10	1446.75 ± 84.47	Pass
MI-7187, 7188	12/8/2010	Sr-90	0.57 ± 0.31	0.66 ± 0.28	0.62 ± 0.21	Pass
WW-7255, 7256	12/8/2010	H-3	243.46 ± 90.39	327.34 ± 94.11	285.40 ± 65.24	Pass
AP-7276, 7277	12/9/2010	Be-7	0.13 ± 0.07	0.18 ± 0.10	0.16 ± 0.06	Pass
XWW-7297, 7298	12/9/2010	H-3	686.00 ± 102.00	764.60 ± 105.00	725.30 ± 73.19	Pass
AP-7344, 7345	12/16/2010	Be-7	0.16 ± 0.09	0.17 ± 0.09	0.16 ± 0.06	Pass
SWT-7480, 7481	12/28/2010	Gr. Beta	0.90 ± 0.40	1.03 ± 0.41	0.97 ± 0.29	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.

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

<sup>b</sup> Analysis was repeated, result of reanalysis: 4.83 ± 0.29 pCi/L.

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)<sup>a</sup>.

Lab Code <sup>c</sup>	Date	Analysis	Laboratory result	Concentration <sup>b</sup>		Acceptance
				Known Activity	Control Limits <sup>d</sup>	
STVE-1199	03/01/10	Co-57	0.01 ± 0.03	0.00	-	Pass
STVE-1199	03/01/10	Co-60	3.39 ± 0.12	3.27	2.29 - 4.25	Pass
STVE-1199	03/01/10	Cs-134	4.74 ± 0.15	4.39	3.07 - 5.71	Pass
STVE-1199	03/01/10	Cs-137	3.32 ± 0.17	3.06	2.14 - 3.98	Pass
STVE-1199	03/01/10	Mn-54	0.01 ± 0.05	0.00	-	Pass
STVE-1199	03/01/10	Zn-65	8.03 ± 0.33	7.10	4.97 - 9.23	Pass
STW-1200	03/01/10	Gr. Alpha	0.40 ± 0.05	0.68	0.00 - 1.35	Pass
STW-1200	03/01/10	Gr. Beta	3.03 ± 0.07	3.09	1.55 - 4.64	Pass
STW-1201	03/01/10	Am-241	1.05 ± 0.08	1.30	0.91 - 1.69	Pass
STW-1201	03/01/10	Co-57	28.90 ± 0.40	28.30	19.80 - 36.80	Pass
STW-1201	03/01/10	Co-60	0.06 ± 0.05	0.00	-	Pass
STW-1201	03/01/10	Cs-134	-0.03 ± 0.09	0.00	-	Pass
STW-1201	03/01/10	Cs-137	60.60 ± 0.60	60.60	42.40 - 78.80	Pass
STW-1201	03/01/10	Fe-55	3.00 ± 14.40	0.00	-	Pass
STW-1201	03/01/10	H-3	93.20 ± 18.30	90.80	63.60 - 118.00	Pass
STW-1201	03/01/10	Mn-54	27.80 ± 0.40	26.90	18.80 - 35.00	Pass
STW-1201	03/01/10	Ni-63	49.10 ± 3.50	59.90	41.90 - 77.90	Pass
STW-1201	03/01/10	Sr-90	-0.10 ± 0.60	0.00	-	Pass
STW-1201	03/01/10	Tc-99	0.50 ± 0.50	0.00	-	Pass
STW-1201	03/01/10	U-233/4	1.21 ± 0.05	1.22	0.85 - 1.59	Pass
STW-1201	03/01/10	U-238	1.20 ± 0.05	1.25	0.88 - 1.63	Pass
STW-1201	03/01/10	Zn-65	42.70 ± 0.80	40.70	28.50 - 52.90	Pass
STSO-1202	03/01/10	Co-57	520.00 ± 10.80	522.00	365.00 - 679.00	Pass
STSO-1202	03/01/10	Co-60	599.10 ± 2.80	622.00	435.00 - 809.00	Pass
STSO-1202	03/01/10	Cs-134	666.10 ± 4.70	733.00	513.00 - 953.00	Pass
STSO-1202	03/01/10	Cs-137	774.40 ± 4.50	779.00	545.00 - 1013.00	Pass
STSO-1202	03/01/10	K-40	562.00 ± 15.30	559.00	391.00 - 727.00	Pass
STSO-1202	03/01/10	Mn-54	866.20 ± 4.60	849.00	594.00 - 1104.00	Pass
STSO-1202	03/01/10	Sr-90	225.50 ± 11.80	288.00	202.00 - 374.00	Pass
STSO-1202	03/01/10	U-233/4	59.90 ± 2.50	60.00	42.00 - 78.00	Pass
STSO-1202	03/01/10	U-238	62.10 ± 2.60	64.00	45.00 - 83.00	Pass
STSO-1202	03/01/10	Zn-65	-1.23 ± 1.96	0.00	-	Pass
STAP-1203	03/01/10	Am-241	0.10 ± 0.01	0.15	0.10 - 0.19	Pass
STAP-1203	03/01/10	Co-57	0.01 ± 0.02	0.00	-	Pass
STAP-1203	03/01/10	Co-60	2.63 ± 0.19	2.47	1.73 - 3.22	Pass
STAP-1203	03/01/10	Cs-134	2.21 ± 0.34	2.13	1.49 - 2.77	Pass
STAP-1203	03/01/10	Cs-137	1.66 ± 0.22	1.53	1.07 - 1.99	Pass
STAP-1203	03/01/10	Mn-54	3.42 ± 0.26	3.02	2.11 - 3.93	Pass
STAP-1203	03/01/10	Sr-90	0.02 ± 0.06	0.00	-	Pass
STAP-1203	03/01/10	Zn-65	-0.05 ± 0.11	0.00	-	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)<sup>a</sup>.

Lab Code <sup>c</sup>	Date	Analysis	Laboratory result	Concentration <sup>b</sup>		Acceptance
				Known Activity	Control Limits <sup>d</sup>	
STAP-1204	03/01/10	Gr. Alpha	0.13 ± 0.03	0.43	0.00 - 0.85	Pass
STAP-1204	03/01/10	Gr. Beta	1.46 ± 0.07	1.29	0.65 - 1.94	Pass
STW-1211	08/01/10	Am-241	0.02 ± 0.02	0.00	-	Pass
STW-1211	08/01/10	Co-57	36.40 ± 4.80	36.00	25.20 - 46.80	Pass
STW-1211	08/01/10	Co-60	28.30 ± 1.00	28.30	19.80 - 36.80	Pass
STW-1211	08/01/10	Cs-134	29.30 ± 2.10	31.40	22.00 - 40.80	Pass
STW-1211	08/01/10	Cs-137	44.60 ± 1.80	44.20	30.90 - 57.50	Pass
STW-1211	08/01/10	Fe-55	48.50 ± 20.10	60.20	42.10 - 78.30	Pass
STW-1211	08/01/10	H-3	503.60 ± 12.80	453.40	317.40 - 589.40	Pass
STW-1211	08/01/10	K-40	38.50 ± 2.50	38.90	27.20 - 50.60	Pass
STW-1211	08/01/10	Mn-54	0.10 ± 0.30	0.00	-	Pass
STW-1211	08/01/10	Ni-63	49.30 ± 3.10	56.10	39.30 - 72.90	Pass
STW-1211	08/01/10	Pu-238	1.49 ± 0.15	1.81	1.27 - 2.35	Pass
STW-1211	08/01/10	Pu-239/40	1.20 ± 0.10	1.35	0.95 - 1.76	Pass
STW-1211	08/01/10	Sr-90	9.20 ± 1.30	8.30	5.80 - 10.80	Pass
STW-1211	08/01/10	Tc-99	28.10 ± 0.90	33.60	23.50 - 43.70	Pass
STW-1211	08/01/10	U-233/4	2.04 ± 0.14	2.01	1.41 - 2.61	Pass
STW-1211	08/01/10	U-238	2.05 ± 0.14	2.07	1.45 - 2.69	Pass
STW-1211	08/01/10	Zn-65	32.80 ± 3.00	31.00	21.70 - 40.30	Pass
STW-1212	08/01/10	Gr. Alpha	1.54 ± 0.09	1.92	0.58 - 3.26	Pass
STW-1212	08/01/10	Gr. Beta	4.13 ± 0.15	4.39	2.20 - 6.59	Pass
STVE-1213	08/01/10	Co-57	9.60 ± 0.54	8.27	5.79 - 10.75	Pass
STVE-1213	08/01/10	Co-60	0.05 ± 0.08	0.00	-	Pass
STVE-1213	08/01/10	Cs-134	4.83 ± 0.26	4.79	3.35 - 6.23	Pass
STVE-1213	08/01/10	Cs-137	6.45 ± 0.66	5.88	4.12 - 7.64	Pass
STVE-1213	08/01/10	Mn-54	7.12 ± 0.66	6.29	4.40 - 8.17	Pass
STVE-1213	08/01/10	Zn-65	6.05 ± 0.74	5.39	3.77 - 7.01	Pass
STSO-1214	08/01/10	Co-57	0.10 ± 1.60	0.00	-	Pass
STSO-1214	08/01/10	Co-60	370.00 ± 6.00	343.00	240.00 - 446.00	Pass
STSO-1214	08/01/10	Cs-134	1005.00 ± 21.00	940.00	658.00 - 1222.00	Pass
STSO-1214	08/01/10	Cs-137	755.00 ± 15.00	670.00	469.00 - 871.00	Pass
STSO-1214	08/01/10	K-40	783.00 ± 54.00	699.00	489.00 - 909.00	Pass
STSO-1214	08/01/10	Mn-54	942.00 ± 15.00	820.00	574.00 - 1066.00	Pass
STSO-1214	08/01/10	Pu-238	69.20 ± 6.20	64.00	45.00 - 83.00	Pass
STSO-1214	08/01/10	Pu-239/40	76.50 ± 6.20	71.00	50.00 - 92.00	Pass
STSO-1214	08/01/10	Sr-90	3.50 ± 8.00	0.00	-	Pass
STSO-1214	08/01/10	U-233/4	76.50 ± 6.20	71.00	50.00 - 92.00	Pass
STSO-1214	08/01/10	U-238	271.40 ± 9.00	289.00	202.00 - 376.00	Pass
STSO-1214	08/01/10	Zn-65	310.00 ± 18.00	265.00	186.00 - 345.00	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)<sup>a</sup>.

Lab Code <sup>c</sup>	Date	Analysis	Laboratory result	Concentration <sup>b</sup>		Acceptance
				Known Activity	Control Limits <sup>d</sup>	
STAP-1215	08/01/10	Co-57	4.47 ± 0.21	4.08	2.86 - 5.30	Pass
STAP-1215	08/01/10	Co-60	3.15 ± 0.30	2.92	2.04 - 3.80	Pass
STAP-1215	08/01/10	Cs-134	3.03 ± 0.17	2.98	2.09 - 3.87	Pass
STAP-1215	08/01/10	Cs-137	0.01 ± 0.05	0.00	-	Pass
STAP-1215	08/01/10	Mn-54	3.69 ± 0.39	3.18	2.23 - 4.13	Pass
STAP-1215	08/01/10	Sr-90	1.00 ± 0.12	1.01	0.71 - 1.31	Pass
STAP-1215	08/01/10	Zn-65	0.03 ± 0.15	0.00	-	Pass
STAP-1216	08/01/10	Gr. Alpha	0.01 ± 0.01	0.00	-	Pass
STAP-1216	08/01/10	Gr. Beta	0.54 ± 0.05	0.50	0.25 - 0.75	Pass

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

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

<sup>c</sup> Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation).

<sup>d</sup> 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.

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)<sup>a</sup>.

Lab Code <sup>b</sup>	Date	Analysis	Concentration (pCi/L)			Acceptance
			Laboratory Result <sup>c</sup>	ERA Result <sup>d</sup>	Control Limits	
STAP-1217	09/20/10	Am-241	55.6 ± 2.9	74.1	43.3 - 102.0	Pass
STAP-1217	09/20/10	Co-60	517.1 ± 9.1	479.0	371.0 - 598.0	Pass
STAP-1217	09/20/10	Cs-134	384.6 ± 33.7	388.0	253.0 - 480.0	Pass
STAP-1217	09/20/10	Cs-137	589.4 ± 7.1	514.0	386.0 - 675.0	Pass
STAP-1217	09/20/10	Mn-54	0.0 ± 0.0	-	-	Pass
STAP-1217	09/20/10	Pu-238	76.5 ± 4.0	72.9	50.0 - 95.8	Pass
STAP-1217	09/20/10	Pu-239/40	73.0 ± 3.8	69.6	50.5 - 90.1	Pass
STAP-1217	09/20/10	Sr-90	172.9 ± 21.3	159.0	70.0 - 247.0	Pass
STAP-1217	09/20/10	U-233/234	64.9 ± 3.9	71.8	45.2 - 106.0	Pass
STAP-1217	09/20/10	U-238	68.0 ± 4.0	71.2	45.6 - 101.0	Pass
STAP-1217	09/20/10	Uranium	135.5 ± 8.7	146.0	74.6 - 232.0	Pass
STAP-1217	09/20/10	Zn-65	563.1 ± 15.3	465.0	322.0 - 644.0	Pass
STAP-1218	09/20/10	Gr. Alpha	66.1 ± 3.2	52.3	27.1 - 78.7	Pass
STAP-1218	09/20/10	Gr. Beta	69.9 ± 2.5	52.7	32.5 - 77.0	Pass
STSO-1219	09/20/10	Ac-228	1632.0 ± 80.4	1830.0	1170.0 - 2580.0	Pass
STSO-1219	09/20/10	Am-241	1063.0 ± 120.9	1120.0	669.0 - 1440.0	Pass
STSO-1219	09/20/10	Bi-212	1752.0 ± 255.6	2070.0	543.0 - 3100.0	Pass
STSO-1219	09/20/10	Bi-214	909.3 ± 38.9	983.0	603.0 - 1410.0	Pass
STSO-1219	09/20/10	Co-60	4852.0 ± 153.5	4780.0	3480.0 - 6420.0	Pass
STSO-1219	09/20/10	Cs-134	2190.0 ± 50.7	2240.0	1440.0 - 2700.0	Pass
STSO-1219	09/20/10	Cs-137	3584.0 ± 42.5	3530.0	2700.0 - 4580.0	Pass
STSO-1219	09/20/10	K-40	10017.0 ± 274.5	10700.0	7760.0 - 14500.0	Pass
STSO-1219	09/20/10	Mn-54	0.0 ± 0.0	-	-	Pass
STSO-1219	09/20/10	Pb-212	1573.0 ± 28.2	1640.0	1060.0 - 2310.0	Pass
STSO-1219	09/20/10	Pb-214	999.0 ± 39.2	969.0	580.0 - 1440.0	Pass
STSO-1219	09/20/10	Pu-238	1568.0 ± 155.0	1280.0	733.0 - 1800.0	Pass
STSO-1219	09/20/10	Pu-239/40	1445.0 ± 142.9	1180.0	805.0 - 1570.0	Pass
STSO-1219 <sup>e</sup>	09/20/10	U-233/234	599.4 ± 69.4	1360.0	862.0 - 1690.0	Fail
STSO-1219 <sup>e</sup>	09/20/10	U-238	633.8 ± 71.3	1340.0	819.0 - 1700.0	Fail
STSO-1219 <sup>e</sup>	09/20/10	Uranium	1248.0 ± 152.7	2770.0	1580.0 - 3740.0	Fail
STSO-1219	09/20/10	Zn-65	2447.0 ± 60.1	2300.0	1820.0 - 3080.0	Pass
STVE-1220	09/20/10	Co-60	1108.0 ± 38.7	1010.0	683.0 - 1450.0	Pass
STVE-1220	09/20/10	Cs-134	1161.0 ± 57.3	1040.0	595.0 - 1440.0	Pass
STVE-1220	09/20/10	Cs-137	1400.0 ± 43.0	1260.0	924.0 - 1750.0	Pass
STVE-1220	09/20/10	K-40	27400.0 ± 683.4	22600.0	16200.0 - 32000.0	Pass
STVE-1220	09/20/10	Mn-54	0.0 ± 0.0	-	-	Pass

TABLE A-7. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)<sup>a</sup>.

Lab Code <sup>b</sup>	Date	Analysis	Concentration (pCi/L)		Control Limits	Acceptance
			Laboratory Result <sup>c</sup>	ERA Result <sup>d</sup>		
STVE-1220	09/20/10	Am-241	4185.0 ± 180.0	4760.0	2710.0 - 6540.0	Pass
STVE-1220	09/20/10	Cm-244	2329.0 ± 132.5	2740.0	1350.0 - 4270.0	Pass
STVE-1220	09/20/10	Pu-238	4912.0 ± 194.0	4740.0	2560.0 - 6940.0	Pass
STVE-1220	09/20/10	Pu-239/40	4765.0 ± 111.0	4470.0	2770.0 - 6100.0	Pass
STVE-1220	09/20/10	Sr-90	7706.0 ± 583.9	7810.0	4360.0 - 10400.0	Pass
STVE-1220	09/20/10	U-233/234	3862.0 ± 203.0	4010.0	2750.0 - 5320.0	Pass
STVE-1220	09/20/10	U-238	3926.0 ± 205.3	3980.0	2800.0 - 5030.0	Pass
STVE-1220	09/20/10	Uranium	7671.0 ± 201.2	8180.0	5620.0 - 10600.0	Pass
STVE-1220	09/20/10	Zn-65	1443.0 ± 81.0	1210.0	874.0 - 1650.0	Pass
STW-1221	09/20/10	Am-241	127.9 ± 4.2	176.0	120.0 - 238.0	Pass
STW-1221	09/20/10	Co-60	697.8 ± 10.4	714.0	622.0 - 844.0	Pass
STW-1221	09/20/10	Cs-134	437.5 ± 13.3	492.0	363.0 - 565.0	Pass
STW-1221	09/20/10	Cs-137	612.8 ± 11.6	625.0	531.0 - 749.0	Pass
STW-1221	09/20/10	Fe-55	936.8 ± 508.2	825.0	480.0 - 1100.0	Pass
STW-1221	09/20/10	Mn-54	0.0 ± 0.0	-	-	Pass
STW-1221	09/20/10	Pu-238	148.1 ± 6.0	162.0	122.0 - 201.0	Pass
STW-1221	09/20/10	Pu-239/40	154.1 ± 6.2	148.0	114.0 - 183.0	Pass
STW-1221	09/20/10	Sr-90	872.3 ± 13.4	921.0	585.0 - 1230.0	Pass
STW-1221	09/20/10	U-233/234	99.1 ± 4.4	109.0	82.2 - 140.0	Pass
STW-1221	09/20/10	U-238	103.7 ± 4.5	108.0	82.5 - 134.0	Pass
STW-1221	09/20/10	Uranium	206.5 ± 9.8	221.0	159.0 - 294.0	Pass
STW-1221	09/20/10	Zn-65	489.1 ± 16.2	489.0	414.0 - 610.0	Pass
STW-1222	09/20/10	Gr. Alpha	110.6 ± 3.5	146.0	64.8 - 216.0	Pass
STW-1222	09/20/10	Gr. Beta	134.6 ± 2.6	143.0	83.6 - 210.0	Pass
STW-1223	09/20/10	H-3	23500.0 ± 1438.0	21600.0	14100.0 - 31900.0	Pass

<sup>a</sup> 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).

<sup>b</sup> Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation).

<sup>c</sup> Unless otherwise indicated, the laboratory result is given as the mean ± standard deviation for three determinations.

<sup>d</sup> 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.

<sup>e</sup> Analysis was repeated using total dissolution. Results of the reanalysis,

U-233/234: 1137 ± 254 pCi/kg, U-238: 1193 ± 116 pCi/kg, Total Uranium: 2379 ± 254 pCi/kg.

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;  
 $s = 2\sigma$  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  $4.66\sigma$  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  $x_1, x_2, \dots, x_n$  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<sup>a</sup>.

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

<sup>a</sup> 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.

<sup>b</sup> Value adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-milk-child pathway.

<sup>c</sup> A natural radionuclide.

APPENDIX D

SUMMARY OF THE LAND USE CENSUS

## Appendix D

### Summary of the Land Use Census

The Duane Arnold Energy Land Use Census for 2010 was completed during September of 2010. 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 July 21<sup>st</sup>, 2010 for water use downstream of the DAEC to Cedar Rapids. This survey identified no new usages of river water from previous surveys. Irrigation at the strawberry farm in Palo has been discontinued. 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 75 vegetable gardens identified during the performance of the 2010 Census. This number is less than the number of gardens found in the 2009 survey by two. In the sector towards the Southwest, the distance to the nearest vegetation receptor changed from 4370 meters to 4380 meters. There were no other changes to the locations of the nearest vegetable receptors.

There were no changes in the observed milk animal or cattle locations within the 3 mile radius of the plant in the past year.

The locations of the nearest residence for each sector remained the same as 2009. In 2010, only three new homes were constructed within three miles of the DAEC.

Since the last performance of the land use census, a new drinking water well has been identified within a two mile radius of the site. The well is located 3,200 meters towards the West-North-West. The well is (hydrologically) up-gradient of the site. There were no other new land use or water use activities that could affect the Site Hydrogeological Conceptual Model.

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:

- Per Objectives 2.2 and 2.4, there were no on-site leaks or spills that warranted notification of state or local officials or other local stakeholders.
- No radioactive reactor by-product material was identified in samples taken by the DAEC's Radiological Environmental Monitoring Program (REMP) 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 2010 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**

- 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 ODA. 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".
- 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 0.0000229 mrem.
2. The whole body dose equivalent to the hypothetical maximally exposed individual due to liquid effluents was 0.0000229 mrem.
3. The maximum dose to air at the site boundary from noble gases released was 0.000541 mrad from gamma radiation at 1,257 meters towards the North-North-West.
4. The maximum dose to air at the site boundary from noble gases released was 0.000647 mrad beta radiation at 1,257 meters towards the North-North-West.
5. The whole body dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.000320 mrem, at 805 meters towards the West.
6. The skin dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.000650 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 was the thyroid of a child at 805 meters to the West, with an estimated dose equivalent of 0.00636 mrem.



**Carbon14**

The estimate of gaseous carbon-14 (C-14) released from the Duane Arnold Energy Center was derived using guidance from the EPRI document, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents", Report 1021106, issued December 2010. The total amount of C-14 released in 2010 was estimated to be 8.17 Curies.

Using the dose calculation methodology from Regulatory Guide 1.109, the resultant maximally exposed receptor organ from C-14 is the bone of a child, located 1.5 miles to the West-South-West of the site. The dose is 9.8E-02 mrem. (0.098 mrem).

**Conclusion:**

No measurable dose due to the operation of the DAEC was detected by environmental TLDs in 2009. The calculated doses are below the regulatory limits stated in Appendix I to 10 CFR 50 and in 40 CFR 190.

**Estimated Maximum Offsite Individual Doses for 2010**

Type	Age Group	Distance (meters)	Direction	Dose or Dose Equivalent (mrem)	Annual 10 CFR 50, Appendix I "Limit"
<b>Direct Radiation</b> (as measured by TLDs)				None	*
<b>Liquid Releases</b>					
Whole Body Dose	Child		S	0.00000229 mrem	3 mrem
Organ Dose	Child - Liver		S	0.00000229 mrem	10 mrem
<b>Noble Gas</b>					
Gamma Air Dose		1,257	NNW	0.000541 mrad	10 mrad
Beta Air Dose		1,257	NNW	0.000647 mrad	20 mrad
Whole Body	All	805	W	0.000320 mrem	5 mrem
Skin	Child	1,620	NNW	0.000650 mrem	15 mrem
<b>Particulates &amp; Iodines</b>					
Organ Dose	Child - Thyroid	805	W	0.00636 mrem	15 mrem
<b>Carbon 14</b>					
Organ Dose	Child - Bone	2,470	WSW	0.098 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.



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

RADIOLOGICAL ENVIRONMENTAL  
MONITORING PROGRAM (REMP)

ANNUAL REPORT - PART II  
DATA TABULATIONS AND ANALYSES

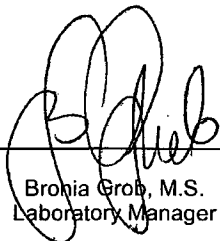
January 1 to December 31, 2010

Prepared by

ATI ENVIRONMENTAL, Inc.  
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Project No. 8001

Reviewed and  
Approved



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## 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 2010. 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 Gamma	D-15	02-04-10	No particulates found deposited on filter.
P	Gamma	D-16	2-25-10	Required limits of detection not met due to insufficient sample volume.
AP/AI	Gross Beta Gamma	D-7	05-13-10	Partial sample, 77 m3, due to faulty line cord.
MI	I-131, Gamma	D-108	06-15-10	Sample damaged and lost in transit.
MI	I-131, Gamma	D-110	06-15-10	Sample damaged and lost in transit.
AP/AI	Gross Beta Gamma	D-6	08-05-10 to 09-02-10	No sample due to construction
AP/AI	Gross Beta Gamma	D-7	08-12-10	Partial sample, 85 m3, due to faulty line cord.
AP/AI	Gross Beta Gamma	D-15	09-30-10	Partial sample, 205 m3, due to power outage.
SW	H-3 Gamma	D-50	12-08-10	No sample; water frozen.
SW	H-3 Gamma	D-99	12-08-10.	No sample; water frozen.
VE	Gamma	D-94	2010	Location dropped from program.

### 3.0 DATA TABLES

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Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-3 (Hiawatha)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	343	0.045 ± 0.004	07-08-10	275	0.020 ± 0.003
01-14-10	299	0.042 ± 0.004	07-15-10	274	0.031 ± 0.004
01-21-10	300	0.033 ± 0.004	07-22-10	275	0.028 ± 0.004
01-28-10	302	0.025 ± 0.003	07-29-10	274	0.021 ± 0.003
02-04-10	297	0.030 ± 0.004	08-05-10	265	0.032 ± 0.004
02-11-10	300	0.028 ± 0.003	08-12-10	275	0.027 ± 0.004
02-18-10	301	0.024 ± 0.003	08-19-10	273	0.032 ± 0.004
02-25-10	299	0.036 ± 0.004	08-26-10	274	0.041 ± 0.004
03-04-10	297	0.031 ± 0.004	09-02-10	268	0.023 ± 0.004
03-11-10	291	0.027 ± 0.003	09-09-10	266	0.024 ± 0.003
03-18-10	290	0.020 ± 0.003	09-16-10	284	0.020 ± 0.003
03-25-10	292	0.023 ± 0.004	09-23-10	287	0.029 ± 0.004
04-01-10	291	0.028 ± 0.003	09-30-10	284	0.023 ± 0.003
1st Quarter Mean ± s.d.		<u>0.030 ± 0.007</u>	3rd Quarter Mean ± s.d.		<u>0.027 ± 0.006</u>
04-08-10	288	0.023 ± 0.003	10-08-10	330	0.022 ± 0.003
04-15-10	288	0.029 ± 0.004	10-14-10	241	0.049 ± 0.005
04-22-10	290	0.025 ± 0.003	10-21-10	284	0.032 ± 0.004
04-28-10	249	0.025 ± 0.004	10-28-10	284	0.031 ± 0.004
05-06-10	334	0.018 ± 0.003	11-04-10	286	0.022 ± 0.003
05-13-10	290	0.011 ± 0.003	11-11-10	286	0.029 ± 0.004
05-20-10	290	0.017 ± 0.003	11-18-10	287	0.050 ± 0.004
05-27-10	291	0.016 ± 0.003	11-24-10	244	0.031 ± 0.004
06-03-10	278	0.027 ± 0.003	12-02-10	324	0.039 ± 0.004
06-10-10	271	0.020 ± 0.003	12-09-10	264	0.046 ± 0.004
06-16-10	235	0.018 ± 0.003	12-15-10	196	0.070 ± 0.006
06-24-10	312	0.017 ± 0.003	12-22-10	263	0.053 ± 0.005
07-01-10	273	0.020 ± 0.003	12-29-10	260	0.024 ± 0.004
2nd Quarter Mean ± s.d.		<u>0.021 ± 0.005</u>	4th Quarter Mean ± s.d.		<u>0.038 ± 0.014</u>
			Cumulative Average		0.029
			Previous Annual Average		0.029

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.



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Table 2. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-5 (Palo)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	317	0.050 ± 0.004	07-08-10	292	0.048 ± 0.004
01-14-10	263	0.051 ± 0.005	07-15-10	291	0.024 ± 0.003
01-21-10	286	0.036 ± 0.004	07-22-10	292	0.028 ± 0.003
01-28-10	289	0.026 ± 0.003	07-29-10	290	0.019 ± 0.003
02-04-10	282	0.031 ± 0.004	08-05-10	290	0.030 ± 0.004
02-11-10	286	0.033 ± 0.004	08-12-10	292	0.028 ± 0.004
02-18-10	290	0.022 ± 0.003	08-19-10	290	0.031 ± 0.004
02-25-10	269	0.045 ± 0.004	08-26-10	291	0.039 ± 0.004
			09-02-10	291	0.029 ± 0.004
03-04-10	281	0.033 ± 0.004	09-09-10	292	0.026 ± 0.003
03-11-10	285	0.031 ± 0.004	09-16-10	291	0.029 ± 0.004
03-18-10	286	0.018 ± 0.003	09-23-10	293	0.026 ± 0.003
03-25-10	288	0.017 ± 0.003	09-30-10	290	0.026 ± 0.004
04-01-10	265	0.032 ± 0.004			
1st Quarter Mean ± s.d.		0.033 ± 0.011	3rd Quarter Mean ± s.d.		0.029 ± 0.007
04-08-10	263	0.030 ± 0.004	10-08-10	337	0.022 ± 0.003
04-15-10	266	0.028 ± 0.004	10-14-10	245	0.048 ± 0.005
04-22-10	264	0.025 ± 0.004	10-21-10	291	0.033 ± 0.004
04-28-10	228	0.021 ± 0.004	10-28-10	290	0.026 ± 0.003
05-06-10	304	0.018 ± 0.003	11-04-10	292	0.023 ± 0.003
05-13-10	265	0.013 ± 0.003	11-11-10	292	0.027 ± 0.004
05-20-10	266	0.019 ± 0.003	11-18-10	293	0.039 ± 0.004
05-27-10	285	0.016 ± 0.003	11-24-10	249	0.033 ± 0.004
06-03-10	268	0.028 ± 0.004	12-02-10	322	0.043 ± 0.004
06-10-10	263	0.026 ± 0.004	12-09-10	279	0.039 ± 0.004
06-16-10	229	0.016 ± 0.003	12-15-10	242	0.049 ± 0.005
06-24-10	331	0.017 ± 0.003	12-22-10	283	0.052 ± 0.004
07-01-10	290	0.018 ± 0.003	12-29-10	276	0.021 ± 0.003
2nd Quarter Mean ± s.d.		0.021 ± 0.006	4th Quarter Mean ± s.d.		0.035 ± 0.011
Cumulative Average					0.030
Previous Annual Average					0.031

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

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

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	326	0.047 ± 0.004	07-08-10	311	0.033 ± 0.004
01-14-10	286	0.054 ± 0.005	07-15-10	277	0.033 ± 0.004
01-21-10	284	0.042 ± 0.004	07-22-10	223	0.036 ± 0.004
01-28-10	288	0.028 ± 0.003	07-29-10	272	0.020 ± 0.003
02-04-10	283	0.046 ± 0.004	08-05-10		ND <sup>c</sup>
02-11-10	285	0.034 ± 0.004	08-12-10		ND <sup>c</sup>
02-18-10	294	0.026 ± 0.003	08-19-10		ND <sup>c</sup>
02-25-10	294	0.039 ± 0.004	08-26-10		ND <sup>c</sup>
03-04-10	292	0.028 ± 0.003	09-02-10		ND <sup>c</sup>
03-11-10	294	0.024 ± 0.003	09-09-10	287	0.023 ± 0.003
03-18-10	293	0.017 ± 0.003	09-16-10	285	0.025 ± 0.003
03-25-10	294	0.021 ± 0.003	09-23-10	287	0.025 ± 0.003
04-01-10	294	0.028 ± 0.003	09-30-10	284	0.026 ± 0.004
1st Quarter Mean ± s.d.		0.033 ± 0.011	3rd Quarter Mean ± s.d.		0.028 ± 0.006
04-08-10	294	0.020 ± 0.003	10-08-10	330	0.025 ± 0.003
04-15-10	209 <sup>b</sup>	0.039 ± 0.005	10-14-10	240	0.054 ± 0.005
04-22-10	207 <sup>b</sup>	0.026 ± 0.004	10-21-10	286	0.029 ± 0.004
04-28-10	179 <sup>b</sup>	0.027 ± 0.005	10-28-10	285	0.026 ± 0.003
05-06-10	239 <sup>b</sup>	0.020 ± 0.004	11-04-10	287	0.021 ± 0.003
05-13-10	207 <sup>b</sup>	0.012 ± 0.004	11-11-10	286	0.028 ± 0.004
05-20-10	285	0.021 ± 0.003	11-18-10	286	0.034 ± 0.004
05-27-10	285	0.017 ± 0.003	11-24-10	253	0.032 ± 0.004
06-03-10	290	0.029 ± 0.003	12-02-10	336	0.043 ± 0.004
06-10-10	282	0.022 ± 0.003	12-09-10	292	0.046 ± 0.004
06-16-10	246	0.024 ± 0.004	12-15-10	254	0.055 ± 0.005
06-24-10	324	0.018 ± 0.003	12-22-10	296	0.053 ± 0.004
07-01-10	284	0.018 ± 0.003	12-29-10	290	0.020 ± 0.003
2nd Quarter Mean ± s.d.		0.023 ± 0.007	4th Quarter Mean ± s.d.		0.036 ± 0.013
Cumulative Average					0.030
Previous Annual Average					0.030

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> Recalculated with revised flowrate at client request.

<sup>c</sup> ND = No data; see Table 2.0, Listing of Missed Samples.

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Table 4. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-7 (Shellsburg)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	327	0.040 ± 0.004	07-08-10	286	0.016 ± 0.003
01-14-10	254	0.051 ± 0.005	07-15-10	285	0.031 ± 0.004
01-21-10	286	0.039 ± 0.004	07-22-10	287	0.026 ± 0.003
01-28-10	289	0.013 ± 0.003	07-29-10	282	0.018 ± 0.003
02-04-10	285	0.010 ± 0.003	08-05-10	286	0.044 ± 0.004
02-11-10	280	0.034 ± 0.004	08-12-10	85 <sup>c</sup>	0.026 ± 0.008
02-18-10	282	0.029 ± 0.004	08-19-10	284	0.028 ± 0.004
02-25-10	279	0.043 ± 0.004	08-26-10	285	0.042 ± 0.004
			09-02-10	285	0.022 ± 0.003
03-04-10	276	0.035 ± 0.004	09-09-10	286	0.022 ± 0.003
03-11-10	278	0.029 ± 0.004	09-16-10	285	0.030 ± 0.004
03-18-10	276	0.018 ± 0.003	09-23-10	287	0.027 ± 0.003
03-25-10	274	0.019 ± 0.004	09-30-10	284	0.022 ± 0.003
04-01-10	261	0.035 ± 0.004			
1st Quarter Mean ± s.d.		<u>0.030 ± 0.012</u>	3rd Quarter Mean ± s.d.		<u>0.027 ± 0.008</u>
04-08-10	269	0.028 ± 0.003	10-08-10	330	0.024 ± 0.003
04-15-10	277	0.029 ± 0.004	10-14-10	240	0.046 ± 0.005
04-22-10	278	0.024 ± 0.003	10-21-10	286	0.030 ± 0.004
04-28-10	240	0.024 ± 0.004	10-28-10	285	0.026 ± 0.003
05-06-10	236	0.024 ± 0.004	11-04-10	287	0.024 ± 0.003
05-13-10	77 <sup>b</sup>	< 0.013	11-11-10	255	0.029 ± 0.004
05-20-10	284	0.017 ± 0.003	11-18-10	277	0.038 ± 0.004
05-27-10	286	0.018 ± 0.003	11-24-10	209	0.036 ± 0.005
06-03-10	290	0.024 ± 0.003	12-02-10	294	0.043 ± 0.004
06-10-10	282	0.018 ± 0.003	12-09-10	235	0.047 ± 0.005
06-16-10	246	0.018 ± 0.003	12-15-10	195	0.078 ± 0.007
06-24-10	325	0.016 ± 0.003	12-22-10	218	0.067 ± 0.006
07-01-10	285	0.022 ± 0.003	12-29-10	219	0.029 ± 0.004
2nd Quarter Mean ± s.d.		<u>0.022 ± 0.004</u>	4th Quarter Mean ± s.d.		<u>0.040 ± 0.017</u>
Cumulative Average					0.030
Previous Annual Average					0.028

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> Low volume due to loose electric plug. Iodine-131 result = 0.043 pCi/m<sup>3</sup>; LLD not reached due to low volume.

<sup>c</sup> Low volume due to loose electric plug. Iodine-131 result = 0.042 pCi/m<sup>3</sup>; LLD not reached due to low volume.

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Table 5. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-11 (Toddville)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	320	0.047 ± 0.004	07-08-10	286	0.016 ± 0.003
01-14-10	280	0.048 ± 0.004	07-15-10	285	0.027 ± 0.003
01-21-10	280	0.037 ± 0.004	07-22-10	287	0.025 ± 0.003
01-28-10	283	0.028 ± 0.003	07-29-10	282	0.021 ± 0.003
02-04-10	277	0.030 ± 0.004	08-05-10	288	0.044 ± 0.004
02-11-10	280	0.030 ± 0.004	08-12-10	286	0.025 ± 0.003
02-18-10	307	0.016 ± 0.003	08-19-10	284	0.023 ± 0.003
02-25-10	305	0.033 ± 0.004	08-26-10	285	0.033 ± 0.004
03-04-10	303	0.020 ± 0.003	09-02-10	285	0.019 ± 0.003
03-11-10	305	0.024 ± 0.003	09-09-10	287	0.023 ± 0.003
03-18-10	304	0.015 ± 0.003	09-16-10	285	0.022 ± 0.003
03-25-10	306	0.011 ± 0.003	09-23-10	287	0.025 ± 0.003
04-01-10	305	0.023 ± 0.003	09-30-10	284	0.021 ± 0.003
1st Quarter Mean ± s.d.		0.028 ± 0.011	3rd Quarter Mean ± s.d.		0.025 ± 0.007
04-08-10	306	0.015 ± 0.003	10-08-10	330	0.018 ± 0.003
04-15-10	306	0.026 ± 0.003	10-14-10	243	0.043 ± 0.005
04-22-10	303	0.020 ± 0.003	10-21-10	283	0.026 ± 0.004
04-28-10	262	0.012 ± 0.003	10-28-10	282	0.024 ± 0.003
05-06-10	350	0.003 ± 0.002	11-04-10	287	0.020 ± 0.003
05-13-10	284	0.014 ± 0.003	11-11-10	276	0.029 ± 0.004
05-20-10	286	0.018 ± 0.003	11-18-10	278	0.038 ± 0.004
05-27-10	285	0.019 ± 0.003	11-24-10	238	0.035 ± 0.004
06-03-10	290	0.023 ± 0.003	12-02-10	316	0.043 ± 0.004
06-10-10	282	0.020 ± 0.003	12-09-10	275	0.038 ± 0.004
06-16-10	246	0.017 ± 0.003	12-15-10	240	0.048 ± 0.005
06-24-10	324	0.016 ± 0.003	12-22-10	281	0.036 ± 0.004
07-01-10	285	0.020 ± 0.003	12-29-10	271	0.017 ± 0.003
2nd Quarter Mean ± s.d.		0.017 ± 0.006	4th Quarter Mean ± s.d.		0.032 ± 0.010
			Cumulative Average		0.025
			Previous Annual Average		0.031

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

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Table 6. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-13 (Alburnett)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	326	0.048 ± 0.004	07-08-10	292	0.015 ± 0.003
01-14-10	286	0.052 ± 0.004	07-15-10	291	0.026 ± 0.003
01-21-10	284	0.041 ± 0.004	07-22-10	293	0.028 ± 0.003
01-28-10	289	0.027 ± 0.003	07-29-10	291	0.020 ± 0.003
02-04-10	285	0.033 ± 0.004	08-05-10	290	0.029 ± 0.004
02-11-10	250	0.037 ± 0.004	08-12-10	292	0.024 ± 0.003
02-18-10	245	0.029 ± 0.004	08-19-10	290	0.030 ± 0.004
02-25-10	246	0.053 ± 0.005	08-26-10	291	0.032 ± 0.004
03-04-10	272	0.032 ± 0.004	09-02-10	291	0.020 ± 0.003
03-11-10	285	0.025 ± 0.003	09-09-10	292	0.021 ± 0.003
03-18-10	284	0.023 ± 0.003	09-16-10	282	0.027 ± 0.004
03-25-10	267	0.022 ± 0.004	09-23-10	284	0.026 ± 0.003
04-01-10	299	0.029 ± 0.003	09-30-10	282	0.023 ± 0.003
1st Quarter Mean ± s.d.		0.035 ± 0.011	3rd Quarter Mean ± s.d.		0.025 ± 0.005
04-08-10	310	0.024 ± 0.003	10-08-10	327	0.024 ± 0.003
04-15-10	317	0.026 ± 0.003	10-14-10	238	0.053 ± 0.005
04-22-10	306	0.020 ± 0.003	10-21-10	283	0.029 ± 0.004
04-28-10	265	0.022 ± 0.004	10-28-10	282	0.013 ± 0.003
05-06-10	353	0.015 ± 0.003	11-04-10	284	0.022 ± 0.003
05-13-10	307	0.010 ± 0.003	11-11-10	228	0.030 ± 0.004
05-20-10	308	0.019 ± 0.003	11-18-10	264	0.040 ± 0.004
05-27-10	308	0.015 ± 0.003	11-24-10	221	0.033 ± 0.005
06-03-10	313	0.020 ± 0.003	12-02-10	300	0.042 ± 0.004
06-10-10	305	0.019 ± 0.003	12-09-10	278	0.036 ± 0.004
06-16-10	265	0.017 ± 0.003	12-15-10	221	0.053 ± 0.005
06-24-10	331	0.016 ± 0.003	12-22-10	261	0.027 ± 0.004
07-01-10	290	0.023 ± 0.003	12-29-10	252	0.021 ± 0.003
2nd Quarter Mean ± s.d.		0.019 ± 0.004	4th Quarter Mean ± s.d.		0.032 ± 0.012
			Cumulative Average		0.028
			Previous Annual Average		0.030

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

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Table 7. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-15 (On-site, north)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	328	0.036 ± 0.004	07-08-10	283	0.017 ± 0.003
01-14-10	286	0.050 ± 0.004	07-15-10	282	0.026 ± 0.003
01-21-10	286	0.033 ± 0.004	07-22-10	284	0.026 ± 0.003
01-28-10	287	0.030 ± 0.004	07-29-10	282	0.021 ± 0.003
02-04-10		ND <sup>b</sup>	08-05-10	282	0.031 ± 0.004
02-11-10	286	0.033 ± 0.004	08-12-10	285	0.029 ± 0.004
02-18-10	288	0.026 ± 0.003	08-19-10	281	0.026 ± 0.003
02-25-10	285	0.043 ± 0.004	08-26-10	277	0.038 ± 0.004
			09-02-10	276	0.022 ± 0.003
03-04-10	282	0.036 ± 0.004			
03-11-10	278	0.028 ± 0.004	09-09-10	277	0.022 ± 0.003
03-18-10	289	0.019 ± 0.003	09-16-10	277	0.026 ± 0.004
03-25-10	291	0.023 ± 0.004	09-23-10	279	0.027 ± 0.004
04-01-10	292	0.027 ± 0.003	09-30-10	274	0.008 ± 0.003 <sup>c</sup>
<u>1st Quarter Mean ± s.d.</u>		<u>0.032 ± 0.009</u>	<u>3rd Quarter Mean ± s.d.</u>		<u>0.025 ± 0.007</u>
04-08-10	288	0.023 ± 0.003	10-08-10	314	0.025 ± 0.003
04-15-10	292	0.030 ± 0.004	10-14-10	232	0.051 ± 0.005
04-22-10	288	0.024 ± 0.003	10-21-10	276	0.028 ± 0.004
04-28-10	243	0.027 ± 0.004	10-28-10	205	0.037 ± 0.005 <sup>d</sup>
05-06-10	331	0.013 ± 0.003	11-04-10	278	0.024 ± 0.003
05-13-10	286	0.011 ± 0.003	11-11-10	278	0.026 ± 0.004
05-20-10	286	0.019 ± 0.003	11-18-10	278	0.038 ± 0.004
05-27-10	289	0.018 ± 0.003	11-24-10	234	0.035 ± 0.004
06-03-10	285	0.012 ± 0.003	12-02-10	314	0.042 ± 0.004
06-10-10	281	0.022 ± 0.003	12-09-10	272	0.042 ± 0.004
06-16-10	243	0.016 ± 0.003	12-15-10	237	0.058 ± 0.005
06-24-10	321	0.017 ± 0.003	12-22-10	275	0.055 ± 0.005
07-01-10	283	0.019 ± 0.003	12-29-10	270	0.021 ± 0.003
<u>2nd Quarter Mean ± s.d.</u>		<u>0.019 ± 0.006</u>	<u>4th Quarter Mean ± s.d.</u>		<u>0.037 ± 0.012</u>
<u>Cumulative Average</u>					<u>0.028</u>
<u>Previous Annual Average</u>					<u>0.032</u>

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> ND = No data; filter white; result less than detection limit.

<sup>c</sup> Filter light.

<sup>d</sup> Low volume due to power outage.

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Table 8. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-16 (On-site)

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	354	0.034 ± 0.003	07-08-10	266	0.012 ± 0.003
01-14-10	289	0.046 ± 0.004	07-15-10	265	0.016 ± 0.003
01-21-10	300	0.042 ± 0.004	07-22-10	267	0.020 ± 0.003
01-28-10	302	0.029 ± 0.003	07-29-10	265	0.019 ± 0.003
02-04-10	298	0.035 ± 0.004	08-05-10	265	0.026 ± 0.004
02-11-10	301	0.037 ± 0.004	08-12-10	266	0.027 ± 0.004
02-18-10	302	0.026 ± 0.003	08-19-10	264	0.027 ± 0.004
02-25-10	299	0.049 ± 0.004	08-26-10	265	0.041 ± 0.004
03-04-10	298	0.033 ± 0.004	09-02-10	265	0.023 ± 0.004
03-11-10	283	0.029 ± 0.004	09-09-10	266	0.022 ± 0.003
03-18-10	281	0.020 ± 0.003	09-16-10	291	0.029 ± 0.004
03-25-10	283	0.017 ± 0.003	09-23-10	292	0.026 ± 0.003
04-01-10	283	0.031 ± 0.004	09-30-10	282	0.023 ± 0.003
1st Quarter Mean ± s.d.		0.033 ± 0.009	3rd Quarter Mean ± s.d.		0.024 ± 0.007
04-08-10	283	0.028 ± 0.003	10-08-10	338	0.027 ± 0.003
04-15-10	284	0.031 ± 0.004	10-14-10	245	0.047 ± 0.005
04-22-10	280	0.023 ± 0.003	10-21-10	291	0.031 ± 0.004
04-28-10	243	0.023 ± 0.004	10-28-10	290	0.028 ± 0.004
05-06-10	323	0.018 ± 0.003	11-04-10	292	0.027 ± 0.003
05-13-10	276	0.010 ± 0.003	11-11-10	292	0.027 ± 0.004
05-20-10	283	0.016 ± 0.003	11-18-10	293	0.036 ± 0.004
05-27-10	282	0.018 ± 0.003	11-24-10	249	0.031 ± 0.004
06-03-10	284	0.023 ± 0.003	12-02-10	341	0.038 ± 0.004
06-10-10	265	0.016 ± 0.003	12-09-10	279	0.040 ± 0.004
06-16-10	228	0.015 ± 0.003	12-15-10	230	0.055 ± 0.005
06-24-10	302 <sup>b</sup>	0.006 ± 0.002	12-22-10	279	0.054 ± 0.005
07-01-10	266	0.017 ± 0.003	12-29-10	287	0.021 ± 0.003
2nd Quarter Mean ± s.d.		0.019 ± 0.007	4th Quarter Mean ± s.d.		0.036 ± 0.011
			Cumulative Average		0.028
			Previous Annual Average		0.028

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> Filter light.

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Table 9. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131<sup>a</sup>.

Location: D-40

Units: pCi/m<sup>3</sup>

Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Date Collected	Volume (m <sup>3</sup> )	Gross Beta
<u>Required LLD</u>		<u>0.010</u>	<u>Required LLD</u>		<u>0.010</u>
01-07-10	306	0.050 ± 0.004	07-08-10	286	0.014 ± 0.003
01-14-10	269	0.052 ± 0.005	07-15-10	285	0.029 ± 0.004
01-21-10	269	0.041 ± 0.004	07-22-10	287	0.027 ± 0.003
01-28-10	269	0.030 ± 0.004	07-29-10	285	0.017 ± 0.003
02-04-10	269	0.029 ± 0.004	08-05-10	269	0.034 ± 0.004
02-11-10	299	0.031 ± 0.004	08-12-10	286	0.026 ± 0.003
02-18-10	302	0.025 ± 0.003	08-19-10	285	0.022 ± 0.003
02-25-10	300	0.044 ± 0.004	08-26-10	271	0.022 ± 0.003
03-04-10	298	0.022 ± 0.003	09-02-10	271	0.040 ± 0.004
03-11-10	298	0.021 ± 0.003	09-09-10	273	0.020 ± 0.003
03-18-10	298	0.017 ± 0.003	09-16-10	284	0.024 ± 0.003
03-25-10	300	0.022 ± 0.003	09-23-10	287	0.023 ± 0.003
04-01-10	300	0.033 ± 0.004	09-30-10	285	0.021 ± 0.003
1st Quarter Mean ± s.d.		0.032 ± 0.011	3rd Quarter Mean ± s.d.		0.025 ± 0.007
04-08-10	300	0.021 ± 0.003	10-08-10	330	0.020 ± 0.003
04-15-10	300	0.026 ± 0.003	10-14-10	241	0.038 ± 0.005
04-22-10	298	0.024 ± 0.003	10-21-10	285	0.027 ± 0.004
04-28-10	257	0.025 ± 0.004	10-28-10	285	0.026 ± 0.003
05-06-10	345	0.016 ± 0.002	11-04-10	287	0.020 ± 0.003
05-13-10	282	0.010 ± 0.003	11-11-10	286	0.027 ± 0.004
05-20-10	286	0.017 ± 0.003	11-18-10	287	0.038 ± 0.004
05-27-10	285	0.015 ± 0.003	11-24-10	246	0.031 ± 0.004
06-03-10	285	0.023 ± 0.003	12-02-10	316	0.044 ± 0.004
06-10-10	287	0.019 ± 0.003	12-09-10	275	0.044 ± 0.004
06-16-10	246	0.015 ± 0.003	12-15-10	240	0.047 ± 0.005
06-24-10	319	0.018 ± 0.003	12-22-10	280	0.056 ± 0.005
07-01-10	284	0.015 ± 0.003	12-29-10	271	0.026 ± 0.003
2nd Quarter Mean ± s.d.		0.019 ± 0.005	4th Quarter Mean ± s.d.		0.034 ± 0.011
			Cumulative Average		0.027
			Previous Annual Average		0.036

<sup>a</sup> Iodine-131 concentrations are < 0.03 pCi/m<sup>3</sup> unless noted otherwise.



Table 10. Airborne particulates, analyses for gamma-emitting isotopes.  
Collection: Quarterly Composite

Units: pCi/m<sup>3</sup>

Location				
D-3				
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1810	DAP- 3754	DAP- 6153	DAP- 7654
Volume (m <sup>3</sup> )	3902	3691	3574	3548
Be-7	0.071 ± 0.017	0.098 ± 0.017	0.097 ± 0.020	0.073 ± 0.015
Mn-54	< 0.0007	< 0.0009	< 0.0011	< 0.0007
Fe-59	< 0.0016	< 0.0011	< 0.0017	< 0.0025
Co-58	< 0.0005	< 0.0006	< 0.0013	< 0.0007
Co-60	< 0.0007	< 0.0008	< 0.0010	< 0.0004
Zn-65	< 0.0007	< 0.0010	< 0.0015	< 0.0012
Nb-95	< 0.0007	< 0.0012	< 0.0010	< 0.0010
Zr-95	< 0.0008	< 0.0016	< 0.0019	< 0.0016
Ru-103	< 0.0006	< 0.0014	< 0.0015	< 0.0011
Ru-106	< 0.0062	< 0.0082	< 0.0107	< 0.0061
Cs-134	< 0.0007	< 0.0009	< 0.0005	< 0.0006
Cs-137	< 0.0007	< 0.0012	< 0.0007	< 0.0005
Ce-141	< 0.0014	< 0.0016	< 0.0025	< 0.0016
Ce-144	< 0.0025	< 0.0047	< 0.0046	< 0.0038

Location				
D-5				
Lab Code	DAP- 1811	DAP- 3755	DAP- 6154	DAP- 7655
Volume (m <sup>3</sup> )	3686	3523	3785	3692
Be-7	0.087 ± 0.016	0.085 ± 0.015	0.085 ± 0.016	0.065 ± 0.019
Mn-54	< 0.0008	< 0.0009	< 0.0005	< 0.0007
Fe-59	< 0.0017	< 0.0010	< 0.0015	< 0.0014
Co-58	< 0.0006	< 0.0007	< 0.0006	< 0.0005
Co-60	< 0.0007	< 0.0004	< 0.0009	< 0.0004
Zn-65	< 0.0006	< 0.0015	< 0.0007	< 0.0007
Nb-95	< 0.0007	< 0.0008	< 0.0009	< 0.0009
Zr-95	< 0.0011	< 0.0015	< 0.0015	< 0.0016
Ru-103	< 0.0008	< 0.0012	< 0.0007	< 0.0015
Ru-106	< 0.0043	< 0.0058	< 0.0065	< 0.0061
Cs-134	< 0.0004	< 0.0009	< 0.0008	< 0.0004
Cs-137	< 0.0004	< 0.0010	< 0.0006	< 0.0008
Ce-141	< 0.0013	< 0.0015	< 0.0019	< 0.0014
Ce-144	< 0.0051	< 0.0040	< 0.0025	< 0.0047

Location				
D-6				
Lab Code	DAP- 1812	DAP- 3756	DAP- 6155	DAP- 7656
Volume (m <sup>3</sup> )	3808	3333	2226	3720
Be-7	0.084 ± 0.014	0.099 ± 0.018	0.086 ± 0.024	0.080 ± 0.018
Mn-54	< 0.0009	< 0.0010	< 0.0011	< 0.0008
Fe-59	< 0.0016	< 0.0020	< 0.0023	< 0.0012
Co-58	< 0.0007	< 0.0009	< 0.0010	< 0.0007
Co-60	< 0.0007	< 0.0008	< 0.0012	< 0.0004
Zn-65	< 0.0006	< 0.0015	< 0.0015	< 0.0007
Nb-95	< 0.0011	< 0.0006	< 0.0015	< 0.0009
Zr-95	< 0.0019	< 0.0011	< 0.0019	< 0.0015
Ru-103	< 0.0011	< 0.0013	< 0.0018	< 0.0009
Ru-106	< 0.0056	< 0.0065	< 0.0089	< 0.0054
Cs-134	< 0.0008	< 0.0006	< 0.0011	< 0.0006
Cs-137	< 0.0007	< 0.0005	< 0.0010	< 0.0005
Ce-141	< 0.0009	< 0.0011	< 0.0024	< 0.0020
Ce-144	< 0.0036	< 0.0036	< 0.0060	< 0.0037

Table 10. Airborne particulates, analyses for gamma-emitting isotopes.  
Collection: Quarterly Composite

Units: pCi/m<sup>3</sup>

Location		D-7			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	
Lab Code	DAP- 1813	DAP- 3757	DAP- 6156	DAP- 7657	
Volume (m <sup>3</sup> )	3648	3375	3509	3329	
Be-7	0.074 ± 0.014	0.108 ± 0.016	0.103 ± 0.020	0.086 ± 0.019	
Mn-54	< 0.0007	< 0.0004	< 0.0010	< 0.0008	
Fe-59	< 0.0019	< 0.0015	< 0.0012	< 0.0019	
Co-58	< 0.0008	< 0.0006	< 0.0010	< 0.0006	
Co-60	< 0.0008	< 0.0005	< 0.0008	< 0.0005	
Zn-65	< 0.0007	< 0.0009	< 0.0008	< 0.0008	
Nb-95	< 0.0008	< 0.0009	< 0.0009	< 0.0009	
Zr-95	< 0.0011	< 0.0013	< 0.0025	< 0.0021	
Ru-103	< 0.0007	< 0.0010	< 0.0010	< 0.0009	
Ru-106	< 0.0075	< 0.0036	< 0.0054	< 0.0069	
Cs-134	< 0.0005	< 0.0006	< 0.0004	< 0.0008	
Cs-137	< 0.0006	< 0.0006	< 0.0006	< 0.0005	
Ce-141	< 0.0015	< 0.0010	< 0.0028	< 0.0018	
Ce-144	< 0.0040	< 0.0029	< 0.0032	< 0.0062	

Location		D-11			
Lab Code	DAP- 1814	DAP- 3758	DAP- 6157	DAP- 7658	
Volume (m <sup>3</sup> )	3856	3810	3713	3599	
Be-7	0.073 ± 0.012	0.090 ± 0.016	0.079 ± 0.017	0.069 ± 0.015	
Mn-54	< 0.0008	< 0.0007	< 0.0006	< 0.0008	
Fe-59	< 0.0016	< 0.0015	< 0.0018	< 0.0012	
Co-58	< 0.0005	< 0.0009	< 0.0006	< 0.0007	
Co-60	< 0.0007	< 0.0006	< 0.0008	< 0.0004	
Zn-65	< 0.0020	< 0.0008	< 0.0008	< 0.0007	
Nb-95	< 0.0006	< 0.0009	< 0.0011	< 0.0010	
Zr-95	< 0.0017	< 0.0016	< 0.0014	< 0.0013	
Ru-103	< 0.0008	< 0.0012	< 0.0007	< 0.0009	
Ru-106	< 0.0051	< 0.0065	< 0.0061	< 0.0053	
Cs-134	< 0.0005	< 0.0009	< 0.0005	< 0.0004	
Cs-137	< 0.0005	< 0.0010	< 0.0007	< 0.0005	
Ce-141	< 0.0015	< 0.0015	< 0.0016	< 0.0019	
Ce-144	< 0.0048	< 0.0043	< 0.0044	< 0.0031	

Location		D-13			
Lab Code	DAP- 1815	DAP- 3759	DAP- 6158	DAP- 7660	
Volume (m <sup>3</sup> )	3618	3979	3761	3437	
Be-7	0.081 ± 0.013	0.082 ± 0.017	0.084 ± 0.017	0.073 ± 0.017	
Mn-54	< 0.0007	< 0.0008	< 0.0006	< 0.0009	
Fe-59	< 0.0021	< 0.0013	< 0.0017	< 0.0013	
Co-58	< 0.0007	< 0.0009	< 0.0008	< 0.0006	
Co-60	< 0.0008	< 0.0007	< 0.0008	< 0.0004	
Zn-65	< 0.0006	< 0.0014	< 0.0007	< 0.0008	
Nb-95	< 0.0006	< 0.0008	< 0.0010	< 0.0009	
Zr-95	< 0.0013	< 0.0012	< 0.0017	< 0.0008	
Ru-103	< 0.0012	< 0.0011	< 0.0004	< 0.0013	
Ru-106	< 0.0051	< 0.0076	< 0.0072	< 0.0085	
Cs-134	< 0.0007	< 0.0008	< 0.0008	< 0.0007	
Cs-137	< 0.0007	< 0.0010	< 0.0008	< 0.0006	
Ce-141	< 0.0014	< 0.0012	< 0.0011	< 0.0011	
Ce-144	< 0.0037	< 0.0042	< 0.0047	< 0.0054	

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

Location				
D-15				
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1816	DAP- 3760	DAP- 6159	DAP- 7661
Volume (m <sup>3</sup> )	3476	3715	3639	3465
Be-7	0.075 ± 0.012	0.082 ± 0.013	0.078 ± 0.018	0.075 ± 0.016
Mn-54	< 0.0008	< 0.0006	< 0.0007	< 0.0009
Fe-59	< 0.0018	< 0.0016	< 0.0016	< 0.0019
Co-58	< 0.0005	< 0.0010	< 0.0006	< 0.0007
Co-60	< 0.0007	< 0.0005	< 0.0008	< 0.0004
Zn-65	< 0.0007	< 0.0006	< 0.0007	< 0.0008
Nb-95	< 0.0007	< 0.0011	< 0.0011	< 0.0013
Zr-95	< 0.0008	< 0.0016	< 0.0018	< 0.0008
Ru-103	< 0.0009	< 0.0008	< 0.0009	< 0.0013
Ru-106	< 0.0057	< 0.0066	< 0.0082	< 0.0070
Cs-134	< 0.0008	< 0.0010	< 0.0005	< 0.0006
Cs-137	< 0.0006	< 0.0004	< 0.0006	< 0.0009
Ce-141	< 0.0012	< 0.0017	< 0.0009	< 0.0010
Ce-144	< 0.0043	< 0.0036	< 0.0041	< 0.0027

Location				
D-16				
Lab Code	DAP- 1817	DAP- 3761	DAP- 6160	DAP- 7662
Volume (m <sup>3</sup> )	3873	3598	3520	3706
Be-7	0.087 ± 0.014	0.076 ± 0.013	0.078 ± 0.015	0.073 ± 0.018
Mn-54	< 0.0007	< 0.0005	< 0.0005	< 0.0010
Fe-59	< 0.0018	< 0.0011	< 0.0016	< 0.0012
Co-58	< 0.0006	< 0.0006	< 0.0006	< 0.0006
Co-60	< 0.0007	< 0.0003	< 0.0010	< 0.0004
Zn-65	< 0.0006	< 0.0011	< 0.0011	< 0.0007
Nb-95	< 0.0006	< 0.0008	< 0.0006	< 0.0010
Zr-95	< 0.0010	< 0.0017	< 0.0022	< 0.0007
Ru-103	< 0.0009	< 0.0011	< 0.0009	< 0.0008
Ru-106	< 0.0065	< 0.0066	< 0.0081	< 0.0054
Cs-134	< 0.0005	< 0.0006	< 0.0004	< 0.0008
Cs-137	< 0.0004	< 0.0006	< 0.0007	< 0.0004
Ce-141	< 0.0015	< 0.0008	< 0.0010	< 0.0019
Ce-144	< 0.0030	< 0.0035	< 0.0026	< 0.0048

Location				
D-40				
Lab Code	DAP- 1818	DAP- 3762	DAP- 6161	DAP- 7663
Volume (m <sup>3</sup> )	3776	3777	3655	3628
Be-7	0.073 ± 0.014	0.099 ± 0.016	0.073 ± 0.016	0.056 ± 0.018
Mn-54	< 0.0007	< 0.0005	< 0.0005	< 0.0008
Fe-59	< 0.0016	< 0.0029	< 0.0016	< 0.0016
Co-58	< 0.0007	< 0.0006	< 0.0007	< 0.0006
Co-60	< 0.0009	< 0.0004	< 0.0008	< 0.0004
Zn-65	< 0.0006	< 0.0011	< 0.0007	< 0.0007
Nb-95	< 0.0006	< 0.0011	< 0.0010	< 0.0008
Zr-95	< 0.0008	< 0.0015	< 0.0012	< 0.0020
Ru-103	< 0.0010	< 0.0013	< 0.0006	< 0.0013
Ru-106	< 0.0056	< 0.0060	< 0.0067	< 0.0053
Cs-134	< 0.0008	< 0.0007	< 0.0010	< 0.0007
Cs-137	< 0.0006	< 0.0009	< 0.0006	< 0.0006
Ce-141	< 0.0012	< 0.0023	< 0.0018	< 0.0022
Ce-144	< 0.0044	< 0.0052	< 0.0052	< 0.0022

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

<u>Controls</u>	<u>1st Qtr.</u>	<u>2nd Qtr.</u>	<u>3rd Qtr.</u>	<u>4th Qtr.</u>
D-1	17.1 ± 2.0	17.3 ± 1.1	16.7 ± 1.1	15.5 ± 1.6
D-2	15.0 ± 1.3	15.4 ± 1.6	17.0 ± 1.0	14.1 ± 1.0
D-3	16.3 ± 1.0	18.9 ± 0.9	16.7 ± 1.5	15.5 ± 0.6
D-5	17.2 ± 1.2	22.1 ± 0.9	17.8 ± 1.2	19.8 ± 0.8
D-6	17.1 ± 1.1	24.0 ± 0.8	16.8 ± 1.1	18.5 ± 0.6
D-7	14.1 ± 1.3	22.4 ± 1.4	17.3 ± 1.1	18.2 ± 1.0
D-8	18.4 ± 1.2	26.8 ± 1.4	19.7 ± 0.9	21.0 ± 1.1
D-10	16.7 ± 1.0	18.6 ± 0.9	19.4 ± 1.0	16.2 ± 1.0
D-11	13.7 ± 1.0	19.1 ± 2.2	15.3 ± 0.8	16.4 ± 1.9
D-13	13.5 ± 1.1	20.3 ± 2.1	16.6 ± 1.1	17.3 ± 1.1
Mean ± s.d.	15.9 ± 1.7	20.5 ± 3.4	17.3 ± 1.3	17.3 ± 2.1
<u>Within 0.5 mi. of Stack</u>				
D-15	15.6 ± 1.3	20.2 ± 0.8	16.9 ± 1.4	16.8 ± 0.6
D-16	17.3 ± 1.2	21.8 ± 1.6	18.6 ± 1.1	18.7 ± 0.9
D-17	15.9 ± 1.6	20.5 ± 1.2	18.9 ± 1.2	16.9 ± 1.7
D-18	15.6 ± 1.7	17.9 ± 1.0	16.6 ± 1.2	14.8 ± 0.9
D-19	14.6 ± 1.5	17.0 ± 1.2	15.3 ± 1.3	13.5 ± 0.7
D-20	17.7 ± 1.3	23.4 ± 1.5	17.9 ± 1.0	17.1 ± 0.9
D-21	19.1 ± 1.8	21.9 ± 1.0	19.2 ± 1.3	15.5 ± 0.9
D-22	18.5 ± 1.1	23.3 ± 1.4	18.3 ± 1.1	17.1 ± 0.8
D-23	16.3 ± 1.1	21.4 ± 1.7	16.7 ± 1.1	15.3 ± 0.9
D-28	18.1 ± 1.5	28.9 ± 1.5	19.0 ± 1.2	22.6 ± 2.2
D-29	20.0 ± 1.1	29.0 ± 1.3	21.1 ± 1.0	22.5 ± 1.3
D-30	18.2 ± 1.3	27.3 ± 2.2	19.8 ± 1.3	21.5 ± 1.6
D-31	18.0 ± 1.3	30.4 ± 1.8	19.9 ± 1.3	22.9 ± 1.1
D-32	<u>21.0 ± 1.0</u>	<u>26.9 ± 1.4</u>	<u>21.7 ± 0.9</u>	<u>21.1 ± 0.8</u>
Mean ± s.d.	17.7 ± 1.9	24.0 ± 4.5	18.7 ± 1.9	18.4 ± 3.5

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Table 11. Ambient gamma radiation as measured by thermoluminescent dosimeters (TLD).

Quarterly collection.

Units: mR/91 days

<u>Within 1.0 mi. of Stack</u>	<u>1st Qtr.</u>	<u>2nd Qtr.</u>	<u>3rd Qtr.</u>	<u>4th Qtr.</u>
D-43	16.5 ± 1.1	20.9 ± 1.8	16.8 ± 1.0	17.5 ± 1.2
D-44	21.0 ± 1.1	27.1 ± 1.0	20.3 ± 1.0	20.7 ± 0.6
D-45	17.5 ± 1.0	20.0 ± 1.8	17.1 ± 0.9	16.8 ± 0.9
D-46	20.1 ± 1.6	26.5 ± 1.4	20.6 ± 1.2	21.4 ± 1.0
D-47	19.2 ± 1.2	24.6 ± 2.1	19.8 ± 1.1	20.1 ± 0.9
D-48	20.9 ± 1.1	27.1 ± 1.7	20.6 ± 0.9	20.5 ± 1.1
D-82	17.1 ± 1.0	14.8 ± 1.1	15.7 ± 0.9	12.2 ± 0.8
D-83	18.1 ± 1.1	21.6 ± 1.0	17.5 ± 1.0	16.3 ± 0.7
D-84	17.9 ± 1.3	20.7 ± 1.8	16.7 ± 1.4	15.8 ± 1.0
D-85	18.6 ± 1.8	21.1 ± 1.2	17.1 ± 0.8	15.6 ± 0.9
D-86	20.1 ± 1.6	22.7 ± 1.6	19.7 ± 1.7	17.2 ± 1.1
D-91	17.9 ± 1.4	23.8 ± 1.5	17.7 ± 1.3	17.8 ± 0.9
Mean ± s.d.	18.7 ± 1.5	22.6 ± 3.6	18.3 ± 1.8	17.7 ± 2.6
<u>Within 3.0 mi. of Stack</u>				
D-33	14.9 ± 1.2	19.1 ± 1.1	15.2 ± 1.0	15.9 ± 0.6
D-34	13.6 ± 1.2	17.9 ± 1.8	14.9 ± 0.9	14.8 ± 1.2
D-35	14.5 ± 1.1	18.6 ± 1.0	15.4 ± 0.9	15.0 ± 0.7
D-36	16.2 ± 1.0	20.4 ± 1.6	17.0 ± 0.9	16.4 ± 0.9
D-37	17.9 ± 1.6	26.3 ± 2.4	19.6 ± 1.3	19.7 ± 2.0
D-38	16.6 ± 1.2	21.3 ± 1.6	17.7 ± 1.2	17.4 ± 1.2
D-39	17.0 ± 1.3	21.8 ± 1.1	17.5 ± 1.0	17.7 ± 0.7
D-40	14.8 ± 1.2	20.3 ± 1.5	15.6 ± 1.0	16.8 ± 0.8
D-41	14.6 ± 1.1	19.6 ± 1.3	15.5 ± 1.0	16.5 ± 0.9
D-42	15.1 ± 1.0	20.2 ± 2.0	16.0 ± 1.2	16.8 ± 1.3
Mean ± s.d.	15.5 ± 1.3	20.6 ± 2.3	16.4 ± 1.5	16.7 ± 1.4

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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 (C)					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-10	DMI- 37	< 0.3	1570 ± 105	< 2.9	< 3.0	< 14.5	< 1.0
02-02-10	DMI- 420	< 0.3	1171 ± 107	< 3.4	< 4.0	< 15.6	< 2.0
03-02-10	DMI- 830	< 0.3	1286 ± 105	< 3.1	< 2.8	< 11.5	< 2.0
04-13-10	DMI- 1598	< 0.3	1387 ± 115	< 3.1	< 3.8	< 17.4	< 1.6
05-04-10	DMI- 2202	< 0.3	1644 ± 122	< 2.4	< 2.8	< 12.1	< 1.5
05-18-10	DMI- 2504	< 0.3	1692 ± 116	< 3.5	< 4.6	< 7.7	< 2.3
06-02-10	DMI- 2866	< 0.3	1568 ± 120	< 3.1	< 4.5	< 16.2	< 3.1
06-15-10			ND <sup>a</sup>				
06-29-10	DMI- 3367	< 0.3	1386 ± 118	< 2.3	< 4.0	< 10.5	< 2.9
07-13-10	DMI- 3777	< 0.3	1495 ± 117	< 2.2	< 3.6	< 15.9	< 1.7
07-27-10	DMI- 3989	< 0.3	1246 ± 109	< 3.7	< 3.5	< 11.9	< 2.6
08-10-10	DMI- 4434	< 0.2	1309 ± 114	< 4.3	< 4.3	< 11.9	< 3.3
08-24-10	DMI- 4693	< 0.2	1272 ± 48	< 1.7	< 1.4	< 33.4	< 4.9
09-08-10	DMI- 5036	< 0.4	1597 ± 125	< 3.2	< 4.5	< 17.4	< 3.3
09-21-10	DMI- 5281	< 0.5	1362 ± 108	< 3.3	< 2.2	< 13.6	< 2.3
10-05-10	DMI- 5577	< 0.2	1352 ± 109	< 2.8	< 3.8	< 12.9	< 1.9
11-02-10	DMI- 6510	< 0.3	1270 ± 112	< 3.8	< 3.9	< 14.1	< 1.2
12-07-10	DMI- 7181	< 0.3	1386 ± 107	< 3.5	< 3.3	< 13.0	< 1.2

Location		D-110					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-10	DMI- 38	< 0.3	1301 ± 98	< 3.0	< 2.6	< 9.8	< 2.5
02-02-10	DMI- 421	< 0.3	1435 ± 107	< 2.9	< 3.6	< 12.0	< 3.5
03-02-10	DMI- 831	< 0.3	1288 ± 107	< 3.2	< 3.3	< 10.3	< 3.7
04-13-10	DMI- 1599	< 0.3	1386 ± 107	< 3.0	< 3.8	< 16.5	< 3.8
05-04-10	DMI- 2203	< 0.3	1444 ± 108	< 3.2	< 3.8	< 13.1	< 2.1
05-18-10	DMI- 2505	< 0.3	1348 ± 101	< 2.8	< 3.6	< 12.1	< 2.9
06-02-10	DMI- 2867	< 0.3	1321 ± 101	< 2.3	< 3.2	< 9.0	< 1.6
06-15-10			ND <sup>a</sup>				
06-29-10	DMI- 3368	< 0.3	1377 ± 118	< 3.1	< 3.7	< 17.0	< 1.3
07-13-10	DMI- 3778	< 0.3	1383 ± 110	< 2.6	< 2.8	< 12.1	< 2.4
07-27-10	DMI- 3990	< 0.2	1374 ± 106	< 3.1	< 3.5	< 12.3	< 2.0
08-10-10	DMI- 4435	< 0.2	1386 ± 105	< 3.4	< 3.7	< 10.4	< 3.6
08-24-10	DMI- 4694	< 0.3	1320 ± 118	< 3.0	< 3.4	< 16.4	< 1.9
09-08-10	DMI- 5037	< 0.4	1399 ± 114	< 4.2	< 3.7	< 21.6	< 3.3
09-21-10	DMI- 5282	< 0.2	1426 ± 111	< 3.4	< 3.1	< 10.3	< 3.2
10-05-10	DMI- 5578	< 0.4	1386 ± 99	< 2.4	< 2.3	< 11.1	< 2.9
11-02-10	DMI- 6511	< 0.4	1441 ± 121	< 3.5	< 3.5	< 11.5	< 1.3
12-07-10	DMI- 7182	< 0.4	1377 ± 108	< 3.9	< 3.8	< 11.5	< 2.0

<sup>a</sup> ND = No data; see Table 2.0, Listing of Missed Samples.

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Table 13.1. Well water samples, analyses for gross beta and tritium.

Collection: Quarterly

Units: pCi/L

Location				
D-53 Treated Municipal Water				
Collection Date	03-22-10	06-25-10	09-15-10	11-10-10
Lab Code	DWW-1161	DWW-3334	DWW-5233	DWW-6703
Gross Beta	1.2 ± 0.7	1.5 ± 0.6	1.2 ± 0.6	1.2 ± 0.4
H-3	< 152	< 164	< 164	< 162
Location				
D-54 Inlet to Municipal Water				
Collection Date	03-22-10	06-25-10	09-15-10	11-10-10
Lab Code	DWW-1162	DWW-3335	DWW-5234	DWW-6704
Gross Beta	< 1.2	1.0 ± 0.6	1.4 ± 0.6	1.5 ± 0.4
H-3	< 152	< 164	< 164	< 162
Location				
D-55 On-site Well				
Collection Date	03-22-10	06-25-10	09-15-10	11-09-10
Lab Code	DWW-1163	DWW-3336	DWW-5235	DWW-6705
Gross Beta	< 1.3	1.0 ± 0.6	< 0.9	< 0.7
H-3	< 152	< 164	< 164	< 162
Location				
D-57 Bull Farm				
Collection Date	03-22-10	06-25-10	09-15-10	11-09-10
Lab Code	DWW-1164	DWW-3337	DWW-5236	DWW-6706
Gross Beta	< 1.2	< 0.8	< 0.8	< 0.9
H-3	< 152	< 164	< 164	< 162
Location				
D-58 Franz Farm				
Collection Date	03-22-10	06-25-10	09-15-10	11-09-10
Lab Code	DWW-1165	DWW-3338	DWW-5237	DWW-6708
Gross Beta	2.0 ± 0.8	2.7 ± 0.6	1.6 ± 0.6	4.0 ± 0.6 <sup>a</sup>
H-3	< 152	< 164	< 164	< 162
Location				
D-72 Van Note Farm				
Collection Date	03-22-10	06-25-10	09-15-10	11-09-10
Lab Code	DWW-1166	DWW-3339	DWW-5238	DWW-6709
Gross Beta	< 1.3	< 0.8	< 0.9	< 1.4
H-3	< 152	< 164	< 164	< 162

<sup>a</sup> Gamma isotopic analysis performed if gross beta activity is greater than 3 pCi/L and/or H3 activity exceeds MDA.

Refer to Appendix A, Supplementary Analyses.

Table 13.2. Ground water, Monitoring wells, analyses for gross beta and tritium <sup>a</sup>.

Collection: Quarterly

Units: pCi/L

Location		MW-01A (shallow)				
Collection Date	03-23-10	06-28-10	07-20-10	08-17-10	09-24-10	
Lab Code	DWW-1183	DWW-3361	DWW-3926	DWW-4619	DWW-5371	
Gross Beta	3.1 ± 1.3	2.0 ± 0.6	3.1 ± 0.4	1.7 ± 0.6	2.9 ± 0.7	
H-3	1817 ± 151	<sup>a</sup> 1053 ± 126	777 ± 125	571 ± 118	661 ± 111	
Collection Date	11-22-10	12-08-10				
Lab Code	DWW-6934	DWW-7255				
Gross Beta	2.8 ± 0.9	< 1.8				
H-3	421 ± 96	243 ± 90				

Location		MW-01B (intermediate)			
Collection Date	03-23-10	06-28-10	09-24-10	11-22-10	
Lab Code	DWW-1184	DWW-3362	DWW-5372	DWW-6935	
Gross Beta	2.9 ± 1.1	< 0.8	1.1 ± 0.6	1.9 ± 0.8	
H-3	< 144	< 164	< 154	< 144	

Location		MW-02A (shallow)			
Collection Date	03-30-10	06-09-10	09-22-10	11-30-10	
Lab Code	DWW-1347	DWW-3194	DWW-5321	DWW-7054	
Gross Beta	3.4 ± 0.8	1.7 ± 0.4	1.3 ± 0.7	1.8 ± 0.8	
H-3	< 143	< 158	< 159	< 139	

Location		MW-02B (intermediate)			
Collection Date	03-30-10	06-09-10	09-22-10	11-30-10	
Lab Code	DWW-1348	DWW-3196	DWW-5322	DWW-7055	
Gross Beta	1.5 ± 0.6	1.0 ± 0.4	1.0 ± 0.6	< 1.2	
H-3	< 143	< 158	< 159	< 139	

Location		MW-03A (shallow)			
Collection Date	03-23-10	06-04-10	09-22-10	11-30-10	
Lab Code	DWW-1185	DWW-2945	DWW-5323	DWW-7056	
Gross Beta	3.2 ± 1.3	3.1 ± 0.4	1.0 ± 0.6	2.1 ± 0.8	
H-3	< 144	< 140	< 159	< 139	

Location		MW-03B (intermediate)			
Collection Date	03-23-10	06-04-10	09-22-10	11-30-10	
Lab Code	DWW-1186	DWW-2946	DWW-5324	DWW-7058	
Gross Beta	2.6 ± 1.1	1.5 ± 0.3	2.1 ± 0.6	2.9 ± 1.6	
H-3	< 144	< 140	< 159	< 139	

<sup>a</sup> Tritium recounted with a result of 1721±143 pCi/L.



Table 13.2. Ground water, Monitoring wells, analyses for gross beta and tritium.<sup>a</sup>

Collection: Quarterly

Units: pCi/L

Location		MW-04A (shallow)			
Collection Date	03-23-10	06-28-10	08-30-10	09-24-10	11-22-10
Lab Code	DWW-1187	DWW-3363	DWW-4789	DWW-5373	DWW-6936
Gross Beta	2.9 ± 1.2	1.2 ± 0.6	3.6 ± 1.6	1.1 ± 0.6	< 1.3
H-3	< 144	222 ± 92	169 ± 85	< 154	< 144
Collection Date	12-08-10				
Lab Code	DWW-7257				
Gross Beta	1.9 ± 1.0				
H-3	< 150				

Location		MW-04B (intermediate)		
Collection Date	03-23-10	06-28-10	09-24-10	11-22-10
Lab Code	DWW-1188	DWW-3364	DWW-5374	DWW-6937
Gross Beta	2.4 ± 1.2	0.9 ± 0.6	1.4 ± 0.6	< 1.3
H-3	< 144	< 164	< 154	< 144

Location		MW-05A (shallow)		
Collection Date	03-23-10	06-04-10	09-22-10	11-30-10
Lab Code	DWW-1189	DWW-2948	DWW-5325	DWW-7059
Gross Beta	3.6 ± 1.2	2.1 ± 0.4	2.0 ± 0.7	1.6 ± 0.8
H-3	< 163	< 140	< 159	< 139

Location		MW-05B (intermediate)		
Collection Date	03-23-10	06-04-10	09-22-10	11-30-10
Lab Code	DWW-1190	DWW-2949	DWW-5326	DWW-7060
Gross Beta	1.9 ± 1.2	1.1 ± 0.3	< 0.9	< 1.3
H-3	< 163	< 140	< 159	< 139

Location		MW-06A (shallow)		
Collection Date	03-30-10	06-04-10	09-24-10	11-30-10
Lab Code	DWW-1349	DWW-2950	DWW-5375	DWW-7061
Gross Beta	6.4 ± 0.7	6.1 ± 0.5	4.4 ± 0.7	3.1 ± 1.5
H-3	< 143	< 140	< 154	< 139

Location		MW-06B (intermediate)		
Collection Date	03-30-10	06-04-10	09-24-10	11-30-10
Lab Code	DWW-1350	DWW-2951	DWW-5376	DWW-7062
Gross Beta	2.2 ± 0.6	2.1 ± 0.6	1.1 ± 0.6	4.6 ± 1.6
H-3	< 143	< 140	< 154	< 139

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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-109	D-108 (C)
Lab Code	DVE- 3369	DVE- 3371	DVE- 3370
Date Collected	06-29-10	06-29-10	06-29-10
Sample Type	Green-Broadleaf	Green-Broadleaf	Green-Broadleaf
K-40	3.33 ± 0.37	3.14 ± 0.34	4.04 ± 0.43
Mn-54	< 0.014	< 0.014	< 0.015
Fe-59	< 0.029	< 0.027	< 0.032
Co-58	< 0.012	< 0.011	< 0.009
Co-60	< 0.013	< 0.011	< 0.018
Zn-65	< 0.024	< 0.013	< 0.032
Nb-95	< 0.009	< 0.014	< 0.009
Zr-95	< 0.029	< 0.022	< 0.015
Ru-103	< 0.011	< 0.009	< 0.014
Ru-106	< 0.093	< 0.093	< 0.15
I-131	< 0.016	< 0.016	< 0.018
Cs-134	< 0.007	< 0.014	< 0.014
Cs-137	< 0.011	< 0.008	< 0.015
Ce-141	< 0.020	< 0.022	< 0.022
Ce-144	< 0.079	< 0.094	< 0.11

Location	D-118
Lab Code	DVE- 5487
Date Collected	09-30-10
Sample Type	Green Leafy
K-40	2.60 ± 0.28
Mn-54	< 0.006
Fe-59	< 0.020
Co-58	< 0.009
Co-60	< 0.009
Zn-65	< 0.014
Nb-95	< 0.010
Zr-95	< 0.017
Ru-103	< 0.009
Ru-106	< 0.094
I-131	< 0.017
Cs-134	< 0.010
Cs-137	< 0.009
Ce-141	< 0.017
Ce-144	< 0.064

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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-58	D-72
Lab Code	DVE- 3475	DVE- 3476	DVE- 5900	DVE- 5901	DVE- 5902
Date Collected	06-30-10	06-30-10	10-13-10	10-13-10	10-13-10
Sample Type	Wheat	Hay	Corn	Beans	Corn
K-40	3.54 ± 0.32	17.96 ± 0.77	2.58 ± 0.27	12.79 ± 0.55	2.68 ± 0.27
Mn-54	< 0.008	< 0.023	< 0.010	< 0.009	< 0.009
Fe-59	< 0.019	< 0.052	< 0.012	< 0.019	< 0.015
Co-58	< 0.012	< 0.025	< 0.006	< 0.007	< 0.006
Co-60	< 0.010	< 0.022	< 0.007	< 0.009	< 0.007
Zn-65	< 0.018	< 0.034	< 0.006	< 0.026	< 0.006
Nb-95	< 0.007	< 0.024	< 0.007	< 0.007	< 0.009
Zr-95	< 0.019	< 0.058	< 0.015	< 0.019	< 0.016
Ru-103	< 0.011	< 0.018	< 0.007	< 0.010	< 0.008
Ru-106	< 0.078	< 0.175	< 0.075	< 0.104	< 0.058
Cs-134	< 0.010	< 0.018	< 0.005	< 0.007	< 0.007
Cs-137	< 0.010	< 0.022	< 0.006	< 0.010	< 0.009
Ce-141	< 0.014	< 0.039	< 0.014	< 0.017	< 0.014
Ce-144	< 0.051	< 0.153	< 0.029	< 0.053	< 0.047

Location	D-96	D-109	D-108 (C)	D-108 (C)
Lab Code	DVE- 5903	DVE- 5904	DVE- 3477	DVE- 5579
Date Collected	10-13-10	10-13-10	06-30-10	10-05-10
Sample Type	Corn	Corn	Hay	Corn Silage
K-40	3.42 ± 0.30	2.90 ± 0.27	10.22 ± 0.66	4.83 ± 0.40
Mn-54	< 0.008	< 0.007	< 0.014	< 0.017
Fe-59	< 0.013	< 0.017	< 0.032	< 0.025
Co-58	< 0.008	< 0.008	< 0.014	< 0.008
Co-60	< 0.009	< 0.008	< 0.015	< 0.014
Zn-65	< 0.025	< 0.010	< 0.053	< 0.035
Nb-95	< 0.007	< 0.007	< 0.016	< 0.013
Zr-95	< 0.013	< 0.009	< 0.023	< 0.024
Ru-103	< 0.004	< 0.006	< 0.015	< 0.013
Ru-106	< 0.084	< 0.069	< 0.111	< 0.121
Cs-134	< 0.010	< 0.008	< 0.017	< 0.014
Cs-137	< 0.010	< 0.007	< 0.018	< 0.013
Ce-141	< 0.014	< 0.017	< 0.021	< 0.024
Ce-144	< 0.070	< 0.031	< 0.136	< 0.103

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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- 336	DSW- 657	DSW- 1136	DSW- 2017	DSW- 2633	DSW- 3157
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
I-131(Chemistry)	< 0.5	< 0.3	< 0.3	< 0.4	< 0.3	< 0.3
Mn-54	< 2.2	< 4.4	< 2.8	< 2.5	< 2.5	< 2.8
Fe-59	< 4.2	< 3.6	< 3.4	< 4.0	< 3.8	< 7.5
Co-58	< 1.9	< 2.9	< 2.3	< 3.5	< 1.9	< 1.9
Co-60	< 1.3	< 1.6	< 2.2	< 2.7	< 2.8	< 2.5
Zn-65	< 3.5	< 4.6	< 3.3	< 5.0	< 5.6	< 2.0
Nb-95	< 2.6	< 3.7	< 1.8	< 2.1	< 3.3	< 2.7
Zr-95	< 4.8	< 7.1	< 4.8	< 3.5	< 5.5	< 3.8
I-131	< 5.1	< 6.4	< 4.5	< 4.2	< 4.4	< 3.3
Cs-134	< 2.6	< 3.0	< 2.8	< 2.9	< 2.2	< 2.7
Cs-137	< 2.5	< 4.2	< 2.9	< 4.3	< 2.3	< 2.4
Ba-140	< 11.9	< 19.7	< 10.0	< 10.2	< 10.6	< 12.0
La-140	< 3.7	< 2.7	< 2.0	< 1.8	< 1.4	< 2.5

Lab Code	DSW- 3927	DSW- 4612	DSW- 5146	DSW- 6200	DSW- 6710	DSW- 7258
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-08-10
H-3	< 158	< 156	< 154	< 165	< 167	< 150
I-131(Chemistry)	< 0.3	< 0.2	< 0.8	< 0.4	< 0.4	< 0.3
Mn-54	< 2.8	< 2.6	< 3.5	< 2.4	< 2.8	< 2.5
Fe-59	< 4.8	< 4.8	< 3.5	< 5.8	< 3.5	< 3.9
Co-58	< 2.8	< 2.4	< 3.0	< 2.4	< 2.4	< 2.4
Co-60	< 3.2	< 2.9	< 3.4	< 3.2	< 2.7	< 1.5
Zn-65	< 3.0	< 3.7	< 7.9	< 3.4	< 4.2	< 4.2
Nb-95	< 2.8	< 2.4	< 3.9	< 2.9	< 2.8	< 4.3
Zr-95	< 3.1	< 4.2	< 4.7	< 4.0	< 3.1	< 3.3
I-131	< 4.0	< 7.2	< 5.1	< 3.7	< 3.5	< 3.8
Cs-134	< 3.0	< 2.1	< 4.1	< 3.3	< 2.9	< 2.5
Cs-137	< 2.6	< 2.7	< 3.3	< 2.8	< 2.6	< 3.8
Ba-140	< 6.7	< 11.4	< 16.7	< 16.2	< 9.6	< 12.9
La-140	< 1.4	< 2.5	< 2.6	< 2.7	< 2.5	< 2.8

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Table 16. Surface water samples, analyses for tritium and gamma-emitting isotopes.

Collection: Monthly  
 Units: pCi/L  
 Location: D-50

Lab Code	DSW- 337	DSW- 658	DSW- 1137	DSW- 2018	DSW- 2634	DSW- 3158
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
Mn-54	< 2.5	< 1.9	< 3.0	< 2.9	< 3.1	< 3.5
Fe-59	< 4.9	< 4.5	< 6.7	< 5.8	< 3.9	< 6.1
Co-58	< 3.2	< 1.3	< 2.9	< 3.5	< 3.4	< 3.2
Co-60	< 2.7	< 2.3	< 1.5	< 2.1	< 2.3	< 2.9
Zn-65	< 3.3	< 4.1	< 4.4	< 3.6	< 4.5	< 5.2
Nb-95	< 3.0	< 1.9	< 3.1	< 4.2	< 2.1	< 4.8
Zr-95	< 4.1	< 3.6	< 5.9	< 5.3	< 4.8	< 5.2
I-131	< 8.0	< 2.8	< 6.3	< 7.4	< 4.2	< 6.1
Cs-134	< 2.4	< 2.5	< 2.7	< 3.2	< 2.9	< 2.4
Cs-137	< 2.0	< 3.2	< 3.5	< 4.0	< 3.6	< 3.8
Ba-140	< 17.8	< 10.7	< 18.3	< 20.9	< 9.0	< 20.4
La-140	< 3.3	< 2.8	< 2.9	< 2.7	< 2.4	< 2.5
Lab Code	DSW- 3938	DSW- 4613	DSW- 5147	DSW- 6201	DSW- 6711	ND <sup>a</sup>
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-08-10
H-3	< 158	< 156	< 154	< 165	< 167	-
Mn-54	< 3.1	< 3.1	< 2.5	< 2.8	< 3.1	-
Fe-59	< 5.6	< 4.7	< 3.3	< 4.9	< 5.2	-
Co-58	< 2.8	< 3.0	< 2.7	< 2.3	< 3.4	-
Co-60	< 2.2	< 2.8	< 2.6	< 2.4	< 3.1	-
Zn-65	< 5.6	< 4.9	< 4.2	< 5.2	< 4.4	-
Nb-95	< 3.4	< 3.8	< 3.0	< 3.1	< 4.3	-
Zr-95	< 6.6	< 4.9	< 3.8	< 4.6	< 4.8	-
I-131	< 7.1	< 4.6	< 4.9	< 5.9	< 8.1	-
Cs-134	< 3.5	< 3.7	< 2.8	< 2.8	< 3.1	-
Cs-137	< 4.1	< 2.0	< 3.3	< 3.3	< 3.9	-
Ba-140	< 19.8	< 12.8	< 13.5	< 14.0	< 24.9	-
La-140	< 2.5	< 2.6	< 2.8	< 2.5	< 4.2	-

<sup>a</sup> "ND" = No data; see Table 2.0, Listing of Missed Samples.

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Table 16. Surface water samples, analyses for tritium and gamma-emitting isotopes.

Collection: Monthly  
 Units: pCi/L  
 Location: D-51

Lab Code	DSW- 338	DSW- 659	DSW- 1138	DSW- 2019	DSW- 2635	DSW- 3159
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
Mn-54	< 2.6	< 3.1	< 3.0	< 2.7	< 1.7	< 2.0
Fe-59	< 3.8	< 4.3	< 3.3	< 3.0	< 2.4	< 4.2
Co-58	< 2.8	< 2.6	< 2.8	< 2.1	< 3.2	< 2.0
Co-60	< 0.8	< 2.9	< 1.4	< 2.8	< 2.2	< 3.6
Zn-65	< 2.6	< 2.6	< 3.4	< 2.9	< 3.9	< 7.7
Nb-95	< 2.3	< 2.9	< 2.1	< 2.7	< 2.1	< 4.7
Zr-95	< 3.3	< 3.4	< 5.3	< 1.9	< 4.6	< 5.2
I-131	< 4.2	< 4.8	< 5.4	< 4.8	< 5.4	< 5.2
Cs-134	< 2.7	< 3.0	< 3.0	< 2.4	< 3.3	< 3.0
Cs-137	< 2.2	< 2.4	< 3.8	< 3.1	< 2.0	< 3.3
Ba-140	< 11.4	< 7.6	< 13.4	< 13.9	< 10.3	< 19.4
La-140	< 2.4	< 4.0	< 2.4	< 1.9	< 2.6	< 4.5
Lab Code	DSW- 3939	DSW- 4614	DSW- 5148	DSW- 6202	DSW- 6712	DSW- 7259
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-08-10
H-3	< 179	< 156	< 154	< 165	< 167	< 150
Mn-54	< 2.0	< 2.8	< 2.6	< 2.4	< 2.5	< 2.6
Fe-59	< 5.7	< 6.5	< 4.0	< 3.3	< 2.8	< 5.3
Co-58	< 3.1	< 3.4	< 3.4	< 2.2	< 3.4	< 4.2
Co-60	< 2.8	< 3.7	< 3.2	< 3.0	< 3.1	< 4.0
Zn-65	< 4.1	< 4.0	< 5.3	< 5.1	< 3.2	< 3.9
Nb-95	< 3.9	< 3.9	< 3.6	< 3.4	< 2.0	< 4.2
Zr-95	< 6.5	< 6.4	< 6.1	< 3.8	< 3.4	< 7.4
I-131	< 6.2	< 6.7	< 8.6	< 5.9	< 7.7	< 7.2
Cs-134	< 3.8	< 3.1	< 3.9	< 3.7	< 2.5	< 3.2
Cs-137	< 2.7	< 4.2	< 2.8	< 2.2	< 3.4	< 3.7
Ba-140	< 16.3	< 19.4	< 20.7	< 14.2	< 17.6	< 22.5
La-140	< 1.9	< 3.6	< 3.2	< 2.4	< 2.7	< 2.6

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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- 339	DSW- 660	DSW- 1139	DSW- 2020	DSW- 2636	DSW- 3160
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
I-131(Chemistry)	< 0.3	< 0.5	< 0.3	< 0.3	< 0.3	< 0.3
Mn-54	< 1.6	< 2.4	< 2.1	< 3.8	< 1.6	< 2.4
Fe-59	< 7.0	< 6.8	< 2.2	< 4.8	< 6.2	< 4.0
Co-58	< 1.5	< 3.1	< 1.2	< 3.2	< 1.5	< 2.7
Co-60	< 1.9	< 3.3	< 1.6	< 3.9	< 2.2	< 2.5
Zn-65	< 3.1	< 4.6	< 4.4	< 4.1	< 2.5	< 1.7
Nb-95	< 2.5	< 3.7	< 2.0	< 4.0	< 3.1	< 2.2
Zr-95	< 3.4	< 4.2	< 4.5	< 6.9	< 5.1	< 5.4
I-131	< 3.9	< 5.5	< 2.8	< 6.9	< 4.2	< 3.5
Cs-134	< 2.1	< 2.9	< 2.1	< 4.3	< 2.1	< 2.2
Cs-137	< 2.1	< 2.6	< 2.3	< 2.9	< 2.9	< 2.6
Ba-140	< 13.7	< 9.2	< 12.2	< 15.7	< 7.9	< 10.3
La-140	< 2.9	< 1.9	< 3.5	< 2.8	< 1.8	< 2.6
Lab Code	DSW- 3940	DSW- 4615	DSW- 5149	DSW- 6203	DSW- 6713	DSW- 7260
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-08-10
H-3	< 158	< 156	< 154	< 165	< 167	< 150
I-131(Chemistry)	< 0.4	< 0.2	< 0.3	< 0.4	< 0.4	< 0.3
Mn-54	< 2.9	< 4.3	< 2.5	< 2.4	< 3.8	< 2.8
Fe-59	< 3.5	< 7.9	< 4.9	< 3.8	< 5.6	< 7.4
Co-58	< 4.2	< 3.1	< 3.1	< 2.2	< 1.9	< 4.8
Co-60	< 1.0	< 3.7	< 3.9	< 2.1	< 3.2	< 4.3
Zn-65	< 5.1	< 3.9	< 4.3	< 4.6	< 7.5	< 3.3
Nb-95	< 3.5	< 3.0	< 4.6	< 2.8	< 3.7	< 4.5
Zr-95	< 7.3	< 7.4	< 4.3	< 4.0	< 6.6	< 10.4
I-131	< 8.5	< 5.3	< 5.8	< 5.0	< 5.7	< 9.2
Cs-134	< 3.6	< 3.3	< 3.6	< 2.2	< 3.1	< 5.0
Cs-137	< 4.3	< 3.3	< 2.7	< 3.1	< 2.9	< 5.8
Ba-140	< 18.6	< 13.4	< 12.1	< 13.3	< 15.2	< 21.1
La-140	< 2.8	< 3.3	< 2.8	< 2.9	< 2.1	< 4.0

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Table 16. Surface water samples, analyses for tritium and gamma-emitting isotopes.

Collection: Monthly  
 Units: pCi/L  
 Location: D-99

Lab Code	DSW- 340	DSW- 661	DSW- 1140	DSW- 2021	DSW- 2637	DSW- 3161
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
Mn-54	< 1.8	< 1.4	< 3.3	< 2.9	< 3.2	< 2.5
Fe-59	< 2.9	< 4.0	< 3.8	< 2.4	< 6.5	< 4.7
Co-58	< 2.4	< 1.4	< 2.2	< 2.3	< 3.1	< 1.8
Co-60	< 2.2	< 1.1	< 2.1	< 2.3	< 2.3	< 1.5
Zn-65	< 3.2	< 3.4	< 2.6	< 2.4	< 2.5	< 2.3
Nb-95	< 2.4	< 1.8	< 2.1	< 3.4	< 3.0	< 2.9
Zr-95	< 4.7	< 5.1	< 5.3	< 5.8	< 5.8	< 5.4
I-131	< 5.4	< 5.3	< 4.6	< 5.2	< 6.2	< 4.1
Cs-134	< 2.4	< 3.1	< 2.4	< 2.9	< 2.8	< 2.8
Cs-137	< 2.6	< 2.7	< 2.7	< 3.0	< 3.6	< 2.7
Ba-140	< 18.9	< 15.2	< 19.7	< 12.0	< 13.2	< 10.8
La-140	< 3.2	< 3.2	< 2.7	< 2.5	< 1.7	< 2.4

Lab Code	DSW- 3928	DSW- 4616	DSW- 5150	DSW- 6204	DSW- 6714	ND <sup>a</sup>
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-08-10
H-3	< 158	< 156	< 154	< 165	< 167	-
Mn-54	< 2.1	< 2.2	< 4.5	< 2.9	< 2.5	-
Fe-59	< 6.0	< 3.9	< 7.5	< 5.1	< 6.7	-
Co-58	< 3.0	< 2.7	< 2.9	< 1.9	< 2.7	-
Co-60	< 1.9	< 2.8	< 4.0	< 3.0	< 3.0	-
Zn-65	< 4.3	< 1.7	< 4.6	< 2.6	< 2.8	-
Nb-95	< 5.3	< 3.0	< 4.6	< 2.0	< 2.4	-
Zr-95	< 5.5	< 6.1	< 6.1	< 4.9	< 5.0	-
I-131	< 4.6	< 3.9	< 8.4	< 4.0	< 8.9	-
Cs-134	< 4.1	< 3.1	< 3.7	< 3.1	< 3.4	-
Cs-137	< 2.8	< 3.1	< 3.5	< 2.5	< 2.7	-
Ba-140	< 21.2	< 14.6	< 23.3	< 14.1	< 19.2	-
La-140	< 3.7	< 3.7	< 4.1	< 3.3	< 2.1	-



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Table 16. Surface water samples, analyses for tritium and gamma-emitting isotopes.

Collection: Monthly  
 Units: pCi/L  
 Location: D-107

Lab Code	DSW- 342	DSW- 662	DSW- 1141	DSW- 2022	DSW- 2638	DSW- 3162
Date Collected	01-26-10	02-22-10	03-19-10	04-21-10	05-24-10	06-18-10
H-3	< 160	< 145	< 152	< 175	< 170	< 152
Mn-54	< 2.4	< 3.3	< 2.7	< 2.1	< 2.9	< 2.8
Fe-59	< 4.5	< 5.2	< 4.3	< 3.6	< 3.8	< 5.4
Co-58	< 2.1	< 3.1	< 2.0	< 2.6	< 3.0	< 3.3
Co-60	< 1.6	< 5.0	< 2.1	< 2.1	< 2.7	< 3.0
Zn-65	< 4.5	< 5.8	< 3.3	< 3.2	< 4.0	< 2.3
Nb-95	< 2.7	< 5.3	< 1.7	< 3.1	< 2.0	< 3.5
Zr-95	< 5.3	< 5.1	< 4.6	< 6.6	< 2.5	< 5.1
I-131	< 5.2	< 6.0	< 3.5	< 6.3	< 3.6	< 3.6
Cs-134	< 2.7	< 4.5	< 2.3	< 2.4	< 2.8	< 2.6
Cs-137	< 2.9	< 3.4	< 3.5	< 3.0	< 3.1	< 3.0
Ba-140	< 14.7	< 23.9	< 15.2	< 11.9	< 11.2	< 9.9
La-140	< 3.8	< 5.1	< 1.7	< 2.4	< 2.5	< 2.8

Lab Code	DSW- 3941	DSW- 4617	DSW- 5151	DSW- 6205	DSW- 6715	DSW- 7261
Date Collected	07-20-10	08-18-10	09-14-10	10-20-10	11-09-10	12-09-10
H-3	< 158	< 156	< 154	< 165	< 167	< 150
Mn-54	< 3.9	< 2.7	< 3.0	< 3.2	< 3.1	< 2.7
Fe-59	< 4.8	< 3.9	< 4.3	< 4.4	< 4.5	< 6.4
Co-58	< 2.6	< 2.4	< 3.0	< 2.1	< 3.3	< 2.5
Co-60	< 4.6	< 2.0	< 2.1	< 2.0	< 1.9	< 4.3
Zn-65	< 10.3	< 5.6	< 3.2	< 4.3	< 4.9	< 4.2
Nb-95	< 4.4	< 2.7	< 2.5	< 3.2	< 2.9	< 3.5
Zr-95	< 7.5	< 4.8	< 4.2	< 6.1	< 2.4	< 4.3
I-131	< 5.8	< 5.5	< 4.3	< 6.8	< 7.4	< 7.5
Cs-134	< 3.4	< 1.9	< 3.0	< 2.9	< 3.2	< 3.8
Cs-137	< 4.6	< 2.3	< 3.2	< 3.0	< 2.7	< 3.7
Ba-140	< 22.9	< 8.3	< 18.5	< 18.6	< 14.4	< 17.5
La-140	< 3.0	< 2.6	< 3.6	< 2.0	< 5.6	< 3.5

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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-1178	DSW-3190	DSW-5214	DSW-7274	
Sr-89	< 0.66	< 0.63	< 0.62	< 0.80	
Sr-90	< 0.54	< 0.51	< 0.51	< 0.54	

Location		D-61			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	
Lab Code	DSW-1179	DSW-3191	DSW-5215	DSW-7275	
Sr-89	< 0.64	< 0.71	< 0.74	< 0.87	
Sr-90	< 0.51	< 0.59	< 0.55	< 0.53	

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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- 2868	DF- 2869	DF- 5032	DF- 5033	
Date Collected	05-26-10	05-26-10	09-03-10	09-03-10	
Sample Type	Moxostoma sp.	Carp	Moxostoma sp.	Carpiodes sp.	
K-40	3.63 ± 0.39	3.36 ± 0.53	3.34 ± 0.39	3.48 ± 0.40	
Mn-54	< 0.014	< 0.021	< 0.008	< 0.008	
Fe-59	< 0.025	< 0.033	< 0.029	< 0.021	
Co-58	< 0.007	< 0.016	< 0.010	< 0.012	
Co-60	< 0.011	< 0.024	< 0.013	< 0.011	
Zn-65	< 0.007	< 0.051	< 0.008	< 0.016	
Nb-95	< 0.011	< 0.028	< 0.011	< 0.008	
Zr-95	< 0.018	< 0.036	< 0.019	< 0.021	
Ru-103	< 0.013	< 0.016	< 0.006	< 0.006	
Ru-106	< 0.088	< 0.186	< 0.109	< 0.093	
Cs-134	< 0.011	< 0.021	< 0.010	< 0.009	
Cs-137	< 0.007	< 0.013	< 0.009	< 0.010	
Ce-141	< 0.030	< 0.026	< 0.019	< 0.026	
Ce-144	< 0.069	< 0.159	< 0.094	< 0.093	

Location		Downstream, D-61			
Lab Code	DF- 2870	DF- 2871	DF- 5034	DF- 5035	
Date Collected	05-26-10	05-26-10	09-03-10	09-03-10	
Sample Type	Carpiodies sp.	Common Carp	Cyprinis Carpio	Carpiodes sp.	
K-40	2.92 ± 0.35	2.87 ± 0.40	2.95 ± 0.37	3.14 ± 0.37	
Mn-54	< 0.011	< 0.013	< 0.012	< 0.008	
Fe-59	< 0.037	< 0.022	< 0.035	< 0.020	
Co-58	< 0.008	< 0.018	< 0.010	< 0.010	
Co-60	< 0.010	< 0.006	< 0.012	< 0.012	
Zn-65	< 0.015	< 0.033	< 0.008	< 0.015	
Nb-95	< 0.013	< 0.028	< 0.015	< 0.009	
Zr-95	< 0.015	< 0.031	< 0.030	< 0.020	
Ru-103	< 0.014	< 0.022	< 0.008	< 0.010	
Ru-106	< 0.071	< 0.120	< 0.094	< 0.107	
Cs-134	< 0.012	< 0.017	< 0.006	< 0.011	
Cs-137	< 0.012	< 0.016	< 0.010	< 0.013	
Ce-141	< 0.014	< 0.032	< 0.024	< 0.020	
Ce-144	< 0.052	< 0.125	< 0.046	< 0.051	

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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- 3340	DBS- 5154
Date Collected	06-25-10	09-14-10
K-40	$6.60 \pm 0.81$	$7.29 \pm 0.50$
Mn-54	< 0.047	< 0.018
Fe-59	< 0.076	< 0.021
Co-58	< 0.028	< 0.015
Co-60	< 0.030	< 0.015
Zn-65	< 0.062	< 0.028
Nb-95	< 0.043	< 0.012
Zr-95	< 0.073	< 0.024
Ru-103	< 0.043	< 0.006
Ru-106	< 0.28	< 0.095
Cs-134	< 0.029	< 0.009
Cs-137	< 0.039	< 0.012
Ce-141	< 0.078	< 0.021
Ce-144	< 0.19	< 0.077

Location	D-51 (Discharge)	
Lab Code	DBS- 3341	DBS- 5155
Date Collected	06-25-10	09-14-10
K-40	$5.75 \pm 0.66$	$8.21 \pm 0.54$
Mn-54	< 0.030	< 0.014
Fe-59	< 0.058	< 0.024
Co-58	< 0.026	< 0.015
Co-60	< 0.022	< 0.013
Zn-65	< 0.061	< 0.034
Nb-95	< 0.039	< 0.013
Zr-95	< 0.065	< 0.015
Ru-103	< 0.045	< 0.011
Ru-106	< 0.21	< 0.091
Cs-134	< 0.027	< 0.005
Cs-137	< 0.035	< 0.013
Ce-141	< 0.074	< 0.026
Ce-144	< 0.12	< 0.085

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Table 19. River sediment, analysis for gamma-emitting isotopes.

Collection: Semiannually

Units: pCi/g dry

Location	D-107A (North Drainage Ditch)	
Lab Code	DBS- 3342	DBS- 5156
Date Collected	06-25-10	09-14-10
K-40	7.41 ± 0.76	7.10 ± 0.86
Mn-54	< 0.030	< 0.043
Fe-59	< 0.090	< 0.085
Co-58	< 0.041	< 0.032
Co-60	< 0.030	< 0.024
Zn-65	< 0.080	< 0.078
Nb-95	< 0.069	< 0.040
Zr-95	< 0.059	< 0.041
Ru-103	< 0.036	< 0.033
Ru-106	< 0.21	< 0.27
Cs-134	< 0.034	< 0.029
Cs-137	< 0.029	< 0.038
Ce-141	< 0.087	< 0.064
Ce-144	< 0.22	< 0.24

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Table 20.1 Precipitation, monthly collections, analyses for gamma emitting isotopes.

Units: pCi/L

Location: D-16

Date Collected	01-28-10	02-25-10	03-18-10	04-22-10	05-20-10	06-03-10
Lab Code	DP- 343	DP- 792 <sup>a</sup>	DP- 1142	DP- 2023	DP- 2556	DP- 2952
Mn-54	< 4.3	< 7.1	< 5.5	< 5.3	< 4.7	< 3.8
Fe-59	< 5.9	< 12.6	< 7.8	< 8.2	< 8.0	< 5.5
Co-58	< 3.4	< 8.4	< 5.4	< 4.1	< 3.9	< 2.0
Co-60	< 3.0	< 10.3	< 3.9	< 4.2	< 4.5	< 2.8
Zn-65	< 6.8	< 18.3	< 5.3	< 6.6	< 3.6	< 4.8
Nb-95	< 4.7	< 9.8	< 5.4	< 3.7	< 3.5	< 4.1
Zr-95	< 9.0	< 12.5	< 12.2	< 4.7	< 5.3	< 6.1
I-131	< 6.7	< 17.1	< 8.9	< 4.3	< 5.7	< 6.0
Cs-134	< 5.0	< 6.7	< 5.3	< 3.8	< 4.0	< 2.8
Cs-137	< 4.9	< 8.0	< 5.3	< 3.8	< 7.2	< 3.8
Ba-140	< 26.8	< 59.4	< 26.0	< 18.9	< 14.7	< 12.8
La-140	< 2.4	< 11.4	< 4.5	< 5.0	< 4.4	< 4.0

Date Collected	07-22-10	08-19-10	09-16-10	10-21-10	11-11-10	12-30-10
Lab Code	DP- 3982	DP- 4618	DP- 5239	DP- 6206	DP- 6719	DP- 7466
Mn-54	< 3.5	< 1.1	< 4.3	< 3.5	< 7.3	< 5.2
Fe-59	< 7.9	< 2.9	< 7.1	< 5.5	< 11.5	< 7.9
Co-58	< 3.3	< 1.7	< 2.9	< 3.1	< 3.8	< 4.4
Co-60	< 3.2	< 1.6	< 4.6	< 3.1	< 5.1	< 1.7
Zn-65	< 3.9	< 2.1	< 8.4	< 4.8	< 8.6	< 6.3
Nb-95	< 2.8	< 2.2	< 3.3	< 4.0	< 4.5	< 3.3
Zr-95	< 3.7	< 3.2	< 10.3	< 7.3	< 7.5	< 4.6
I-131	< 6.4	< 14.8	< 10.4	< 6.0	< 12.5	< 4.7
Cs-134	< 3.0	< 1.1	< 3.5	< 3.3	< 4.8	< 3.1
Cs-137	< 2.8	< 1.1	< 4.2	< 4.0	< 7.0	< 3.3
Ba-140	< 12.3	< 19.5	< 24.0	< 16.4	< 38.6	< 21.4
La-140	< 2.8	< 3.7	< 4.1	< 1.5	< 5.8	< 2.7

<sup>a</sup> Some required LLDs were not reached, due to low volume of sample (250 ml.).

Table 20.2. Precipitation, quarterly composites of monthly samples, analysis for tritium.

Units: pCi/L

Location: D-16

Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4thQtr.
Lab Code	DP-1148	DP-2993	DP-5274	DP-7467
H-3	< 144	< 140	< 159	< 142

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Table 21. Soil, analysis for strontium-90 and gamma-emitting isotopes.

Collection: Annually

Units: pCi/g dry

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Location	D-15a	D-16
Lab Code	DSO- 5152	DSO- 5153
Date Collected	09-14-10	09-14-10
Sr-90	< 0.023	< 0.023
H-3 (pCi/L)	< 165	176 ± 96
K-40	14.62 ± 0.73	9.02 ± 0.79
Mn-54	< 0.025	< 0.024
Fe-59	< 0.036	< 0.066
Co-58	< 0.009	< 0.025
Co-60	< 0.013	< 0.015
Zn-65	< 0.049	< 0.065
Nb-95	< 0.020	< 0.033
Zr-95	< 0.016	< 0.021
Ru-103	< 0.022	< 0.029
Ru-106	< 0.17	< 0.25
Cs-134	< 0.017	< 0.015
Cs-137	0.15 ± 0.034	0.13 ± 0.034
Ce-141	< 0.047	< 0.040
Ce-144	< 0.13	< 0.12

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APPENDIX A  
SUPPLEMENTAL ANALYSES



A-1. Supplemental analyses in support of the Groundwater Protection Plan.

Results of analyses for tritium and gamma emitting isotopes.

Location	Sluice Pond
Lab Code	DSW- 4790
Date Collected	08-30-10
H-3	< 153
Mn-54	< 4.4
Fe-59	< 8.5
Co-58	< 5.3
Co-60	< 5.8
Zn-65	< 7.5
Nb-95	< 6.5
Zr-95	< 7.1
I-131	< 6.8
Cs-134	< 5.7
Cs-137	< 5.0
Ba-140	< 30.6
La-140	< 3.6

Results of analyses for gross beta and tritium in ground water and precipitation.

Location	Lab Code	Collection Date	Concentration (pCi/L)	
			Gross Beta	H-3
MH-209	DWW-1422	04-01-10	20.8 ± 1.1	< 142
MH-210	DWW-1424	04-01-10	150.7 ± 2.9	188 ± 95
MH-211	DWW-1425	04-01-10	29.9 ± 1.9	< 142
D-111	DP- 7461	12-30-10	-	< 142
D-112	DP- 7462	12-30-10	-	< 142
D-114	DP- 7463	12-30-10	-	< 142
D-115	DP- 7464	12-30-10	-	< 142
D-116	DP- 7465	12-30-10	-	< 142

A-2. Supplemental REMP analyses in response to conditional requirements.

Results of analyses for gamma emitting isotopes.

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Location	D-58
Lab Code	DSW- 6708 <sup>a</sup>
Date Collected	11-09-10

Mn-54	< 0.9
Fe-59	< 7.8
Co-58	< 1.4
Co-60	< 0.7
Zn-65	< 2.1
Nb-95	< 5.2
Zr-95	< 3.0
I-131	-
Cs-134	< 0.8
Cs-137	< 1.0
Ba-140	-
La-140	-

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<sup>a</sup> Gamma isotopic analysis performed if gross beta activity > 3 pCi/L and/or H3 activity exceeds MDA (Table 13.1).