May 14, 2020

NG-20-0038
TS 5.6.2

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

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

Subject: 2019 Annual Radiological Environmental Operating Report

Please find as Enclosure 1 to this letter, a copy of NextEra Energy Duane Arnold, LLC's 2019 Annual Radiological Environmental Operating Report for the Duane Arnold Energy Center, pursuant to the requirements of ODAM Section 8.2.2 and Technical Specification Section 5.6.2.

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

Should you have any questions regarding this matter, please contact Michael Casey at (319) 851-7606.

Sincerely,

Dean Curtland
Site Director
NextEra Energy Duane Arnold, LLC

Enclosure

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

Enclosure to
NG-20-0038

Duane Arnold Energy Center

2019 Annual Radiological Environmental Operating Report

133 pages follow

2019

Annual Radiological Environmental Operating Report

Duane Arnold Energy Center

Cedar Rapids, Iowa

Docket No. 50-331

January 1, 2018 through December 31, 2019

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2019
Annual Radiological Environmental Operating Report

Duane Arnold Energy Center
DOCKET NUMBER. 50-331

Prepared By: _____ Date: 5/1/20
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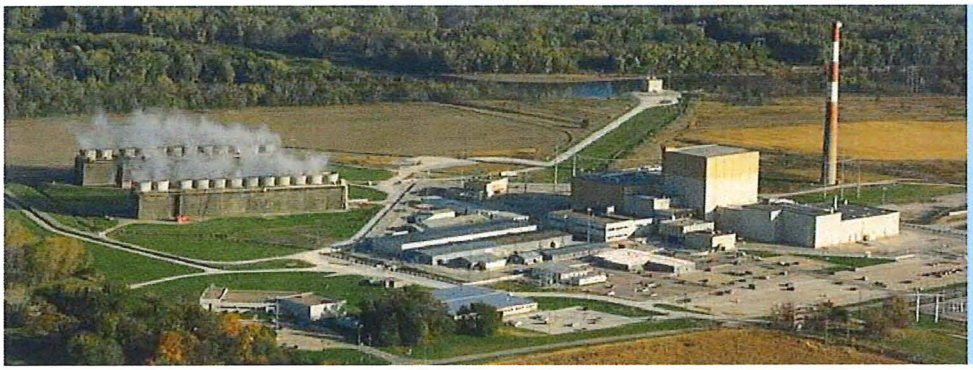
NEXTera ENERGY
DUANE ARNOLD

Fact Sheet

Duane Arnold Energy Center



SITE ADDRESS
3277 DAEC Road
Palo, IA 52324

CORPORATE MEDIA LINE
(561) 694-4442

Safety Information

Built in a low-risk seismic zone: Duane Arnold is in a very seismically stable area of the country.

Constructed to withstand earthquakes and tornados: Despite the low risk from seismic events, the plant is designed to withstand earthquakes, tornados and other events stronger than ever recorded in the region.

Protected from flooding: The plant is elevated 20 feet above river level to protect against flooding.

» During 2008's historic 500-year flood, the Cedar River crested 14 feet below the plant's design flood level
» During this event, DAEC was able to continue safe and reliable operations

Seven-day power supply: Safety and cooling systems can be powered for seven days without requiring any offsite power or additional fuel.

Designed with multiple safety systems: The Nuclear Regulatory Commission has mandated several structural improvements over time, enhancing Duane Arnold's ability to deal with significant events:

» Four offsite power lines power the site's cooling system
» Two on-site diesel generators are available to provide back-up emergency power to plant safety equipment
» Multiple steam-driven cooling pumps are available to power cooling systems (do not require external power)
» Back-up batteries for all critical cooling and control room systems are stored on-site
» External cooling options (i.e. injection and fire pumps) are pre-staged on-site; can use river water for cooling

Highly trained plant operators: For one full week out of every six weeks, plant operators must prove their ability to safely operate the plant in a variety of worst-case scenarios that include earthquakes, severe storms, flooding, loss-of-power and loss of reactor core cooling.

System Information

PRIMARY SYSTEM	
Reactor Type	One General Electric Boiling Water Reactor with a net electrical output of 615 MWe
Reactor Core	368 fuel assemblies
Reactor Vessel	67' high; 15' wide
Reactor Design	General Electric Mark 1
SECONDARY SYSTEM	
Turbine/Generator	General Electric
Cooling Towers	Mechanical draft type — two towers, 12 cells each, makeup water from Cedar River

General Information

The Duane Arnold Energy Center (DAEC) is located in Palo, Iowa, approximately nine miles northwest of Cedar Rapids. It is bordered by cornfields of neighboring farms and the banks of the Cedar River.

» Workforce
600 during normal operations; nearly 1,500 during outage operations

» Salaries
Approximately $85 million annually

» Economic impact
Stimulates $255 million in economic activity in Iowa, $514 million nationally

» Property taxes paid
Approximately $3 million annually

» Construction permit granted
June 1970

» Full power operating license
February 1974

» Commercial operation
February 1975

For More Information:
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duanearnold.com
nrc.gov

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

REPORT

to the

UNITED STATES
NUCLEAR REGULATORY COMMISSION

Annual Radiological Environmental Operating Report

January 1 to December 31, 2019

Prepared by

ATI ENVIRONMENTAL, Inc.
Midwest Laboratory

Project No. 8001

Approved: _____

Ashok Banavali, Ph.D..
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 (REMP) conducted by Environmental, Inc., Midwest Laboratory at the Duane Arnold Energy Center, Palo, Iowa, during the period January - December, 2019. 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.

The REMP fulfills the requirements of Sections IV.B.2 and IV.B.3 of Appendix I to 10 CFR 50 for the operation of the plant. The REMP also fulfills the requirements of 10 CFR 72.44(d)(2) for operation of the ISFSI.

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

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

2.0 SUMMARY

The Radiological Environmental Monitoring Program, as required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Duane Arnold Energy Center, is herein described. Results for the year 2019 are summarized and discussed. Information regarding DAEC effluents and the Offsite Dose Assessment Manual (ODAM) can be found in the 2019 Annual Radiological material release Report (ARMRR).

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.

Characteristic properties of isotopes quantified in gamma-spectroscopic analysis are presented in Table 5.1. Other means of distinguishing sources of environmental radiation can be employed in interpreting the data. Current radiation levels can be compared with previous levels, including those measured before the Plant became operational. Results of the DAEC's Monitoring Program

can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations.

3.2 Program Description

3.2.1 Environmental Monitoring

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

To monitor the air environment, a continuous air sampler is employed. Airborne particulates and activated charcoal canisters are mounted on the intake of the air sampler to collect airborne particulates and airborne iodine respectively at ten sampling locations. 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 canister samples are analyzed weekly for iodine-131.

Ambient gamma radiation is monitored at a total of 52 locations. A TLD is placed at each location and exchanged and analyzed quarterly. The TLD locations are distributed as follows:

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

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

The aquatic environment is also monitored by upstream and downstream (D-49 and D-61) semiannual collections of fish.

River bottom sediment is collected semiannually at the plant's intake (D-49) and discharge (D-51) and the site's north drainage ditch (D-107a). The samples are analyzed for gamma-emitting isotopes.

Potable groundwater is collected monthly from the Cedar Rapids treated municipal water system (D-53), the inlet to the Cedar Rapids municipal water treatment system (D-54), four indicator locations (D-52, D-55, D-57, D-58) and one control location (D-72). The samples are analyzed for tritium and gamma emitting isotopes. Any positive identification of a reactor by-product material initiates analyses for hard to detect isotopes of Ni-63, Sr-89, Sr-90, Fe-55 and gross alpha. The samples are analyzed for tritium, I-131 by chemical separation to an MDC of 1 pCi/L, and gamma emitting isotopes.

For 2019, dairy cow milk was collected monthly from one indicator (D-110) and one control location (D-138) from January to December. Monthly sampling was determined to be sufficient due to the milk sampling locations more than five miles from the facility. The samples are analyzed for iodine-131 and gamma-emitting isotopes. This sampling is supplemented with goat's milk when available from indicator location (D-76).

Additional monitoring of the terrestrial environment, grain, hay, grass and broadleaf vegetation samples are collected annually, as available, from nine locations: one control (D-138) and seven indicators (D-57, D-58, D-77, D-96, D-109, D-110 and D-118). Grain, hay and broadleaf (green leafy) vegetation samples are analyzed for gamma-emitting isotopes and at least two broad leaf vegetation samples are analyzed for iodine-131. Vegetation control samples are purchased from local grocery and feed stores provided the sample source is outside the State of Iowa.

If any of the cattle grazing on-site are slaughtered for home use, a meat sample is collected. The sample is analyzed for gamma-emitting isotopes. A single deer meat sample from a legally harvested animal was collected near D-58.

3.2.2 Groundwater Protection Program

Environmental, Inc., Midwest Laboratory provides laboratory services for the Duane Arnold Energy Center Groundwater Protection Program (GWPP). The GWPP is formally included within REMP and the standards are set forth in the ODAM, Table 6.3-2. The Groundwater Protection Program encompasses activities to ensure the protection of groundwater within the owner controlled area by sampling the groundwater, soil, precipitation, electrical vault and sewage effluent. For sewage effluent results only, refer to the Duane Arnold Energy Center, 2019 Annual Radioactive Material Release Report and Table 23 of Part II of this report for groundwater, soil, electrical vault, and precipitation sample results.

3.3 Program Execution

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

(1) Airborne Particulates / Airborne Iodine:

The air station at location D-16 had a mechanical pump failure (02/01/19). The air station at location D-11 experienced pump failures 03/29/19 and 04/05/19. Details of the failures are listed in table 5.6.

(2) Thermoluminescent Dosimetry

The TLD from location D-17 was found missing for the second quarter of 2019.

(3) Milk

Goat's milk was unavailable at location D-76 throughout 2019 due to limited herd production. Details of the missed scheduled collections are listed in table 5.6.

(4) Well Water

Well water was not collected at location D-55 for the 5/14/19 collection.

(5) Surface Water

Surface water was unavailable at locations D-50 and D-99 for the 02/21/19 and the 12/18/19 sampling event due to freezing.

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 spectrometry.

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, 2018). The QA Program includes participation in Interlaboratory Comparison (crosscheck) Programs. Results obtained in crosscheck programs are presented in Appendix A.

3.5 Program Modifications

There were a few changes to the REMP program in 2019. REMP and GWPP standards and requirements can be found in the Duane Arnold Energy Center 2019 Annual Radiological Material Release Report in Attachment 2, ODAM.

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 2019 is contained in Part II of the Annual Report on the Radiological Environmental Monitoring Program for the Duane Arnold Energy Center.

4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no reported accidents involving significant release to the environment at nuclear reactor facilities in 2019. The Fukushima Daiichi nuclear accident occurred March 11, 2011.

There were no reported atmospheric nuclear tests in 2019. The last reported test was conducted on October 16, 1980 by the People's Republic of China. However, a failed Russian weapon test in August 2019 did release strontium-91, barium-139, barium-140, and lanthanum-140. These isotopes have half-lives of 83 minutes to 12.8 days.

4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected outside of the Owner Controlled Area in 2019. The trace levels of cesium-137, still measurable in soil, are attributed to deposition of fallout from nuclear weapons testing from previous decades.

Airborne Particulates

The average annual gross beta concentrations in airborne particulates were similar at indicator and control locations (0.026 and 0.025 pCi/m^3, respectively) and similar to levels observed from 1995 through 2018. The results are tabulated below.

Year	Indicators	Controls		Year	Indicators	Controls
Concentration (pCi/m^3)				Concentration (pCi/m^3)		
2000	0.026	0.027		2010	0.028	0.028
2001	0.026	0.026		2011	0.030	0.029
2002	0.027	0.027		2012	0.030	0.029
2003	0.029	0.029		2013	0.028	0.025
2004	0.028	0.028		2014	0.026	0.025
2005	0.031	0.031		2015	0.027	0.024
2006	0.029	0.027		2016	0.027	0.023
2007	0.031	0.031		2017	0.028	0.025
2008	0.029	0.029		2018	0.028	0.026
2009	0.031	0.030		2019	0.026	0.025

Average annual gross beta concentrations in airborne particulates.

4.2 Program Findings, Airborne Particulates (continued)

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7,produced continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples, with an average activity of 0.080 pCi/m^3 for indicator locations and 0.077 pCi/m^3 for the control location. No reactor by-product radionuclides were identified. All samples met required lower limits of detection as specified in the ODAM.

Airborne Iodine

527 weekly air samples were collected in 2019 from ten air monitoring stations. Levels of airborne iodine-131 measured below the required limit of 0.030 pCi/m^3 with the exception of the samples collected at location D-16 for the week ending 02/01/19 (pump failure) and at location D-11 for the weeks ending 3/29/19 (Pump failure) and 4/05/19 (pump failure).

Ambient Radiation (TLDs)

207 TLDs were collected and analyzed in 2019. At twelve control locations, thermoluminescent dosimeter (TLD) readings averaged 20.0 mR/quarter. At locations within a half mile, one mile and three mile radius of the stack, the measurements averaged 19.2, 18.4 and 17.2 mR/quarter, respectively. The two on-site locations D-15 and D-16 averaged 16.8 and 18.9 mR/quarter respectively. These average measurements are similar to the estimated average natural background radiation for Middle America, 19.5 mR/quarter, which is based on data on Pages 71 and 108 of the report, "Natural Background Radiation in the United States" (National Council on Radiation Protection and Measurements, 1975). The terrestrial absorbed dose (uncorrected for structural and body shielding) ranges from 8.8 to 18.8 mrad/quarter and averages 11.5 mrad/quarter for Middle America. Cosmic radiation and cosmogenic radionuclides contribute 8.0 mrad/quarter for a total average of 19.5 mrad/quarter. No plant effect is indicated.

ISFSI Facility Operations Monitoring

Four TLDs, placed directionally along the ISFSI fence line, averaged 32.7 mR/quarter. The TLD site D-30, located between the nearest residence and the ISFSI site averaged 19.7 mR/quarter. Calculated dose rates indicate the site is in compliance with 10 CFR 72.104 and 40 CFR 190.

Milk

24 milk samples were collected from two commercial dairies in 2019. Iodine-131 concentrations in milk samples were less than the LLD level of 1.0 pCi/L.

No gamma-emitting isotopes, excepting naturally occurring potassium-40, were detected in any milk samples. This is consistent with findings that most radio-contaminants 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).

No reactor by-product radionuclides were identified. All samples met required lower limits of detection as specified in the ODAM.

Groundwater (drinking water-potable)

51 drinking water samples from seven locations were collected in 2019. Tritium concentrations in ground water samples were less than the MDC of 160 pCi/L in all samples analyzed. Gamma-emitting isotopes were below detection limits.

No reactor by-product radionuclides could be identified. All samples met required lower limits of detection as specified in the ODAM.

4.2 Program Findings (continued)

Vegetation

Eleven vegetation samples from six locations were collected in 2019. Iodine-131 concentrations in vegetation samples were less than the LLD level of 0.058 pCi/g wet weight in all samples analyzed. Samples of both broadleaf vegetation as well as grain and forage types were analyzed.

With the exception of potassium-40, which was observed in all vegetation samples, all other gamma-emitting isotopes were below detection limits. No reactor by-product radionuclides were identified. All samples met required lower limits of detection as specified in the ODAM.

Surface Water

57 surface water samples were collected from five locations in 2019. Surface water was tested for tritium and gamma emitting isotopes. No measurable tritium activity was detected above an LLD of 160 pCi/L.

Analyses for I-131 were performed on samples from locations D-49 (control) and D-61 (0.5 mi. downstream, indicator). No measurable I-131 was detected above an LLD of 0.5 pCi/L.

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

Ten fish samples from five sport fish species were collected in June and August, 2019, and analyzed for gamma-emitting isotopes. With the exception of naturally-occurring potassium-40, no gamma-emitting isotopes were identified in edible portions of fish. The potassium-40 level was similar at both the indicator and control locations (3.82 and 4.04 pCi/g wet, respectively).

No reactor by-product radionuclides were identified. All samples met required lower limits of detection as specified in the ODAM.

River Sediments

Six river sediment samples from three locations were collected in 2019 during the months of April and October, and analyzed for gamma-emitting isotopes. Potassium-40 activity ranged from 5.22 to 8.19 pCi/g dry weight at the indicator locations and between 7.11 and 7.71 pCi/g dry weight at the control location.

All samples met required lower limits of detection as specified in the ODAM.

4.3 Ground Water Protection Program Findings

Environmental, Inc., Midwest Laboratory provides laboratory services for the Duane Arnold Energy Center Ground Water Protection Program except for sewage effluent results; refer to Appendix E. Sewage effluent sample results can be found in the Duane Arnold Energy Center 2019 Annual Radiological Material Release Report.

Groundwater

270 groundwater samples (non-potable water) were collected from 56 permitted monitoring wells and three permitted extraction wells in 2019. Tritium was the only plant by-product identified. Concentrations of tritium ranged from less than 148 pCi/L to 95,396 pCi/L at D-66A, monitoring

well MW-22A. An explanation of tritium mitigation can be found in the Duane Arnold Energy Center 2019 Radioactive Material Release Report. Tritium was not identified in any drinking water well on-site or at off-site wells or Cedar Rapids municipal drinking water samples. Lastly, the monitoring well farthest down gradient prior to the boundary of the owner controlled area and the Cedar River, MW-33A, did not indicate tritium above the lower level of detection, less than 155 pCi/L.

Soil

Two soil samples were collected in 2019, from D-15a and from D-16. Both samples were positive for cesium-137 with an average level of 0.12 pCi/g dry weight which is consistent with previous results at these locations. The cesium-137 source is determined to be from nuclear weapons testing and not from plant activities.

Precipitation

83 precipitation samples were collected in 2019 from seven precipitation collection locations. Tritium was consistently identified at locations D-127 and D-128. Tritium concentrations range from less than 363 pCi/L to 2,256 pCi/L (+/- 155 pCi/L) from D-127. The proximity of the plant gaseous effluent release points coupled with atmospheric conditions enables recapture of gaseous effluent, specifically tritiated water vapor, to be entrained in precipitation and deposited within the protected area. Occasionally, tritiated precipitation collects in a basin or pit. This water is then sampled and released in accordance with the Offsite Dose Assessment Manual (ODAM), "Clean" system batch release of a liquid effluent as documented in ODAM, Table 7.1-2.

Electrical Vaults

25 electrical vaults samples were collected in 2019 from nine electrical vaults. Electrical vaults are below grade structures designed for electrical cabling. Surface water and groundwater may seep into the vaults. Tritium concentrations range from less than 150 pCi/L to 295 pCi/L (+/- 88 pCi/L) from D-120, which is consistent with rainfall recapture of tritiated water vapor from plant gaseous effluent release points.

Storm Drains, Sluice Pond, and Drainage Ditches.

21 samples were collected in 2019 from storm drains, sluice ponds and drainage ditches. Surface water sampling from these locations is consistent with non-point source runoff sampling activities. Similar to electrical vaults, tritium recapture is the source for tritium. Tritium concentrations range from less than 150 pCi/L to 3,774 pCi/L(+/- 193 pCi/L) from D-125.

5.0 TABLES AND FIGURES

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

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

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

[b] Includes fission-product daughters.

Table 5.2 Sample collection and analysis program.

Sampling Location [a]				
Exposure Pathway and/or Sample Type	Sample Point	Description	Sampling and Collection Frequency	Type and Frequency of Analysis [b]
Airborne Particulates	3 4 5A 6 7 11 13 15 16 40	Hiawatha Pleasant Creek SRA Palo Center Point Shellsburg Toddville Alburnett (C) On-site North On-site South Wickiup Hill	Continuous operation of sampler with sample collection at least once per week or as required by dust loading	Analyze for gross beta activity more than 72 hours after filter change. Perform gamma isotopic analysis on each sample having gross beta activity greater than ten times the yearly mean of the control samples. Composite weekly samples to form a quarterly composite (by location). Analyze quarterly composite for gamma isotopic.
Airborne Iodine	3 4 5A 6 7 11 13 15 16 40	Hiawatha Pleasant Creek SRA North Palo Center Point Shellsburg Toddville Alburnett (C) On-site North On-site South Wickiup Hill	Continuous operation of sampler with sample collection at least once per week.	Analyze each cartridge for iodine-131.
Ambient Radiation	1-3, 5A, 6-8 10, 11, 13 15-23, 28-32, 4, 33-42 43-48 82-86, 91 161-164	(Controls) (Controls) (Indicators) Within 0.5 mile of Stack Within 3.0 miles of Stack Within 1.0 mile of Stack ISFSI Fence line	One dosimeter continuously at each location. Dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly.
Surface Water	49 50 51 61 99	Lewis Access (C) Plant Intake Plant Discharge ~ ½ mi. downstream from Plant Discharge Pleasant Creek Lake	Once per month.	Gamma isotopic and tritium analysis for each sample (by location). Locations 49 and 61, analyses for low-level I-131. Quarterly composites for Sr-89, Sr-90.

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

Sampling Location [a]				
Exposure Pathway and/or Sample Type	Sample Point	Description	Sampling and Collection Frequency	Type and Frequency of Analysis [b]
Ground Water	52 53 54 55 57, 58 72 (C)	Plant potable water Treated Municipal Water Inlet to Municipal Water Treatment System On-site well Wells off-site and within 4 km of DAEC	Grab sample at least once per quarter	Analysis gamma emitting isotopes, iodine-131 and tritium on quarterly samples. If reactor by-product gamma emitters are identified, or if tritium concentrations measure > MDA, then analyze for Ni-63, Sr-89, Sr-90 and alpha emitters.
River Sediment	49 50 51 107a	Lewis Access Plant Intake (C) Plant Discharge North Drainage Ditch (on-site)	At least once every six months.	Gamma isotopic analysis of each sample
Vegetation	16,57 56, 57, 58,77, 96,108, 110,118 138 (C)	Farms raising food crops	Annually at harvest time. Two samples of each: grain, green leafy, and forage.	Gamma isotopic analysis, including iodine-131, on each sample.
Fish	49 56 61	Cedar River upstream of DAEC not influenced by effluent (C) Downstream of DAEC in influence of effluent	One sample per 6 months (once during January through June and once during July through December).	Gamma isotopic analysis on edible portions.
Milk	138 (C) 110 76	Farm near Newhall, IA Dairy Farm within 7.8 miles from Site Goat Farm ENE of site.	Monthly. Monthly. Monthly depending on availability.	Gamma isotopic and iodine-131 analyses of each sample.

[a] (C) denotes control location. All other locations are indicators.
[b] Gamma isotopic analysis and analysis for gamma-emitting nuclides refer to high resolution gamma ray spectrum analysis.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

Sampling Location		
Code	Location Description	Distance and Direction from Site Stack
D-1	Cedar Rapids	20,800 meters SE
D-2	Marion	16,900 meters ESE
D-3	Hiawatha	10,800 meters SE
D-5	Palo	4,500 meters SSW
D-4	Pleasant Creek SRA	4,960 meters NW
D-5A	Palo	3,470 meters SSW
D-6	Center Point	9,660 meters N
D-7	Shellsburg	7,950 meters W
D-8	Urbana	15,000 meters NNW
D-10	Atkins	13,600 meters SSW
D-11	Toddville	4,980 meters E
D-13	Alburnett	14,500 meters ENE
D-15	On-site, North-Northwest	1,050 meters NNW
D-16	On-site, South-Southeast	520 meters SSE
D-17	On-site, N	1,050 meters N
D-18	On-site, NNE	630 meters NNE
D-19	On-site, NE	590 meters NE
D-20	On-site, ENE	550 meters ENE
D-21	On-site, ENE	515 meters ENE
D-22	On-site, ESE	535 meters ESE
D-23	On-site, SE	490 meters SE
D-28	On-site, WSW	730 meters WSW
D-29	On-site, W	630 meters W
D-30	On-site, WNW	640 meters WNW
D-31	On-site, NW	1,020 meters NW
D-32	On-site, NNW	1,110 meters NNW
D-33	3 mile ring	4,340 meters N
D-34	3 mile ring	3,930 meters NNE
D-35	3 mile ring	2,800 meters NE
D-36	3 mile ring	3,500 meters ENE
D-37	3 mile ring	2,960 meters E
D-38	3 mile ring	3,180 meters ESE
D-39	3 mile ring	2,510 meters SE
D-40	3 mile ring	2,430 meters SSE
D-41	3 mile ring	5,680 meters S
D-42	3 mile ring	4,380 meters SSE
D-43	1 mile ring	1,590 meters SSW
D-44	1 mile ring	1,580 meters WSW
D-45	1 mile ring	1,420 meters W
D-46	1 mile ring	1,580 meters WNW
D-47	1 mile ring	1,760 meters NW
D-48	1 mile ring	1,680 meters NNW

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

Sampling Location		
Code	Location Description	Distance and Direction from Site Stack
D-49	Lewis Access, upstream of DAEC	6,750 meters NNW
D-50	Plant Intake	560 meters SE
D-51	Plant Discharge	600 meters SE
D-52	Plant potable water	On-site
D-53	Treated Municipal Water	13,900 meters SE
D-54	Inlet, Municipal Water Treatment System	13,900 meters SE
D-55	Production Well	Production wells A-D
D-56	Control samples from various locations	Sample location varies
D-57	Farm (Off-site Well)	805 meters W
D-58	Farm (Off-site Well)	974 meters WSW-SW
D-61	Downstream of plant discharge	670 meters SSE
D-72	Farm	3,200 meters SSW
D-76	Farm	2,888 meters ENE
D-77	Farm	2,288 meters SW
D-82	On-site, SSE	660 meters SSE
D-83	On-site, SSE	620 meters SSE
D-84	On-site, S	610 meters S
D-85	On-site, SSW	660 meters SSW
D-86	On-site, SW	850 meters SW
D-91	On-site, NNW	1,090 meters NNW
D-96	Farm	11,400 meters SSW
D-99	Pleasant Creek Lake	3,880 meters WNW
D-107a	North Drainage Ditch	On-site
D-109	Farm	5,890 meters SW
D-110	Farm	12,700 meters SW
D-118	Farm	2,230 meters NW
D-138	Farm	21,600 meters WSW
D-161	ISFSI Fence East	On-site
D-162	ISFSI Fence South	On-site
D-163	ISFSI Fence West	On-site
D-164	ISFSI Fence North	On-site

Table 5.4 Type and Frequency of collection.

Location	Weekly	Monthly	Quarterly	Semiannually	Annually
D-1			TLD		
D-2			TLD		
D-3	AP, AI		TLD		
D-4	AP, AI		TLD		
D-5			TLD		
D-5A	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		TLD		G, SO
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-52			WW		
D-53			WW		
D-54			WW		
D-55			WW		
D-56					
D-57			WW		G
D-58			WW		
D-61		SW		F	
D-72			WW		
D-76		MI*			
D-77					G
D-82 to D-86			TLD		
D-91			TLD		
D-99		SW			ME**
D-107A				BS	
D-108					G
D-110		MI			G
D-118					G
D-138		MI			G
D-161 to D-164			TLD		
On-site					

* Goat's milk sampled when available.

**Meat sampled when available.

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

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

Table 5.6. Program Deviations, Duane Arnold Energy Center.

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
MI		D-76	01-15-19	Goat's milk unavailable due to limited herd production.
AP/AI		D-16	02-01-19	Filter very light due to mechanical pump failure. Samples discarded.
MI		D-76	02-14-19	Goat's milk unavailable due to limited herd production.
SW		D-50	02-21-19	No Sample; river frozen.
SW		D-99	02-21-19	No sample; river frozen.
AP/AI		D-11	03-29-19	No samples; pump failure.
MI		D-76	03-12-19	Goat's milk unavailable due to limited herd production.
AP/AI		D-11	04-05-19	No samples; pump failure.
MI		D-76	04-09-19	Goat's milk unavailable due to limited herd production.
MI		D-76	05-14-19	Goat's milk unavailable due to limited herd production.
WW		D-55	05-14-19	Sample not collected.
MI		D-76	06-11-19	Goat's milk unavailable due to limited herd production.
TLD		D-17	07-01-19	Sample missing in field.
MI		D-76	07-16-19	Goat's milk unavailable due to limited herd production.
MI		D-76	08-13-19	Goat's milk unavailable due to limited herd production.

Table 5.6. Program Deviations, Duane Arnold Energy Center.(Continued).

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
MI		D-76	09-10-19	Goat's milk unavailable due to limited herd production.
MI		D-76	10-15-19	Goat's milk unavailable due to limited herd production.
MI		D-76	11-13-19	Goat's milk unavailable due to limited herd production.
SW		D-50	12-18-19	No sample; river frozen.
SW		D-99	12-18-19	No sample; river frozen.

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa	Reporting Period	January-December, 2019

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean		Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
				Location [d]	Mean (F) [c] Range [c]		
Airborne Pathway							
Airborne Particulates (pCi/m^3)	GB 527	0.003	0.026 (474/474) (0.004-0.060)	D-15	0.026 (52/52) (0.007-0.047)	0.025 (53/53) (0.008-0.046)	0
	GS 40						
	Be-7	0.020	0.072 (36/36) (0.050-0.091)	D-3	0.079 (4/4) (0.068-0.091)	0.064 (4/4) (0.045-0.085)	0
	Mn-54	0.0013	< LLD	-	-	< LLD	0
	Fe-59	0.0028	< LLD	-	-	< LLD	0
	Co-58	0.0012	< LLD	-	-	< LLD	0
	Co-60	0.0012	< LLD	-	-	< LLD	0
	Zn-65	0.0032	< LLD	-	-	< LLD	0
	Nb-95	0.0036	< LLD	-	-	< LLD	0
	Zr-95	0.0024	< LLD	-	-	< LLD	0
	Ru-103	0.0016	< LLD	-	-	< LLD	0
	Ru-106	0.0124	< LLD	-	-	< LLD	0
	Cs-134	0.0014	< LLD	-	-	< LLD	0
	Cs-137	0.0011	< LLD	-	-	< LLD	0
	Ce-141	0.0032	< LLD	-	-	< LLD	0
	Ce-144	0.0063	< LLD	-	-	< LLD	0
Airborne Iodine (pCi/m^3)	I-131 527	0.030	< LLD	-	-	< LLD	0
Direct Radiation							
TLDs (m R/quarter) Control Locations	Gamma 48	1.0	None	D-5	20.0 (4/4) (16.9-27.4)	17.7 (48/48) (12.7-27.4)	0
Within 0.5 mi. of Stack	Gamma 79	1.0	19.2 (79/79) (12.9-31.2)	D-17	22.5 (3/4) (16.9-31.2)	None	0
Within 1.0 mi. of Stack	Gamma 24	1.0	18.4 (24/24) (13.1-26.5)	D-48	19.6 (4/4) (14.4-24.2)	None	0
Within 3.0 mi.of Stack	Gamma 40	1.0	17.2 (40/40) (10.9-27.1)	D-37	19.1 (4/4) (16.7-22.4)	None	0
ISFSI border	Gamma 16	1.0	32.7 (16/16) (13.9-54.4)	D-161	48.4 (4/4) (43.4-53.7)	None	0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa	Reporting Period	January-December, 2019

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean		Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
				Location [d]	Mean (F) [c] Range [c]		
Waterborne Pathway							
Surface Water (pCi/L)	H-3 57	177	< LLD	-	-	< LLD	0
	I-131chem 24	0.5	< LLD	-	-	< LLD	0
	Sr-89 8	0.81	< LLD	-	-	< LLD	0
	Sr-90 8	0.58	< LLD	-	-	< LLD	0
	GS 57						
	Mn-54	6.8	< LLD	-	-	< LLD	0
	Fe-59	12.4	< LLD	-	-	< LLD	0
	Co-58	5.0	< LLD	-	-	< LLD	0
	Co-60	4.7	< LLD	-	-	< LLD	0
	Zn-65	14.5	< LLD	-	-	< LLD	0
	Nb-95	9.6	< LLD	-	-	< LLD	0
	Zr-95	8.5	< LLD	-	-	< LLD	0
	I-131	10.4	< LLD	-	-	< LLD	0
	Cs-134	6.0	< LLD	-	-	< LLD	0
	Cs-137	5.8	< LLD	-	-	< LLD	0
	Ba-140	24.2	< LLD	-	-	< LLD	0
	La-140	17.8	< LLD	-	-	< LLD	0
Sediments (pCi/g dry)	GS 6						
	K-40	1.0	6.74 (4/4) (5.22-8.19)	D-51	8.16 (2/2) (8.12-8.19)	7.71 (2/2) (7.11-7.71)	0
	Mn-54	0.017	< LLD	-	-	< LLD	0
	Fe-59	0.058	< LLD	-	-	< LLD	0
	Co-58	0.020	< LLD	-	-	< LLD	0
	Co-60	0.017	< LLD	-	-	< LLD	0
	Zn-65	0.039	< LLD	-	-	< LLD	0
	Nb-95	0.047	< LLD	-	-	< LLD	0
	Zr-95	0.032	< LLD	-	-	< LLD	0
	Ru-103	0.029	< LLD	-	-	< LLD	0
	Ru-106	0.107	< LLD	-	-	< LLD	0
	Cs-134	0.013	< LLD	-	-	< LLD	0
	Cs-137	0.016	< LLD	-	-	< LLD	0
	Ce-141	0.073	< LLD	-	-	< LLD	0
	Ce-144	0.100	< LLD	-	-	< LLD	0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa	Reporting Period	January-December, 2019

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean		Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
				Location [d]	Mean (F) [c] Range [c]		
Waterborne Pathway							
Ground Water, potable (pCi/L)	I-131 51	0.5	< LLD	-	-	< LLD	0
	H-3 51	160	< LLD	-	-	< LLD	0
	GS 51						
	Mn-54	7.3	< LLD	-	-	< LLD	0
	Fe-59	10.8	< LLD	-	-	< LLD	0
	Co-58	5.7	< LLD	-	-	< LLD	0
	Co-60	6.9	< LLD	-	-	< LLD	0
	Zn-65	15.2	< LLD	-	-	< LLD	0
	Nb-95	8.8	< LLD	-	-	< LLD	0
	Zr-95	10.6	< LLD	-	-	< LLD	0
	I-131	8.9	< LLD	-	-	< LLD	0
	Cs-134	8.2	< LLD	-	-	< LLD	0
	Cs-137	6.4	< LLD	-	-	< LLD	0
	Ba-140	32.2	< LLD	-	-	< LLD	0
	La-140	7.2	< LLD	-	-	< LLD	0
Ingestion Pathway							
Milk (pCi/L)	1-131 24	0.5	< LLD	-	-	< LLD	0
	GS 24						
	K-40	100	1436(12/12) (1388-1561)	D-110	1436(12/12) (1388-1561)	1392(12/12) (1388-1561)	0
	Cs-134	5	< LLD	-	-	< LLD	0
	Cs-137	5	< LLD	-	-	< LLD	0
	Ba-140	60	< LLD	-	-	< LLD	0
	La-140	5	< LLD	-	-	< LLD	0
Broadleaf Vegetation (pCi/g wet)	GS 9						
	K-40	0.05	4.70 (9/9) (2.23-6.93)	D-57	6.46 (1/1)	None	0
	Mn-54	0.041	< LLD	-	-		0
	Fe-59	0.063	< LLD	-	-		0
	Co-58	0.046	< LLD	-	-		0
	Co-60	0.039	< LLD	-	-		0
	Zn-65	0.091	< LLD	-	-		0
	Nb-95	0.038	< LLD	-	-		0
	Zr-95	0.089	< LLD	-	-		0
	Ru-103	0.047	< LLD	-	-		0
	Ru-106	0.401	< LLD	-	-		0
	1-131	0.058	< LLD	-	-		0
	Cs-134	0.046	< LLD	-	-		0
	Cs-137	0.059	< LLD	-	-		0
	Ce-141	0.057	< LLD	-	-		0
	Ce-144	0.215	< LLD	-	-		0

Table 5.7 Radiological Environmental Monitoring Program Summary.

Name of Facility	Duane Arnold Energy Center	Docket No.	50-331
Location of Facility	Linn, Iowa (County, State)	Reporting Period	January-December, 2019

Sample Type (Units)	Type and Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] Range [c]	Location with Highest Annual Mean		Control Locations Mean (F) [c] Range [c]	Number Non-Routine Results [e]
				Location [d]	Mean (F) [c] Range [c]		
Ingestion Pathway (cont.)							
Vegetation (Grain and Forage) (pCi/g wet)	GS 2						
	K-40	0.05	23.23 (2/2) (22.33-24.13)	D-57	24.13 (1/1)	None	0
	Mn-54	0.033	< LLD	-	-		0
	Fe-59	0.068	< LLD	-	-		0
	Co-58	0.020	< LLD	-	-		0
	Co-60	0.027	< LLD	-	-		0
	Zn-65	0.070	< LLD	-	-		0
	Nb-95	0.030	< LLD	-	-		0
	Zr-95	0.064	< LLD	-	-		0
	Ru-103	0.032	< LLD	-	-		0
	Ru-106	0.27	< LLD	-	-		0
	I-131	0.054	< LLD	-	-		0
	Cs-134	0.035	< LLD	-	-		0
	Cs-137	0.036	< LLD	-	-		0
	Ce-141	0.039	< LLD	-	-		0
	Ce-144	0.21	< LLD	-	-		0
Fish (pCi/g wet)	GS	10					
	K-40	1.0	3.82 (5/5) (3.54-4.30)	D-49	4.19 (4/4) (3.40-4.78)	4.04 (5/5) (3.40-4.78)	0 0
	Mn-54	0.025	< LLD	-	-	< LLD	0
	Fe-59	0.101	< LLD	-	-	< LLD	0
	Co-58	0.038	< LLD	-	-	< LLD	0
	Co-60	0.025	< LLD	-	-	< LLD	0
	Zn-65	0.053	< LLD	-	-	< LLD	0
	Nb-95	0.066	< LLD	-	-	< LLD	0
	Zr-95	0.068	< LLD	-	-	< LLD	0
	Ru-103	0.053	< LLD	-	-	< LLD	0
	Ru-106	0.258	< LLD	-	-	< LLD	0
	Cs-134	0.027	< LLD	-	-	< LLD	0
	Cs-137	0.023	< LLD	-	-	< LLD	0
	Ce-141	0.105	< LLD	-	-	< LLD	0
	Ce-144	0.171	< LLD	-	-	< LLD	0

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

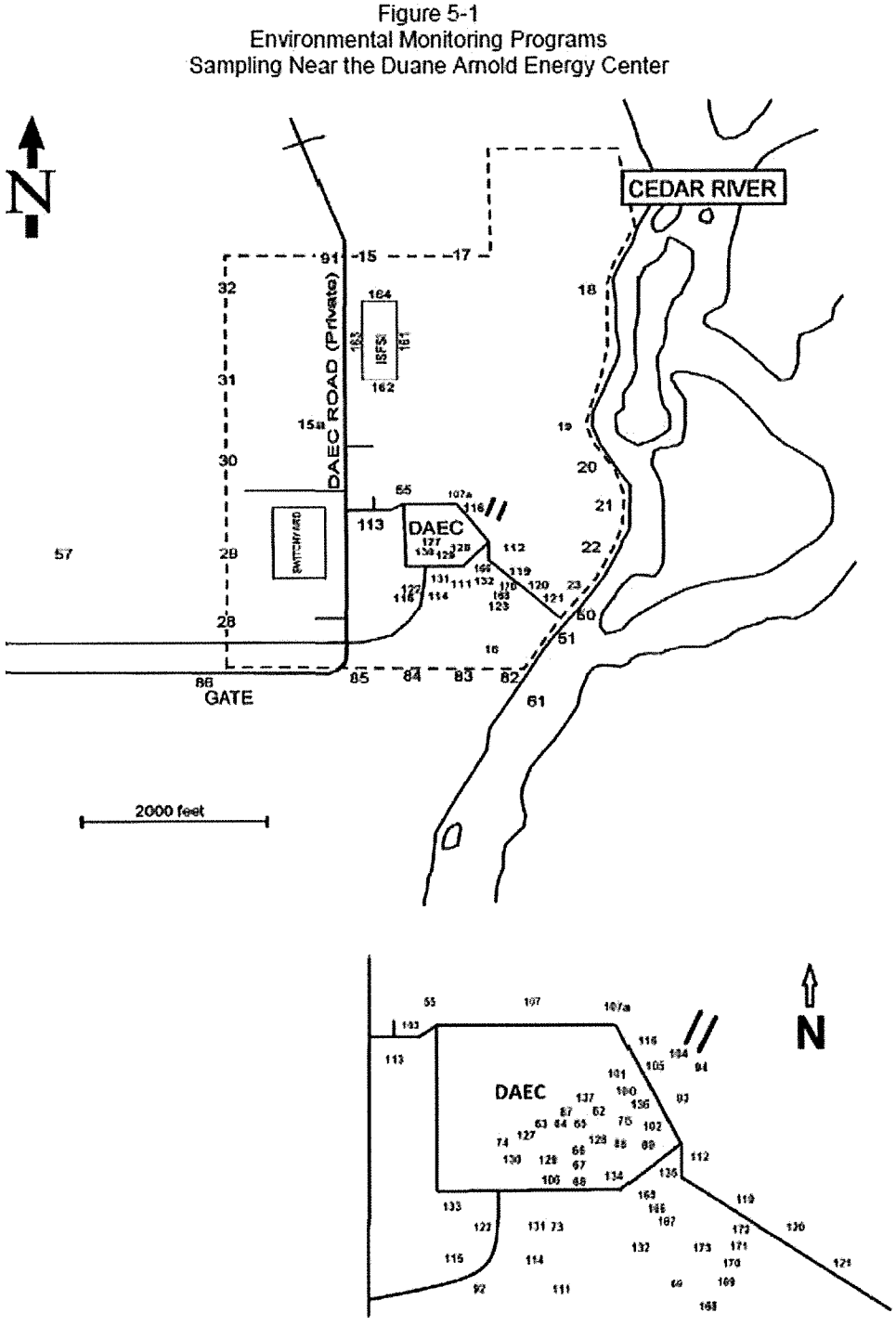
[b] LLD = Nominal lower limit of detection based on 4.66 sigma counting error for the background sample.

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

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

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

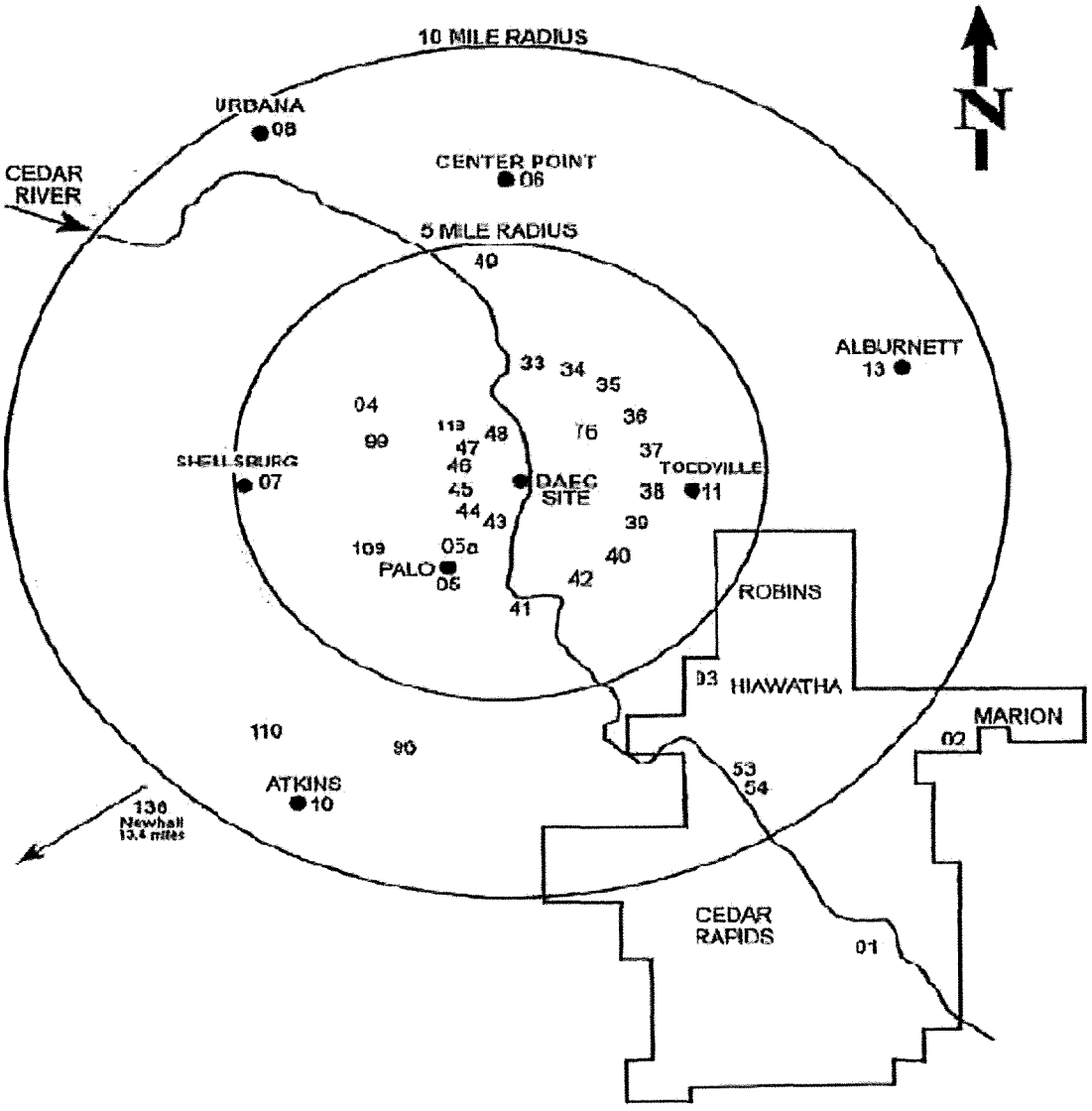
Figure 5.1 Radiological Environmental Monitoring Program Sampling Stations near the Duane Arnold Energy Center.



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

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

Figure 5-2
Radiological Environmental Monitoring Program
Sampling Stations Outside 0.5 Miles from DAEC



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

6.0 REFERENCES CITED

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

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

Environmental, Inc., Midwest Laboratory.

_____2015 Study Plan, SP-DAEC-8001, revision 24 February 12, 2015, The Operational Radiological Environmental Monitoring Program for the Duane Arnold Energy Center, Cedar Rapids, Iowa

_____2001 through 2018. Environmental Radiological Monitoring Program for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December, 2001 – 2018.

_____1984 to 2000. (formerly Teledyne Brown Engineering, Environmental Services, Midwest Laboratory) Environmental Radiological Monitoring Program for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December, 1983 - 1999.

_____1982 to 1984. (formerly Hazleton Environmental Sciences Corporation) Environmental Radiation Monitoring for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December 1981 - 1983.

_____2018. Quality Manual, Rev. 6, 20 June 2018.

_____2012. Quality Assurance Program Manual, Rev. 3, 14 November 2012.

_____2020. Quality Control Procedures Manual, Rev. 3, 15 January 2020.

_____2009. Quality Control Program, Rev. 2, 12 November 2009.

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

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

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

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

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

https://www.businessinsider.com/russian-missile-disaster-shows-signs-nuke-reactor-blew-up-experts-2019-8, last accessed on April 30, 2020.

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

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

ANNUAL REPORT - PART II
DATA TABULATIONS AND ANALYSES

January 1 to December 31, 2019

Prepared by

ATI ENVIRONMENTAL, Inc.
Midwest Laboratory

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 2019. 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
MI		D-76	01-15-19	Goat's milk unavailable due to limited herd production.
AP/AI		D-16	02-01-19	Filter very light due to mechanical pump failure. Samples discarded.
MI		D-76	02-14-19	Goat's milk unavailable due to limited herd production.
SW		D-50	02-21-19	No Sample; river frozen.
SW		D-99	02-21-19	No sample; river frozen.
AP/AI		D-11	03-29-19	No samples; pump failure.
MI		D-76	03-12-19	Goat's milk unavailable due to limited herd production.
AP/AI		D-11	04-05-19	No samples; pump failure.
MI		D-76	04-09-19	Goat's milk unavailable due to limited herd production.
MI		D-76	05-14-19	Goat's milk unavailable due to limited herd production.
WW		D-55	05-14-19	Sample not collected.
MI		D-76	06-11-19	Goat's milk unavailable due to limited herd production.
TLD		D-17	07-01-19	Sample missing in field.
MI		D-76	07-16-19	Goat's milk unavailable due to limited herd production.
MI		D-76	08-13-19	Goat's milk unavailable due to limited herd production.

2.0 PROGRAM DEVIATIONS

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
MI		D-76	09-10-19	Goat's milk unavailable due to limited herd production.
MI		D-76	10-15-19	Goat's milk unavailable due to limited herd production.
MI		D-76	11-13-19	Goat's milk unavailable due to limited herd production.
SW		D-50	12-18-19	No sample; river frozen.
SW		D-99	12-18-19	No sample; river frozen.

3.0 DATA TABLES

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-3 (Hiawatha)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta	
Required LLD		0.010	Required LLD		0.010	
01-04-19	282	0.035 ± 0.004	07-05-19	271	0.006 ± 0.003	[b]
01-11-19	286	0.044 ± 0.004	07-12-19	273	0.021 ± 0.003	
01-18-19	285	0.039 ± 0.004	07-19-19	276	0.023 ± 0.004	
01-24-19	246	0.030 ± 0.004	07-26-19	275	0.021 ± 0.004	
02-01-19	327	0.038 ± 0.004	08-02-19	273	0.026 ± 0.004	
02-08-19	288	0.042 ± 0.004	08-09-19	274	0.034 ± 0.004	
02-15-19	283	0.030 ± 0.004	08-15-19	237	0.026 ± 0.004	
02-22-19	295	0.025 ± 0.004	08-23-19	311	0.024 ± 0.004	
03-01-19	277	0.033 ± 0.004	08-30-19	273	0.017 ± 0.003	
03-08-19	284	0.031 ± 0.004	09-06-19	275	0.034 ± 0.004	
03-15-19	285	0.031 ± 0.004	09-13-19	279	0.031 ± 0.004	
03-22-19	272	0.027 ± 0.004	09-20-19	280	0.032 ± 0.004	
03-29-19	274	0.024 ± 0.004	09-26-19	238	0.028 ± 0.004	
1st Quarter Mean ± s.d.		0.033 ± 0.006	3rd Quarter Mean ± s.d.		0.025 ± 0.008	
04-05-19	274	0.015 ± 0.004	10-04-19	320	0.017 ± 0.003	
04-12-19	274	0.013 ± 0.004	10-11-19	279	0.004 ± 0.003	[c]
04-19-19	274	0.013 ± 0.003	10-19-19	320	0.020 ± 0.003	
04-26-19	275	0.018 ± 0.004	10-24-19	200	0.023 ± 0.005	
05-03-19	277	0.011 ± 0.003	11-01-19	323	0.023 ± 0.003	
05-10-19	270	0.020 ± 0.003	11-08-19	279	0.028 ± 0.004	
05-17-19	276	0.027 ± 0.004	11-15-19	280	0.039 ± 0.004	
05-24-19	276	0.007 ± 0.003	11-22-19	280	0.037 ± 0.004	
05-30-19	231	0.009 ± 0.003	11-27-19	199	0.027 ± 0.005	
06-07-19	321	0.029 ± 0.004	12-06-19	360	0.015 ± 0.003	
06-14-19	266	0.020 ± 0.004	12-12-19	240	0.026 ± 0.004	
06-21-19	274	0.022 ± 0.004	12-20-19	320	0.042 ± 0.004	
06-28-19	277	0.023 ± 0.004	12-27-19	281	0.047 ± 0.005	
			01-03-20	279	0.034 ± 0.004	
2nd Quarter Mean ± s.d.		0.017 ± 0.007	4th Quarter Mean ± s.d.		0.027 ± 0.012	
			Cumulative Average		0.026	

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

Table 2. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-4 (NW Sector)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)		Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD			0.010	Required LLD		0.010
01-04-19	306		0.035 ± 0.004	07-05-19	308	0.024 ± 0.003
01-11-19	308		0.043 ± 0.004	07-12-19	310	0.018 ± 0.003
01-18-19	308		0.039 ± 0.004	07-19-19	313	0.020 ± 0.003
01-24-19	266		0.034 ± 0.004	07-26-19	311	0.022 ± 0.003
02-01-19	352		0.041 ± 0.004	08-02-19	311	0.025 ± 0.003
02-08-19	316		0.026 ± 0.003	08-09-19	309	0.030 ± 0.004
02-15-19	300		0.031 ± 0.004	08-15-19	265	0.029 ± 0.004
02-22-19	324		0.037 ± 0.004	08-23-19	352	0.019 ± 0.003
03-01-19	299		0.027 ± 0.004	08-30-19	307	0.017 ± 0.003
03-08-19	310		0.028 ± 0.004	09-06-19	309	0.028 ± 0.004
03-15-19	309		0.032 ± 0.004	09-13-19	306	0.031 ± 0.004
03-22-19	312		0.026 ± 0.003	09-20-19	308	0.035 ± 0.004
03-29-19	311		0.021 ± 0.004	09-26-19	272	0.028 ± 0.004
1st Quarter Mean ± s.d.			0.032 ± 0.007	3rd Quarter Mean ± s.d.		0.025 ± 0.006
04-05-19	311		0.018 ± 0.003	10-04-19	345	0.014 ± 0.003
04-12-19	311		0.013 ± 0.003	10-11-19	308	0.022 ± 0.004
04-19-19	311		0.009 ± 0.003	10-19-19	353	0.016 ± 0.003
04-26-19	312		0.016 ± 0.003	10-24-19	220	0.019 ± 0.004
05-03-19	314		0.009 ± 0.003	11-01-19	356	0.019 ± 0.003
05-10-19	308		0.015 ± 0.003	11-08-19	307	0.024 ± 0.004
05-17-19	305		0.021 ± 0.003	11-15-19	308	0.033 ± 0.004
05-24-19	310		0.007 ± 0.002	11-22-19	309	0.036 ± 0.004
05-30-19	265		0.009 ± 0.003	11-27-19	219	0.020 ± 0.004
06-10-19	362	[b]	0.020 ± 0.003	12-06-19	397	0.015 ± 0.003
06-14-19	172	[c]	0.023 ± 0.005	12-12-19	264	0.031 ± 0.004
06-21-19	311		0.016 ± 0.003	12-20-19	353	0.036 ± 0.004
06-28-19	278	[d]	0.020 ± 0.004	12-27-19	309	0.038 ± 0.004
				01-03-20	271	0.028 ± 0.004
2nd Quarter Mean ± s.d.			0.015 ± 0.005	4th Quarter Mean ± s.d.		0.025 ± 0.008
				Cumulative Average		0.024

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

[b] Sample collected 3 days later due to power failure.

[c] Lower volume due to 4 days collection period.

[d] Lower volume due to power failure.

Table 3. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-5A (Palo)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	284	0.035 ± 0.004	07-05-19	291	0.027 ± 0.004
01-11-19	284	0.040 ± 0.004	07-12-19	293	0.021 ± 0.003
01-18-19	283	0.033 ± 0.004	07-19-19	296	0.022 ± 0.003
01-24-19	245	0.025 ± 0.004	07-26-19	296	0.022 ± 0.004
02-01-19	324	0.042 ± 0.004	08-02-19	292	0.028 ± 0.004
02-08-19	282	0.022 ± 0.003	08-09-19	295	0.035 ± 0.004
02-15-19	285	0.008 ± 0.003	08-15-19	251	0.032 ± 0.004
02-22-19	289	0.031 ± 0.004	08-23-19	303 [b]	0.023 ± 0.004
03-01-19	280	0.033 ± 0.004	08-30-19	293	0.017 ± 0.003
03-08-19	282	0.031 ± 0.004	09-06-19	296	0.033 ± 0.004
03-15-19	281	0.028 ± 0.004	09-13-19	292	0.031 ± 0.004
03-22-19	284	0.026 ± 0.004	09-20-19	283	0.036 ± 0.004
03-29-19	294	0.024 ± 0.004	09-26-19	245	0.031 ± 0.004
1st Quarter Mean ± s.d.		0.029 ± 0.009	3rd Quarter Mean ± s.d.		0.027 ± 0.006
04-05-19	294	0.018 ± 0.004	10-04-19	319	0.015 ± 0.003
04-12-19	294	0.016 ± 0.004	10-11-19	282	0.026 ± 0.004
04-19-19	294	0.005 ± 0.003	10-19-19	323	0.021 ± 0.003
04-26-19	295	0.016 ± 0.003	10-24-19	203	0.024 ± 0.005
05-03-19	298	0.011 ± 0.003	11-01-19	325	0.024 ± 0.003
05-10-19	289	0.019 ± 0.003	11-08-19	281	0.024 ± 0.004
05-17-19	297	0.025 ± 0.004	11-15-19	283	0.039 ± 0.004
05-24-19	291	0.008 ± 0.003	11-22-19	283	0.031 ± 0.004
05-30-19	253	0.004 ± 0.003	11-27-19	201	0.026 ± 0.005
06-07-19	337	0.023 ± 0.003	12-06-19	364	0.017 ± 0.003
06-14-19	293	0.018 ± 0.003	12-12-19	242	0.044 ± 0.005
06-21-19	294	0.020 ± 0.003	12-20-19	324	0.042 ± 0.004
06-28-19	297	0.022 ± 0.003	12-27-19	281	0.049 ± 0.005
			01-03-20	285	0.031 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.007	4th Quarter Mean ± s.d.		0.029 ± 0.010
			Cumulative Average		0.025

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

[b] Power off at the station; appr. 20 hrs less than other stations.

Table 4. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-6 (Center Point)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	280	0.033 ± 0.004	07-05-19	280	0.024 ± 0.004
01-11-19	283	0.048 ± 0.005	07-12-19	282	0.020 ± 0.003
01-18-19	282	0.039 ± 0.004	07-19-19	284	0.020 ± 0.003
01-24-19	244	0.028 ± 0.004	07-26-19	271	0.023 ± 0.004
02-01-19	323	0.039 ± 0.004	08-02-19	271	0.027 ± 0.004
02-08-19	284	0.025 ± 0.004	08-09-19	272	0.029 ± 0.004
02-15-19	280	0.022 ± 0.004	08-15-19	235	0.035 ± 0.005
02-22-19	289	0.034 ± 0.004	08-23-19	308	0.024 ± 0.004
03-01-19	277	0.030 ± 0.004	08-30-19	270	0.020 ± 0.004
03-08-19	282	0.033 ± 0.004	09-06-19	272	0.025 ± 0.004
03-15-19	280	0.029 ± 0.004	09-13-19	269	0.026 ± 0.004
03-22-19	283	0.025 ± 0.004	09-20-19	271	0.022 ± 0.004
03-29-19	283	0.022 ± 0.004	09-26-19	232	0.026 ± 0.004
1st Quarter Mean ± s.d.		0.031 ± 0.008	3rd Quarter Mean ± s.d.		0.025 ± 0.004
04-05-19	282	0.021 ± 0.004	10-04-19	310	0.017 ± 0.003
04-12-19	283	0.011 ± 0.003	10-11-19	271	0.026 ± 0.004
04-19-19	282	0.013 ± 0.003	10-19-19	310	0.021 ± 0.003
04-26-19	283	0.017 ± 0.003	10-24-19	194	0.028 ± 0.005
05-03-19	286	0.006 ± 0.003	11-01-19	313	0.018 ± 0.003
05-10-19	279	0.016 ± 0.003	11-08-19	270	0.025 ± 0.004
05-17-19	284	0.023 ± 0.004	11-15-19	271	0.036 ± 0.004
05-24-19	284	0.008 ± 0.003	11-22-19	272	0.035 ± 0.004
05-30-19	238	0.006 ± 0.003	11-27-19	193	0.026 ± 0.005
06-07-19	330	0.023 ± 0.003	12-06-19	349	0.016 ± 0.003
06-14-19	275	0.021 ± 0.004	12-12-19	237	0.040 ± 0.005
06-21-19	282	0.024 ± 0.004	12-20-19	317	0.039 ± 0.004
06-28-19	285	0.018 ± 0.003	12-27-19	278	0.043 ± 0.005
			01-03-20	277	0.032 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.006	4th Quarter Mean ± s.d.		0.029 ± 0.009
			Cumulative Average		0.025

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

Table 5. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: D-7 (Shellsburg)
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	272	0.033 ± 0.004	07-05-19	302	0.025 ± 0.003
01-11-19	272	0.040 ± 0.005	07-12-19	305	0.016 ± 0.003
01-18-19	271	0.040 ± 0.004	07-19-19	307	0.020 ± 0.003
01-24-19	234	0.025 ± 0.004	07-26-19	292	0.026 ± 0.004
02-01-19	310	0.044 ± 0.004	08-02-19	289	0.028 ± 0.004
02-08-19	270	0.028 ± 0.004	08-09-19	292	0.040 ± 0.004
02-15-19	307	0.022 ± 0.003	08-15-19	249	0.031 ± 0.004
02-22-19	311	0.018 ± 0.003	08-23-19	334	0.024 ± 0.003
03-01-19	301	0.029 ± 0.004	08-30-19	290	0.017 ± 0.003
03-08-19	304	0.029 ± 0.004	09-06-19	293	0.033 ± 0.004
03-15-19	303	0.032 ± 0.004	09-13-19	290	0.034 ± 0.004
03-22-19	306	0.021 ± 0.003	09-20-19	292	0.034 ± 0.004
03-29-19	306	0.019 ± 0.004	09-26-19	247	0.031 ± 0.004
1st Quarter Mean ± s.d.		0.029 ± 0.008	3rd Quarter Mean ± s.d.		0.028 ± 0.007
04-05-19	305	0.023 ± 0.004	10-04-19	334	0.015 ± 0.003
04-12-19	305	0.015 ± 0.003	10-11-19	294	0.022 ± 0.004
04-19-19	305	0.011 ± 0.003	10-19-19	333	0.021 ± 0.003
04-26-19	306	0.017 ± 0.003	10-24-19	208	0.031 ± 0.005
05-03-19	306	0.012 ± 0.003	11-01-19	336	0.018 ± 0.003
05-10-19	304	0.017 ± 0.003	11-08-19	290	0.024 ± 0.004
05-17-19	309	0.023 ± 0.003	11-15-19	291	0.039 ± 0.004
05-24-19	304	0.007 ± 0.003	11-22-19	291	0.035 ± 0.004
05-30-19	260	0.010 ± 0.003	11-27-19	207	0.024 ± 0.005
06-07-19	354	0.023 ± 0.003	12-06-19	375	0.019 ± 0.003
06-14-19	300	0.021 ± 0.003	12-12-19	249	0.037 ± 0.005
06-21-19	305	0.020 ± 0.003	12-20-19	333	0.037 ± 0.004
06-28-19	309	0.019 ± 0.003	12-27-19	298	0.044 ± 0.004
			01-03-20	294	0.026 ± 0.004
2nd Quarter Mean ± s.d.		0.017 ± 0.006	4th Quarter Mean ± s.d.		0.028 ± 0.009
			Cumulative Average		0.025

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

Table 6. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-11 (Toddville)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	277	0.041 ± 0.004	07-05-19	274	0.023 ± 0.004
01-11-19	280	0.038 ± 0.004	07-12-19	276	0.023 ± 0.004
01-18-19	279	0.035 ± 0.004	07-19-19	278	0.022 ± 0.004
01-24-19	241	0.024 ± 0.004	07-26-19	278	0.025 ± 0.004
02-01-19	320	0.037 ± 0.004	08-02-19	276	0.028 ± 0.004
02-08-19	282	0.016 ± 0.003	08-09-19	277	0.032 ± 0.004
02-15-19	277	0.016 ± 0.003	08-15-19	240	0.034 ± 0.005
02-22-19	289	0.031 ± 0.004	08-23-19	315	0.023 ± 0.003
03-01-19	272	0.032 ± 0.004	08-30-19	276	0.022 ± 0.004
03-08-19	279	0.030 ± 0.004	09-06-19	278	0.034 ± 0.004
03-15-19	278	0.028 ± 0.004	09-13-19	276	0.025 ± 0.004
03-22-19	280	0.024 ± 0.004	09-20-19	278	0.036 ± 0.004
03-29-19		NS[b]	09-26-19	239	0.033 ± 0.005
1st Quarter Mean ± s.d.		0.029 ± 0.008	3rd Quarter Mean ± s.d.		0.028 ± 0.005
04-05-19		NS[b]	10-04-19	313	0.019 ± 0.003
04-12-19	280	0.013 ± 0.004	10-11-19	276	0.026 ± 0.004
04-19-19	280	0.012 ± 0.003	10-19-19	317	0.020 ± 0.003
04-26-19	280	0.016 ± 0.003	10-24-19	198	0.030 ± 0.005
05-03-19	280	0.013 ± 0.003	11-01-19	320	0.020 ± 0.003
05-10-19	273	0.016 ± 0.003	11-08-19	276	0.026 ± 0.004
05-17-19	278	0.027 ± 0.004	11-15-19	277	0.038 ± 0.004
05-24-19	280	0.013 ± 0.003	11-22-19	277	0.034 ± 0.004
05-30-19	233	0.011 ± 0.004	11-27-19	197	0.023 ± 0.005
06-07-19	324	0.026 ± 0.003	12-06-19	357	0.019 ± 0.003
06-14-19	269	0.023 ± 0.004	12-12-19	237	0.040 ± 0.005
06-21-19	276	0.020 ± 0.004	12-20-19	317	0.043 ± 0.004
06-28-19	280	0.023 ± 0.004	12-27-19	278	0.049 ± 0.005
			01-03-20	277	0.023 ± 0.004
2nd Quarter Mean ± s.d.		0.018 ± 0.006	4th Quarter Mean ± s.d.		0.029 ± 0.010
			Cumulative Average		0.026

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

[b] No sample; pump problems.

Table 7. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-13 (Alburnett)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	271	0.032 ± 0.004	07-05-19	274	0.025 ± 0.004
01-11-19	274	0.044 ± 0.005	07-12-19	276	0.018 ± 0.003
01-18-19	274	0.034 ± 0.004	07-19-19	278	0.017 ± 0.003
01-24-19	236	0.025 ± 0.004	07-26-19	277	0.019 ± 0.004
02-01-19	314	0.046 ± 0.004	08-02-19	277	0.024 ± 0.004
02-08-19	276	0.027 ± 0.004	08-09-19	277	0.028 ± 0.004
02-15-19	272	0.028 ± 0.004	08-15-19	240	0.031 ± 0.004
02-22-19	282	0.034 ± 0.004	08-23-19	315	0.024 ± 0.004
03-01-19	266	0.031 ± 0.004	08-30-19	276	0.019 ± 0.003
03-08-19	274	0.039 ± 0.004	09-06-19	278	0.026 ± 0.004
03-15-19	272	0.032 ± 0.004	09-13-19	266	0.027 ± 0.004
03-22-19	277	0.020 ± 0.003	09-20-19	269	0.037 ± 0.005
03-29-19	277	0.017 ± 0.004	09-26-19	231	0.028 ± 0.004
1st Quarter Mean ± s.d.		0.031 ± 0.008	3rd Quarter Mean ± s.d.		0.025 ± 0.006
04-05-19	277	0.019 ± 0.004	10-04-19	305	0.018 ± 0.003
04-12-19	277	0.012 ± 0.004	10-11-19	268	0.023 ± 0.004
04-19-19	277	0.011 ± 0.003	10-19-19	307	0.019 ± 0.003
04-26-19	277	0.015 ± 0.003	10-24-19	192	0.030 ± 0.005
05-03-19	280	0.011 ± 0.003	11-01-19	310	0.016 ± 0.003
05-10-19	273	0.016 ± 0.003	11-08-19	267	0.025 ± 0.004
05-17-19	278	0.020 ± 0.003	11-15-19	269	0.036 ± 0.004
05-24-19	278	0.008 ± 0.003	11-22-19	269	0.037 ± 0.004
05-30-19	233	0.009 ± 0.003	11-27-19	191	0.019 ± 0.005
06-07-19	324	0.020 ± 0.003	12-06-19	346	0.019 ± 0.003
06-14-19	269	0.019 ± 0.004	12-12-19	230	0.036 ± 0.005
06-21-19	277	0.017 ± 0.004	12-20-19	307	0.043 ± 0.004
06-28-19	280	0.018 ± 0.003	12-27-19	269	0.046 ± 0.005
			01-03-20	268	0.032 ± 0.004
2nd Quarter Mean ± s.d.		0.015 ± 0.004	4th Quarter Mean ± s.d.		0.028 ± 0.010
			Cumulative Average		0.025

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

Table 8. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

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

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	264	0.025 ± 0.004	07-05-19	271	0.026 ± 0.004
01-11-19	266	0.047 ± 0.005	07-12-19	273	0.019 ± 0.003
01-18-19	265	0.036 ± 0.004	07-19-19	276	0.025 ± 0.004
01-24-19	229	0.030 ± 0.004	07-26-19	274	0.024 ± 0.004
02-01-19	303	0.042 ± 0.004	08-02-19	274	0.021 ± 0.003
02-08-19	267	0.025 ± 0.004	08-09-19	274	0.034 ± 0.004
02-15-19	264	0.030 ± 0.004	08-15-19	236	0.031 ± 0.005
02-22-19	278	0.037 ± 0.004	08-23-19	313	0.021 ± 0.003
03-01-19	254	0.026 ± 0.004	08-30-19	273	0.021 ± 0.004
03-08-19	265	0.037 ± 0.004	09-06-19	275	0.033 ± 0.004
03-15-19	263	0.036 ± 0.004	09-13-19	272	0.034 ± 0.004
03-22-19	266	0.026 ± 0.004	09-20-19	305	0.037 ± 0.004
03-29-19	274	0.023 ± 0.004	09-26-19	269	0.030 ± 0.004
1st Quarter Mean ± s.d.		0.032 ± 0.007	3rd Quarter Mean ± s.d.		0.028 ± 0.006
04-05-19	274	0.019 ± 0.004	10-04-19	341	0.018 ± 0.003
04-12-19	274	0.014 ± 0.004	10-11-19	305	0.028 ± 0.004
04-19-19	274	0.011 ± 0.003	10-19-19	349	0.022 ± 0.003
04-26-19	275	0.021 ± 0.004	10-24-19	218	0.028 ± 0.005
05-03-19	276	0.013 ± 0.003	11-01-19	353	0.019 ± 0.003
05-10-19	271	0.018 ± 0.003	11-08-19	304	0.023 ± 0.004
05-17-19	268	0.024 ± 0.004	11-15-19	306	0.038 ± 0.004
05-24-19	279	0.007 ± 0.003	11-22-19	306	0.038 ± 0.004
05-30-19	227	0.010 ± 0.004	11-27-19	217	0.026 ± 0.004
06-07-19	319	0.024 ± 0.003	12-06-19	393	0.019 ± 0.003
06-14-19	268	0.024 ± 0.004	12-12-19	261	0.040 ± 0.005
06-21-19	274	0.019 ± 0.004	12-20-19	350	0.040 ± 0.004
06-28-19	277	0.017 ± 0.003	12-27-19	305	0.042 ± 0.004
			01-03-20	307	0.023 ± 0.004
2nd Quarter Mean ± s.d.		0.017 ± 0.006	4th Quarter Mean ± s.d.		0.029 ± 0.009
			Cumulative Average		0.027

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

Table 9. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].

Location: D-16 (On-site)

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	270	0.028 ± 0.004	07-05-19	274	0.027 ± 0.004
01-11-19	271	0.036 ± 0.004	07-12-19	276	0.021 ± 0.003
01-18-19	271	0.034 ± 0.004	07-19-19	278	0.025 ± 0.004
01-24-19	234	0.030 ± 0.004	07-26-19	277	0.025 ± 0.004
02-01-19	317	NS[b]	08-02-19	277	0.026 ± 0.004
02-08-19	265	0.018 ± 0.003	08-09-19	277	0.041 ± 0.004
02-15-19	273	0.027 ± 0.004	08-15-19	238	0.033 ± 0.005
02-22-19	286	0.030 ± 0.004	08-23-19	317	0.023 ± 0.003
03-01-19	265	0.033 ± 0.004	08-30-19	276	0.022 ± 0.004
03-08-19	276	0.040 ± 0.004	09-06-19	278	0.032 ± 0.004
03-15-19	275	0.036 ± 0.004	09-13-19	277	0.034 ± 0.004
03-22-19	277	0.029 ± 0.004	09-20-19	277	0.038 ± 0.005
03-29-19	277	0.020 ± 0.004	09-26-19	244	0.033 ± 0.004
1st Quarter Mean ± s.d.		0.030 ± 0.006	3rd Quarter Mean ± s.d.		0.029 ± 0.007
04-05-19	277	0.021 ± 0.004	10-04-19	309	0.017 ± 0.003
04-12-19	277	0.019 ± 0.004	10-11-19	276	0.024 ± 0.004
04-19-19	277	0.012 ± 0.003	10-19-19	317	0.020 ± 0.003
04-26-19	277	0.022 ± 0.004	10-24-19	198	0.026 ± 0.005
05-03-19	279	0.011 ± 0.003	11-01-19	320	0.026 ± 0.003
05-10-19	274	0.020 ± 0.003	11-08-19	276	0.025 ± 0.004
05-17-19	277	0.024 ± 0.004	11-15-19	277	0.037 ± 0.004
05-24-19	285	0.008 ± 0.003	11-22-19	277	0.029 ± 0.004
05-30-19	229	0.012 ± 0.004	11-27-19	197	0.026 ± 0.005
06-07-19	321	0.025 ± 0.003	12-06-19	357	0.018 ± 0.003
06-14-19	272	0.020 ± 0.004	12-12-19	237	0.041 ± 0.005
06-21-19	276	0.018 ± 0.004	12-20-19	317	0.033 ± 0.004
06-28-19	280	0.019 ± 0.003	12-27-19	277	0.046 ± 0.005
			01-03-20	284	0.028 ± 0.004
2nd Quarter Mean ± s.d.		0.018 ± 0.005	4th Quarter Mean ± s.d.		0.028 ± 0.008
			Cumulative Average		0.026

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

[b] Sample very light; discarded per station request.

Table 10. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131[a].
Location: D-40 (Wickiup Hill)
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-04-19	299	0.032 ± 0.004	07-05-19	291	0.025 ± 0.004
01-11-19	303	0.017 ± 0.003	07-12-19	293	0.018 ± 0.003
01-18-19	302	0.039 ± 0.004	07-19-19	296	0.023 ± 0.004
01-24-19	261	0.028 ± 0.004	07-26-19	295	0.022 ± 0.004
02-01-19	346	0.039 ± 0.004	08-02-19	292	0.027 ± 0.004
02-08-19	307	0.024 ± 0.003	08-09-19	295	0.030 ± 0.004
02-15-19	298	0.028 ± 0.004	08-15-19	255	0.027 ± 0.004
02-22-19	313	0.032 ± 0.004	08-23-19	334	0.020 ± 0.003
03-01-19	295	0.060 ± 0.005	08-30-19	293	0.018 ± 0.003
03-08-19	305	0.030 ± 0.004	09-06-19	296	0.030 ± 0.004
03-15-19	296	0.030 ± 0.004	09-13-19	293	0.035 ± 0.004
03-22-19	304	0.027 ± 0.004	09-20-19	295	0.033 ± 0.004
03-29-19	303	0.017 ± 0.003	09-26-19	254	0.029 ± 0.004
1st Quarter Mean ± s.d.		0.031 ± 0.011	3rd Quarter Mean ± s.d.		0.026 ± 0.005
04-05-19	302	0.020 ± 0.004	10-04-19	333	0.016 ± 0.003
04-12-19	303	0.016 ± 0.003	10-11-19	268	0.026 ± 0.004
04-19-19	302	0.014 ± 0.003	10-19-19	307	0.023 ± 0.004
04-26-19	303	0.018 ± 0.003	10-24-19	191	0.027 ± 0.005
05-03-19	298	0.010 ± 0.003	11-01-19	310	0.020 ± 0.003
05-10-19	290	0.019 ± 0.003	11-08-19	267	0.024 ± 0.004
05-17-19	295	0.022 ± 0.003	11-15-19	269	0.035 ± 0.004
05-24-19	299	0.011 ± 0.003	11-22-19	269	0.038 ± 0.004
05-30-19	262	0.011 ± 0.003	11-27-19	191	0.027 ± 0.005
06-07-19	345	0.024 ± 0.003	12-06-19	345	0.017 ± 0.003
06-14-19	284	0.019 ± 0.003	12-12-19	230	0.041 ± 0.005
06-21-19	294	0.015 ± 0.003	12-20-19	307	0.045 ± 0.004
06-28-19	297	0.019 ± 0.003	12-27-19	269	0.047 ± 0.005
			01-03-20	269	0.030 ± 0.004
2nd Quarter Mean ± s.d.		0.017 ± 0.004	4th Quarter Mean ± s.d.		0.030 ± 0.010
			Cumulative Average		0.026

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

Table 11. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location	D-3			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1296	DAP- 2689	DAP- 4075	DAP- 5052
Volume (m^3)	3684	3565	3537	3960
Be-7	0.083 ± 0.015	0.075 ± 0.018	0.091 ± 0.019	0.068 ± 0.013
Mn-54	< 0.0006	< 0.0012	< 0.0010	< 0.0007
Fe-59	< 0.0010	< 0.0011	< 0.0024	< 0.0007
Co-58	< 0.0009	< 0.0009	< 0.0011	< 0.0004
Co-60	< 0.0010	< 0.0007	< 0.0009	< 0.0005
Zn-65	< 0.0008	< 0.0008	< 0.0012	< 0.0007
Nb-95	< 0.0010	< 0.0015	< 0.0010	< 0.0012
Zr-95	< 0.0010	< 0.0021	< 0.0022	< 0.0017
Ru-103	< 0.0008	< 0.0008	< 0.0016	< 0.0011
Ru-106	< 0.0064	< 0.0075	< 0.0081	< 0.0064
Cs-134	< 0.0010	< 0.0012	< 0.0010	< 0.0009
Cs-137	< 0.0007	< 0.0009	< 0.0011	< 0.0007
Ce-141	< 0.0017	< 0.0017	< 0.0017	< 0.0011
Ce-144	< 0.0045	< 0.0043	< 0.0048	< 0.0039
Location	D-4			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1297	DAP- 2691	DAP- 4076	DAP- 5053
Volume (m^3)	4021	3869	3981	4320
Be-7	0.083 ± 0.014	0.068 ± 0.016	0.079 ± 0.014	0.058 ± 0.012
Mn-54	< 0.0007	< 0.0009	< 0.0009	< 0.0005
Fe-59	< 0.0014	< 0.0024	< 0.0021	< 0.0009
Co-58	< 0.0005	< 0.0009	< 0.0005	< 0.0005
Co-60	< 0.0008	< 0.0008	< 0.0007	< 0.0004
Zn-65	< 0.0014	< 0.0013	< 0.0016	< 0.0010
Nb-95	< 0.0010	< 0.0010	< 0.0010	< 0.0008
Zr-95	< 0.0015	< 0.0014	< 0.0014	< 0.0016
Ru-103	< 0.0005	< 0.0009	< 0.0011	< 0.0009
Ru-106	< 0.0054	< 0.0073	< 0.0057	< 0.0044
Cs-134	< 0.0007	< 0.0014	< 0.0010	< 0.0007
Cs-137	< 0.0007	< 0.0007	< 0.0006	< 0.0005
Ce-141	< 0.0015	< 0.0015	< 0.0014	< 0.0015
Ce-144	< 0.0032	< 0.0029	< 0.0035	< 0.0042
Location	D-5A			
Lab Code	DAP- 1298	DAP- 2692	DAP- 4077	DAP- 5054
Volume (m^3)	3697	3825	3726	3996
Be-7	0.070 ± 0.015	0.071 ± 0.016	0.090 ± 0.015	0.058 ± 0.011
Mn-54	< 0.0009	< 0.0009	< 0.0008	< 0.0006
Fe-59	< 0.0015	< 0.0015	< 0.0020	< 0.0012
Co-58	< 0.0007	< 0.0007	< 0.0007	< 0.0007
Co-60	< 0.0006	< 0.0004	< 0.0007	< 0.0004
Zn-65	< 0.0006	< 0.0016	< 0.0016	< 0.0007
Nb-95	< 0.0008	< 0.0009	< 0.0009	< 0.0009
Zr-95	< 0.0010	< 0.0017	< 0.0015	< 0.0019
Ru-103	< 0.0008	< 0.0011	< 0.0011	< 0.0006
Ru-106	< 0.0057	< 0.0074	< 0.0069	< 0.0040
Cs-134	< 0.0010	< 0.0012	< 0.0009	< 0.0009
Cs-137	< 0.0006	< 0.0006	< 0.0008	< 0.0005
Ce-141	< 0.0010	< 0.0015	< 0.0013	< 0.0011
Ce-144	< 0.0041	< 0.0034	< 0.0035	< 0.0029

Table 11. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location	D-6			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1299	DAP- 2693	DAP- 4078	DAP- 5055
Volume (m^3)	3670	3674	3516	3861
Be-7	0.084 ± 0.014	0.071 ± 0.015	0.067 ± 0.015	0.050 ± 0.011
Mn-54	< 0.0010	< 0.0009	< 0.0008	< 0.0006
Fe-59	< 0.0009	< 0.0016	< 0.0015	< 0.0010
Co-58	< 0.0010	< 0.0007	< 0.0009	< 0.0004
Co-60	< 0.0010	< 0.0007	< 0.0009	< 0.0006
Zn-65	< 0.0008	< 0.0014	< 0.0014	< 0.0006
Nb-95	< 0.0013	< 0.0010	< 0.0014	< 0.0012
Zr-95	< 0.0013	< 0.0018	< 0.0021	< 0.0010
Ru-103	< 0.0013	< 0.0010	< 0.0011	< 0.0008
Ru-106	< 0.0080	< 0.0093	< 0.0064	< 0.0036
Cs-134	< 0.0011	< 0.0011	< 0.0010	< 0.0010
Cs-137	< 0.0010	< 0.0007	< 0.0006	< 0.0004
Ce-141	< 0.0014	< 0.0019	< 0.0015	< 0.0017
Ce-144	< 0.0053	< 0.0032	< 0.0034	< 0.0027
Location	D-7			
Lab Code	DAP- 1300	DAP- 2694	DAP- 4079	DAP- 5056
Volume (m^3)	3765	3973	3782	4135
Be-7	0.078 ± 0.014	0.073 ± 0.014	0.077 ± 0.014	0.054 ± 0.011
Mn-54	< 0.0009	< 0.0010	< 0.0008	< 0.0004
Fe-59	< 0.0015	< 0.0025	< 0.0022	< 0.0011
Co-58	< 0.0007	< 0.0008	< 0.0005	< 0.0005
Co-60	< 0.0006	< 0.0007	< 0.0009	< 0.0005
Zn-65	< 0.0009	< 0.0007	< 0.0011	< 0.0010
Nb-95	< 0.0008	< 0.0008	< 0.0010	< 0.0009
Zr-95	< 0.0017	< 0.0006	< 0.0012	< 0.0011
Ru-103	< 0.0010	< 0.0006	< 0.0011	< 0.0012
Ru-106	< 0.0045	< 0.0060	< 0.0078	< 0.0050
Cs-134	< 0.0009	< 0.0010	< 0.0010	< 0.0008
Cs-137	< 0.0006	< 0.0009	< 0.0005	< 0.0008
Ce-141	< 0.0011	< 0.0013	< 0.0015	< 0.0012
Ce-144	< 0.0051	< 0.0036	< 0.0035	< 0.0037
Location	D-11			
Lab Code	DAP- 1301	DAP- 2695	DAP- 4080	DAP- 5057
Volume (m^3)	3353	3334	3560	3916
Be-7	0.076 ± 0.022	0.078 ± 0.019	0.075 ± 0.015	0.060 ± 0.013
Mn-54	< 0.0013	< 0.0010	< 0.0009	< 0.0007
Fe-59	< 0.0021	< 0.0027	< 0.0015	< 0.0011
Co-58	< 0.0012	< 0.0010	< 0.0008	< 0.0008
Co-60	< 0.0012	< 0.0006	< 0.0011	< 0.0005
Zn-65	< 0.0032	< 0.0009	< 0.0014	< 0.0005
Nb-95	< 0.0036	< 0.0015	< 0.0014	< 0.0010
Zr-95	< 0.0024	< 0.0015	< 0.0020	< 0.0016
Ru-103	< 0.0016	< 0.0014	< 0.0013	< 0.0009
Ru-106	< 0.0124	< 0.0092	< 0.0063	< 0.0066
Cs-134	< 0.0012	< 0.0011	< 0.0012	< 0.0007
Cs-137	< 0.0009	< 0.0005	< 0.0005	< 0.0005
Ce-141	< 0.0032	< 0.0017	< 0.0016	< 0.0011
Ce-144	< 0.0052	< 0.0040	< 0.0035	< 0.0034

Table 11. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite Units: pCi/m^3

Location	D-13			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1302	DAP- 2696	DAP- 4081	DAP- 5058
Volume (m^3)	3565	3600	3534	3797
Be-7	0.085 ± 0.018	0.060 ± 0.014	0.063 ± 0.013	0.045 ± 0.015
Mn-54	< 0.0011	< 0.0011	< 0.0011	< 0.0007
Fe-59	< 0.0010	< 0.0023	< 0.0024	< 0.0014
Co-58	< 0.0006	< 0.0011	< 0.0008	< 0.0006
Co-60	< 0.0008	< 0.0005	< 0.0009	< 0.0010
Zn-65	< 0.0010	< 0.0012	< 0.0008	< 0.0007
Nb-95	< 0.0018	< 0.0009	< 0.0014	< 0.0016
Zr-95	< 0.0008	< 0.0022	< 0.0020	< 0.0020
Ru-103	< 0.0011	< 0.0009	< 0.0013	< 0.0011
Ru-106	< 0.0083	< 0.0074	< 0.0068	< 0.0061
Cs-134	< 0.0011	< 0.0010	< 0.0012	< 0.0010
Cs-137	< 0.0009	< 0.0010	< 0.0009	< 0.0007
Ce-141	< 0.0018	< 0.0015	< 0.0015	< 0.0018
Ce-144	< 0.0061	< 0.0039	< 0.0037	< 0.0029
Location	D-15			
Lab Code	DAP- 1303	DAP- 2697	DAP- 4082	DAP- 5059
Volume (m^3)	3458	3556	3585	4316
Be-7	0.088 ± 0.016	0.067 ± 0.016	0.067 ± 0.014	0.066 ± 0.015
Mn-54	< 0.0007	< 0.0012	< 0.0009	< 0.0008
Fe-59	< 0.0016	< 0.0028	< 0.0023	< 0.0028
Co-58	< 0.0006	< 0.0006	< 0.0009	< 0.0006
Co-60	< 0.0005	< 0.0009	< 0.0008	< 0.0010
Zn-65	< 0.0018	< 0.0017	< 0.0014	< 0.0019
Nb-95	< 0.0015	< 0.0009	< 0.0015	< 0.0005
Zr-95	< 0.0012	< 0.0016	< 0.0017	< 0.0012
Ru-103	< 0.0007	< 0.0009	< 0.0011	< 0.0011
Ru-106	< 0.0076	< 0.0090	< 0.0083	< 0.0068
Cs-134	< 0.0009	< 0.0010	< 0.0008	< 0.0009
Cs-137	< 0.0010	< 0.0006	< 0.0009	< 0.0008
Ce-141	< 0.0019	< 0.0018	< 0.0018	< 0.0019
Ce-144	< 0.0031	< 0.0042	< 0.0040	< 0.0045
Location	D-16			
Lab Code	DAP- 1304	DAP- 2698	DAP- 4083	DAP- 5060
Volume (m^3)	3557	3602	3565	3918
Be-7	0.074 ± 0.018	0.080 ± 0.016	0.077 ± 0.017	0.063 ± 0.012
Mn-54	< 0.0011	< 0.0009	< 0.0008	< 0.0011
Fe-59	< 0.0012	< 0.0020	< 0.0018	< 0.0013
Co-58	< 0.0011	< 0.0009	< 0.0010	< 0.0006
Co-60	< 0.0011	< 0.0004	< 0.0009	< 0.0009
Zn-65	< 0.0028	< 0.0016	< 0.0014	< 0.0007
Nb-95	< 0.0016	< 0.0017	< 0.0015	< 0.0007
Zr-95	< 0.0021	< 0.0017	< 0.0013	< 0.0013
Ru-103	< 0.0009	< 0.0009	< 0.0012	< 0.0012
Ru-106	< 0.0079	< 0.0062	< 0.0087	< 0.0066
Cs-134	< 0.0011	< 0.0011	< 0.0011	< 0.0010
Cs-137	< 0.0011	< 0.0006	< 0.0008	< 0.0011
Ce-141	< 0.0028	< 0.0018	< 0.0017	< 0.0013
Ce-144	< 0.0063	< 0.0035	< 0.0035	< 0.0050

Table 11. Airborne particulates, analyses for gamma-emitting isotopes.

Collection: Quarterly Composite Units: pCi/m^3

Location	D-40			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP- 1305	DAP- 2699	DAP- 4084	DAP- 5062
Volume (m^3)	3931	3875	3780	3824
Be-7	0.074 ± 0.016	0.081 ± 0.015	0.080 ± 0.017	0.053 ± 0.011
Mn-54	< 0.0005	< 0.0010	< 0.0004	< 0.0005
Fe-59	< 0.0016	< 0.0015	< 0.0026	< 0.0014
Co-58	< 0.0004	< 0.0008	< 0.0005	< 0.0005
Co-60	< 0.0005	< 0.0007	< 0.0011	< 0.0005
Zn-65	< 0.0016	< 0.0007	< 0.0011	< 0.0006
Nb-95	< 0.0006	< 0.0010	< 0.0015	< 0.0010
Zr-95	< 0.0008	< 0.0013	< 0.0017	< 0.0011
Ru-103	< 0.0013	< 0.0010	< 0.0009	< 0.0009
Ru-106	< 0.0060	< 0.0079	< 0.0068	< 0.0054
Cs-134	< 0.0009	< 0.0009	< 0.0011	< 0.0008
Cs-137	< 0.0008	< 0.0007	< 0.0007	< 0.0005
Ce-141	< 0.0014	< 0.0015	< 0.0014	< 0.0009
Ce-144	< 0.0032	< 0.0036	< 0.0035	< 0.0041

Table 12. Ambient gamma radiation as measured by thermoluminescent dosimeters (TLD). Quarterly collection. Units: mR/91 days

Control Locations	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-1	15.6 ± 1.7	14.4 ± 1.7	16.6 ± 1.7	22.2 ± 0.8
D-2	14.7 ± 1.6	13.4 ± 1.2	15.6 ± 1.1	22.2 ± 1.0
D-3	13.9 ± 2.2	13.4 ± 1.2	14.5 ± 0.6	23.5 ± 1.5
D-4	15.0 ± 0.4	14.7 ± 1.6	16.5 ± 1.7	24.3 ± 1.3
D-5	17.3 ± 2.1	16.9 ± 1.1	18.6 ± 1.3	27.4 ± 1.5
D-5A	15.9 ± 1.2	18.8 ± 1.1	16.5 ± 0.7	20.6 ± 0.8
D-6	15.1 ± 1.3	15.6 ± 1.2	15.6 ± 0.8	25.0 ± 1.0
D-7	12.7 ± 1.7	14.4 ± 1.2	13.4 ± 0.6	23.8 ± 1.0
D-8	18.0 ± 1.6	16.9 ± 1.7	18.9 ± 1.1	26.2 ± 1.7
D-10	17.1 ± 1.6	16.8 ± 1.7	18.3 ± 1.0	24.6 ± 1.4
D-11	13.4 ± 1.4	13.5 ± 1.7	13.4 ± 0.7	21.5 ± 1.1
D-13	15.8 ± 1.4	15.4 ± 1.6	16.4 ± 0.8	23.2 ± 1.4
Mean ± s.d.	15.4 ± 1.6	15.4 ± 1.7	16.2 ± 1.8	23.7 ± 1.9
Within 0.5 mi. of Stack				
D-15	14.9 ± 1.6	16.0 ± 1.0	15.0 ± 1.0	21.5 ± 0.8
D-16	16.1 ± 1.7	16.7 ± 1.3	17.6 ± 1.1	25.4 ± 1.3
D-17	16.9 ± 1.3	ND[a]	19.5 ± 1.0	31.2 ± 1.2
D-18	15.1 ± 1.9	17.2 ± 1.1	17.3 ± 1.4	25.7 ± 1.0
D-19	14.8 ± 1.7	16.0 ± 1.1	15.9 ± 1.2	24.8 ± 0.9
D-20	17.9 ± 1.5	16.6 ± 1.3	18.4 ± 1.1	26.8 ± 1.6
D-21	15.9 ± 1.3	18.0 ± 1.5	18.1 ± 0.8	27.5 ± 1.3
D-22	16.6 ± 1.6	18.2 ± 1.0	16.6 ± 0.9	26.8 ± 1.0
D-23	13.0 ± 1.7	17.3 ± 1.7	13.8 ± 1.0	21.2 ± 1.1
D-28	16.6 ± 1.6	19.7 ± 1.2	19.4 ± 0.9	29.1 ± 1.4
D-29	16.3 ± 1.4	18.8 ± 1.6	19.9 ± 1.0	28.9 ± 1.5
D-30	14.4 ± 1.6	21.8 ± 2.8	17.3 ± 1.3	25.4 ± 2.3
D-31	15.4 ± 1.5	19.7 ± 2.0	19.4 ± 1.3	29.4 ± 1.8
D-32	16.8 ± 1.6	21.2 ± 1.6	18.3 ± 1.1	25.6 ± 1.3
D-82	16.3 ± 1.5	15.7 ± 2.0	17.0 ± 0.9	24.7 ± 1.5
D-83	12.9 ± 1.4	18.0 ± 1.4	15.5 ± 0.7	21.6 ± 1.3
D-84	15.6 ± 1.4	18.0 ± 1.6	16.5 ± 1.1	26.4 ± 1.2
D-85	16.5 ± 1.1	20.4 ± 1.9	18.4 ± 0.5	24.9 ± 1.3
D-86	14.9 ± 1.8	14.0 ± 2.6	15.6 ± 1.0	22.3 ± 1.4
D-91	16.0 ± 1.6	19.7 ± 2.2	17.6 ± 0.9	25.3 ± 2.0
Mean ± s.d.	15.7 ± 1.3	18.1 ± 2.0	17.4 ± 1.7	25.7 ± 2.7

[a] "ND" = No data; see Table 2.0, Program Deviations.

Table 12. Ambient gamma radiation as measured by thermoluminescent dosimeters (TLD). Quarterly collection. Units: mR/91 days

Within 1.0 mi. of Stack	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-43	13.1 ± 1.4	14.3 ± 2.2	16.3 ± 1.2	22.1 ± 0.8
D-44	14.5 ± 1.4	17.9 ± 1.1	17.5 ± 0.9	26.5 ± 0.9
D-45	13.7 ± 1.4	15.2 ± 1.5	15.8 ± 0.9	23.7 ± 1.4
D-46	15.3 ± 1.8	19.0 ± 2.1	18.8 ± 1.3	24.1 ± 1.6
D-47	14.5 ± 1.5	18.0 ± 1.2	17.8 ± 1.1	25.6 ± 1.4
D-48	14.4 ± 1.8	20.9 ± 1.3	18.6 ± 1.5	24.2 ± 1.1
Mean ± s.d.	14.3 ± 0.8	17.5 ± 2.4	17.5 ± 1.2	24.4 ± 1.6
Within 3.0 mi. of Stack				
D-33	10.9 ± 1.3	13.5 ± 1.2	13.4 ± 0.8	22.7 ± 0.9
D-34	11.5 ± 1.4	13.5 ± 1.5	13.7 ± 0.7	22.6 ± 1.6
D-35	12.6 ± 1.4	14.1 ± 1.3	14.5 ± 0.7	23.4 ± 1.5
D-36	13.6 ± 1.7	14.8 ± 1.4	14.7 ± 0.7	22.8 ± 1.5
D-37	16.7 ± 1.8	20.1 ± 2.1	17.4 ± 1.2	22.4 ± 1.3
D-38	14.3 ± 1.5	18.1 ± 1.7	16.7 ± 1.0	27.1 ± 1.7
D-39	14.2 ± 1.4	16.9 ± 1.0	16.8 ± 1.1	25.7 ± 0.8
D-40	13.7 ± 1.2	16.1 ± 1.2	15.6 ± 0.5	25.2 ± 1.3
D-41	14.6 ± 1.5	15.9 ± 1.5	18.4 ± 0.8	25.2 ± 1.4
D-42	11.7 ± 1.3	15.5 ± 1.2	14.0 ± 1.1	23.7 ± 1.2
Mean ± s.d.	13.4 ± 1.7	15.8 ± 2.1	15.5 ± 1.7	24.1 ± 1.6
ISFSI Fenceline				
D-161	48.2 ± 2.8	48.4 ± 2.6	43.4 ± 1.6	53.7 ± 2.0
D-162	18.6 ± 1.4	16.8 ± 2.3	16.8 ± 1.1	22.0 ± 1.6
D-163	42.8 ± 2.7	45.4 ± 2.9	41.1 ± 1.9	54.4 ± 2.3
D-164	13.9 ± 1.5	20.2 ± 2.1	15.5 ± 0.9	22.0 ± 1.3
Mean ± s.d.	30.9 ± 17.1	32.7 ± 16.5	29.2 ± 15.1	38.0 ± 18.5

Table 13. Milk samples, analyses for iodine-131 and gamma emitting isotopes.
Collection: Milk samples are collected monthly throughout the year.

Location		D-76					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-15-19				ND[a]			
02-14-19				ND[a]			
03-12-19				ND[a]			
04-09-19				ND[a]			
05-14-19				ND[a]			
06-11-19				ND[a]			
07-16-19				ND[a]			
08-13-19				ND[a]			
09-10-19				ND[a]			
10-15-19				ND[a]			
11-13-19				ND[a]			
12-10-19				ND[a]			

Location		D-110					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-15-19	DMI- 165	< 0.5	1416 ± 120	< 4.2	< 4.2	< 12.8	< 2.0
02-14-19	DMI- 440	< 0.4	1392 ± 121	< 4.6	< 3.6	< 16.6	< 2.8
03-12-19	DMI- 705	< 0.3	1466 ± 116	< 3.1	< 3.4	< 19.8	< 3.5
04-09-19	DMI- 1083	< 0.3	1482 ± 129	< 5.7	< 5.9	< 20.2	< 3.6
05-14-19	DMI- 1653	< 0.4	1394 ± 115	< 3.0	< 3.1	< 9.5	< 4.3
06-11-19	DMI- 2044	< 0.3	1472 ± 122	< 4.9	< 2.9	< 13.8	< 3.2
07-16-19	DMI- 2555	< 0.3	1411 ± 113	< 0.1	< 0.7	< 0.2	< 0.1
08-13-19	DMI- 2995	< 0.5	1425 ± 122	< 4.1	< 4.3	< 8.8	< 2.6
09-10-19	DMI- 3360	< 0.5	1418 ± 119	< 3.7	< 3.4	< 19.2	< 2.6
10-15-19	DMI- 3926	< 0.3	1403 ± 119	< 0.0	< 0.0	< 0.1	< 0.0
11-13-19	DMI- 4371	< 0.3	1388 ± 108	< 4.6	< 5.2	< 16.1	< 2.5
12-10-19	DMI- 4679	< 0.4	1561 ± 148	< 4.8	< 4.8	< 16.6	< 1.9

[a] "ND" = No data; see Table 2.0, Program Deviations.

Table 13. Milk samples, analyses for iodine-131 and gamma emitting isotopes.
Collection: Milk samples are collected monthly throughout the year.

Location		D-138					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-15-19	DMI- 166	< 0.4	1362 ± 123	< 4.3	< 3.4	< 15.3	< 2.3
02-14-19	DMI- 441	< 0.5	1366 ± 123	< 4.3	< 4.3	< 16.2	< 2.9
03-12-19	DMI- 706	< 0.3	1416 ± 116	< 3.1	< 3.4	< 19.8	< 3.5
04-09-19	DMI- 1084	< 0.5	1240 ± 116	< 5.7	< 5.9	< 20.2	< 3.6
05-14-19	DMI- 1654	< 0.4	1377 ± 118	< 3.0	< 3.1	< 9.5	< 4.3
06-11-19	DMI- 2045	< 0.3	1316 ± 120	< 4.3	< 4.3	< 8.9	< 2.9
07-16-19	DMI- 2556	< 0.4	1460 ± 128	< 0.1	< 0.7	< 0.2	< 0.1
08-13-19	DMI- 2996	< 0.4	1413 ± 116	< 3.6	< 4.2	< 11.9	< 2.4
09-10-19	DMI- 3361	< 0.3	1555 ± 119	< 3.7	< 3.4	< 19.2	< 2.6
10-15-19	DMI- 3927	< 0.3	1460 ± 115	< 0.0	< 0.0	< 0.1	< 0.0
11-13-19	DMI- 4372	< 0.4	1387 ± 104	< 4.6	< 5.2	< 16.1	< 2.5
12-10-19	DMI- 4680	< 0.3	1348 ± 123	< 4.1	< 4.5	< 15.1	< 2.9

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-52 Drinking Water			
Lab Code	DWW- 200	DWW- 455	DWW- 831	DWW- 1329
Date Collected	01-16-19	02-19-19	03-19-19	04-16-19
H-3	< 159	< 155	< 153	< 152
I-131	< 0.4	< 0.4	< 0.3	< 0.3
Mn-54	< 2.1	< 7.3	< 3.0	< 2.7
Fe-59	< 5.3	< 10.8	< 3.8	< 4.5
Co-58	< 3.1	< 5.7	< 2.8	< 2.3
Co-60	< 3.0	< 6.9	< 2.1	< 1.5
Zn-65	< 1.8	< 6.0	< 5.7	< 6.7
Nb-95	< 3.0	< 5.8	< 2.6	< 3.2
Zr-95	< 4.2	< 10.6	< 4.2	< 5.0
I-131	< 7.7	< 8.9	< 4.1	< 2.9
Cs-134	< 3.8	< 8.2	< 3.4	< 3.4
Cs-137	< 2.6	< 6.1	< 2.2	< 2.5
Ba-140	< 19.1	< 32.2	< 15.0	< 10.9
La-140	< 1.6	< 7.2	< 4.0	< 2.1

Lab Code	DWW- 1663	DWW- 2156	DWW- 2593	DWW- 3065
Date Collected	05-14-19	06-17-19	07-16-19	08-19-19
H-3	< 154	< 150	< 159	< 152
I-131	< 0.4	< 0.4	< 0.2	< 0.2
Mn-54	< 5.1	< 3.1	< 3.9	< 2.2
Fe-59	< 9.0	< 5.5	< 3.9	< 5.0
Co-58	< 3.6	< 2.2	< 2.5	< 1.9
Co-60	< 5.4	< 2.5	< 2.9	< 2.6
Zn-65	< 8.3	< 4.1	< 5.9	< 1.9
Nb-95	< 5.7	< 3.1	< 2.9	< 3.0
Zr-95	< 9.0	< 4.9	< 6.3	< 2.1
I-131	< 6.1	< 5.4	< 4.2	< 3.0
Cs-134	< 5.0	< 3.6	< 4.4	< 4.4
Cs-137	< 4.0	< 3.2	< 3.8	< 3.5
Ba-140	< 17.1	< 14.9	< 15.0	< 12.2
La-140	< 1.6	< 1.7	< 2.8	< 2.9

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-52 Drinking Water			
Lab Code	DWW- 3451	DWW- 3934	DWW- 4374	DWW- 4748
Date Collected	09-16-19	10-15-19	11-12-19	12-16-19
H-3	< 153	< 151	< 155	< 160
I-131	< 0.5	< 0.2	< 0.5	< 0.3
Mn-54	< 3.2	< 2.9	< 3.3	< 3.5
Fe-59	< 4.7	< 4.8	< 5.7	< 2.6
Co-58	< 2.2	< 1.5	< 4.1	< 4.0
Co-60	< 2.4	< 2.9	< 1.7	< 1.9
Zn-65	< 1.9	< 6.6	< 5.8	< 4.0
Nb-95	< 4.6	< 3.9	< 5.9	< 2.3
Zr-95	< 4.8	< 4.1	< 6.6	< 5.3
I-131	< 4.7	< 3.8	< 5.6	< 4.8
Cs-134	< 4.4	< 3.0	< 4.2	< 3.4
Cs-137	< 3.6	< 4.2	< 3.8	< 3.2
Ba-140	< 16.0	< 13.2	< 14.9	< 14.1
La-140	< 2.0	< 2.5	< 3.6	< 2.1

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-53 Treated Municipal Water, Drinking Water			
Lab Code	DWW- 201	DWW- 525	DWW- 832	DWW- 1330
Date Collected	01-16-19	02-19-19	03-19-19	04-16-19
H-3	< 159	< 158	< 153	< 152
I-131	< 0.3	< 0.5	< 0.3	< 0.4
Mn-54	< 2.9	< 2.8	< 3.1	< 2.3
Fe-59	< 3.5	< 5.6	< 5.0	< 3.1
Co-58	< 3.0	< 2.1	< 2.2	< 3.2
Co-60	< 1.7	< 1.4	< 1.5	< 2.3
Zn-65	< 5.4	< 1.7	< 4.5	< 5.6
Nb-95	< 3.8	< 3.3	< 2.4	< 4.9
Zr-95	< 5.1	< 6.2	< 4.6	< 5.8
I-131	< 4.9	< 6.5	< 2.4	< 4.6
Cs-134	< 3.9	< 3.3	< 2.9	< 3.8
Cs-137	< 3.6	< 3.2	< 2.6	< 4.5
Ba-140	< 11.3	< 11.1	< 10.2	< 12.1
La-140	< 3.5	< 3.5	< 3.1	< 4.2
Lab Code	DWW- 1664	DWW- 2157	DWW- 2594	DWW- 3066
Date Collected	05-14-19	06-17-19	07-16-19	08-19-19
H-3	< 154	< 150	< 159	< 152
I-131	< 0.3	< 0.3	< 0.2	< 0.2
Mn-54	< 2.7	< 2.7	< 2.9	< 3.1
Fe-59	< 3.6	< 4.7	< 4.6	< 3.1
Co-58	< 1.9	< 1.6	< 2.1	< 3.1
Co-60	< 2.1	< 2.8	< 3.8	< 2.4
Zn-65	< 7.9	< 5.1	< 4.4	< 7.2
Nb-95	< 2.6	< 4.0	< 2.8	< 3.4
Zr-95	< 3.9	< 5.3	< 6.0	< 3.0
I-131	< 4.2	< 4.7	< 3.5	< 4.6
Cs-134	< 4.1	< 3.7	< 3.1	< 3.2
Cs-137	< 2.7	< 3.4	< 2.9	< 2.4
Ba-140	< 11.6	< 13.2	< 13.3	< 9.4
La-140	< 3.1	< 1.7	< 2.5	< 1.2

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-53 Treated Municipal Water, Drinking Water			
Lab Code	DWW- 3452	DWW- 3935	DWW- 4303	DWW- 4749
Date Collected	09-16-19	10-15-19	11-07-19	12-16-19
H-3	< 153	< 151	< 154	< 160
I-131	< 0.5	< 0.2	< 0.3	< 0.3
Mn-54	< 2.6	< 3.4	< 2.2	< 3.3
Fe-59	< 4.3	< 5.5	< 2.2	< 1.5
Co-58	< 1.8	< 0.9	< 2.0	< 2.9
Co-60	< 2.0	< 2.4	< 1.2	< 2.6
Zn-65	< 3.1	< 4.0	< 4.5	< 6.7
Nb-95	< 3.6	< 1.6	< 1.7	< 3.3
Zr-95	< 4.3	< 4.2	< 5.0	< 3.6
I-131	< 5.0	< 3.1	< 5.7	< 4.5
Cs-134	< 4.2	< 3.2	< 3.0	< 3.2
Cs-137	< 2.2	< 2.3	< 2.2	< 1.9
Ba-140	< 9.1	< 11.6	< 14.6	< 13.3
La-140	< 3.2	< 2.9	< 2.3	< 2.6

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-54 Untreated Municipal Water, Drinking Water			
Lab Code	DWW- 202	DWW- 526	DWW- 833	DWW- 1331
Date Collected	01-16-19	02-19-19	03-19-19	04-16-19
H-3	< 159	< 158	< 153	< 152
I-131	< 0.3	< 0.5	< 0.3	< 0.5
Mn-54	< 4.0	< 2.4	< 4.8	< 3.3
Fe-59	< 4.1	< 4.1	< 8.9	< 7.1
Co-58	< 2.7	< 2.6	< 4.7	< 3.4
Co-60	< 2.8	< 1.8	< 3.7	< 1.8
Zn-65	< 4.1	< 2.7	< 13.8	< 5.6
Nb-95	< 2.7	< 3.7	< 7.2	< 5.4
Zr-95	< 8.5	< 6.4	< 5.2	< 6.9
I-131	< 5.3	< 7.9	< 7.3	< 6.5
Cs-134	< 4.9	< 3.4	< 5.7	< 4.9
Cs-137	< 3.1	< 3.3	< 5.9	< 3.1
Ba-140	< 19.5	< 19.8	< 20.2	< 16.5
La-140	< 5.1	< 4.3	< 3.6	< 3.3
Lab Code	DWW- 1665	DWW- 2158	DWW- 2595	DWW- 3067
Date Collected	05-14-19	06-17-19	07-16-19	08-19-19
H-3	< 154	< 150	< 159	< 152
I-131	< 0.3	< 0.3	< 0.3	< 0.5
Mn-54	< 4.2	< 7.0	< 2.9	< 3.5
Fe-59	< 3.7	< 9.1	< 4.2	< 7.3
Co-58	< 2.0	< 3.9	< 1.9	< 2.2
Co-60	< 2.3	< 6.9	< 2.5	< 3.7
Zn-65	< 5.0	< 15.2	< 5.7	< 6.9
Nb-95	< 3.2	< 8.8	< 3.4	< 3.0
Zr-95	< 5.8	< 8.7	< 3.9	< 6.2
I-131	< 3.3	< 7.1	< 4.0	< 5.7
Cs-134	< 4.2	< 6.5	< 3.2	< 5.1
Cs-137	< 3.4	< 6.4	< 3.1	< 5.8
Ba-140	< 12.9	< 24.3	< 11.9	< 20.1
La-140	< 2.6	< 6.9	< 2.7	< 3.3

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Monthly
Units: pCi/L

Location	D-54 Untreated Municipal Water, Drinking Water			
Lab Code	DWW- 3453	DWW- 3936	DWW- 4304	DWW- 4750
Date Collected	09-16-19	10-15-19	11-07-19	12-16-19
H-3	< 153	< 151	< 154	< 160
I-131	< 0.5	< 0.4	< 0.4	< 0.4
Mn-54	< 1.9	< 4.2	< 2.9	< 2.9
Fe-59	< 5.8	< 2.4	< 3.5	< 3.9
Co-58	< 3.4	< 3.7	< 3.3	< 2.1
Co-60	< 3.3	< 3.6	< 2.4	< 1.6
Zn-65	< 5.3	< 6.9	< 6.4	< 6.7
Nb-95	< 4.1	< 2.5	< 3.6	< 2.7
Zr-95	< 3.4	< 6.1	< 6.3	< 5.4
I-131	< 4.4	< 4.6	< 7.1	< 6.8
Cs-134	< 3.5	< 4.9	< 3.9	< 4.3
Cs-137	< 4.5	< 5.2	< 1.7	< 3.9
Ba-140	< 11.5	< 17.1	< 14.6	< 14.2
La-140	< 1.2	< 2.7	< 2.8	< 3.4

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Quarterly
Units: pCi/L

Location	D-55 On-site Treated Drinking Water			
Lab Code	DWW- 527	NS[a]	DWW- 3117	DWW- 4305
Date Collected	02-19-19	05-14-19	08-21-19	11-07-19
H-3	< 158	-	< 151	< 154
I-131	< 0.5	-	< 0.4	< 0.5
Mn-54	< 2.8	-	< 2.6	< 4.5
Fe-59	< 1.8	-	< 5.4	< 7.2
Co-58	< 2.9	-	< 3.0	< 3.7
Co-60	< 2.4	-	< 3.4	< 1.7
Zn-65	< 3.7	-	< 7.4	< 7.5
Nb-95	< 2.8	-	< 3.0	< 3.3
Zr-95	< 5.0	-	< 7.5	< 3.6
I-131	< 5.9	-	< 4.8	< 4.8
Cs-134	< 2.9	-	< 4.1	< 4.7
Cs-137	< 3.2	-	< 2.6	< 2.9
Ba-140	< 12.0	-	< 12.3	< 22.6
La-140	< 4.1	-	< 3.0	< 4.2

Location	D-57 Untreated Drinking Water			
Lab Code	DWW- 456	DWW- 1666	DWW- 3118	DWW- 4306
Date Collected	02-19-19	05-14-19	08-21-19	11-07-19
H-3	< 155	< 154	< 151	< 154
I-131	< 0.5	< 0.3	< 0.4	< 0.4
Mn-54	< 2.6	< 2.7	< 3.5	< 4.3
Fe-59	< 5.7	< 5.0	< 6.3	< 5.6
Co-58	< 3.8	< 2.4	< 3.0	< 4.6
Co-60	< 2.6	< 3.0	< 2.4	< 4.9
Zn-65	< 5.7	< 5.5	< 4.6	< 6.4
Nb-95	< 5.2	< 4.8	< 2.4	< 5.4
Zr-95	< 5.3	< 3.5	< 4.1	< 7.6
I-131	< 4.9	< 3.4	< 5.5	< 6.7
Cs-134	< 4.8	< 3.7	< 3.8	< 4.8
Cs-137	< 5.4	< 2.7	< 3.1	< 4.4
Ba-140	< 19.9	< 10.0	< 16.0	< 13.3
La-140	< 3.9	< 2.7	< 2.9	< 3.5

NS[a] - Sample not collected

Table 14. Well water samples, analyses for gamma emitting isotopes iodine-131 and tritium.
Collection: Quarterly
Units: pCi/L

Location	D-58 Untreated Drinking Water			
Lab Code	DWW- 458	DWW- 1667	DWW- 3119	DWW- 4307
Date Collected	02-19-19	05-14-19	08-21-19	11-07-19
H-3	< 155	< 154	< 151	< 154
I-131	< 0.3	< 0.3	< 0.5	< 0.4
Mn-54	< 2.4	< 2.5	< 3.9	< 2.8
Fe-59	< 7.3	< 6.1	< 6.8	< 4.0
Co-58	< 1.8	< 1.6	< 4.6	< 2.2
Co-60	< 2.3	< 2.5	< 3.8	< 2.0
Zn-65	< 5.5	< 6.5	< 9.7	< 4.8
Nb-95	< 3.1	< 2.4	< 6.0	< 4.3
Zr-95	< 3.1	< 4.6	< 8.0	< 4.5
I-131	< 4.2	< 4.2	< 4.1	< 5.5
Cs-134	< 3.3	< 3.4	< 5.6	< 3.4
Cs-137	< 2.0	< 4.4	< 5.4	< 3.9
Ba-140	< 12.9	< 11.2	< 21.8	< 15.5
La-140	< 2.1	< 2.3	< 4.2	< 2.9

Location	D-72(C) Untreated Drinking Water			
Lab Code	DWW- 459	DWW- 1668	DWW- 3120	DWW- 4308
Date Collected	02-19-19	05-14-19	08-21-19	11-07-19
H-3	< 155	< 154	< 151	< 154
I-131	< 0.3	< 0.3	< 0.3	< 0.3
Mn-54	< 3.1	< 4.1	< 3.3	< 3.9
Fe-59	< 2.0	< 6.0	< 2.8	< 5.5
Co-58	< 2.4	< 2.7	< 2.6	< 3.6
Co-60	< 3.1	< 3.5	< 2.7	< 3.7
Zn-65	< 5.0	< 7.3	< 5.1	< 4.9
Nb-95	< 1.7	< 3.3	< 2.9	< 3.1
Zr-95	< 4.9	< 5.8	< 5.5	< 6.9
I-131	< 4.6	< 5.9	< 4.0	< 7.3
Cs-134	< 3.4	< 4.8	< 2.9	< 4.6
Cs-137	< 2.9	< 3.5	< 3.5	< 5.2
Ba-140	< 11.1	< 15.2	< 10.6	< 16.1
La-140	< 1.5	< 3.4	< 2.1	< 2.5

Table 15. Vegetation (broadleaf), analyses for iodine-131 and other gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-57	D-77	D-108	D-108
Lab Code	DVE- 3433	DVE- 3619	DVE- 3486	DVE- 3487
Date Collected	09-12-19	09-30-19	09-16-19	09-16-19
Sample Type	Rhubarb Leaves	Herbs leaves (lovage)	Kale	Cabbage
K-40	6.46 ± 0.69	6.23 ± 0.44	4.10 ± 0.54	4.92 ± 0.56
Mn-54	< 0.016	< 0.011	< 0.019	< 0.013
Fe-59	< 0.028	< 0.042	< 0.041	< 0.043
Co-58	< 0.019	< 0.016	< 0.014	< 0.019
Co-60	< 0.011	< 0.021	< 0.011	< 0.013
Zn-65	< 0.048	< 0.040	< 0.048	< 0.044
Nb-95	< 0.020	< 0.021	< 0.021	< 0.020
Zr-95	< 0.032	< 0.027	< 0.039	< 0.039
Ru-103	< 0.015	< 0.019	< 0.014	< 0.016
Ru-106	< 0.184	< 0.164	< 0.191	< 0.166
I-131	< 0.029	< 0.023	< 0.037	< 0.033
Cs-134	< 0.020	< 0.018	< 0.024	< 0.023
Cs-137	< 0.028	< 0.021	< 0.024	< 0.026
Ce-141	< 0.031	< 0.031	< 0.027	< 0.043
Ce-144	< 0.153	< 0.075	< 0.150	< 0.108

Location	D-110	D-110	D-118	D-118
Lab Code	DVE- 3260		DVE- 3261	
Date Collected	08-30-19		08-30-19	
Sample Type	Rhubarb leaves		Cabbage	
K-40	3.77 ± 0.20		2.23 ± 0.33	
Mn-54	< 0.009		< 0.012	
Fe-59	< 0.011		< 0.018	
Co-58	< 0.009		< 0.011	
Co-60	< 0.010		< 0.007	
Zn-65	< 0.021		< 0.018	
Nb-95	< 0.011		< 0.014	
Zr-95	< 0.014		< 0.020	
Ru-103	< 0.008		< 0.016	
Ru-106	< 0.085		< 0.070	
I-131	< 0.016		< 0.034	
Cs-134	< 0.008		< 0.015	
Cs-137	< 0.009		< 0.014	
Ce-141	< 0.017		< 0.033	
Ce-144	< 0.052		< 0.117	

Table 15. Vegetation (broadleaf), analyses for iodine-131 and other gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-138	D-58	D-58	D-58
Lab Code		DVE- 3406	DVE- 3407	DVE- 3408
Date Collected		09-09-19	09-09-19	09-09-19
Sample Type		Cucumber Leaves	Cantaloupe Leaves [a]	Radish Leaves [b]
K-40		6.93 ± 0.30	4.56 ± 0.81	3.06 ± 0.60
Mn-54		< 0.012	< 0.041	< 0.020
Fe-59		< 0.019	< 0.061	< 0.063
Co-58		< 0.011	< 0.046	< 0.018
Co-60		< 0.011	< 0.039	< 0.024
Zn-65		< 0.026	< 0.091	< 0.066
Nb-95		< 0.013	< 0.038	< 0.037
Zr-95		< 0.018	< 0.089	< 0.055
Ru-103		< 0.010	< 0.047	< 0.036
Ru-106		< 0.127	< 0.401	< 0.262
I-131		< 0.018	< 0.058	< 0.045
Cs-134		< 0.012	< 0.046	< 0.032
Cs-137		< 0.009	< 0.059	< 0.038
Ce-141		< 0.025	< 0.055	< 0.057
Ce-144		< 0.110	< 0.203	< 0.215

[a] Very small sample (40.82 g wet.)

[b] Very small sample (55.11 g wet.)

Table 16. Vegetation (hay and grain), analyses for iodine-131 and other gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-57
Lab Code	DVE- 3488
Date Collected	09-17-19
Sample Type	Hay
K-40	24.13 ± 1.43
Mn-54	< 0.033
Fe-59	< 0.064
Co-58	< 0.017
Co-60	< 0.027
Zn-65	< 0.070
Nb-95	< 0.030
Zr-95	< 0.064
Ru-103	< 0.020
Ru-106	< 0.266
I-131	< 0.052
Cs-134	< 0.035
Cs-137	< 0.036
Ce-141	< 0.039
Ce-144	< 0.213

Location	D-110
Lab Code	DVE- 3259
Date Collected	08-30-19
Sample Type	Hay
K-40	22.33 ± 0.81
Mn-54	< 0.026
Fe-59	< 0.068
Co-58	< 0.020
Co-60	< 0.024
Zn-65	< 0.070
Nb-95	< 0.028
Zr-95	< 0.035
Ru-103	< 0.032
Ru-106	< 0.203
I-131	< 0.054
Cs-134	< 0.026
Cs-137	< 0.029
Ce-141	< 0.035
Ce-144	< 0.190

Table 17. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-49

Lab Code	DSW- 167	DSW- 571	DSW- 824	DSW- 1360	DSW- 1870	DSW- 2185
Date Collected	01-15-19	02-28-19	03-18-19	04-18-19	05-23-19	06-18-19
H-3	< 177	< 157	< 153	< 156	< 153	< 150
I-131(Chemistry)	< 0.4	< 0.3	< 0.3	< 0.4	< 0.4	< 0.3
Mn-54	< 1.8	< 3.9	< 3.8	< 3.4	< 3.2	< 3.8
Fe-59	< 3.4	< 6.0	< 2.8	< 5.0	< 6.7	< 4.0
Co-58	< 1.7	< 2.2	< 3.0	< 3.9	< 2.1	< 2.9
Co-60	< 2.2	< 2.4	< 3.1	< 1.8	< 1.3	< 1.9
Zn-65	< 4.4	< 4.6	< 5.5	< 6.8	< 3.9	< 5.2
Nb-95	< 2.8	< 2.2	< 1.6	< 3.1	< 2.3	< 3.2
Zr-95	< 2.5	< 5.1	< 4.7	< 5.0	< 4.5	< 5.3
I-131	< 3.2	< 5.6	< 5.1	< 4.9	< 6.5	< 4.9
Cs-134	< 2.3	< 4.5	< 4.4	< 3.4	< 3.7	< 3.9
Cs-137	< 2.4	< 2.5	< 2.3	< 4.1	< 3.5	< 3.1
Ba-140	< 10.7	< 13.8	< 10.4	< 17.0	< 13.0	< 14.1
La-140	< 1.9	< 4.1	< 2.3	< 3.0	< 2.2	< 2.3

Lab Code	DSW- 2650	DSW- 3138	DSW- 3443	DSW- 3929	DSW- 4426	DSW- 4756
Date Collected	07-18-19	08-22-19	09-12-19	10-15-19	11-14-19	12-18-19
H-3	< 159	< 151	< 147	< 151	< 155	< 160
I-131(Chemistry)	< 0.4	< 0.3	< 0.4	< 0.3	< 0.5	< 0.2
Mn-54	< 2.1	< 3.2	< 4.0	< 5.3	< 1.7	< 1.9
Fe-59	< 4.8	< 7.3	< 4.0	< 3.5	< 3.1	< 5.0
Co-58	< 3.3	< 5.0	< 1.6	< 2.9	< 2.4	< 3.7
Co-60	< 2.8	< 3.6	< 2.5	< 4.2	< 1.7	< 3.1
Zn-65	< 8.8	< 3.6	< 4.1	< 8.9	< 2.7	< 5.5
Nb-95	< 4.8	< 3.7	< 2.7	< 3.5	< 1.9	< 3.1
Zr-95	< 5.9	< 5.1	< 3.4	< 7.4	< 6.4	< 5.9
I-131	< 6.7	< 6.7	< 4.6	< 5.1	< 3.7	< 5.0
Cs-134	< 4.1	< 4.5	< 3.3	< 4.4	< 3.6	< 4.6
Cs-137	< 3.3	< 3.0	< 2.8	< 4.6	< 3.8	< 2.6
Ba-140	< 14.7	< 17.5	< 10.6	< 8.1	< 14.4	< 17.8
La-140	< 3.3	< 3.0	< 3.1	< 3.7	< 2.9	< 2.1

Table 17. Surface water samples, analyses for tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-50

Lab Code	DSW- 168	ND[a]	DSW- 825	DSW- 1361	DSW- 1871	DSW- 2186
Date Collected	01-15-19	02-21-19	03-18-19	04-18-19	05-23-19	06-18-19
H-3	< 177	-	< 153	< 156	< 153	< 150
Mn-54	< 3.2	-	< 2.3	< 2.8	< 3.4	< 2.8
Fe-59	< 3.3	-	< 4.1	< 7.6	< 2.4	< 5.3
Co-58	< 3.3	-	< 3.2	< 3.4	< 2.6	< 2.2
Co-60	< 2.2	-	< 3.1	< 2.3	< 1.6	< 2.5
Zn-65	< 3.7	-	< 5.0	< 3.4	< 6.8	< 2.9
Nb-95	< 3.3	-	< 1.9	< 3.0	< 4.1	< 4.3
Zr-95	< 3.6	-	< 5.1	< 6.5	< 4.1	< 7.4
I-131	< 5.4	-	< 5.1	< 6.3	< 7.2	< 4.8
Cs-134	< 2.7	-	< 4.0	< 4.4	< 4.1	< 4.6
Cs-137	< 3.1	-	< 3.4	< 3.4	< 3.1	< 2.7
Ba-140	< 13.7	-	< 9.5	< 12.8	< 21.6	< 13.6
La-140	< 1.7	-	< 2.9	< 3.1	< 3.2	< 2.8

Lab Code	DSW- 2651	DSW- 3139	DSW- 3444	DSW- 3930	DSW- 4427	ND[a]
Date Collected	07-18-19	08-22-19	09-12-19	10-15-19	11-14-19	12-18-19
H-3	< 159	< 151	< 147	< 151	< 155	-
Mn-54	< 2.6	< 2.2	< 2.6	< 2.6	< 3.0	-
Fe-59	< 2.8	< 2.9	< 6.4	< 2.2	< 5.6	-
Co-58	< 2.2	< 1.8	< 1.6	< 1.9	< 1.5	-
Co-60	< 2.3	< 2.6	< 1.5	< 1.8	< 2.7	-
Zn-65	< 4.6	< 4.5	< 3.4	< 5.8	< 4.6	-
Nb-95	< 3.1	< 2.3	< 2.4	< 3.4	< 1.8	-
Zr-95	< 3.5	< 5.7	< 4.1	< 4.6	< 4.8	-
I-131	< 3.4	< 4.5	< 4.1	< 5.9	< 7.0	-
Cs-134	< 2.8	< 3.1	< 3.0	< 3.1	< 3.9	-
Cs-137	< 2.8	< 2.3	< 3.3	< 3.0	< 2.3	-
Ba-140	< 10.0	< 10.6	< 13.9	< 13.8	< 15.8	-
La-140	< 1.7	< 1.6	< 3.8	< 2.6	< 2.7	-

[a] "ND" = No data; see Table 2.0, Program Deviations.

Table 17. Surface water samples, analyses for tritium and gamma-emitting isotopes.

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

Lab Code	DSW- 169	DSW- 476	DSW- 572	DSW- 826	DSW- 1362	DSW- 1872
Date Collected	01-15-19	02-21-19	02-28-19	03-18-19	04-18-19	05-23-19
H-3	< 177	< 157	< 157	< 153	< 156	< 153
Mn-54	< 2.2	< 2.6	< 3.1	< 2.3	< 2.7	< 2.6
Fe-59	< 5.4	< 2.4	< 4.3	< 4.9	< 2.8	< 6.7
Co-58	< 2.9	< 2.9	< 3.0	< 3.3	< 1.5	< 1.9
Co-60	< 2.2	< 1.5	< 3.2	< 2.2	< 3.2	< 3.3
Zn-65	< 3.9	< 4.5	< 3.1	< 6.7	< 4.2	< 6.1
Nb-95	< 2.7	< 2.3	< 1.9	< 3.3	< 4.3	< 3.2
Zr-95	< 2.3	< 3.8	< 5.8	< 5.4	< 4.8	< 4.0
I-131	< 3.9	< 4.8	< 4.8	< 4.8	< 5.2	< 6.2
Cs-134	< 3.5	< 3.2	< 3.1	< 3.1	< 3.1	< 3.7
Cs-137	< 2.9	< 2.3	< 2.2	< 3.3	< 3.0	< 3.1
Ba-140	< 14.0	< 13.3	< 17.2	< 15.8	< 13.4	< 17.9
La-140	< 1.5	< 3.5	< 3.1	< 2.2	< 2.6	< 4.1

Lab Code	DSW- 2187	DSW- 2652	DSW- 3140	DSW- 3446	DSW- 3931	DSW- 4428
Date Collected	06-18-19	07-18-19	08-22-19	09-12-19	10-15-19	11-14-19
H-3	< 150	< 159	< 151	< 147	< 151	< 155
Mn-54	< 6.8	< 2.5	< 3.0	< 2.7	< 3.0	< 2.3
Fe-59	< 12.4	< 3.3	< 8.9	< 4.8	< 3.2	< 5.7
Co-58	< 3.8	< 2.7	< 4.0	< 3.1	< 2.3	< 2.0
Co-60	< 4.7	< 1.3	< 3.4	< 1.9	< 1.3	< 2.0
Zn-65	< 10.9	< 3.0	< 6.9	< 2.4	< 3.6	< 6.1
Nb-95	< 7.9	< 2.8	< 2.3	< 2.6	< 3.1	< 1.6
Zr-95	< 7.5	< 5.8	< 5.5	< 3.8	< 2.8	< 3.8
I-131	< 7.1	< 4.3	< 5.9	< 4.5	< 6.9	< 7.9
Cs-134	< 6.0	< 3.1	< 4.4	< 3.3	< 3.1	< 3.1
Cs-137	< 5.2	< 3.2	< 3.5	< 3.4	< 2.0	< 3.5
Ba-140	< 20.4	< 16.5	< 17.0	< 10.8	< 15.1	< 19.7
La-140	< 3.6	< 2.8	< 4.5	< 2.8	< 3.7	< 2.2

Table 17. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-61

Lab Code	DSW- 170	DSW- 573	DSW- 827	DSW- 1363	DSW- 1873	DSW- 2188
Date Collected	01-15-19	02-28-19	03-18-19	04-18-19	05-23-19	06-18-19
H-3	< 177	< 157	< 153	< 156	< 153	< 150
I-131(Chemistry)	< 0.3	< 0.3	< 0.3	< 0.4	< 0.5	< 0.3
Mn-54	< 3.0	< 2.3	< 2.4	< 2.4	< 3.6	< 3.9
Fe-59	< 4.6	< 5.9	< 2.6	< 1.6	< 5.8	< 4.2
Co-58	< 3.2	< 3.0	< 1.2	< 3.1	< 3.6	< 2.1
Co-60	< 2.5	< 1.2	< 2.2	< 3.5	< 3.2	< 2.6
Zn-65	< 7.2	< 3.6	< 3.7	< 6.7	< 14.5	< 5.3
Nb-95	< 4.4	< 3.4	< 2.0	< 3.7	< 9.6	< 4.9
Zr-95	< 6.0	< 5.2	< 4.5	< 3.7	< 8.3	< 6.9
I-131	< 4.3	< 6.4	< 5.5	< 4.3	< 9.0	< 5.0
Cs-134	< 4.2	< 3.7	< 3.4	< 3.1	< 6.0	< 5.2
Cs-137	< 3.1	< 2.7	< 3.4	< 2.7	< 5.8	< 3.0
Ba-140	< 10.7	< 15.7	< 6.7	< 11.6	< 22.2	< 17.9
La-140	< 5.7	< 3.5	< 1.7	< 2.6	< 9.7	< 3.6

Lab Code	DSW- 2653	DSW- 3141	DSW- 3447	DSW- 3932	DSW- 4429	DSW- 4758
Date Collected	07-18-19	08-22-19	09-12-19	10-15-19	11-14-19	12-18-19
H-3	< 159	< 151	< 147	< 151	< 155	< 160
I-131(Chemistry)	< 0.4	< 0.5	< 0.4	< 0.3	< 0.4	< 0.4
Mn-54	< 2.9	< 2.2	< 3.3	< 3.0	< 3.9	< 3.3
Fe-59	< 6.1	< 6.0	< 5.5	< 3.9	< 4.8	< 3.4
Co-58	< 2.1	< 2.1	< 3.0	< 2.1	< 3.9	< 2.3
Co-60	< 2.6	< 1.5	< 1.9	< 1.7	< 4.0	< 1.8
Zn-65	< 5.5	< 3.4	< 4.4	< 3.6	< 6.0	< 6.4
Nb-95	< 2.1	< 3.0	< 3.9	< 2.8	< 2.6	< 5.8
Zr-95	< 4.1	< 3.0	< 4.5	< 4.4	< 8.5	< 4.9
I-131	< 5.0	< 6.8	< 4.4	< 2.9	< 7.2	< 3.2
Cs-134	< 3.0	< 3.2	< 3.8	< 3.6	< 4.8	< 3.9
Cs-137	< 3.0	< 2.4	< 2.5	< 3.2	< 3.9	< 4.2
Ba-140	< 14.8	< 11.1	< 16.7	< 11.9	< 7.7	< 8.3
La-140	< 2.3	< 1.7	< 2.9	< 2.0	< 3.4	< 3.2

Table 17. Surface water samples, analyses for tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-99

Lab Code	DSW- 171	ND[a]	DSW- 828	DSW- 1364	DSW- 1874	DSW- 2189
Date Collected	01-15-19	02-21-19	03-18-19	04-18-19	05-23-19	06-18-19
H-3	< 177	-	< 153	< 156	< 153	< 150
Mn-54	< 2.3	-	< 3.4	< 3.6	< 3.6	< 4.1
Fe-59	< 5.8	-	< 2.8	< 5.6	< 11.4	< 5.9
Co-58	< 2.1	-	< 2.0	< 2.1	< 4.1	< 2.7
Co-60	< 3.0	-	< 1.4	< 1.8	< 3.0	< 4.1
Zn-65	< 5.3	-	< 6.5	< 8.0	< 9.2	< 7.0
Nb-95	< 2.3	-	< 3.1	< 4.6	< 6.2	< 4.7
Zr-95	< 3.4	-	< 5.2	< 7.8	< 8.5	< 6.9
I-131	< 4.6	-	< 3.1	< 8.6	< 10.4	< 5.2
Cs-134	< 3.2	-	< 3.1	< 5.0	< 5.6	< 4.4
Cs-137	< 3.3	-	< 2.7	< 4.1	< 5.3	< 3.3
Ba-140	< 9.8	-	< 12.7	< 24.1	< 23.9	< 18.3
La-140	< 2.5	-	< 3.2	< 3.2	< 3.7	< 4.2

Lab Code	DSW- 2654	DSW- 3142	DSW- 3448	DSW- 3933	DSW- 4430	ND[a]
Date Collected	07-18-19	08-22-19	09-12-19	10-15-19	11-14-19	12-18-19
H-3	< 159	< 151	< 147	< 151	< 155	-
Mn-54	< 3.9	< 2.0	< 3.9	< 1.9	< 1.7	-
Fe-59	< 3.6	< 4.6	< 8.5	< 3.0	< 4.3	-
Co-58	< 1.4	< 1.6	< 4.9	< 1.4	< 1.7	-
Co-60	< 2.9	< 2.2	< 2.7	< 2.3	< 1.4	-
Zn-65	< 2.0	< 4.6	< 10.2	< 1.8	< 3.5	-
Nb-95	< 2.0	< 1.9	< 5.9	< 2.3	< 2.1	-
Zr-95	< 3.6	< 3.6	< 5.3	< 4.2	< 4.5	-
I-131	< 3.1	< 3.5	< 7.9	< 5.5	< 4.8	-
Cs-134	< 3.2	< 2.9	< 5.4	< 3.0	< 3.3	-
Cs-137	< 3.4	< 2.8	< 4.9	< 2.8	< 2.5	-
Ba-140	< 13.8	< 16.3	< 23.1	< 19.6	< 15.5	-
La-140	< 2.4	< 3.5	< 4.3	< 3.3	< 4.1	-

[a] "ND" = No data; see Table 2.0, Program Deviations.

Table 18. 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-878	DSW-2219	DSW-3490	DSW-4853
Sr-89	< 0.65	< 0.50	< 0.60	< 0.53
Sr-90	< 0.46	< 0.46	< 0.42	< 0.53

Location	D-61			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-879	DSW-2220	DSW-3491	DSW-4854
Sr-89	< 0.66	< 0.76	< 0.65	< 0.64
Sr-90	< 0.44	< 0.44	< 0.50	< 0.58

Table 19. Fish, analyses of edible portion for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g wet

Location	Upstream, D-49		Control, D-56
Lab Code	DF- 2088	DF- 2089	DF- 2443
Date Collected	06-11-19	06-11-19	06-11-19
Sample Type	Largemouth bass	Channel catfish	Largemouth bass
K-40	4.17 ± 0.48	3.40 ± 0.39	3.44 ± 0.57
Mn-54	< 0.014	< 0.013	< 0.018
Fe-59	< 0.048	< 0.040	< 0.051
Co-58	< 0.016	< 0.012	< 0.026
Co-60	< 0.019	< 0.010	< 0.017
Zn-65	< 0.033	< 0.038	< 0.028
Nb-95	< 0.020	< 0.021	< 0.027
Zr-95	< 0.029	< 0.022	< 0.027
Ru-103	< 0.020	< 0.022	< 0.034
Ru-106	< 0.168	< 0.122	< 0.206
Cs-134	< 0.020	< 0.015	< 0.025
Cs-137	< 0.016	< 0.013	< 0.022
Ce-141	< 0.069	< 0.037	< 0.047
Ce-144	< 0.114	< 0.079	< 0.161

Location	Upstream, D-49	
Lab Code	DF- 3075	DF- 3076
Date Collected	08-16-19	08-16-19
Sample Type	Northern pike	Channel catfish
K-40	4.78 ± 0.59	4.39 ± 0.55
Mn-54	< 0.017	< 0.021
Fe-59	< 0.069	< 0.035
Co-58	< 0.013	< 0.025
Co-60	< 0.016	< 0.008
Zn-65	< 0.045	< 0.039
Nb-95	< 0.032	< 0.019
Zr-95	< 0.026	< 0.030
Ru-103	< 0.025	< 0.019
Ru-106	< 0.131	< 0.226
Cs-134	< 0.021	< 0.022
Cs-137	< 0.019	< 0.017
Ce-141	< 0.043	< 0.044
Ce-144	< 0.115	< 0.138

Table 19. Fish, analyses of edible portion for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g wet

Location	Downstream, D-61	
Lab Code	DF- 2090	DF- 2091
Date Collected	06-11-19	06-11-19
Sample Type	Smallmouth bass	Northern pike
K-40	3.92 ± 0.49	4.30 ± 0.41
Mn-54	< 0.008	< 0.017
Fe-59	< 0.044	< 0.035
Co-58	< 0.020	< 0.015
Co-60	< 0.010	< 0.016
Zn-65	< 0.010	< 0.030
Nb-95	< 0.024	< 0.022
Zr-95	< 0.024	< 0.033
Ru-103	< 0.025	< 0.023
Ru-106	< 0.161	< 0.163
Cs-134	< 0.017	< 0.017
Cs-137	< 0.020	< 0.015
Ce-141	< 0.027	< 0.028
Ce-144	< 0.119	< 0.086

Location	Downstream, D-61		
Lab Code	DF- 3073	DF- 3074	DF- 3077
Date Collected	08-16-19	08-16-19	08-16-19
Sample Type	White crappie	Channel catfish	Smallmouth bass
K-40	3.52 ± 0.45	3.67 ± 0.45	3.67 ± 0.36
Mn-54	< 0.017	< 0.016	< 0.018
Fe-59	< 0.050	< 0.053	< 0.059
Co-58	< 0.017	< 0.025	< 0.016
Co-60	< 0.011	< 0.014	< 0.022
Zn-65	< 0.014	< 0.018	< 0.042
Nb-95	< 0.026	< 0.019	< 0.027
Zr-95	< 0.027	< 0.025	< 0.031
Ru-103	< 0.019	< 0.025	< 0.025
Ru-106	< 0.183	< 0.217	< 0.165
Cs-134	< 0.018	< 0.020	< 0.017
Cs-137	< 0.013	< 0.020	< 0.019
Ce-141	< 0.045	< 0.049	< 0.050
Ce-144	< 0.080	< 0.111	< 0.109

Table 20. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-49 (Control)	
Lab Code	DBS- 1476	DBS- 4029
Date Collected	04-01-19	10-18-19
K-40	7.11 ± 0.41	7.71 ± 0.46
Mn-54	< 0.010	< 0.014
Fe-59	< 0.037	< 0.053
Co-58	< 0.011	< 0.018
Co-60	< 0.008	< 0.017
Zn-65	< 0.026	< 0.036
Nb-95	< 0.022	< 0.047
Zr-95	< 0.025	< 0.023
Ru-103	< 0.021	< 0.024
Ru-106	< 0.063	< 0.099
Cs-134	< 0.008	< 0.010
Cs-137	< 0.008	0.027 ± 0.012 [a]
Ce-141	< 0.065	< 0.060
Ce-144	< 0.054	< 0.074

Location	D-51 (Discharge)	
Lab Code	DBS- 1477	DBS- 4031
Date Collected	04-01-19	10-18-19
K-40	8.19 ± 0.46	8.12 ± 0.48
Mn-54	< 0.011	< 0.013
Fe-59	< 0.057	< 0.050
Co-58	< 0.020	< 0.018
Co-60	< 0.014	< 0.010
Zn-65	< 0.029	< 0.030
Nb-95	< 0.041	< 0.034
Zr-95	< 0.025	< 0.020
Ru-103	< 0.029	< 0.021
Ru-106	< 0.097	< 0.056
Cs-134	< 0.011	< 0.010
Cs-137	< 0.008	< 0.014
Ce-141	< 0.058	< 0.048
Ce-144	< 0.100	< 0.074

[a] Source determined to be from atmospheric deposition from nuclear weapons testing.

Table 20. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-107A (North Drainage Ditch)	
Lab Code	DBS- 1478	DBS- 4032
Date Collected	04-01-19	10-18-19
K-40	5.44 ± 0.38	5.22 ± 0.35
Mn-54	< 0.017	< 0.014
Fe-59	< 0.035	< 0.058
Co-58	< 0.020	< 0.017
Co-60	< 0.012	< 0.012
Zn-65	< 0.039	< 0.026
Nb-95	< 0.042	< 0.031
Zr-95	< 0.032	< 0.029
Ru-103	< 0.026	< 0.017
Ru-106	< 0.102	< 0.107
Cs-134	< 0.013	< 0.012
Cs-137	< 0.016	< 0.013
Ce-141	< 0.073	< 0.049
Ce-144	< 0.075	< 0.077

Table 21. Soil, analysis for strontium-90 and gamma-emitting isotopes.
Collection: Annually
Units: pCi/g dry

Location	D-15a	D-16
Lab Code	DSO- 2221	DSO- 2222
Date Collected	06-20-19	06-20-19
Sr-90	< 0.037	< 0.037
H-3 (pCi/L)	< 150	< 150
K-40	9.58 ± 0.47	13.55 ± 0.62
Mn-54	< 0.017	< 0.026
Fe-59	< 0.045	< 0.065
Co-58	< 0.020	< 0.020
Co-60	< 0.015	< 0.014
Zn-65	< 0.041	< 0.052
Nb-95	< 0.041	< 0.039
Zr-95	< 0.038	< 0.038
Ru-103	< 0.023	< 0.018
Ru-106	< 0.158	< 0.125
Cs-134	< 0.015	< 0.015
Cs-137	0.114 ± 0.019 [a]	0.120 ± 0.022 [a]
Ce-141	< 0.055	< 0.073
Ce-144	< 0.101	< 0.143

[a] Source determined to be from atmospheric deposition from nuclear weapons testing.

Table 22. Supplemental meat sample, analysis for gamma emitting isotopes. Free range chicken collected from location D-58.

Location	D-058
Lab Code	DME- 4373
Date Collected	11-12-19
K-40	2.39 ± 0.59
Mn-54	< 0.02
Fe-59	< 0.05
Co-58	< 0.02
Co-60	< 0.02
Zn-65	< 0.05
Nb-95	< 0.03
Zr-95	< 0.05
Ru-103	< 0.03
Ru-106	< 0.23
Cs-134	< 0.02
Cs-137	< 0.03
Ce-141	< 0.04
Ce-144	< 0.11

Table 23. Groundwater Protection Program Summary.

Precipitation samples for tritium analysis. Units: pCi/L

Lab Code	Date	H-3	Lab Code	Date	H-3
D-016			D-111		
DP- 79	01/07/19	< 148	DP- 81	01/07/19	167 ± 78
DP- 344	02/05/19	< 150	DP- 347	02/05/19	205 ± 82
DP- 665	03/05/19	< 155	DP- 667	03/05/19	< 155
DP- 985	04/01/19	< 155	DP- 987	04/01/19	< 155
DP- 1546	05/02/19	< 154	DP- 1548	05/02/19	224 ± 85
DP- 1970	06/04/19	< 154	DP- 1972	06/04/19	280 ± 87
DP- 2317	07/01/19	< 149	DP- 2319	07/01/19	< 149
DP- 2876	08/01/19	260 ± 90	DP- 2878	08/01/19	< 152
DP- 3273	09/03/19	< 155	DP- 3275	09/03/19	< 155
DP- 3671	10/01/19	< 151	DP- 3673	10/01/19	< 147
DP- 4208	11/04/19	< 151	DP- 4210	11/04/19	231 ± 84
DP- 4583	12/02/19	< 150	DP- 4585	12/02/19	< 156
D-112			D-114		
DP- 82	01/07/19	< 147		ND[a]	
DP- 348	02/04/19	913 ± 112		ND[a]	
DP- 668	03/05/19	< 155		ND[a]	
DP- 988	04/01/19	< 155		ND[a]	
DP- 1549	05/02/19	< 147		ND[a]	
DP- 1973	06/04/19	198 ± 83		ND[a]	
DP- 2320	07/01/19	< 149		ND[a]	
DP- 2879	08/01/19	160 ± 80		ND[a]	
DP- 3276	09/03/19	182 ± 82		ND[a]	
DP- 3674	10/01/19	< 147		ND[a]	
DP- 4211	11/04/19	332 ± 89		ND[a]	
DP- 4586	12/02/19	< 156		ND[a]	
D-127			D-128		
DP- 84	01/07/19	794 ± 107	DP- 85	01/07/19	157 ± 77
DP- 350	02/04/19	2256 ± 155	DP- 351	02/04/19	1411 ± 130
DP- 671	03/05/19	785 ± 109	DP- 672	03/05/19	200 ± 83
DP- 990	04/01/19	785 ± 110	DP- 991	04/01/19	241 ± 86
DP- 1552	05/02/19	1400 ± 131	DP- 1553	05/02/19	< 153
DP- 1975	06/04/19	1208 ± 124	DP- 1976	06/04/19	420 ± 94
DP- 2322	07/01/19	1130 ± 121	DP- 2323	07/01/19	316 ± 88
DP- 2881	08/01/19	517 ± 97	DP- 2882	08/01/19	327 ± 88
DP- 3278	09/03/19	1076 ± 121	DP- 3280	09/03/19	236 ± 85
DP- 3676	10/01/19	363 ± 91	DP- 3677	10/01/19	259 ± 85
DP- 4212	11/04/19	1010 ± 118	DP- 4213	11/04/19	705 ± 106
DP- 4588	12/02/19	647 ± 105	DP- 4589	12/02/19	< 156
D-081			D-115		
DP- 80	01/07/19	169 ± 78	DP- 83	01/07/19	< 147
DP- 345	02/04/19	245 ± 84	DP- 349	02/05/19	< 150
DP- 666	03/05/19	< 155	DP- 669	03/05/19	< 155
DP- 986	04/01/19	< 155	DP- 989	04/01/19	< 155
DP- 1547	05/02/19	< 147	DP- 1551	05/02/19	< 147
DP- 1971	06/04/19	< 154	DP- 1974	06/04/19	< 154
DP- 2318	07/01/19	< 149	DP- 2321	07/01/19	< 149
DP- 2877	08/01/19	165 ± 80	DP- 2880	08/01/19	< 152
DP- 3274	09/03/19	< 155	DP- 3277	09/03/19	< 155
DP- 3672	10/01/19	< 147	DP- 3675	10/01/19	< 147
DP- 4209	11/04/19	198 ± 83		11/04/19	NS[b]
DP- 4584	12/02/19	< 156	DP- 4587	12/02/19	< 156

[a] No sampler at the location.

[b] No sample collected due to broken collection container.

Table 23. Groundwater Protection Program Summary.

Precipitation, monthly collections, analyses for gamma emitting isotopes.

Location: D-16

		Concentration (pCi/L)										
Lab Code	Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{131}I	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
DP- 79	01/07/19	< 2.5	< 4.9	< 3.2	< 4.0	< 5.7	< 2.7	< 7.3	< 4.3	< 3.8	< 4.0	< 17.3	< 4.2
DP- 344	02/05/19	< 6.4	< 12.9	< 4.5	< 5.8	< 11.0	< 5.7	< 9.6	< 7.1	< 8.1	< 4.9	< 20.3	< 9.0
DP- 665	03/05/19	< 3.3	< 6.0	< 2.6	< 3.1	< 6.2	< 3.2	< 6.3	< 5.8	< 3.1	< 3.4	< 19.8	< 3.5
DP- 985	04/01/19	< 5.2	< 9.9	< 5.8	< 3.5	< 9.4	< 5.2	< 10.0	< 8.1	< 5.0	< 6.4	< 17.9	< 7.6
DP- 1546	05/02/19	< 3.1	< 4.0	< 3.0	< 3.1	< 5.6	< 3.4	< 4.6	< 4.6	< 3.0	< 3.1	< 9.5	< 4.3
DP- 1970	06/04/19	< 4.6	< 4.0	< 5.0	< 3.5	< 8.2	< 5.5	< 5.9	< 6.0	< 4.3	< 6.1	< 14.2	< 2.6
DP- 2317	07/01/19	< 3.6	< 4.0	< 3.0	< 3.0	< 6.3	< 4.2	< 5.7	< 5.7	< 3.2	< 4.3	< 13.8	< 4.2
DP- 2876	08/01/19	< 5.3	< 8.6	< 3.7	< 4.4	< 5.9	< 3.0	< 8.6	< 8.3	< 4.2	< 5.6	< 19.3	< 7.8
DP- 3273	09/03/19	< 3.9	< 3.9	< 3.8	< 2.8	< 6.3	< 3.9	< 6.0	< 5.8	< 3.7	< 3.4	< 19.2	< 2.6
DP- 3671	10/01/19	< 6.1	< 7.0	< 4.4	< 5.2	< 10.7	< 6.1	< 14.0	< 11.6	< 8.6	< 5.5	< 20.5	< 6.8
DP- 4208	11/04/19	< 5.3	< 10.5	< 4.9	< 4.3	< 11.5	< 5.3	< 8.9	< 5.7	< 6.6	< 4.9	< 17.4	< 8.7
DP- 4583	12/02/19	< 5.6	< 11.7	< 7.2	< 7.7	< 10.5	< 7.8	< 9.5	< 9.8	< 7.5	< 6.4	< 27.1	< 7.0

Table 23. Groundwater Protection Program Summary.

Ground water, Monitoring wells, analyses for tritium [a].

Lab Code	Date	H-3 (pCi/L)	Lab Code	Date	H-3 (pCi/L)
		D-111A		(01A)	
DWW- 750	03/12/19	158 ± 81			
DWW- 1773	05/07/19	197 ± 82			
DWW- 3088	08/13/19	< 152			
DWW- 4322	11/06/19	< 154			
		D-111B		(01B)	
DWW- 751	03/12/19	< 154	DWW- 4323	11/06/19	< 154
DWW- 1725	05/07/19	< 150			
DWW- 3089	08/13/19	< 152			
		D-112A		(02A)	
DWW- 752	03/11/19	< 155	DWW- 4324	11/07/19	< 154
DWW- 1774	05/07/19	< 151			
DWW- 3090	08/13/19	< 152			
		D-112B		(02B)	
DWW- 753	03/11/19	< 155	DWW- 4325	11/07/19	< 154
DWW- 1726	05/07/19	< 150			
DWW- 3078	08/13/19	< 152			
		D-113A		(03A)	
DWW- 754	03/12/19	< 154	DWW- 4326	11/07/19	< 154
DWW- 1775	05/07/19	< 151			
DWW- 3079	08/13/19	< 152			
		D-113B		(03B)	
DWW- 755	03/12/19	< 154	DWW- 4327	11/07/19	< 154
DWW- 1728	05/07/19	< 150			
DWW- 3081	08/13/19	< 152			
		D-114A		(04A)	
DWW- 767	03/14/19	230 ± 85	DWW- 4328	11/06/19	207 ± 83
DWW- 1807	05/07/19	189 ± 81			
DWW- 3082	08/14/19	163 ± 80			
		D-114B		(04B)	
DWW- 768	03/14/19	< 154	DWW- 4329	11/06/19	< 154
DWW- 1729	05/07/19	< 150			
DWW- 3083	08/14/19	< 152			
		D-115A		(05A)	
DWW- 757	03/12/19	< 154	DWW- 4330	11/06/19	< 154
DWW- 1776	05/07/19	< 151			
DWW- 3093	08/13/19	< 152			
		D-115B		(05B)	
DWW- 758	03/12/19	< 154	DWW- 4331	11/06/19	< 154
DWW- 1730	05/07/19	< 150			
DWW- 3094	08/13/19	< 152			
		D-116A		(06A)	
DWW- 759	03/12/19	< 154	DWW- 4332	11/07/19	< 154
DWW- 1777	05/09/19	< 151			
DWW- 3095	08/13/19	< 152			
		D-116B		(06B)	
DWW- 760	03/12/19	< 154	DWW- 4333	11/07/19	< 154
DWW- 1731	05/09/19	< 150			
DWW- 3096	08/13/19	< 152			

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L.

Table 23. Groundwater Protection Program Summary.

Ground water, Monitoring wells, analyses for tritium [a].

Lab Code	Date	H-3 (pCi/L)	Lab Code	Date	H-3 (pCi/L)
		D-127A		(07A)	
DWW- 87	01/08/19	1936 ± 150			
DWW- 761	03/11/19	3150 ± 179			
DWW- 1196	04/09/19	1106 ± 120			
DWW- 1778	05/06/19	1476 ± 133			
DWW- 3216	08/14/19	2713 ± 169			
DWW- 3500	09/11/19	13115 ± 350			
DWW- 4065	10/07/19	4197 ± 205			
DWW- 4287	11/06/19	2294 ± 159			
		D-127B		(07B)	
DWW- 762	03/11/19	< 155	DWW- 4288	11/06/19	< 154
DWW- 1784	05/06/19	< 151			
DWW- 3169	08/14/19	< 151			
		D-128A		(08A)	
DWW- 88	01/08/19	2984 ± 177			
DWW- 462	02/14/19	31343 ± 520			
DWW- 763	03/11/19	17373 ± 392			
DWW- 1197	04/09/19	45337 ± 625			
DWW- 1808	05/06/19	59075 ± 713			
DWW- 2168	06/05/19	42592 ± 604			
DWW- 2632	07/09/19	17644 ± 402			
DWW- 3501	09/11/19	3218 ± 185			
DWW- 4066	10/07/19	1188 ± 124			
DWW- 4431	11/13/19	1050 ± 121			
DWW- 4912	12/18/19	2491 ± 166			
		D-128B		(08B)	
DWW- 764	03/11/19	991 ± 117			
DWW- 1785	05/06/19	911 ± 113			
DWW- 3170	08/14/19	739 ± 107			
DWW- 4289	11/06/19	492 ± 97			
		D-129A		(09A)	
DWW- 765	03/11/19	309 ± 89			
DWW- 1766	05/06/19	990 ± 116			
DWW- 3171	08/14/19	761 ± 108			
DWW- 4291	11/05/19	528 ± 99			
		D-129B		(09B)	
DWW- 766	03/11/19	281 ± 88			
DWW- 1826	05/21/19	305 ± 87			
DWW- 3172	08/14/19	349 ± 89			
DWW- 4293	11/05/19	227 ± 84			
		D-130A		(10A)	
DWW- 775	03/11/19	< 155			
DWW- 1767	05/06/19	< 151			
DWW- 3179	08/14/19	171 ± 80			
DWW- 4294	11/05/19	< 154			

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L.

Table 23. Groundwater Protection Program Summary.

Ground water, Monitoring wells, analyses for tritium [a].

		D-130B	(10B)
DWW- 776	03/11/19	< 155	
DWW- 1787	05/06/19	< 151	
DWW- 3180	08/14/19	< 151	
DWW- 4295	11/05/19	< 154	
		D-131A	(11A)
DWW- 769	03/14/19	< 154	
DWW- 1768	05/07/19	< 151	
DWW- 3097	08/14/19	157 ± 80	
DWW- 4335	11/06/19	< 154	
		D-131B	(11B)
DWW- 770	03/14/19	< 154	
DWW- 1788	05/07/19	< 151	
DWW- 3098	08/14/19	< 152	
DWW- 4336	11/06/19	< 154	
		D-132A	(12A)
DWW- 771	03/14/19	< 154	
DWW- 1770	05/07/19	272 ± 86	
DWW- 3099	08/14/19	205 ± 82	
DWW- 4337	11/06/19	195 ± 83	
		D-132B	(12B)
DWW- 772	03/14/19	390 ± 93	
DWW- 1789	05/07/19	400 ± 92	
DWW- 3100	08/14/19	401 ± 92	
DWW- 4338	11/06/19	559 ± 101	
		D-133A	(13A)
DWW- 773	03/14/19	< 154	
DWW- 1771	05/07/19	< 151	
DWW- 3102	08/14/19	< 152	
DWW- 4339	11/06/19	161 ± 81	
		D-133B	(13B)
DWW- 774	03/14/19	< 154	
DWW- 1745	05/07/19	< 150	
DWW- 3103	08/14/19	< 152	
DWW- 4340	11/06/19	< 155	
		D-134A	(14A)
DWW- 778	03/11/19	9549 ± 294	
DWW- 1198	04/09/19	640 ± 102	
DWW- 1772	05/06/19	1746 ± 141	
DWW- 3217	08/14/19	20724 ± 432	
DWW- 3502	09/11/19	19742 ± 427	
DWW- 4296	11/05/19	372 ± 92	

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

Table 23. Groundwater Protection Program Summary.
Ground water, Monitoring wells, analyses for tritium [a].

		D-134B	(14B)
DWW- 779	03/11/19	< 155	
DWW- 1746	05/06/19	283 ± 87	
DWW- 3174	08/14/19	316 ± 88	
DWW- 4297	11/05/19	556 ± 100	
		D-135A	(15A)
DWW- 785	03/14/19	< 154	
DWW- 1754	05/07/19	< 151	
DWW- 3113	08/14/19	< 151	
DWW- 4348	11/06/19	< 155	
		D-135B	(15B)
DWW- 786	03/14/19	< 154	
DWW- 1747	05/07/19	< 150	
DWW- 3114	08/14/19	< 151	
DWW- 4349	11/06/19	< 155	
		D-136A	(16A)
DWW- 780	03/11/19	< 155	
DWW- 1755	05/06/19	< 151	
DWW- 3175	08/14/19	< 151	
DWW- 4298	11/06/19	< 154	
		D-136B	(16B)
DWW- 781	03/11/19	< 155	
DWW- 1809	05/06/19	< 151	
DWW- 3176	08/14/19	< 151	
DWW- 4350	11/06/19	< 155	
		D-137	(17C)
DWW- 782	03/11/19	< 155	
DWW- 1749	05/06/19	< 150	
DWW- 3177	08/14/19	< 151	
DWW- 4290	11/06/19	< 154	
		D-62	(18A)
DWW- 783	03/11/19	1213 ± 125	
DWW- 1756	05/13/19	734 ± 106	
DWW- 3178	08/14/19	1282 ± 127	
DWW- 4299	11/05/19	1231 ± 126	
		D-63	(19A)
DWW- 89	01/08/19	< 148	
DWW- 784	03/11/19	520 ± 99	
DWW- 1200	04/09/19	156 ± 79	
DWW- 1757	05/06/19	214 ± 83	
DWW- 3173	08/14/19	< 151	
DWW- 4067	10/07/19	222 ± 83	
DWW- 4300	11/05/19	405 ± 93	

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

Table 23. Groundwater Protection Program Summary.

Ground water, Monitoring wells, analyses for tritium [a].

Lab Code	Date	H-3 (pCi/L)	Lab Code	Date	H-3 (pCi/L)
		D-64		(20A)	
DWW- 90	01/08/19	< 148			
DWW- 792	03/11/19	433 ± 95			
DWW- 1201	04/09/19	173 ± 80			
DWW- 1758	05/06/19	< 151			
DWW- 3181	08/14/19	199 ± 81			
DWW- 4301	11/05/19	< 154			
		D-65		(21A)	
DWW- 91	01/08/19	1027 ± 121			
DWW- 463	02/14/19	722 ± 110			
DWW- 791	03/11/19	480 ± 97			
DWW- 1202	04/09/19	1458 ± 132			
DWW- 1810	05/06/19	266 ± 85			
DWW- 2169	06/05/19	< 150			
DWW- 2633	07/09/19	2218 ± 158			
DWW- 3182	08/14/19	608 ± 101			
DWW- 4302	11/05/19	2801 ± 172			
		D-66		(22A)	
DWW- 92	01/08/19	57663 ± 701			
DWW- 464	02/14/19	7714 ± 267			
DWW- 793	03/11/19	13094 ± 340			
DWW- 1203	04/09/19	21985 ± 438			
DWW- 1804	05/06/19	95396 ± 905			
DWW- 2170	06/05/19	32092 ± 525			
DWW- 2634	07/09/19	20950 ± 437			
DWW- 3218	08/14/19	23111 ± 456			
DWW- 3503	09/11/19	10742 ± 319			
DWW- 4068	10/07/19	12197 ± 335			
DWW- 4490	11/20/19	33257 ± 549			
DWW- 4915	12/18/19	90728 ± 899			
		D-67		(23A)	
DWW- 93	01/08/19	11280 ± 318			
DWW- 465	02/14/19	33310 ± 536			
DWW- 794	03/11/19	11662 ± 322			
DWW- 1204	04/09/19	17577 ± 393			
DWW- 2171	06/05/19	7477 ± 261			
DWW- 2635	07/09/19	34435 ± 557			
DWW- 3504	09/11/19	13590 ± 356			
DWW- 4069	10/07/19	7305 ± 263			
DWW- 4491	11/19/19	7229 ± 264			
DWW- 4916	12/18/19	5070 ± 224			
		D-165		(24A)	
DWW- 787	03/14/19	< 154			
DWW- 1805	05/07/19	< 151			
DWW- 3115	08/14/19	156 ± 79			
DWW- 4351	11/06/19	< 155			

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

Table 23. Groundwater Protection Program Summary

Ground water, Monitoring wells, analyses for tritium [a].

		D-167	(26A)
DWW- 790	03/15/19	245 ± 86	
DWW- 1759	05/07/19	176 ± 81	
DWW- 3116	08/14/19	243 ± 84	
DWW- 4352	11/06/19	315 ± 89	

		D-168A	(27A)
DWW- 795	03/12/19	196 ± 82	
DWW- 1750	05/07/19	262 ± 86	
DWW- 3091	08/13/19	< 152	
DWW- 4353	11/06/19	261 ± 87	
DWW- 4432	11/13/19	253 ± 86	

		D-168B	(27B)
DWW- 796	03/12/19	< 153	
DWW- 1760	05/07/19	< 151	
DWW- 3092	08/13/19	< 152	
DWW- 4354	11/06/19	< 155	

		D-169A	(28A)
DWW- 797	03/12/19	222 ± 83	
DWW- 1751	05/07/19	216 ± 83	
DWW- 3104	08/13/19	487 ± 96	
DWW- 4356	11/06/19	441 ± 95	

		D-169B	(28B)
DWW- 799	03/12/19	< 153	
DWW- 1761	05/07/19	< 151	
DWW- 3105	08/13/19	< 152	
DWW- 4357	11/06/19	< 155	

		D-170A	(29A)
DWW- 466	02/14/19	259 ± 90	
DWW- 788	03/14/19	219 ± 85	
DWW- 1752	05/08/19	265 ± 85	
DWW- 3106	08/13/19	621 ± 102	
DWW- 3505	09/11/19	709 ± 108	
DWW- 4070	10/07/19	808 ± 110	
DWW- 4433	11/13/19	696 ± 107	

		D-170B	(29B)
DWW- 789	03/14/19	< 154	
DWW- 1762	05/08/19	< 151	
DWW- 3107	08/13/19	388 ± 91	
DWW- 4434	11/13/19	560 ± 101	

		D171A	(30A)
DWW- 800	03/11/19	262 ± 85	
DWW- 1753	05/09/19	< 151	
DWW- 3108	08/13/19	< 152	
DWW- 4358	11/07/19	161 ± 81	

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

Table 23. Groundwater Protection Program Summary
Ground water, Monitoring wells, analyses for tritium [a].

		D-171B	(30B)
DWW- 801	03/11/19	< 153	
DWW- 1763	05/09/19	< 151	
DWW- 3109	08/13/19	< 152	
DWW- 4359	11/07/19	< 155	
		D172A	(31A)
DWW- 802	03/12/19	< 153	
DWW- 1779	05/09/19	< 151	
DWW- 3110	08/13/19	< 152	
DWW- 4360	11/07/19	< 155	
		D-172B	(31B)
DWW- 803	03/12/19	< 153	
DWW- 1764	05/09/19	< 151	
DWW- 3111	08/13/19	< 151	
DWW- 4361	11/07/19	< 155	
		D-173A	(32A)
DWW- 804	03/12/19	258 ± 85	
DWW- 1780	05/07/19	314 ± 88	
DWW- 3112	08/13/19	871 ± 112	
DWW- 4362	11/06/19	519 ± 99	
		D-173B	(32B)
DWW- 805	03/12/19	156 ± 80	
DWW- 1765	05/07/19	204 ± 82	
DWW- 3084	08/13/19	159 ± 80	
DWW- 4363	11/06/19	321 ± 90	
		D-79	MW-33A
DWW- 806	03/11/19	< 153	
DWW- 1781	05/08/19	< 151	
DWW- 3085	08/13/19	< 152	
DWW- 4364	11/06/19	< 155	
		D-80	MW-34A
DWW- 807	03/11/19	< 153	
DWW- 1782	05/08/19	< 151	
DWW- 3086	08/13/19	< 152	
DWW- 4365	11/06/19	< 155	
		D-81	MW-35A
DWW- 467	02/14/19	< 155	
DWW- 808	03/13/19	194 ± 82	
DWW- 1205	04/09/19	171 ± 80	
DWW- 1783	05/08/19	< 151	
DWW- 2172	06/05/19	< 150	
DWW- 2636	07/09/19	< 159	
DWW- 3087	08/13/19	< 152	
DWW- 4366	11/06/19	219 ± 84	
DWW- 4913	12/18/19	< 158	
		D-68	EW-01[b]

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

[b] EW-01 is a permanent extraction well. No sample taken in 2019.

Table 23. Groundwater Protection Program Summary.
Surface water, analysis for tritium.

		D-119	(2MH209)
DSW- 949	03/25/19	246 ± 84	
DWW- 1517	04/25/19	266 ± 86	
DSW- 1733	05/09/19	262 ± 86	
DSW- 3144	08/20/19	258 ± 85	
DSW- 4492	11/19/19	264 ± 87	
		D-120	(2MH210)
DSW- 950	03/25/19	246 ± 84	
DWW- 1518	04/25/19	295 ± 88	
DSW- 1734	05/09/19	194 ± 82	
DSW- 3145	08/20/19	239 ± 83	
DSW- 4495	11/19/19	264 ± 87	
		D-121	(2MH211)
DSW- 951	03/25/19	< 153	
DWW- 1519	04/25/19	< 150	
DSW- 1735	05/09/19	< 150	
DSW- 3146	08/20/19	< 151	
DSW- 4496	11/19/19	159 ± 81	
		D-122	(Sluice Pond)
DSW- 952	03/25/19	218 ± 83	
DSW- 1736	05/09/19	372 ± 91	
DSW- 1979	05/29/19	< 154	
DSW- 3147	08/20/19	173 ± 80	
DSW- 4375	10/24/19	< 155	
		D-123	(S. Drainage Ditch)
DSW- 953	03/25/19	< 153	
DSW- 1737	05/09/19	< 150	
DSW- 3148	08/20/19	< 151	
DSW- 4497	11/19/19	< 156	
		D-124	(N. Drainage Ditch)
DSW- 954	03/25/19	< 153	
DSW- 1738	05/09/19	< 150	
DSW- 3149	08/20/19	< 151	
DSW- 4498	11/19/19	< 156	
		D-125	(Onsite S. Storm Drain Outfall)
DSW- 955	03/25/19	1232 ± 124	
DSW- 1806	05/09/19	3775 ± 193	
DSW- 3219	08/20/19	2558 ± 165	
DSW- 4489	11/19/19	2825 ± 174	
		D-89	(MH221)[a]

[a] No sample taken in 2019.

Table 23. Groundwater Protection Program Summary.
Surface water, analysis for tritium.

		D-101	(1MH109)
DSW- 1484	04/24/19	281 ± 87	
		D-102	(1MH110)
DSW- 1485	04/24/19	< 150	
		D-25	(MH105)
DWW- 1480	04/24/19	< 150	
DWW- 4102	10/21/19	< 152	
		D-27	(MH-107)
DWW- 1482	04/24/19	< 150	
DWW- 4104	10/21/19	< 152	
		D-24	(MW-104)
DWW- 1479	04/24/19	173 ± 82	
DWW- 4101	10/21/19	< 152	
		D-26	(MW-106)
DWW- 1481	04/24/19	188 ± 82	
DWW- 4103	10/21/19	234 ± 85	

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
						D-127A (MW-07A)						
DWW- 87	1/8/2019	< 0.8	< 3.4	< 1.5	< 1.3	< 2.3	< 1.8	< 2.6	< 1.5	< 1.7	< 9.5	< 2.0
DWW- 761	3/11/2019	< 2.4	< 6.5	< 3.4	< 2.7	< 5.6	< 4.3	< 6.9	< 3.5	< 4.2	< 24.0	< 9.2
DWW- 1196	4/9/2019	< 2.4	< 5.7	< 1.4	< 1.5	< 4.4	< 2.1	< 3.4	< 2.7	< 1.9	< 14.3	< 4.3
DWW- 1778	5/6/2019	< 1.5	< 4.6	< 1.3	< 1.2	< 2.9	< 3.5	< 4.0	< 1.5	< 1.6	< 47.5	< 14.0
DWW- 3216	8/14/2019	< 1.9	< 4.9	< 1.5	< 1.2	< 1.5	< 2.6	< 3.8	< 1.5	< 1.8	< 38.0	< 9.4
DWW- 3500	9/11/2019	< 1.5	< 4.3	< 1.9	< 1.6	< 3.4	< 2.3	< 3.8	< 1.5	< 1.5	< 16.2	< 8.6
DWW- 4065	10/7/2019	< 1.9	< 3.7	< 3.6	< 1.6	< 2.7	< 4.8	< 5.0	< 3.2	< 3.0	< 39.8	< 9.7
DWW- 4287	11/6/2019	< 2.3	< 3.8	< 1.8	< 1.8	< 4.0	< 3.1	< 5.2	< 2.6	< 1.9	< 17.6	< 5.4
						D-128A (MW-08A)						
DWW- 88	1/8/2019	< 2.9	< 6.1	< 2.6	< 2.8	< 3.9	< 3.3	< 4.4	< 2.7	< 3.4	< 15.9	< 2.7
DWW- 462	2/14/2019	< 3.6	< 4.0	< 2.7	< 4.0	< 3.1	< 3.2	< 5.2	< 4.2	< 3.9	< 21.8	< 5.0
DWW- 763	3/11/2019	< 2.7	< 5.7	< 3.2	< 2.8	< 6.2	< 3.1	< 4.9	< 3.3	< 3.6	< 33.6	< 7.6
DWW- 1197	4/9/2019	< 1.8	< 3.5	< 2.2	< 2.0	< 2.0	< 1.6	< 3.7	< 2.0	< 2.4	< 18.5	< 6.8
DWW- 1808	5/6/2019	< 1.2	< 5.0	< 1.9	< 1.3	< 3.6	< 2.3	< 4.4	< 1.4	< 1.5	<61.2[a]	< 11.2
DWW- 2168	6/5/2019	< 1.5	< 4.2	< 1.6	< 1.6	< 2.7	< 3.0	< 4.0	< 1.5	< 1.7	< 40.7	< 6.5
DWW- 2632	7/9/2019	< 1.8	< 4.8	< 1.6	< 1.5	< 3.4	< 2.3	< 3.7	< 1.4	< 1.4	< 24.3	< 7.2
DWW- 3501	9/11/2019	< 1.5	< 3.7	< 1.4	< 1.3	< 2.3	< 2.6	< 3.2	< 1.4	< 1.9	< 21.9	< 4.6
DWW- 4066	10/7/2019	< 3.2	< 4.9	< 2.0	< 2.9	< 3.2	< 6.0	< 7.3	< 3.9	< 3.7	< 53.1	< 9.1
DWW- 4431	11/13/2019	< 1.6	< 5.8	< 2.1	< 1.5	< 3.2	< 3.4	< 3.4	< 1.6	< 1.3	< 41.0	< 5.6
DWW- 4912	12/18/2019	< 1.6	< 3.2	< 2.2	< 1.3	< 4.2	< 4.9	< 3.8	< 1.7	< 2.4	< 37.2	< 13.3
						D-128B (MW-08B)						
						D-129A (MW-09A)						
						D-129B (MW-09B)						
						D-130A (MW-10A)						
						D-130B (MW-10B)						
						D-132A (MW-12A)						

[a] LLDs not reached due to age and small sample volume.

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-132B (MW-12B)												
D-134A (MW-14A)												
DWW- 778	3/11/2019	< 2.5	< 3.5	< 2.3	< 2.8	< 4.6	< 2.6	< 4.5	< 2.3	< 2.2	< 27.7	< 4.8
DWW- 1772	5/6/2019	< 1.8	< 3.3	< 2.2	< 1.2	< 3.5	< 4.0	< 3.8	< 1.5	< 1.5	< 58.5	< 12.9
DWW- 3217	8/14/2019	< 1.9	< 5.9	< 1.8	< 1.8	< 2.9	< 3.1	< 3.7	< 1.5	< 1.3	< 36.6	< 9.0
DWW- 3502	9/11/2019	< 1.9	< 5.8	< 1.6	< 1.4	< 3.8	< 2.1	< 5.0	< 2.0	< 1.5	< 20.3	< 6.4
D-134B (MW-14B)												
D-62 (MW-18A)												
DWW- 783	3/11/2019	< 2.0	< 3.9	< 1.8	< 1.5	< 3.4	< 2.8	< 3.7	< 1.6	< 1.7	< 21.9	< 8.3
DWW- 3178	8/14/2019	< 1.8	< 3.0	< 1.7	< 1.5	< 3.0	< 2.5	< 2.8	< 1.5	< 1.7	< 30.8	< 11.3
DWW- 4299	11/5/2019	< 2.4	< 3.1	< 1.8	< 2.0	< 3.9	< 4.0	< 4.2	< 2.1	< 1.7	< 24.1	< 4.3
D-63 (MW-19A)												
D-64 (MW-20A)												
D-65 (MW-21A)												
DWW- 91	1/8/2019	< 2.5	< 2.6	< 1.5	< 1.8	< 4.9	< 3.0	< 4.7	< 2.9	< 3.2	< 12.3	< 4.6
DWW- 1202	4/9/2019	< 1.9	< 4.0	< 2.2	< 1.9	< 3.6	< 3.5	< 2.0	< 2.1	< 1.9	< 20.0	< 3.2
DWW- 2633	7/9/2019	< 3.3	< 8.4	< 2.8	< 2.7	< 4.1	< 4.0	< 7.9	< 3.6	< 4.0	< 39.8	< 13.0
DWW- 4302	11/5/2019	< 2.1	< 3.6	< 2.7	< 1.3	< 2.2	< 2.9	< 3.8	< 2.0	< 2.0	< 13.1	< 5.7

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-66 (MW-22A)												
DWW- 92	1/8/2019	< 2.2	< 5.7	< 2.6	< 2.0	< 4.3	< 3.3	< 2.9	< 2.9	< 2.3	< 17.0	< 2.8
DWW- 464	2/14/2019	< 5.1	< 5.4	< 3.1	< 1.9	< 7.7	< 4.9	< 8.1	< 5.6	< 3.3	< 34.2	< 3.7
DWW- 793	3/11/2019	< 1.6	< 3.7	< 1.8	< 1.4	< 3.5	< 2.0	< 2.8	< 1.5	< 1.4	< 23.1	< 3.4
DWW- 1203	4/9/2019	< 1.8	< 4.2	< 1.7	< 1.0	< 3.6	< 2.9	< 3.4	< 2.1	< 1.9	< 18.0	< 5.4
DWW- 1804	5/6/2019	< 1.9	< 4.2	< 2.0	< 1.4	< 3.2	< 4.2	< 2.5	< 1.5	< 1.8	< 50.5	< 17.4 [a]
DWW- 2170	6/5/2019	< 2.0	< 4.4	< 2.3	< 1.7	< 4.0	< 2.8	< 4.7	< 2.3	< 1.2	< 47.3	< 13.1
DWW- 2634	7/9/2019	< 3.6	< 5.6	< 2.1	< 2.6	< 3.2	< 5.1	< 5.0	< 3.3	< 3.2	< 52.7	< 10.8
DWW- 3218	8/14/2019	< 1.7	< 3.0	< 2.3	< 1.7	< 2.7	< 3.5	< 2.9	< 1.5	< 1.5	< 42.6	< 9.4
DWW- 3503	9/11/2019	< 1.9	< 3.8	< 1.5	< 1.5	< 3.5	< 3.2	< 2.6	< 1.5	< 1.4	< 26.1	< 6.7
DWW- 4068	10/7/2019	< 3.5	< 6.8	< 4.8	< 2.7	< 3.6	< 4.3	< 5.9	< 3.7	< 3.3	< 41.9	< 8.3
DWW- 4490	11/20/2019	< 1.2	< 3.3	< 1.3	< 0.9	< 3.4	< 2.8	< 3.3	< 1.5	< 1.5	< 22.6	< 7.6
DWW- 4915	12/18/2019	< 2.2	< 6.3	< 2.7	< 1.8	< 3.6	< 5.1	< 4.5	< 1.9	< 1.9	< 53.8	< 12.9
D-67 (MW-23A)												
DWW- 93	1/8/2019	< 2.7	< 6.2	< 3.0	< 1.8	< 5.5	< 3.7	< 3.6	< 3.0	< 2.2	< 13.2	< 2.5
DWW- 465	2/14/2019	< 4.6	< 8.6	< 4.4	< 2.7	< 3.9	< 3.2	< 8.4	< 4.9	< 3.1	< 38.0	< 8.3
DWW- 794	3/11/2019	< 1.9	< 4.0	< 1.8	< 1.2	< 2.5	< 2.7	< 2.2	< 1.6	< 1.7	< 21.8	< 5.6
DWW- 1204	4/9/2019	< 1.3	< 3.6	< 1.9	< 0.9	< 3.7	< 2.7	< 3.6	< 1.7	< 1.5	< 16.8	< 2.6
DWW- 2171	6/5/2019	< 1.4	< 5.2	< 1.6	< 1.2	< 2.7	< 2.9	< 4.0	< 1.5	< 1.2	< 50.0	< 8.8
DWW- 2635	7/9/2019	< 2.1	< 4.9	< 1.9	< 2.4	< 3.1	< 4.4	< 4.0	< 2.9	< 3.2	< 48.8	< 9.7
DWW- 3504	9/11/2019	< 1.6	< 4.5	< 1.7	< 1.5	< 2.7	< 2.3	< 3.4	< 1.5	< 1.6	< 17.9	< 4.7
DWW- 4069	10/7/2019	< 3.0	< 5.3	< 2.3	< 1.8	< 5.0	< 3.6	< 5.4	< 3.1	< 3.6	< 43.9	< 6.7
DWW- 4491	11/19/2019	< 1.5	< 4.3	< 1.4	< 1.8	< 3.4	< 2.1	< 3.8	< 1.5	< 2.0	< 24.4	< 4.4
DWW- 4916	12/18/2019	< 1.4	< 4.3	< 1.8	< 1.0	< 2.5	< 2.3	< 2.2	< 1.2	< 1.4	< 46.3	< 11.1
D-165 (MW-24A)												
D-167 (MW-26A)												
D-168 (MW-27A)												
D-168 (MW-27B)												

[a] LLDs for Ba-140 and/or La-140 not reached due to age of samples and smaller sample size.

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-169 (MW-28A)												
D-169 (MW-28B)												
D-170 (MW-29A)												
D-170 (MW-29B)												
D-171 (MW-30A)												
D-171 (MW-30B)												
D-172 (MW-31A)												
D-172 (MW-31B)												
D-173 (MW-32A)												
D-173 (MW-32B)												

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-79 (MW-33A)												
D-80 (MW-34A)												
D-81 (MW-35A)												
D-111 (MW-01A)												
D-111 (MW-01B)												
D-112 (MW-02A)												
D-112 (MW-02B)												
D-113 (MW-03A)												
D-113 (MW-03B)												
D-114 (MW-04A)												
D-114 (MW-04B)												

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-115 (MW-05A)												
D-115 (MW-05B)												
D-116 (MW-06A)												
D-116 (MW-06B)												
D-131 (MW-11A)												
D-131 (MW-11B)												
D-133 (MW-13A)												
D-133 (MW-13B)												
D-135 (MW-15A)												
D-135 (MW-15B)												

Table 23. Groundwater Protection Program Summary.

Monitoring wells, analyses for gamma-emitting isotopes.

Lab Code	Collection Date	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{65}Zn	^{95}Nb	^{95}Zr	^{134}Cs	^{137}Cs	^{140}Ba	^{140}La
D-136 (MW-16A)												
D-136 (MW-16B)												
D-137 (MW-17C)												
D-68 (EW-01)												

Table 23. Groundwater Protection Program Summary.

Monitoring wells, conditional analyses for gross alpha, iron-55, nickel-63, strontium-89 and strontium-90 [a].

Lab Code	Collection Date	Location	Gross Alpha	^{55}Fe	^{63}Ni	^{89}Sr	^{90}Sr
DWW- 87	1/8/2019	d-127a	0.9 ± 0.7	< 606	< 64	< 1.1	< 1.0
DWW- 88	1/8/2019	d-128a	< 1.1	< 589	< 64	< 1.5	< 1.3
DWW- 91	1/8/2019	mw-21a	< 2.2	< 555	< 71	< 1.1	< 1.0
DWW- 92	1/8/2019	mw-22a	1.4 ± 0.1	< 589	< 65	< 1.3	< 1.1
DWW- 93	1/8/2019	mw-23a	< 1.5	< 555	< 63	< 1.1	< 1.1
DWW- 462	2/14/2019	d-128a	< 1.2	< 610	< 71	< 1.1	< 1.0
DWW- 464	2/14/2019	mw-22a	< 2.1	< 597	< 68	< 1.1	< 0.9
DWW- 465	2/14/2019	mw-23a	< 1.4	< 623	< 69	< 1.0	< 0.9
DWW- 761	3/11/2019	d-127a	< 1.1	< 530	< 69	< 1.6	< 1.0
DWW- 763	3/11/2019	d-128a	1.8 ± 1.2	< 506	< 75	< 1.7	< 1.0
DWW- 778	3/11/2019	d-134a	< 1.2	< 530	< 67	< 1.4	< 0.9
DWW- 783	3/11/2019	mw-18a	3.8 ± 2.1	< 595	< 67	< 1.5	< 1.0
DWW- 793	3/11/2019	mw-22a	< 4.9	< 603	< 70	< 1.5	< 0.8
DWW- 794	3/11/2019	mw-23a	< 2.5	< 611	< 68	< 1.4	< 0.9
DWW- 1196	4/9/2019	d-127a	< 1.1	< 607	< 66	< 1.4	< 1.1
DWW- 1197	4/9/2019	d-128a	< 1.2	< 580	< 67	< 1.3	< 1.0
DWW- 1202	4/9/2019	mw-21a	< 2.3	< 603	< 67	< 1.4	< 1.1
DWW- 1203	4/9/2019	mw-22a	< 2.4	< 623	< 67	< 1.6	< 1.2
DWW- 1204	4/9/2019	mw-23a	< 2.0	< 623	< 67	< 1.3	< 1.0
DWW- 1772	5/6/2019	d-134a	< 1.1	< 581	< 67	< 1.9	< 1.1
DWW- 1778	5/6/2019	d-127a	< 1.0	< 574	< 67	< 1.9	< 1.1
DWW- 1804	5/6/2019	mw-22a	3.3 ± 1.8	< 588	< 66	< 1.7	< 0.9
DWW- 1808	5/6/2019	d-128a	< 1.2	< 581	< 66	< 1.9	< 1.0
DWW- 2168	6/5/2019	d-128a	< 2.1	< 608	< 63	< 1.8	< 0.9
DWW- 2170	6/5/2019	mw-22a	6.7 ± 3.3	< 676	< 63	< 2.0	< 1.0
DWW- 2171	6/5/2019	mw-23a	5.1 ± 3.3	< 638	< 63	< 1.7	< 0.9
DWW- 2632	7/9/2019	d-128a	< 2.0	< 558	< 64	< 1.7	< 1.0
DWW- 2633	7/9/2019	mw-21a	< 2.6	< 606	< 64	< 1.9	< 1.0
DWW- 2634	7/9/2019	mw-22a	< 4.0	< 576	< 64	< 1.5	< 0.9
DWW- 2635	7/9/2019	mw-23a	< 2.0	< 579	< 64	< 1.5	< 0.9
DWW- 3178	8/14/2019	mw-18a	< 4.3	< 595	< 63	< 1.8	< 0.9
DWW- 3216	8/14/2019	d-127a	< 0.9	< 595	< 68	< 2.1	< 1.0
DWW- 3217	8/14/2019	d-134a	< 2.0	< 569	< 65	< 2.3	< 1.0
DWW- 3218	8/14/2019	mw-22a	< 4.1	< 569	< 63	< 1.9	< 0.9
DWW- 3500	9/11/2019	d-127a	< 0.9	< 710	< 69	< 1.7	< 1.2
DWW- 3501	9/11/2019	d-128a	< 0.7	< 701	< 70	< 1.8	< 1.2
DWW- 3502	9/11/2019	d-134a	2.0 ± 1.3	< 679	< 67	< 1.5	< 1.0
DWW- 3503	9/11/2019	mw-22a	< 2.3	< 663	< 65	< 1.4	< 0.9
DWW- 3504	9/11/2019	mw-23a	2.4 ± 1.6	< 720	< 68	< 1.4	< 1.1
DWW- 4065	10/7/2019	d-127a	< 2.5	< 633	< 70	< 1.8	< 1.3

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

NOTE: Gross alpha values are related to the natural radioactive decay of radon gas held dissolved in groundwater.

Table 23. Groundwater Protection Program Summary.

Monitoring wells, conditional analyses for gross alpha, iron-55, nickel-63, strontium-89 and strontium-90 [a].

Lab Code	Collection Date	Location	Gross Alpha	^{55}Fe	^{63}Ni	^{89}Sr	^{90}Sr
DWW- 4066	10/7/2019	d-128a	< 2.1	< 637	< 69	< 1.7	< 1.1
DWW- 4068	10/7/2019	mw-22a	< 2.5	< 625	< 67	< 1.8	< 1.3
DWW- 4069	10/7/2019	mw-23a	< 2.5	< 662	< 69	< 1.4	< 1.0
DWW- 4299	11/5/2019	mw-18a	2.1 ± 1.0	< 690	< 69	< 3.1	< 2.1
DWW- 4302	11/5/2019	mw-21a	< 3.8	< 666	< 68	< 1.3	< 1.0
DWW- 4287	11/6/2019	d-127a	< 1.1	< 674	< 69	< 2.0	< 1.1
DWW- 4431	11/13/2019	d-128a	< 2.2	< 701	< 65	< 1.7	< 1.0
DWW- 4491	11/19/2019	mw-23a	< 2.5	< 694	< 65	< 1.5	< 1.0
DWW- 4490	11/20/2019	mw-22a	< 3.2	< 655	< 65	< 1.7	< 1.1
DWW- 4912	12/18/2019	d-128a	< 1.6	< 652	< 71	< 2.0	< 1.0
DWW- 4915	12/18/2019	mw-22a	7.8 ± 2.1	< 640	< 69	< 2.3	< 1.0
DWW- 4916	12/18/2019	mw-23a	< 2.0	< 660	< 70	< 2.0	< 0.9

[a] Analyses for gamma, gross alpha, Sr-89, Sr-90, Fe-55 and Ni-63 will be performed if tritium activity > 1K pCi/L .

NOTE: Gross alpha values are related to the natural radioactive decay of radon gas held dissolved in groundwater.

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APPENDIX A

INTERLABORATORY AND INTRALABORATORY
COMPARISON PROGRAM RESULTS

NOTE: Appendix A is updated four times a year. The complete appendix is included in March, June, September and December monthly progress reports only.

January, 2019 through December, 2019

Appendix A

Interlaboratory/ Intralaboratory Comparison Program Results

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

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

Results in Table A-1 were obtained through participation in the RAD PT Study Proficiency Testing Program administered by Environmental Resource Associates, serving as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Results in Table A-2 were obtained through participation in the New York Department of Health Environmental Laboratory Approval Program (ELAP) PT

Table A-3 lists results for thermoluminescent dosimeters (TLDs), via irradiation and evaluation by the University of Wisconsin-Madison Radiation Calibration Laboratory at the University of Wisconsin Medical Radiation Research Center.

Table A-4 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-5 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-6 lists analytical results from the in-house "duplicate" program for the past twelve months. Acceptance is based on the each result being with 25% of the mean of the two results or the two sigma uncertanties of each result overlap.

The results in Table A-7 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

Results in Table A-8 were obtained through participation in the MRAD PT Study Proficiency Testing Program administered by Environmental Resource Associates, serving as a replacement for studies conducted previously by the Environmental Measurement Laboratory Quality Assessment Program (EML).

Attachment A lists the laboratory acceptance criteria for various analyses.

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

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

Analysis	Ratio of lab result to known value.
Gamma Emitters	0.8 to 1.2
Strontium-89, Strontium-90	0.8 to 1.2
Potassium-40	0.8 to 1.2
Gross alpha	0.5 to 1.5
Gross beta	0.8 to 1.2
Tritium	0.8 to 1.2
Radium-226, Radium-228	0.7 to 1.3
Plutonium	0.8 to 1.2
Iodine-129, Iodine-131	0.8 to 1.2
Nickel-63, Technetium-99, Uranium-238	0.7 to 1.3
Iron-55	0.8 to 1.2
Other Analyses	0.8 to 1.2

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

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result	ERA Result	Control Limits	Acceptance
ERW-71	1/7/2019	Ba-133	97.9 ± 4.5	99.5	84.1 - 109	Pass
ERW-71	1/7/2019	Cs-134	45.4 ± 3.1	49.1	39.5 - 54.0	Pass
ERW-71	1/7/2019	Cs-137	129 ± 6	125	112 - 140	Pass
ERW-71	1/7/2019	Co-60	98.1 ± 4.1	96.4	86.8 - 108	Pass
ERW-71	1/7/2019	Zn-65	80.4 ± 7.8	77.4	69.5 ± 93.2	Pass
ERW-73	1/7/2019	Gr. Alpha	22.2 ± 1.6	21.8	10.9 - 29.5	Pass
ERW-73	1/7/2019	Gr. Beta	46.4 ± 1.4	55.7	38.1 - 62.6	Pass
ERW-75	1/7/2019	Ra-226	7.19 ± 0.30	7.37	5.55 ± 8.72	Pass
ERW-75	1/7/2019	Ra-228	4.02 ± 0.70	4.28	2.48 - 5.89	Pass
ERW-75	1/7/2019	Uranium	50.2 ± 2.9	68.2	55.7 - 75.0	Fail[b]
ERW-77	1/7/2019	H-3	2,129 ± 158	2,110	1,740 - 2,340	Pass
ERW-397	2/11/2019	I-131	27.2 ± 1.0	25.9	25.1 - 30.6	Pass
ERW-1141	4/8/2019	Ra-226	7.58 ± 0.53	7.15	5.39 - 8.48	Pass
ERW-1141	4/8/2019	Ra-228	2.64 ± 0.79	2.94	1.54 - 4.35	Pass
ERW-1141	4/8/2019	Uranium	67.0 ± 0.9	55.9	45.6 - 61.5	Fail[c]
ERW-2471	7/8/2019	Ba-133	66.5 ± 4.0	66.9	55.8 - 73.6	Pass
ERW-2471	7/8/2019	Cs-134	29.6 ± 2.6	32.0	25.1 - 35.2	Pass
ERW-2471	7/8/2019	Cs-137	21.3 ± 3.6	21.4	17.6 - 26.7	Pass
ERW-2471	7/8/2019	Co-60	99.9 ± 4.4	95.1	85.6 - 107.0	Pass
ERW-2471	7/8/2019	Zn-65	43.7 ± 6.2	41.2	35.3 - 51.4	Pass
ERW-2473	7/8/2019	Gr. Alpha	41.7 ± 2.1	70.6	37.1 - 87.1	Pass
ERW-2473	7/8/2019	Gr. Beta	57.0 ± 1.6	63.9	44.2 - 70.5	Pass
ERW-2477	7/8/2019	Ra-226	16.2 ± 0.5	18.5	13.8 - 21.1	Pass
ERW-2477	7/8/2019	Ra-228	6.2 ± 0.8	8.2	5.2 - 10.3	Pass
ERW-2477	7/8/2019	Uranium	63.8 ± 3.6	68.3	55.8 - 75.1	Pass
ERW-2479	7/8/2019	H-3	8,630 ± 200	16,700	14,600 - 18,400	Fail[d]
ERW-2475	7/8/2019	I-131	33.6 ± 1.3	29.6	24.6 - 34.6	Pass

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

[b] In order to get to the root cause of the above "Fail" resolution the U-232 tracer was standardized using a known concentration of NIST U-238 solution. A duplicate analysis was performed and the results obtained were well within the acceptance range (Known value for Total Uranium=68.2 pCi/L, acceptance range of (55.7-75 pCi/L). The results obtained were 63.3 pCi/L and 66.0 pCi/L respectively.

[c] The standardized U-232 value utilized on ERA sample ERW-1141 above was found to be estimated high due to interferences in the U-238 solution causing ERW-1141 to fail the study. After performing U-isotopic chemistry on the NIST-Uranium solution to remove interferences a more accurate U-232 tracer concentration was obtained. The Uranium result in the subsequent ERA PT study was acceptable. See ERW-2477 Uranium result above.

[d] EIML's routine H-3 analysis does include a blank sample. The ERA provided blank was paired with a H-3 standard vial and EIML's blank was also paired with a standard vial. Inadvertently the efficiency was overestimated by a factor of 2. This understated the calculated results by half. The result of reanalysis (17,400 pCi/L) is within the control limits for the study.

TABLE A-2. Interlaboratory Comparison Crosscheck program, New York Department of Health (ELAP)[a].

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result	Assigned Value	Acceptance Limits	Acceptance
			Shipment 427R			
NYW-3472	9/17/2019	H-3	5250 ± 229	4991	4280 - 5490	Pass
NYW-3476	9/17/2019	Gross Alpha	18.0 ± 1.2	20.1	9.99 - 27.5	Pass
NYW-3476	9/17/2019	Gross Beta	22.7 ± 1.0	27.2	17.1 - 35.1	Pass
NYW-3478	9/17/2019	I-131	18.7 ± 1.8	15.6	12.8 - 19.3	Pass
NYW-3480	9/17/2019	Ra-226	5.02 ± 0.37	4.41	3.37 - 5.43	Pass
NYW-3480	9/17/2019	Ra-228	16.0 ± 1.9	18.3	12.3 - 21.9	Pass
NYW-3480	9/17/2019	Uranium	13.7 ± 0.9	13.9	11.0 - 15.7	Pass
NYW-3482	9/17/2019	Co-60	63.9 ± 4.0	63.0	56.7 - 71.8	Pass
NYW-3482	9/17/2019	Zn-65	108 ± 9	113	97.2 - 129	Pass
NYW-3482	9/17/2019	Ba-133	53.3 ± 4.3	61.9	51.4 - 68.2	Pass
NYW-3482	9/17/2019	Cs-134	47.2 ± 3.4	55.8	45.1 - 61.4	Pass
NYW-3482	9/17/2019	Cs-137	52.0 ± 4.6	53.8	48.4 - 62.0	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by the New York Department of Health Laboratory Approval Program(NY ELAP).

TABLE A-3. Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards).[a]

Lab Code	Irradiation Date	Description	Delivered Dose (mrem)	Reported[b] Dose (mrem)	Performance[c] Quotient (P)	
Environmental, Inc.		Group 1				
2019-1	11/11/2019	Spike 1	126.0	128.3	0.02	
2019-1	11/11/2019	Spike 2	126.0	122.2	-0.03	
2019-1	11/11/2019	Spike 3	126.0	122.5	-0.03	
2019-1	11/11/2019	Spike 4	126.0	119.3	-0.05	
2019-1	11/11/2019	Spike 5	126.0	116.9	-0.07	
2019-1	11/11/2019	Spike 6	126.0	109.5	-0.13	
2019-1	11/11/2019	Spike 7	126.0	114.6	-0.09	
2019-1	11/11/2019	Spike 8	126.0	121.8	-0.03	
2019-1	11/11/2019	Spike 9	126.0	120.2	-0.05	
2019-1	11/11/2019	Spike 10	126.0	126.4	0.00	
2019-1	11/11/2019	Spike 11	126.0	125.0	-0.01	
2019-1	11/11/2019	Spike 12	126.0	109.0	-0.13	
2019-1	11/11/2019	Spike 13	126.0	123.4	-0.02	
2019-1	11/11/2019	Spike 14	126.0	118.2	-0.06	
2019-1	11/11/2019	Spike 15	126.0	134.3	0.07	
2019-1	11/11/2019	Spike 16	126.0	120.1	-0.05	
2019-1	11/11/2019	Spike 17	126.0	131.3	0.04	
2019-1	11/11/2019	Spike 18	126.0	120.4	-0.04	
2019-1	11/11/2019	Spike 19	126.0	121.1	-0.04	
2019-1	11/11/2019	Spike 20	126.0	122.8	-0.03	
Mean (Spike 1-20)				121.4	-0.04	Pass[d]
Standard Deviation (Spike 1-20)				6.2	0.05	Pass[d]

a TLD's were irradiated by the University of Wisconsin-Madison Radiation Calibration Laboratory following ANSI N13.37 protocol from a known air kerma rate. TLD's were read and the results were submitted by Environmental Inc. to the University of Wisconsin-Madison Radiation Calibration Laboratory for comparison to the delivered dose.

b Reported dose was converted from exposure (R) to Air Kerma (cGy) using a conversion of 0.876. Conversion from air kerma to ambient dose equivalent for Cs-137 at the reference dose point $H^*(10)K_a = 1.20$. mrem/cGy = 1000.

c Performance Quotient (P) is calculated as ((reported dose - conventially true value) ÷ conventially true value) where the conventially true value is the delivered dose.

d Acceptance is achieved when neither the absolute value of the mean of the P values, nor the standard deviation of the P values exceed 0.15.

TABLE A-3. Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards).[a]

Lab Code	Irradiation Date	Description	Delivered Dose (mrem)	Reported[b] Dose (mrem)	Performance[c] Quotient (P)	
Environmental, Inc.		Group 2				
2019-2	11/11/2019	Spike 21	79.0	78.8	0.00	
2019-2	11/11/2019	Spike 22	79.0	71.8	-0.09	
2019-2	11/11/2019	Spike 23	79.0	75.8	-0.04	
2019-2	11/11/2019	Spike 24	79.0	71.3	-0.10	
2019-2	11/11/2019	Spike 25	79.0	74.5	-0.06	
2019-2	11/11/2019	Spike 26	79.0	71.6	-0.09	
2019-2	11/11/2019	Spike 27	79.0	73.3	-0.07	
2019-2	11/11/2019	Spike 28	79.0	74.0	-0.06	
2019-2	11/11/2019	Spike 29	79.0	73.8	-0.07	
2019-2	11/11/2019	Spike 30	79.0	76.0	-0.04	
2019-2	11/11/2019	Spike 31	79.0	76.7	-0.03	
2019-2	11/11/2019	Spike 32	79.0	77.8	-0.02	
2019-2	11/11/2019	Spike 33	79.0	75.2	-0.05	
2019-2	11/11/2019	Spike 34	79.0	69.1	-0.13	
2019-2	11/11/2019	Spike 35	79.0	68.7	-0.13	
2019-2	11/11/2019	Spike 36	79.0	68.2	-0.14	
2019-2	11/11/2019	Spike 37	79.0	67.9	-0.14	
2019-2	11/11/2019	Spike 38	79.0	68.9	-0.13	
2019-2	11/11/2019	Spike 39	79.0	78.1	-0.01	
2019-2	11/11/2019	Spike 40	79.0	68.6	-0.13	
Mean (Spike 21-40)				73.0	-0.08	Pass[d]
Standard Deviation (Spike 21-40)				3.6	0.05	Pass[d]

a TLD's were irradiated by the University of Wisconsin-Madison Radiation Calibration Laboratory following ANSI N13.37 protocol from a known air kerma rate. TLD's were read and the results were submitted by Environmental Inc. to the University of Wisconsin-Madison Radiation Calibration Laboratory for comparison to the delivered dose.

b Reported dose was converted from exposure (R) to Air Kerma (cGy) using a conversion of 0.876. Conversion from air kerma to ambient dose equivalent for Cs-137 at the reference dose point $H^*(10)K_a = 1.20$. mrem/cGy = 1000.

c Performance Quotient (P) is calculated as ((reported dose - conventially true value) ÷ conventially true value) where the conventially true value is the delivered dose.

d Acceptance is achieved when neither the absolute value of the mean of the P values, nor the standard deviation of the P values exceed 0.15.

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

Lab Code[b]	Date	Concentration[a] Analysis	Laboratory results 2s, n=1[c]	Known Activity	Control Limits[d]	Acceptance	Ratio Lab/Known
SPW-61	1/5/2019	Ra-226	13.4 ± 0.4	12.3	9.8 - 14.8	Pass	1.09
SPW-118	1/14/2019	H-3	15,463 ± 369	16,507	13,206 - 19,808	Pass	0.94
SPW-178	1/16/2019	Ra-228	17.7 ± 2.1	15.1	12.10 - 18.14	Pass	1.17
SPW-199	1/18/2019	Sr-90	17.6 ± 1.2	17.9	14.3 - 21.5	Pass	0.98
SPW-250	1/24/2019	Ni-63	356.3 ± 44.5	465	326 - 605	Pass	0.77
SPW-256	1/15/2019	Ra-226	12.0 ± 0.4	12.3	9.8 - 14.8	Pass	0.98
SPW-271	3/18/2019	H-3	22,035 ± 450	21,700	17,360 - 26,040	Pass	1.02
SPW-281	1/25/2019	Ra-226	11.6 ± 0.4	12.3	9.8 - 14.8	Pass	0.94
W-012119	4/29/2016	Cs-134	37.3 ± 10.6	36.2	29.0 - 43.4	Pass	1.03
W-012119	4/29/2016	Cs-137	82.7 ± 8.0	71.9	57.5 - 86.3	Pass	1.15
W-012319	4/29/2016	Cs-134	33.4 ± 10.1	36.2	25.3 - 47.1	Pass	0.92
W-012319	4/29/2016	Cs-137	79.1 ± 9.6	71.9	57.5 - 86.3	Pass	1.10
W-012519	4/29/2016	Cs-134	35.0 ± 7.7	36.2	29.0 - 43.4	Pass	0.97
W-012519	4/29/2016	Cs-137	79.2 ± 7.9	71.9	57.5 - 86.3	Pass	1.10
W-012919	4/29/2016	Cs-134	32.3 ± 8.3	36.2	29.0 - 43.4	Pass	0.89
W-012919	4/29/2016	Cs-137	82.3 ± 8.3	71.9	57.5 - 86.3	Pass	1.14
SPW-370	3/19/2019	H-3	21,689 ± 444	21,700	17,360 - 26,040	Pass	1.00
SPW-400	1/31/2019	Ra-226	11.6 ± 0.4	12.3	8.6 - 16.0	Pass	0.95
SPW-461	2/12/2019	Ra-226	11.1 ± 0.4	12.3	8.6 - 16.0	Pass	0.90
W-020619	4/26/2016	Cs-134	35.0 ± 14.9	36.2	29.0 - 43.4	Pass	0.97
W-020619	4/29/2016	Cs-137	72.8 ± 8.9	71.9	57.5 - 86.3	Pass	1.01
W-020819	4/26/2016	Cs-134	36.7 ± 8.6	36.2	29.0 - 43.4	Pass	1.01
W-020819	4/29/2016	Cs-137	76.7 ± 8.7	71.9	57.5 - 86.3	Pass	1.07
SPW-568	2/21/2019	Ra-226	10.3 ± 0.3	12.3	8.6 - 16.0	Pass	0.84
W-021319	4/29/2016	Cs-134	37.7 ± 11.5	36.2	29.0 - 43.4	Pass	1.04
W-021319	4/26/2016	Cs-137	75.8 ± 9.6	71.9	57.5 - 86.3	Pass	1.05
SPW-469	3/19/2019	H-3	21,696 ± 447	21,700	17,360 - 26,040	Pass	1.00
SPW-600	3/6/2019	H-3	20,710 ± 425	21,700	17,360 - 26,040	Pass	0.95
SPW-837	3/21/2019	Ra-228	11.7 ± 1.5	15.1	10.58 - 19.66	Pass	0.78
SPW-709	3/19/2019	H-3	20,369 ± 421	21,700	17,360 - 26,040	Pass	0.94
SPW-818	3/19/2019	H-3	20,457 ± 424	21,700	17,360 - 26,040	Pass	0.94
SPW-845	3/22/2019	U-234	15.1 ± 0.5	13.6	9.5 - 17.7	Pass	1.11
SPW-845	3/22/2019	U-238	15.3 ± 0.5	13.1	9.2 - 17.0	Pass	1.17
SPW-934	3/19/2019	H-3	20,487 ± 421	21,700	17,360 - 26,040	Pass	0.94
SPW-1061	3/1/2019	Ra-226	10.6 ± 0.3	12.3	8.6 - 16.0	Pass	0.86
SPW-1091	4/10/2019	H-3	20,323 ± 421	21,700	17,360 - 26,040	Pass	0.94
SPW-1093	4/8/2019	Ra-228	14.9 ± 1.9	15.1	10.6 - 19.6	Pass	0.98
SPW-1267	4/16/2019	H-3	20,302 ± 421	21,700	17,360 - 26,040	Pass	0.94
SPW-1339	4/18/2019	H-3	19,924 ± 417	21,700	17,360 - 26,040	Pass	0.92
SPW-1403[e]	4/25/2019	Gr. Alpha	56.7 ± 2.6	72.4	36.2 - 108.6	Pass	0.78
SPW-1403[e]	4/25/2019	Gr. Beta	43.2 ± 1.4	54.8	43.8 - 65.8	Fail	0.79
SPW-1427	4/26/2019	H-3	20,119 ± 418	21,700	15,190 - 28,210	Pass	0.93
SPW-1537	5/6/2019	Sr-90	19.9 ± 1.2	17.9	14.3 - 21.5	Pass	1.11
W-050719	4/29/2016	Cs-134	38.5 ± 9.0	36.2	29.0 - 43.4	Pass	1.06
W-050719	4/26/2016	Cs-137	85.2 ± 8.5	71.9	57.5 - 86.3	Pass	1.18
SPW-1582	5/9/2019	H-3	20,492 ± 423	21,700	15,190 - 28,210	Pass	0.94

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

Lab Code[b]	Date	Concentration[a] Analysis	Laboratory results 2s, n=1[c]	Known Activity	Control Limits[d]	Acceptance	Ratio Lab/Known
W-050919	4/29/2016	Cs-134	37.4 ± 8.9	36.2	29.0 - 43.4	Pass	1.03
W-050919	4/26/2016	Cs-137	81.5 ± 7.8	71.9	57.5 - 86.3	Pass	1.13
SPW-1596	5/8/2019	Ra-228	14.1 ± 1.7	15.1	10.6 - 19.6	Pass	0.94
W-051419	4/29/2016	Cs-134	36.2 ± 11.7	36.2	29.0 - 43.4	Pass	1.00
W-051419	4/26/2016	Cs-137	75.8 ± 10.0	71.9	57.5 - 86.3	Pass	1.05
SPW-1676	5/17/2019	H-3	20,233 ± 420	21,700	15,190 - 28,210	Pass	0.93
SPW-1799	5/20/2019	H-3	20,428 ± 422	21,700	15,190 - 28,210	Pass	0.94
SPW-1858	5/28/2019	H-3	20,367 ± 522	21,700	15,190 - 28,210	Pass	0.94
SPW-1890	5/30/2019	H-3	20,206 ± 419	21,700	15,190 - 28,210	Pass	0.93
SPW-2014	5/31/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97
SPW-2030	6/12/2019	Ni-63	377 ± 45	464.8	325 - 604	Pass	0.81
SPW-2093	6/18/2019	H-3	20,158 ± 418	21,700	17,360 - 26,040	Pass	0.93
W-062419	4/29/2016	Cs-134	33.0 ± 12.4	36.2	29.0 - 43.4	Pass	0.91
W-062419	4/26/2016	Cs-137	66.0 ± 10.4	71.9	57.5 - 86.3	Pass	0.92
SPW-2338	6/26/2019	H-3	20,032 ± 417	21,700	17,360 - 26,040	Pass	0.92
SPW-2552	7/1/2019	Gr. Alpha	20.4 ± 1.5	21.8	10.9 - 32.7	Pass	0.94
SPW-2552	7/1/2019	Gr. Beta	46.1 ± 1.3	55.7	44.6 - 66.8	Pass	0.83
W-072619	4/29/2016	Cs-134	36.3 ± 9.2	36.2	29.0 - 43.4	Pass	1.00
W-072619	4/26/2016	Cs-137	79.7 ± 7.6	71.9	57.5 - 86.3	Pass	1.11
SPW-3188	7/30/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97
SPW-2947	8/9/2019	H-3	20,128 ± 425	21,700	17,360 - 26,040	Pass	0.93
SPW-3003	8/14/2019	H-3	20,588 ± 435	21,700	17,360 - 26,040	Pass	0.95
W-081519	4/26/2019	Cs-134	36.2 ± 9.2	36.2	29.0 - 43.4	Pass	1.00
W-081519	4/26/2019	Cs-137	78.1 ± 8.4	71.9	57.5 - 86.3	Pass	1.09
W-082119	4/26/2019	Cs-134	32.8 ± 9.1	36.2	29.0 - 43.4	Pass	0.91
W-082119	4/26/2019	Cs-137	79.1 ± 7.9	71.9	57.5 - 86.3	Pass	1.10
SPW-3151	8/26/2019	H-3	20,329 ± 428	21,700	17,360 - 26,040	Pass	0.94
W-082619	4/26/2019	Cs-134	33.3 ± 17.8	36.2	29.0 - 43.4	Pass	0.92
W-082619	4/26/2019	Cs-137	82.6 ± 13.2	71.9	57.5 - 86.3	Pass	1.15
W-082719	4/26/2019	Cs-134	33.9 ± 7.0	36.2	29.0 - 43.4	Pass	0.94
W-082719	4/26/2019	Cs-137	81.4 ± 6.0	71.9	57.5 - 86.3	Pass	1.13
SPW-3359	8/30/2019	Gr. Alpha	54.2 ± 0.3	72.4	36.2 - 108.6	Pass	0.75
SPW-3359	8/30/2019	Gr. Beta	59.7 ± 0.2	54.8	43.8 - 65.8	Pass	1.09
SPW-3323	9/6/2019	Ra-228	12.7 ± 1.8	15.1	10.6 - 19.6	Pass	0.84
W-091019	4/26/2019	Cs-134	31.0 ± 11.3	36.2	29.0 - 43.4	Pass	0.86
W-091019	4/26/2019	Cs-137	80.5 ± 10.0	71.9	57.5 - 86.3	Pass	1.12
SPW-3349	9/10/2019	H-3	19,851 ± 422	21,700	17,360 - 26,040	Pass	0.91
SPW-3410	9/13/2019	H-3	20,267 ± 431	21,700	17,360 - 26,040	Pass	0.93
W-091719	4/26/2019	Cs-134	39.3 ± 12.6	36.2	29.0 - 43.4	Pass	1.09
W-091719	4/26/2019	Cs-137	81.1 ± 9.9	71.9	57.5 - 86.3	Pass	1.13
SPW-3450	9/17/2019	H-3	20,036 ± 427	21,700	17,360 - 26,040	Pass	0.92
W-091919	9/19/2019	Cs-134	40.0 ± 10.7	36.2	29.0 - 43.4	Pass	1.10
W-091919	9/19/2019	Cs-137	71.0 ± 8.7	71.9	57.5 - 86.3	Pass	0.99
SPW-3569	8/28/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97
SPW-3571	9/27/2019	H-3	21,026 ± 440	21,700	17,360 - 26,040	Pass	0.97

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

Lab Code[b]	Date	Concentration[a] Analysis	Laboratory results 2s, n=1[c]	Known Activity	Control Limits[d]	Acceptance	Ratio Lab/Known
SPW-3615	10/1/2019	Ra-228	18.9 ± 2.5	14.9	10.4 - 19.3	Pass	1.27
SPW-3706	10/8/2019	H-3	20,082 ± 427	21,700	17,360 - 26,040	Pass	0.93
SPW-4093	10/14/2019	Gr. Alpha	20.8 ± 0.1	19.7	9.9 - 29.6	Pass	1.06
SPW-4093	10/14/2019	Gr. Beta	63.2 ± 0.1	61.1	48.9 - 73.3	Pass	1.03
SPW-4095	10/24/2019	H-3	20,684 ± 432	21,700	17,360 - 26,040	Pass	0.95
SPW-4144	9/26/2019	Ra-226	12.8 ± 0.3	12.3	8.6 - 16.0	Pass	1.04
W-091719	3/19/2018	H-3	22,291 ± 470	21,700	17,360 - 26,040	Pass	1.03
SPW-4239	10/30/2019	Ra-228	12.4 ± 1.8	14.9	10.4 - 19.3	Pass	0.84
SPW-4254	11/8/2019	H-3	20,187 ± 427	21,700	17,360 - 26,040	Pass	0.93
SPW-4368	11/14/2019	H-3	20,386 ± 429	21,700	17,360 - 26,040	Pass	0.94
SPW-4370	10/30/2019	Ra-226	12.8 ± 0.4	12.3	8.6 - 16.0	Pass	1.04
SPW-4472	11/21/2019	H-3	20,479 ± 432.0	21,700	17,360 - 26,040	Pass	0.94
SPW-4474	11/22/2019	Sr-90	18.9 ± 1.2	17.9	14.3 - 21.5	Pass	1.06
SPW-4602	12/5/2019	H-3	20,187 ± 429	21,700	17,360 - 26,040	Pass	0.93
W-121119	3/19/2018	H-3	22,734 ± 477	21,700	17,360 - 26,040	Pass	1.05
SPW-4663	12/11/2019	Ra-228	11.2 ± 1.6	14.9	10.4 - 19.3	Pass	0.75
SPW-4688	12/13/2019	H-3	20,506 ± 431	21,700	17,360 - 26,040	Pass	0.94
SPW-4734	11/15/2019	Ra-226	12.6 ± 0.3	12.3	8.6 - 16.0	Pass	1.02
SPW-4743	12/5/2019	Ra-226	10.0 ± 0.3	12.3	8.6 - 16.0	Pass	0.81
SPW-4745	12/19/2019	H-3	20,067 ± 427	21,700	17,360 - 26,040	Pass	0.92
SPW-4889	12/19/2019	Ra-226	9.3 ± 0.3	12.3	8.6 - 16.0	Pass	0.76
SPW-4636	12/27/2019	Tc-99	94.3 ± 8.2	90.3	72.2 - 108.4	Pass	1.04
SPW-4899	1/3/2020	H-3	20,386 ± 432	21,700	17,360 - 26,040	Pass	0.94

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m3), charcoal (pCi/charcoal canister), and solid samples (pCi/kg).

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

[c] Results are based on single determinations.

[d] Control limits are listed in Attachment A of this report.

[e] The LCS sample was prepared from an Environmental Resource Associates (ERA) sample of known activity. While the analysis did satisfy the acceptance criteria of the ERA study from which it was sourced, it did not satisfy EIML's internal LCS acceptance criteria. An investigation is in process to determine the reason for the low bias and to evaluate the acceptance criteria.

NOTE: For fish, gelatin is used for the spike matrix. For vegetation, cabbage is used for the spike matrix.

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

Lab Code[b]	Sample Type	Date	Analysis[c]	Concentration[a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[d]	Criteria (4.66 σ)
SPW-5449	Water	1/7/2019	Gr. Alpha	0.76	-0.30 ± 0.52	2
SPW-5449	Water	1/7/2019	Gr. Beta	0.42	0.19 ± 0.31	4
SPW-34	Water	1/7/2019	I-131	0.36	0.13 ± 0.18	1
SPW-60	Water	11/5/2018	Ra-226	0.03	0.15 ± 0.03	2
SPW-119	Water	1/14/2019	H-3	148	42 ± 80	200
SPW-177	Water	1/16/2019	Ra-228	0.93	-0.10 ± 0.42	2
SPW-198	Water	1/18/2019	Sr-89	0.67	0.25 ± 0.50	5
SPW-198	Water	1/18/2019	Sr-90	0.67	-0.16 ± 0.29	1
SPW-249	Water	1/24/2019	Ni-63	67	31 ± 41	200
SPW-255	Water	1/15/2019	Ra-226	0.04	0.16 ± 0.03	2
SPW-280	Water	1/25/2019	Ra-226	0.06	-0.09 ± 0.14	2
SPW-399	Water	1/31/2019	Ra-226	0.03	0.15 ± 0.03	2
SPW-460	Water	2/12/2019	Ra-226	0.03	0.15 ± 0.02	2
SPW-567	Water	2/21/2019	Ra-226	0.03	0.13 ± 0.02	2
SPW-844	Water	3/22/2019	U-234	0.19	0.04 ± 0.14	1
SPW-844	Water	3/22/2019	U-238	0.19	0.00 ± 0.11	1
SPW-836	Water	3/21/2019	Ra-228	0.74	0.53 ± 0.41	2
SPW-1060	Water	3/31/2019	Ra-226	0.04	-0.02 ± 0.03	2
SPW-1090	Water	4/10/2019	H-3	155	-14 ± 72	200
SPW-1092	Water	4/8/2019	Ra-228	0.82	0.75 ± 0.46	2
SPW-1266	Water	4/16/2019	H-3	152	67 ± 74	200
SPW-1338	Water	4/18/2019	H-3	152	66 ± 79	200
SPW-1386	Water	4/8/2019	Ra-226	0.03	0.09 ± 0.03	2
SPW-1426	Water	4/26/2019	H-3	156	34 ± 75	200
SPW-1536	Water	5/6/2019	Sr-89	0.66	-0.07 ± 0.45	5
SPW-1536	Water	5/6/2019	Sr-90	0.59	-0.10 ± 0.26	1
SPW-1581	Water	5/9/2019	H-3	147	73 ± 77	200
SPW-1644	Water	4/22/2019	Ra-226	0.02	0.15 ± 0.02	2
SPW-1675	Water	5/17/2019	H-3	154	-30 ± 71	200
SPW-1798	Water	5/20/2019	H-3	149	24 ± 73	200
SPW-1857	Water	5/28/2019	H-3	150	54 ± 74	200
SPW-1889	Water	5/30/2019	H-3	152	45 ± 73	200
SPW-2013	Water	5/31/2019	Ra-226	0.01	0.13 ± 0.02	2
SPW-2029	Water	6/12/2019	Ni-63	66	10 ± 40	200
SPW-2092	Water	6/18/2019	H-3	154	-42 ± 70	200
SPW-2237	Water	6/26/2019	H-3	150	-9 ± 69	200
SPW-2107	Water	6/18/2019	I-131	0.16	0.04 ± 0.09	1
SPW-2152	Water	6/19/2019	I-131	0.16	0.04 ± 0.09	1

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

Lab Code[b]	Sample Type	Date	Analysis[c]	Concentration[a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[d]	Criteria (4.66 σ)
SPW-3187	Water	7/30/2019	Ra-226	0.02	0.17 ± 0.02	2
SPW-2924	Water	8/6/2019	Sr-89	0.71	-0.06 ± 0.57	5
SPW-2924	Water	8/6/2019	Sr-90	0.59	0.08 ± 0.28	1
SPW-2946	Water	8/9/2019	H-3	152	33 ± 72	200
SPW-3002	Water	8/14/2019	H-3	152	-22 ± 74	200
SPW-3150	Water	8/26/2019	H-3	151	115 ± 77	200
SPW-3358	Water	8/30/2019	Gr. Alpha	0.44	-0.08 ± 0.30	2
SPW-3358	Water	8/30/2019	Gr. Beta	0.72	-0.31 ± 0.49	4
SPW-3568	Water	8/28/2019	Ra-226	0.03	0.16 ± 0.03	2
SPW-3322	Water	9/6/2019	Ra-228	0.82	0.46 ± 0.43	2
SPW-3348	Water	9/10/2019	H-3	150	107 ± 76	200
SPW-3409	Water	9/13/2019	H-3	154	133 ± 79	200
SPW-3449	Water	9/17/2019	H-3	147	102 ± 79	200
SPW-3570	Water	9/27/2019	H-3	151	70 ± 77	200
SPW-3614	Water	10/1/2019	Ra-228	1.29	1.03 ± 0.73	2
SPW-3705	Water	10/8/2019	H-3	147	107 ± 77	200
SPW-4238	Water	10/30/2019	Ra-228	0.99	0.58 ± 0.52	2
SPW-4253	Water	11/8/2019	H-3	151	80 ± 76	200
SPW-4367	Water	11/14/2019	H-3	154	42 ± 74	200
SPW-4369	Water	10/30/2016	Ra-226	0.03	0.14 ± 0.03	2
SPW-4471	Water	11/21/2019	H-3	155	81 ± 77	200
SPW-4474	Water	11/21/2019	C-14	12	0 ± 7	200
SPW-4476	Water	11/22/2019	Sr-89	0.62	0.23 ± 0.45	5
SPW-4476	Water	11/22/2019	Sr-90	0.57	-0.16 ± 0.24	1
SPW-4601	Water	12/5/2019	H-3	155	28 ± 74	200
SPW-4635	Water	12/9/2019	Tc-99	12	-6 ± 7	20
SPW-4662	Water	12/17/2019	Ra-228	0.77	0.55 ± 0.42	2
SPW-4687	Water	12/13/2019	H-3	150	143 ± 78	200
SPW-4733	Water	11/15/2019	Ra-226	0.03	0.13 ± 0.03	2
SPW-4742	Water	12/5/2019	Ra-226	0.04	0.10 ± 0.10	2
SPW-4744	Water	12/19/2019	H-3	151	119 ± 81	200
SPW-4888	Water	12/19/2019	Ra-226	0.03	0.15 ± 0.02	2
SPW-4898	Water	1/3/2020	H-3	159	19 ± 78	200

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

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

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

[d] Activity reported is a net activity result.

TABLE A-6. In-House "Duplicate" Samples

			Concentration[a]			
Lab Code[b]	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
AP-5499,5500	1/2/2019	Fe-55	941 ± 220	1027 ± 226	984 ± 158	Pass
AP-5499,5500	1/2/2019	Sr-89	20.2 ± 7.3	14.9 ± 5.7	17.5 ± 4.7	Pass
AP-5499,5500	1/2/2019	Ni-63	12.1 ± 8.5	15.6 ± 8.5	13.8 ± 6.0	Pass
CF-20,21	1/2/2019	Gr. Beta	10.0 ± 0.2	10.7 ± 0.2	10.3 ± 0.2	Pass
CF-20,21	1/2/2019	Sr-90	0.005 ± 0.002	0.005 ± 0.002	0.005 ± 0.001	Pass
CF-20,21	1/2/2019	Be-7	0.27 ± 0.09	0.29 ± 0.08	0.28 ± 0.06	Pass
CF-20,21	1/2/2019	K-40	6.69 ± 0.34	6.83 ± 0.34	6.76 ± 0.24	Pass
SG-211,212	1/21/2019	Ra-226	7.94 ± 0.26	8.50 ± 0.29	8.22 ± 0.19	Pass
SG-211,212	1/21/2019	Ac-228	4.46 ± 0.37	4.63 ± 0.43	4.55 ± 0.28	Pass
WW-324,325	2/4/2019	Gr. Alpha	0.68 ± 0.44	0.49 ± 0.46	0.59 ± 0.32	Pass
WW-324,325	2/4/2019	Gr. Beta	1.80 ± 0.55	2.95 ± 0.63	2.37 ± 0.42	Pass
W-345,346	2/4/2019	H-3	245 ± 84	277 ± 85	261 ± 60	Pass
WW-797,798	3/5/2019	H-3	165 ± 80	222 ± 83	193 ± 58	Pass
WW-648,649	3/8/2019	H-3	587 ± 101	630 ± 102	608 ± 72	Pass
SW-713,714	3/14/2019	H-3	326 ± 90	254 ± 86	290 ± 62	Pass
AP-1241,1242	4/2/2019	Be-7	0.097 ± 0.018	0.108 ± 0.020	0.103 ± 0.013	Pass
AP-1285,1286	4/3/2019	Be-7	0.080 ± 0.014	0.078 ± 0.012	0.079 ± 0.009	Pass
AP-1306,1307	4/3/2019	Be-7	0.085 ± 0.009	0.096 ± 0.011	0.090 ± 0.007	Pass
AP-1327,1328	4/3/2019	Be-7	0.078 ± 0.010	0.079 ± 0.011	0.078 ± 0.007	Pass
AP-1327,1328	4/3/2019	K-40	0.012 ± 0.007	0.021 ± 0.010	0.017 ± 0.006	Pass
AP-2119,2120	4/3/2019	Be-7	0.276 ± 0.098	0.265 ± 0.116	0.270 ± 0.076	Pass
AP-2225,2226	4/3/2019	Be-7	0.231 ± 0.128	0.208 ± 0.123	0.220 ± 0.089	Pass
CF-820,821	4/3/2019	K-40	6.39 ± 0.30	6.63 ± 0.37	6.51 ± 0.24	Pass
WW-648,649	4/5/2019	H-3	587 ± 101	630 ± 102	608 ± 72	Pass
WW-1043,1044	4/5/2019	H-3	666 ± 121	662 ± 121	664 ± 86	Pass
SW-1087,1088	4/8/2019	H-3	9,997 ± 300	10,330 ± 305	10,164 ± 214	Pass
WW-1198,1199	4/9/2019	H-3	562 ± 99	640 ± 102	601 ± 71	Pass
LW-1503,1504	4/25/2019	Gr. Beta	1.09 ± 0.55	1.46 ± 0.57	1.27 ± 0.39	Pass
WW-1789,1790	5/7/2019	H-3	366 ± 90	400 ± 92	383 ± 64	Pass
SG-2269,2270	5/7/2019	Pb-214	39.1 ± 0.5	40.3 ± 0.5	39.7 ± 0.4	Pass
SG-2269,2270	5/7/2019	Ac-228	53.2 ± 1.0	57.1 ± 1.0	55.2 ± 0.7	Pass
DW-10049,10050	5/7/2019	Ra-226	1.31 ± 0.13	1.66 ± 0.15	1.49 ± 0.10	Pass
DW-10049,10050	5/7/2019	Ra-228	1.24 ± 0.52	1.33 ± 0.53	1.29 ± 0.37	Pass
WW-1690A,B	5/8/2019	H-3	325 ± 89	303 ± 93	314 ± 64	Pass
S-1812,1813	5/16/2019	K-40	22.0 ± 0.9	23.3 ± 1.0	22.6 ± 0.7	Pass
S-1812,1813	5/16/2019	Cs-137	0.05 ± 0.03	0.07 ± 0.04	0.06 ± 0.02	Pass
DW-10053,10054	5/22/2019	Gr. Alpha	0.93 ± 0.63	1.14 ± 0.72	1.04 ± 0.48	Pass
DW-10053,10054	5/22/2019	Gr. Beta	1.43 ± 0.62	1.13 ± 0.59	1.28 ± 0.43	Pass
W-2053,2054	5/29/2019	H-3	1572 ± 135	1470 ± 131	1521 ± 94	Pass

TABLE A-6. In-House "Duplicate" Samples

			Concentration[a]			
Lab Code[b]	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
G-1989,1990	6/3/2019	Be-7	0.80 ± 0.18	0.72 ± 0.15	0.76 ± 0.12	Pass
G-1989,1990	6/3/2019	K-40	6.15 ± 0.51	5.98 ± 0.46	6.07 ± 0.34	Pass
G-1989,1990	6/3/2019	Gr. Beta	7.24 ± 0.19	7.00 ± 0.19	7.12 ± 0.13	Pass
WW-2204,2205	6/6/2019	H-3	3861 ± 194	3722 ± 191	3792 ± 136	Pass
S-2031,2032	6/10/2019	Pb-214	5.16 ± 0.19	4.75 ± 0.22	4.96 ± 0.15	Pass
S-2031,2032	6/10/2019	Ac-228	3.81 ± 0.31	3.63 ± 0.33	3.72 ± 0.23	Pass
S-2010,2011	6/10/2019	Pb-214	1.48 ± 0.10	1.05 ± 0.11	1.27 ± 0.07	Pass
F-2140,2141	6/12/2019	K-40	1.01 ± 0.28	1.39 ± 0.32	1.20 ± 0.21	Pass
S-2162,2163	6/12/2019	Pb-214	0.65 ± 0.06	0.54 ± 0.05	0.60 ± 0.04	Pass
S-2162,2163	6/12/2019	Ac-228	0.46 ± 0.10	0.44 ± 0.08	0.45 ± 0.07	Pass
S-2162,2163	6/12/2019	K-40	4.22 ± 0.49	3.81 ± 0.41	4.02 ± 0.32	Pass
S-2162,2163	6/12/2019	Tl-208	0.09 ± 0.02	0.10 ± 0.02	0.09 ± 0.01	Pass
S-2162,2163	6/12/2019	Pb-212	0.34 ± 0.03	0.26 ± 0.03	0.30 ± 0.02	Pass
SWT-2355,2356	6/25/2019	Gr. Beta	1.12 ± 0.57	1.24 ± 0.56	1.18 ± 0.40	Pass
AP-2689,2690	6/28/2019	Be-7	0.089 ± 0.020	0.075 ± 0.018	0.082 ± 0.013	Pass
AP-2710,2711	7/1/2019	Be-7	0.091 ± 0.010	0.097 ± 0.010	0.094 ± 0.007	Pass
AP-2731,2732	7/2/2019	Be-7	0.073 ± 0.013	0.072 ± 0.011	0.072 ± 0.009	Pass
DW-10062,10063	7/5/2019	Ra-226	4.10 ± 0.30	4.03 ± 0.30	4.07 ± 0.21	Pass
DW-10062,10063	7/5/2019	Ra-228	1.95 ± 0.60	2.31 ± 0.62	2.13 ± 0.43	Pass
AP-70818,70819	7/8/2019	Gr. Beta	0.021 ± 0.004	0.023 ± 0.004	0.022 ± 0.003	Pass
XW-2459,2460	7/10/2019	H-3	304 ± 92	234 ± 89	269 ± 64	Pass
VE-2516,2517	7/10/2019	Be-7	0.63 ± 0.16	0.52 ± 0.19	0.58 ± 0.12	Pass
VE-2516,2517	7/10/2019	K-40	6.50 ± 0.47	6.81 ± 0.54	6.66 ± 0.36	Pass
AP-71518A,B	7/15/2019	Gr. Beta	0.022 ± 0.004	0.025 ± 0.004	0.023 ± 0.003	Pass
VE-2668,2669	7/16/2019	K-40	3.84 ± 0.27	3.74 ± 0.26	3.79 ± 0.19	Pass
DW-10076,10077	7/16/2019	Gr. Alpha	3.01 ± 0.92	4.13 ± 0.91	3.57 ± 0.65	Pass
DW-10073,10074	7/16/2019	Ra-226	1.57 ± 0.18	1.51 ± 0.21	1.54 ± 0.14	Pass
DW-10073,10074	7/16/2019	Ra-228	1.29 ± 0.56	1.48 ± 0.57	1.385 ± 0.40	Pass
AP-72218A,B	7/22/2019	Gr. Beta	0.013 ± 0.004	0.016 ± 0.004	0.015 ± 0.003	Pass
G-2752,2753	7/23/2019	K-40	4.53 ± 0.42	4.47 ± 0.46	4.50 ± 0.31	Pass
G-2752,2753	7/23/2019	Be-7	1.98 ± 0.29	1.96 ± 0.29	1.97 ± 0.20	Pass
AP-2800,2801	7/25/2019	Be-7	0.208 ± 0.090	0.321 ± 0.147	0.264 ± 0.086	Pass
AP-72918A,B	7/29/2019	Gr. Beta	0.026 ± 0.005	0.025 ± 0.005	0.025 ± 0.003	Pass
VE-2840,2841	7/31/2019	K-40	3.94 ± 0.38	3.99 ± 0.47	3.96 ± 0.30	Pass
AP-2903,2904	8/1/2019	Be-7	0.198 ± 0.102	0.228 ± 0.102	0.213 ± 0.072	Pass
P-2882,2983	8/1/2019	H-3	265 ± 85	327 ± 88	296 ± 61	Pass
SG-2926,2927	8/5/2019	Pb-214	9.07 ± 0.39	8.82 ± 0.39	8.95 ± 0.28	Pass
SG-2926,2927	8/5/2019	Ac-228	9.00 ± 0.76	8.58 ± 0.72	8.79 ± 0.52	Pass
AV-2993,2994	8/9/2019	Gr. Beta	1.22 ± 0.19	1.28 ± 0.21	1.25 ± 0.14	Pass
AV-2993,2994	8/9/2019	K-40	3.12 ± 0.36	3.14 ± 0.35	3.13 ± 0.25	Pass

TABLE A-6. In-House "Duplicate" Samples

			Concentration[a]			
Lab Code[b]	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
DW-10088,10089	8/9/2019	Ra-228	0.60 ± 0.50	1.20 ± 0.50	0.90 ± 0.35	Pass
DW-10088,10089	8/9/2019	Ra-226	1.40 ± 0.20	0.94 ± 0.20	1.17 ± 0.14	Pass
VE-3016,3017	8/12/2019	Be-7	0.39 ± 0.12	0.47 0.28	0.43 0.15	Pass
VE-3016,3017	8/12/2019	K-40	6.13 ± 0.41	6.24 0.64	6.18 0.38	Pass
G-3600,3601	8/12/2019	Be-7	4.42 ± 0.33	4.35 0.27	4.39 0.21	Pass
WW-3100,3101	8/14/2019	H-3	480 ± 96	401 ± 92	441 ± 66	Pass
MI-3211,3212	8/27/2019	K-40	1862 ± 131	1923 ± 136	1893 ± 94	Pass
MI-3211,3212	8/27/2019	Sr-90	0.90 ± 0.33	0.56 ± 0.29	0.73 ± 0.22	Pass
LW-3512,3513	8/30/2019	Gr. Beta	0.79 ± 0.50	1.39 ± 0.58	1.09 ± 0.38	Pass
DW-10100,10101	9/5/2019	Ra-226	0.50 ± 0.11	0.57 0.12	0.54 ± 0.08	Pass
DW-10100,10101	9/5/2019	Ra-228	3.38 ± 0.82	2.54 1.03	2.96 ± 0.66	Pass
DW-10111,10112	9/23/2019	Gr. Alpha	1.72 ± 0.73	1.41 0.68	1.57 ± 0.50	Pass
DW-10115,10116	9/25/2019	Ra-228	3.65 ± 0.80	2.76 0.68	3.21 ± 0.52	Pass
DW-10115,10116	9/25/2019	Ra-226	2.99 ± 0.23	2.74 0.25	2.87 ± 0.17	Pass
WW-3793,3794	10/8/2019	Gr. Beta	3.75 ± 1.18	4.34 1.20	4.05 ± 0.84	Pass
BS-3879,3880	10/9/2019	Pb-214	0.60 ± 0.03	0.65 ± 0.05	0.63 ± 0.03	Pass
BS-3879,3880	10/9/2019	Ra-226	1.27 ± 0.14	1.15 ± 0.14	1.21 ± 0.10	Pass
BS-3879,3880	10/9/2019	K-40	11.05 ± 0.29	10.69 ± 0.30	10.87 ± 0.21	Pass
BS-3879,3880	10/9/2019	Pb-212	0.58 ± 0.02	0.55 ± 0.02	0.56 ± 0.01	Pass
BS-3879,3880	10/9/2019	Tl-208	0.21 ± 0.02	0.21 ± 0.01	0.21 ± 0.01	Pass
BS-3879,3880	10/9/2019	Bi-212	0.75 ± 0.17	0.62 ± 0.17	0.68 ± 0.12	Pass
BS-3879,3880	10/9/2019	Bi-214	0.57 ± 0.02	0.52 ± 0.06	0.54 ± 0.03	Pass
BS-4161,4162	10/29/2019	K-40	15.3 ± 0.6	15.3 ± 0.7	15.3 ± 0.5	Pass
BS-4161,4162	10/29/2019	Ra-226	2.16 ± 0.35	2.27 ± 0.78	2.22 ± 0.43	Pass
DW-10126,10127	10/22/2019	Ra-228	0.85 ± 0.58	1.19 ± 0.62	1.02 ± 0.42	Pass
DW-10129,10130	10/22/2019	Gr. Alpha	1.44 ± 0.96	3.06 ± 0.95	2.25 ± 0.68	Pass
SG-4071	10/22/2019	Ac-228	2.10 ± 0.16	2.16 ± 0.20	2.13 ± 0.13	Pass
SPSG-4071,4072	10/22/2019	Pb-214	1.61 ± 0.10	1.29 ± 0.08	1.45 ± 0.06	Pass
SS-3900,3901	10/15/2019	Bi-212	0.29 ± 0.14	0.19 ± 0.12	0.24 ± 0.09	Pass
WW-4291,4292	11/5/2019	H-3	481 ± 97	528 ± 97	505 ± 68	Pass
DW-10139,10140	11/6/2019	Ra-228	2.61 ± 0.62	2.26 ± 0.63	2.44 ± 0.44	Pass
DW-10139,10140	11/6/2019	Ra-226	1.49 ± 0.17	1.32 ± 0.19	1.41 ± 0.13	Pass
WW-4270,4271	11/6/2019	H-3	112 ± 78	165 ± 81	139 ± 56	Pass
S-4312,4313	11/7/2019	K-40	20.2 ± 0.8	23.0 ± 0.9	21.6 ± 0.6	Pass
AP-4379,4380	11/12/2019	Be-7	0.133 ± 0.075	0.134 ± 0.073	0.134 ± 0.052	Pass
S-4422,4223	11/13/2019	Pb-214	1.22 ± 0.09	1.28 ± 0.10	1.25 ± 0.07	Pass
S-4422,4423	11/13/2019	Ac-228	1.14 ± 0.15	1.21 ± 0.17	1.18 ± 0.11	Pass
WW-4556,4557	11/13/2019	H-3	438 ± 96	482 ± 98	460 ± 69	Pass
SO-5024,5025	11/14/2019	K-40	6.60 ± 0.54	6.26 ± 0.58	6.43 ± 0.40	Pass
MI-4443,4444	11/18/2019	K-40	1304 ± 114	1340 ± 109	1322 ± 79	Pass

TABLE A-6. In-House "Duplicate" Samples

			Concentration[a]			
Lab Code[b]	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
SW-4492,4493	11/19/2019	H-3	188 ± 87	264 ± 97	226 ± 65	Pass
WW-4577,4578	11/21/2019	H-3	212 ± 83	232 ± 84	222 ± 59	Pass
AP-4514,4515	11/21/2019	Be-7	0.130 ± 0.055	0.193 ± 0.112	0.162 ± 0.062	Pass
SWT-4598,4599	11/26/2019	Gr. Beta	1.43 ± 0.57	1.14 ± 0.54	1.28 ± 0.39	Pass
AP-120218A,B	12/2/2019	Gr. Beta	0.009 ± 0.004	0.013 ± 0.004	0.011 ± 0.003	Pass
S-4644,4645	12/4/2019	Pb-214	1.01 ± 0.09	0.91 ± 0.09	0.96 ± 0.06	Pass
S-4644,4645	12/4/2019	Ac-228	0.85 ± 0.15	0.96 ± 0.16	0.91 ± 0.11	Pass
AP-121618A,B	12/16/2019	Gr. Beta	0.028 ± 0.005	0.030 ± 0.005	0.029 ± 0.003	Pass
S-4735,4736	12/16/2019	Pb-214	9.33 ± 0.38	9.45 ± 0.27	9.39 ± 0.23	Pass
S-4735,4736	12/16/2019	Ac-228	13.4 ± 0.7	14.9 ± 0.7	14.1 ± 0.5	Pass
AP-122318A,B	12/23/2019	Gr. Beta	0.034 ± 0.005	0.035 ± 0.005	0.035 ± 0.003	Pass
AP-123018A,B	12/30/2019	Gr. Beta	0.037 ± 0.005	0.037 ± 0.005	0.037 ± 0.004	Pass

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

[a] Results are reported in units of pCi/L, except for air filters (pCi/Filter or pCi/m3), food products, vegetation, soil and sediment (pCi/g).

[b] CH (Charcoal Canister), DW (Drinking Water), E (Egg), F (Fish), G (Grass), LW (Lake Water), P (Precipitation), PM (Powdered Milk), S, (Solid), SG (Sludge), SO (Soil), SS (Shoreline Sediment), SW (Surface Water), SWT (Surface Water Treated), SWU (Surface Water Untreated), VE (Vegetation), W Water (Water), WW (Well Water).

TABLE A-7. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration[a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MAAP-609	2/1/2019	Gross Alpha	0.16 ± 0.03	0.528	0.158 - 0.898	Pass
MAAP-609	2/1/2019	Gross Beta	1.09 ± 0.07	0.948	0.474 - 1.422	Pass
MAW-550	2/1/2019	Gross Alpha	0.73 ± 0.06	0.84	0.25 - 1.43	Pass
MAW-550	2/1/2019	Gross Beta	2.26 ± 0.06	2.33	1.17 - 3.50	Pass
MASO-605	2/1/2019	Am-241	38.89 ± 5.92	49.9	34.9 ± 64.9	Pass
MASO-605	2/1/2019	Cs-134	0.45 ± 2.52	0.0	NA [c]	Pass
MASO-605	2/1/2019	Cs-137	1273.1 ± 13.0	1164	815 - 1513	Pass
MASO-605	2/1/2019	Co-57	0.46 ± 1.1	0.0	NA [c]	Pass
MASO-605	2/1/2019	Co-60	857.96 ± 8.52	855.0	599 - 1112	Pass
MASO-605	2/1/2019	Mn-54	1,138.0 ± 13.5	1027	719 - 1335	Pass
MASO-605	2/1/2019	Zn-65	730.92 ± 16.48	668	468 - 868	Pass
MASO-605	2/1/2019	K-40	676 ± 47	585	410 - 761	Pass
MASO-605	2/1/2019	Sr-90	0.0007 ± 0.0007	0.000	NA [c]	Pass
MASO-605	2/1/2019	Pu-238	78.15 ± 6.11	71.0	49.7 - 92.3	Pass
MASO-605	2/1/2019	Pu-239/240	65.00 ± 5.4	59.8	41.9 - 77.7	Pass
MASO-605	2/1/2019	U-234	65 ± 13	56	39 - 73	Pass
MASO-605	2/1/2019	U-238	237 ± 23	205	144 - 267	Pass
MAW-613	2/1/2019	Am-241	0.46 ± 0.03	0.582	0.407 - 0.757	Pass
MAW-613	2/1/2019	Cs-134	5.49 ± 0.18	5.99	4.19 - 7.79	Pass
MAW-613	2/1/2019	Cs-137	0.089 ± 0.080	0	NA [c]	Pass
MAW-613	2/1/2019	Co-57	10.87 ± 0.24	10.00	7.0 - 13.0	Pass
MAW-613	2/1/2019	Co-60	6.78 ± 0.19	6.7	4.7 - 8.7	Pass
MAW-613	2/1/2019	Mn-54	8.98 ± 0.17	8.4	5.9 - 10.9	Pass
MAW-613	2/1/2019	Zn-65	0.096 ± 0.141	0	NA [c]	Pass
MAW-613	2/1/2019	Fe-55	0.004 ± 4.00	0	NA [c]	Pass
MAW-613	2/1/2019	Ni-63	5.54 ± 1.52	5.8	4.1 - 7.5	Pass
MAW-613	2/1/2019	Sr-90	6.02 ± 0.53	6.35	4.45 - 8.26	Pass
MAW-613	2/1/2019	Pu-238	0.315 ± 0.088	0.451	0.316 - 0.586	Fail[e]
MAW-613	2/1/2019	Pu-239/240	0.07 ± 0.07	0.005	NA [d]	Pass
MAW-613	2/1/2019	U-234	0.96 ± 0.07	0.800	0.56 ± 1.04	Pass
MAW-613	2/1/2019	U-238	0.94 ± 0.07	0.810	0.57 ± 1.05	Pass
MAAP-611	2/1/2019	Cs-134	0.185 ± 0.025	0.216	0.151 - 0.281	Pass
MAAP-611	2/1/2019	Cs-137	0.288 ± 0.045	0.290	0.203 - 0.377	Pass
MAAP-611	2/1/2019	Co-57	0.369 ± 0.033	0.411	0.288 - 0.534	Pass
MAAP-611	2/1/2019	Co-60	0.333 ± 0.045	0.340	0.238 - 0.442	Pass
MAAP-611	2/1/2019	Mn-54	0.546 ± 0.058	0.547	0.383 - 0.711	Pass
MAAP-611	2/1/2019	Zn-65	0.025 ± 0.0348	0	NA [c]	Pass
MAAP-611	2/1/2019	Sr-90	1.34 ± 0.13	0.662	0.463 - 0.861	Fail[f]
MAAP-611	2/1/2019	U-234	4.14 ± 0.97	0.106	0.074 - 0.138	Fail[f]
MAAP-611	2/1/2019	U-238	3.89 ± 0.94	0.110	0.077 - 0.143	Fail[f]
MAW-601	2/1/2019	I-129	0.56 ± 0.08	0.616	0.431 - 0.801	Pass

TABLE A-7. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration[a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MAVE-607	2/1/2019	Cs-134	2.33 ± 0.10	2.44	1.71 - 3.17	Pass
MAVE-607	2/1/2019	Cs-137	2.62 ± 0.13	2.30	1.61 - 2.99	Pass
MAVE-607	2/1/2019	Co-57	2.39 ± 0.11	2.07	1.45 - 2.69	Pass
MAVE-607	2/1/2019	Co-60	0.046 ± 0.04	0	NA [c]	Pass
MAVE-607	2/1/2019	Mn-54	0.031 ± 0.04	0	NA [c]	Pass
MAVE-607	2/1/2019	Sr-90	0.013 ± 0.022	0	NA [c]	Pass
MAAP-3299	8/1/2019	Gross Alpha	0.13 ± 0.03	0.528	0.158 - 0.898	Fail[g]
MAAP-3299	8/1/2019	Gross Beta	1.06 ± 0.07	0.937	0.469 - 1.406	Pass
MAW-3252	8/1/2019	Gross Alpha	0.93 ± 0.06	1.06	0.32 - 1.80	Pass
MAW-3252	8/1/2019	Gross Beta	3.03 ± 0.07	3.32	1.66 - 4.98	Pass
MASO-3297	8/19/2019	Cs-134	881.98 ± 9.03	1020	714 - 1326	Pass
MASO-3297	8/19/2019	Cs-137	871.50 ± 10.83	789	552 - 1026	Pass
MASO-3297	8/19/2019	Co-57	-1.72 ± 3.01	0	NA [c]	Pass
MASO-3297	8/19/2019	Co-60	783.69 ± 8.21	760	532 - 988	Pass
MASO-3297	8/19/2019	Mn-54	834.48 ± 11.29	745	522 - 969	Pass
MASO-3297	8/19/2019	Zn-65	-3.01 ± 5.27	0	NA [c]	Pass
MASO-3297	8/19/2019	K-40	662.91 ± 42.65	555	389 - 722	Pass
MAW-3240	8/1/2019	Cs-134	-0.08 ± 0.06	0	NA [c]	Pass
MAW-3240	8/1/2019	Cs-137	18.48 ± 0.90	18.4	12.9 - 23.9	Pass
MAW-3240	8/1/2019	Co-57	14.68 ± 0.52	15.6	10.9 - 20.3	Pass
MAW-3240	8/1/2019	Co-60	8.67 ± 0.39	8.8	6.2 - 11.4	Pass
MAW-3240	8/1/2019	Mn-54	20.72 ± 0.93	20.6	14.4 - 26.8	Pass
MAW-3240	8/1/2019	Zn-65	20.52 ± 1.05	20.3	14.200 - 26.400	Pass
MAW-3240	8/1/2019	K-40	5.11 ± 0.68	0	NA [c]	Fail
MAW-3240	8/1/2019	H-3	179.52 ± 3.32	175	123 - 228	Pass
MAW-3240	8/1/2019	U-234	1.11 ± 0.04	1.07	0.75 - 1.39	Pass
MAW-3240	8/1/2019	U-238	1.08 ± 0.04	1.05	0.74 - 1.37	Pass
MAVE-3295	8/1/2019	Cs-134	0.02 ± 0.02	0	NA [c]	Pass
MAVE-3295	8/1/2019	Cs-137	3.38 ± 0.32	3.28	2.30 - 4.26	Pass
MAVE-3295	8/1/2019	Co-57	4.99 ± 0.51	4.57	3.20 - 5.94	Pass
MAVE-3295	8/1/2019	Co-60	5.29 ± 0.39	5.30	3.71 - 6.89	Pass
MAVE-3295	8/1/2019	Mn-54	4.73 ± 0.45	4.49	3.14 - 5.84	Pass
MAVE-3295	8/1/2019	Zn-65	3.10 ± 0.31	2.85	2.00 - 3.71	Pass

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

[b] Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil) and MAVE (vegetation).

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

[d] Provided in the series for "sensitivity evaluation". MAPEP does not provide control limits.

[e] Past results have been acceptable so will watch to see if a trend develops.

[f] An erroneous volume conversion caused some incorrect values to be submitted. If the conversion had been performed properly the results in Bq/sample would have been (Sr-90: 0.671 ± 0.066) and (U-234: 0.153 ± 0.036) and (U-238: 0.144 ± 0.035). This result had been included in the Uranium investigation. See footnote "C" on Table A-1.

[g] The lab will adopt a MAPEP specific gross alpha/beta filter calibration as discussed in the MAPEP test instructions.. Utilizing a MAPEP specific calibration, the result in Bq/sample yields a result of (0.39 ± 0.09 Bq/total).

TABLE A-8. Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)[a].

MRAD-30 Study

Lab Code [b]	Concentration [a]					
	Date	Analysis	Laboratory Result	ERA Value [c]	Control Limits [d]	Acceptance
ERAP-846	3/18/2019	Am-241	19.1	18.7	13.3 - 24.9	Pass
ERAP-846	3/18/2019	Cs-134	612	721	468 - 884	Pass
ERAP-846	3/18/2019	Cs-137	679	634	521 - 832	Pass
ERAP-846	3/18/2019	Co-60	93.7	93.8	79.7 - 119	Pass
ERAP-846	3/18/2019	Fe-55	612	718	262 - 1150	Pass
ERAP-846	3/18/2019	Mn-54	< 0.5	< 50.0	0.00 - 50.0	Pass
ERAP-846	3/18/2019	Zn-65	1500	1380	1130 - 2110	Pass
ERAP-846	3/18/2019	Pu-238	34.0	33.8	25.5 - 41.5	Pass
ERAP-846	3/18/2019	Pu-239	64.9	67.0	50.1 - 80.8	Pass
ERAP-846	3/18/2019	Sr-90	199	181	114 - 246	Pass
ERAP-846	3/18/2019	U-234[e]	29.0	18.2	13.5 - 21.3	Fail
ERAP-846	3/18/2019	U-238[e]	28.6	18.1	13.7 - 21.6	Fail
ERAP-848	3/18/2019	Gross Alpha	48.4	50.3	26.3 - 82.9	Pass
ERAP-848	3/18/2019	Gross Beta	95.5	78.6	47.7 - 119	Pass

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

[b] Laboratory code ERAP (air filter). Results are reported in units of (pCi/Filter).

[c] The ERA Assigned values for the air filter standards are equal to 100% of the parameter present in the standard as determined by the gravimetric and/or volumetric measurements made during standard preparation as applicable.

[d] The acceptance limits are established per the guidelines contained in the Department of Energy (DOE) report EML-564, Analysis of Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) Data Determination of Operational Criteria and Control Limits for Performance Evaluation Purposes or ERA's SOP for the generation of Performance Acceptance Limits.

[e] Failure traced to an over-estimated U-232 tracer value. Tracer has been re-standardized. (See footnote "c" on Table A-1).

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Appendix B

Data Reporting Conventions

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 4.66σ uncertainty for a background sample.

3.0. Duplicate analyses

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

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

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

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

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

4.0. Computation of Averages and Standard Deviations

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

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

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

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

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

4.5 In rounding off, the following rules are followed:

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

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

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Appendix C

Maximum permissible concentrations of radioactivity
in air and water above natural background in unrestricted areas

APPENDIX C

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

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

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

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

[c] A natural radionuclide.

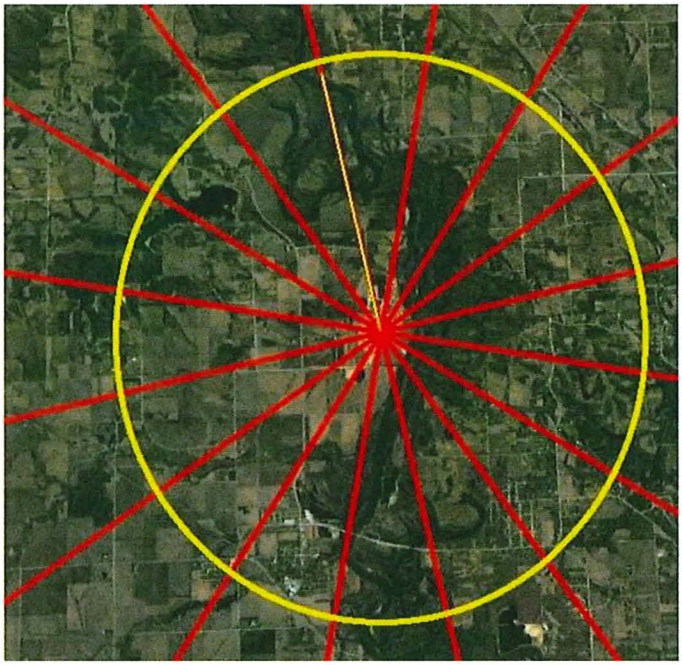
APPENDIX D

SUMMARY OF THE LAND USE CENSUS AND REMP-GWPP DATA

Appendix D

Summary of the 2019 Land Use Census and REMP-GWPP Data

The Duane Arnold Energy Center Land Use Census was completed during September 2019. All residences, milk animals, cattle, and gardens greater than 500 square feet were identified within three miles for each of the 16 meteorological sectors. If none were identified within three-mile range, additional surveys were performed out to a distance of five miles. The 16 meteorological sectors were identified using Google Earth and digital compass rose overlay for accuracy and precision.



The 2019 Land Use Census identified 81 gardens, which is 37 fewer gardens than in 2018 and 40 fewer gardens than in 2017. Six farmers/residents provided vegetation samples including two adjacent neighbors to DAEC, D-58 and D-57. Vegetation providers are found in ODAM, Table 5-1. Gardens were identified using Google Earth, Linn County GIS data, field observation, and interviewing local residents.

There are no nearest resident changes. In addition, the Pleasant Creek State Recreation Area has a large transient population of 50-300 people camping in RV's and tents from April to October. An analysis of 2016 data indicated an air sampler should be installed near this population. Therefore, an air sampler and TLD were installed in 2018 and the location is identified as D-4, Pleasant Creek SRA.

There are six nearest livestock change attributed to field observation verification. Farmers in the NW and ENE sectors were observed to have goats. If the farmer provides goat milk, the farm will be included as a sample location in the ODAM, Table 5-1. The Iowa Department of Agriculture and Land Stewardship provided a list of permitted commercial dairy farms located with Benton and Linn Counties. Large commercial dairies were included in the survey, but none were located within five miles of the DAEC facility. DAEC continues to collect milk samples from two permitted dairy

farms located in WSW and SW sectors. No goat milk samples were collected in 2019 from D-76, ODAM table 5-1.

The Cedar River was surveyed by University of Iowa Hygienic Laboratory boat on June 13, 2019, and August 23, 2019, for water use downstream of the DAEC to Cedar Rapids. Both surveys identified no new usages of river water when compared to previous surveys. Recreational fishing is the only identified food pathway use of Cedar River water between the DAEC and the City of Cedar Rapids eight miles down-river.

The State of Iowa Hygienic Laboratory performed fish sampling on June 11, 2019, and August 16, 2019. Fish filets from smallmouth bass, northern pike, white crappie, channel catfish, and largemouth bass were processed for off-site laboratory analysis and results indicate no impact to human consumable fish.

Cedar River bed sediment samples were collected on April 1, 2019, and October 18, 2019. A background sample from D-49 identified Cesium 137 (Cs-137), Similarly, on-site sediment samples collected from D-15a and D16 on June 20, 2019, also identified Cs-137. An investigation with the State of Iowa Hygienic Laboratory determined the source of Cs-137 is not from DAEC operations, but rather historical atmospheric deposition from nuclear weapon testing.

Benton County Public Health Department and Linn County Public Health Department provided ground water well permit data. In 2019, no new drinking wells were installed within three miles of the facility and none of these wells are impacted by plant activities.

As a result of the 2019 Land Use Census, adjustments were made to the Meteorological Information and Dose Assessment System (MIDAS-NU) projection software model for changes in receptor distances. No significant annual dose corrections were necessary. The 2019 annual radiation dose assessment can be found in Appendix E.

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:

- Radioactive reactor-by-product material was identified in multiple groundwater samples collected by the DAEC's Ground Water Protection Program (GWPP). The following was included to the DAEC Offsite Dose Assessment Manual (ODAM):

"In February 2016, the GWPP routine sampling identified a contaminate plume in the shallow aquifer (less than 25 feet deep). Release standards are set forth in Section 6.0, Radiological Liquid Effluent Release O.6.1.2, Table 7.1-2. In accordance with GWPP Administrative Control Procedure (ACP) 1411.35 and Environmental Protection Agency (EPA) drinking water standards for tritium, 20,000 pCi/L, groundwater batch and continuous releases are expected less than (<) 20,000 pCi/L. Groundwater samples are analyzed on-site and validated by off-site secondary laboratory. Off-site laboratory results are published Annual Radiological Environmental Operating Report."

- There are 56 monitoring wells on-site. Tritium concentrations from on-site monitoring wells range from non-detectable at less than (<) 150 pCi/L to 95,396 pCi/L, from monitoring well MW-22A (D-66). Gross alpha values in several samples are believed to be influenced by naturally occurring radioactive materials in the environment, i.e. radon. No on-site or neighboring drinking water wells are installed in this shallow aquifer. No plant by-products were identified in any drinking water samples or samples from the Cedar River at the intake, D-50, and the discharge point, D-51. Tritiated groundwater remains within the owner controlled area and the shallow aquifer is undergoing mitigation in accordance with ACP 1411.35.

  From January 1 to December 31, 2019, three extraction wells were in operation and are designed to remove tritiated groundwater continuously from the shallow aquifer. In addition, temporary mitigation of monitoring wells was performed at MW-08A (D-128A), MW-22A (D-66), and MW-23A (D-67). For specific liquid effluent release data, see the 2019 Duane Arnold Annual Radioactive Material Release Report.

- The United States Nuclear Regulatory Commission, NRC, provides an informative resource for tritium. The information can be found at:

  https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html

Updates to REMP and GWPP sampling include:

1. D-6 Center Point and D-7 Shellsburg air samplers will be continued until 2021.
2. D-58 sample location includes groundwater, vegetables, and meat (chicken)
3. D-97 sample location was corrected to account for surface water samples.

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 2019 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 as per Environmental Sampling Procedure, ESP 4.5.

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 the central United States.

Section B. Estimated Offsite Dose from Effluent Releases

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

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

Results of the MIDAS dose calculations are displayed below.

1.) There were 82 batch and continuous releases of radioactive material (tritium) to liquid effluents (groundwater mitigation) in 2019. The maximum dose from tritiated groundwater release to a child total body and liver was 0.114 mrem.

2.) The maximum dose to air at the site boundary from noble gases released was 0.00724 mrad from gamma radiation at 481 meters towards the South-Southeast.

3.) The maximum dose to air at the site boundary from noble gases released was 0.0000847 mrad beta radiation at 4,022 meters towards the West-Northwest.

4.) The whole body dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.00270 mrem, at 805 meters towards the West.

5.) The skin dose equivalent to the hypothetical maximally exposed individual (child) from noble gases was 0.00270 mrem, at 805 meters towards the West.

6.) The hypothetical maximally exposed organ due to airborne iodines and particulates with half-lives greater than eight days (excluding carbon-14) was the lungs of a child at 805 meters towards the West, with an estimated dose equivalent of 0.00557 mrem.

7.) The hypothetical maximally exposed organ due to airborne carbon-14 was the bone of a child located 3,510 meters to the West-Northwest of the site. The dose was 0.385 mrem.

Conclusion

No measurable dose due to the operation of the DAEC or the DAEC ISFSI was detected by environmental TLDs in 2019. The calculated doses are below the regulatory limits stated in Appendix I to 10CFR50, 40CFR190, and 10 CFR 72.104.

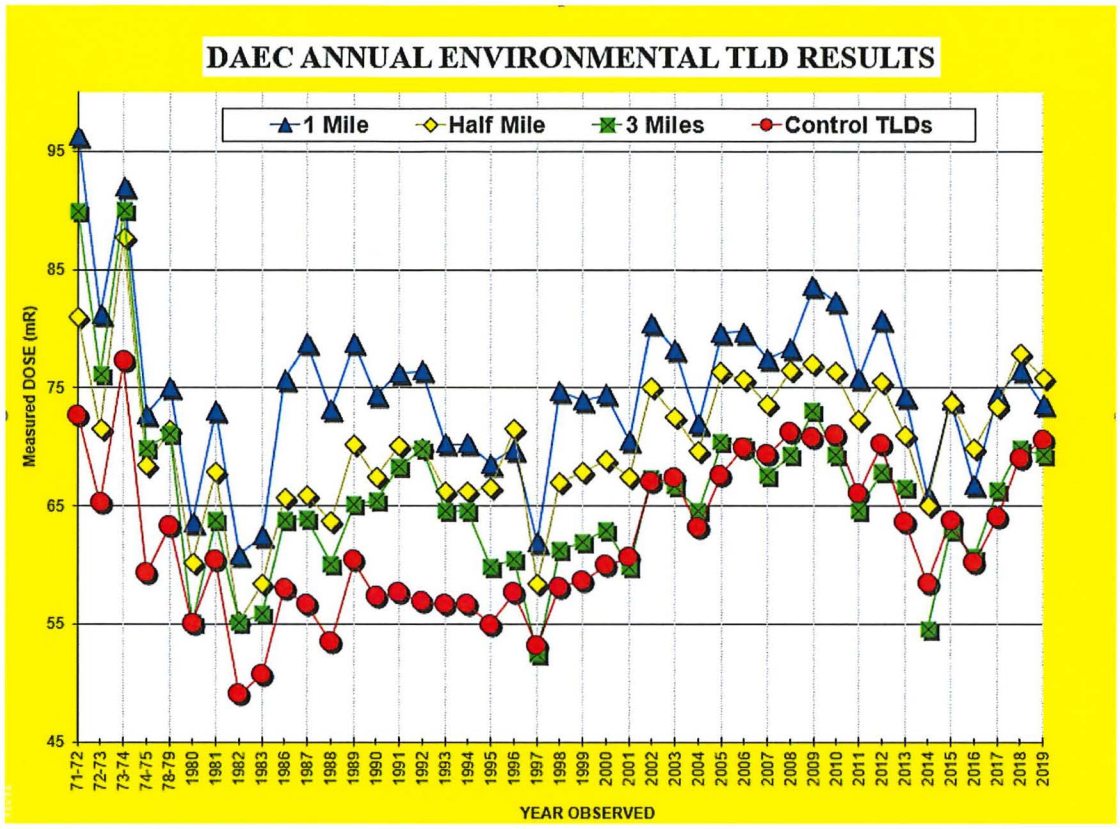
Estimated Maximum Offsite Individual Doses for 2019

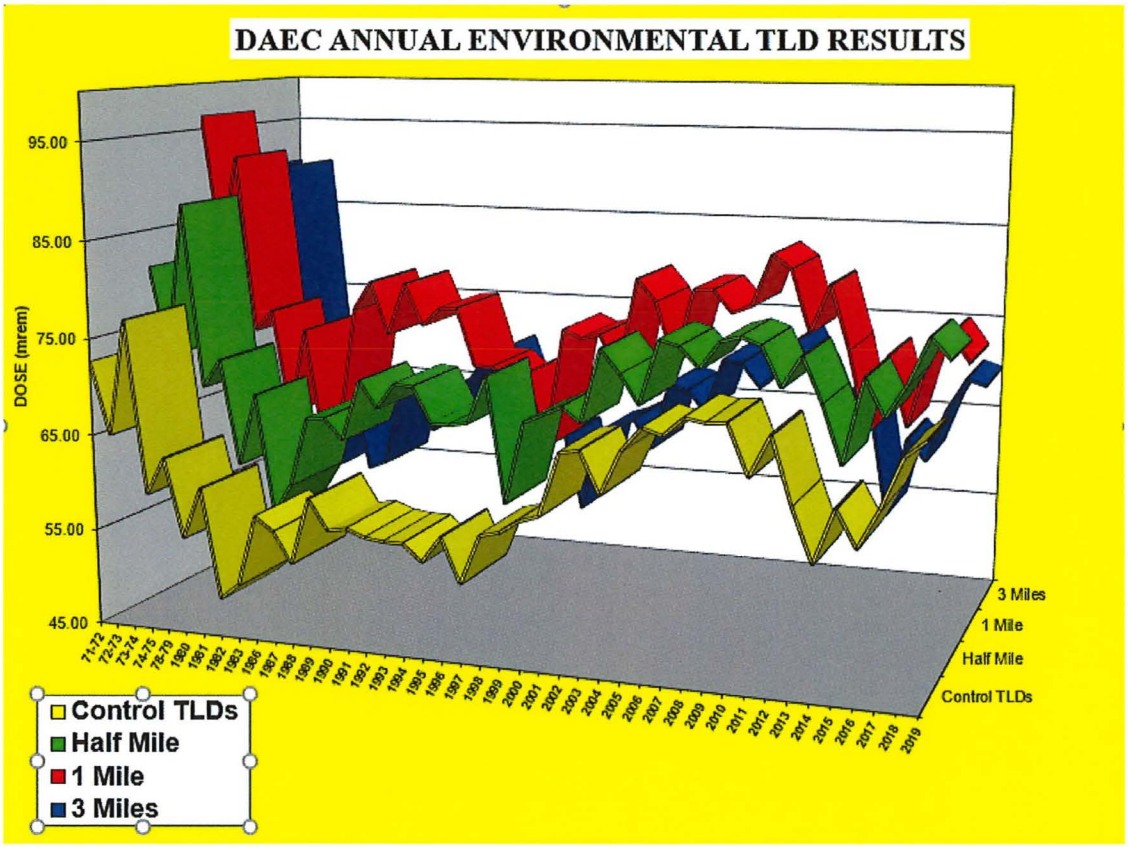
Type	Age Group	Distance (meters)	Direction	Dose or Dose Equivalent (mrem)	Annual 10 CFR 50, Appendix I "Limit"
Direct Radiation (as measured by TLDs)				None	*
Liquid Releases					
Whole Body Dose	Child	D*	SE	0.114 mrem	3 mrem
Organ Dose	Child - Liver	D*	SE	0.114 mrem	10 mrem
Noble Gas					
Gamma Air Dose		481	SSE	0.000724 mrad	10 mrad
Beta Air Dose		4.022	WNW	0.0000847 mrad	20 mrad
Whole Body	All	805	W	0.00270 mrem	5 mrem
Skin	Child	805	W	0.00270 mrem	15 mrem
Particulates & Iodines					
Organ Dose	Child – Lungs	805	W	0.00557 mrem	15 mrem
Carbon 14					
Organ Dose	Child – Bone	3,015	WNW	0.385 mrem	15 mrem

* There is no Appendix I limit for direct radiation. Compliance with 40 CFR 190 limits of 25 mrem whole body and 75 mrem thyroid is demonstrated in the Duane Arnold Energy Center 2018 Annual Radiological Environmental Operating Report, subsections "Ambient Radiation (TLDs)" and "ISFSI Facility Operations Monitoring".

D* Receptor location is aquatic pathway at Cedar River, See Offsite Dose Assessment Manual, ODAM, figure 3-2.

The following graphs are TLD trends based on distance to the facility over time.





Appendix E Errata **Correction and Amendments**

1. The 2018 Annual Radiological Environmental Operating Report was provided to the NRC on May 14, 2019, ADAMS Accession No. ML19134A051. That report contained a typographical error such that the table heading on page E-3 cited 2017 when it should have cited 2018. NextEra Energy Duane Arnold, LLC has determined the error to be small in accordance with Regulatory Guide 1.21, Revision 2, Section 7.1. The affected page has been submitted to the NRC by letter dated May 7, 2020.