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April 21, 2017
L-17-076

10CFR50.36(a)

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

SUBJECT:
Perry Nuclear Power Plant Annual Environmental and Effluent Release Report
Docket No. 50-440

Enclosed is the Annual Environmental and Effluent Release Report for the Perry Nuclear Power Plant (PNPP) for the period of January 1, 2016 through December 31, 2016. This document includes the radiological environmental operating report, radioactive effluent release report, and the non-radiological environmental operating report which satisfies the requirements of the PNPP Technical Specifications (TS), the PNPP Offsite Dose Calculation Manual (ODCM), and the Environmental Protection Plan, Appendix B of the PNPP Operating License. Also enclosed are two corrected pages to the 2013 Annual Environmental and Effluent Release Report.

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Steven Benedict, Chemistry Manager at (440) 280-5032.

Sincerely,

David Hamilton

Enclosures:
A PNPP 2016 Annual Environmental and Effluent Release Report
B Corrections to the 2013 PNPP Annual Environmental and Effluent Release Report

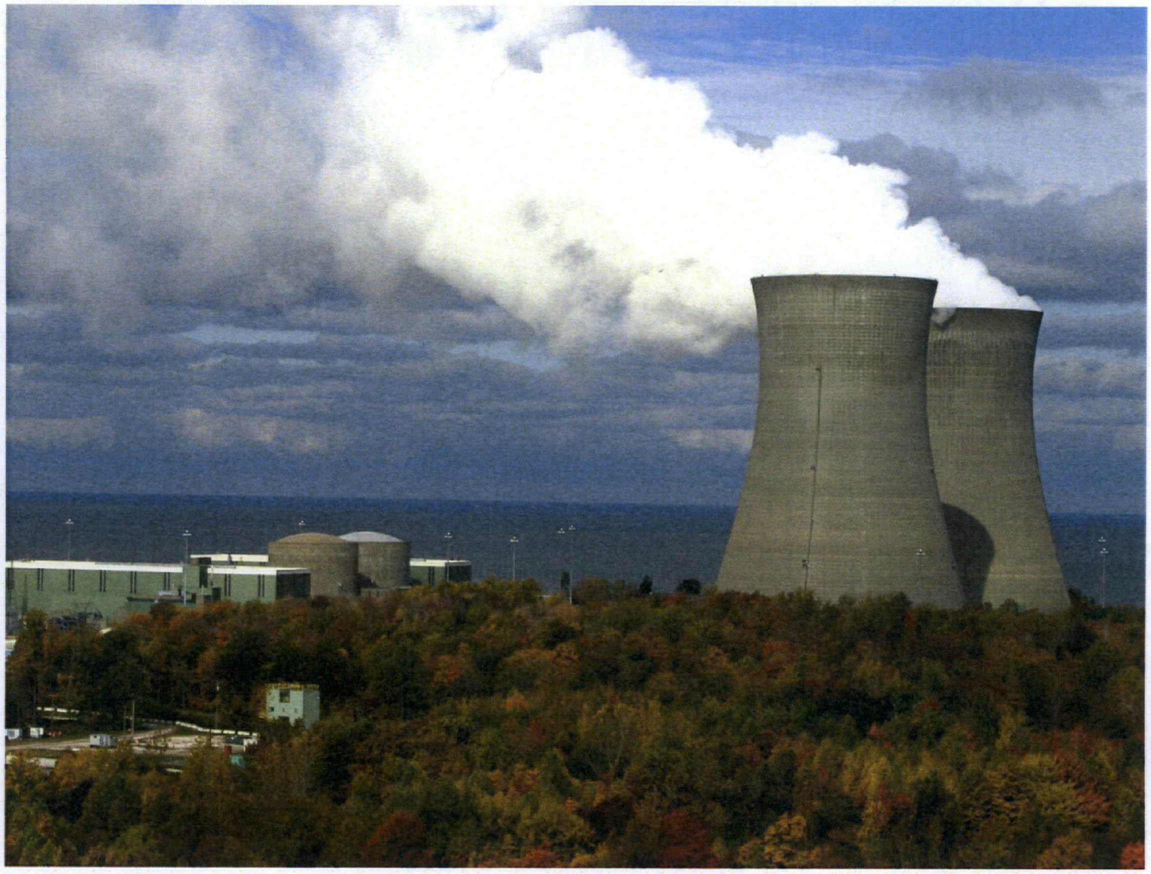
cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

Enclosure A

L-17-076

PNPP 2016 Annual Environmental and Effluent Release Report

Perry Nuclear Power Plant



Annual Environmental and Effluent Release Report

2016

2016

ANNUAL ENVIRONMENTAL AND EFFLUENT RELEASE REPORT

for the Perry Nuclear Power Plant

PREPARED BY:
CHEMISTRY SECTION
PERRY NUCLEAR POWER PLANT
FIRSTENERGY NUCLEAR OPERATING COMPANY
PERRY, OHIO
APRIL, 2017

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Appendices

EXECUTIVE SUMMARY

The Annual Environmental and Effluent Release Report (AEERR) details the results of environmental and effluent monitoring programs conducted at the Perry Nuclear Power Plant (PNPP) from January 01 through December 31, 2016. This report meets all of the requirements in PNPP Technical Specifications, the Offsite Dose Calculation Manual (ODCM), the Environmental Protection Plan (EPP) and Regulatory Guide 1.21. It incorporates the requirements of the Annual Radioactive Effluent Release Report (ARERR), the Annual Radiological Environmental Operating Report (AREOR) and the Annual Environmental Operating Report (AEOR). Report topics include radioactive effluent releases, radiological environmental monitoring, land use census, clam/mussel monitoring, herbicide use, and special reports. The results of the environmental and effluent programs indicate that the operations of the PNPP did not result in any significant environmental impact.

RADIOACTIVE EFFLUENT RELEASES

During the normal operation of a nuclear power plant, small quantities of radioactivity are released to the environment through liquid and gaseous effluents. Radioactive material is also shipped offsite as solid waste. PNPP maintains a comprehensive program to control and monitor the release of radioactive materials from the site in accordance with Nuclear Regulatory Commission (NRC) release regulations.

Dose to the general public from the plant's liquid and gaseous effluents was well below regulatory limits. The calculated maximum individual whole body dose potentially received by an individual resulting from PNPP liquid effluents was 1.07E-03 mrem (0.04% of the regulatory limit). The calculated maximum individual whole body dose potentially received by an individual resulting from PNPP gaseous effluents, excluding carbon-14 (C-14) was 3.63E-04 mrem (0.01% of the regulatory limit).

Radioactivity released to the environment in the form of gaseous C-14 was estimated based on plant type and power production. The calculation is based on an industry initiative supported by the Nuclear Energy Institute (NEI), the Electric Power Research Institute (EPRI) and the NRC. The calculated hypothetical maximum individual whole body dose potentially received by an individual resulting from PNPP gaseous effluents including C-14 is 0.25 mrem (5.0% of the limit). Refer to page 23 for additional C-14 information.

The summation of the hypothetical maximum individual dose from effluents is less than 1% of the total dose an individual living in the PNPP area receives from all sources of man-made and background radiation.

Shipments of solid waste consisted of waste generated during water treatment, radioactive material generated during normal daily operations and maintenance, and irradiated components. PNPP complied with regulations governing radioactive shipments of solid radioactive waste.

RADIOLOGICAL ENVIRONMENTAL MONITORING

The Radiological Environmental Monitoring Program (REMP) was established in 1981 to monitor the radiological conditions in the environment around PNPP. The operational REMP was initiated in 1986 and has continued through this reporting period. The REMP is conducted in accordance with the PNPP ODCM. This program includes collection and analysis of environmental samples and evaluation of results at indicator as well as control locations. Indicator samples are collected at locations determined to be most influenced by operation of the PNPP. Control samples are collected at locations beyond the measurable influence of the PNPP for data comparison.

PRE-OPERATIONAL REMP

The REMP was established at PNPP six years before the plant became operational. Between 1981 and 1986, environmental monitoring involved collection and analysis of environmental samples. This pre-operational program was designed to provide data on background radiation levels and radioactivity normally present in the area in order to establish a baseline for data comparison prior to operation of the plant. PNPP has continued to monitor the environment during plant operation by collecting and analyzing samples of air, milk, fish, vegetation, water, and sediment, as well as by measuring radiation directly.

The contribution of radionuclides to the environment resulting from PNPP operation is assessed by comparing results from the environmental monitoring program with pre-operational data, operational data from previous years, and control location data. The results for each sample type are compared to historical data to determine whether trends or changes in concentrations are observable.

OPERATIONAL REMP

Results of air samples collected to monitor the radioactivity in the atmosphere revealed normal background radionuclide concentrations. Terrestrial monitoring included the analysis of milk and vegetation; the results of which indicated concentrations of radioactivity similar to those found in previous years. Analyses of vegetation samples detected only natural radioactivity, similar to those observed in previous years and indicated no radioactivity attributable to operation of the PNPP.

Aquatic monitoring included the collection and analyses of water, fish, and shoreline sediments. The analytical results of these samples showed normal background radionuclide concentrations.

Direct radiation measurements showed no significant changes from previous years. The indicator locations averaged 13.2 mrem/quarter and control locations averaged 12.7 mrem/quarter. Radiation dose in the area of PNPP was similar to the radiation dose measured at locations greater than ten miles away from PNPP.

Results from indicator samples collected during this reporting period were compared to control sample results and pre-operational data. Based on the results, the operation of the PNPP resulted in no measureable increase in the radionuclide concentrations observed in the surrounding environment. The results of the REMP indicate adequate control of radioactivity released from PNPP effluents. These results also demonstrate that PNPP complies with federal regulations.

LAND USE CENSUS

In order to estimate radiation dose attributable to operation of the PNPP, the potential pathways through which public exposure can occur must be known. To identify these pathways, an Annual Land Use Census is performed as part of the REMP. During the census, PNPP personnel travel public roads within a five mile radius of the plant to locate key radiological exposure pathways. These key pathways include the nearest resident, garden, and milk animal in each of the ten meteorological land sectors that surround the plant. The information obtained from the census is entered into a computer program used to assess hypothetical dose to members of the public. The predominant land use within the census area continues to be rural and/or agricultural.

CLAM/MUSSEL MONITORING

Clam and mussel shells can clog plant piping and components that use water from Lake Erie. For this reason, sampling for clams and mussels has been conducted in Lake Erie near PNPP since 1971. The monitoring is specifically for Corbicula (Asiatic clams) since their introduction into the Great Lakes in 1981, and for Dreissena (zebra mussels) since their discovery in Lake Erie in 1989. Since no Corbicula have been found at PNPP, routine Corbicula monitoring will provide early detection capability if this pest species arrives at PNPP. The Dreissena program includes both monitoring and control and is directed at minimizing impact of the mussels on plant operation. As in past years, this program has successfully prevented Dreissena from causing any significant operational problems at PNPP.

HERBICIDE USE

The use of herbicides on the PNPP site is monitored to ensure compliance with Ohio Environmental Protection Agency (OEPA) requirements and to protect the site's natural areas. Based on weekly inspections, herbicide use has not had a negative impact on the environment around the plant.

SPECIAL ENVIRONMENTAL REPORTS

Significant environmental events (e.g. spills, releases), noncompliance with environmental regulations (e.g., OEPA discharge limits), and changes in plant design or operation that affect the environment are reported to regulatory agencies as they occur. No reports were submitted in 2016 and further details can be found on page 45.

INTRODUCTION

Nuclear energy provides an alternative energy source that is readily available with a very limited impact upon the environment. To more fully understand nuclear energy as a source of generating electricity, it is helpful to understand basic radiation concepts and the occurrence of radioactivity in nature.

RADIATION FUNDAMENTALS

Atoms are the basic building blocks of all matter. Simply described, atoms are made up of positively and negatively charged particles and particles which are neutral. These particles are called protons, electrons, and neutrons, respectively. The relatively large protons and neutrons are packed together in the center of the atom called the nucleus. Orbiting around the nucleus are one or more smaller electrons. In an electrically neutral atom, the positively charged protons in the nucleus balance the negatively charged electrons. Due to their dissimilar charges, the protons and electrons have a strong attraction for each other, which helps hold the atom together. Other attractive forces between the protons and neutrons keep the densely packed protons from repelling each other and prevent the nucleus from breaking apart.

Atoms with the same number of protons in their nuclei make up an element. The number of neutrons in the nuclei of an element may vary. Atoms with the same number of protons but different numbers of neutrons are called isotopes. All isotopes of the same element have the same chemical properties and many are stable or non-radioactive. An unstable or radioactive isotope of an element is called a radionuclide. Radionuclides contain an excess amount of energy in the nucleus, which is usually due to an excess number of neutrons.

Radioactive atoms attempt to reach a stable, non-radioactive state through a process known as radioactive decay. Radioactive decay is the release of energy from an atom's nucleus through the emission of alpha and beta particles and gamma rays. Radionuclides vary greatly in the rate in which they decay. The length of time an atom remains radioactive is defined in terms of its half-life. Half-life is defined as the time required for a radioactive substance to lose half its activity through the process of radioactive decay. Half-lives vary from millionths of a second to millions of years.

RADIATION AND RADIOACTIVITY

Radioactive decay is a process in which the nucleus of an unstable atom becomes more stable by spontaneously emitting energy. Radiation refers to the energy that is released when radioactive decay occurs within the nucleus. This section includes a discussion on the three primary forms of radiation produced by radioactive decay.

Alpha Particles

Alpha particles consist of two protons and two neutrons and have a positive charge. Because of their charge and large size, alpha particles do not travel very far when released (less than 4 inches in air). They are unable to penetrate any solid material, such as paper or skin, to any significant depth. If alpha particles are released inside the body, however, they can damage the soft internal tissues because they deposit all their energy in a small area.

Beta Particles

Beta particles have the same characteristics as electrons but originate from the nucleus. They are much smaller than alpha particles and travel at nearly the speed of light, thus they travel longer distances than alpha particles. External beta radiation primarily affects the skin. Because of their electrical charge, beta particles are stopped by paper, plastic or thin metal.

Gamma Rays

Gamma rays are bundles of electromagnetic energy called photons. They are similar to visible light, but at a much higher energy. Gamma rays can travel long distances in air and are often released during radioactive decay along with alpha and beta particles. Potassium-40 is an example of a naturally-occurring radionuclide found in all humans that emits a gamma ray when it decays.

Interaction with Matter

When radiation interacts with other materials, it affects the atoms of those materials principally by removing the negatively charged electrons out of their orbits. This causes an atom to lose its electrical neutrality and become positively charged. An atom that is charged, either positively or negatively, is called an ion, and the radiation is called ionizing radiation.

Activity

Activity is the number of atoms in a material that decay per unit of time. Each time an atom decays, radiation is emitted. A curie (Ci) is the unit used to describe the activity of a material and indicates the rate at which the atoms are decaying. One curie of activity indicates the decay of 37 billion atoms per second. Smaller units of the curie are often used in this report. Two common units are the microcurie (µCi), one millionth of a curie, and the picocurie (pCi), one trillionth of a curie. The mass, or weight, of radioactive material, which would result in one curie of activity depends on the disintegration rate. For example, one gram of radium-226 is equivalent to one curie of activity. It would require about 1.5 million grams of natural uranium, however, to equal one curie.

Dose

Biological damage due to alpha, beta, and gamma radiation may result from the ionization caused by these types of radiation. Some types of radiation, especially alpha particles that cause dense local ionization, can result in much more biological damage for the same energy imparted than does gamma or beta radiation. A quality factor, therefore, must be applied to account for the different ionizing capabilities of various types of ionizing radiation. When the quality factor is multiplied by the absorbed dose (as measured in rads), the result is the dose equivalent, which is an estimate of the possible biological damage resulting from exposure to any type of ionizing radiation. The dose equivalent is measured in terms of the Roentgen Equivalent Man (rem). When discussing environmental radiation effects, the rem is a large unit; therefore, a smaller unit, the millirem (mrem) is often used. One mrem is equivalent to 1/1000 of a rem.

LOWER LIMIT OF DETECTION

Sample results are often reported as below the Lower Limit of Detection (LLD). The LLD for an analysis is the smallest amount of radioactive material that will show a positive result, for which there can be a 95% confidence that radioactivity is present. This statistical parameter is used as a measure of the sensitivity of a sample analysis. When a measurement is reported as less than the LLD (<LLD), it means that no radioactivity was detected. Had radioactivity been present at or above the stated LLD value, it statistically would have been detected. The NRC has established the required LLD values for environmental and effluent sample analyses.

OTHER SOURCES OF RADIATION DOSE TO THE U.S. POPULATION

This section discusses the doses that the average American typically receives each year from naturally-occurring background radiation and all other sources of radiation. With the information presented in this section, the reader can compare the doses received from Nuclear Power Plant (NPP) effluents with the doses received from natural, medical, and other sources of radiation. This comparison provides some context to the concept of radiation dose effects.

In March 2009, the National Council on Radiation Protection and Measurements (NCRP) published Report No. 160 as an update to the 1987 NCRP Report No. 93, Ionizing Radiation Exposure of the Population of the United States. Report No. 160 describes the doses to the U.S. population from all sources of ionizing radiation for 2006, the most recent data available at the time the NCRP report was written. The NCRP report also includes information on the variability of those doses from one individual to another. The NCRP estimated that the average person in the United States receives about 620 mrem of radiation dose each year. NCRP Report No. 160 describes each of the sources of radiation that contribute to this dose, including:

- Naturally-occurring sources (natural background) such as cosmic radiation from space, terrestrial radiation from radioactive materials in the earth, and naturally-occurring radioactive materials in the food people eat and in the air people breathe;
- Medical sources from diagnosis and treatment of health disorders using radioactive pharmaceuticals and radiation-producing equipment;
- Consumer products (such as household smoke detectors);
- Industrial processes, security devices, educational tools, and research activities; and
- Exposures of workers that result from their occupations.

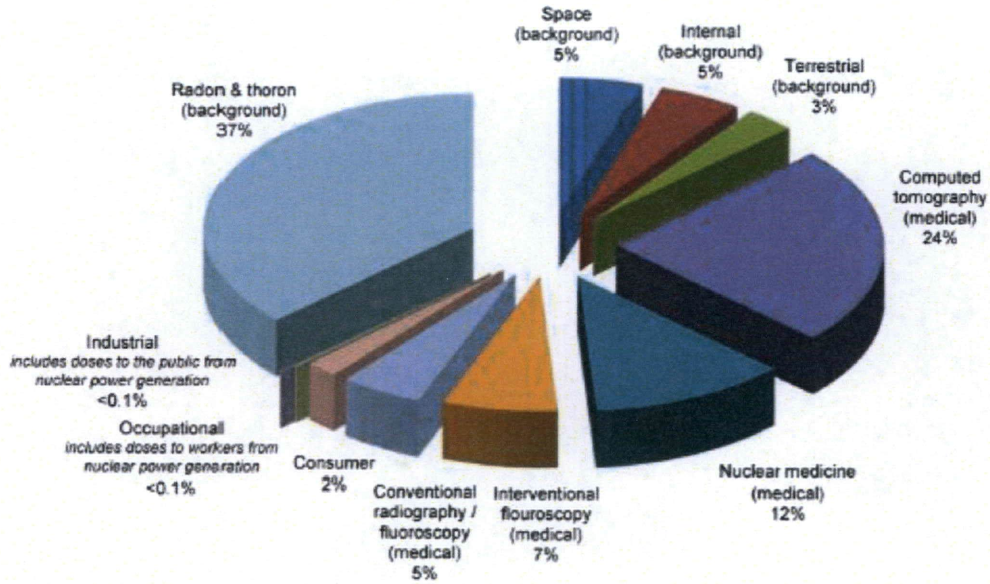

Figure 1: Sources of Radiation Exposure to the U.S. Population

Figure 1 shows the contribution of various sources of exposure to the total collective effective dose and the total effective dose per individual in the U.S. population in 2006. Larger contributors to dose are represented by proportionally larger slices of the pie. Doses to the public from NPPs are included in the industrial category; doses to workers from nuclear power generation are included in the category of occupational dose. Doses to the public due to effluents from NPPs are less than 0.1% of what the average person receives each year from all other sources of radiation.

ENVIRONMENTAL RADIONUCLIDES

Many radionuclides are present in the environment due to sources such as cosmic radiation and fallout from nuclear weapons testing. These radionuclides are expected to be present in many of the environmental samples collected in the vicinity of PNPP. Some of the radionuclides normally present include: beryllium-7, a result of the interaction of cosmic radiation with the upper atmosphere; potassium-40, a naturally-occurring radionuclide normally found in humans and throughout the environment; radionuclides from nuclear weapons testing fallout, including tritium and cesium-137; and tritium due to the interaction of nitrogen in the air and cosmic rays.

Beryllium-7 and potassium-40 are common in REMP samples. Since they are naturally-occurring and are expected to be present, positive results for these radionuclides are not discussed in the section for the Sampling Program results. These radionuclides are included; however, in Appendix A, 2016 Inter-Laboratory Cross Check Comparison Program Results.

RADIOACTIVE EFFLUENT RELEASES

INTRODUCTION

The source of radioactive material in a nuclear power plant is the generation of fission products (e.g., noble gas, iodine, and particulate) or neutron activation of water and corrosion products (e.g., tritium and cobalt). The majority of the fission products generated remain within the nuclear fuel pellet and fuel cladding. Most fission products that escape from the fuel cladding, as well as the majority of the activated corrosion products, are removed by plant processing equipment.

During the normal operation of a nuclear power plant, small amounts of radioactive material are released in the form of solids, liquids, and gases. PNPP was designed and is operated in such a manner as to control and monitor these effluent releases. Effluents are controlled to ensure any radioactivity released to the environment is minimal and within regulatory limits. Effluent release programs include the operation of monitoring systems, in-plant sampling and analysis, quality assurance, and detailed procedures covering all aspects of effluent monitoring.

The liquid and gaseous radioactive waste treatment systems at PNPP are designed to collect and process these wastes in order to remove most of the radioactivity. Effluent monitoring systems are used to provide continuous indication of the radioactivity present and are sensitive enough to measure several orders of magnitude lower than the release limits. This monitoring instrumentation is equipped with alarms and indicators in the plant control room. The alarms are set to provide warnings to alert plant operators when radioactivity levels reach a small fraction of the limits. The waste streams are sampled and analyzed to identify and quantify the radionuclides being released to the environment.

Gaseous effluent release data is coupled with on-site meteorological data in order to calculate the dose to the general public. Devices are maintained at various locations around PNPP to continuously sample the air in the surrounding environment. Frequent samples of other environmental media are also taken to determine if any radioactive material deposition has occurred. The REMP is described in detail later in this report.

Generation of solid waste is controlled to identify opportunities for minimization. Limiting the amount of material taken into the plant and sorting material as radioactive or non-radioactive waste helps to lower the volume of radioactive solid waste generated. After vendor processing, solid waste is shipped to a licensed burial site.

REGULATORY LIMITS

The Nuclear Regulatory Commission has established limits for liquid and gaseous effluents that comply with:

Title 10 of the Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, Appendix B;

Title 10 of the Code of Federal Regulations, Part 50, Domestic Licensing of Production and Utilization Facilities, Appendix I;

Title 10 of the Code of Federal Regulations, Part 72.104, Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS

Title 40 of the Code of Federal Regulations, Part 190, Environmental Radiation Protection Standards for Nuclear Power Operations

These limits were incorporated into the PNPP Technical Specifications, and subsequently into the PNPP ODCM. The ODCM prescribes the maximum doses and dose rates due to radioactive effluents resulting from the operation of PNPP. These limits are defined in several ways to limit the overall impact on persons living near the plant. Since there are no other fuel sources near the PNPP, the 40CFR190 limits, described below, were not exceeded.

40CFR190 AND 10CFR72.104 – URANIUM FUEL CYCLE DOSE ASSESSMENT

The 40CFR190 limit for whole body dose is 25 mrem. Considering all sectors, the total whole body dose to a member of the general public was 0.25 mrem. This value was determined by summing the annual whole body doses from liquid and gaseous radioactive effluents and the annual gaseous C-14 dose. Since the direct radiation dose, as determined by TLD, was indistinguishable from natural background (Figure 8), it was not included in the calculation. More information regarding direct radiation dose and the Independent Spent Fuel Storage Installation (ISFSI), may be found on page 11.

LIQUID EFFLUENTS

The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to the concentrations specified in 10CFR20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases, as required by the ODCM. For dissolved or entrained noble gases, the concentration is limited to a concentration of 2.0E-04 µCi/ml. These values are the maximum effluent concentrations.

The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas shall be limited to the following:

During any calendar quarter:

Less than or equal to 1.5 mrem to the whole body, and

Less than or equal to 5 mrem to any organ

During any calendar year:

Less than or equal to 3 mrem to the whole body, and

Less than or equal to 10 mrem to any organ

GASEOUS EFFLUENTS

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary are governed by 10CFR20 and shall be limited to the following as required by the PNPP ODCM:

- Noble gases:

  Less than or equal to 500 mrem per year to the whole body, and

  Less than or equal to 3000 mrem per year to the skin

- Iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days:

  Less than or equal to 1500 mrem per year to any organ

Air dose due to noble gases to areas at and beyond the site boundary are governed by 10CFR50 Appendix I and shall be limited to the following:

- During any calendar quarter:

  Less than or equal to 5 mrad for gamma radiation, and

  Less than or equal to 10 mrad for beta radiation

- During any calendar year:

  Less than or equal to 10 mrad for gamma radiation, and

  Less than or equal to 20 mrad for beta radiation

- Dose to a member of the public from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

  Less than or equal to 7.5 mrem to any organ per any calendar quarter, and

  Less than or equal to 15 mrem to any organ per any calendar year

The PNPP ODCM does not contain a concentration limit for gaseous effluents. For this reason, effluent concentrations are not used to calculate maximum release rates for gaseous effluents.

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

During any calendar year:

Less than or equal to 25 mrem whole body dose;
Less than or equal to 75 mrem thyroid dose; and
Less than or equal to 25 mrem to any other critical organ.

RELEASE SUMMARY

Effluents are sampled and analyzed to identify both the type and quantity of radionuclides present. This information is combined with effluent path flow measurements to determine the composition, concentration, and dose contribution of the radioactive effluents.

40CFR190 and 10CFR72.104 Compliance

Since implementation of the Independent Spent Fuel Storage Installation (ISFSI) in 2011, eight TLDs have been placed on the outer perimeter fence of the cask storage area (located within the site boundary) to monitor dose due to direct radiation from the spent fuel source. Two particular TLDs, those closest to the nearest resident, numbers 18 (NNE corner) and 19 (ENE corner) of the ISFSI pad, were used to calculate direct dose to the nearest resident to determine compliance with the 40CFR190 and 10CFR72.104 limits.

The dose calculation was performed for using the location of the nearest residence, assuming they remain at the location all year, because that individual would incur the maximum potential dose from direct exposure. The TLD at REMP location 7 (refer to Figure 3), which is positioned in close proximity to the nearest resident, was also reviewed for significant changes in readings.

To determine the dose rate to the nearest resident and demonstrate compliance, the following equation was used:

$$D_1R_1^2=D_2R_2^2$$

Where:

D_1 = dose rate (mrem) at the pad perimeter

D_2 = dose rate (mrem) to nearest resident

R_1 = distance (feet) of nearest TLD location to max individual

R_2 = distance (feet) to nearest resident

The two nearest TLDs were chosen to estimate dose rates, but the higher of the two northeast corner TLDs was used for conservative estimates. The center of the pad was chosen as the highest point source.

Using the more conservative TLD result, the estimated dose to the nearest resident was 0.38 mrem/yr in 2016, not considering vegetation and shielding from buildings. In 2016, the calculated values were slightly higher, but statistically comparable to results of 2015. Unlike the whole body dose value of 0.25 mrem value presented on page 9, this dose rate of 0.38 mrem/yr is an estimate based on TLD readings to demonstrate compliance. The calculation confirms that direct dose from the ISFSI does not exceed the 40 CFR 190 limit of 25 mrem/year.

Review of the TLD results from 2016 have shown no detectable impact on dose to the public due to radiation from the ISFSI nor significant changes in results to the public since employment of the ISFSI.

Liquid Effluents

The PNPP liquid radioactive waste system is designed to collect and treat all radioactive liquid waste produced in the plant. The treatment process used for radioactive liquid waste depends on its physical and chemical properties. It is designed to reduce the concentration of radioactive material in the liquid by filtration to remove suspended solids and demineralization to remove dissolved solids. Normally, the effluent from the liquid radioactive waste system is returned to plant systems. To reduce the volume of water stored in plant systems, however, the processed liquid effluents may be discharged from the plant via a controlled release. In this case, effluent activity and dose calculations are performed prior to and after discharging this processed water to Lake Erie to ensure regulatory compliance and dose minimization principles are maintained.

Liquid radioactive waste system effluents may be intermittently released, which are considered to be "batch" releases. Table 1 provides information on the number and duration of these releases.

Table 1: Liquid Batch Releases

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Number of batch releases	25	2	2	0
Total time period for batch releases, min	6.40E+03	4.62E+02	4.53E+02	0.00E+00
Maximum time for a batch release, min	5.57E+02	2.32E+02	2.27E+02	0.00E+00
Average time period for a batch release, min	2.56E+02	2.31E+02	2.27E+02	0.00E+00
Minimum time for a batch release, min	2.20E+02	2.30E+02	2.26E+02	0.00E+00
Average quarterly flow rate, L/min	1.60E+05	1.80E+05	2.22E+05	0.00E+00

Table 2 provides information on the nuclide composition for the liquid radioactive effluent system releases. In each case, LLDs were met or below the required values. Table 2a provides information specific to radioactive effluent batch releases and Table 2b provides information specific to continuous radioactive effluent releases.

Table 2: Summation of All Liquid Effluent Releases

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, (%)
A. Fission and Activation Products					
1. Total Released, Ci (excluding tritium, gases, alpha)	**1.65E-02**	**2.69E-04**	**5.73E-05**	**2.32E-05**	1.00E+01
2 Average Diluted Concentration, µCi/mL *	9.85E-10	1.19E-11	2.11E-12	1.04E-12	
3. Percent of Applicable Limit, %	2.14E-02	3.24E-04	6.54E-05	3.47E-05	
B. Tritium					
1. Total Released, Ci	**8.47E+00**	**8.00E-01**	**1.04E+00**	**1.16E-07**	1.00E+01
2. Average Diluted Concentration, µCi/mL	5.06E-07	3.53E-08	3.82E-08	5.21E-15	
3. Percent of Applicable Limit, %	5.06E-02	3.53E-03	3.82E-03	5.21E-10	
C. Dissolved and Entrained Gases					
1. Total Released, Ci	**1.59E-05**	**0.00E+00**	**0.00E+00**	**0.00E+00**	1.00E+01
2. Average Diluted Concentration, µCi/mL	9.49E-13	0.00E+00	0.00E+00	0.00E+00	
3. Percent of Applicable Limit, %	4.75E-07	0.00E+00	0.00E+00	0.00E+00	
D. Gross Alpha Activity, Ci	**1.44E-06**	**1.39E-06**	**0.00E+00**	**0.00E+00**	1.00E+01
E. Waste Volume Released, Liters (prior to dilution)	3.55E+06	6.60E+05	6.67E+05	4.04E+05	
F. Dilution Water Volume Used, Liters	1.67E+10	2.27E+10	2.72E+10	2.23E+10	

*Average diluted concentrations are based on total volume of water released during quarter.

Table 2a: Summation of Batch Liquid Effluent Releases

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, (%)
A. Fission and Activation Products					
Total Released, Ci (excluding tritium, gases, alpha)	1.65E-02	7.66E-05	1.91E-05	<LLD	1.00E+01
B. Tritium					
Total Released, Ci	8.44E+00	8.00E-01	1.04E+00	<LLD	1.00E+01
C. Dissolved and Entrained Gases					
Total Released, Ci	1.59E-05	<LLD	<LLD	<LLD	1.00E+01
D. Gross Alpha Activity, Ci	<LLD	<LLD	<LLD	<LLD	1.00E+01
E. Waste Volume Released, Liters (prior to dilution)	3.28E+06	2.61E+05	2.63E+05	<LLD	

<LLD – Less than the lower limit of detection

Table 2b: Summation of Continuous Liquid Effluent Releases

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, (%)
A. Fission and Activation Products					
Total Released, Ci (excluding tritium, gases, alpha)	<LLD	1.92E-04	3.82E-05	2.32E-05	1.00E+01
B. Tritium					
Total Released, Ci	2.65E-02	<LLD	<LLD	1.16E-07	1.00E+01
C. Dissolved and Entrained Gases					
Total Released, Ci	<LLD	<LLD	<LLD	<LLD	1.00E+01
D. Gross Alpha Activity, Ci	1.44E-06	1.39E-06	<LLD	<LLD	1.00E+01
E. Waste Volume Released, Liters (prior to dilution)	2.64E+05	4.00E+05	4.04E+05	4.04E+05	

<LLD – Less than the lower limit of detection

Table 3 lists the total number of curies of each radionuclide present in liquid effluent releases for each quarter. In each case, the LLDs were either met or were below the levels required by the ODCM.

Table 3: Radioactive Liquid Effluent Nuclide Composition

	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Tritium	Ci	8.47E+00	8.00E-01	1.04E+00	1.16E-07	1.03E+01
Chromium-51	Ci	7.44E-05	<LLD	<LLD	<LLD	7.44E-05
Manganese-54	Ci	3.94E-03	2.20E-05	<LLD	<LLD	3.96E-03
Iron-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Iron-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	2.77E-03	3.34E-05	<LLD	<LLD	2.80E-03
Cobalt-60	Ci	9.57E-03	2.14E-04	5.34E-05	2.32E-05	9.86E-03
Zinc-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Strontium-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Lanthanum-140	Ci	<LLD	<LLD	3.88E-06	<LLD	3.88E-06
Molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Silver-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Tin-113	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Iodine-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	1.25E-04	<LLD	<LLD	<LLD	1.25E-04
Cerium-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cerium-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Krypton-88	Ci	1.59E-05	<LLD	<LLD	<LLD	1.59E-05
Xenon-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Gross Alpha	Ci	1.44E-06	1.39E-06	<LLD	<LLD	2.83E-06

<LLD – Less than the lower limit of detection

Gaseous Effluents

Gaseous effluents are made up of fission and activation gases, iodine, and particulate releases. Gaseous effluents from PNPP exit the plant via one of four effluent vents. Each of these four effluent vents contains radiation detectors that continuously monitor the air to ensure that the levels of radioactivity released are below regulatory limits. Samples are also collected and analyzed on a periodic basis to ensure regulatory compliance. Gaseous effluents released from PNPP are considered continuous and at ground level.

In 2013, PNPP increased the volume of air sampled for tritium in gaseous effluents, increasing the detection capability by a factor of 20, which lowered the LLD. With the increased sample volume, gaseous effluent tritium releases can be detected; whereas, in previous years the concentration was too dilute to measure. This has resulted in increased reported tritium releases over the last few years. A summation of all gaseous radioactive effluent releases is given in Table 4.

Table 4: Summation of All Gaseous Effluents

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error, %
A. Fission and Activation Products					
1. Total Released, Ci	**6.71E-01**	**0.00E+00**	**0.00E+00**	**0.00E+00**	1.00E+01
2. Average Release Rate, μCi/sec	8.53E-02	0.00E+00	0.00E+00	0.00E+00	
3. Percent of Applicable Limit, %	N/A	N/A	N/A	N/A	
B. Iodine					
1. Total Iodine-131 Released, Ci	**7.46E-05**	**0.00E+00**	**0.00E+00**	**0.00E+00**	1.00E+01
2. Average Release Rate, μCi/sec	9.49E-06	0.00E+00	0.00E+00	0.00E+00	
3. Percent of Applicable Limit, %	N/A	N/A	N/A	N/A	
C. Particulates with Half-Lives > 8 days					
1. Total Released, Ci	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	1.00E+01
2. Average Release Rate, μCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of Applicable Limit, %	N/A	N/A	N/A	N/A	
D. Alpha Activity, Ci	**3.01E-07**	**5.50E-07**	**2.31E-06**	**1.89E-06**	1.00E+01
E. Tritium					
1. Total Released, Ci	**1.16E+00**	**2.03E+00**	**1.59E+00**	**2.77E+00**	1.00E+01
2. Average Release Rate, μCi/sec	1.48E-01	2.58E-01	2.00E-01	3.49E-01	
3. Percent of Applicable Limit, %	N/A	N/A	N/A	N/A	
F. Carbon-14, Ci	**3.89E+00**	**4.58E+00**	**4.62E+00**	**4.76E+00**	1.00E+00

<LLD – Less than the lower limit of detection

N/A – Not Applicable, the ODCM does not have a release rate limit for gaseous effluents.

carbon-14 activity was calculated based on power production and using the EPRI-provided spreadsheet.

The radionuclide composition of all gaseous radioactive effluents for a continuous-mode, ground-level release is given in Table 5. In each case, LLDs were met or were below the levels required by the ODCM.

Table 5: Radioactive Gaseous Effluent Nuclide Composition

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
1. Fission and Activation Gases						
Tritium	Ci	1.16E+00	2.03E+00	1.59E+00	2.77E+00	7.55E+00
Krypton-85m	Ci	3.44E-02	<LLD	<LLD	<LLD	3.44E-02
Krypton-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Krypton-88	Ci	1.94E-02	<LLD	<LLD	<LLD	1.94E-02
Xenon-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Xenon-135m	Ci	1.12E-01	<LLD	<LLD	<LLD	1.12E-01
Xenon-135	Ci	5.04E-01	<LLD	<LLD	<LLD	5.04E-01
Xenon-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	**1.83E+00**	**2.03E+00**	**1.59E+00**	**2.77E+00**	**8.22E+00**
2. Iodine/Halogens						
Iodine-131	Ci	7.46E-05	<LLD	<LLD	<LLD	7.46E-05
Iodine-133	Ci	4.27E-04	<LLD	<LLD	<LLD	4.27E-04
Total for Period	Ci	**5.01E-04**	**<LLD**	**<LLD**	**<LLD**	**5.01E-04**
3. Particulates						
Chromium-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Manganese-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Iron-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Zinc-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cerium-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Cerium-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	**<LLD**	**<LLD**	**<LLD**	**<LLD**	**<LLD**

<LLD – Less than the lower limit of detection

Solid Waste

All solid radioactive waste from PNPP was processed and combined with waste from several other utilities by intermediate vendors (Energy Solutions and Erwin Resin Solutions). This waste was ultimately sent to Clive, Utah disposal facilities for burial.

Table 6: Solid Waste Shipped Offsite for Burial or Disposal

1. Type of Solid Waste Shipped	Volume (m^3)	Activity (Ci)	Est. Total Error (%)
a. Resins, Filters and Evaporator Bottoms	6.10E+01	5.27E+02	± 25
b. Dry Active Waste	5.11E+02	6.30E+00	± 25
c. Irradiated components, control rods, etc.	2.61E-01	7.40E+01	± 25
d. Other Waste	1.25E+00	3.67E-01	± 25

2. Estimate of Major [(1)] Nuclide Composition (by type of waste)	Radionuclide	Abundance (%)	Est. Total Error, (%)
a. Resins, Filters and Evaporator Bottoms	Mn-54	5.89	± 25
	Fe-55	23.18	
	Co-58	4.08	
	Co-60	58.73	
	Zn-65	7.15	
b. Dry Active Waste	Mn-54	2.62	± 25
	Fe-55	32.30	
	Co-60	61.84	
	Ni-63	1.03	
c. Irradiated Components, Control Rods, etc.	Fe-55	27.76	± 25
	Co-60	67.17	
	Ni-63	4.93	
d. Other Waste	Mn-54	2.43	± 25
	Fe-55	17.12	
	Co-60	75.77	
	Zn-65	3.58	

(1) – "Major" is defined as any individual radionuclide identified as >1% of the waste type abundance.

3. Solid Waste Disposition		
Number of Shipments	Mode of Transportation	Destination
1	FedEx Custom Critical	Energy Solutions Bear Creek Operations
41	Hittman Transport	Energy Solutions Bear Creek Operations
1	Hittman Transport	Energy Solutions, LLC, Clive Disposal Site Treatment Facility

METEOROLOGICAL DATA

The Meteorological Monitoring System at PNPP consists of a 60-meter tower equipped with two independent systems for measuring wind speed, wind direction, and temperature at both 10-meter and 60-meter heights. The tower also has instrumentation to measure dew point and barometric pressure. Data is logged from the tower through separate data loggers and transmitted to a common plant computer. This program compiles the data and calculates a variety of atmospheric parameters, communicates with the Meteorological Information Dose Assessment System (MIDAS), and sends data over communication links to the plant Control Room.

A detailed report of the monthly and annual operation of the PNPP Meteorological Monitoring Program is produced as a separate document that is retained in PNPP Records and available upon request. The report substantiates the quality and quantity of meteorological data collected in accordance with applicable regulatory guidance.

DOSE ASSESSMENT

The maximum concentration for any radioactive release is controlled by the limits set forth in Title 10 of the Code of Federal Regulations, Part 20 (10CFR20). Sampling, analyzing, processing, and monitoring the effluent streams ensures compliance with these concentration limits. Dose limit compliance is verified through periodic dose assessment calculations. Some dose calculations are conservatively performed for a hypothetical maximum individual who is assumed to reside on the site boundary at the highest potential dose location all year. This person, called the "maximum individual", would incur the maximum potential dose from direct exposure (air plus ground plus water), inhalation, and ingestion of water, milk, vegetation, and fish. Because no individual actually meets these criteria, the actual dose received by a real member of the public is significantly less than what is calculated for this hypothetical individual.

Dose calculations for this maximum individual at the site boundary are performed for two cases:

- Using data for a 360-degree radius around the plant site (land and water-based meteorological sectors); even though some of these sectors are over Lake Erie, which has no permanent residents;

- Considering only those sectors around the plant in which people reside (land-based meteorological sectors).

The calculated hypothetical, maximum individual dose values at the site boundary are provided in Table 7. This table considers all meteorological sectors around PNPP and provides whole body and worst-case organ-dose values.

Table 7: Maximum Yearly Individual Site Boundary Dose, Considering All Sectors

Type of Dose	Organ	Estimated Dose, (mrem)	Limit (mrem)	% of Limit
Liquid Effluent	Whole body	1.07E-03	3.0E+00	3.6E-02
	Liver	1.59E-03	1.0E+01	1.6E-02
Noble Gas	Air Dose Gamma – mrad	9.92E-04	1.0E+01	9.9E-03
	Air Dose Beta – mrad	7.18E-04	2.0E+01	3.6E-03
Noble Gas	Whole body	3.63E-04	5.0E+00	7.3E-03
	Skin	7.90E-04	1.5E+01	5.3E-03
Particulate & Iodine	Thyroid	4.22E-03	1.5E+01	2.8E-02
Carbon-14 *	Whole Body	2.52E-01	5.0E+00	5.0E+00

*C-14 dose calculated at nearest garden.

The hypothetical maximum dose within a 50-mile radius of site was calculated and is presented in Table 8. This table considers all meteorological sectors around PNPP and provides whole body and worst-case organ dose values.

Table 8: Population Yearly Dose, Considering All Sectors out to 50 miles

	Organ	Estimated Dose (person-rem)
Liquid Effluent	Whole body	1.7E-01
	Thyroid	8.1E-02
Gaseous Effluent	Whole body	9.1E-04
	Thyroid	9.6E-04

Table 9 provides the calculated hypothetical maximum site boundary dose values considering only the land-based sectors.

Table 9: Maximum Yearly Individual Site Boundary Dose (Only Land Sectors)

Type of Dose	Organ	Estimated Dose, (mrem)	Limit (mrem)	% of Limit
Liquid Effluent	Whole Body	1.07E-03	3.0E+00	3.6E-02
	Liver	1.59E-03	1.0E+01	1.6E-02
Noble Gas	Air Dose Gamma – mrad	1.88E-04	1.0E+01	1.9E-03
	Air Dose Beta – mrad	1.21E-04	2.0E+01	6.0E-04
Noble Gas	Whole Body	1.25E-05	5.0E+00	2.5E-04
	Skin	2.54E-05	1.5E+01	1.7E-04
Particulate & Iodine	Thyroid	4.70E-04	1.5E+01	3.1E-03
Carbon-14 *	Whole Body	2.52E-01	5.0E+00	5.0E+00

*C-14 dose calculated at nearest garden.

Other dose calculations are performed for a hypothetical individual assumed to be inside the site boundary for some specified amount of time. This person would receive the maximum dose during the time spent inside site boundary. Because no person actually meets the criteria established for these conservative calculations, the actual dose received by a member of the public is significantly less than what is calculated for this hypothetical individual. This dose is assessed relative to the offsite dose, and considers dilution, dispersion, and occupancy factors.

The highest hypothetical dose from liquid effluents to a member of the public inside the site boundary is to a person who is fishing on Lake Erie from the shore on PNPP property. The calculations assume that this person will spend 60 hours per year fishing, with a liquid dilution factor of 10. The ratio of the exposure pathway to the doses calculated for offsite locations yields the dose values shown in Table 10.

Table 10: Maximum Site Dose from Liquid Effluents

	Whole Body Dose, (mrem)	Organ Dose, (mrem)
First Quarter	6.5E-04	8.0E-04
Second Quarter	1.3E-05	1.6E-05
Third Quarter	2.8E-06	3.3E-06
Fourth Quarter	1.8E-06	2.1E-06
Annual	6.8E-04	8.1E-04

Although several cases were evaluated to determine the highest hypothetical dose from gaseous effluents to members of the public inside site boundary, the activity inside the site boundary with the highest dose potential is also shoreline fishing. The cases evaluated included traversing a public road within the site boundary, shoreline fishing (assuming fishing 60 hours per year), non-plant related training, car-pooling, and job interviews. The maximum on-site gaseous doses generated are shown in Table 11.

Table 11: Maximum Site Dose from Gaseous Effluents

	Whole Body Dose, (mrem)	Organ Dose, (mrem)
First Quarter	1.1E-04	2.5E-04
Second Quarter	6.9E-05	6.9E-05
Third Quarter	6.9E-05	6.9E-05
Fourth Quarter	1.6E-04	1.6E-04
Annual	4.0E-04	5.4E-04

An average whole body dose to individual members of the public at or beyond the site boundary is then determined by combining the dose from gaseous and liquid radiological effluents. The dose from gaseous radiological effluents is based upon the population that lives within 50 miles of PNPP. The dose from liquid radiological effluents is determined for the population that receives drinking water from intakes within 50 miles of PNPP. The results of this calculation are provided in Table 12.

Table 12: Average Individual Whole Body Dose

	Liquid Effluents, (mrem)	Gaseous Effluents, (mrem)
First Quarter	6.7E-05	3.8E-08
Second Quarter	2.0E-06	1.3E-07
Third Quarter	1.9E-06	9.2E-08
Fourth Quarter	4.2E-08	1.2E-07
Annual	7.1E-05	3.8E-07

CARBON-14 SUPPLEMENTAL INFORMATION

Carbon-14, with a half-life of 5730 years, is a naturally-occurring isotope of carbon produced by cosmic ray interactions in the atmosphere. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. Carbon-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally or from weapons testing. It is released primarily from Boiling Water Reactors through the Offgas system in the form of carbon dioxide (CO_2). The quantity of gaseous C-14 released to the environment can be estimated using a C-14 source term scaling factor based on power generation.

The U.S. Nuclear Regulatory Commission (NRC) requires an assessment of gaseous C-14 dose impact to a member of the public resulting from routine releases in radiological effluents. Prior to 2011, the industry did not estimate the dose impact of C-14 releases because the dose contribution had been considered negligible compared to the dose impact from effluent releases of noble gases, tritium, particulates and radioiodines. At PNPP, improvements over the years in effluent management practices and fuel performance have resulted in a decrease in the concentration and changes in the distribution of gaseous radionuclides released to the environment.

This report contains estimates of the gaseous C-14 radioactivity released and the resulting public dose resulting from this release. The calculation is performed using a spreadsheet provided by EPRI and is based on power production. This method for estimating C-14 released has been endorsed by the NRC. Because the dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste at PNPP is not required. Refer to Table 4, Table 7, and Table 9 for C-14 estimated release values and doses.

GROUNDWATER MONITORING PROGRAM

Based on the Environmental Resource Management hydrogeology study, 12 monitoring wells were recommended for the site. Since most groundwater flow drains north toward Lake Erie, the majority of wells are drilled north of the plant. A set of control wells was drilled south of the plant to assess a typical groundwater profile.

There are sets of three wells installed at four locations. Each set has a shallow well of approximately 25 feet, a mid-depth well of approximately 50 feet, and a deep well of approximately 75 feet. These three depths are designated A, B, and C, from shallowest to deepest, respectively.

PNPP has an Underdrain system to prevent groundwater hydrostatic pressure buildup on plant structures. The Underdrain system has two installed radiation monitors that assess the process stream prior to flowing into the Emergency Service Water system.

Refer to Figure 2 for locations of Groundwater Wells 1A through 4C and Underdrain Manholes 20 and 23. These wells and manholes encompass the groundwater monitoring locations at PNPP.

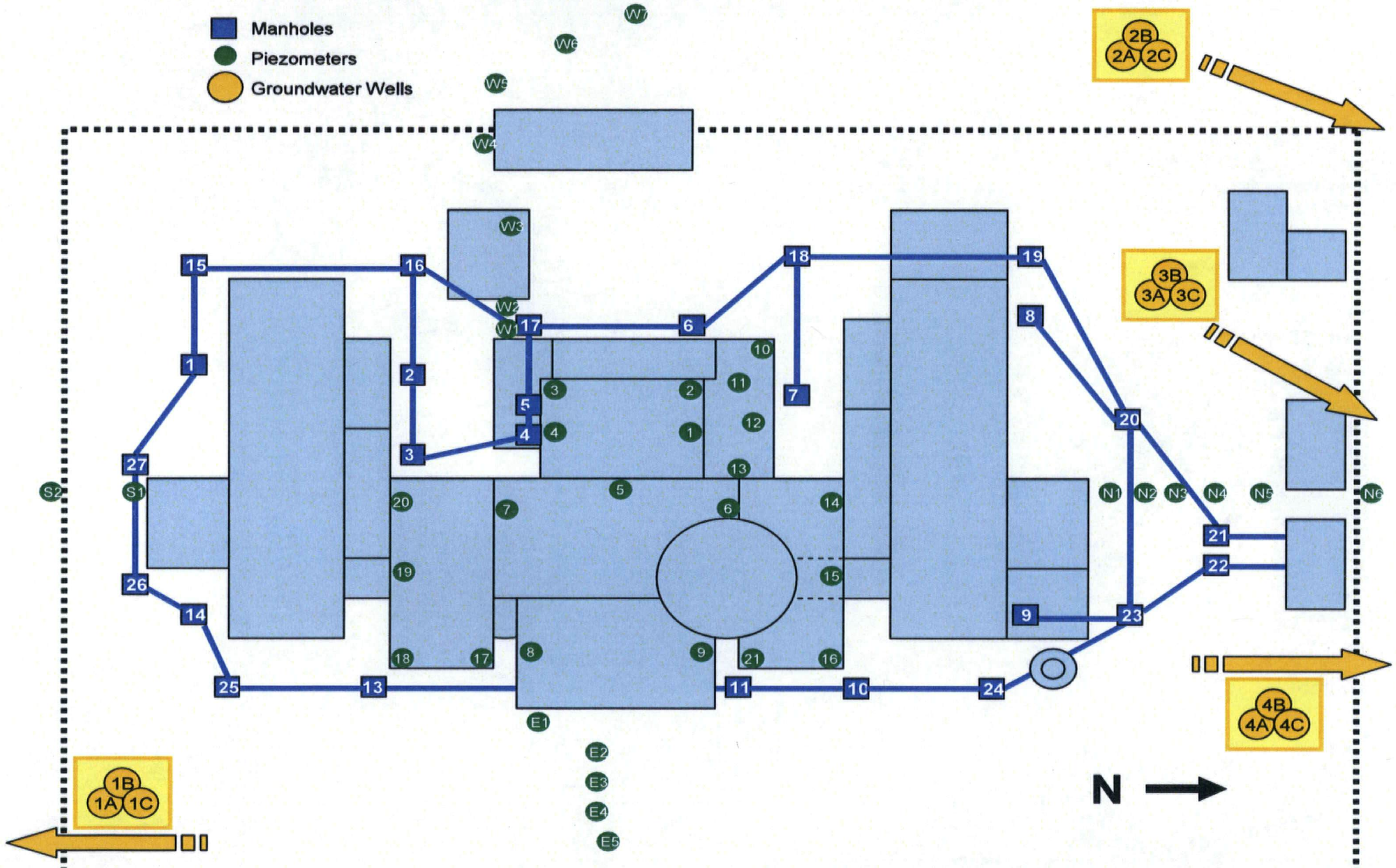

Figure 2: Underdrain System and Groundwater Monitoring Wells

The monitoring wells are sampled twice annually, in spring and fall. The samples are shipped to a vendor for gamma isotopic and tritium analysis. Any positive result less than 500 pCi/L is considered as background activity and not due to plant operations. The ODCM reporting level for tritium in an environmental water sample is 20,000 pCi/L. The tritium results of samples obtained in 2016 can be found in Table 13. There was no indication of any effluent releases via groundwater.

Table 13: Summary of Onsite Groundwater Samples

Monitoring Well	Spring H-3, pCi/L	Fall H-3, pCi/L
1A	<LLD	<LLD
1B	<LLD	<LLD
1C	<LLD	<LLD
2A	<LLD	<LLD
2B	<LLD	<LLD
2C	<LLD	<LLD
3A	223	<LLD
3B	<LLD	<LLD
3C	<LLD	<LLD
4A	<LLD	<LLD
4B	<LLD	<LLD
4C	<LLD	<LLD

The Underdrain manholes are sampled and analyzed quarterly for principal gamma emitters and tritium by PNPP personnel in accordance with site procedures. The tritium results of samples obtained in 2016 can be found in Table 14. These results have not been previously included in the annual report, but are considered part of the PNPP Groundwater Monitoring program. Results from the previous three years can be found in Attachment D.

Table 14: Summary of Underdrain Manhole Samples

Underdrain Manhole	Quarter 1 H-3, pCi/L	Quarter 2 H-3, pCi/L	Quarter 3 H-3, pCi/L	Quarter 4 H-3, pCi/L
20	<LLD	<LLD	NS	<LLD
23	<LLD	<LLD	NS	<LLD

NS – not sampled, insufficient water to obtain sample

RADIOLOGICAL ENVIRONMENTAL MONITORING

INTRODUCTION

The REMP was established at PNPP for several reasons. First, it verifies the adequacy of plant design and operation to control radioactive materials and limit effluent releases. Second, it assesses the radiological impact, if any, that the plant has had on the surrounding environment. Third, it ensures compliance with regulatory guidelines. The REMP is conducted in accordance with the PNPP Operating License, Appendix B, Technical Specifications, and the ODCM. The Nuclear Regulatory Commission (NRC) established the REMP requirements.

A variety of samples are collected as part of the PNPP REMP. The selection of sample types, locations, and collection frequency are based on many variables. Potential pathways for the transfer of radionuclides through the environment to humans, sample availability, local meteorology, population characteristics, land use, and NRC requirements are all factors.

To ensure that the REMP data is significant and valuable, detailed sampling methods and procedures are followed to ensure that samples are collected in the same manner and from the same locations each time. All samples are packaged on site and then shipped to an independent vendor laboratory for analysis. The vendor laboratory analyzes the samples and reports results to the PNPP Chemistry Unit staff, the Lake County General Health District, and the State of Ohio Department of Health. Additionally, the Lake County General Health District obtains monthly "split" samples of milk, water, and vegetation to permit an independent verification of PNPP's REMP.

SAMPLING LOCATIONS

REMP samples are collected at numerous locations, both on site and up to 17.1 miles away from the plant. Sampling locations are divided into two general categories: indicator and control. Indicator locations are relatively close to the plant that monitor for any environmental impact due to plant operations. Control locations are those that are unaffected by plant operation; they are a greater distance from the plant and in the least prevalent wind directions. Data obtained from the indicator locations are compared with data from the control locations. This comparison allows naturally-occurring background radiation to be taken into account when evaluating any radiological impact PNPP may have had on the environment. Table 15, Figure 3, Figure 4, and Figure 5 identify the PNPP REMP sampling locations.

Many REMP samples are collected in addition to those required by the PNPP ODCM. The ODCM requirements for each sample type are discussed in more detail later in the report.

Table 15: REMP Sampling Locations

Location #	Description	Miles	Direction	Media (1)
1	Chapel Road	3.2	ENE	TLD, AIP
2	Kanda Garden	2.0	ENE	Broadleaf Vegetation
3	Meteorological Tower	1.0	SE	TLD, AIP
4	Site Boundary	0.7	S	TLD, AIP
5	Quincy Substation	0.6	SW	TLD, AIP
6	Concord Service Center	11.1	SSW	TLD, AIP
7	Site Boundary	0.6	NE	TLD, AIP
8	Site Boundary	0.7	E	TLD
9	Site Boundary	0.7	ESE	TLD
10	Site Boundary	0.6	SSE	TLD
11	Parmly Rd. at Center Rd.	0.6	SSW	TLD
12	Site Boundary	0.6	WSW	TLD
13	Madison-on-the-Lake	4.6	ENE	TLD
14	Hubbard Rd.	4.9	E	TLD
15	Eagle St. Substation	5.1	ESE	TLD
16	Eubank Garden	0.9	S	Broadleaf Vegetation
19	Goodfield Dairy	9.2	S	Milk
20	Rainbow Farms	1.9	E	Broadleaf Vegetation
21	Hardy Rd. at Painesville Township Park	5.1	WSW	TLD
23	High St. Substation	7.9	WSW	TLD
24	St. Clair Ave. at Mentor Substation	15.0	SW	TLD
25	Offshore - PNPP discharge	2.0	NNW	Fish
29	River Rd.at Turney Rd.	4.5	SSE	TLD
30	Lane Rd.	4.9	SSW	TLD
31	Wood Rd. at River Rd.	4.9	SE	TLD
32	Offshore – Mentor on the Lake	15.8	WSW	Fish
33	River Rd. at Blair Rd.	4.7	S	TLD
34	PNPP Intake	0.2	NW	Surface Water
35	Site Boundary	0.7	E	TLD, AIP
36	Lake County Water Plant	4.0	WSW	TLD, Drinking Water

Location #	Description	Miles	Direction	Media (1)
37	Gerlica Farm	1.6	ENE	Broadleaf Vegetation
39	Painesville Purification Plant	8.3	W	Drinking Water
51	Rettger Milk Farm (cow)	9.7	S	Milk
53	Great Lakes Nuclear Services	0.7	WSW	TLD
54	Hale Rd. School	4.7	SW	TLD
55	Center Rd. behind soccer field	2.5	S	TLD
56	Madison High School	4.0	ESE	TLD
57	Perry High School	1.7	S	TLD
58	Antioch Rd.	0.8	ENE	TLD
59	Lake Shoreline at Green Rd.	4.0	ENE	Surface Water
60	Lake Shoreline at Perry Park	1.0	WSW	Surface Water
64	Northwest Drain Mouth	0.4	WNW	Sediment
66	Lake Shore, Metropolitan Park	1.4	NE	Sediment
70	H&H Farm Stand	17.1	SSW	Broadleaf Vegetation

(1) AIP = Air, Iodine and Particulate
TLD = Thermoluminescent Dosimeter

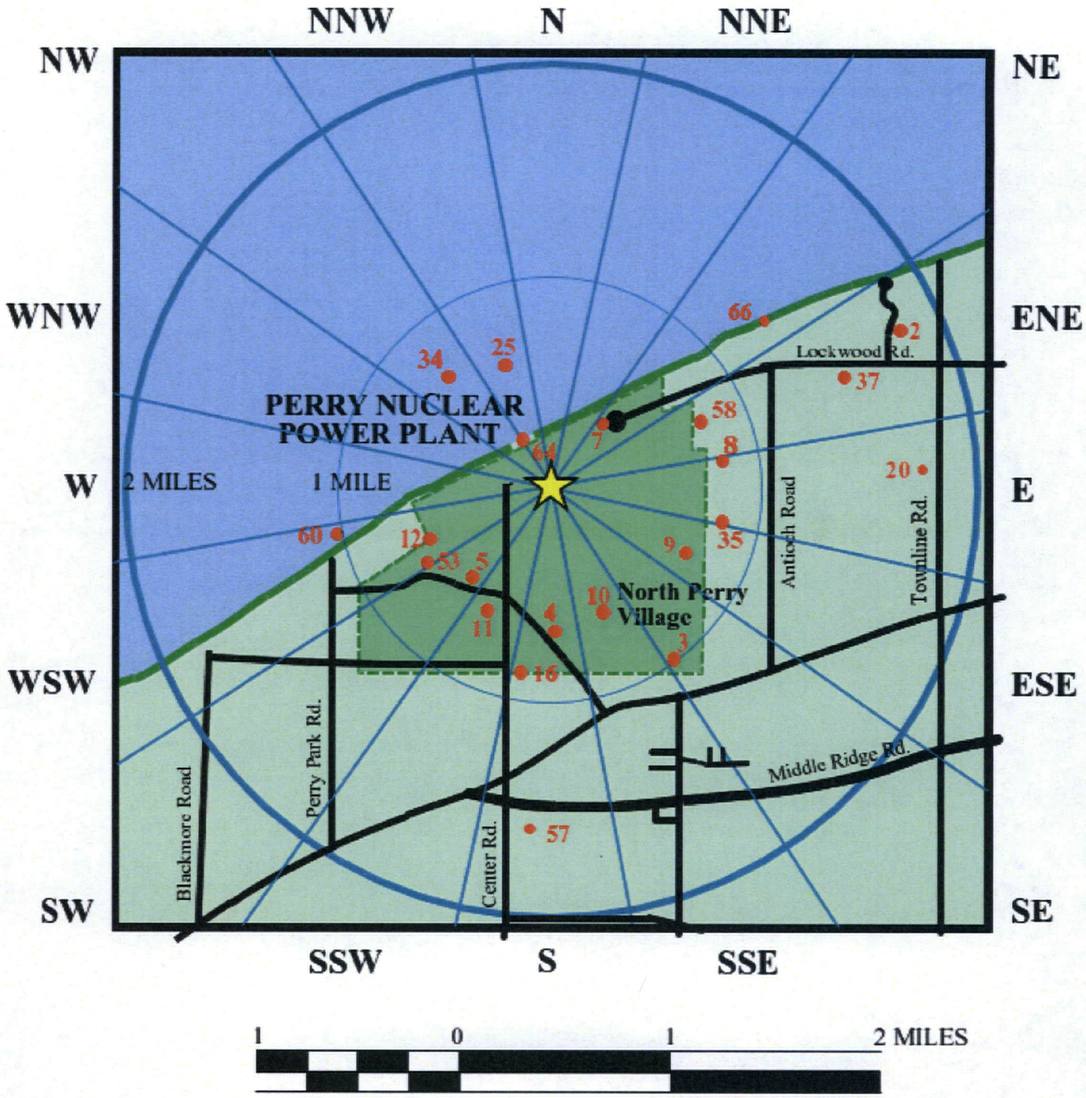

Figure 3: REMP Sampling Locations within Two Miles of the Plant Site

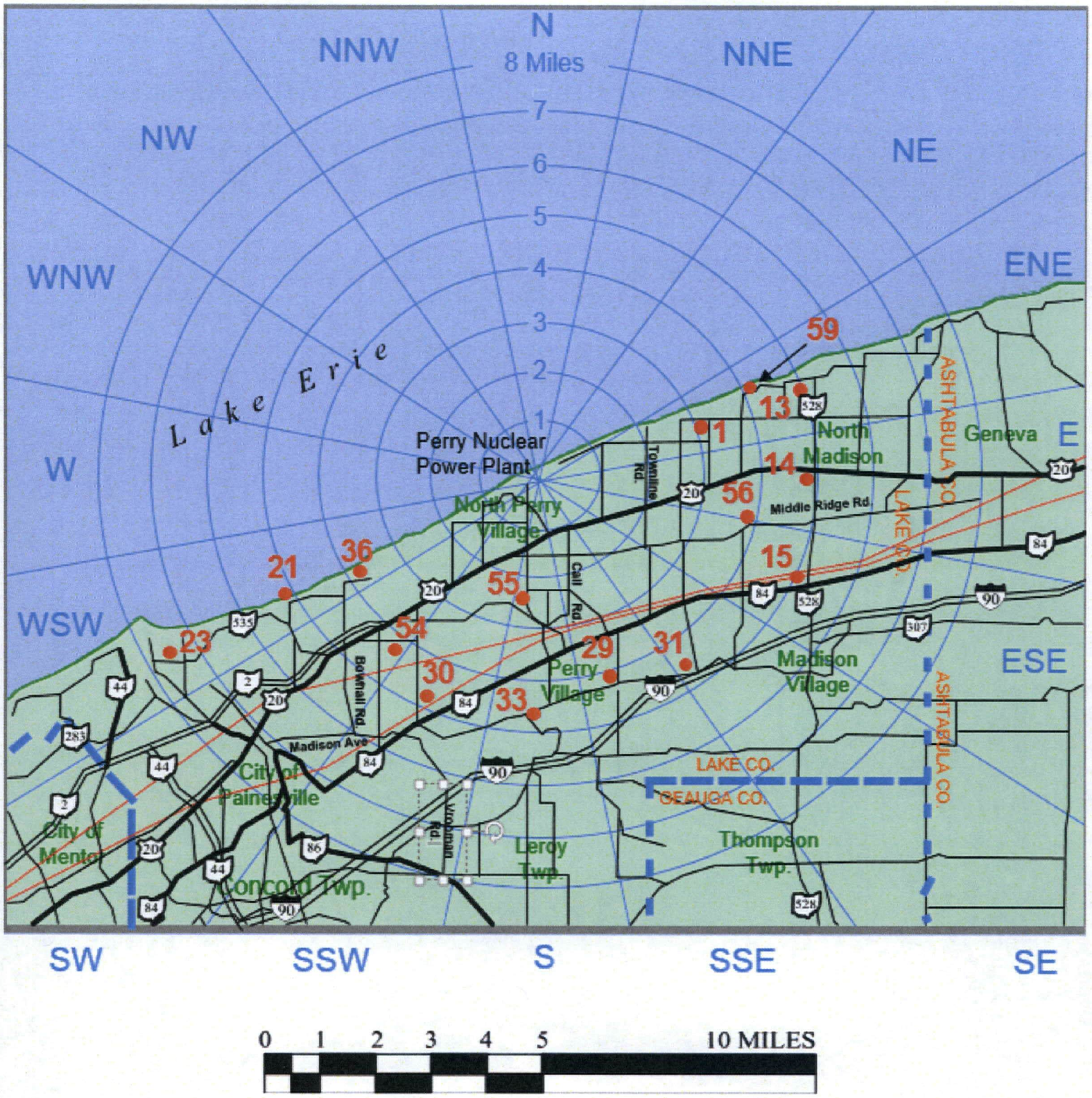

Figure 4: REMP Sampling Locations between Two and Eight Miles from the Plant Site

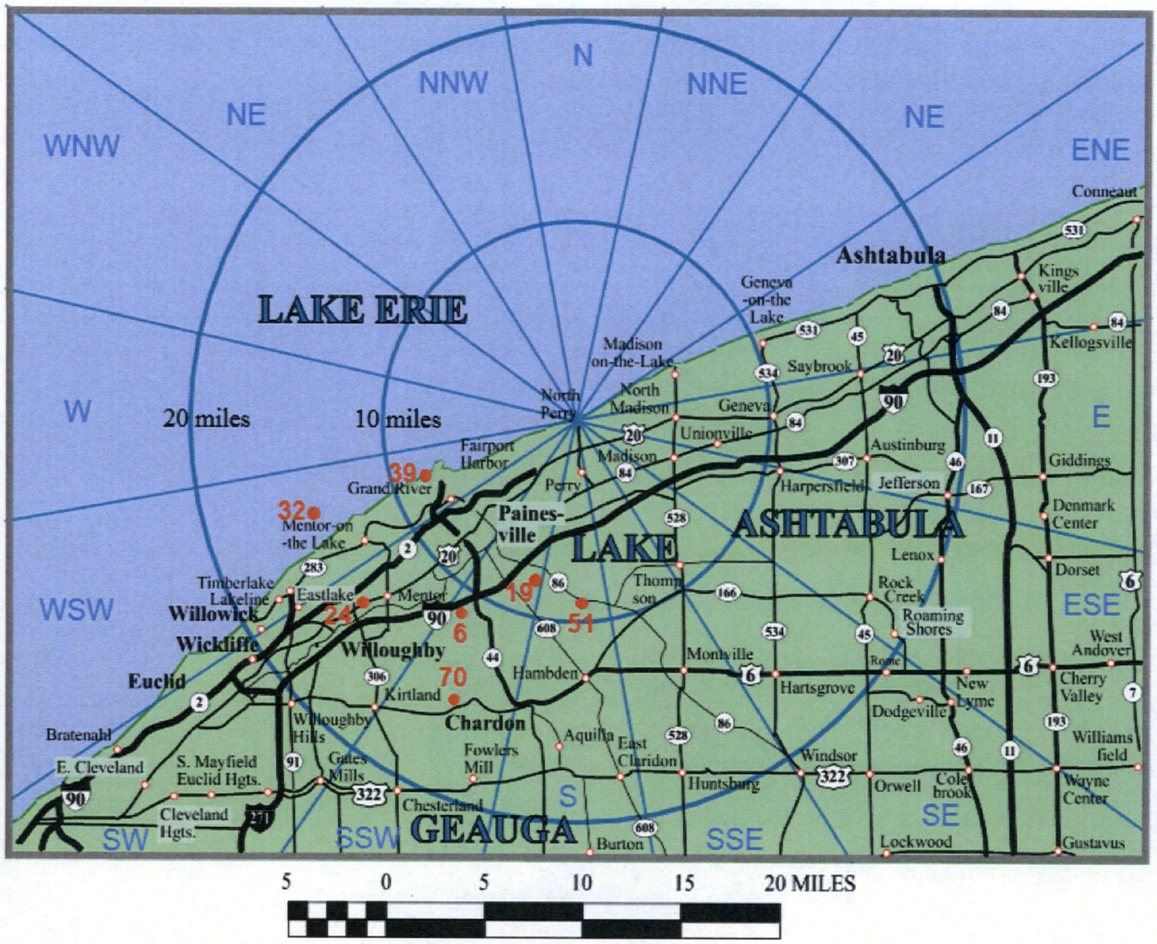

Figure 5: REMP Sampling Locations Greater Than Eight Miles from the Plant Site

SAMPLE ANALYSIS

When environmental samples are analyzed for radioactivity, several types of measurements are performed to provide information about the types of radiation and radionuclides present. The major analyses that are performed are discussed below.

Gross beta activity measures the total amount of beta-emitting radioactivity present in a sample and acts as a tool to identify samples that may require further analysis. Beta radiation may be released by many different radionuclides. Since beta-decay results in a continuous energy spectrum rather than the discrete energy levels, or "peaks", associated with gamma radiation, identification of specific beta-emitting nuclides is more difficult. Therefore, gross beta activity only indicates whether the sample contains normal or abnormal amounts of beta-emitting radioactivity; it does not specifically identify the radionuclides present.

Gamma spectral analysis provides more specific information than does the analysis for gross beta activity. Gamma spectral analysis identifies each radionuclide, and the amount of radioactivity, present in the sample emitting gamma radiation. Each radionuclide has a very specific "fingerprint" that allows for accurate identification and quantification.

Iodine activity analysis measures the amount of radioactive iodine present in a sample. Some media (e.g. air sample charcoal cartridges) are analyzed directly by gamma spectral analysis. With other media (e.g. milk), the radioiodines are extracted by chemical separation before being analyzed by gamma spectral analysis.

Tritium activity analysis measures the amount of the radionuclide tritium (H-3) present in a sample. Tritium is an isotope of hydrogen that emits low-energy beta particles. Tritium occurs naturally and is also man-made.

Gamma doses received by Thermoluminescent Dosimeters (TLD) while in the field are determined by a special laboratory procedure. Thermoluminescence is a process by which ionizing radiation interacts with the sensitive phosphor material in the TLD. Energy is trapped in the TLD material and can be stored for months or years. This capability provides a method to measure the dose received over long periods of time. The amount of energy that was stored in the TLD as a result of interaction with radiation is released by a controlled heating process and measured in a calibrated reading system. As the TLD is heated, the phosphor releases the stored energy as light. The amount of light is directly proportional to the amount of radiation to which the TLD was exposed. Table 16 provides a list of the analyses performed on environmental samples collected for the PNPP REMP.

The required REMP detection limits for samples is determined by sample media and the radionuclide that is being analyzed. The NRC has established LLDs for REMP sample analysis. These LLDs are listed in the PNPP ODCM. The vendor laboratory for REMP sample analysis has complied with these LLDs.

Table 16: REMP Sample Analyses

Type	Sample	Frequency	Analysis
Atmospheric Monitoring	Airborne Particulates	Weekly & Quarterly	Gross Beta Activity & Gamma Spectral Analysis
	Airborne Radioiodine	Weekly	Iodine-131
Terrestrial Monitoring	Milk	Monthly & Semi-Monthly when cows are on pasture	Gamma Spectral Analysis & Iodine-131
	Broadleaf Vegetation	Monthly during growing season	Gamma Spectral Analysis
Aquatic Monitoring	Water	Monthly	Gross Beta Activity & Gamma Spectral Analysis
		Quarterly	Tritium Activity
	Fish	Semi-Annually	Gamma Spectral Analysis
	Sediment	Semi-annually	Gamma Spectral Analysis
Direct Radiation Monitoring	TLD	Quarterly & Annually	Gamma Dose

SAMPLING PROGRAM

The contribution of radionuclides to the environment resulting from PNPP operation is assessed by comparing results from the environmental monitoring program with pre-operational data (i.e., data from before 1986), operational data from previous years, and control location data. The results for each sample type are discussed below and compared to historical data to determine if there are any observable trends. All results are expressed as concentrations. Refer to Appendix B, 2016 REMP Data Summary Reports for a detailed listing of these results. The NRC requires special reporting whenever sample analysis results exceed set limits. No values exceeded those limits.

PROGRAM CHANGES

The milking animal (goat) at location 18 died during the summer of 2015 and the owner chose not to replace the animal. This removes the one milk sample that was in the vicinity of the PNPP. There still remain no other milking animals in the required five-mile radius of PNPP to use as a replacement, however samples will continue to be collected and analyzed from locations 19 and 51.

ATMOSPHERIC MONITORING

Air

Air sampling is conducted to detect any increase in the concentration of airborne radionuclides. The PNPP REMP maintains an additional two air sampling locations above the five locations (four indicators and one control) required by the ODCM. Six of these locations are within four miles of the plant site; the seventh is used as a control location and is eleven miles from PNPP. Air sampling pumps draw continuous samples at a rate of approximately two cubic feet per minute. The air is drawn through glass fiber filters to collect particulate material and a charcoal cartridge to adsorb iodine. The samples are collected on a weekly basis, 52 weeks a year, from each of the seven air sampling stations.

Air samples are analyzed weekly for gross beta activity and radioiodine activity. The air samples are also analyzed by gamma spectral analysis quarterly. A total of 364 air particulate and 364 air radioiodine samples were collected and analyzed.

Gross beta activity was detected in 363 of the 364 air samples. The average gross beta activity for indicator locations was 0.024 pCi/m^3 and the controls was 0.024 pCi/m^3. Historically, the concentration of gross beta in air has been essentially identical at indicator and control locations. Figure 6 reflects the average gross beta activity for 2016 and previous years. All radioiodine samples were less than the lower limit of detection for iodine-131.

With the exception of naturally-occurring beryllium-7, no radionuclides were identified in the quarterly gamma spectral analysis above the LLD values.

Figure 6: Annual Average Gross Beta Activity, in Air

TERRESTRIAL MONITORING

Collecting and analyzing samples of milk and broadleaf vegetation provides data to assess the build-up of radionuclides that may be ingested by humans. The historical data from soil and vegetation samples provides information on atmospheric radionuclide deposition.

Milk

Samples of milk are collected once each month from November through March, and twice each month from April through October. Sampling is increased during the summer because animals usually feed outside on pasture rather than on stored feed. The PNPP REMP includes two milk locations.

Since the milk sampling locations do not meet the requirements of the ODCM (no milk-producing animals are located within the required distance vs. the two required), broadleaf vegetation sampling (discussed below) is performed. Milk is collected from the available locations to augment vegetation sampling.

Milk samples are analyzed by gamma spectral analysis for radioiodines and other radionuclides. A total of 38 milk samples were collected. With the exception of naturally-occurring potassium-40, no other radionuclides were detected.

Broadleaf Vegetation

Because there are not a sufficient number of milk sampling locations, the PNPP REMP samples broadleaf vegetation. These samples are collected monthly during the growing season from four gardens in the vicinity of PNPP and one control location 17.1 miles SSW from PNPP.

Fifty-nine samples were collected and analyzed by gamma spectral analysis. Four vegetation types were grown and collected: collard greens, turnip greens, Japanese greens, and Swiss chard. Beryllium-7 and potassium-40, both naturally-occurring radionuclides, were found in the samples. No other radionuclides were detected.

AQUATIC MONITORING

Radionuclides may be present in Lake Erie from many sources other than the PNPP. These sources include atmospheric deposition, run-off, soil erosion, and releases of radioactivity in liquid effluents from hospitals, universities, or other industrial facilities. These sources provide two forms of potential radiation exposure: external and internal. External exposure can occur from contact with water or shoreline sediments, while internal exposure can occur from either direct ingestion of radionuclides or the transfer of radionuclides through the aquatic food chain. Direct exposure can occur through ingestion by drinking the water, while the transfer via the aquatic food chain occurs from the eventual consumption of aquatic organisms, such as fish. PNPP samples water, shoreline sediments, and fish to monitor these pathways.

Water

Water is sampled from five locations along Lake Erie in the vicinity of the PNPP as required by the PNPP ODCM. Sixty water samples were collected and analyzed for gross beta activity and gamma spectral analysis. From these monthly samples, 20 quarterly composite samples were analyzed for tritium activity.

Gross beta activity was detected in 52 of the 60 samples collected. The indicator average gross beta activity was 1.8 pCi/L and the control average gross beta activity was also 1.8 pCi/L. Refer to Figure 7 for the annual average gross beta activity for both indicator and control locations. No tritium or gamma activity was detected.

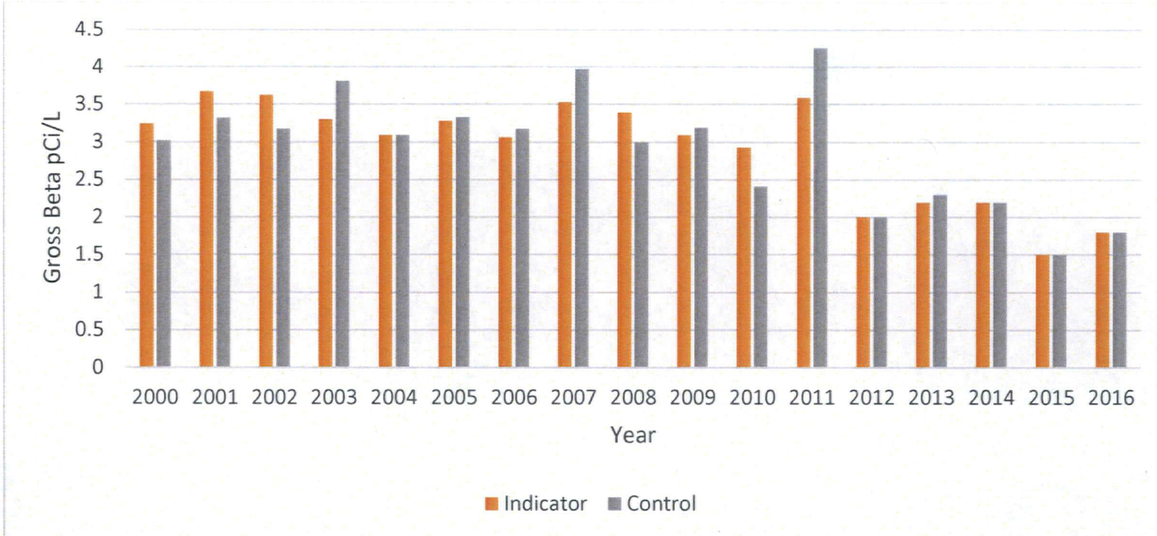

Figure 7: Annual Average Gross Beta Activity, in Water

Sediment

Sampling shoreline sediments provides an indication of the accumulation of particulate radionuclides which may lead to an external radiation source to fishermen and swimmers from shoreline exposure. Sediment was sampled from two locations.

Four sediment samples were collected and analyzed by gamma spectroscopy. The only radionuclide detected was naturally-occurring potassium-40.

Fish

Fish are analyzed primarily to quantify the radionuclide intake by humans and secondarily to serve as indicators of radioactivity in the aquatic ecosystem. Fish are collected from two locations annually during the fishing season as required by the ODCM. Important sport or commercial species are targeted, and only the fillets are sent to the laboratory for analysis.

Seventeen fish samples were collected and analyzed: 10 indicator and seven control samples. The species were smallmouth bass, white perch, walleye, channel catfish, freshwater drum, and yellow perch. Only naturally-occurring potassium-40 was detected in the samples.

DIRECT RADIATION MONITORING

Thermoluminescent Dosimeter (TLD)

Environmental radiation is measured directly at 27 locations around the PNPP site and at two control locations. The locations are positioned in two rings around the plant as well as at the site boundary. The inner ring is within a one-mile radius of the plant site; the outer ring is four to five miles from the plant. The control locations are over ten miles from the plant in the two least prevalent wind directions. Each location has three TLDs, two of which are changed quarterly and one that is changed annually.

A total of 261 TLDs were collected and analyzed. This includes 232 collected on a quarterly basis and 29 collected annually. Annual TLDs are not required per the ODCM and are used for supplemental data only.

The annual average dose for all indicator locations was 65.8 mrem and 61.8 mrem for the control locations.

The average quarterly dose for the indicator locations was 13.2 mrem, and 12.7 mrem for the control locations. Refer to Figure 8 for the average quarterly TLD dose rates for both indicator and control locations.

Figure 8: Average Quarterly TLD Dose

Conclusion

There are no discernable trends or increase in radiological parameters when comparing current monitoring results to pre-operational studies. Non-routine analyses were not required during this reporting period. There is no detectable radiological effect on the surrounding environment due to operation of the Perry Nuclear Power Plant.

INTER-LABORATORY CROSS-CHECK COMPARISON PROGRAM

Introduction

The purpose of the Inter-laboratory Cross-Check Comparison Program is to provide an independent check on the vendor laboratory's analytical procedures. Samples with a known concentration of specific radionuclides are provided to the vendor laboratory. The vendor laboratory measures and reports the concentration of specified radionuclides. The known values are then compared to the vendor results. Results consistently outside established acceptance criteria indicate a need to check instruments or procedures. Regulatory Guide 4.15 specifically requires that contractor laboratories that performed environmental measurement participate in the EPA's Environmental Radioactivity Laboratory Inter-Comparison Studies Program, or an equivalent program.

The EPA's program is no longer funded or offered. The reason that the EPA program was referenced in the regulatory guide is that the EPA standards were traceable to National Bureau of Standards (now known as National Institute Standard Technology). In response to this problem, the vendor lab incorporated a program offered by Environmental Resource Associates (ERA Company), which covered the same analyses in the same matrix at the same frequency as the EPA program. The ERA Company has received NIST accreditation as an equivalent program. In addition to comparison cross checks performed with the ERA Company, the vendor laboratory routinely monitors the quality of their analyses by:

- Analyzing "spiked" samples (samples with a specific quantity of radioactive material present in them) and

- Participating in the Department of Energy's Mixed Analyte Performance Program (MAPEP).

See Appendix A, for the vendor Inter-Laboratory Cross-Check Comparison Program Results.

LAND USE CENSUS

Introduction

Each year a Land Use Census is conducted to identify the locations of the nearest milking animal, garden (of greater than 500 square feet), and residence in each of the meteorological sectors that is over land. Information gathered during the Land Use Census is used for off-site dose assessment and to update sampling locations for the REMP. The census is conducted by traveling all roads within a five-mile radius of the plant site and recording and mapping the locations of the nearest resident, milk animal, and vegetable garden. The Land Use Census was conducted in August, 2016. The census identified the garden, residence and milking animal locations identified in Tables 17 and 18 and depicted in Figure 9. Note that the W, WNW, NW, NNW, N, and NNE sectors extend over Lake Erie and are not included in the survey.

Discussions and Results

In general, the predominant land use within the census area continues to be rural/ agricultural. In recent years, however, it has been noted that tracts of land once used for farming are now being developed as mini-industrial parks and residential housing. This is reflected in the loss of available milking animals within a five-mile radius of PNPP to support the REMP.

There is one change from the 2015 Land Use Census. In the summer of 2015, the nearest milking animal died. The nearest milking animal to the PNPP is now located outside of the five mile radius. REMP location 19, Goodfield Dairy, 9.2 miles in the south sector is the closest location. Refer to Figure 5 for the map identification.

Table 17 identifies the nearest residences, by sector, to the PNPP. There were no changes from last year's Land Use Census.

Table 17: Nearest Residence, By Sector

Sector	Location Address	Miles from PNPP	Map Locator Number
NE	4384 Lockwood	0.7	1
ENE	4602 Lockwood	1.1	2
E	2626 Antioch	1.0	3
ESE	2836 Antioch	1.1	4
SE	4495 North Ridge	1.3	5
SSE	3119 Parmly	0.9	6
S	3121 Center	0.9	7
SSW	3850 Clark	0.9	8
SW	2997 Perry Park	1.2	9
WSW	3460 Parmly	1.0	10

Table 18 lists the nearest gardens by sector to the PNPP consisting of at least 500 square feet. There were no changes from last year's Land Use Census.

Table 18: Nearest Garden, By Sector

Sector	Location Address	Miles from PNPP	Map Locator Number
NE	2340 Hemlock	0.9	11
ENE	4630 Lockwood	1.1	12
E	2626 Antioch	1.0	3
ESE	2836 Antioch	1.1	4
SE	4671 North Ridge	1.3	15
SSE	4225 Red Mill Valley	1.1	16
S	3121 Center Rd.	0.9	7
SSW	3431 Perry Park	1.9	17
SW	3021 Perry Park	1.3	13
WSW	3460 Parmly	1.0	14

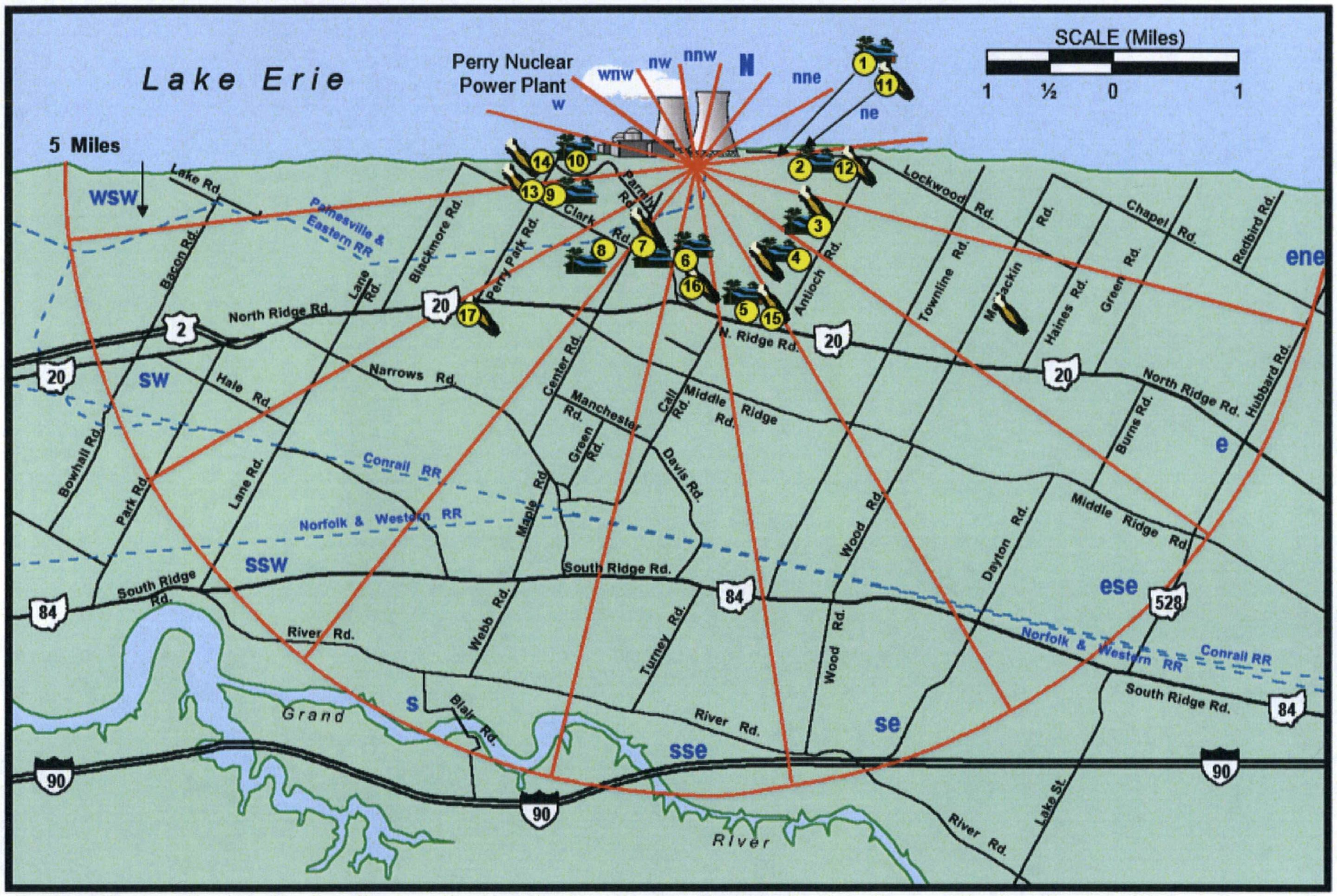

Figure 9: Land Use Census Map

CLAM/MUSSEL MONITORING

INTRODUCTION

Sampling for macro-invertebrates (clams and mussels) has been conducted in Lake Erie in the vicinity of PNPP since 1971. The clam/mussel program currently focuses on two species: Corbicula fluminea (Asiatic clam) and Dreissena polymorpha (zebra mussel).

CORBICULA PROGRAM

Monitoring for Corbicula was initiated in response to an NRC bulletin and concerns of the Atomic Safety and Licensing Board. The monitoring was done as part of the Environmental Protection Plan (Operating License, Appendix B). The program consists of visually inspecting the raw water systems, when they are opened for maintenance. The purpose of this program is to detect Corbicula, should it appear at PNPP.

Monitoring

Samples were collected from raw water systems and examined for shells and fragments. In addition to sample collections, plant components that use raw water are inspected when opened for maintenance or repair. Sample collection/inspection dates are listed in Table 19.

Table 19: Corbicula Monitoring

Date	Sample Location
01/25/2016	LP Condenser "C" Outlet Waterbox
01/27/2016	HP Condenser "C"
02/24/2016	P54 – Fire Protection
03/15/2016	ESW Strainer
06/09/2016	P54 – Fire Protection
07/01/2016	N34 – Turbine Lube Oil Cooler "B"
07/08/2016	N34 – Turbine Lube Oil Cooler "A"
07/31/2016	P45 – ESW "A" Discharge Strainer
08/11/2016	N34 – Turbine Lube Oil Cooler "B"
08/11/2016	N34 – Turbine Lube Oil Cooler "A"
08/11/2016	N34 – Turbine Lube Oil Cooler "B"
08/18/2016	N34 – Turbine Lube Oil Cooler "A"
09/03/2016	N34 – Turbine Lube Oil Cooler "A"
10/09/2016	N34 – Turbine Lube Oil Cooler "B"
12/21/2016	P54 – Fire Protection

Conclusions

Although Corbicula have been detected at the Eastlake Power Plant, it has not been demonstrated that their presence has created any operational problems at PNPP. As in the past, the monitoring program did not identify Corbicula in any sample collected.

DREISSENA PROGRAM

Dreissena, or zebra mussels, were first discovered at PNPP in September 1988. The initial collection of 19 mussels was made as part of the Corbicula monitoring program. The Dreissena monitoring program began in 1989 with monitoring and testing. The current control program was designed and implemented in 1990.

Monitoring

In addition to visually inspecting the plant's raw water systems when they are opened for maintenance or repair, monitoring methods include the use of commercial divers and side-stream monitors. Commercial divers monitor mussel infestation during the inspection of forebays, basins, and the intake and discharge structures. Divers have also been used to take underwater videos of the water basins and intake tunnel. Side-stream monitors are flow-through containers that receive water diverted from plant systems and are set up at two in-plant locations during the mussel season.

Treatment

Chemicals used for mussel control included sodium hypochlorite and a commercial molluscicide. The chlorine is intermittently injected into the plant service water, emergency service water, and circulating water systems by metering sodium hypochlorite into each system's influent. Sodium bisulfite is added at the plant discharge structure for dechlorination prior to return into Lake Erie.

The OEPA has approved the use of a commercial molluscicide. The chemical selected for use at the PNPP was alkyl-dimethyl-benzyl-ammonium chloride. Treatment was applied once in 2016. The active ingredients were detoxified by adsorption using bentonite clay prior to discharge into Lake Erie.

Results

The effectiveness of the intermittent biocide treatment has been determined in several ways. First, visual inspections of raw water system components are conducted when systems are open during maintenance or repair. In addition, settlement monitors were inspected for new settlement. No live settlement has been found in any plant component to date.

The effectiveness of the application of the commercial molluscicide was measured by observing mortality of mussels placed in a flow-through container installed in plant service water and subjected to the chemical treatment. The observed mortality rate utilizing the flow-through container was 100%. To date, PNPP has had no significant problems related to zebra mussels.

Conclusions

PNPP has taken the approach that the best method for avoiding problems with zebra mussels is preventive treatment of plant water systems. The current program of monitoring and chemical treatment will be continued to minimize the possibility that PNPP will experience future problems due to zebra mussels.

HERBICIDE APPLICATIONS

Herbicides are used sparingly on the PNPP site. A request must be made to and approved by the PNPP Chemistry Unit prior to spraying to ensure that only approved chemicals are used, and only in approved areas. Each application was in compliance with the OEPA rules and regulations. There were no adverse environmental impacts observed during weekly site environmental inspections as a result of these applications. The herbicides used were Mojave, Bromicil, and Glystar Plus. For each application, the type of weed to be treated dictated the herbicide and concentration to be used. Table 20 provides quantity for each chemical used. The quantity represents the amount of herbicide applied, prior to any dilution.

Table 20: Herbicide Applications

Chemical	Amount
Mojave	196 lb.
Bromicil	50 lb.
Glystar Plus	375 gal.

SPECIAL REPORTS

NPDES PERMIT EXCEEDANCES

The OEPA issues the National Pollutant Discharge Elimination System (NPDES) permit. It establishes monitoring requirements and limits for discharges from the PNPP. It also specifies the locations from which the plant is allowed to discharge.

There were no NPDES issues identified at PNPP in 2016.

ENVIRONMENTAL PROTECTION PLAN

The Environmental Protection Plan (EPP), which is Appendix B of the PNPP Operating License, requires a non-radiological environmental monitoring and reporting program be established at the PNPP.

There were no non-compliance reports submitted in 2016.

ENVIRONMENTAL IMPACT EVALUATIONS

All proposed changes to the PNPP design or operation, as well as tests or experiments, must be evaluated for potential environmental impacts in accordance with the EPP and administrative quality assurance procedures. There were no proposed changes to the facility or programs that if performed could have resulted in an adverse environmental impact in 2016.

Appendix A
Inter-Laboratory Cross Check Comparison Program Results

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APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

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

January, 2016 through December, 2016

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January, 2016 through December, 2016

Appendix A

Interlaboratory Comparison Program Results

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

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

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

Table A-2 lists results for thermoluminescent dosimeters (TLDs), via irradiation and evaluation by the University of Wisconsin-Madison Radiation Calibration Laboratory at the University of Wisconsin Medical Radiation Research Center.

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

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

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

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

Results in Table A-7 were obtained through participation in the MRAD PT Study Proficiency Testing Program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurement Laboratory Quality Assessment Program (EML).

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

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

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

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

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

[b] Laboratory limit.

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

RAD study

Lab Code	Date	Concentration (pCi/L)				
		Analysis	Laboratory Result	ERA Result	Control Limits	Acceptance
ERW-1392	4/4/2016	Sr-89	43.5 ± 4.3	48.2	37.8 - 55.6	Pass
ERW-1392	4/4/2016	Sr-90	27.5 ± 1.9	28.5	20.7 - 33.1	Pass
ERW-1394 [b]	4/4/2016	Ba-133	65.2 ± 3.8	58.8	48.7 - 64.9	Fail
ERW-1394 [c]	4/4/2016	Ba-133	57.8 ± 5.3	58.8	48.7 - 64.9	Pass
ERW-1394	4/4/2016	Cs-134	43.7 ± 3.0	43.3	34.6 - 47.6	Pass
ERW-1394	4/4/2016	Cs-137	86.1 ± 5.3	78.4	70.6 - 88.9	Pass
ERW-1394	4/4/2016	Co-60	108 ± 44	102	91.8 - 114	Pass
ERW-1394	4/4/2016	Zn-65	240 ± 13	214	193 - 251	Pass
ERW-1397	4/4/2016	Gr. Alpha	52.0 ± 2.2	62.7	32.9 - 77.8	Pass
ERW-1397	4/4/2016	Gr. Beta	33.9 ± 1.2	39.2	26.0 - 46.7	Pass
ERW-1400	4/4/2016	I-131	24.7 ± 0.6	26.6	22.1 - 31.3	Pass
ERW-1402	4/4/2016	Ra-226	15.6 ± 0.5	15.2	11.3 - 17.4	Pass
ERW-1402	4/4/2016	Ra-228	5.28 ± 0.76	5.19	3.12 - 6.93	Pass
ERW-1403	4/4/2016	Uranium	4.02 ± 0.42	4.64	3.39 - 5.68	Pass
ERW-1405	4/4/2016	H-3	8,150 ± 270	7,840	6,790 - 8,620	Pass
SPW-2845	7/7/2015	Ba-133	60.3 ± 5.7	64.7	53.9 - 71.2	Pass
SPW-2845	7/7/2015	Cs-134	48.8 ± 9.3	50.1	40.3 - 55.1	Pass
SPW-2845	7/7/2015	Cs-137	101 ± 8	89.8	80.8 - 101	Pass
SPW-2845	7/7/2015	Co-60	65.1 ± 5.8	59.9	53.9 - 68.4	Pass
SPW-2845	7/7/2015	Zn-65	288 ± 29	265	238 - 310	Pass
ERW-3485	7/11/2016	Sr-89	43.3 ± 6.5	53.3	42.3 - 60.9	Pass
ERW-3485	7/11/2016	Sr-90	39.0 ± 2.8	39.2	28.8 - 45.1	Pass
ERW-3487	7/11/2016	Ba-133	83.3 ± 4.9	82.9	69.7 - 91.2	Pass
ERW-3487	7/11/2016	Cs-134	62.5 ± 4.4	65.3	53.1 - 71.8	Pass
ERW-3487	7/11/2016	Cs-137	98.1 ± 5.6	95.2	85.7 - 107	Pass
ERW-3487	7/11/2016	Co-60	122 ± 5	117	105 - 131	Pass
ERW-3487	7/11/2016	Zn-65	124 ± 9	113	102 - 134	Pass
ERW-3490	7/11/2016	Gr. Alpha	46.6 ± 2.2	48.1	25.0 - 60.5	Pass
ERW-3490	7/11/2016	Gr. Beta	26.8 ± 1.1	28.6	18.2 - 36.4	Pass
ERW-3492	7/11/2016	I-131	23.7 ± 1.0	24.9	20.7 - 29.5	Pass
ERW-3493	7/11/2016	Ra-226	12.9 ± 0.4	12.3	9.2 - 14.2	Pass
ERW-3493	7/11/2016	Ra-228	5.8 ± 0.8	5.8	3.5 - 7.6	Pass
ERW-3493	7/11/2016	Uranium	32.8 ± 0.8	25.2	28.4 - 39.3	Pass
ERW-3495	7/11/2016	H-3	12,400 ± 334	12,400	10,800 - 13,600	Pass

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

[b] No reason determined for failure of Ba-133 result.

[c] The result of reanalysis (Compare to original result, footnoted "b" above).

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

				mrem		
Lab Code	Irradiation Date	Description	Delivered Dose	Reported Dose	Performance [c] Quotient (P)	Acceptance [d]
Environmental, Inc.		Group 1				
2016-1	10/7/2016	Spike 1	135.0	148.3	0.10	
2016-1	10/7/2016	Spike 2	135.0	144.3	0.07	
2016-1	10/7/2016	Spike 3	135.0	133.2	-0.01	
2016-1	10/7/2016	Spike 4	135.0	139.6	0.03	
2016-1	10/7/2016	Spike 5	135.0	128.4	-0.05	
2016-1	10/7/2016	Spike 6	135.0	123.9	-0.08	
2016-1	10/7/2016	Spike 7	135.0	124.0	-0.08	
2016-1	10/7/2016	Spike 8	135.0	121.5	-0.10	
2016-1	10/7/2016	Spike 9	135.0	148.3	0.10	
2016-1	10/7/2016	Spike 10	135.0	126.8	-0.06	
2016-1	10/7/2016	Spike 11	135.0	123.3	-0.09	
2016-1	10/7/2016	Spike 12	135.0	137.9	0.02	
2016-1	10/7/2016	Spike 13	135.0	126.0	-0.07	
2016-1	10/7/2016	Spike 14	135.0	127.2	-0.06	
2016-1	10/7/2016	Spike 15	135.0	144.5	0.07	
2016-1	10/7/2016	Spike 16	135.0	140.5	0.04	
2016-1	10/7/2016	Spike 17	135.0	146.0	0.08	
2016-1	10/7/2016	Spike 18	135.0	127.7	-0.05	
2016-1	10/7/2016	Spike 19	135.0	146.8	0.09	
2016-1	10/7/2016	Spike 20	135.0	122.6	-0.09	
2016-1	10/7/2016	Spike 21	135.0	108.6	-0.20	
2016-1	10/7/2016	Spike 22	135.0	119.6	-0.11	
2016-1	10/7/2016	Spike 23	135.0	135.1	0.00	
2016-1	10/7/2016	Spike 24	135.0	116.2	-0.14	
2016-1	10/7/2016	Spike 25	135.0	118.9	-0.12	
2016-1	10/7/2016	Spike 26	135.0	128.5	-0.05	
2016-1	10/7/2016	Spike 27	135.0	115.6	-0.14	
2016-1	10/7/2016	Spike 28	135.0	126.4	-0.06	
2016-1	10/7/2016	Spike 29	135.0	115.0	-0.15	
2016-1	10/7/2016	Spike 30	135.0	147.3	0.09	
Mean (Spike 1-30)				130.4	0.03	Pass
Standard Deviation (Spike 1-30)				11.5	0.09	Pass

[a] Table A-2 assumes 1 roentgen = 1 rem (NRC -Health Physics Questions and Answers 10 CFR Part 20 - Question 96 - Page Last Reviewed/Updated Thursday, October 01, 2015).

[b] 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.

[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 mean of the P values, nor the standard deviation of the P values exceed 0.15.

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

				mrem		
Lab Code	Irradiation Date	Description	Delivered Dose	Reported Dose	Performance Quotient (P) [c]	Acceptance [d]
Environmental, Inc.		Group 2				
2016-2	10/7/2016	Spike 31	87.0	83.0	-0.05	
2016-2	10/7/2016	Spike 32	87.0	88.3	0.01	
2016-2	10/7/2016	Spike 33	87.0	83.1	-0.04	
2016-2	10/7/2016	Spike 34	87.0	81.4	-0.06	
2016-2	10/7/2016	Spike 35	87.0	78.9	-0.09	
2016-2	10/7/2016	Spike 36	87.0	80.3	-0.08	
2016-2	10/7/2016	Spike 37	87.0	101.1	0.16	
2016-2	10/7/2016	Spike 38	87.0	78.3	-0.10	
2016-2	10/7/2016	Spike 39	87.0	86.6	0.00	
2016-2	10/7/2016	Spike 40	87.0	81.8	-0.06	
2016-2	10/7/2016	Spike 41	87.0	84.8	-0.03	
2016-2	10/7/2016	Spike 42	87.0	79.9	-0.08	
2016-2	10/7/2016	Spike 43	87.0	80.8	-0.07	
2016-2	10/7/2016	Spike 44	87.0	80.2	-0.08	
2016-2	10/7/2016	Spike 45	87.0	82.7	-0.05	
2016-2	10/7/2016	Spike 46	87.0	104.0	0.20	
2016-2	10/7/2016	Spike 47	87.0	86.1	-0.01	
2016-2	10/7/2016	Spike 48	87.0	104.0	0.20	
2016-2	10/7/2016	Spike 49	87.0	86.1	-0.01	
2016-2	10/7/2016	Spike 50	87.0	90.8	0.04	
2016-2	10/7/2016	Spike 51	87.0	85.7	-0.01	
2016-2	10/7/2016	Spike 52	87.0	86.5	-0.01	
2016-2	10/7/2016	Spike 53	87.0	86.4	-0.01	
2016-2	10/7/2016	Spike 54	87.0	92.6	0.06	
2016-2	10/7/2016	Spike 55	87.0	88.6	0.02	
2016-2	10/7/2016	Spike 56	87.0	78.9	-0.09	
2016-2	10/7/2016	Spike 57	87.0	82.6	-0.05	
2016-2	10/7/2016	Spike 58	87.0	80.6	-0.07	
2016-2	10/7/2016	Spike 59	87.0	89.9	0.03	
2016-2	10/7/2016	Spike 60	87.0	85.0	-0.02	
Mean (Spike 31-60)				86.0	0.01	Pass
Standard Deviation (Spike 31-60)				6.9	0.08	Pass

[a] Table A-2 assumes 1 roentgen = 1 rem (NRC -Health Physics Questions and Answers 10 CFR Part 20 - Question 96 - Page Last Reviewed/Updated Thursday, October 01, 2015).

[b] 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.

[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 mean of the P values, nor the standard deviation of the P values exceed 0.15.

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

Lab Code [b]	Date	Concentration [a]				
		Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-290	1/21/2016	Sr-90	38.6 ± 1.5	37.3	22.4 - 52.2	Pass
SPW-292	1/21/2016	Sr-90	35.8 ± 1.6	37.3	22.4 - 52.2	Pass
SPW-294	1/21/2016	C-14	4,689 ± 18	4,735	2,841 - 6,629	Pass
SPW-414	2/1/2016	Ra-228	18.4 ± 2.2	17.7	10.6 - 24.8	Pass
W-020416	2/4/2016	Gr. Alpha	20.8 ± 0.4	20.1	12.0 - 28.1	Pass
W-020416	2/4/2016	Gr. Beta	29.7 ± 0.3	28.9	17.3 - 40.4	Pass
W-021716	2/17/2016	Ra-226	17.9 ± 0.5	16.7	10.0 - 23.4	Pass
W-030716	3/7/2016	Gr. Alpha	16.3 ± 0.8	20.1	12.0 - 28.1	Pass
W-030716	3/7/2016	Gr. Beta	27.0 ± 0.7	28.9	17.3 - 40.4	Pass
SPDW-70046	3/29/2016	Ra-226	13.4 ± 0.4	16.7	10.0 - 23.4	Pass
SPW-1163	3/22/2016	Ra-228	4.2 ± 0.7	4.4	2.6 - 6.2	Pass
SPW-1235	3/29/2016	Gr. Alpha	21.0 ± 0.4	20.1	12.0 - 28.1	Pass
SPW-1235	3/29/2016	Gr. Beta	29.4 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-1739	4/21/2016	Ra-228	16.2 ± 2.0	17.7	10.6 - 24.8	Pass
SPW-2052	4/21/2016	Ra-226	16.0 ± 0.5	16.7	10.0 - 23.4	Pass
W-042616	4/21/2016	Fe-55	1,519 ± 61	1,482	889 - 2,075	Pass
SPW-1823	4/23/2016	Gr. Alpha	21.0 ± 0.4	20.1	12.0 - 28.1	Pass
SPW-1823	4/23/2016	Gr. Beta	26.6 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-1998	4/29/2016	Cs-134	35.9 ± 6.0	36.2	21.7 - 50.6	Pass
SPW-1998	4/29/2016	Cs-137	82.5 ± 7.6	71.9	43.1 - 100.6	Pass
SPW-2097	5/3/2016	H-3	3,349 ± 184	3,280	1,968 - 4,592	Pass
SPW-2132	5/4/2016	H-3	3,174 ± 178	3,280	1,968 - 4,592	Pass
SPW-2229	5/7/2016	H-3	3,182 ± 179	3,280	1,968 - 4,592	Pass
SPW-2313	5/13/2016	H-3	3,183 ± 179	3,280	1,968 - 4,592	Pass
SPW-2341	5/13/2016	H-3	3,201 ± 178	3,280	1,968 - 4,592	Pass
SPW-2374	5/14/2016	H-3	3,037 ± 175	3,280	1,968 - 4,592	Pass
SPW-2411	5/17/2016	Sr-90	37.3 ± 1.6	37.3	22.4 - 52.2	Pass
SPW-2455	5/19/2016	Gr. Alpha	19.3 ± 0.4	20.1	12.0 - 28.1	Pass
SPW-2455	5/19/2016	Gr. Beta	28.6 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-2457	5/19/2016	U-238	48.2 ± 2.4	41.7	25.0 - 58.4	Pass
SPW-2504	5/20/2016	H-3	3,181 ± 178	3,280	1,968 - 4,592	Pass
SPW-2528	5/23/2016	H-3	2,998 ± 175	3,280	1,968 - 4,592	Pass
SPW-2566	5/24/2016	Gr. Alpha	19.8 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-2566	5/24/2016	Gr. Beta	30.4 ± 0.3	28.9	17.3 - 40.4	Pass
W-053116	4/29/2016	Cs-134	34.0 ± 5.0	36.2	21.7 - 50.6	Pass
W-053116	4/29/2016	Cs-137	78.8 ± 7.0	71.9	43.1 - 100.6	Pass
SPW-2704	6/1/2016	Sr-90	38.0 ± 1.6	37.3	22.4 - 52.2	Pass
SPW-2719	6/2/2016	Ra-228	18.1 ± 2.1	17.7	10.6 - 24.8	Pass
SPW-2749	6/3/2016	H-3	3,197 ± 180	3,280	1,968 - 4,592	Pass
SPW-2843	6/7/2016	H-3	3,133 ± 179	3,280	1,968 - 4,592	Pass
SPW-3227	6/17/2016	Ra-226	18.6 ± 0.4	16.7	10.0 - 23.4	Pass
W-061716	4/29/2016	Cs-134	37.3 ± 8.2	36.2	21.7 - 50.6	Pass
W-061716	4/29/2016	Cs-137	79.7 ± 10.8	71.9	43.1 - 100.6	Pass
SPW-3240	6/28/2016	Gr. Alpha	25.3 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-3240	6/28/2016	Gr. Beta	27.1 ± 0.3	28.9	17.3 - 40.4	Pass

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

Lab Code [b]	Date	Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
		Concentration [a]				
SPW-3241	7/1/2016	H-3	8,821 ± 283	8,650	5,190 - 12,110	Pass
SPW-3309	7/1/2016	H-3	8,619 ± 278	8,650	5,190 - 12,110	Pass
SPW-3313	7/1/2016	Ra-228	16.6 ± 2.0	17.7	10.6 - 24.8	Pass
SPW-3328	7/6/2016	Sr-89	13.4 ± 9.2	14.8	8.9 - 20.7	Pass
SPW-3328	7/6/2016	Sr-90	12.3 ± 1.3	11.4	6.8 - 16.0	Pass
SPAP-3365	7/7/2016	Gr. Beta	39.7 ± 0.1	42.2	25.3 - 59.0	Pass
SPAP-3367	7/7/2016	Cs-134	1.2 ± 0.7	1.2	0.7 - 1.7	Pass
SPAP-3367	7/7/2016	Cs-137	94.4 ± 2.8	94.0	56.4 - 131.6	Pass
SPW-3370	7/7/2016	C-14	4,444 ± 17	4,735	2,841 - 6,629	Pass
SPW-3373	7/7/2016	Ni-63	446 ± 5	401	241 - 561	Pass
SPW-3375	7/7/2016	Tc-99	545 ± 9	539	324 - 755	Pass
SPW-3519	7/14/2016	H-3	8,621 ± 279	8650	5,190 - 12,110	Pass
SPW-3688	6/29/2016	Ra-226	17.5 ± 0.4	16.7	10.0 - 23.4	Pass
SPW-3711	7/20/2016	H-3	44,368 ± 612	43,766	26,260 - 61,273	Pass
SPW-3774	7/22/2016	H-3	45,259 ± 619	43,766	26,260 - 61,273	Pass
SPW-3776	7/22/2016	Gr. Alpha	23.3 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-3776	7/22/2016	Gr. Beta	27.5 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-3884	7/26/2016	H-3	45,850 ± 623	43,766	26,260 - 61,273	Pass
SPW-3950	7/28/2016	Ra-228	17.8 ± 1.8	16.7	10 - 23	Pass
SPW-3982	7/29/2016	H-3	45,273 ± 619	43,766	26,260 - 61,273	Pass
W-073016	4/29/2016	Cs-134	36.5 ± 6.1	36.2	21.7 - 50.6	Pass
W-073016	4/29/2016	Cs-137	80.6 ± 7.5	71.9	43.1 - 100.6	Pass
SPW-4134	8/4/2016	Ra-228	5.5 ± 0.8	6.7	4.0 - 9.3	Pass
SPW-4340	8/17/2016	Ra-228	19.9 ± 2.0	16.7	10.0 - 23.4	Pass
SPW-4386	7/15/2016	Ra-226	18.0 ± 0.4	16.7	10.0 - 23.4	Pass
W-082716	4/29/2016	Ra-228	32.5 ± 5.2	36.2	21.7 - 50.6	Pass
W-082716	4/29/2016	Ra-226	78.5 ± 8.3	71.9	43.1 - 100.6	Pass
SPW-4642	9/6/2016	U-238	45.8 ± 2.5	41.7	25.0 - 58.4	Pass
SPW-4999	9/26/2016	Sr-90	35.1 ± 2.2	36.8	22.1 - 51.5	Pass
SPW-5091	9/12/2016	Ra-226	18.2 ± 0.4	16.7	10.0 - 23.4	Pass
W-092716	4/29/2016	Cs-134	37.3 ± 11.8	36.2	21.7 - 50.6	Pass
W-092716	4/29/2016	Cs-137	78.3 ± 11.2	71.9	43.1 - 100.6	Pass
SPW-5165	9/30/2016	Gr. Alpha	22.2 ± 0.4	20.1	12.0 - 28.1	Pass
SPW-5165	9/30/2016	Gr. Beta	27.2 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-5426	9/28/2016	Ra-226	18.2 ± 0.4	16.7	10.0 - 23.4	Pass
SPW-5510	10/18/2016	H-3	44,398 ± 618	43,766	26,260 - 61273	Pass
SPW-5553	10/19/2016	U-238	50.0 ± 2.6	41.7	25.0 - 58.4	Pass
SPW-5555	10/19/2016	Ra-228	17.4 ± 1.9	16.7	10.0 - 23.4	Pass
SPW-5612	10/20/2016	H-3	44,681 ± 622	43,766	26,260 - 61,273	Pass
SPW-5741	10/25/2016	H-3	44,946 ± 624	43,766	26,260 - 61,273	Pass
SPU-5833	10/26/2016	H-3	10,018 ± 946	8,622	5,173 - 12,071	Pass
SPW-5862	10/28/2016	H-3	18,061 ± 374	17,244	10,346 - 24,141	Pass
W-103116	4/29/2016	Cs-134	36.0 ± 4.6	36.2	21.7 - 50.6	Pass
W-103116	4/29/2016	Cs-137	81.1 ± 7.3	71.9	43.1 - 100.6	Pass

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

Lab Code [b]	Date	Concentration [a]				
		Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-5984	11/2/2016	H-3	17,727 ± 399	17,244	10,346 - 24,141	Pass
SPW-6008	11/4/2016	H-3	17,854 ± 402	17,244	10,346 - 24,141	Pass
SPW-6124	11/8/2016	Ra-228	14.4 ± 1.9	16.0	9.6 - 22.4	Pass
SPW-6132	11/9/2016	H-3	18,135 ± 374	17,243	10,346 - 24,140	Pass
SPW-6135	10/12/2016	Ra-226	18.9 ± 0.4	16.7	10.0 - 23.4	Pass
SPW-6146	11/10/2016	H-3	17,488 ± 398	17,243	10,346 - 24,140	Pass
SPW-6222	11/12/2016	H-3	17,787 ± 408	17,243	10,346 - 24,140	Pass
SPW-6318	11/16/2016	H-3	17,379 ± 408	17,243	10,346 - 24,140	Pass
SPW-6349	11/17/2016	H-3	17,893 ± 371	17,243	10,346 - 24,140	Pass
SPW-6424	11/19/2016	H-3	18,258 ± 379	17,243	10,346 - 24,140	Pass
W-112616	4/29/2016	Cs-134	35.0 ± 6.0	36.2	21.7 - 50.6	Pass
W-112616	4/29/2016	Cs-137	75.0 ± 7.1	71.9	43.1 - 100.6	Pass
SPW-6456	11/28/2016	Sr-90	41.9 ± 2.5	36.8	22.1 - 51.5	Pass
SPW-6486	11/30/2016	Sr-90	35.6 ± 2.2	36.6	21.9 - 51.2	Pass
SPW-6490	11/29/2016	Ra-226	18.8 ± 0.4	16.7	10.0 - 23.4	Pass
SPW-6519	11/30/2016	Ni-63	438 ± 4	400	240 - 560	Pass
SPW-6527	12/1/2016	U-238	49.5 ± 2.5	41.7	25.0 - 58.4	Pass
SPW-6616	12/3/2016	H-3	18,018 ± 374	17,243	10,346 - 24,140	Pass
SPW-6669	12/5/2016	H-3	18,237 ± 377	17,243	10,346 - 24,140	Pass
SPW-6735	12/9/2016	H-3	17,939 ± 396	17,243	10,346 - 24,140	Pass
SPW-6880	12/21/2016	H-3	17,835 ± 396	17,243	10,346 - 24,140	Pass
SPW-6947	12/22/2016	Ni-63	450 ± 4	400	240 - 560	Pass
W-122316	4/29/2016	Cs-134	36.0 ± 2.2	36.2	21.7 - 50.6	Pass
W-122316	4/29/2016	Cs-134	76.1 ± 2.9	71.9	43.1 - 100.6	Pass
SPW-6948	12/30/2016	H-3	17,999 ± 398	17,243	10,346 - 24,140	Pass
SPW-6974	12/29/2016	Ra-226	17.6 ± 0.4	16.7	10.0 - 23.4	Pass

[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 (Water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish), U (urine).

[c] Results are based on single determinations.

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

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

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

Lab Code	Sample Type	Date	Analysis[b]	Concentration [a] Laboratory results (4.66σ) LLD	Activity[c]	Acceptance Criteria (4.66 σ)
SPW-289	Water	1/21/2016	Sr-90	0.55	0.28 ± 0.29	1
SPW-291	Water	1/21/2016	Sr-90	0.61	0.15 ± 0.30	1
SPW-293	Water	1/21/2016	C-14	147	-12 ± 89	200
SPW-413	Water	2/1/2016	Ra-228	0.86	1.86 ± 0.60	2
W-020416	Water	2/4/2016	Gr. Alpha	0.43	-0.17 ± 0.28	2
W-020416	Water	2/4/2016	Gr. Beta	0.73	0.36 ± 0.53	4
W-020916	Water	2/9/2016	Ra-226	0.02	0.01 ± 0.01	2
W-030716	Water	3/7/2016	Gr. Alpha	0.90	-0.36 ± 0.32	2
W-030716	Water	3/7/2016	Gr. Beta	1.59	-0.62 ± 0.71	4
SPDW-70045	Water	3/29/2016	Ra-226	0.03	0.01 ± 0.02	2
SPDW-1234	Water	3/30/2016	Gr. Alpha	0.44	-0.05 ± 0.30	2
SPDW-1234	Water	3/30/2016	Gr. Beta	0.79	-0.54 ± 0.54	4
SPW-1738	Water	4/21/2016	Ra-228	1.05	0.13 ± 0.50	2
SPW-1822	Water	4/23/2016	Gr. Alpha	0.50	-0.18 ± 0.33	2
SPW-1822	Water	4/23/2016	Gr. Beta	0.08	-0.35 ± 0.51	4
SPW-2051	Water	4/12/2016	Ra-226	0.02	0.03 ± 0.02	2
SPW-2069	Water	5/3/2016	I-131	0.15	0.06 ± 0.09	1
SPW-2133	Water	5/4/2016	H-3	148	55 ± 76	200
SPW-2230	Water	5/7/2016	H-3	149	-11 ± 73	200
SPW-2314	Water	5/13/2016	H-3	150	-29 ± 72	200
SPW-2342	Water	5/13/2016	H-3	143	50 ± 74	200
SPW-2364	Water	5/13/2016	I-131	0.22	-0.03 ± 0.12	1
SPW-2375	Water	5/14/2016	H-3	146	1 ± 70	200
SPW-2410	Water	5/17/2016	Sr-90	0.59	0.10 ± 0.29	1
SPW-2454	Water	5/19/2016	Gr. Alpha	0.47	-0.21 ± 0.31	2
SPW-2454	Water	5/19/2016	Gr. Beta	0.77	-0.49 ± 0.52	4
SPW-2456	Water	5/19/2016	U-238	0.15	0.00 ± 0.09	1
SPW-2485	Water	5/20/2016	I-131	0.18	-0.01 ± 0.10	1
SPW-2505	Water	5/20/2016	H-3	144	64 ± 75	200
SPW-2529	Water	5/23/2016	H-3	152	-3 ± 75	200
SPW-2530	Water	5/23/2016	Ra-228	0.96	-0.12 ± 0.43	2
SPW-2565	Water	5/24/2016	Gr. Alpha	0.47	0.03 ± 0.33	2
SPW-2565	Water	5/24/2016	Gr. Beta	0.77	-0.23 ± 0.53	4
SPW-2703	Water	6/1/2016	Sr-89	0.68	-0.13 ± 0.50	5
SPW-2703	Water	6/1/2016	Sr-90	0.55	0.11 ± 0.27	1
SPW-2718	Water	6/2/2016	Ra-228	0.67	0.23 ± 0.34	2
SPW-2720	Water	6/2/2016	I-131	0.16	0.01 ± 0.09	1
SPW-2750	Water	6/3/2016	H-3	151	-31 ± 73	200
SPW-2844	Water	6/7/2016	H-3	148	-55 ± 75	200
SPMI-2959	Milk	6/14/2016	I-131	0.16	0.09 ± 0.10	1
SPW-3137	Water	6/23/2016	I-131	0.15	-0.03 ± 0.08	1
SPW-3226	Water	6/17/2016	Ra-226	0.02	-0.01 ± 0.04	2
SPW-3239	Water	6/28/2016	Gr. Alpha	0.40	-0.15 ± 0.26	2
SPW-3239	Water	6/28/2016	Gr. Beta	0.73	0.14 ± 0.52	4
SPW-3687	Water	6/29/2016	Ra-226	0.04	0.03 ± 0.03	2

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

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

[c] Activity reported is a net activity result.

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

Lab Code	Sample Type	Date	Analysis[b]	Concentration[a] Laboratory results (4.66σ) LLD	Activity[c]	Acceptance Criteria (4.66 σ)
SPW-3312	Water	7/1/2016	Ra-228	0.67	0.35 ± 0.35	2
SPW-3327	Water	7/6/2016	Sr-89	0.67	0.51 ± 0.51	5
SPW-3327	Water	7/6/2016	Sr-90	0.60	-0.14 ± 0.26	1
SPAP-3364	AP	7/7/2016	Gr.Beta	0.002	0.005 ± 0.001	0.01
SPW-3370	Water	7/7/2016	C-14	115	49 ± 71	200
SPW-3372	Water	7/7/2016	Ni-63	122	115 ± 76	200
SPW-3374	Water	7/7/2016	Tc-99	6.07	1.00 ± 3.70	10
SPW-3710	Water	7/20/2016	H-3	147	35 ± 75	200
SPW-3775	Water	7/22/2016	Gr. Alpha	0.73	0.41 ± 0.53	2
SPW-3775	Water	7/22/2016	Gr. Beta	0.45	-0.14 ± 0.30	4
SPW-3884	Water	7/26/2016	H-3	151	-1 ± 73	200
SPW-3949	Water	7/28/2016	Ra-228	0.76	0.32 ± 0.39	2
SPW-3982	Water	7/29/2016	H-3	145	49 ± 75	200
SPW-4133	Water	8/4/2016	Ra-228	0.80	0.26 ± 0.40	2
SPW-4257	Water	8/11/2016	I-131	0.17	-0.01 ± 0.10	1
SPW-4339	Water	8/17/2016	Ra-228	0.73	0.36 ± 0.39	2
SPW-4385	Water	7/15/2016	Ra-226	0.09	0.75 ± 0.09	2
SPW-4641	Water	9/6/2016	U-238	0.21	0.00 ± 0.13	1
SPW-4684	Water	9/8/2016	H-3	151	48 ± 78	200
SPW-4872	Water	9/16/2016	I-131	0.21	0.05 ± 0.11	1
SPW-4998	Water	9/26/2016	Sr-89	0.54	0.06 ± 0.39	5
SPW-4998	Water	9/26/2016	Sr-90	0.53	-0.03 ± 0.24	1
SPW-5090	Water	8/19/2016	Ra-226	0.03	0.03 ± 0.02	2
SPW-5164	Water	9/30/2016	Gr. Alpha	0.46	-0.05 ± 0.32	2
SPW-5164	Water	9/30/2016	Gr. Beta	0.74	-0.02 ± 0.52	4
SPW-5425	Water	9/28/2016	Ra-226	0.02	0.07 ± 0.05	2
SPW-5323	Water	10/7/2016	H-3	157	-12 ± 75	200
SPW-5552	Water	10/19/2016	U-238	0.18	0.00 ± 0.11	1
SPW-5554	Water	10/19/2016	Ra-228	0.72	0.22 ± 0.36	2
SPW-5611	Water	10/20/2016	H-3	153	67 ± 80	200
SPW-5613	Water	10/21/2016	Gr. Alpha	0.76	-0.55 ± 0.51	2
SPW-5613	Water	10/21/2016	Gr. Beta	0.42	0.02 ± 0.29	4
SPW-5740	Water	10/25/2016	H-3	154	-2 ± 72	200
SPW-5743	Water	10/25/2016	Sr-90	1.26	0.72 ± 0.67	1
SPW-5861	Water	10/28/2016	H-3	179	129 ± 91	200
SPW-5983	Water	11/2/2016	H-3	156	8 ± 78	200
SPW-6007	Water	11/4/2016	H-3	156	-34 ± 73	200
SPW-6131	Water	11/9/2016	H-3	180	80 ± 92	200
SPW-6134	Water	10/12/2016	Ra-226	0.05	-0.02 ± 0.12	2
SPW-6145	Water	11/10/2016	H-3	171	-46 ± 80	200
SPW-6317	Water	11/16/2016	H-3	180	-43 ± 82	200
SPW-6348	Water	11/17/2016	H-3	182	-45 ± 88	200
SPW-6423	Water	11/19/2016	H-3	181	8 ± 95	200
SPW-6455	Water	11/28/2016	Sr-89	0.58	-0.15 ± 0.46	5
SPW-6455	Water	11/28/2016	Sr-90	0.67	0.09 ± 0.32	1
SPW-6489	Water	11/29/2016	Ra-226	0.03	0.03 ± 0.02	2

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

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

[c] Activity reported is a net activity result.

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

Lab Code	Sample Type	Date	Analysis[b]	Concentration [a]		
				Laboratory results (4.66σ)		Acceptance Criteria (4.66 σ)
				LLD	Activity[c]	
SPW-6529	Water	12/1/2016	I-131	0.18	-0.03 ± 0.10	1
SPW-6616	Water	12/3/2016	H-3	180	72 ± 92	200
SPW-6670	Water	12/5/2016	H-3	174	28 ± 92	200
SPW-6735	Water	12/9/2016	H-3	152	2 ± 73	200
SPW-6792	Water	12/15/2016	I-131	0.17	0.03 ± 0.12	1
SPW-6819	Water	12/16/2016	H-3	158	14 ± 77	200
SPW-6879	Water	12/21/2016	H-3	147	80 ± 75	200
SPW-6947	Water	12/22/2016	Ni-63	93	26 ± 57	200
SPW-6973	Water	12/29/2016	Ra-226	0.03	0.03 ± 0.02	2

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

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

[c] Activity reported is a net activity result.

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

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
AP-010416	1/4/2016	Gr. Beta	0.044 ± 0.006	0.051 ± 0.006	0.047 ± 0.004	Pass
SPS-62, 63	1/7/2016	K-40	21.1 ± 1.9	21.2 ± 2.1	21.2 ± 1.4	Pass
WW-125, 126	1/7/2016	H-3	659 ± 102	748 ± 106	703 ± 74	Pass
SPS-199, 200	1/7/2016	Cs-137	0.09 ± 0.02	0.08 ± 0.03	0.08 ± 0.02	Pass
SPS-199, 200	1/7/2016	K-40	7.60 ± 0.60	8.62 ± 0.62	8.11 ± 0.43	Pass
AP-011116	1/11/2016	Gr. Beta	0.024 ± 0.005	0.027 ± 0.005	0.026 ± 0.003	Pass
AP-011216	1/12/2016	Gr. Beta	0.030 ± 0.004	0.034 ± 0.004	0.032 ± 0.003	Pass
WW-262, 263	1/14/2016	H-3	153 ± 78	141 ± 78	147 ± 55	Pass
WW-346, 347	1/14/2016	H-3	1,036 ± 117	959 ± 115	997 ± 82	Pass
WW-283, 284	1/18/2016	H-3	437 ± 92	427 ± 91	432 ± 65	Pass
AP-011916	1/19/2016	Gr. Beta	0.042 ± 0.005	0.037 ± 0.004	0.040 ± 0.003	Pass
AP-012016	1/20/2016	Gr. Beta	0.023 ± 0.003	0.030 ± 0.004	0.027 ± 0.002	Pass
AP-020116	2/1/2016	Gr. Beta	0.023 ± 0.005	0.023 ± 0.005	0.023 ± 0.004	Pass
SWU-472, 473	2/2/2016	Gr. Beta	4.37 ± 0.47	4.60 ± 0.49	4.49 ± 0.34	Pass
SG-493, 494	2/6/2016	Ac-228	2.10 ± 0.20	2.13 ± 0.20	2.12 ± 0.14	Pass
SG-493, 494	2/6/2016	K-40	5.79 ± 0.57	5.50 ± 0.69	5.65 ± 0.45	Pass
SG-493, 494	2/6/2016	Pb-214	1.84 ± 0.11	1.91 ± 0.11	1.88 ± 0.08	Pass
AP-020816	2/8/2016	Gr. Beta	0.020 ± 0.004	0.019 ± 0.004	0.020 ± 0.003	Pass
AP-020916	2/9/2016	Be-7	0.032 ± 0.005	0.041 ± 0.006	0.036 ± 0.004	Pass
SPS-619, 620	2/18/2016	K-40	20.0 ± 1.8	19.1 ± 1.6	19.5 ± 1.2	Pass
WW-640, 641	2/18/2016	H-3	90.1 ± 75.0	153.6 ± 78.4	121.8 ± 54.2	Pass
AP-021916	2/19/2016	Gr. Beta	0.021 ± 0.003	0.025 ± 0.004	0.023 ± 0.002	Pass
WW-822, 823	2/26/2016	H-3	2,770 ± 173	2,974 ± 178	2,872 ± 124	Pass
DW-70010, 70011	2/29/2016	Ra-226	4.88 ± 0.29	4.93 ± 0.28	4.91 ± 0.20	Pass
DW-70010, 70011	2/29/2016	Ra-228	3.00 ± 0.77	1.90 ± 0.62	2.45 ± 0.49	Pass
SW-934, 935	3/1/2016	Gr. Beta	0.94 ± 0.52	1.36 ± 0.60	1.15 ± 0.40	Pass
SPS-913, 914	3/3/2016	Cs-137	0.08 ± 0.03	0.10 ± 0.03	0.09 ± 0.02	Pass
SPS-913, 914	3/3/2016	K-40	17.45 ± 0.94	16.83 ± 0.95	17.14 ± 0.67	Pass
SPS-913, 914	3/3/2016	Ra-226	1.02 ± 0.08	1.13 ± 0.17	1.07 ± 0.09	Pass
SPS-913, 914	3/3/2016	Ra-228	1.09 ± 0.15	1.13 ± 0.17	1.11 ± 0.11	Pass
AP-030716	3/7/2016	Gr. Beta	0.018 ± 0.005	0.021 ± 0.005	0.019 ± 0.003	Pass
F-1303,1304	3/7/2016	K-40	3.320 ± 0.475	3.508 ± 0.396	3.414 ± 0.309	Pass
SG-976, 977	3/8/2016	Ra-226	6.75 ± 0.25	6.28 ± 0.22	6.52 ± 0.17	Pass
SG-976, 977	3/8/2016	Ra-228	9.21 ± 0.49	9.09 ± 0.49	9.15 ± 0.35	Pass
PM-1094, 1095	3/9/2016	K-40	14.01 ± 0.68	14.47 ± 0.72	14.24 ± 0.49	Pass
MI-1042,1043	3/7/2016	K-40	1,684 ± 124	1,804 ± 119	1,744 ± 86	Pass
DW-70023, 70024	3/7/2016	Ra-226	3.40 ± 0.43	2.68 ± 0.35	3.04 ± 0.28	Pass
DW-70023, 70024	3/7/2016	Ra-228	4.46 ± 0.83	5.74 ± 0.94	5.10 ± 0.63	Pass
DW-70014, 70015	3/7/2016	Gr. Alpha	13.38 ± 1.58	11.40 ± 1.43	12.39 ± 1.07	Pass
DW-70026, 70027	3/7/2016	Gr. Alpha	3.46 ± 0.79	3.08 ± 0.74	3.27 ± 0.54	Pass
DW-70038, 70039	3/8/2016	Gr. Alpha	1.14 ± 0.89	1.73 ± 0.95	1.44 ± 0.65	Pass
DW-70035, 70036	3/8/2016	Ra-226	0.47 ± 0.10	0.45 ± 0.09	0.46 ± 0.07	Pass
DW-70035, 70036	3/8/2016	Ra-228	0.56 ± 0.45	0.47 ± 0.44	0.52 ± 0.31	Pass
AP-031516	3/15/2016	Gr. Beta	0.014 ± 0.003	0.016 ± 0.004	0.015 ± 0.002	Pass
AP-032116	3/21/2016	Gr. Beta	0.014 ± 0.004	0.020 ± 0.004	0.017 ± 0.003	Pass
AP-1218,1219	3/24/2016	Be-7	0.135 ± 0.065	0.167 ± 0.081	0.151 ± 0.052	Pass
AP-1719,1720	3/28/2016	Be-7	0.075 ± 0.008	0.076 ± 0.007	0.076 ± 0.005	Pass
AP-033016	3/30/2016	Gr. Beta	0.023 ± 0.004	0.025 ± 0.004	0.024 ± 0.003	Pass
SPS-1260, 1261	3/30/2016	K-40	18.00 ± 1.92	19.67 ± 1.77	18.84 ± 1.30	Pass
XW-1467, 1468	3/30/2016	H-3	310 ± 87	295 ± 86	303 ± 61	Pass
XWW-1530, 1531	3/30/2016	H-3	198 ± 84	162 ± 82	180 ± 59	Pass
AP-1827, 1828	3/30/2016	Be-7	0.069 ± 0.011	0.072 ± 0.011	0.071 ± 0.008	Pass
AP-1323,1324	3/31/2016	Be-7	0.206 ± 0.120	0.197 ± 0.091	0.202 ± 0.076	Pass
LW-1446,1447	3/31/2016	Gr. Beta	2.36 ± 0.93	2.23 ± 1.01	2.29 ± 0.69	Pass

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

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
WW-1740,1741	4/2/2016	H-3	21,162 ± 120	21,091 ± 427	21,126 ± 222	Pass
SPS-1344, 1345	4/4/2016	K-40	17.98 ± 0.93	17.14 ± 0.96	17.56 ± 0.67	Pass
SPS-1344, 1345	4/4/2016	Pb-214	1.12 ± 0.09	1.04 ± 0.08	1.08 ± 0.06	Pass
SPS-1344, 1345	4/4/2016	Ac-228	1.23 ± 0.15	1.33 ± 0.19	1.28 ± 0.12	Pass
SPS-1344, 1345	4/4/2016	Cs-137	0.13 ± 0.03	0.13 ± 0.03	0.13 ± 0.02	Pass
P-1509,1510	4/8/2016	H-3	1,084 ± 120	1,038 ± 119	1,061 ± 85	Pass
AP-041116	4/11/2016	Gr. Beta	0.020 ± 0.004	0.019 ± 0.004	0.019 ± 0.003	Pass
SS-1551,1552	4/12/2016	Gr. Beta	8.71 ± 1.11	8.88 ± 1.13	8.80 ± 0.79	Pass
SS-1551,1552	4/12/2016	K-40	3.50 ± 0.25	3.06 ± 0.28	3.28 ± 0.19	Pass
SS-1551,1552	4/12/2016	Tl-208	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.01	Pass
SS-1551,1552	4/12/2016	Bi-214	0.10 ± 0.02	0.09 ± 0.02	0.10 ± 0.02	Pass
SS-1551,1552	4/12/2016	Pb-212	0.13 ± 0.02	0.11 ± 0.02	0.12 ± 0.01	Pass
SS-1551,1552	4/12/2016	Ra-226	0.35 ± 0.17	0.30 ± 0.17	0.32 ± 0.12	Pass
SS-1551,1552	4/12/2016	Ac-228	0.16 ± 0.05	0.17 ± 0.05	0.17 ± 0.04	Pass
SS-1593,1594	4/12/2016	K-40	14.80 ± 0.73	14.89 ± 0.78	14.85 ± 0.53	Pass
WW-1677, 1678	4/14/2016	Ra-226	0.23 ± 0.13	0.35 ± 0.15	0.29 ± 0.10	Pass
WW-1783,1784	4/14/2016	H-3	768 ± 111	632 ± 107	700 ± 77	Pass
BS-1804,1805	4/18/2016	K-40	0.79 ± 0.02	0.87 ± 0.19	0.83 ± 0.10	Pass
WW-2021,2022	4/18/2016	H-3	5,548 ± 221	5,707 ± 224	5,627 ± 157	Pass
XWW-2240, 2241	4/18/2016	H-3	638 ± 104	543 ± 101	591 ± 72	Pass
XWW-2109, 2110	4/19/2016	H-3	3461 ± 185	3250 ± 180	3356 ± 129	Pass
SPS-2130, 2131	4/25/2016	K-40	7.80 ± 0.84	6.80 ± 0.60	7.30 ± 0.52	Pass
AP-042516	4/25/2016	Gr. Beta	0.020 ± 0.004	0.023 ± 0.004	0.022 ± 0.003	Pass
BS-2065, 2066	4/25/2016	K-40	14.40 ± 1.50	14.72 ± 1.19	14.56 ± 0.96	Pass
AP-042716	4/27/2016	Gr. Beta	0.023 ± 0.003	0.019 ± 0.003	0.021 ± 0.002	Pass
SPS-1999, 2000	4/28/2016	K-40	19.84 ± 1.76	18.963 ± 2.42	19.40 ± 1.50	Pass
SO-2153,2154	5/2/2016	K-40	21.80 ± 0.81	21.17 ± 0.85	21.48 ± 0.59	Pass
SO-2153,2154	5/2/2016	Cs-137	0.11 ± 0.03	0.11 ± 0.07	0.11 ± 0.04	Pass
SO-2153,2154	5/2/2016	Ra-226	1.50 ± 0.29	1.22 ± 0.29	1.36 ± 0.21	Pass
SO-2153,2154	5/2/2016	Pb-214	0.56 ± 0.06	0.57 ± 0.06	0.57 ± 0.04	Pass
W-2394,2395	5/5/2016	H-3	736 ± 106	631 ± 102	683 ± 74	Pass
VE-2284,2285	5/9/2016	K-40	3.50 ± 0.25	3.06 ± 0.28	3.28 ± 0.19	Pass
AP-051016	5/10/2016	Gr. Beta	0.020 ± 0.005	0.018 ± 0.005	0.019 ± 0.003	Pass
SG-2261, 2262	5/10/2016	Ac-228	34.4 ± 1.2	34.4 ± 1.4	34.4 ± 0.9	Pass
SG-2261, 2262	5/10/2016	Pb-214	29.5 ± 3.0	31.9 ± 3.3	30.7 ± 2.2	Pass
BS-2439, 2440	5/12/2016	K-40	9.96 ± 0.91	10.27 ± 0.76	10.11 ± 0.59	Pass
WW-2534,2535	5/16/2016	H-3	14,342 ± 354	14,613 ± 357	14,477 ± 252	Pass
AP-051716	5/17/2016	Gr. Beta	0.014 ± 0.004	0.015 ± 0.004	0.014 ± 0.003	Pass
SPS-2945, 2946	5/19/2016	K-40	30.71 ± 0.74	31.75 ± 0.78	31.23 ± 0.54	Pass
SPS-2945, 2946	5/19/2016	Be-7	1.55 ± 0.24	1.90 ± 0.35	1.73 ± 0.21	Pass
SPS-2578, 2579	5/24/2016	Pb-214	0.96 ± 0.12	0.80 ± 0.14	0.88 ± 0.09	Pass
AP-052516	5/25/2016	Gr. Beta	0.022 ± 0.004	0.022 ± 0.004	0.022 ± 0.003	Pass
G-2642,2643	5/26/2016	Be-7	0.443 ± 0.178	0.247 ± 0.247	0.345 ± 0.152	Pass
SO-2663, 2664	5/26/2016	Cs-137	0.08 ± 0.03	0.07 ± 0.03	0.07 ± 0.02	Pass
SO-2663, 2664	5/26/2016	K-40	12.44 ± 0.68	11.64 ± 0.63	12.04 ± 0.46	Pass
SO-2663, 2664	5/26/2016	Tl-208	0.13 ± 0.02	0.14 ± 0.03	0.14 ± 0.02	Pass
SO-2663, 2664	5/26/2016	Pb-212	0.43 ± 0.04	0.41 ± 0.04	0.42 ± 0.03	Pass
SO-2663, 2664	5/26/2016	Ra-226	1.19 ± 0.34	0.87 ± 0.28	1.03 ± 0.22	Pass
SO-2663, 2664	5/26/2016	Ac-228	0.45 ± 0.09	0.53 ± 0.10	0.49 ± 0.07	Pass
SPS-2817, 2818	5/31/2016	K-40	12.10 ± 0.70	11.05 ± 0.70	11.58 ± 0.49	Pass
DW-70091, 70092	6/1/2016	Ra-226	5.61 ± 0.29	5.53 ± 0.30	5.57 ± 0.21	Pass
DW-70091, 70092	6/1/2016	Ra-228	1.45 ± 0.58	1.91 ± 0.62	1.68 ± 0.42	Pass
BS-2925,2926	6/3/2016	K-40	7.74 ± 0.44	7.86 ± 0.42	7.80 ± 0.30	Pass
SPS-2796, 2797	6/2/2016	K-40	20.91 ± 2.38	21.16 ± 1.82	21.04 ± 1.50	Pass
SPS-2882, 2883	6/7/2016	K-40	14.64 ± 0.52	14.60 ± 0.52	14.62 ± 0.37	Pass
SPS-2882, 2883	6/7/2016	Be-7	2.00 ± 0.25	1.94 ± 0.20	1.97 ± 0.16	Pass
DW-70102, 70103	6/13/2016	Ra-226	0.34 ± 0.09	0.36 ± 0.08	0.35 ± 0.06	Pass

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

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
DW-70102, 70103	6/13/2016	Ra-228	0.93 ± 0.47	1.11 ± 0.53	1.02 ± 0.35	Pass
AP-061416	6/14/2016	Gr. Beta	0.026 ± 0.004	0.023 ± 0.004	0.024 ± 0.003	Pass
SG-3144, 3145	6/17/2016	Be-7	2.23 ± 0.12	2.24 ± 0.12	2.24 ± 0.08	Pass
SG-3144, 3145	6/17/2016	K-40	7.57 ± 0.25	7.09 ± 0.23	7.33 ± 0.17	Pass
SPS-3165, 3166	6/22/2016	K-40	21.14 ± 2.27	22.88 ± 1.60	22.01 ± 1.39	Pass
SPS-3323, 3324	6/24/2016	K-40	18.67 ± 1.57	21.53 ± 1.65	20.10 ± 1.14	Pass
WW-3231, 3232	6/27/2016	H-3	414 ± 104	498 ± 108	456 ± 75	Pass
AP-3830,3831	6/29/2016	Gr. Beta	0.088 ± 0.012	0.093 ± 0.015	0.091 ± 0.010	Pass
AP-070516A	7/5/2016	Gr. Beta	0.018 ± 0.002	0.014 ± 0.002	0.016 ± 0.002	Pass
AP-070516B	7/5/2016	Gr. Beta	0.025 ± 0.005	0.026 ± 0.005	0.025 ± 0.004	Pass
XWW-3605,3606	7/7/2016	H-3	3,316 ± 186	3,316 ± 181	3,316 ± 130	Pass
DW-70135,70136	7/8/2016	Gr. Alpha	3.68 ± 1.01	2.76 ± 0.98	3.22 ± 0.70	Pass
DW-70132,70133	7/8/2016	Ra-226	1.32 ± 0.14	1.11 ± 0.15	1.22 ± 0.10	Pass
DW-70132,70133	7/8/2016	Ra-228	3.92 ± 0.94	2.94 ± 0.90	3.43 ± 0.65	Pass
AP-071216	7/12/2016	Gr. Beta	0.014 ± 0.004	0.018 ± 0.004	0.016 ± 0.003	Pass
DW-70150,70151	7/14/2016	Gr. Alpha	5.00 ± 1.06	4.43 ± 1.04	4.72 ± 0.74	Pass
SPS-3649,3650	7/15/2016	Cs-137	0.12 ± 0.03	0.12 ± 0.03	0.12 ± 0.02	Pass
SPS-3649,3650	7/15/2016	K-40	16.68 ± 0.79	16.52 ± 0.86	16.6 ± 0.58	Pass
SPS-3649,3650	7/15/2016	Pb-214	1.20 ± 0.08	1.17 ± 0.08	1.19 ± 0.06	Pass
SPS-3649,3650	7/15/2016	Ac-228	1.28 ± 0.16	1.28 ± 0.16	1.28 ± 0.11	Pass
AP-071816	7/18/2016	Gr. Beta	0.022 ± 0.005	0.024 ± 0.005	0.023 ± 0.003	Pass
DW-70163,70164	7/19/2016	Gr. Alpha	1.08 ± 0.66	1.36 ± 0.70	1.22 ± 0.48	Pass
WW-3761,3762	7/20/2016	H-3	347 ± 90	466 ± 96	407 ± 66	Pass
SPS-4003,4004	7/23/2016	K-40	7.15 ± 1.59	6.86 ± 1.21	7.00 ± 1.00	Pass
AP-072516	7/25/2016	Gr. Beta	0.023 ± 0.004	0.020 ± 0.004	0.022 ± 0.003	Pass
VE-3936,3937	7/25/2016	Sr-90	0.048 ± 0.007	0.058 ± 0.010	0.053 ± 0.006	Pass
VE-3936,3937	7/25/2016	Be-7	0.49 ± 0.15	0.51 ± 0.15	0.50 ± 0.10	Pass
VE-3936,3937	7/25/2016	K-40	4.70 ± 0.35	4.86 ± 0.37	4.78 ± 0.25	Pass
VE-3959,3960	7/27/2016	Sr-90	0.002 ± 0.002	0.003 ± 0.001	0.003 ± 0.001	Pass
VE-3959,3960	7/27/2016	Be-7	0.30 ± 0.14	0.25 ± 0.12	0.27 ± 0.09	Pass
VE-3959,3960	7/27/2016	K-40	4.01 ± 0.37	4.16 ± 0.34	4.08 ± 0.25	Pass
DW-70169,70170	7/28/2016	Ra-226	0.83 ± 0.11	0.69 ± 0.11	0.76 ± 0.08	Pass
DW-70169,70170	7/28/2016	Ra-228	1.85 ± 0.63	1.31 ± 0.84	1.58 ± 0.53	Pass
AP-080116	8/1/2016	Gr. Beta	0.029 ± 0.003	0.033 ± 0.003	0.031 ± 0.002	Pass
SS-4131,4132	8/1/2016	K-40	12.47 ± 0.71	13.24 ± 0.81	12.86 ± 0.54	Pass
SS-4131,4132	8/1/2016	Cs-137	0.10 ± 0.03	0.13 ± 0.04	0.12 ± 0.02	Pass
SPS-4087,4088	8/2/2016	K-40	17.06 ± 1.58	19.5 ± 1.97	18.28 ± 1.26	Pass
WW-4976,4977	8/4/2016	H-3	17,043 ± 390	16,821 ± 388	16,932 ± 275	Pass
SPS-4266,4267	8/10/2016	K-40	1.06 ± 0.47	1.69 ± 0.52	1.375 ± 0.35	Pass
AP-081616	8/16/2016	Gr. Beta	0.029 ± 0.005	0.025 ± 0.004	0.027 ± 0.003	Pass
VE-4399,4400	8/18/2016	K-40	3.85 ± 0.23	3.27 ± 0.41	3.56 ± 0.24	Pass
VE-4399,4400	8/18/2016	Be-7	0.30 ± 0.08	0.45 ± 0.20	0.37 ± 0.11	Pass
WW-5394,5395	8/18/2016	H-3	947 ± 122	846 ± 119	896 ± 85	Pass
SPS-4441,4442	8/22/2016	K-40	20.55 ± 2.23	19.69 ± 1.74	20.12 ± 1.41	Pass
AP-082216	8/22/2016	Gr. Beta	0.021 ± 0.005	0.015 ± 0.005	0.018 ± 0.003	Pass
VE-4462,4463	8/22/2016	Be-7	0.91 ± 0.09	0.89 ± 0.11	0.90 ± 0.07	Pass
VE-4462,4463	8/22/2016	K-40	7.48 ± 0.26	7.60 ± 0.23	7.54 ± 0.17	Pass
WW-4594,4595	8/26/2016	H-3	675 ± 107	788 ± 111	731 ± 77	Pass
WW-4663,4664	8/26/2016	H-3	607 ± 104	501 ± 100	554 ± 72	Pass
SPS-4529,4530	8/26/2016	K-40	21.98 ± 2.52	21.85 ± 1.56	21.92 ± 1.48	Pass
AP-083016A	8/30/2016	Gr. Beta	0.030 ± 0.003	0.035 ± 0.004	0.033 ± 0.002	Pass
AP-083016B	8/30/2016	Gr. Beta	0.032 ± 0.009	0.026 ± 0.004	0.029 ± 0.005	Pass
VE-4615,4616	8/31/2016	K-40	2.96 ± 0.16	3.11 ± 0.17	3.03 ± 0.11	Pass

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

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
AP-090216	9/2/2016	Gr. Beta	0.022 ± 0.004	0.027 ± 0.004	0.024 ± 0.003	Pass
AP-090616	9/6/2016	Gr. Beta	0.023 ± 0.005	0.023 ± 0.005	0.023 ± 0.003	Pass
MI-4751,4752	9/7/2016	K-40	1,693 ± 112	1,760 ± 99	1,726 ± 75	Pass
MI-4751,4752	9/7/2016	Sr-90	1.23 ± 0.38	1.00 ± 0.33	1.11 ± 0.25	Pass
SW-4772,4773	9/8/2016	H-3	196 ± 91	236 ± 93	216 ± 65	Pass
WW-5285,5286	9/13/2016	H-3	18,010 ± 400	18,686 ± 407	18,348 ± 286	Pass
MI-4826,4827	9/14/2016	K-40	1,372.6 ± 105	1,198.1 ± 97	1,285.4 ± 71	Pass
VE-4868,4869	9/15/2016	Gr. Beta	2.50 ± 0.06	2.57 ± 0.06	2.53 ± 0.04	Pass
VE-4868,4869	9/15/2016	K-40	2.20 ± 0.17	2.30 ± 0.17	2.25 ± 0.12	Pass
CF-4934,4935	9/19/2016	K-40	11.47 ± 0.82	11.76 ± 0.50	11.61 ± 0.48	Pass
CF-4934,4935	9/19/2016	Be-7	0.43 ± 0.22	0.46 ± 0.13	0.45 ± 0.13	Pass
AP-092016	9/20/2016	Gr. Beta	0.021 ± 0.004	0.017 ± 0.004	0.019 ± 0.003	Pass
DW-70196,70197	9/20/2016	Gr. Alpha	13.8 ± 1.36	15.28 ± 1.36	14.54 ± 0.96	Pass
F-4955,4956	9/20/2016	K-40	3.40 ± 0.44	2.86 ± 0.39	3.13 ± 0.30	Pass
VE-5044,5045	9/20/2016	Be-7	0.46 ± 0.05	0.50 ± 0.11	0.48 ± 0.06	Pass
VE-5044,5045	9/20/2016	K-40	4.37 ± 0.12	4.68 ± 0.24	4.53 ± 0.13	Pass
WW-5219,5220	9/20/2016	H-3	63,744 ± 743	64,755 ± 749	64,250 ± 527	Pass
SPS-5087,5088	9/23/2016	K-40	21.04 ± 2.32	18.84 ± 1.88	19.94 ± 1.49	Pass
AP-092716	9/27/2016	Gr. Beta	0.031 ± 0.005	0.032 ± 0.005	0.031 ± 0.003	Pass
AP-5660,5661	9/28/2016	Be-7	0.093 ± 0.014	0.086 ± 0.019	0.089 ± 0.012	Pass
AP-5681,5682	9/27/2016	Be-7	0.079 ± 0.019	0.071 ± 0.015	0.075 ± 0.012	Pass
VE-5110,5111	9/28/2016	K-40	1.82 ± 0.15	2.14 ± 0.18	1.98 ± 0.12	Pass
AP-5154,5155	9/29/2016	Be-7	0.237 ± 0.116	0.195 ± 0.096	0.216 ± 0.075	Pass
AP-5702,5703	9/30/2016	Be-7	0.084 ± 0.015	0.070 ± 0.018	0.077 ± 0.012	Pass
MI-5264,5265	10/4/2016	K-40	1,636 ± 128	1,610 ± 124	1,623 ± 89	Pass
MI-5264,5265	10/4/2016	Sr-90	2.00 ± 0.44	1.28 ± 0.37	1.64 ± 0.29	Pass
SS-5547,5548	10/11/2016	Gr. Beta	11.27 ± 1.19	9.47 ± 1.20	10.37 ± 0.84	Pass
SS-5547,5548	10/11/2016	K-40	8.03 ± 0.45	7.23 ± 0.46	7.63 ± 0.32	Pass
SS-5547,5548	10/11/2016	Tl-208	0.04 ± 0.02	0.04 ± 0.02	0.04 ± 0.01	Pass
SS-5547,5548	10/11/2016	Bi-214	0.14 ± 0.03	0.12 ± 0.03	0.13 ± 0.02	Pass
SS-5547,5548	10/11/2016	Pb-212	0.12 ± 0.02	0.11 ± 0.02	0.11 ± 0.01	Pass
SS-5547,5548	10/11/2016	Ac-228	0.10 ± 0.05	0.16 ± 0.05	0.13 ± 0.04	Pass
AP-101116	10/11/2016	Gr. Beta	0.032 ± 0.004	0.028 ± 0.004	0.030 ± 0.003	Pass
WW-5526,5527	10/11/2016	H-3	18,865 ± 408	18,904 ± 408	18,884 ± 289	Pass
WW-5639,5640	10/19/2016	H-3	192 ± 103	52 ± 98	122 ± 71	Pass
WW-5723,5724	10/18/2016	H-3	36,012 ± 560	36,207 ± 561	36,110 ± 396	Pass
F-5811,5812	10/20/2016	K-40	0.91 ± 0.30	0.75 ± 0.22	0.83 ± 0.19	Pass
SO-5900,5901	10/22/2016	Cs-137	0.05 ± 0.02	0.03 ± 0.02	0.04 ± 0.02	Pass
SO-5900,5901	10/22/2016	K-40	9.82 ± 0.60	10.77 ± 0.61	10.29 ± 0.43	Pass
SO-5900,5901	10/22/2016	Tl-208	0.10 ± 0.02	0.14 ± 0.03	0.12 ± 0.02	Pass
SO-5900,5901	10/22/2016	Pb-212	0.32 ± 0.03	0.33 ± 0.03	0.32 ± 0.02	Pass
SO-5900,5901	10/22/2016	Bi-214	0.20 ± 0.04	0.27 ± 0.04	0.23 ± 0.03	Pass
SO-5900,5901	10/22/2016	Ac-228	0.41 ± 0.08	0.48 ± 0.09	0.44 ± 0.06	Pass
SO-5900,5901	10/22/2016	Ra-226	0.45 ± 0.23	0.61 ± 0.27	0.53 ± 0.18	Pass
SO-5900,5901	10/22/2016	Gr. Beta	16.49 ± 1.01	17.71 ± 1.03	17.10 ± 0.72	Pass
SS-5879,5880	10/25/2016	K-40	14.94 ± 0.83	15.26 ± 0.84	15.10 ± 0.59	Pass
SS-5879,5880	10/25/2016	Cs-137	0.06 ± 0.03	0.09 ± 0.04	0.08 ± 0.02	Pass
LW-6072,6073	10/27/2016	Gr. Beta	0.88 ± 0.49	1.53 ± 0.56	1.21 ± 0.37	Pass
BS-6009, 6010	10/27/2016	Cs-137	0.14 ± 0.08	0.13 ± 0.06	0.13 ± 0.05	Pass
BS-6009, 6010	10/27/2016	K-40	17.04 ± 1.58	18.30 ± 1.42	17.67 ± 1.06	Pass
F-6211,6212	10/28/2016	Gr. Beta	3.25 ± 0.07	3.27 ± 0.07	3.26 ± 0.05	Pass
F-6211,6212	10/28/2016	K-40	2.45 ± 0.33	2.49 ± 0.37	2.47 ± 0.25	Pass
DW-70230, 70231	10/28/2016	Ra-226	4.00 ± 0.20	4.10 ± 0.30	4.05 ± 0.18	Pass
DW-70230, 70231	10/28/2016	Ra-228	5.30 ± 0.80	5.20 ± 0.80	5.25 ± 0.57	Pass
F-6093,6094	10/31/2016	K-40	3.77 ± 0.50	3.51 ± 0.44	3.64 ± 0.33	Pass

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

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
AP-110116	11/1/2016	Gr. Beta	0.021 ± 0.004	0.024 ± 0.004	0.023 ± 0.003	Pass
S-5963, 5964	11/1/2016	K-40	20.35 ± 2.29	18.59 ± 1.90	19.47 ± 1.49	Pass
SG-6119, 6120	11/1/2016	Ac-228	5.70 ± 0.44	6.28 ± 0.57	5.99 ± 0.36	Pass
SG-6119, 6120	11/1/2016	Gr. Alpha	21.59 ± 1.88	24.35 ± 1.93	22.97 ± 1.35	Pass
SG-6119, 6120	11/1/2016	K-40	4.89 ± 1.10	5.90 ± 1.08	5.40 ± 0.77	Pass
SG-6119, 6120	11/1/2016	Pb-214	3.99 ± 0.21	4.35 ± 0.32	4.17 ± 0.19	Pass
S-6051, 6052	11/4/2016	K-40	7.05 ± 0.60	7.56 ± 0.53	7.31 ± 0.40	Pass
WW-6297, 6298	11/8/2016	H-3	207 ± 98	165 ± 97	186 ± 69	Pass
WW-6341,6342	11/8/2016	H-3	1,356 ± 140	1,404 ± 141	1,380 ± 99	Pass
SO-6406,6407	11/9/2016	Cs-137	0.36 ± 0.04	0.43 ± 0.05	0.40 ± 0.03	Pass
SO-6406,6407	11/9/2016	K-40	10.90 ± 0.68	11.29 ± 0.74	11.09 ± 0.50	Pass
AP-111416	11/14/2016	Gr. Beta	0.024 ± 0.005	0.021 ± 0.006	0.022 ± 0.004	Pass
WW-6829,6830	11/15/2016	H-3	39,982 ± 589	40,315 ± 591	40,149 ± 417	Pass
DW-70239, 70240	11/17/2016	Gr. Alpha	7.99 ± 1.15	6.41 ± 1.05	7.20 ± 0.78	Pass
AP-112216	11/22/2016	Gr. Beta	0.049 ± 0.005	0.045 ± 0.005	0.047 ± 0.003	Pass
S-6473, 6474	11/24/2016	K-40	19.37 ± 1.97	23.80 ± 3.54	21.58 ± 2.02	Pass
SG-6938, 6939	11/28/2016	Ac-228	18.99 ± 0.59	19.92 ± 0.79	19.46 ± 0.49	Pass
SG-6938, 6939	11/28/2016	Pb-214	15.28 ± 0.34	14.96 ± 0.43	15.12 ± 0.27	Pass
AP-120116	12/1/2016	Gr. Beta	0.029 ± 0.003	0.030 ± 0.003	0.030 ± 0.002	Pass
F-6567,6568	12/1/2016	K-40	3.76 ± 0.40	3.83 ± 0.46	3.80 ± 0.30	Pass
S-6522, 6523	12/1/2016	Ac-228	1.08 ± 0.13	1.29 ± 0.16	1.19 ± 0.10	Pass
S-6522, 6523	12/1/2016	Pb-214	1.00 ± 0.08	1.01 ± 0.09	1.01 ± 0.06	Pass
S-6609, 6610	12/1/2016	K-40	15.57 ± 1.01	15.99 ± 0.78	15.78 ± 0.64	Pass
S-6718, 6719	12/7/2016	K-40	18.19 ± 2.13	18.76 ± 1.80	18.48 ± 1.39	Pass
WW-6784, 6785	12/7/2016	H-3	922 ± 117	905 ± 116	914 ± 82	Pass
AP-121216	12/12/2016	Gr. Beta	0.026 ± 0.005	0.028 ± 0.005	0.027 ± 0.003	Pass
AP-7178,7179	1/3/2017	Be-7	0.047 ± 0.015	0.062 ± 0.017	0.054 ± 0.012	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).

TABLE A-6. 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
MASO-1053	2/1/2016	Ni-63	1,206 ± 20	1250	875 - 1625	Pass
MASO-1053	2/1/2016	Sr-90	0.65 ± 1.27	0.00	NA [c]	Pass
MASO-1053	2/1/2016	Tc-99	0.1 ± 5.5	0.0	NA [c]	Pass
MASO-1053	2/1/2016	Cs-134	908 ± 26	1030	721 - 1339	Pass
MASO-1053	2/1/2016	Cs-137	0.10 ± 6.20	0.00	NA [c]	Pass
MASO-1053	2/1/2016	Co-57	1058 ± 26	992	694 - 1290	Pass
MASO-1053	2/1/2016	Co-60	1229 ± 28	1190	833 - 1547	Pass
MASO-1053	2/1/2016	Mn-54	1235 ± 43	1160	812 - 1508	Pass
MASO-1053	2/1/2016	Zn-65	753 ± 64	692	484 - 900	Pass
MASO-1053	2/1/2016	K-40	753 ± 140	607	425 - 789	Pass
MASO-1053	2/1/2016	Am-241	79 ± 6	103	72 - 134	Pass
MASO-1053	2/1/2016	Pu-238	73.9 ± 9.2	63.6	44.5 - 82.7	Pass
MASO-1053	2/1/2016	Pu-239/240	0.76 ± 1.34	0.21	NA [d]	Pass
MASO-1053	2/1/2016	U-234/233	45.0 ± 5.1	45.9	32.1 - 59.7	Pass
MASO-1053	2/1/2016	U-238	129 ± 9	146	102 - 190	Pass
MAW-989	2/1/2016	Am-241	0.018 ± 0.015	0.00	NA [c]	Pass
MAW-989	2/1/2016	H-3	0.2 ± 2.8	0.0	NA [c]	Pass
MAW-989	2/1/2016	Ni-63	12.8 ± 2.7	12.3	8.6 - 16.0	Pass
MAW-989	2/1/2016	Sr-90	8.70 ± 1.20	8.74	6.12 - 11.36	Pass
MAW-989	2/1/2016	Tc-99	-1.1 ± 0.6	0.0	NA [c]	Pass
MAW-989	2/1/2016	Cs-134	15.5 ± 0.3	16.1	11.3 ± 20.9	Pass
MAW-989	2/1/2016	Cs-137	23.7 ± 0.5	21.2	14.8 - 27.6	Pass
MAW-989 [e]	2/1/2016	Co-57	1.38 ± 0.12	0.00	NA [c]	Fail
MAW-989	2/1/2016	Co-60	12.5 ± 0.3	11.8	8.3 - 15.3	Pass
MAW-989	2/1/2016	Mn-54	12.2 ± 0.4	11.1	7.8 - 14.4	Pass
MAW-989	2/1/2016	Zn-65	15.7 ± 0.7	13.6	9.5 - 17.7	Pass
MAW-989	2/1/2016	K-40	288 ± 5	251	176 - 326	Pass
MAW-989	2/1/2016	Fe-55	17.3 ± 7.0	16.2	11.3 - 21.1	Pass
MAW-989	2/1/2016	Ra-226	0.710 ± 0.070	0.718	0.503 - 0.933	Pass
MAW-989	2/1/2016	Pu-238	1.280 ± 0.110	1.244	0.871 ± 1.617	Pass
MAW-989	2/1/2016	Pu-239/240	0.640 ± 0.080	0.641	0.449 - 0.833	Pass
MAW-989	2/1/2016	U-234/233	1.39 ± 0.12	1.48	1.04 - 1.92	Pass
MAW-989	2/1/2016	U-238	1.43 ± 0.12	1.53	1.07 - 1.99	Pass
MAW-893	2/1/2016	Gross Alpha	0.600 ± 0.050	0.673	0.202 - 1.144	Pass
MAW-893	2/1/2016	Gross Beta	2.10 ± 0.06	2.15	1.08 - 3.23	Pass
MAW-896	2/1/2016	I-129	3.67 ± 0.20	3.85	2.70 - 5.01	Pass
MAAP-1056	2/1/2016	Gross Alpha	0.39 ± 0.05	1.20	0.36 - 2.04	Pass
MAAP-1056	2/1/2016	Gross Beta	1.03 ± 0.07	0.79	0.40 - 1.19	Pass

TABLE A-6. 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-1057	2/1/2016	Sr-90	1.34 ± 0.15	1.38	0.97 ± 1.79	Pass
MAAP-1057	2/1/2016	Cs-134	-0.01 ± 0.03	0.00	NA [c]	Pass
MAAP-1057	2/1/2016	Cs-137	2.57 ± 0.10	2.30	1.61 - 2.99	Pass
MAAP-1057	2/1/2016	Co-57	3.01 ± 0.06	2.94	2.06 - 3.82	Pass
MAAP-1057	2/1/2016	Co-60	4.28 ± 0.10	4.02	2.81 - 5.23	Pass
MAAP-1057	2/1/2016	Mn-54	4.90 ± 0.13	4.53	3.17 - 5.89	Pass
MAAP-1057	2/1/2016	Zn-65	4.09 ± 0.18	3.57	2.50 - 4.64	Pass
MAAP-1057	2/1/2016	Am-241	0.059 ± 0.015	0.0805	0.0564 - 0.1047	Pass
MAAP-1057	2/1/2016	Pu-238	0.066 ± 0.020	0.0637	0.0446 - 0.0828	Pass
MAAP-1057	2/1/2016	Pu-239/240	0.074 ± 0.020	0.099	NA [d]	Pass
MAAP-1057	2/1/2016	U-234/233	0.151 ± 0.026	0.165	0.116 - 0.215	Pass
MAAP-1057	2/1/2016	U-238	0.160 ± 0.026	0.172	0.120 - 0.224	Pass
MAVE-1050	2/1/2016	Cs-134	9.83 ± 0.19	10.62	7.43 - 13.81	Pass
MAVE-1050	2/1/2016	Cs-137	6.06 ± 0.19	5.62	3.93 - 7.31	Pass
MAVE-1050	2/1/2016	Co-57	13.8 ± 0.2	11.8	8.3 - 15.3	Pass
MAVE-1050	2/1/2016	Co-60	0.022 ± 0.040	0.00	NA [c]	Pass
MAVE-1050	2/1/2016	Mn-54	0.009 ± 0.044	0.000	NA [c]	Pass
MAVE-1050	2/1/2016	Zn-65	10.67 ± 0.39	9.60	6.70 - 12.50	Pass
MASO-4780 [f]	8/1/2016	Ni-63	648 ± 14	990	693 - 1287	Fail
MASO-4780 [g]	8/1/2016	Ni-63	902 ± 46	990	693 - 1287	Pass
MASO-4780	8/1/2016	Sr-90	757 ± 16	894	626 - 1162	Pass
MASO-4780	8/1/2016	Tc-99	559 ± 12	556	389 - 723	Pass
MASO-4780	8/1/2016	Cs-134	0.93 ± 2.92	0.00	NA [c]	Pass
MASO-4780	8/1/2016	Cs-137	1061 ± 12	1067	747 - 1387	Pass
MASO-4780	8/1/2016	Co-57	1178 ± 8	1190	833 - 1547	Pass
MASO-4780	8/1/2016	Co-60	841 ± 9	851	596 - 1106	Pass
MASO-4780	8/1/2016	Mn-54	0.69 ± 2.53	0.00	NA [c]	Pass
MASO-4780	8/1/2016	Zn-65	724 ± 19	695	487 - 904	Pass
MASO-4780	8/1/2016	K-40	566 ± 52	588	412 - 764	Pass
MASO-4780	8/1/2016	Am-241	0.494 ± 0.698	0.000	NA [c]	Pass
MASO-4780	8/1/2016	Pu-238	69.7 ± 7.4	70.4	49.3 - 91.5	Pass
MASO-4780	8/1/2016	Pu-239/240	53.9 ± 6.3	53.8	37.7 - 69.9	Pass
MASO-4780 [h]	8/1/2016	U-233/234	46.8 ± 3.9	122	85 - 159	Fail
MASO-4780 [h]	8/1/2016	U-238	46.6 ± 3.9	121	85 - 157	Fail
MAW-4776	8/1/2016	I-129	4.40 ± 0.20	4.54	3.18 - 5.90	Pass
MAVE-4782	8/1/2016	Cs-134	-0.01 ± 0.05	0.00	NA [c]	Pass
MAVE-4782	8/1/2016	Cs-137	6.18 ± 0.20	5.54	3.88 - 7.20	Pass
MAVE-4782	8/1/2016	Co-57	8.13 ± 0.16	6.81	4.77 - 8.85	Pass
MAVE-4782	8/1/2016	Co-60	5.30 ± 0.15	4.86	3.40 - 6.32	Pass
MAVE-4782	8/1/2016	Mn-54	8.08 ± 0.24	7.27	5.09 - 9.45	Pass
MAVE-4782	8/1/2016	Zn-65	6.24 ± 0.36	5.40	3.78 - 7.02	Pass

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

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	NA [c] Limits [c]	Acceptance
MAAP-4784	8/1/2016	Sr-90	1.18 ± 0.10	1.03	0.72 - 1.34	Pass
MAAP-4784	8/1/2016	Cs-134	1.58 ± 0.08	2.04	1.43 - 2.65	Pass
MAAP-4784	8/1/2016	Cs-137	1.85 ± 0.09	1.78	1.25 - 2.31	Pass
MAAP-4784	8/1/2016	Co-57	2.39 ± 0.52	2.48	1.74 - 3.22	Pass
MAAP-4784	8/1/2016	Co-60	3.22 ± 0.08	3.26	2.28 - 4.24	Pass
MAAP-4784	8/1/2016	Mn-54	2.82 ± 0.12	2.75	1.93 - 3.58	Pass
MAAP-4784	8/1/2016	Zn-65	-0.015 ± 0.062	0.00	NA [c]	Pass
MAAP-4784	8/1/2016	Am-241	-0.001 ± 0.006	0.00	NA [c]	Pass
MAAP-4784	8/1/2016	Pu-238	0.075 ± 0.022	0.069	0.049 - 0.090	Pass
MAAP-4784	8/1/2016	Pu-239/240	0.048 ± 0.015	0.054	0.038 - 0.070	Pass
MAAP-4784	8/1/2016	U-234/233	0.151 ± 0.036	0.150	0.105 - 0.195	Pass
MAAP-4784	8/1/2016	U-238	0.147 ± 0.034	0.156	0.109 - 0.203	Pass
MAW-4778	8/1/2016	H-3	365 ± 11	334	234 - 434	Pass
MAW-4778	8/1/2016	Fe-55	23.6 ± 16.3	21.5	15.1 ± 28.0	Pass
MAW-4778	8/1/2016	Ni-63	17.0 ± 2.8	17.2	12.0 ± 22.4	Pass
MAW-4778	8/1/2016	Sr-90	0.17 ± 0.28	0.00	NA [c]	Pass
MAW-4778	8/1/2016	Tc-99	9.50 ± 0.41	11.60	8.10 - 15.10	Pass
MAW-4778	8/1/2016	Cs-134	22.6 ± 0.4	23.9	16.7 - 31.1	Pass
MAW-4778	8/1/2016	Cs-137	0.018 ± 0.117	0.00	NA [c]	Pass
MAW-4778	8/1/2016	Co-57	27.6 ± 0.2	27.3	19.1 ± 35.5	Pass
MAW-4778	8/1/2016	Co-60	0.018 ± 0.090	0.00	NA [c]	Pass
MAW-4778	8/1/2016	Mn-54	16.2 ± 0.4	14.8	10.4 - 19.2	Pass
MAW-4778	8/1/2016	Zn-65	19.3 ± 0.7	17.4	12.2 - 22.6	Pass
MAW-4778	8/1/2016	K-40	286 ± 6	252	176 - 328	Pass
MAW-4778	8/1/2016	Ra-226	1.48 ± 0.09	1.33	0.93 - 1.73	Pass
MAW-4778	8/1/2016	Pu-238	1.09 ± 0.13	1.13	0.79 - 1.47	Pass
MAW-4778	8/1/2016	Pu-239/240	0.003 ± 0.011	0.016	NA [d]	Pass
MAW-4778	8/1/2016	U-234/233	1.80 ± 0.13	1.86	1.30 - 2.42	Pass
MAW-4778	8/1/2016	U-238	1.77 ± 0.13	1.92	1.34 - 2.50	Pass
MAW-4778	8/1/2016	Am-241	0.678 ± 0.086	0.814	0.570 ± 1.058	Pass

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

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

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

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

[e] The laboratory properly identified the Sn-75 interfering peak in the vicinity of Co-57 and stated so in the comment field. MAPEP requires results to be reported as an activity with an uncertainty. Since the calculated uncertainty was less than the activity MAPEP interpreted the submitted result as a "false positive" resulting in a failure.

[f] Original analysis for Ni-63 failed.

[g] Reanalysis with a smaller aliquot resulted in acceptable results. An investigation is in process to identify better techniques for analyzing samples with complex matrices.

[h] MAPEP states that samples contain two fractions of Uranium; one that is soluble in concentrated HNO^3 and HCl acid and one that is "fundamentally insoluble in these acids". They also state that HF treatment can not assure complete dissolution. Results are consistent with measuring the soluble form.

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

MRAD Study

Lab Code [b]	Concentration [a]					
	Date	Analysis	Laboratory Result	ERA Result	Control Limits	Acceptance
ERAP-1101	3/14/2016	Am-241	37.3	45.9	28.3 - 62.1	Pass
ERAP-1101	3/14/2016	Co-60	637	623	482 - 778	Pass
ERAP-1101	3/14/2016	Cs-134	251	304	193 - 377	Pass
ERAP-1101	3/14/2016	Cs-137	1,273	1,150	864 - 1,510	Pass
ERAP-1101	3/14/2016	Fe-55	< 162	126	39.1 - 246	Pass
ERAP-1101	3/14/2016	Mn-54	< 2.64	< 50.0	0.00 - 50.0	Pass
ERAP-1101	3/14/2016	Pu-238	68.0	70.5	48.3 - 92.7	Pass
ERAP-1101	3/14/2016	Pu-239/240	54.1	54.8	39.70 - 71.60	Pass
ERAP-1101	3/14/2016	Sr-90	139	150	73.3 - 225.0	Pass
ERAP-1101	3/14/2016	U-233/234	59.3	64.8	40.2 - 97.7	Pass
ERAP-1101	3/14/2016	U-238	55.5	64.2	41.5 - 88.8	Pass
ERAP-1101	3/14/2016	Zn-65	428	356	255 - 492	Pass
ERAP-1101	3/14/2016	Gr. Alpha	98.0	70.1	23.5 - 109	Pass
ERAP-1101	3/14/2016	Gr. Beta	78.6	54.4	34.4 - 79.3	Pass
ERSO-1105	3/14/2016	Am-241	1,030	1,360	796 - 1,770	Pass
ERSO-1105	3/14/2016	Ac-228	1,540	1,240	795 - 1,720	Pass
ERSO-1105	3/14/2016	Bi-212	1,550	1,240	330 - 1,820	Pass
ERSO-1105	3/14/2016	Bi-214	3,100	3,530	2,130 - 5,080	Pass
ERSO-1105	3/14/2016	Co-60	5,600	5,490	3,710 - 7,560	Pass
ERSO-1105	3/14/2016	Cs-134	3,030	3,450	2,260 - 4,140	Pass
ERSO-1105	3/14/2016	Cs-137	4,440	4,310	3,300 - 5,550	Pass
ERSO-1105	3/14/2016	K-40	10,300	10,600	7,740 - 14,200	Pass
ERSO-1105	3/14/2016	Mn-54	< 50.8	< 1000	0.0 - 1,000	Pass
ERSO-1105	3/14/2016	Pb-212	1,140	1,240	812 - 1,730	Pass
ERSO-1105	3/14/2016	Pb-214	3,190	3,710	2,170 - 5,530	Pass
ERSO-1105	3/14/2016	Pu-238	680	658	396 - 908	Pass
ERSO-1105	3/14/2016	Pu-239/240	460	496	324 - 0,685	Pass
ERSO-1105	3/14/2016	Sr-90	7,740	8,560	3,260 - 13,500	Pass
ERSO-1105	3/14/2016	Th-234	3,630	3,430	1,080 - 6,450	Pass
ERSO-1105	3/14/2016	U-233/234	3,090	3,460	2,110 - 4,430	Pass
ERSO-1105	3/14/2016	U-238	3,280	3,430	2,120 - 4,350	Pass
ERSO-1105	3/14/2016	Zn-65	2,940	2,450	1,950 - 3,260	Pass
ERW-1115	3/14/2016	Gr. Alpha	105.0	117.0	41.5 - 181.0	Pass
ERW-1115	3/14/2016	Gr. Beta	76.2	75.5	43.2 - 112.0	Pass
ERW-1117	3/14/2016	H-3	8,870	8,650	5,800 - 12,300	Pass

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

MRAD Study

Lab Code [b]	Concentration [a]					
	Date	Analysis	Laboratory Result	ERA Result	Control Limits	Acceptance
ERVE-1108	3/14/2016	Am-241	1,930	2,120	1,300 - 2,820	Pass
ERVE-1108	3/14/2016	Cm-244	1,294	1,560	764 - 2,430	Pass
ERVE-1108	3/14/2016	Co-60	1,164	1,100	759 - 1,540	Pass
ERVE-1108	3/14/2016	Cs-134	1,056	1,070	687 - 1,390	Pass
ERVE-1108	3/14/2016	Cs-137	930	838	608 - 1,170	Pass
ERVE-1108	3/14/2016	K-40	32,200	31,000	22,400 - 43,500	Pass
ERVE-1108	3/14/2016	Mn-54	< 24.5	< 300	0.00 - 300	Pass
ERVE-1108	3/14/2016	Zn-65	3,320	2,820	2,030 - 3,960	Pass
ERVE-1108	3/14/2016	Pu-238	3,410	2,810	1,680 - 3,850	Pass
ERVE-1108	3/14/2016	Pu-239/240	4,120	3,640	2,230 - 5,010	Pass
ERVE-1108	3/14/2016	Sr-90	8,120	8,710	4,960 - 11,500	Pass
ERVE-1108	3/14/2016	U-233/234	4,350	4,160	2,740 - 5,340	Pass
ERVE-1108	3/14/2016	U-238	4,220	4,120	2,750 - 5,230	Pass
ERW-1111	3/14/2016	Am-241	113	121	81.5 - 162	Pass
ERW-1111	3/14/2016	Co-60	1,120	1,050	912 - 1,230	Pass
ERW-1111	3/14/2016	Cs-134	806	842	618 - 968	Pass
ERW-1111	3/14/2016	Cs-137	1,190	1,100	934 - 1,320	Pass
ERW-1111	3/14/2016	Mn-54	< 5.89	< 100	0.00 - 100	Pass
ERW-1111	3/14/2016	Pu-238	159	138	102 - 172	Pass
ERW-1111	3/14/2016	Pu-239/240	113	98.7	76.6 - 124	Pass
ERW-1111	3/14/2016	U-233/234	46.9	52.7	39.6 - 68.0	Pass
ERW-1111	3/14/2016	U-238	50.4	52.3	39.9 - 64.2	Pass
ERW-1111	3/14/2016	Zn-65	1,160	1,010	842 - 1,270	Pass
ERW-1111	3/14/2016	Fe-55	1,600	1,650	984 - 2,240	Pass
ERW-1111	3/14/2016	Sr-90	430	434	283 - 574	Pass

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

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

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

Appendix B
2016 REMP Data Summary Reports

Environmental Radiological Monitoring Program Annual Summary
Perry Nuclear Power Plant   Docket Number 50-440/50-441
Lake County, Ohio   Reporting Period: 2016

Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean		Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
					Location # Distance & Direction	Mean Detected/ Collected Range		
Air pCi/m3	Be-7 28	N/A	0.068 28/28 0.048 - 0.094	0.068 24/24 0.048 - 0.094	7 0.6 NE	0.074 4/4 0.062 - 0.088	0.066 4/4 0.057 - 0.084	0
Air pCi/m3	Co-58 28	N/A	< LLD 0/28 —	< LLD 0/24 —	—	—	< LLD 0/4 —	0
Air pCi/m3	Co-60 28	N/A	< LLD 0/28 —	< LLD 0/24 —	—	—	< LLD 0/4 —	0
Air pCi/m3	Cs-134 28	0.037	< LLD 0/28 —	< LLD 0/24 —	—	—	< LLD 0/4 —	0
Air pCi/m3	Cs-137 28	0.045	< LLD 0/28 —	< LLD 0/24 —	—	—	< LLD 0/4 —	0
Air pCi/m3	Gross Beta 364	0.0075	0.024 363/364 0.011 - 0.054	0.024 311/312 0.011 - 0.054	7 0.6 NE	0.026 52/52 0.012 - 0.044	0.024 52/52 0.013 - 0.038	0
Air pCi/m3	I-131 364	0.05	<LLD 0/364 —	<LLD 0/312 —	—	—	<LLD 0/52 —	0

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					Location # Distance & Direction	Mean Detected/ Collected Range		
Broadleaf Vegetation pCi/kg wet	Be-7 59	N/A	384.1 47/59 116 - 934	363.7 38/46 116 - 934	70 17.1 SSW	470.6 9/13 392 - 585	470.6 9/13 392 - 585	0
Broadleaf Vegetation pCi/kg wet	K-40 59	N/A	5016.5 59/59 2880 - 12034	4660.1 46/46 2880 - 8884	70 17.1 SSW	6277.6 13/13 4283 - 12034	6277.6 13/13 4283 - 12034	0
Broadleaf Vegetation pCi/kg wet	Co-58 59	N/A	<LLD 0/59 —	<LLD 0/46 —	—	—	<LLD 0/13 —	0
Broadleaf Vegetation pCi/kg wet	Co-60 59	N/A	<LLD 0/59 —	<LLD 0/46 —	—	—	<LLD 0/13 —	0
Broadleaf Vegetation pCi/kg wet	I-131 59	45	<LLD 0/59 —	<LLD 0/46 —	—	—	<LLD 0/13 —	0
Broadleaf Vegetation pCi/kg wet	Cs-134 59	45	<LLD 0/59 —	<LLD 0/46 —	—	—	<LLD 0/13 —	0
Broadleaf Vegetation pCi/kg wet	Cs-137 59	60	<LLD 0/59 —	<LLD 0/46 —	—	—	<LLD 0/13 —	0

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Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean		Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
					Location # Distance & Direction	Mean Detected/ Collected Range		
Fish pCi/kg wet	K-40 17	N/A	1503.2 17/17 710 - 2752	1491.9 10/10 748 - 2557	32 15.8 WSW	1519.3 7/7 710 - 2752	1519.3 7/7 710 - 2752	0
Fish pCi/kg wet	Mn-54 17	94	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Fish pCi/kg wet	Fe-59 17	195	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Fish pCi/kg wet	Co-58 17	97	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Fish pCi/kg wet	Co-60 17	97	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Fish pCi/kg wet	Zn-65 17	195	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Fish pCi/kg wet	Cs-134 17	97	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0

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Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean Location # Distance & Direction	Location with Highest Annual Mean Mean Detected/ Collected Range	Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
Fish pCi/kg wet	Cs-137 17	112	<LLD 0/17 —	<LLD 0/10 —	—	—	<LLD 0/7 —	0
Milk pCi/L	K-40 38	N/A	1487.2 38/38 1181 - 3646	N/A N/A N/A	19 9.2 S	1363.1 19/19 1252 - 1473	1487.2 38/38 1181 - 3646	0
Milk pCi/L	I-131 38	0.8	<LLD 0/38 —	N/A N/A N/A	—	—	<LLD 0/38 —	0
Milk pCi/L	Cs-134 38	11	<LLD 0/38 —	N/A N/A N/A	—	—	<LLD 0/38 —	0
Milk pCi/L	Cs-137 38	13	<LLD 0/38 —	N/A N/A N/A	—	—	<LLD 0/38 —	0
Milk pCi/L	Ba-140 38	45	<LLD 0/38 —	N/A N/A N/A	—	—	<LLD 0/38 —	0
Milk pCi/L	La-140 38	11	<LLD 0/38 —	N/A N/A N/A	—	—	<LLD 0/38 —	0

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Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean		Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
					Location # Distance & Direction	Mean Detected/ Collected Range		
Sediment pCi/kg wet	K-40 4	N/A	9663.5 4/4 8401 - 11614	9663.5 4/4 8401 - 11614	64 0.4 WNW	10411.5 2/2 9209 - 11614	N/A N/A N/A	0
Sediment pCi/kg wet	Co-58 4	50	<LLD 0/4 —	<LLD 0/4 —	—	—	N/A N/A N/A	0
Sediment pCi/kg wet	Co-60 4	40	<LLD 0/4 —	<LLD 0/4 —	—	—	N/A N/A N/A	0
Sediment pCi/kg wet	Cs-134 4	112	<LLD 0/4 —	<LLD 0/4 —	—	—	N/A N/A N/A	0
Sediment pCi/kg wet	Cs-137 4	135	<LLD 0/4 —	<LLD 0/4 —	—	—	N/A N/A N/A	0
TLD (E) mR/91 days	Direct 116	1.0	12.9 116/116 7.6 – 20.1	12.9 108/108 7.6 - 20.1	33 4.7 S	18.5 4/4 17.1 – 20.1	12.3 8/8 9.0 – 15.3	0
TLD (Q) mR/91 days	Direct 116	1.0	13.2 116/116 7.5 – 22.6	13.2 108/108 7.5 – 22.6	33 4.7 S	19.2 4/4 16.8 – 22.6	12.7 8/8 11.0 - 15.3	0

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Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean		Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
					Location # Distance & Direction	Mean Detected/ Collected Range		
TLD mR/365 days	Direct 29	1.0	65.5 29/29 56.0 – 85.3	65.8 27/27 56.0 – 85.3	29 4.5 SSE	85.3 1/1 85.3 – 85.3	61.8 2/2 61.1 – 62.4	0
Water pCi/L	Gross Beta 60	3.0	1.8 52/60 0.9 – 4.0	1.8 40/48 0.9 – 3.2	34 0.2 NW	2.1 7/12 1.2 – 3.2	1.8 12/12 1.0 – 4.0	0
Water pCi/L	H-3 20	1500	<LLD 0/20 —	<LLD 0/16 —	—	—	<LLD 0/4 —	0
Water pCi/L	Mn-54 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Fe-59 60	22	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Co-58 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Co-60 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0

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Pathway Sampled Units	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) *	Mean for All Locations Detected/Collected Range	Mean for Indicator Locations Detected/Collected Range	Location with Highest Annual Mean		Mean for Control Locations Detected/Collected Range	Number of Non-routine Reported Measurements
					Location # Distance & Direction	Mean Detected/ Collected Range		
Water pCi/L	Zn-65 60	22	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Zr-95 60	22	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Nb-95 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Cs-134 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Cs-137 60	13	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	Ba-140 60	45	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0
Water pCi/L	La-140 60	11	<LLD 0/60 —	<LLD 0/48 —	—	—	<LLD 0/12 —	0

*This value is the LLD that is met by the vendor and is lower than required by the ODCM

Appendix C
2016 REMP Detailed Data Report

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MONTHLY PROGRESS REPORT
to
FIRST ENERGY CORPORATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
FOR THE
PERRY NUCLEAR POWER PLANT

Reporting Period: January-December, 2016

Prepared and Submitted by
ENVIRONMENTAL, INC.,
MIDWEST LABORATORY

Project Number: 8033

Reviewed and Approved ____________________
B. Grob, M.S.
Laboratory Manager

Date 02-02-2017

Distribution: M. Baker
R. Leidy, Ohio Department of Health
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PERRY NUCLEAR POWER PLANT

1.0 INTRODUCTION

The following constitutes the final 2016 Report for the Radiological Environmental Monitoring Program conducted at the Perry Nuclear Power Plant in Perry, Ohio. Results of completed analyses are presented in the attached tables.

The data obtained in the program were within ranges previously encountered and to be expected in the environmental media sampled.

All concentrations, except gross beta, are decay corrected to the time of collection. Airborne iodine is decay corrected to the midpoint of the collection period.

All samples were collected within the scheduled period, unless noted otherwise in Table 2.0, Listing of Missed Samples.

2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
MI	P-18	01-04-16	No milk available.
MI	P-41	01-04-16	No milk available.
MI	P-18	02-01-16	No milk available.
MI	P-41	02-01-16	No milk available.
MI	P-18	03-07-16	No milk available.
MI	P-41	03-07-16	No milk available.
MI	P-18	04-05-16	No milk available.
MI	P-41	04-05-16	No milk available.
MI	P-18	04-18-16	No milk available.
MI	P-41	04-18-16	No milk available.
MI	P-18	05-02-16	No milk available.
MI	P-41	05-02-16	No milk available.
MI	P-18	05-16-16	No milk available.
MI	P-41	05-16-16	No milk available.
MI	P-18	06-06-16	No milk available.
MI	P-41	06-06-16	No milk available.
MI	P-18	06-20-16	No milk available.
MI	P-41	06-20-16	No milk available.
MI	P-18	07-05-16	No milk available.
MI	P-41	07-05-16	No milk available.
MI	P-18	07-18-16	No milk available.
MI	P-41	07-18-16	No milk available.
MI	P-18	08-02-16	No milk available.
MI	P-41	08-02-16	No milk available.
MI	P-18	08-16-16	No milk available.
MI	P-41	08-16-16	No milk available.
MI	P-18	09-06-16	No milk available.
MI	P-41	09-06-16	No milk available.
MI	P-18	09-19-16	No milk available.
MI	P-41	09-19-16	No milk available.
MI	P-18	10-03-16	No milk available.
MI	P-41	10-03-16	No milk available.
MI	P-18	10-17-16	No milk available.
MI	P-41	10-17-16	No milk available.
MI	P-18	11-07-16	No milk available.
MI	P-41	11-07-16	No milk available.
MI	P-18	12-05-16	No milk available.
MI	P-41	12-05-16	No milk available.

Table 1. Direct Radiation (TLDs), Quarterly Exposure.
Units: mR/91 days

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Date Placed	01-05-16	04-07-16	07-05-16	10-06-16
Date Removed	04-07-16	07-05-16	10-16-16	01-11-17
E-1	14.2 ± 3.5	10.6 ± 1.3	9.4 ± 0.9	13.5 ± 1.4
E-3	14.0 ± 3.5	10.3 ± 1.1	9.3 ± 0.6	12.8 ± 1.3
E-4	15.2 ± 3.5	11.0 ± 0.8	10.6 ± 0.7	13.0 ± 1.0
E-5	13.0 ± 3.5	8.3 ± 0.8	8.4 ± 0.6	10.6 ± 0.9
E-6	14.9 ± 3.6	9.0 ± 0.9	10.1 ± 0.9	12.1 ± 0.9
E-7	12.2 ± 3.5	9.1 ± 1.2	8.2 ± 0.7	13.0 ± 1.1
E-8	14.5 ± 3.5	8.6 ± 1.1	9.6 ± 0.6	11.1 ± 0.8
E-9	10.9 ± 3.4	9.9 ± 0.8	7.6 ± 0.8	12.6 ± 1.0
E-10	13.3 ± 3.5	9.4 ± 0.9	9.2 ± 0.5	11.3 ± 1.1
E-11	16.6 ± 3.5	12.9 ± 0.8	11.9 ± 0.8	15.1 ± 1.1
E-12	15.2 ± 3.5	12.9 ± 1.3	11.2 ± 0.5	16.1 ± 1.0
E-13	13.4 ± 3.5	9.3 ± 1.1	9.0 ± 1.1	12.5 ± 1.2
E-14	10.6 ± 3.5	10.9 ± 0.9	9.5 ± 0.6	13.7 ± 1.1
E-15	8.5 ± 3.4	9.9 ± 0.9	10.3 ± 0.4	12.5 ± 0.8
E-21	17.8 ± 3.4	14.6 ± 0.8	15.2 ± 0.6	17.1 ± 1.3
E-23	16.3 ± 3.5	14.6 ± 1.0	12.9 ± 1.5	17.4 ± 0.9
E-24	15.3 ± 3.5	11.4 ± 1.1	12.4 ± 0.7	13.4 ± 1.0
E-29	17.0 ± 3.5	15.4 ± 1.1	14.2 ± 0.9	17.8 ± 1.6
E-30	16.3 ± 3.4	14.7 ± 0.9	14.1 ± 0.6	16.7 ± 0.9
E-31	15.9 ± 3.5	13.0 ± 0.9	14.2 ± 0.9	15.6 ± 1.0
E-33	20.1 ± 3.5	17.1 ± 0.9	18.0 ± 0.8	18.7 ± 0.9
E-35	13.6 ± 3.4	10.9 ± 1.0	11.1 ± 0.6	13.0 ± 1.0
E-36	17.8 ± 3.4	12.8 ± 0.7	16.1 ± 0.5	15.7 ± 0.7
E-53	15.4 ± 3.5	9.5 ± 1.0	13.7 ± 0.5	12.9 ± 1.0
E-54	14.4 ± 3.5	10.1 ± 0.8	12.1 ± 0.6	12.0 ± 0.8
E-55	15.2 ± 3.7	12.0 ± 1.2	13.0 ± 1.4	14.4 ± 1.3
E-56	14.2 ± 3.5	11.6 ± 0.8	11.3 ± 0.5	13.8 ± 0.9
E-57	15.5 ± 3.5	11.9 ± 1.2	12.9 ± 0.7	14.4 ± 1.3
E-58	12.7 ± 3.5	9.8 ± 0.8	10.2 ± 0.6	12.0 ± 1.0
Mean ± s.d.	14.6 ± 2.4	11.4 ± 2.2	11.6 ± 2.5	14.0 ± 2.1
E-Control 1	8.6 ± 3.5	5.0 ± 1.1	7.1 ± 1.2	5.7 ± 1.1
E-Control 2	8.9 ± 3.5	4.9 ± 0.8	7.0 ± 0.6	5.1 ± 0.7

Table 1. Direct Radiation (TLDs), Quarterly Exposure.
Units: mR/91 days

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Date Placed	01-12-15	04-07-16	07-05-16	10-06-16
Date Removed	04-03-15	07-05-16	10-16-16	01-11-17
Q-1	13.0 ± 1.6	12.0 ± 1.1	12.1 ± 1.5	12.3 ± 1.4
Q-3	10.7 ± 0.6	10.0 ± 1.1	10.2 ± 0.7	11.7 ± 1.3
Q-4	11.5 ± 0.6	11.9 ± 0.9	11.5 ± 0.6	13.3 ± 1.0
Q-5	8.3 ± 0.6	11.7 ± 1.2	7.7 ± 0.6	13.1 ± 1.5
Q-6	11.7 ± 0.8	13.7 ± 0.8	11.0 ± 0.8	15.3 ± 1.1
Q-7	14.0 ± 0.8	14.0 ± 0.8	13.1 ± 0.4	15.7 ± 1.2
Q-8	11.2 ± 0.6	9.6 ± 0.7	11.2 ± 0.7	11.7 ± 1.0
Q-9	13.1 ± 0.7	9.3 ± 0.9	12.8 ± 0.7	10.8 ± 1.0
Q-10	11.4 ± 0.8	11.4 ± 0.8	11.1 ± 0.8	12.9 ± 1.3
Q-11	13.0 ± 0.8	13.2 ± 0.8	13.1 ± 0.9	14.8 ± 1.0
Q-12	12.0 ± 0.5	11.4 ± 0.9	12.0 ± 0.5	12.8 ± 1.0
Q-13	9.3 ± 0.5	10.1 ± 1.0	11.9 ± 1.2	11.8 ± 1.3
Q-14	12.6 ± 0.7	14.2 ± 1.1	12.3 ± 0.7	16.1 ± 1.3
Q-15	11.6 ± 0.5	9.1 ± 0.8	11.8 ± 0.9	11.8 ± 1.2
Q-21	10.4 ± 0.6	13.2 ± 1.2	15.0 ± 0.7	17.3 ± 1.5
Q-23	10.9 ± 1.0	14.8 ± 1.4	15.8 ± 1.1	16.7 ± 1.6
Q-24	11.8 ± 1.4	11.7 ± 0.8	11.4 ± 1.2	14.8 ± 1.0
Q-29	16.9 ± 0.7	16.1 ± 1.2	17.5 ± 0.7	19.8 ± 1.1
Q-30	13.7 ± 0.7	12.0 ± 0.8	14.3 ± 0.7	14.5 ± 1.1
Q-31	15.6 ± 0.6	14.6 ± 0.7	16.7 ± 0.7	17.5 ± 1.0
Q-33	16.8 ± 0.8	19.2 ± 1.0	18.0 ± 1.0	22.6 ± 1.6
Q-35	12.0 ± 0.5	10.7 ± 0.7	12.1 ± 0.7	13.4 ± 1.1
Q-36	15.7 ± 0.6	15.0 ± 1.0	16.9 ± 0.5	19.8 ± 1.6
Q-53	13.0 ± 0.6	11.7 ± 1.1	13.7 ± 0.6	15.5 ± 1.2
Q-54	12.6 ± 0.6	12.5 ± 0.8	12.6 ± 0.5	14.6 ± 1.2
Q-55	13.5 ± 0.8	11.3 ± 1.0	14.6 ± 1.2	14.7 ± 1.2
Q-56	13.1 ± 0.9	13.9 ± 0.9	13.2 ± 0.6	17.9 ± 1.4
Q-57	13.1 ± 1.5	10.9 ± 0.8	13.8 ± 1.4	16.3 ± 1.1
Q-58	7.5 ± 0.7	10.7 ± 0.8	10.2 ± 1.0	13.4 ± 1.0
Mean ± s.d.	12.4 ± 2.2	12.4 ± 2.2	13.0 ± 2.4	14.9 ± 2.8
Q-Control 1	6.7 ± 0.5	5.2 ± 0.8	6.4 ± 0.5	6.9 ± 0.9
Q-Control 2	7.4 ± 0.6	6.9 ± 0.7	7.2 ± 0.6	6.9 ± 1.0

Table 1. Direct Radiation (TLDs), Annual Exposure.
Units: mR/365 days

	2016
Date Placed	01-05-16
Date Removed	01-11-17
A-1	66.4 ± 3.9
A-3	65.5 ± 2.7
A-4	58.6 ± 2.6
A-5	58.4 ± 2.4
A-6	62.4 ± 2.4
A-7	65.0 ± 3.1
A-8	58.1 ± 2.0
A-9	56.0 ± 2.2
A-10	60.2 ± 1.8
A-11	65.0 ± 2.0
A-12	61.8 ± 2.5
A-13	61.5 ± 2.9
A-14	61.4 ± 3.1
A-15	59.2 ± 2.6
A-21	70.5 ± 4.6
A-23	69.9 ± 3.0
A-24	61.1 ± 3.2
A-29	85.3 ± 3.3
A-30	68.7 ± 4.5
A-31	80.0 ± 4.4
A-33	81.2 ± 2.8
A-35	58.4 ± 1.2
A-36	77.1 ± 2.2
A-53	63.7 ± 1.8
A-54	63.2 ± 1.7
A-55	64.0 ± 1.3
A-56	67.9 ± 4.4
A-57	70.1 ± 4.8
A-58	60.2 ± 2.6
Mean ± s.d.	65.5 ± 7.4
A-Control 1	26.1 ± 1.4
A-Control 2	27.4 ± 1.6

Table 2. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.
Location: P-1
Units: pCi/m³
Collection: Continuous, weekly exchange.

Date Collected	Volume (m³)	Gross Beta	I-131	Date Collected	Volume (m³)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	586	0.034 ± 0.003	< 0.012	07-07-16	586	0.019 ± 0.003	< 0.005
01-14-16	624	0.030 ± 0.003	< 0.007	07-13-16	497	0.017 ± 0.003	< 0.005
01-20-16	505	0.029 ± 0.004	< 0.005	07-20-16	337	0.017 ± 0.004	< 0.014
01-27-16	549	0.026 ± 0.003	< 0.008	07-27-16	575	0.024 ± 0.003	< 0.005
02-03-16	549	0.024 ± 0.003	< 0.004	08-03-16	575	0.020 ± 0.003	< 0.005
02-10-16	556	0.027 ± 0.003	< 0.007	08-10-16	586	0.020 ± 0.003	< 0.007
02-17-16	551	0.019 ± 0.003	< 0.005	08-17-16	591	0.014 ± 0.003	< 0.007
02-24-16	550	0.021 ± 0.003	< 0.006	08-24-16	568	0.020 ± 0.003	< 0.008
03-02-16	551	0.020 ± 0.003	< 0.009	09-01-16	662	0.023 ± 0.003	< 0.007
03-09-16	550	0.022 ± 0.003	< 0.008	09-07-16	493	0.023 ± 0.003	< 0.006
03-16-16	563	0.015 ± 0.003	< 0.007	09-14-16	589	0.023 ± 0.003	< 0.007
03-23-16	547	0.019 ± 0.003	< 0.006	09-21-16	571	0.028 ± 0.003	< 0.010
03-30-16	548	0.021 ± 0.003	< 0.012	09-28-16	561	0.027 ± 0.003	< 0.008
1Q 2016	Mean ± s.d.	0.024 ± 0.005	< 0.012	3Q 2016	Mean ± s.d.	0.021 ± 0.004	< 0.014
04-05-16	491	0.023 ± 0.003	< 0.010	10-05-16	564	0.017 ± 0.003	< 0.005
04-13-16	611	0.018 ± 0.003	< 0.005	10-12-16	579	0.023 ± 0.003	< 0.007
04-19-16	83	0.054 ± 0.017	< 0.045 [a]	10-19-16	113	0.025 ± 0.012	< 0.029 [b]
04-27-16	700	0.019 ± 0.002	< 0.006	10-26-16	663	0.017 ± 0.002	< 0.004
				11-02-16	557	0.034 ± 0.003	< 0.007
05-04-16	613	0.013 ± 0.002	< 0.006				
05-11-16	591	0.013 ± 0.003	< 0.006	11-09-16	546	0.045 ± 0.004	< 0.010
05-18-16	600	0.013 ± 0.003	< 0.009	11-16-16	542	0.034 ± 0.003	< 0.011
05-25-16	587	0.017 ± 0.003	< 0.010	11-23-16	562	0.039 ± 0.003	< 0.006
06-01-16	593	0.028 ± 0.003	< 0.011	11-30-16	581	0.031 ± 0.003	< 0.003
06-08-16	436	0.013 ± 0.003	< 0.007	12-07-16	541	0.027 ± 0.003	< 0.009
06-15-16	588	0.012 ± 0.003	< 0.006	12-14-16	549	0.032 ± 0.003	< 0.007
06-23-16	669	0.017 ± 0.002	< 0.009	12-21-16	545	0.034 ± 0.003	< 0.007
06-30-16	575	0.014 ± 0.003	< 0.006	12-28-16	554	0.041 ± 0.004	< 0.013
2Q 2016	Mean ± s.d.	0.020 ± 0.011	< 0.045	4Q 2016	Mean ± s.d.	0.031 ± 0.009	< 0.029
				Cumulative Average		0.024	

[a] No explanation given for low volume.

[b] Low volume; pump tripped off.

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

Location: P-3

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	570	0.037 ± 0.004	< 0.012	07-07-16	547	0.020 ± 0.003	< 0.005
01-14-16	612	0.035 ± 0.003	< 0.007	07-13-16	458	0.015 ± 0.003	< 0.006
01-20-16	487	0.031 ± 0.004	< 0.005	07-20-16	552	0.017 ± 0.003	< 0.009
01-27-16	534	0.025 ± 0.003	< 0.009	07-27-16	529	0.021 ± 0.003	< 0.006
02-03-16	538	0.025 ± 0.003	< 0.004	08-03-16	539	0.020 ± 0.003	< 0.006
02-10-16	571	0.025 ± 0.003	< 0.007	08-10-16	542	0.020 ± 0.003	< 0.008
02-17-16	549	0.020 ± 0.003	< 0.005	08-17-16	543	0.017 ± 0.003	< 0.008
02-24-16	578	0.021 ± 0.003	< 0.006	08-24-16	535	0.016 ± 0.003	< 0.008
03-02-16	566	0.022 ± 0.003	< 0.009	09-01-16	628	0.027 ± 0.003	< 0.008
03-09-16	579	0.018 ± 0.003	< 0.007	09-07-16	451	0.022 ± 0.004	< 0.007
03-16-16	552	0.017 ± 0.003	< 0.007	09-14-16	538	0.021 ± 0.003	< 0.008
03-23-16	552	0.022 ± 0.003	< 0.006	09-21-16	547	0.026 ± 0.003	< 0.010
03-30-16	568	0.020 ± 0.003	< 0.011	09-28-16	544	0.028 ± 0.003	< 0.009
1Q 2016	Mean ± s.d.	0.024 ± 0.006	< 0.012	3Q 2016	Mean ± s.d.	0.021 ± 0.004	< 0.010
04-05-16	500	0.025 ± 0.003	< 0.009	10-05-16	517	0.015 ± 0.003	< 0.006
04-13-16	610	0.021 ± 0.003	< 0.005	10-12-16	561	0.023 ± 0.003	< 0.007
04-19-16	516	0.021 ± 0.003	< 0.007	10-19-16	636	0.031 ± 0.003	< 0.005
04-27-16	644	0.019 ± 0.003	< 0.007	10-26-16	450	0.012 ± 0.003	< 0.007
				11-02-16	557	0.029 ± 0.003	< 0.007
05-04-16	578	0.011 ± 0.003	< 0.007				
05-11-16	578	0.012 ± 0.003	< 0.007	11-09-16	539	0.035 ± 0.003	< 0.010
05-18-16	560	0.012 ± 0.003	< 0.009	11-16-16	590	0.030 ± 0.003	< 0.010
05-25-16	576	0.018 ± 0.003	< 0.010	11-23-16	531	0.041 ± 0.004	< 0.007
06-01-16	632	0.027 ± 0.003	< 0.011	11-30-16	544	0.035 ± 0.003	< 0.003
06-08-16	482	0.012 ± 0.003	< 0.006	12-07-16	568	0.025 ± 0.003	< 0.008
06-15-16	586	0.013 ± 0.003	< 0.006	12-14-16	557	0.029 ± 0.003	< 0.007
06-23-16	626	0.019 ± 0.003	< 0.010	12-21-16	547	0.032 ± 0.003	< 0.007
06-30-16	535	0.014 ± 0.003	< 0.006	12-28-16	539	0.040 ± 0.004	< 0.013
2Q 2016	Mean ± s.d.	0.017 ± 0.005	< 0.011	4Q 2016	Mean ± s.d.	0.029 ± 0.009	< 0.013
				Cumulative Average		0.023	

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

Location: P-4

Units: pCi/m³

Collection: Continuous, weekly exchange.

Date Collected	Volume (m³)	Gross Beta	I-131	Date Collected	Volume (m³)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	564	0.037 ± 0.004	< 0.012	07-07-16	613	0.022 ± 0.003	< 0.005
01-14-16	641	0.032 ± 0.003	< 0.007	07-13-16	510	0.017 ± 0.003	< 0.005
01-20-16	462	0.034 ± 0.004	< 0.005	07-20-16	628	0.018 ± 0.002	< 0.008
01-27-16	561	0.024 ± 0.003	< 0.008	07-27-16	609	0.029 ± 0.003	< 0.005
02-03-16	562	0.023 ± 0.003	< 0.004	08-03-16	609	0.024 ± 0.003	< 0.005
02-10-16	537	0.028 ± 0.003	< 0.007	08-10-16	614	0.024 ± 0.003	< 0.007
02-17-16	546	0.021 ± 0.003	< 0.005	08-17-16	597	0.017 ± 0.003	< 0.007
02-24-16	543	0.023 ± 0.003	< 0.006	08-24-16	581	0.018 ± 0.003	< 0.008
03-02-16	538	0.023 ± 0.003	< 0.009	09-01-16	671	0.028 ± 0.003	< 0.007
03-09-16	547	0.024 ± 0.003	< 0.008	09-07-16	493	0.027 ± 0.003	< 0.006
03-16-16	545	0.015 ± 0.003	< 0.007	09-14-16	748	0.021 ± 0.002	< 0.006
03-23-16	533	0.019 ± 0.003	< 0.006	09-21-16	586	0.031 ± 0.003	< 0.010
03-30-16	538	0.025 ± 0.003	< 0.012	09-28-16	562	0.035 ± 0.003	< 0.008
1Q 2016	Mean ± s.d.	0.025 ± 0.006	< 0.012	3Q 2016	Mean ± s.d.	0.024 ± 0.006	< 0.010
04-05-16	493	0.028 ± 0.004	< 0.010	10-05-16	564	0.022 ± 0.003	< 0.005
04-13-16	594	0.023 ± 0.003	< 0.005	10-12-16	586	0.020 ± 0.003	< 0.006
04-19-16	487	0.026 ± 0.003	< 0.008	10-19-16	581	0.029 ± 0.003	< 0.006
04-27-16	626	0.020 ± 0.003	< 0.007	10-26-16	565	0.015 ± 0.003	< 0.005
				11-02-16	587	0.026 ± 0.003	< 0.007
05-04-16	597	0.014 ± 0.003	< 0.007				
05-11-16	601	0.014 ± 0.003	< 0.006	11-09-16	579	0.035 ± 0.003	< 0.009
05-18-16	615	0.016 ± 0.003	< 0.008	11-16-16	586	0.028 ± 0.003	< 0.010
05-25-16	624	0.022 ± 0.003	< 0.009	11-23-16	560	0.036 ± 0.003	< 0.006
06-01-16	617	0.028 ± 0.003	< 0.011	11-30-16	578	0.031 ± 0.003	< 0.003
06-08-16	585	0.015 ± 0.003	< 0.005	12-07-16	579	0.025 ± 0.003	< 0.008
06-15-16	606	0.014 ± 0.003	< 0.006	12-14-16	576	0.029 ± 0.003	< 0.007
06-23-16	687	0.022 ± 0.003	< 0.009	12-21-16	571	0.032 ± 0.003	< 0.007
06-30-16	602	0.017 ± 0.003	< 0.005	12-28-16	564	0.039 ± 0.003	< 0.012
2Q 2016	Mean ± s.d.	0.020 ± 0.005	< 0.011	4Q 2016	Mean ± s.d.	0.028 ± 0.007	< 0.012
				Cumulative Average		0.024	

Table 2. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.
Location: P-5
Units: pCi/m[3]
Collection: Continuous, weekly exchange.

Date Collected	Volume (m³)	Gross Beta	I-131	Date Collected	Volume (m³)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	571	0.040 ± 0.004	< 0.012	07-07-16	593	0.021 ± 0.003	< 0.005
01-14-16	628	0.036 ± 0.003	< 0.007	07-13-16	488	0.020 ± 0.003	< 0.005
01-20-16	469	0.032 ± 0.004	< 0.005	07-20-16	342	0.014 ± 0.004	< 0.014
01-27-16	528	0.028 ± 0.003	< 0.009	07-27-16	574	0.025 ± 0.003	< 0.005
02-03-16	550	0.024 ± 0.003	< 0.004	08-03-16	598	0.025 ± 0.003	< 0.005
02-10-16	554	0.026 ± 0.003	< 0.007	08-10-16	596	0.021 ± 0.003	< 0.007
02-17-16	540	0.020 ± 0.003	< 0.005	08-17-16	601	0.015 ± 0.003	< 0.007
02-24-16	543	0.022 ± 0.003	< 0.006	08-24-16	600	0.024 ± 0.003	< 0.008
03-02-16	544	0.024 ± 0.003	< 0.009	09-01-16	666	0.028 ± 0.003	< 0.007
03-09-16	529	0.023 ± 0.003	< 0.008	09-07-16	516	0.024 ± 0.003	< 0.006
03-16-16	569	0.015 ± 0.003	< 0.007	09-14-16	584	0.024 ± 0.003	< 0.007
03-23-16	543	0.021 ± 0.003	< 0.006	09-21-16	592	0.030 ± 0.003	< 0.010
03-30-16	559	0.022 ± 0.003	< 0.011	09-28-16	576	0.030 ± 0.003	< 0.008
1Q 2016	Mean ± s.d.	0.026 ± 0.007	< 0.012	3Q 2016	Mean ± s.d.	0.023 ± 0.005	< 0.014
04-05-16	484	0.024 ± 0.003	< 0.010	10-05-16	558	0.020 ± 0.003	< 0.005
04-13-16	603	0.026 ± 0.003	< 0.005	10-12-16	597	0.023 ± 0.003	< 0.006
04-19-16	568	0.022 ± 0.003	< 0.007	10-19-16	123	0.020 ± 0.011	< 0.027 [a]
04-27-16	675	0.019 ± 0.002	< 0.006	10-26-16	605	0.018 ± 0.003	< 0.005
				11-02-16	564	0.028 ± 0.003	< 0.007
05-04-16	584	0.013 ± 0.003	< 0.007				
05-11-16	594	0.013 ± 0.003	< 0.006	11-09-16	575	0.031 ± 0.003	< 0.009
05-18-16	623	0.012 ± 0.002	< 0.008	11-16-16	588	0.033 ± 0.003	< 0.010
05-25-16	592	0.020 ± 0.003	< 0.009	11-23-16	568	0.040 ± 0.003	< 0.006
06-01-16	598	0.029 ± 0.003	< 0.011	11-30-16	566	0.032 ± 0.003	< 0.003
06-08-16	403	0.013 ± 0.004	< 0.007	12-07-16	567	0.024 ± 0.003	< 0.008
06-15-16	585	0.013 ± 0.003	< 0.006	12-14-16	526	0.033 ± 0.003	< 0.007
06-23-16	662	0.019 ± 0.003	< 0.009	12-21-16	584	0.033 ± 0.003	< 0.006
06-30-16	574	0.017 ± 0.003	< 0.006	12-28-16	565	0.036 ± 0.003	< 0.012
2Q 2016	Mean ± s.d.	0.018 ± 0.006	< 0.011	4Q 2016	Mean ± s.d.	0.029 ± 0.007	< 0.027
				Cumulative Average		0.024	

[a] Low volume; pump tripped off.

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

Location: P-6

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	588	0.038 ± 0.003	< 0.012	07-07-16	554	0.019 ± 0.003	< 0.005
01-14-16	618	0.034 ± 0.003	< 0.007	07-13-16	494	0.019 ± 0.003	< 0.005
01-20-16	507	0.030 ± 0.004	< 0.005	07-20-16	562	0.017 ± 0.003	< 0.009
01-27-16	524	0.030 ± 0.003	< 0.009	07-27-16	541	0.027 ± 0.003	< 0.006
02-03-16	558	0.024 ± 0.003	< 0.004	08-03-16	547	0.024 ± 0.003	< 0.006
02-10-16	549	0.025 ± 0.003	< 0.007	08-10-16	567	0.024 ± 0.003	< 0.007
02-17-16	555	0.020 ± 0.003	< 0.005	08-17-16	544	0.013 ± 0.003	< 0.008
02-24-16	553	0.022 ± 0.003	< 0.006	08-24-16	555	0.019 ± 0.003	< 0.008
03-02-16	549	0.020 ± 0.003	< 0.009	09-01-16	625	0.026 ± 0.003	< 0.008
03-09-16	542	0.024 ± 0.003	< 0.008	09-07-16	475	0.023 ± 0.003	< 0.007
03-16-16	554	0.015 ± 0.003	< 0.007	09-14-16	566	0.023 ± 0.003	< 0.008
03-23-16	537	0.020 ± 0.003	< 0.006	09-21-16	606	0.030 ± 0.003	< 0.009
03-30-16	546	0.020 ± 0.003	< 0.012	09-28-16	491	0.033 ± 0.004	< 0.009
1Q 2016	Mean ± s.d.	0.025 ± 0.007	< 0.012	3Q 2016	Mean ± s.d.	0.023 ± 0.005	< 0.009
04-05-16	478	0.019 ± 0.003	< 0.010	10-05-16	561	0.021 ± 0.003	< 0.005
04-13-16	604	0.021 ± 0.003	< 0.005	10-12-16	578	0.022 ± 0.003	< 0.007
04-19-16	605	0.029 ± 0.003	< 0.006	10-19-16	571	0.028 ± 0.003	< 0.006
04-27-16	627	0.019 ± 0.003	< 0.007	10-26-16	548	0.015 ± 0.003	< 0.005
				11-02-16	560	0.029 ± 0.003	< 0.007
05-04-16	576	0.014 ± 0.003	< 0.007				
05-11-16	572	0.017 ± 0.003	< 0.007	11-09-16	571	0.034 ± 0.003	< 0.009
05-18-16	582	0.014 ± 0.003	< 0.009	11-16-16	570	0.034 ± 0.003	< 0.011
05-25-16	577	0.019 ± 0.003	< 0.010	11-23-16	559	0.035 ± 0.003	< 0.006
06-01-16	552	0.029 ± 0.003	< 0.012	11-30-16	558	0.034 ± 0.003	< 0.003
06-08-16	544	0.017 ± 0.003	< 0.005	12-07-16	551	0.024 ± 0.003	< 0.009
06-15-16	571	0.016 ± 0.003	< 0.006	12-14-16	557	0.031 ± 0.003	< 0.007
06-23-16	651	0.020 ± 0.003	< 0.009	12-21-16	556	0.030 ± 0.003	< 0.007
06-30-16	548	0.017 ± 0.003	< 0.006	12-28-16	563	0.035 ± 0.003	< 0.012
2Q 2016	Mean ± s.d.	0.019 ± 0.005	< 0.012	4Q 2016	Mean ± s.d.	0.029 ± 0.006	< 0.012
				Cumulative Average		0.024	

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

Location: P-7

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	578	0.032 ± 0.003	< 0.012	07-07-16	467	0.026 ± 0.004	< 0.006
01-14-16	602	0.032 ± 0.003	< 0.007	07-13-16	458	0.027 ± 0.003	< 0.006
01-20-16	486	0.030 ± 0.004	< 0.005	07-20-16	589	0.020 ± 0.003	< 0.008
01-27-16	519	0.032 ± 0.004	< 0.009	07-27-16	592	0.029 ± 0.003	< 0.005
02-03-16	558	0.027 ± 0.003	< 0.004	08-03-16	542	0.026 ± 0.003	< 0.006
02-10-16	547	0.027 ± 0.003	< 0.007	08-10-16	555	0.032 ± 0.003	< 0.008
02-17-16	545	0.021 ± 0.003	< 0.005	08-17-16	568	0.020 ± 0.003	< 0.008
02-24-16	547	0.019 ± 0.003	< 0.006	08-24-16	536	0.028 ± 0.003	< 0.008
03-02-16	548	0.019 ± 0.003	< 0.009	09-01-16	623	0.037 ± 0.003	< 0.008
03-09-16	551	0.020 ± 0.003	< 0.008	09-07-16	454	0.035 ± 0.004	< 0.007
03-16-16	555	0.017 ± 0.003	< 0.007	09-14-16	553	0.032 ± 0.003	< 0.008
03-23-16	543	0.024 ± 0.003	< 0.006	09-21-16	525	0.039 ± 0.004	< 0.011
03-30-16	536	0.021 ± 0.003	< 0.012	09-28-16	535	0.044 ± 0.004	< 0.009
1Q 2016	Mean ± s.d.	0.025 ± 0.006	< 0.012	3Q 2016	Mean ± s.d.	0.030 ± 0.007	< 0.011
04-05-16	481	0.029 ± 0.004	< 0.010	10-05-16	537	0.030 ± 0.003	< 0.005
04-13-16	604	0.021 ± 0.003	< 0.005	10-12-16	579	0.021 ± 0.003	< 0.007
04-19-16	477	0.027 ± 0.004	< 0.008	10-19-16	589	0.027 ± 0.003	< 0.006
04-27-16	631	0.020 ± 0.003	< 0.007	10-26-16	570	0.012 ± 0.003	< 0.005
				11-02-16	568	0.021 ± 0.003	< 0.007
05-04-16	540	0.014 ± 0.003	< 0.007				
05-11-16	530	0.018 ± 0.003	< 0.007	11-09-16	588	0.034 ± 0.003	< 0.009
05-18-16	534	0.016 ± 0.003	< 0.010	11-16-16	574	0.031 ± 0.003	< 0.010
05-25-16	515	0.021 ± 0.003	< 0.011	11-23-16	551	0.037 ± 0.003	< 0.006
06-01-16	552	0.032 ± 0.003	< 0.012	11-30-16	565	0.028 ± 0.003	< 0.003
06-08-16	522	0.013 ± 0.003	< 0.006	12-07-16	548	0.026 ± 0.003	< 0.009
06-15-16	510	0.016 ± 0.003	< 0.007	12-14-16	551	0.034 ± 0.003	< 0.007
06-23-16	578	0.021 ± 0.003	< 0.011	12-21-16	521	0.029 ± 0.003	< 0.007
06-30-16	470	0.024 ± 0.003	< 0.007	12-28-16	562	0.035 ± 0.003	< 0.012
2Q 2016	Mean ± s.d.	0.021 ± 0.006	< 0.012	4Q 2016	Mean ± s.d.	0.028 ± 0.007	< 0.012
				Cumulative Average		0.026	

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

Location: P-35

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
Required LLD		0.0075	0.050			0.0075	0.050
01-06-16	609	0.027 ± 0.003	< 0.009	07-07-16	555	0.020 ± 0.003	< 0.011
01-14-16	635	0.026 ± 0.003	< 0.010	07-13-16	555	0.016 ± 0.003	< 0.004
01-20-16	520	0.024 ± 0.003	< 0.015	07-20-16	309	0.014 ± 0.004	< 0.015
01-27-16	563	0.021 ± 0.003	< 0.007	07-27-16	530	0.026 ± 0.003	< 0.009
02-03-16	567	0.019 ± 0.003	< 0.021	08-03-16	514	0.024 ± 0.003	< 0.009
02-10-16	566	0.021 ± 0.003	< 0.010	08-10-16	527	0.021 ± 0.003	< 0.009
02-17-16	566	0.012 ± 0.003	< 0.008	08-17-16	532	0.014 ± 0.003	< 0.014
02-24-16	571	0.014 ± 0.003	< 0.011	08-24-16	522	0.022 ± 0.003	< 0.010
03-02-16	555	0.019 ± 0.003	< 0.012	09-01-16	602	0.024 ± 0.003	< 0.007
03-09-16	556	0.018 ± 0.003	< 0.009	09-07-16	428	0.023 ± 0.004	< 0.015
03-16-16	560	0.013 ± 0.003	< 0.010	09-14-16	538	0.023 ± 0.003	< 0.013
03-23-16	547	0.018 ± 0.003	< 0.007	09-21-16	514	0.029 ± 0.003	< 0.012
03-30-16	537	0.017 ± 0.003	< 0.008	09-28-16	510	0.033 ± 0.003	< 0.011
1Q 2016	Mean ± s.d.	0.019 ± 0.005	< 0.021	3Q 2016	Mean ± s.d.	0.022 ± 0.006	< 0.015
04-05-16	480	0.019 ± 0.003	< 0.014	10-05-16	485	0.021 ± 0.003	< 0.011
04-13-16	604	0.018 ± 0.003	< 0.008	10-12-16	595	0.020 ± 0.003	< 0.009
04-19-16	474	0.025 ± 0.003	< 0.013	10-19-16	120	< 0.017	< 0.049 [a]
04-27-16	618	0.020 ± 0.003	< 0.008	10-26-16	583	0.013 ± 0.003	< 0.006
				11-02-16	566	0.024 ± 0.003	< 0.010
05-04-16	528	0.015 ± 0.003	< 0.008				
05-11-16	522	0.014 ± 0.003	< 0.015	11-09-16	595	0.030 ± 0.003	< 0.006
05-18-16	523	0.012 ± 0.003	< 0.013	11-16-16	577	0.028 ± 0.003	< 0.010
05-25-16	517	0.019 ± 0.003	< 0.013	11-23-16	569	0.035 ± 0.003	< 0.012
06-01-16	558	0.029 ± 0.003	< 0.011	11-30-16	575	0.027 ± 0.003	< 0.012
06-08-16	415	0.012 ± 0.003	< 0.025	12-07-16	555	0.022 ± 0.003	< 0.009
06-15-16	566	0.013 ± 0.003	< 0.026	12-14-16	583	0.028 ± 0.003	< 0.008
06-23-16	638	0.015 ± 0.003	< 0.010	12-21-16	526	0.028 ± 0.003	< 0.013
06-30-16	544	0.014 ± 0.003	< 0.019	12-28-16	577	0.032 ± 0.003	< 0.015
2Q 2016	Mean ± s.d.	0.017 ± 0.005	< 0.026	4Q 2016	Mean ± s.d.	0.026 ± 0.006	< 0.049
				Cumulative Average		0.021	

[a] Low volume; pump tripped off. Sample recounted for 300 minutes with a result of 0.020±0.005 pCi/m^3.

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

Location	PE-1				
Quarter	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Req. LLD
Lab Code	PEAP- 1836	PEAP- 4170	PEAP- 5709	PEAP- 7205	
Vol. (m^3)	7228	7137	7192	6895	
Be-7	0.058 ± 0.010	0.081 ± 0.011	0.058 ± 0.009	0.056 ± 0.009	-
Co-58	< 0.0004	< 0.0003	< 0.0005	< 0.0004	-
Co-60	< 0.0003	< 0.0003	< 0.0004	< 0.0004	-
Cs-134	< 0.0005	< 0.0005	< 0.0004	< 0.0004	0.037
Cs-137	< 0.0005	< 0.0003	< 0.0003	< 0.0004	0.045

Location	PE-3				
Lab Code	PEAP- 1837	PEAP- 4171	PEAP- 5710	PEAP- 7206	
Vol. (m^3)	7257	7422	6954	7136	
Be-7	0.068 ± 0.009	0.075 ± 0.010	0.065 ± 0.010	0.058 ± 0.011	-
Co-58	< 0.0004	< 0.0005	< 0.0006	< 0.0005	-
Co-60	< 0.0004	< 0.0002	< 0.0003	< 0.0004	-
Cs-134	< 0.0004	< 0.0004	< 0.0006	< 0.0005	0.037
Cs-137	< 0.0005	< 0.0003	< 0.0004	< 0.0004	0.045

Location	PE-4				
Lab Code	PEAP- 1838	PEAP- 4172	PEAP- 5711	PEAP- 7207	
Vol. (m^3)	7118	7734	7822	7474	
Be-7	0.070 ± 0.011	0.085 ± 0.010	0.071 ± 0.009	0.048 ± 0.008	-
Co-58	< 0.0005	< 0.0006	< 0.0003	< 0.0002	-
Co-60	< 0.0003	< 0.0003	< 0.0002	< 0.0002	-
Cs-134	< 0.0004	< 0.0005	< 0.0005	< 0.0004	0.037
Cs-137	< 0.0002	< 0.0004	< 0.0003	< 0.0004	0.045

Location	PE-5				
Lab Code	PEAP- 1839	PEAP- 4173	PEAP- 5712	PEAP- 7208	
Vol. (m^3)	7127	7545	7325	6985	
Be-7	0.071 ± 0.010	0.094 ± 0.012	0.069 ± 0.009	0.060 ± 0.009	-
Co-58	< 0.0006	< 0.0003	< 0.0005	< 0.0003	-
Co-60	< 0.0002	< 0.0003	< 0.0002	< 0.0002	-
Cs-134	< 0.0006	< 0.0005	< 0.0006	< 0.0004	0.037
Cs-137	< 0.0005	< 0.0004	< 0.0004	< 0.0003	0.045

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

Location	PE-6				
Quarter	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Req. LLD
Lab Code	PEAP- 1840	PEAP- 4174	PEAP- 5713	PEAP- 7209	
Vol. (m^3)	7180	7487	7127	7303	
Be-7	0.058 ± 0.010	0.084 ± 0.011	0.066 ± 0.009	0.057 ± 0.011	-
Co-58	< 0.0003	< 0.0005	< 0.0003	< 0.0006	-
Co-60	< 0.0003	< 0.0004	< 0.0002	< 0.0004	-
Cs-134	< 0.0004	< 0.0004	< 0.0004	< 0.0006	0.037
Cs-137	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.045

Location	PE-7				
Lab Code	PEAP- 1841	PEAP- 4175	PEAP- 5714	PEAP- 7210	
Vol. (m^3)	7116	6944	6999	7303	
Be-7	0.065 ± 0.013	0.088 ± 0.012	0.082 ± 0.012	0.062 ± 0.011	-
Co-58	< 0.0005	< 0.0005	< 0.0005	< 0.0002	-
Co-60	< 0.0003	< 0.0003	< 0.0004	< 0.0004	-
Cs-134	< 0.0005	< 0.0004	< 0.0006	< 0.0005	0.037
Cs-137	< 0.0005	< 0.0003	< 0.0003	< 0.0005	0.045

Location	PE-35				
Lab Code	PEAP- 1842	PEAP- 4176	PEAP- 5715	PEAP- 7211	
Vol. (m^3)	7352	6985	6636	6907	
Be-7	0.051 ± 0.008	0.080 ± 0.011	0.064 ± 0.011	0.059 ± 0.009	-
Co-58	< 0.0003	< 0.0004	< 0.0006	< 0.0004	-
Co-60	< 0.0003	< 0.0002	< 0.0003	< 0.0003	-
Cs-134	< 0.0004	< 0.0005	< 0.0006	< 0.0005	0.037
Cs-137	< 0.0003	< 0.0002	< 0.0007	< 0.0003	0.045

Table 4. Lake water, analyses for gross beta and gamma emitting isotopes.

Location: P-34 Collection: Monthly composites Units: pCi/L

Lab Code	PELW- 506	PELW- 982	PELW- 1444	PELW- 2199	
Start Date	12-30-15	01-28-16	02-25-16	03-31-16	Req. LLD
End Date	01-28-16	02-25-16	03-31-16	04-28-16	
Gross beta	< 0.8	2.2 ± 0.7	3.0 ± 1.0	3.2 ± 1.1	3.0
Mn-54	< 3.1	< 3.0	< 2.9	< 1.2	11
Fe-59	< 8.9	< 3.8	< 5.3	< 1.5	22
Co-58	< 1.7	< 2.1	< 1.7	< 1.4	11
Co-60	< 2.5	< 1.5	< 0.8	< 0.8	11
Zn-65	< 2.2	< 2.7	< 2.4	< 2.0	22
Zr-95	< 4.2	< 4.0	< 4.0	< 1.8	22
Nb-95	< 3.5	< 3.0	< 3.2	< 2.1	11
Cs-134	< 2.9	< 2.4	< 2.7	< 1.0	11
Cs-137	< 3.6	< 2.2	< 3.3	< 1.2	13
Ba-140	< 13.8	< 14.0	< 21.3	< 15.7	45
La-140	< 3.2	< 2.3	< 3.6	< 5.5	11

Lab Code	PELW- 2751	PELW- 3439	PELW- 4165	PELW- 4766	
Start Date	04-28-16	05-31-16	06-30-16	07-28-16	Req. LLD
End Date	05-31-16	06-30-16	07-28-16	08-25-16	
Gross beta	< 1.6	< 1.5	< 1.6	1.5 ± 0.7	3.0
Mn-54	< 2.0	< 1.5	< 1.7	< 3.0	11
Fe-59	< 3.5	< 4.5	< 3.5	< 4.9	22
Co-58	< 1.0	< 2.1	< 1.9	< 2.1	11
Co-60	< 1.8	< 1.4	< 0.8	< 2.2	11
Zn-65	< 4.2	< 1.6	< 3.1	< 4.8	22
Zr-95	< 3.5	< 2.9	< 3.9	< 5.2	22
Nb-95	< 2.6	< 1.6	< 2.6	< 3.0	11
Cs-134	< 2.6	< 1.9	< 1.7	< 2.3	11
Cs-137	< 2.2	< 2.4	< 1.4	< 3.0	13
Ba-140	< 12.1	< 15.7	< 22.6	< 32.2	45
La-140	< 1.4	< 4.2	< 5.5	< 3.6	11

Lab Code	PELW- 5064	PELW- 6070	PELW- 6480	PELW- 7003	
Start Date	08-25-16	09-20-16	10-27-16	11-23-16	Req. LLD
End Date	09-20-16	10-27-16	11-23-16	12-29-16	
Gross beta	2.2 ± 0.7	< 0.9	1.2 ± 0.5	1.5 ± 0.4	3.0
Mn-54	< 3.5	< 2.9	< 1.1	< 2.4	11
Fe-59	< 7.7	< 4.7	< 2.9	< 3.9	22
Co-58	< 2.5	< 2.2	< 2.6	< 1.6	11
Co-60	< 4.2	< 1.9	< 2.4	< 1.4	11
Zn-65	< 4.6	< 5.7	< 2.8	< 2.0	22
Zr-95	< 6.6	< 4.2	< 4.2	< 4.4	22
Nb-95	< 4.9	< 4.0	< 3.0	< 3.2	11
Cs-134	< 4.1	< 2.3	< 2.8	< 2.8	11
Cs-137	< 4.1	< 2.3	< 2.2	< 2.4	13
Ba-140	< 26.7	< 30.9	< 22.2	< 15.0	45
La-140	< 6.6	< 6.2	< 5.8	< 4.0	11

Table 4. Lake water, analyses for gross beta and gamma emitting isotopes.

Location: P-36 Collection: Monthly composites Units: pCi/L

Lab Code	PELW- 507	PELW- 983	PELW- 1445	PELW- 2200	
Start Date	12-30-15	01-28-16	02-25-16	03-31-16	Req. LLD
End Date	01-28-16	02-25-16	03-31-16	04-28-16	
Gross beta	1.0 ± 0.5	2.5 ± 1.0	2.2 ± 1.0	3.2 ± 1.0	3.0
Mn-54	< 2.7	< 3.2	< 2.6	< 1.1	11
Fe-59	< 5.0	< 6.5	< 2.8	< 3.8	22
Co-58	< 2.1	< 1.6	< 2.0	< 1.4	11
Co-60	< 1.9	< 1.7	< 1.9	< 1.2	11
Zn-65	< 2.7	< 3.8	< 3.0	< 2.7	22
Zr-95	< 4.8	< 5.1	< 4.6	< 1.9	22
Nb-95	< 3.1	< 3.2	< 3.5	< 1.7	11
Cs-134	< 3.1	< 3.2	< 2.3	< 1.4	11
Cs-137	< 2.8	< 2.1	< 2.9	< 1.3	13
Ba-140	< 21.5	< 30.5	< 27.4	< 22.9	45
La-140	< 3.1	< 3.4	< 6.2	< 4.8	11

Lab Code	PELW- 2752	PELW- 3440	PELW- 4166	PELW- 4767	
Start Date	04-28-16	05-31-16	06-30-16	07-28-16	Req. LLD
End Date	05-31-16	06-30-16	07-28-16	08-25-16	
Gross beta	1.9 ± 1.0	< 1.7	1.8 ± 0.9	1.4 ± 0.7	3.0
Mn-54	< 2.2	< 2.0	< 1.0	< 2.5	11
Fe-59	< 4.3	< 3.7	< 4.5	< 4.7	22
Co-58	< 2.2	< 3.2	< 1.5	< 2.3	11
Co-60	< 2.2	< 2.0	< 1.1	< 1.9	11
Zn-65	< 2.0	< 3.6	< 2.1	< 2.0	22
Zr-95	< 2.1	< 3.9	< 2.6	< 2.9	22
Nb-95	< 2.8	< 4.7	< 2.2	< 3.5	11
Cs-134	< 2.4	< 2.5	< 1.4	< 2.2	11
Cs-137	< 2.4	< 2.5	< 1.2	< 2.4	13
Ba-140	< 11.6	< 20.4	< 15.0	< 23.4	45
La-140	< 1.1	< 6.5	< 5.1	< 5.9	11

Lab Code	PELW- 5065	PELW- 6071	PELW- 6481	PELW- 7004	
Start Date	08-25-16	09-20-16	10-27-16	11-23-16	Req. LLD
End Date	09-20-16	10-27-16	11-23-16	12-29-16	
Gross beta	1.7 ± 0.7	1.1 ± 0.5	1.4 ± 0.5	0.9 ± 0.4	3.0
Mn-54	< 3.0	< 1.0	< 2.3	< 2.2	11
Fe-59	< 8.0	< 1.9	< 6.6	< 4.8	22
Co-58	< 3.2	< 1.2	< 2.3	< 2.4	11
Co-60	< 3.7	< 1.2	< 2.2	< 1.9	11
Zn-65	< 5.0	< 2.4	< 2.0	< 4.2	22
Zr-95	< 4.7	< 2.1	< 7.0	< 4.2	22
Nb-95	< 3.8	< 2.0	< 3.7	< 2.8	11
Cs-134	< 2.8	< 1.1	< 3.4	< 2.5	11
Cs-137	< 3.8	< 1.3	< 2.4	< 2.4	13
Ba-140	< 24.8	< 17.4	< 20.1	< 15.4	45
La-140	< 2.3	< 4.1	< 6.8	< 4.4	11

Table 4. Lake water, analyses for gross beta and gamma emitting isotopes.

Location: P-39 Collection: Monthly composites Units: pCi/L

Lab Code	PELW- 508	PELW- 984	PELW- 1446	PELW- 2201	
Start Date	12-30-15	01-28-16	02-25-16	03-31-16	Req. LLD
End Date	01-28-16	02-25-16	03-31-16	04-28-16	
Gross beta	1.5 ± 0.6	2.1 ± 1.0	2.2 ± 1.0	4.0 ± 1.1	3.0
Mn-54	< 1.3	< 1.9	< 2.6	< 1.1	11
Fe-59	< 4.0	< 4.3	< 6.0	< 2.4	22
Co-58	< 1.9	< 2.4	< 2.7	< 1.2	11
Co-60	< 1.6	< 1.7	< 1.7	< 0.9	11
Zn-65	< 5.5	< 2.5	< 3.0	< 2.5	22
Zr-95	< 5.2	< 5.0	< 4.0	< 2.9	22
Nb-95	< 3.0	< 2.7	< 3.0	< 2.2	11
Cs-134	< 2.8	< 2.4	< 3.3	< 1.2	11
Cs-137	< 2.9	< 3.2	< 2.5	< 1.1	13
Ba-140	< 13.0	< 25.3	< 18.5	< 16.0	45
La-140	< 4.3	< 3.9	< 4.5	< 4.2	11

Lab Code	PELW- 2753	PELW- 3441	PELW- 4167	PELW- 4768	
Start Date	04-28-16	05-31-16	06-30-16	07-28-16	Req. LLD
End Date	05-31-16	06-30-16	07-28-16	08-25-16	
Gross beta	1.7 ± 0.9	1.6 ± 0.9	1.8 ± 0.9	1.4 ± 0.7	3.0
Mn-54	< 2.2	< 2.0	< 1.2	< 2.4	11
Fe-59	< 4.3	< 4.2	< 2.4	< 2.7	22
Co-58	< 2.2	< 1.0	< 1.3	< 1.4	11
Co-60	< 2.2	< 1.4	< 1.2	< 2.2	11
Zn-65	< 2.0	< 4.8	< 1.5	< 4.3	22
Zr-95	< 2.1	< 2.8	< 3.2	< 2.4	22
Nb-95	< 2.8	< 3.2	< 2.4	< 3.5	11
Cs-134	< 2.4	< 3.0	< 1.3	< 2.0	11
Cs-137	< 2.4	< 3.3	< 1.0	< 2.4	13
Ba-140	< 11.6	< 23.7	< 20.5	< 21.9	45
La-140	< 1.1	< 4.5	< 6.1	< 7.0	11

Lab Code	PELW- 5066	PELW- 6072	PELW- 6482	PELW- 7005	
Start Date	08-25-16	09-20-16	10-27-16	11-23-16	Req. LLD
End Date	09-20-16	10-27-16	11-23-16	12-29-16	
Gross beta	1.5 ± 0.7	1.0 ± 0.5	1.1 ± 0.5	1.1 ± 0.4	3.0
Mn-54	< 4.1	< 1.6	< 2.5	< 2.1	11
Fe-59	< 9.0	< 2.8	< 3.8	< 3.7	22
Co-58	< 4.4	< 1.1	< 1.3	< 1.3	11
Co-60	< 3.1	< 1.3	< 1.9	< 1.5	11
Zn-65	< 3.3	< 2.4	< 3.3	< 4.6	22
Zr-95	< 4.3	< 3.0	< 5.9	< 4.9	22
Nb-95	< 5.9	< 2.3	< 2.9	< 3.5	11
Cs-134	< 5.3	< 1.3	< 2.7	< 2.5	11
Cs-137	< 3.9	< 1.5	< 2.0	< 2.6	13
Ba-140	< 24.4	< 14.1	< 33.8	< 14.8	45
La-140	< 6.5	< 3.1	< 3.3	< 3.1	11

Table 4. Lake water, analyses for gross beta and gamma emitting isotopes.

Location: P-59 Collection: Monthly composites Units: pCi/L

Lab Code	PELW- 509	PELW- 985	PELW- 1448	PELW- 2202	
Start Date	12-30-15	01-28-16	02-25-16	03-31-16	Req. LLD
End Date	01-28-16	02-25-16	03-31-16	04-28-16	
Gross beta	0.9 ± 0.5	1.7 ± 0.9	2.4 ± 0.9	1.8 ± 0.7	3.0
Mn-54	< 2.5	< 2.7	< 2.4	< 1.3	11
Fe-59	< 5.6	< 4.7	< 5.9	< 1.7	22
Co-58	< 2.9	< 2.5	< 1.7	< 0.8	11
Co-60	< 2.0	< 2.0	< 1.5	< 1.0	11
Zn-65	< 2.4	< 3.3	< 3.1	< 2.5	22
Zr-95	< 4.6	< 5.0	< 4.0	< 2.7	22
Nb-95	< 3.1	< 2.9	< 2.9	< 2.2	11
Cs-134	< 2.8	< 2.6	< 2.6	< 1.1	11
Cs-137	< 2.9	< 2.4	< 2.1	< 0.9	13
Ba-140	< 20.7	< 28.7	< 22.4	< 16.5	45
La-140	< 4.3	< 2.5	< 1.9	< 4.8	11

Lab Code	PELW- 2754	PELW- 3442	PELW- 4168	PELW- 4769	
Start Date	04-28-16	05-31-16	06-30-16	07-28-16	Req. LLD
End Date	05-31-16	06-30-16	07-28-16	08-25-16	
Gross beta	< 1.8	2.3 ± 1.0	2.5 ± 0.9	1.4 ± 0.7	3.0
Mn-54	< 2.6	< 2.5	< 1.0	< 2.0	11
Fe-59	< 2.1	< 4.0	< 3.6	< 3.1	22
Co-58	< 1.3	< 2.1	< 1.5	< 3.2	11
Co-60	< 1.7	< 1.2	< 1.0	< 1.8	11
Zn-65	< 3.4	< 4.3	< 2.2	< 3.5	22
Zr-95	< 3.5	< 4.1	< 2.8	< 4.6	22
Nb-95	< 3.7	< 2.2	< 2.0	< 3.8	11
Cs-134	< 2.7	< 2.6	< 1.2	< 2.2	11
Cs-137	< 2.5	< 3.2	< 1.3	< 2.6	13
Ba-140	< 12.7	< 24.9	< 20.8	< 24.1	45
La-140	< 2.3	< 6.0	< 5.1	< 5.2	11

Lab Code	PELW- 5068	PELW- 6074	PELW- 6483	PELW- 7006	
Start Date	08-25-16	09-20-16	10-27-16	11-23-16	Req. LLD
End Date	09-20-16	10-27-16	11-23-16	12-29-16	
Gross beta	1.5 ± 0.7	1.0 ± 0.5	1.1 ± 0.5	1.6 ± 0.4	3.0
Mn-54	< 3.2	< 1.2	< 2.0	< 3.1	11
Fe-59	< 3.0	< 2.1	< 2.2	< 3.9	22
Co-58	< 3.0	< 1.3	< 1.5	< 3.0	11
Co-60	< 3.4	< 1.2	< 1.8	< 1.3	11
Zn-65	< 5.5	< 2.6	< 3.6	< 5.5	22
Zr-95	< 4.4	< 2.8	< 4.7	< 4.4	22
Nb-95	< 4.2	< 2.0	< 3.4	< 3.1	11
Cs-134	< 3.5	< 1.1	< 2.1	< 2.7	11
Cs-137	< 3.1	< 1.1	< 3.3	< 2.2	13
Ba-140	< 21.7	< 17.2	< 29.5	< 16.4	45
La-140	< 4.4	< 5.3	< 2.7	< 5.1	11

Table 4. Lake water, analyses for gross beta and gamma emitting isotopes.

Location: P-60 Collection: Monthly composites Units: pCi/L

Lab Code	PELW- 510	PELW- 986	PELW- 1449	PELW- 2203	
Start Date	12-30-15	01-28-16	02-25-16	03-31-16	Req. LLD
End Date	01-28-16	02-25-16	03-31-16	04-28-16	
Gross beta	1.5 ± 0.6	2.2 ± 1.0	1.7 ± 0.8	1.9 ± 0.8	3.0
Mn-54	< 3.6	< 2.3	< 2.2	< 1.4	11
Fe-59	< 9.7	< 5.0	< 4.1	< 2.5	22
Co-58	< 2.2	< 1.1	< 2.8	< 1.3	11
Co-60	< 2.4	< 1.7	< 1.3	< 0.9	11
Zn-65	< 4.6	< 4.7	< 2.9	< 1.7	22
Zr-95	< 6.3	< 3.3	< 2.5	< 1.7	22
Nb-95	< 2.5	< 2.1	< 3.4	< 1.7	11
Cs-134	< 3.3	< 2.3	< 2.5	< 1.1	11
Cs-137	< 2.2	< 2.7	< 2.8	< 1.3	13
Ba-140	< 20.4	< 23.4	< 25.5	< 19.6	45
La-140	< 4.9	< 3.7	< 3.4	< 5.1	11

Lab Code	PELW- 2756	PELW- 3443	PELW- 4169	PELW- 4770	
Start Date	04-28-16	05-31-16	06-30-16	07-28-16	Req. LLD
End Date	05-31-16	06-30-16	07-28-16	08-25-16	
Gross beta	2.9 ± 1.1	< 1.6	2.0 ± 1.0	2.4 ± 0.8	3.0
Mn-54	< 3.1	< 1.6	< 1.1	< 1.4	11
Fe-59	< 2.2	< 6.2	< 3.1	< 3.9	22
Co-58	< 3.5	< 2.1	< 1.3	< 1.3	11
Co-60	< 2.8	< 1.8	< 1.3	< 1.5	11
Zn-65	< 4.3	< 2.0	< 2.3	< 2.6	22
Zr-95	< 3.7	< 5.5	< 1.4	< 2.3	22
Nb-95	< 1.1	< 3.5	< 2.2	< 1.3	11
Cs-134	< 3.7	< 2.3	< 1.0	< 1.7	11
Cs-137	< 3.5	< 2.7	< 1.2	< 1.4	13
Ba-140	< 15.9	< 23.2	< 15.9	< 22.1	45
La-140	< 5.0	< 4.8	< 3.3	< 4.6	11

Lab Code	PELW- 5069	PELW- 6075	PELW- 6484	PELW- 7007	
Start Date	08-25-16	09-20-16	10-27-16	11-23-16	Req. LLD
End Date	09-20-16	10-27-16	11-23-16	12-29-16	
Gross beta	1.4 ± 0.8	1.5 ± 0.6	1.1 ± 0.5	1.5 ± 0.4	3.0
Mn-54	< 3.3	< 1.0	< 3.2	< 2.1	11
Fe-59	< 3.2	< 3.2	< 5.3	< 3.3	22
Co-58	< 3.5	< 1.0	< 1.5	< 3.3	11
Co-60	< 3.1	< 1.0	< 2.0	< 1.8	11
Zn-65	< 3.7	< 1.7	< 3.4	< 2.9	22
Zr-95	< 4.5	< 2.8	< 4.9	< 4.0	22
Nb-95	< 5.1	< 1.2	< 2.3	< 3.0	11
Cs-134	< 3.6	< 1.2	< 2.6	< 3.2	11
Cs-137	< 2.3	< 0.9	< 2.7	< 2.8	13
Ba-140	< 26.3	< 19.3	< 31.5	< 22.1	45
La-140	< 6.1	< 4.3	< 5.1	< 5.2	11

Table 4. Lake Water, analysis for tritium.
Collection: Quarterly composites of monthly collections.
Units: pCi/L

Required limit of detection: 1500 pCi/L

Location	P-34			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	PELW- 1583	PELW- 3497	PELW- 5072	PELW- 7066
H-3	< 148	< 151	< 179	< 155

Location	P-36			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	PELW- 1584	PELW- 3498	PELW- 5073	PELW- 7067
H-3	< 148	< 151	< 179	< 155

Location	P-39			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	PELW- 1585	PELW- 3500	PELW- 5074	PELW- 7068
H-3	< 148	< 151	< 179	< 155

Location	P-59			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	PELW- 1586	PELW- 3501	PELW- 5075	PELW- 7069
H-3	< 148	< 151	< 179	< 155

Location	P-60			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	PELW- 1587	PELW- 3502	PELW- 5076	PELW- 7070
H-3	< 148	< 151	< 179	< 155

Table 5. Milk, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Semimonthly during grazing season, monthly at other times.

Collection Date	Lab Code	Concentration (pCi/L) I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Required LLD	(pCi/L)	0.8	11	13	45	11	-
P-18							
01-04-16	ND [a]	-	-	-	-	-	-
02-01-16	ND [a]	-	-	-	-	-	-
03-07-16	ND [a]	-	-	-	-	-	-
04-05-16	ND [a]	-	-	-	-	-	-
04-18-16	ND [a]	-	-	-	-	-	-
05-02-16	ND [a]	-	-	-	-	-	-
05-16-16	ND [a]	-	-	-	-	-	-
06-06-16	ND [a]	-	-	-	-	-	-
06-20-16	ND [a]	-	-	-	-	-	-
07-05-16	ND [a]	-	-	-	-	-	-
07-18-16	ND [a]	-	-	-	-	-	-
08-02-16	ND [a]	-	-	-	-	-	-
08-16-16	ND [a]	-	-	-	-	-	-
09-06-16	ND [a]	-	-	-	-	-	-
09-19-16	ND [a]	-	-	-	-	-	-
10-03-16	ND [a]	-	-	-	-	-	-
10-17-16	ND [a]	-	-	-	-	-	-
11-07-16	ND [a]	-	-	-	-	-	-
12-05-16	ND [a]	-	-	-	-	-	-
P-19							
01-04-16	PEMI- 106	< 0.4	< 3.8	< 2.6	< 18.7	< 4.1	1248 ± 110
02-01-16	PEMI- 497	< 0.3	< 3.5	< 3.8	< 21.8	< 2.0	1181 ± 96
03-07-16	PEMI- 1042	< 0.4	< 3.2	< 3.4	< 28.0	< 2.8	1684 ± 124
04-05-16	PEMI- 1503	< 0.4	< 2.8	< 3.4	< 16.1	< 1.9	1335 ± 90
04-18-16	PEMI- 1862	< 0.3	< 4.1	< 2.9	< 33.4	< 2.8	1312 ± 108
05-02-16	PEMI- 2186	< 0.3	< 3.9	< 2.4	< 12.7	< 4.0	1293 ± 110
05-16-16	PEMI- 2672	< 0.4	< 3.9	< 4.2	< 27.6	< 2.7	1371 ± 117
06-06-16	PEMI- 2919	< 0.4	< 3.6	< 4.0	< 25.1	< 2.4	1328 ± 114
06-20-16	PEMI- 3176	< 0.5	< 3.1	< 3.2	< 18.2	< 4.0	1393 ± 104
07-05-16	PEMI- 3437	< 0.4	< 1.4	< 1.4	< 17.9	< 5.5	1262 ± 41
07-18-16	PEMI- 3888	< 0.4	< 3.6	< 3.5	< 26.9	< 4.7	1353 ± 102
08-02-16	PEMI- 4163	< 0.2	< 2.7	< 3.0	< 39.0	< 6.7	1294 ± 99
08-16-16	PEMI- 4426	< 0.3	< 3.0	< 3.9	< 25.0	< 4.6	1292 ± 85
09-06-16	PEMI- 4756	< 0.4	< 3.9	< 2.9	< 29.3	< 6.2	1803 ± 127
09-19-16	PEMI- 5058	< 0.5	< 3.9	< 4.5	< 27.5	< 5.4	3646 ± 150
10-03-16	PEMI- 5334	< 0.3	< 2.4	< 1.9	< 43.5	< 7.0	1450 ± 80
10-17-16	PEMI- 5819	< 0.5	< 4.8	< 4.0	< 32.0	< 4.6	3173 ± 161
11-07-16	PEMI- 6335	< 0.5	< 3.8	< 2.2	< 22.0	< 5.9	1272 ± 114
12-05-16	PEMI- 6712	< 0.5	< 3.8	< 3.6	< 31.5	< 3.4	1924 ± 120

[a] ND = No data, no milk available.

Table 5. Milk, analyses for iodine-131 and gamma-emitting isotopes (continued).
Collection: Semimonthly during grazing season, monthly at other times.

Collection	Lab	Concentration (pCi/L)					
Date	Code	I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Required LLD	(pCi/L)	0.8	11	13	45	11	-
P-41							
01-04-16	ND [a]	-	-	-	-	-	-
02-01-16	ND [a]	-	-	-	-	-	-
03-07-16	ND [a]	-	-	-	-	-	-
04-05-16	ND [a]	-	-	-	-	-	-
04-18-16	ND [a]	-	-	-	-	-	-
05-02-16	ND [a]	-	-	-	-	-	-
05-16-16	ND [a]	-	-	-	-	-	-
06-06-16	ND [a]	-	-	-	-	-	-
06-20-16	ND [a]	-	-	-	-	-	-
07-05-16	ND [a]	-	-	-	-	-	-
07-18-16	ND [a]	-	-	-	-	-	-
08-02-16	ND [a]	-	-	-	-	-	-
08-16-16	ND [a]	-	-	-	-	-	-
09-06-16	ND [a]	-	-	-	-	-	-
09-19-16	ND [a]	-	-	-	-	-	-
10-03-16	ND [a]	-	-	-	-	-	-
10-17-16	ND [a]	-	-	-	-	-	-
11-07-16	ND [a]	-	-	-	-	-	-
12-05-16	ND [a]	-	-	-	-	-	-
P-51							
01-04-16	PEMI- 107	< 0.2	< 3.4	< 3.9	< 15.5	< 3.9	1397 ± 105
02-01-16	PEMI- 498	< 0.4	< 4.0	< 4.1	< 23.6	< 2.8	1337 ± 112
03-07-16	PEMI- 1044	< 0.5	< 2.8	< 2.7	< 22.6	< 2.6	1451 ± 94
04-05-16	PEMI- 1504	< 0.4	< 3.0	< 3.5	< 24.2	< 3.6	1403 ± 95
04-18-16	PEMI- 1863	< 0.3	< 3.4	< 2.8	< 22.6	< 3.5	1311 ± 104
05-02-16	PEMI- 2187	< 0.4	< 4.5	< 5.0	< 25.9	< 2.4	1473 ± 118
05-16-16	PEMI- 2673	< 0.4	< 3.1	< 3.6	< 25.5	< 4.9	1411 ± 114
06-06-16	PEMI- 2920	< 0.3	< 2.8	< 3.0	< 20.7	< 2.6	1309 ± 90
06-20-16	PEMI- 3177	< 0.5	< 2.8	< 3.9	< 21.1	< 4.0	1360 ± 109
07-05-16	PEMI- 3438	< 0.5	< 1.3	< 1.0	< 18.4	< 5.0	1363 ± 41
07-18-16	PEMI- 3889	< 0.5	< 3.1	< 2.8	< 21.1	< 5.2	1374 ± 102
08-02-16	PEMI- 4164	< 0.2	< 3.2	< 2.7	< 38.8	< 10.1	1254 ± 95
08-16-16	PEMI- 4427	< 0.5	< 2.8	< 3.0	< 38.4	< 4.2	1318 ± 86
09-06-16	PEMI- 4757	< 0.2	< 3.7	< 3.7	< 31.9	< 3.9	1391 ± 112
09-19-16	PEMI- 5059	< 0.5	< 3.3	< 4.0	< 29.9	< 5.9	1252 ± 106
10-03-16	PEMI- 5335	< 0.3	< 2.5	< 2.4	< 42.0	< 9.9	1409 ± 79
10-17-16	PEMI- 5820	< 0.4	< 3.3	< 3.1	< 32.4	< 5.3	1289 ± 92
11-07-16	PEMI- 6336	< 0.7	< 3.3	< 2.9	< 20.6	< 6.3	1381 ± 106
12-05-16	PEMI- 6713	< 0.4	< 2.7	< 2.6	< 26.3	< 3.0	1415 ± 94

[a] ND = No data, no milk available.

Table 7. Food Products, analyses for gamma emitting isotopes.

Collection: Monthly   Units: pCi/kg wet

Location: P-2

Lab Code	PEVE- 3890	PEVE- 3891	PEVE- 3892	PEVE- 4397	
Date Collected	07-19-16	07-19-16	07-19-16	08-18-16	Req. LLD
Sample Type	Swiss Chard	Collard Greens	Turnip Greens	Collard Greens	
Be-7	347 ± 124	< 103	298 ± 46	< 117	-
K-40	3408 ± 259	3238 ± 304	3529 ± 112	3345 ± 334	-
Co-58	< 7.2	< 9.3	< 3.8	< 8.5	-
Co-60	< 10.2	< 8.7	< 3.6	< 8.5	-
I-131	< 32.4	< 25.2	< 20.7	< 43.3	45
Cs-134	< 9.1	< 11.4	< 3.4	< 9.5	45
Cs-137	< 9.7	< 15.5	< 4.1	< 14.9	60

Lab Code	PEVE- 4398	PEVE- 4399	PEVE- 5041	PEVE- 5042	
Date Collected	08-18-16	08-18-16	09-20-16	09-20-16	Req. LLD
Sample Type	Japanese Greens	Swiss Chard	Swiss Chard	Collard Greens	
Be-7	491 ± 142	451 ± 199	488 ± 97	185 ± 50	-
K-40	4304 ± 334	3268 ± 411	4262 ± 192	3506 ± 145	-
Co-58	< 4.3	< 15.6	< 8.9	< 3.6	-
Co-60	< 12.0	< 11.2	< 5.0	< 4.9	-
I-131	< 40.7	< 27.4	< 24.1	< 21.0	45
Cs-134	< 11.1	< 14.4	< 6.3	< 5.2	45
Cs-137	< 10.7	< 14.9	< 7.2	< 5.8	60

Lab Code	PEVE- 5821	PEVE- 5822	
Date Collected	10-18-16	10-18-16	Req. LLD
Sample Type	Japanese Greens	Collard Greens	
Be-7	572 ± 143	309 ± 137	-
K-40	7611 ± 382	4469 ± 382	-
Co-58	< 13.4	< 12.6	-
Co-60	< 13.3	< 8.2	-
I-131	< 37.9	< 40.9	45
Cs-134	< 10.9	< 11.8	45
Cs-137	< 11.6	< 8.8	60

Table 7. Food Products, analyses for gamma emitting isotopes.

Collection: Monthly | Units: pCi/kg wet

Location: P-16

Lab Code	PEVE- 3893	PEVE- 3894	PEVE- 4401	PEVE- 4402	
Date Collected	07-19-16	07-19-16	08-18-16	08-18-16	Req. LLD
Sample Type	Japanese Greens	Turnip Greens	Japanese Greens	Collard Greens	
Be-7	231 ± 119	496 ± 106	319 ± 99	212 ± 119	-
K-40	3737 ± 318	6964 ± 365	4099 ± 315	3984 ± 338	-
Co-58	< 9.5	< 12.1	< 9.5	< 6.3	-
Co-60	< 8.9	< 7.7	< 10.0	< 9.1	-
I-131	< 30.1	< 16.9	< 30.3	< 31.6	45
Cs-134	< 9.9	< 8.8	< 8.0	< 10.6	45
Cs-137	< 10.6	< 9.6	< 6.7	< 8.4	60

Lab Code	PEVE- 4403	PEVE- 4404	PEVE- 5043	PEVE- 5044	
Date Collected	08-18-16	08-18-16	09-20-16	09-20-16	Req. LLD
Sample Type	Swiss Chard	Turnip Greens	Collard Greens	Swiss Chard	
Be-7	241 ± 121	489 ± 166	264 ± 45	502 ± 107	-
K-40	4432 ± 369	4203 ± 317	3671 ± 127	4684 ± 236	-
Co-58	< 8.6	< 9.2	< 4.3	< 8.2	-
Co-60	< 9.3	< 8.8	< 3.4	< 6.7	-
I-131	< 34.7	< 29.1	< 19.4	< 43.2	45
Cs-134	< 11.1	< 10.2	< 4.5	< 7.0	45
Cs-137	< 14.2	< 10.8	< 4.5	< 8.2	60

Lab Code	PEVE- 5046	PEVE- 5823	PEVE- 5824		
Date Collected	09-20-16	10-18-16	10-18-16		Req. LLD
Sample Type	Turnip Greens	Collard Greens	Japanese Greens		
Be-7	366 ± 98	222 ± 94	450 ± 94		-
K-40	4810 ± 260	4716 ± 279	6488 ± 272		-
Co-58	< 5.4	< 9.2	< 8.8		-
Co-60	< 9.2	< 9.1	< 5.6		-
I-131	< 30.6	< 42.3	< 32.4		45
Cs-134	< 7.9	< 8.7	< 7.0		45
Cs-137	< 8.9	< 7.9	< 4.6		60

Table 7. Food Products, analyses for gamma emitting isotopes.

Collection: Monthly   Units: pCi/kg wet

Location: P-20

Lab Code	PEVE- 3896	PEVE- 3897	PEVE- 4405	PEVE- 4406	
Date Collected	07-19-16	07-19-16	08-18-16	08-18-16	Req. LLD
Sample Type	Japanese Greens	Turnip Greens	Collard Greens	Swiss Chard	
Be-7	280 ± 124	201 ± 44	< 76	470 ± 135	-
K-40	4361 ± 341	4466 ± 124	4135 ± 310	7646 ± 541	-
Co-58	< 9.5	< 4.1	< 10.3	< 17.2	-
Co-60	< 5.2	< 3.4	< 4.3	< 11.5	-
I-131	< 29.6	< 19.1	< 33.9	< 38.3	45
Cs-134	< 9.2	< 3.5	< 9.4	< 14.2	45
Cs-137	< 12.3	< 4.0	< 8.0	< 17.2	60

Lab Code	PEVE- 4407	PEVE- 4408	PEVE- 5047	PEVE- 5048	
Date Collected	08-18-16	08-18-16	09-20-16	09-20-16	Req. LLD
Sample Type	Turnip Greens	Japanese Greens	Collard Greens	Swiss Chard	
Be-7	336 ± 186	< 160	116 ± 66	489 ± 96	-
K-40	2880 ± 360	3117 ± 290	5319 ± 253	8884 ± 245	-
Co-58	< 9.0	< 10.7	< 6.8	< 7.2	-
Co-60	< 10.0	< 9.4	< 8.2	< 7.2	-
I-131	< 39.2	< 32.3	< 34.6	< 35.9	45
Cs-134	< 12.3	< 8.7	< 7.6	< 6.6	45
Cs-137	< 11.8	< 10.6	< 6.6	< 8.0	60

Lab Code	PEVE- 5049	PEVE- 5050	PEVE- 5336	PEVE- 5337	
Date Collected	09-20-16	09-20-16	10-03-16	10-03-16	Req. LLD
Sample Type	Turnip Greens	Japanese Greens	Swiss Chard	Turnip Greens	
Be-7	350 ± 54	347 ± 138	934 ± 80	566 ± 63	-
K-40	5993 ± 153	6457 ± 365	6907 ± 196	5081 ± 138	-
Co-58	< 5.3	< 10.0	< 6.2	< 4.2	-
Co-60	< 3.4	< 8.6	< 6.4	< 2.6	-
I-131	< 19.1	< 41.8	< 25.0	< 22.1	45
Cs-134	< 4.1	< 9.0	< 5.1	< 4.2	45
Cs-137	< 4.7	< 12.3	< 5.8	< 3.2	60

Lab Code	PEVE- 5338	
Date Collected	10-03-16	Req. LLD
Sample Type	Japanese Greens	
Be-7	643 ± 60	-
K-40	4339 ± 130	-
Co-58	< 2.8	-
Co-60	< 3.2	-
I-131	< 21.0	45
Cs-134	< 3.7	45
Cs-137	< 4.1	60

Table 7. Food Products, analyses for gamma emitting isotopes.

Collection: Monthly | Units: pCi/kg wet

Location: P-37

Lab Code	PEVE- 4409	PEVE- 4410	PEVE- 4411	PEVE- 4412	
Date Collected	08-18-16	08-18-16	08-18-16	08-18-16	Req. LLD
Sample Type	Swiss Chard	Collard Greens	Turnip Greens	Japanese Greens	
Be-7	345 ± 127	< 88	< 166	191 ± 96	-
K-40	5049 ± 345	4000 ± 251	3755 ± 405	4571 ± 322	-
Co-58	< 8.5	< 7.5	< 14.4	< 4.6	-
Co-60	< 11.8	< 6.3	< 11.9	< 5.2	-
I-131	< 26.3	< 20.6	< 30.1	< 26.5	45
Cs-134	< 12.1	< 7.2	< 13.9	< 9.2	45
Cs-137	< 12.0	< 5.6	< 11.8	< 9.3	60

Lab Code	PEVE- 5051	PEVE- 5052	PEVE- 5053	PEVE- 5054	
Date Collected	09-20-16	09-20-16	09-20-16	09-20-16	Req. LLD
Sample Type	Swiss Chard	Collard Greens	Turnip Greens	Japanese Greens	
Be-7	< 105	154 ± 75	220 ± 94	271 ± 104	-
K-40	3659 ± 266	4301 ± 281	3485 ± 238	4268 ± 236	-
Co-58	< 5.3	< 9.9	< 7.0	< 6.8	-
Co-60	< 4.3	< 4.6	< 8.4	< 7.2	-
I-131	< 34.0	< 44.4	< 37.0	< 39.3	45
Cs-134	< 7.4	< 8.0	< 7.3	< 6.3	45
Cs-137	< 8.0	< 10.3	< 6.0	< 7.1	60

Lab Code	PEVE- 5825	PEVE- 5826	PEVE- 5827	PEVE- 5828	
Date Collected	10-18-16	10-18-16	10-18-16	10-18-16	Req. LLD
Sample Type	Swiss Chard	Collard Greens	Turnip Greens	Japanese Greens	
Be-7	457 ± 134	< 101	216 ± 77	301 ± 117	-
K-40	6202 ± 380	4867 ± 359	3528 ± 234	4366 ± 324	-
Co-58	< 10.6	< 12.0	< 5.6	< 7.7	-
Co-60	< 4.5	< 7.4	< 6.3	< 5.2	-
I-131	< 37.5	< 40.0	< 34.1	< 39.3	45
Cs-134	< 11.3	< 11.4	< 6.3	< 8.0	45
Cs-137	< 7.3	< 8.0	< 7.8	< 10.8	60

Table 7. Food Products, analyses for gamma emitting isotopes.

Collection: Monthly | Units: pCi/kg wet

Location: P-70

Lab Code	PEVE- 3898	PEVE- 3899	PEVE- 3900	PEVE- 3901	
Date Collected	07-19-16	07-19-16	07-19-16	07-19-16	Req. LLD
Sample Type	Collard Greens	Turnip Greens	Japanese Greens	Swiss Chard	
Be-7	< 107	447 ± 110	502 ± 116	415 ± 149	-
K-40	6291 ± 358	6606 ± 374	5882 ± 360	12034 ± 541	-
Co-58	< 9.7	< 10.6	< 8.7	< 11.5	-
Co-60	< 7.5	< 6.2	< 8.0	< 11.6	-
I-131	< 20.2	< 22.1	< 34.8	< 37.2	45
Cs-134	< 9.1	< 9.9	< 9.9	< 11.2	45
Cs-137	< 9.8	< 7.4	< 6.6	< 10.2	60

Lab Code	PEVE- 4413	PEVE- 4414	PEVE- 4415	PEVE- 5055	
Date Collected	08-18-16	08-18-16	08-18-16	09-20-16	Req. LLD
Sample Type	Turnip Greens	Collard Greens	Swiss Chard	Japanese Greens	
Be-7	392 ± 108	< 124	489 ± 112	434 ± 108	-
K-40	4283 ± 338	4929 ± 396	6561 ± 375	4715 ± 263	-
Co-58	< 7.9	< 11.4	< 9.6	< 5.7	-
Co-60	< 4.3	< 9.4	< 9.6	< 4.8	-
I-131	< 32.1	< 40.2	< 28.0	< 29.8	45
Cs-134	< 9.3	< 11.3	< 8.9	< 6.6	45
Cs-137	< 11.1	< 9.7	< 13.6	< 5.4	60

Lab Code	PEVE- 5056	PEVE- 5057	PEVE- 5829	PEVE- 5830	
Date Collected	09-20-16	09-20-16	10-18-16	10-18-16	Req. LLD
Sample Type	Collard Greens	Swiss Greens	Swiss Chard	Japanese Greens	
Be-7	< 119	585 ± 106	497 ± 123	474 ± 88	-
K-40	4816 ± 322	7240 ± 338	7449 ± 349	5660 ± 247	-
Co-58	< 9.8	< 8.8	< 7.1	< 7.9	-
Co-60	< 4.2	< 6.7	< 9.4	< 7.8	-
I-131	< 41.8	< 35.0	< 41.1	< 43.2	45
Cs-134	< 9.0	< 7.5	< 9.8	< 7.8	45
Cs-137	< 8.7	< 7.1	< 7.8	< 8.4	60

Lab Code	PEVE- 5831	
Date Collected	10-18-16	Req. LLD
Sample Type	Collard Greens	
Be-7	< 154	-
K-40	5143 ± 348	-
Co-58	< 8.6	-
Co-60	< 13.2	-
I-131	< 42.9	45
Cs-134	< 10.6	45
Cs-137	< 9.2	60

Table 9. Fish, analyses for gamma emitting isotopes.
Collection: Annually

Units: pCi/kg wet

Location	P-25				
Lab Code	PEF- 2653	PEF- 2654	PEF- 2655	PEF- 2656	
Date Collected	05-24-16	05-24-16	05-24-16	05-24-16	Req. LLD
Sample Type	Channel Catfish	Walleye	Smallmouth Bass	White Perch	
K-40	1014 ± 265	1256 ± 299	1735 ± 282	1805 ± 289	-
Mn-54	< 14.4	< 19.9	< 19.7	< 28.5	94
Fe-59	< 60.6	< 50.8	< 65.9	< 137.1	195
Co-58	< 11.5	< 25.8	< 16.9	< 38.8	97
Co-60	< 12.8	< 7.2	< 13.5	< 44.9	97
Zn-65	< 40.5	< 32.9	< 46.1	< 75.9	195
Cs-134	< 14.1	< 18.5	< 19.0	< 29.8	97
Cs-137	< 15.2	< 17.1	< 9.2	< 29.9	112

Location	P-25				
Lab Code	PEF- 2657	PEF- 2658	PEF- 5811	PEF- 5813	
Date Collected	05-24-16	05-24-16	10-20-16	10-20-16	Req. LLD
Sample Type	Yellow Perch	Freshwater Drum	Channel Catfish	Walleye	
K-40	2557 ± 205	1225 ± 199	748 ± 223	1659 ± 286	-
Mn-54	< 27.4	< 20.9	< 14.2	< 15.3	94
Fe-59	< 77.7	< 55.4	< 42.4	< 31.0	195
Co-58	< 38.7	< 15.9	< 10.8	< 13.6	97
Co-60	< 28.6	< 17.5	< 10.9	< 12.7	97
Zn-65	< 39.1	< 37.4	< 28.4	< 26.9	195
Cs-134	< 21.3	< 18.3	< 14.2	< 13.6	97
Cs-137	< 19.8	< 14.7	< 12.3	< 13.1	112

Location	P-25		
Lab Code	PEF- 5814	PEF- 5815	
Date Collected	10-20-16	10-20-16	Req. LLD
Sample Type	Smallmouth Bass	Yellow Perch	
K-40	1258 ± 284	1662 ± 332	-
Mn-54	< 14.7	< 41.6	94
Fe-59	< 41.5	< 86.0	195
Co-58	< 18.4	< 49.9	97
Co-60	< 17.3	< 35.0	97
Zn-65	< 31.8	< 41.1	195
Cs-134	< 18.0	< 42.1	97
Cs-137	< 10.9	< 43.1	112

Table 9. Fish, analyses for gamma emitting isotopes.

Collection: Annually | Units: pCi/kg wet

Location	P-32				
Lab Code	PEF- 2659	PEF- 2660	PEF- 2661	PEF- 2662	
Date Collected	05-24-16	05-24-16	05-24-16	05-24-16	Req. LLD
Sample Type	White Perch	Yellow Perch	Channel Catfish	Freshwater Drum	
K-40	710 ± 265	2180 ± 218	1294 ± 311	794 ± 273	-
Mn-54	< 16.3	< 22.8	< 24.4	< 16.3	94
Fe-59	< 36.9	< 80.5	< 71.6	< 60.8	195
Co-58	< 23.5	< 26.7	< 22.1	< 15.9	97
Co-60	< 12.5	< 17.6	< 23.7	< 14.3	97
Zn-65	< 44.8	< 54.6	< 53.5	< 45.6	195
Cs-134	< 18.5	< 21.2	< 23.2	< 18.6	97
Cs-137	< 15.6	< 24.0	< 28.0	< 19.8	112

Location	P-32			
Lab Code	PEF- 5816	PEF- 5817	PEF- 5818	
Date Collected	10-20-16	10-20-16	10-20-16	Req. LLD
Sample Type	Channel Catfish	Walleye	Yellow Perch	
K-40	2752 ± 440	898 ± 258	2007 ± 280	-
Mn-54	< 47.5	< 12.4	< 27.3	94
Fe-59	< 97.5	< 40.5	< 50.3	195
Co-58	< 30.9	< 19.8	< 33.4	97
Co-60	< 36.2	< 10.6	< 19.5	97
Zn-65	< 74.7	< 24.1	< 55.2	195
Cs-134	< 39.1	< 15.5	< 23.6	97
Cs-137	< 38.3	< 14.5	< 19.7	112

Location	P-32	
Lab Code		
Date Collected		Req. LLD
Sample Type		
K-40		-
Mn-54		94
Fe-59		195
Co-58		97
Co-60		97
Zn-65		195
Cs-134		97
Cs-137		112

Table 11. Sediments, analyses for gamma emitting isotopes.

Collection: Semiannually

Units: pCi/kg dry

Location	P-64		
Lab Code	PEBS- 2769	PEBS- 5070	
Date Collected	05-26-16	09-20-16	Req. LLD
K-40	11614 ± 554	9209 ± 484	-
Co-58	< 18.2	< 21.4	50
Co-60	< 14.0	< 12.2	40
Cs-134	< 13.8	< 12.2	112
Cs-137	< 17.5	< 15.9	135

Location	P-66		
Lab Code	PEBS- 2770	PEBS- 5071	
Date Collected	05-26-16	09-20-16	Req. LLD
K-40	9430 ± 299	8401 ± 429	-
Co-58	< 10.5	< 15.4	50
Co-60	< 11.8	< 9.6	40
Cs-134	< 8.4	< 11.2	112
Cs-137	< 7.8	< 14.9	135

Appendix D
Corrections to Previous Annual Environmental and Effluent Release Reports

APPENDIX D

Corrections to Previous Annual Environmental and Effluent Release Reports:

There is one correction to the 2013 Annual Environmental and Effluent Release Report.

This correction changes the radioactive waste volumes in Table 6, Solid Waste Shipped Offsite for Burial or Disposal, to their correct values.

The revised page is included in Enclosure B.

In January 2017, it was determined that Underdrain Manholes 20 and 23 are to be included in the PNPP Groundwater Monitoring Program. Results will be included in the AEERR. Results from the previous three years are listed below.

Summary of Underdrain Manhole Samples

	Underdrain Manhole 20, H-3, pCi/L	Underdrain Manhole 23, H-3, pCi/L
2013 Quarter 1	NS	NS
2013 Quarter 2	<LLD	<LLD
2013 Quarter 3	NS	NS
2013 Quarter 4	NS	NS
2014 Quarter 1	<LLD	<LLD
2014 Quarter 2	<LLD	NS
2014 Quarter 3	NS	NS
2014 Quarter 4	NS	NS
2015 Quarter 1	NS	NS
2015 Quarter 2	NS	NS
2015 Quarter 3	<LLD	<LLD
2015 Quarter 4	<LLD	<LLD

NS – not sampled; insufficient water to obtain sample

<LLD – less than lower limit of detection

Appendix E
Abnormal Releases

APPENDIX E

Abnormal Releases

In November 2011, radioactivity was detected in the Nuclear Closed Cooling (NCC) system. The source of this activity is the primary coolant. There is some leakage from the NCC system to Service Water and from there to the environment. Residual activity remains in the NCC system and it is being tracked as a continuous abnormal release.

The calculated annual doses for the NCC abnormal releases were 1.21E-05 mrem whole body and 2.09E-05 mrem organ.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Total time period for continuous release, min	8.64E+04*	1.31E+05	1.32E+05	1.32E+05
Total volume released, liters	2.64E+05*	4.00E+05	4.04E+05	4.04E+05
Average quarterly flow rate, L/min	1.10E+05*	1.59E+05	1.93E+05	1.33E+05

*Release continued, however, no activity was detected in March; March volumes were omitted from all calculations

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
A. Fission and Activation Products (Ci)					
Mn-54	<LLD	2.19E-05	<LLD	<LLD	2.19E-05
Co-58	<LLD	3.34E-05	<LLD	<LLD	3.34E-05
Co-60	<LLD	1.37E-04	3.82E-05	2.32E-05	1.99E-04
Total Released	<LLD	1.92E-04	3.82E-05	2.32E-05	2.54E-04
B. Tritium (Ci)	7.14E-05	<LLD	<LLD	<LLD	7.14E-05
C. Noble Gases (Ci)	<LLD	<LLD	<LLD	<LLD	<LLD
D. Gross Alpha (Ci)	1.44E-06	6.94E-07	<LLD	<LLD	2.14E-06

There were no abnormal gaseous releases.

Appendix F
ODCM Non-Compliances

APPENDIX F

ODCM Non-Compliances

Effluent Monitoring

On 6/8/16, it was discovered that ODCM Table 3.3.7.9-1, Action 110 had been violated due to a human performance error. Liquid radwaste release permit 16-010L, issued 2/1/16, did not document an independent verification of release rate calculations, which is a requirement at times that the liquid effluent monitor is inoperable. During this release, the Radwaste to Emergency Service Water Radiation Monitor was inoperable. The surveillance instruction for releasing radwaste tanks was revised to include a step for an independent verifier to sign that calculations were verified correct.

Environmental Monitoring

On 4/18/16, the air sampler at location #1 was found not running. The control box indicated turbine failure, which caused the pump to stop. The turbine was replaced, unit calibrated, and pump restarted. The sample LLDs were met.

On 05/25/16, all recreationally and commercially important species of fish were unable to be obtained. The PNPP ODCM and site sampling procedure state that "two or more commercially/recreationally viable fish species indigenous of the Lake Erie region are required per location", which were obtained from the indicator location in 2016. The site defined what is "commercially and recreationally viable", which are Yellow Perch, Walleye, Smallmouth Bass, and White Bass. At the indicator location, the defined species not obtained was White Bass. At the control location, the species not obtained included Small Mouth Bass, Walleye, and White Bass.

On 10/19/16, three air samplers at locations #1, #5, and #35 were found not running. The control boxes were replaced and pumps restarted. Offending control boxes were sent to the vendor for troubleshooting. Volumes and run times were documented. The sample LLDs were met.

Appendix G
ODCM Changes

APPENDIX G
ODCM Changes

There were no changes to the ODCM during this reporting period.

Appendix H
Changes to Process Control Program

APPENDIX H

Process Control Program Changes

There were no changes to the Process Control Program during this reporting period.

Enclosure B

L-17-076

Corrections to the 2013 PNPP Annual Environmental and Effluent Release Report

Solid Waste

All solid radioactive waste from PNPP was processed and combined with waste from several other utilities by intermediate vendors (Energy Solutions, Duratek in Oak Ridge, TN and Studsvik, in Erwin, TN). This waste was ultimately sent to Clive, Utah disposal facilities for burial. The solid radioactive waste summary in Table 6 includes all PNPP shipments for 2013.

Table 6: Solid Waste Shipped Offsite for Burial or Disposal

A. TYPE OF SOLID WASTE SHIPPED	VOLUME (M^3)	ACTIVITY (CI)	EST. TOTAL ERROR (%)
Resins, Filters and Evaporator Bottoms	4.81E+01	5.77E+02	+/- 25
Dry Active Waste	1.91E+03	1.15E+00	+/- 25
Irradiated components, control rods, etc.	0.00E+00	0.00E+00	+/- 25
Other Waste	0.00E+00	0.00E+00	+/- 25

B. ESTIMATE OF MAJOR(1) NUCLIDE COMPOSITION (BY TYPE OF WASTE)	RADIONUCLIDE	ABUNDANCE (%)	EST. TOTAL ERROR, (%)
Resins, Filters and Evaporator Bottoms	Co-60	68.74	+/- 25
	Fe-55	13.48	
	Mn-54	6.03	
	Zn-65	5.77	
	Sr-89	1.56	
	Co-58	1.52	
	Nb-95	1.08	
Dry Active Waste	Co-60	68.74	+/- 25
	Fe-55	13.48	
	Mn-54	6.03	
	Zn-65	5.77	
	Sr-89	1.56	
	Co-58	1.52	
	Nb-95	1.08	
Irradiated Components, Control Rods, etc.	N/A	N/A	N/A
Other Waste	N/A	N/A	N/A

C. DISPOSITION	NUMBER OF SHIPMENTS	MODE OF TRANSPORTATION	DESTINATION
Solid Waste(2)	38	Hittman Transport	Energy Solutions, Bear Creek, TN
Solid Waste(2)	16	Hittman Transport	Studsvik, Erwin, TN

N/A -- Not Applicable

(1) -- "Major" is defined as any individual radionuclide identified as >1% of the waste type abundance.

(2) -- This waste was combined with waste from other utilities and disposed of at Clive, Utah.

METEOROLOGICAL DATA

The Meteorological Monitoring System at PNPP consists of a 60-meter tower equipped with two independent systems for measuring wind speed, wind direction, and temperature at both 10-meter and 60-meter heights. The tower also has instrumentation to measure dew point and barometric pressure. Data is logged from the tower through separate data loggers, and transmitted to a common plant computer. This system compiles the data and calculates a variety of atmospheric parameters, communicates with the Meteorological Information Dose Assessment System (MIDAS), and sends data over communication links to the plant Control Room.

A detailed report of the monthly and annual operation of the PNPP Meteorological Monitoring Program is produced under separate cover. For the period of January 1, 2013 through December 31, 2013, the report substantiates the quality and quantity of meteorological data collected in accordance with applicable regulatory guidance.

DOSE ASSESSMENT

The maximum concentration for any radioactive release is controlled by the limits set forth in Title 10 of the Code of Federal Regulations, Part 20 (10CFR20). Sampling, analyzing, processing, and monitoring the effluent stream ensures compliance with these concentration limits. Dose limit compliance is verified through periodic dose assessment calculations. Some dose calculations are conservatively performed for a hypothetical individual who is assumed to reside on the site boundary at the highest potential dose location all year. This person, called the “maximum individual”, would incur the maximum potential dose from direct exposure (air plus ground plus water), inhalation, and ingestion of water, milk, vegetation, and fish. Because no one actually meets these criteria, the actual dose received by a real member of the public is significantly less than what is calculated for this hypothetical individual.

Dose calculations for this maximum individual at the site boundary are performed for two cases. First, they are performed using data for a 360° radius around the plant site (land and water based meteorological sectors); even though some of these sectors are over Lake Erie, which has no permanent residents. The second calculation is performed considering only those sectors around the plant in which people reside (land-based meteorological sectors).

The calculated hypothetical, maximum individual dose values at the site boundary are provided in Table 7. This table considers all meteorological sectors around PNPP and provides either the whole body or worst-case, organ dose values. If any radionuclide was not present at a level greater than the LLD, it was not used in the dose calculations.