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May 14, 2020

L-MT-20-013
10 CFR 50, Appendix I

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

Monticello Nuclear Generating Plant
Docket No. 50-263
Renewed Facility Operating License No. DPR-22

2019 Annual Radiological Environmental Operating Report

Pursuant to 10 CFR 50, Appendix I, Section IV.B.2, IV.B.3, IV.C and, in accordance with Monticello Nuclear Generating Plant (MNGP) Technical Specifications 5.6.1, the Northern States Power Company, a Minnesota corporation (NSPM), d/b/a Xcel Energy, is submitting the Annual Radiological Environmental Operating Report, under MNGP's "Radiological Environmental Monitoring Program," for year 2019.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

Thomas A. Conboy
Site Vice President, Monticello Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Monticello, USNRC
Resident Inspector, Monticello, USNRC
Minnesota Department of Commerce

ENCLOSURE

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
JANUARY 1 – DECEMBER 31, 2019

Design & Consultancy
for natural and
built assets

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2019 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)

Monticello Nuclear Generating Plant

Last Updated: 4/27/2020

2019 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Monticello Nuclear Generating Plant

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ACRYONYMS AND ABBREVIATIONS

AREOR	Annual Radiological Environmental Operating Report
BTP	Radiological Assessment Branch Technical Position, Rev. 1, on Radiological Monitoring
CFR	Code of Federal Regulations
d/b/a	doing business as
D/Q	deposition coefficient
E	East
EDC	Environmental Dosimetry Company
ENE	East-Northeast
ESE	East-Southeast
ft	feet
ft^2	square feet
GEL	General Engineering Laboratories LLC
GPS	Global Positioning System
I-131	iodine-131
ISFSI	Independent Spent Fuel Storage Installation
LLD	lower limit of detection
MDA	minimum detectable activity
mi	mile
MNGP	Monticello Nuclear Generating Plant
mrem	millirem
MWe	megawatt electric
N	North
NE	Northeast
NIST	National Institute of Standards and Technology
NNE	North-Northeast
NNW	North-Northwest
NRC	Nuclear Regulatory Commission
NW	Northwest
OCA	owner-controlled area

ODCM	Offsite Dose Calculation Manual
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/kg	picocurie per kilogram
pCi/m^3	picocurie per cubic meter
REMP	Radiological Environmental Monitoring Program
S	South
SE	Southeast
SSE	South-Southeast
std quarter	Standard quarter, 91 days
SSW	South-Southwest
SW	Southwest
TLD	thermoluminescent dosimeter
UFSAR	Updated Final Safety Analysis Report
USB	Universal Serial Bus
W	West
WNW	West-Northwest
WSW	West-Southwest

REFERENCES

Arnold, J.R., and H.A. Al-Salih. 1955. Beryllium-7 Produced by Cosmic Rays. *Science*. April 121(3144): 451-453.

MNGP Chemistry Manual, Procedure I.05.41, “Annual Land Use Census and Critical Receptor Identification”.

NRC Generic Letter 79-65 Radiological Environmental Monitoring Program Requirements Enclosing Branch Technical Position (BTP), Revision 1, November 1979.

NUREG 1302 Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors, April 1991

Offsite Dose Calculation Manual (ODCM) 07.01 Monticello Nuclear Generating Plant, Revision 25.

Offsite Dose Calculation Manual (ODCM) 07.01 Monticello Nuclear Generating Plant, Revision 26.

Regulatory Guide 4.15 Quality Assurance for Radiological Monitoring Programs, Revision 1, 1979.

EXECUTIVE SUMMARY

This 2019 Annual Radiological Environmental Operating Report (AREOR) describes the Monticello Nuclear Generating Plant (MNGP) Radiological Environmental Monitoring Program (REMP) and program results for January 1 through December 31, 2019. MNGP is operated by Northern States Power Company, a Minnesota corporation, d/b/a Xcel Energy (Xcel) under a license granted by the U.S. Nuclear Regulatory Commission (NRC).

Provisions of NRC's NUREG-1302, NRC Generic Letter 79-65 Branch Technical Position, MNGP Technical Specifications, and MNGP's Offsite Dose Calculation Manual (ODCM) establish the requirements of the REMP. This report describes the purpose and scope of MNGP's REMP, along with the monitoring and sampling results for the reporting period.

Report Contents

This AREOR includes the following:

- Identification of sampling locations
- Descriptions of environmental sampling and analysis procedures
- Comparisons of present environmental radioactivity levels and historical environmental data
- Analysis of trends in environmental radiological data as potentially affected by plant operations
- Summary of environmental radiological sampling results
- Quality assurance practices, sampling deviations, unavailable samples, and program changes.

Photo Credit: Daniel Thurston, Chemistry Supervisor, MNGP

Plant Stack, used for dispersing treated gaseous effluents, Monticello Nuclear Generating Plant in Winter

Summary of Activities and Results

Sampling activities were conducted as prescribed by MNGP's ODCM. Required analyses were performed and detection capabilities were met for the collected samples required by the ODCM. To compile data for this AREOR, 865 samples were analyzed, yielding 1,961 test results. Based on the annual MNGP Land Use Census, the current number of sampling sites for MNGP is sufficient. Concentrations observed in the environment in 2019 for plant-related radionuclides were within the ranges of concentrations observed in the past. The continued operation of the plant has not contributed measurable radiation or the presence of gamma radioactivity.

1 INTRODUCTION

Welcome to Monticello Nuclear Generating Plant

The Radiological Environmental Monitoring Program (REMP) for the Monticello Nuclear Generating Plant (MNGP),[1] located in Monticello, Minnesota, provides data on measurable levels of radiation and radioactive materials in the areas surrounding the Site[2] and evaluates the relationship between quantities of radioactive materials released from the plant and the resultant doses to individuals from principal pathways of exposure. At any given nuclear utility in the United States, REMPs are designed to provide a check on a nuclear utility's Effluent Release Program[3] and dispersion modeling to ensure that radioactive effluent concentrations in the air, terrestrial, and aquatic environments conform to the "As Low As Reasonably Achievable" (ALARA) design objectives of Appendix I of Chapter 10 of the Code of Federal Regulations (CFR) Part 50.

This 2019 Annual Radiological Environmental Operating Report (AREOR) has been prepared by Arcadis U.S., Inc. and presents an interpretation and summary of the environmental data from exposure pathways, interpretations of that data, along with analyses and trends of the results covering the January, to December 2019, period.

[1] In this document, a distinction is made between "MNGP," "Site," and "Plant." "MNGP" is the name of the facility. "Site" refers to the entire areal extent of MNGP's property, including the uncontrolled and controlled areas. "Plant" refers to the controlled area. The REMP involves monitoring and sampling at various locations across the Site and offsite locations.

[2] Referred to as the Site "environs."

[3] The Effluent Release Program is separate but related to the REMP. Both are required by federal regulations.

Figure 1.0-1[4] below illustrates various exposure pathways[5] for receptors.[6] Routinely monitored pathways include ingestion, inhalation, and direct radiation. Exposure pathways are based on Site-specific information, such as the locations and habitats of receptors, the ages of these receptors, and the distance and relationship of these receptors with respect to release points and water usage around the Plant. A Site-specific REMP has been developed and maintained in accordance with MNGP's Offsite Dose Calculation Manual (ODCM), NUREG-1302, and the Branch Technical Position on Radiological Environmental Monitoring.

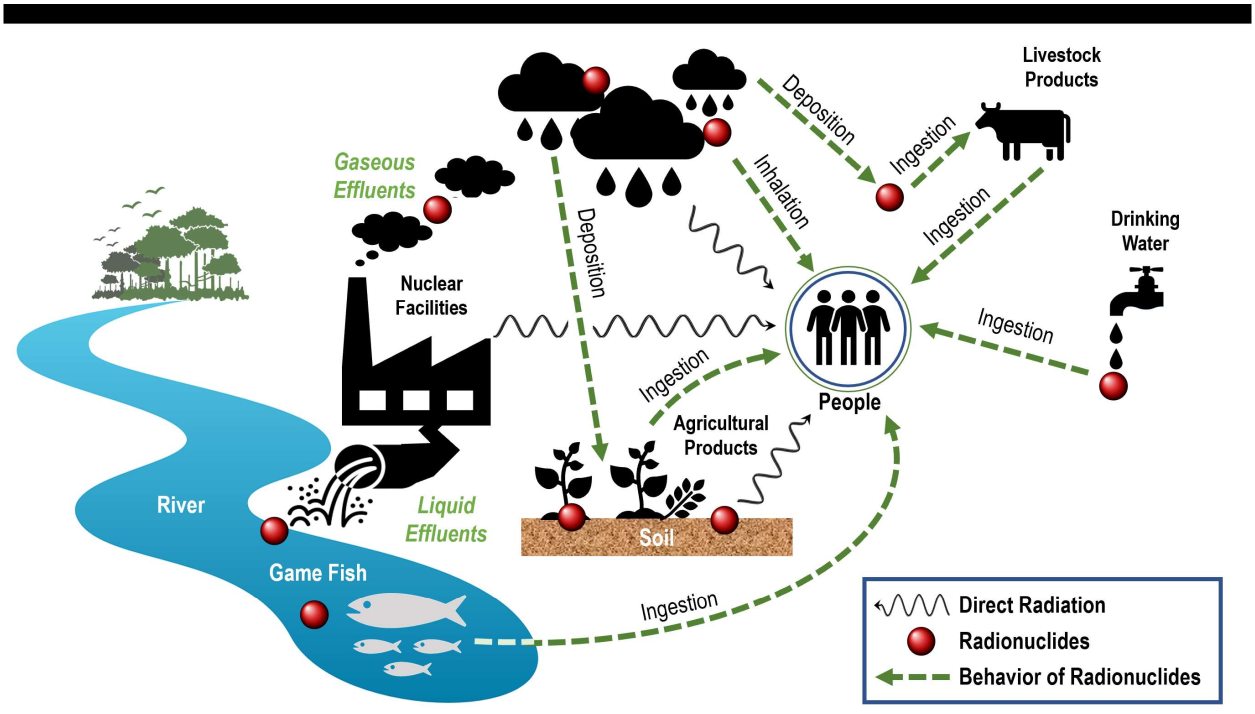


Figure 1.0-1 Monitored Potential Exposure Pathways.

[4] Image Credit: Jesse R. Toepfer, © 2020.

[5] An exposure pathway describes the route of the radiological exposure from a source. The primary form of radiological emissions from the Plant are airborne discharges. The following pathways are monitored as part of MNGP's REMP: external dose, ingestion of radioactive materials, and inhalation of radioactive material.

[6] Living things that can be affected by radioactive effluent releases are referred to as environmental "receptors."

1.1 Site Description and Sample Locations

1.1.1 Site Description

Located in Wright County, Minnesota, MNGP is located along the Mississippi River and is about 40 miles northwest of the Twin Cities of Minneapolis and St. Paul. MNGP generates commercial electrical power via a boiling water reactor with a nominal generating capacity of 681 megawatts electric (MWe). Commercial production was initiated on June 30, 1971.

1.1.2 Rationale for Sample Locations

Although the contribution to background radiation is very small the REMP was established to assess the exposure pathways to humans. Specific methods and different environmental media are required to assess each pathway. Sampling locations for the Site are chosen based upon meteorological factors, preoperational monitoring, and results of the land use surveys. A number of sample points are selected as control locations, because they are distant enough to preclude any plant effect and thus, unaffected by Site operations. MNGP's REMP sampling locations and the TLD monitoring locations are discussed in Section 2 of this report.

1.2 Scope and Requirements of the REMP

MNGP's REMP is based on U.S. Nuclear Regulatory Commission (NRC) guidance, and is conducted in accordance with MNGP's ODCM, and is furthermore guided by applicable procedures for sample media, sampling locations, sampling frequency, and analytical sensitivity requirements. Indicator and control locations were established for comparison purposes to distinguish radioactivity of originating from the Plant versus that from natural or other anthropogenic[7] sources. This program provides for surveillance of appropriate critical exposure pathways to man, protects vital interests of members of the public, and is intended to satisfy compliance with state and federal environmental agencies. Section 3 lists the reporting levels and sample collection frequency for detection of radioactivity in the environment.

[7] An "anthropogenic" source refers to radioactivity from a manmade substance, as well as radioactivity from natural sources that would not otherwise normally be present in the environment either in an amount, concentration, and/or at a specified rate, without human intervention.

Blooming Trees at Monticello Nuclear Generating Plant

The Annual Land Use Census, required by MNGP's ODCM, is performed to ensure changes in the use of areas at or beyond the Site boundary are identified and that appropriate modifications to the REMP are made if necessary. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR 50. Results are described in Section 5 of this document.

In addition, participation in an interlaboratory comparison program is performed in fulfillment of MNGP's ODCM operational requirements. The comparison program provides for independent checks on the precision and accuracy of measurements of radioactive material in REMP sample matrices. These checks are performed as part of the quality assurance (QA) program for environmental monitoring to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 of CFR Part 50 and Regulatory Guide 4.15 "Quality Assurance for Radiological Environmental Monitoring Programs". Appendix A of this 2019 AREOR summarizes the results obtained as part of this comparison program.

2 RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS

Figures 2.2-1 through 2.2-5 depict MNGP's REMP sampling locations and the TLD monitoring locations. The location numbers shown on these maps correspond to those listed in Tables 2.1-2 through 2.1-4. Guidance for the format and layout of these tables and figures is derived from MNGP's ODCM.

2.1 Exposure Pathway and Sample Locations

Table 2.1-1 below presents the sample frequency and collection, analysis type, and number of samples versus their locations for airborne radioiodine and particulates.

Table 2.1-1: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis: Airborne (ODCM 07.01 Table 1)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Airborne Radioiodine & Particulates	Samples from five locations: three samples from offsite locations (in different sectors) of the highest calculated annual average ground level D/Q, one sample from the vicinity of a community having the highest calculated annual average ground-level D/Q, and one sample from a control location specified in Table 2.1-5.	Continuous sampler operation with sample collection weekly.	Radioiodine analysis Weekly for I-131 Particulate: Gross beta activity on each filter weekly*. Analysis **SHALL** be performed more than 24 hours following filter change. Perform gamma isotopic analysis on composite (by location) sample quarterly.

Notes:

* If gross beta activity in any indication sample exceeds 10 times the yearly average of the control sample, a gamma isotopic analysis is required.

** Sample locations are further described in Table 2.1-5.

Table 2.1-2 below presents the sample frequency and collection, analysis type, and number of samples versus their locations for direct radiation.

Table 2.1-2: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis: Direct Radiation (ODCM 07.01 Table 1)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
2. Direct Radiation	40 TLD stations established with duplicate dosimeters placed at the following locations:**** 1. Using the 16 meteorological sectors as guidelines, an inner ring of stations in the general area of the site boundary is established and an outer ring of stations at a distance of 4 to 5 miles distance from the MNGP is established. Because of inaccessibility, two sectors in the inner ring are not covered. 2. Ten dosimeters are established at special interest areas and four control stations. 3. Three neutron and gamma dosimeter sets are located along the OCA fence. Additionally, three neutron dosimeters are stationed with special interest and inner ring TLDs and four neutron control dosimeters are stationed with the REMP control TLDs.	Quarterly	Gamma/Neutron Dose quarterly

Notes:

** Sample locations are further described in Table 2.1-5.

**** Three control TLD locations have only one dosimeter.

Table 2.1-3 below presents the sample frequency and collection, analysis type, and number of samples versus their locations for waterborne pathways.

Table 2.1-3: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis: Waterborne (ODCM 07.01 Table 1)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations*	Sampling and Collection Frequency	Type and Frequency of Analysis
3. Waterborne			
a. Surface Water	Upstream and downstream locations.	Monthly composite of weekly samples (water and ice conditions permitting)	Gamma Isotopic analysis of each monthly composite Tritium analysis of quarterly composites of monthly composites
b. Groundwater	Three samples from wells within 5 miles of the MNGP and one sample from a well greater than 10 miles from the MNGP.	Quarterly	Gamma Isotopic and tritium analyses of each sample
c. Drinking Water	One sample from the City of Minneapolis water supply.	*Composite of 2 weekly samples when I-131 analysis is performed; monthly composite of weekly samples otherwise.* ~~Monthly composite of weekly samples~~	*I-131 analysis on each bi-weekly composite when the dose calculated for the consumption of the water is greater than 1 millirem (mrem) per year[#]. Composite for gross beta and gamma isotopic analyses monthly. Composite for tritium analysis quarterly* ~~I-131 Analysis and Gross beta and Gamma isotopic analysis of each monthly composite Tritium analysis of quarterly composites of monthly composites~~
d. Sediment from Shoreline	One sample upstream of the MNGP, one sample downstream of the MNGP, and one sample from the shoreline of the recreational area.	Semiannually	Gamma isotopic analysis of each sample

Notes:
Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.
The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

** Sample locations are further described in Table 2.1-5.

Table 2.1-4 below presents the sample frequency and collection, analysis type, and number of samples versus their locations for ingestion pathways.

Table 2.1-4: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis: Ingestion (ODCM 07.01 Table 1)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
4. Ingestion			
a. Milk	*Samples from milking animals in three locations within 3 miles from the MNGP having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 3 to 5 miles from the MNGP where doses are calculated to be greater than 1 mrem per year.#* *One sample from milking animals at a control location, 10 to 20 miles from the MNGP and in the least prevalent wind direction.* ~~One sample from dairy farm having highest D/Q, one sample from each of three dairy farms (if available) calculated to have doses from I-131 > 1 mrem/yr, and one sample from 10-20 miles~~	*Biweekly when animals are on pasture; monthly at other times.* ~~Monthly or biweekly if animals are on pasture~~	Gamma Isotopic and I-131 analysis of each sample.
b. Vegetation	Samples of vegetation grown closest to each of the two offsite locations of highest predicted annual average D/Q if milk sampling is not performed, and one sample from 10 to 20 miles in the least prevalent wind direction.	Monthly during growing season	Gamma Isotopic and I-131 analysis of each sample.
c. Fish ~~and Invertebrates~~	One sample of one game species of fish located upstream and downstream of the MNGP. ~~One sample of Invertebrates upstream and downstream of the plant site.~~	Samples collected semi-annually	Gamma isotopic analysis on each sample (edible portion only on fish).
d. Food Products	One sample of corn and potatoes from any area that is irrigated by water in which liquid radioactive effluent has been discharged.***	At time of harvest	Gamma isotopic analysis of edible portion of each sample

<u>Notes:</u>
Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.

** Sample locations are further described in Table 2.1-5.

*** As determined by methods outlined in Section 2.3 of the ODCM 07.01.

 # The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

Table 2.1-5 below presents the location, code designation, and referenced collection site for a given sample type.

Table 2.1-5: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (ODCM 07.01 Table 4)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
River water	M-8c	Upstream of plant	within 1,000 ft upstream of plant intake		
River water	M-9	Downstream of plant	within 1,000 ft downstream of plant discharge		
Drinking water	M-14	City of Minneapolis	37.0	132	SE
Groundwater	M-43c	Imholte Farm	12.3	313	NW
Groundwater	M-11	City of Monticello	3.3	127	SE
Groundwater	M-12	Plant Well No. 11	0.26	252	WSW
Groundwater	M-55	Hasbrouck Residence	1.60	255	WSW
Sediment-River	M-8c	Upstream of plant	within 1,000 ft upstream of plant intake		
Sediment-River	M-9	Downstream of plant	within 1,000 ft downstream of plant discharge		
Sediment-Shoreline	M-15	Montissippi Park	1.27	114	ESE
Fish	M-8c	Upstream of plant	within 1,000 ft upstream of plant intake		
Fish	M-9	Downstream of plant	within 1,000 ft downstream of plant discharge		
Vegetation*	M-41	Training Center	*Near* 0.8	151	SSE
Vegetation*	M-42**	Biology Station Road	*Near 0.7* ~~0.6~~	*136* ~~134~~	SE
	*M-42A***		*Near 0.7*	*108*	*ESE*
Vegetation*	M-43c	Imholte Farm	*Near* 12.3	313	NW
Cultivated Crops					
(corn)***	-	-			
(potatoes)***	-	-			

<u>Notes:</u>

Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.

* Actual location for vegetation sampling may vary depending on availability of broad leaf plant species. The nearest available broad leaf specimens to the location should be used.

** M-42 is the preferred sampling location; however, M-42A may be used in place of M-42, if samples are not available at the preferred location.

*** Collected only if plant discharges radioactive effluent into the river, then only from river irrigated fields. (See Section 2.1 of the ODCM 07.01)

Table 2.1-5: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (ODCM 07.01 Table 4) (Continued)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
Particulates and Radioiodine					
(air)	M-1c	Air Station M-1	11.0	307	NW
(air)	M-2	Air Station M-2	0.8	140	SE
(air)	M-3	Air Station M-3	0.6	104	ESE
(air)	M-4	Air Station M-4	0.8	147	SSE
(air)	M-5	Air Station M-5	2.6	134	SE
Direct Radiation Inner Ring - (general area of the site boundary)					
(TLD)	M01A	Sherburne Ave. So.	0.75	353	N
(TLD)	M02A	Sherburne Ave. So.	0.79	23	NNE
(TLD)	M03A	Sherburne Ave. So.	1.29	56	NE
(TLD)	M04A	Biology Station Rd.	0.5	92	E
(TLD)	M05A	Biology Station Rd.	0.48	122	ESE
(TLD)	M06A	Biology Station Rd.	0.54	138	SE
(TLD)	M07A	Parking Lot H	*0.43* ~~0.47~~	*157*~~158~~	SSE
(TLD)	M08A	Parking Lot F	0.45	175	S
(TLD)	M09A	County Road 75	0.38	206	SSW
(TLD)	M10A & ISFSI-15 (neutron)	County Road 75	0.38	224	SW
(TLD)	M11A	County Road 75	0.4	237	WSW
(TLD)	M12A & ISFSI-14 (neutron)	County Road 75	0.5	262	W
(TLD)	M13A	North Boundary Rd.	0.89	322	NW
(TLD)	M14A	North Boundary Rd.	0.78	335	NNW

Notes:
Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.

Table 2.1-5: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (ODCM 07.01 Table 4) (Continued)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
Direct Radiation Outer Ring - (about 4 to 5 miles distant from the plant)					
(TLD)	M01B	117th Street	4.65	1	N
(TLD)	M02B	County Road 11	4.4	18	NNE
(TLD)	M03B	County Rd. 73 & 81	4.3	51	NE
(TLD)	M04B	County Rd. 73 (196th Street)	4.2	67	ENE
(TLD)	M05B	City of Big Lake	4.3	89	E
(TLD)	M06B	County Rd 14 & 196th Street	4.3	117	ESE
(TLD)	M07B	Monticello Industrial Dr.	4.3	136	SE
(TLD)	M08B	Residence Hwy 25 & Davidson Ave	4.6	162	SSE
(TLD)	M09B	Weinand Farm	4.7	178	S
(TLD)	M10B	Reisewitz Farm - Acacia Ave	4.2	204	SSW
(TLD)	M11B	Vanlith Farm - 97th Ave	4.0	228	SW
(TLD)	M12B	Lake Maria St. Park	4.2	254	WSW
(TLD)	M13B	Bridgewater Sta.	4.1	270	W
(TLD)	M14B	Anderson Res. - Cty Rd 111	4.3	289	WNW
(TLD)	M15B	Red Oak Wild Bird Farm	4.3	309	NW
(TLD)	M16B	*University Ave and Hancock St, Becker* ~~Sand Plain Research Farm~~	4.4	341	NNW

Notes:

Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.

Table 2.1-5: Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (ODCM 07.01 Table 4) (Continued)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
Direct Radiation - (special interest locations)					
(TLD)	M01S	*127th Street NE* ~~Osowski Fun Market~~	0.66	241	WSW
(TLD)	M02S & ISFSI-16 (neutron)	Krone Residence	0.5	220	SW
(TLD)	M03S	Big Oaks Park	1.53	103	ESE
(TLD)	M04S	Pinewood School	2.3	131	SE
(TLD)	M05S	*20500 Co. Rd 11, Big Lake* ~~Rivercrest Christian Academy~~	3.0	118	ESE
(TLD)	M06S	Monticello Public Works	2.6	134	SE
(TLD)	I-11 & ISFSI-11 (neutron)	OCA Fence South, on exit road	0.31	222	SW
(TLD)	I-12 & ISFSI-12 (neutron)	OCA Fence Middle, on exit road	0.32	230	SW
(TLD)	I-13 & ISFSI-13 (neutron)	OCA Fence North, on exit road	0.34	240	WSW
Direct Radiation Controls - (10 to 12 miles distant from plant)					
(TLD)	M01C & Neutron Control D	Kirchenbauer Farm	11.5	323	NW
(TLD)	M02C & Neutron Control C	Cty Rd 4 & 15	11.2	47	NE
(TLD)	M03C & Neutron Control A	Cty Rd 19 & Jason Ave	11.6	130	SE
(TLD)	M04C & Neutron Control B	Maple Lake Water Tower	10.3	226	SW

Notes:

Italicized text reflects revisions that were made to the ODCM in 2019. Struck out text indicates the previous language that was changed.

Code letters are defined below:

A = Locations in the general area of the site boundary

B = Locations about 4 to 5 miles distant from the MNGP

C = Locations of control TLDs greater than 10 miles from the MNGP

S = Special interest locations

2.2 Maps of Sample Locations

Figure 2.2-1 below illustrates the sampling locations associated with surface water, well water, air, and vegetation.

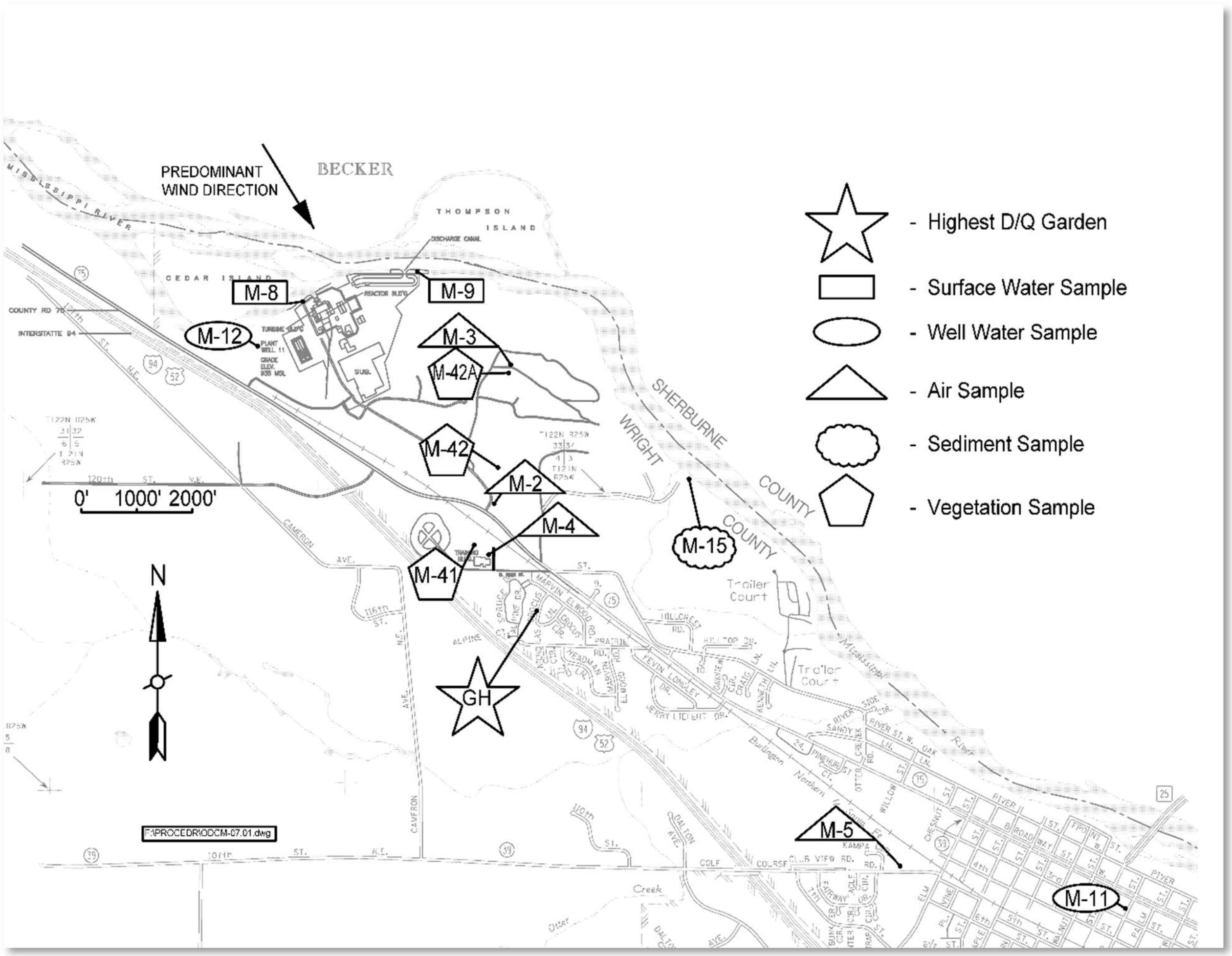


Figure 2.2-1: Radiation Environmental Monitoring Program (ODCM 07.01 Figure 1)

Figure 2.2-2 below illustrates the locations of the 4- to 5-mile ring and special interest TLD monitoring stations.

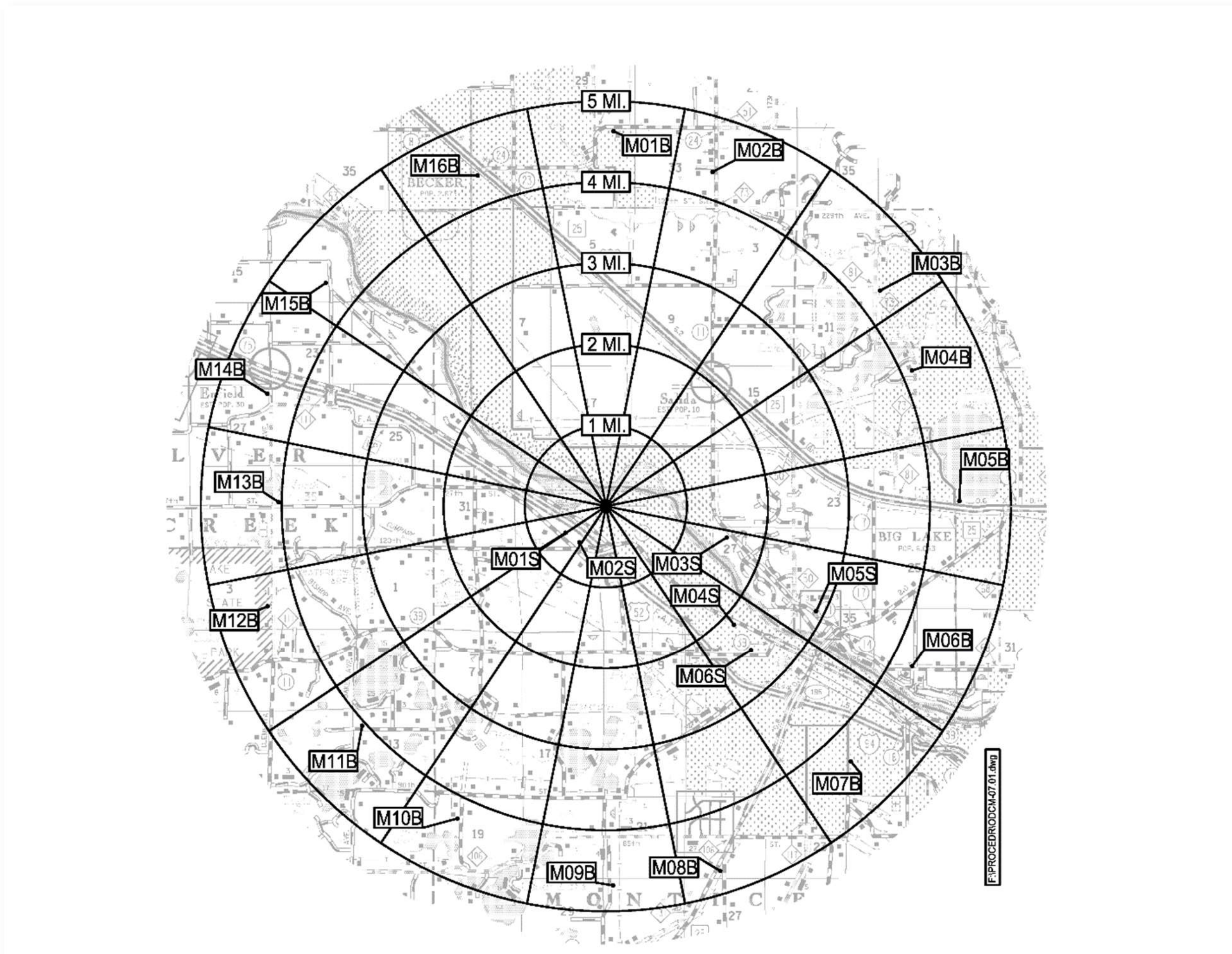


Figure 2.2-2: 4 – 5 Mile Ring and Special Interest TLD Locations (ODCM 07.01 Figure 2)

Figure 2.2-3 below illustrates the locations of site boundary TLD monitoring stations.

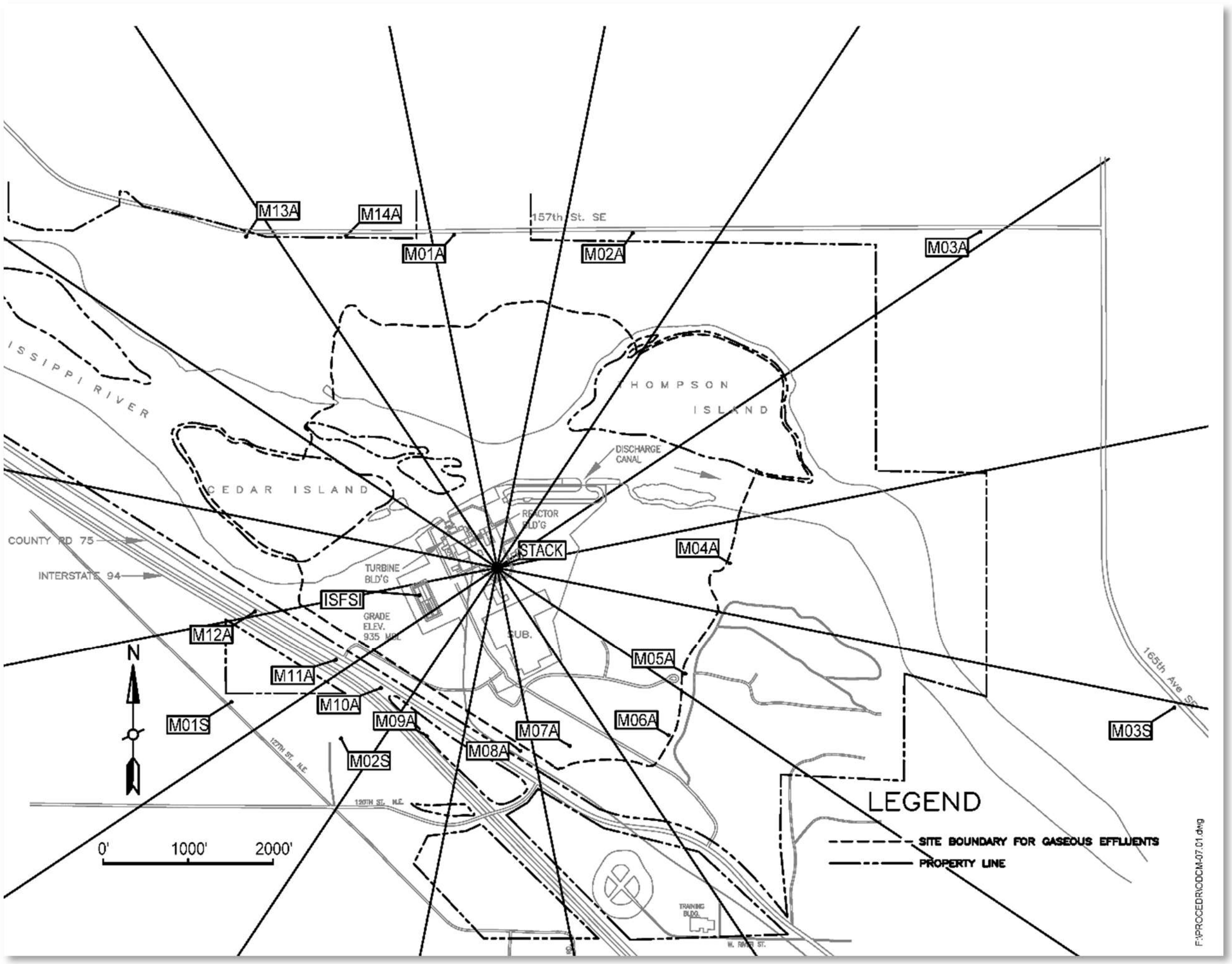


Figure 2.2-3: Site Boundary TLD Locations (ODCM 07.01 Figure 3)

Figure 2.2-4 below illustrates the control sample locations, while Figure 2.2-5 illustrates ISFSI TLD locations.

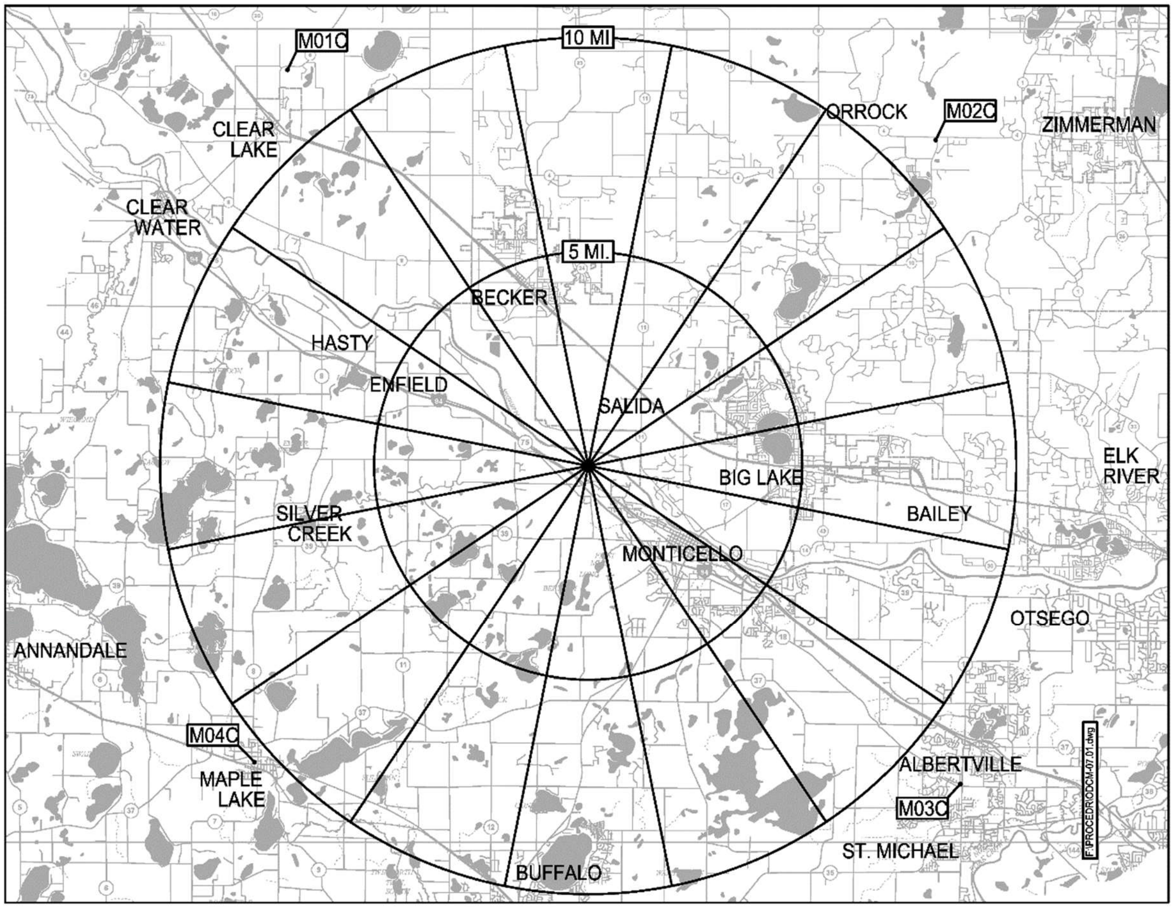


Figure 2.2-4: Control Locations (ODCM 07.01 Figure 4)

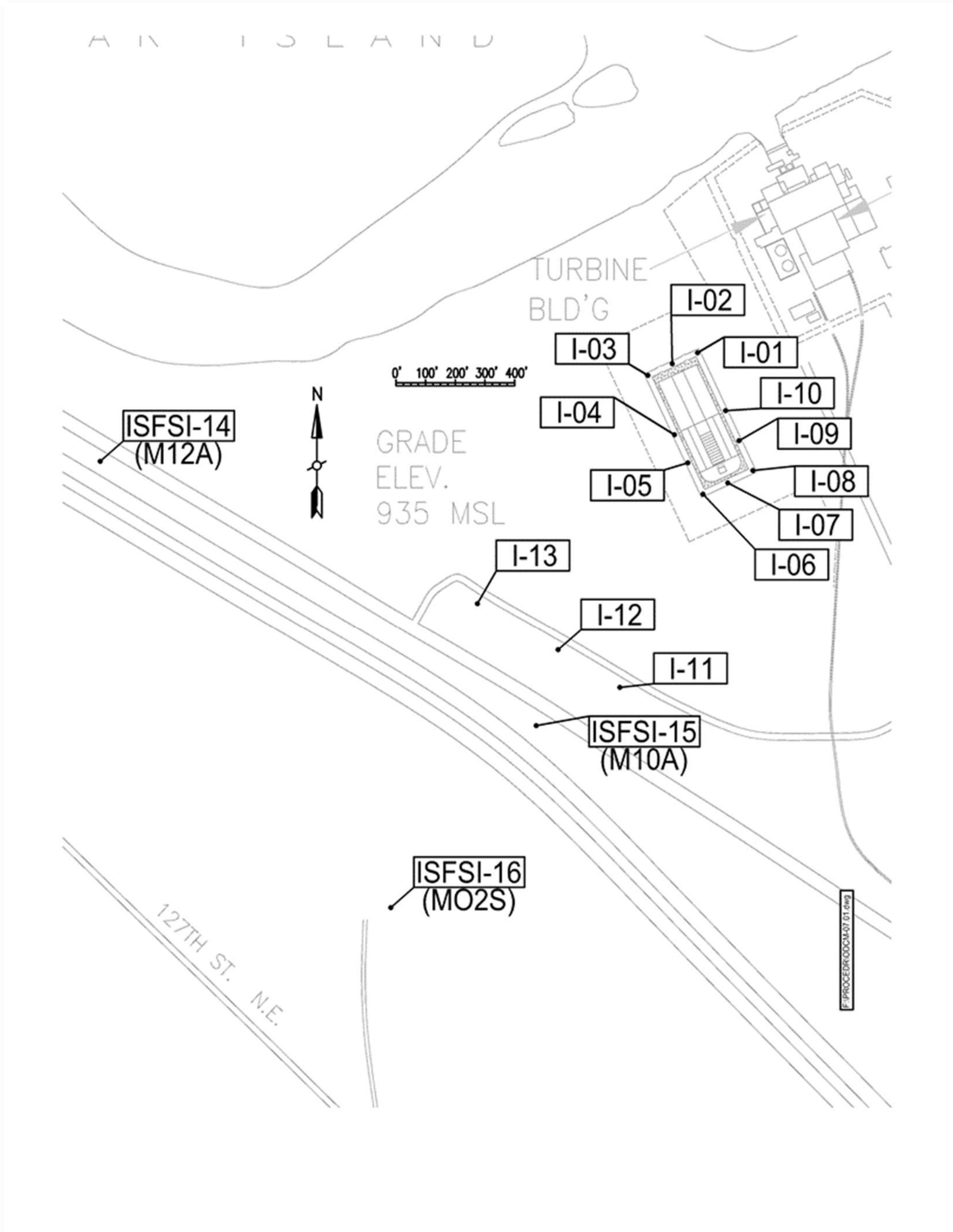


Figure 2.2-5: ISFSI TLD Locations (ODCM 07.01 Figure 5)

3 STATISTICAL AND CALCULATIONAL METHODOLOGY

3.1 Trend Identification

One of the purposes of the REMP is not only to determine the levels of radionuclides in the environment associated with MNGP's operations, but what happens to those levels over a period of time. If data trends indicate changes in the concentration of a radionuclide in an environmental medium, it could indicate that reactor operations are causing that particular radionuclide to fluctuate in the environment. Understanding effluent releases from MNGP is necessary to identify and interpret trends (or lack of trends) based on environmental data. Factors that may affect environmental levels of radionuclides include prevailing weather conditions (periods of drought, solar cycles, and extreme precipitation events) and construction activities in close proximity to MNGP of a given sampling location.[8] Some of these factors may be obvious, such as, the increase of airborne particulate beryllium-7 concentration due to atmospheric mixing or increase of surface water tritium due to atmospheric deposition from heavy precipitation events, while others are sometimes unknown.

3.2 Estimation of the Mean Value

A widely used statistical calculation was performed on the raw data collected under the sample analysis program. The calculation involved the determining the mean value for the indicator and control samples for each sample medium. The mean value was used in the reduction of the data generated by the sampling and analysis of the various media in the REMP. "Net activity (or concentration)" is the activity (or concentration) determined to be present in the sample. No "minimum detectable activity," "lower limit of detection," "less than level," or negative activities or concentrations are included in the calculation of the mean. Equation 1 below was used to calculate the estimated mean. The estimated mean is equal to the sum of all the individual sample values, beginning with the first sample, divided by the total number of samples.

$$\overline{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

(Equation 1)

Where:

$\overline{x}$ = estimate of the mean
i = individual sample
N = total number of samples with a net activity (or concentration)
x_i = net activity (or concentration) for sample i

[8] Additionally, from time to time, the trends may be affected by statistical additions or exclusions of known sources of radioactive materials. For instance, there is a measurable amount of radioactivity attributable to the 1986 Chernobyl accident and the 2011 Japan earthquake and tsunami, which triggered the Fukushima Dai-ichi Nuclear Power Plant incident. It is important to note if these factors are being accounted for, as they affect radiological environmental measurements, even though they are not attributable to MNGP.

3.3 Lower Limit of Detection and Minimum Detectable Activity

The lower limit of detection (LLD) and minimum detectable concentration (MDC) are used throughout the REMP and are defined as follows.

- LLD is defined in the ODCM as the smallest concentration of radioactive material in a sample that will yield a net count, above the system background, that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that a blank observation represents a “real” signal. The LLD is an *a priori* (*i.e.,* before the fact) measurement. The actual LLD is dependent upon the standard deviation of the background-counting rate, the counting efficiency, the sample size (mass or volume), the radiochemical yield, and the radioactive decay of the sample between sample collection and counting. The required LLDs for each sample medium and selected radionuclides are provided in the ODCM and listed in Table 3.4-2.
- MDC is the net counting rate (sample after subtraction of background) that must be surpassed before a sample is considered to contain a scientifically measurable amount of a radioactive material exceeding background amounts. The MDC is calculated using a sample background and may be thought of as an "actual" LLD for a particular sample measurement.

Certain gross counting measurements display a calculated negative value, indicating background is greater than sample activity. In these instances, it does not mean that radioactivity is removed from the environment. Instead, the measurement errors associated with the radiochemical analysis have fluctuated causing the background count rate to be greater than the sample count rate.

3.4 Reporting Levels and Lower Limits of Detection for Radioactivity

Reporting levels and lower limits of detection for activity found in environmental samples are listed in Table 3.4-1 and Table 3.4-2. Required REMP sample analyses and their frequencies are listed in Table 3.4-3.

Table 3.4-1: Reporting Levels for Radioactivity Concentration in Environmental Samples

Analysis	Water (pCi/L)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/L)	Vegetables (pCi/kg, wet)
Tritium (H-3)	20,000[a]				
Manganese-54 (Mn-54)	1,000		30,000		
Iron-59 (Fe-59)	400		10,000		
Cobalt-58 (Co-58)	1,000		30,000		
Cobalt-60 (Co-60)	300		10,000		
Zinc-65 (Zn-65)	300		20,000		
Zirconium-95 and Niobium-95 (Zr-Nb-95)	400[b]				
Iodine-131 (I-131)	2[c]	0.9		3	100
Cesium-134 (Cs-134)	30	10	1,000	60	1,000
Cesium-137 (Cs-137)	50	20	2,000	70	2,000
Barium-140 and Lanthanum-140 (Ba-La-140)	200[b]			300[b]	

Notes:

[a] For drinking water samples. This is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

[b] Total for parent and daughter product.

[c] If no drinking water pathways exist, a value of 20 pCi/L may be used.

Table 3.4-2: Maximum Values for the Lower Limits of Detection (LLD)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/L)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross beta	4	0.01				
Tritium (H-3)	2000[a]					
Manganese-54 (Mn-54)	15		130			
Iron-59 (Fe-59)	30		260			
Cobalt-58 and Cobalt-60 (Co-58, 60)	15		130			
Zinc-65 (Zn-65)	30		260			
Zirconium-95 and Niobium-95 (Zr-Nb-95)	15[b]					
Iodine-131 (I-131)	1[c]	0.07		1	60	
Cesium-134 (Cs-134)	15	0.05	130	15	60	150
Cesium-137 (Cs-137)	18	0.06	150	18	80	180
Barium-140 and Lanthanum-140 (Ba-La-140)	15[b]			15[b]		

Notes:

[a] If no drinking water pathway exists, a value of 3000 pCi/L may be used.

[b] The specified LLD applies to the daughter nuclide of an equilibrium mixture of the parent and daughter nuclides. Per the Radiological Assessment Branch Technical Position, the following values may be used for individual nuclide LLDs when equilibrium conditions are not met: 30 pCi/L for Zr-95, 15 pCi/L for Nb-95, 60 pCi/L for Ba-140, and 15 pCi/L for La-140.

[c] If no drinking water pathway exists, a value of 15 pCi/L may be used.

Table 3.4-3: Analysis and Frequency of Samples

Pathway	Sample Location	Type	I-131	Gross Beta	Gamma Isotopic	Tritium	Gamma Dose
Airborne Particulate and Radioiodine	M-1 Air Station M-1	Control	W	W	Q[1]		
	M-2 Air Station M-2		W	W	Q[1]		
	M-3 Air Station M-3		W	W	Q[1]		
	M-4 Air Station M-4		W	W	Q[1]		
	M-5 Air Station M-5		W	W	Q[1]		
Direct Radiation	M01C to M04C	Control					Q
	M01A to M14A						Q
	M01B to M16B						Q
	M01S to M06S						Q
	I-11 to 1-13						Q
Waterborne: River Water	M-8c Upstream of MNGP	Control			M[1]	Q[1]	
	M-9 Downstream of MNGP				M[1]	Q[1]	
Waterborne: Groundwater	M-43c Imholte Farm	Control			Q	Q	
	M-11 City of Monticello				Q	Q	
	M-12 Plant Well No. 11				Q	Q	
	M-55 Hasbrouck Residence				Q	Q	
Waterborne: Drinking Water	M-14 City of Minneapolis		BW[1,2]	M[1]	M[1]	Q[1]	
Waterborne: Sediment	M-8c Upstream of Plant	Control			SA		
	M-9 Downstream of Plant				SA		
	M-15 Montissippi Park				SA		
Ingestion: Milk	-		M/BW[3,4]		M/BW[3,4]		
Ingestion: Vegetation	M-43c Imholte Farm	Control	M[5]		M[5]		
	M-41 Training Center		M[5]		M[5]		
	M-42 Biology Station Road		M[5]		M[5]		
Ingestion: Fish	M-8c Upstream of Plant	Control			SA		
	M-9 Downstream of Plant				SA		
Ingestion: Invertebrates	M-8c Upstream of Plant	Control			SA[6]		
	M-9 Downstream of Plant				SA[6]		
Ingestion: Food Products	-				A[3]		

Notes for Table 3.4-3:

[1] Composite of weekly samples.

[2] I-131 on each bi-weekly composite when the dose from the consumption of the water is greater than 1 mrem/year. (ODCM Revision 26)

[3] This pathway is currently unavailable at MNGP.

[4] Every two weeks when animals are on pasture; monthly at other times.

[5] During growing season when milk samples are unavailable.

[6] This sample was removed as part of ODCM Revision 26.

W = weekly

BW = every two weeks

M = monthly

Q = quarterly

SA = semi-annually

A = annually

4 INTERPRETATION OF RESULTS

4.1 Airborne Radioiodine and Particulates

The average annual gross beta[9] concentrations in airborne particulates were similar at the indicator and control locations (both 0.035 ± 0.014 pCi/m³ for 2019). These 2019 results are comparable to levels observed from 1999 through 2018. The results are graphed below in Figure 4.1-1.

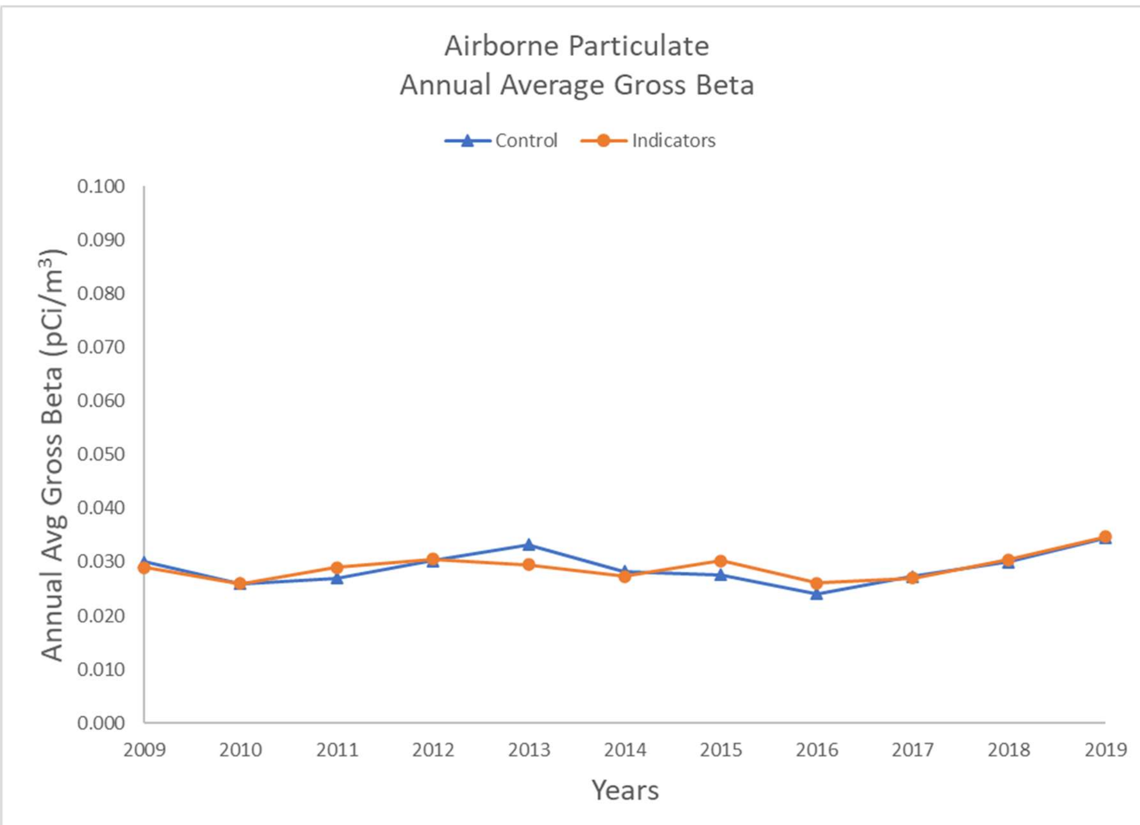


Figure 4.1-1: Graph of Historical Airborne Particulate Gross Beta

Figure 4.1-2 shows the average indictor gross beta from the four indicator locations (Air Station locations M-2, M-3, M-4, M-5) versus the control location (Air Station M-1) in 2019. The error bar represents the statistical uncertainty, as 1.96 sigma (95% confidence), associated with each measurement for a given

[9] Gross beta is a measurement of all beta activity present, regardless of specific radionuclide source. Beta particles are physically identical to electrons, but are differentiated by their source (beta particles are created in the nucleus during certain types of nuclear transformations, whereas electrons come from the electron cloud). Beta particles can have various states of energy.

sample collection date. Despite the variability of gross beta activity in airborne particulates, the average results from the indicator locations were similar to the results from the control location.

Note: the airborne particulate results from December 26, 2018 to January 2, 2019 were reported in the 2018 AREOR.

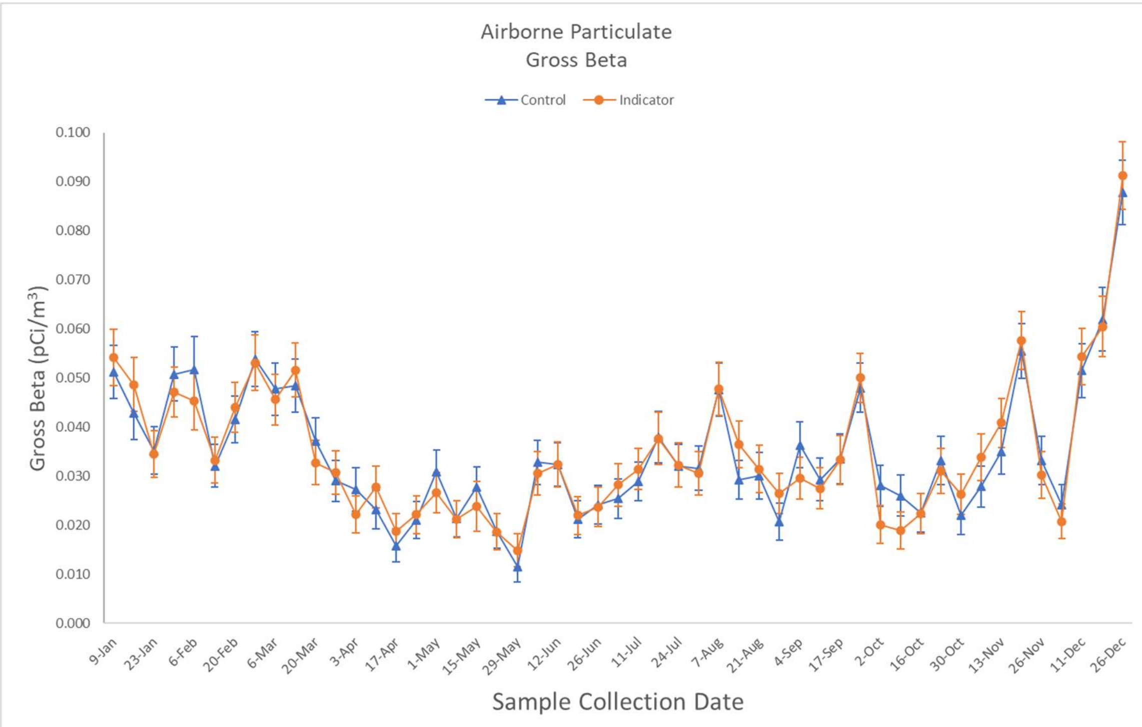


Figure 4.1-2: Graph of 2019 Average Airborne Particulate Gross Beta for Indicator and Control Locations

The upward trend observed in December 2019 is due to increase mixing between the upper and lower atmosphere from atmospheric temperature changes. This mixing relocates suspend particles and beryllium-7, created in the upper atmosphere by cosmic radiation and solar flares, from the upper atmosphere to the lower atmosphere; increasing the airborne particulate gross beta. (Arnold and Al-Salih, 1955) Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7 was detected in all samples, with an average activity of 0.074 ± 0.009 pCi/m^3 for the indicator and control locations. All other gamma-emitting isotopes were below their respective LLD limits.

The weekly levels of airborne radioiodine-131 were below the LLD for the airborne radioiodine cartridge samples analyzed. There was no indication of an emission of radioiodine from the MNGP.

4.2 Drinking Water

Tritium activity measured below the detection limit for all samples. Gamma isotopic results were all below detection limits. Gross beta was detected in 1 out of 12 samples tested, with a concentration of 2.97 ± 1.67 pCi/L and was similar to average levels observed from 2009 through 2018. Gross beta averages are shown in Figure 4.2-1. There was no indication of a plant effect.

The required LLD for lanthanum-140 was not met in three of the twelve river water samples in 2019. See Section 7.5 for further details. The remaining gamma isotopic results were all below detection limits.

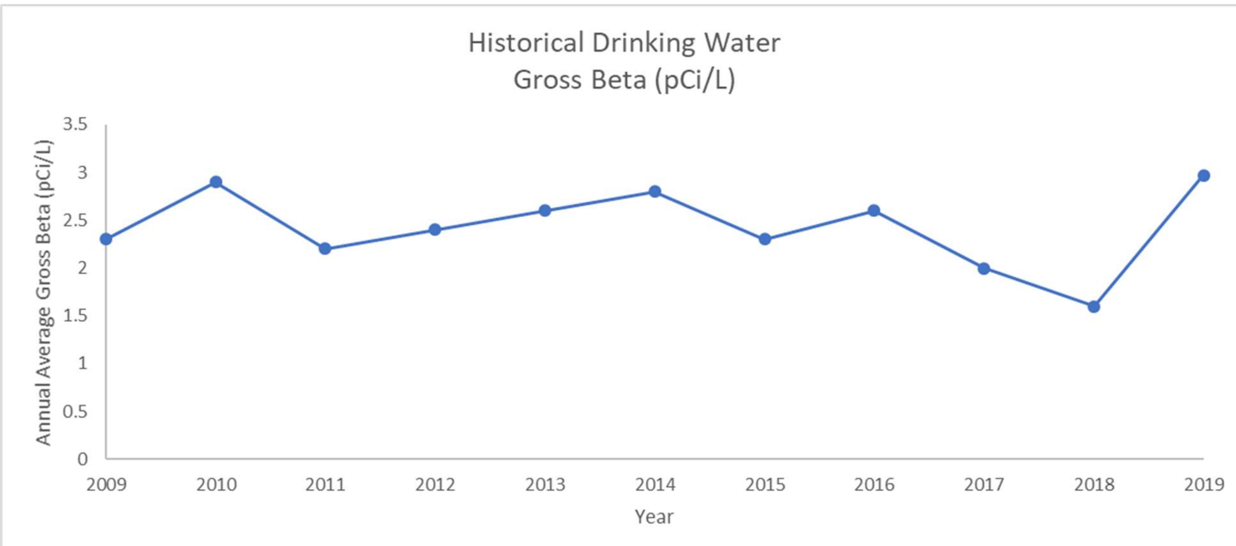


Figure 4.2-1: Graph of Historical Gross Beta for Drinking Water Sample

4.3 River Water

River water was analyzed from samples both upstream and downstream of MNGP. Tritium activity measured below the detection limit for all samples. The required LLD for lanthanum-140 was not met in five of the twenty river water samples in 2019. See Section 7.5 for further details. The remaining gamma isotopic results were all below detection limits.

4.4 Groundwater

Tritium, gamma isotopic, and iodine-131 were below the detection limit for all samples taken. The data for 2019 was consistent with the previous years' results and no plant operational effects were indicated.

4.5 Broadleaf Vegetation

Vegetation samples were collected during the growing season of July, August and September 2019. Iodine-131 concentrations measured below the detection limit in all samples. These samples are required when milk samples are not available.

4.6 Food Products

Corn and potato samples were not required for 2019. There were no crops, within five miles of the plant, using irrigation water from the Mississippi River, and the plant did not discharge radioactive liquid effluents.

4.7 Fish

Eight fish were analyzed in 2019, consisting of two fish collected from upstream locations and two collected from downstream locations in May and then again in September. Two species of fish, shorthead redhorse and smallmouth bass, were collected from each location. Gamma spectroscopy was performed on the edible portion of the fish. Only naturally occurring potassium-40 was found with an average of 3.32 ± 0.24 pCi/g wet weight for four upstream samples and 3.01 ± 0.26 picocuries per gram (pCi/g) wet weight for the four downstream samples. These results are consistent with historical results. Other gamma-emitting isotopes remained below detection limits. There were no gamma emitting radionuclides attributable to plant operations identified in any of the 2019 fish samples.

4.8 Aquatic Invertebrates

Invertebrates (crayfish) were collected in July 2019 at the control and indicator locations. Revision 26 of ODCM 07.01 removed invertebrate sample collection and analysis. Thus, only one sample collection was performed during 2019. There were no gamma emitting radionuclides attributable to plant operations identified in any of the 2019 aquatic invertebrate samples.

Canada Goose and Goslings Crossing Near an MNGP Radiological Environmental Sampling Point

4.9 Shoreline Sediment

Upstream, downstream and downstream recreational area shoreline sediment collections were made in June and October 2019 and analyzed for gamma-emitting isotopes. Cesium-137 was detected in October at the downstream samples (M-9), with a concentration of 0.120 ± 0.049 pCi/g dry weight. Similar levels of activity have been observed since 1996 (see Figure 4.9-1) and are indicative of the influence of fallout deposition from above ground nuclear weapons testing. Levels of Cs-137 in sediments are observed to fluctuate as silt distributions shift due to natural erosion and transport processes. Naturally occurring beryllium-7 and potassium-40 were also detected. There was no indication of a plant effect.

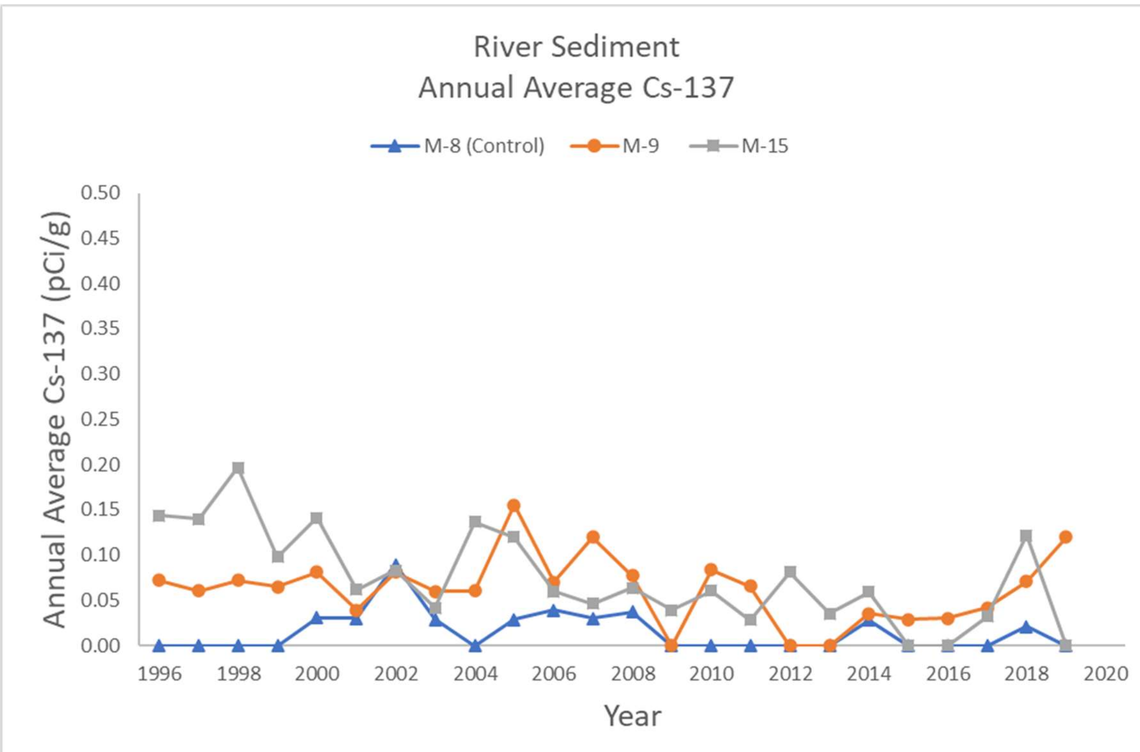


Figure 4.9-1: Graph of Historical Cs-137 in River Sediment

4.10 Direct Gamma Radiation

4.10.1 Environmental TLD

Ambient radiation was measured in the general area of the site boundary, inner ring, at an outer ring 4 to 5 miles (mi) from the plant, at special interest areas and at four control locations. The means were similar for both inner and outer rings (13.8 and 13.7 millirem (mrem/91 days), respectively. The mean for special interest locations was 13.8 mrem/91 days and the mean for the control locations was 13.1 mrem/91 days. Figure 4.10.1-1 shows the average measured dose from each standard (std) quarter. The error bars represent the statistical uncertainty associated with each average measurement.

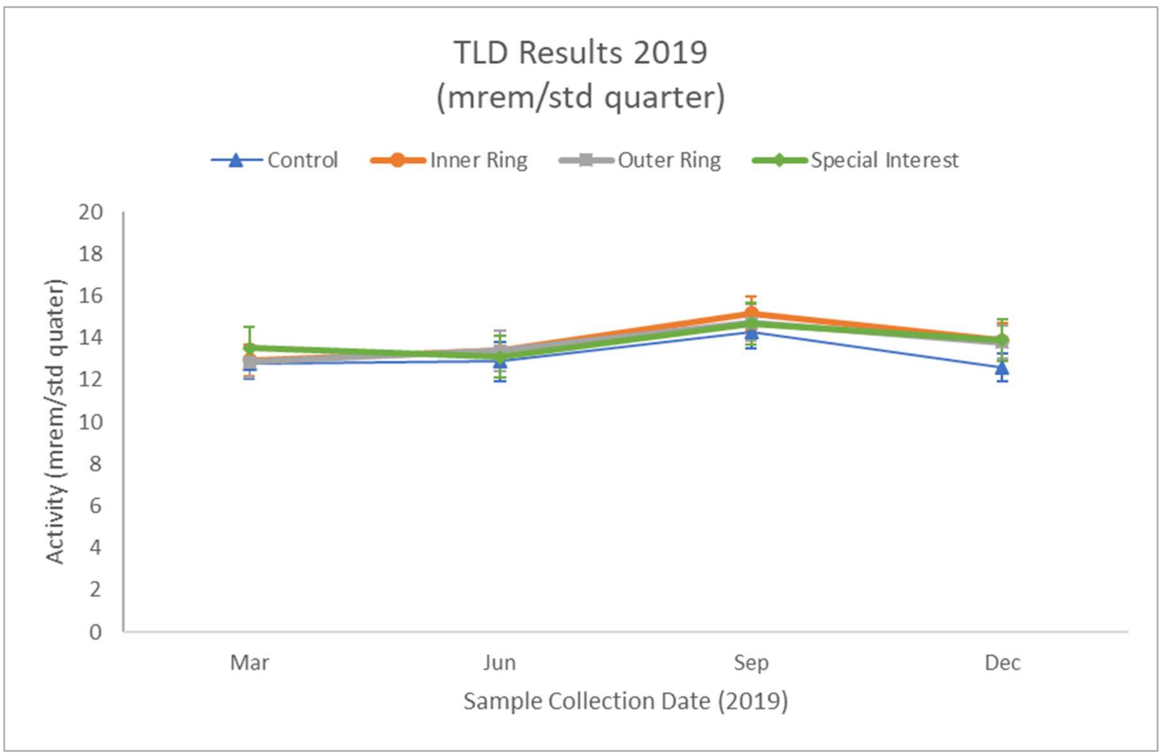


Figure 4.10.1-1: Graph of Direct Gamma Radiation Measurements

Dose rates measured at the inner and outer ring locations were similar to those observed from 1999 through 2018 and are shown in Figure 4.10.1-2. No plant effect on ambient gamma radiation is indicated.

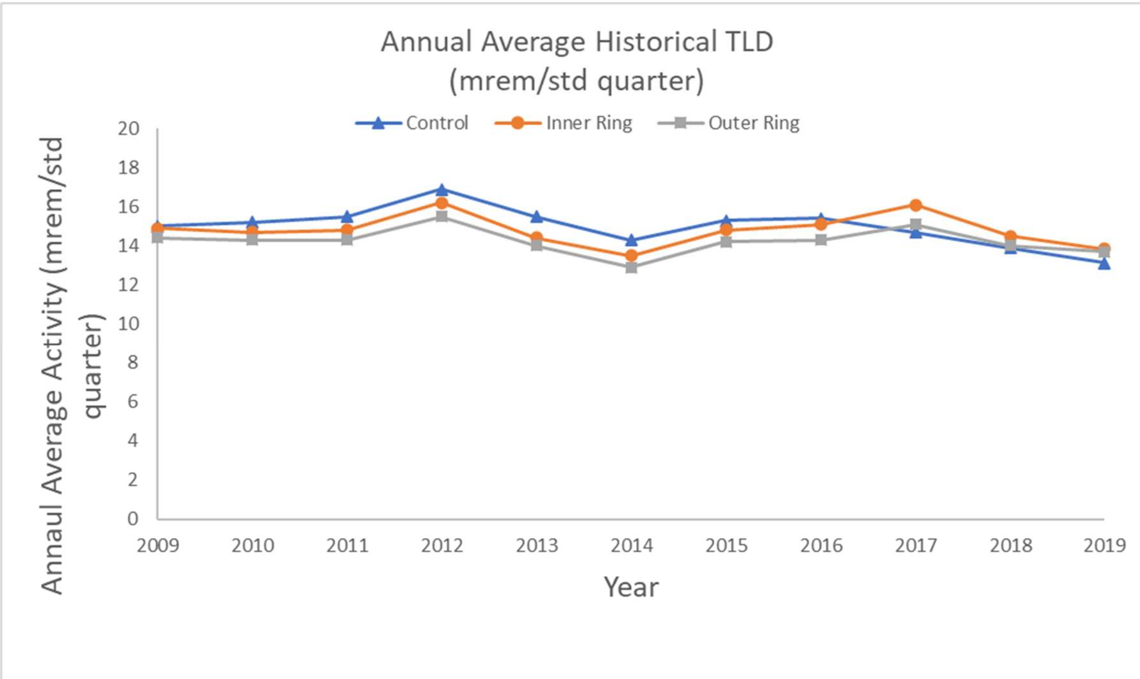


Figure 4.10.1-2: Graph of Historical Direct Gamma Measurements

4.10.2 ISFSI TLD

Gamma and Neutron TLDs are located around the Independent Spent Fuel Storage Installation (ISFSI) to monitor direct radiation from stored fuel for trending purposes. The ISFSI TLDs are not considered true REMP TLDs and are not representative of the dose to members of the public. Results for monitoring are included in Section 10.

No additional spent fuel casks were moved to the ISFSI during 2019. Review of the ISFSI TLD data indicates that in some cases TLDs at positions I-04 and I-10 showed higher uncertainty than at the other ISFSI locations. The increased uncertainty is driven by what appear to be statistically significant differences between the readings for the two TLD badges located at each location. In these cases, all data was still included in the averages in order to provide consistent data treatment. Annual data trends at the ISFSI are consistent with what is expected, based on the amount of spent fuel in the installation. During 2019, the average quarterly gamma dose rate for locations I-01 through I-10 was 50 ± 23 mrem/quarter. There were no detectable dose rate increases observed at the site boundary TLDs during 2019 (See Figures 4.10.1-2, and 4.10.1-1, Table 8.1-1).

5 LAND USE CENSUS

5.1 Purpose

The Land Use Census identifies the pathways (or routes) by which radioactive material may reach the general populations near commercial nuclear generating stations. This is accomplished by completing studies each year that identify how the surrounding lands are used by the population. A comprehensive census of the use of the land within a five-mile distance of the plant is completed during the growing season each year. This information is used for dose assessment and to identify changes to the stations sampled and the type of samples. Therefore, the purpose of the Land Use Census is to ensure the REMP is current based on human activity near MNGP, as well as provide data for the calculation of estimated radiation exposure.

Woodchuck Near an MNGP Radiological Environmental Sampling Point.

The pathways evaluated are:

- Ingestion Pathway - Results from eating food crops that may have radioactive materials deposited on them or incorporated radioactive materials from the soil or atmosphere. Another potential pathway is through drinking milk or eating cheese from local cows or goats. The vegetation used to feed these animals may include radioactive material due to deposition or uptake from soil and the radioactivity transferred to the milk. If milk animals are not present, vegetation is collected in lieu of milk.
- Direct Radiation Exposure Pathway- Results from deposition of radioactive materials on the ground or from passage of these radioactive materials in the air.
- Inhalation Pathway- Results from breathing radioactive materials transported in the air.

5.2 Methodology

The following must be identified within the five-mile radius of the plant for each of the sixteen meteorological sectors (compass direction the winds may blow, for example NNE [North-Northeast]):

- The nearest resident
- The nearest garden of greater than 500 square feet (ft^2), producing broadleaf vegetables
- The nearest meat animal
- The nearest milk animal
- In addition, all milk animals, meat animals, and gardens greater than 500 ft^2 within three miles of the site are located.

The primary methods are visual inspection from the roadside within the 5-mile radius, inputs from field data forms, Google Earth Pro satellite imagery, and Homeland Security Emergency Management Monticello base map.

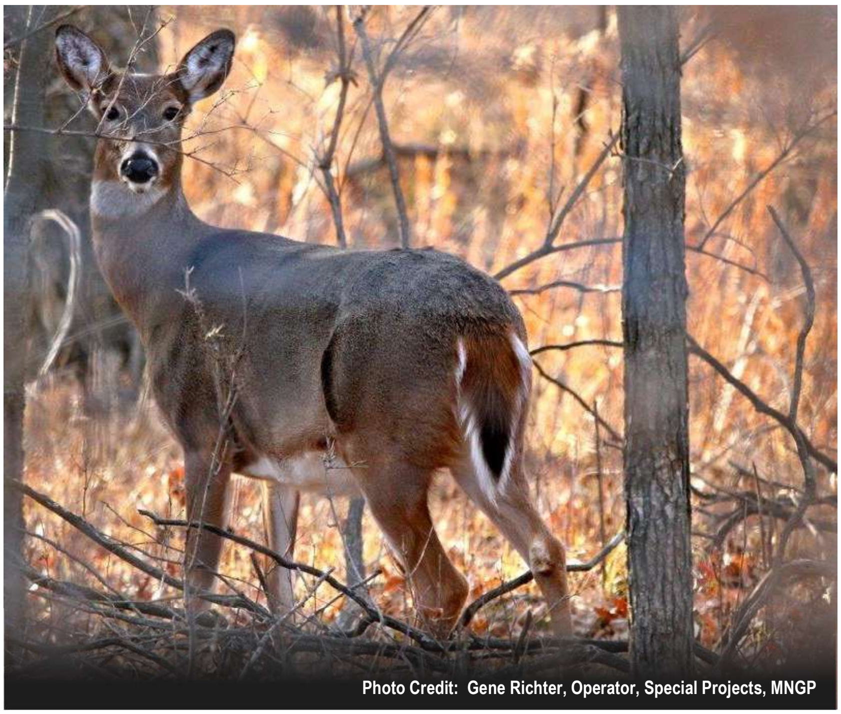
5.3 2019 Land Use Census

The 2019 Land Use Census was conducted between August 26 and September 20, 2019, by the REMP Coordinator in accordance with MNGP's Chemistry Manual, Procedure I.05.41, "Annual Land Use Census and Critical Receptor Identification." The survey was performed in order to identify the nearest residence, milk animals, meat animals, and gardens of greater than 500 ft^2 with broadleaf vegetables, in each of the sixteen meteorological sectors within a five-mile radius. In addition, all milk animals, meat animals and all gardens of 500 ft^2 or greater with broadleaf vegetables within a three mile radius of the plant were located. Distance, direction and dose pathway information is used to determine if any sampling locations need to be changed in the REMP sampling program and for determining Critical Receptor data.

The 2019 survey was performed using door-to-door surveys and visual observations while driving; additionally, inputs from the 2018 field data forms were used to evaluate changes to the land use. Google Earth Pro satellite imagery and Homeland Security Emergency Management Monticello Basemap were used in determining changes in land use. Data was collected using a combination of the Spyglass App and in Google Earth Pro, using a universal serial bus (USB) global positioning system (GPS) receiver.

Google Earth Pro was used to determine receptor location distances and sectors; these results were used in determining dispersion parameters for dose calculations.

The nearest garden in one sector had an increase in deposition coefficient (D/Q) of greater than 20 percent, from compared to 2018; from South-Southwest sector went from 2.10 miles from the site (2018) to 1.63 miles from the site (2019). The highest D/Q garden for 2019 remains in sector SSE at 1.20 miles from the plant.



Deer Near an MNGP Radiological Environmental Sampling Point.

There was one sector where the highest D/Q value for meat increased by greater than 20 percent. The highest D/Q meat location is in the West-Southwest sector, 1.78 miles from the plant. The highest D/Q combined Meat/Garden location is in the West Sector, 1.82 miles from the plant.

There were no sectors in which the highest D/Q values for the nearest residence increased by more than 20 percent in 2019. The highest D/Q residence remains at 0.99 miles from the plant in the South-Southeast sector.

One milk animal was identified within five miles radius of the site. The new milk location is located 3.25 miles in the North-Northeast sector. Due to the relativity low deposition, the calculated dose at this location is lower than the vegetation sample locations. Milk samples are required for three locations within 3 miles or three locations where doses are calculated to be greater than 1 mrem/year (ODCM 07.01). The identified milk animal is greater than 3 miles from the site and the dose from all pathways at that location is 0.046 mrem/year. Thus, vegetation sampling was performed in lieu of milk sampling.

There are no crops being irrigated from the Mississippi River within five miles downstream of the plant, based upon the most recent Water Use Resources Permit Index Report from the Minnesota Department of Natural Resources. The nearest downstream drinking water supplies, drawn from the Mississippi River, remain St. Paul and Minneapolis water supplies as currently documented in the ODCM and UFSAR.

Table 5.3-1 summarizes the locations showing >20% increase in D/Q as identified in the Land Use Census from 2018 to 2019. The identified locations in Table 5.3-1 do not necessarily represent the highest D/Q locations for a pathway (i.e. garden, meat, milk) but are > 20% increase in the D/Q of a pathway within a specific sector . The highest D/Q location for each pathway is described in Table 5.3-2.

Table 5.3-1: Changes in Land Use Census from 2018 to 2019

Sector	Pathway	2018 Distance (mi)	2019 Distance (mi)	2018 D/Q	2019 D/Q
SSW	Garden	2.10	1.63	7.0E-10	1.2E-09
SSW	Meat	4.53	2.77	1.5E-10	4.1E-10
NNE	Milk	-	3.25	-	3.90E-10

Table 5.3-2: Summary of Highest Location for each pathway in 2019

Pathway	Sector	Distance (mi)	D/Q
Residence	SSE	0.99	1.40E-08
Meat	WSW	1.78	9.60E-10
Meat + Garden	W	1.82	6.90E-10
Garden	SSE	1.20	6.70E-09
Milk[1,2]	NNE	3.25	3.90E-10
Crops	-	-	-

Notes:

[1] Represents a change from 2018

[2] Vegetation performed in lieu of milk sampling

Doses due to ground plane, inhalation, and ingestion of vegetables and meat, were calculated for the highest D/Q Residence, Meat Animal, Vegetable Garden, and combined Vegetable/Meat locations identified in the 2019 Land Use Census. In accordance with the ODCM, the long- and short-duration gaseous releases from the Reactor Building Vent and the Off-gas Stack for the previous calendar year were used as the source terms.

Doses were calculated using the RADEAS computer program with the 2018 Annual Effluent Data report source term as input. This resulted in identifying the same Sector, Distance, and Pathway, as compared to last year's Critical Receptor. The location is a residence with a garden located 1.20 miles away in the SSE sector (designated GH) and the pathway identified is the combination of ground plane, inhalation, and vegetable ingestion, to the thyroid of the child age group. The critical receptor, for purposes of compliance with 10CFR50 Appendix I for this period, is defined as follows: SSE Sector at a distance of 1.20 miles considering ground plane, inhalation, and vegetable exposure pathways to the thyroid of a child with a dose of 7.50E-02 mrem/year.

6 QUALITY ASSURANCE

6.1 Sample Collection

MNGP personnel performed the environmental sample collections as specified by approved sample collection procedures.

6.2 Sample Analysis

General Engineering Laboratories (GEL), LLC performed the environmental sample analyses as specified by approved analysis procedures. GEL is located in Charleston, South Carolina.

6.3 Dosimetry Analysis

Environmental Dosimetry Company (EDC) works in conjunction with Stanford Dosimetry to perform the environmental dosimetry measurements as specified by approved dosimetry analysis procedures. The Environmental TLD program at the EDC provides Panasonic TLD badges containing calcium sulfate ($CaSO_4$) phosphor elements for posting in the field. The raw TLD results are corrected for individual element sensitivity and reader sensitivity as determined by the quality control results. Control dosimeters are used to determine the background radiation exposure during the shipment and serve to evaluate transit exposures. The transit exposures are subtracted from the field dosimeters. Since the measured signal fades from time of exposure to analysis the fade of the thermoluminescent response is compensated.

6.4 Laboratory Equipment Quality Assurance

6.4.1 Daily Quality Control

GEL has an internal quality assurance program which monitors each type of instrumentation for reliability and accuracy. Daily quality control checks ensure that instruments are in proper working order and these checks are used to monitor instrument performance.

6.4.2 Calibration Verification

National Institute of Standards and Technology (NIST) standards that represent counting geometries are analyzed as unknowns at various frequencies, ranging from weekly to annually, to verify that efficiency calibrations are valid. The frequency is dependent upon instrument use and performance. Investigations are performed and documented should calibration verification data fall outside of the acceptable limits.

6.5 General Engineering Laboratory, LLC (GEL)

GEL participated in various Quality Assurance Programs for Inter-laboratory, Intra-laboratory, Third Party Cross Check programs, and a number of proficiency testing programs during 2019. A summary of the GEL quality assurance program results for the sample media types sent to GEL during 2019 is documented in Appendix A.

6.6 Environmental Dosimetry Company

Environmental Dosimetry Company participates in an internal performance acceptance criteria and a quarterly independent testing TLD intercomparison program. In 2019, 100 percent of the individual dosimeters passed the performance criteria. A summary of the 2019 Environmental Dosimetry Company Annual Quality Assurance Status Report is documented in Appendix B.

7 ENVIRONMENTAL SAMPLING MODIFICATIONS

7.1 Program Modifications

ODCM-07.01 Revision 26 was issued December 12, 2019. This revision included the following changes to the REMP:

- Added new broadleaf vegetation sample location M-42A to supplement location M-42. Previous location M-42 did not produce enough quantity and species for sample.

- Revised drinking water I-131 analysis to be required when the dose from the consumption of the water is greater than 1 mrem/year. NUREG 1302 specifies a composite sample over a 2-week period when I-131 analysis is performed and monthly composite otherwise. Also, I-131 analysis is required only when the dose calculated for consumption of the water is greater than 1 mrem/year. This change is consistent with NUREG-1302 and historical grab sampling practices at MNGP.

- The equilibrium pairs listed in ODCM 07.01 Table 3 (Zr-Nb-95 and Ba-La-140) will establish full equilibrium following approximately 7 daughter half-lives. In the event that a sample is counted when equilibrium has not been established, then the guidance from the NRC's "Radiological Assessment Branch Technical Position, Rev. 1, on Radiological Monitoring" (referred to as the BTP) was used for guidance on what LLD should be used for the parent isotope (which is harder to detect in both cases). The BTP was the original NRC guidance for REMP that was eventually adapted into NUREG-1302 and remains a valid basis document for LLDs.

- Removed the requirement to sample invertebrates. NUREG-1302 specifies 'One sample of each commercially and recreationally important species in vicinity of plant discharge area.' Aquatic invertebrate species near Monticello include freshwater clams and mussels, and crayfish. None of these species are commercially or recreationally important in the area. Further, freshwater mussels are protected, and several endangered mussel species are present in the Mississippi River, making it problematic to harvest these organisms when they are found. These invertebrate samples do not provide useful data for monitoring public dose and were removed from the program, consistent with NUREG-1302.

7.2 Change of Sampling Procedures

There were no changes to sampling procedures in 2019.

7.3 Change of Analysis Procedures

In 2018, samples were analyzed by Environmental, Inc. Midwest Laboratory. In 2019, the samples were analyzed by GEL Laboratory, Charleston, South Carolina. While the laboratory change did not impact the required LLDs, the actual MDC of some analyses, such as tritium and gross beta, could be different between the two laboratories due to variations between laboratory background and analytical equipment. This may cause positive detection of radioactivity in instances when the MDC is lower at GEL than Environmental, Inc or no detection when then MDC was higher at GEL than Environmental, Inc. This may result is a slight skewing of the long term annual average trends due to the number of positive detections from one laboratory to another.

The standard operating procedures used by GEL are approved methods. Copies of GEL's accreditations and certifications are available on their website, www.gel.com.

7.4 Sample Deviations and Unavailable Analysis

Table 7.4-1 lists the deviations from the required REMP sample collection in 2019. Despite these sample deviations, the intent of the program was satisfied as 98.9 percent of the required samples were obtained.

Table 7.4-1: Sample Deviations and Unavailable Analysis

Sample Type	Analysis	Location	Collection Date or Period	Reason for not conducting REMP as required	Corrective Action	Condition Report
Surface Water	Gamma Isotopic	M-8C	Composite - Gamma: Jan, Feb, Mar 2019 and Tritium: 1st quarter	Unsafe condition for sampling due to river surface being frozen	Sample obtained when water thawed	501000021813
	Tritium					
TLD	Direct Radiation	M-15B	Quarter 1 (Jan through Mar 2019)	TLD was missing in the field	Relocted to a pole across the road	501000025016
Air Particulate & Air Cartridge	Gamma Isotopic	M-5	May 8 – 14, 2019	Air sampler power loss – sample collected 47.9 of ~192 hour period	Restored Power to station, sample collected and analyzed	501000027446
	Gross Beta					
	Radioiodine					
TLD	Direct Radiation	M-12B	Quarter 2 (Apr through Jun 2019)	TLD was missing in the field	Replaced TLD	501000029403
TLD	Direct Radiation	M-02C	Quarter 2 (Apr through Jun 2019)	TLD was damaged by lawn mowing equipment	Replaced TLD	501000029403
Air Particulate & Air Cartridge	Gamma Isotopic	M-2	Aug 8 – 14, 2019	Air sampler power loss – sample collected 113.6 of ~192 hour period	Restored Power to station, sample collected and analyzed	501000030820
	Gross Beta					
	Radioiodine					
Invertebrate	Gamma Isotopic	M-8 & M-9	Quarter 3	ODCM Revision 26 deleted semi-annual sample requirement	Sample requirement removed from program	616000000020
Surface Water	Gamma Isotopic	M-8C	Composite- Gamma: Nov 7 – 30, Dec 2019	Unsafe condition for sampling due to river surface being frozen	Sample obtained when water thawed	501000021813
	Tritium		Tritium: Nov 7 - Dec 31, 2019			
TLD	Direct Radiation	M-02A	Quarter 4 2019 (Oct through Dec 2019)	TLD was missing in the field	Replaced TLD	501000036267
TLD	Direct Radiation	M-16B	Quarter 4 2019 (Oct through Dec 2019)	TLD post leaning	Relocated Pole	501000032318

7.5 Analytical Deviations

The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95 percent probability with 5 percent probability of falsely concluding that a blank observation represents a real signal. The LLD is established *a priori*, before sample analysis, and is a statement of the expected capability of the analysis. The MDC measured *a posteriori,* after the fact, is the actual performance of the analytical measurement and is based upon the actual sample background count rate, sample hold time, and sample volume. The ODCM 07.01 Table 3 LLD for the parent-daughter isotopic pair Barium-140/Lathanum-140 is 15 pCi/L. (*see* Table 3.4-2) Of the 46 groundwater, surface water, and drinking water samples performed in 2019, the lower limit of detection of 15 pCi/L was not satisfied in eight of the Barium-140/Lanthanum-140 samples (17%). In each sample, the *a posteriori* MDC was higher than the ODCM Table 3 LLD.

The cause of the deviation was largely due to the time period between sample analysis and sample collection. Shipping delays, laboratory closure due to Hurricane Dorian, and short radiochemical half-life caused the deviations. The average number of days between sample collection and analysis for the 46 water samples was 23 days. Since Barium-140 and Lathanum-140 half-lives are 12.75 days and 1.68 days, respectively, 30 days beyond the sample collect and analysis challenges the laboratory's ability to meet the required lower limit of detection. *See* Table 7.5-1 for more details.

Table 7.5-1: Analytical Deviations for Lanthanum-140

Location	Collect Date/Time	Analysis Date/Time	Result (pCi/L)	ODCM 07.01 Table 3 Required LLD (pCi/L)	Minimum Detectible Concentration (MDC) (pCi/L)	Cause
M-14 City of Minneapolis	4/24/2019 6:00	6/5/2019 11:56	-8.15	15	16.50	A
M-8 Upstream of plant	4/24/2019 8:25	6/5/2019 11:56	-1.95	15	15.60	A
M-9 Downstream of plant	4/24/2019 8:40	6/5/2019 11:56	-2.99	15	15.80	A
M-14 City of Minneapolis	8/27/2019 14:00	10/15/2019 12:41	4.00	15	20.20	B
M-8 Upstream of plant	8/28/2019 8:20	10/15/2019 12:41	1.40	15	24.30	B
M-9 Downstream of plant	8/28/2019 8:30	10/15/2019 12:41	-11.7	15	20.80	B
M-8 Upstream of plant	11/6/2019 8:30	12/30/2019 14:11	-2.01	15	28.10	C
M-14 City of Minneapolis	11/26/2019 6:00	12/30/2019 14:10	-13.8	15	26.80	D

Cause Codes:

A = Shipping delayed sample receipt to laboratory.
B = Hurricane Dorian flooding closed laboratory.
C = Sample Exceeded hold time due to sample unavailability after November 6, 2019.
D = High statistical error associated with analysis.

8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM – SUMMARY OF RESULTS

This section presents a summary of MNGP's REMP sampling and monitoring results for the 2019 period for airborne particulates, airborne radioiodine, direct radiation, and measurable radioactivity in milk, broadleaf vegetation, river water, aquatic invertebrates, shoreline sediments, groundwater, drinking water, and fish. In all, there were no reported non-routine measurements.

8.1 Radiological Environmental Monitoring Program Data Summary

Table 8.1-1 below presents the summary of MNGP's REMP sampling and monitoring results for the 2019 period.

Notes from Table 8.1-1:

[1] Mean and range are based upon detectible measurements only.
[2] (f) Fraction of detectible measurements at a specific location
[3] Natural and not due to plant influence
[4] The specified LLD applies to the daughter nuclide of an equilibrium mixture of the parent and daughter nuclides. Per the Radiological Assessment Branch Technical Position, the following values may be used for individual nuclide LLDs when equilibrium conditions are not met: 30 pCi/L for Zr-95, 15 pCi/L for Nb-95, 60 pCi/L for Ba-140, and 15 pCi/L for La-140.
[5] If no drinking water pathway exists, a value of 15 pCi/L may be used.
[6] Positive Ba-140 results were due to analytical deviations rather than actual detection of plant related material. La-140 was not detected in any of the water samples. In some cases, the required LLD was not met for Ba-La-140. See Section 7.5 for further details.
[7] Not required

Table 8.1-1: Radiological Environmental Monitoring Program Summary

Name of Facility:	Monticello Nuclear Generating Plant	Docket No:	50-263
Location of Facility:	Wright, Minnesota	Reporting Period	January – December 2019

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g. I-131, 400)	ODCM Table 3 Lower Limit of Detection (LLD)	Indicator Mean[1]; (f)[2] Range[1]	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean[1] (f)[2] Range[1]	Control Mean[1] (f)[2] Range[1]	Number of Nonroutine Reported Measurements
Airborne Particulates (pCi/m^3)	Gross Beta (255)	0.01	0.035 (204/204) 0.013 - 0.11	M-4, Air Station 0.8 mi @ 147/SSE	0.035 (51/51) 0.016 - 0.11	0.035 (51/51) 0.012 - 0.088	0
	Gamma (20)						0
	Be-7 [3]	-	0.074 (16/16) 0.048 – 0.098	M-3, Air Station 0.6 m @ 104/ESE	0.077 (4/4) 0.048 – 0.098	0.074 (4/4) 0.054 – 0.097	
	Mn-54	-	<LLD	-	-	<LLD	
	Co-58	-	<LLD	-	-	<LLD	
	Co-60	-	<LLD	-	-	<LLD	
	Zn-65	-	<LLD	-	-	<LLD	
	Zr-Nb-95	-	<LLD	-	-	<LLD	
	Ru-103	-	<LLD	-	-	<LLD	
	Ru-106	-	<LLD	-	-	<LLD	
	Cs-134	0.05	<LLD	-	-	<LLD	
	Cs-137	0.06	<LLD	-	-	<LLD	
	Ba-La-140	-	<LLD	-	-	<LLD	
	Ce-141	-	<LLD	-	-	<LLD	
	Ce-144	-	<LLD	-	-	<LLD	
Airborne Radioiodine (pCi/m^3)	I-131 (255)	0.07	<LLD	-	-	<LLD	0
Broadleaf Vegetation (pCi/kg-wet)	Gamma (9)						0
	Mn-54	-	<LLD	-	-	<LLD	
	Fe-59	-	<LLD	-	-	<LLD	
	Co-58	-	<LLD	-	-	<LLD	
	Co-60	-	<LLD	-	-	<LLD	
	Zn-65	-	<LLD	-	-	<LLD	
	Zr-Nb-95	-	<LLD	-	-	<LLD	
	I-131	60	<LLD	-	-	<LLD	
	Cs-134	60	<LLD	-	-	<LLD	
	Cs-137	80	<LLD	-	-	<LLD	
Milk (pCi/L)	I-131 (0)	1	N/A	N/A	N/A	N/A	0
	Gamma (0)	N/A	N/A	N/A	N/A	N/A	0

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g. I-131, 400)	ODCM Table 3 Lower Limit of Detection (LLD)	Indicator Mean[1]; (f)[2] Range[1]	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean[1] (f)[2] Range[1]	Control Mean[1] (f)[2] Range[1]	Number of Nonroutine Reported Measurements
Aquatic Invertebrates (pCi/kg-wet)	Gamma (2)						0
	K-40[3]	-	<LLD	-	-	<LLD	
	Mn-54	130	<LLD	-	-	<LLD	
	Fe-59	260	<LLD	-	-	<LLD	
	Co-58	130	<LLD	-	-	<LLD	
	Co-60	130	<LLD	-	-	<LLD	
	Zn-65	260	<LLD	-	-	<LLD	
	Zr-Nb-95	-	<LLD	-	-	<LLD	
	Cs-134	130	<LLD	-	-	<LLD	
	Cs-137	150	<LLD	-	-	<LLD	
	Ba-La-140	-	<LLD	-	-	<LLD	
	Ce-144	-	<LLD	-	-	<LLD	
Fish (pCi/kg-wet)	Gamma (8)						0
	K-40[3]	-	3010 (4/4) 2730 - 3290	M-9 Downstream of plant	3010 (4/4) 2730 - 3290	3320 (4/4) 3020 – 3600	
	Mn-54	130	<LLD	-	-	<LLD	
	Fe-59	260	<LLD	-	-	<LLD	
	Co-58	130	<LLD	-	-	<LLD	
	Co-60	130	<LLD	-	-	<LLD	
	Zn-65	260	<LLD	-	-	<LLD	
	Zr-Nb-95	-	<LLD	-	-	<LLD	
	Cs-134	130	<LLD	-	-	<LLD	
	Cs-137	150	<LLD	-	-	<LLD	
	Ba-La-140	-	<LLD	-	-	<LLD	
	Ce-144	-	<LLD	-	-	<LLD	
Shoreline Sediments (pCi/kg-dry)	Gamma (6)						0
	Be-7[3]	-	1040 (1/4) 1040 - 1040	M-9, Downstream of plant	1040 (1/2) 1040 - 1040	<LLD	
	K-40[3]	-	15800 (4/4) 12700-23100	M-15 Montissippi Park	17900 (2/2) 12700-23100	11850 (2/2) 11800-11900	
	Mn-54	-	<LLD	-	-	<LLD	
	Fe-59	-	<LLD	-	-	<LLD	
	Co-58	-	<LLD	-	-	<LLD	
	Co-60	-	<LLD	-	-	<LLD	
	Zn-65	-	<LLD	-	-	<LLD	
	Zr-Nb-95	-	<LLD	-	-	<LLD	
	Cs-134	150	<LLD	-	-	<LLD	
	Cs-137	180	120 (1/4) 120 - 120	M-9, Downstream of plant	120 (1/2) 120 - 120	<LLD	
	Ba-La-140	-	<LLD	-	-	<LLD	
	Ce-144	-	<LLD	-	-	<LLD	

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g. I-131, 400)	ODCM Table 3 Lower Limit of Detection (LLD)	Indicator Mean[1]; (f)[2] Range[1]	Location with Highest Annual Mean: Name / Distance and Direction	Location with Highest Annual Mean: Mean[1] (f)[2] Range[1]	Control Mean[1] (f)[2] Range[1]	Number of Nonroutine Reported Measurements
Drinking Water (pCi/L)	Gross Beta (12)	4	2.97 (1/12) 2.97 - 2.97	M-14 City of Minneapolis	2.97 (1/12) 2.97 - 2.97	None	0
	Gamma (12)						0
	Mn-54	15	<LLD	-	-	None	
	Fe-59	30	<LLD	-	-	None	
	Co-58	15	<LLD	-	-	None	
	Co-60	15	<LLD	-	-	None	
	Zn-65	30	<LLD	-	-	None	
	Zr-Nb-95	15[4]	<LLD	-	-	None	
	Cs-134	15	<LLD	-	-	None	
	Cs-137	18	<LLD	-	-	None	
	Ba-La-140	15[4]	<LLD [6]	-	<LLD [6]	None	
	Ce-144	-	<LLD	-	-	None	
	I-131 (51)	1	<LLD	-	-	None	0
	Tritium (4)	2000	<LLD	-	-	None	0
Groundwater (pCi/L)	Gamma (16)						0
	Mn-54	15	<LLD	-	-	<LLD	
	Fe-59	30	<LLD	-	-	<LLD	
	Co-58	15	<LLD	-	-	<LLD	
	Co-60	15	<LLD	-	-	<LLD	
	Zn-65	30	<LLD	-	-	<LLD	
	Zr-Nb-95	15[4]	<LLD	-	-	<LLD	
	Cs-134	15	<LLD	-	-	<LLD	
	Cs-137	18	<LLD	-	-	<LLD	
	Ba-La-140	15[4]	<LLD	-	-	<LLD	
	Ce-144	-	<LLD	-	-	<LLD	
	I-131[7] (4)	1[5]	<LLD	-	-	<LLD	0
	Tritium (16)	2000	<LLD	-	-	<LLD	0
River Water (pCi/L)	Gamma (20)						0
	Mn-54	15	<LLD	-	<LLD	<LLD	
	Fe-59	30	<LLD	-	<LLD	<LLD	
	Co-58	15	<LLD	-	<LLD	<LLD	
	Co-60	15	<LLD	-	<LLD	<LLD	
	Zn-65	30	<LLD	-	<LLD	<LLD	
	Zr-Nb-95	15[4]	<LLD	-	<LLD	<LLD	
	Cs-134	15	<LLD	-	<LLD	<LLD	
	Cs-137	18	<LLD	-	<LLD	<LLD	
	Ba-La-140	15[4]	<LLD [6]	-	<LLD [6]	<LLD [6]	
	Ce-144	-	<LLD	-	<LLD	<LLD	
	Tritium (7)	2000	<LLD	-	-	<LLD	0

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g. I-131, 400)	ODCM Table 3 Lower Limit of Detection (LLD)	Indicator Mean[1]; (f)[2] Range[1]	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean[1] (f)[2] Range[1]	Control Mean[1] (f)[2] Range[1]	Number of Nonroutine Reported Measurements
Direct Radiation: Control (10 to 12 miles distant) (mrem/91 days)	Gamma (15)	-	N/A	M03C 11.6 mi @ 130/SE	13.7 (4/4) (12.9-14.9)	13.1 (15/15) (11.8 - 14.9)	0
Direct Radiation: Inner Ring (General Area at Site Boundary) (mrem/91 days)	Gamma (55)	-	13.8 (55/55) (11.7- 16.1)	M11A, 0.4 mi @ 237/WSW	14.6 (4/4) (13.8 -15.9)		0
Direct Radiation: Outer Ring (4-5 mi. distant) (mrem/91 days)	Gamma (62)	-	13.7 (62/62) (10.3 - 16.0)	M14B, 4.3 mi @ 289/WNW	15.5 (4/4) (14.3 - 16.0)		0
Direct Radiation: Special Interest Areas (mrem/91 days)	Gamma (36)	-	13.8 (36/36) (10.6 - 15.9)	M06S, 2.6 mi @134/SE	14.8 (4/4) (13.8 - 15.9)		0

9 ERRATA TO PREVIOUS REPORTS

9.1 Errata to the MNGP AREOR

There are no errata for previous reports from 2019.

10 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS

Data below was analyzed by GEL Laboratories, LLC (GEL). The results reported relate only to the items tested and to the sample as received by the laboratory. Copies of GEL's accreditations and certificates can be found at www.gel.com.

Notes:

1. LLDs are a priori values.
2. MDCs are calculated a posteriori value.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Results with either no qualifier, an M, or an L are considered positive results. While a U, UI, or ND are negative.

Matrix Abbreviations

AC	Airborne Cartridge
AP	Airborne Particulate
SE	Sediment
TA	Aquatic Tissue
TP	Plant Tissue
WG	Groundwater
WP	Drinking Water
WS	Surface Water

Qualifiers

L	Analyte present. Reported value may be biased low. Actual value is expected to be higher
M	M if above MDC and less than LLD
M	REMP Result >MDC/CL and <RDL
ND	Analyte concentration is not detected above the limits as defined as the “U” qualifier
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC, or LOD
UI	Gamma Spectroscopy – uncertain identification; these results were evaluated and found to be false positives, unless otherwise noted
X	Lab specific qualifier – see notes from data tables for details.

10.1 Detection of activity

It is often not possible to say for certain when net radioactivity is present in samples at environmental background levels due to natural variations in counting instrument backgrounds and other factors. The data below is reported as determined by the lab with uncertainties and all data has been included (even results with negative numbers). Results with U, UI, or ND qualifiers are considered ‘not detected’ and results with L, M, or blank qualifiers are considered to be “detected.”

AIRBORNE CARTRIDGE: RADIOIODINE

Sample Date	Air Station M-1 (pCi/m^3)	Air Station M-2 (pCi/m^3)	Air Station M-3 (pCi/m^3)	Air Station M-4 (pCi/m^3)	Air Station M-5 (pCi/m^3)
1/9/2019	2.15E-03 ± 6.44E-03 U	-1.56E-03 ± 6.56E-03 U	-5.85E-04 ± 5.87E-03 U	-1.85E-04 ± 5.40E-03 U	-6.60E-04 ± 7.79E-03 U
1/16/2019	4.83E-03 ± 1.10E-02 U	4.61E-03 ± 9.36E-03 U	9.66E-03 ± 1.10E-02 U	5.74E-03 ± 1.28E-02 U	-9.31E-03 ± 1.34E-02 U
1/23/2019	-3.89E-03 ± 1.25E-02 U	3.00E-03 ± 1.04E-02 U	2.59E-03 ± 1.02E-02 U	1.24E-02 ± 1.58E-02 U	7.51E-03 ± 1.18E-02 U
1/31/2019	1.00E-03 ± 6.77E-03 U	-1.14E-03 ± 4.71E-03 U	-2.77E-03 ± 6.32E-03 U	2.01E-03 ± 6.68E-03 U	8.17E-04 ± 5.91E-03 U
2/6/2019	4.45E-03 ± 1.03E-02 U	-1.39E-03 ± 9.27E-03 U	-3.79E-03 ± 1.00E-02 U	1.26E-03 ± 6.66E-03 U	4.99E-03 ± 8.35E-03 U
2/13/2019	-7.76E-03 ± 9.63E-03 U	-2.02E-03 ± 1.11E-02 U	5.42E-04 ± 1.99E-02 U	2.12E-03 ± 1.43E-02 U	3.38E-03 ± 1.12E-02 U
2/20/2019	-1.86E-03 ± 5.43E-03 U	7.55E-03 ± 8.39E-03 U I	-4.46E-04 ± 5.75E-03 U	-6.28E-04 ± 5.95E-03 U	4.73E-04 ± 7.71E-03 U
2/27/2019	-9.20E-03 ± 1.29E-02 U	-8.06E-03 ± 1.58E-02 U	-2.53E-03 ± 1.24E-02 U	-6.06E-03 ± 1.47E-02 U	-4.52E-03 ± 1.15E-02 U
3/6/2019	4.66E-03 ± 7.36E-03 U	5.86E-03 ± 5.75E-03 U	3.45E-03 ± 6.41E-03 U	-1.31E-03 ± 6.10E-03 U	2.35E-03 ± 6.18E-03 U
3/13/2019	-6.84E-03 ± 6.26E-03 U	7.91E-04 ± 7.36E-03 U	-1.35E-03 ± 1.01E-02 U	4.32E-03 ± 9.69E-03 U	1.22E-03 ± 9.19E-03 U
3/20/2019	5.07E-03 ± 5.31E-03 U	-1.06E-03 ± 6.12E-03 U	5.42E-04 ± 5.82E-03 U	-2.71E-03 ± 6.63E-03 U	-5.48E-03 ± 6.52E-03 U
3/27/2019	1.81E-03 ± 7.64E-03 U	1.49E-03 ± 6.04E-03 U	8.06E-03 ± 8.92E-03 U	-3.05E-03 ± 9.20E-03 U	2.66E-03 ± 1.68E-02 U
4/3/2019	4.21E-03 ± 6.83E-03 U	1.88E-03 ± 7.52E-03 U	-5.16E-03 ± 8.09E-03 U	6.88E-03 ± 8.31E-03 U	3.14E-03 ± 6.72E-03 U
4/10/2019	-5.68E-03 ± 1.46E-02 U	7.19E-04 ± 1.09E-02 U	-2.10E-03 ± 1.00E-02 U	-1.06E-02 ± 1.13E-02 U	-9.24E-03 ± 2.24E-02 U
4/17/2019	-3.51E-03 ± 6.74E-03 U	-3.51E-03 ± 6.28E-03 U	5.65E-03 ± 8.62E-03 U	5.78E-03 ± 8.49E-03 U	1.23E-03 ± 7.17E-03 U
4/24/2019	-2.00E-03 ± 2.15E-02 U	-5.13E-03 ± 7.10E-03 U	-8.20E-03 ± 1.05E-02 U	-5.62E-03 ± 1.26E-02 U	-6.90E-03 ± 1.59E-02 U
5/1/2019	-4.21E-03 ± 7.10E-03 U	3.86E-03 ± 8.24E-03 U	-2.36E-03 ± 6.96E-03 U	6.03E-03 ± 9.28E-03 U	1.18E-02 ± 1.58E-02 U
5/8/2019	-5.34E-04 ± 5.73E-03 U	-9.44E-04 ± 5.94E-03 U	-8.33E-04 ± 6.63E-03 U	-3.54E-03 ± 6.61E-03 U	1.44E-04 ± 4.80E-03 U

Sample Date	Air Station M-1 (pCi/m³)	Air Station M-2 (pCi/m³)	Air Station M-3 (pCi/m³)	Air Station M-4 (pCi/m³)	Air Station M-5 (pCi/m³)
5/15/2019 (1)	-4.95E-03 ± 1.11E-02 U	-1.02E-03 ± 8.62E-03 U	-6.52E-03 ± 7.32E-03 U	-5.80E-04 ± 7.86E-03 U	1.89E-02 ± 2.62E-02 U
5/22/2019	4.08E-03 ± 6.74E-03 U	5.88E-03 ± 7.77E-03 U	3.53E-03 ± 8.01E-03 U	2.18E-03 ± 6.10E-03 U	-5.34E-04 ± 6.33E-03 U
5/29/2019	2.30E-03 ± 5.32E-03 U	-6.56E-04 ± 6.38E-03 U	3.77E-03 ± 1.02E-02 U	2.70E-03 ± 6.92E-03 U	-5.28E-03 ± 5.68E-03 U
6/5/2019	-1.80E-02 ± 1.34E-02 U	-6.28E-03 ± 1.28E-02 U	1.16E-02 ± 1.33E-02 U	9.44E-03 ± 1.29E-02 U	1.30E-02 ± 1.35E-02 U
6/12/2019	2.07E-03 ± 9.75E-03 U	8.30E-04 ± 9.45E-03 U	5.16E-03 ± 9.77E-03 U	2.22E-03 ± 7.84E-03 U	-1.81E-03 ± 1.01E-02 U
6/19/2019	-4.32E-04 ± 5.66E-03 U	9.83E-03 ± 1.13E-02 U	7.70E-03 ± 8.36E-03 U	-6.28E-04 ± 5.54E-03 U	-2.03E-03 ± 5.62E-03 U
6/26/2019	-2.89E-03 ± 1.20E-02 U	3.84E-03 ± 9.88E-03 U	1.26E-02 ± 1.32E-02 U	-6.55E-03 ± 1.47E-02 U	-3.13E-03 ± 1.45E-02 U
7/3/2019	4.18E-04 ± 1.19E-02 U	4.06E-02 ± 2.05E-02 U I	2.54E-03 ± 6.03E-03 U	-3.68E-03 ± 1.08E-02 U	1.07E-02 ± 1.49E-02 U
7/11/2019	-5.66E-03 ± 6.57E-03 U	2.24E-03 ± 6.18E-03 U	-1.37E-03 ± 6.03E-03 U	2.87E-03 ± 7.25E-03 U	-1.17E-03 ± 5.75E-03 U
7/17/2019	-1.65E-03 ± 7.24E-03 U	-1.21E-03 ± 7.47E-03 U	5.87E-03 ± 6.47E-03 U	1.07E-03 ± 7.80E-03 U	-3.77E-03 ± 8.58E-03 U
7/24/2019	-4.64E-04 ± 5.38E-03 U	4.12E-03 ± 7.70E-03 U	2.17E-03 ± 5.96E-03 U	-4.07E-03 ± 6.51E-03 U	7.30E-03 ± 5.48E-03 U
7/31/2019	1.22E-03 ± 5.81E-03 U	5.56E-03 ± 6.69E-03 U	-6.75E-03 ± 8.09E-03 U	1.31E-02 ± 1.61E-02 U I	1.11E-03 ± 6.43E-03 U
8/7/2019	1.40E-03 ± 6.61E-03 U	2.22E-03 ± 5.54E-03 U	1.70E-03 ± 6.31E-03 U	-9.68E-04 ± 6.94E-03 U	1.78E-03 ± 7.73E-03 U
8/15/2019 (2)	2.43E-03 ± 5.30E-03 U	9.18E-04 ± 6.22E-03 U	7.66E-04 ± 5.36E-03 U	4.97E-03 ± 4.53E-03 U	-1.66E-03 ± 3.75E-03 U
8/21/2019	-1.57E-03 ± 7.51E-03 U	3.33E-03 ± 9.46E-03 U	3.37E-03 ± 9.37E-03 U	-1.18E-03 ± 1.01E-02 U	1.87E-03 ± 1.01E-02 U
8/28/2019	7.09E-03 ± 1.47E-02 U	-1.16E-02 ± 2.72E-02 U	-3.60E-03 ± 1.85E-02 U	2.22E-03 ± 2.46E-02 U	-1.11E-02 ± 2.67E-02 U
9/4/2019	1.09E-02 ± 2.14E-02 U	8.24E-03 ± 1.90E-02 U	-3.14E-03 ± 1.94E-02 U	-1.12E-02 ± 2.63E-02 U	-2.37E-02 ± 2.06E-02 U
9/11/2019	5.23E-03 ± 8.15E-03 U	7.24E-04 ± 7.06E-03 U	-8.57E-03 ± 8.78E-03 U	1.91E-03 ± 5.61E-03 U	2.30E-03 ± 1.64E-02 U
9/17/2019	-1.00E-02 ± 1.19E-02 U	3.60E-03 ± 7.06E-03 U	-5.11E-04 ± 7.07E-03 U	1.88E-02 ± 2.07E-02 U	5.39E-03 ± 1.27E-02 U
9/25/2019	4.33E-03 ± 1.24E-02 U	-4.88E-03 ± 6.96E-03 U	-6.40E-03 ± 8.86E-03 U	3.88E-03 ± 7.76E-03 U	5.54E-04 ± 8.21E-03 U

Sample Date	Air Station M-1 (pCi/m³)	Air Station M-2 (pCi/m³)	Air Station M-3 (pCi/m³)	Air Station M-4 (pCi/m³)	Air Station M-5 (pCi/m³)
10/2/2019	-4.63E-03 ± 1.01E-02 U	-2.99E-03 ± 9.78E-03 U	7.24E-03 ± 8.45E-03 U	3.69E-03 ± 1.32E-02 U	8.68E-04 ± 8.63E-03 U
10/9/2019	-4.65E-03 ± 8.85E-03 U	-1.22E-03 ± 1.01E-02 U	1.21E-02 ± 1.16E-02 U	-4.07E-04 ± 8.01E-03 U	9.52E-03 ± 1.37E-02 U
10/16/2019	-3.20E-03 ± 8.33E-03 U	1.64E-03 ± 1.27E-02 U	-2.62E-03 ± 8.71E-03 U	-1.14E-02 ± 1.04E-02 U	2.26E-03 ± 8.26E-03 U
10/23/2019	-4.60E-03 ± 7.03E-03 U	3.35E-03 ± 8.41E-03 U	-5.11E-03 ± 1.12E-02 U	2.53E-04 ± 7.54E-03 U	-1.53E-03 ± 6.51E-03 U
10/30/2019	1.29E-03 ± 4.99E-03 U	-1.13E-03 ± 6.17E-03 U	4.33E-03 ± 5.03E-03 U	4.40E-03 ± 8.62E-03 U	-2.18E-03 ± 6.94E-03 U
11/6/2019	1.50E-02 ± 9.89E-03 U I	-4.42E-03 ± 8.49E-03 U	2.22E-03 ± 1.03E-02 U	7.27E-03 ± 6.40E-03 U	-1.61E-03 ± 6.31E-03 U
11/13/2019	4.76E-03 ± 4.90E-03 U	1.48E-04 ± 7.20E-03 U	-2.60E-03 ± 5.51E-03 U	-1.89E-03 ± 5.14E-03 U	-3.48E-04 ± 4.94E-03 U
11/20/2019	3.60E-03 ± 1.26E-02 U	-5.64E-03 ± 1.06E-02 U	-4.30E-03 ± 9.18E-03 U	1.69E-03 ± 9.50E-03 U	7.60E-03 ± 7.94E-03 U
11/26/2019	1.43E-02 ± 1.45E-02 U	2.50E-03 ± 1.03E-02 U	3.92E-03 ± 1.59E-02 U	1.25E-02 ± 1.11E-02 U	2.99E-03 ± 9.30E-03 U
12/4/2019	-3.59E-03 ± 1.12E-02 U	-6.62E-03 ± 1.12E-02 U	-6.99E-04 ± 1.17E-02 U	-2.99E-03 ± 8.43E-03 U	1.08E-04 ± 7.90E-03 U
12/11/2019	2.36E-05 ± 8.13E-03 U	3.43E-03 ± 8.18E-03 U	-2.32E-05 ± 7.27E-03 U	1.89E-03 ± 7.21E-03 U	1.57E-03 ± 5.81E-03 U
12/18/2019	-6.61E-03 ± 7.89E-03 U	-1.69E-03 ± 7.17E-03 U	5.42E-03 ± 8.15E-03 U	-1.12E-03 ± 1.29E-02 U	1.75E-03 ± 5.34E-03 U
12/26/2019	7.38E-03 ± 8.49E-03 U	3.39E-03 ± 1.11E-02 U	5.01E-03 ± 1.12E-02 U	-1.04E-03 ± 9.78E-03 U	4.82E-04 ± 9.31E-03 U

Notes:

1 – Air Station M-5 air sampler power loss – sample collected 47.9 of ~192 hour period (Condition Report 501000027446)

2 – Air Station M-2 air sampler power loss – sample collected 113.6 of ~192 hour period (Condition Report 501000030820)

AIRBORNE PARTICULATES: GROSS BETA

Sample Date	Air Station M-1 (pCi/m³)	Air Station M-2 (pCi/m³)	Air Station M-3 (pCi/m³)	Air Station M-4 (pCi/m³)	Air Station M-5 (pCi/m³)
1/9/2019	0.0513 ± 0.00542	0.0523 ± 0.00567	0.0519 ± 0.00582	0.0557 ± 0.00549	0.0568 ± 0.00604
1/16/2019	0.0428 ± 0.00532	0.049 ± 0.00551	0.0474 ± 0.00556	0.0487 ± 0.00514	0.0494 ± 0.00579
1/23/2019	0.0352 ± 0.00482	0.0339 ± 0.00468	0.0345 ± 0.00483	0.035 ± 0.00446	0.0346 ± 0.00486
1/31/2019	0.0508 ± 0.00553	0.0462 ± 0.00501	0.0446 ± 0.0048	0.0457 ± 0.00489	0.0519 ± 0.00544
2/6/2019	0.0517 ± 0.00675	0.0367 ± 0.00509	0.0447 ± 0.00581	0.0431 ± 0.00546	0.0565 ± 0.0072
2/13/2019	0.0321 ± 0.00437	0.037 ± 0.00488	0.0303 ± 0.00455	0.0300 ± 0.0042	0.0357 ± 0.00485
2/20/2019	0.0416 ± 0.00475	0.0332 ± 0.00429	0.0555 ± 0.00614	0.0423 ± 0.00494	0.0452 ± 0.00496
2/27/2019	0.0539 ± 0.00559	0.0492 ± 0.00529	0.0591 ± 0.00632	0.0542 ± 0.00573	0.0499 ± 0.00548
3/6/2019	0.0477 ± 0.00526	0.0386 ± 0.0046	0.0562 ± 0.00622	0.0432 ± 0.00501	0.0444 ± 0.00495
3/13/2019	0.0484 ± 0.00542	0.0464 ± 0.00494	0.0533 ± 0.00568	0.0504 ± 0.00543	0.0563 ± 0.00587
3/20/2019	0.0371 ± 0.00478	0.0297 ± 0.00404	0.0372 ± 0.0048	0.0293 ± 0.00444	0.0348 ± 0.00471
3/27/2019	0.029 ± 0.00421	0.0319 ± 0.00437	0.0269 ± 0.00434	0.0298 ± 0.00435	0.0341 ± 0.00479
4/3/2019	0.0273 ± 0.0044	0.02 ± 0.00345	0.0236 ± 0.00398	0.0211 ± 0.00373	0.024 ± 0.00403
4/10/2019	0.0231 ± 0.00392	0.0247 ± 0.00365	0.0281 ± 0.00437	0.0321 ± 0.00476	0.0263 ± 0.0042
4/17/2019	0.0158 ± 0.00338	0.0157 ± 0.00303	0.0165 ± 0.00362	0.0275 ± 0.00446	0.0151 ± 0.00341
4/24/2019	0.021 ± 0.00382	0.0262 ± 0.00397	0.0205 ± 0.00382	0.0209 ± 0.00369	0.0209 ± 0.00386
5/1/2019	0.0308 ± 0.00449	0.0247 ± 0.00389	0.0274 ± 0.00399	0.0256 ± 0.00419	0.029 ± 0.00437
5/8/2019	0.0213 ± 0.0037	0.0194 ± 0.00348	0.0227 ± 0.00387	0.0231 ± 0.00403	0.0193 ± 0.0037
5/15/2019 (1)	0.0278 ± 0.00408	0.029 ± 0.00424	0.0273 ± 0.00414	0.0237 ± 0.00387	0.0152 ± 0.00819
5/22/2019	0.0188 ± 0.00352	0.0175 ± 0.00353	0.0204 ± 0.00382	0.0187 ± 0.0037	0.0178 ± 0.00363
5/29/2019	0.0115 ± 0.00304	0.0134 ± 0.00309	0.0159 ± 0.00351	0.0156 ± 0.00343	0.0144 ± 0.00328
6/5/2019	0.0328 ± 0.00453	0.0288 ± 0.00423	0.0352 ± 0.00492	0.0272 ± 0.00414	0.0311 ± 0.00441
6/12/2019	0.0323 ± 0.00445	0.0294 ± 0.00428	0.0373 ± 0.00505	0.031 ± 0.00454	0.0315 ± 0.0044
6/19/2019	0.0212 ± 0.00371	0.0247 ± 0.00396	0.0202 ± 0.00392	0.0207 ± 0.00368	0.0222 ± 0.00377
6/26/2019	0.0241 ± 0.00394	0.0249 ± 0.00406	0.0249 ± 0.00416	0.0245 ± 0.00411	0.0205 ± 0.00385
7/3/2019	0.0254 ± 0.00405	0.0303 ± 0.00443	0.0265 ± 0.00431	0.0252 ± 0.00407	0.0308 ± 0.0046
7/11/2019	0.0289 ± 0.00399	0.0359 ± 0.0043	0.0272 ± 0.00411	0.0297 ± 0.00396	0.0328 ± 0.00442
7/17/2019	0.038 ± 0.00525	0.0349 ± 0.00498	0.0379 ± 0.00542	0.0434 ± 0.00582	0.0344 ± 0.00525
7/24/2019	0.0321 ± 0.00442	0.0327 ± 0.00444	0.0344 ± 0.00484	0.0339 ± 0.00456	0.0279 ± 0.00434
7/31/2019	0.0316 ± 0.00446	0.0367 ± 0.00469	0.0332 ± 0.0048	0.0256 ± 0.00402	0.0268 ± 0.00416

Sample Date	Air Station M-1 (pCi/m³)	Air Station M-2 (pCi/m³)	Air Station M-3 (pCi/m³)	Air Station M-4 (pCi/m³)	Air Station M-5 (pCi/m³)
8/7/2019	0.0476 ± 0.00544	0.0506 ± 0.0055	0.0489 ± 0.00539	0.0476 ± 0.00531	0.044 ± 0.00523
8/15/2019 (2)	0.0292 ± 0.00395	0.0583 ± 0.00728	0.027 ± 0.00381	0.0302 ± 0.00406	0.0301 ± 0.004
8/21/2019	0.03 ± 0.00479	0.0289 ± 0.00463	0.036 ± 0.00513	0.0293 ± 0.00463	0.0315 ± 0.00488
8/28/2019	0.0207 ± 0.0037	0.0284 ± 0.00418	0.0279 ± 0.00423	0.024 ± 0.00389	0.0256 ± 0.00405
9/4/2019	0.0363 ± 0.00467	0.0289 ± 0.0043	0.0295 ± 0.00426	0.0295 ± 0.00428	0.0301 ± 0.00428
9/11/2019	0.0293 ± 0.00428	0.0268 ± 0.00416	0.0277 ± 0.00413	0.0274 ± 0.00424	0.028 ± 0.00418
9/17/2019	0.0335 ± 0.00503	0.0327 ± 0.00495	0.0351 ± 0.005	0.0341 ± 0.00509	0.0312 ± 0.00479
9/25/2019	0.048 ± 0.00499	0.0487 ± 0.00498	0.0524 ± 0.0052	0.0509 ± 0.00504	0.0481 ± 0.00499
10/2/2019	0.028 ± 0.00419	0.0201 ± 0.00387	0.0189 ± 0.00382	0.0217 ± 0.00393	0.0196 ± 0.00392
10/9/2019	0.026 ± 0.00416	0.015 ± 0.00346	0.0234 ± 0.00414	0.0189 ± 0.0037	0.0182 ± 0.00381
10/16/2019	0.0225 ± 0.00394	0.0225 ± 0.00401	0.0238 ± 0.00415	0.0234 ± 0.00404	0.0196 ± 0.00393
10/23/2019	0.0332 ± 0.0049	0.0321 ± 0.00465	0.0268 ± 0.00416	0.0302 ± 0.00451	0.0352 ± 0.00522
10/30/2019	0.022 ± 0.00388	0.0228 ± 0.00353	0.0277 ± 0.00421	0.0305 ± 0.00475	0.024 ± 0.00409
11/6/2019	0.0279 ± 0.0042	0.0304 ± 0.00423	0.0349 ± 0.00485	0.0386 ± 0.00524	0.0314 ± 0.00441
11/13/2019	0.035 ± 0.00468	0.0422 ± 0.00486	0.0368 ± 0.00469	0.042 ± 0.00539	0.0423 ± 0.00506
11/20/2019	0.0555 ± 0.00565	0.0542 ± 0.00543	0.0587 ± 0.00603	0.0657 ± 0.00688	0.0519 ± 0.00547
11/26/2019	0.0331 ± 0.00492	0.0286 ± 0.00445	0.0271 ± 0.00471	0.0383 ± 0.00564	0.0269 ± 0.00451
12/4/2019	0.0242 ± 0.00399	0.0193 ± 0.0033	0.0213 ± 0.00349	0.019 ± 0.00329	0.0233 ± 0.00392
12/11/2019	0.0515 ± 0.00546	0.0529 ± 0.00539	0.0513 ± 0.00567	0.0645 ± 0.00681	0.0486 ± 0.00531
12/18/2019	0.0619 ± 0.00649	0.059 ± 0.00584	0.0584 ± 0.00589	0.0561 ± 0.00593	0.0684 ± 0.00679
12/26/2019	0.0879 ± 0.00656	0.0853 ± 0.00627	0.0905 ± 0.00688	0.107 ± 0.00809	0.0821 ± 0.00632

Notes:

1 – Air Station M-5 air sampler power loss – sample collected 47.9 of ~192 hour period (Condition Report 501000027446)

2 – Air Station M-2 air sampler power loss – sample collected 113.6 of ~192 hour period (Condition Report 501000030820)

AIRBORNE PARTICULATES: GAMMA ISOTOPIC

Air Station M-1	Qtr 1 (pCi/m³)	Qtr 2 (pCi/m³)	Qtr 3 (pCi/m³)	Qtr 4 (pCi/m³)
Barium-140	-3.79E-03 ± 5.68E-03 U	1.33E-03 ± 2.72E-03 U	1.86E-03 ± 2.86E-03 U	-1.81E-03 ± 4.64E-03 U
Beryllium-7	7.79E-02 ± 1.03E-02	9.70E-02 ± 9.31E-03	6.70E-02 ± 9.25E-03	5.38E-02 ± 8.58E-03
Cerium-141	-8.66E-05 ± 6.36E-04 U	-1.78E-04 ± 4.04E-04 U	-2.75E-04 ± 4.36E-04 U	2.41E-05 ± 4.43E-04 U
Cerium-144	-3.43E-04 ± 1.21E-03 U	1.21E-04 ± 9.63E-04 U	-1.25E-04 ± 1.06E-03 U	-4.21E-05 ± 1.19E-03 U
Cesium-134	-5.46E-05 ± 3.31E-04 U	8.19E-05 ± 3.08E-04 U	3.87E-05 ± 3.61E-04 U	-1.92E-04 ± 2.87E-04 U
Cesium-137	8.69E-05 ± 3.49E-04 U	1.65E-04 ± 3.19E-04 U	-2.32E-06 ± 2.71E-04 U	-2.63E-04 ± 3.37E-04 U
Cobalt-58	1.30E-05 ± 3.94E-04 U	2.00E-04 ± 2.74E-04 U	6.29E-04 ± 5.01E-04 U I	3.12E-04 ± 3.41E-04 U
Cobalt-60	-9.85E-05 ± 3.30E-04 U	1.31E-04 ± 3.68E-04 U	-4.17E-05 ± 3.47E-04 U	2.45E-04 ± 3.18E-04 U
Lanthanum-140	-6.49E-04 ± 2.66E-03 U	1.01E-03 ± 1.10E-03 U	-6.30E-05 ± 1.00E-03 U	-1.50E-04 ± 1.48E-03 U
Manganese-54	-5.95E-05 ± 3.35E-04 U	-8.78E-05 ± 3.08E-04 U	7.14E-05 ± 3.10E-04 U	1.19E-04 ± 2.56E-04 U
Niobium-95	-1.72E-05 ± 3.11E-04 U	4.37E-04 ± 3.58E-04 U	-7.06E-05 ± 3.62E-04 U	2.61E-06 ± 3.25E-04 U
Ruthenium-103	-7.14E-05 ± 4.43E-04 U	-3.61E-04 ± 3.17E-04 U	-1.07E-04 ± 2.96E-04 U	5.25E-05 ± 3.51E-04 U
Ruthenium-106	3.78E-03 ± 3.51E-03 U	1.68E-03 ± 2.51E-03 U	1.36E-03 ± 2.24E-03 U	2.94E-03 ± 2.29E-03 U
Zinc-65	-4.22E-04 ± 6.79E-04 U	7.10E-05 ± 5.80E-04 U	-1.03E-04 ± 7.20E-04 U	1.78E-05 ± 6.00E-04 U
Zirconium-95	-2.05E-04 ± 7.13E-04 U	5.23E-04 ± 6.55E-04 U	5.89E-04 ± 5.85E-04 U	2.32E-04 ± 6.37E-04 U

Air Station M-2	Qtr 1 (pCi/m³)	Qtr 2 (pCi/m³)	Qtr 3 (pCi/m³)	Qtr 4 (pCi/m³)
Barium-140	-3.11E-03 ± 4.12E-03 U	6.98E-04 ± 1.55E-03 U	-3.52E-04 ± 2.22E-03 U	2.13E-03 ± 3.70E-03 U
Beryllium-7	6.60E-02 ± 8.97E-03	8.20E-02 ± 6.86E-03	8.05E-02 ± 7.21E-03	5.85E-02 ± 7.54E-03
Cerium-141	-1.89E-04 ± 5.04E-04 U	-1.04E-04 ± 3.05E-04 U	-2.93E-04 ± 4.59E-04 U	-5.31E-06 ± 6.69E-04 U
Cerium-144	-6.05E-04 ± 1.12E-03 U	-4.35E-04 ± 6.75E-04 U	-9.63E-05 ± 1.23E-03 U	4.64E-04 ± 1.34E-03 U
Cesium-134	2.02E-05 ± 2.95E-04 U	-1.95E-05 ± 1.60E-04 U	2.15E-04 ± 2.38E-04 U	3.09E-04 ± 3.01E-04 U
Cesium-137	3.12E-05 ± 2.53E-04 U	-1.77E-05 ± 1.41E-04 U	5.33E-05 ± 2.24E-04 U	-1.41E-04 ± 2.79E-04 U
Cobalt-58	4.84E-04 ± 5.61E-04 U	7.72E-05 ± 1.98E-04 U	9.31E-06 ± 2.60E-04 U	4.83E-05 ± 3.22E-04 U
Cobalt-60	-6.19E-06 ± 2.57E-04 U	-1.15E-04 ± 2.18E-04 U	-2.02E-04 ± 2.59E-04 U	-5.99E-05 ± 2.78E-04 U
Lanthanum-140	-5.39E-04 ± 1.80E-03 U	-9.85E-04 ± 7.06E-04 U	-1.25E-04 ± 1.00E-03 U	-6.47E-04 ± 1.25E-03 U
Manganese-54	7.89E-06 ± 2.90E-04 U	1.75E-05 ± 1.76E-04 U	-3.37E-05 ± 2.27E-04 U	-2.05E-04 ± 2.52E-04 U
Niobium-95	-1.35E-04 ± 3.54E-04 U	-4.19E-05 ± 1.96E-04 U	-8.64E-05 ± 3.01E-04 U	3.14E-06 ± 3.16E-04 U
Ruthenium-103	-1.88E-04 ± 3.64E-04 U	-2.97E-05 ± 2.06E-04 U	1.57E-05 ± 2.89E-04 U	-1.03E-04 ± 3.53E-04 U
Ruthenium-106	1.77E-04 ± 2.38E-03 U	9.32E-04 ± 1.29E-03 U	-4.23E-04 ± 1.71E-03 U	-1.17E-03 ± 2.57E-03 U
Zinc-65	-1.81E-04 ± 6.58E-04 U	3.08E-05 ± 4.35E-04 U	-6.92E-05 ± 5.54E-04 U	-2.31E-04 ± 6.68E-04 U
Zirconium-95	3.21E-04 ± 5.62E-04 U	1.04E-04 ± 3.00E-04 U	-9.43E-05 ± 4.87E-04 U	4.39E-05 ± 5.68E-04 U

Air Station M-3	Qtr 1 (pCi/m³)	Qtr 2 (pCi/m³)	Qtr 3 (pCi/m³)	Qtr 4 (pCi/m³)
Barium-140	-3.25E-04 ± 6.15E-03 U	2.83E-03 ± 2.86E-03 U	-1.87E-03 ± 3.50E-03 U	-3.64E-04 ± 3.50E-03 U
Beryllium-7	7.95E-02 ± 1.13E-02	9.82E-02 ± 1.01E-02	8.07E-02 ± 8.22E-03	4.78E-02 ± 8.74E-03
Cerium-141	1.32E-04 ± 7.54E-04 U	7.75E-05 ± 4.04E-04 U	-1.53E-04 ± 3.99E-04 U	-2.34E-04 ± 5.23E-04 U
Cerium-144	-1.23E-04 ± 1.63E-03 U	-4.21E-04 ± 1.27E-03 U	4.24E-04 ± 1.21E-03 U	-4.19E-04 ± 9.77E-04 U
Cesium-134	-9.60E-05 ± 3.21E-04 U	2.88E-05 ± 2.84E-04 U	-7.42E-05 ± 2.78E-04 U	3.57E-05 ± 2.58E-04 U
Cesium-137	-2.74E-04 ± 3.82E-04 U	2.99E-04 ± 2.00E-04 U	-1.55E-04 ± 2.53E-04 U	1.70E-04 ± 2.75E-04 U
Cobalt-58	-6.20E-05 ± 3.51E-04 U	8.34E-05 ± 3.38E-04 U	-9.22E-05 ± 3.10E-04 U	-1.10E-04 ± 3.91E-04 U
Cobalt-60	-1.52E-04 ± 3.82E-04 U	9.50E-05 ± 3.70E-04 U	1.29E-04 ± 3.06E-04 U	-1.33E-04 ± 3.24E-04 U
Lanthanum-140	-1.59E-03 ± 2.46E-03 U	-8.01E-04 ± 8.84E-04 U	1.42E-04 ± 9.28E-04 U	9.72E-04 ± 1.22E-03 U
Manganese-54	-9.32E-06 ± 3.20E-04 U	2.46E-04 ± 3.88E-04 U	3.73E-04 ± 3.17E-04 U	1.30E-05 ± 2.81E-04 U
Niobium-95	7.53E-06 ± 4.30E-04 U	-7.69E-05 ± 2.66E-04 U	-2.62E-06 ± 2.85E-04 U	6.37E-05 ± 3.12E-04 U
Ruthenium-103	1.37E-04 ± 4.31E-04 U	1.60E-04 ± 2.87E-04 U	-1.78E-04 ± 3.66E-04 U	5.46E-04 ± 3.46E-04 U
Ruthenium-106	-2.16E-03 ± 3.35E-03 U	-1.21E-03 ± 2.06E-03 U	1.26E-03 ± 2.54E-03 U	7.20E-04 ± 2.66E-03 U
Zinc-65	4.32E-04 ± 9.49E-04 U	2.16E-04 ± 6.83E-04 U	-2.08E-04 ± 4.78E-04 U	9.16E-04 ± 7.80E-04 U
Zirconium-95	-2.31E-04 ± 7.30E-04 U	-1.13E-04 ± 6.24E-04 U	2.16E-04 ± 5.26E-04 U	2.96E-04 ± 7.38E-04 U

Air Station M-4	Qtr 1 (pCi/m³)	Qtr 2 (pCi/m³)	Qtr 3 (pCi/m³)	Qtr 4 (pCi/m³)
Barium-140	-1.33E-03 ± 4.13E-03 U	4.11E-03 ± 3.06E-03 U	-1.59E-03 ± 2.53E-03 U	9.07E-04 ± 2.70E-03 U
Beryllium-7	7.52E-02 ± 9.09E-03	9.57E-02 ± 8.91E-03	7.42E-02 ± 8.66E-03	5.62E-02 ± 7.85E-03
Cerium-141	5.45E-04 ± 8.48E-04 U	-1.06E-04 ± 3.52E-04 U	6.11E-04 ± 7.91E-04 U	-2.62E-04 ± 4.12E-04 U
Cerium-144	3.10E-04 ± 1.10E-03 U	-3.58E-04 ± 8.84E-04 U	1.04E-04 ± 1.21E-03 U	-1.49E-04 ± 8.61E-04 U
Cesium-134	-9.73E-05 ± 2.48E-04 U	5.58E-05 ± 2.70E-04 U	8.37E-05 ± 2.66E-04 U	-5.26E-05 ± 2.66E-04 U
Cesium-137	4.31E-05 ± 2.64E-04 U	3.92E-04 ± 4.39E-04 U	-3.12E-05 ± 2.71E-04 U	-9.01E-06 ± 1.95E-04 U
Cobalt-58	7.89E-05 ± 2.51E-04 U	3.68E-04 ± 5.61E-04 U	-6.52E-06 ± 2.92E-04 U	1.57E-04 ± 2.76E-04 U
Cobalt-60	3.77E-05 ± 2.38E-04 U	1.10E-04 ± 2.67E-04 U	-1.09E-05 ± 2.11E-04 U	6.35E-05 ± 2.85E-04 U
Lanthanum-140	5.40E-04 ± 1.44E-03 U	3.03E-04 ± 5.80E-04 U	1.22E-04 ± 1.33E-03 U	4.20E-04 ± 1.25E-03 U
Manganese-54	1.12E-04 ± 2.67E-04 U	2.82E-04 ± 2.56E-04 U I	-7.63E-05 ± 2.79E-04 U	2.09E-04 ± 2.14E-04 U
Niobium-95	4.62E-05 ± 3.65E-04 U	3.25E-04 ± 2.43E-04 U	-2.18E-04 ± 3.17E-04 U	1.53E-04 ± 2.76E-04 U
Ruthenium-103	-1.51E-04 ± 3.71E-04 U	2.33E-04 ± 2.62E-04 U	1.25E-04 ± 3.17E-04 U	-2.81E-06 ± 2.70E-04 U
Ruthenium-106	7.88E-04 ± 2.30E-03 U	-3.52E-04 ± 1.74E-03 U	-1.52E-04 ± 2.65E-03 U	2.10E-03 ± 1.98E-03 U
Zinc-65	-2.17E-04 ± 5.61E-04 U	-3.95E-04 ± 6.33E-04 U	3.79E-04 ± 6.97E-04 U	-1.91E-04 ± 5.14E-04 U
Zirconium-95	5.28E-04 ± 5.42E-04 U	-1.74E-04 ± 4.27E-04 U	5.91E-04 ± 6.91E-04 U	1.41E-04 ± 3.97E-04 U

Air Station M-5	Qtr 1 (pCi/m³)	Qtr 2 (pCi/m³)	Qtr 3 (pCi/m³)	Qtr 4 (pCi/m³)
Barium-140	-1.41E-03 ± 4.94E-03 U	1.60E-04 ± 2.04E-03 U	1.62E-03 ± 2.49E-03 U	1.56E-03 ± 3.02E-03 U
Beryllium-7	7.57E-02 ± 1.01E-02	8.46E-02 ± 9.06E-03	7.36E-02 ± 8.29E-03	4.98E-02 ± 7.02E-03
Cerium-141	-1.66E-04 ± 3.10E-04 U	-9.98E-05 ± 3.56E-04 U	6.92E-05 ± 4.05E-04 U	-1.98E-06 ± 4.12E-04 U
Cerium-144	-9.02E-04 ± 8.40E-04 U	-5.50E-04 ± 9.86E-04 U	-2.91E-04 ± 1.06E-03 U	-7.54E-05 ± 9.45E-04 U
Cesium-134	-1.96E-04 ± 2.97E-04 U	1.13E-04 ± 2.28E-04 U	-1.81E-04 ± 2.97E-04 U	1.21E-04 ± 2.16E-04 U
Cesium-137	-6.38E-07 ± 3.55E-04 U	8.00E-05 ± 2.27E-04 U	4.24E-05 ± 2.03E-04 U	1.60E-04 ± 2.30E-04 U
Cobalt-58	9.98E-05 ± 3.09E-04 U	-1.44E-04 ± 3.01E-04 U	2.99E-05 ± 2.38E-04 U	1.57E-05 ± 2.74E-04 U
Cobalt-60	1.59E-04 ± 4.33E-04 U	3.42E-04 ± 2.76E-04 U	-2.81E-04 ± 2.66E-04 U	-4.78E-05 ± 2.13E-04 U
Lanthanum-140	-8.64E-05 ± 2.61E-03 U	-5.25E-04 ± 9.55E-04 U	-1.56E-04 ± 8.09E-04 U	-8.49E-05 ± 9.35E-04 U
Manganese-54	2.04E-04 ± 3.15E-04 U	1.34E-04 ± 2.15E-04 U	2.13E-04 ± 1.97E-04 U	1.57E-04 ± 2.53E-04 U
Niobium-95	-6.78E-05 ± 4.31E-04 U	-1.80E-04 ± 2.36E-04 U	-3.19E-04 ± 3.73E-04 U	-2.14E-05 ± 2.82E-04 U
Ruthenium-103	3.50E-04 ± 3.60E-04 U	7.35E-05 ± 2.58E-04 U	-2.75E-05 ± 2.88E-04 U	-4.81E-05 ± 2.90E-04 U
Ruthenium-106	-6.96E-04 ± 2.42E-03 U	4.70E-04 ± 2.25E-03 U	-8.49E-04 ± 2.06E-03 U	-1.29E-03 ± 1.87E-03 U
Zinc-65	-1.25E-05 ± 8.34E-04 U	-2.60E-04 ± 5.35E-04 U	-2.16E-04 ± 4.64E-04 U	7.43E-04 ± 7.51E-04 U
Zirconium-95	-2.44E-04 ± 7.95E-04 U	4.83E-04 ± 5.24E-04 U	7.16E-05 ± 4.89E-04 U	-2.10E-04 ± 4.79E-04 U

SEDIMENT: GAMMA ISOTOPIC

M-8c Upstream of plant	Qtr 2 (pCi/Kg, dry)	Qtr 4 (pCi/Kg, dry)
Barium-140	166 ± 137 **U**	21.3 ± 103 **U**
Beryllium-7	-32.6 ± 263 **U**	131 ± 194 **U**
Cerium-144	-111 ± 131 **U**	36.9 ± 105 **U**
Cesium-134	-2.96 ± 30.8 **U**	11.3 ± 24 **U**
Cesium-137	29.9 ± 32.9 **U**	10 ± 20.7 **U**
Cobalt-58	10.3 ± 25.2 **U**	-10.2 ± 15.9 **U**
Cobalt-60	-25.2 ± 37.2 **U**	-23.9 ± 20.1 **U**
Iron-59	-17.8 ± 60.2 **U**	20.3 ± 46.9 **U**
Lanthanum-140	26 ± 42.6 **U**	-12.2 ± 33.7 **U**
Manganese-54	12.4 ± 29.1 **U**	14.1 ± 19.9 **U**
Niobium-95	0.627 ± 32.3 **U**	0.288 ± 21.5 **U**
Potassium-40	11800 ± 1340	11900 ± 1070
Ruthenium-103	-4.85 ± 24.4 **U**	6.1 ± 17.9 **U**
Ruthenium-106	-12.1 ± 238 **U**	47.5 ± 159 **U**
Zinc-65	3.44 ± 66.2 **U**	22.5 ± 54.4 **U**
Zirconium-95	-20.4 ± 44.1 **U**	-8.18 ± 37 **U**

M-9 Downstream of plant	Qtr 2 (pCi/Kg, dry)	Qtr 4 (pCi/Kg, dry)
Barium-140	-75.7 ± 188 **U**	-18.4 ± 194 **U**
Beryllium-7	561 ± 344 **U**	1040 ± 529
Cerium-144	12.9 ± 149 **U**	-143 ± 182 **U**
Cesium-134	-5.03 ± 39.2 **U**	80.8 ± 38.8 **UI**
Cesium-137	61.4 ± 54.1 **UI**	120 ± 48.6 **M**
Cobalt-58	-0.694 ± 31.7 **U**	4.03 ± 26.4 **U**
Cobalt-60	-2.32 ± 40.1 **U**	35.8 ± 31.1 **U**
Iron-59	-43.1 ± 74.4 **U**	-68.8 ± 69.2 **U**
Lanthanum-140	-32.7 ± 71.1 **U**	-16.1 ± 42.2 **U**
Manganese-54	-9.71 ± 32.9 **U**	-2.53 ± 37.7 **U**
Niobium-95	6.16 ± 40.5 **U**	-17.7 ± 29 **U**
Potassium-40	13700 ± 1680	13700 ± 1560
Ruthenium-103	-1.52 ± 34.5 **U**	16.1 ± 29.4 **U**
Ruthenium-106	267 ± 291 **U**	83.3 ± 272 **U**
Zinc-65	18.5 ± 82.1 **U**	-27.1 ± 88.8 **U**
Zirconium-95	-32.3 ± 61.8 **U**	-18.3 ± 51.9 **U**

M-15 Montissippi Park	Qtr 2 (pCi/Kg, dry)	Qtr 4 (pCi/Kg, dry)
Barium-140	77 ± 148 **U**	-578 ± 3390 **U**
Beryllium-7	588 ± 584 **UI**	459 ± 819 **U**
Cerium-144	-12.9 ± 128 **U**	-39.2 ± 123 **U**
Cesium-134	-13.1 ± 26.7 **U**	104 ± 46.9 **UI**
Cesium-137	20.2 ± 30.7 **U**	17.5 ± 22.7 **U**
Cobalt-58	-18.1 ± 26.1 **U**	-2.18 ± 35.1 **U**
Cobalt-60	10.7 ± 25.2 **U**	-1.04 ± 22.3 **U**
Iron-59	-7.69 ± 51.9 **U**	-18.2 ± 125 **U**
Lanthanum-140	-20.7 ± 45.3 **U**	-1050 ± 1390 **U**
Manganese-54	7.37 ± 23.1 **U**	28.9 ± 25.5 **U**
Niobium-95	5.09 ± 32.3 **U**	-38.3 ± 48.5 **U**
Potassium-40	12700 ± 1420	23100 ± 1190
Ruthenium-103	4.08 ± 26 **U**	-4.67 ± 62.9 **U**
Ruthenium-106	48.5 ± 226 **U**	57.2 ± 168 **U**
Zinc-65	-15.4 ± 62.1 **U**	-8.41 ± 63 **U**
Zirconium-95	-17.6 ± 49.8 **U**	12.8 ± 78.1 **U**

TISSUE - FISH: GAMMA ISOTOPIC

(pCi/Kg, wet)	M-8c Upstream of plant				M-9 Downstream of plant			
	May		Sep		May		Sep	
	Fish 1	Fish 2	Fish 1	Fish 2	Fish 1	Fish 2	Fish 1	Fish 2
Barium-140	-14.7 ± 20.1 U	1420 ± 2800 U	-62.8 ± 55.3 U	39.7 ± 61.1 U	-6.09 ± 23 U	1250 ± 2610 U	2.6 ± 40.2 U	-26.4 ± 45.9 U
Cerium-144	-11.1 ± 21.5 U	-1.69 ± 34.4 U	15.7 ± 43.6 U	-12.7 ± 53.7 U	-7.5 ± 20.5 U	13.5 ± 30.4 U	6.35 ± 35.9 U	3.56 ± 38.7 U
Cesium-134	2.01 ± 5.09 U	9.27 ± 10.5 U	-0.309 ± 6.9 U	-3.2 ± 12.3 U	1.92 ± 4.95 U	2.79 ± 5.78 U	-0.652 ± 8.36 U	2.41 ± 7.47 U
Cesium-137	1.72 ± 3.78 U	4.53 ± 8.44 U	2.71 ± 8.28 U	1.06 ± 11.4 U	4.14 ± 5.31 U	2.46 ± 5.49 U	4.12 ± 5.99 U	6.11 ± 7.22 U
Cobalt-58	3.64 ± 3.61 U	10.9 ± 11 U	-2.14 ± 7.74 U	-2.24 ± 10.2 U	0.333 ± 5.08 U	-5.5 ± 12 U	0.835 ± 5.83 U	3.66 ± 7.51 U
Cobalt-60	-0.302 ± 3.62 U	-0.0298 ± 5.97 U	5 ± 9.22 U	4.4 ± 8.87 U	0.855 ± 5.3 U	2.33 ± 4.13 U	8.01 ± 9.09 U	-2.35 ± 10.1
Iron-59	0.285 ± 9.54 U	-5.6 ± 42.8 U	23.7 ± 15.6 U	10.5 ± 14.5 U	14.3 ± 11.8 U	-6.67 ± 47 U	-5.61 ± 17.1 U	-4.4 ± 17.2 U
Lanthanum-140	0.813 ± 6.17 U	272 ± 1020 U	4.15 ± 12.3 U	-16.9 ± 18.8 U	10.6 ± 7.73 U	87.5 ± 854 U	0.22 ± 13.3 U	4.49 ± 14.2 U
Manganese -54	0.5 ± 3.79 U	0.753 ± 5.84 U	0.25 ± 6.98 U	5.67 ± 10.7 U	1.37 ± 4.62 U	2.71 ± 4.74 U	2.22 ± 5.9 U	3.49 ± 7.37 U
Niobium-95	1.92 ± 3.89 U	8.45 ± 11.3 U	11.2 ± 9.36 U	9.95 ± 9.64 U	-0.729 ± 5.43 U	-0.307 ± 14.9 U	-3.07 ± 8.75 U	-3.95 ± 7.06 U
Potassium-40	3020 ± 224	3160 ± 313	3500 ± 474	3600 ± 458	2790 ± 238	2730 ± 249	3290 ± 395	3230 ± 434
Zinc-65	4 ± 9.86 U	-0.605 ± 14.4 U	-4.86 ± 19.1 U	1.35 ± 16.3 U	2.13 ± 13.1 U	7.19 ± 15.4 U	4.8 ± 19.2 U	7.67 ± 19.5 U
Zirconium-95	-0.0203 ± 7.38 U	0.369 ± 22.1 U	7.97 ± 15.2 U	-0.72 ± 17.5 U	-6.09 ± 11.1 U	-19.5 ± 21.7 U	0.254 ± 11 U	3.6 ± 13.5 U

TISSUE - INVERTEBRATE: GAMMA ISOTOPIC

(pCi/Kg, wet)	M-9 Downstream of plant	M-8c Upstream of plant
	Qtr 2	Qtr 3
Barium-140	-150 ± 401 **U**	-127 ± 467 **U**
Beryllium-7	-227 ± 576 **U**	338 ± 403 **U**
Cerium-144	-86.2 ± 334 **U**	54.9 ± 193 **U**
Cesium-134	-17.4 ± 101 **U**	-24.6 ± 50.9 **U**
Cesium-137	69.4 ± 72.9 **U**	-23.5 ± 45.2 **U**
Cobalt-58	25.2 ± 71 **U**	18.1 ± 47.2 **U**
Cobalt-60	35.9 ± 84.7 **U**	10.9 ± 49.8 **U**
Iron-59	-50.3 ± 179 **U**	32.1 ± 127 **U**
Lanthanum-140	-48.3 ± 149 **U**	66.5 ± 174 **U**
Manganese-54	52.9 ± 80.9 **U**	-5.32 ± 49.4 **U**
Niobium-95	4.68 ± 91.5 **U**	46.8 ± 50.9 **U**
Potassium-40	1420 ± 1300 **UI**	1110 ± 1420 **UI**
Ruthenium-103	20.6 ± 70.8 **U**	5.08 ± 53.8 **U**
Ruthenium-106	219 ± 637 **U**	222 ± 421 **U**
Zinc-65	60.1 ± 155 **U**	-41.4 ± 111 **U**
Zirconium-95	4.25 ± 129 **U**	-85 ± 96.4 **U**

TISSUE – PLANT: GAMMA ISOTOPIC

pCi/Kg	M-41 Training Center			M-42 Biology Station Road			M-43 Imholte Farm		
	Jul	Aug	Sep	Jul	Aug	Sep	Jul	Aug	Sep
Cesium-134	3.35 ± 9.66 U	7.46 ± 9.42 U	-0.619 ± 13.5 U	8.32 ± 11.4 U	9.2 ± 9.98 U	4.52 ± 14 U	2.2 ± 9.24 U	4.66 ± 16.2 U	3.29 ± 17.1 U
Cesium-137	-0.285 ± 8.35 U	3.36 ± 8.65 U	19.3 ± 21.4 U	16.2 ± 11.1 U	-8.31 ± 10.2 U	15.1 ± 14.5 U	-0.344 ± 9.48 U	9.92 ± 12.7 U	3.45 ± 16.5 U
Cobalt-58	-1.43 ± 9.18 U	-1.4 ± 8.11 U	2.98 ± 12.9 U	-0.0224 ± 9.7 U	2.67 ± 9.59 U	-4.13 ± 13.7 U	1.15 ± 8.04 U	0.427 ± 12.8 U	-13.3 ± 17 U
Cobalt-60	-8.35 ± 11.3 U	1.71 ± 8.59 U	-14.6 ± 14.5 U	1.02 ± 11.2 U	5.13 ± 11.1 U	1.47 ± 14.3 U	-7.66 ± 9.84 U	-3.35 ± 11 U	1.98 ± 17.3 U
Iodine-131	2.2 ± 11.5 U	-6.9 ± 11.8 U	-5.0 ± 25.8 U	7.8 ± 14.7 U	-6.8 ± 13.8 U	19.4 ± 27.8 U	-13.2 ± 15.4 U	8.6 ± 19.7 U	13.3 ± 30.8 U
Iron-59	4.2 ± 17.7 U	9.87 ± 18.9 U	48.8 ± 47 U	12.4 ± 21.9 U	-6.87 ± 23.5 U	37.1 ± 36.3 U	9.58 ± 19.4 U	10.1 ± 23 U	-24.7 ± 36.5 U
Manganese-54	-3.55 ± 9.82 U	1.72 ± 8.71 U	-7.85 ± 12.8 U	3.39 ± 9.39 U	1.67 ± 9.4 U	7 ± 15.4 U	0.556 ± 9.28 U	1.1 ± 13 U	-3.67 ± 16.5 U
Niobium-95	7.82 ± 11.3 U	2.29 ± 8.97 U	-10.4 ± 15.8 U	0.083 ± 11.2 U	6.74 ± 9.97 U	10.6 ± 15.2 U	1.68 ± 8.59 U	8.29 ± 12.7 U	-4.66 ± 21.5 U
Zinc-65	39.6 ± 52.2 UI	-13.8 ± 20.2 U	-6.35 ± 33.8 U	12.6 ± 26.1 U	10.7 ± 23.6 U	9.44 ± 32.3 U	4.83 ± 24.7 U	-6.4 ± 24.2 U	5.29 ± 33.1 U

WATER: TRITIUM

pCi/L	Jan	Mar	Apr	Jun	Jul	Sep	Oct	Nov	Dec
M-11 City of Monticello	83.4 ± 207 U		60.5 ± 126 U		187 ± 236 U		-71.1 ± 117 U		
M-12 Plant Well #11	98 ± 211 U		-9.46 ± 111 U		-127 ± 212 U		-103 ± 117 U		
M-14 City of Minneapolis		29.6 ± 129 U		77.3 ± 218 U		-8.81 ± 232 U			-135 ± 253 U
M-43 Imholte Farm	256 ± 224 U		62.8 ± 127 U		291 ± 243 U		51.5 ± 92 U		
M-55 Hasbrouck Residence	-111 ± 185 U		50.9 ± 125 U		61.9 ± 229 U		92.7 ± 95.1 U		
M-8 Upstream of plant				130 ± 216 U		127 ± 251 U		-227 ± 241 U	
M-9 Downstream of plant		25.2 ± 127 U		99.4 ± 213 U		-163 ± 218 U			-208 ± 251 U

WATER – DRINKING: GROSS BETA

M-14 City of Minneapolis	Gross Beta (pCi/L)
Jan	2.550 ± 1.980 **U**
Feb	-0.370 ± 2.300 **U**
Mar	1.990 ± 2.240 **U**
Apr	2.970 ± 1.670 **M**
May	0.894 ± 1.960 **U**
Jun	1.340 ± 2.080 **U**
Jul	1.430 ± 1.400 **U**
Aug	1.660 ± 1.540 **U**
Sep	2.110 ± 2.140 **U**
Oct	-0.111 ± 2.050 **U**
Nov	1.780 ± 1.990 **U**
Dec	2.120 ± 2.350 **U**

WATER – DRINKING: IODINE-131

M-14 City of Minneapolis	Iodine-131 (pCi/L)
1/7/2019	-4.04E-02 ± 3.78E-01 **U**
1/16/2019	2.58E-01 ± 4.99E-01 **U**
1/23/2019	-1.79E-02 ± 3.92E-01 **U**
1/29/2019	-2.06E-01 ± 2.89E-01 **U**
2/6/2019	1.88E-02 ± 4.83E-01 **U**
2/13/2019	-3.33E-01 ± 3.57E-01 **U**
2/19/2019	1.05E-01 ± 3.57E-01 **U**
2/27/2019	4.52E-01 ± 4.90E-01 **U**
3/6/2019	5.96E-01 ± 5.65E-01 **U**
3/13/2019	2.79E-01 ± 5.59E-01 **U**
3/20/2019	-2.79E-01 ± 4.69E-01 **U**
3/27/2019	4.23E-01 ± 5.48E-01 **U**
4/3/2019	-1.79E-01 ± 4.54E-01 **U**
4/10/2019	-1.91E-01 ± 4.22E-01 **U**
4/17/2019	1.41E-01 ± 5.12E-01 **U**
4/24/2019	2.41E-01 ± 5.35E-01 **U**
5/1/2019	2.43E-02 ± 1.99E-01 **U**
5/8/2019	-1.24E-01 ± 5.51E-01 **U**
5/15/2019	1.34E-01 ± 3.31E-01 **U**
5/22/2019	1.66E-01 ± 5.60E-01 **U**
5/29/2019	1.57E-01 ± 5.18E-01 **U**
6/5/2019	-2.35E-01 ± 4.01E-01 **U**
6/12/2019	-1.61E-01 ± 4.45E-01 **U**
6/19/2019	-1.12E+00 ± 3.44E-01 **U**
6/26/2019	-3.36E-01 ± 3.17E-01 **U**
7/3/2019	-1.54E+00 ± 4.16E-01 **U**

M-14 City of Minneapolis	Iodine-131 (pCi/L)
7/11/2019	-1.79E-01 ± 5.52E-01 **U**
7/17/2019	-4.64E-01 ± 4.82E-01 **U**
7/24/2019	3.91E-01 ± 5.40E-01 **U**
7/31/2019	5.43E-01 ± 5.84E-01 **U**
8/7/2019	-8.49E-01 ± 3.98E-01 **U**
8/14/2019	-2.47E-01 ± 4.47E-01 **U**
8/21/2019	1.33E-01 ± 4.54E-01 **U**
8/27/2019	-7.05E-02 ± 1.52E+00 **U**
9/4/2019	7.55E-02 ± 5.58E-01 **U**
9/11/2019	3.30E-01 ± 4.38E-01 **U**
9/18/2019	2.10E-01 ± 4.27E-01 **U**
9/25/2019	-1.63E-01 ± 2.90E-01 **U**
10/2/2019	-2.54E-01 ± 2.23E-01 **U**
10/9/2019	4.14E-01 ± 5.21E-01 **U**
10/16/2019	-7.84E-02 ± 4.65E-01 **U**
10/23/2019	-2.36E-01 ± 3.30E-01 **U**
10/30/2019	-1.53E-01 ± 5.16E-01 **U**
11/6/2019	2.59E-01 ± 5.57E-01 **U**
11/13/2019	3.68E-01 ± 5.50E-01 **U**
11/20/2019	1.33E-01 ± 4.50E-01 **U**
11/26/2019	5.69E-02 ± 3.15E-01 **U**
12/4/2019	7.09E-01 ± 4.68E-01 **U**
12/11/2019	9.20E-01 ± 5.88E-01 **U**
12/18/2019	-3.56E-02 ± 4.78E-01 **U**
12/26/2019	5.90E-01 ± 5.17E-01 **U**

WATER – GROUNDWATER: GAMMA ISOTOPIC

M-11 City of Monticello	Qtr 1 (pCi/L)	Qtr 2 (pCi/L)	Qtr 3 (pCi/L)	Qtr 4 (pCi/L)
Barium-140	1.22 ± 4.97 U	0.181 ± 5.94 U	-2.35 ± 6.33 U	7.33 ± 4.61 U
Cerium-144	-3.31 ± 6.41 U	-3.69 ± 6.37 U	0.0441 ± 5.29 U	4.52 ± 5.41 U
Cesium-134	0.462 ± 1.06 U	0.278 ± 0.889 U	0.142 ± 0.863 U	-0.62 ± 0.882 U
Cesium-137	0.454 ± 1.02 U	-0.451 ± 0.907 U	-1.05 ± 1.98 U	-0.45 ± 0.756 U
Cobalt-58	-0.862 ± 0.962 U	-0.433 ± 0.79 U	0.515 ± 0.826 U	-0.422 ± 0.826 U
Cobalt-60	0.469 ± 0.95 U	-0.306 ± 0.922 U	-0.0326 ± 0.823 U	0.518 ± 0.842 U
Iodine-131 [1]	1.61 ± 1.85 U	(1)	(1)	(1)
Iron-59	-0.759 ± 2.34 U	0.305 ± 1.94 U	-0.27 ± 1.51 U	-1.05 ± 1.6 U
Lanthanum-140	0.493 ± 1.79 U	0.713 ± 1.99 U	-0.5 ± 1.58 U	-0.471 ± 1.69 U
Manganese-54	-0.363 ± 0.965 U	0.308 ± 0.894 U	-0.53 ± 0.848 U	0.404 ± 0.768 U
Niobium-95	0.0192 ± 1.03 U	-1.12 ± 1.73 U	-0.164 ± 0.834 U	-0.0995 ± 0.906 U
Zinc-65	-2.3 ± 2.16 U	0.461 ± 1.87 U	0.0783 ± 1.63 U	-0.387 ± 1.62 U
Zirconium-95	0.855 ± 1.8 U	0.89 ± 1.5 U	-0.307 ± 1.56 U	-0.0617 ± 1.42 U

[1] I-131 analysis not required

M-12 Plant Well #11	Qtr 1 (pCi/L)	Qtr 2 (pCi/L)	Qtr 3 (pCi/L)	Qtr 4 (pCi/L)
Barium-140	-4.8 ± 6.91 U	1.2 ± 5.74 U	-1.77 ± 5.62 U	3.11 ± 7.95 U
Cerium-144	-3.67 ± 6.98 U	0.826 ± 5.77 U	-1.93 ± 6.68 U	1.53 ± 6.07 U
Cesium-134	-0.523 ± 1.08 U	-0.278 ± 0.849 U	0.727 ± 1.09 U	0.346 ± 0.863 U
Cesium-137	-0.155 ± 1.03 U	0.205 ± 1.67 U	-0.023 ± 1.19 U	0.649 ± 0.811 U
Cobalt-58	-1.53 ± 4.97 U	0.317 ± 0.816 U	-0.718 ± 0.96 U	0.92 ± 0.767 U
Cobalt-60	-0.177 ± 1 U	-1.99 ± 2.03 U	-0.338 ± 0.916 U	0.168 ± 0.753 U
Iodine-131 [1]	-0.0267 ± 2.81 U	(1)	(1)	(1)
Iron-59	2.06 ± 2.16 U	-0.592 ± 1.81 U	0.565 ± 1.95 U	-0.489 ± 1.63 U
Lanthanum-140	-2.02 ± 2.23 U	0.00665 ± 2.38 U	0.913 ± 1.96 U	0.0205 ± 1.51 U
Manganese-54	-0.598 ± 1.42 U	1.31 ± 1.33 UI	-0.238 ± 0.929 U	0.581 ± 0.827 U
Niobium-95	0.842 ± 1.14 U	0.186 ± 0.853 U	-0.372 ± 1.44 U	-0.547 ± 0.856 U
Zinc-65	0.0957 ± 2.38 U	0.837 ± 1.8 U	0.931 ± 1.96 U	1 ± 1.64 U
Zirconium-95	-0.0184 ± 1.79 U	1.9 ± 1.56 U	2.54 ± 1.64 U	0.642 ± 1.53 U

[1] I-131 analysis not required

M-43 Imholte Farm	Qtr 1 (pCi/L)	Qtr 2 (pCi/L)	Qtr 3 (pCi/L)	Qtr 4 (pCi/L)
Barium-140	-3.57 ± 4.87 U	-2.23 ± 7.14 U	0.665 ± 5.37 U	1.68 ± 4.63 U
Cerium-144	0.0956 ± 7.41 U	-5.93 ± 8.98 U	-0.55 ± 7.36 U	0.824 ± 5.39 U
Cesium-134	0.335 ± 1.08 U	0.201 ± 1.07 U	-0.119 ± 1.08 U	0.556 ± 0.988 U
Cesium-137	0.07 ± 1.03 U	0.347 ± 1.02 U	0.591 ± 1.07 U	0.118 ± 0.832 U
Cobalt-58	-0.941 ± 1.18 U	-0.749 ± 1.04 U	-0.0469 ± 0.979 U	0.252 ± 0.811 U
Cobalt-60	1.25 ± 1.23 U	0.102 ± 1.01 U	0.612 ± 1.27 U	0.569 ± 0.804 U
Iodine-131 [1]	0.727 ± 1.91 U	(1)	(1)	(1)
Iron-59	1.42 ± 1.97 U	-0.941 ± 2.14 U	-0.194 ± 2.14 U	0.236 ± 1.7 U
Lanthanum-140	0.685 ± 1.88 U	-0.541 ± 2.26 U	0.747 ± 1.92 U	-0.69 ± 1.67 U
Manganese-54	-0.418 ± 0.95 U	-0.476 ± 1.08 U	0.492 ± 1.01 U	0.053 ± 0.799 U
Niobium-95	-0.0978 ± 1.16 U	0.32 ± 0.942 U	-1.34 ± 1.89 U	0.397 ± 0.901 U
Zinc-65	0.238 ± 2.27 U	-1.19 ± 1.99 U	1.92 ± 2.24 U	-1.68 ± 1.9 U
Zirconium-95	0.238 ± 1.81 U	-0.368 ± 1.79 U	-0.438 ± 1.64 U	-0.374 ± 1.58 U

[1] I-131 analysis not required

M-55 Hasbrouck Residence	Qtr 1 (pCi/L)	Qtr 2 (pCi/L)	Qtr 3 (pCi/L)	Qtr 4 (pCi/L)
Barium-140	-3.37 ± 5.59 U	3.18 ± 5.53 U	4.03 ± 6.15 U	-0.308 ± 5.24 U
Cerium-144	6.33 ± 6.73 U	-2.43 ± 5.36 U	3.07 ± 5.83 U	1.95 ± 6.76 U
Cesium-134	0.0915 ± 1.06 U	-1.23 ± 1.36 U	-0.657 ± 0.856 U	0.105 ± 0.946 U
Cesium-137	-0.76 ± 1.07 U	0.379 ± 0.927 U	0.723 ± 0.945 U	0.565 ± 0.942 U
Cobalt-58	-1.35 ± 1.02 U	-0.302 ± 0.849 U	0.116 ± 0.818 U	-0.511 ± 0.922 U
Cobalt-60	-0.025 ± 1.03 U	0.172 ± 0.827 U	0.558 ± 1.11 U	-0.439 ± 0.902 U
Iodine-131 [1]	0.816 ± 1.95 U	(1)	(1)	(1)
Iron-59	-0.537 ± 2.07 U	0.0598 ± 1.95 U	-1.08 ± 1.79 U	-1.23 ± 1.87 U
Lanthanum-140	-1.78 ± 1.95 U	-0.293 ± 1.86 U	-0.51 ± 1.61 U	-2.78 ± 3.89 U
Manganese-54	-0.135 ± 1.08 U	0.677 ± 1.3 U	0.153 ± 1.21 U	-0.605 ± 0.952 U
Niobium-95	0.193 ± 1.07 U	0.475 ± 0.864 U	0.0968 ± 0.896 U	-0.285 ± 1.02 U
Zinc-65	0.354 ± 2.1 U	-0.408 ± 2.07 U	-0.83 ± 1.76 U	-1.39 ± 1.96 U
Zirconium-95	0.0692 ± 1.85 U	0.495 ± 1.56 U	0.79 ± 1.43 U	0.416 ± 1.76 U

[1] I-131 analysis not required

WATER - DRINKING: GAMMA ISOTOPIC

M-14 City of Minneapolis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Barium-140	1.470 ± 11.500 U	2.060 ± 13.900 U	4.890 ± 17.600 U	7.600 ± 28.500 U	-0.130 ± 7.720 U	-0.640 ± 6.900 U	6.190 ± 22.000 U	-0.600 ± 63.500 U	3.830 ± 9.790 U	-3.030 ± 19.200 U	24.700 ± 52.400 [1] X	-2.090 ± 13.700 U
Cerium-144	1.970 ± 5.340 U	4.210 ± 4.820 U	-1.880 ± 6.000 U	-2.910 ± 6.470 U	-1.110 ± 4.680 U	-5.670 ± 5.530 U	0.460 ± 5.410 U	-3.300 ± 5.070 U	-2.070 ± 6.990 U	3.490 ± 6.700 U	-5.030 ± 11.100 U	2.180 ± 4.960 U
Cesium-134	-0.415 ± 0.714 U	0.285 ± 0.761 U	-0.932 ± 0.966 U	1.520 ± 1.510 U	0.117 ± 0.783 U	0.052 ± 0.858 U	-0.130 ± 1.220 U	0.357 ± 1.560 U	-0.432 ± 0.972 U	-0.891 ± 0.985 U	-2.310 ± 1.900 U	0.776 ± 0.757 U
Cesium-137	0.042 ± 0.720 U	1.030 ± 1.830 U	0.333 ± 0.829 U	-1.120 ± 1.840 U	0.018 ± 0.807 U	-0.066 ± 0.780 U	0.092 ± 1.160 U	0.512 ± 1.500 U	0.068 ± 0.971 U	0.317 ± 0.898 U	-3.410 ± 2.890 U	0.550 ± 0.701 U
Cobalt-58	0.076 ± 0.774 U	-0.243 ± 0.934 U	-0.389 ± 1.030 U	-0.217 ± 1.270 U	-0.264 ± 0.793 U	0.302 ± 0.825 U	0.308 ± 1.260 U	0.842 ± 1.030 U	-0.598 ± 1.050 U	-0.070 ± 1.220 U	-2.410 ± 2.390 U	0.844 ± 0.844 U
Cobalt-60	0.305 ± 0.721 U	0.417 ± 0.753 U	-3.080 ± 2.890 U	1.610 ± 1.000 U	0.045 ± 0.802 U	-0.645 ± 0.785 U	0.095 ± 1.150 U	-0.197 ± 0.655 U	-0.297 ± 0.912 U	0.221 ± 1.030 U	1.440 ± 1.610 U	-0.119 ± 0.720 U
Iron-59	0.448 ± 1.910 U	0.004 ± 2.190 U	1.350 ± 2.790 U	0.886 ± 3.060 U	-0.262 ± 1.800 U	-0.304 ± 2.140 U	1.120 ± 3.470 U	-1.080 ± 2.580 U	1.710 ± 2.220 U	2.900 ± 2.650 U	-0.247 ± 5.360 U	-1.390 ± 2.070 U
Lanthanum-140	1.390 ± 3.850 U	-5.480 ± 4.420 U	5.330 ± 6.420 U	-8.150 ± 10.500 U	-1.220 ± 2.450 U	-0.938 ± 2.380 U	-2.220 ± 6.310 U	4.000 ± 11.600 U	-1.610 ± 3.160 U	-1.310 ± 7.520 U	-13.800 ± 17.800 U	-0.533 ± 5.300 U
Manganese-54	0.192 ± 0.663 U	-1.070 ± 1.550 U	-0.378 ± 0.859 U	-0.484 ± 0.940 U	0.039 ± 0.679 U	-0.563 ± 0.793 U	-0.063 ± 1.720 U	-0.132 ± 0.713 U	-0.181 ± 0.955 U	-0.328 ± 0.873 U	0.044 ± 1.790 U	0.482 ± 0.712 U
Niobium-95	1.630 ± 1.730 UI	0.154 ± 0.965 U	0.521 ± 1.180 U	0.413 ± 1.380 U	1.360 ± 1.390 UI	0.177 ± 0.944 U	0.636 ± 1.290 U	0.120 ± 1.110 U	-0.276 ± 1.070 U	-2.020 ± 2.840 U	-0.544 ± 2.270 U	-0.956 ± 1.600 U
Zinc-65	0.553 ± 1.550 U	-0.017 ± 1.490 U	0.831 ± 1.950 U	0.142 ± 1.980 U	1.870 ± 1.670 U	0.196 ± 1.710 U	-1.230 ± 2.330 U	-0.183 ± 1.630 U	1.990 ± 2.180 U	-0.478 ± 2.240 U	-1.490 ± 3.530 U	0.513 ± 1.610 U
Zirconium-95	-0.369 ± 1.560 U	0.603 ± 1.520 U	-1.070 ± 2.280 U	0.101 ± 2.220 U	0.135 ± 1.430 U	0.971 ± 1.660 U	0.853 ± 2.390 U	1.160 ± 1.990 U	0.795 ± 1.920 U	1.750 ± 2.050 U	0.552 ± 4.350 U	0.280 ± 1.630 U

[1] Positive Ba-140 results were due to analytical deviations rather than actual detection of plant related material. La-140 was not detected in any of the water samples. In some cases, the required LLD was not met for Ba-La-140. See Section 7.5 for further details.

WATER - SURFACE: GAMMA ISOTOPIC

M-8 Upstream of plant

pCi/L	Jan[1]	Feb[1]	Mar[1]	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov[2]	Dec[1]
Barium-140	-	-	-	6.790 ± 29.700 U	7.840 ± 8.230 U	-0.517 ± 7.030 U	1.880 ± 11.600 U	54.800 ± 47.600 [3] X	1.680 ± 11.600 U	-21.400 ± 19.400 U	46.200 ± 47.100 [3]	-
Cerium-144	-	-	-	6.280 ± 7.600 U	2.980 ± 6.130 U	2.720 ± 5.610 U	2.240 ± 5.720 U	-0.913 ± 5.740 U	-3.060 ± 7.270 U	0.495 ± 6.310 U	0.972 ± 5.180 U	-
Cesium-134	-	-	-	-0.989 ± 1.440 U	-0.331 ± 0.830 U	-0.413 ± 0.870 U	0.316 ± 0.891 U	0.443 ± 0.962 U	-1.370 ± 1.060 U	0.450 ± 0.935 U	0.802 ± 0.801 U	-
Cesium-137	-	-	-	0.158 ± 0.786 U	0.492 ± 0.851 U	0.596 ± 0.861 U	-0.342 ± 0.826 U	1.310 ± 0.810 U	0.053 ± 0.979 U	1.300 ± 1.520 U	-0.063 ± 0.755 U	-
Cobalt-58	-	-	-	0.302 ± 1.140 U	0.118 ± 1.270 U	0.544 ± 0.875 U	-0.580 ± 0.893 U	-0.903 ± 1.190 U	0.725 ± 1.210 U	0.473 ± 1.090 U	0.395 ± 1.080 U	-
Cobalt-60	-	-	-	0.229 ± 0.965 U	0.294 ± 0.901 U	-0.436 ± 0.970 U	0.403 ± 0.807 U	0.973 ± 0.868 U	-0.642 ± 1.760 U	1.340 ± 0.910 U	0.147 ± 0.844 U	-
Iron-59	-	-	-	-1.820 ± 3.060 U	3.410 ± 5.190 U	-1.550 ± 2.190 U	-1.710 ± 5.270 U	-2.440 ± 3.610 U	-1.230 ± 3.170 U	0.448 ± 2.770 U	-0.446 ± 3.050 U	-
Lanthanum-140	-	-	-	-1.950 ± 9.320 U	-0.874 ± 2.770 U	-1.280 ± 2.390 U	2.060 ± 3.790 U	1.400 ± 14.700 U	-0.395 ± 3.740 U	-3.650 ± 6.950 U	-2.010 ± 16.700 U	-
Manganese-54	-	-	-	0.875 ± 0.887 U	0.897 ± 1.340 U	-0.323 ± 0.835 U	0.102 ± 0.792 U	-0.358 ± 0.835 U	0.468 ± 0.973 U	0.344 ± 0.897 U	-0.388 ± 1.340 U	-
Niobium-95	-	-	-	0.937 ± 2.300 U	0.491 ± 1.040 U	-0.648 ± 0.943 U	-0.228 ± 0.990 U	2.470 ± 2.450 UI	-0.643 ± 1.140 U	0.400 ± 1.100 U	-2.070 ± 2.210 U	-
Zinc-65	-	-	-	-0.703 ± 2.030 U	1.120 ± 1.980 U	-1.900 ± 2.240 U	0.913 ± 1.700 U	0.116 ± 2.150 U	-0.510 ± 2.530 U	1.860 ± 2.800 U	-0.056 ± 1.980 U	-
Zirconium-95	-	-	-	2.240 ± 2.160 U	0.022 ± 1.610 U	-0.188 ± 1.530 U	-1.140 ± 1.660 U	1.680 ± 2.350 U	-0.484 ± 1.980 U	-1.090 ± 2.150 U	-0.983 ± 2.100 U	-

Notes:

[1] Sample unavailable because unsafe condition for sampling due to river surface being frozen.

[2] Sample collection November 1 – 6th, 2019, sample unavailable because river surface was frozen.

[3] Positive Ba-140 results were due to analytical deviations rather than actual detection of plant related material. La-140 was not detected in any of the water samples. In some cases, the required LLD was not met for Ba-La-140. See Section 7.5 for further details.

M-9 Downstream of plant

pCi/L	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Barium-140	5.660 ± 10.300 U	-5.260 ± 27.900 U	1.020 ± 16.400 U	28.50 ± 26.30 U	3.200 ± 14.40 U	1.450 ± 6.670 U	-0.551 ± 10.200 U	28.400 ± 38.700 [1] X	5.140 ± 12.600 U	0.688 ± 13.600 U	-0.400 ± 16.100 U	-1.950 ± 14.800 U
Cerium-144	-2.250 ± 4.850 U	0.468 ± 5.180 U	0.818 ± 5.230 U	0.171 ± 5.770 U	8.660 ± 7.730 UI	1.810 ± 5.480 U	2.690 ± 4.820 U	1.830 ± 6.800 U	2.290 ± 7.290 U	2.830 ± 4.550 U	0.865 ± 4.980 U	-2.100 ± 6.220 U
Cesium-134	0.081 ± 0.757 U	0.241 ± 0.802 U	1.360 ± 0.964 U	1.380 ± 1.060 U	0.005 ± 0.912 U	0.485 ± 0.885 U	-0.454 ± 1.590 U	-0.053 ± 0.955 U	-0.081 ± 1.300 U	0.308 ± 0.718 U	0.688 ± 0.860 U	0.985 ± 0.979 U
Cesium-137	-0.504 ± 0.715 U	1.190 ± 1.340 UI	-0.142 ± 0.830 U	0.425 ± 0.832 U	0.360 ± 0.831 U	0.091 ± 0.867 U	0.252 ± 0.765 U	-1.100 ± 1.810 U	0.866 ± 1.170 U	-0.073 ± 0.681 U	1.610 ± 1.060 UI	-0.051 ± 0.829 U
Cobalt-58	-0.839 ± 0.835 U	-0.539 ± 0.875 U	-0.607 ± 1.060 U	-1.010 ± 1.160 U	-0.166 ± 0.907 U	-0.046 ± 0.918 U	0.512 ± 1.410 U	-0.240 ± 1.230 U	-0.100 ± 1.340 U	-0.200 ± 0.838 U	-0.266 ± 0.880 U	-0.822 ± 1.080 U
Cobalt-60	-0.252 ± 0.727 U	-0.195 ± 0.804 U	0.141 ± 0.987 U	0.556 ± 0.939 U	-0.237 ± 0.901 U	0.971 ± 0.830 U	-0.227 ± 0.790 U	-1.320 ± 1.040 U	-0.913 ± 1.080 U	0.185 ± 0.681 U	0.376 ± 0.770 U	-0.220 ± 0.757 U
Iron-59	0.781 ± 1.960 U	0.881 ± 1.990 U	-0.552 ± 3.160 U	2.080 ± 2.960 U	0.729 ± 2.080 U	0.133 ± 1.910 U	-0.983 ± 2.390 U	1.230 ± 3.580 U	-0.433 ± 2.970 U	-2.340 ± 2.050 U	1.270 ± 2.390 U	3.370 ± 3.110 UI
Lanthanum-140	-2.940 ± 3.960 U	-2.930 ± 5.080 U	0.403 ± 6.770 U	-2.990 ± 9.960 U	-0.935 ± 2.940 U	-1.720 ± 2.210 U	-2.540 ± 3.440 U	-11.700 ± 13.300 U	0.437 ± 4.860 U	2.080 ± 4.810 U	-4.640 ± 5.260 U	-0.766 ± 5.370 U
Manganese-54	0.041 ± 0.669 U	-0.344 ± 0.651 U	0.083 ± 0.945 U	-0.044 ± 0.864 U	0.388 ± 0.798 U	0.164 ± 0.891 U	0.718 ± 0.745 U	-0.467 ± 0.924 U	-1.470 ± 1.720 U	0.177 ± 0.785 U	-0.657 ± 0.738 U	-0.070 ± 0.855 U
Niobium-95	-1.340 ± 1.540 U	-1.660 ± 1.530 U	0.427 ± 1.150 U	0.506 ± 1.230 U	-0.436 ± 0.980 U	1.170 ± 1.190 U	0.981 ± 0.917 U	1.310 ± 1.390 U	-0.197 ± 1.350 U	-0.127 ± 0.884 U	-0.728 ± 1.000 U	-0.102 ± 1.080 U
Zinc-65	0.296 ± 1.510 U	0.553 ± 1.650 U	0.843 ± 2.130 U	-0.611 ± 2.030 U	-0.186 ± 1.930 U	-0.262 ± 1.620 U	-0.642 ± 1.880 U	-2.640 ± 3.800 U	-2.560 ± 2.580 U	-1.710 ± 1.590 U	-0.762 ± 1.780 U	-0.083 ± 1.930 U
Zirconium-95	0.158 ± 1.450 U	0.964 ± 1.650 U	2.710 ± 2.480 U	-0.720 ± 2.140 U	-1.480 ± 1.680 U	2.470 ± 2.520 U	0.237 ± 1.570 U	-0.063 ± 2.420 U	1.010 ± 2.370 U	0.357 ± 1.500 U	-0.252 ± 1.720 U	-1.350 ± 1.890 U

[1] Positive Ba-140 results were due to analytical deviations rather than actual detection of plant related material. La-140 was not detected in any of the water samples. In some cases, the required LLD was not met for Ba-La-140. See Section 7.5 for further details.

Data below was analyzed Environmental Dosimetry Company (EDC). The results reported relate only to the items tested and to the sample as received by the laboratory. The raw TLD results are corrected for individual element sensitivity and reader sensitivity and determined by QC results. Transit exposures are subtracted and the fade of the thermoluminescent response is compensated. Abbreviations

ISFSI	Independent Spent Fuel Storage Installation
TLD	Thermoluminescent Dosimeter
mR/Std. Qtr	Millirem per standard quarter (91 days)

DIRECT RADIATION – TLD: GAMMA

mrem/91 day		Qtr 1	Qtr 2	Qtr 3	Qtr 4
Control					
M01C	Kirchenbauer Farm	12.6 ± 0.7	11.8 ± 0.9	14.4 ± 0.8	12.9 ± 0.7
M02C	Cty Rd 4 & 15	12.1 ± 0.6	(1)	13.5 ± 0.6	12.0 ± 0.6
M03C	Cty Rd 19 & Jason Ave	13.0 ± 0.6	13.9 ± 0.9	14.9 ± 0.8	12.9 ± 0.6
M04C	Maple Lake Water Tower	13.4 ± 1.0	12.9 ± 1.0	14.2 ± 0.7	12.6 ± 0.8
Inner					
M01A	Sherburne Ave. So.	13.5 ± 0.6	13.6 ± 0.9	15.2 ± 0.8	13.8 ± 0.9
M02A	Sherburne Ave. So.	13.7 ± 0.7	13.3 ± 1.0	15.5 ± 0.8	(2)
M03A	Sherburne Ave. So.	11.7 ± 0.6	14.3 ± 1.2	14.7 ± 0.8	12.9 ± 0.6
M04A	Biology Station Rd.	12.8 ± 0.7	12.3 ± 0.8	14.7 ± 1.0	13.1 ± 0.9
M05A	Biology Station Rd.	12.3 ± 0.8	12.1 ± 0.9	14.7 ± 0.9	13.6 ± 0.8
M06A	Biology Station Rd.	13.3 ± 0.7	13.7 ± 1.1	15.6 ± 1.0	14.2 ± 0.9
M07A	Parking Lot H	12.6 ± 0.6	13.1 ± 1.0	15.1 ± 0.8	13.9 ± 0.9
M08A	Parking Lot F	12.6 ± 0.6	13.8 ± 1.1	15.1 ± 0.7	14.4 ± 0.8
M09A	County Road 75	13.2 ± 0.7	13.7 ± 1.1	15.5 ± 1.0	14.1 ± 0.9
M10A	County Road 75	12.8 ± 0.7	12.5 ± 1.0	14.1 ± 1.0	13.8 ± 0.8
M11A	County Road 75	13.8 ± 0.8	14.2 ± 0.9	15.9 ± 0.7	14.4 ± 0.9
M12A	County Road 75	13.3 ± 0.6	13.1 ± 0.8	14.8 ± 0.7	14.1 ± 0.7
M13A	North Boundary Rd.	13.1 ± 0.8	13.7 ± 1.0	15.1 ± 0.7	13.7 ± 0.6
M14A	North Boundary Rd.	12.2 ± 0.8	13.8 ± 0.9	16.1 ± 0.8	14.1 ± 0.8
Outer					
M01B	117th Street	12.5 ± 0.7	12.6 ± 0.9	14.4 ± 0.8	13.4 ± 0.9
M02B	County Road 11	13.4 ± 0.9	13.2 ± 1.0	15.6 ± 1.0	14.2 ± 0.8
M03B	County Rd. 73 & 81	11.1 ± 0.7	10.3 ± 0.8	13.2 ± 0.7	11.5 ± 0.6
M04B	County Rd. 73 (196th Street)	11.9 ± 0.7	12.8 ± 0.8	14.5 ± 1.0	12.9 ± 0.7
M05B	City of Big Lake	13.2 ± 0.8	15.0 ± 1.1	14.8 ± 0.9	13.8 ± 0.9
M06B	County Rd 14 & 196th Street	11.0 ± 0.6	13.7 ± 1.0	15.1 ± 0.7	13.2 ± 0.8
M07B	Monticello Industrial Dr.	13.5 ± 0.6	13.6 ± 0.9	14.8 ± 0.6	14.2 ± 0.7
M08B	Residence Hwy 25 & Davidson Ave	13.3 ± 0.6	12.7 ± 0.9	13.5 ± 0.7	12.9 ± 0.7
M09B	Weinand Farm	13.3 ± 0.9	14.7 ± 1.1	15.5 ± 0.9	15.0 ± 1.0
M10B	Reisewitz Farm - Acacia Ave	12.4 ± 0.7	13.3 ± 0.9	14.9 ± 0.7	13.7 ± 0.6

mrem/91 day	Qtr 1	Qtr 2	Qtr 3	Qtr 4
M11B Vanlith Farm - 97th Ave	13.1 ± 0.8	14.4 ± 1.2	15.2 ± 1.2	14.8 ± 0.9
M12B Lake Maria St. Park	12.8 ± 0.7	(3)	15.1 ± 0.9	14.1 ± 0.8
M13B Bridgewater Sta.	13.8 ± 0.8	13.1 ± 1.0	14.8 ± 0.9	14.0 ± 0.9
M14B Anderson Res. - Cty Rd 111	14.3 ± 0.9	15.9 ± 1.1	16.0 ± 0.8	15.8 ± 0.8
M15B Red Oak Wild Bird Farm	(4)	13.2 ± 0.9	14.0 ± 0.9	13.9 ± 0.9
M16B University Ave and Hancock St, Becker	13.1 ± 0.5	12.3 ± 1.0	14.1 ± 0.9	13.4 ± 0.9
Special Interest				
I-11 OCA Fence South, on exit road	13.6 ± 0.6	13.7 ± 1.0	14.9 ± 0.7	14.3 ± 0.7
I-12 OCA Fence Middle, on exit road	13.1 ± 0.5	13.8 ± 0.9	14.7 ± 0.9	14.8 ± 0.7
I-13 OCA Fence North, on exit road	15.0 ± 1.0	13.4 ± 1.0	15.2 ± 0.9	15.1 ± 0.7
M01S 127th St. NE	11.6 ± 0.9	10.6 ± 0.8	12.9 ± 0.6	11.4 ± 1.0
M02S Krone Residence	12.8 ± 0.8	11.9 ± 0.8	13.0 ± 1.0	12.1 ± 0.8
M03S Big Oaks Park	13.2 ± 0.8	13.4 ± 0.9	15.2 ± 0.9	13.9 ± 0.9
M04S Pinewood School	13.9 ± 0.9	13.8 ± 1.0	15.4 ± 0.7	15.0 ± 0.8
M05S 20500 Co. Rd 11, Big Lake	13.6 ± 0.8	13.5 ± 0.9	14.9 ± 0.9	13.3 ± 0.9
M06S Monticello Public Works	14.7 ± 0.7	13.8 ± 1.1	15.9 ± 0.6	15.0 ± 1.1

Notes:

[1] TLD was damaged by lawn mowing equipment. (Condition Report 501000029403)
[2] TLD was missing in the field. (Condition Report 501000036267)
[3] TLD was missing in the field. (Condition Report 501000029403)
[4] TLD was missing in the field. (Condition Report 501000025016)

DIRECT RADIATION – ISFSI: GAMMA

mrem/91 day	Type	Qtr1	Qtr2	Qtr3	Qtr4
I-01 NE corner of ISFSI	Gamma	38.1 ± 2.3	35.0 ± 2.3	41.5 ± 2.0	40.3 ± 4.1
I-02 North side of ISFSI, center	Gamma	34.0 ± 2.1	31.7 ± 2.3	34.0 ± 2.3	37.0 ± 2.1
I-03 NW corner of ISFSI	Gamma	31.5 ± 1.6	30.2 ± 3.7	32.1 ± 2.1	32.2 ± 2.3
I-04 West side of ISFSI, middle	Gamma	86.3 ± 12.9	86.7 ± 8.1	82.0 ± 6.2	103.7 ± 19.3
I-05 West side of ISFSI, at center of array	Gamma	52.4 ± 2.3	57.6 ± 4.6	54.6 ± 5.6	56.9 ± 4.5
I-06 SW corner of ISFSI	Gamma	29.7 ± 1.0	28.6 ± 2.5	30.3 ± 2.1	34.3 ± 3.9
I-07 South side of ISFSI, center	Gamma	34.2 ± 3.3	32.4 ± 3.5	33.4 ± 2.2	34.7 ± 3.6
I-08 SE corner of ISFSI	Gamma	33.5 ± 3.0	32.8 ± 2.3	33.5 ± 3.6	32.2 ± 2.4
I-09 East side of ISFSI, at center of array	Gamma	64.8 ± 3.6	69.3 ± 5.0	61.2 ± 4.7	68.7 ± 5.9
I-10 East side of ISFSI, middle	Gamma	81.3 ± 4.7	94.9 ± 13.4	84.4 ± 5.2	90.1 ± 7.2

APPENDIX A

GEL 2019 ANNUAL ENVIRONMENTAL QA REPORT

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2019 ANNUAL QUALITY ASSURANCE REPORT

FOR THE

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

2019 ANNUAL QUALITY ASSURANCE REPORT

FOR THE

RADIOLOGICAL ENVIRONMENTAL

MONITORING PROGRAM (REMP)

Approved By ______________________ February 28, 2020
Robert L. Pullano Date
Director, Quality Systems

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2019 ANNUAL QUALITY ASSURANCE REPORT FOR THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

1. Introduction

GEL Laboratories, LLC (GEL) is a privately owned environmental laboratory dedicated to providing personalized client services of the highest quality. GEL was established as an analytical testing laboratory in 1981. Now a full service lab, our analytical divisions use state of the art equipment and methods to provide a comprehensive array of organic, inorganic, and radiochemical analyses to meet the needs of our clients.

At GEL, quality is emphasized at every level of personnel throughout the company. Management's ongoing commitment to good professional practice and to the quality of our testing services to our customers is demonstrated by their dedication of personnel and resources to develop, implement, assess, and improve our technical and management operations.

The purpose of GEL's quality assurance program is to establish policies, procedures, and processes to meet or exceed the expectations of our clients. To achieve this, all personnel that support these services to our clients are introduced to the program and policies during their initial orientation, and annually thereafter during company-wide training sessions.

GEL's primary goals are to ensure that all measurement data generated are scientifically and legally defensible, of known and acceptable quality per the data quality objectives (DQOs), and thoroughly documented to provide sound support for environmental decisions. In addition, GEL continues to ensure compliance with all contractual requirements, environmental standards, and regulations established by local, state and federal authorities.

GEL administers the QA program in accordance with the Quality Assurance Plan, GL-QS-B-001. Our Quality Systems include all quality assurance (QA) policies and quality control (QC) procedures necessary to plan, implement, and assess the work we perform. GEL's QA Program establishes a quality management system (QMS) that governs all of the activities of our organization.

This report entails the quality assurance program for the proficiency testing and environmental monitoring aspects of GEL for 2019. GEL's QA Program is designed to monitor the quality of analytical processing associated with environmental, radiobioassay, effluent (10 CFR Part 50), and waste (10 CFR Part 61) sample analysis.

This report covers the category of Radiological Environmental Monitoring Program (REMP) and includes:

- Intra-laboratory QC results analyzed during 2019.
- Inter-laboratory QC results analyzed during 2019 where known values are available.

2. Quality Assurance Programs for Inter-laboratory, Intra-laboratory and Third Party Cross-Check

In addition to internal and client audits, our laboratory participates in annual performance evaluation studies conducted by independent providers. We routinely participate in the following types of performance audits:

- Proficiency testing and other inter-laboratory comparisons
- Performance requirements necessary to retain Certifications
- Evaluation of recoveries of certified reference and in-house secondary reference materials using statistical process control data.
- Evaluation of relative percent difference between measurements through SPC data.

We also participate in a number of proficiency testing programs for federal and state agencies and as required by contracts. It is our policy that no proficiency evaluation samples be analyzed in any special manner. Our annual performance evaluation participation generally includes a combination of studies that support the following:

- US Environmental Protection Agency Discharge Monitoring Report, Quality Assurance Program (DMR-QA). Annual national program sponsored by EPA for laboratories engaged in the analysis of samples associated with the NPDES monitoring program. Participation is mandatory for all holders of NPDES permits. The permit holder must analyze for all of the parameters listed on the discharge permit. Parameters include general chemistry, metals, BOD/COD, oil and grease, ammonia, nitrates, etc.

- Department of Energy Mixed Analyte Performance Evaluation Program (MAPEP). A semiannual program developed by DOE in support of DOE contractors performing waste analyses. Participation is required for all laboratories that perform environmental analytical measurements in support of environmental management activities. This program includes radioactive isotopes in water, soil, vegetation and air filters.

- ERA's MRAD-Multimedia Radiochemistry Proficiency test program. This program is for labs seeking certification for radionuclides in wastewater and solid waste. The program is conducted in strict compliance with USEPA National Standards for Water Proficiency study.

- ERA's InterLaB RadCheM Proficiency Testing Program for radiological analyses. This program completes the process of replacing the USEPA EMSL-LV Nuclear Radiation Assessment Division program discontinued in 1998. Laboratories seeking certification for radionuclide analysis in drinking water also use the study. This program is conducted in strict compliance with the USEPA National Standards for Water Proficiency Testing Studies. This program encompasses Uranium by EPA method 200.8 (for drinking water certification in Utah/Primary NELAP), gamma emitters, Gross Alpha/Beta, Iodine-131, naturally occurring radioactive isotopes, Strontium-89/90, and Tritium.

- ERA's Water Pollution (WP) biannual program for waste methodologies includes parameters for both organic and inorganic analytes.

- ERA's Water Supply (WS) biannual program for drinking water methodologies includes parameters for organic and inorganic analytes.

- Environmental Cross-Check Program administered by Eckert & Ziegler Analytics, Inc. This program encompasses radionuclides in water, soil, milk, naturally occurring radioactive isotopes in soil and air filters.

GEL procures single-blind performance evaluation samples from Eckert & Ziegler Analytics to verify the analysis of sample matrices processed at GEL. Samples are received on a quarterly basis. GEL's Third-Party Cross-Check Program provides environmental matrices encountered in a typical nuclear utility REMP. The Third-Party Cross-Check Program is intended to meet or exceed the inter-laboratory comparison program requirements discussed in NRC Regulatory Guide 4.15. Once performance evaluation samples have been prepared in accordance with the instructions provided by the PT provider, samples are managed and analyzed in the same manner as environmental samples from GEL's clients.

3. Quality Assurance Program for Internal and External Audits

During each annual reporting period, at least one internal assessment of each area of the laboratory is conducted in accordance with the pre-established schedule from Standard Operating Procedure for the Conduct of Quality Audits, GL-QS-E-001. The annual internal audit plan is reviewed for adequacy and includes the scheduled frequency and scope of quality control actions necessary to GEL's QA program. Internal audits are conducted at least annually in accordance with a schedule approved by the Quality Systems Director. Supplier audits are contingent upon the categorization of the supplier, and may or may not be conducted prior to the use of a supplier or subcontractor. Type I suppliers and subcontractors, regardless of how they were initially qualified, are re-evaluated at least once every three years.

In addition, prospective customers audit GEL during pre-contract audits. GEL hosts several external audits each year for both our clients and other programs. These programs include environmental monitoring, waste characterization, and radiobioassay. The following list of programs may audit GEL at least annually or up to every three years depending on the program.

- TNI, The NELAC Institute, National Environmental Laboratory Accreditation Program
- DOECAP, U.S. Department of Energy Consolidated Audit Program
- DOELAP, U.S. Department of Energy Laboratory Accreditation Program
- DOE QSAS, U.S. Department of Energy, Quality Systems for Analytical Services
- ISO/IEC 17025:2005
- A2LA, American Association for Laboratory Accreditation
- DoD ELAP, US Department of Defense Environmental Accreditation Program
- NUPIC, Nuclear Procurement Issues Committee
- South Carolina Department of Health and Environmental Control (SC DHEC)

The annual radiochemistry laboratory internal audit (19-RAD-001) was conducted in July and August, 2019. There were no findings or observations and four noteworthy improvements from this assessment.

4. Performance Evaluation Acceptance Criteria for Environmental Sample Analysis

GEL utilized an acceptance protocol based upon two performance models. For those inter-laboratory programs that already have established performance criteria for bias (i.e., MAPEP, and ERA/ELAP), GEL will utilize the criteria for the specific program. For intra-laboratory or third party quality control programs that do not have a specific acceptance criteria (i.e. the Eckert-Ziegler Analytics Environmental Cross-check Program), results will be evaluated in accordance with GEL's internal acceptance criteria.

5. Performance Evaluation Samples

Performance Evaluation (PE) results and internal quality control sample results are evaluated in accordance with GEL acceptance criteria. The first criterion concerns bias, which is defined as the deviation of any one result from the known value. The second criterion concerns precision, which deals with the ability of the measurement to be replicated by comparison of an individual result with the mean of all results for a given sample set.

At GEL, we also evaluate our analytical performance on a regular basis through statistical process control (SPC) acceptance criteria. Where feasible, this criterion is applied to both measures of precision and accuracy and is specific to sample matrix. We establish environmental process control limits at least annually.

For Radiochemistry analysis, quality control evaluation is based on static limits rather than those that are statistically derived. Our current process control limits are maintained in GEL's AlphaLIMS. We also measure precision with matrix duplicates and/or matrix spike duplicates. The upper and lower control limits (UCL and LCL respectively) for precision are plus or minus three times the standard deviation from the mean of a series of relative percent differences. The static precision criteria for radiochemical analyses are 0 - 20%, for activity levels exceeding the contract required detection limit (CRDL).

6. Quality Control Program for Environmental Sample Analysis

GEL's internal QA Program is designed to include QC functions such as instrumentation calibration checks (to insure proper instrument response), blank samples, instrumentation backgrounds, duplicates, as well as overall staff qualification analyses and statistical process controls. Both quality control and qualification analyses samples are used to be as similar as the matrix type of those samples submitted for analysis by the various laboratory clients. These performance test samples (or performance evaluation samples) are either actual sample submitted in duplicate in order to evaluate the precision of laboratory measurements, or fortified blank samples, which have been given a known quantity of a radioisotope that is in the interest to GEL's clients.

Accuracy (or Bias) is measured through laboratory control samples and/or matrix spikes, as well as surrogates and internal standards. The UCLs and LCLs for accuracy are plus or minus three times the standard deviation from the mean of a series of recoveries. The static limit for most radiochemical analyses is 75 - 125%. Specific instructions for out-of-control situations are provided in the applicable analytical SOP.

GEL's Laboratory Control Standard (LCS) is an aliquot of reagent water or other blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements. Some methods may refer to these samples as Laboratory Fortified Blanks (LFB). The requirement for recovery is between 75% and 125% for radiological analyses excluding drinking water matrix.

$$\text{Bias (\%)} = \frac{\text{(observed concentration)}}{\text{(known concentration)}} * 100\ \%$$

Precision is a data quality indicator of the agreement between measurements of the same property, obtained under similar conditions, and how well they conform to themselves. Precision is usually expressed as standard deviation, variance or range in either absolute or relative (percentage) terms.

GEL's laboratory duplicate (DUP or LCSD) is an aliquot of a sample taken from the same container and processed in the same manner under identical laboratory conditions. The aliquot is analyzed independently from the parent sample and the results are compared to measure precision and accuracy.

If a sample duplicate is analyzed, it will be reported as Relative Percent Difference (RPD). The RPD must be 20 percent or less, if both samples are greater than 5 times the MDC. If both results are less than 5 times MDC, then the RPD must be equal to or less than 100%. If one result is above the MDC and the other is below the MDC, then the RPD can be calculated using the MDC for the result of the one below the MDC. The RPD must be 100%

or less. In the situation where both results are above the MDC but one result is greater than 5 times the MDC and the other is less than 5 times the MDC, the RPD must be less than or equal to 20%. If both results are below MDC, then the limits on % RPD are not applicable.

$$\text{Difference (\%)} = \frac{\text{(high duplicate result – low duplicate result)}}{\text{(average of results)}} * 100\ \%$$

7. Summary of Data Results

During 2019, forty-five (45) radioisotopes associated with seven (7) matrix types were analyzed under GEL's Performance Evaluation program in participation with ERA, MAPEP, and Eckert & Ziegler Analytics. Matrix types were representative of client analyses performed during 2019. Of the four hundred twenty-five (425) total results, 97.2% (413 of 425) were found to be acceptable within the PT providers three sigma or other statistical criteria. The list below contains the type of matrix evaluated by GEL.

- Air Filter
- Cartridge
- Water
- Milk
- Soil
- Liquid
- Vegetation

Graphs are provided in Figures 1-9 of this report to allow for the evaluation of trends or biases. These graphs include radioisotopes Cobalt-60, Cesium-137, Tritium, Strontium-90, Gross Alpha, Gross Beta, Iodine-131, Americium-241, and Plutonium-238.

8. Summary of Participation in the Eckert & Ziegler Analytics Environmental Cross-Check Program

Eckert & Ziegler Analytics provided samples for eighty-nine (89) individual environmental analyses. The accuracy of each result reported to Eckert & Ziegler Analytics, Inc. is measured by the ratio of GEL's result to the known value. All results fell within GEL's acceptance criteria (100% within acceptance).

9. Summary of Participation in the MAPEP Monitoring Program

MAPEP Series 40 and 41 were analyzed by the laboratory. Of the one hundred twenty-eight (128) analyses, 98% (126 out of 128) fell within the PT provider's acceptance criteria.

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10. Summary of Participation in the ERA MRaD PT Program

The ERA MRad program provided samples (MRAD-30 and MRAD-31) for one hundred sixty-six (166) individual environmental analyses. Of the 166 analyses, 96% (160 out of 166) fell within the PT provider's acceptance criteria.

11. Summary of Participation in the ERA PT Program

The ERA program provided samples (RAD-116, RAD-117, RAD-118, and 9116) for forty-two (42) individual environmental analyses. Of the 42 analyses, 90% (38 out of 42) fell within the PT provider's acceptance criteria.

All corrective actions are summarized in Table 8.

12. Corrective Action Request and Report (CARR)

There are two categories of corrective action at GEL. One is corrective action implemented at the analytical and data review level in accordance with the analytical SOP. The other is formal corrective action documented by the Quality Systems Team in accordance with GL-QS-E-002. A formal corrective action is initiated when a nonconformance reoccurs or is so significant that permanent elimination or prevention of the problem is required. Formal corrective action investigations include root cause analysis.

GEL includes quality requirements in most analytical standard operating procedures to ensure that data are reported only if the quality control criteria are met or the quality control measures that did not meet the acceptance criteria are documented. A formal corrective action is implemented according to GL-QS-E-002 for Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement. Recording and documentation is performed following guidelines stated in GL-QS-E-012 for Client NCR Database Operation.

Any employee at GEL can identify and report a nonconformance and request that corrective action be taken. Any GEL employee can participate on a corrective action team as requested by the QS team or Group Leaders. The steps for conducting corrective action are detailed in GL-QS-E-002. In the event that correctness or validity of the laboratory's test results in doubt, the laboratory will take corrective action. If investigations show that the results have been impacted, affected clients will be informed of the issue in writing within five (5) calendar days of the discovery.

- CARR190225-1192 documents the unacceptable result of Strontium-89 of ERA Study 116
- CARR190530-1211 documents the unacceptable results of Uranium-238, Uranium-238, Uranium-Mass and Plutonium-238 in vegetation and Uranium-238 in soil of ERA MRAD-30
- CARR 190603-1212 documents the unacceptable result of Iron-55 in soil of MAPEP-40, CARR 190826-1250 documents the unacceptable result of Strontium-89 and Gross Alpha of RAD-118
- CARR 191212-1262 documents the unacceptable result of Lead-212 of MRAD-31
- CARR 191213-1265 documents the unacceptable result of Radium-226 of MAPEP-41

Table 8 provides the status of CARRs for radiological performance testing during 2019. **It has been determined that causes of the unacceptable results did not impact any data reported to our clients.**

13. References

1. GEL Quality Assurance Plan, GL-QS-B-001
2. GEL Standard Operating Procedure for the Conduct of Quality Audits, GL-QS-E-001
3. GEL Standard Operating Procedure for Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement, GL-QS-E-002
4. GEL Standard Operating Procedure for AlphaLIMS Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items, GL-QS-E-004
5. GEL Standard Operating Procedure for Handling Proficiency Evaluation Samples, GL-QS-E-013
6. GEL Standard Operating Procedure for Quality Assurance Measurement Calculations and Processes, GL-QS-E-014
7. 40 CFR Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants
8. ISO/IEC 17025-2017, General Requirements for the Competence of Testing and Calibration Laboratories
9. ANSI/ASQC E4-1994, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, American National Standard
10. 2003 NELAC Standard, National Environmental Laboratory Accreditation Program
11. 2009 TNI Standard, The NELAC Institute, National Environmental Accreditation Program
12. MARLAP, Multi-Agency Radiological Laboratory Analytical Protocols
13. 10 CFR Part 21, Reporting of Defects and Noncompliance
14. 10 CFR Part 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
15. 10 CFR Part 61, Licensing Requirements for Land Disposal and Radioactive Waste
16. NRC REG Guide 4.15 and NRC REG Guide 4.8

TABLE 1

2019 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA

PT Provider	Quarter / Year	Report Closing / Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Barium-133	105	99.5	84.1 - 109	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Cesium-134	48.2	49.1	39.5 - 54.0	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Cesium-137	128	125	112 - 140	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Cobalt-60	104	96.4	86.8 - 108	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Zinc-65	88.1	77.4	69.5 - 93.2	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Gross Alpha	22.3	21.8	10.9 - 29.5	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Gross Alpha	23.5	21.8	10.9 - 29.5	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Gross Beta	43.6	55.7	38.1 - 62.6	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Radium-226	6.47	7.37	5.55 - 8.72	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Radium-228	3.99	4.28	2.48 - 5.89	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Radium-228	4.48	4.28	2.48 - 5.89	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Uranium (Nat)	70	68.2	55.7 - 75.0	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	µg/L	Uranium (Nat) mass	99.3	99.5	81.3 - 109	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Tritium	2160	2110	1740 - 2340	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Tritium	1920	2110	1740 - 2340	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Strontium-89	78.5	66.9	54.4 - 75.0	Not Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Strontium-89	76.5	66.9	54.4 - 75.0	Not Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Strontium-90	40.1	41	30.2 - 47.1	Acceptable
ERA	1st /2019	2/25/19	RAD-116	Water	pCi/L	Strontium-90	42.2	41	30.2 - 47.1	Acceptable
ERA	1st /2019	3/14/19	RAD-9116	Water	pCi/L	Iodine-131	27.4	25.9	21.5 - 30.6	Acceptable
ERA	1st /2019	3/14/19	RAD-9116	Water	pCi/L	Iodine-131	25.1	25.9	21.5 - 30.6	Acceptable
EZA	1st/2019	05/10/19	E12364	Cartridge	pCi	Iodine-131	7.80E+01	7.54E+01	1.03	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cerium-141	1.23E+02	1.17E+02	1.05	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cobalt-58	1.51E+02	1.43E+02	1.05	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cobalt-60	3.12E+02	2.99E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Chromium-51	3.04E+02	2.93E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cesium-134	1.53E+02	1.60E+02	0.96	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cesium-137	2.04E+02	1.96E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Manganese-54	1.55E+02	1.43E+02	1.08	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Iron-59	1.78E+02	1.59E+02	1.12	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Zinc-65	2.42E+02	2.20E+02	1.1	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cerium-141	1.20E+02	1.13E+02	1.06	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cesium-134	1.43E+02	1.55E+02	0.92	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cesium-137	2.09E+02	1.91E+02	1.10	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Chromium-51	3.55E+02	2.84E+02	1.25	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cobalt-58	1.43E+02	1.39E+02	1.03	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cobalt-60	3.18E+02	2.90E+02	1.10	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Iodine-131	8.89E+01	9.65E+01	1.03	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Iron-59	1.76E+02	1.54E+02	1.14	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Manganese-54	1.55E+02	1.39E+02	1.12	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Zinc-65	2.44E+02	2.14E+02	1.14	Acceptable
EZA	2nd/2019	07/29/19	E12360	Cartridge	pCi	Iodine-131	8.40E+01	8.17E+01	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12361	Milk	pCi/L	Strontium-89	1.01E+02	8.29E+01	1.22	Acceptable

EZA	2nd/2019	07/29/19	E12361	Milk	pCi/L	Strontium-90	1.21E+01	1.35E+01	0.90	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cerium-141	1.39E+02	1.33E+02	1.04	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cobalt-58	1.17E+02	1.12E+02	1.05	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cobalt-60	2.05E+02	1.98E+02	1.04	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Chromium-51	3.41E+02	3.37E+02	1.01	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cesium-134	1.30E+02	1.40E+02	0.93	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cesium-137	1.78E+02	1.68E+02	1.06	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Iron-59	1.66E+02	1.41E+02	1.18	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Iodine-131	8.51E+01	8.14E+01	1.05	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Manganese-54	2.09E+02	1.90E+02	1.10	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Zinc-65	2.82E+02	2.47E+02	1.14	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cerium-141	1.50E+02	1.45E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cobalt-58	1.22E+02	1.22E+02	1.00	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cobalt-60	2.22E+02	2.16E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Chromium-51	3.56E+02	3.68E+02	0.97	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cesium-134	1.37E+02	1.53E+02	0.89	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cesium-137	1.90E+02	1.84E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Iron-59	1.73E+02	1.54E+02	1.12	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Iodine-131	8.92E+01	8.91E+01	1.00	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Manganese-54	2.27E+02	2.70E+00	1.10	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Zinc-65	3.01E+02	2.70E+02	1.11	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrF40	Filter	Bq/sample	Gross alpha	0.540	0.528	0.158-0.898	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrF41	Filter	Bq/sample	Gross beta	0.928	0.948	0.474-1.422	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrW40	Water	Bq/L	Gross alpha	0.819	0.840	0.25-1.43	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrW40	Water	Bq/L	Gross beta	2.390	2.330	1.17-3.50	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Americium-241	52.8	49.9	34.9-64.9	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cesium-134	2.25		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cesium-137	1290.00	1164.0	815-1513	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cobalt-57	0.133		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cobalt-60	853	855	599-1112	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Iron-55	486	344	241-447	Not Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Manganese-54	1130	1027	719-1335	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Nickel-63	524.00	519	363-675	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Plutonium-238	75.2	71.0	49.7-92.3	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Plutonium-239/240	67.3	59.8	41.9-77.7	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Potassium-40	596	585	410-761	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Strontium-90	3.44		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Technetium-99	381	408	286-530	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Uranium 234	54.7	56.0	39-73	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Uranium-238	204	205	144-267	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Zinc-65	751	668	468-868	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Americium-241	0.549	0.582	0.407-0.757	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cesium-134	5.32	5.99	4.19-7.79	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cesium-137	0.0		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cobalt-57	9.840	10	7.0-13.0	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cobalt-60	6.7	6.7	4.7-8.7	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Hydrogen-3	389.00	421	295-547	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Iron-55	0.0173		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Manganese-54	8.80	8.4	5.9-10.9	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Nickel-63	4.62	5.8	4.1-7.5	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Plutonium-238	0.419	0.451	0.316-0.586	Acceptable

MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Plutonium-239/240	0.0158	0.0045	Sens. Eval.	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Potassium-40	-0.156		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Radium-226	0.593	0.672	0.470-0.874	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Strontium-90	5.86	6.350	4.45-8.26	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Technetium-99	3.66	3.3	2.34-4.34	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Uranium-234	0.81	0.8	0.56-1.04	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Uranium-238	0.802	0.81	0.57-1.05	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Zinc-65	-0.0318		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-235	0.0566	0.0640	0.0448-0.0832	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-238	7.76	8.8	6.2-11.4	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-Total	7.72	8.9	6.2-11.6	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Americium-241	0.0284	0.0294	0.0206-0.0382	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cesium-134	0.251	0.216	0.151-0.281	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cesium-137	0.313	0.290	0.203-0.377	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cobalt-57	0.424	0.411	0.288-0.534	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cobalt-60	0.373	0.34	0.238-0.442	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Manganese-54	0.576	0.547	0.383-0.711	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Plutonium-238	0.0551	0.0526	0.0368-0.0684	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Plutonium-239/240	0.0377	0.038	0.0265-0.0493	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Strontium-90	0.616	0.662	0.463-0.861	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Uranium-234	0.108	0.106	0.074-0.138	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Uranium-238	0.118	0.110	0.077-0.143	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Zinc-65	0.0143		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Americium-241	0.000092		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cesium-134	2.25	2.44	1.71-3.17	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cesium-137	2.37	2.30	1.61-2.99	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cobalt-57	2.04	2.07	1.45-2.69	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cobalt-60	-0.0061		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Manganese-54	0.00255		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Plutonium-238	0.0247	0.0339	0.0237-0.0441	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Plutonium-239/240	0.0425	0.0460	0.0322-0.0598	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Strontium-90	0.00951		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Uranium-234	0.20	0.217	0.152-0.282	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Uranium-238	0.216	0.225	0.158-0.293	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Zinc-65	1.85	1.71	1.20-2.22	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-XaW40	Water	Bq/L	Iodine-129	0.64	0.62	0.431-0.801	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Actinium-228	3060	3280	2160 - 4130	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Americium-241	346	474	256 - 671	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Bismuth-212	3200	3400	973 - 5070	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Bismuth-214	1160	1370	658 - 2040	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cesium-134	6590	9280	6350 - 11100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cesium-137	831	1030	779 - 1300	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cobalt-60	4830	5880	4630 - 7260	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Lead-212	3360	3380	2360 - 4270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Lead-214	1500	1450	609 - 2280	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Manganese-54	<25.4	<1000	<1000	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Plutonium-238	955	1220	608 - 1850	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Plutonium-239	579	829	452 - 1190	Acceptable

ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Potassium-40	25800	24300	16700 - 29000	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Strontium-90	1220	1350	420 - 2100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Thorium-234	1050	1470	555 - 2520	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	1170	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	925	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	925	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	437	1030	565 - 1380	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	928	1030	565 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	880	1030	565 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-Total	2090	2030	1130 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-Total	1910	2030	1130 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	1360	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	2780	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	2630	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Zinc-65	1300	1460	1170 - 1990	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Americium-241	2090	1680	1040 - 2370	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cesium-134	1590	1640	1090 - 2180	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cesium-137	1510	1410	1080 - 1900	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cobalt-60	1200	1000	785 - 1310	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Curium-244	87.1	87.3	49.2 - 109	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Manganese-54	<35.9	<300	<300	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Plutonium-238	110	76	52.6 - 98.0	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Plutonium-239	1150	941	650 - 1190	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Potassium-40	41500	34500	25900 - 43700	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Strontium-90	4670	3530	1990 - 4600	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-234	1210	961	675 - 1230	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-238	1230	953	673 - 1190	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-Total	2540	1940	1240 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	µg/kg	Uranium-Total (mass)	3720	2830	2170 - 3500	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Zinc-65	715	527	393 - 781	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Americium-241	18.7	18.7	13.3 - 24.9	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cesium-134	639	721	468 - 884	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cesium-137	627	634	521 - 832	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cobalt-60	103	93.8	79.7 - 119	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Iron-55	613	718	262 - 1150	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Manganese-54	<3.29	<50.0	<50.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Plutonium-238	31.1	33.8	25.5 - 41.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Plutonium-239	62	67	50.1 - 80.8	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Strontium-90	169	181	114 - 246	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-234	17.1	18.2	13.5 - 21.3	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-234	16.4	18.2	13.5 - 21.3	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-238	16.9	18.1	13.7 - 21.6	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-238	16	18.1	13.7 - 21.6	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-Total	33.1	37.1	27.1 - 44.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-Total	34.7	37.1	27.1 - 44.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	µg/Filter	Uranium-Total (mass)	50.9	54.1	43.4 - 63.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	µg/Filter	Uranium-Total (mass)	48	54.1	43.4 - 63.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Zinc-65	1520	1380	1130 - 2110	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Gross Alpha	43	50.3	26.3 - 82.9	Acceptable

ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Gross Beta	75.7	78.6	47.7 - 119	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Americium-241	180	168	115 - 215	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cesium-134	116	123	92.9 - 135	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cesium-137	126	125	107 - 142	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cobalt-60	1200	1100	949 - 1260	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Iron-55	1310	1320	776 - 1920	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Manganese-54	<5.6	<100	<100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Plutonium-238	41.2	42.8	25.7 - 55.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Plutonium-239	117	123	76.1 - 152	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Strontium-90	365	315	227 - 389	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56.3	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	53.7	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	55.3	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	51.8	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	51	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-Total	107.3	112	87.4 - 128	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-Total	113	112	87.4 - 128	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	µg/L	Uranium-Total (mass)	166	163	132 - 185	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	µg/L	Uranium-Total (mass)	153	163	132 - 185	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Zinc-65	1990	1780	1580 - 2250	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Gross Alpha	79.8	68.5	25.0 - 94.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Gross Beta	140	151	75.5 - 208	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Tritium	22200	23700	17900 - 28800	Acceptable
ERA	2nd/2019	05/23/19	RAD-117	Water	pCi/L	Strontium-89	35.9	33.3	24.5-40.1	Acceptable
ERA	2nd/2019	05/24/19	RAD-117	Water	pCi/L	Strontium-89	34.4	33.3	24.5-40.2	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Barium-133	68.2	66.9	55.8 - 73.6	Acceptable
ERA	3rd/2019	3rd/2019	RAD - 118	Water	pCi/L	Cesium-134	30.4	32	25.1 - 35.2	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Cesium-137	22.7	21.4	17.6 - 26.7	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Cobalt-60	102	95.1	85.6 - 107	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Zinc-65	49.2	41.2	35.3 - 51.4	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Gross Alpha	88.7	70.6	37.1 - 87.1	Not Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Gross Alpha	80.7	70.6	37.1 - 87.1	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Gross Beta	57.7	63.9	44.2 - 70.5	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Radium-226	18.5	18.5	13.8 - 21.1	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Radium-228	7.97	8.16	5.21 - 10.3	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Radium-228	6.72	8.16	5.21 - 10.3	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Uranium (Nat)	67.8	68.3	55.8 - 75.1	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	µg/L	Uranium (Nat) mass	100.73	99.6	81.4 - 110	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Tritium	14700	16700	14600 - 18400	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Tritium	15000	16700	14600 - 18400	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Strontium-89	69.4	58.7	47.1 - 66.5	Not Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Strontium-89	62.1	58.7	47.1 - 66.5	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Strontium-90	34.3	38.5	28.3 - 44.3	Acceptable
ERA	3rd/2019	08/26/19	RAD - 118	Water	pCi/L	Strontium-90	33.4	38.5	28.3 - 44.3	Acceptable
EZA	3rd/2019	11/08/19	E12368	Cartridge	pCi	Iodine-131	9.93E+01	9.33E+01	1.06	Acceptable
EZA	3rd/2019	11/08/19	E12369	Milk	pCi/L	Strontium-89	8.71E+01	9.39E+01	0.93	Acceptable
EZA	3rd/2019	11/08/19	E12369	Milk	pCi/L	Strontium-90	7.02E+00	1.29E+01	0.54	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cerium-141	1.69E+02	1.67E+02	1.01	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cobalt-58	1.74E+02	1.75E+02	0.99	Acceptable

EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cobalt-60	2.08E+02	2.11E+02	0.99	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Chromium-51	3.64E+02	3.31E+02	1.1	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cesium-134	1.93E+02	2.07E+02	0.93	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cesium-137	1.49E+02	1.51E+02	0.99	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Iron-59	1.66E+02	1.48E+02	1.12	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Iodine-131	9.28E+01	9.21E+01	1.01	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Manganese-54	1.69E+02	1.54E+02	1.09	Acceptable
EZA	3rd/2019	11/08/19	E12371	Milk	pCi/L	Zinc-65	3.21E+02	2.93E+02	1.1	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cerium-141	1.41E+02	1.27E+02	1.11	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cobalt-58	1.36E+02	1.33E+02	1.03	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cobalt-60	1.68E+02	1.60E+02	1.036	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Chromium-51	2.45E+02	2.51E+02	0.98	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cesium-134	1.50E+02	1.57E+02	0.96	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cesium-137	1.22E+02	1.14E+02	1.07	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Iron-59	1.27E+02	1.12E+02	1.13	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Iodine-131	9.34E+01	8.94E+01	1.04	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Manganese-54	1.34E+02	1.17E+02	1.15	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Zinc-65	2.57E+02	2.22E+02	1.16	Acceptable
EZA	4th/2019	02/05/20	E12372	Cartridge	pCi	Iodine-131	9.07E+01	8.88E+01	1.02	Acceptable
EZA	4th/2019	02/05/20	E12373	Milk	pCi/L	Strontium-89	6.60E+01	8.06E+01	0.82	Acceptable
EZA	4th/2019	02/05/20	E12373	Milk	pCi/L	Strontium-90	1.11E+01	1.10E+01	1.00	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cerium-141	7.95E+01	8.30E+01	0.96	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cobalt-58	8.93E+01	8.99E+01	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cobalt-60	1.17E+02	1.15E+02	1.02	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Chromium-51	2.67E+02	2.41E+02	1.11	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cesium-134	9.79E+01	1.13E+02	0.87	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cesium-137	1.01E+02	1.02E+02	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Iron-59	1.01E+02	8.71E+01	1.16	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Iodine-131	9.34E+01	9.45E+01	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Manganese-54	1.34E+02	1.30E+02	1.03	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Zinc-65	1.17E+02	1.59E+02	1.08	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cerium-141	8.92E+01	8.41E+01	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cobalt-58	9.54E+01	9.11E+01	1.05	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cobalt-60	1.22E+02	1.17E+02	1.05	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Chromium-51	2.64E+02	2.44E+02	1.08	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cesium-134	1.06E+02	1.14E+02	0.93	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cesium-137	1.09E+02	1.03E+02	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Iron-59	9.32E+01	8.82E+01	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Iodine-131	1.04E+02	9.45E+01	1.10	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Manganese-54	1.44E+02	1.31E+02	1.10	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Zinc-65	1.91E+02	1.61E+02	1.19	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Americium-241	86.1	74.7	52.3-97.1	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cesium-134	896	1020	714-1326	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cesium-137	865	789	552-1026	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cobalt-57	0.227		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cobalt-60	761	760	532-988	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Iron-55	-48.0		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Manganese-54	816	745	522-969	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Nickel-63	552	629	440-818	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Plutonium-238	55.3	52.1	36.5-67.7	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Plutonium-239/240	59.9	61.4	43.0-79.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Potassium-40	604	555	389-722	Acceptable

MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Strontium-90	609	572	400-744	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Technetium-99	514	593	415-771	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	U-234/233	125	116	81-151	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Uranium-238	122	117	82-152	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Zinc-65	-0.650		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Americium-241	0.511	0.522	0.365-0.679	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cesium-134	0.0266		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cesium-137	19.70	18.4	12.9-23.9	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cobalt-57	16.2	15.6	10.9-20.3	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cobalt-60	9.01	8.8	6.2-11.4	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Hydrogen-3	166	175	123-228	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Iron-55	13.80	15.7	11.0-20.4	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Manganese-54	22.6	20.6	14.4-26.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Nickel-63	9.26	9.7	6.8-12.6	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Plutonium-238	0.0164	0.0063	Sens. Evaluation	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Plutonium-239/240	0.701	0.727	0.509-0.945	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Potassium-40	-0.121		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Radium-226	0.481	0.307	0.215-0.399	Not Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Strontium-90	9.34	10.60	7.4-13.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Technetium-99	0.119		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Uranium-234/233	1.09	1.07	0.75-1.39	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Uranium-238	1.12	1.05	0.74-1.37	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Zinc-65	23.1	20.3	5.27-9.79	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-235	0.0565	0.0565	0.0396-0.0735	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-238	7.8	7.7	5.4-10.0	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-Total	7.9	7.8	5.5-10.1	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Americium-241	0.00106		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cesium-134	0.00080		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cesium-137	1.63	1.58	1.11-2.05	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cobalt-57	1.23	1.16	0.81-1.51	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cobalt-60	0.783	0.815	0.571-1.060	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Manganese-54	1.35	1.37	0.96-1.78	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Plutonium-238	0.0755	0.0761	0.0533-0.0989	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Plutonium-239/240	0.0485	0.0468	0.0328-0.0608	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Strontium-90	0.442	0.498	0.349-0.647	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Uranium-234/233	0.0965	0.093	0.065-0.121	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Uranium-238	0.0935	0.096	0.067-0.125	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Zinc-65	1.09	1.06	0.74-1.38	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Americium-241	0.0958	0.090	0.063-0.117	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cesium-134	0.0190		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cesium-137	3.34	3.28	2.30-4.26	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cobalt-57	4.50	4.57	3.20-5.94	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cobalt-60	5.34	5.30	3.71-6.89	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Manganese-54	4.57	4.49	3.14-5.84	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Plutonium-238	0.0882	0.081	0.057-0.105	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Plutonium-239/240	0.00127		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Strontium-90	0.847	1.00	0.70-1.30	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Uranium-234/233	0.0656	0.0647	0.0453-0.0841	Acceptable

MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Uranium-238	0.0660	0.0670	0.0469-0.871	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Zinc-65	2.89	2.85	2.00-3.71	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-XaW41	Alk. Water	Bq/L	Iodine-129	1.69	1.78	1.25-2.31	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Actinium-228	3730	3170	2090 - 3990	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Americium-241	1740	1920	1040 - 2720	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Bismuth-212	4130	3280	939 - 4890	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Bismuth-214	1370	1330	638 - 1980	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cesium-134	7600	7650	5230 - 9140	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cesium-137	1350	1230	930 - 1560	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cobalt-60	3840	3710	2920 - 4580	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Lead-212	4300	3350	2340 - 4240	Not Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Lead-214	1740	1450	609 - 2280	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Manganese-54	<26.5	<1000	<1000	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Plutonium-238	680	546	272 - 830	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Plutonium-239	1010	1090	594 - 1570	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Potassium-40	26200	24700	17000 - 29500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Strontium-90	1660	1910	594 - 2980	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Thorium-234	1580	1360	513 - 2330	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-234	1140	1030	483 - 1350	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-234	1290	1030	483 - 1350	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-238	1080	974	534 - 1310	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-238	1070	974	534 - 1310	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-Total	2290	1930	1070 - 2500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-Total	2409	1930	1070 - 2500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Uranium-Total (mass)	3250	2410	1090 - 3250	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Uranium-Total (mass)	3200	2410	1090 - 3250	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Zinc-65	3100	2690	2150 - 3670	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Americium-241	2070	2050	1270 - 2900	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cesium-134	1910	2210	1470 - 2940	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cesium-137	2500	2480	1910-3340	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cobalt-60	604	607	476 - 793	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Curium-244	2760	3010	1700 - 3740	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Manganese-54	<35.4	<300	<300	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Plutonium-238	2120	1920	1330 - 2480	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Plutonium-239	2860	2600	1800 - 3290	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Potassium-40	41600	39300	29500 - 49800	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Strontium-90	4010	3940	2220 - 5130	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-234	3510	3320	2330 - 4230	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-238	3620	3290	2320 - 4110	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-Total	7360	6670	4260 - 8990	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-Total (mass)	10900	9730	7470 - 12100	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Zinc-65	1860	1620	1210 - 2400	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Americium-241	34.5	32	22.8 - 42.7	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cesium-134	55.6	59	38.3 - 72.3	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cesium-137	443	437	359 - 573	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cobalt-60	63.7	58.4	49.6 - 74.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Iron-55	150	151	55.1 - 241	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Manganese-54	<1.96	<50.0	<50.0	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Plutonium-238	23.8	21	15.9 - 25.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Plutonium-239	19.9	19	14.2 - 22.9	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Strontium-90	34.8	34.5	21.8 - 47.0	Acceptable

ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-234	27.1	27.5	20.4 - 32.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-234	30.4	27.5	20.4 - 32.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-238	28.4	27.3	20.6 - 32.6	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-238	25.2	27.3	20.6 - 32.6	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-Total	57.3	56.1	41.0 - 66.5	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-Total	55.6	56.1	41.0 - 66.5	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	µg/Filter	Uranium-Total (mass)	85.4	81.8	65.6 - 95.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	µg/Filter	Uranium-Total (mass)	75.6	81.8	65.6 - 95.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Zinc-65	412	364	298 - 556	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Gross Alpha	71	59	30.8 - 97.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Gross Beta	54.7	57.6	34.9 - 87.0	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Americium-241	67.6	64.2	44.1 - 82.1	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cesium-134	1820	1960	1480 - 2160	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cesium-137	1820	1840	1580 - 2090	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cobalt-60	1970	1870	1610 - 2150	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Iron-55	1410	1460	858 - 2120	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Manganese-54	<7.24	<100	<100	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Plutonium-238	41.2	47.8	28.7 - 61.9	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Plutonium-239	36.9	46.8	29.0 - 57.7	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Strontium-90	508	481	346 - 595	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-234	135	139	106 - 159	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-234	138	139	106 - 159	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-238	141	137	106 - 161	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-238	118	137	106 - 161	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-Total	285	282	220 - 321	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-Total	261.3	282	220 - 321	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	µg/L	Uranium-Total (mass)	424	411	333 - 466	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	µg/L	Uranium-Total (mass)	353	411	333 - 466	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Zinc-65	1490	1370	1220 - 1730	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Gross Alpha	147	124	45.3 - 171	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Gross Beta	72.9	68	34.0 - 93.6	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Tritium	20900	22300	16800 - 27100	Acceptable

TABLE 2
2019 ECKERT & ZIEGLER ANALYTICS PERFORMANCE EVALUATION RESULTS

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	2nd/2019	07/29/19	E12360	Cartridge	pCi	Iodine-131	8.40E+01	8.17E+01	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12361	Milk	pCi/L	Strontium-89	1.01E+02	8.29E+01	1.22	Acceptable
EZA	2nd/2019	07/29/19	E12361	Milk	pCi/L	Strontium-90	1.21E+01	1.35E+01	0.90	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cerium-141	1.39E+02	1.33E+02	1.04	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cobalt-58	1.17E+02	1.12E+02	1.05	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cobalt-60	2.05E+02	1.98E+02	1.04	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Chromium-51	3.41E+02	3.37E+02	1.01	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cesium-134	1.30E+02	1.40E+02	0.93	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Cesium-137	1.78E+02	1.68E+02	1.06	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Iron-59	1.66E+02	1.41E+02	1.18	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Iodine-131	8.51E+01	8.14E+01	1.05	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Manganese-54	2.09E+02	1.90E+02	1.10	Acceptable
EZA	2nd/2019	07/29/19	E12362	Milk	pCi/L	Zinc-65	2.82E+02	2.47E+02	1.14	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cerium-141	1.50E+02	1.45E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cobalt-58	1.22E+02	1.22E+02	1.00	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cobalt-60	2.22E+02	2.16E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Chromium-51	3.56E+02	3.68E+02	0.97	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cesium-134	1.37E+02	1.53E+02	0.89	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Cesium-137	1.90E+02	1.84E+02	1.03	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Iron-59	1.73E+02	1.54E+02	1.12	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Iodine-131	8.92E+01	8.91E+01	1.00	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Manganese-54	2.27E+02	2.70E+00	1.10	Acceptable
EZA	2nd/2019	07/29/19	E12363	Water	pCi/L	Zinc-65	3.01E+02	2.70E+02	1.11	Acceptable
EZA	1st/2019	05/10/19	E12364	Cartridge	pCi	Iodine-131	7.80E+01	7.54E+01	1.03	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cerium-141	1.23E+02	1.17E+02	1.05	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cobalt-58	1.51E+02	1.43E+02	1.05	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cobalt-60	3.12E+02	2.99E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Chromium-51	3.04E+02	2.93E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cesium-134	1.53E+02	1.60E+02	0.96	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Cesium-137	2.04E+02	1.96E+02	1.04	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Manganese-54	1.55E+02	1.43E+02	1.08	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Iron-59	1.78E+02	1.59E+02	1.12	Acceptable
EZA	1st/2019	05/10/19	E12366A	Milk	pCi/L	Zinc-65	2.42E+02	2.20E+02	1.1	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cerium-141	1.20E+02	1.13E+02	1.06	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cesium-134	1.43E+02	1.55E+02	0.92	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cesium-137	2.09E+02	1.91E+02	1.10	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Chromium-51	3.55E+02	2.84E+02	1.25	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cobalt-58	1.43E+02	1.39E+02	1.03	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Cobalt-60	3.18E+02	2.90E+02	1.10	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Iodine-131	8.89E+01	9.65E+01	1.03	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Iron-59	1.76E+02	1.54E+02	1.14	Acceptable
EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Manganese-54	1.55E+02	1.39E+02	1.12	Acceptable

EZA	1st/2019	05/10/19	E12367	Water	pCi/L	Zinc-65	2.44E+02	2.14E+02	1.14	Acceptable
EZA	3rd/2019	11/08/19	E12368	Cartridge	pCi	Iodine-131	9.93E+01	9.33E+01	1.06	Acceptable
EZA	3rd/2019	11/08/19	E12369	Milk	pCi/L	Strontium-89	8.71E+01	9.39E+01	0.93	Acceptable
EZA	3rd/2019	11/08/19	E12369	Milk	pCi/L	Strontium-90	7.02E+00	1.29E+01	0.54	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cerium-141	1.69E+02	1.67E+02	1.01	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cobalt-58	1.74E+02	1.75E+02	0.99	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cobalt-60	2.08E+02	2.11E+02	0.99	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Chromium-51	3.64E+02	3.31E+02	1.1	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cesium-134	1.93E+02	2.07E+02	0.93	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Cesium-137	1.49E+02	1.51E+02	0.99	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Iron-59	1.66E+02	1.48E+02	1.12	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Iodine-131	9.28E+01	9.21E+01	1.01	Acceptable
EZA	3rd/2019	11/08/19	E12370	Milk	pCi/L	Manganese-54	1.69E+02	1.54E+02	1.09	Acceptable
EZA	3rd/2019	11/08/19	E12371	Milk	pCi/L	Zinc-65	3.21E+02	2.93E+02	1.1	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cerium-141	1.41E+02	1.27E+02	1.11	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cobalt-58	1.36E+02	1.33E+02	1.03	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cobalt-60	1.68E+02	1.60E+02	1.036	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Chromium-51	2.45E+02	2.51E+02	0.98	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cesium-134	1.50E+02	1.57E+02	0.96	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Cesium-137	1.22E+02	1.14E+02	1.07	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Iron-59	1.27E+02	1.12E+02	1.13	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Iodine-131	9.34E+01	8.94E+01	1.04	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Manganese-54	1.34E+02	1.17E+02	1.15	Acceptable
EZA	3rd/2019	11/08/19	E12371	Water	pCi/L	Zinc-65	2.57E+02	2.22E+02	1.16	Acceptable
EZA	4th/2019	02/05/20	E12372	Cartridge	pCi	Iodine-131	9.07E+01	8.88E+01	1.02	Acceptable
EZA	4th/2019	02/05/20	E12373	Milk	pCi/L	Strontium-89	6.60E+01	8.06E+01	0.82	Acceptable
EZA	4th/2019	02/05/20	E12373	Milk	pCi/L	Strontium-90	1.11E+01	1.10E+01	1.00	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cerium-141	7.95E+01	8.30E+01	0.96	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cobalt-58	8.93E+01	8.99E+01	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cobalt-60	1.17E+02	1.15E+02	1.02	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Chromium-51	2.67E+02	2.41E+02	1.11	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cesium-134	9.79E+01	1.13E+02	0.87	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Cesium-137	1.01E+02	1.02E+02	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Iron-59	1.01E+02	8.71E+01	1.16	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Iodine-131	9.34E+01	9.45E+01	0.99	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Manganese-54	1.34E+02	1.30E+02	1.03	Acceptable
EZA	4th/2019	02/05/20	E12374	Milk	pCi/L	Zinc-65	1.17E+02	1.59E+02	1.08	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cerium-141	8.92E+01	8.41E+01	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cobalt-58	9.54E+01	9.11E+01	1.05	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cobalt-60	1.22E+02	1.17E+02	1.05	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Chromium-51	2.64E+02	2.44E+02	1.08	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cesium-134	1.06E+02	1.14E+02	0.93	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Cesium-137	1.09E+02	1.03E+02	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Iron-59	9.32E+01	8.82E+01	1.06	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Iodine-131	1.04E+02	9.45E+01	1.10	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Manganese-54	1.44E+02	1.31E+02	1.10	Acceptable
EZA	4th/2019	02/05/20	E12375	Water	pCi/L	Zinc-65	1.91E+02	1.61E+02	1.19	Acceptable

TABLE 3

2019 DEPARTMENT OF ENERGY MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) RESULTS

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrF40	Filter	Bq/sample	Gross alpha	0.540	0.528	0.158-0.898	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrF41	Filter	Bq/sample	Gross beta	0.928	0.948	0.474-1.422	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrW40	Water	Bq/L	Gross alpha	0.819	0.840	0.25-1.43	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-GrW40	Water	Bq/L	Gross beta	2.390	2.330	1.17-3.50	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Americium-241	52.8	49.9	34.9-64.9	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cesium-134	2.25		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cesium-137	1290.00	1164.0	815-1513	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cobalt-57	0.133		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Cobalt-60	853	855	599-1112	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Iron-55	486	344	241-447	Not Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Manganese-54	1130	1027	719-1335	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Nickel-63	524.00	519	363-675	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Plutonium-238	75.2	71.0	49.7-92.3	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Plutonium-239/240	67.3	59.8	41.9-77.7	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Potassium-40	596	585	410-761	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Strontium-90	3.44		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Technetium-99	381	408	286-530	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Uranium 234	54.7	56.0	39-73	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Uranium-238	204	205	144-267	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaS40	Soil	Bq/Kg	Zinc-65	751	668	468-868	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Americium-241	0.549	0.582	0.407-0.757	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cesium-134	5.32	5.99	4.19-7.79	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cesium-137	0.0		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cobalt-57	9.840	10	7.0-13.0	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Cobalt-60	6.7	6.7	4.7-8.7	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Hydrogen-3	389.00	421	295-547	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Iron-55	0.0173		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Manganese-54	8.80	8.4	5.9-10.9	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Nickel-63	4.62	5.8	4.1-7.5	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Plutonium-238	0.419	0.451	0.316-0.586	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Plutonium-239/240	0.0158	0.0045	Sens. Eval.	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Potassium-40	-0.156		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Radium-226	0.593	0.672	0.470-0.874	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Strontium-90	5.86	6.350	4.45-8.26	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Technetium-99	3.66	3.3	2.34-4.34	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Uranium-234	0.81	0.8	0.56-1.04	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Uranium-238	0.802	0.81	0.57-1.05	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-MaW40	Water	Bq/L	Zinc-65	-0.0318		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-235	0.0566	0.0640	0.0448-0.0832	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-238	7.76	8.8	6.2-11.4	Acceptable

MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	ug/sample	Uranium-Total	7.72	8.9	6.2-11.6	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Americium-241	0.0284	0.0294	0.0206-0.0382	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cesium-134	0.251	0.216	0.151-0.281	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cesium-137	0.313	0.290	0.203-0.377	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cobalt-57	0.424	0.411	0.288-0.534	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Cobalt-60	0.373	0.34	0.238-0.442	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Manganese-54	0.576	0.547	0.383-0.711	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Plutonium-238	0.0551	0.0526	0.0368-0.0684	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Plutonium-239/240	0.0377	0.038	0.0265-0.0493	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Strontium-90	0.616	0.662	0.463-0.861	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Uranium-234	0.108	0.106	0.074-0.138	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Uranium-238	0.118	0.110	0.077-0.143	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdF40	Filter	Bq/sample	Zinc-65	0.0143		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Americium-241	0.000092		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cesium-134	2.25	2.44	1.71-3.17	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cesium-137	2.37	2.30	1.61-2.99	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cobalt-57	2.04	2.07	1.45-2.69	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Cobalt-60	-0.0061		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Manganese-54	0.00255		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Plutonium-238	0.0247	0.0339	0.0237-0.0441	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Plutonium-239/240	0.0425	0.0460	0.0322-0.0598	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Strontium-90	0.00951		False Pos Test	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Uranium-234	0.20	0.217	0.152-0.282	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Uranium-238	0.216	0.225	0.158-0.293	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-RdV40	Vegetation	Bq/sample	Zinc-65	1.85	1.71	1.20-2.22	Acceptable
MAPEP	2nd/2019	05/31/19	MAPEP-19-XaW40	Water	Bq/L	Iodine-129	0.64	0.62	0.431-0.801	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Americium-241	86.1	74.7	52.3-97.1	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cesium-134	896	1020	714-1326	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cesium-137	865	789	552-1026	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cobalt-57	0.227		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Cobalt-60	761	760	532-988	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Iron-55	-48.0		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Manganese-54	816	745	522-969	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Nickel-63	552	629	440-818	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Plutonium-238	55.3	52.1	36.5-67.7	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Plutonium-239/240	59.9	61.4	43.0-79.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Potassium-40	604	555	389-722	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Strontium-90	609	572	400-744	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Technetium-99	514	593	415-771	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	U-234/233	125	116	81-151	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Uranium-238	122	117	82-152	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaS41	Soil	Bq/Kg	Zinc-65	-0.650		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Americium-241	0.511	0.522	0.365-0.679	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cesium-134	0.0266		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cesium-137	19.70	18.4	12.9-23.9	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cobalt-57	16.2	15.6	10.9-20.3	Acceptable

MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Cobalt-60	9.01	8.8	6.2-11.4	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Hydrogen-3	166	175	123-228	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Iron-55	13.80	15.7	11.0-20.4	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Manganese-54	22.6	20.6	14.4-26.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Nickel-63	9.26	9.7	6.8-12.6	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Plutonium-238	0.0164	0.0063	Sens. Evaluation	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Plutonium-239/240	0.701	0.727	0.509-0.945	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Potassium-40	-0.121		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Radium-226	0.481	0.307	0.215-0.399	Not Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Strontium-90	9.34	10.60	7.4-13.8	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Technetium-99	0.119		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Uranium-234/233	1.09	1.07	0.75-1.39	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Uranium-238	1.12	1.05	0.74-1.37	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-MaW41	Water	Bq/L	Zinc-65	23.1	20.3	5.27-9.79	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-235	0.0565	0.0565	0.0396-0.0735	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-238	7.8	7.7	5.4-10.0	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	ug/sample	Uranium-Total	7.9	7.8	5.5-10.1	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Americium-241	0.00106		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cesium-134	0.00080		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cesium-137	1.63	1.58	1.11-2.05	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cobalt-57	1.23	1.16	0.81-1.51	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Cobalt-60	0.783	0.815	0.571-1.060	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Manganese-54	1.35	1.37	0.96-1.78	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Plutonium-238	0.0755	0.0761	0.0533-0.0989	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Plutonium-239/240	0.0485	0.0468	0.0328-0.0608	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Strontium-90	0.442	0.498	0.349-0.647	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Uranium-234/233	0.0965	0.093	0.065-0.121	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Uranium-238	0.0935	0.096	0.067-0.125	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdF41	Filter	Bq/sample	Zinc-65	1.09	1.06	0.74-1.38	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Americium-241	0.0958	0.090	0.063-0.117	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cesium-134	0.0190		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cesium-137	3.34	3.28	2.30-4.26	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cobalt-57	4.50	4.57	3.20-5.94	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Cobalt-60	5.34	5.30	3.71-6.89	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Manganese-54	4.57	4.49	3.14-5.84	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Plutonium-238	0.0882	0.081	0.057-0.105	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Plutonium-239/240	0.00127		False Pos Test	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Strontium-90	0.847	1.00	0.70-1.30	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Uranium-234/233	0.0656	0.0647	0.0453-0.0841	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Uranium-238	0.0660	0.0670	0.0469-0.871	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-RdV41	Vegetation	Bq/sample	Zinc-65	2.89	2.85	2.00-3.71	Acceptable
MAPEP	4th/2019	12/13/19	MAPEP-19-XaW41	Alk. Water	Bq/L	Iodine-129	1.69	1.78	1.25-2.31	Acceptable

TABLE 4

2019 ERA PROGRAM PERFORMANCE EVALUATION RESULTS

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range	Evaluation
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Barium-133	105	99.5	84.1 - 109	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Cesium-134	48.2	49.1	39.5 - 54.0	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Cesium-137	128	125	112 - 140	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Cobalt-60	104	96.4	86.8 - 108	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Zinc-65	88.1	77.4	69.5 - 93.2	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Gross Alpha	22.3	21.8	10.9 - 29.5	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Gross Alpha	23.5	21.8	10.9 - 29.5	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Gross Beta	43.6	55.7	38.1 - 62.6	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Radium-226	6.47	7.37	5.55 - 8.72	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Radium-228	3.99	4.28	2.48 - 5.89	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Radium-228	4.48	4.28	2.48 - 5.89	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Uranium (Nat)	70	68.2	55.7 - 75.0	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	µg/L	Uranium (Nat) mass	99.3	99.5	81.3 - 109	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Tritium	2160	2110	1740 - 2340	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Tritium	1920	2110	1740 - 2340	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Strontium-89	78.5	66.9	54.4 - 75.0	Not Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Strontium-89	76.5	66.9	54.4 - 75.0	Not Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Strontium-90	40.1	41	30.2 - 47.1	Acceptable
ERA	2nd/2019	2/25/19	RAD-116	Water	pCi/L	Strontium-90	42.2	41	30.2 - 47.1	Acceptable
ERA	2nd/2019	3/14/19	RAD-9116	Water	pCi/L	Iodine-131	27.4	25.9	21.5 - 30.6	Acceptable
ERA	2nd/2019	3/14/19	RAD-9116	Water	pCi/L	Iodine-131	25.1	25.9	21.5 - 30.6	Acceptable
ERA	2nd/2019	05/23/19	RAD-117	Water	pCi/L	Strontium-89	35.9	33.3	24.5-40.1	Acceptable
ERA	2nd/2019	05/24/19	RAD-117	Water	pCi/L	Strontium-89	34.4	33.3	24.5-40.2	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Barium-133	68.2	66.9	55.8 - 73.6	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Cesium-134	30.4	32	25.1 - 35.2	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Cesium-137	22.7	21.4	17.6 - 26.7	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Cobalt-60	102	95.1	85.6 - 107	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Zinc-65	49.2	41.2	35.3 - 51.4	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Gross Alpha	88.7	70.6	37.1 - 87.1	Not Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Gross Alpha	80.7	70.6	37.1 - 87.1	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Gross Beta	57.7	63.9	44.2 - 70.5	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Radium-226	18.5	18.5	13.8 - 21.1	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Radium-228	7.97	8.16	5.21 - 10.3	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Radium-228	6.72	8.16	5.21 - 10.3	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Uranium (Nat)	67.8	68.3	55.8 - 75.1	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	µg/L	Uranium (Nat) mass	100.73	99.6	81.4 - 110	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Tritium	14700	16700	14600 - 18400	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Tritium	15000	16700	14600 - 18400	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Strontium-89	69.4	58.7	47.1 - 66.5	Not Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Strontium-89	62.1	58.7	47.1 - 66.5	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Strontium-90	34.3	38.5	28.3 - 44.3	Acceptable
ERA	3rd/2019	08/26/19	RAD-118	Water	pCi/L	Strontium-90	33.4	38.5	28.3 - 44.3	Acceptable

TABLE 5

2019 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Actinium-228	3060	3280	2160 - 4130	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Americium-241	346	474	256 - 671	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Bismuth-212	3200	3400	973 - 5070	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Bismuth-214	1160	1370	658 - 2040	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cesium-134	6590	9280	6350 - 11100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cesium-137	831	1030	779 - 1300	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Cobalt-60	4830	5880	4630 - 7260	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Lead-212	3360	3380	2360 - 4270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Lead-214	1500	1450	609 - 2280	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Manganese-54	<25.4	<1000	<1000	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Plutonium-238	955	1220	608 - 1850	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Plutonium-239	579	829	452 - 1190	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Potassium-40	25800	24300	16700 - 29000	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Strontium-90	1220	1350	420 - 2100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Thorium-234	1050	1470	555 - 2520	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	1170	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	925	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-234	925	1050	492 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	437	1030	565 - 1380	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	928	1030	565 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-238	880	1030	565 - 1380	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-Total	2090	2030	1130 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Uranium-Total	1910	2030	1130 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	1360	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	2780	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	µg/kg	Uranium-Total (mass)	2630	2420	1090 - 3270	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Soil	pCi/kg	Zinc-65	1300	1460	1170 - 1990	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Americium-241	2090	1680	1040 - 2370	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cesium-134	1590	1640	1090 - 2180	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cesium-137	1510	1410	1080 - 1900	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Cobalt-60	1200	1000	785 - 1310	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Curium-244	87.1	87.3	49.2 - 109	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Manganese-54	<35.9	<300	<300	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Plutonium-238	110	76	52.6 - 98.0	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Plutonium-239	1150	941	650 - 1190	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Potassium-40	41500	34500	25900 - 43700	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Strontium-90	4670	3530	1990 - 4600	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-234	1210	961	675 - 1230	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-238	1230	953	673 - 1190	Not Acceptable

ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Uranium-Total	2540	1940	1240 - 2620	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	µg/kg	Uranium-Total (mass)	3720	2830	2170 - 3500	Not Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Vegetation	pCi/kg	Zinc-65	715	527	393 - 781	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Americium-241	18.7	18.7	13.3 - 24.9	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cesium-134	639	721	468 - 884	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cesium-137	627	634	521 - 832	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Cobalt-60	103	93.8	79.7 - 119	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Iron-55	613	718	262 - 1150	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Manganese-54	<3.29	<50.0	<50.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Plutonium-238	31.1	33.8	25.5 - 41.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Plutonium-239	62	67	50.1 - 80.8	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Strontium-90	169	181	114 - 246	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-234	17.1	18.2	13.5 - 21.3	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-234	16.4	18.2	13.5 - 21.3	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-238	16.9	18.1	13.7 - 21.6	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-238	16	18.1	13.7 - 21.6	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-Total	33.1	37.1	27.1 - 44.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Uranium-Total	34.7	37.1	27.1 - 44.0	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	µg/Filter	Uranium-Total (mass)	50.9	54.1	43.4 - 63.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	µg/Filter	Uranium-Total (mass)	48	54.1	43.4 - 63.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Zinc-65	1520	1380	1130 - 2110	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Gross Alpha	43	50.3	26.3 - 82.9	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Filter	pCi/Filter	Gross Beta	75.7	78.6	47.7 - 119	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Americium-241	180	168	115 - 215	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cesium-134	116	123	92.9 - 135	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cesium-137	126	125	107 - 142	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Cobalt-60	1200	1100	949 - 1260	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Iron-55	1310	1320	776 - 1920	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Manganese-54	<5.6	<100	<100	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Plutonium-238	41.2	42.8	25.7 - 55.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Plutonium-239	117	123	76.1 - 152	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Strontium-90	365	315	227 - 389	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56.3	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	53.7	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-234	56	55.2	42.0 - 63.1	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	55.3	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	51.8	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-238	51	54.7	42.4 - 64.4	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-Total	107.3	112	87.4 - 128	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Uranium-Total	113	112	87.4 - 128	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	µg/L	Uranium-Total (mass)	166	163	132 - 185	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	µg/L	Uranium-Total (mass)	153	163	132 - 185	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Zinc-65	1990	1780	1580 - 2250	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Gross Alpha	79.8	68.5	25.0 - 94.5	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Gross Beta	140	151	75.5 - 208	Acceptable
ERA	2nd/2019	05/21/19	MRAD-30	Water	pCi/L	Tritium	22200	23700	17900 - 28800	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Actinium-228	3730	3170	2090 - 3990	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Americium-241	1740	1920	1040 - 2720	Acceptable

ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Bismuth-212	4130	3280	939 - 4890	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Bismuth-214	1370	1330	638 - 1980	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cesium-134	7600	7650	5230 - 9140	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cesium-137	1350	1230	930 - 1560	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Cobalt-60	3840	3710	2920 - 4580	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Lead-212	4300	3350	2340 - 4240	Not Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Lead-214	1740	1450	609 - 2280	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Manganese-54	<26.5	<1000	<1000	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Plutonium-238	680	546	272 - 830	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Plutonium-239	1010	1090	594 - 1570	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Potassium-40	26200	24700	17000 - 29500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Strontium-90	1660	1910	594 - 2980	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Thorium-234	1580	1360	513 - 2330	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-234	1140	1030	483 - 1350	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-234	1290	1030	483 - 1350	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-238	1080	974	534 - 1310	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-238	1070	974	534 - 1310	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-Total	2290	1930	1070 - 2500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	pCi/kg	Uranium-Total	2409	1930	1070 - 2500	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Uranium-Total (mass)	3250	2410	1090 - 3250	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Uranium-Total (mass)	3200	2410	1090 - 3250	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Soil	µg/kg	Zinc-65	3100	2690	2150 - 3670	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Americium-241	2070	2050	1270 - 2900	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cesium-134	1910	2210	1470 - 2940	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cesium-137	2500	2480	1910-3340	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Cobalt-60	604	607	476 - 793	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Curium-244	2760	3010	1700 - 3740	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Manganese-54	<35.4	<300	<300	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Plutonium-238	2120	1920	1330 - 2480	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Plutonium-239	2860	2600	1800 - 3290	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Potassium-40	41600	39300	29500 - 49800	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Strontium-90	4010	3940	2220 - 5130	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-234	3510	3320	2330 - 4230	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-238	3620	3290	2320 - 4110	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-Total	7360	6670	4260 - 8990	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Uranium-Total (mass)	10900	9730	7470 - 12100	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Vegetation	pCi/kg	Zinc-65	1860	1620	1210 - 2400	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Americium-241	34.5	32	22.8 - 42.7	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cesium-134	55.6	59	38.3 - 72.3	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cesium-137	443	437	359 - 573	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Cobalt-60	63.7	58.4	49.6 - 74.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Iron-55	150	151	55.1 - 241	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Manganese-54	<1.96	<50.0	<50.0	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Plutonium-238	23.8	21	15.9 - 25.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Plutonium-239	19.9	19	14.2 - 22.9	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Strontium-90	34.8	34.5	21.8 - 47.0	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-234	27.1	27.5	20.4 - 32.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-234	30.4	27.5	20.4 - 32.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-238	28.4	27.3	20.6 - 32.6	Acceptable

ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-238	25.2	27.3	20.6 - 32.6	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-Total	57.3	56.1	41.0 - 66.5	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Uranium-Total	55.6	56.1	41.0 - 66.5	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	µg/Filter	Uranium-Total (mass)	85.4	81.8	65.6 - 95.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	µg/Filter	Uranium-Total (mass)	75.6	81.8	65.6 - 95.8	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Zinc-65	412	364	298 - 556	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Gross Alpha	71	59	30.8 - 97.2	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Filter	pCi/Filter	Gross Beta	54.7	57.6	34.9 - 87.0	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Americium-241	67.6	64.2	44.1 - 82.1	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cesium-134	1820	1960	1480 - 2160	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cesium-137	1820	1840	1580 - 2090	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Cobalt-60	1970	1870	1610 - 2150	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Iron-55	1410	1460	858 - 2120	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Manganese-54	<7.24	<100	<100	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Plutonium-238	41.2	47.8	28.7 - 61.9	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Plutonium-239	36.9	46.8	29.0 - 57.7	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Strontium-90	508	481	346 - 595	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-234	135	139	106 - 159	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-234	138	139	106 - 159	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-238	141	137	106 - 161	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-238	118	137	106 - 161	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-Total	285	282	220 - 321	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Uranium-Total	261.3	282	220 - 321	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	µg/L	Uranium-Total (mass)	424	411	333 - 466	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	µg/L	Uranium-Total (mass)	353	411	333 - 466	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Zinc-65	1490	1370	1220 - 1730	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Gross Alpha	147	124	45.3 - 171	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Gross Beta	72.9	68	34.0 - 93.6	Acceptable
ERA	4th/2019	11/19/19	MRAD-31	Water	pCi/L	Tritium	20900	22300	16800 - 27100	Acceptable

FIGURE 1

COBALT-60 PERFORMANCE EVALUATION RESULTS AND % BIAS

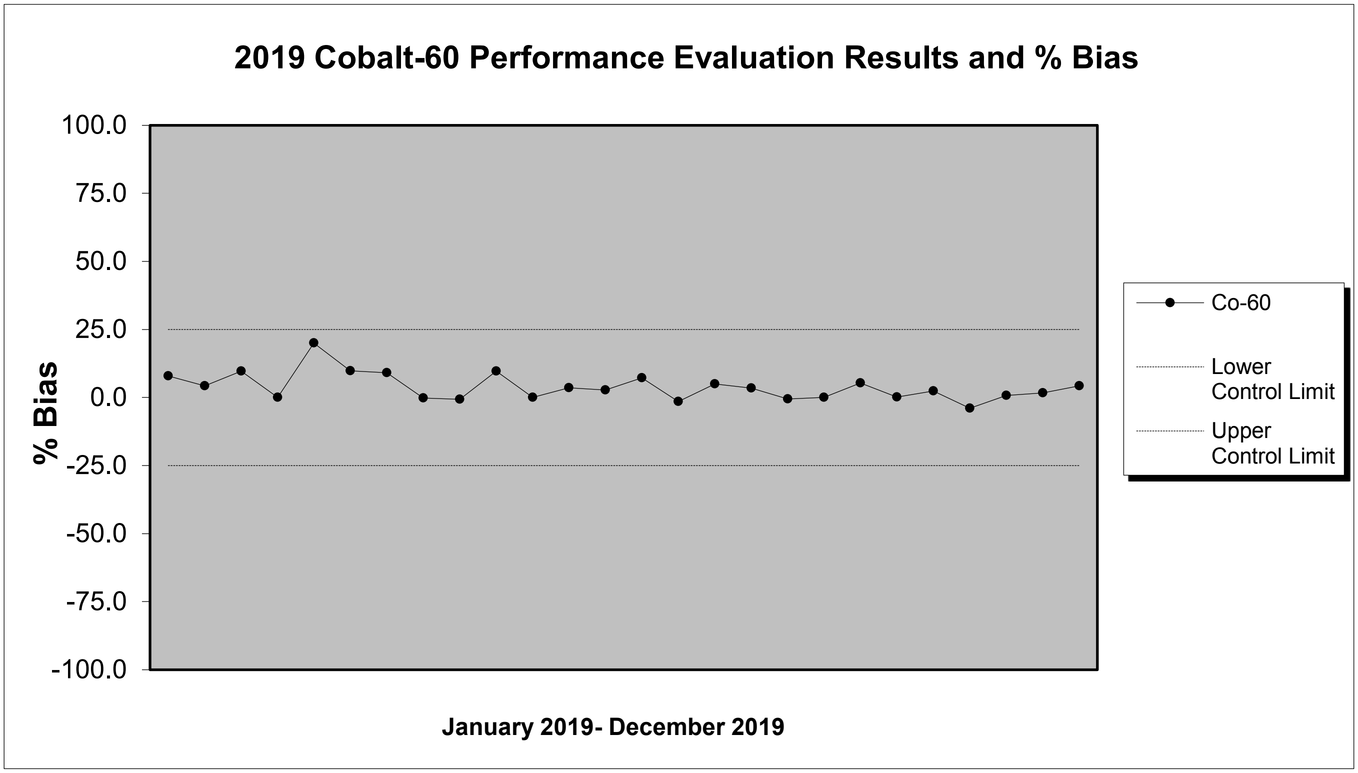

FIGURE 2

CESIUM-137 PERFORMANCE EVALUATION RESULTS AND % BIAS

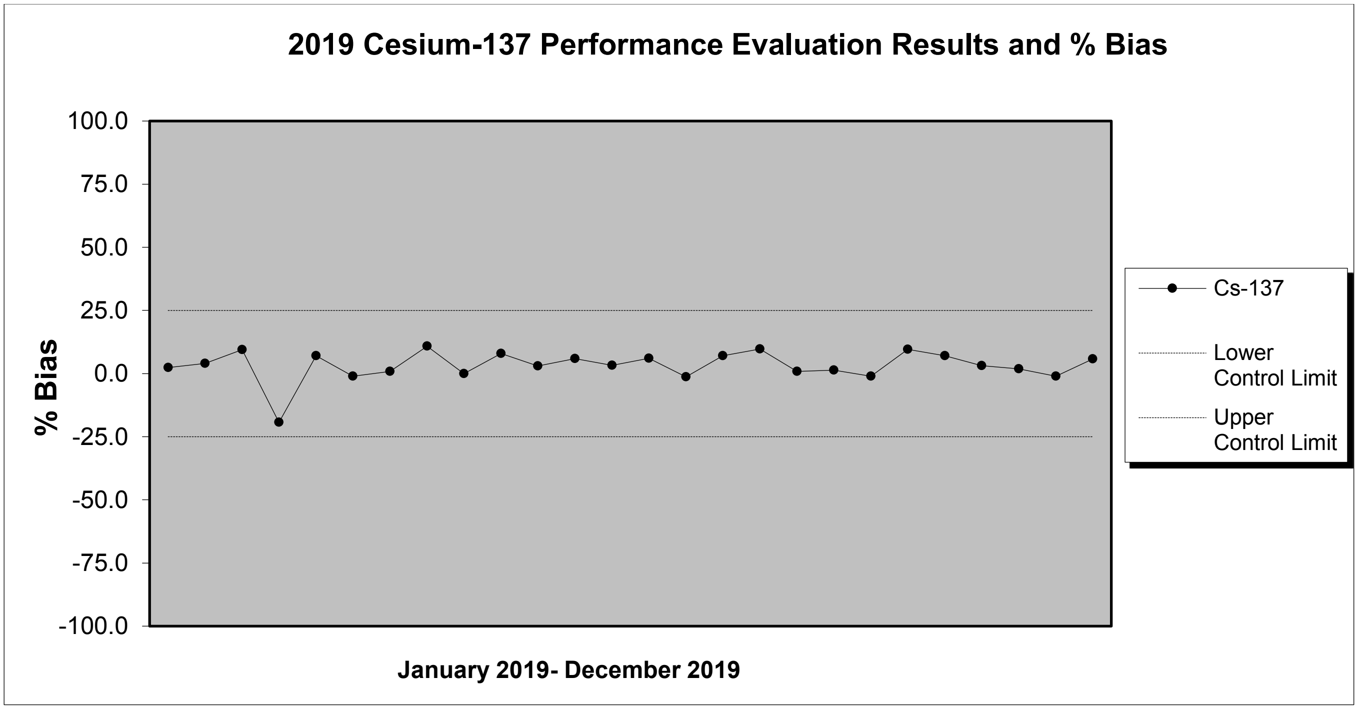

FIGURE 3

TRITIUM PERFORMANCE EVALUATION RESULTS AND % BIAS

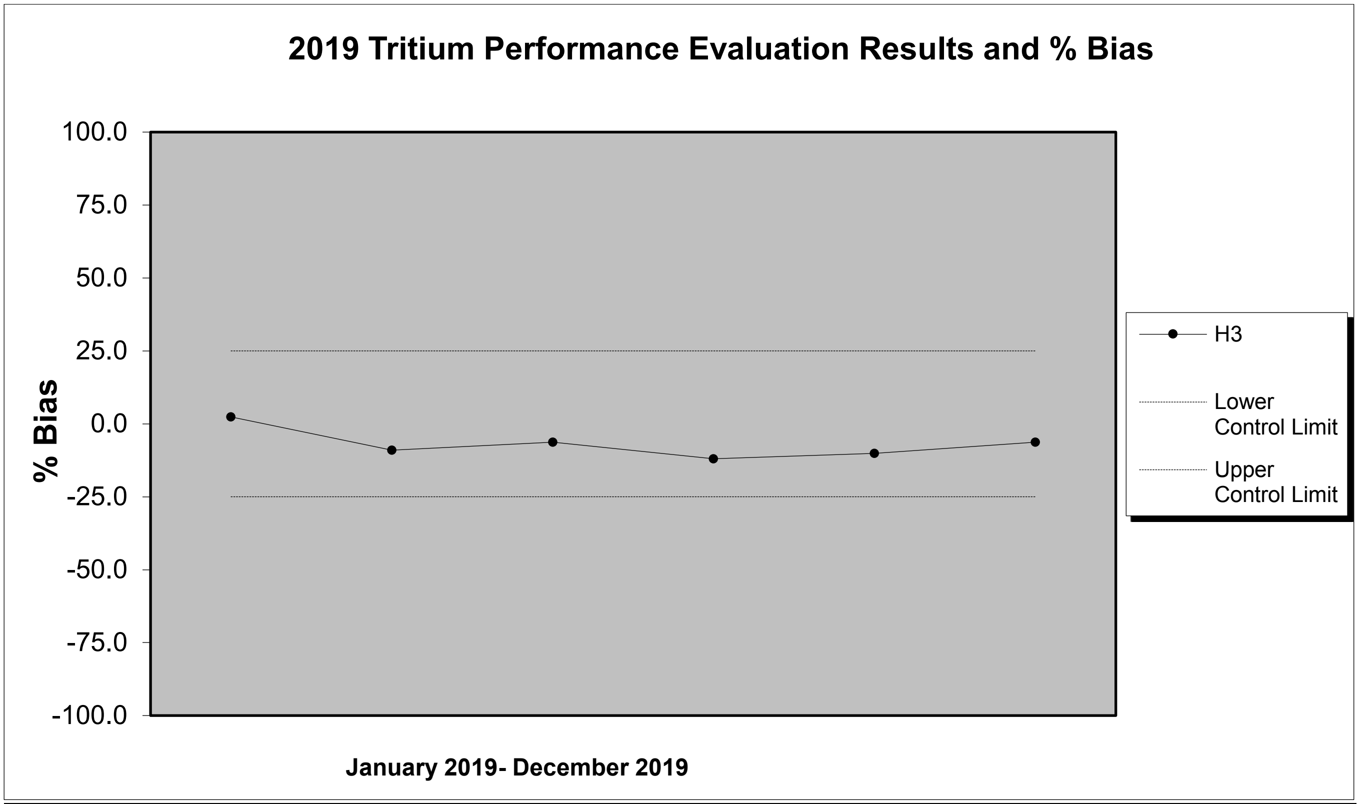

FIGURE 4

STRONTIUM-90 PERFORMANCE EVALUATION RESULTS AND % BIAS

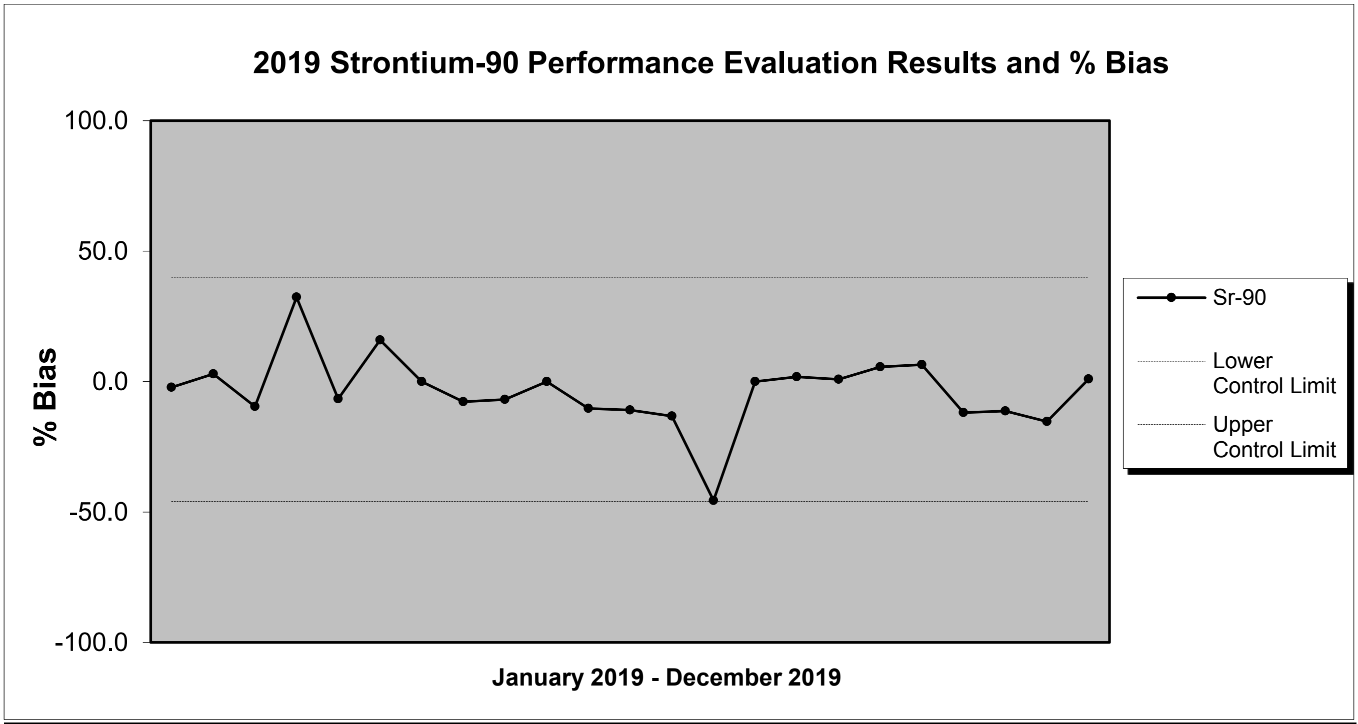

FIGURE 5

GROSS ALPHA PERFORMANCE EVALUATION RESULTS AND % BIAS

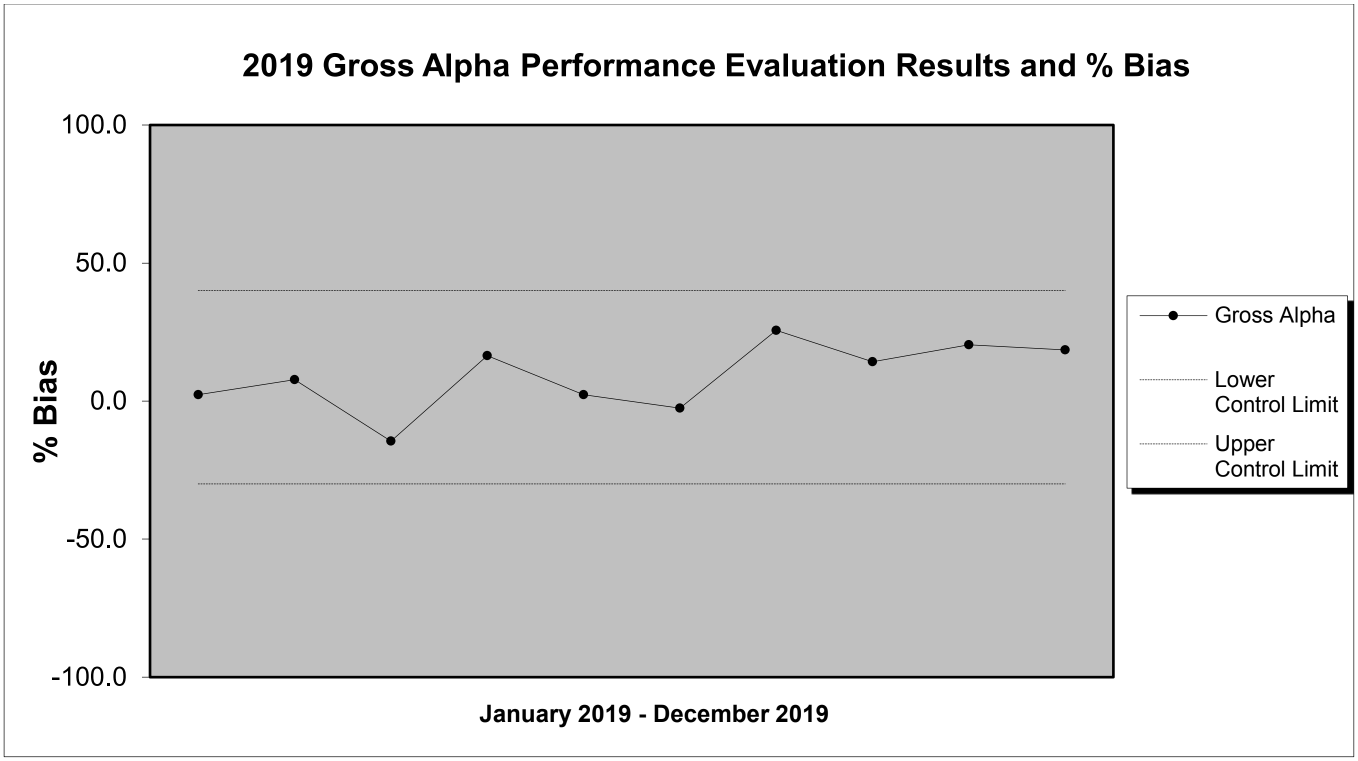

FIGURE 6

GROSS BETA PERFORMANCE EVALUATION RESULTS AND % BIAS

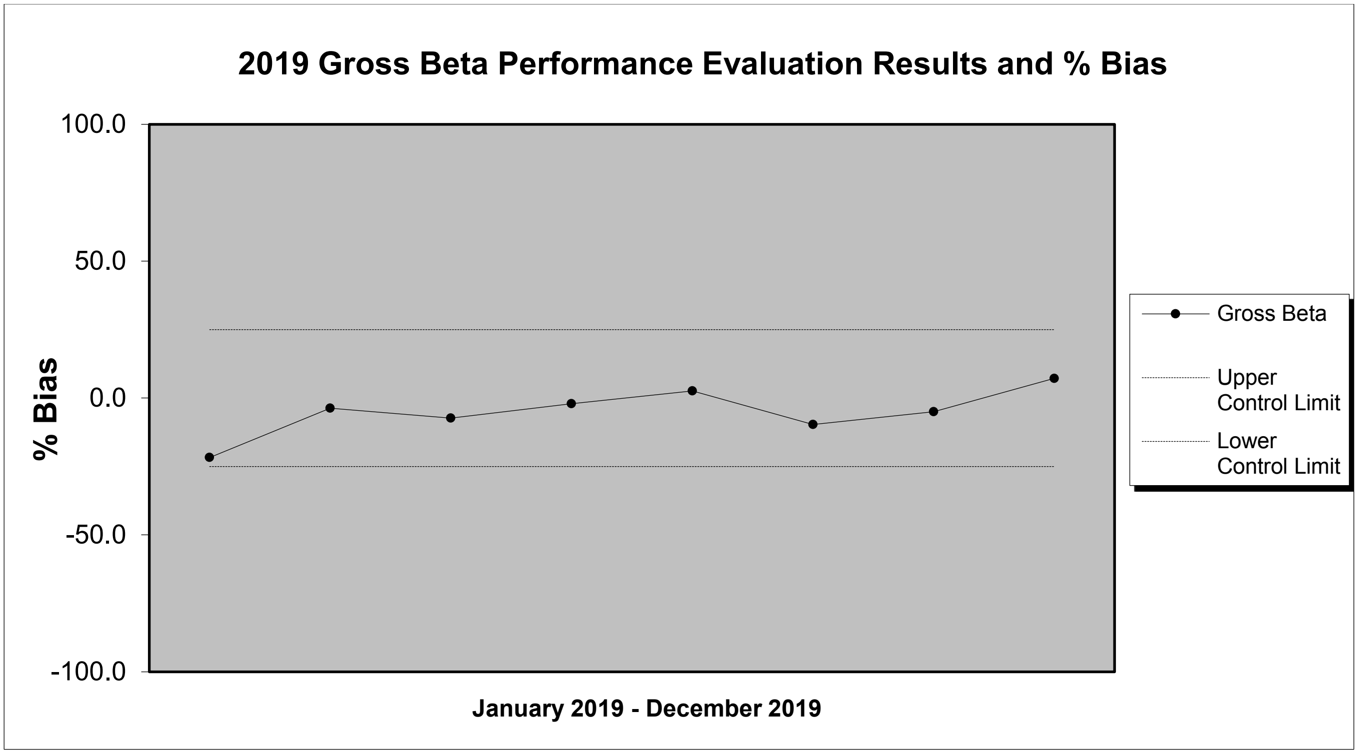

FIGURE 7

IODINE-131 PERFORMANCE EVALUATION RESULTS AND % BIAS

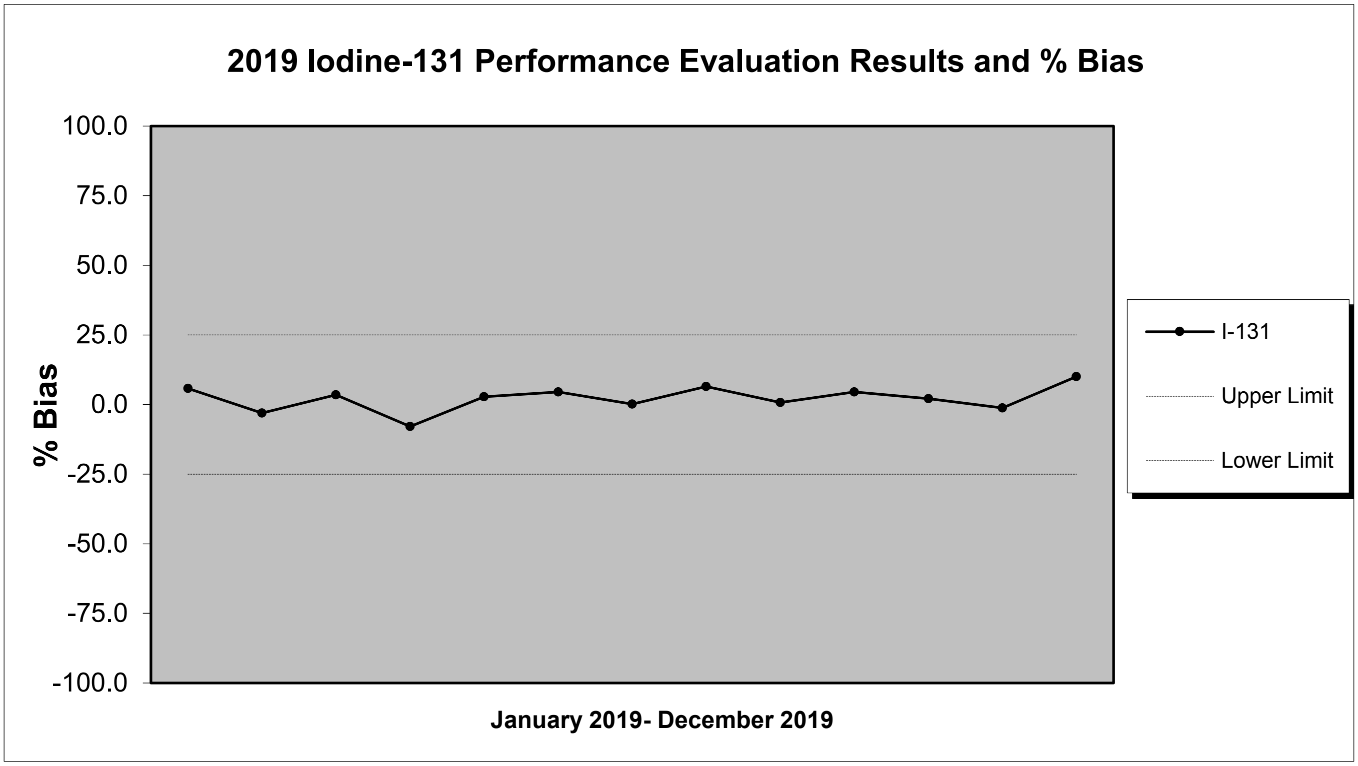

FIGURE 8

AMERICIUM-241 PERFORMANCE EVALUATION RESULTS AND % BIAS

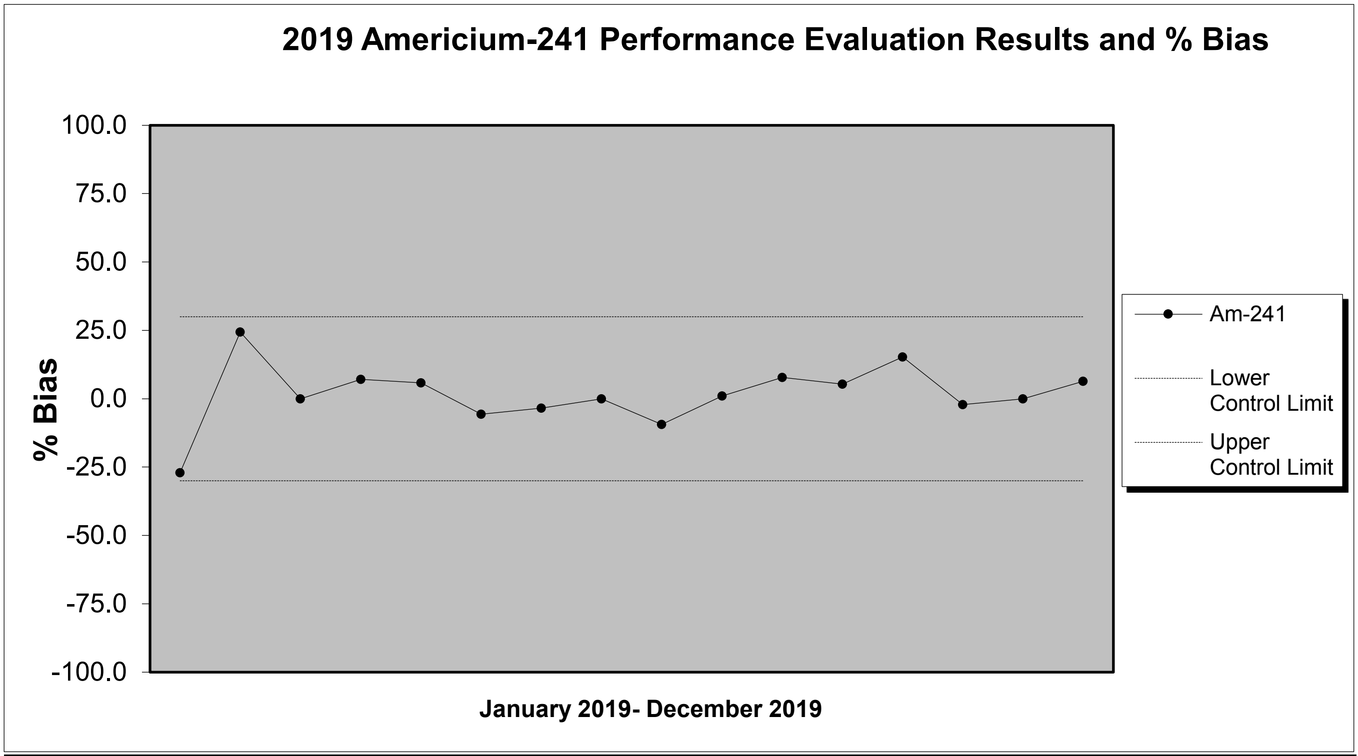

FIGURE 9

PLUTONIUM-238 PERFORMANCE EVALUATION RESULTS AND % BIAS

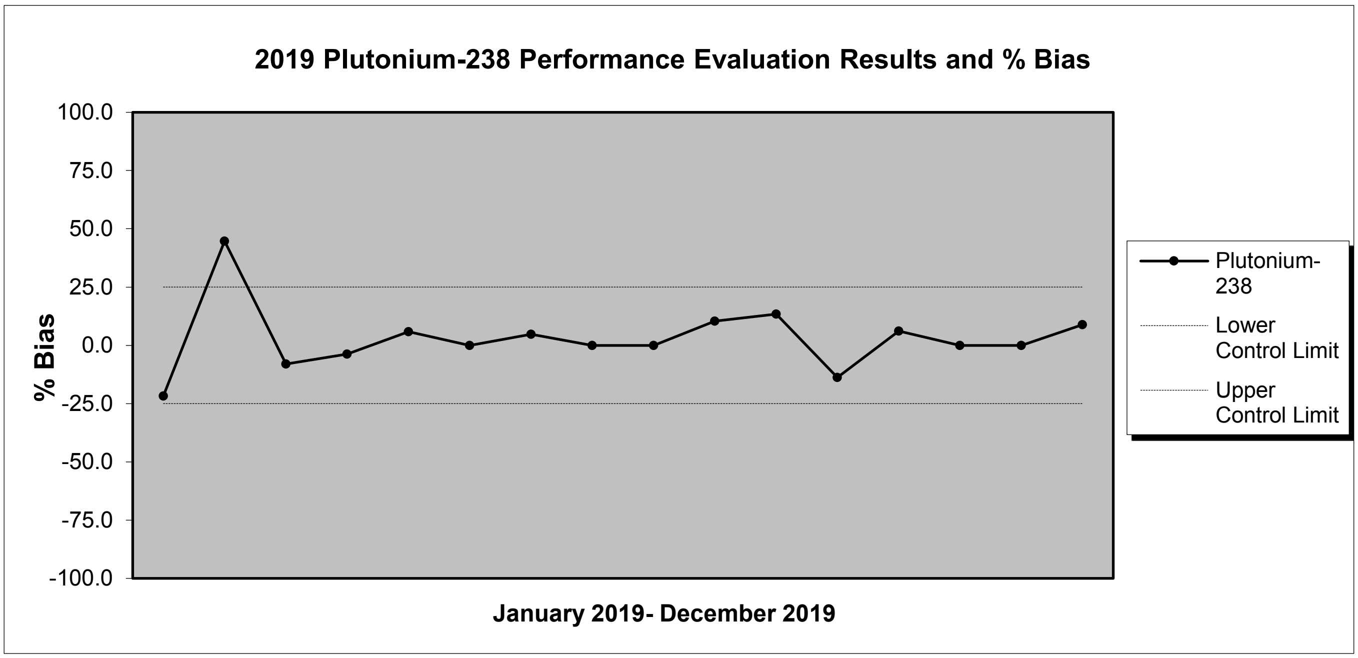

TABLE 6

REMP INTRA-LABORATORY DATA SUMMARY: BIAS AND PRECISION BY MATRIX

2019 Total All REMP Intra-Laboratory Data	Bias Criteria (+ / - 25%)		Precision Criteria (Note 1)	
	WITHIN CRITERIA	OUTSIDE CRITERIA	WITHIN CRITERIA	OUTSIDE CRITERIA
MILK				
Gas Flow Sr 2nd count	34	0	39	0
Gas Flow Total Strontium	20	0	21	0
Gamma Spec Liquid RAD A-013 with Ba, La	21	0	71	0
SOLID				
Gamma Spec Solid RAD A-013	9	0	13	0
LSC Nickel 63	5	0	5	0
Gas Flow Sr 2nd count	4	0	7	0
Gas Flow Total Strontium	4	0	4	0
Gamma Spec Solid RAD A-013 with Iodine	16	0	37	0
FILTER				
Gas Flow Sr 2nd Count	5	0	5	0
Gross A & B	462	0	333	0
Gas Flow Sr-90	1	0	1	0
Gamma Spec Filter	34	0	76	0
LIQUID				
Alpha Spec Uranium	7	0	10	0
Tritium	169	0	225	0
LSC Iron-55	17	0	15	0
LSC Nickel 63	18	0	16	0
Gamma Iodine-131	19	0	19	0
Alpha Spec Plutonium	9	0	9	0
Gas Flow Sr 2nd count	6	0	5	0
Alpha Spec Am241 Curium	9	0	9	0
Gas Flow Total Strontium	11	0	9	0
Gross Alpha Non Vol Beta	28	0	55	0
Gamma Spec Liquid RAD A-013 with Ba, La	51	0	116	0
Gamma Spec Liquid RAD A-013 with Iodine	25	0	98	0
TISSUE				
Gamma Spec Solid RAD A-013	31	0	37	0
Gas Flow Sr 2nd count	7	0	7	0
Gas Flow Total Strontium	10	0	10	0
Gamma Spec Solid RAD A-013 with Iodine	13	0	14	0
VEGETATION				
Gamma Spec Solid RAD A-013	14	0	13	0
Gas Flow Sr 2nd count	8	0	8	0
Gamma Spec Solid RAD A-013 with Iodine	63	0	79	0
AIR CHARCOAL				
Carbon-14 (Ascarite/Soda Lime Filter per Liter)	25	0	25	0
DRINKING WATER				
Tritium	20	0	24	0
LSC Iron-55	14	0	16	0
LSC Nickel 63	14	0	16	0
Gamma Iodine-131	24	0	16	0

Gas Flow Sr 2nd count	10	0	11	0
Gas Flow Total Strontium	13	0	15	0
Gross Alpha Non Vol Beta	52	0	61	0
Gamma Spec Liquid RAD A-013 with Ba, La	21	0	53	0
Gamma Spec Liquid RAD A-013 with Iodine	0	0	6	0
Total	**1323**		**1609**	

Note 1: The RPD must be 20 percent or less, if both samples are greater than 5 times the MDC. If both results are less than 5 times MDC, then the RPD must be equal to or less than 100%. If one result is above the MDC and the other is below the MDC, then the RPD can be calculated using the MDC for the result of the one below the MDC. The RPD must be 100% or less. In the situation where both results are above the MDC but one result is greater than 5 times the MDC and the other is less than 5 times the MDC, the RPD must be less than or equal to 20%. If both results are below MDC, then the limits on % RPD are not applicable.

TABLE 7

ALL RADIOLOGICAL INTRA-LABORATORY DATA SUMMARY:
BIAS AND PRECISION BY MATRIX:

2019 Total All Intra-Laboratory Data	Bias Criteria (+ / - 25%) WITHIN CRITERIA	Bias Criteria (+ / - 25%) OUTSIDE CRITERIA	Precision Criteria (Note 1) WITHIN CRITERIA	Precision Criteria (Note 1) OUTSIDE CRITERIA
MILK				
Gamma Spec Liquid RAD A-013	4	0	5	0
Gamma Iodine-129	4	0	4	0
Gamma Iodine-131	5	0	93	0
Gas Flow Sr 2nd count	34	0	39	0
Gas Flow Strontium 90	6	0	7	0
Gas Flow Total Strontium	20	0	21	0
Gamma Spec Liquid RAD A-013 with Ba, La	21	0	71	0
Gamma Spec Liquid RAD A-013 with Iodine	4	0	4	0
SOLID				
Gamma Percent Leach	2	0	0	0
Gas Flow Radium 228	72	0	76	0
Tritium	315	0	367	0
Tritium by Pyrolysis	2	0	3	0
Carbon-14	229	0	261	0
Carbon-14 by Pyrolysis	3	0	3	0
LSC Iron-55	132	0	145	0
Alpha Spec Polonium Solid	66	0	83	0
Gamma Nickel 59 RAD A-022	116	0	127	0
LSC Chlorine-36 in Solids	1	0	1	0
Gamma Spec Ra226 RAD A-013	15	0	17	0
Gamma Spec Solid RAD A-013	946	0	1312	0
LSC Nickel 63	226	0	239	0
LSC Plutonium	209	0	216	0
Technetium-99	526	0	561	0
Gross Alpha Beta Soil Leach	24	0	29	0
ICP-MS Technetium-99 in Soil	7	0	6	0
LSC Selenium 79	10	0	12	0
Total Activity,	9	0	10	0
Tritium	29	0	29	0
Alpha Spec Am243	87	0	94	0
Gamma Iodine-129	142	0	164	0
Gas Flow Lead 210	13	0	14	0
Alpha Spec Uranium	551	0	628	0
LSC Promethium 147	4	0	4	0
LSC, Rapid Strontium 89 and 90	51	0	58	0
Alpha Spec Thorium	429	0	491	0
ICP-MS Uranium-233, 234 in Solid	99	0	100	0
LSC Sulfur 35	5	0	5	0
Alpha Spec Plutonium	510	0	497	0
ICP-MS Technetium-99 Prep in Soil	7	0	6	0
LSC Calcium 45	0	0	2	0
Alpha Spec Neptunium	383	0	392	0

Alpha Spec Plutonium	129	0	145	0
Alpha Spec Radium 226	34	0	43	0
Gas Flow Sr 2nd count	31	0	36	0
Gas Flow Strontium 90	316	0	297	0
Lucas Cell Radium 226	165	0	193	0
Total Activity Screen	1	0	1	0
Alpha Spec Am241 Curium	395	0	400	0
LSC Phosphorus-32	1	0	1	0
Alpha Spec Total Uranium	11	0	12	0
Gas Flow Total Strontium	75	0	76	0
ICP-MS Uranium-233, 234 Prep in Solid	99	0	103	0
ICP-MS Uranium-235, 236, 238 in Solid	84	0	85	0
Alpha Spec Polonium Solid	5	0	5	0
Gamma Spec Solid RAD A-013 with Iodine	16	0	37	0
GFC Chlorine-36 in Solids	29	0	29	0
Gamma Spec Solid RAD A-013 (pCi/Sample)	1	0	4	0
Tritium	5	0	5	0
Calculation for Percent Uranium and Ratios	2	0	0	0
ICP-MS Uranium-234, 235, 236, 238 in Solid	189	0	182	0
ICP-MS Uranium-235, 236, 238 Prep in Solid	81	0	85	0
Gross Alpha/Beta (Am/Cs Calibration) Solid	5	0	6	0
Gross Alpha/Beta	445	0	597	0
Gross Alpha/Beta (Americium Calibration) Solid	3	0	3	0
ICP-MS Uranium-234, 235, 236, 238 Prep in Solid	107	0	106	0
Gross Alpha Beta (F,U)	37	0	45	0
FILTER				
Alpha Spec Uranium	4	0	22	0
Alpha Spec Polonium	3	0	4	0
Gamma I-131, filter	4	0	4	0
LSC Plutonium Filter	59	0	91	0
Tritium	31	0	265	0
Alpha Spec Californium	1	0	1	0
Carbon-14	6	0	70	0
ICP-MS Tc-99 in Filter	0	0	4	0
Nickel-63	1	0	47	0
LSC Iron-55	42	0	68	0
Gamma Nickel 59 RAD A-022	56	0	84	0
Alpha Spec Californium FPL	4	0	14	0
Gamma Iodine 131 RAD A-013	3	0	3	0
LSC Nickel 63	46	0	73	0
Technetium-99	7	0	86	0
Gamma Spec Filter RAD A-013	111	0	181	0
ICP-MS Tc-99 Prep in Filter	0	0	4	0
Alphaspec Np Filter per Liter	16	0	22	0
Alphaspec Pu Filter per Liter	24	0	29	0
Gamma Iodine-129	4	0	54	0
Gross Alpha/Beta	0	0	115	0
Alpha Spec Am243	8	0	15	0
Alpha Spec Uranium	56	0	88	0
LSC Promethium 147	1	0	3	0
LSC, Rapid Strontium 89 and 90	55	0	77	0

Alpha Spec Thorium	34	0	55	0
Gas Flow Radium 228	2	0	4	0
Alpha Spec Plutonium	70	0	123	0
ICP-MS Uranium-233, 234 in Filter	0	0	4	0
Alpha Spec Neptunium	43	0	69	0
Alpha Spec Plutonium	63	0	113	0
Alpha Spec Plutonium	12	0	12	0
Alpha Spec Polonium,(Filter/Liter)	0	0	3	0
Alpha Spec Radium 226	1	0	4	0
Alpha/Beta (Americium Calibration)	0	0	1	0
Carbon-14 (Soda Lime)	0	0	2	0
Gas Flow Sr 2nd Count	31	0	45	0
Gas Flow Strontium 90	67	0	101	0
Gas Flow Total Radium	2	0	2	0
LSC Plutonium 241 Filter per Liter	29	0	42	0
Lucas Cell Radium-226	1	0	1	0
Alpha Spec Am241Curium	100	0	158	0
Gas Flow Total Strontium	3	0	4	0
ICP-MS Uranium-233, 234 Prep in Filter	0	0	3	0
ICP-MS Uranium-235, 236, 238 in Filter	2	0	5	0
Total Activity in Filter,	0	0	6	0
Alphaspec Am241 Curium Filter per Liter	30	0	55	0
Tritium	79	0	105	0
GFC Chlorine-36 in Filters	0	0	3	0
Gamma Spec Filter RAD A-013 Direct Count	2	0	7	0
Carbon-14	24	0	40	0
GFC Chlorine-36 in Filters PL	3	0	3	0
Gross A & B (Americium Calibration) Liquid	5	0	31	0
Direct Count-Gross Alpha/Beta	78	0	0	0
Gross Alpha/Beta	26	0	39	0
ICP-MS Uranium-234, 235, 236, 238 in Filter	4	0	78	0
ICP-MS Uranium-235, 236, 238 Prep in Filter	2	0	7	0
Alpha Spec U	25	0	64	0
Gross A & B	514	0	388	0
LSC Iron-55	6	0	10	0
Technetium-99	24	0	41	0
Gas Flow Sr-90	28	0	47	0
LSC Nickel 63	29	0	37	0
Gamma Spec Charcoal	9	0	11	0
Gas Flow Pb-210	20	0	38	0
Gas Flow Ra-228	22	0	35	0
Gross Alpha Beta (Flame, Unflame)	9	0	9	0
Direct Count- Alpha/Beta (Americium Calibration)	20	0	0	0
Gamma Iodine 129	29	0	29	0
ICP-MS Uranium-234, 235, 236, 238 Prep in Filter	2	0	39	0
Gamma Spec Filter	87	0	142	0
Lucas Cell Ra-226	16	0	25	0
Alpha Spec Thorium	18	0	31	0
LIQUID				
Alpha Spec Uranium	482	0	778	0
Alpha Spec Polonium	27	0	36	0

Tritium	1142	0	1267	0
Carbon-14	167	0	204	0
Plutonium	128	0	147	0
Chlorine-36 in Liquids	3	0	3	0
Iodine-131	2	0	2	0
LSC Iron-55	85	0	135	0
Gamma Nickel 59 RAD A-022	28	0	40	0
Gamma Iodine 131 RAD A-013	2	0	2	0
LSC Nickel 63	144	0	188	0
LSC Radon 222	17	0	16	0
Technetium-99	555	0	657	0
Direct Tritium	1	0	1	0
Gamma Spec Liquid RAD A-013	794	0	899	0
Alpha Spec Total U RAD A-011	17	0	17	0
LSC Selenium 79	31	0	33	0
Total Activity,	3	0	4	0
Alpha Spec Am243	14	0	28	0
Gamma Iodine-129	128	0	169	0
Gamma Iodine-131	19	0	19	0
ICP-MS Technetium-99 in Water	5	0	11	0
Gas Flow Lead 210	14	0	41	0
LSC Promethium 147	18	0	19	0
LSC, Rapid Strontium 89 and 90	8	0	10	0
Alpha Spec Polonium	2	0	2	0
Alpha Spec Thorium	190	0	287	0
Gas Flow Radium 228	387	0	474	0
Gas Flow Radium 228	9	0	9	0
Alpha Spec Plutonium	346	0	508	0
LSC Sulfur 35	11	0	12	0
Alpha Spec Neptunium	135	0	233	0
Alpha Spec Plutonium	25	0	29	0
Alpha Spec Radium 226	28	0	31	0
Gas Flow Sr 2nd count	73	0	108	0
Gas Flow Strontium 90	489	0	550	0
Gas Flow Strontium 90	2	0	2	0
Gas Flow Total Radium	183	0	156	0
ICP-MS Technetium-99 Prep in Water	6	0	12	0
ICP-MS Uranium-233, 234 in Liquid	6	0	21	0
LSC Calcium 45	11	0	12	0
Lucas Cell Radium 226	309	0	450	0
Lucas Cell Radium-226	10	0	10	0
Chlorine-36 in Liquids	17	0	27	0
Alpha Spec Am241 Curium	305	0	433	0
Gas Flow Total Strontium	77	0	88	0
Gross Alpha Non Vol Beta	830	0	1183	0
LSC Phosphorus-32	8	0	10	0
ICP-MS Uranium-233, 234 Prep in Liquid	10	0	24	0
Tritium in Drinking Water by EPA 906.0	5	0	3	0
Gamma Spec Liquid RAD A-013 with Ba, La	51	0	124	0
Gamma Spec Liquid RAD A-013 with Iodine	101	0	188	0
Gas Flow Strontium 89 & 90	5	0	3	0
ICP-MS Uranium-235, 236, 238 in Liquid	13	0	25	0
Gas Flow Total Alpha Radium	10	0	10	0

Gross Alpha Co-precipitation	4	0	7	0
ICP-MS Uranium-235, 236, 238 Prep in Liquid	9	0	24	0
Gross Alpha/Beta (Am/Cs Calibration) Liquid	2	0	2	0
Gross Alpha/Beta	0	0	3	0
ICP-MS Uranium-234, 235, 236, 238 in Liquid	170	0	172	0
Gross Alpha Beta (Flame, Unflame)	195	0	213	0
Gross Alpha Beta (Americium Calibration) Liquid	33	0	72	0
ICP-MS Uranium-234, 235, 236, 238 Prep in Liquid	84	0	85	0
Alpha/Beta (Americium Calibration) Drinking Water	27	0	19	0
ECLS-R-GA NJ 48 Hr Rapid Gross Alpha	4	0	3	0
TISSUE				
Gamma Spec Solid RAD A-013	46	0	62	0
Alpha Spec Uranium	10	0	12	0
Alpha Spec Plutonium	6	0	6	0
Gas Flow Sr 2nd count	7	0	7	0
Gas Flow Strontium 90	9	0	11	0
Alpha Spec Am241 Curium	3	0	3	0
Gas Flow Total Strontium	10	0	10	0
Gamma Spec Solid RAD A-013 with Iodine	13	0	14	0
Gross Alpha/Beta	1	0	2	0
VEGETATION				
Carbon-14	4	0	4	0
Gamma Spec Solid RAD A-013	42	0	30	0
Gas Flow Lead 210	1	0	3	0
Alpha Spec Uranium	29	0	21	0
Alpha Spec Thorium	5	0	6	0
Alpha Spec Plutonium	27	0	14	0
Gas Flow Sr 2nd count	8	0	8	0
Gas Flow Strontium 90	24	0	11	0
Gas Flow Total Radium	1	0	3	0
Lucas Cell Radium 226	1	0	1	0
Alpha Spec Am241 Curium	5	0	8	0
Gamma Spec Solid RAD A-013 with Iodine	63	0	79	0
Gamma Spec Solid RAD A-013 (pCi/Sample)	2	0	2	0
Alpha Spec Am241 (pCi/Sample)	1	0	2	0
Alpha Spec Uranium	1	0	2	0
Gross Alpha/Beta	3	0	3	0
Alpha Spec Plutonium	0	0	2	0
Gas Flow Strontium 90	4	0	2	0
AIR CHARCOAL				
Gamma Iodine-129	25	0	8	0
Carbon-14 (Soda Lime)	0	0	5	0
Carbon-14	12	0	12	0
Carbon-14 (Ascarite/Soda Lime Filter per Liter)	28	0	29	0
Gamma Spec Charcoal	12	0	12	0
Gamma Iodine 129	12	0	12	0

DRINKING WATER				
Alpha Spec Uranium	2	0	2	0
Tritium	21	0	25	0
Iodine-131	0	0	1	0
LSC Iron-55	14	0	16	0
LSC Nickel 63	14	0	16	0
LSC Radon 222	31	0	39	0
Gamma Spec Liquid RAD A-013	7	0	6	0
Gamma Iodine-129	1	0	2	0
Gamma Iodine-131	24	0	16	0
Gas Flow Radium 228	35	0	33	0
Gas Flow Sr 2nd count	10	0	11	0
Gas Flow Strontium 90	17	0	16	0
Gas Flow Total Radium	1	0	1	0
Lucas Cell Radium 226	1	0	0	0
Lucas Cell Radium-226	36	0	37	0
Gamma Spec Drinking Water RAD A-013	29	0	36	0
Gas Flow Total Strontium	13	0	15	0
Gross Alpha Non Vol Beta	142	0	151	0
Tritium in Drinking Water by EPA 906.0	30	0	32	0
Gamma Spec Liquid RAD A-013 with Ba, La	21	0	53	0
Gamma Spec Liquid RAD A-013 with Iodine	0	0	6	0
Gas Flow Strontium 89 & 90	20	0	14	0
Gas Flow Total Alpha Radium	1	0	1	0
ICP-MS Uranium-234, 235, 236, 238 in Liquid	2	0	2	0
ICP-MS Uranium-234, 235, 236, 238 Prep in Liquid	1	0	1	0
Alpha/Beta (Americium Calibration) Drinking Water	10	0	10	0
ECLS-R-GA NJ 48 Hr Rapid Gross Alpha	19	0	16	0
Total	**18630**		**23501**	

Note 1: The RPD must be 20 percent or less, if both samples are greater than 5 times the MDC. If both results are less than 5 times MDC, then the RPD must be equal to or less than 100%. If one result is above the MDC and the other is below the MDC, then the RPD can be calculated using the MDC for the result of the one below the MDC. The RPD must be 100% or less. In the situation where both results are above the MDC but one result is greater than 5 times the MDC and the other is less than 5 times the MDC, the RPD must be less than or equal to 20%. If both results are below MDC, then the limits on % RPD are not applicable.

TABLE 8

2019 CORRECTIVE ACTION REPORT SUMMARY

<table>
<tr><th>CORRECTIVE ACTION ID#
&
PE FAILURE</th><th>DISPOSITION</th></tr>
<tr><td>CARR190225-1192

ISO Documentation of PT Failures in RAD 116 for Strontium-89.</td><td>Root Cause Analysis

Strontium-89 in Drinking Water by EPA 905.0 and 905.0 Mod.

A review of the data as well as the preparation processes did not reveal any errors or possible contributors to the high bias. The Laboratory has concluded that this positive bias was an isolated occurrence and that our overall process is within control. In addition, the reported value is 117% of the reference value which is within the laboratory’s standard acceptance criteria of +/- 25% for Laboratory Control Samples.

Permanent Corrective/Preventive Actions or Improvements

The laboratory must assume unidentified random errors caused the biases because all quality control criteria were met for the batches. The laboratory will continue to monitor</td></tr>
<tr><td>CARR190530-1211

ISO Documentation of PT Failures in MRAD-30 for:
Uranium-238 by 6020 (in soil)
Sr-90 (in vegetation)
Pu-238 (in vegetation)
Uranium-238 (in vegetation)
Uranium-Total (in vegetation)</td><td>Root Cause Analysis

Upon receipt of the report, an investigation was initiated by our Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected areas. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, instruments used during analysis and interviews with the analysts.

The investigation determined that the laboratory met all quality control criteria specified in the methods. Additionally, all internal procedures and processes were evaluated and found to have been performed as required. These failures were tracked through GEL’s internal non-conformance system.

Additionally, trending of historical PT samples for these isotope/matrix/methods were conducted. Specific tendencies of failures were not observed.

Uranium-238 by 6020: Per the method an acid leach is used instead of a more aggressive total dissolution that other methods use. This method is not the laboratory’s standard method of choice for the analysis of Uranium-238.</td></tr>
</table>

	Permanent Corrective/Preventive Actions or Improvements The laboratory does not use this digestion method for this isotope and therefore will discontinue analyzing and reporting a PT by using this method. **Sr-90:** A reanalysis for Strontium for the Vegetation sample was performed using a larger aliquot. The reanalysis was performed using the same processes as the original reported analysis. The reanalysis result meets the acceptance range with 96% recovery. **Permanent Corrective/Preventive Actions or Improvements** None at this time. A reanalysis was performed and results were within acceptance limits. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes **Pu-238:** A reanalysis for Plutonium for the Vegetation sample was performed using approximately the same size aliquot. Prior to the analysis, the sample was shaken and stirred vigorously to ensure homogenization. Reanalysis values fell within the acceptability range for all Plutonium isotopes. It is noted that the Pu-238 count rate is low (0.05 cpm) which results in an uncertainty of 32% at the 95% confidence interval, even with a long count time of 1000 minutes. The reported Pu-238 result is 116% of the study mean and the Z score is less than 1. Failure was potentially due to high uncertainty due to low count rates for the Pu-238, as well as a possible homogeneity issue **Permanent Corrective/Preventive Actions or Improvements** None at this time. A reanalysis was performed and results were within acceptance limits. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes **U-238/Total U mass:** A reanalysis for Uranium for the Vegetation sample was performed using approximately the same size aliquot. Prior to the analysis, the sample was shaken and stirred vigorously to ensure homogenization. Reanalysis values fell within the acceptability range for all Uranium isotopes. The original Uranium results were 126% (for U-234) and 129% (for U-238) of the assigned value, yet the Z-scores were both less than 1 and the results were 106% and 108% of the study mean. Additionally, the U-238 value fails, while the Total Uranium value in Activity units (which is simply a calculation) passes, and the Total Uranium in mass units (simply a conversion from the activity results) fails. Failures were potentially due to a possible homogeneity issue. **Permanent Corrective/Preventive Actions or Improvements** None at this time. A reanalysis was performed and results were within acceptance limits. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes.

CORRECTIVE ACTION ID# & PE FAILURE	**DISPOSITION**
CARR190603-1212 **ISO Documentation of PT Failures in MAPEP-19-MaS40:** • **Fe-55**	**Root Cause Analysis** Upon receipt of the report, an investigation was initiated by our Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected areas. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, instruments used during analysis and interviews with the analysts. The investigation determined that the laboratory met all quality control criteria specified in the methods. Additionally, all internal procedures and processes were evaluated and found to have been performed as required. These failures were tracked through GEL's internal non-conformance system. **Iron-55:** In reviewing the data, it was found that too small of an aliquot was used in the original analysis resulting in a high uncertainty in the result and variance or results between counts. A larger aliquot was used during reanalysis and the result was within the acceptance range and had a lower uncertainty. **Permanent Corrective/Preventive Actions or Improvements** None at this time. A reanalysis was performed and results were within acceptance limits. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes.
CARR190826-1250 **ISO Documentation of PT Failures in RAD-118** • **Sr-89** • **Gross Alpha**	**Root Cause Analysis** Upon receipt of the report, an investigation was initiated by our Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected areas. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, instruments used during analysis and interviews with the analysts. The investigation determined that the laboratory met all quality control criteria specified in the methods. Additionally, all internal procedures and processes were evaluated and found to have been performed as required. These failures were tracked through GEL's internal non-conformance system.

	Strontium-89: A review of the data as well as the preparation processes did not reveal any errors or possible contributors to the high bias. In addition, the reported value is 118% of the reference value which is with the laboratory's standard acceptance criteria of +/- 25% for Laboratory Control Samples. In addition, the Sr-89 was also reported by a method using separation resin and the result was with the acceptance range. The results from the two methods compared with a relative percent difference (RPD) of 11.1% which meets the laboratory's duplicate acceptance criteria. **Gross Alpha:** The analysis data was reviewed and no errors were found. The investigation into the sample preparation did not result in any contributors to the high bias. This analysis was performed by Co-Precipitation. The laboratory also reported the gross alpha analysis by the evaporation method (EPA 900.0) and had an acceptable result. The laboratory's alpha results between the two methods compared with a relative percent difference (RPD) of 9.45% which meets the laboratory's duplicate acceptance criteria. **Permanent Corrective/Preventive Actions or Improvements** The Laboratory has concluded that these positive biases were isolated occurrences and that the overall process is within control. The lab wil complete PT studies for these parameters as they become available to verify that these were isolated incidences.
CARR191212-1262 **ISO Documentation of PT Failures in MRAD-31** • **Pb-212**	**Root Cause Analysis** Upon receipt of the report, an investigation was initiated by our Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected areas. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, instruments used during analysis and interviews with the analysts. The investigation determined that the laboratory met all quality control criteria specified in the methods. Additionally, all internal procedures and processes were evaluated and found to have been performed as required. These failures were tracked through GEL's internal non-conformance system. **Lead-212:** The data was reviewed and no anomalies noted. The Duplicate result of the original analysis met the acceptance criteria of the study and replication criteria of the laboratory. Laboratory processes were evaluated and no errors were found. The other reported analytes for the method were within the limits of the study. A definitive contributor to the slightly high bias could not be identified concluding that this was an isolated occurrence.

	Permanent Corrective/Preventive Actions or Improvements None at this time. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes
CARR191212-1265 **ISO Documentation of PT Failures in MAPEP-19-MaW41** • **Ra-226**	**Root Cause Analysis** Upon receipt of the report, an investigation was initiated by our Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected laboratory areas. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, and interviews with the analysts. The investigation determined that the laboratory met all quality control criteria specified in each method. Additionally, all internal procedures and policies were performed as required. These failures were tracked through GEL's internal non-conformance system. The laboratory reviewed the data and no errors were found. The preparation and counting processes were reviewed and no anomalies were noted. It was noted that verification counts of the sample preparations were within limits and met laboratory replication criteria **Permanent Corrective/Preventive Actions or Improvements** None at this time. The laboratory will continue to monitor the recoveries of these parameters to ensure that there are no continued issues in the processes

APPENDIX B

2019 ANNUAL DOSIMETRY QA REPORT

ENVIRONMENTAL DOSIMETRY COMPANY

ANNUAL QUALITY ASSURANCE STATUS REPORT

January - December 2019

Prepared By: ______________________ Date: 3/12/20

Approved By: ______________________ Date: 3/12/20

Environmental Dosimetry Company
10 Ashton Lane
Sterling, MA 01564

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EXECUTIVE SUMMARY

Routine quality control (QC) testing was performed for dosimeters issued by the Environmental Dosimetry Company (EDC) .

During this annual period100% (72/72) of the individual dosimeters, evaluated against the EDC internal performance acceptance criteria (high-energy photons only), met the criterion for accuracy and 100% (72/72) met the criterion for precision (Table 1). In addition, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance limits met EDC acceptance criteria (Table 2) and 100% (6/6) of independent testing passed the performance criteria (Table 3). Trending graphs, which evaluate performance statistic for high-energy photon irradiations and co-located stations are given in Appendix A.

One internal assessment and one external audit were performed in 2019.There were no findings identified.

I. INTRODUCTION

The TLD systems at the Environmental Dosimetry Company (EDC) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to EDC clients is ensured by in-house performance testing and independent performance testing by EDC clients, and both internal and client directed program assessments.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of EDC dosimeters. Performance testing provides a statistical measure of the bias and precision of dosimetry processing against a reliable standard, which in turn points out any trends or performance changes. Two programs are used:

A. QC Program

Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in-house testing program coordinated by the EDC QA Officer and (2) independent test perform by EDC clients. In-house test are performed using six pairs of 814 dosimeters, a pair is reported as an individual result and six pairs are reported as the mean result.Results of these tests are described in this report.

Excluded from this report are instrumentation checks. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks in this report. Instrumentation checks represent between 5-10% of the TLDs processed.

B. QA Program

An internal assessment of dosimetry activities is conducted annually by the Quality Assurance Officer (Reference 1). The purpose of the assessment is to review procedures, results, materials or components to identify opportunities to improve or enhance processes and/or services.

II. PERFORMANCE EVALUATION CRITERIA

A. Acceptance Criteria for Internal Evaluations

1. Bias

For each dosimeter tested, the measure of bias is the percent deviation of the reported result relative to the delivered exposure. The percent deviation relative to the delivered exposure is calculated as follows:

$$\frac{(H_i' - H_i)}{H_i} 100$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated dosimeter (i.e., the delivered exposure)

2. Mean Bias

For each group of test dosimeters, the mean bias is the average percent deviation of the reported result relative to the delivered exposure. The mean percent deviation relative to the delivered exposure is calculated as follows:

$$\sum\left(\frac{(H_i' - H_i)}{H_i}\right)100\left(\frac{1}{n}\right)$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated test dosimeter (i.e., the delivered exposure)

n = the number of dosimeters in the test group

3. Precision

For a group of test dosimeters irradiated to a given exposure, the measure of precision is the percent deviation of individual results relative to the mean reported exposure. At least two values are required for the determination of precision. The measure of precision for the i^{th} dosimeter is:

$$\left(\frac{(H_i' - \bar{H})}{\bar{H}}\right)100$$

where:

H_i' = the reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

$\bar{H}$ = the mean reported exposure; i.e., $\bar{H} = \sum H_i'\left(\frac{1}{n}\right)$

n = the number of dosimeters in the test group

4. EDC Internal Tolerance Limits

All evaluation criteria are taken from the "EDC Quality System Manual," (Reference 2). These criteria are only applied to individual test dosimeters irradiated with high-energy photons (Cs-137) and are as follows for Panasonic Environmental dosimeters: ± 15% for bias and ± 12.8% for precision.

B. QC Investigation Criteria and Result Reporting

EDC Quality System Manual (Reference 2) specifies when an investigation is required due to a QC analysis that has failed the EDC bias criteria. The criteria are as follows:

1. No investigation is necessary when an individual QC result falls outside the QC performance criteria for accuracy.

2. Investigations are initiated when the mean of a QC processing batch is outside the performance criterion for bias.

C. Reporting of Environmental Dosimetry Results to EDC Customers

1. All results are to be reported in a timely fashion.

2. If the QA Officer determines that an investigation is required for a process, the results shall be issued as normal. If the QC results prompting the investigation have a mean bias from the known of greater than ±20%, the results shall be issued with a note indicating that they may be updated in the future, pending resolution of a QA issue.

3. Environmental dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±20%.

III. DATA SUMMARY FOR ISSUANCE PERIOD JANUARY-DECEMBER 2019

A. General Discussion

Results of performance tests conducted are summarized and discussed in the following sections. Summaries of the performance tests for the reporting period are given in Tables 1 through 3 and Figures 1 through 4.

Table 1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons only. During this period100% (72/72) of the individual dosimeters, evaluated against these criteria, met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision. A graphical interpretation is provided in Figures 1 and 2.

Table 2 provides the bias and standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall,100% (12/12) of the dosimeter sets, evaluated against the internal tolerance performance criteria, met these criteria. A graphical interpretation is provided in Figure 3.

Table 3 presents the independent blind spike results for dosimeters processed during this annual period. All results passed the performance acceptance criterion. Figure 4 is a graphical interpretation of Seabrook Station blind co-located station results.

B. Result Trending

One of the main benefits of performing quality control tests on a routine basis is to identify trends or performance changes. The results of the Panasonic environmental dosimeter performance tests are presented in Appendix A. The results are evaluated against each of the performance criteria listed in Section II, namely: individual dosimeter accuracy, individual dosimeter precision, and mean bias.

All of the results presented in Appendix A are plotted sequentially by processing date.

IV. STATUS OF EDC CONDITION REPORTS (CR)

No condition reports were issued during this annual period.

V. STATUS OF AUDITS/ASSESSMENTS

1. Internal

EDC Internal Quality Assurance Assessment was conducted during the fourth quarter 2019. There were no findings identified.

2. External

None.

VI. PROCEDURES AND MANUALS REVISED DURING JANUARY - DECEMBER 2019

No procedures or manuals were revised in 2019.

VII. CONCLUSION AND RECOMMENDATIONS

The quality control evaluations continue to indicate the dosimetry processing programs at the EDC satisfy the criteria specified in the Quality System Manual. The EDC demonstrated the ability to meet all applicable acceptance criteria.

VIII. REFERENCES

1. EDC Quality Control and Audit Assessment Schedule, 2019.

2. EDC Manual 1, Quality System Manual, Rev. 3, August 1, 2017.

TABLE 1

PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA
JANUARY – DECEMBER 2019[(1), (2)]

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

[(1)]This table summarizes results of tests conducted by EDC.
[(2)]Environmental dosimeter results are free in air.

TABLE 2

MEAN DOSIMETER ANALYSES (N=6)
JANUARY – DECEMBER 2019[(1), (2)]

Process Date	Exposure Level	Mean Bias %	Standard Deviation %	Tolerance Limit +/- 15%
4/25/2019	26	1.8	1.7	Pass
4/29/2019	51	3.1	1.5	Pass
5/04/2019	85	-0.4	1.4	Pass
7/28/2019	75	5.9	1.1	Pass
7/30/2019	32	2.8	1.2	Pass
8/4/2019	107	-0.7	1.2	Pass
10/25/2019	64	1.8	1.2	Pass
11/04/2019	90	-0.5	1.8	Pass
11/05/2019	117	3.0	1.7	Pass
01/20/2020	45	1.0	2.0	Pass
01/30/2020	57	1.8	2.6	Pass
02/17/2020	121	-2.6	2.4	Pass

[(1)]This table summarizes results of tests conducted by EDC for TLDs issued in 2019.
[(2)]Environmental dosimeter results are free in air.

TABLE 3
SUMMARY OF INDEPENDENT DOSIMETER TESTING
JANUARY – DECEMBER 2019[(1), (2)]

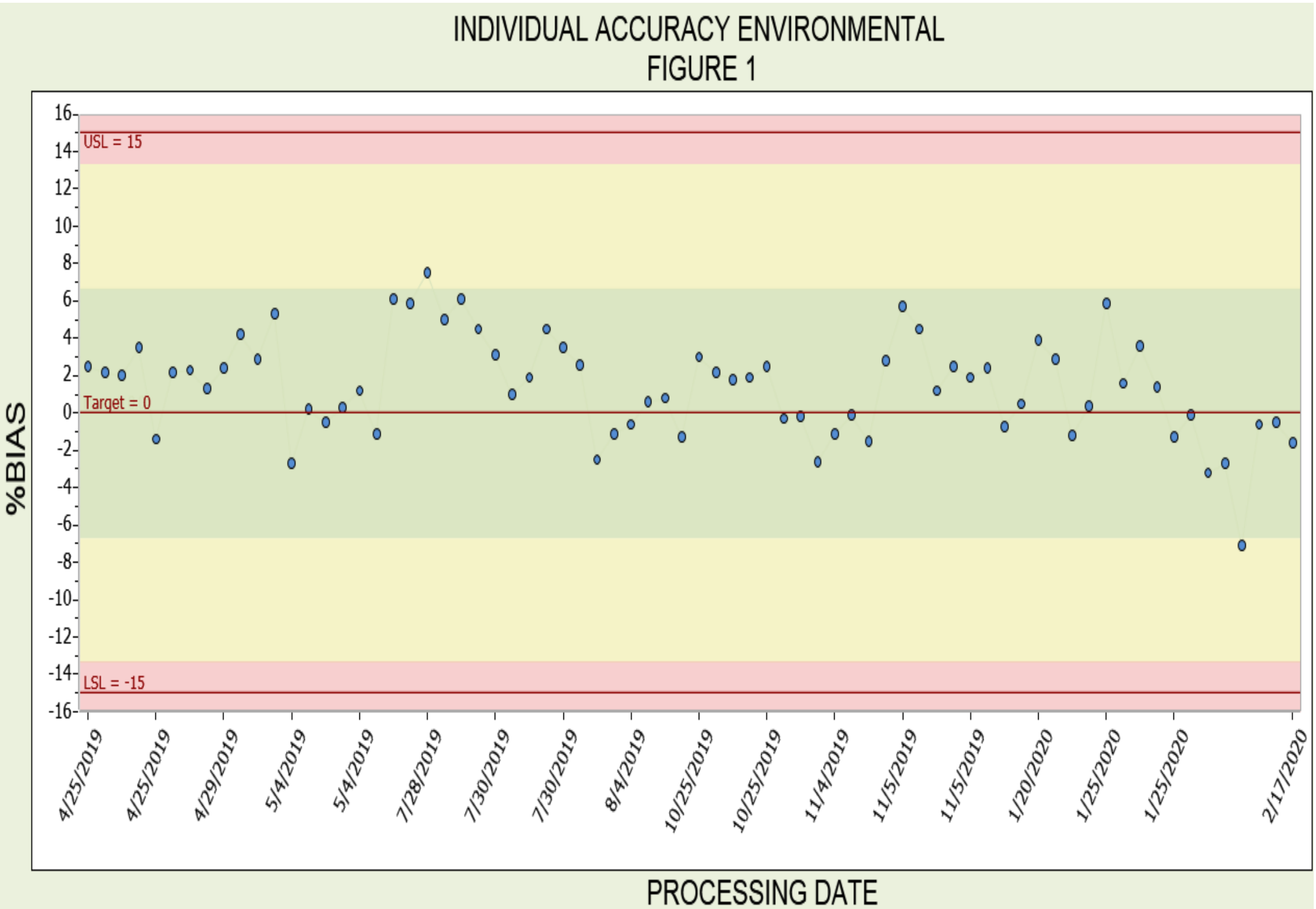
Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2019	Millstone	0.6	2.6	Pass
2nd Qtr.2019	Seabrook	7.8	2.0	Pass
3rd Qtr. 2019	SONGS	0.1	2.4	Pass
3rd Qtr. 2019	Millstone	1.1	1.9	Pass
4th Qtr.2019	PSEG(PNNL)	-3.2	0.9	Pass
4th Qtr.2019	Seabrook	0.9	1.0	Pass

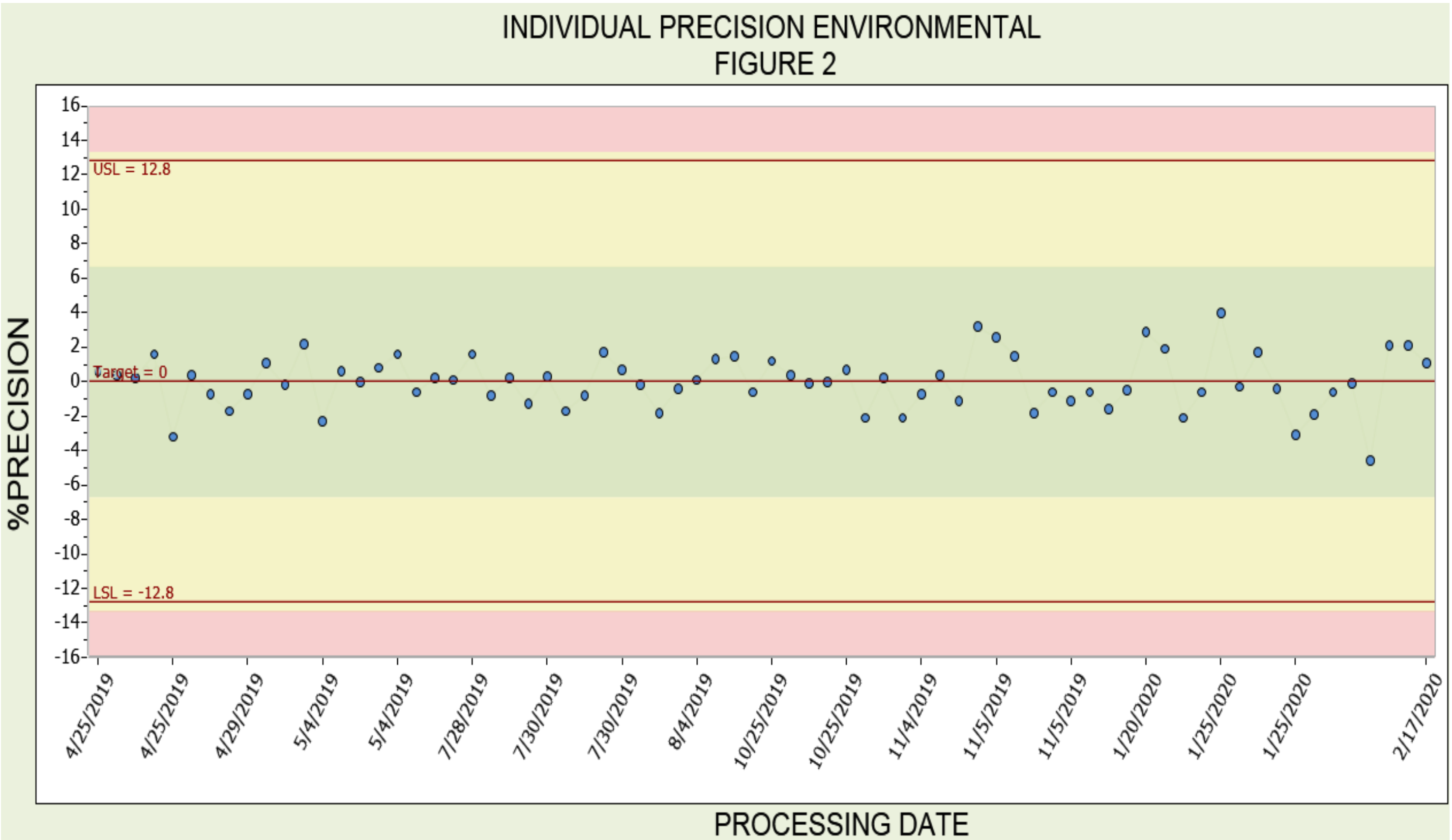
[(1)]Performance criteria are +/- 15%.
[(2)]Blind spikeirradiations using Cs-137

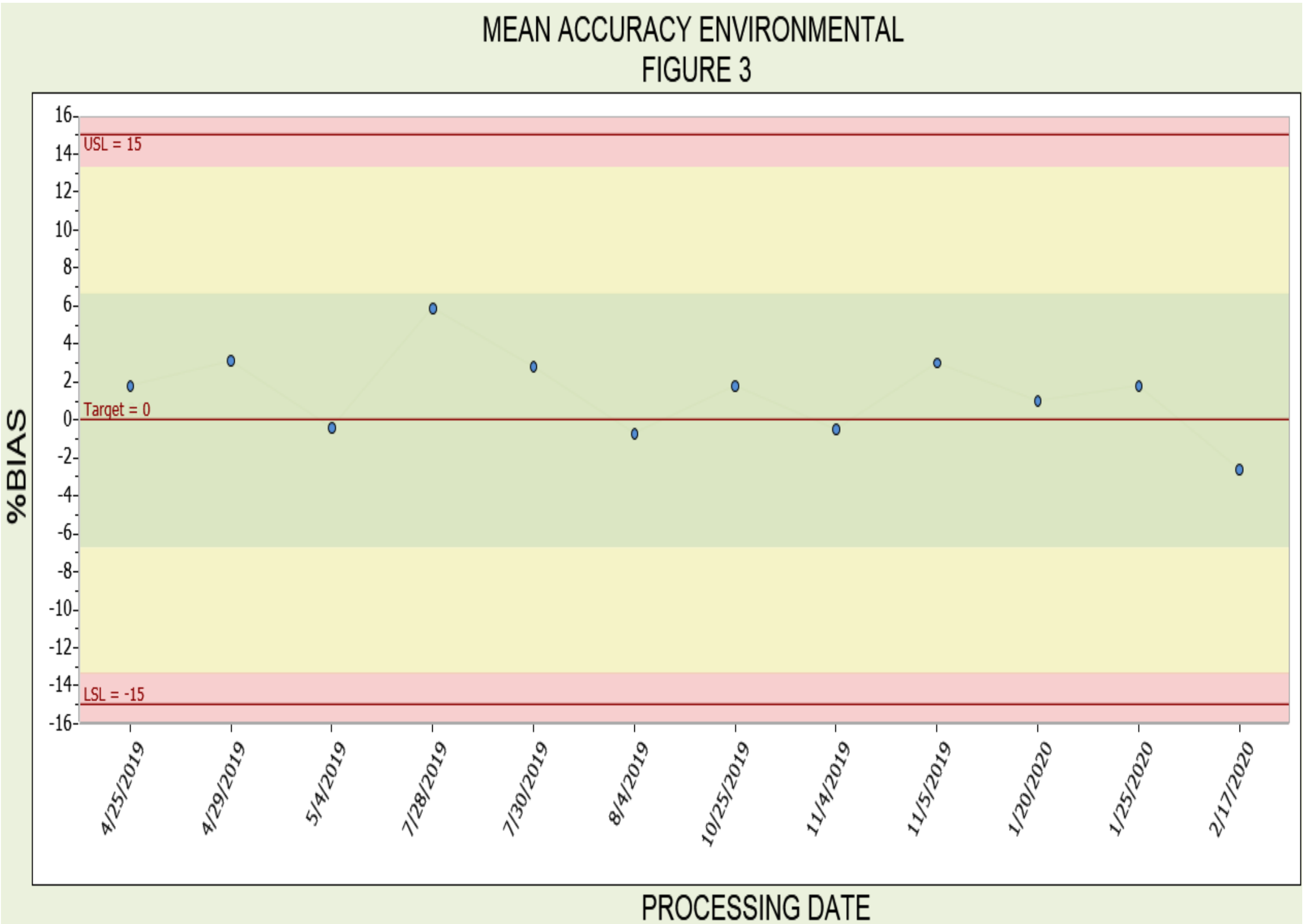
APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS

ISSUE PERIOD JANAURY - DECEMBER 2019


INDIVIDUAL ACCURACY ENVIRONMENTAL
FIGURE 1
%BIAS
USL = 15
Target = 0
LSL = -15
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4/25/2019
4/25/2019
4/29/2019
5/4/2019
5/4/2019
7/28/2019
7/30/2019
7/30/2019
8/4/2019
10/25/2019
10/25/2019
11/4/2019
11/5/2019
11/5/2019
1/20/2020
1/25/2020
1/25/2020
2/17/2020
PROCESSING DATE


INDIVIDUAL PRECISION ENVIRONMENTAL
FIGURE 2
%PRECISION
USL = 12.8
Target = 0
LSL = -12.8
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4/25/2019
4/25/2019
4/29/2019
5/4/2019
5/4/2019
7/28/2019
7/30/2019
7/30/2019
8/4/2019
10/25/2019
10/25/2019
11/4/2019
11/5/2019
11/5/2019
1/20/2020
1/25/2020
1/25/2020
2/17/2020
PROCESSING DATE


MEAN ACCURACY ENVIRONMENTAL
FIGURE 3
%BIAS
USL = 15
Target = 0
LSL = -15
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4/25/2019
4/29/2019
5/4/2019
7/28/2019
7/30/2019
8/4/2019
10/25/2019
11/4/2019
11/5/2019
1/20/2020
1/25/2020
2/17/2020
PROCESSING DATE

SEABROOK CO-LOCATE ACCURACY
FIGURE 4