KEWAUNEE SOLUTIONS

May 14, 2024 KS-2024-011

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

Kewaunee Solutions, Inc.
Facility Operating License No. DPR-43
NRC Docket No. 50-305

Subject: Kewaunee Power Station 2023 Annual Radiological Environmental Operating Report

Enclosed is the Kewaunee Power Station (KPS) 2023 Annual Radiological Environmental Operating Report for January through December 2023. This report was prepared by Microbac Laboratories-Northbrook and is submitted to meet the requirements of KPS Technical Requirements Manual (TRM) Section 10.3.

The results of the 2023 Land Use Census, submitted in accordance with the KPS Radiological Environmental Monitoring Manual, Section 2.2.2/2.3.2, are also included in this report.

If you have any questions or require additional information, please feel free to contact myself at 508-728-1421.

Respectfully,

Joseph R. Lynch Digitally signed by Joseph R. Lynch
Date: 2024.05.14 13:45:38 -04'00'

Joseph R. Lynch
Licensing Manager
Kewaunee Solutions, Inc.

Commitments made in this letter: None

Attachment:

1. Kewaunee Power Station 2023 Annual Radiological Environmental Operating Report

cc:
Regional Administrator, Region III U.S. Nuclear Regulatory Commission
Mr. Karl Sturzebecher, Project Manager U.S. Nuclear Regulatory Commission
Mr. Robert Busch, Wisconsin Department of Health Services Radiation Protection Section Radioactive Materials Program
Mr. Edward Everett, Director Engineering and Loss Control Support American Nuclear Insurers

ATTACHMENT 1

Kewaunee Power Station 2023 Annual Radiological Environmental Operating Report.

(261 Pages)

KEWAUNEE SOLUTIONS

2023 Annual Radiological Environmental Operating Report

Kewaunee Power Station

KEWAUNEE SOLUTIONS

2023 Annual Radiological Environmental Operating Report

Kewaunee Power Station

Part I

Summary and Interpretation

MICROBAC®

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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

TO

RADIOLOGICAL MONITORING PROGRAM FOR
THE KEWAUNEE POWER STATION
KEWAUNEE, WISCONSIN

PART I - SUMMARY AND INTERPRETATION

January 1 to December 31, 2023

Prepared and submitted by:

Microbac Laboratories – Northbrook

Project No. 8002

Approved :

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Microbac Laboratories – Northbrook

Daniel J. Shannon
Radiation Protection Technical Manager
Kewaunee Power Station

PREFACE

The staff of Microbac Laboratories - Northbrook were responsible for the presentation of data in this report. Assistance in sample collection was provided by Kewaunee Power Station personnel. The report was prepared by staff members of Microbac Laboratories - Northbrook. Teledyne Brown Engineering, Inc. is responsible for the radiochemical analyses. Mirion Dosimetry Services is responsible for the Thermoluminescent Dosimetry.

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1.0 INTRODUCTION

The Kewaunee Power Station was a 598 megawatt pressurized water reactor located on the Wisconsin shore of Lake Michigan in Kewaunee County. The Plant became critical on March 7, 1974. Initial power generation was achieved on April 8, 1974, and the Plant was declared commercial on June 16, 1974.

Power operations of the Kewaunee Power Station ceased on May 7, 2013. The fuel was permanently removed from the reactor and placed in the spent fuel pool for storage on May 14, 2013. On June 15, 2017, the transfer of all spent fuel from the KPS Spent Fuel Pool (SFP) to the Independent Spent Fuel Storage Installation (ISFSI) was completed. All remaining irradiated materials were removed from the SFP in October of 2017. All radioactive liquid was drained from systems in the Auxiliary Building by the end of the first week of August 2018.

On June 28, 2022, Dominion Energy Kewaunee (DEK) was sold to Energy Solutions and assumed the new company name of Kewaunee Solutions. The sale included the Kewaunee Power Station and ISFSI, and the transfer of the operating license DPR-43.

This report summarizes the environmental operation data collected during the period January – December 2023.

Energy Solutions, operator, and owner of the Kewaunee Power Station, assumes responsibility for the environmental program at the Plant. Any questions should be directed to Mr. Daniel J. Shannon, Radiological Protection Technical Manager, at (920) 304-1129.

2.0 SUMMARY

Results of sample analyses during the period January - December 2023 are summarized in Table 4.5. Radionuclide concentrations measured at indicator locations are compared with levels measured at control locations and in preoperational studies. In no instance were REMP threshold reporting levels exceeded.

3.0 RADIOLOGICAL SURVEILLANCE PROGRAM

Following is a description of the Radiological Surveillance Program and its execution.

3.1 METHODOLOGY

The sampling locations are shown in Figure 4-1. Table 4.1 describes the locations, lists for each direction and distance from the reactor, and defines which are the indicator and control locations.

The sampling program monitors the air, terrestrial, and aquatic environments. The types of samples collected at each location and the frequency of collections are presented in Table 4.2, using sample codes defined in Table 4.3. The collections and analyses that comprise the program are described below. Finally, the execution of the program in the current reporting year is discussed.

3.1.1 The Air Program

Ambient Gamma Radiation – TLDs

Ambient gamma radiation is monitored at the one control location (K-2), at four inner ring locations (K-1f, K-25, K-27 and K-30), and at six outer ring locations (K-3, K-5, K-8, K-17, K-39 and K-43) by thermoluminescent dosimeters (TLDs). Two TLDs are placed at each location; one TLD is exchanged and read quarterly; the other TLD is exchanged annually and only read on an emergency basis.

Dosimeters have also been placed at four additional locations (K-1m, K-1o, K-1q and K-1r), to monitor the independent Spent Fuel Storage Installation (ISFSI) as part of the inner ring locations. They are exchanged and read quarterly.

Airborne Particulates

Airborne particulates are on 47 mm diameter filters, at a volumetric rate of approx. one cubic foot per minute. The filters are collected weekly from four locations (K-1f, K-2(control), K-8 and K-43), and dispatched by mail to the vendor lab for radiometric analysis. The particulate filters are counted for gross beta activity, a minimum of three days after collection, to allow for the decay of naturally-occurring short-lived radionuclides.

Quarterly composites from each sampling location are analyzed for gamma-emitting isotopes by gamma spectroscopy.

Airborne Iodine

Airborne iodine analysis was discontinued beginning in 2018 due to the cessation of power operations (see Introduction on page 1).

Precipitation

The collection and analysis of precipitation samples was discontinued beginning in 2018 due to the cessation of power operations (see Introduction on page 1).

3.1.2 The Terrestrial Program

Milk

The collection and analysis of milk samples was discontinued beginning in 2018 due to the cessation of power operations (see Introduction on page 1).

Well Water

Well water is collected quarterly from one off-site well location K-13 and from three on-site wells located at K-1h, K-1u and K-1v. Samples are only collected at locations K-1u and K-1v when these sources are tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

Gamma spectroscopic analysis, tritium and gross beta on the total residue are performed for each water sample. The concentration of potassium-40 is calculated from total potassium. Samples of water from the three on-site wells (K-1h, K-1u and K-1v) are analyzed for gross alpha. The water sample from K-1h is also tested for strontium-90.

Monitoring wells and results associated with the Ground Water Protection Program (GWPP) are reported in the KPS Annual Radioactive Effluent Release Report (ARERR). The groundwater monitoring well locations associated with the GWPP are included in Figure 4-2 along with the onsite well water sampling locations associated with the REMP.

Domestic Meat

The collection and analysis of domestic meat was discontinued in 2018 due to the cessation of power operations (see Introduction on page 1).

Eggs

The collection and analysis of eggs was discontinued in 2018 due to the cessation of power operations (see Introduction on page 1).

Broad leaf Vegetation

Annually, during the third quarter, samples of broad leaf vegetation are collected from location K-26. Samples may also be obtained from other local sources to supplement the program. In addition, two samples of broad leaf vegetation are collected annually from farmland owned by Dominion Energy Kewaunee (K-23a and K-23b) and rented to a private individual for growing crops. The samples are analyzed for gamma emitting isotopes.

Cattle Feed

Cattle feed (e.g., hay and silage) is collected during the first quarter from dairy farm locations (K-3, K-34, K-35, K-38 and K-45). The samples are analyzed for gross beta, strontium-90 and gamma emitting isotopes.

Grass

Grass is collected during the second, third and fourth quarters from two on-site locations (K-1b and K-1f) and from the dairy farm locations (K-3, K-5, K-34, K-35, K-38 and K-39). The samples are analyzed for gross beta, strontium-90 and gamma emitting isotopes.

Soil

Soil samples are collected twice a year on-site at K-1f and from the dairy farm locations (K-3, K-34, K-35 and K-38). The samples are analyzed for gross alpha, gross beta, strontium-90 and gamma emitting isotopes.

3.1.3 The Aquatic Program

Surface Water

Surface water samples are taken quarterly from two locations on Lake Michigan: 1) at the point where plant effluent water is discharged into Lake Michigan (K-1d); and 2) at the main pumping station located approximately equidistant from Kewaunee and Green Bay, which pumps water from the Rostok water intake (K-9) located 11.5 miles NNE of the reactor site. Both raw and tap water are collected at K-9. One-gallon water samples are taken quarterly from two creeks that pass through the site (K-1b and K- 1e). Samples from the Middle Creek (K-1b) are collected near the mouth of the creek. Samples from the South Creek (K-1e) are collected about ten feet downstream from the point where the outflow from the two drain pipes meets.

The water is analyzed for gamma emitting isotopes, gross beta activity in total residue, dissolved and suspended solids, tritium and strontium-90.

Fish

Fish samples are collected during the third quarter near location K-1d. The flesh is separated from the bones, gamma scanned and analyzed for gross beta activity. Bone samples are analyzed for gross beta, and strontium-90. A local fish market, (e.g.,Lafond's in Kewaunee), may be used for backup fish samples, if needed.

Aquatic Slime

The collection and analysis of aquatic slime was discontinued in 2018 due to the cessation of power operations (see Introduction on page 1).

Shoreline Sediment

Shoreline sediments are collected in May and November from three locations (K-1c, K-1j and K-9) in areas with potential for recreational value. The samples are analyzed for gross beta, strontium-90 and gamma emitting isotopes.

3.1.4 Program Execution

Program execution is summarized in Table 4.4. The program was executed for the year 2023 as described in the preceding sections, with the following exceptions:

Air Particulates

Run time was low at location K-43 for the air particulate sample, period ending 3/28/23, due to a power outage (CR#2438). Air sampler at location K-8 was found off (not running) during the filter change for the period ending 5/30/23(CR2474). The plug was adjusted in the receptacle and the pump was restarted after the filter change. WPS secured power to the location K-2 on 10/16/23 at approximately 0900 to support a site electrical modification. Power was restored to the site on 10/23/23 at approximately 0830. (CR#2612).

3.1.5 Program Modifications

Beginning in January 2023 Mirion type 20 environmental TLD's replaced Teledyne Isotope environmental TLD's provided by Environmental Inc.

Well water sampling at location K-1t Gatehouse was discontinued after the 7/5/23 sample collection due to abandonment of the Gatehouse well as part of the site decommissioning. Sampling at new location K-1v South Well was initiated on 10/2/23 due to installation of a potable water supply for the new trailer complex at the site.

Changes were made to the Groundwater Protection Program based on the recommendations from the revised Hydrogeologic Conceptual Site Model, and to support the active decommissioning of the site. These changes included abandonment of the eight AB wells due to their location in the demolition area, the addition of four paired (deep/shallow) monitoring wells, and the addition of the three new deep monitoring wells. Potable water supply and groundwater monitoring well locations are shown on Figure 4-2.

3.2 RESULTS AND DISCUSSION

Results for the reporting period January to December, 2023 are presented in summary form in Table 4.5. For each type of analysis, of each sampled medium, the table shows the annual mean and range for all indicator and control locations. The location with the highest annual mean and the results for this location are also given.

The discussion of the results has been divided into three broad categories: the air, terrestrial, and aquatic environments. Within each category, samples will be discussed in the order listed in Table 4.4.

Results of all measurements made in 2023 are not included in this section, although references to these results will be made in the discussion. A complete tabulation of results is provided in Part II of the 2023 annual report on the Radiological Monitoring Program for the Kewaunee Power Station.

3.2.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no atmospheric nuclear tests or accidents reported in 2023. The Chernobyl and Fukushima Daiichi nuclear accidents occurred on April 26, 1986 and March 11, 2011, respectively. The last reported atmospheric nuclear test was conducted by the People's Republic of China on October 16, 1980. Contributions from these events have resulted in the presence of long-lived radioisotopes of cesium and strontium still detectable in the environment.

3.2.2 The Air Environment

Ambient Gamma Radiation – TLDs

Ambient gamma radiation was monitored by TLDs at eleven locations, ten indicators (K-1f, K-3, K-5, K-8, K-17, K-25, K-27, K-30, K-39 and K-43) and one control (K-2). TLDs at the indicator locations measured a mean dose equivalent of 14.9 mR/91 days, in close agreement with the control location 14.8 mR/91 days. The readings are slightly lower than the averages obtained from 2002 (and prior to) through 2022 due to the change to a new Environmental TLD vendor and the accounting for transit and control dose.

These results support the conclusion that no plant effect on ambient gamma radiation was indicated. These values are comparable to the United States average value of 19.5 mR/91 days due to natural background radiation (National Council on Radiation Protection and Measurements, 1975). The highest annual mean was 16.4 mR/91 days, measured at indicator location K-39.

Year	Average (Indicators)	Average (Controls)
	Dose rate (mR/91 days)	
2008	15.6	14.2
2009	15.2	13.9
2010	15.2	14.3
2011	15.0	14.5
2012	16.1	15.3
2013	16.2	16.5
2014	15.0	14.8
2015	16.2	16.11
2016	16.1	15.9
2017	16.1	15.4
2018	16.4	17.1
2019	15.8	16.6
2020	16.4	16.7
2021	16.4	16.5
2022	17.1	16.6
2023	14.9	14.8

Using ANSI/HPS N13.37-2014 as guidance, a determination of facility related dose was performed using quarterly TLD data from control and indicator locations from 2013 through 2022. A Quarterly Baseline Background Dose (B_Q) was computed for each TLD location. Then a Quarterly Minimum Differential Dose (MDD_Q) was calculated as 3 times the 90th percentile of the standard deviations of the historical quarterly results. The result of this calculation was 5.1 mrem. Due to changing TLD vendors starting in January 2023, transit and storage doses needed to be considered and the quarterly results reported by the vendor were corrected for the extraneous dose.

2023 results at all locations, both indicator and control, were lower than the sum of the Baseline Background Dose (B_Q) and the Quarterly Minimum Differential Dose (MDD_Q) which according to ANSI/HPS 13.37-2014 indicates no detection (ND) and which supports the conclusion that there is no plant effect.

Monitoring Location	Quarterly Baseline B_Q(mrem)	Normalized Quarterly Monitoring Data M_Q (mrem per standard quarter)				Quarterly Facility Dose $F_Q = M_Q - [B_Q+MDD_Q]$(mrem)			
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Indicators									
K-1f	14.5	13.7	12.5	12.4	14.6	ND	ND	ND	ND
K-3	17.0	14.0	13.6	14.5	16.6	ND	ND	ND	ND
K-5	15.8	13.7	14.5	12.7	15.8	ND	ND	ND	ND
K-8	16.0	14.3	14.6	15.8	16.3	ND	ND	ND	ND
K-17	17.1	13.6	16.1	15.7	19.1	ND	ND	ND	ND
K-25	18.2	14.6	14.8	14.9	18.9	ND	ND	ND	ND
K-27	16.5	14.5	14.2	14.6	17.8	ND	ND	ND	ND
K-30	15.9	13.2	13.1	15.4	14.4	ND	ND	ND	ND
K-39	16.8	15.7	15.1	16.3	18.3	ND	ND	ND	ND
K-43	14.7	13.1	13.1	15.0	15.6	ND	ND	ND	ND
Control									
K-2	16.7	13.5	14.8	14.3	16.5	ND	ND	ND	ND

Table assumes 1 roentgen = 1 rem.

Airborne Particulates

The annual gross beta concentration in air particulates averaged 0.020 pCi/m^3 at both the indicator and control locations, similar to the means observed from 2002 (and prior to) through 2022. There is no indication of a plant effect, the average readings were evenly distributed between indicator and control locations Results are tabulated below.

Year	Average (Indicators)	Average (Controls)
	Concentration (pCi/m^3)	
2002	0.023	0.023
2003	0.022	0.022
2004	0.019	0.020
2005	0.023	0.023
2006	0.021	0.021
2007	0.022	0.021
2008	0.022	0.022
2009	0.023	0.023
2010	0.023	0.022
2011	0.029	0.029
2012	0.029	0.030
2013	0.024	0.025
2014	0.019	0.019
2015	0.022	0.022
2016	0.021	0.020
2017	0.021	0.021
2018	0.023	0.024
2019	0.021	0.019
2020	0.023	0.023
2021	0.025	0.023
2022	0.025	0.023
2023	0.020	0.020

Average annual gross beta concentrations in airborne particulates.

Variation in the gross beta activity throughout the year is not unusual. Typically, higher beta averages occur during the months of January and December, and the first and fourth quarters, as noted in data from 2002 through 2022.

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, produced continuously in the upper atmosphere by cosmic radiation, was detected in all samples, with an average activity of 0.193 pCi/m^3 at the indicator locations and an average of 0.180 pCi/m^3 at the control location. All other gamma-emitting isotopes were below their respective MDC levels.

3.2.3 The Terrestrial Environment

Well Water

One of twelve indicator samples tested positive for gross alpha at a reading of 2.3 pCi/L. Detectable gross beta activity was measured in all twelve indicator samples at average level of 6.0 pCi/L. None of the four control samples tested were positive for gross beta. Potassium-40, as measured by gamma spectroscopy, was not detected in any of the 16 samples tested. The positive gross beta is likely due to the presence of potassium-40 at a level below what gamma spectroscopy is able to detect. Past analysis for potassium by mass spectrometry has confirmed the presence of potassium in water samples obtained from these wells and potassium-40 is present in all naturally occurring potassium in the environment. Therefore, positive results can be attributed to agricultural runoff. The gross alpha activities are most likely contributions from naturally-occurring daughters of radium and thorium when detected in the well water.

No strontium-90 was detected in any of the four samples tested. All concentrations measured below an MDC value 2.8 pCi/L.

Sixteen well water samples were tested for tritium and gamma emitting isotopes. All tritium concentrations measured below a detection level of 188 pCi/L. Gamma-emitting isotopes measured below respective MDC levels.

Broad Leaf Vegetation

Three samples of broad leaf vegetation were analyzed for gamma emitters. Only naturally occurring potassium-40 and beryllium-7 were detected.

Cattle Feed

In the ten cattle feed samples analyzed in 2023 the gross beta average concentrations of 11.72 pCi/g wet indicator and 8.98 pCi/g wet control which agrees well with the potassium-40 average concentration results of 7.08 pCi/g wet indicator and 4.76 pCi/g wet control. Strontium-90 was detected in two of the six indicator samples at an average level of 0.010 pCi/g wet and at three of the four control samples also at an average level 0.010 pCi/g wet. Trace levels of strontium-90 in the environment can be attributed to nuclear testing and accidents. These results are also comparable to historical results for analysis of cattle feed. No plant effect is indicated.

Grass

Eighteen grass samples were collected in June, August and October at six indicator locations and two control locations for a total of twenty-four samples for the year. The samples were analyzed for gross beta, strontium-90 and gamma emitting isotopes. Analysis results show very good agreement between the gross beta results and the potassium-40 results. Naturally occurring beryllium-7 was also detected in a majority of the samples. Strontium-90 was detected in two of the eighteen samples tested in 2023. Trace levels of strontium-90 in the environment can be attributed to nuclear testing and accidents.

With the exception of the naturally-occurring beryllium and potassium, all gamma-emitting isotopes were below MDC levels. These results are comparable to historical results for analysis of grass. No plant effect is indicated.

Soil

Gross alpha concentrations in soil averaged 4.73 pCi/g dry in the six indicator samples and 3.50 pCi/g dry in the four control samples. Mean gross beta levels measured at indicator and control locations averaged 32.27 and 22.8 pCi/g dry, respectively, primarily due to potassium-40 activity. Strontium-90 was detected in one of the control location soil samples tested in 2023. Trace levels of strontium-90 in the environment can be attributed to nuclear testing and accidents.

Cesium-137 was detected in one of the indicator location samples tested at a concentration of 0.13 pCi/g dry. Trace levels of Cs-137 in the environment can be attributed to nuclear testing and accidents. Potassium-40 was detected in all samples and averaged 18.7 and 16.5 pCi/g dry for indicator and control locations, respectively. All other gamma-emitting isotopes were below respective MDC levels. The levels of detected activities are comparable to those observed from 1990 through 2022. The data suggests no evidence of a plant effect.

3.2.4 The Aquatic Environment

Surface Water

Average gross beta activity in surface water measured slightly higher at the indicator locations (5.3 pCi/L) than at the control locations (2.9 pCi/L). A similar pattern of activity has been observed since 1978. The highest gross beta activity measured in 2023 was sampled from location K-1b at 7.4 pCi/L which is most likely due potassium-40 present in agricultural runoff.

Year	Average (Indicators)	Average (Controls)
	Gross Beta (pCi/L)	
2002	5.7	2.2
2003	7.3	2.4
2004	6.2	2.3
2005	5.2	1.7
2006	5.5	1.8
2007	5.7	1.8
2008	4.7	1.5
2009	4.7	1.5
2010	4.7	1.4
2011	5.0	1.5
2012	6.1	1.4
2013	5.7	1.5
2014	4.4	1.9
2015	4.2	1.4
2016	5.2	1.6
2017	4.2	1.4
2018	2.8	1.1
2019	3.1	1.2
2020	3.3	0.9
2021	2.2	1.1
2022	5.0	1.6
2023	5.3	2.9

Average annual gross beta concentrations in surface water.

These results are comparable with what has been observed in the past.

Tritium was below an MDC of 199 pCi/L in all twenty samples tested in 2023. No Sr-90 was detected above an MDC of 4.6 pCi/L in any of the twenty samples tested in 2023.

With the exception of naturally occurring potassium-40, gamma-emitting isotopes measured below their respective MDC levels in all samples.

Fish

In the fish sample, the gross beta concentration was 6.12 pCi/g wet in flesh and 4.23 pCi/g wet in bone fractions. In flesh, the gross beta concentration was primarily due to the potassium-40 concentration of 3.27 pCi/g wet. Sr-90 was not detected in the bone fraction above an MDC of 0.06 pCi/g wet.

Excluding potassium-40, gamma-emitting isotopes measured below their respective MDC levels.

Shoreline Sediments

In shoreline sediment samples, the mean gross beta concentrations measured an average 10.3 pCi/g dry at the indicator locations versus an average of 15.5 pCi/g dry at the control location. These results are consistent with the average levels of potassium-40 measured in these samples (6.68 pCi/g dry and 8.13 pCi/g dry respectively).

Other gamma-emitting isotopes, with the exception of naturally-occurring potassium-40, were below their respective MDC levels.

Strontium-90 was measured below an MDC of 0.581 pCi/g dry for all locations.

These results support the conclusion that there is no plant effect.

3.3 LAND USE CENSUS

The Land Use Census satisfies the requirements of the KPS Radiological Environmental Monitoring Manual. Section 2.2.2 states:

"A land use census shall be conducted and shall identify within a distance of 8 km (5 mi.) the location, in each of the 10 meteorological sectors, of the nearest residence and the nearest garden of greater than $50 m^2$ ($500 ft^2$) producing broad leaf vegetation." (Figure 4-1)

The 2023 Land Use Census was completed to identify the presence of the nearest residences and gardens surrounding the Kewaunee Power Station. The Land Use Census was conducted on September 5, 2023. The census is performed annually during the growing season per Radiation Protection Procedure RP-KW-001-014.

No changes were observed during the course of the Land Use Census. A summary of the Land Use Census is shown in table 4.6.

3.4 LABORATORY PROCEDURES

Analytical procedures and the quality assurance manual used by Teledyne Brown Engineering Environmental Service (TBE-ES) Laboratory are available for inspection, and the QA Program includes participation in Interlaboratory Comparison Programs. Results obtained for the TBE-ES Laboratory are presented in Appendix A.

4.0 FIGURES AND TABLES

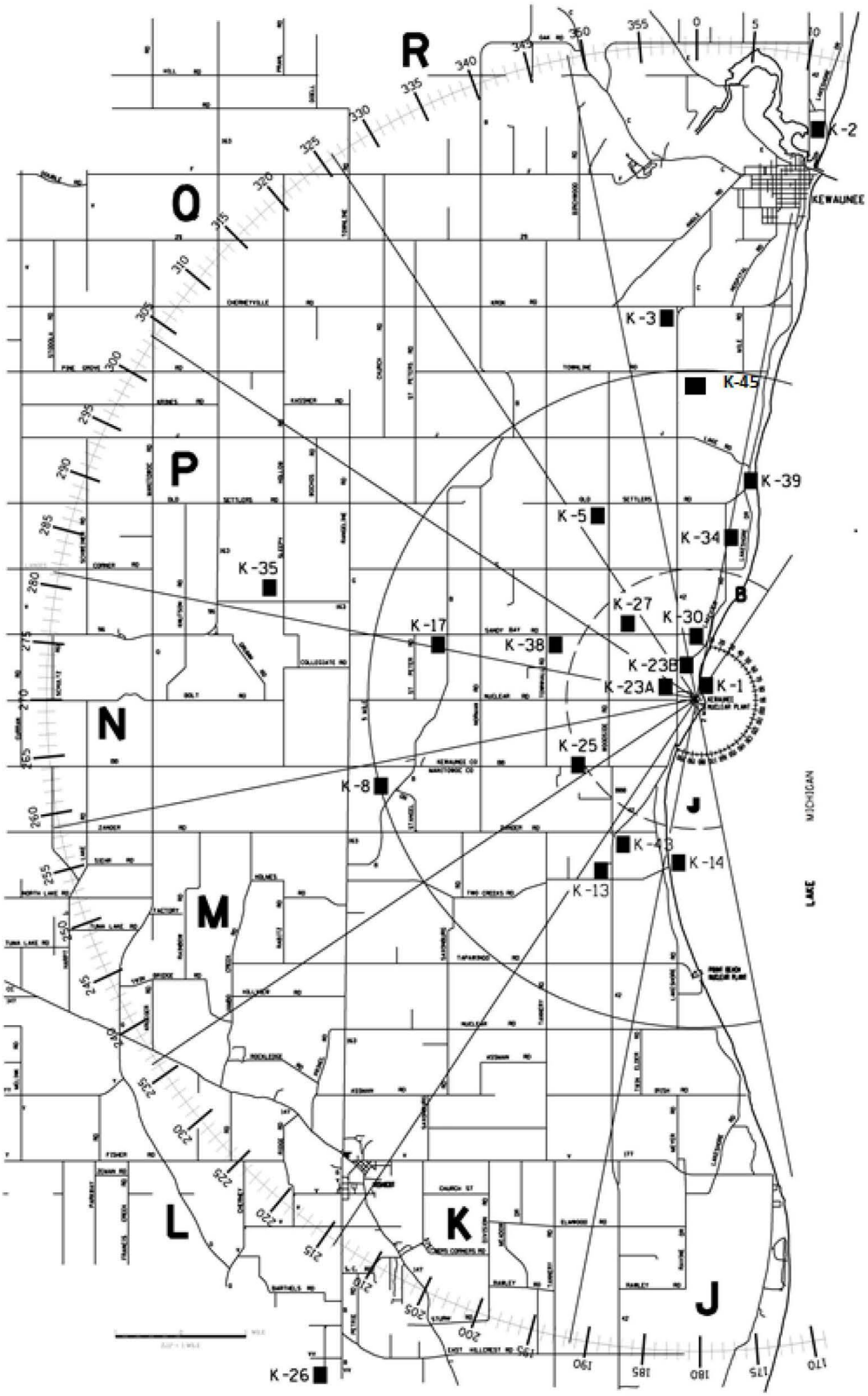

Figure 4-1. Sampling locations, Kewaunee Power Station.

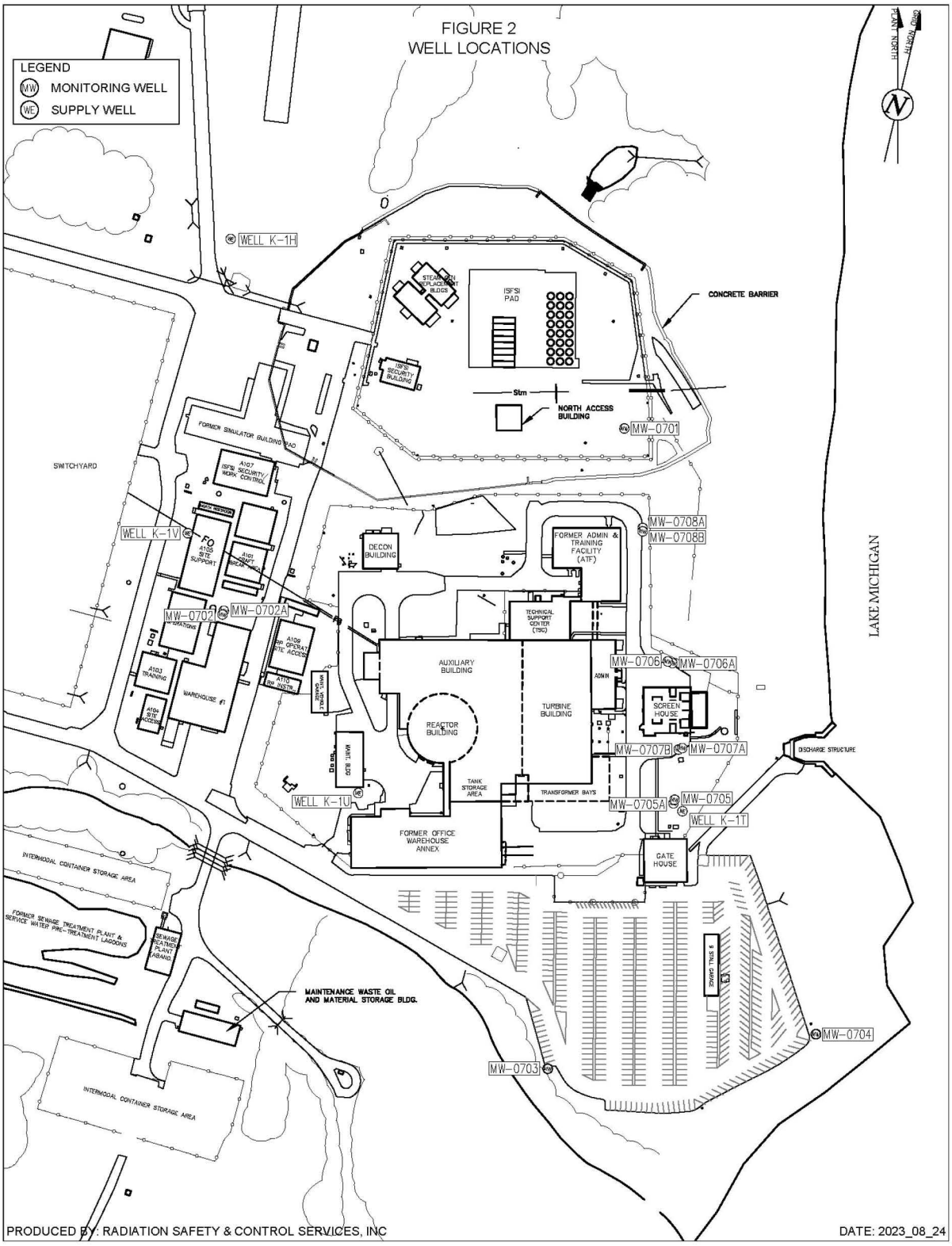

Figure 4-2. Groundwater Monitoring Wells, Kewaunee Power Station.

Table 4.1. Sampling locations, Kewaunee Power Station.

Code	Type [a]	Distance (miles)[b] and Sector	Location
K-1	I		Onsite
K-1b	I	0.12 N	Middle Creek
K-1c	I	0.10 N	500' north of condenser discharge
K-1d	I	0.10 E	Condenser discharge
K-1e	I	0.12 S	South Creek
K-1f	I	0.12 S	Maintenance Waste Oil and Material Storage Building
K-1h	I	0.12 NW	North Well
K-1j	I	0.10 S	500' south of condenser discharge
K-1m	I	0.15 N	ISFSI East
K-1o	I	0.16 N	ISFSI North
K-1q	I	0.16 N	ISFSI West
K-1r	I	0.13 N	ISFSI West
K-1t[d]	I	0.10 ESE	Gatehouse
K-1u	I	0.05 SSW	Maintenance Building
K-1v[e]	I	0.06 W	South Well
K-2	C	8.91 NNE	WPS Operations Building in Kewaunee
K-3[c]	I/C	5.9 N	Lyle and John Siegmund Farm, N2815 Hwy 42, Kewaunee
K-5	I	3.2 NNW	Ed Paplham Farm, E4160 Old Settlers Rd, Kewaunee
K-8	I	4.85 WSW	St. Isadore the Farmer Church, 18424 Tisch Mills Rd, Tisch Mills
K-9	C	11.5 NNE	Green Bay Municipal Pumping Station, six miles east of Green Bay (sample source is Lake Michigan from Rostok Intake two miles north of Kewaunee.
K-13	C	3.0 SSW	Rand's General Store, Two Creeks
K-17	I	4.0 W	Klimesh's' Farm, N885 Tk B, Kewaunee
K-23a	I	0.5 W	0.5 miles west of plant, Kewaunee site
K-23b	I	0.6 N	0.6 miles north of plant, Kewaunee site
K-25	I	1.9 SW	Wotachek Farm, 3968 E. Cty Tk BB, Two Rivers
K-26	C	9.1 SSW	Wilfert Farms Vegetable Stand (9.1 miles south of "BB")
K-27	I	1.53 NW	Schleis Farm, E4298 Sandy Bay Rd, Kewaunee
K-30	I	0.8 N	End of site boundary
K-34	I	2.7 N	Leon and Vicky Struck, N1549 Lakeshore Dr., Kewaunee
K-35	C	6.71 WNW	Duane Ducat, N1215 Sleepy Hollow Rd., Kewaunee
K-38	I	2.45 WNW	Dave Sinkula Farm, N890 Town Hall Road, Kewaunee
K-39	I	3.46 N	Francis Wojta, N1859 Lakeshore Dr., Kewaunee
K-43	I	2.71 SSW	Gary Maigatter Property, 17333 Hwy 42, Two Rivers
K-45	I	5.1 N	Wakker's Dairy, N2348 Highway 42, Kewaunee

[a] I = indicator; C = control

[b] Distances are measured from reactor stack.

[c] Location K-3 is an indicator for ambient radiation and a control for soil, cattle feed, and grass.

[d] Sampling discontinued at location K-1t after 7 /5/23 sample collection due to abandonment of Gatehouse well.

[e] Sampling initiated at location K-1v on 10/2/23 due to installation of new potable water supply well (South Well).

Table 4.2. Type and frequency of collection.

Location	Weekly	Quarterly	Semiannually	Annually
K-1b		SW GR [a]		
K-1c			SS [b]	
K-1d		SW		FI[c]
K-1e		SW		
K-1f	AP [g]	GR [a] TLD	SO	
K-1h		WW		
K-1j			SS [b]	
K-1m		TLD		
K-1o		TLD		
K-1q		TLD		
K-1r		TLD		
K-1t / K-1v		WW[h]		
K-1u		WW		
K-2	AP [g]	TLD		
K-3		GR [a] TLD	SO	CF [d]
K-5		GR [a] TLD		
K-8	AP [g]	TLD		
K-9		SW [f]	SS [b]	
K-13		WW		
K-17		TLD		
K-23a				BLV [e]
K-23b				BLV [e]
K-25		TLD		
K-26				BLV [e]
K-27		TLD		
K-30		TLD		
K-34		GR [a]	SO	CF [d]
K-35		GR [a]	SO	CF [d]
K-38		GR [a]	SO	CF [d]
K-39		GR [a] TLD		
K-43	AP [g]	TLD		
K-45				CF [d]

[a] Three times a year, second (April, May, June), third (July, August, September), and fourth (October, November, December) quarters
[b] Collected in May and November
[c] Annually in the third quarter (July, August, or September).
[d] First quarter (January, February or March) only.
[e] Alternate since milk sampling is no longer performed.
[f] Two samples, raw and treated
[g] The frequency may be increased dependent on the dust loading.
[h] Sampling discontinued at location K-1t after 7/5/23 sample collection due to abandonment of Gatehouse well; sampling initiated at location K-1v on 10/2/23 due to installation of new potable water supply well (South Well).

Table 4.3. Sample Codes:

Code	Description
AP	Airborne particulates
BLV	Broad leaf vegetation
CF	Cattle feed
FI	Fish
GR	Grass
SO	Soil
SW	Surface water
SS	Shoreline sediment
TLD	Thermoluminescent dosimeter
WW	Well water

Table 4.4. Sampling Summary, January – December, 2023.

Sample Type	Collection Type and Frequency [a]	Number of Locations	Number of Samples Collected	Number of Samples Missed
Air Environment				
TLD's	C/Q	15	60	0
Airborne particulates	C/W	4	207	1
Terrestrial Environment				
Well water	G/Q	4	16	0
Broad Leaf Vegetation	G/A	3	3	0
Cattle Feed	G/A	5	10	0
Grass	G/TA	8	24	0
Soil	G/SA	5	10	0
Aquatic Environment				
Surface water	G/Q	4	20	0
Fish	G/A	1	1	0
Shoreline sediments	G/SA	3	6	0

[a] Type of collection is coded as follows: C = continuous; G = grab.
Frequency is coded as follows: W = weekly; BW = bi-weekly; SM = semimonthly; M = monthly; Q = quarterly; SA = semiannually; TA = three times per year; A = annually.

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station
Location of Facility: Kewaunee County, Wisconsin (County, State)
Docket No.: 50-305
Reporting Period: January-December, 2023

Sample Type (Units)	Type and Number of Analyses[a]	MDC[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
TLDs (Quarterly) (mR/91days)	Gamma 44	5.1[f]	14.9 (40/40) (14.1-16.7)	K-39,Wojta Property 3.46 N	16.4 (4/4) (15.1-18.3)	14.8 (4/4) (13.5-16.5)	0
TLDs, Quarterly (Protected Area) (mR/91days)	Gamma 16	5.1[f]	56.5 (16/16) (54.1-59.3)	K-1m, ISFSI E 0.15 N	103.2 (4/4) (96.6 -111.6)	None	0
Airborne Particulates (pCi/m^3)	GB 208	0.010	0.020 (156/156) (0.006-0.065)	K-43, Maigatter Property, 2.71 SSW	0.021 (52/52) (0.007-0.065)	0.020 (52/52) (0.005-0.039)	0
	GS 16						
	Be-7	0.020	0.193 (12/12) (0.122-0.263)	K-8,St. Isadore the Farmer Church 4.85 WSW	0.201 (4/4) (0.177-0.263)	0.180 (4/4) (0.098-0.249)	0
	Nb-95	0.0377	< MDC	-	-	< MDC	0
	Zr-95	0.0142	< MDC	-	-	< MDC	0
	Ru-103	0.0183	< MDC	-	-	< MDC	0
	Ru-106	0.0286	< MDC	-	-	< MDC	0
	Cs-134	0.0030	< MDC	-	-	< MDC	0
	Cs-137	0.0024	< MDC	-	-	< MDC	0
	Ce-141	0.0294	< MDC	-	-	< MDC	0
	Ce-144	0.0188	< MDC	-	-	< MDC	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station
Location of Facility: Kewaunee County, Wisconsin (County, State)
Docket No. 50-305
Reporting Period January-December, 2023

Sample Type (Units)	Type and Number of Analyses[a]	MDC[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Well Water (pCi/L)	GA 12	3.9	2.3 (1/12)	K-1t, Gatehouse, 0.10 mi, ESE	2.3 (1/4)	None	0
	GB 16	3.1	6.0 (12/12) (3.3-11.1)	K-1v, South Well, 0.06 mi, W	11.1 (1/1)	< MDC	0
	H-3 16	188	< MDC	-	-	< MDC	0
	K-40 16	170	< MDC	-	-	-	0
	Sr-90 4	2.8	< MDC	-	-	None	0
	GS 16						
	Mn-54	8	< MDC	-	-	< MDC	0
	Fe-59	20	< MDC	-	-	< MDC	0
	Co-58	9	< MDC	-	-	< MDC	0
	Co-60	9	< MDC	-	-	< MDC	0
	Zn-65	18	< MDC	-	-	< MDC	0
	Zr-Nb-95	10	< MDC	-	-	< MDC	0
	Cs-134	10	< MDC	-	-	< MDC	0
	Cs-137	9	< MDC	-	-	< MDC	0
	Ba-La-140	16	< MDC	-	-	< MDC	0
Broad leaf Vegetation (pCi/g wet)	GS 3						
	Be-7	0.13	2.33 (2/2) (2.17-2.50)	K-23b 0.6 mi N. of Plant	2.50 (1/1)	< MDC	0
	K-40	0.50	3.73 (2/2) (3.33-4.12)	K-23a 0.5 mi W. of Plant	4.12 (1/1)	1.78 (1/1)	0
	Nb-95	0.044	< MDC	-	-	< MDC	0
	Zr-95	0.076	< MDC	-	-	< MDC	0
	Ru-103	0.051	< MDC	-	-	< MDC	0
	Ru-106	0.454	< MDC	-	-	< MDC	0
	Cs-134	0.055	< MDC	-	-	< MDC	0
	Cs-137	0.056	< MDC	-	-	< MDC	0
	Ce-141	0.078	< MDC	-	-	< MDC	0
	Ce-144	0.296	< MDC	-	-	< MDC	0
Cattle feed (pCi/g wet)	GB 10	0.008	11.72(6/6) (5.30-22.90)	K-38, Sinkula Farm 2.45mi. WNW	14.10 (2/2) (5.30-22.90)	8.98 (4/4) (5.04-13.80)	0
	Sr-90 10	0.006	0.010 (2/6) (0.009-0.010)	K-34, Struck Farm 2.7 mi. N	0.010 (1/2)	0.010 (3/4) (0.003-0.017)	0
	GS 10						
	Be-7	0.269	0.42 (5/6) (0.25-0.55)	K-34, Struck Farm 2.7 mi. N	0.51 (2/2) (0.48-0.53)	< MDC	0
	K-40	0.50	7.08 (6/6) (2.27-13.10)	K-38, Sinkula Farm 2.45 mi. WNW	8.57 (2/2) (4.03-13.10)	4.76 (4/4) (2.27-7.63)	0
	Nb-95	0.055	< MDC	-	-	< MDC	0
	Zr-95	0.084	< MDC	-	-	< MDC	0
	Ru-103	0.047	< MDC	-	-	< MDC	0
	Ru-106	0.433	< MDC	-	-	< MDC	0
	Cs-134	0.055	< MDC	-	-	< MDC	0
	Cs-137	0.049	< MDC	-	-	< MDC	0
	Ce-141	0.086	< MDC	-	-	< MDC	0
	Ce-144	0.339	< MDC	-	-	< MDC	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station — Docket No. 50-305
Location of Facility: Kewaunee County, Wisconsin (County, State) — Reporting Period January-December, 2023

Sample Type (Units)	Type and Number of Analyses[a]	MDC[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Grass (pCi/g wet)	GB 24	0.10	9.03 (18/18) (1.01-14.50)	K-38, Sinkula Farm 2.4 mi WNW	11.2 (3/3) (7.9-14.5)	9.64 (6/6) (6.07-11.90)	0
	Sr-90 24	0.005	0.011(2/18) (0.005-0.017)	K-38, Sinkula Farm, 2.45 mi. WNW	(0.017) (1/3)	< MDC	0
	GS 24						
	Be-7	0.26	1.82 (12/18) (1.06-3.30)	K-35, Ducat Residence 6.71 mi WNW	3.10 (2/3) (2.62-3.57)	1.96 (4/6) (0.63-3.57)	0
	K-40	0.50	5.70 (18/18) (3.16-8.19)	K-38, Sinkula Farm 2.45 mi. WNW	7.08 (3/3) (6.28-7.82)	5.17 (6/6) (3.23-6.56)	0
	Mn-54	0.051	< MDC	-	-	< MDC	0
	Co-58	0.063	< MDC	-	-	< MDC	0
	Co-60	0.092	< MDC	-	-	< MDC	0
	Nb-95	0.054	< MDC	-	-	< MDC	0
	Zr-95	0.106	< MDC	-	-	< MDC	0
	Ru-103	0.056	< MDC	-	-	< MDC	0
	Ru-106	0.457	< MDC	-	-	< MDC	0
	Cs-134	0.055	< MDC	-	-	< MDC	0
	Cs-137	0.057	< MDC	-	-	< MDC	0
	Ce-141	0.088	< MDC	-	-	< MDC	0
	Ce-144	0.332	< MDC	-	-	< MDC	0
Soil (pCi/g dry)	GA 10	5.6	4.73 (6/6) (2.64-8.27)	K-38, Sinkula Farm 2.4 mi WNW	5.64 (2/2) (3.00-8.27)	3.50 (2/2) (2.80-4.19)	0
	GB 10	2.0	32.27 (6/6) (21.90-39.40)	K-38, Sinkula Farm 2.4 mi. WNW	36.4 (2/2) (33.9-38.9)	22.8 (4/4) (17.6-28.5)	0
	Sr-90 10	0.063	< MDC	K-3, Sigmund Farm, 5.9 mi. N	(0.145) 1/2	(0.145) 1/4	0
	GS 10						
	Be-7	0.76	< MDC	-	-	< MDC	0
	K-40	1.4	18.7 (6/6) (15.6-21.4)	K-3, Sigmund Farm 5.9 mi N	21.5 (2/2) (20.1-22.9)	16.5 (4/4) (10.9-22.9)	0
	Nb-95	0.236	< MDC	-	-	< MDC	0
	Zr-95	0.191	< MDC	-	-	< MDC	0
	Ru-103	0.094	< MDC	-	-	< MDC	0
	Ru-106	0.822	< MDC	-	-	< MDC	0
	Cs-134	0.116	< MDC	-	-	< MDC	0
	Cs-137	0.120	0.13 (1/6)	K-1f,Maint & Mtrl Bldg 0.21 mi S &	0.13 (1/2)	< MDC	0
	Ce-141	0.166	< MDC	-	-	< MDC	0
	Ce-144	0.581	< MDC	-	-	< MDC	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station
Location of Facility: Kewaunee County, Wisconsin (County, State)
Docket No.: 50-305
Reporting Period: January-December, 2023

Sample Type (Units)	Type and Number of Analyses[a]	MDC[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Surface Water (pCi/L)	GB (TR) 20	3.5	5.3 (9/12) (2.5 - 7.4)	K-1b, Middle Creek 0.12 mi. N	6.0 (4/4) (2.5-7.4)	2.9 (3/8) (2.2-3.3)	0
	GS 20						
	K-40	137	133 (1/12)	K-1d, Cond. Discharge 0.10 mi. E	133 (1/4)	< MDC	0
	Mn-54	6.9	< MDC	-	-	< MDC	0
	Fe-59	15.1	< MDC	-	-	< MDC	0
	Co-58	7.4	< MDC	-	-	< MDC	0
	Co-60	9.0	< MDC	-	-	< MDC	0
	Zn-65	14.6	< MDC	-	-	< MDC	0
	Zr-Nb-95	11.6	< MDC	-	-	< MDC	0
	Cs-134	8.2	< MDC	-	-	< MDC	0
	Cs-137	8.0	< MDC	-	-	< MDC	0
	Ba-La-140	18.2	< MDC	-	-	< MDC	0
	H-3 20	199	< MDC	-	-	< MDC	0
	Sr-90 20	4.6	< MDC	-	-	< MDC	0
Fish (Flesh) (pCi/g wet)	GB 1	0.5	6.12 (1/1)	K-1d, Cond. Discharge 0.10 mi. E	6.12 (1/1)	None	0
	GS 1						
	K-40	0.5	3.27 (1/1)	K-1d, Cond. Discharge 0.10 mi. E	3.27 (1/1)	None	0
	Mn-54	0.068	< MDC	-	-	None	0
	Fe-59	0.360	< MDC	-	-	None	0
	Co-58	0.121	< MDC	-	-	None	0
	Co-60	0.080	< MDC	-	-	None	0
	Cs-134	0.073	< MDC	-	-	None	0
	Cs-137	0.065	< MDC	-	-	None	0
Fish (Bones) (pCi/g wet)	GB 1	0.5	4.23 (1/1)	K-1d, Cond. Discharge 0.10 mi. E	4.23 (1/1)	None	0
	Sr-90 1	0.06	< MDC	-	-	None	0

Table 4.5 Environmental Radiation Monitoring Program Summary.

Name of Facility: Kewaunee Power Station
Location of Facility: Kewaunee County, Wisconsin (County, State)
Docket No. 50-305
Reporting Period January-December, 2023

Sample Type (Units)	Type and Number of Analyses[a]	MDC[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Shoreline Sediments (pCi/g)	GB 6	1.0	10.3 (4/4) (7.85-11.8)	K-9, Rostok Intake 11.5 mi. NNE	15.5 (2/2) (15.0-15.9)	15.5 (2/2) (15.0-15.9)	0
	Sr-90 6	0.581	< MDC	-	-	< MDC	0
	GS 6						
	K-40	0.5	6.68 (4/4) (4.79–8.55)	K-9, Rostok Intake 11.5 mi. NNE	8.13 (2/2) (7.55–8.71)	8.13 (2/2) (7.55–8.71)	0
	Co-58	0.054	< MDC	-	-	< MDC	0
	Co-60	0.063	< MDC	-	-	< MDC	0
	Cs-134	0.063	< MDC	-	-	< MDC	0
	Cs-137	0.065	< MDC	-	-	< MDC	0

[a] GA = gross alpha, GB = gross beta, GS = gamma spectroscopy, TR = total residue.
[b] MDC = Minimum Detectable Concentration based on a 4.66 sigma counting error for background sample.
[c] Mean and range are based on detectable measurements only (i.e., >MDC) Fraction of detectable measurements at specified locations is indicated in parentheses (F).
[d] Locations are specified by station code (Table 4.1) and distance (miles) and direction relative to reactor site.
[e] Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.
[f] For TLD's this value is the Quarterly Minimum Differential Dose(MDD_Q). See page 8 of this report for the details of how it is computed.

Table 4.6 Land Use Census

The following table lists an inventory of residence gardens ≥ 500 ft^2 found nearest the plant in each of the 10 meteorological sectors within a five mile radius of the Kewaunee Power Station. (Figure 4-1)

Sector	Township No.	Residence	Garden	Distance From Plant (miles)	Location ID
A	24	X		1.12	
A	12		X	3.71	
B	24	X	(Note 1)	1.01	
R	26	X		0.96	
R	23		X	2.16	
Q	23	X		1.27	
Q	23		X	1.53	K-27
P	26	X		1.35	
P	26		X	1.41	
N	35	X		0.94	
N	28		X	2.37	
M	35	X	(Note 2)	1.38	
L	35	X		1.00	
L	2		X	2.04	
K	36	X	(Note 3)	0.91	
J	11	X	(Note 4)	2.72	

Note 1. There were no gardens located in Sector B within five miles of the Kewaunee Power Station.
Note 2. There were no gardens located in Sector M within five miles of the Kewaunee Power Station.
Note 3. There was no garden located in Sector K within five miles of the Kewaunee Power Station.
Note 4. There were no gardens located in Sector J within five miles of the Kewaunee Power Station.

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APPENDIX A

INTERLABORATORY AND INTRALABORATORY COMPARISON PROGRAM RESULTS

TELEDYNE
BROWN ENGINEERING
A Teledyne Technologies Company

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Knoxville Laboratory

4th Quarter 2023 QUALITY ASSURANCE REPORT

January – December 2023

Teledyne Brown Engineering
2508 Quality Lane
Knoxville, TN 37931-3133

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4th Quarter 2023
Quality Assurance Report

Review and Signatures

Quality Assurance Manager:
Contractual Review

Sharon L Northcutt 01/23/24

Sharon L. Northcutt **Date**

Laboratory Operations Manager:
Technical Review

Keith O. Jeter 1/23/24

Keith O. Jeter **Date**

TABLE OF CONTENTS

I. INTRODUCTION

This report covers the Quality Assurance (QA) Program for the Analytical Services function of the Teledyne Brown Engineering Environmental Services (TBE-ES) laboratory for January through December 2023.

A. Operational Quality Control Scope

The TBE-ES Laboratory Quality Control (QC) Program is designed to monitor the quality of analytical processing associated with environmental, effluent (USNRC Regulatory Guide 4.15), bioassay, industrial process, and waste characterization (10CFR Part 61) samples.

Quality Control of radioanalyses involves an internal process control program and participation in external independent third party programs administered by Analytics, Environmental Resource Associates (ERA) and the Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP). *The MAPEP is designed to evaluate specific analytical capabilities that are of importance for DOE analytical services. These types of performance evaluation samples may contain both radiological and non-radiological "mixed" analytes and are reflective of real-world samples seen from DOE monitoring sites. Although TBE-ES is not currently under contract to analyze samples for DOE sites, the laboratory chooses to participate in PE program because it offers a variety of matrices and nuclides that are analyzed on a routine basis (water, soil, air filters, etc.).*

1. Interlaboratory

Results for third-party process checks prepared by Analytics, ERA and MAPEP are not reported during the first quarter of the year.

Inter-laboratory cross-check samples are received and reported as follows:

- Analytics cross-check samples are analyzed by TBE two times per year, typically in April and September.
- MAPEP provides samples semi-annually in March and September with required reporting dates in May and November, respectively, following sample receipt.
- ERA cross-check samples are analyzed by TBE semi-annually in April and October with required reporting dates in May and November, respectively, following sample receipt.

2. Intralaboratory

The internal QC program is designed to include QC functions such as instrumentation checks (to insure proper instrument response) and blank samples (to which no analyte radioactivity has been added) for contamination checks and instrumentation backgrounds. Process controls (or process checks) are actual samples analyzed in duplicate (duplicates) in order to evaluate the precision of laboratory measurements. Accuracy of analyses is measured by analyzing blank samples which have been spiked

with a known quantity of a radioisotope (spikes) that are of interest to laboratory clients. Some client samples are also spiked with a known activity of target analyte (matrix spikes) and aid in evaluating analytical method performance.

QC samples are intended to evaluate the entire radiochemical and radiometric process. Process control and qualification analyses samples seek to mimic the media type of those samples submitted for analysis by laboratory clients. The magnitude of the process control program combines both internal and external sources targeted at 10% of the routine sample analysis load. A summary of blanks, spikes and duplicates is found in Attachments B.1 and B.2.

3. Quality Assurance Program

To provide direction and consistency in administering the quality assurance program, TBE-ES has developed and follows a Quality Manual and a set of Standard Operating Procedures (SOP). The plan describes the scheduled frequency and scope of Quality Assurance and Quality Control (QA/QC) considered necessary for an adequate QA/QC program conducted throughout the year.

Internal audits are performed on an annual schedule, usually during the 4th quarter. External audits are performed by prospective and/or existing clients in accordance with contractual specifications. State audits are conducted to maintain client-specific certification requirements and for accreditation by the National Environmental Laboratory Accreditation Program (NELAP). The Nuclear Procurement Issues Corporation (NUPIC) evaluates suppliers of laboratory services to nuclear utilities. TBE-ES is audited every 33-36 months by NUPIC as a function of the utilities' Radiological Environmental Monitoring Program (REMP).

Two external audits have been performed this year. The State of Utah NELAP and the PJLA ISO 17025 audit results are found in Attachment D.

B. Performance Characteristics

1. Interlaboratory Accuracy

TBE-ES has adopted a QC acceptance protocol based upon two external performance models. For the interlaboratory programs that have established performance criteria (e.g., established warning and failure limits), the laboratory uses those established criteria to evaluate QC sample results. For interlaboratory QC programs which report no pre-set acceptance (pass/fail) criteria (e.g. Analytics Cross Check Program), results are evaluated in accordance with TBE-ES internal acceptance criteria.

a) Analytics' Evaluation Criteria

Analytics' evaluation report provides a ratio of TBE's result and the Analytics known value. Since flag values are not assigned, TBE-ES

evaluates the reported ratios based on internal QC requirements, which are based on the DOE MAPEP criteria.

b) MAPEP Evaluation Criteria

MAPEP evaluation criteria found in the *Handbook for the Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP)*, MAPEP-HB-1 Rev. 2 (June 13, 2018), pp. 9-11 & 30-32 and online at https://www.id.energy.gov/resl/mapep/MAPEP-HB-1%20Rev%202.pdf contains the following information:

MAPEP's evaluation report provides a calculated relative bias for the lab's reported results, the acceptance range, and associated flag values. The relative bias places the laboratory result in one of three categories:

- *Acceptable (flag = A)* — *Bias <= 20%*
- *Acceptable with Warning (flag = W)* — *20% < Bias <=30%*
- *Not Acceptable (flag = N)* — *Bias > 30%*

Radiological results must be reported with an associated uncertainty at one standard deviation. The uncertainty associated with a result is not currently used as part of the acceptance criteria, but an uncertainty evaluation is used to flag potential areas of concern. MAPEP assigns A (Acceptable), W (Acceptable with Warning) and N (Not Acceptable) uncertainty flags based upon the relative precision (RP) ratio:

RP = (Reported Uncertainty / Reported Result) x 100

Uncertainty flags are currently for information only, but reported total uncertainties are used to evaluate performance in false positive/ negative tests and sensitivity evaluations.

The MAPEP program uses false-positive testing in each session to identify laboratory results that indicate the presence of a particular radionuclide when, in fact, the actual activity of the radionuclide is far below the detection limit of the measurement. Not Acceptable (N) performance, and hence a false positive result, is indicated when the range encompassing the result, plus or minus the total uncertainty at three standard deviations, does not include zero (i.e. 2.5 ± 0.2; range of 1.9 –3.1). Statistically, the probability that a result can exceed the absolute value of its total uncertainty at three standard deviations by chance alone is less than 1%. MAPEP uses a three standard deviation criterion for the false positive test to ensure confidence about issuing a false-positive performance evaluation. A result that is greater than three times the total uncertainty of the measurement represents a statistically- positive detection with over 99% confidence.

Sensitivity evaluations are routinely performed to complement the false-positive tests. In a sensitivity evaluation, the radionuclide is present at or near the detection limit, and the difference between the reported result and the MAPEP reference value is compared to the propagated combined total uncertainties. The results are evaluated at three standard deviations. If the observed difference is greater than three times the combined total uncertainty, the sensitivity evaluation in "Not Acceptable". The probability that such a difference

can occur by chance alone is less than 1%. If the participant did not report a statistically-positive result, a "Not Detected" is noted in the text field of the MAPEP performance report. A non-detect is potentially a false-negative result, dependent upon the laboratory's detection limit for the radionuclide.

False-negative tests are also performed in combination with the sensitivity evaluations. In this scenario, the sensitivity of the reported measurement indicates that the known specific activity of the targeted radionuclide in the performance evaluation sample should have been detected, but was not, and a "Not Acceptable" performance evaluation is issued. The uncertainty of the MAPEP reference value and of the reported result at three standard deviations is used for the false-negative test.

The false-positive/negative and sensitivity evaluation tests are conducted in a manner that assists the participants with their measurement uncertainty estimates and helps ensure they are not underestimating or over inflating their total uncertainties. If the total uncertainty is over-inflated in order to pass a false-positive test, it will result in a "Not Detected" if the test is actually a sensitivity evaluation. The opposite is true for a false-positive test. False-negatives and failed sensitivity evaluations can also result from under-estimating the total uncertainty. An accurate estimate of measurement uncertainty is required for consistent performance at the acceptable level.

c) ERA Evaluation Criteria

The ERA evaluation report provides an acceptance range for control and warning limits with associated flag values. Acceptance limits for drinking/potable water are established per The NELAC Institute's (TNI) guidance. The TNI Standard uses Fields of Proficiency Testing (FoPT) Tables to calculate upper and lower acceptance limits set at the Mean ± 2 standard deviations (SD). ERA's acceptance limits for other matrices differ based on historical data from past studies.

d) NRC Verification Test Comparison Criteria

Some laboratory clients submit double-blind 10 CFR Part 50 performance evaluation samples. The lab processes these samples as routine client samples and sends the reports to the client, who then reports the result(s) to the sample's originator. This may be via an outside vendor (i.e. Analytics) or prepared by the client. After the results are received by the client, NRC Resolution Criteria is used to determine acceptance of results using a calculated resolution number (known value / 1-sigma uncertainty) and a calculated ratio (lab result of unknown/known value). Clients may or may not share the result with the laboratory and are therefore usually not included with this report.

2. Intralaboratory Accuracy Acceptance Criteria

a) Process Controls

The measure of accuracy for a group of test measurements to a given spike level is found by calculating the recovery of the spike activity found versus the added spike activity. The percent recovery is calculated as follows:

$$\% \text{ Recovery} = (A_m / A_s)\ 100$$

Where: A_m = the activity measured

A_s = the spiked activity

Internal Process Control sample results use acceptance criteria of 70%-130% for spike recovery. Warning limits are set from 70%-79% and 121%-130%. Results evaluated as "Warning" are assessed for trends of low or high bias and are used to detect potential problems. The laboratory's internal acceptance criteria are based on MAPEP's defined performance levels of bias greater than 30%.

Matrix spikes (MS) may be used to document the bias of a method in a sample matrix. MS acceptance criteria is 60% - 140% recovery.

b) Other Measures

Backgrounds, which represent the ambient signal response recorded by measuring instruments, are independent of radioactivity contributed by the radionuclides being measured in the sample. If possible, equivalent media for preparing laboratory processing blanks will be used.

Acceptable method blank sample results have no three-sigma statistically-positive activity for the target parameters. If all sample results associated with the blank are greater than the MDC, then the blank MDC shall be less than the activity of the least active sample in the work order or it will be flagged with a qualifier in the client report with a case narrative.

Replicate/duplicate (DUP) and matrix spike duplicate (MSD) samples are produced by taking two aliquots from a single sample and assigning each aliquot a different Lab Sample Number. In cases of duplicate analyses where there are no "known" values, the analyses will be evaluated for precision only. All duplicates are carried through the complete sample preparation and analytical procedure. Precision is evaluated by calculating the Relative Percent Difference (RPD) between the two samples. Relative Percent Difference is calculated as the absolute difference between two values normalized to the average value, expressed as a percentage:

$$\% \text{ RPD} = (\text{abs}[\text{orig} - \text{dup}] / [\text{orig} + \text{dup}]/2) \times 100$$

Matrix spike duplicates are split samples spiked with identical concentrations of a target analyte and are used to evaluate precision and bias. The matrix spike duplicate recovery is expressed as a percentage:

% MSD = (abs[orig activity* – dup activity]/spike activity) x 100

**If the original activity is not detected then the activity is considered zero (0)*

For purposes of analytical reporting, each result specifies the radionuclide concentration and the *a posteriori* Minimum Detectable Concentration (MDC). TBE-ES calculates the *a posteriori* MDC using the sample's actual measurement parameters (i.e., sample volume, chemical recovery, instrument background, etc.) to demonstrate that the Nuclear Regulatory Commission's (NRC) *a priori* MDC has been met for each radionuclide/sample. By TBE-ES policy, the *a posteriori* MDC must be less than the required NRC *a priori* MDC.

3. Investigations and Nonconformance Reports

QC investigations are initiated when QC results fall outside of the QC criteria. Other investigations may arise from unanticipated situations which are not clearly defined in the procedures or bounded by pre-established performance criteria but have the potential of becoming QA-related issues. The QA investigation is the mechanism to quickly ascertain if there is "due cause" to issue a formal Non-Conformance Report (NCR).

An NCR is issued to formally document a QC investigation into the root cause of failure, the corrective action taken, and the action taken to prevent recurrence where applicable. Investigations may include review of procedures, interviews of personnel, review of laboratory and instrument logbooks, observation of analyst techniques and any other items identified as necessary to resolve the issue. For intercomparison performance evaluation samples, it is TBE's policy to issue an NCR for all unacceptable results for nuclides listed as part of the ICP program. Some nuclides are analyzed for internal information only.

II. ANALYTICAL SERVICES QUALITY CONTROL SYNOPSIS

A. Interlaboratory Cross-Check Program

During this reporting period, 26 nuclides associated with seven media types (Air Filter, Charcoal [Air Iodine], Milk, Soil, Urine, Vegetation and Water) were analyzed. Samples were obtained from Analytics, the Department of Energy's (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) and Environmental Resource Associates (ERA). Media types representative of client analyses performed during this reporting period were selected. The results are presented in Attachment A and associated NCR's are in Attachment C.

1. Analytics Environmental Cross Check Program
   Twelve nuclides were evaluated in air particulate, charcoal filter, milk and soil matrices during this reporting period. All analyses were within acceptable criteria except for one Sr-90 milk. **NCR 23-24** was initiated to address the failure.

2. DOE's MAPEP Quality Assessment Program
   Eleven nuclides in water, soil, urine and vegetation samples were evaluated in 2023. All of the environmental analyses performed were evaluated as within the acceptable/acceptable with warning criteria except for the soil Ni-63 and vegetation Sr-90. **NCR's 23-08** and **23-09** were initiated to address the failures. (Some new nuclides were analyzed in the 2nd half of 2023 for informational purposes – soil Fe-55 and Th isotopes. These are not listed as part of the official cross-check program at this time.)

3. ERA Environmental Cross Check Program (RAD/MRAD)
   Eighteen nuclides were evaluated in water, soil, and air particulate samples were evaluated in 2023. All analyses performed were within acceptable criteria except for the AP Pu-238/239, water Ba-133 and soil alpha spec nuclides. **NCR's 23-05, 23-10**, **23-18**, **23-19**, **23-20**, and **23-21** were initiated to address the failure. (Some new nuclides were analyzed in the 2nd half of 2023 for informational purposes – soil Am-241 and Pu isotopes. These are not listed as part of the official cross-check program at this time.)

B. Intralaboratory Cross-Check Program

During this reporting period, 21 nuclides (and numerous other gamma nuclides) in various matrices, including air particulate, charcoal, vegetation, milk, and water were analyzed by means of the laboratory's internal process control program. A compilation of intralaboratory comparison data for this reporting period is summarized in Attachment B. *(Note: Only gamma nuclides that are typically seen in samples are included in the attachment – a complete list is available upon request).*

The TBE-ES laboratory's internal process control program evaluated 7,286 analyses during this period.

1. Blanks
   During this reporting period, 1,627/1,629 workgroup blanks analyzed were less than the MDC. There were two blanks that were positive due to high activity in the associated workgroup samples. Results were >5 times the blank value, which was documented in the case narrative with the sample results.

2. Spikes
   During this reporting period, all 1,583 workgroup and matrix spikes analyzed were within the acceptance criteria.

3. Duplicates
   All 3,169 duplicate sets analyzed were within acceptance criteria.

C. Non-Conformance Reports (NCRs)

There were 25 NCRs that were initiated during this period. All NCR's have been closed except for NCR's 23-18 & 23-19, which are still are under root cause investigation. Copies are included in Attachment C.

D. Instrumentation

TBE-ES uses the statistical principle method of evaluation for instrument quality control check data based on the mean, 2-sigma and 3-sigma set point model or uses pre-set tolerance limits. Each detector is checked prior to use for that day and the resulting data points are automatically compared to statistical baselines to determine the instrument's acceptability for counting. Control charts showing this data are available during audits or upon request. TBE-ES instrumentation includes:

1. Gamma Spectroscopy

   Gamma detectors are routinely monitored for energy, full width at half maximum, efficiency, and background. TBE-ES gamma detectors operated without incident during this reporting period. Occasional second runs (as allowed by our QA program) were necessary to verify acceptable operation. Some amplifier fine gain adjustments and liquid nitrogen addition to the dewars were also necessary when data trends indicate an energy drift on the detector.

2. Liquid Scintillation Counters (LSC):

   LSC instruments, used in tritium, carbon-14, nickel-63 and other low-energy beta-emitters, are monitored for background and efficiency. The reliability of these instruments is exceptional with zero instances of background or efficiency values outside of control limits.

3. Alpha/Beta Gas Flow Proportional (GFP) Counters:

GFP detectors used for gross alpha/beta, strontium-89/90, iodine-131 (low level) and other nuclides are monitored for background and efficiency. These detectors operated without incident during this reporting period. Occasionally, second runs (primarily for alpha due to the sensitivity of source placement) were necessary to verify acceptable operation or because of low P-10 pressure. After gas change-out and purging, control check values return to control norms.

4. Alpha Spectroscopy:

Alpha detectors are routinely monitored for energy, full width at half maximum, efficiency, and background. TBE-ES alpha detectors operated without incident during this reporting period. Occasional second runs (as allowed by our QA program) were necessary to verify acceptable operation.

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ATTACHMENT A

Interlaboratory Quality Control Program Results

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A.1

Analytics Cross Check Program Results

A.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
March 2023	E13826	Milk	Sr-89	pCi/L	70.5	93.1	0.76	W
			Sr-90	pCi/L	12.3	14.7	0.84	A
	E13827	Milk	Ce-141	pCi/L	127	139	0.91	A
			Co-58	pCi/L	119	131	0.91	A
			Co-60	pCi/L	250	279	0.90	A
			Cr-51	pCi/L	246	302	0.82	A
			Cs-134	pCi/L	172	200	0.86	A
			Cs-137	pCi/L	125	140	0.89	A
			Fe-59	pCi/L	122	122	1.00	A
			I-131	pCi/L	70.2	82.0	0.86	A
			Mn-54	pCi/L	165	180	0.92	A
			Zn-65	pCi/L	306	306	1.00	A
	E13828	Charcoal	I-131	pCi	79.0	89.9	0.88	A
	E13829	AP	Ce-141	pCi	91.9	87.8	1.05	A
			Co-58	pCi	87.5	82.5	1.06	A
			Co-60	pCi	199	176	1.13	A
			Cr-51	pCi	218	191	1.14	A
			Cs-134	pCi	119	126	0.94	A
			Cs-137	pCi	92.4	88.7	1.04	A
			Fe-59	pCi	95.5	76.9	1.24	A
			Mn-54	pCi	120	113	1.06	A
			Zn-65	pCi	179	193	0.93	A
	E13830	Soil	Ce-141	pCi/g	0.224	0.220	1.02	A
			Co-58	pCi/g	0.193	0.207	0.93	A
			Co-60	pCi/g	0.406	0.441	0.92	A
			Cr-51	pCi/g	0.464	0.477	0.97	A
			Cs-134	pCi/g	0.334	0.316	1.06	A
			Cs-137	pCi/g	0.270	0.288	0.94	A
			Fe-59	pCi/g	0.183	0.193	0.95	A
			Mn-54	pCi/g	0.263	0.284	0.93	A
			Zn-65	pCi/g	0.475	0.484	0.98	A
	E13831	AP	Sr-89	pCi	99.4	90.8	1.09	A
			Sr-90	pCi	14.6	14.3	1.02	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

A.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Ratio of TBE to Analytics Result	Evaluation [b]
September 2023	E13832	Milk	Sr-89	pCi/L	49.8	71.4	0.70	W
			Sr-90	pCi/L	7.28	12.8	0.57	N[1]
	E13833	Milk	Ce-141	pCi/L	93.4	104	0.90	A
			Co-58	pCi/L	58.2	65.8	0.88	A
			Co-60	pCi/L	190	223	0.85	A
			Cr-51	pCi/L	207	205	1.01	A
			Cs-134	pCi/L	96.0	114	0.84	A
			Cs-137	pCi/L	121	141	0.86	A
			Fe-59	pCi/L	78.8	78.8	1.00	A
			I-131	pCi/L	27.9	37.4	0.75	W
			Mn-54	pCi/L	128	146	0.88	A
			Zn-65	pCi/L	185	203	0.91	A
	E13834	Charcoal	I-131	pCi	76.9	78.7	0.98	A
	E13835	AP	Ce-141	pCi	91.9	87.1	1.05	A
			Co-58	pCi	58.7	55.2	1.06	A
			Co-60	pCi	200	187	1.07	A
			Cr-51	pCi	192	172	1.12	A
			Cs-134	pCi	89.6	96	0.94	A
			Cs-137	pCi	109	119	0.92	A
			Fe-59	pCi	68.3	66.1	1.03	A
			Mn-54	pCi	129	123	1.05	A
			Zn-65	pCi	163	171	0.96	A
	E13836	Soil	Ce-141	pCi/g	0.228	0.184	1.24	W
			Co-58	pCi/g	0.103	0.116	0.89	A
			Co-60	pCi/g	0.364	0.394	0.92	A
			Cr-51	pCi/g	0.371	0.362	1.02	A
			Cs-134	pCi/g	0.176	0.202	0.87	A
			Cs-137	pCi/g	0.285	0.315	0.90	A
			Fe-59	pCi/g	0.140	0.139	1.00	A
			Mn-54	pCi/g	0.237	0.259	0.92	A
			Zn-65	pCi/g	0.349	0.359	0.97	A
	E13837	AP	Sr-89	pCi	74.6	80.2	0.93	A
			Sr-90	pCi	13.9	14.4	0.96	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) See **NCR 23-24**

A.2

MAPEP Quality Assessment Program Results

A.2 DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Range	Evaluation [b]
February 2023	23-MaS48	Soil	Ni-63	Bq/kg	294	1130	791 - 1469	N[3]
			Tc-99	Bq/kg	898	1100	770 - 1430	A
	23-MaSU48	Urine	Cs-134	Bq/L	9.92	9.5	6.7 - 12.4	A
			Cs-137	Bq/L	0.0994		*(1)*	A
			Co-57	Bq/L	9.352	8.67	6.07 - 11.27	A
			Co-60	Bq/L	9.034	8.13	5.69 - 10.57	A
			Mn-54	Bq/L	11.8	10.0	7.0 - 13.0	A
			U-234	Bq/L	0.0098		*Not spiked*	
			U-238	Bq/L	0.0096		*Not spiked*	
			Zn-65	Bq/L	10.6	9.29	6.50 - 12.08	A
	23-MaW48	Water	Ni-63	Bq/L	23.1	27.3	19.1 - 35.5	A
			Tc-99	Bq/L	9.75	9.31	6.52 - 12.1	A
	23-RdV48	Vegetation	Cs-134	Bq/sample	5.56	7.6	5.32 - 9.88	W
			Cs-137	Bq/sample	0.026		*(1)*	A
			Co-57	Bq/sample	5.91	6.93	4.85 - 9.01	A
			Co-60	Bq/sample	5.00	6.51	4.56 - 8.46	W
			Mn-54	Bq/sample	6.08	8.03	5.62 - 10.44	W
			Sr-90	Bq/sample	0.0542		*(1)*	N[4]
			Zn-65	Bq/sample	5.49	7.43	5.20 - 9.66	W
August 2023	23-MaS49	Soil	Fe-55	Bq/kg	346	1280	896 - 1664	N[5]
			Ni-63	Bq/kg	1260	1370	959 - 1781	A
			Tc-99	Bq/kg	0.683		*(1)*	A
			Th-228	Bq/kg	48.2	44.8	31.4 - 58.2	A[5]
			Th-230	Bq/kg	40.0	41.1	28.8 - 53.4	A[5]
			Th-232	Bq/kg	29.6	45.5	31.9 - 59.2	N[5]
	23-MaW49	Water	Ni-63	Bq/L	0.971	1.11	*(2)*	A
			Tc-99	Bq/L	8.88	8.85	6.20 - 11.51	A
	23-RdV49	Vegetation	Cs-134	Bq/sample	3.86	4.98	3.49 - 6.47	W
			Cs-137	Bq/sample	0.0269		*(1)*	A
			Co-57	Bq/sample	3.88	4.24	2.97 - 5.51	A
			Co-60	Bq/sample	2.37	2.79	*1.95 - 3.63*	A
			Mn-54	Bq/sample	2.04	2.56	1.79 - 3.33	W
			Sr-90	Bq/sample	0.957	1.17	0.82 - 1.52	A
			Zn-65	Bq/sample	-0.514		*(1)*	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test
(2) Sensitivity evaluation
(3) See **NCR 23-08**
(4) See **NCR 23-09**
(5) Initial evaluation for lab information (not on current ICP list)

A.3

ERA Cross Check Program Results

A.3 ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Limits	Evaluation [b]
March 2023	MRAD-38	Water	Am-241	pCi/L	28.1	32.1	22.0 - 41.0	A
			Fe-55	pCi/L	1180	1380	811 - 2010	A
			Pu-238	pCi/L	65.6	70.7	42.5 - 91.6	A
			Pu-239	pCi/L	82.9	92.4	57.2 - 114	A
		Soil	Sr-90	pCi/kg	2630	2580	803 - 4020	A
			U-234	pCi/kg	3758	4300	2020 - 5630	A
			U-238	pCi/kg	3717	4260	2340 - 5720	A
		AP	Fe-55	pCi/filter	640	578	211 - 922	A
			Pu-238	pCi/filter	5.93	9.59	7.24 - 11.8	N(1)
			Pu-239	pCi/filter	34.5	68.9	51.5 - 83.1	N(1)
			U-234	pCi/filter	49.7	53.1	39.4 - 62.2	A
			U-238	pCi/filter	45.2	52.6	39.7 - 62.8	A
			GR-A	pCi/filter	69.6	76.8	40.1 - 127	A
			GR-B	pCi/filter	36.8	32.8	19.9 - 49.6	A
April 2023	RAD-133	Water	Ba-133	pCi/L	26.0	22.3	17.1 - 25.8	N(2)
			Cs-134	pCi/L	72.1	77.6	63.4 - 85.4	A
			Cs-137	pCi/L	62.1	63.1	56.8 - 72.2	A
			Co-60	pCi/L	32.6	30.3	26.7 - 36.1	A
			Zn-65	pCi/L	253	242	218 - 283	A
			GR-A	pCi/L	34.2	29.2	14.9 - 38.2	A
			GR-B	pCi/L	64.3	60.7	41.8 - 67.4	A
			U-Nat	pCi/L	61.75	62.7	51.2 - 69.0	A
			H-3	pCi/L	13,300	12,700	11,100 - 14,400	A
			Sr-89	pCi/L	67.0	61.1	49.2 - 69.0	A
			Sr-90	pCi/L	36.5	36.0	26.4 - 41.5	A
			I-131	pCi/L	24.3	28.7	23.9 - 33.6	A
September 2023	MRAD-39	Water	Am-241	pCi/L	54.0	71.0	48.7 - 90.8	A
			Fe-55	pCi/L	2430	2630	1550 - 3830	A
			Pu-238	pCi/L	172	177	106 - 229	A
			Pu-239	pCi/L	171	182	113 - 224	A
		Soil	Am-241	pCi/kg	2810	1300	702 - 1840	N(3)
			Pu-238	pCi/kg	1028	481	240 - 731	N(3)
			Pu-239	pCi/kg	2406	1250	681 - 1800	N(3)
			Sr-90	pCi/kg	9580	6800	2120 - 10,600	A
			U-234	pCi/kg	9140	3160	1480 - 4140	N(3)
			U-238	pCi/kg	9800	3140	1720 - 4210	N(3)
		AP	Am-241	pCi/filter	49.64	69.3	49.5 - 92.4	A
			Fe-55	pCi/filter	1020	1180	431 - 1880	A
			Pu-238	pCi/filter	11.19	49.3	37.2 - 60.6	N(4)
			Pu-239	pCi/filter	102	47.2	35.3 - 56.9	N(4)
			U-234	pCi/filter	19.9	20.1	14.9 - 23.6	A
			U-238	pCi/filter	17.7	20.0	15.1 - 23.9	A
			GR-A	pCi/filter	82.2	79.8	41.7 - 131	A
			GR-B	pCi/filter	54.3	42.6	25.8 - 64.4	A
October 2023	RAD-135	Water	Ba-133	pCi/L	86.3	92.2	73.8 - 111	A
			Cs-134	pCi/L	38.4	41.2	27.9 - 54.5	A
			Cs-137	pCi/L	194	199	161 - 237	A
			Co-60	pCi/L	49.5	47.8	33.8 - 61.8	A
			Zn-65	pCi/L	59.7	57.0	23.7 - 90.3	A
			GR-A	pCi/L	53.2	70.6	54.0 - 87.2	N(5)
			GR-B	pCi/L	46.9	42.2	30.5 - 53.9	A
			U-Nat	pCi/L	51.26	51.7	45.9- 57.5	A
			H-3	pCi/L	20,100	22,900	19,700 - 26,100	A
			Sr-89	pCi/L	51.1	38.2	25.2 - 51.2	A
			Sr-90	pCi/L	31.7	35.7	30.3 - 41.1	A
			I-131	pCi/L	23.5	29.7	25.8 - 33.6	N(6)

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation:
A = Acceptable - Reported value falls within the Acceptance Limits
N = Not Acceptable - Reported value falls outside of the Acceptance Limits

*(1) See **NCR 23-05***
*(2) See **NCR 23-10***
*(3) See **NCR 23-18***
*(4) See **NCR 23-19***
*(5) See **NCR 23-20***
*(5) See **NCR 23-21***

A.4

Formal Interlaboratory Quality Control Program Results

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ANAB ACCREDITED ISO/IEC 17043 PROFICIENCY TESTING PROVIDER

RESULTS OF ENVIRONMENTAL CROSS CHECK PROGRAM

TELEDYNE BROWN ENGINEERING

1st QUARTER 2023

(Ref. Date 16 Mar 2023, Rev. 0)

L. Tk 21 Apr 2023

Levan Tkavadze , Nuclear Metrologist

Sample	Analysis	ENGINEERING Value, pCi/L	EZA Value, pCi/L	Ratio ENGINEERING: EZA
E13826 Milk	Sr-89	7.05E+01	9.31E+01	0.76
	Sr-90	1.23E+01	1.47E+01	0.84

Sample	Analysis	ENGINEERING Value, pCi/L	EZA Value, pCi/L	Ratio ENGINEERING: EZA
E13827 Milk	Ce-141	1.27E+02	1.39E+02	0.91
	Co-58	1.19E+02	1.31E+02	0.91
	Co-60	2.50E+02	2.79E+02	0.90
	Cr-51	2.46E+02	3.02E+02	0.82
	Cs-134	1.72E+02	2.00E+02	0.86
	Cs-137	1.25E+02	1.40E+02	0.89
	Fe-59	1.22E+02	1.22E+02	1.00
	I-131	7.02E+01	8.20E+01	0.86
	K-40	1.32E+03	Not Measured	—
	Mn-54	1.65E+02	1.80E+02	0.92
	Zn-65	3.06E+02	3.06E+02	1.00

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13828 Cartridge	I-131	7.90E+01	8.99E+01	0.88

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13829 Filter	Ce-141	9.19E+01	8.78E+01	1.05
	Co-58	8.75E+01	8.25E+01	1.06
	Co-60	1.99E+02	1.76E+02	1.13
	Cr-51	2.18E+02	1.91E+02	1.14
	Cs-134	1.19E+02	1.26E+02	0.94
	Cs-137	9.24E+01	8.87E+01	1.04
	Fe-59	9.55E+01	7.69E+01	1.24
	Mn-54	1.20E+02	1.13E+02	1.06
	Zn-65	1.79E+02	1.93E+02	0.93

Sample	Analysis	ENGINEERING Value, pCi/g	EZA Value, pCi/g	Ratio ENGINEERING: EZA
E13830 Soil	Ce-141	2.24E-01	2.20E-01	1.02
	Co-58	1.93E-01	2.07E-01	0.93
	Co-60	4.06E-01	4.41E-01	0.92
	Cr-51	4.64E-01	4.77E-01	0.97
	Cs-134	3.34E-01	3.16E-01	1.06
	Cs-137	2.70E-01	2.88E-01	0.94
	Fe-59	1.83E-01	1.93E-01	0.95
	Mn-54	2.63E-01	2.84E-01	0.93
	Zn-65	4.75E-01	4.84E-01	0.98

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13831 Filter	Sr-89	9.94E+01	9.08E+01	1.09
	Sr-90	1.46E+01	1.43E+01	1.02

Performance Results Archive

MAPEP-23-MaS48: Radiological and Inorganic combined soil standard

Inorganic — Units: Mass/Mass

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Antimony	NR	6.4				4.5 - 8.3		
Arsenic	NR	8.4				5.9 - 10.9		
Barium	NR	300				210 - 390		
Beryllium	NR	18.3				12.8 - 23.8		
Cadmium	NR	3.53				2.47 - 4.59		
Chromium	NR	43.4				30.4 - 56.4		
Cobalt	NR	39.4				27.6 - 51.2		
Copper	NR	83.9				58.7 - 109.1		
Lead	NR	20.5				14.4 - 26.7		
Mercury	NR	0.0174				Sensitivity Evaluation		
Nickel	NR	84.5				59.2 - 109.9		
Selenium	NR	5.76				4.03 - 7.49		
Silver	NR	19.6				13.7 - 25.5		
Technetium-99	NR	0.00174				0.00122 - 0.00226		
Thallium	NR	0.19				Sensitivity Evaluation		
Uranium-235	NR	0.055				0.039 - 0.072		
Uranium-238	NR	20.8				14.6 - 27.0		
Uranium-Total	NR	20.8				14.6 - 27.0		
Vanadium	NR	85				60 - 111		
Zinc	NR	96				67 - 125		

Radiological — Units: Bq/Kg

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Americium-241	NR	0.9				Sensitivity Evaluation		
Cesium-134	NR					False Positive Test		
Cesium-137	NR					False Positive Test		
Cobalt-57	NR	698				489 - 907		
Cobalt-60	NR	795				557 - 1034		
Iron-55	NR					False Positive Test		
Manganese-54	NR	1230				861 - 1599		
Nickel-63	294	1130	N		-74.0	791 - 1469	32.2	A
Plutonium-238	NR	0.52				Sensitivity Evaluation		
Plutonium-239/240	NR	101				71 - 131		
Potassium-40	NR	574				402 - 746		
Strontium-90	NR	920				644 - 1196		
Technetium-99	898	1100	A		-18.4	770 - 1430	78.8	A
Thorium-228	NR	43.3				30.3 - 56.3		
Thorium-230	NR	40.0				28.0 - 52.0		
Thorium-232	NR	43.3				30.3 - 56.3		
Uranium-234	NR	64				45 - 83		
Uranium-238	NR	258				181 - 335		
Zinc-65	NR	990				693 - 1287		

MAPEP-23-MaSU48: Radiological urine standard

Water

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag	Units
Plutonium-239	NR	90.2				63.1 - 117.3			pg/L
Plutonium-240	NR	1.90				1.33 - 2.47			pg/L
Uranium-236	NR	5.38				3.77 - 6.99			ng/L

☒ Radiological

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag	Units
Americium-241	NR	0.236				0.165 -	0.307			Bq/L
Cesium-134	9.92	9.5			4.4	6.7 -	12.4	.308		Bq/L
Cesium-137	.0994					False Positive Test		.16		Bq/L
Cobalt-57	9.352	8.67			7.9	6.07 -	11.27	.294		Bq/L
Cobalt-60	9.034	8.13			11.1	5.69 -	10.57	0.333		Bq/L
Curium-244	NR					False Positive Test				Bq/L
Hydrogen-3	NR					False Positive Test				Bq/L
Manganese-54	11.8	10.0			18.0	7.0 -	13.0	0.5		Bq/L
Plutonium-238	NR	0.234				0.164 -	0.304			Bq/L
Plutonium-239/240	NR	0.223				0.156 -	0.290			Bq/L
Strontium-89	NR	43.9				30.7 -	57.1			Bq/L
Strontium-90	NR	1.58				1.11 -	2.05			Bq/L
Technetium-99	NR					False Positive Test				Bq/L
Uranium-234	0.0098							0.00372		Bq/L
Uranium-238	0.0096							0.0045		Bq/L
Zinc-65	10.6	9.29			14.1	6.50 -	12.08	.933		Bq/L

MAPEP-23-MaW48: Radiological and Inorganic combined water standard

☒ Inorganic — Units: (mg/L)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Antimony	NR	5.69				3.98 -	7.40		
Arsenic	NR	4.21				2.95 -	5.47		
Barium	NR	6.38				4.47 -	8.29		
Beryllium	NR	1.01				0.71 -	1.31		
Cadmium	NR	0.250				0.175 -	0.325		
Chromium	NR	1.50				1.05 -	1.95		
Cobalt	NR	4.20				2.94 -	5.46		
Copper	NR	4.03				2.82 -	5.24		
Lead	NR	3.13				2.19 -	4.07		
Mercury	NR	0.107				0.075 -	0.139		
Nickel	NR	4.61				3.23 -	5.99		
Selenium	NR	0.316				0.221 -	0.411		
Technetium-99	NR	1.47E-5				1.03E-5 -	1.91E-5		
Thallium	NR	2.14				1.50 -	2.78		
Uranium-235	NR	6.7E-4				4.69E-4 -	8.71E-4		
Uranium-238	NR	0.094				0.066 -	0.122		
Uranium-Total	NR	0.094				0.066 -	0.122		
Vanadium	NR	4.43				3.10 -	5.76		
Zinc	NR	4.57				3.20 -	5.94		

☒ Radiological — Units: (Bq/L)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Americium-241	NR	0.387				0.271 -	0.503		
Cesium-134	NR	9.6				6.7 -	12.5		
Cesium-137	NR	8.7				6.1 -	11.3		
Cobalt-57	NR					False Positive Test			
Cobalt-60	NR	7.24				5.07 -	9.41		
Hydrogen-3	NR	573				401 -	745		
Iron-55	NR					False Positive Test			
Manganese-54	NR	11.3				7.9 -	14.7		
Nickel-63	23.1	27.3	A		-15.4	19.1 -	35.5	1.1	A
Plutonium-238	NR	0.846				0.592 -	1.100		
Plutonium-239/240	NR	0.0174				Sensitivity Evaluation			
Potassium-40	NR					False Positive Test			

Radium-226	NR	0.759			0.531 -	0.987		
Strontium-90	NR				False Positive Test			
Technetium-99	9.75	9.31	A	4.7	6.52 -	12.10	1.58	W
Uranium-234	NR	1.15			0.81 -	1.50		
Uranium-238	NR	1.16			0.81 -	1.51		
Zinc-65	NR	15.3			10.7 -	19.9		

MAPEP-23-RdV48: Radiological vegetation

☒ Inorganic — Units: (ug/sample)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Uranium-235	NR	0.000144				Sensitivity Evaluation			
Uranium-238	NR	0.0206				Sensitivity Evaluation			
Uranium-Total	NR	0.0208				Sensitivity Evaluation			

☒ Radiological — Units: (Bq/Sample)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Americium-241	NR	0.189				0.132 -	0.246		
Cesium-134	5.56	7.60	W		-26.8	5.32 -	9.88	0.322	A
Cesium-137	0.026		A			False Positive Test		.110	
Cobalt-57	5.91	6.93	A		-14.7	4.85 -	9.01	.188	A
Cobalt-60	5.00	6.51	W		-23.2	4.56 -	8.46	.215	A
Manganese-54	6.08	8.03	W		-24.3	5.62 -	10.44	.33	A
Plutonium-238	NR	0.187				0.131 -	0.243		
Plutonium-239/240	NR	0.178				0.125 -	0.231		
Strontium-90	0.0542		N	(1)		False Positive Test		0.00742	
Uranium-234	NR	0.00044				Sensitivity Evaluation			
Uranium-238	NR	0.000256				Sensitivity Evaluation			
Zinc-65	5.49	7.43	W		-26.1	5.20 -	9.66	.657	A

Notes:

(1) = False Positive

MRAD-38 Final Evaluation Report

ERA
A Waters Company

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EPA ID: TN11387
ERA Customer Number: T200801
Report Issued: 05/23/2023
Study Dates: 03/20/2023 - 05/19/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Soil Radionuclides (cat# 802, lot# A038-608)												
2700	Actinium-228	pCi/kg		1670	1100 - 2100	Not Reported				1570	230	
2755	Americium-241	pCi/kg		1410	761 - 2000	Not Reported				1270	289	
2772	Bismuth-212	pCi/kg		1670	478 - 2490	Not Reported				1770	179	
2773	Bismuth-214	pCi/kg		790	379 - 1180	Not Reported				805	182	
2800	Cesium-134	pCi/kg		1170	800 - 1400	Not Reported				1060	235	
2805	Cesium-137	pCi/kg		3570	2700 - 4520	Not Reported				3480	632	
2815	Cobalt-60	pCi/kg		3490	2750 - 4310	Not Reported				3350	599	
2902	Lead-212	pCi/kg		1630	1140 - 2060	Not Reported				1630	294	
2903	Lead-214	pCi/kg		838	352 - 1320	Not Reported				884	179	
2905	Manganese-54	pCi/kg		< 555	0.00 - 555	Not Reported						
2930	Plutonium-238	pCi/kg		1040	519 - 1580	Not Reported				973	135	
2932	Plutonium-239	pCi/kg		2000	1090 - 2880	Not Reported				1820	219	
2946	Potassium-40	pCi/kg		41800	28800 - 49900	Not Reported				41400	2510	
3005	Strontium-90	pCi/kg	2630	2580	803 - 4020	Acceptable	HASL 300 Sr-03 28th ED 1997	5/15/2023	0.845	2090	641	Shannon Cooper
3028	Thorium-234	pCi/kg		4260	1610 - 7300	Not Reported				4330	402	
3036	Uranium-234	pCi/kg	3758	4300	2020 - 5630	Acceptable	HASL 300 U-02 28th ED 1997	4/25/2023	-0.444	4070	692	Shannon Cooper
3038	Uranium-238	pCi/kg	3717	4260	2340 - 5720	Acceptable	HASL 300 U-02 28th ED 1997	4/25/2023	-0.611	4210	815	Shannon Cooper
3055	Uranium-Total	pCi/kg		8760	4860 - 11300	Not Reported				8880	936	
1184	Uranium (mass)	µg/kg		12800	5780 - 17300	Not Reported				12000	1910	
3070	Zinc-65	pCi/kg		8340	6660 - 11400	Not Reported				8170	1560	

MRAD-38 Final Evaluation Report

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ERA Customer Number: T200801
Report Issued: 05/23/2023
Study Dates: 03/20/2023 - 05/19/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Air Filter Radionuclides (cat# 800, lot# A038-606)												
2755	Americium-241	pCi/Filter		55.6	39.7 - 74.1	Not Reported				54.9	4.66	
2800	Cesium-134	pCi/Filter		153	99.3 - 188	Not Reported				135	15.6	
2805	Cesium-137	pCi/Filter		892	733 - 1170	Not Reported				913	66.4	
2815	Cobalt-60	pCi/Filter		467	397 - 593	Not Reported				479	22.2	
2885	Iron-55	pCi/Filter	640	578	211 - 922	Acceptable	TBE Proprietary	5/3/2023	1.06	452	177	Shannon Cooper
2905	Manganese-54	pCi/Filter		< 35.0	0.00 - 35.0	Not Reported						
2930	Plutonium-238	pCi/Filter	5.93	9.59	7.24 - 11.8	Not Acceptable	TBE Proprietary	4/19/2023	-5.54	9.01	0.556	Shannon Cooper
2932	Plutonium-239	pCi/Filter	34.5	68.9	51.5 - 83.1	Not Acceptable	TBE Proprietary	4/19/2023	-4.82	61.1	5.52	Shannon Cooper
3005	Strontium-90	pCi/Filter		137	86.7 - 187	Not Reported				143	13.7	
3036	Uranium-234	pCi/Filter	49.7	53.1	39.4 - 62.2	Acceptable	TBE Proprietary	4/28/2023	0.351	49.0	1.92	Shannon Cooper
3038	Uranium-238	pCi/Filter	45.2	52.6	39.7 - 62.8	Acceptable	TBE Proprietary	4/28/2023	-1.83	49.1	2.13	Shannon Cooper
3055	Uranium-Total	pCi/Filter		108	78.8 - 128	Not Reported				100	2.57	
1184	Uranium (mass)	µg/Filter		158	127 - 185	Not Reported				147	5.02	
3070	Zinc-65	pCi/Filter		1110	910 - 1700	Not Reported				1230	95.9	
MRAD Air Filter Gross Alpha/Beta (cat# 801, lot# A038-607)												
2830	Gross Alpha	pCi/Filter	69.6	76.8	40.1 - 127	Acceptable	EMSL-LV p. 1 1979	4/27/2023	-0.0115	69.7	9.50	Susan Ogletree
2840	Gross Beta	pCi/Filter	36.8	32.8	19.9 - 49.6	Acceptable	EMSL-LV p. 1 1979	4/27/2023	0.366	34.8	5.49	Susan Ogletree

MRAD-38 Final Evaluation Report

A Waters Company

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Study Dates: 03/20/2023 - 05/19/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Water Radionuclides (cat# 804, lot# A038-617)												
2755	Americium-241	pCi/L	28.1	32.1	22.0 - 41.0	Acceptable	HASL 300 Am-03 28th ED 1997	4/27/2023	-1.25	32.1	3.17	Shannon Cooper
2800	Cesium-134	pCi/L		298	225 - 328	Not Reported				263	27.1	
2805	Cesium-137	pCi/L		762	652 - 866	Not Reported				750	35.1	
2815	Cobalt-60	pCi/L		412	355 - 473	Not Reported				415	21.7	
2885	Iron-55	pCi/L	1180	1380	811 - 2010	Acceptable	TBE Proprietary	5/3/2023	-0.176	1190	81.7	Shannon Cooper
2905	Manganese-54	pCi/L		< 71.0	0.00 - 71.0	Not Reported						
2930	Plutonium-238	pCi/L	65.6	70.7	42.5 - 91.6	Acceptable	HASL 300 Pu-10 28th ED 1997	4/19/2023	-0.583	69.3	6.35	Shannon Cooper
2932	Plutonium-239	pCi/L	82.9	92.4	57.2 - 114	Acceptable	HASL 300 Pu-10 28th ED 1997	4/19/2023	-0.330	86.3	10.4	Shannon Cooper
3005	Strontium-90	pCi/L		121	87.1 - 150	Not Reported				127	11.3	
3036	Uranium-234	pCi/L		53.9	41.0 - 61.6	Not Reported				51.9	4.29	
3038	Uranium-238	pCi/L		53.4	41.4 - 62.9	Not Reported				53.5	4.69	
3055	Uranium-Total	pCi/L		110	85.8 - 125	Not Reported				105	6.49	
1184	Uranium (mass)	µg/L		160	130 - 181	Not Reported				158	14.3	
3070	Zinc-65	pCi/L		228	203 - 288	Not Reported				240	9.70	

RAD-133 Final Evaluation Report

ERA
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Report Issued: 06/02/2023
Study Dates: 04/10/2023 - 05/25/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
RAD Gamma EmitterS™ (cat# 808, lot# R133-758)												
2765	Barium-133	pCi/L	26.0	22.3	17.1 - 25.8	Not Acceptable	EPA 901.1 1980	4/18/2023	0.827	23.6	2.90	Shannon Cooper
2800	Cesium-134	pCi/L	72.1	77.6	63.4 - 85.4	Acceptable	EPA 901.1 1980	4/18/2023	-1.10	76.7	4.17	Shannon Cooper
2805	Cesium-137	pCi/L	62.1	63.1	56.8 - 72.2	Acceptable	EPA 901.1 1980	4/18/2023	-0.760	66.0	5.15	Shannon Cooper
2815	Cobalt-60	pCi/L	32.6	30.3	26.7 - 36.1	Acceptable	EPA 901.1 1980	4/18/2023	0.201	32.3	1.27	Shannon Cooper
3070	Zinc-65	pCi/L	253	242	218 - 283	Acceptable	EPA 901.1 1980	4/18/2023	-0.101	254	13.8	Shannon Cooper
RAD GroSS™ Alpha/Beta (cat# 809, lot# R133-759)												
2830	Gross Alpha	pCi/L	34.2	29.2	14.9 - 38.2	Acceptable	EPA 900.0 1980	4/20/2023	2.22	26.7	3.39	Susan Ogletree
2840	Gross Beta	pCi/L	64.3	60.7	41.8 - 67.4	Acceptable	EPA 900.0 1980	4/20/2023	1.50	55.5	5.88	Susan Ogletree
RAD NaturalS™ (cat# 811, lot# R133-751)												
2965	Radium-226	pCi/L		7.68	5.78 - 9.07	Not Reported				8.11	1.34	
2970	Radium-228	pCi/L		9.34	6.04 - 11.7	Not Reported				8.34	1.35	
3055	Uranium (Nat)	pCi/L	61.75	62.7	51.2 - 69.0	Acceptable	EPA 908.0 1980	4/25/2023	0.333	61.4	1.20	Shannon Cooper
1184	Uranium (mass)	µg/L		93.6	76.4 - 103	Not Reported				87.5	3.90	
RAD TritiuM™ (cat# 812, lot# R133-752)												
3030	Tritium	pCi/L	13300	12700	11100 - 14000	Acceptable	EPA 906.0 1980	5/23/2023	0.769	12600	890	Susan Ogletree
RAD Strontium-89/90 (cat# 807, lot# R133-757)												
2995	Strontium-89	pCi/L	67.0	61.1	49.2 - 69.0	Acceptable	EPA 905.0 1980	5/15/2023	1.69	55.3	6.88	Shannon Cooper
3005	Strontium-90	pCi/L	36.5	36.0	26.4 - 41.5	Acceptable	EPA 905.0 1980	5/15/2023	-0.0343	36.6	2.83	Shannon Cooper
RAD Iodine-131 (cat# 810, lot# R133-750)												
2875	Iodine-131	pCi/L	24.3	28.7	23.9 - 33.6	Acceptable	SM 7500-I C (GPC)-2000 2000	4/21/2023	-2.40	28.5	1.73	Shannon Cooper

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ANAB ACCREDITED ISO/IEC 17043 PROFICIENCY TESTING PROVIDER

RESULTS OF ENVIRONMENTAL CROSS CHECK PROGRAM

TELEDYNE BROWN ENGINEERING

3rd QUARTER 2023

(Ref. Date 14 Sep 2023, Rev. 0)

L. Tk 07 Dec 2023

Levan Tkavadze , Nuclear Metrologist

Sample	Analysis	ENGINEERING Value, pCi/L	EZA Value, pCi/L	Ratio ENGINEERING: EZA
E13832 Milk	Sr-89	4.98E+01	7.14E+01	0.70
	Sr-90	7.28E+00	1.28E+01	0.57

Sample	Analysis	ENGINEERING Value, pCi/L	EZA Value, pCi/L	Ratio ENGINEERING: EZA
E13833 Milk	Ce-141	9.34E+01	1.04E+02	0.90
	Co-58	5.82E+01	6.58E+01	0.88
	Co-60	1.90E+02	2.23E+02	0.85
	Cr-51	2.07E+02	2.05E+02	1.01
	Cs-134	9.60E+01	1.14E+02	0.84
	Cs-137	1.21E+02	1.41E+02	0.86
	Fe-59	7.88E+01	7.88E+01	1.00
	I-131	2.79E+01	3.74E+01	0.75
	K-40	1.15E+03	Not Measured	---
	Mn-54	1.28E+02	1.46E+02	0.88
	Zn-65	1.85E+02	2.03E+02	0.91

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13834 Cartridge	I-131	7.69E+01	7.87E+01	0.98

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13835 Filter	Ce-141	9.19E+01	8.71E+01	1.05
	Co-58	5.87E+01	5.52E+01	1.06
	Co-60	2.00E+02	1.87E+02	1.07
	Cr-51	1.92E+02	1.72E+02	1.12
	Cs-134	8.96E+01	9.57E+01	0.94
	Cs-137	1.09E+02	1.19E+02	0.92
	Fe-59	6.83E+01	6.61E+01	1.03
	Mn-54	1.29E+02	1.23E+02	1.05
	Zn-65	1.63E+02	1.71E+02	0.96

Sample	Analysis	ENGINEERING Value, pCi/g	EZA Value, pCi/g	Ratio ENGINEERING: EZA
E13836 Soil	Ce-141	2.28E-01	1.84E-01	1.24
	Co-58	1.03E-01	1.16E-01	0.89
	Co-60	3.64E-01	3.94E-01	0.92
	Cr-51	3.71E-01	3.62E-01	1.02
	Cs-134	1.76E-01	2.02E-01	0.87
	Cs-137	2.85E-01	3.15E-01	0.90
	Fe-59	1.40E-01	1.39E-01	1.00
	Mn-54	2.37E-01	2.59E-01	0.92
	Zn-65	3.49E-01	3.59E-01	0.97

Sample	Analysis	ENGINEERING Value, pCi	EZA Value, pCi	Ratio ENGINEERING: EZA
E13831 Filter	Sr-89	9.94E+01	9.08E+01	1.09
	Sr-90	1.46E+01	1.43E+01	1.02

Eckert & Ziegler

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ANAB ACCREDITED ISO/IEC 17043 PROFICIENCY TESTING PROVIDER

RESULTS OF RADIOCHEMISTRY
CROSS CHECK PROGRAM

TELEDYNE BROWN
ENGINEERING

4th QUARTER 2023

(Ref. Date 03 Nov 2023, Rev. 0)

L. Tk

19 Dec 2023

Levan Tkavadze , Nuclear Metrologist

Sample	Analysis	ENGINEERING Value, uCi	EZA Value, uCi	Ratio ENGINEERING / EZA	Resolution	Comparison
A39861 Filter	Gross Alpha (Am-241)	7.88E-04	8.05E-04	0.98	12.5	AGREEMENT

Performance Results Archive

MAPEP-23-MaS48: Radiological and Inorganic combined soil standard

Inorganic — Units: mg/kg

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Antimony	NR	6.4				4.5 - 8.3		
Arsenic	NR	8.4				5.9 - 10.9		
Barium	NR	300				210 - 390		
Beryllium	NR	18.3				12.8 - 23.8		
Cadmium	NR	3.53				2.47 - 4.59		
Chromium	NR	43.4				30.4 - 56.4		
Cobalt	NR	39.4				27.6 - 51.2		
Copper	NR	83.9				58.7 - 109.1		
Lead	NR	20.5				14.4 - 26.7		
Mercury	NR	0.0174				Sensitivity Evaluation		
Nickel	NR	84.5				59.2 - 109.9		
Selenium	NR	5.76				4.03 - 7.49		
Silver	NR	19.6				13.7 - 25.5		
Technetium-99	NR	0.00174				0.00122 - 0.00226		
Thallium	NR	0.19				Sensitivity Evaluation		
Uranium-235	NR	0.055				0.039 - 0.072		
Uranium-238	NR	20.8				14.6 - 27.0		
Uranium-Total	NR	20.8				14.6 - 27.0		
Vanadium	NR	85				60 - 111		
Zinc	NR	96				67 - 125		

Radiological — Units: Bq/kg

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Americium-241	NR	0.9				Sensitivity Evaluation		
Cesium-134	NR					False Positive Test		
Cesium-137	NR					False Positive Test		
Cobalt-57	NR	698				489 - 907		
Cobalt-60	NR	795				557 - 1034		
Iron-55	NR					False Positive Test		
Manganese-54	NR	1230				861 - 1599		
Nickel-63	294	1130	N		-74.0	791 - 1469	32.2	A
Plutonium-238	NR	0.52				Sensitivity Evaluation		
Plutonium-239/240	NR	101				71 - 131		
Potassium-40	NR	574				402 - 746		
Strontium-90	NR	920				644 - 1196		
Technetium-99	898	1100	A		-18.4	770 - 1430	78.8	A
Thorium-228	NR	43.3				30.3 - 56.3		
Thorium-230	NR	40.0				28.0 - 52.0		
Thorium-232	NR	43.3				30.3 - 56.3		
Uranium-234	NR	64				45 - 83		
Uranium-238	NR	258				181 - 335		
Zinc-65	NR	990				693 - 1287		

MAPEP-23-MaSU48: Radiological urine standard

Radio

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag	Units
Plutonium-239	NR	90.2				63.1 - 117.3			pg/L
Plutonium-240	NR	1.90				1.33 - 2.47			pg/L
Uranium-236	NR	5.38				3.77 - 6.99			ng/L

MAPEP Mixed Analyte Performance Evaluation Program

2508 Quality Lane
Knoxville, TN 37931-6819

MAPEP-23-MaW49: Radiological and inorganic combined water standard

Inorganic — Units: (mg/L)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Antimony	NR					False Positive Test		
Arsenic	NR	4.01				2.81 - 5.21		
Barium	NR	5.91				4.14 - 7.68		
Beryllium	NR	1.40				0.98 - 1.82		
Cadmium	NR	0.315				0.221 - 0.410		
Chromium	NR	2.07				1.45 - 2.69		
Cobalt	NR	6.02				4.21 - 7.83		
Copper	NR	4.93				3.45 - 6.41		
Lead	NR	2.83				1.98 - 3.68		
Mercury	NR	0.124				0.087 - 0.161		
Nickel	NR	5.24				3.67 - 6.81		
Selenium	NR	0.369				0.258 - 0.480		
Technetium-99	NR	1.40E-5				9.80E-6 - 1.82E-5		
Thallium	NR	1.97				1.38 - 2.56		
Uranium-235	NR	3.94E-4				2.76E-4 - 5.12E-4		
Uranium-238	NR	0.0542				0.0379 - 0.0705		
Uranium-Total	NR	0.0546				0.0382 - 0.0710		
Vanadium	NR	5.01				3.51 - 6.51		
Zinc	NR	5.55				3.89 - 7.22		

Radiological — Units: (Bq/L)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Americium-241	NR					False Positive Test		
Cesium-134	NR	11.3				7.9 - 14.7		
Cesium-137	NR	8.7				6.1 - 11.3		
Cobalt-57	NR	19.3				13.5 - 25.1		
Cobalt-60	NR					False Positive Test		
Hydrogen-3	NR					False Positive Test		
Iron-55	NR	41.1				28.8 - 53.4		
Manganese-54	NR	12.7				8.9 - 16.5		
Nickel-63	.971	1.11	A			Sensitivity Evaluation	.148	
Plutonium-238	NR	0.726				0.508 - 0.944		
Plutonium-239/240	NR	0.784				0.549 - 1.019		
Potassium-40	NR					False Positive Test		
Radium-226	NR	0.650				0.455 - 0.845		
Strontium-90	NR	7.31				5.12 - 9.50		
Technetium-99	8.88	8.85	A		0.3	6.20 - 11.51	.905	A
Uranium-234	NR	0.67				0.47 - 0.87		
Uranium-238	NR	0.67				0.47 - 0.87		
Zinc-65	NR	19.1				13.4 - 24.8		

Laboratory Results For MAPEP Series 49

(TELE01) Teledyne Brown Engineering - Environmental Services
2508 Quality Lane
Knoxville, TN 37931-6819

MAPEP-23-RdV49: Radiological vegetation

Inorganic — Units: (ug/sample)

MAPEP Mixed Analyte Performance Evaluation Program

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Uranium-235	NR	0.0523				0.0366 - 0.0680		
Uranium-238	NR	7.4				5.2 - 9.6		
Uranium-Total	NR	7.5				5.3 - 9.8		

Radiological — Units: (Bq/sample)

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range	Unc Value	Unc Flag
Americium-241	NR	0.131				0.092 - 0.170		
Cesium-134	3.86	4.98	W		-22.5	3.49 - 6.47	.151	A
Cesium-137	.0269		A			False Positive Test	.0922	
Cobalt-57	3.88	4.24	A		-8.5	2.97 - 5.51	.157	A
Cobalt-60	2.37	2.79	A		-15.1	1.95 - 3.63	.166	A
Manganese-54	2.04	2.56	W		-20.3	1.79 - 3.33	.226	A
Plutonium-238	NR	0.186				0.130 - 0.242		
Plutonium-239/240	NR	0.184				0.129 - 0.239		
Strontium-90	.957	1.17	A		-18.2	0.82 - 1.52	.0272	A
Uranium-234	NR	0.091				0.064 - 0.118		
Uranium-238	NR	0.092				0.064 - 0.120		
Zinc-65	-.514		A			False Positive Test	.243	

MRAD-39 Final Evaluation Report

ERA
A Waters Company

Sharon Northcutt
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Teledyne Brown Engineering
2508 Quality Ln.
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(865) 934-0374

EPA ID: TN11387
ERA Customer Number: T200801
Report Issued: 11/20/2023
Study Dates: 09/18/2023 - 11/17/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Soil Radionuclides (cat# 802, lot# A039-608)												
2700	Actinium-228	pCi/kg		1590	1050 - 2000	Not Reported				1570	122	
2755	Americium-241	pCi/kg	2810	1300	702 - 1840	Not Acceptable	HASL 300 Am-01 28th ED 1997	11/17/2023	6.05	1150	274	Shannon Cooper
2772	Bismuth-212	pCi/kg		1670	478 - 2490	Not Reported				1740	382	
2773	Bismuth-214	pCi/kg		786	377 - 1170	Not Reported				742	146	
2800	Cesium-134	pCi/kg		1570	1070 - 1880	Not Reported				1380	283	
2805	Cesium-137	pCi/kg		1780	1350 - 2250	Not Reported				1720	345	
2815	Cobalt-60	pCi/kg		7960	6270 - 9830	Not Reported				7730	1290	
2902	Lead-212	pCi/kg		1650	1150 - 2090	Not Reported				1660	256	
2903	Lead-214	pCi/kg		851	357 - 1340	Not Reported				808	120	
2905	Manganese-54	pCi/kg		< 555	0.00 - 555	Not Reported						
2930	Plutonium-238	pCi/kg	1028	481	240 - 731	Not Acceptable	HASL 300 Pu-02 28th ED 1997	11/14/2023	2.13	448	273	Shannon Cooper
2932	Plutonium-239	pCi/kg	2406	1250	681 - 1800	Not Acceptable	HASL 300 Pu-02 28th ED 1997	11/14/2023	1.95	1110	665	Shannon Cooper
2946	Potassium-40	pCi/kg		41800	28800 - 49900	Not Reported				42700	2440	
3005	Strontium-90	pCi/kg	9580	6800	2120 - 10600	Acceptable	HASL 300 Sr-03 28th ED 1997	11/15/2023	1.88	6080	1860	Shannon Cooper
3028	Thorium-234	pCi/kg		3140	1190 - 5380	Not Reported				3400	1140	
3036	Uranium-234	pCi/kg	9140	3160	1480 - 4140	Not Acceptable	HASL 300 U-02 28th ED Rev 1 2000	11/16/2023	5.58	2510	1190	Shannon Cooper
3038	Uranium-238	pCi/kg	9800	3140	1720 - 4210	Not Acceptable	HASL 300 U-02 28th ED Rev 1 2000	11/16/2023	6.22	2730	1140	Shannon Cooper
3055	Uranium-Total	pCi/kg		6440	3570 - 8330	Not Reported				5760	845	
1184	Uranium (mass)	µg/kg		9400	4240 - 12700	Not Reported				7480	886	
3070	Zinc-65	pCi/kg		2030	1620 - 2770	Not Reported				2060	417	

MRAD-39 Final Evaluation Report

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ERA Customer Number: T200801
Report Issued: 11/20/2023
Study Dates: 09/18/2023 - 11/17/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Air Filter Radionuclides (cat# 800, lot# A039-606)												
2755	Americium-241	pCi/Filter	49.64	69.3	49.5 - 92.4	Acceptable	HASL 300 Am-01 28th ED 1997	11/14/2023	-2.73	70.5	7.65	Shannon Cooper
2800	Cesium-134	pCi/Filter		1350	876 - 1660	Not Reported				1180	162	
2805	Cesium-137	pCi/Filter		932	765 - 1220	Not Reported				962	44.8	
2815	Cobalt-60	pCi/Filter		95.5	81.2 - 121	Not Reported				103	7.55	
2885	Iron-55	pCi/Filter	1020	1180	431 - 1680	Acceptable	TBE Proprietary	11/3/2023	0.416	986	80.8	Shannon Cooper
2905	Manganese-54	pCi/Filter		< 35.0	0.00 - 35.0	Not Reported						
2930	Plutonium-238	pCi/Filter	11.19	49.3	37.2 - 60.6	Not Acceptable	HASL 300 Pu-02 28th ED 1997	11/14/2023	-15.9	48.2	2.32	Shannon Cooper
2932	Plutonium-239	pCi/Filter	102	47.2	35.3 - 56.9	Not Acceptable	HASL 300 Pu-02 28th ED 1997	11/14/2023	34.5	45.0	1.65	Shannon Cooper
3005	Strontium-90	pCi/Filter		162	102 - 221	Not Reported				178	4.81	
3036	Uranium-234	pCi/Filter	19.9	20.1	14.9 - 23.6	Acceptable	HASL 300 U-02 28th ED 1997	11/17/2023	1.73	18.6	0.757	Shannon Cooper
3038	Uranium-238	pCi/Filter	17.7	20.0	15.1 - 23.9	Acceptable	HASL 300 U-02 28th ED 1997	11/16/2023	-1.57	19.0	0.799	Shannon Cooper
3055	Uranium-Total	pCi/Filter		41.0	29.9 - 48.6	Not Reported				38.3	0.258	
1184	Uranium (mass)	µg/Filter		59.9	48.1 - 70.2	Not Reported				56.7	2.53	
3070	Zinc-65	pCi/Filter		161	132 - 246	Not Reported				180	20.4	
MRAD Air Filter Gross Alpha/Beta (cat# 801, lot# A039-607)												
2830	Gross Alpha	pCi/Filter	82.2	79.8	41.7 - 131	Acceptable	EMSL-LV p. 1 1979	10/19/2023	-0.530	88.2	11.4	Susan Ogletree
2840	Gross Beta	pCi/Filter	54.3	42.6	25.8 - 64.4	Acceptable	EMSL-LV p. 1 1979	10/19/2023	0.403	51.3	7.51	Susan Ogletree

MRAD-39 Final Evaluation Report

A Waters Company

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EPA ID: TN11387
ERA Customer Number: T200801
Report Issued: 11/20/2023
Study Dates: 09/18/2023 - 11/17/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
MRAD Water Radionuclides (cat# 804, lot# A039-617)												
2755	Americium-241	pCi/L	54.0	71.0	48.7 - 90.8	Acceptable	HASL 300 Am-01 28th ED 1997	10/23/2023	-1.81	70.3	9.02	Shannon Cooper
2800	Cesium-134	pCi/L		1010	763 - 1110	Not Reported				939	72.5	
2805	Cesium-137	pCi/L		1010	865 - 1150	Not Reported				1010	41.1	
2815	Cobalt-60	pCi/L		2020	1740 - 2320	Not Reported				2060	94.5	
2885	Iron-55	pCi/L	2430	2630	1550 - 3830	Acceptable	TBE Proprietary	10/25/2023	0.351	2330	288	Shannon Cooper
2905	Manganese-54	pCi/L		< 71.0	0.00 - 71.0	Not Reported						
2930	Plutonium-238	pCi/L	172	177	106 - 229	Acceptable	HASL 300 Pu-02 28th ED 1997	10/23/2023	0.982	156	16.5	Shannon Cooper
2932	Plutonium-239	pCi/L	171	182	113 - 224	Acceptable	HASL 300 Pu-02 28th ED 1997	10/23/2023	0.923	155	17.5	Shannon Cooper
3005	Strontium-90	pCi/L		878	632 - 1090	Not Reported				903	59.4	
3036	Uranium-234	pCi/L		98.9	75.3 - 113	Not Reported				96.2	5.27	
3038	Uranium-238	pCi/L		98.1	76.0 - 115	Not Reported				96.7	6.62	
3055	Uranium-Total	pCi/L		202	158 - 230	Not Reported				199	8.87	
1184	Uranium (mass)	µg/L		295	239 - 335	Not Reported				283	9.45	
3070	Zinc-65	pCi/L		1990	1770 - 2510	Not Reported				2080	142	

RAD-135 Final Evaluation Report

A Waters Company

Sharon Northcutt
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EPA ID: TN11387
ERA Customer Number: T200801
Report Issued: 11/22/2023
Study Dates: 10/06/2023 - 11/20/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
RAD Gamma EmitterS™ (cat# 808, lot# R135-758)												
2765	Barium-133	pCi/L	86.3	92.2	73.8 - 111	Acceptable	EPA 901.1 1980	10/13/2023	-0.494	90.0	7.44	Shannon Cooper
2800	Cesium-134	pCi/L	38.4	41.2	27.9 - 54.5	Acceptable	EPA 901.1 1980	10/13/2023	-0.677	39.8	2.12	Shannon Cooper
2805	Cesium-137	pCi/L	194	199	161 - 237	Acceptable	EPA 901.1 1980	10/13/2023	-1.12	203	8.39	Shannon Cooper
2815	Cobalt-60	pCi/L	49.5	47.8	33.8 - 61.8	Acceptable	EPA 901.1 1980	10/13/2023	0.292	48.8	2.38	Shannon Cooper
3070	Zinc-65	pCi/L	59.7	57.0	23.7 - 90.3	Acceptable	EPA 901.1 1980	10/13/2023	0.194	58.8	4.71	Shannon Cooper
RAD GroSS™ Alpha/Beta (cat# 809, lot# R135-759)												
2830	Gross Alpha	pCi/L	53.2	70.6	54.0 - 87.2	Not Acceptable	EPA 900.0 (GPC) 1 2018	11/20/2023	-0.810	59.3	7.56	Susan Ogletree
2840	Gross Beta	pCi/L	46.9	42.2	30.5 - 53.9	Acceptable	EPA 900.0 (GPC) 1 2018	11/20/2023	0.943	40.3	7.04	Susan Ogletree
RAD NaturalS™ (cat# 811, lot# R135-751)												
2965	Radium-226	pCi/L		15.8	13.3 - 18.3	Not Reported				15.9	1.54	
2970	Radium-228	pCi/L		2.63	1.28 - 3.98	Not Reported				2.62	0.846	
3055	Uranium (activity)	pCi/L	51.26	51.7	45.9 - 57.5	Acceptable	EPA 908.0 1980	11/16/2023	0.342	50.3	2.81	Shannon Cooper
1184	Uranium (mass)	µg/L		75.4	66.9 - 83.9	Not Reported				73.9	2.94	
RAD TritiuM™ (cat# 812, lot# R135-752)												
3030	Tritium	pCi/L	2010	22900	19700 - 26100	Not Acceptable	EPA 906.0 1980	10/30/2023	-17.6	23100	1200	Susan Ogletree
RAD TritiuM™ (cat# 812, lot# R135-752)												
3030	Tritium	pCi/L	20100**	22900	19700 - 26100	Acceptable	EPA 906.0 1980	10/30/2023	-2.51	23100	1200	Susan Ogletree
RAD Strontium-89/90 (cat# 807, lot# R135-757)												
2995	Strontium-89	pCi/L	51.1	38.2	25.2 - 51.2	Acceptable	EPA 905.0 1980	11/1/2023	1.17	35.1	13.7	Shannon Cooper
3005	Strontium-90	pCi/L	31.7	35.7	30.3 - 41.1	Acceptable	EPA 905.0 1980	11/1/2023	-0.969	35.4	3.83	Shannon Cooper
RAD Iodine-131 (cat# 810, lot# R135-750)												
2875	Iodine-131	pCi/L	23.5	29.7	25.8 - 33.6	Not Acceptable	SM 7500-I C (GPC)-2000 2000	10/20/2023	-2.26	29.8	2.81	Shannon Cooper

** Result(s) have been revised by ERA. Report Revised: 11/30/2023

A.5

Analytics Cross Check Program Results
Client-Supplied Samples

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Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39389 Liquid	Fe-55	9.63E-06	9.98E-06	0.96	12.5	AGREEMENT
	Sr-89	5.37E-05	5.04E-05	1.07	17	AGREEMENT
	Sr-90	5.84E-06	4.99E-06	1.17	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39523 Liquid TBE	Gross Beta (Cs-137)	8.53E-04	9.98E-04	0.85	17	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39524 Liquid TBE	H-3	2.01E-05	2.50E-05	0.81	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
A39525 Filter TBE	Fe-55	2.08E-03	2.16E-03	0.96	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
A39528 Filter TBE	Ce-141	2.62E-02	2.59E-02	1.01	20	AGREEMENT
	Co-58	2.01E-02	2.01E-02	1.00	20	AGREEMENT
	Co-60	3.85E-02	3.89E-02	0.99	20	AGREEMENT
	Cr-51	7.00E-02	7.17E-02	0.98	20	AGREEMENT
	Cs-134	1.93E-02	1.98E-02	0.98	20	AGREEMENT
	Cs-137	2.38E-02	2.41E-02	0.99	20	AGREEMENT
	Fe-59	3.08E-02	3.06E-02	1.01	20	AGREEMENT
	Mn-54	1.84E-02	1.83E-02	1.00	20	AGREEMENT
	Zn-65	2.84E-02	2.86E-02	0.99	20	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39526 Liquid	Ni-63	2.45E-03	2.50E-03	0.98	12.5	AGREEMENT
	Sr-89	8.57E-03	7.00E-03	1.22	17	AGREEMENT
	Sr-90	3.16E-03	4.09E-03	0.77	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39527 Liquid TBE	Gross Alpha (Am-241)	8.32E-05	9.01E-05	0.92	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39320 Liquid TBE L100586	Ni-63	1.76E-03	1.81E-03	0.97	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
A39321 Filter TBE L100586	Gross Alpha (Am-241)	8.62E-04	7.92E-04	1.09	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39322 Liquid TBE L100586	Sr-89	8.23E-03	9.30E-03	0.88	17	AGREEMENT
	Sr-90	6.80E-04	8.57E-04	0.79	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
[redacted]	Am-241	1.57E-02	1.58E-02	1.00	20	AGREEMENT
	Ce-141	2.13E-02	2.14E-02	0.99	20	AGREEMENT
	Co-58	8.88E-03	9.18E-03	0.97	20	AGREEMENT
	Co-60	2.15E-02	2.26E-02	0.95	20	AGREEMENT
	Cr-51	4.53E-02	4.79E-02	0.95	20	AGREEMENT
	Cs-134	1.15E-02	1.18E-02	0.98	20	AGREEMENT
	Cs-137	1.31E-02	1.42E-02	0.92	20	AGREEMENT
	Fe-59	1.35E-02	1.34E-02	1.01	20	AGREEMENT
	Mn-54	1.48E-02	1.58E-02	0.94	20	AGREEMENT
	Zn-65	2.09E-02	2.24E-02	0.93	20	AGREEMENT

Sample	Analysis	PEACH BOTTOM Value, uCi/ml	EZA Value, uCi/ml	Ratio PEACH BOTTOM / EZA	Resolution	Comparison
A39529 Liquid TBE	Fe-55	7.86E-04	7.08E-04	1.11	12.5	AGREEMENT

Sample	Analysis	PEACH BOTTOM Value, uCi/ml	EZA Value, uCi/ml	Ratio PEACH BOTTOM / EZA	Resolution	Comparison
A39530 Liquid TBE	H-3	8.01E-04	1.00E-03	0.80	12.5	AGREEMENT

Sample	Analysis	PEACH BOTTOM Value, uCi	EZA Value, uCi	Ratio PEACH BOTTOM / EZA	Resolution	Comparison
A39531A Filter TBE	Gross Alpha (Am-241)	1.30E-04	9.03E-04	0.14	12.5	DISAGREEMENT

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39532 Liquid TBE	Ce-141	7.00E-03	5.09E-03	1.38	20	DISAGREEMENT
	Co-60	3.93E-03	3.02E-03	1.30	20	AGREEMENT
	Cr-51	1.32E-02	9.65E-03	1.37	20	DISAGREEMENT
	Cs-134	6.12E-03	4.73E-03	1.30	20	AGREEMENT
	Cs-137	5.22E-03	3.90E-03	1.34	20	DISAGREEMENT
	Fe-59	6.97E-03	5.29E-03	1.32	20	AGREEMENT
	Mn-54	4.43E-03	3.36E-03	1.32	20	AGREEMENT
	Zn-65	5.78E-03	4.42E-03	1.31	20	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
A39533 Filter TBE	Ni-63	5.02E-04	5.61E-04	0.89	12.5	AGREEMENT
	Sr-89	2.14E-03	2.41E-03	0.89	17	AGREEMENT
	Sr-90	1.96E-04	2.30E-04	0.85	12.5	AGREEMENT

Sample	Analysis	[redacted] Value, uCi	EZA Value, uCi	Ratio [redacted] / EZA	Resolution	Comparison
A39534 Filter TBE	Gross Beta (Cs-137)	7.98E-04	7.05E-04	1.13	17	AGREEMENT

ATTACHMENT B

Intralaboratory Quality Control Program Results

B.1 Blanks, Spikes and Matrix Spikes

ATTACHMENT B.1
TBE - ES QC Program
In-House Water Blanks and Spikes

Nuclide	# of Samples Analyzed	Blank Results	Spike Recovery % (Range*)	% of Samples Within 20% of Known Value
Am-241	45	All < MDC[1]	74.9 - 100	84.4
C-14	72	All < MDC	78.2 - 120	97.2
Ce-144 (RAD)	30	All < MDC	NA	
Cs-137 (RAD)	19	All < MDC	78.5 - 121	89.5
Fe-55	120	All < MDC	71.5 - 121	90.8
Gross Alpha	164	All < MDC	73.0 - 130	81.7
Gross Beta	114	All < MDC	74.3 - 130	66.7
H-3	362	All < MDC	72.6 - 129	93.6
I-129/131	89	All < MDC	76.6 - 126	84.3
Ni-63	128	All < MDC	79.7 - 127	93.0
P-32	13	All < MDC	NA	
Pu-239/240	46	All < MDC[1]	73.4 - 127	84.8
S-35 (RAD)	3	All < MDC	NA	
Sr-89	157	All < MDC	70.2 - 130	88.5
Sr-90	170	All < MDC	72.2 - 129	87.1
Tc-99	38	All < MDC	79.2 - 104	97.4
Th-230	17	All < MDC	79.5 - 101	94.1
U-238	42	All < MDC	75.0 - 115	98

**Internal Process Control results use TBE-ES acceptance criteria of 70 -130% recovery*
(1) Ecept for one positive blank - qualified on report of analyses

Matrix Spikes

Nuclide	Count Date	Sample Result (pCi/L)	Spiked Result (pCi/L)	Spike Value (pCi/L)	% Recovery**
Fe-55	02/01/23	<75.3	1167	1130	103
Fe-55	05/18/23	<86.4	1403	1020	137
Fe-55	08/15/23	<69.4	822	962	85.5
Fe-55	11/16/23	<101	2100	1800	117
Gr-A	01/31/23	4.28	36.5	42.8	75.3
Gr-A	05/10/23	2.69	39.1	42.8	85.1
Gr-A	08/10/23	<1.2	35.7	42.8	83.4
Gr-A	11/08/23	1.3	37.3	42.8	84.1
Gr-A	12/20/23	2.7	38.1	42.8	82.7
Gr-B	01/30/23	15.9	73.5	54.5	106
Gr-B	05/08/23	15.8	60.3	54.5	82.4
Gr-B	08/10/23	21.0	82.4	53.7	114
Gr-B	11/01/23	21.1	82.5	53.4	115
Gr-B	12/20/23	22.3	71.5	53.2	92.5
H-3	01/25/23	<293	6450	7410	87.0
H-3	05/06/23	<224	4070	3620	112
H-3	08/14/23	<280	4450	3570	125
H-3	11/03/23	<293	4800	3523	136
H-3	12/19/23	<299	4320	3503	123
Ni-63	02/01/23	<4.50	781	861	90.7
Ni-63	05/22/23	<4.63	832	859	96.9
Ni-63	08/17/23	<4.57	879	857	103
Ni-63	11/01/23	<4.28	813	856	95
Sr-89	01/31/23	< 8.25	211	203	104
Sr-89	05/17/23	< 7.76	1800	2040	88.1
Sr-89	08/15/23	< 7.83	496	593	83.7
Sr-89	11/01/23	< 6.58	128	168	76.3
Sr-89	12/26/23	< 6.79	64.3	84.6	76.1
Sr-90	01/31/23	< 0.81	53.2	53.0	100
Sr-90	05/17/23	<0.93	47.1	52.5	89.7
Sr-90	08/14/23	<0.87	47.4	52.2	90.8
Sr-90	11/01/23	<0.65	38.3	51.9	73.8
Sr-90	12/26/23	<0.69	41.3	51.7	79.9

***Internal Process Control results use TBE-ES acceptance criteria of 60 -140% recovery*

B.2 Duplicates

ATTACHMENT B.2

TBE - ES QC Program In-House Duplicates*

Matrix	Nuclide	# of Dups Analyzed	# Samples Evaluated for RPD**	RPD Range	RPD Upper Limit
Air Particulates	Be-7 (Gamma)	49	3	6.2 - 20.7	30
	Gross Alpha	63	19	3.0 - 16.6	30
	Gross Beta	509	260	0.0 - 29.7	30
	Sr-89	69	4	1.4 - 26.5	30
	Sr-90	70	1	14.0	30
Charcoal	I-131 (Gamma)	370	2	1.8 - 2.0	50
Feed/Food/Grass/Veg	Be-7 (Gamma)	53	13	0.2 - 28.9	50
	K-40 (Gamma)	56	54	0.4 - 23.1	50
Fish/Shellfish/SF	Be-7 (Gamma)	11	0		50
	K-40 (Gamma)	12	10	4.8 - 46.5	50
Milk	K-40 (Gamma)	99	99	0.0 - 29.8	30
Sediment/Solid	C-14 (RAD)	2	0		50
	H-3 (RAD)	2	0		50
	K-40 (Gamma)	8	7	2.1 - 20.4	50
Water/Liquid	Am-241	1	1	4.0	30
	Fe-55	6	2	0.3 - 14.2	30
	Gross Alpha	29	1	18.6	30
	Gross Beta	37	11	0.0 - 18.1	30
	H-3	246	29	0.2 - 18.9	30
	K-40 (Gamma)	60	2	14.5 - 22.3	30
	Ni-63	5	1	0.0	30
	Sr-89	19	1	7.3	30
	Sr-90	23	3	5.6 - 16.1	30
LO/LR	C-14	2	0	1.3	30
LO/LR	H-3	6	2	1.3 - 10.0	30
LCSD's	Am-241 (AS)	39	39	0.1 - 21.0	30
	C-14 (RAD)	57	57	0.0 - 27.9	30
	Cs-137 (RAD)	19	19	0.1 - 16.8	30
	Co-60	2	2	0.5 - 2.0	30
	Fe-55	102	102	0.0 - 26.6	30
	Gross Alpha	58	58	0.0 - 28.4	30
	Gross Beta	47	47	0.0 - 25.6	30
	H-3	94	94	0.0 - 24.2	30
	I-129	86	86	0.2 - 29.7	30
	Ni-63	108	108	0.0 - 27.1	30
	Pu-239/240 (AS)	40	40	1.0 - 28.8	30
	Sr-89	59	59	0.0 - 26.2	30
	Sr-90	68	68	0.0 - 27.2	30
	Tc-99	37	37	1.3 - 20.9	30
	Th-230 (AS)	17	17	0.2 - 13.6	30
	U-238 (AS)	39	39	0.2 - 26.6	30
MSD's	N/A				30

**NOTE: Duplicates listed for Gamma analyses are only for nuclides reported in QC data packages (All Gamma nuclides are duplicated at the time of analysis)*

Precision is not evaluated if results are < 5x MDC* ***or *if both results are non-detect*

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ATTACHMENT C

Non-Conformance Reports

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TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-01

Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Gamma Reviewal	Client/Project Affected: XXXXXXXX
Requirement Reference: TBE-1016	Affected Data: L#: L98879
NCR Description: Gamma nuclide (Eu-154) misidentified	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-01
Prepared By: Karli Arterburn	Date:02/09/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: During gamma results reviewal per client request it was noticed that the results for the individual Eu-154 identified energy lines were not comparing and therefore should have been assigned to other nuclides. The root cause was due to human error. Gamma data reviewers have been made aware of the potential for energy line misidentification for Eu-154.	
Corrective Action Plan: Gamma reviewers will be more careful to ensure the individual energy line results are comparative within each nuclide.	
Planned Completion Date(s) for Actions(s): 02/09/23	
Prepared By: Karli Arterburn	Date:02/09/23
Approved By: Keith Jeter	Date: 2/10/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Adrian L Northcutt	Date: 02/10/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO Description: Notifies Client of issue will sent completed NCR	Date: 2/10/23
Prepared By: Karli Arterburn	Date: 2/10/23

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-02

Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Project Management	Client/Project Affected: XXXXXXXXXXX
Requirement Reference: TBE-2010	Affected Data: L#: L99284
NCR Description: Samples were distilled before received. Note on chain of custody says to prep as received but the samples were distilled again at TBE.	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-03, CAR 23-01
Prepared By: Karli Arterburn	Date:02/15/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The notation to prep as received was not in the technical specifications on the paperwork for the laboratory technicians.	
Corrective Action Plan: The notation will be added to the technical specifications. Programing will be done to add the technical specifications to the work lists that the technicians print. In addition, we will be logging the samples that need to be analyzed as received will now be logged under "H-3 DIRECT" instead of "H-3".	
Planned Completion Date(s) for Actions(s): To be completed by 4/1/23	
Prepared By: Karli Arterburn	Date: 02/16/23
Approved By: Keith Jete	Date: 2/16/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Shawn L Northcutt	Date: 03/28/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☒ YES ☐ NO Description: Completed NCR and CC sent to client.	Date:
Prepared By: Karli Arterburn	Date:02/16/23

C.2

From:
To:
Cc:
Subject:
Date:

External Email

Karli,

Traditionallly, when performing splits, we were in good agreement with Teledyne.
A couple years ago, our results compared to Teledyne, were high, but passing.

For quarter 1 2023 we had the follow results on 3 samples, some weeks apart:

XXXXXXXX	Teledyne	percent difference	pass/fail
5.63E-01	5.05E-01	11%	pass
9.38E-01	5.91E-01	59%	fail
9.65E-01	5.94E-01	62%	fail

In an effort to resolve, we sent off samples to XXXXXXXX. The agreement was within 1%
And we received a sample from Analytics. The agreement was good.

I am suspecting that the issue may be on Teledyne's part.
When we first had the initial disparity, we started distilling samples on site, sending Teledyne a distilled sample.
We add the comment, "Please analyze all others for tritium as received with no additional preparation".
Or it could be another issue.

We are agreeing with Analytics and XXXXXXXXXX. Please review your process for possible correction.

Northcutt, Sharon (US)

From: Wright II, Jim (US)
Sent: Tuesday, March 28, 2023 2:35 PM
To: jeter, Keith (US) <keith.jeter@Teledyne.com>; Arterburn, Karli (US) <Karli.Arterburn@Teledyne.com>; rohleder, Deanna (US) <deanna.rohleder@Teledyne.com>; Thurman, Kimberly (US) <Kimberly.Thurman@Teledyne.com>; Dearcop, Casey (US) <Casey.Dearcop@Teledyne.com>; Northcutt, Sharon (US) <Sharon.Northcutt@Teledyne.com>; Kazeneza, Francoise (US) <Francoise.Kazeneza@Teledyne.com>; Cooper, Shannon M (US) <Shannon.Cooper@Teledyne.com>; Ogletree, Susan (US) <Susan.Ogletree@Teledyne.com>; Coulston, Kristen (US) <Kristen.Coulston@Teledyne.com>; Cavin, Tyler (US) <Tyler.Cavin@Teledyne.com>; Hill, Cindy (US) <Cindy.Hill@Teledyne.com>; Webb, Donna (US) <donna.webb@Teledyne.com>; Gildner, Blake (US) <Blake.Gildner@Teledyne.com>; Beane, Belinda (US) <Belinda.Beane@teledyne.com>; Cooper, Kenny J (US) <Kenny.Cooper@Teledyne.com>
Subject: Outstanding Nuclide Reports with Tech notes

Everyone,

Starting now, any outstanding reports should have Technical Instructions for the project's that apply.

Not all projects have technical instructions (112 project do and 121 do not).

But if you do not have any technical instructions on any of your outstanding reports this week please let me know. I found 5 different version of the outstanding nuclide report and added technical instructions to them but there could be more versions.

The Technical Instructions will be listed below the samples they apply to

C.2

REPORT OF OUTSTANDING TRITIUM SAMPLES Rundate: 03/28/2023

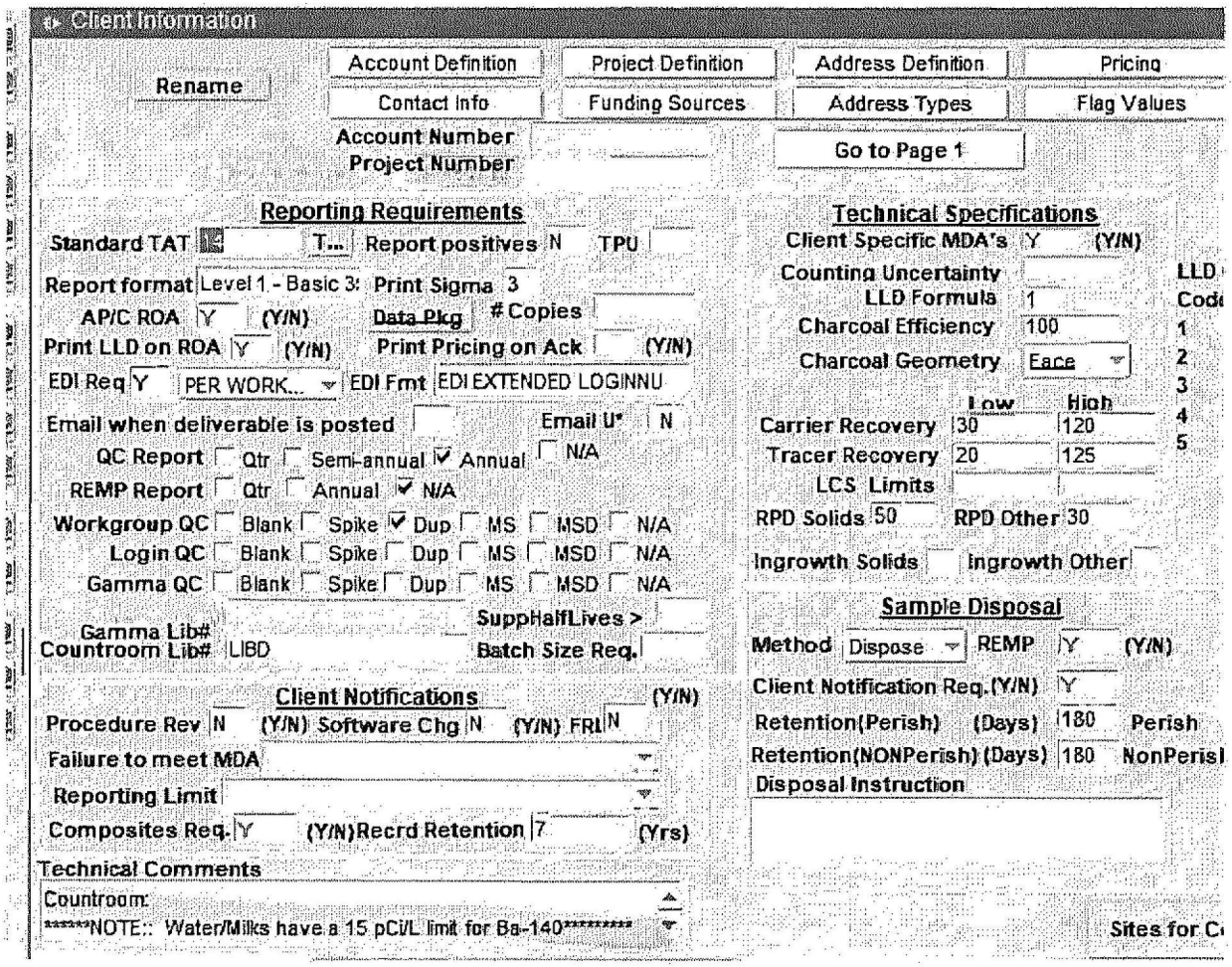
Projectnum	Clientid	Samplenum	Mat	Prod	Reporting Limit	Org	Composite#	Shelf
	MW206	L77487-1	WG	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	MW215	L77487-2	WG	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	MW216	L77487-3	WG	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	MW218	L77487-4	WG	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	MW219	L77487-5	WG	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	SEAWATER INTAKE	L77487-6	WT	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-091
	SEWAGE TREATMENT	L77990-5	WO	H-3 (DIST)	3.50E+02 pCi/L	E	N	DISPOSED-100
Technical instructions: Count composite APs for Sr for 5 minutes.								
		L99898-1	WG	H-3 (DIST)	2.00E+03 pCi/L	E	N	E27D
		L99898-2	WG	H-3 (DIST)	2.00E+03 pCi/L	E	N	E27D
	MW-02	L99907-1	WG	H-3 (DIST)	4.00E+02 pCi/L	E	N	E27D
	MW-04	L99907-2	WG	H-3 (DIST)	4.00E+02 pCi/L	E	N	E27D

REPORT OF OUTSTANDING TRITIUM SAMPLES Rundate: 03/28/2023

Projectnum	Clientid	Samplenum	Mat	Prod	Reporting Limit	Org		Shelf
	EL-4147_00	L99897-5	U	H-3	1.00E+04 pCi/L	E	N	B1B
	AL-6248_00	L99897-6	U	H-3	1.00E+04 pCi/L	E	N	B1B
	GIANTS NECK	L99905-2	WS	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D
Technical instructions: Milk requires composite. Do not consume all of sample.								
	MW-PB-28	L99878-1	WG	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D
	MW-PB-19	L99878-2	WG	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D
	MW-PB-29	L99878-3	WG	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D
	MW-PB-31	L99878-4	WG	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D
	MW-PB-20	L99878-5	WG	H-3 (DIST)	3.00E+02 pCi/L	E	N	E27D

Jim

Jim Wright
Teledyne Brown Engineering, Inc.
(Knoxville Laboratory)
Phone: 865-934-0426
Fax: 865-690-6187



TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-03

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: In-Plant Lab	Client/Project Affected: XXXXXXX
Requirement Reference: TBE-4006	Affected Data: L# 99457
NCR Description: Failed cross-check for LR Sr-90	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CC 23-05, CAR-23-04
Prepared By: Sharon Northcutt	Date:03/28/05

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Results were incorrectly reported by Eckert & Ziegler.	
Corrective Action Plan: E&Z to reissue report w/ corrected results.	
Planned Completion Date(s) for Actions(s): 05/15/23	
Prepared By: Sharon L Northcutt	Date: 05/15/23
Approved By: Keith Jete	Date: 5/15/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 05/15/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO	Date:
Description:	
Prepared By: Sharon L Northcutt	Date: 05/10/23

C.3

Supplemental Sheet

NCR No: 23-03

Description of Nonconformance:

Client cross-check for Liquid Sr-90 failure. TBE reported 5.84E-06 uCi/ml and the EZA value was 9.98E-06 uCi/ml (59% recovery)

Root Cause:

After receiving the client complaint, the sample was reanalyzed 3 times, each with similar results (4.24 E-06, 3.99E-06, 4.07E-06). Two different techs performed the reruns. As the Lab Manager was reviewing the E&Z report, he noticed that the Fe-55 and Sr-90 results were exactly the same value and questioned if there could possibly be a typo on the report. We notified the client, who appealed the result. E&Z discovered that there was a typo for the Sr-90 result and reissued the report with the corrected result (5.84E-06 pCi/ml). Our original result was within 117% of the known.

Corrective Action to Prevent Recurrence:

No corrective action needed on TBE's part.

Keith Deter — 5/15/23

Department Manager or Designee — Date

Sharon L Westcott — 05/15/23

Quality Assurance Manager or Designee — Date

C.3

Thurman, Kimberly (US)

From:
Sent: Monday, May 15, 2023 9:12 AM
To: Thurman, Kimberly (US)
Subject: RE: Emailing: XXXXX Hot_Crosscheck_(1st_QTR_-_2023)_Ref_Date_10_Feb_2023

Attachments: XXXXX Hot_Crosscheck (1st_Qtr_2023)_Ref_Date_10_Feb_ 2023.pdf

--External Email--

Appealed results, appears you guys found their problem

-----Original Message-----
From: Thurman, Kimberly (US) <Kimberly.Thurman@Teledyne.com>
Sent: Thursday, May 11, 2023 7:11 AM
To: XXXXXXX
Subject: RE: Emailing: XXXXXXXX Hot_Crosscheck_(1st_QTR_-_2023)_Ref_Date_10_Feb_2023

Thank you!

Teledyne Confidential; Commercially Sensitive Business Data -----Original Message-----
From: XXXXXXX
Sent: Thursday, May 11, 2023 7:32 AM
To: Thurman, Kimberly (US) <Kimberly.Thurman@Teledyne.com>
Subject: RE: Emailing: XXXXXX Hot_Crosscheck_(1st_QTR_-_2023)_Ref_Date_10_Feb_2023

---External Email---

I'll appeal and see and get back to you

(Original results)

C.3

Sample	Analysis	[redacted] Value, uCi/ml	EZA Value, uCi/ml	Ratio [redacted] / EZA	Resolution	Comparison
A39389 Liquid	Fe-55	9.63E-06	9.98E-06	0.96	12.5	AGREEMENT
	Sr-89	5.37E-05	5.04E-05	1.07	17	AGREEMENT
	Sr-90	5.84E-06	9.98E-06	0.59	12.5	DISAGREEMENT

Sample	Analysis	Value, uCi/ml	EZA Value, uCi/ml	Ratio / EZA	Resolution	Comparison
A39389 Liquid	Fe-55	9.63E-06	9.98E-06	0.96	12.5	AGREEMENT
	Sr-89	5.37E-05	5.04E-05	1.07	17	AGREEMENT
	Sr-90	5.84E-06	4.99E-06	1.17	12.5	AGREEMENT

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-04

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR		
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation		
Process Area: In-Plant Lab	Client/Project Affected: XXXXXXXXXXXX	
Requirement Reference: TBE-4006	Affected Data: L# 99723	
NCR Description: Failed cross-check for AP Gr-A		
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CC 23-06, CAR-23-05	
Prepared By: Sharon Northcutt		Date:04/08/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR		
Root Cause: No cause could be found - all QC was acceptable and sample was reanalyzed several times.		
Corrective Action Plan: CAR 23-05 - ordering a replacement but will not receive it until November.		
Planned Completion Date(s) for Actions(s): 07/20/23		
Prepared By: Sharon L Northcutt		Date: 07/20/23
Approved By: Keith Gete		Date: 7/20/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/20/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO Description: Results of Followup XCHK	Date:
Prepared By: Sharon L Northcutt	Date: 07/20/23

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-05

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Environmental Lab	Client/Project Affected: NA
Requirement Reference: TBE-4006	Affected Data: L# 100003
NCR Description: Unacceptable XHCK result for AP PU-238, PU-239	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-06
Prepared By: Sharon Northcutt	Date: 05/23/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: After the initial investigation, the Lab Mgr continued to search for a root cause. It appears that tracer was added twice to the sample (2 different lab techs at different points in the procedure)	
Corrective Action Plan: List summary to be generated by Lab Mgmt for techs concerning carrier/tracer addition & aliquot volumes for AP Cross checks.	
Planned Completion Date(s) for Actions(s): 09/15/23	
Prepared By: Keith Jeter	Date: 8/16/23
Approved By: Sharon L Northcutt	Date: 08/16/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 08/16/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO (Included in QA Report) Description:	Date:
Prepared By: Sharon L Northcutt	Date: 08/16/23

C.5

Supplemental Sheet

NCR No: 23-06

Description of Nonconformance:

TBE cross check failure for MRAD AP Pu-238 & Pu-239. Reported (and known) results were as follows: Pu-238 - 5.93 pCi (9.59), or 61.8% recovery and Pu-239 – 34.5 pCi (68.9), or 50.1% recovery. The lower acceptance results were 7.24 pCi (Pu-238) and 51.5 (Pu-239).

Root Cause:

The sample aliquot volume was verified to be correct. The AP sample was used as the workgroup duplicate with results of 6.29 pCi (Pu-238) and 35.8 pCi (Pu-239), which were still lower than the acceptance criteria. The U-234 and U-238 AP results both passed at 93.6% and 85.9% respectively. It appears that the procedure prep and sample counting functions were performed correctly. All workgroup QC was thoroughly reviewed and no anomalies discovered.

Because the AP sample included plutonium, uranium and Fe-55, the initial prepped sample was limited for each analysis. The lab could not reanalyze the sample after the results were received, as the plutonium and uranium portions were used as workgroup duplicates, and no sufficient sample volume remained.

After reviewing the initial prep steps for AP filters, it was determined that the tracer was added in error to the sample twice – once as part of the filter digestion (one lab tech) and then after the sample was aliquotted (another lab tech). When the tracer volume was doubled, the calculated values were as follows: Pu-238 – 10.5 pCi (sample) and 10.5 pCi (WG duplicate); Pu-239 – 69.07 pCi (sample) and 71.64 pCi (WG duplicate). Both sets of results would be in the acceptable range at 109% and 100%/104% recoveries respectively.

Corrective Action to Prevent Recurrence:

The Lab Manager & Lab Production Manager will generate a summary for the lab techs to clarify carrier & tracer additions as well as correct aliquot volumes for all AP cross checks.

Keith Jete — 8/16/23

Department Manager or Designee — Date

Sharon L Boothcutt — 08/16/23

Quality Assurance Manager or Designee — Date

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-06

Responsible Manager: Kimberly Thurman

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Count Room	Client/Project Affected: [redacted]
Requirement Reference: TBE-1016, TBE-1018	Affected Data: L# 100118, 99947
NCR Description: Unexpectedly high Ni-63 results	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-07, CC 23-07
Prepared By: Sharon Northcutt	Date: 05/25/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Samples were switched in the count room.	
Corrective Action Plan: Technicians have been made aware & will be more diligent in verifying sample IDs. (1st occurrence since 2016)	
Planned Completion Date(s) for Actions(s): 06/25/23	
Prepared By: Sharon L Northcutt	Date: 06/07/23
Approved By: Keith Jeter	Date: 6/7/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 06/07/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☒ NO Description:	Date:
Prepared By: Kimberly Thurman	Date: 06/07/23

C.6

Supplemental Sheet

NCR No: 23-06

Description of Nonconformance:

Incorrect result reported for Ni-63 discovered due to client complaint. Sample was ~~sent~~ went back to the original raw data and found only one other sample that was counted at the same time and was also a Part 61-type sample. The other sample was recounted and its result was higher than originally reported.

Root Cause:

It appears that two samples which were counted sequentially were incorrectly identified prior to the data being uploaded to LIMS. The samples were either placed in the detector in a different order than on the raw data sheet or were recorded in a different order than in the detector. Either way, the samples were switched due to human error.

Corrective Action to Prevent Recurrence:

TBE processed around 49,000 analyses over the past year. This is the first NCR due to sample switching in the countroom since 2016. Countroom technicians have been made aware of the situation and will be more diligent to confirm sample ID's prior to recording data.

Keith Pete — 6/7/23
Department Manager or Designee — Date

Sharon L Northcutt — 06/07/23
Quality Assurance Manager or Designee — Date

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-07

Responsible Manager: Keith Jeter

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☒ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Count Room	Client/Project Affected: NA
Requirement Reference: TNI 2016 V1M2 5.5	Affected Data:
NCR Description: Incomplete Alpha Spec Instrument Maintenance Records (cleaning record missing)	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-08
Prepared By: Sharon Northcutt	Date: 06/06/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Records for instrumentation have historically included maintenance, repair and/or replacement but not cleaning.	
Corrective Action Plan: Add cleaning activities to maintenance log	
Planned Completion Date(s) for Actions(s): 07/06/23	
Prepared By: Sharon L Northcutt	Date: 07/05/23
Approved By: Keith Jeter	Date: 7/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 07/05/23

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-08

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR		
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation		
Process Area: In-Plant Lab	Client/Project Affected: TBE	
Requirement Reference: TBE-4006	Affected Data: L# 99860	
NCR Description: Failed cross-check for soil Ni-63		
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-09	
Prepared By: Sharon Northcutt		Date: 06/21/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR		
Root Cause: See Supplemental Sheet		
Corrective Action Plan: Revise TBE-3013		
Planned Completion Date(s) for Actions(s): 09/30/23		
Prepared By: Keith Pate		Date: 9/7/23
Approved By: Sharon L Northcutt		Date: 09/07/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 09/07/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 09/07/23

C.8

Supplemental Sheet

NCR No: 23-08

Description of Nonconformance:

The reported value for the S Ni-63 MAPEP cross-check of 294 Bq/kg was in disagreement with the known result of 1100 Bq/kg. The acceptable range was 791 – 1469 Bq/kg. This is a repeat of NCR 21-03 & NCR 21-13.

Root Cause:

The sample was re-prepped and analyzed by a senior lab technician, who used it as the workgroup duplicate. The results were 1120 and 1250 Bq/kg respectively. It is evident that there was some discrepancy in the prep between the two analysts. The 2nd analyst made some observations regarding sample aliquot size along with the steps for addition of carriers and filtering in Section 9.3.4 that should be incorporated into the procedure and improve the process.

Corrective Action to Prevent Recurrence:

Revised procedure TBE-2013 Section 9.3.4 and technicians trained.

Keith Foster — 9/7/23

Department Manager or Designee — Date

Shawn L Northrup — 09/12/23

Quality Assurance Manager or Designee — Date

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-09

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: In-Plant Lab	Client/Project Affected: TBE
Requirement Reference: TBE-4006	Affected Data: L# 99860
NCR Description: Failed cross-check for vegetation Sr-90	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #:
Prepared By: Sharon Northcutt	Date: 06/21/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Statistical failure - See Supplemental Sheet	
Corrective Action Plan: No corrective action warranted @ this time.	
Planned Completion Date(s) for Actions(s): 07/05/23	
Prepared By: Sharon L Northcutt	Date: 07/05/23
Approved By: Keith Peter	Date: 7/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 07/05/23

C.9

Supplemental Sheet

NCR No: 23-09

Description of Nonconformance:

Failed cross-check for vegetation Sr-90. TBE reported result was 0.0542 +/- 00.00742 Bq/kg dry and the known was a "false positive".

Root Cause:

According to the MAPEP handbook, "Not Acceptable (N) performance, and hence a false positive result, is indicated when the range encompassing the result, plus or minus the total uncertainty at three standard deviations, does not include zero (e.g., 2.5 +/- 0.2; range of 1.9 to 3.1). A result greater than three times the total uncertainty of the measurement represents a statistically positive detection with over 99% confidence."

TBE's reported result with 3 times the uncertainty resulted in a slightly positive net result (0.03194 Bq/kg dry). The reported result was significantly below TBE's average detection limit for vegetation samples of 4.25 pCi/kg wet (or 0.157 Bq). The root cause was a statistical failure and not due to any analytical deficiency.

Corrective Action to Prevent Recurrence:

No corrective action is needed at this time. The QA Manager and Lab Operations Manager will verify any possibility of "false positive" reporting going forward.

Keith Jeter — 7/5/23

Department Manager or Designee — Date

Sharon L Northcutt — 07/05/23

Quality Assurance Manager or Designee — Date

Radium-226	NR	0.759			0.531 -	0.987		
Strontium-90	NR				False Positive Test			
Technetium-99	9.75	9.31	A	4.7	6.52 -	12.10	1.58	W
Uranium-234	NR	1.15			0.81 -	1.50		
Uranium-238	NR	1.16			0.81 -	1.51		
Zinc-65	NR	15.3			10.7 -	19.9		

MAPEP-23-RdV48: Radiological vegetation

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Uranium-235	NR	0.000144				Sensitivity Evaluation			
Uranium-238	NR	0.0206				Sensitivity Evaluation			
Uranium-Total	NR	0.0208				Sensitivity Evaluation			

Analyte	Result	Ref Value	Flag	Notes	Bias (%)	Acceptance Range		Unc Value	Unc Flag
Americium-241	NR	0.189				0.132 -	0.246		
Cesium-134	5.56	7.60	W		-26.8	5.32 -	9.88	0.322	A
Cesium-137	0.026		A			False Positive Test		.110	
Cobalt-57	5.91	6.93	A		-14.7	4.85 -	9.01	.188	A
Cobalt-60	5.00	6.51	W		-23.2	4.56 -	8.46	.215	A
Manganese-54	6.08	8.03	W		-24.3	5.62 -	10.44	.33	A
Plutonium-238	NR	0.187				0.131 -	0.243		
Plutonium-239/240	NR	0.178				0.125 -	0.231		
Strontium-90	0.0542		N	(1)		False Positive Test		0.00742	
Uranium-234	NR	0.00044				Sensitivity Evaluation			
Uranium-238	NR	0.000256				Sensitivity Evaluation			
Zinc-65	5.49	7.43	W		-26.1	5.20 -	9.66	.657	A

Notes:

(1) = False Positive

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-10

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Countroom	Client/Project Affected: TBE
Requirement Reference: TBE-4006	Affected Data: L# 100193
NCR Description: Failed cross-check for water Ba-133	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #:
Prepared By: Sharon Northcutt	Date: 06/27/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The reported result was 117% recovery (well within TBE QA acceptance range). The sample was used as the workgroup duplicate with a passing result of 25.4 (114%). The sample was counted on a different detector with a passing result of 21.9 (98% recovery).	
Corrective Action Plan: This was the first failure for Ba-133 and the result was within 20% of the known. Previous recoveries have ranged from 93 – 108%. No corrective action planned at this time.	
Planned Completion Date(s) for Actions(s): N/A	
Prepared By: Sharon Northcutt	Date: 06/27/23
Approved By: Keith Jeter	Date: 6/27/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 06/27/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☒ NO Description: (included in CA report)	Date:
Prepared By: Sharon L Northcutt	Date: 06/27/23

RAD-133 Final Evaluation Report

A Waters Company

Sharon Northcutt
QA Manager
Teledyne Brown Engineering
2508 Quality Ln.
Knoxville, TN 37931
(865) 934-0374

EPA ID: TN11387
ERA Customer Number: T200801
Report Issued: 06/02/2023
Study Dates: 04/10/2023 - 05/25/2023

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
RAD Gamma EmitterS™ (cat# 808, lot# R133-758)												
2765	Barium-133	pCi/L	26.0	22.3	17.1 - 25.8	Not Acceptable	EPA 901.1 1980	4/18/2023	0.827	23.6	2.90	Shannon Cooper
2800	Cesium-134	pCi/L	72.1	77.6	63.4 - 85.4	Acceptable	EPA 901.1 1980	4/18/2023	-1.10	76.7	4.17	Shannon Cooper
2805	Cesium-137	pCi/L	62.1	63.1	56.8 - 72.2	Acceptable	EPA 901.1 1980	4/18/2023	-0.760	66.0	5.15	Shannon Cooper
2815	Cobalt-60	pCi/L	32.6	30.3	26.7 - 36.1	Acceptable	EPA 901.1 1980	4/18/2023	0.201	32.3	1.27	Shannon Cooper
3070	Zinc-65	pCi/L	253	242	218 - 283	Acceptable	EPA 901.1 1980	4/18/2023	-0.101	254	13.8	Shannon Cooper
RAD GroSS™ Alpha/Beta (cat# 809, lot# R133-759)												
2830	Gross Alpha	pCi/L	34.2	29.2	14.9 - 38.2	Acceptable	EPA 900.0 1980	4/20/2023	2.22	26.7	3.39	Susan Ogletree
2840	Gross Beta	pCi/L	64.3	60.7	41.8 - 67.4	Acceptable	EPA 900.0 1980	4/20/2023	1.50	55.5	5.98	Susan Ogletree
RAD NaturalS™ (cat# 811, lot# R133-751)												
2965	Radium-226	pCi/L		7.68	5.78 - 9.07	Not Reported				8.11	1.34	
2970	Radium-228	pCi/L		9.34	6.04 - 11.7	Not Reported				8.34	1.35	
3055	Uranium (Nat)	pCi/L	61.75	62.7	51.2 - 69.0	Acceptable	EPA 908.0 1980	4/25/2023	0.333	61.4	1.20	Shannon Cooper
1184	Uranium (mass)	µg/L		93.6	76.4 - 103	Not Reported				87.5	3.90	
RAD TritiuM™ (cat# 812, lot# R133-752)												
3030	Tritium	pCi/L	13300	12700	11100 - 14000	Acceptable	EPA 906.0 1980	5/23/2023	0.769	12600	890	Susan Ogletree
RAD Strontium-89/90 (cat# 807, lot# R133-757)												
2995	Strontium-89	pCi/L	57.0	61.1	49.2 - 69.0	Acceptable	EPA 905.0 1980	5/15/2023	1.69	55.3	6.88	Shannon Cooper
3005	Strontium-90	pCi/L	36.5	36.0	26.4 - 41.5	Acceptable	EPA 905.0 1980	5/15/2023	-0.0343	36.6	2.83	Shannon Cooper
RAD Iodine-131 (cat# 810, lot# R133-750)												
2875	Iodine-131	pCi/L	24.3	28.7	23.9 - 33.6	Acceptable	SM 7500-I C (GPC)-2000 2000	4/21/2023	-2.40	28.5	1.73	Shannon Cooper

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-11

Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Composite program/Project Management	Client/Project Affected: [redacted]
Requirement Reference:	Affected Data: L# L101112
NCR Description: Matrix was not accurate causing results to be incorrect.	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: 23-09 CAR 23-12
Prepared By: Karli Arterburn	Date: 07/20/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The composite program in LIMS assigned the first 3 samples as "LR" matrix instead of "AP" matrix. Composite paperwork did have "AP" listed. This was not caught in login review.	
Corrective Action Plan: Programing is being done on the LIMS system to be able to composite multiple matrices.	
Planned Completion Date(s) for Actions(s): 08/21/23	
Prepared By: Karli Arterburn	Date:07/20/23
Approved By: Sharon L Northcutt	Date: 07/20/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/20/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☒ YES ☐ NO Description: Sent to client with revised report.	Date: 8/22/23
Prepared By: Karli Arterburn	Date: 8/22/23

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-12

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: In-Plant Lab	Client/Project Affected: XXXXX
Requirement Reference:	Affected Data: L#100871
NCR Description: Failed client cross-check AP Sr-89	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-08, CAR 23-14
Prepared By: Sharon Northcutt	Date: 07/20/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: See Supplemental Sheet	
Corrective Action Plan: Update project setup to include tech spec notes for sample prep. Training for lab techs	
Planned Completion Date(s) for Actions(s):	
Prepared By: Keith Oeter	Date: 7/25/23
Approved By: Sharon L Northcutt	Date: 07/25/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/25/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO Description: Revised Report	Date: 7/25/23
Prepared By: Kimberly O'Steen	Date: 7/25/23

C.12

Supplemental Sheet

NCR No: 23-12

Description of Nonconformance:

The TBE cross-check result for AP Sr-89 of 7.55E-04 uCi was in disagreement with the known result of 1.05E-03 uCi. The acceptable range for a resolution of 17 would be 75-133% of the known or 7.80E-04 - 1.40E-03 uCi. The TBE result was at 72% (within TBE QA acceptance range of 70 – 130%).

Root Cause Investigation:

The sample was originally prepped using a 10% aliquot. The sample was reprepped using a 30% aliquot. The R1 Sr-89 result was 9.60E-04 uCi (91.4% recovery), well within acceptance limits with a 17 resolution.

As a side note, the sample was also reprepped using a 30% aliquot for Sr-90. The original reported result was 6.09E-05 uCi (agreement - 63% recovery); the R1 result was 8.61E-05 uCi (89% recovery). The known was 9.66E-05 uCi.

The root cause for this nonconformance is an incorrect aliquot volume used in sample prep for AP cross checks.

Corrective Action to Prevent Recurrence:

Tech spec direction will be made in the client project information to direct lab techs to use a 30% aliquot for crosscheck AP's. Training for lab techs on sample prep for AP samples.

Keith Oeter 7/25/23

Department Manager or Designee Date

Shawn L Northcutt 07/25/23

Quality Assurance Manager or Designee Date

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: NCR-23-13

Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Project Management	Client/Project Affected: XXXXX
Requirement Reference: TBE-6010	Affected Data: L# L101112 and L101483
NCR Description: Incorrect Reference date option chosen in project setup.	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: XXXXXXXXX CAR-23-17
Prepared By: Karli Arterburn	Date: 081723

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The correct reference date option was not chosen during the project setup.	
Corrective Action Plan: The reference date options will be changed in the project setup. REMP will be "END" and effluent (P50) will be "MID".	
Planned Completion Date(s) for Actions(s):082223	
Prepared By: Karli Arterburn	Date:081723
Approved By: Sharon L Northcutt	Date: 08/22/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 08/22/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☒ YES ☐ NO Description: Revised report, complete CC/NCR sent.	Date:082223
Prepared By: Karli Arterburn	Date: 8/22/23

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-14

Responsible Manager: Kim Thurman

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Project Management	Client/Project Affected: [redacted]
Requirement Reference:	Affected Data: L#101947
NCR Description: Samples assigned to the incorrect project #/client.	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-12; CAR 23-18
Prepared By: Kim Thurman Kim Thurman	Date: 09/11/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Multiple crosschecks were unpackaged and logged on the same date. Only one of the two shipments contained a packing list indicating the specific client for the samples to be associated and both were assigned to that client.	
Corrective Action Plan: Login/Project Manager ensure paperwork received with each crosscheck indicates a specific client name. PM to contact client if it isn't clear.	
Planned Completion Date(s) for Actions(s): 09/15/23	
Prepared By: Kim Thurman	Date: 09/11/23
Approved By: Shawn L Northcutt	Date: 09/11/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Shawn L Northcutt	Date: 09/11/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO Description: Report submitted.	Date: 9/12/23
Prepared By: Kim Thurman	Date: 09/11/23

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: NCR-23-15

Responsible Manager: Kim Thurman

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Laboratory	Client/Project Affected: [redacted]
Requirement Reference:	Affected Data: L#101947
NCR Description: Failed Crosscheck Gross Alpha – Air Particulate	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC-23-13; CAR 23-19
Prepared By: Kim Thurman	Date: 09/13/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Mylar cover which sealed the spike to the filter was separated and not included in the original analysis which resulted in the majority of the spike being omitted from the original analysis. Mylar filter was analyzed showing the majority of the activity @6.06E-04 uCi/Total. The filter portion originally analyzed with an activity of 1.30E-04 uCi/Total combined with the mylar activity for a total of @7.36E-04 uCi/Total agrees with the EZ known value of 9.03E-04 uCi/Total.	
Corrective Action Plan: Laboratory instructed to include the mylar cover in the analysis.	
Planned Completion Date(s) for Actions(s): 09/20/23	
Prepared By: Kim Thurman	Date: 9/26/23
Approved By: Keith Gotte	Date: 9/26/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 09/26/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO Description: Report & NCR provided	Date: 09/26/23
Prepared By: Kim Thurman	Date: 9/26/23

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-16

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☒ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: QA Cross-checks	Client/Project Affected: N/A
Requirement Reference: DoD/DOE QSM 5.4	Affected Data: L# N/A
NCR Description: Lab is deficient in analyzing at least 2 PT samples for each analyte/matrix/method combination for which it seeks accreditation	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-20
Prepared By: Sharon Northcutt	Date: 09/26/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Lab has only analyzed available commercial PT's to this point. (New requirement for DoD/DOE accreditation)	
Corrective Action Plan: Will confirm that we are ordering all available commercial cross-checks. PJLA allows spike comparisons to fulfill this requirement. Will generate necessary data and send to them ASAP for those not commercially available.	
Planned Completion Date(s) for Actions(s): 11/30/23 – to PJLA by 11/15/23	
Prepared By: Sharon L Northcutt	Date: 11/03/23
Approved By: Keith Jeter	Date: 11/3/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 11/03/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO (QA Report) Description:	Date:
Prepared By: Sharon L Northcutt	Date: 11/03/23

PJLA

NONCONFORMANCE REPORT

ASSESSMENT INFORMATION		
Number	**Type**	**Date(s)**
A2023-01264	*Virtual offsite surveillance*	*September 14 - 15, 2023*
Standard(s):	*ISO/IEC 17025:2017/DoD-ELAP/DOECAP-AP QSM 5.4*	
Team: (Lead)	*Maurice Downer* (LA, TA, TE)	
CONFORMITY ASSESSMENT BODY (CAB)		
Name	**Location(s)**	
Teledyne Brown Engineering	*2508 Quality Lane Knoxville, TN 37931*	

TOTALS			
Repeat	**Major**	**Minor**	**Observation(s)**
0	0	*2*	*0*

NUMBER & TYPE (Major, Minor or Observation)	FINDING & OBJECTIVE EVIDENCE	REQUIREMENT
NCR 1 - Minor ☐ *Repeat?"*	*Finding – The laboratory has not analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.* *Objective Evidence – The laboratory has not maintained and analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation. For the following analytes and methods* 1. *EiChroM Tc-01 (TBE SOP TBE-2021) (LSC) (Beta) - Technetium-99 (Tc-99) (3020) missing (Air).* 2. *EPA 900.0 & EPA 9310 (TBE SOP TBE-2008) by (GPC) (Alpha Beta) Gross Alpha (2830) and Gross Beta (2840) missing (Solid).* 3. *EPA 908.0 & HASL U-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Uranium (Isotopic) (3055) missing (Solid).* 4. *Harvey (TBE SOP TBE-2003) by (LSC) (Beta) Carbon-14 (C-14) (2790) and Tritium (3030) missing (Solid).* 5. *HASL Am-01 (TBE SOP TBE-2001) by Alpha Spectroscopy Americium (Isotopic) missing (Air), and Curium (Isotopic) missing (Air, Aqueous, Solid.)* 6. *HASL Pu-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Neptunium (Isotopic) missing (Air, Aqueous, Solid), Plutonium (Isotopic) (2940) missing (Solid).* 7. *HASL Pu-02 (TBE SOP TBE-2001) by (LSC) (Beta) Plutonium-241 (Pu-241) (2936) missing (Air, Aqueous, Solid).* 8. *LANL ER-200 (TBE SOP TBE-2001) by Alpha Spectroscopy Thorium (Isotopic) (3012) missing (Air, Aqueous, Solid).* 9. *ORISE AP2 (TBE SOP TBE-2010) by (LSC) (Beta) Tritium (3030) missing (Aqueous).* 10. *ORISE AP9 (TBE SOP TBE-2010) by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Aqueous).* 11. *TBE SOP TBE-2002 by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Air, Aqueous, Solid).* 12. *TBE SOP TBE-2006 by Gamma Spectroscopy Iron-55 (2885) missing (Solid).* 13. *TBE SOP TBE-2012 by Gamma Spectroscopy Iodine-129 (2874) missing (Air, Aqueous, Solid).* 14. *TBE SOP TBE-2013 by Gamma Spectroscopy Nickel-59 (1108) missing (Air, Aqueous, Solid).*	*DoD/DOE QSM 5.4 V1M1 2.2.1: To maintain DoD ELAP accreditation, the laboratory shall successfully analyze at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.*
NCR 2 - Minor ☐ *Repeat?"*	*Finding – The laboratory SOP for Liquid Scintillation Counters does not include or reference the computer hardware and software in use for each unit.* *Objective Evidence – The laboratory SOP for Liquid Scintillation Counters 3004 Rev 7 LSC Calibration does not include or reference the computer hardware and software in use for each unit.*	*DoD/DOE QSM 5.4 V1M2 4.2.8.5.f) xxv: Each method shall include or reference the following topics where applicable: computer hardware and software.*

PJLA

NONCONFORMANCE REPORT

NUMBER & TYPE (Major, Minor or Observation)	FINDING & OBJECTIVE EVIDENCE	REQUIREMENT

an Identify assessment Number and NCR# in the objective evidence discussion.

Note: Corrective Action Responses shall be submitted **within 60 days** on the organization's internal corrective form in accordance with the standard. Corrective Actions should be sent to CA@pjlabs.com.

SUBMITTED BY ASSESSOR:

Name: Maurice Downer Signature: _____ Date: *September 15, 2023*

ACCEPTED BY CAB:

Name: Sharon Northcutt Signature: Sharon L Northcutt Date: 09/15/23

ASSESSOR CORRECTIVE ACTION ACCEPTANCE: (with receipt of evidence of corrective actions)

Assessor Signature: _____ Date: _____

PJLA

FOUR-YEAR PT (Proficiency Test) SCHEDULE

(At a minimum this should include 4 years of PT activities. Additional sheets may be used for further years)

Teledyne Brown Engineering

This plan defines the specific calibration or test disciplines or sub disciplines for which PTs will be performed during the four year period indicated. This plan includes representative sub disciplines from each calibration or test discipline for which the organization is accredited. Please refer to PL-1 *Proficiency Testing* for the PJLA PT policy.

#	Proficiency Test Discipline	Year 2022	Year 2023	Year 2024	Year 2025	Source or Type (ISO/IEC 17043 PT Provider, 3rd party/Inter laboratory, Repeatability/Intra-lab)
Environmental Testing (Radiochemistry)						
1	Drinking Water - Gamma, Gr-A, Gr-B, I-131, U, H-3, Sr-89/90	2/yr	2/yr	2/yr	2/yr	ERA RAD
2	Water - Am-241, Fe-55, Pu-238, Pu-239	2/yr	2/yr	2/yr	2/yr	ERA MRAD
3	Soil (Solid) - Sr-90	2/yr	2/yr	2/yr	2/yr	ERA MRAD
4	AP - Fe-55, Pu-238, Pu-239, U-234, U-238, Gr-A, Gr-B	2/yr	2/yr	2/yr	2/yr	ERA MRAD
5	Milk (Liquid) - Gamma, I-131, Sr-89/90	2/yr	2/yr	2/yr	2/yr	E&Z Analytics
6	Charcoal (Solid) - I-131	2/yr	2/yr	2/yr	2/yr	E&Z Analytics
7	AP - Gamma, Sr-89/90	2/yr	2/yr	2/yr	2/yr	E&Z Analytics
8	Soil (Solid) - Gamma	2/yr	2/yr	2/yr	2/yr	E&Z Analytics
9	Soil (Solid) - Ni-63, Tc-99	2/yr	2/yr	2/yr	2/yr	MAPEP
10	Urine (Liquid) - Gamma, U-234, U-238 (as available)	2/yr	2/yr	2/yr	2/yr	MAPEP
11	Water - Ni-63, Tc-99	2/yr	2/yr	2/yr	2/yr	MAPEP
12	Vegetation (Solid) - Gamma, Sr-90	2/yr	2/yr	2/yr	2/yr	MAPEP
13	Water - C-14, I-129, Th-ISO					Repeatability
14	Air – Ni-63 (Client-provided as available)	2/yr	2/yr	2/yr	2/yr	E&Z Analytics
15	Soil (Solid) – Th-228, Th-230, Th-232, Fe-55		1 (new)	2/yr	2/yr	MAPEP
16	Solid – H-3, C-14					Repeatability
17	Air – Am-241		1 (new)	2/yr	2/yr	ERA MRAD
18	Soil (Solid) – Am-241, Pu-238, Pu-239, U-234, U-238		1 (new)	2/yr	2/yr	ERA MRAD

FOUR-YEAR PT (Proficiency Test) SCHEDULE

(At a minimum this should include 4 years of PT activities. Additional sheets may be used for further years)

Intra-laboratory comparisons and repeatability studies
Where third party proficiency testing or inter-laboratory comparisons are not achievable in accordance with PJLA PL-1 *Proficiency Testing*, the organization must obtain PJLA headquarters approval for other means of evaluating performance (e.g., intra-laboratory and/or repeatability studies). The laboratory shall submit this LF-81 *Four-Year PT (Proficiency Test) Schedule* along with the reasoning for doing so and procedure for administering/evaluating the PTs. **PJLA Headquarters Approval:** (only required when third party proficiency testing or inter-laboratory comparisons are not achievable) _____ Signature _____ Date

NCR No. 23-16 Supplemental Sheet

The following items were listed on the NCR 1 Objective Evidence for not analyzing at least two PT samples per calendar year for each analyte-matrix-method combination on the scope of accreditation:

#/Analyte	TBE#	Matrix	Plan or Explanation
1. Tc-99	2021	Air	*See Note 1 below*
2. Gr-A, Gr-B	2008	Solid	PT's not commercially available – same process as/like other matrices
3. U ISO	2001	Solid	Successfully passed U-234 (MRAD-27) and MRAD-38. MRAD-39 due 11/17
4. H-3, C-14	2003	Solid	(Harvey) Remove from list
5. Am ISO	2001	Air & Solid	MRAD-39 in-house & due 11/17
		Aqueous	Sent results for MRAD 36, 37 & 38 during audit. MRAD-39 due 11/17
5. Cm ISO	2001	ALL	Am & Cm are the same procedure – the tracer and spike use Am only and the Cm is seen on the Am spectrum. Chemically, they are inseparable from each other. *See Note 1*
6. Np ISO	2001	ALL	Pu & Np are the same procedure – the tracer and spike use Pu only and the Np-137 is well-separated from the Pu peaks. *See Note 1*
6. Pu ISO	2001	Solid	MRAD-39 in-house & due 11/17
7. Pu-241	2001	ALL	Should have been included with PU ISO instead of on a separate line.
8. Th ISO	2001	Air	PT's not commercially available – same process as/like other matrices
		Aqueous	Including a spike reproducibility study with documents
		Solid	MAPEP-49 in house and due 11/15
9/10 H-3, C-14	2010	Aqueous	H-3 same process as/like TBE-2011; Reproducibility studies with documents
		Solid	Spike reproducibility studies with documents.
11. C-14	2002	Aqueous	Spike reproducibility study with documents
		Air & Solid	Remove from list
12. Fe-55	2006	Solid	MAPEP-49 in-house and due 11/17
13. I-129	2012	ALL	Same process as I-131 – these should be grouped together. PT's not commercially available. Including spike reproducibility for aqueous.
14. Ni-59	2013	ALL	Same process as Ni-63 – these should be grouped together. PT's not commercially available.

Note 1 – Due to limited vendor availability, the addition of this analyte/matrix to our current cross-check program is cost prohibitive in relation to the amount of samples processed.

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-20

SECTION 1 (To be completed by initiator)

Initiator Name: Sharon Northcutt	Date: 09/26/23

Identified Through: ☐ Daily Operations ☐ Management Review ☒ Audit ☐ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition:

Missing cross-checks for analytes/matrices for which we are seeking accreditation

Manager Acknowledgement: Sharon L Northcutt	Date: 09/26/23

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Sharon Northcutt	Priority: ☒ High ☐ Medium ☐ Low	Date: 09/26/23

Requested date for root cause investigation: 10/15/23

NCR # 23-16 **(if applicable)**

Comments: Research all available possibilities and add as needed. <See attached>

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☑ Yes	Existing processes investigated and understood? ☑ Yes

Summary of Proposed Action(s):

Researched all PT (commercial) vendors and made sure all available are ordered. Spike Reproducibility studies for the others not available.

Documents Requiring Update: TB E-4006

Solution approval signature(s): Sharon L Northcutt

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☐ Yes N/A	Has the solution been effective? ☐ Yes ☐ No	Date Closed:

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*

TBE Cross-Check Program

Nuclide	Air	Aqueous	Solid
Am-241	MRAD-39	MRAD-39	MRAD-39
Am-241		MRAD-38	
Am-241		MRAD-37	
Am-241		MRAD-36	
C-14	N/A	Spike Study	Spike Study
Cm Iso	Uses the same exact processes as Am-241 (run together)		
Fe-55	MRAD-39	MRAD-39	MAPEP 49
Fe-55	MRAD-38	MRAD-38	
Fe-55	MRAD-37	MRAD-37	
Fe-55	MRAD-36	MRAD-36	
Gamma	E&Z E13835	E&Z E13833, ERA RAD-135	E&Z E13836, MAPEP 49
Gamma	E&Z E13829	E&Z E13827, ERA RAD-133, MAPEP 48	E&Z E13830, MAPEP 48
Gamma	E&Z E13715	E&Z E13713, ERA RAD-131	E&Z E13716, MAPEP 47
Gamma	E&Z E13709, MAPEP 46	E&Z E13707, ERA RAD-129, MAPEP 46	E&Z E13710, MAPEP 46
GR-A	MRAD-39	ERA RAD-135	***Not commercially*
GR-A	MRAD-38	ERA RAD-133	*available - As Like*
GR-A	MRAD-37	ERA RAD-131	*Gr-A Air/Water*
GR-A	MRAD-36	ERA RAD-129	*Samples"*
GR-B	MRAD-39	ERA RAD-135	***Not commercially*
GR-B	MRAD-38	ERA RAD-133	*available - As Like*
GR-B	MRAD-37	ERA RAD-131	*Gr-B Air/Water*
GR-B	MRAD-36	ERA RAD-129	*Samples"*
H-3	N/A	ERA RAD-135	Spike Study
H-3	N/A	ERA RAD-133	
H-3	N/A	ERA RAD-131	
H-3	N/A	ERA RAD-129	
I-129	*Not commercially avail*	Spike Study	*Not commercially avail*
I-131	N/A	E&Z E13833, ERA RAD-135	E&Z E13834
I-131	N/A	E&Z E13827, ERA RAD-133	E&Z E13828
I-131	N/A	E&Z E13713, ERA RAD-131	E&Z E13716
I-131	N/A	E&Z E13707, ERA RAD-129	E&Z E13710
Ni-59	Uses the same exact processes as Ni-63 (run together)		
Ni-63		MAPEP 49	MAPEP 49
Ni-63		MAPEP 48	MAPEP 48
Ni-63	*Client A38539*	MAPEP 47	MAPEP 47
Ni-63		MAPEP 46	MAPEP 46
Np Iso	Uses the same exact processes as Pu-ISO (run together)		
Pu-241	Uses the same exact processes as Pu-ISO (run together)		
Pu Iso	MRAD-39	MRAD-39	MRAD-39
Pu Iso	MRAD-38	MRAD-38	
Pu Iso	MRAD-37 (Pu-238)	MRAD-37	
Pu Iso	MRAD-36	MRAD-36	
Sr-89	E&Z E13837	E&Z E13832, ERA RAD-135	***Not commercially*
Sr-89	E&Z E13831	E&Z E13826, ERA RAD-133	*available - As Like*
Sr-89	E&Z E13717	E&Z E13712, ERA RAD-131	*Sr-89 Air/Water*
Sr-89	E&Z E13711	E&Z E13706, ERA RAD-129	*Samples"*
Sr-90	E&Z E13837	E&Z E13832, ERA RAD-135	MAPEP 49, MRAD-39
Sr-90	E&Z E13831	E&Z E13826, ERA RAD-133	MAPEP 48, MRAD-38
Sr-90	E&Z E13717	E&Z E13712, ERA RAD-131	MAPEP 47, MRAD-37
Sr-90	E&Z E13711	E&Z E13706, ERA RAD-129	MAPEP 46, MRAD-36
Tc-99	*Cost-prohibitive in comp*	MAPEP 49	MAPEP 49
Tc-99	*to amount of work*	MAPEP 48	MAPEP 48
Tc-99	*done at TBE*	MAPEP 47	MAPEP 47
Tc-99		MAPEP 46	MAPEP 46
Th Iso	*Not commercially avail*	Spike Study	MAPEP 49
U Iso	MRAD-39	ERA RAD-135	MRAD-39
U Iso	MRAD-38	ERA RAD-133	MRAD-38
U Iso	MRAD-37	ERA RAD-131	MRAD-37 (U-238)
U Iso	MRAD-36	ERA RAD-129	

KEY:

NO XCHK In House Currently Failure Reproducibility Option

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-17

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☒ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Countroom Procedure TBE-3004	Client/Project Affected: N/A
Requirement Reference: DoD/DOE QSM 5.4	Affected Data: L# N/A
NCR Description: Computer hardware/software information not referenced in procedure	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-21
Prepared By: Sharon Northcutt	Date: 09/26/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: New requirement for DoD/DOE accreditation	
Corrective Action Plan: Add hardware/software information to TBE-3004	
Planned Completion Date(s) for Actions(s): 10/26/23	
Prepared By: Sharon L Northcutt	Date: 10/05/23
Approved By: Keith Gete	Date: 10/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 10/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 10/05/23

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-21

SECTION 1 (To be completed by initiator)

Initiator Name: Sharon Northcutt	Date: 09/26/23

Identified Through: ☐ Daily Operations ☐ Management Review ☒ Audit ☐ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition:

LSC computer hardware/software information not referenced n TBE-3004

Manager Acknowledgement: Sharon L Northcutt	Date: 09/26/23

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Keith Jeter	Priority: ☐ High ☒ Medium ☐ Low	Date: 09/26/23

Requested date for root cause investigation: 10/26/23

NCR # 23-17 **(if applicable)**

Comments: No "root cause" per se - New QSM 5.4 Requirement for accreditation (audit finding)

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☑ Yes	Existing processes investigated and understood? ☑ Yes

Summary of Proposed Action(s): Update TBE-3004 w/ required info

Documents Requiring Update: TBE-3004

Solution approval signature(s): Sharon L Northcutt

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☑ Yes TBE-3004	Has the solution been effective? ☑ Yes ☐ No	Date Closed: 10/05/23

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*

PJLA

NONCONFORMANCE REPORT

ASSESSMENT INFORMATION		
Number	**Type**	**Date(s)**
A2023-01264	*Virtual offsite surveillance*	*September 14 - 15, 2023*
Standard(s):	*ISO/IEC 17025:2017/DoD-ELAP/DOECAP-AP QSM 5.4*	
Team: (Lead)	*Maurice Downer* (LA, TA, TE)	

CONFORMITY ASSESSMENT BODY (CAB)	
Name	**Location(s)**
Teledyne Brown Engineering	*2508 Quality Lane Knoxville, TN 37931*

TOTALS			
Repeat	**Major**	**Minor**	**Observation(s)**
0	0	*2*	*0*

NUMBER & TYPE (Major, Minor or Observation)	FINDING & OBJECTIVE EVIDENCE	REQUIREMENT
NCR 1 - Minor ☐ *Repeat?"*	*Finding – The laboratory has not analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.* *Objective Evidence – The laboratory has not maintained and analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation. For the following analytes and methods* 1. *EiChroM Tc-01 (TBE SOP TBE-2021) (LSC) (Beta) - Technetium-99 (Tc-99) (3020) missing (Air).* 2. *EPA 900.0 & EPA 9310 (TBE SOP TBE-2008) by (GPC) (Alpha Beta) Gross Alpha (2830) and Gross Beta (2840) missing (Solid).* 3. *EPA 908.0 & HASL U-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Uranium (Isotopic) (3055) missing (Solid).* 4. *Harvey (TBE SOP TBE-2003) by (LSC) (Beta) Carbon-14 (C-14) (2790) and Tritium (3030) missing (Solid).* 5. *HASL Am-01 (TBE SOP TBE-2001) by Alpha Spectroscopy Americium (Isotopic) missing (Air), and Curium (Isotopic) missing (Air, Aqueous, Solid.)* 6. *HASL Pu-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Neptunium (Isotopic) missing (Air, Aqueous, Solid), Plutonium (Isotopic) (2940) missing (Solid).* 7. *HASL Pu-02 (TBE SOP TBE-2001) by (LSC) (Beta) Plutonium-241 (Pu-241) (2936) missing (Air, Aqueous, Solid).* 8. *LANL ER-200 (TBE SOP TBE-2001) by Alpha Spectroscopy Thorium (Isotopic) (3042) missing (Air, Aqueous, Solid).* 9. *ORISE AP2 (TBE SOP TBE-2010) by (LSC) (Beta) Tritium (3030) missing (Aqueous).* 10. *ORISE AP9 (TBE SOP TBE-2010) by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Aqueous).* 11. *TBE SOP TBE-2002 by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Air, Aqueous, Solid).* 12. *TBE SOP TBE-2006 by Gamma Spectroscopy Iron-55 (2885) missing (Solid).* 13. *TBE SOP TBE-2012 by Gamma Spectroscopy Iodine-129 (2874) missing (Air, Aqueous, Solid).* 14. *TBE SOP TBE-2013 by Gamma Spectroscopy Nickel-59 (1108) missing (Air, Aqueous, Solid).*	*DoD/DOE QSM 5.4 V1M1 2.2.1: To maintain DoD ELAP accreditation, the laboratory shall successfully analyze at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.*
NCR 2 - Minor ☐ *Repeat?"*	*Finding – The laboratory SOP for Liquid Scintillation Counters does not include or reference the computer hardware and software in use for each unit.* *Objective Evidence – The laboratory SOP for Liquid Scintillation Counters 3004 Rev 7 LSC Calibration does not include or reference the computer hardware and software in use for each unit.*	*DoD/DOE QSM 5.4 V1M2 4.2.8.5 f) xxv: Each method shall include or reference the following topics where applicable: computer hardware and software.*

Procedure	Number: TBE-3004	Revision: 7
	Issue Date: 11/25/03	Revision Date: 10/01/2021
Responsible Individual:	Laboratory Production Manager	Review Date: 10/01/2024
Subject:	Calibration and Control of Liquid Scintillation Counters	

frequency, the check sources shall be counted before and after the long sample batches. The standards for this are purchased as prepared sources. The standards for this check are retained in their own cassette.

11.2 Standards will be automatically counted until a minimum of 20,000 counts or a minimum of 30 seconds is reached. This is automatically programmed into the instrument and cannot be altered. The background will be counted for the time predetermined by the factory program. It should be noted that this background is not used for data calculation. Background counts equal to the sample counts are made with each work order and are used for the purpose of data calculation.

11.3 Tritium and Carbon-14 backgrounds and efficiencies are automatically plotted on a control chart and compared historically to the mean of the prior 90 measurements (moving average). Control chart evaluation is described in Procedure TBE-4011, "Quality Calculations and Charting (Accuracy, Precision, Recovery, Efficiency, Control Charts and Data Quality Objectives".

11.4 If an individual result is greater than three deviations (>99.7%) from the mean, a warning flag is printed out for operator action and the background or efficiency shall be checked again. If the result is still outside the 3-sigma limit, the detector shall be placed out of service and the Laboratory Operation Manager, or designee, contacted to resolve the issue.

NOTE Over time, the Tritium efficiency will slowly decline for any beta liquid scintillation instrument. This is normal and is due to the low energy of the Tritium beta and accumulation of dust on the internal optics. Given the use of LCS spikes, this is a self-correcting situation and will not affect the sample results.

11.5 While a detector is designated as out of control, it is labelled not to be used. The Laboratory Operations Manager or designee will evaluate the detector and the electronic system to determine the cause of the problem.

11.6 Corrective action must be documented in the maintenance log kept in the laboratory. If a sample (or samples) had been counted during a time period for which the detector was judged out of control, the sample (or samples) are counted a second time on a detector which is within control limits.

12.0 REFERENCES

12.1 Tri-Carb Liquid Scintillation Operation Manual: Perkin Elmer, or as appropriate. TBE Perkin Elmer 3180 detectors use the following QuantaSmart software: LS6 & LS9 – v 4.00, LS8 – v 3.00

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-20

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Environmental Prep	Client/Project Affected: N/A
Requirement Reference: TBE-4006	Affected Data: L#102753
NCR Description: Failed cross-check for WO Gr-A	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #:
Prepared By: Sharon Northcutt	Date: 11/30/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Reported the WG duplicate result instead of original sample result.	
Corrective Action Plan: N/A	
Planned Completion Date(s) for Actions(s): N/A	
Prepared By: Sharon L Northcutt	Date: 11/30/23
Approved By: Keith Gotte	Date: 11/30/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☒ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 11/30/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☒ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 11/30/23

Supplemental Sheet

NCR No: 23-20

Description of Nonconformance:

The 4Q23 RAD water result for gross alpha was not acceptable. TBE's reported result was 53.2 pCi/L (75% ratio); the known was 70.6 pCi/L with an acceptance range of 54.0 – 87.2 pCi/L.

Root Cause Investigation:

QC for workgroup WG43363 was reviewed and no anomalies were found. The reported result was actually the WG DUP. The original sample result was 63.3 pCi/L, which was well within the acceptable range and a 90% ratio. Because the LCS result was slightly higher at 123%, we felt that the lower Gr-A result would be more in line with expected results.

Corrective Action to Prevent Recurrence:

No effective corrective action can be done at this time, as both the original result and the WG DUP were within TBE's acceptable range (70%-130%). This is the first Gr-A result lower than 85% since 2020 – prior to this sample, results have ranged from 85% - 129%. Will take corrective action if this issue persists going forward.

Keith Jeter — 11/30/23

Department Manager or Designee — Date

Shawn L Northcutt — 11/30/23

Quality Assurance Manager or Designee — Date

Counter ID: G3A *Analyst:* KOJ

Sample ID	*Alpha Cts*	*Beta Cts*	*Min. Ctd*	*Date/Time*	*Net Wt*	*Spl Vol*	*Spl Units*	*Act*	*A-eff*	*B-eff*	*A-Act*	*A-Err*	*B-Act*	*B-Err*	*A-MDA*	*B-MDA*	*Act Units*	*MDA-F**	*Flags*
BKG	6	61	50.00	11/02/2023 17:44															
WG43363-3	106	421	50.00	11/02/2023 20:15	0.0890	1.90E+02	ml	pCi	0.089		5.32E+01	1.13E+01			6.07E+00		L	4.66	
L102753-3	122	440	50.00	11/02/2023 21:05	0.0963	1.90E+02	ml	pCi	0.087		6.33E+01	1.24E+01			6.23E+00		L	4.66	

Reviewed 11/20/23 Date

Data Filename: 3awg43363.xls

MDAF*: 2.71 = 2.71/Sample Count Time + Normal MDA Calcs

Error calculations are 2-Sigma. If tpu flagged, error is TPU

Act = ((sam counts / sam ct time) - (bkgcts / bkgtim)) / eff / putvol / splvolf * actvolf / actf / samaliq
Err = 2 * Sqr(sam counts / sam ct time ^ 2 + bkgcts / bkgtim ^ 2) / eff / putvol / splvolf * actvolf / actf / samaliq
TPU = 2 * Sqr((sam counts / sam ct time ^ 2 + bkgcts / bkgtim ^ 2) + (net sample count rate ^ 2 * TPU factor)) / eff / putvol / splvolf * actvolf / actf / samaliq
MDA = mdaf * Sqr(bkgcts / bkgtim / sam ct time) / eff / putvol / splvolf * actvolf / actf / samaliq
putvol: spl wt, splvolf: vol conv fac, actvolf: act vol conv fac, actf: act conv fac, samaliq: Spl Aliq

Calculated using AlphaBeta.XLS Workbook, v073013

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-21

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Environmental Prep	Client/Project Affected: N/A
Requirement Reference: TBE-4006	Affected Data: L#102753
NCR Description: Failed cross-check for WO I-131	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-22 SUD 25
Prepared By: Sharon Northcutt	Date: 11/30/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Technician did not follow ERA-provided instructions to prep shortly after receipt (see supplemental sheet)	
Corrective Action Plan: QA Mgr and Lab Supervisor to follow up with scheduling of sample analyses going forward.	
Planned Completion Date(s) for Actions(s): 03/01/24	
Prepared By: Sharon L Northcutt	Date: 11/30/23
Approved By: Keith Gotte	Date: 11/30/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 11/30/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☒ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 11/30/23

Supplemental Sheet

NCR No: 23-21

Description of Nonconformance:

The 4Q23 RAD water result for I-131 was not acceptable. TBE's reported result was 23.5 pCi/L (79% ratio); the known was 29.7 pCi/L with an acceptance range of 25.8 – 33.6 pCi/L.

Root Cause Investigation:

QC for workgroup WG43241 was reviewed and no anomalies were found. The LCS/LCSD results were 109% and 86.1% respectively. The sample was received on Tuesday, 10/10/23, with a reference date of Friday, 10/06/23. The sample was not prepped until 10/19/23 and then counted on 10/20/23. The directions for this analysis state "Due to the short half life (8.04 d) of Iodine-131, this standard should be analyzed shortly after receipt". Because the sample was not analyzed until 2 weeks after the reference date, the I-131 decayed slightly, causing the result to be lower than expected.

Corrective Action to Prevent Recurrence:

The QA Manager and Lab Supervisor will follow up with the lab technician going forward to ensure that the sample is prepped and counted within the same week it is received. Since 2020, there has only been one other low failure (81% ratio) and was due to the same issue.

Keith Jeter — 11/30/23

Department Manager or Designee — Date

Sharon L Northcutt — 11/30/23

Quality Assurance Manager or Designee — Date

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-25

SECTION 1 (To be completed by initiator)

Initiator Name: Sharon Northcutt	**Date: 11/30/23**

Identified Through: ☒ Daily Operations ☐ Management Review ☐ Audit ☐ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition:

Cross-check failure due to I-131 analysis not being completed in a timely manner.

Manager Acknowledgement: Sharon Northcutt	**Date:** 11/30/233

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Sharon Northcutt	**Priority:** ☐ High ☒ Medium ☐ Low	**Date:** 11/30/23

Requested date for root cause investigation: ~~11/29/23~~ 11/30/23

NCR # 23-21 **(if applicable)**

Comments: Sample date 10/06, received 10/10, counted 10/20. I-131 half life is 8.04 days.

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☒ Yes	**Existing processes investigated and understood?** ☒ Yes

Summary of Proposed Action(s):

This is a repeat of NCR 20-17. Previous CA was for the QA Mgr to follow up with lab technician to ensure the analysis was started ASAP. The QA Mgr failed to follow thru this time.

Documents Requiring Update: N/A

Solution approval signature(s): Sharon L Northcutt

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☐ Yes N/A	**Has the solution been effective?** ☐ Yes ☐ No	**Date Closed:**

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-22

Responsible Manager: Casey Dearcop

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Count room	Client/Project Affected: [redacted]
Requirement Reference: TBE-2001	Affected Data: L# 102514-32
NCR Description: Incorrect isotopic uranium results reported	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-14; CAR 23-16
Prepared By: Casey Dearcop	Date: 12/01/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The laboratory technician accidently labeled the same detector with two different samples, which caused spectral file ND-AMS_ARCHIVE_S:S_102623U$L102514-32_UU.CNF to be overwritten. The original sample was never counted.	
Corrective Action Plan: The laboratory technician will be counseled to be more careful in transcription.	
Planned Completion Date(s) for Actions(s): 12/05/23	
Prepared By: Casey Dearcop	Date: 12/05/23
Approved By: Keith Jeter	Date: 12/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Amanda L Northcutt	Date: 12/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☑ YES ☐ NO	Date: 12/04/23
Description: Revised Report	
Prepared By: Casey Dearcop	Date: 12/04/23

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-26

SECTION 1 (To be completed by initiator)

Initiator Name: Casey Dearcop	Date: 12/01/23

Identified Through: ☐ Daily Operations ☐ Management Review ☐ Audit ☒ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition:

Client's original sample results did not match expected result (spike), but R1 was acceptable.

Manager Acknowledgement: Keith Gete	Date: 12/1/23

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Casey Dearcop	Priority: ☒ High ☐ Medium ☐ Low	Date: 12/05/23

Requested date for root cause investigation: 12/05/23

NCR # 23-22 (if applicable)

Comments: Sample was reanalyzed with result more in line with expectations. Original sample was recounted with result similar to reanalysis. It appears that the countroom technician accidently labeled the same detector with two different samples, causing the spectral file to be overwritten. The original sample was never counted.

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☐ Yes	Existing processes investigated and understood? ☐ Yes

Summary of Proposed Action(s): The countroom technician was advised of the transcription error and is aware of the importance of assigning correct detectors. This is the first time this error has occurred with this technician.

Documents Requiring Update: N/A

Solution approval signature(s): Sharon Lawrence

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☐ Yes	Has the solution been effective? ☐ Yes ☐ No	Date Closed:

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*

TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-23

Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Laboratory	Client/Project Affected: [redacted]
Requirement Reference:	Affected Data: L#: L103281
NCR Description: The H-3 Direct results to not align with the split sample results.	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-15
Prepared By: Karli Arterburn	Date: 12/05/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: The samples were diluted incorrectly during preparation.	
Corrective Action Plan: Reanalyze the samples completely to ensure dilution is done as instructed and the results align with split sample results.	
Planned Completion Date(s) for Actions(s): 12/5/23	
Prepared By: Karli Arterburn	Date:12/05/23
Approved By: Keith Jete	Date: 12/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 12/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☒ YES ☐ NO Description: Sent revised report and NCR/CC info	Date:12/7/23
Prepared By: Karli Arterburn	Date: 12/7/23

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-27

SECTION 1 (To be completed by initiator)

Initiator Name: Karli Arterburn	Date: 12/5/23

Identified Through: ☐ Daily Operations ☐ Management Review ☐ Audit ☒ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition: Client's sample results did not match the split sample results. The dilution of the samples were done incorrectly during the sample preparation process.

Manager Acknowledgement:	Date:

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Karli Arterburn	Priority: ☒ High ☐ Medium ☐ Low	Date: 12/5/23

Requested date for root cause investigation: 12/5/23

NCR # 23-23 (if applicable)

Comments:

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☒ Yes	Existing processes investigated and understood? ☒ Yes

Summary of Proposed Action(s): Add the dilution description into the technical comments in the account set up. This technical comment will show up on the laboratory technicians work lists for all samples within this account.

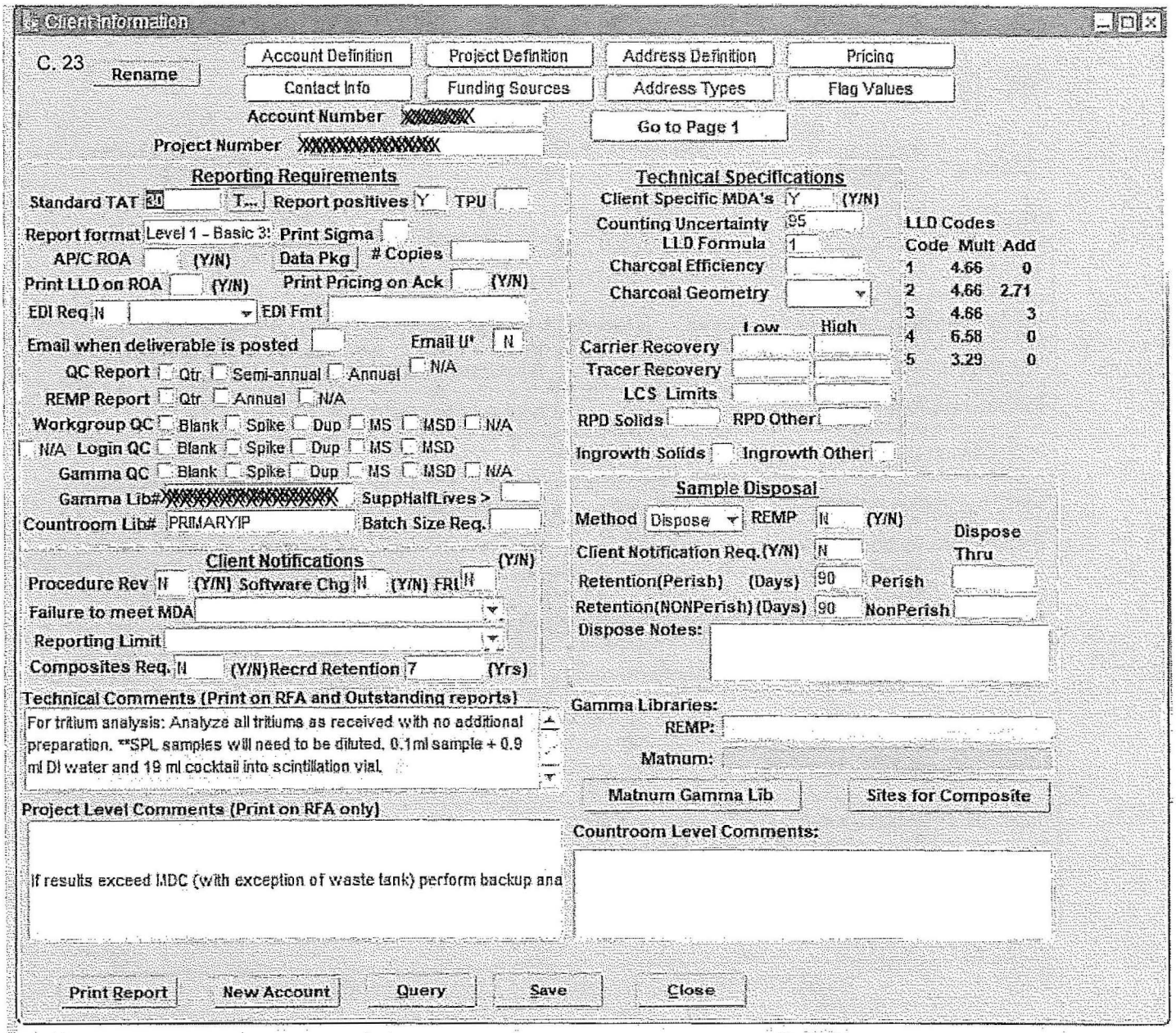
Documents Requiring Update: Account setup technical comments section.

Solution approval signature(s): Karli Arterburn

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☐ Yes	Has the solution been effective? ☐ Yes ☐ No	Date Closed:

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*



TELEDYNE BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-24

Responsible Manager: Sharon Northcutt

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area: Environmental Lab	Client/Project Affected: TBE XCHKs
Requirement Reference: TBE-4006	Affected Data: L#102345
NCR Description: Failed XCHK for Sr-90 (milk matrix)	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-28
Prepared By: Sharon Northcutt	Date: 12/08/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: NONE Could be determined. See Supplemental Sheet	
Corrective Action Plan: None at this time.	
Planned Completion Date(s) for Actions(s): N/A	
Prepared By: Sharon L Northcutt	Date: 12/18/23
Approved By: Keith Geter	Date: 12/18/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 12/18/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO (QA Report) Description:	Date:
Prepared By: Sharon L Northcutt	Date: 12/18/23

Supplemental Sheet

NCR No: 23-24

Description of Nonconformance:

Unacceptable cross-check result for Sr-90 in milk. TBE reported 7.28 pCi/L and the known value was 12.8 pCi/L (57% ratio of reported to known). This is the first failure (low) for Sr-90 in milk. The last failure was in 2016 (reported slightly high).

Root Cause:

A thorough review of all QC for this sample showed nothing unusual. The sample was used as the workgroup duplicate. The carrier yields for both samples was 107% and 75% respectively. The WG LCS recovery was at 106%.

The ERA drinking water Sr-90 cross-check that was analyzed around the same time was acceptable (108% ratio of reported to known). It was also run as the workgroup duplicate, with carrier yields of 100 and 87% respectively. The WG LCS recovery was at 105%.

There appears to be no root cause for the low failure for this sample.

Corrective Action to Prevent Recurrence:

No effective corrective action to prevent recurrence can be done at this time. We believe that this result is an anomaly compared to TBE's historical performance. If the failure is repeated, an additional root cause investigation will be performed.

Keith Jeter 12/18/23

Department Manager or Designee Date

Sharon L Northcutt 12/18/23

Quality Assurance Manager or Designee Date

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-25

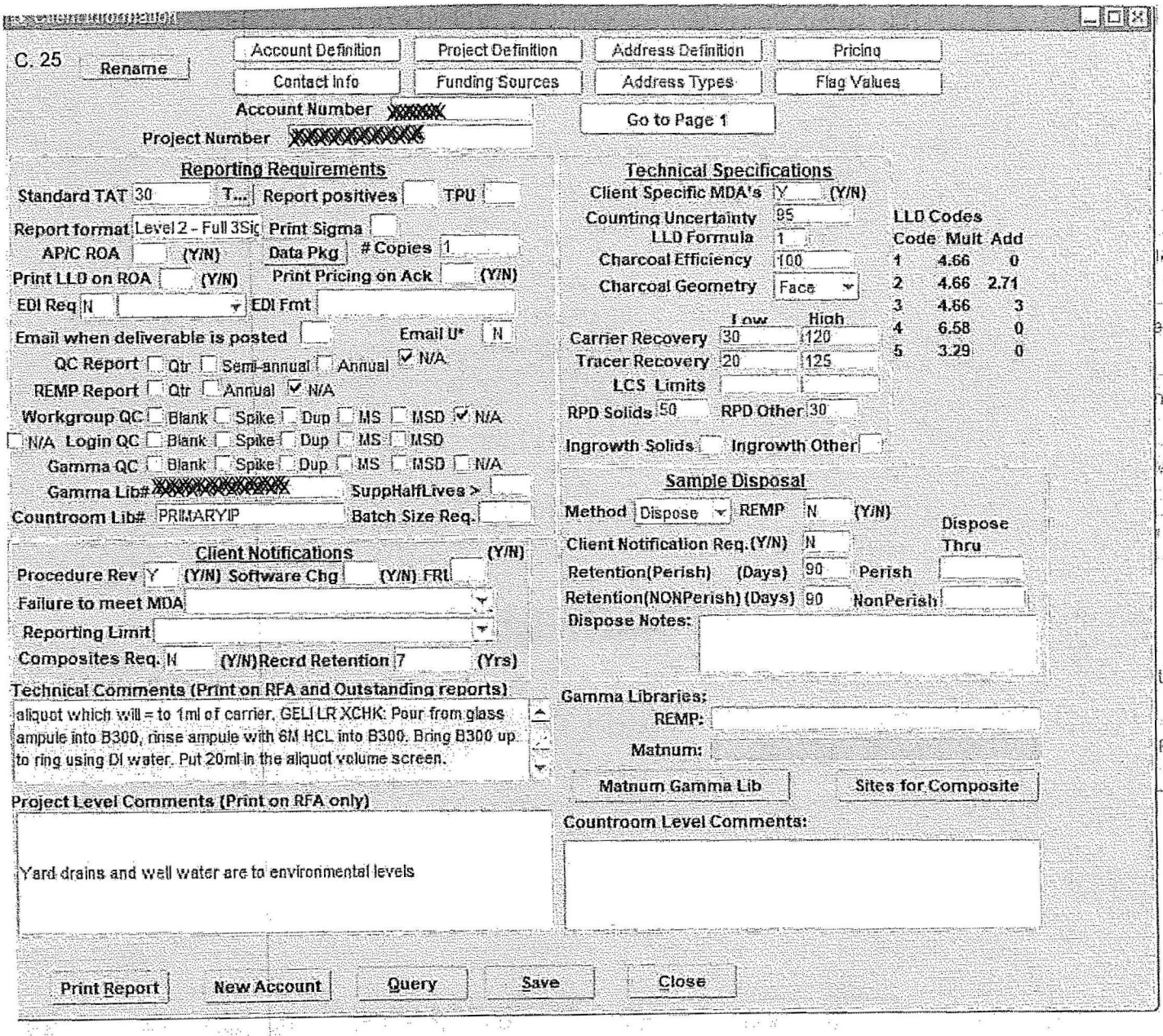
Responsible Manager: Karli Arterburn

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☒ Customer Complaint ☐ Audit/Mgmt Rept ☒ XCHK Failure ☐ Staff Observation	
Process Area:	Client/Project Affected: [redacted]
Requirement Reference:	Affected Data: L#: L103073
NCR Description: **Ce-141, Cr-51, and Cs-137 crosscheck gamma result in disagreement with known results.**	
Client Notification Needed: ☒ YES ☐ NO	Associated CAR or CC #: CC 23-16
Prepared By: Karli Arterburn	Date: 12/28/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Sample was prepped in a geometry that was not the best match for the sample type.	
Corrective Action Plan: Reprepare the sample in a more appropriate geometry and recount. Added to the project notes how to prep this sample going forward and trained the new technician.	
Planned Completion Date(s) for Actions(s): 12/13/23	
Prepared By: Karli Arterburn	Date:12/12/23
Approved By: Keith Jeter	Date: 1/8/24

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Nathcutt	Date: 01/08/24

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☒ YES ☐ NO Description: Sent revised report with reanalysis (repreparation) results.	Date:12/15/23
Prepared By: Karli Arterburn	Date:12/28/23



ATTACHMENT D

Audit Reports

D.1

INTERNAL AUDITS

IA 23-01

TBE Huntsville

November 13 – 16, 2023

TELEDYNE BROWN ENGINEERING
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INTERNAL AUDIT REPORT

Audit Plan

Auditor: Charles Hurstdieck/ Cheryl Larson (auditor)	Audit Date: 13-16 November 2023	Audit No.: 2023-026
Auditee(s): Sharon Northcutt	Methods: Review of objective evidence, documentation, and through interview of personnel	
Scope: TBE Knoxville Lab Operations Criteria: TBE Knoxville Quality Manual and Procedures ISO 17025	Tools: ISO 17025 Standard (or other standard as noted in Scope & Criteria), Quality Manual, Procedures, Internal Audit Checklists, associated forms, and other tools as needed	

Date	Time	Area / Department / Process / Function	Key Contact
13-14 Nov	All day	Lab functions	Sharon Northcutt, Karli Arterburn, Kenny Cooper, Sarah Griffiths, Kimberly Thurman, Jim Wright

Process Effectiveness Assessment Report (PEAR)

Process Name: TBE Knoxville Quality Systems and Operations

Process details, including associated process interfaces:

Personnel training, Contracts management, method verification, handling of tests, results reporting, nonconformances, audit reports, corrective actions.

Applicable AS9100 clause(s): This annual internal audit is conducted for the purpose of assessing TBE Knoxville Lab's quality system as documented in the Quality Assurance Manual for Teledyne Brown Engineering Environmental Services, Document K-QAM-1, Rev 36, effective July 14, 2023, and associated implementing Procedures. A specific checklist was developed and used for this audit. The completed checklist is attached to this form.

Organization's method for determining process effectiveness:

- Audit results
- NCRs generated
- Other external audits
- Customer Complaints
- Internal process documentation

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INTERNAL AUDIT REPORT

Auditor observations and comments supporting process effectiveness determination:

The quality program and lab operations of TBE Lab Knoxville were well documented, organized and implemented. All required information was readily available, and all involved in the audit were very helpful and knowledgeable.

Statement of Effectiveness Level:

The process is:

☐ 1. Not implemented; planned results are not achieved.

☐ 2. Implemented; planned results are not achieved, and appropriate actions not taken.

☐ 3. Implemented; planned results are not achieved, but appropriate actions being taken.

☒ 4. Implemented; planned results are achieved.

Auditor Name(s): Charles Hurst (lead), Cheryl Larson (auditor)	Auditee Representative Acknowledgement Name: Sharon Northcutt

Audit Summary

The results of this audit are documented in the attached checklist.

There were **zero (0) findings** noted during the course of this audit with **two (2) Opportunities for Improvement (OFIs)** recommended

Based on the results of this audit, TBE Knoxville Lab QA program and operations are determined to be effectively implemented.

Previous Year's Finding

REF	Requirements	Observation, Comments, Objective Evidence	ACC	REJ
	No findings in 2022.			

Current Year Audit Findings and Opportunities for Improvement (OFI's)				
REF	Requirements	Observation, Comments, Objective Evidence	ACC	REJ
K-QAM-1 Rev 36	8.8.4 An analytical procedure surveillance is scheduled to observe analysts as they perform a method to verify that it is being done as written and to note any changes that may need to be made to the written procedure. The results of the QC workgroup are included to show that the results are within control limits. All audit results are evaluated by the Operations Manager and any necessary changes are made where needed.	*OFI #1: While surveillances are being conducted, there have only been 2 completed for CY23. CY22 showed similar numbers. While there is no specific number of surveillances required by internal procedures or external requirements, it is recommended that more emphasis be placed in this area to achieve more surveillances throughout the year. This will require other personnel becoming involved in that process but doing so will enable better monitoring/assessment of how processes are being conducted while also providing a cross training benefit if additional personnel are involved in conducting the surveillances.*	X	
K-QAM-1 Rev 36	6.6.3 New vendors are qualified by the QA Manager, based upon ISO/IEC accreditation, on-site or desktop audit and are maintained on the Approved Supplier List (ASL). The list is reviewed periodically, and vendors are requalified annually. Consideration is given to vendors who agree to applicable TBE quality codes, provide updated quality and/or accreditation information, and past customer experience. (TBE-1015 "Procurement Controls")	*OFI #2: Additional review of the hardcopy AVL, compared to the electronic supplier database, indicated ISO certification information was not documented on suppliers and not all locations were accurately identified as Knoxville specific. Those issues were brought to the attention of TBE Supplier Quality Assurance to review and work with TBE Knoxville to confirm agreement between the electronic database of record and the hardcopy listing maintained by TBE Knoxville.* ***During the course of this audit, the TBE Knox Quality Manager and TBE HSV Supplier QA have effectively cleaned up both the electronic AVL records in Costpoint and the hardcopy AVL maintained in Knoxville. It is very important that this level of coordination and communication remain in place between TBE Knoxville Lab and TBE HSV Supplier QA.***	X	

TELEDYNE BROWN ENGINEERING
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INTERNAL AUDIT REPORT

Checklist

REF	Requirements	Observation, Comments, Objective Evidence	ACC	REJ
K-QAM-1 Rev 36	8.6.3.4 Lab quality performance is reviewed and summarized in a quarterly QA Report. Audits and nonconformance/corrective actions are also included in the report. This report is distributed to TBE management and is also available for clients. A summary of this report is included with the Annual Management Report.	Quarterly QA Reports are being conducted as required. Review of the most recent report, 3rd Quarter 2023, included extensive reporting and analysis. Contractual Review for this report was signed out by the Quality Assurance Manager on 10/4/23. The Technical Review portion was completed by the Laboratory Operations Manager on 10/9/23	X	
K-QAM-1 Rev 36	8.7.1 Corrective action is taken as the result of a departure from specifications imposed by client contract, regulatory requirement or TBE stated policy or procedure. It is a measure taken to discover the source of a deviation and to avoid similar issues going forward. Corrective action is taken promptly and to a degree appropriate to the magnitude and risk of the issue. Conditions adverse to quality are documented and tracked with proposed and actual completion dates. (*TBE-1018 "Corrective/Preventative Action and Nonconformity Control"*)	Corrective Actions appear to be managed and documented well. CAs were observed to have been generated based on external audit findings as well as internal conditions that could potentially affect overall quality. The following CAs were reviewed: • 23-01 • 23-02 • 22-19 • 22-10 • 22-18	X	
K-QAM-1 Rev 36	8.8.4 An analytical procedure surveillance is scheduled to observe analysts as they perform a method to verify that it is being done as written and to note any changes that may need to be made to the written procedure. The results of the QC workgroup are included to show that the results are within control limits. All audit results are evaluated by the Operations Manager and any necessary changes are made where needed.	***OFI #1:*** *While surveillances are being conducted, there have only been 2 completed for CY23. CY22 showed similar numbers. While there is no specific number of surveillances required by internal procedures or external requirements, it is recommended that more emphasis be placed in this area to achieve more surveillances throughout the year. This will require other personnel becoming involved in that process but doing so will enable better monitoring/assessment of how processes are being conducted while also providing a cross training benefit if additional personnel are involved in conducting the surveillances.*	X	
K-QAM-1 Rev 36	6.5.1 In order to produce accurate data, TBE has established and maintains an unbroken chain of calibration records for all instruments used in analytical measurements that could affect the accuracy of results. These instruments are calibrated prior to use with NIST traceable reference standards which contribute to measurement uncertainty.	Asset tagged C033887185, date 03/02/2023 cal due 3/31/24 Cal cert # TE030223BC-04 dated 03/02/23 and is traceable to NIST (they have the entire month of march to recalibrate)	X	
K-QAM-1 Rev 36	6.5.4 Instrument calibration standards must originate from a different lot number or manufacturer than those used for quality control spike/matrix spike standards.	Verified Instrument Calibration standard and Spike standard originated from different lots. • Carbon Instrument standard lot ID 86330 Source cert of cal Spike ID 14C-032123 • Carbon spike standard lot ID 86329 Source cert of cal Spike ID 14C-062322	X	

K-QAM-1 Rev 36	6.6.3 New vendors are qualified by the QA Manager, based upon ISO/IEC accreditation, on-site or desktop audit and are maintained on the Approved Supplier List (ASL). The list is reviewed periodically, and vendors are requalified annually. Consideration is given to vendors who agree to applicable TBE quality codes, provide updated quality and/or accreditation information, and past customer experience. (TBE-1015 "Procurement Controls")	New vendor record for Ludlam (Protean) Measurements was reviewed. The documentation included F-380 risk assessment documentation along with ISO/IEC 17025 Certification information. Review of Costpoint verified entry of this vendor into the TBE supplier system. That record includes the scope of approval, location (Knox) and 17025 certification end date. *OFI #2: Additional review of the hardcopy AVL, compared to the electronic supplier database, indicated ISO certification information was not documented on suppliers and not all locations were accurately identified as Knoxville specific. Those issues were brought to the attention of TBE Supplier Quality Assurance to review and work with TBE Knoxville to confirm agreement between the electronic database of record and the hardcopy listing maintained by TBE Knoxville.* ***During the course of this audit, the TBE Knox Quality Manager and TBE HSV Supplier QA have effectively cleaned up both the electronic AVL records in Costpoint and the hardcopy AVL maintained in Knoxville. It is very important that this level of coordination and communication remain in place between TBE Knoxville Lab and TBE HSV Supplier QA.***	X	
K-QAM-1 Rev 36	7.4.1 General Sample custody includes laboratory receipt, handling, processing, protection, storage, and disposal. The sample custody procedure outlines steps to protect sample integrity and minimize the possibility of deterioration, contamination, loss or damage during each stage of the analytical process. (TBE-4003 Sample Receipt and Control)	Interview Karli Arterbum PM and Sarah Griffiths Receiving **TBE-4003 Rev 15 11/01/22 Sample Receipt and Control:** Samples are off loaded from UPS Fedex delivery then the Receiving person (Sarah Griffiths) scans the barcode on the package label and barcode ID of the company (customer) to create a record of receipt. Items are segregated, radioactive and not radioactive, and moved to the receiving lab for processing. Reviewed Chain of Custody document, received with package assigned TBE-ES lot ID L103200. Documents tie to the samples labeled with this lot ID. Items are stored until PM "Flips" and releases samples for testing. All the samples stay together when released for testing	X	
K-QAM-1 Rev 36	7.8.2 Required Items Sample results are compiled into a report and contain the following items: a. title (Report of Analysis or ROA) b. name and address of the laboratory (where analyses are performed) c. unique identification that correlates individual pages to the entirety of the report d. contact name/address of the client e. sample description information (ID, collection date/time) and lab ID information f. sample receipt date, condition and any sample acceptance criteria variance g. TBE Procedure (SOP) ID h. test result (activity) directly as obtained with appropriate number of significant figures, measurement uncertainty estimation, detection limit (MDC), measurement units, reference date, count date/time, and flagged values (results outside of technical specifications) i. notation for method changes (if applicable)	Verified data on file for completed analysis of Lot ID L102922 including Chain of custody, variance report, analysis, review and certification of analysis are complete and legible. The Certification of analysis contains the statement that "the report shall not be reproduced, except in full without approval of the laboratory"	X	

	j. name, title and signature of the person(s) authorizing the report k. statement that results relate only to the items tested l. statement that the report shall not be reproduced, except in full without approval of the laboratory m. clear identification of any subcontracted analyses and results			
K-QAM-1 Rev 36	8.4.2 Records are legible, systematically identified, maintained, stored, and scheduled for disposal based upon regulatory or contract requirement, but always at a minimum of seven (7) years. Records are controlled in a manner that ensures retrievability, confidentiality and protection from loss and/or damage.	Files are maintained per contract requirement in the PM office; currently housing files from 2021 to present (2023) and maintained per contract requirements.	X	
TBE-1003	5.2.1 All records shall be legible. All generated data, unless produced via automated data collection systems, shall be recorded legibly in permanent ink.	Records reviewed included • Calibration for LS6 dated 1/4/23 • Completed Analysis cert and processing documentation on file for lot ID L102922. The in process chain of custody documentation sample for L103200	X	
TBE-1003	5.2.3 Corrections are made by drawing a single line through the error/change. The individual making the correction signs (or initials) and dates the correction, then briefly describes the reason (if it is not self-evident). Corrections due to reasons other than transcription errors shall specify the reason for the correction.	There were no corrections on documents reviewed. Karli Arterburn stated during interview that errors are struck thru and initialed and dated. All records reviewed in the course of this audit showed very good attention to detail in terms of completion of manual entries with the absence of manual corrections.	X	
TBE-1003	5.4.2.1 Hard-copy records are stored in labelled filing cabinets to minimize the risk of loss, damage or destruction from natural disasters or severe environmental or other harmful conditions. Access to processing, storage and retrieval of these records is limited to authorized personnel.	Files stored in the program manager area, archived files are in a specific storage area in the building.	X	
TBE-1003	5.4.2.2 Hard-copy laboratory/quality assurance records are generated throughout the laboratory and are maintained by those responsible in that area. (See Section 5.3). When these records are no longer needed by the operational section, they are processed as quality assurance records, and are re-located to the TBE corporate records storage facility area in Lewisburg, TN.	Reviewed in process hardcopy documents for L103200, L103173, and completed hardcopy file for L102922	X	
K-QAM-1 Rev 36	8.8.1 In order to detect actual or potential nonconformities before data quality could be affected, internal audits are planned and conducted. These audits verify conformance of lab operations and the management system to regulatory and accreditation requirements, and to the lab's own policies and procedures. (*TBE-1013 "Audits and Management Review"*)	The CY23 audit schedule was reviewed. Scheduled audits are being planned and conducted in an ongoing fashion. There were no noted delays in completing the scheduled audits.	X	

K-QAM-1 Rev 36	8.8.2 An internal audit plan is generated annually and includes the procedures and surveillances that are planned during the year. The goal is to review each area of the lab in some fashion. The plan is maintained by the QA Manager, but audits may be performed by other staff. Auditors are trained in performing audits, have some technical background in the subject matter, and are independent of the activity to be audited (not directly involved or have supervisory responsibility).	The following Audit Plans and reports were reviewed and demonstrated conformance to this requirement: • 2007 (5/15/23) • 3001 (8/16/23) • 3004 (8/16/23) • 2011 (8/15/23) • 2020 (3/30/23) • 2025 (8/10/23) • 3009 (10/18/23)	X	
K-QAM-1 Rev 36	8.8.6 Audit findings of nonconformances are documented and timely corrective action is taken, tracked to closure, and evaluated for effectiveness. An audit response including corrective action is sent to the auditor, (and to the Director of Quality Management Systems for the annual Quality System audit). Any findings that could cast doubt on the validity of results are disclosed in writing to the affected client(s) within 7 days. The QA Manager (or designee) verifies that the client was contacted properly.	Based on review of the above listed specific reports, as well as the overall CY23 schedule, it appears **there were ZERO findings identified during the course of these audits.** Several audits showed evidence of actions taken as a result of the audits but those appeared to be minor administrative changes/improvements to current procedures.	X	
TBE-1013	5.1.1.4. Audits may only be performed by trained and qualified personnel who are independent of the activity to be audited. Internal audits of the Knoxville Laboratory Quality Program will be performed by personnel from another Teledyne Brown Engineering location (i.e., Huntsville office).	All CY22/23 audits were performed by a single auditor, Sharon Northcutt. Her training record was reviewed and found to be current. ***NOTE: Sharon's record is due for Annual Review by the Director of Quality by 11/18/23.***	X	
K-QAM-1 Rev 36	Management Reviews 8.9.1 In conjunction with the Internal Audits (Section 8.9 above), the laboratory conducts an annual management review to ensure continuing suitability, adequacy, and effectiveness of stated policies and objectives in this Quality Manual. (*TBE-1013 "Audits and Management Review"*)	Management Reviews are being conducted as required. The CY22 Review was completed 3/30/23. CY23 is scheduled for completion in March 2024.	X	
K-QAM-1 Rev 36	8.9.2 The review includes: • a summary of any changes to the QA program from the previous year • adequacy of staff and equipment resources • a list of staff specialty training certificates with expiration dates • highlights from the 4th Qtr (annual) QA Report (QC sample and proficiency results • and audits) • an analysis of QA results (indication of analytical bias) • internal/external audit results and associated investigations and corrective actions • commentary on effectiveness of corrective actions • a listing of current accreditations and/or plans for any changes • comparisons of sample volume and turnaround times to previous years	A review of the CY22 Management Review demonstrated all the elements of this requirement were addressed in the document.	X	

	• client feedback not included with the QA Report • observations by staff for improvements • results of risk identification • any changes/updates to methodology • radiological health/safety, waste and management functions • a statement of management system effectiveness and fulfillment of objectives			
ISO 17025	**6 Resource Requirements** 6.2.5 The laboratory shall have procedure(s) and retain records for: a) Determining the competence requirements: b) Selection of personnel c) Training of personnel d) Authorization of personnel f) Monitoring competence of personnel	TBE-1007 Rev 9 Training, Qualification and Certification of personnel Reviewed training records including: • ICP & DOC for Donna Webb and Susan Ogletree • Receiving training for Sarah Griffith	X	
ISO 17025	6.3.3 The laboratory shall monitor, control, and record environmental conditions in accordance with relevant specifications, methods, or procedures or where they influence the validity of the results.	Temp & Humidity detectors are checked every morning, the information is logged into OM-70 series interface program -logger and excel. Temp and humidity recorded for 11/11 temp 28.86 Humidity 38.15 Meeting the requirements of TBE-4014 Rev 7 para 5.2.3.1 a) & b)	X	
ISO 17025	6.4.8 All equipment requiring calibration, or which has a defined period of validity shall be labelled, coded, or otherwise identified to allow the user of the equipment to readily identify the status of calibration or period of validity.	Verified. Reviewed the following assets: • C033887185, date 03/02/2023 cal due 3/31/24. Cal cert # TE030223BC-04 dated 03/02/23 and is traceable to NIST • Asset Pipette # 17 calibration check 09/28/23, next cal due 01/02/24. Reviewed in-house quarterly pipette calibration record.	X	

D.2

EXTERNAL AUDITS

EA 23-01 Utah NELAP AUDIT

May 25, 2023

State of Utah
SPENCER J. COX
Governor
DEIDRE HENDERSON
Lieutenant Governor

Department of Health Human Services
TRACY S. GRUBER
Executive Director
NATE CHECKETTS
Deputy Director
DR. MICHELLE HOFMANN
Executive Medical Director
DAVID LITVAK
Deputy Director
NATE WINTERS
Deputy Director

Keith O. Jeter

6/5/2023

Teledyne Brown Engineering Environmental Services

2508 Quality Lane

Knoxville, TN 37931

Dear Keith O. Jeter,

An on-site assessment of Teledyne Brown Engineering Environmental Services was performed beginning 05/25/2023. The purpose of the on-site assessment was to evaluate your facility and determine Teledyne Brown Engineering Environmental Services's compliance with Utah Rule R444-14 Rules for the Certification of Environmental Laboratories and the TNI standard. The on-site assessment was performed by staff of the Utah Environmental Laboratory Certification Program (ELCP) and included participation by Teledyne Brown Engineering Environmental Services's personnel listed at the end of this report.

Areas of Assessment

TNI Environmental Standard 2016 V1M1 Proficiency Testing
TNI Environmental Standard 2016 V1M2 Quality Systems General Requirements
TNI Environmental Standard 2016 V1M6 Radiochemistry Testing

I. Introduction

This assessment report reflects only the findings and decisions germane to the on-site evaluation and related application information, including personnel qualifications, laboratory procedures, detection limit studies, training records, quality assurance records, and quality assurance manual.

This assessment report does not attempt to comprehensively address all ongoing certification requirements prescribed in the Utah Rule (R444-14), promulgated methods, and applicable Code of Federal Regulations (40CFR 136, 141, and 261).

The on-site assessment portion for the evaluation of the laboratory included the following steps:

1. Opening conference.
2. Interviews with laboratory management, quality assurance personnel, and technical staff.
3. Review of sample collection, preservation, handling, and transport practices.
4. Review of procedures used for the analysis of environmental samples.
5. Inspection of laboratory facilities and equipment.
6. Review of data reporting, record keeping, instrument maintenance, and self-monitoring (QA records).
7. Discussion of assessment results with the laboratory director and/or personnel.

II. Completion of the Certification Process

Requirements specified in this report, the approved methods, and the Utah Rule, R444-14, pertain to all analyses identifying the method(s) indicated in Teledyne Brown Engineering Environmental Services's application for certification and/or certificate letter(s).

A) Teledyne Brown Engineering Environmental Services's Corrective Action Response (CAR)

- To complete the certification process without interruption to Teledyne Brown Engineering Environmental Services's certification status (if applicable), Teledyne Brown Engineering Environmental Services must respond with a written plan of correction within 30 calendar days of receipt of this assessment report.
- The corrective action response (CAR), signed by the laboratory director, must address the findings listed below in section III. Recommendations in section III do not have to be addressed in the corrective action response. The corrective action response (CAR) must fully describe how the cited standard has been, or will be fully achieved by the laboratory; and, must demonstrate that the full extent of the standard is understood by the laboratory management.
- Teledyne Brown Engineering Environmental Services must indicate the expected implementation dates for each corrective action (CA) listed in the CAR. Implementation dates for individual CAs should not exceed 3 months from the date of Teledyne Brown Engineering Environmental Services's receipt of this assessment report.
- Please provide appropriate and concise supportive documentation demonstrating compliance with the cited standards. Attachments should be clearly referenced in the CAR. The CAR should include, when applicable, copies of documents related to completed actions.

Where supportive documentation is not available for inclusion with the CAR for planned actions, please provide dates when the supportive documentation will be made available to the ELCP for review (e.g., training & assessments).

The CAR should always include specific language that is to be incorporated into future revisions of procedures, policies, and the quality assurance manual.

B) ELCP review of Teledyne Brown Engineering Environmental Services's CAR

- Any CARs received by the specified due date will be reviewed by the Environmental Laboratory Certification Program (ELCP) within 30 days.

C) Completion of Teledyne Brown Engineering Environmental Services's Application

- If a CAR indicating acceptable CAs for items in section III (not listed as a recommendation) is received, the ELCP will issue a certificate indicating approvals for all parameters (method and associated analyte or interdependent analyte group) requested in the current application. The current certification application cycle will be complete.

- If a CAR indicating unacceptable CAs for any General Laboratory Findings is received, Teledyne Brown Engineering Environmental Services will be notified. You may experience a delay and/or lapse in Teledyne Brown Engineering Environmental Services's certification status until acceptable CAs are received by the ELCP. Teledyne Brown Engineering Environmental Services's certification will expire on the date cited in Teledyne Brown

Engineering Environmental Services's latest certificate letter (if applicable).

- If a CAR indicating unacceptable CAs for any Method Specific Findings is received, the ELCP will issue a certificate letter without approval for the affected parameter (method(s) and associated analyte or interdependent analyte group). The current certification cycle will be complete. The affected parameter (method and associated analyte or interdependent analyte group) may be requested again at any time in the future, by notifying the ELCP in writing. A parameter change fee may be assessed.

-Certificate extensions for previously certified laboratories will be issued only if a delay in the certification process is caused by the ELCP.

III. Assessment Findings, Requirements, and Recommendations

Findings

TNI 2016 V1M2 5.5 Calibration Requirements (Quality Systems)

1 Citation

V1M2 5.5.13.1 b) /TNI 2016 V1M2 5.5 Calibration Requirements (Quality Systems)

The laboratory shall maintain all support equipment in proper working order. The records of all repair and maintenance activities, including service calls, shall be kept.

ELCP Finding

The alpha instrumentation maintenance logs did not contain cleaning. Maintenance should logs should include all maintenance on the instrument.

Recommendations

TNI 2016 V1M2 5.4 Environmental Methods and Method Validation (Quality Systems)

1 Citation

V1M2 5.4.7.1

Calculations and data transfers shall be subject to appropriate checks in a systematic manner.

ELCP Recommendation

It is recommended that method validation documentation include verification of the calculation used for data reporting.

IV. Conclusion

Based upon the findings of the on-site evaluation, I will recommend to the Certification Authority that Teledyne Brown Engineering Environmental Services be certified for analyses pertaining to environmental compliance monitoring applicable to the CWA, RCRA and SDWA -- provided that the items listed in section III of this report have been adequately addressed within the time frame specified in section II of this report.

If Teledyne Brown Engineering Environmental Services needs additional clarification, or believes that any of the findings and requirements have been improperly evaluated, please feel free to contact me for clarification or re-evaluation. I can be reached by phone at 801-648-8147.

Sincerely

Max Patterson
Certification Officer (Lead Assessor)
Utah Environmental Laboratory Certification Program

Assessment Participants

Assessor

Kristin Brown
Max Patterson

Laboratory Representatives

Karli Arterburn
Belinda Crouse
Blake Gildner
Keith Jeter
Sharon Northcutt
Donna Webb

TELEDYNE
BROWN ENGINEERING
A Teledyne Technologies Company

July 5, 2023

Max Patterson
Certification Officer (Lead Assessor)
Utah Environmental Laboratory Certification Program
Utah Department of Health
4431 South 2700 West
Taylorsville, UT 84129

Dear Mr. Patterson,

Please find attached the corrective action response (CAR) which was prepared in response to the National Environmental Laboratory Approval Program (NELAP) audit report, issued and received via email on June 5, 2023. The onsite audit was conducted May 25, 2023.

This CAR is arranged by suggestions/deficiency in the order presented in the audit report and includes objective evidence for the action item identified.

Teledyne Brown Engineering would like to note the professional and technically competent manner in which this audit was conducted. We appreciate the identification of these opportunities for improvement, as well as your department's assistance in our NELAP certification process. Please do not hesitate to contact us with any questions regarding this transmittal or with any request for additional information.

Contacts:

Keith Jeter	Laboratory Operations Manager	(865) 934-0373
Sharon Northcutt	Quality Assurance Manager	(865) 934-0374

Sincerely,

Sharon L Northcutt

Sharon Northcutt
Quality Assurance Manager
Teledyne Brown Engineering

Findings:

1. TNI 2016 V1M2 5.5.13.1 b) Calibration Requirements (Quality Systems)
   The laboratory shall maintain all support equipment in proper working order. The records of all repair and maintenance activities, including service calls, shall be kept.

   The alpha instrumentation maintenance logs did not contain cleaning. Maintenance logs should include all maintenance on the instrument

   Response: Please see CAR 23-08 & NCR 23-07 Forms attached.

Recommendations:

1. TNI 2016 V1M2 5.4 Environmental Methods and Method Validation (Quality Systems)
   Calculations and data transfers shall be subject to appropriate checks in a systematic manner.

   It is recommended that method validation documentation include verification of the calculation used for data reporting.

   Response: All calculations used for analyses have been verified prior to use. These V&V calculations are located in several notebooks in the QA Manager's office.

TELEDYNE
BROWN ENGINEERING

NONCONFORMANCE REPORT (NCR) FORM

NCR No.: 23-07

Responsible Manager: Keith Jeter

PART 1. TO BE COMPLETED BY ORIGINATOR OF NCR	
Initiated due to: ☐ Customer Complaint ☒ Audit/Mgmt Rept ☐ XCHK Failure ☐ Staff Observation	
Process Area: Count Room	Client/Project Affected: NA
Requirement Reference: TNI 2016 V1M2 5.5	Affected Data:
NCR Description: Incomplete Alpha Spec Instrument Maintenance Records (cleaning record missing)	
Client Notification Needed: ☐ YES ☒ NO	Associated CAR or CC #: CAR 23-08
Prepared By: Sharon Northcutt	Date: 06/06/23

PART 2. TO BE COMPLETED BY ROOT CAUSE INVESTIGATOR	
Root Cause: Records for instrumentation have historically included maintenance, repair and/or replacement but not cleaning.	
Corrective Action Plan: Add cleaning activities to maintenance log	
Planned Completion Date(s) for Actions(s): 07/06/23	
Prepared By: Sharon L Northcutt	Date: 07/05/23
Approved By: Keith Jeter	Date: 7/5/23

PART 3. TO BE COMPLETED BY QUALITY ASSURANCE MANAGER	
Review and Verification of Corrective Action: ☑ Accepted ☐ Rejected ☐ Follow-up Needed (describe) ☐ Completed	
Prepared By: Sharon L Northcutt	Date: 07/05/23

PART 4. TO BE COMPLETED BY RESPONSIBLE MANAGER	
Client Follow-Up Notification: ☐ YES ☑ NO Description:	Date:
Prepared By: Sharon L Northcutt	Date: 07/05/23

TELEDYNE BROWN ENGINEERING

Corrective Action Request & Report

CAR NO.: 23-08

SECTION 1 (To be completed by initiator)

Initiator Name: Sharon Northcutt	**Date: 06/06/23**

Identified Through: ☐ Daily Operations ☐ Management Review ☒ Audit ☐ Client Feedback ☐ Other
(check one)

Corrective action is requested to address the following condition:
Alpha Spec Instrument Maintenance Logs do not include cleaning records.

Manager Acknowledgement:	**Date:**

SECTION 2 (To be completed by Quality Assurance Manager)

Assigned to: Keith Jeter	**Priority:** ☐ High ☐ Medium ☒ Low	**Date: 06/06/23**

Requested date for root cause investigation: 06/23/23

NCR # 23-07 (if applicable)

Comments:

SECTION 3 (To be completed by Assignee - attach additional information as necessary)

Relevant background information collected? ☑ Yes	**Existing processes investigated and understood?** ☑ Yes

Summary of Proposed Action(s):
Add cleaning activities to Instrument maintenance log

Documents Requiring Update: Instrument Maintenance log

Solution approval signature(s): Sharon L Northcutt

SECTION 4 (To be completed by Quality Assurance Manager)

Documents Updated? ☐ Yes	**Has the solution been effective?** ☐ Yes ☐ No	**Date Closed:**

Closing Comments: *(If the corrective action has not been effective, reference the new corrective action form to readdress the problem area.)*

State of Utah
SPENCER J. COX
Governor
DEIDRE HENDERSON
Lieutenant Governor

Department of Health Human Services
TRACY S. GRUBER
Executive Director
NATE CHECKETTS
Deputy Director
DR. MICHELLE HOFMANN
Executive Medical Director
DAVID LITVAK
Deputy Director
NATE WINTERS
Deputy Director

Keith O. Jeter
2508 Quality Lane
Knoxville, TN 37931

7/10/2023

Dear: Keith O. Jeter

Your corrective action in response to the onsite assessment performed 05/25/2023 were received on 7/5/2023. The corrective actions were evaluated for compliance with Utah (Rule R444-14), published methods, and applicable Code of Federal Regulations (40CFR 136, 141, and 261). The response was determined to be sufficient for continued compliance to these regulations on 07/10/2023.

Teledyne Brown Engineering Environmental Services has been accredited by the State of Utah. Continued accreditation will be dependent upon the laboratories continued compliance with the relevant TNI standards, methods, and regulations.

If Teledyne Brown Engineering Environmental Services needs additional clarification, or has any other questions or needs regarding accreditation, please feel free to contact me.

Sincerely

Max Patterson
Certification Officer
Utah Environmental Laboratory Certification Program

EA 23-02 PJLA ISO/IEC 17025:2017 AUDIT

September 14-15, 2023

CONFORMITY ASSESSMENT BODY (CAB) ON-SITE ASSESSMENT REPORT

ASSESSMENT		
Number	**Type**	**Date(s)**
A2023-01264	*Virtual offsite surveillance*	*September 14 - 15, 2023*
Standard(s):	*ISO/IEC 17025:2017/DoD-ELAP/DOECAP-AP QSM 5.4*	
Team: (Lead))	*Maurice Downer* (LA, TA, TE))	

CONFORMITY ASSESSMENT BODY (CAB) ORGANIZATION	
Name	**Location(s)**
Teledyne Brown Engineering	*2508 Quality Lane Knoxville, TN 37931*

ASSESSMENT INFORMATION

☐ PRELIMINARY ☐ INITIAL ☒ SURVEILLANCE ☐ REACCREDITATION
☐ SCOPE EXPANSION ☐ SCOPE UPGRADE ☐ REVISIT ☐ OTHER (e.g., ownership/location change)

OTHER CAB ORGANIZATION INFORMATION

MAIN CONTACT(S)	OTHER ADDRESS(ES) ASSESSED (List Headquarters first, attach separate sheet if needed)
Sharon Northcutt	

SUMMARY REPORT

SCOPE(S): *Chemical and Environmental Testing as detailed in supplement(s) L22-882 (DOD) and Teledyne_L22-883 (DOE)*

SCOPE(S) VERIFIED DURING THIS ASSESSMENT

EiChroM Tc-01 (TBE SOP TBE-2021) by Liquid Scintillation Counting (LSC) (Beta) - Technetium-99 (Tc-99), EPA 600/4-75-009 (TBE SOP TBE-2037) by Gas Proportional Counting (GPC) (Alpha Beta) - Gross Alpha, EPA 900.0 & EPA 9310 (TBE SOP TBE-2008) by Gas Proportional Counting (GPC) (Alpha Beta), Gross Alpha, Gross Beta, EPA 901.1 & HASL Ga-01-R/EML 4.5.2.3 by Gamma Spectroscopy - Gamma Emitters, EPA 905.0, HASL Sr-02 & Sr-03 by Gas Proportional Counting (GPC) (Beta) - Strontium-89 (Sr-89), Strontium-90 (Sr-90), EPA 906.0 (TBE SOP TBE-2011) by Liquid Scintillation Counting (LSC) (Beta) – Tritium, EPA 908.0 & HASL U-02 (TBE SOP TBE-2001) by Alpha Spectroscopy - Uranium (Isotopic), Harvey (TBE SOP TBE-2003) by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), Tritium, HASL Am-01 (TBE SOP TBE-2001) by Alpha Spectroscopy - Americium (Isotopic), Curium (Isotopic), HASL Pu-02 (TBE SOP TBE-2001) by Alpha Spectroscopy - Neptunium (Isotopic), Plutonium (Isotopic), HASL Pu-02 (TBE SOP TBE-2001) by Liquid Scintillation Counting (LSC) (Beta) - Plutonium-241 (Pu-241), HASL Pu-02 (TBE SOP TBE-2001) by Liquid Scintillation Counting (LSC) (Beta) - Plutonium-241 (Pu-241), LANL ER-200 (TBE SOP TBE-2001) by Alpha Spectroscopy - Thorium (Isotopic), ORISE AP2 (TBE SOP TBE-2010) by Liquid Scintillation Counting (LSC) (Beta) – Tritium, ORISE AP9 (TBE SOP TBE-2010) by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), TBE SOP TBE-2002 by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), TBE SOP TBE-2006 by Gamma Spectroscopy - Iron-55 - TBE SOP TBE-2012 by Gamma Spectroscopy - Iodine-129, TBE SOP TBE-2012 by Gas Proportional Counting (GPC) (Alpha Beta) - Iodine-131 - TBE SOP TBE-2013 by Gamma Spectroscopy, Nickel-59 1108, TBE SOP TBE-2013 by Liquid Scintillation Counting (LSC) (Beta) - Nickel-63 2912, Preparation - TBE SOP TBE-2032 Part-61 Sample Prep

☒ An Opening Meeting was held with personnel as detailed on a separate attendance sheet (LF-06).
☒ Documentation and activities related to the above scope were assessed.
☒ All relevant observations were recorded on a separate form (LF-56 Supp).
☒ Identified nonconformities were discussed with personnel.
☒ The Nonconformance(s)/Observation(s) detailed in the LF-08 report are summarized below.
☒ A Closing Meeting was held with personnel, as detailed on a separate attendance sheet (LF-06).

CONCLUSIONS

An effective conformity body system was found to be implemented.
☐ without any OR ☒ without serious nonconformances, as detailed in the LF-08 report.
For surveillance assessments, when evidence of satisfactory corrective actions to the nonconformance(s) detailed in the LF-08 report has been received by PJLA, recommendation for continuation of accreditation can be made.
☐ An insufficient conformity body system was found to facilitate a recommendation for accreditation or continued accreditation, as detailed in the LF-08 report and in this report.
☐ The conformity body system was not fully assessed as detailed in this report.

A follow-up visit ☒ is not required **OR** ☐ is required and the date arranged is: _____

PJLA

CONFORMITY ASSESSMENT BODY (CAB)
ON-SITE ASSESSMENT REPORT

SUMMARY OF NONCONFORMANCE / OBSERVATION REPORTS ISSUED

(Note: The absence of reported nonconformances cannot be taken to mean that none exist.)

Nonconformance Key:

MAJOR:	A total absence of a required system element or a group of minor nonconformances within an element.
MINOR:	A single lapse in discipline or control.
OBSERVATION:	Where, in the opinion of the assessor, clarification or improvement is appropriate.

Below is a brief summary of the nonconformance(s) and observation(s) issued. Nonconformances and observations are detailed in the LF-08 report.

MAJOR: # **0.**

General areas of nonconformance:

MINOR: # **2.**

General areas of nonconformance:

1. *DoD/DOE QSM 5.4 V1M1 2.2.1*
2. *DoD/DOE QSM 5.4 V1M2 4.2.8.5 f) xxv*

OBSERVATIONS: # **0.**

General areas for observation:

TOTAL NUMBER OF NONCONFORMANCES: **0.**

TOTAL NUMBER OF OBSERVATIONS: **0.**

CONFORMITY ASSESSMENT BODY (CAB)
ON-SITE ASSESSMENT REPORT

ASSESSMENT ACTIVITIES

☐ A checklist other than the LF-56 or LF-56 Supplement series was used and is listed below:

Description of activities witnessed during assessment:
EPA 906.0 (TBE SOP TBE-2011) by Liquid Scintillation Counting (LSC) (Beta), ORISE AP2 (TBE SOP TBE-2010) by Liquid Scintillation Counting (LSC) (Beta) - Tritium (Aqueous), TBE SOP TBE-2012 by Gas Proportional Counting (GPC) (Alpha Beta) - Iodine-131 2875 (Aqueous) Prep

Description of activities verified during assessment: (Not applicable for ISO/IEC 17020 assessments)
EiChroM Tc-01 (TBE SOP TBE-2021) by Liquid Scintillation Counting (LSC) (Beta) - Technetium-99 (Tc-99), EPA 600/4-75-009 (TBE SOP TBE-2037) by Gas Proportional Counting (GPC) (Alpha Beta) - Gross Alpha, EPA 900.0 & EPA 9310 (TBE SOP TBE-2008) by Gas Proportional Counting (GPC) (Alpha Beta), Gross Alpha, Gross Beta, EPA 901.1 & HASL Ga-01-R/EML 4.5.2.3 by Gamma Spectroscopy - Gamma Emitters, EPA 905.0, HASL Sr-02 & Sr-03 by Gas Proportional Counting (GPC) (Beta) - Strontium-89 (Sr-89), Strontium-90 (Sr-90), EPA 906.0 (TBE SOP TBE-2011) by Liquid Scintillation Counting (LSC) (Beta) – Tritium, EPA 908.0 & HASL U-02 (TBE SOP TBE-2001) by Alpha Spectroscopy - Uranium (Isotopic), Harvey (TBE SOP TBE-2003) by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), Tritium, HASL Am-01 (TBE SOP TBE-2001) by Alpha Spectroscopy - Americium (Isotopic), Curium (Isotopic), HASL Pu-02 (TBE SOP TBE-2001) by Alpha Spectroscopy - Neptunium (Isotopic), Plutonium (Isotopic), HASL Pu-02 (TBE SOP TBE-2001) by Liquid Scintillation Counting (LSC) (Beta) - Plutonium-241 (Pu-241), HASL Pu-02 (TBE SOP TBE-2001) by Liquid Scintillation Counting (LSC) (Beta) - Plutonium-241 (Pu-241), LANL ER-200 (TBE SOP TBE-2001) by Alpha Spectroscopy - Thorium (Isotopic), ORISE AP2 (TBE SOP TBE-2010) by Liquid Scintillation Counting (LSC) (Beta) – Tritium, ORISE AP9 (TBE SOP TBE-2010) by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), TBE SOP TBE-2002 by Liquid Scintillation Counting (LSC) (Beta) - Carbon-14 (C-14), TBE SOP TBE-2006 by Gamma Spectroscopy - Iron-55 - TBE SOP TBE-2012 by Gamma Spectroscopy - Iodine-129, TBE SOP TBE-2012 by Gas Proportional Counting (GPC) (Alpha Beta) - Iodine-131 - TBE SOP TBE-2013 by Gamma Spectroscopy, Nickel-59 1108, TBE SOP TBE-2013 by Liquid Scintillation Counting (LSC) (Beta) - Nickel-63 2912, Preparation - TBE SOP TBE-2032 Part-61 Sample Prep

PROFICIENCY TESTING PROGRAM

Type of Proficiency Test Program assessed: (e.g., ISO/IEC 17043 Third-Party, Intra-Laboratory)

The proficiency-testing program was appropriate (source, frequencies): ☒ Yes ☐ No
If no, comment because it was not appropriate.

The results of the PTs were acceptable (initial/continuing, number, failures): ☒ Yes ☐ No
If no, comment why they were not acceptable and include the corrective action(s) taken by the CAB.

The (CAB's) PJLA approved 4-year PT plan was followed: ☒ Yes ☐ No
If no, comment what was not followed and include the (CAB's) reasoning.
LF_81 provided

CONTINUED DETAILS
Quality Manual (if applicable) and/or QMS Documentation (Issue Date/Revision): *Teledyne Brown Engineering Quality Assurance Manual rev 36 effective July 14, 2023; Both general and specific technical and supporting procedures.* Details of other documentation: *Laboratory protocols, Data Integrity, Ethics, proficiency testing study results, Analyst training records, control charts, internal audit review checklist, certificates, traceability records, reports, preparation data sheets, Management review record, QC check sheet, working logbooks, equipment list, laboratory forms, test procedures, personnel training documentation, etc.*
Results of evaluation from previous assessment's NCRs: Total #: 0. ("0" if none)
Scope Changes: ☒ Yes ☒ No *If yes, provide a brief summary in the details section of this report.*
Other assessment details: Include CAB system changes, scope changes, improvements, areas of concern, follow-up activities or recommendations for next visit.

PJLA

CONFORMITY ASSESSMENT BODY (CAB)
ON-SITE ASSESSMENT REPORT

ASSESSOR'S ACCREDITATION RECOMMENDATION

☒ Yes ☐ No (provide explanation): Recommend accreditation/continued accreditation/scope expansion/upgrade/address change/name change as identified above to the standard(s) identified above with receipt of acceptable corrective actions to nonconformities identified in the LF-08 report (when applicable).

The laboratory is complying to the ISO/IEC 17025:2017(Option A) and DoD/DOE QSM version 5.4 for their accredited scope and they should continue their accreditation without lapse, upon receipt of acceptable corrective action plans with objective evidence to the NCRs sited during the assessment within 60 days of this report and compliance with PJLA protocols.

☐ Yes ☐ No ☒ NA: Proceed with initial accreditation assessment (if preliminary assessment).

Offsite Surveillance Considerations:

☐ Next assessment is a 1 year surveillance (offsite not an option).

☒ Offsite recommended.

☐ Offsite **not** recommended (provide explanation).

Notes for next assessment ("None" if none) (e.g., forecasted organizational/facility/LIMS changes, areas requiring attention or additional time (e.g., LIMS upgrades, 2nd-shifts, Major/Repeat NCRs): None

Ownership of this report lies with PJLA and CAB. A third party can only obtain right of perusal after permission from the CAB.

Distribution: PJLA, CAB and as required by program/state specific (e.g., DOECAP-AP, DoD-ELAP, TNI) requirements. Additional reports may be distributed as necessary upon permission of the laboratory and as required by program specific requirements and/or by the state requirements.

Report reviews: If an additional or revised report is required as a result of PJLA Headquarters or program/state review, one will be issued within 30 days from the receipt of this report, upon final review by PJLA.

Acknowledgment: PJLA wishes to thank the CAB for their assistance and cooperation during this assessment.

Signed: _____ Date: *September 15, 2023*
(Lead Assessor)

Amended report (if yes, provide summary of changes) ☐ Yes Date: _____

PJLA

NONCONFORMANCE REPORT

ASSESSMENT INFORMATION		
Number	**Type**	**Date(s)**
A2023-01264	*Virtual offsite surveillance*	*September 14 - 15, 2023*
Standard(s):	*ISO/IEC 17025:2017/DoD-ELAP/DOECAP-AP QSM 5.4*	
Team: (Lead)	*Maurice Downer* (LA, TA, TE)	
CONFORMITY ASSESSMENT BODY (CAB)		
Name	**Location(s)**	
Teledyne Brown Engineering	*2508 Quality Lane Knoxville, TN 37931*	

TOTALS			
Repeat	**Major**	**Minor**	**Observation(s)**
0	0	*2*	*0*

NUMBER & TYPE (Major, Minor or Observation)	FINDING & OBJECTIVE EVIDENCE	REQUIREMENT
NCR 1 - Minor ☐ *Repeat?* [a]	***Finding*** *– The laboratory has not analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.* ***Objective Evidence*** *– The laboratory has not maintained and analyzed at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation. For the following analytes and methods* 1. *EiChroM Tc-01 (TBE SOP TBE-2021) (LSC) (Beta) - Technetium-99 (Tc-99) (3020) missing (Air).* 2. *EPA 900.0 & EPA 9310 (TBE SOP TBE-2008) by (GPC) (Alpha Beta) Gross Alpha (2830) and Gross Beta (2840) missing (Solid).* 3. *EPA 908.0 & HASL U-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Uranium (Isotopic) (3055) missing (Solid).* 4. *Harvey (TBE SOP TBE-2003) by (LSC) (Beta) Carbon-14 (C-14) (2790) and Tritium (3030) missing (Solid).* 5. *HASL Am-01 (TBE SOP TBE-2001) by Alpha Spectroscopy Americium (Isotopic) missing (Air), and Curium (Isotopic) missing (Air, Aqueous, Solid.)* 6. *HASL Pu-02 (TBE SOP TBE-2001) by Alpha Spectroscopy Neptunium (Isotopic) missing (Air, Aqueous, Solid), Plutonium (Isotopic) (2940) missing (Solid).* 7. *HASL Pu-02 (TBE SOP TBE-2001) by (LSC) (Beta) Plutonium-241 (Pu-241) (2936) missing (Air, Aqueous, Solid).* 8. *LANL ER-200 (TBE SOP TBE-2001) by Alpha Spectroscopy Thorium (Isotopic) (3042) missing (Air, Aqueous, Solid).* 9. *ORISE AP2 (TBE SOP TBE-2010) by (LSC) (Beta) Tritium (3030) missing (Aqueous).* 10. *ORISE AP9 (TBE SOP TBE-2010) by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Aqueous).* 11. *TBE SOP TBE-2002 by (LSC) (Beta) Carbon-14 (C-14) (2790) missing (Air, Aqueous, Solid).* 12. *TBE SOP TBE-2006 by Gamma Spectroscopy Iron-55 (2885) missing (Solid).* 13. *TBE SOP TBE-2012 by Gamma Spectroscopy Iodine-129 (2874) missing (Air, Aqueous, Solid).* 14. *TBE SOP TBE-2013 by Gamma Spectroscopy Nickel-59 (1108) missing (Air, Aqueous, Solid).*	***DoD/DOE QSM 5.4 V1M1 2.2.1:*** *To maintain DoD ELAP accreditation, the laboratory shall successfully analyze at least two PT samples per calendar year for each analyte-matrix-method combination on their scope of accreditation.*
NCR 2 - Minor ☐ *Repeat?* [a]	***Finding*** *– The laboratory SOP for Liquid Scintillation Counters does not include or reference the computer hardware and software in use for each unit.* ***Objective Evidence*** *– The laboratory SOP for Liquid Scintillation Counters 3004 Rev 7 LSC Calibration does not include or reference the computer hardware and software in use for each unit.*	***DoD/DOE QSM 5.4 V1M2 4.2.8.5 f) xxv:*** *Each method shall include or reference the following topics where applicable: computer hardware and software.*

PJLA

NONCONFORMANCE REPORT

NUMBER & TYPE (Major, Minor or Observation)	FINDING & OBJECTIVE EVIDENCE	REQUIREMENT

an Identify assessment Number and NCR# in the objective evidence discussion.

Note: Corrective Action Responses shall be submitted **within 60 days** on the organization's internal corrective form in accordance with the standard. Corrective Actions should be sent to CA@pjlabs.com.

SUBMITTED BY ASSESSOR:

Name: Maurice Downer Signature: _____ Date: *September 15, 2023*

ACCEPTED BY CAB:

Name: Sharon Northcutt Signature: Sharon L Northcutt Date: 09/15/23

ASSESSOR CORRECTIVE ACTION ACCEPTANCE: (with receipt of evidence of corrective actions)

Assessor Signature: _____ Date: _____

END OF DOCUMENT

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Appendix B

Data Reporting Conventions

APPENDIX B. DATA REPORTING CONVENTIONS

Data Reporting Conventions

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

2.0. Single Measurements

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

where: x = value of the measurement;

$s = 2\sigma$ counting uncertainty (corresponding to the 95% confidence level).

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

3.0. Duplicate analyses

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

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

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

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

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

4.0. Computation of Averages and Standard Deviations

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

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

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

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

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

4.5 In rounding off, the following rules are followed:

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

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

Appendix C

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

APPENDIX C

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

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

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

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

[c] A natural radionuclide.

KEWAUNEE SOLUTIONS

2023 Annual Radiological Environmental Operating Report

Kewaunee Power Station
Part II, Data Tabulations, Graphs and Analyses

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phone (847) 564-0700 • fax (847) 564-4517

REPORT TO

KEWAUNEE SOLUTIONS

RADIOLOGICAL MONITORING PROGRAM FOR THE KEWAUNEE POWER STATION KEWAUNEE, WISCONSIN

ANNUAL REPORT - PART II
DATA TABULATIONS AND ANALYSES

January 1 to December 31, 2023

Prepared and submitted by

Microbac Laboratories – Northbrook

Project No. 8002

Approved:

Ashok Banavali, Ph.D.
Laboratory Director
Microbac Laboratories – Northbrook

Daniel J. Shannon
Radiation Protection Technical Manager
Kewaunee Power Station

PREFACE

The staff of Microbac Laboratories - Northbrook were responsible for the presentation of data in this report. Assistance in sample collection was provided by Kewaunee Power Station personnel. The report was prepared by staff members of Microbac Laboratories - Northbrook. Teledyne Brown Engineering, Inc. is responsible for the radiochemical analyses. Mirion Dosimetry Services is responsible for the Thermoluminescent Dosimetry.

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1.0 INTRODUCTION

The following constitutes Part II of the final report for the 2023 Radiological Monitoring Program conducted at the Kewaunee Power Station (KPS), Kewaunee, Wisconsin.

Included are tabulations of data for all samples collected in 2023 along with graphs of data trends. A summary and interpretation of the data presented here are published in Part I of the 2023 Annual Report on the Radiological Monitoring Program for the Kewaunee Power Station.

FIGURE 1
ENVIRONMENTAL SAMPLING LOCATION

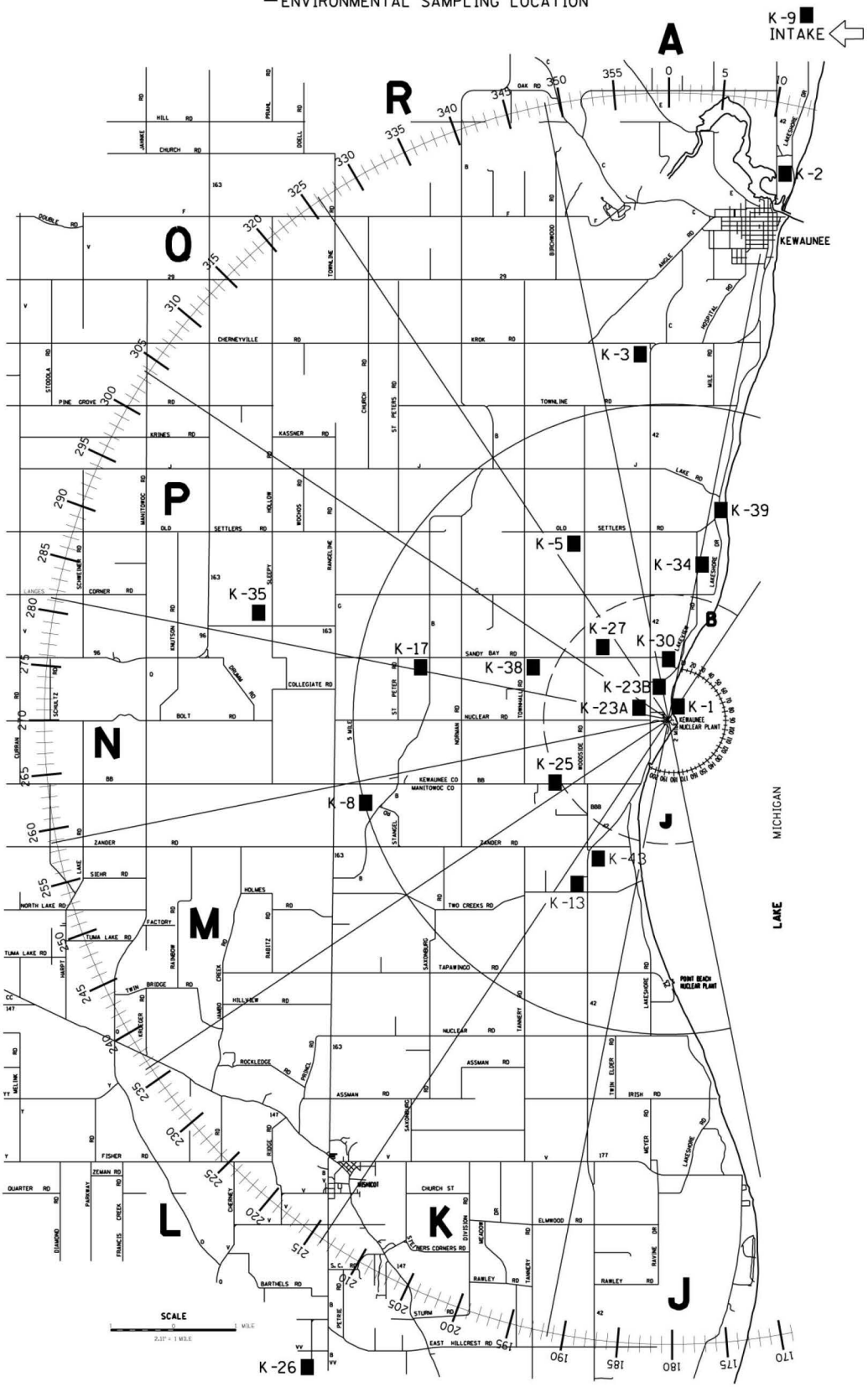

Table 1. Sampling locations, Kewaunee Power Station.

Code	Type[a]	Distance (miles)[b] and Sector	Location
K-1	I		Onsite
K-1b	I	0.12 N	Middle Creek
K-1c	I	0.10 N	500' north of condenser discharge
K-1d	I	0.10 E	Condenser discharge
K-1e	I	0.12 S	South Creek
K-1f	I	0.12 S	Maintenance Waste Oil and Material Storage Building
K-1h	I	0.12 NW	North Well
K-1j	I	0.10 S	500' south of condenser discharge
K-1m	I	0.15 N	ISFSI East
K-1o	I	0.16 N	ISFSI North
K-1q	I	0.16 N	ISFSI West
K-1r	I	0.13 N	ISFSI West
K-1t[d]	I	0.10 ESE	Gatehouse
K-1u	I	0.05 SSW	Maintenance Building
K-1v[e]	I	0.06 W	South Well
K-2	C	8.91 NNE	WPS Operations Building in Kewaunee
K-3[c]	I/C	5.9 N	Lyle and John Siegmund Farm, N2815 Hwy 42, Kewaunee
K-5	I	3.2 NNW	Ed Paplham Farm, E4160 Old Settlers Rd, Kewaunee
K-8	I	4.85 WSW	St. Isadore the Farmer Church, 18424 Tisch Mills Rd, Tisch Mills
K-9	C	11.5 NNE	Green Bay Municipal Pumping Station, six miles east of Green Bay (sample source is Lake Michigan water from Rostok Intake, two miles north of Kewaunee)
K-13	C	3.0 SSW	Rand's General Store, Two Creeks
K-17	I	4.0 W	Klimesh's Farm, N885 Tk B, Kewaunee
K-23a	I	0.5 W	0.5 miles west of plant, Kewaunee site
K-23b	I	0.6 N	0.6 miles north of plant, Kewaunee site
K-25	I	1.9 SW	Wotachek Farm, 3968 E. Cty Tk BB, Two Rivers
K-26	C	9.1 SSW	Wilfert Farms Vegetable Stand (9.1 miles south of "BB")
K-27	I	1.53 NW	Schleis Farm, E4298 Sandy Bay Rd, Kewaunee
K-30	I	0.8 N	End of site boundary
K-34	I	2.7 N	Leon and Vicki Struck, N1549 Lakeshore Dr., Kewaunee
K-35	C	6.71 WNW	Duane Ducat, N1215 Sleepy Hollow Rd., Kewaunee
K-38	I	2.45 WNW	Dave Sinkula Farm, N890 Town Hall Road, Kewaunee
K-39	I	3.46 N	Francis Wojta, N1859 Lakeshore Dr., Kewaunee
K-43	I	2.71 SSW	Gary Maigatter Property, 17333 Hwy 42, Two Rivers
K-45	I	5.1 N	Wakker's Dairy, N2348 Highway 42, Kewaunee

[a] I = indicator; C = control.

[b] Distances are measured from reactor stack.

[c] Location K-3 is an indicator for ambient radiation and a control for soil, cattle feed and grass.

[d] Sampling discontinued at location K-1t after 7/5/23 sample collection due to abandonment of Gatehouse well.

[e] Sampling initiated at location K-1v on 10/2/23 due to installation of new potable water supply well (South Well).

Table 2. Type and frequency of collection.

Location	Weekly	Quarterly	Semiannually	Annually
K-1b		SW GR [a]		
K-1c			SS [b]	
K-1d		SW		FI [c]
K-1e		SW		
K-1f	AP [g]	GR [a] TLD	SO	
K-1h		WW		
K-1j			SS [b]	
K-1m		TLD		
K-1o		TLD		
K-1q		TLD		
K-1r		TLD		
K-1u		WW		
K-1t / K-1v		WW [h]		
K-2	AP [g]	TLD		
K-3		GR [a] TLD	SO	CF [d]
K-5		GR [a] TLD		CF [d]
K-8	AP [g]	TLD		
K-9		SW [f]	SS [b]	
K-13		WW		
K-17		TLD		
K-23a				BLV [e]
K-23b				BLV [e]
K-25		TLD		
K-26				BLV [e]
K-27		TLD		
K-30		TLD		
K-34		GR [a]	SO	CF [d]
K-35		GR [a]	SO	CF [d]
K-38		GR [a]	SO	CF [d]
K-39		GR [a] TLD		CF [d]
K-43	AP [g]	TLD		
K-45				CF [d]

[a] Three times a year, second third and fourth quarters.
[b] Collected in May and November.
[c] Collected annually in the third quarter (July, August or September).
[d] First quarter (January, February, March) only.
[e] Alternate since milk sampling is no longer performed.
[f] Two samples, raw and treated.
[g] Frequency may be increased dependent on dust loading.
[h] Sampling discontinued at location K-1t after 7/5/23 sample collection due to abandonment of Gatehouse well; sampling initiated at location K-1v on 10/2/23 due to installation of new potable water supply well (South Well).

Table 3. Sample Codes:

Code	Description
AP	Airborne particulates
BLV	Broad leaf vegetation
CF	Cattle feed
FI	Fish
GR	Grass
SO	Soil
SW	Surface water
SS	Shoreline Sediment
TLD	Thermoluminescent dosimeter
WW	Well water

2.0 GRAPHS OF DATA TRENDS

Note: Conventions used in trending data.

The following conventions should be used in the interpretation of the graphs of data trends:

1. Both solid and open data points may be used in the graphs. A solid point indicates an activity, an open point, a lower limit of detection (LLD) value.
2. Data points are connected by a solid line. A break in the plot indicates missing data.

Air Particulates – Gross Beta

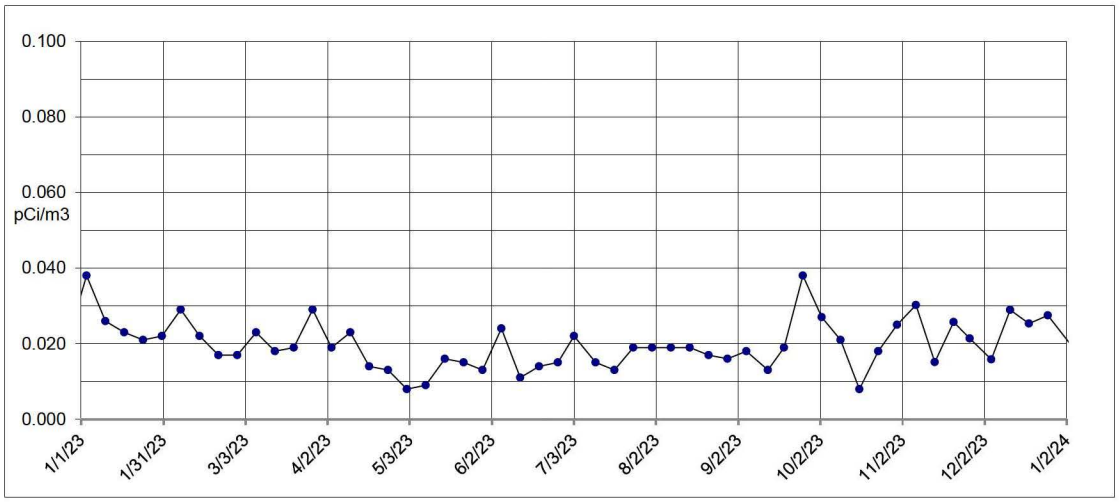

Figure 2. Location K-1f (weekly samples, 2023).

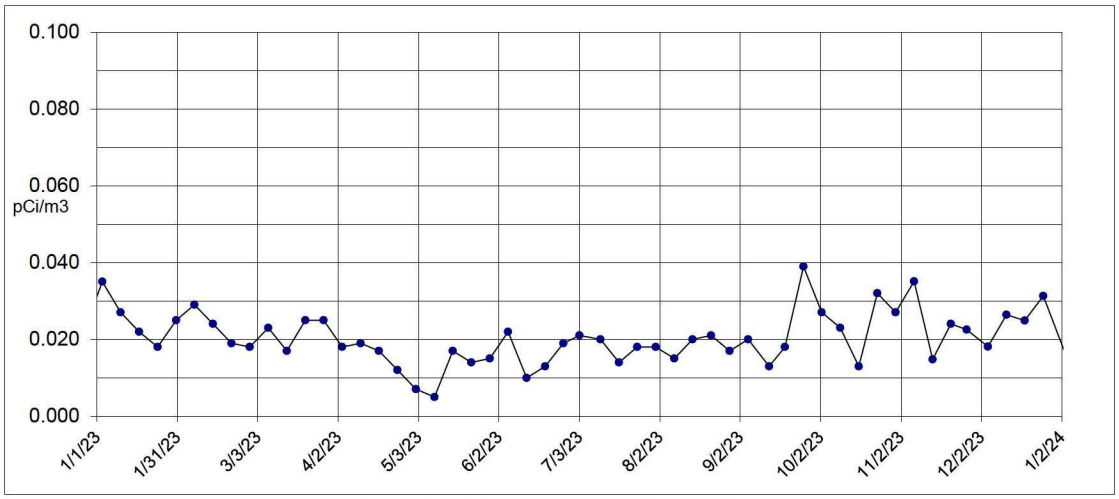

Figure 3. Location K-2 (weekly samples, 2023).

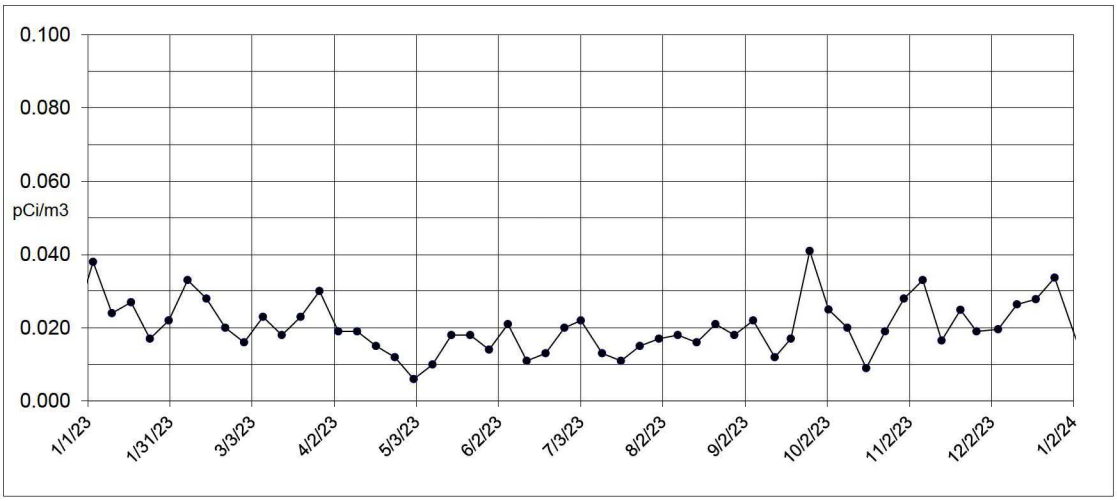

Figure 4. Location K-8 (weekly samples, 2023).

Air Particulates – Gross Beta

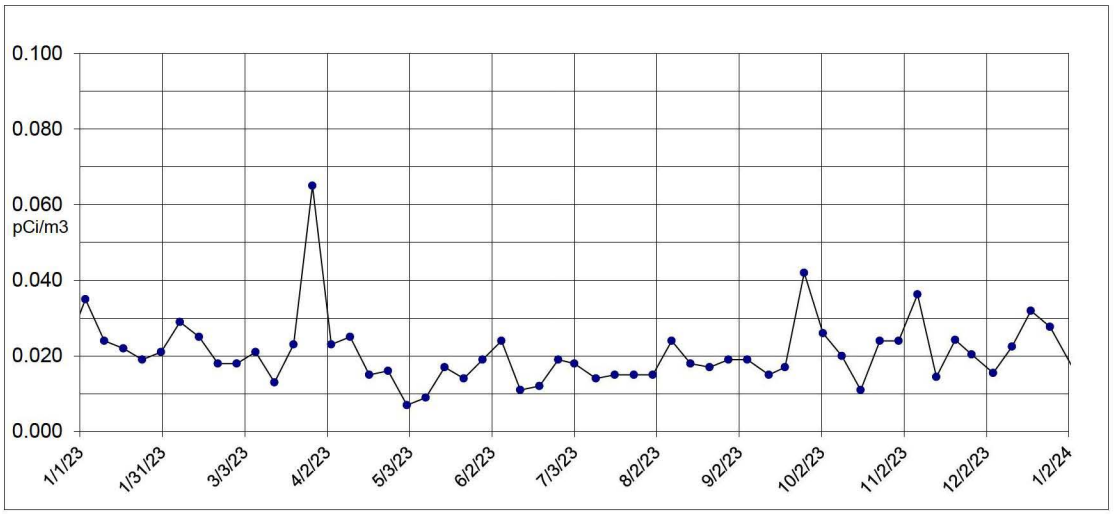

Figure 5. Location K-43 (weekly samples, 2023). Reduced run time and sample volume collection at location K-43 for the sample period ending 3/28/23 due to power outage (CR#2438).

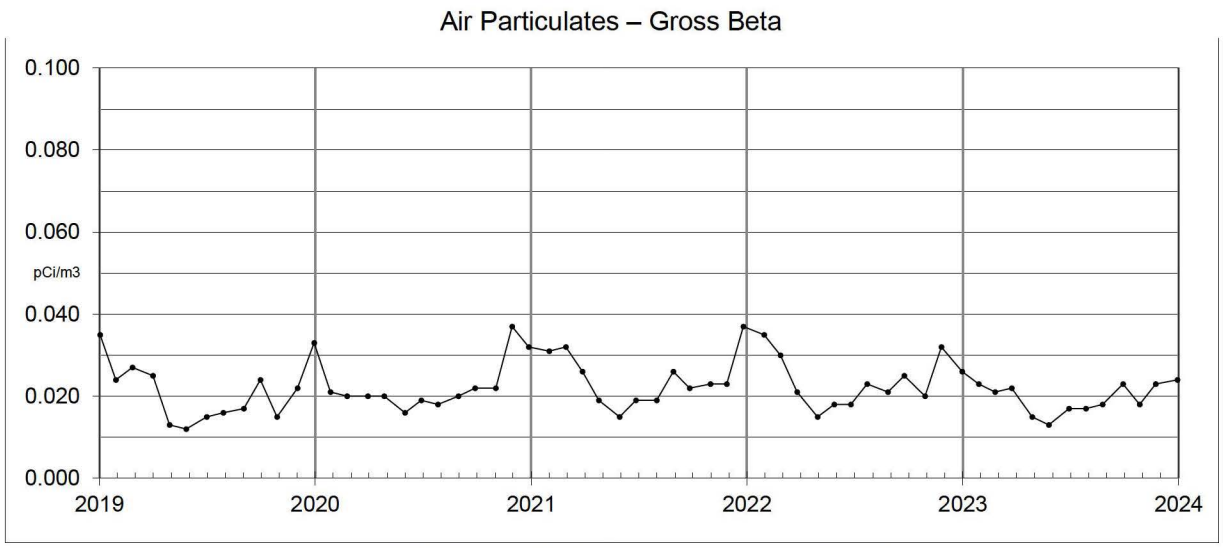

Figure 6. Location K-1f (monthly averages, 2019-2023).

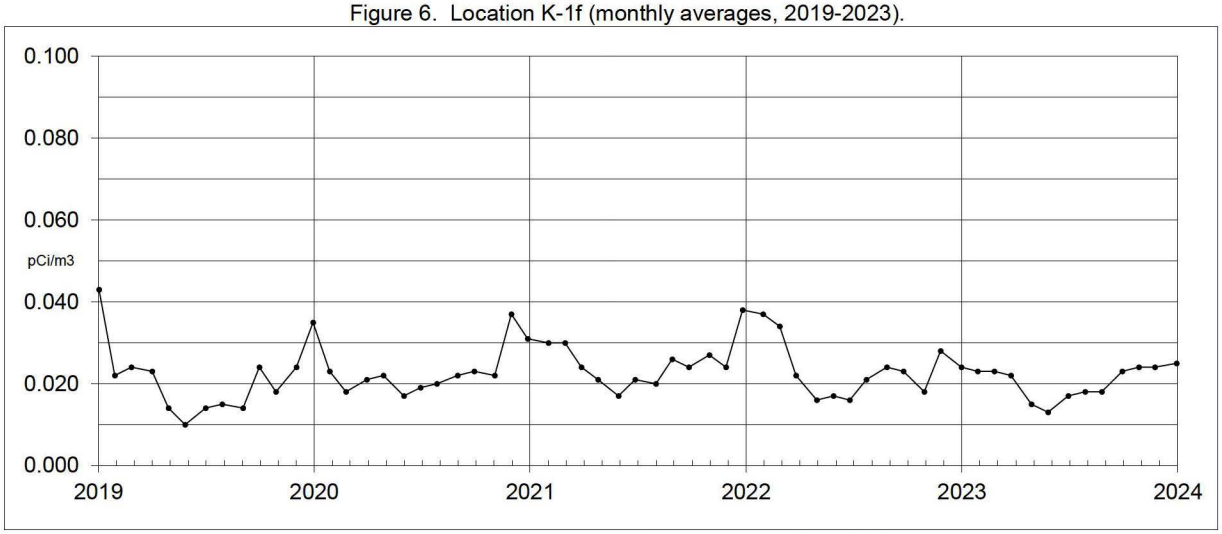

Figure 7. Location K-2 (monthly averages, 2019-2023).

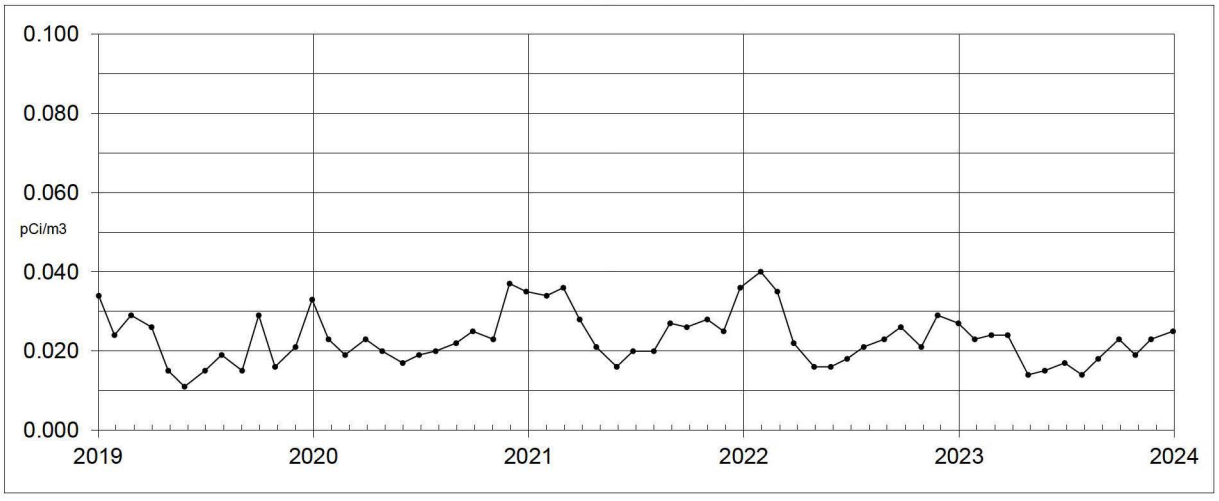

Figure 8. Location K-8 (monthly averages, 2019-2023).

KPS

Air Particulates – Gross Beta

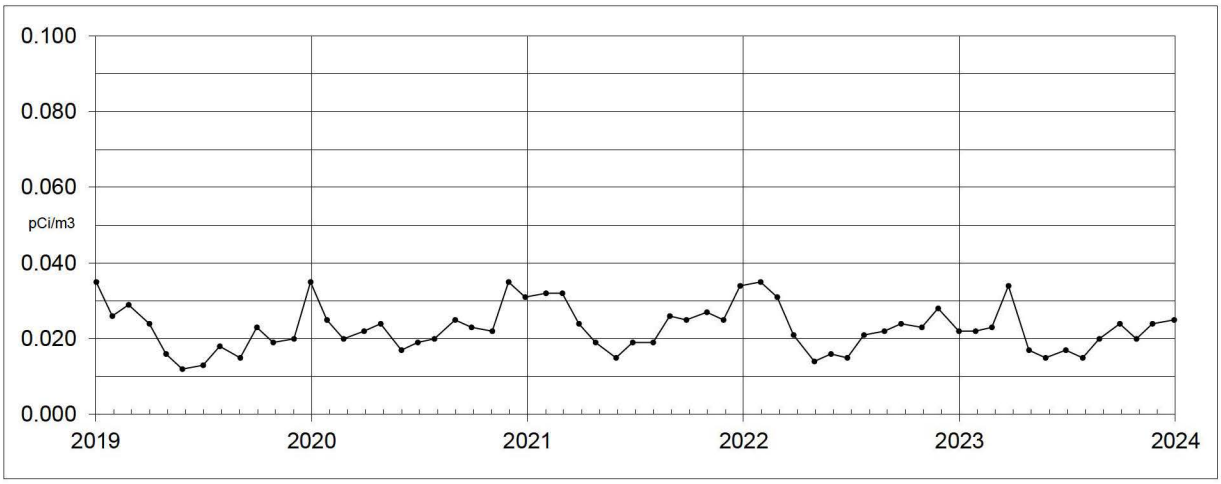

Figure 9. Location K-43 (monthly averages, 2019-2023).

Well Water – Gross Alpha

Note: An open data point indicates activity less than the lower limit of detection (LLD).

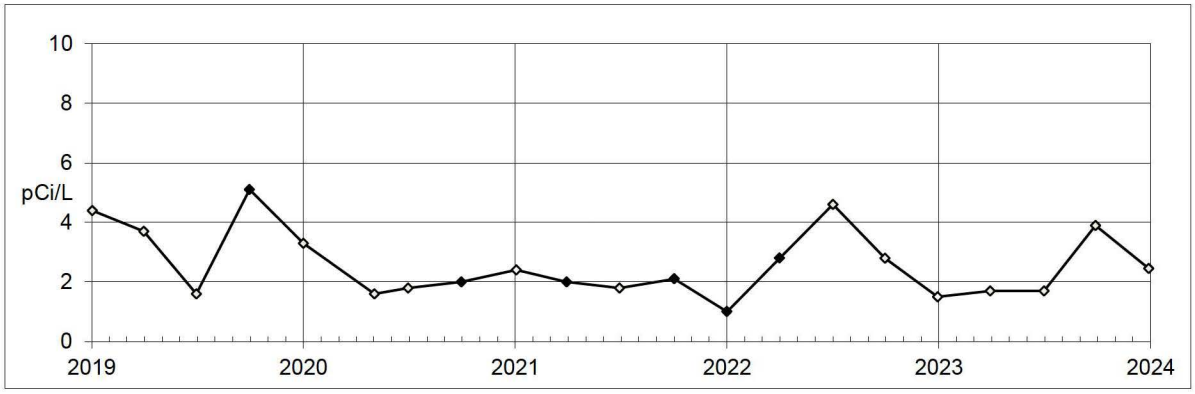

Figure 10. Location K-1h. Total Residue. Quarterly collection.

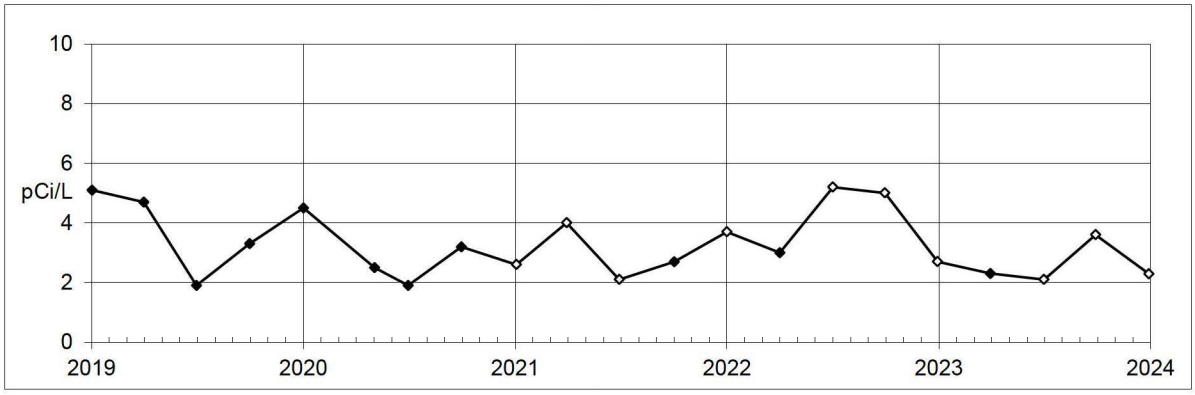

Figure 11. Location K-1t / K-1v. Total Residue. Sampling discontinued at location K-1t after 7/5/23; sampling initiated at location K-1v on 10/2/23.

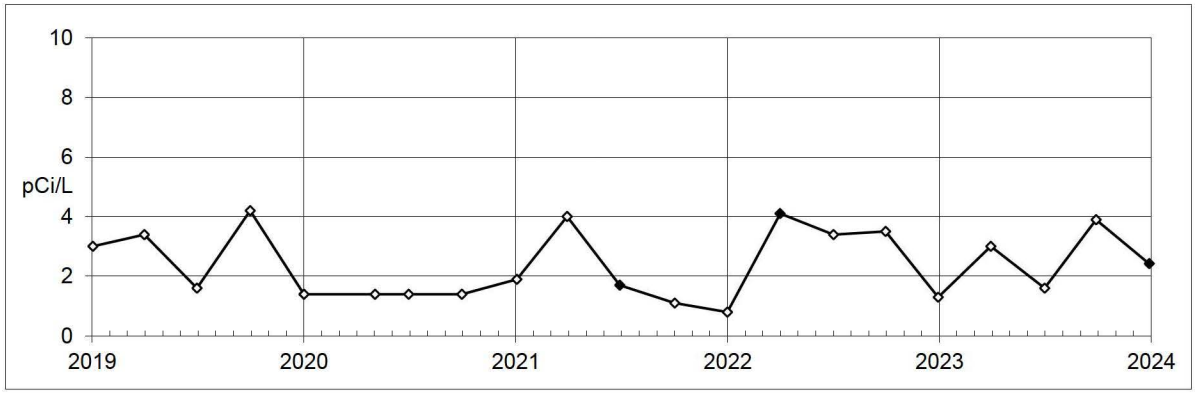

Figure 12. Location K-1u. Total Residue. Quarterly collection.(sample taken only when source has been tapped for drinking or irrigation purposes.)

Well Water – Gross Beta

Note: An open data point indicates activity less than the lower limit of detection (LLD).

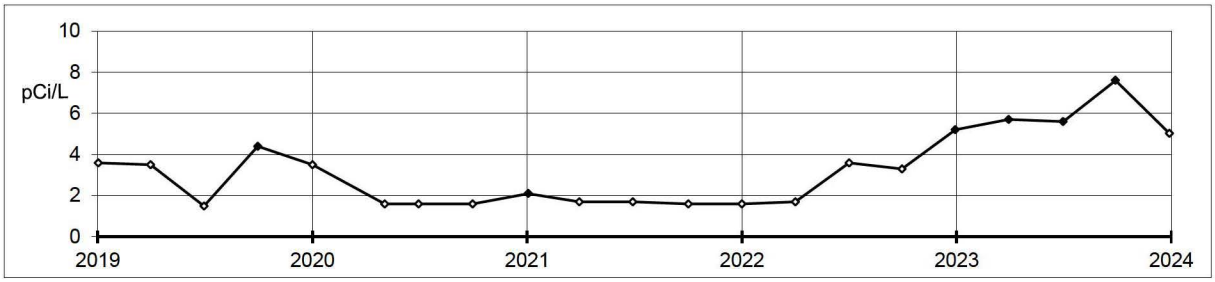

Figure 13. Location K-1h. Total Residue. Quarterly collection.

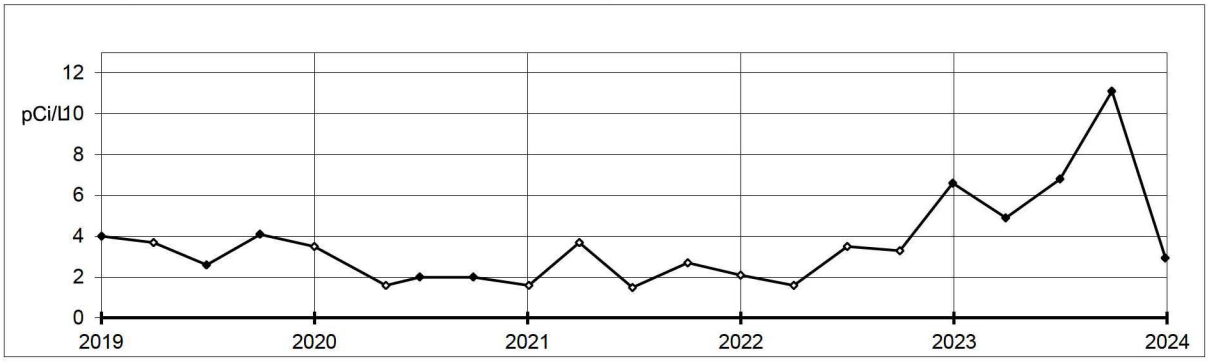

Figure 14. Location K-1t/K-1v. Total Residue. Sampling discontinued at location K-1t after 7/5/23; sampling initiated at location K-1v on 10/2/23.

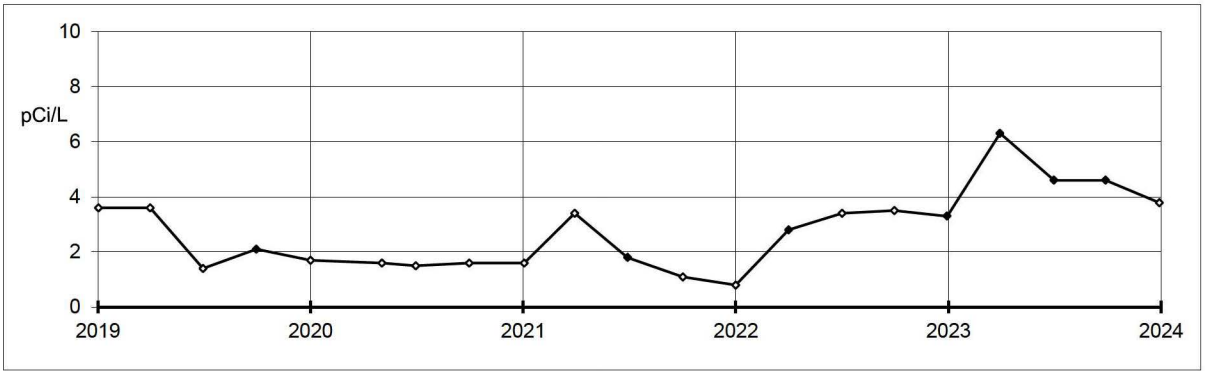

Figure 15. Location K-1u. Total Residue. Quarterly collection.(Initiated 1/2/18; sample taken only when source has been tapped for drinking or irrigation purposes.)

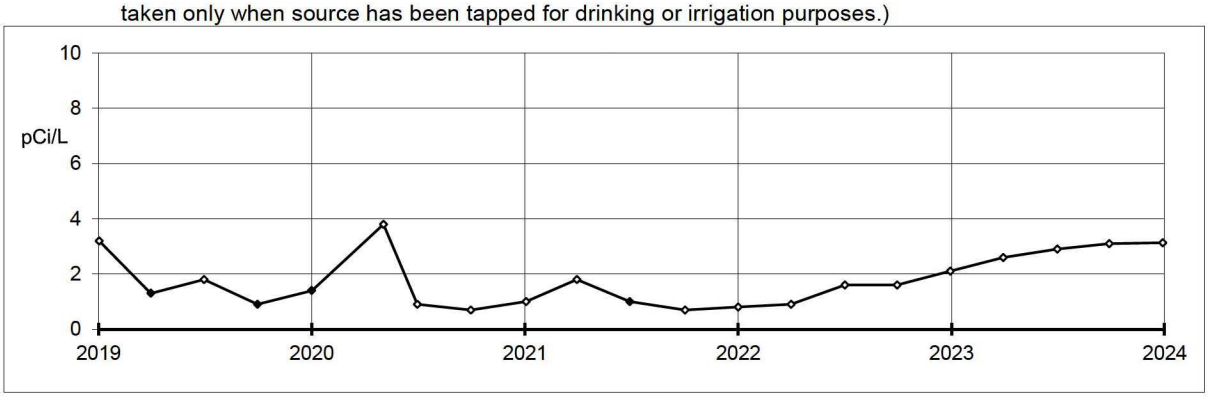

Figure 16. Location K-13. Total Residue. Quarterly collection.

Surface Water – Gross Beta

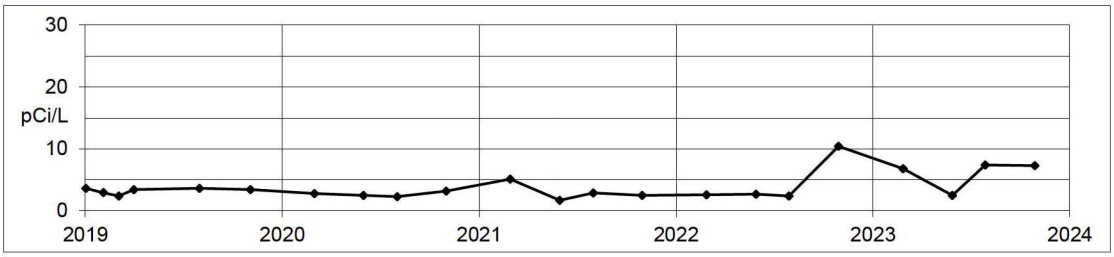

Figure 17. Surface water . Middle Creek, Onsite (K-1b).

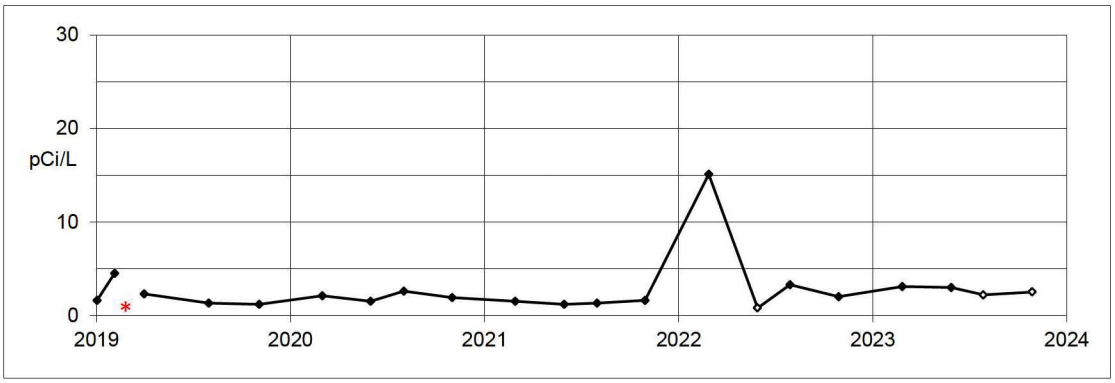

Figure 18. Surface water. Lake Michigan, condenser discharge, Onsite (K-1d).
* Sample not available 3/4/19 due to frozen conditions. (CR#1890)

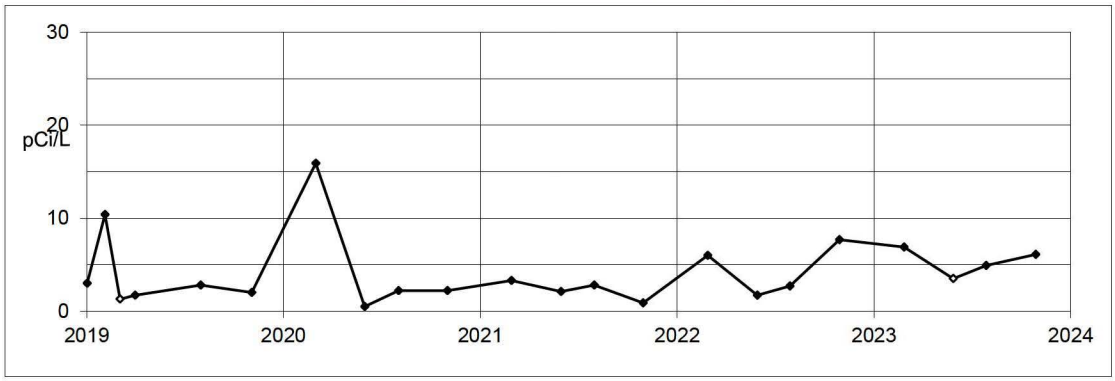

Figure 19. Surface water. South Creek, Onsite (K-1e).

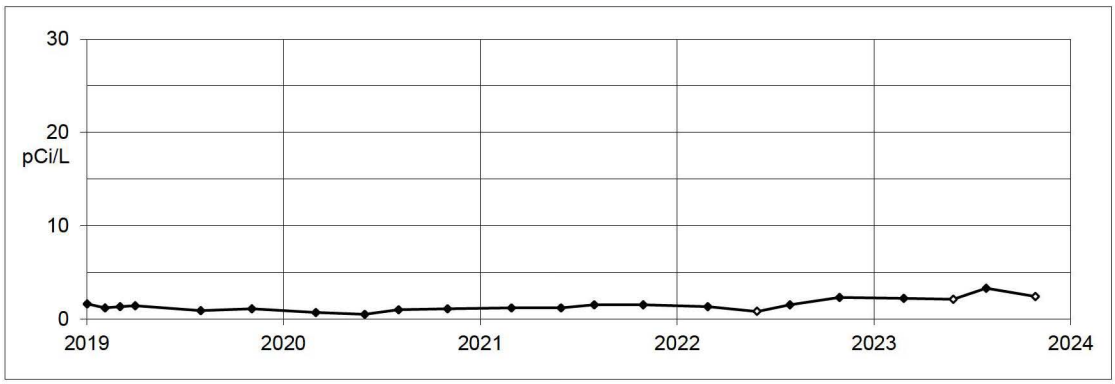

Figure 20. Surface water (raw). Lake Michigan, Rostok Intake (K-9)

Surface Water - H-3

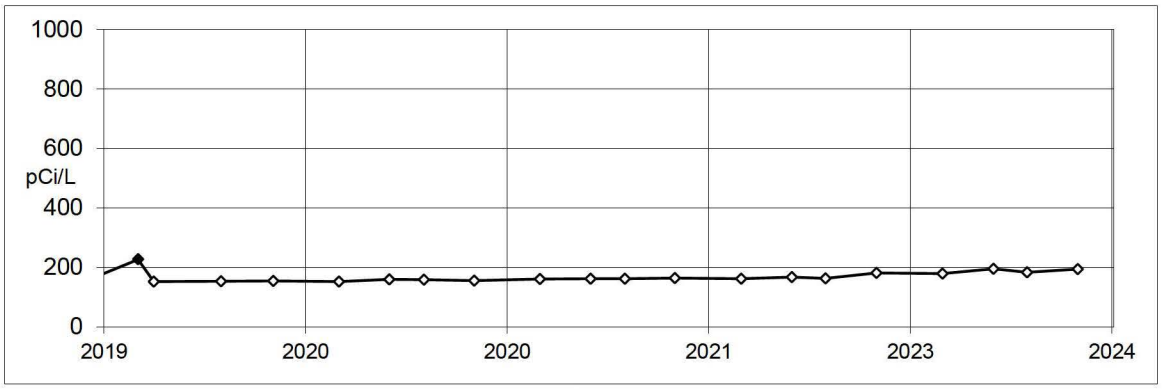

Figure 21. Surface water. Lake Michigan, condenser discharge, K-1d. Quarterly collection.

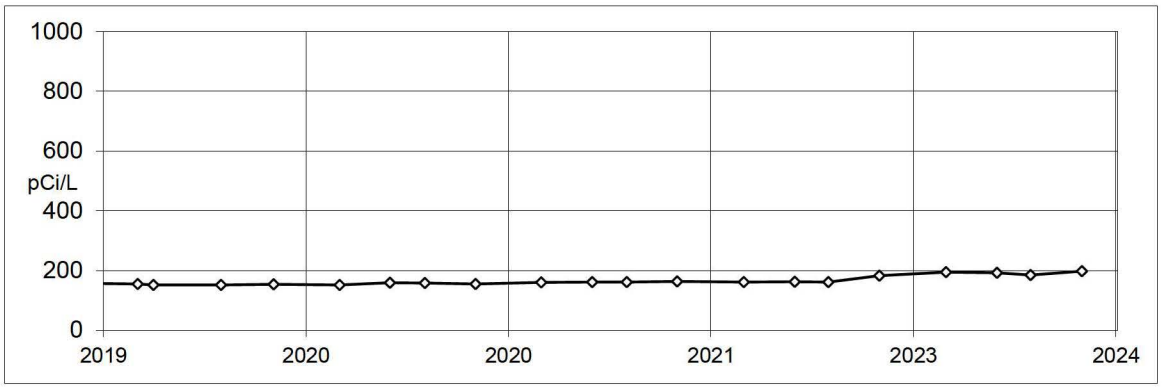

Figure 22. Surface water. Lake Michigan, Rostok Intake, K-9. Quarterly collection.

3.0 DATA TABULATIONS

Table 4. Airborne particulates, analyses for gross beta.

Location: K-1f

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-10-23	304	0.026 ± 0.009	07-11-23	341	0.015 ± 0.008
01-17-23	302	0.023 ± 0.008	07-18-23	306	0.013 ± 0.007
01-24-23	301	0.021 ± 0.007	07-25-23	297	0.019 ± 0.009
01-31-23	302	0.022 ± 0.011	08-01-23	309	0.019 ± 0.009
02-07-23	296	0.029 ± 0.014	08-08-23	301	0.019 ± 0.009
02-14-23	305	0.022 ± 0.011	08-15-23	304	0.019 ± 0.009
02-21-23	303	0.017 ± 0.009	08-22-23	297	0.017 ± 0.008
02-28-23	301	0.017 ± 0.009	08-29-23	309	0.016 ± 0.008
03-07-23	307	0.023 ± 0.011	09-05-23	301	0.018 ± 0.009
03-14-23	299	0.018 ± 0.009	09-13-23	342	0.013 ± 0.007
03-21-23	305	0.019 ± 0.010	09-19-23	265	0.019 ± 0.010
03-28-23	298	0.029 ± 0.014	09-26-23	300	0.038 ± 0.018
			10-03-23	299	0.027 ± 0.013
1st Quarter Mean ± s.d.		0.022 ± 0.004	3rd Quarter Mean ± s.d.		0.019 ± 0.007
04-04-23	305	0.019 ± 0.009	10-10-23	307	0.021 ± 0.010
04-11-23	303	0.023 ± 0.011	10-17-23	301	0.008 ± 0.005
04-18-23	300	0.014 ± 0.007	10-24-23	308	0.018 ± 0.009
04-25-23	299	0.013 ± 0.007	10-31-23	295	0.025 ± 0.012
05-02-23	302	0.008 ± 0.005			
			11-07-23	306	0.030 ± 0.014
05-09-23	303	0.009 ± 0.005	11-14-23	302	0.015 ± 0.008
05-16-23	304	0.016 ± 0.008	11-21-23	306	0.026 ± 0.012
05-23-23	303	0.015 ± 0.008	11-27-23	262	0.021 ± 0.011
05-30-23	304	0.013 ± 0.007			
06-06-23	301	0.024 ± 0.012	12-05-23	340	0.016 ± 0.008
06-13-23	303	0.011 ± 0.006	12-12-23	303	0.029 ± 0.014
06-20-23	299	0.014 ± 0.007	12-19-24	299	0.025 ± 0.012
06-27-23	307	0.015 ± 0.008	12-26-23	304	0.028 ± 0.013
07-03-23	259	0.022 ± 0.011	01-03-24	339	0.020 ± 0.010
2nd Quarter Mean ± s.d.		0.015 ± 0.005	4th Quarter Mean ± s.d.		0.022 ± 0.006
			Cumulative Average		0.020

Table 5. Airborne particulates, analyses for gross beta.

Location: K-2
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-10-23	304	0.027 ± 0.009	07-11-23	342	0.020 ± 0.010
01-17-23	302	0.022 ± 0.008	07-18-23	306	0.014 ± 0.007
01-24-23	302	0.018 ± 0.006	07-25-23	297	0.018 ± 0.009
01-31-23	307	0.025 ± 0.012	08-01-23	310	0.018 ± 0.009
02-07-23	296	0.029 ± 0.014	08-08-23	301	0.015 ± 0.008
02-14-23	305	0.024 ± 0.012	08-15-23	303	0.020 ± 0.010
02-21-23	303	0.019 ± 0.010	08-22-23	297	0.021 ± 0.010
02-28-23	301	0.018 ± 0.009	08-29-23	310	0.017 ± 0.009
03-07-23	307	0.023 ± 0.011	09-05-23	300	0.020 ± 0.010
03-14-23	299	0.017 ± 0.009	09-13-23	342	0.013 ± 0.007
03-21-23	305	0.025 ± 0.012	09-19-23	264	0.018 ± 0.009
03-28-23	298	0.025 ± 0.012	09-26-23	299	0.039 ± 0.018
			10-03-23	299	0.027 ± 0.013
1st Quarter Mean ± s.d.		0.023 ± 0.004	3rd Quarter Mean ± s.d.		0.020 ± 0.007
04-04-23	305	0.018 ± 0.009	10-10-23	307	0.023 ± 0.011
04-11-23	300	0.019 ± 0.009	10-17-23	253	0.013 ± 0.007 [a]
04-18-23	303	0.017 ± 0.009	10-24-23	54	0.032 ± 0.020 [a]
04-25-23	299	0.012 ± 0.006	10-31-23	295	0.027 ± 0.013
05-02-23	302	0.007 ± 0.004			
			11-07-23	306	0.035 ± 0.017
05-09-23	303	0.005 ± 0.004	11-14-23	302	0.015 ± 0.008
05-16-23	304	0.017 ± 0.009	11-21-23	307	0.024 ± 0.012
05-23-23	303	0.014 ± 0.007	11-27-23	262	0.023 ± 0.011
05-30-23	304	0.015 ± 0.008			
06-06-23	301	0.022 ± 0.011	12-05-23	340	0.018 ± 0.009
06-13-23	303	0.010 ± 0.006	12-12-23	303	0.026 ± 0.013
06-20-23	300	0.013 ± 0.007	12-19-24	303	0.025 ± 0.012
06-27-23	307	0.019 ± 0.009	12-26-23	304	0.031 ± 0.015
07-03-23	259	0.021 ± 0.011	01-03-24	339	0.017 ± 0.008
2nd Quarter Mean ± s.d.		0.015 ± 0.005	4th Quarter Mean ± s.d.		0.024 ± 0.007
			Cumulative Average		0.020

[a] Sample pump found not running due to power outage. WPS secured power to perform site electrical modification on 10/16/23 at approximately 09:00. Power restored 10/23/23 at approximately 08:30. (CR#2612)

Table 6. Airborne particulates, analyses for gross beta.

Location: K-8
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-10-23	304	0.024 ± 0.008	07-11-23	342	0.013 ± 0.007
01-17-23	302	0.027 ± 0.009	07-18-23	306	0.011 ± 0.006
01-24-23	302	0.017 ± 0.006	07-25-23	297	0.015 ± 0.008
01-31-23	307	0.022 ± 0.011	08-01-23	309	0.017 ± 0.009
02-07-23	296	0.033 ± 0.016	08-08-23	301	0.018 ± 0.009
02-14-23	305	0.028 ± 0.013	08-15-23	303	0.016 ± 0.008
02-21-23	303	0.020 ± 0.010	08-22-23	297	0.021 ± 0.010
02-28-23	301	0.016 ± 0.008	08-29-23	310	0.018 ± 0.009
03-07-23	307	0.023 ± 0.011	09-05-23	300	0.022 ± 0.011
03-14-23	299	0.018 ± 0.009	09-13-23	342	0.012 ± 0.006
03-21-23	305	0.023 ± 0.011	09-19-23	264	0.017 ± 0.009
03-28-23	298	0.030 ± 0.014	09-26-23	290	0.041 ± 0.019
			10-03-23	299	0.025 ± 0.012
1st Quarter Mean ± s.d.		0.023 ± 0.005	3rd Quarter Mean ± s.d.		0.019 ± 0.008
04-04-23	305	0.019 ± 0.009	10-10-23	303	0.020 ± 0.010
04-11-23	303	0.019 ± 0.009	10-17-23	301	0.009 ± 0.005
04-18-23	301	0.015 ± 0.008	10-24-23	308	0.019 ± 0.009
04-25-23	299	0.012 ± 0.006	10-31-23	293	0.028 ± 0.014
05-02-23	302	0.006 ± 0.004			
			11-07-23	304	0.033 ± 0.016
05-09-23	303	0.010 ± 0.006	11-14-23	255	0.017 ± 0.008
05-16-23	304	0.018 ± 0.009	11-21-23	306	0.024 ± 0.012
05-23-23	303	0.018 ± 0.009	11-27-23	262	0.019 ± 0.010
05-30-23	257	0.014 ± 0.008 [a]			
06-06-23	301	0.021 ± 0.010	12-05-23	340	0.020 ± 0.010
06-13-23	303	0.011 ± 0.006	12-12-23	303	0.026 ± 0.013
06-20-23	300	0.013 ± 0.007	12-19-24	303	0.028 ± 0.013
06-27-23	307	0.020 ± 0.010	12-26-23	304	0.034 ± 0.016
07-03-23	259	0.022 ± 0.011	01-03-24	339	0.017 ± 0.008
2nd Quarter Mean ± s.d.		0.016 ± 0.005	4th Quarter Mean ± s.d.		0.023 ± 0.007
			Cumulative Average		0.020

[a] Sampler at K-8 found off (not running). Pump re-started after filter change and adjusting plug in receptacle. (CR#2474)

Table 7. Airborne particulates, analyses for gross beta.

Location: K-43

Units: pCi/m^3

Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010	Required LLD		0.010
01-10-23	304	0.024 ± 0.008	07-11-23	341	0.014 ± 0.007
01-17-23	302	0.022 ± 0.008	07-18-23	306	0.015 ± 0.008
01-24-23	301	0.019 ± 0.007	07-25-23	297	0.015 ± 0.008
01-31-23	307	0.021 ± 0.010	08-01-23	309	0.015 ± 0.008
02-07-23	296	0.029 ± 0.014	08-08-23	301	0.024 ± 0.012
02-14-23	300	0.025 ± 0.012	08-15-23	304	0.018 ± 0.009
02-21-23	303	0.018 ± 0.009	08-22-23	291	0.017 ± 0.008
02-28-23	301	0.018 ± 0.009	08-29-23	309	0.019 ± 0.009
03-07-23	307	0.021 ± 0.010	09-05-23	301	0.019 ± 0.010
03-14-23	299	0.013 ± 0.007	09-13-23	342	0.015 ± 0.008
03-21-23	305	0.023 ± 0.011	09-19-23	264	0.017 ± 0.009
03-28-23	123	0.065 ± 0.031 [a]	09-26-23	300	0.042 ± 0.020
			10-03-23	299	0.026 ± 0.013
1st Quarter Mean ± s.d.		0.025 ± 0.013	3rd Quarter Mean ± s.d.		0.020 ± 0.008
04-04-23	305	0.023 ± 0.011	10-10-23	307	0.020 ± 0.010
04-11-23	303	0.025 ± 0.012	10-17-23	301	0.011 ± 0.006
04-18-23	300	0.015 ± 0.008	10-24-23	308	0.024 ± 0.012
04-25-23	299	0.016 ± 0.008	10-31-23	295	0.024 ± 0.012
05-02-23	302	0.007 ± 0.004			
			11-07-23	306	0.036 ± 0.017
05-09-23	303	0.009 ± 0.005	11-14-23	302	0.014 ± 0.007
05-16-23	304	0.017 ± 0.009	11-21-23	306	0.024 ± 0.012
05-23-23	303	0.014 ± 0.007	11-27-23	262	0.020 ± 0.010
05-30-23	304	0.019 ± 0.009			
06-06-23	302	0.024 ± 0.012	12-05-23	340	0.016 ± 0.008
06-13-23	303	0.011 ± 0.006	12-12-23	303	0.023 ± 0.011
06-20-23	300	0.012 ± 0.006	12-19-24	303	0.032 ± 0.015
06-27-23	307	0.019 ± 0.010	12-26-23	304	0.028 ± 0.013
07-03-23	259	0.018 ± 0.009	01-03-24	339	0.017 ± 0.009
2nd Quarter Mean ± s.d.		0.016 ± 0.005	4th Quarter Mean ± s.d.		0.022 ± 0.007
			Cumulative Average		0.021

[a] Run time low due to power outage. (CR#2438).

Table 8. Airborne particulate data, gross beta analyses, monthly averages, minima and maxima.

January

Location	Average	Minima	Maxima
Indicators	0.023	0.017	0.027
K-1f	0.023	0.021	0.026
K-8	0.023	0.017	0.027
K-43	0.022	0.019	0.024
Controls	0.023	0.018	0.027
K-2	0.023	0.018	0.027

February

Location	Average	Minima	Maxima
Indicators	0.023	0.016	0.033
K-1f	0.021	0.017	0.029
K-8	0.024	0.016	0.033
K-43	0.023	0.018	0.029
Controls	0.023	0.018	0.029
K-2	0.023	0.018	0.029

March

Location	Average	Minima	Maxima
Indicators	0.027	0.013	0.065
K-1f	0.022	0.018	0.029
K-8	0.024	0.018	0.030
K-43	0.034	0.013	0.065
Controls	0.022	0.017	0.025
K-2	0.022	0.017	0.025

April

Location	Average	Minima	Maxima
Indicators	0.015	0.007	0.025
K-1f	0.015	0.008	0.023
K-8	0.014	0.008	0.023
K-43	0.017	0.007	0.025
Controls	0.015	0.007	0.019
K-2	0.015	0.007	0.019

May

Location	Average	Minima	Maxima
Indicators	0.014	0.009	0.019
K-1f	0.013	0.009	0.016
K-8	0.015	0.010	0.018
K-43	0.015	0.009	0.019
Controls	0.013	0.005	0.017
K-2	0.013	0.005	0.017

June

Location	Average	Minima	Maxima
Indicators	0.017	0.011	0.024
K-1f	0.017	0.011	0.024
K-8	0.017	0.011	0.022
K-43	0.017	0.011	0.024
Controls	0.017	0.010	0.022
K-2	0.017	0.010	0.022

Note: Samples collected on the first, second or third day of the month are grouped with data of the previous month.

Table 8. Airborne particulate data, gross beta analyses, monthly averages, minima and maxima, (continued)

July

Location	Average	Minima	Maxima
Indicators	0.015	0.011	0.019
K-1f	0.017	0.013	0.019
K-8	0.014	0.011	0.017
K-43	0.015	0.014	0.015
Controls	0.018	0.014	0.020
K-2	0.018	0.014	0.020

August

Location	Average	Minima	Maxima
Indicators	0.019	0.016	0.024
K-1f	0.018	0.016	0.019
K-8	0.018	0.016	0.021
K-43	0.020	0.017	0.024
Controls	0.018	0.015	0.021
K-2	0.018	0.015	0.021

September

Location	Average	Minima	Maxima
Indicators	0.023	0.012	0.042
K-1f	0.023	0.013	0.038
K-8	0.023	0.012	0.041
K-43	0.024	0.015	0.042
Controls	0.023	0.013	0.039
K-2	0.023	0.013	0.039

October

Location	Average	Minima	Maxima
Indicators	0.019	0.008	0.028
K-1f	0.018	0.008	0.025
K-8	0.019	0.009	0.028
K-43	0.020	0.011	0.024
Controls	0.024	0.013	0.032
K-2	0.024	0.013	0.032

November

Location	Average	Minima	Maxima
Indicators	0.023	0.014	0.036
K-1f	0.023	0.015	0.030
K-8	0.023	0.017	0.033
K-43	0.024	0.014	0.036
Controls	0.024	0.015	0.035
K-2	0.024	0.015	0.035

December

Location	Average	Minima	Maxima
Indicators	0.025	0.016	0.034
K-1f	0.024	0.016	0.029
K-8	0.025	0.017	0.034
K-43	0.025	0.016	0.032
Controls	0.025	0.018	0.031
K-2	0.025	0.018	0.031

Note: Samples collected on the first, second or third day of the month are grouped with data of the previous month.

Table 9. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes.

	Sample Description and Concentration (pCi/m^3)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Indicator				
K-1f				
Lab Code	L100154-1	L101465-1	L102824-1	L103912-1
Volume (m^3)	3932	3888	3969	3972
Be-7	0.158 ± 0.075	0.244 ± 0.051	0.248 ± 0.060	0.122 ± 0.047
Nb-95	< 0.0091	< 0.0043	< 0.0056	< 0.0096
Zr-95	< 0.0142	< 0.0102	< 0.0099	< 0.0139
Ru-103	< 0.0183	< 0.0087	< 0.0116	< 0.0156
Ru-106	< 0.0286	< 0.0172	< 0.0189	< 0.0229
Cs-134	< 0.0030	< 0.0023	< 0.0018	< 0.0030
Cs-137	< 0.0023	< 0.0016	< 0.0024	< 0.0022
Ce-141	< 0.0291	< 0.0176	< 0.0185	< 0.0294
Ce-144	< 0.0188	< 0.0080	< 0.0097	< 0.0150
K-8				
Lab Code	L100154-3	L101465-3	L102824-3	L103912-3
Volume (m^3)	3932	3841	3960	3921
Be-7	0.177 ± 0.049	0.263 ± 0.057	0.224 ± 0.058	0.141 ± 0.042
Nb-95	< 0.0377	< 0.0034	< 0.0071	< 0.0046
Zr-95	< 0.0090	< 0.0065	< 0.0094	< 0.0083
Ru-103	< 0.0100	< 0.0057	< 0.0101	< 0.0092
Ru-106	< 0.0198	< 0.0121	< 0.0165	< 0.0179
Cs-134	< 0.0026	< 0.0015	< 0.0026	< 0.0017
Cs-137	< 0.0019	< 0.0013	< 0.0017	< 0.0014
Ce-141	< 0.0172	< 0.0109	< 0.0204	< 0.0165
Ce-144	< 0.0086	< 0.0060	< 0.0099	< 0.0088

Table 9. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, (continued).

	Sample Description and Concentration (pCi/m^3)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Indicator				
K-43				
Lab Code	L100154-2	L101465-2	L102824-2	L103912-2
Volume (m^3)	3752	3888	3963	3976
Be-7	0.132 ± 0.063	0.219 ± 0.051	0.209 ± 0.054	0.180 ± 0.046
Nb-95	< 0.0250	< 0.0055	< 0.0071	< 0.0046
Zr-95	< 0.0071	< 0.0100	< 0.0103	< 0.0098
Ru-103	< 0.0104	< 0.0105	< 0.0105	< 0.0099
Ru-106	< 0.0206	< 0.0019	< 0.0249	< 0.0169
Cs-134	< 0.0024	< 0.0019	< 0.0028	< 0.0022
Cs-137	< 0.0018	< 0.0020	< 0.0019	< 0.0023
Ce-141	< 0.0212	< 0.0190	< 0.0172	< 0.0178
Ce-144	< 0.0096	< 0.0093	< 0.0095	< 0.0089
Control				
K-2				
Lab Code	L100154-4	L101465-4	L102824-4	L103912-4
Volume (m^3)	3932	3889	3969	3674
Be-7	0.168 ± 0.057	0.249 ± 0.080	0.206 ± 0.066	0.098 ± 0.058
Nb-95	< 0.0301	< 0.0087	< 0.0047	< 0.0057
Zr-95	< 0.0020	< 0.0162	< 0.0095	< 0.0115
Ru-103	< 0.0097	< 0.0183	< 0.0110	< 0.0103
Ru-106	< 0.0184	< 0.0334	< 0.0163	< 0.0236
Cs-134	< 0.0020	< 0.0036	< 0.0026	< 0.0024
Cs-137	< 0.0014	< 0.0033	< 0.0015	< 0.0019
Ce-141	< 0.0137	< 0.0255	< 0.0150	< 0.0212
Ce-144	< 0.0082	< 0.0125	< 0.0090	< 0.0104

Table 10. Ambient gamma radiation (TLD), quarterly exposure.

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	
Date Placed	01-02-23	04-03-23	07-05-23	10-02-23	
Date Removed	04-03-23	07-05-23	10-02-23	01-02-24	
	mR/Qtr				
Indicator					Mean±s.d.
K-1f	13.7	12.5	12.4	14.6	13.3 ± 1.0
K-3	14.0	13.6	14.5	16.6	14.7 ± 1.3
K-5	13.7	14.5	12.7	15.8	14.2 ± 1.3
K-8	14.3	14.6	15.8	16.3	15.2 ± 1.0
K-17	13.6	16.1	15.7	19.1	16.1 ± 2.3
K-25	14.6	14.8	14.9	18.9	15.8 ± 2.1
K-27	14.5	14.2	14.6	17.8	15.3 ± 1.7
K-30	13.2	13.1	15.4	14.4	14.1 ± 1.1
K-39	15.7	15.1	16.3	18.3	16.4 ± 1.4
K-43	13.1	13.1	15.0	15.6	14.2 ± 1.3
Mean ± s.d.	14.1 ± 0.8	14.2 ± 1.1	14.7 ± 1.3	16.7 ± 1.7	14.9 ± 1
Control					
K-2	13.5	14.8	14.3	16.5	14.8 ± 1.3

Inside the Protected Area

					Mean±s.d.
K-1m	103.5	96.6	100.9	111.6	103.2 ± 6.3
K-1o	93.6	92.2	82.8	89.8	89.6 ± 4.8
K-1q	18.6	18.0	18.7	19.6	18.7 ± 0.7
K-1r	14.9	13.4	14.1	16.1	14.6 ± 1.2
Mean ± s.d.	57.7 ± 47.4	55.1 ± 45.5	54.1 ± 44.2	59.3 ± 48.7	56.6 ± 2.4

Table 11. Well water, analyses for gross alpha, gross beta, tritium, strontium-90 and gamma-emitting isotopes.

Collection: Quarterly.

Sample Description and Concentration (pCi/L)				
Indicator				
K-1h				
Date Collected	01-02-23	04-03-23	07-05-23	10-02-23
Lab Code	L98995-1	L100076-1	L101328-1	L102674-1
Gross alpha	< 1.5	< 1.7	< 1.7	< 3.9
Gross beta	5.2 ± 3.3	5.7 ± 3.5	5.6 ± 3.9	7.6 ± 5.1
H-3	< 178	< 180	< 189	< 182
Sr-90	< 2.5	< 1.0	< 2.8	< 0.6
K-40	< 115	< 58.9	< 128	< 126
Mn-54	< 7.0	< 5.8	< 7.0	< 8.2
Fe-59	< 14.5	< 15.6	< 14.7	< 19.2
Co-58	< 7.4	< 7.6	< 7.0	< 9.2
Co-60	< 6.5	< 9.0	< 7.9	< 8.3
Zn-65	< 15.7	< 12.9	< 16.4	< 13.3
Zr-Nb-95	< 6.6	< 7.9	< 9.1	< 9.6
Cs-134	< 8.3	< 9.1	< 8.8	< 9.5
Cs-137	< 6.8	< 7.0	< 6.9	< 7.6
Ba-La-140	< 6.4	< 7.4	< 11.9	< 15.7
K-1t / K-1v [a]	K-1t	K-1t	K-1t	K-1v
Date Collected	01-02-23	04-03-23	07-05-23	10-02-23
Lab Code	L98995-2	L100076-2	L101328-2	L102674-2
Gross alpha	< 2.7	2.3 ± 2.1	< 2.1	< 3.6
Gross beta	6.6 ± 4.0	4.9 ± 3.2	6.8 ± 4.4	11.1 ± 6.5
H-3	< 173	< 179	< 185	< 188
K-40	< 127	< 138	< 109	< 122
Mn-54	< 7.4	< 6.9	< 6.0	< 7.4
Fe-59	< 14.1	< 12.6	< 10.6	< 15.2
Co-58	< 5.4	< 8.0	< 5.4	< 6.6
Co-60	< 8.2	< 8.1	< 6.3	< 7.9
Zn-65	< 16.3	< 12.1	< 12.0	< 18.4
Zr-Nb-95	< 5.5	< 7.6	< 7.6	< 6.7
Cs-134	< 9.2	< 3.7	< 6.2	< 8.3
Cs-137	< 7.5	< 6.9	< 6.4	< 7.5
Ba-La-140	< 7.4	< 11.7	< 11.4	< 13.4

[a] Sampling discontinued at location K-1t afer 7/5/23; sampling initiated at location K-1v on 10/2/23.

Table 11. Well water, analyses for gross alpha, gross beta, tritium, strontium-90 and gamma-emitting isotopes (continued).

Collection: Quarterly.

Sample Description and Concentration (pCi/L)				
Indicator				
K-1u				
Date Collected	01-02-23	04-03-23	07-05-23	10-02-23
Lab Code	L98995-3	L100076-3	L101328-3	L102674-3
Gross alpha	< 1.3	< 3.0	< 1.6	< 3.9
Gross beta	3.3 ± 2.4	6.3 ± 4.0	4.6 ± 3.4	4.6 ± 3.0
H-3	< 169	< 176	< 177	< 184
K-40	< 152	< 151	< 142	< 140
Mn-54	< 5.8	< 6.5	< 7.5	< 6.9
Fe-59	< 14.8	< 14.6	< 12.7	< 15.0
Co-58	< 7.4	< 6.3	< 4.9	< 7.8
Co-60	< 8.3	< 7.9	< 8.2	< 8.4
Zn-65	< 15.1	< 14.6	< 15.9	< 13.9
Zr-Nb-95	< 5.8	< 8.1	< 7.6	< 8.9
Cs-134	< 8.3	< 9.9	< 7.2	< 7.8
Cs-137	< 7.2	< 8.2	< 8.1	< 6.9
Ba-La-140	< 10.5	< 10.9	< 11.5	< 12.6
Control				
K-13				
Date Collected	01-03-23	04-03-23	07-05-23	10-02-23
Lab Code	L98995-4	L-100076-4	L101328-4	L102674-4
Gross beta	< 2.1	< 2.6	< 2.9	< 3.1
H-3	< 181	< 183	< 184	< 183
K-40	< 170	< 104	< 91.1	< 148
Mn-54	< 7.8	< 7.7	< 5.4	< 8.3
Fe-59	< 15.8	< 17.7	< 15.8	< 20.1
Co-58	< 5.4	< 6.1	< 8.0	< 8.0
Co-60	< 7.1	< 6.9	< 9.1	< 9.1
Zn-65	< 13.0	< 12.3	< 14.0	< 18.3
Zr-Nb-95	< 8.4	< 8.4	< 8.2	< 8.6
Cs-134	< 8.0	< 8.4	< 7.6	< 7.3
Cs-137	< 8.2	< 7.1	< 7.5	< 9.2
Ba-La-140	< 8.5	< 4.9	< 12.2	< 13.9

Table 12. Broadleaf vegetation samples, analyses for gamma-emitting isotopes. Annual collection.

Sample Description and Concentration (pCi/g wet)		
	Indicator	
Location	K-23a	K-23b
Date Collected	08-01-23	08-01-23
Lab Code	L101812-1	L101812-2
Type	Broad leaf veg.	Broad leaf veg.
Be-7	2.17 ± 0.51	2.50 ± 0.58
K-40	4.12 ± 0.96	3.33 ± 0.80
Nb-95	< 0.044	< 0.039
Zr-95	< 0.058	< 0.076
Ru-103	< 0.048	< 0.051
Ru-106	< 0.454	< 0.412
Cs-134	< 0.055	< 0.048
Cs-137	< 0.056	< 0.044
Ce-141	< 0.064	< 0.078
Ce-144	< 0.257	< 0.296
	Control	
Location	K-26	
Date Collected	09-06-23	
Lab Code	L102314-1	
Type	Broad leaf veg.	
Be-7	< 0.13	
K-40	1.78 ± 0.28	
Nb-95	< 0.016	
Zr-95	< 0.026	
Ru-103	< 0.015	
Ru-106	< 0.129	
Cs-134	< 0.018	
Cs-137	< 0.015	
Ce-141	< 0.029	
Ce-144	< 0.104	

Table 13. Cattlefeed, analyses for gross beta, strontium-90, and gamma-emitting isotopes.
Collection: First Quarter

	Sample Description and Concentration (pCi/g wet)			
	Control			
Location	K-3	K-35	K-3	K-35
Date Collected	01-02-23	01-02-23	01-02-23	01-02-23
Lab Code	L99007-1	L99007-4	L99006-1	L99006-4
Type	Hay	Haylage	Silage	Silage
Gross beta	13.80 ± 6.23	11.90 ± 5.39	5.04 ± 2.28	5.16 ± 2.33
Sr-90	0.010 ± 0.007	0.017 ± 0.012	< 0.003	0.003 ± 0.003
Be-7	< 0.607	< 0.254	< 0.110	< 0.19
K-40	7.63 ± 1.13	5.48 ± 0.65	3.66 ± 0.33	2.27 ± 0.39
Nb-95	< 0.055	< 0.024	< 0.009	< 0.020
Zr-95	< 0.083	< 0.037	< 0.019	< 0.020
Ru-103	< 0.047	< 0.022	< 0.009	< 0.019
Ru-106	< 0.433	< 0.193	< 0.098	< 0.155
Cs-134	< 0.055	< 0.030	< 0.012	< 0.019
Cs-137	< 0.049	< 0.027	< 0.012	< 0.020
Ce-141	< 0.086	< 0.026	< 0.015	< 0.028
Ce-144	< 0.339	< 0.114	< 0.078	< 0.115
	Indicator			
Location	K-5 / K-39	K-34	K-38	K-5 / K-39
Date Collected	01-02-23	01-02-23	01-02-23	01-02-23
Lab Code	L99007-2	L99007-3	L99007-5	L99006-2
Type	Hay	Haylage	Hay	Silage
Gross beta	11.60 ± 5.26	12.10 ± 5.48	5.30 ± 2.40	9.99 ± 4.52
Sr-90	< 0.003	0.010 ± 0.007	< 0.003	< 0.003
Be-7	0.25 ± 0.19	0.48 ± 0.19	0.55 ± 0.17	0.27 ± 0.25
K-40	10.40 ± 0.79	9.07 ± 0.71	4.03 ± 0.57	2.27 ± 0.25
Nb-95	< 0.021	< 0.019	< 0.019	< 0.011
Zr-95	< 0.038	< 0.038	< 0.034	< 0.017
Ru-103	< 0.020	< 0.019	< 0.022	< 0.010
Ru-106	< 0.203	< 0.132	< 0.186	< 0.009
Cs-134	< 0.027	< 0.022	< 0.025	< 0.011
Cs-137	< 0.023	< 0.022	< 0.019	< 0.010
Ce-141	< 0.029	< 0.035	< 0.031	< 0.016
Ce-144	< 0.122	< 0.128	< 0.110	< 0.061

Table 13. Cattlefeed, analyses for gross beta, strontium-90, and gamma-emitting isotopes (continued).
Collection: First Quarter

	Sample Description and Concentration (pCi/g wet)	
	Indicator	
Location	K-34	K-38
Date Collected	01-02-23	01-02-23
Lab Code	L99006-3	L99006-5
Type	Silage	Silage
Gross beta	8.43 ± 3.81	22.9 ± 10.4
Sr-90	< 0.006	0.009 ± 0.006
Be-7	0.53 ± 0.22	< 0.35
K-40	3.59 ± 0.42	13.1 ± 1.3
Nb-95	< 0.019	< 0.050
Zr-95	< 0.039	< 0.084
Ru-103	< 0.022	< 0.043
Ru-106	< 0.197	< 0.362
Cs-134	< 0.020	< 0.048
Cs-137	< 0.021	< 0.048
Ce-141	< 0.037	< 0.065
Ce-144	< 0.151	< 0.265

Table 14. Grass, analyses for gross beta, strontium-90, and gamma-emitting isotopes.
Collection: Quarterly, April through December
Units: pCi/g wet

Sample Description and Concentration (pCi/g wet)				
	Indicator			
Location	K-1b	K-1f	K-5	K-34
Date Collected	06-01-23	06-01-23	06-01-23	06-01-23
Lab Code	L100858-1	L100858-2	L100858-4	L100858-5
Gross beta	9.73 ± 4.40	10.4 ± 4.7	12.0 ± 5.4	6.51 ± 2.95
Sr-90	< 0.004	< 0.004	< 0.004	< 0.004
Be-7	< 0.51	< 0.26	< 0.34	< 0.27
K-40	4.36 ± 0.92	3.31 ± 0.56	6.80 ± 0.98	4.53 ± 0.70
Mn-54	< 0.043	< 0.028	< 0.044	< 0.033
Co-58	< 0.040	< 0.030	< 0.039	< 0.026
Co-60	< 0.045	< 0.026	< 0.033	< 0.032
Nb-95	< 0.048	< 0.021	< 0.042	< 0.033
Zr-95	< 0.082	< 0.052	< 0.062	< 0.054
Ru-103	< 0.039	< 0.031	< 0.036	< 0.021
Ru-106	< 0.394	< 0.249	< 0.408	< 0.280
Cs-134	< 0.038	< 0.025	< 0.055	< 0.027
Cs-137	< 0.043	< 0.021	< 0.035	< 0.033
Ce-141	< 0.070	< 0.039	< 0.063	< 0.037
Ce-144	< 0.255	< 0.156	< 0.210	< 0.160
	Indicator		Control	
Location	K-38	K-39	K-3	K-35
Date Collected	06-01-23	06-01-23	06-01-23	06-01-23
Lab Code	L100858-7	L100858-8	L100858-3	L100858-6
Gross beta	11.2 ± 5.1	11.4 ± 5.2	11.3 ± 5.1	6.07 ± 2.75
Sr-90	< 0.005	< 0.004	< 0.003	< 0.004
Be-7	< 0.31	< 0.50	< 0.35	< 0.38
K-40	6.28 ± 0.89	8.19 ± 1.13	5.42 ± 0.84	3.23 ± 0.71
Mn-54	< 0.041	< 0.040	< 0.032	< 0.034
Co-58	< 0.033	< 0.055	< 0.036	< 0.038
Co-60	< 0.039	< 0.052	< 0.029	< 0.044
Nb-95	< 0.039	< 0.046	< 0.031	< 0.046
Zr-95	< 0.059	< 0.074	< 0.051	< 0.072
Ru-103	< 0.031	< 0.045	< 0.032	< 0.045
Ru-106	< 0.324	< 0.396	< 0.306	< 0.347
Cs-134	< 0.035	< 0.048	< 0.036	< 0.041
Cs-137	< 0.036	< 0.044	< 0.034	< 0.042
Ce-141	< 0.051	< 0.059	< 0.041	< 0.062
Ce-144	< 0.215	< 0.267	< 0.174	< 0.289

Table 14. Grass, analyses for gross beta, strontium-90, and gamma-emitting isotopes (continued).
Collection: Quarterly, April through December
Units: pCi/g wet

Sample Description and Concentration (pCi/g wet)				
	Indicator			
Location	K-1b	K-1f	K-5	K-34
Date Collected	08-01-23	08-01-23	08-01-23	08-01-23
Lab Code	L101810-1	L101810-2	L101810-4	L101810-5
Gross beta	5.19 ± 2.35	1.01 ± 4.58	7.43 ± 3.36	7.95 ± 3.60
Sr-90	< 0.004	< 0.004	< 0.005	< 0.005
Be-7	3.30 ± 0.67	1.10 ± 0.43	2.80 ± 0.59	2.80 ± 0.50
K-40	5.10 ± 1.17	5.13 ± 0.89	4.78 ± 0.79	4.70 ± 0.80
Mn-54	< 0.048	< 0.048	< 0.045	< 0.050
Co-58	< 0.037	< 0.041	< 0.042	< 0.048
Co-60	< 0.054	< 0.049	< 0.059	< 0.052
Nb-95	< 0.053	< 0.048	< 0.047	< 0.054
Zr-95	< 0.095	< 0.089	< 0.089	< 0.088
Ru-103	< 0.056	< 0.056	< 0.056	< 0.042
Ru-106	< 0.440	< 0.388	< 0.449	< 0.441
Cs-134	< 0.047	< 0.055	< 0.042	< 0.053
Cs-137	< 0.057	< 0.049	< 0.045	< 0.056
Ce-141	< 0.074	< 0.080	< 0.088	< 0.061
Ce-144	< 0.255	< 0.262	< 0.332	< 0.260
	Indicator		Control	
Location	K-38	K-39	K-3	K-35
Date Collected	08-01-23	08-01-23	08-01-23	08-01-23
Lab Code	L101810-7	L101810-8	L101810-3	L101810-6
Gross beta	7.94 ± 3.59	8.84 ± 4.00	9.44 ± 4.27	8.21 ± 3.71
Sr-90	< 0.005	< 0.004	< 0.004	< 0.005
Be-7	1.78 ± 0.46	1.45 ± 0.41	1.00 ± 0.33	2.62 ± 0.57
K-40	7.14 ± 1.04	3.16 ± 0.68	6.48 ± 0.92	4.87 ± 1.18
Mn-54	< 0.045	< 0.035	< 0.031	< 0.051
Co-58	< 0.063	< 0.035	< 0.039	< 0.053
Co-60	< 0.056	< 0.092	< 0.042	< 0.030
Nb-95	< 0.046	< 0.039	< 0.041	< 0.054
Zr-95	< 0.078	< 0.055	< 0.080	< 0.106
Ru-103	< 0.048	< 0.038	< 0.046	< 0.048
Ru-106	< 0.409	< 0.370	< 0.338	< 0.457
Cs-134	< 0.051	< 0.040	< 0.048	< 0.044
Cs-137	< 0.054	< 0.040	< 0.035	< 0.056
Ce-141	< 0.076	< 0.061	< 0.063	< 0.075
Ce-144	< 0.317	< 0.226	< 0.231	< 0.236

Table 14. Grass, analyses for gross beta, strontium-90, and gamma-emitting isotopes (continued).
Collection: Quarterly, April through December
Units: pCi/g wet

Sample Description and Concentration (pCi/g wet)				
	Indicator			
Location	K-1b	K-1f	K-5	K-34
Date Collected	10-02-23	10-02-23	10-02-23	10-02-23
Lab Code	L102673-1	L102673-2	L102673-4	L102673-5
Gross beta	9.63 ± 4.37	9.99 ± 4.54	10.60 ± 4.78	13.60 ± 6.15
Sr-90	< 0.003	< 0.004	0.005 ± 0.004	< 0.004
Be-7	1.94 ± 0.46	1.06 ± 0.37	1.45 ± 0.31	1.54 ± 0.45
K-40	5.63 ± 0.75	6.56 ± 0.94	5.27 ± 0.68	8.09 ± 1.09
Mn-54	< 0.034	< 0.051	< 0.025	< 0.046
Co-58	< 0.036	< 0.040	< 0.027	< 0.051
Co-60	< 0.045	< 0.043	< 0.031	< 0.046
Nb-95	< 0.032	< 0.048	< 0.033	< 0.045
Zr-95	< 0.068	< 0.070	< 0.053	< 0.090
Ru-103	< 0.038	< 0.043	< 0.026	< 0.046
Ru-106	< 0.297	< 0.345	< 0.236	< 0.414
Cs-134	< 0.034	< 0.054	< 0.030	< 0.054
Cs-137	< 0.036	< 0.043	< 0.028	< 0.046
Ce-141	< 0.056	< 0.063	< 0.039	< 0.069
Ce-144	< 0.218	< 0.247	< 0.156	< 0.280
	Indicator		Control	
Location	K-38	K-39	K-3	K-35
Date Collected	10-02-23	10-02-33	10-02-23	10-02-23
Lab Code	L102673-7	L102673-8	L102673-3	L102673-6
Gross beta	14.50 ± 6.57	4.61 ± 2.11	10.90 ± 4.91	11.90 ± 5.40
Sr-90	0.017 ± 0.012	< 0.004	< 0.005	< 0.003
Be-7	1.12 ± 0.27	1.47 ± 0.29	0.63 ± 0.29	3.57 ± 0.56
K-40	7.82 ± 0.75	5.70 ± 0.66	6.56 ± 0.58	4.47 ± 0.69
Mn-54	< 0.033	< 0.030	< 0.027	< 0.041
Co-58	< 0.030	< 0.026	< 0.026	< 0.040
Co-60	< 0.036	< 0.033	< 0.030	< 0.038
Nb-95	< 0.033	< 0.035	< 0.030	< 0.048
Zr-95	< 0.057	< 0.056	< 0.049	< 0.074
Ru-103	< 0.031	< 0.028	< 0.029	< 0.043
Ru-106	< 0.275	< 0.242	< 0.256	< 0.351
Cs-134	< 0.040	< 0.036	< 0.030	< 0.045
Cs-137	< 0.034	< 0.030	< 0.033	< 0.037
Ce-141	< 0.043	< 0.042	< 0.049	< 0.065
Ce-144	< 0.173	< 0.152	< 0.194	< 0.263

Table 15. Soil samples, analyses for gross alpha, gross beta, strontium-90, and gamma-emitting isotopes.
Collection: Semiannually

Sample Description and Concentration (pCi/g dry)

	Indicator		
Location	K-1f	K-34	K-38
Date Collected	05-01-23	05-01-23	05-01-23
Lab Code	L100430-1	L100430-3	L100430-5
Gross alpha	5.06 ± 3.22	4.90 ± 3.47	3.00 ± 2.51
Gross beta	31.2 ± 14.3	21.9 ± 10.2	38.9 ± 17.8
Sr-90	< 0.059	< 0.062	< 0.061
Be-7	< 0.56	< 0.42	< 0.71
K-40	17.7 ± 1.9	15.6 ± 1.7	20.5 ± 1.9
Nb-95	< 0.077	< 0.051	< 0.100
Zr-95	< 0.101	< 0.100	< 0.156
Ru-103	< 0.066	< 0.048	< 0.093
Ru-106	< 0.602	< 0.431	< 0.822
Cs-134	< 0.103	< 0.070	< 0.102
Cs-137	< 0.110	< 0.063	< 0.096
Ce-141	< 0.099	< 0.063	< 0.133
Ce-144	< 0.360	< 0.241	< 0.496
Date Collected	10-02-23	10-02-23	10-02-23
Lab Code	L102672-1	L102672-3	L102672-5
Gross alpha	2.64 ± 2.50	4.51 ± 3.34	8.27 ± 4.95
Gross beta	39.40 ± 18.00	28.30 ± 13.10	33.90 ± 15.50
Sr-90	< 0.063	< 0.053	< 0.042
Be-7	< 0.76	< 0.61	< 0.73
K-40	21.40 ± 2.35	15.60 ± 2.08	21.10 ± 2.50
Nb-95	< 0.236	< 0.084	< 0.116
Zr-95	< 0.167	< 0.108	< 0.191
Ru-103	< 0.083	< 0.075	< 0.094
Ru-106	< 0.699	< 0.699	< 0.808
Cs-134	< 0.094	< 0.096	< 0.116
Cs-137	0.13 ± 0.10	< 0.100	< 0.12
Ce-141	< 0.102	< 0.091	< 0.166
Ce-144	< 0.413	< 0.332	< 0.581

Table 15. Soil samples, analyses for gross alpha, gross beta, strontium-90, and gamma-emitting isotopes (continued).
Collection: Semiannually

Sample Description and Concentration (pCi/g dry)

	Control	
Location	K-3	K-35
Date Collected	05-01-23	05-01-23
Lab Code	L100430-2	L100430-4
Gross alpha	< 2.17	2.80 ± 2.56
Gross beta	23.6 ± 10.9	21.4 ± 9.9
Sr-90	< 0.056	< 0.056
Be-7	< 0.55	< 0.56
K-40	20.1 ± 1.9	10.9 ± 1.5
Nb-95	< 0.086	< 0.056
Zr-95	< 0.133	< 0.138
Ru-103	< 0.071	< 0.052
Ru-106	< 0.564	< 0.617
Cs-134	< 0.087	< 0.078
Cs-137	< 0.116	< 0.079
Ce-141	< 0.101	< 0.080
Ce-144	< 0.373	< 0.316
Date Collected	10-02-23	10-02-23
Lab Code	L102672-2	L102672-4
Gross alpha	4.19 ± 3.10	< 2.15
Gross beta	28.50 ± 13.10	17.60 ± 8.22
Sr-90	0.145 ± 0.108	< 0.057
Be-7	< 0.60	< 0.54
K-40	22.90 ± 22.60	12.20 ± 1.54
Nb-95	< 0.098	< 0.062
Zr-95	< 0.162	< 0.111
Ru-103	< 0.092	< 0.059
Ru-106	< 0.519	< 0.538
Cs-134	< 0.109	< 0.073
Cs-137	< 0.08	< 0.093
Ce-141	< 0.129	< 0.097
Ce-144	< 0.472	< 0.294

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

Collection: Quarterly

	Sample Description and Concentration (pCi/L)		
Indicator			
K-1b			
Date Collected	03-01-23	06-01-23	08-01-23
Lab Code	L99716-1	L100855-1	L101809-1
Gross beta			
Suspended Solids	1.7 ± 1.3	< 1.4	< 1.4
Dissolved Solids	6.4 ± 3.5	2.6 ± 1.7	4.3 ± 2.5
Total Residue	6.8 ± 4.1	2.5 ± 2.1	7.4 ± 4.4
K-40	< 105.0	< 103.0	< 108.0
Mn-54	< 6.5	< 7.4	< 4.4
Fe-59	< 9.4	< 15.3	< 13.2
Co-58	< 5.3	< 6.9	< 5.4
Co-60	< 5.1	< 7.3	< 6.4
Zn-65	< 12.3	< 11.6	< 9.7
Zr-Nb-95	< 5.6	< 7.1	< 6.7
Cs-134	< 5.0	< 7.5	< 6.3
Cs-137	< 5.1	< 8.4	< 5.4
Ba-La-140	< 9.1	< 16.7	< 10.3
K-1d			
Date Collected	03-01-23	06-01-23	08-01-23
Lab Code	L99716-2	L100855-2	L101809-2
Gross beta			
Suspended Solids	< 1.4	< 1.5	< 1.4
Dissolved Solids	2.2 ± 1.4	1.7 ± 1.2	2.0 ± 1.3
Total Residue	3.1 ± 2.2	3.0 ± 2.2	< 2.2
K-40	< 114.0	133.0 ± 78.6	< 129.0
Mn-54	< 4.6	< 5.6	< 7.1
Fe-59	< 12.7	< 7.7	< 15.5
Co-58	< 5.5	< 5.9	< 6.4
Co-60	< 8.0	< 10.0	< 5.9
Zn-65	< 13.4	< 12.2	< 11.5
Zr-Nb-95	< 6.1	< 4.8	< 6.4
Cs-134	< 6.2	< 7.7	< 10.6
Cs-137	< 6.0	< 8.0	< 6.2
Ba-La-140	< 12.2	< 13.4	< 4.6

Table 16. Surface water samples, analyses for gross beta and gamma-emitting isotopes (continued).

Collection: Quarterly

	Sample Description and Concentration (pCi/L)
Indicator	
K-1b	
Date Collected	11-01-23
Lab Code	L103110-1
Gross beta	
Suspended Solids	< 1.5
Dissolved Solids	6.4 ± 3.5
Total Residue	7.3 ± 4.5
K-40	< 92.4
Mn-54	< 5.3
Fe-59	< 10.7
Co-58	< 6.5
Co-60	< 5.4
Zn-65	< 12.9
Zr-Nb-95	< 5.7
Cs-134	< 6.3
Cs-137	< 5.9
Ba-La-140	< 10.2
K-1d	
Date Collected	11-01-23
Lab Code	L103110-2
Gross beta	
Suspended Solids	< 1.5
Dissolved Solids	1.9 ± 1.2
Total Residue	< 2.5
K-40	< 118.0
Mn-54	< 5.7
Fe-59	< 16.9
Co-58	< 5.4
Co-60	< 6.1
Zn-65	< 10.2
Zr-Nb-95	< 7.2
Cs-134	< 7.7
Cs-137	< 6.7
Ba-La-140	< 10.7

Table 16. Surface water samples, analyses for gross beta and gamma-emitting isotopes (continued).

Collection: Quarterly

Sample Description and Concentration (pCi/L)			
Indicator			
K-1e			
Date Collected	03-01-23	06-01-23	08-01-23
Lab Code	L99716-3	L100855-3	L101809-3
Gross beta			
Suspended Solids	< 1.3	3.2 ± 2.0	< 1.4
Dissolved Solids	7.1 ± 3.9	4.0 ± 2.4	5.8 ± 3.3
Total Residue	6.9 ± 4.2	< 3.5	4.9 ± 3.4
K-40	< 92.9	< 120.0	< 89.7
Mn-54	< 4.9	< 5.5	< 5.1
Fe-59	< 11.6	< 12.4	< 12.0
Co-58	< 5.8	< 8.1	< 4.5
Co-60	< 7.8	< 5.8	< 4.5
Zn-65	< 14.7	< 15.8	< 9.7
Zr-Nb-95	< 6.5	< 8.2	< 4.9
Cs-134	< 5.0	< 5.6	< 9.3
Cs-137	< 5.8	< 7.9	< 4.6
Ba-La-140	< 9.1	< 10.3	< 10.7

Date Collected	11-01-23
Lab Code	L103110-3
Gross beta	
Suspended Solids	< 1.5
Dissolved Solids	5.3 ± 3.0
Total Residue	6.1 ± 4.0
K-40	< 126.0
Mn-54	< 6.5
Fe-59	< 12.1
Co-58	< 5.8
Co-60	< 6.1
Zn-65	< 12.8
Zr-Nb-95	< 5.5
Cs-134	< 7.0
Cs-137	< 6.5
Ba-La-140	< 13.4

Table 16. Surface water samples, analyses for gross beta and gamma-emitting isotopes (continued).

Collection: Quarterly

Sample Description and Concentration (pCi/L)			
Control			
K-9 (Raw)			
Date Collected	03-01-23	06-01-23	08-01-23
Lab Code	L99716-4	L100855-4	L101809-4
Gross beta			
Suspended Solids	< 1.3	2.3 ± 1.6	< 1.4
Dissolved Solids	1.3 ± 1.0	2.8 ± 1.7	1.7 ± 1.2
Total Residue	< 2.0	< 2.1	3.1 ± 2.3
K-40	< 121.0	< 101.0	< 128.0
Mn-54	< 6.0	< 5.1	< 6.5
Fe-59	< 11.7	< 7.9	< 11.9
Co-58	< 6.1	< 5.3	< 5.9
Co-60	< 5.7	< 8.4	< 7.0
Zn-65	< 14.1	< 11.7	< 14.6
Zr-Nb-95	< 5.4	< 6.0	< 6.2
Cs-134	< 5.7	< 7.0	< 6.8
Cs-137	< 6.6	< 5.9	< 7.8
Ba-La-140	< 9.8	< 14.9	< 9.4
K-9 (Tap)			
Date Collected	03-01-23	06-01-23	08-01-23
Lab Code	L99716-5	L100855-5	L101809-5
Gross beta			
Suspended Solids	< 1.3	1.9 ± 1.4	< 1.4
Dissolved Solids	2.7 ± 1.8	1.9 ± 1.3	2.6 ± 1.6
Total Residue	2.2 ± 1.8	< 2.1	3.3 ± 2.3
K-40	< 128.0	< 137.0	< 120.0
Mn-54	< 6.2	< 5.4	< 6.7
Fe-59	< 13.4	< 14.6	< 14.9
Co-58	< 6.2	< 7.0	< 6.3
Co-60	< 6.8	< 6.8	< 6.9
Zn-65	< 10.9	< 13.9	< 14.3
Zr-Nb-95	< 6.2	< 6.9	< 6.9
Cs-134	< 5.1	< 7.1	< 8.3
Cs-137	< 6.1	< 7.4	< 6.1
Ba-La-140	< 7.5	< 13.2	< 9.8

Table 16. Surface water samples, analyses for gross beta, potassium-40, and gamma-emitting isotopes (continued).
Collection: Quarterly

	Sample Description and Concentration (pCi/L)
Control	
K-9 (Raw)	
Date Collected	11-01-23
Lab Code	L103110-4
Gross beta	
Suspended Solids	< 1.5
Dissolved Solids	1.9 ± 1.2
Total Residue	< 2.4
K-40	< 138.0
Mn-54	< 6.0
Fe-59	< 11.9
Co-58	< 5.7
Co-60	< 6.4
Zn-65	< 13.6
Zr-Nb-95	< 6.3
Cs-134	< 5.8
Cs-137	< 7.1
Ba-La-140	< 8.3
K-9 (Tap)	
Date Collected	11-01-23
Lab Code	L103110-5
Gross beta	
Suspended Solids	< 1.5
Dissolved Solids	2.4 ± 1.4
Total Residue	< 2.3
K-40	< 101.0
Mn-54	< 7.1
Fe-59	< 17.0
Co-58	< 5.7
Co-60	< 5.1
Zn-65	< 14.4
Zr-Nb-95	< 5.2
Cs-134	< 5.0
Cs-137	< 6.2
Ba-La-140	< 7.4

Table 17. Surface water, analyses for tritium and strontium-90.

Location and Collection Date	Lab Code		Concentration pCi/L H-3	Concentration pCi/L Sr-90
Indicator				
K-1b				
3/1/2023	L99716-1		< 179	< 1.6
6/1/2023	L100855-1		< 192	< 2.8
8/1/2023	L101809-1		< 184	< 2.0
11/1/2023	L103110-1		< 194	< 2.0
K-1d				
3/1/2023	L99716-2		< 178	< 3.4
6/1/2023	L100855-2		< 194	< 4.6
8/1/2023	L101809-2		< 183	< 2.7
11/1/2023	L103110-2		< 193	< 4.2
K-1e				
3/1/2023	L99716-3		< 180	< 1.5
6/1/2023	L100855-3		< 193	< 2.1
8/1/2023	L101809-3		< 183	< 1.8
11/1/2023	L103110-3		< 194	< 2.6
Control				
K-9				
3/1/2023	L99716-4	(Raw)	< 194	< 2.2
3/1/2023	L99716-5	(Tap)	< 185	< 4.0
6/1/2023	L100855-4	(Raw)	< 192	< 2.5
6/1/2023	L100855-5	(Tap)	< 191	< 1.8
8/1/2023	L101809-4	(Raw)	< 185	< 2.4
8/1/2023	L101809-5	(Tap)	< 184	< 4.4
11/1/2023	L103110-4	(Raw)	< 197	< 4.1
11/1/2023	L103110-5	(Tap)	< 199	< 2.9

Table 18. Fish, collected at K-1d, analyses for gross beta, and strontium-90 and gamma-emitting isotopes.
Collection: Annually

	Sample Description and Concentration (pCi/g wet)	
Collected	07-30-23	
Lab Code	L102671-1	L102671-2
Type		
Portion	Flesh	Bones
Gross beta	6.12 ± 2.77	4.23 ± 1.93
Sr-90	NA[a]	< 0.06
K-40	3.27 ± 1.16	NA[a]
Mn-54	< 0.068	NA[a]
Fe-59	< 0.360	NA[a]
Co-58	< 0.121	NA[a]
Co-60	< 0.080	NA[a]
Cs-134	< 0.073	NA[a]
Cs-137	< 0.065	NA[a]

[a] NA = Not analyzed; analyses not required.

Table 19. Shoreline sediment samples, analyses for gross beta and strontium-90, and gamma-emitting isotopes.
Collection: May and November

	Sample Description and Concentration (pCi/g dry)		
	Indicator		Control
Location	K-1c	K-1j	K-9
Collection Date	05-01-23	05-01-23	05-01-23
Lab Code	L100429-1	L100429-2	L100429-3
Gross beta	7.85 ± 3.86	9.88 ± 4.80	15.9 ± 7.5
Sr-90	< 0.057	< 0.051	< 0.581
K-40	4.79 ± 0.88	5.38 ± 1.01	7.55 ± 1.02
Co-58	< 0.043	< 0.033	< 0.036
Co-60	< 0.057	< 0.051	< 0.046
Cs-134	< 0.044	< 0.044	< 0.044
Cs-137	< 0.050	< 0.046	< 0.046
Location	K-1c	K-1j	K-9
Collection Date	11-01-23	11-01-23	11-01-23
Lab Code	L103109-1	L103109-2	L103109-3
Gross beta	11.60 ± 5.56	11.80 ± 5.70	15.0 ± 7.1
Sr-90	< 0.065	< 0.068	< 0.062
K-40	8.55 ± 1.23	8.01 ± 1.40	8.71 ± 1.23
Co-58	< 0.044	< 0.052	< 0.054
Co-60	< 0.063	< 0.056	< 0.059
Cs-134	< 0.063	< 0.059	< 0.060
Cs-137	0.060	< 0.063	< 0.065

KEWAUNEE SOLUTIONS

2023 Annual Radiological Environmental Operating Report

Kewaunee Power Station
Part III, Corrective Actions written during reporting period

Print

CR_ID	2421
Short description	Environmental TLD dislodged from ISFSI perimeter fence.
Site	Kewaunee
Discovery Date/Time	3/5/2023 2:00 PM
Submitter	James D. Kruse-ext
Submitters Dept	15. Technical Support
Supervisor	Daniel J. Shannon-ext
Unit 1 Mode	DEF
Unit ISFSI?	No
Revision #	
Long Description	On 3/5/2023 at approximately 1400 a Security Officer identified Environmental TLD K-1M - ISFSI EAST (annual / quarterly) TLDs and mesh holder on the ground in the area that they were hanging on the fence. It is unknown how long the TLDs were on the ground.
Initial Actions	Security took possession of the TLDs, brought them to CAS and notified RP. RP walked the area down and noted two broken plastic tie wraps on the ground at location K-1M. On 3/6/2023 at 1300 the TLDs were re-hung and secured with metal cable ties. An extent of condition was performed and all other Environmental / State TLDs were found to be in satisfactory condition. As a precautionary measure, metal cable ties were added to all other TLD holders on the ISFSI fence.
Recom Actions:	Close CR to actions taken. The proximity of the TLDs were within a few feet of their original location and should not significantly affect read results. This CR will be added to the 2023 Annual Radiological Environmental Operating report.

additional Contacts

Tag #:

Equipment Location	NA
Equipment Description	NA
Plant System	NA
OP-AA-102 Review Reqd?	No
Operability Assesment	N/A
Operability Comments	NA
Functionality Assessment	N/A
Reportable Condition	No
Reportability Comments	NA
Is Equipment Important to Emergency Response WM-KW-100 values	No
O/R Comments	Close to actions taken
Significance (screening)	3
Potential Repeat (screening)	No
Previous Issue	No previous history identified
CRT Comments	CA965 (Kruse/Shannon) to add CR2421 to the 2023 Annual Radiological Environmental Operating report
Work Order #	
Comments	
Status	Pending

Content Type: Item
Version: 4.0
Created at 3/7/2023 10:45 AM by James D. Kruse-ext
Last modified at 3/8/2023 11:37 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

Title	Environmental TLD dislodged from ISFSI perimeter fence.
CA_ID	965
CR#	2421
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	Per Schedule
Due Date	5/2/2024
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	No
Manager	
Additional Reviewer	
Detailed Assignment	Add CR2421 to the 2023 Annual Radiological Environmental Operating report
Response	
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	
Comments	
Email Notification 1	
Email Notification 2	
Due date -6	4/26/2024
Status	Perform Action
CR#:Description (location)	NA
Location	NA
CR Short description	Environmental TLD dislodged from ISFSI perimeter fence.

Content Type: Item

Version: 2.0
Created at 3/8/2023 11:35 AM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 10/18/2023 10:13 AM by ☐ Rick Adams

Close

Print

CR_ID	2438
Short description	K-43 Environmental Air Sampler run hours was short by about 97 hours.
Site	Kewaunee
Discovery Date/Time	3/28/2023 10:13 AM
Submitter	Mark Peroutka-ext
Submitters Dept	14. Chemistry
Supervisor	Daniel J. Shannon-ext
Unit 1 Mode	DEF
Unit ISFSI?	No
Revision #	
Long Description	K-43 Environmental Air Sampler run time was short by about 97 hours. The sampler run time meter readout indicated that it ran for 68 hours and 6 min. The sampler should have recorded approximately 165 hour and 25 minutes of run time based on the time of the previous week's filter change. The sampler was running normally at the time it was changed out.
Initial Actions	Inspected air sampling unit and could not find any issues with the air sampler or the run time meter. After the meter was reset, ensured the run time meter was recording the time correctly. Called landowner where K-43 is located, and they stated that they did experience an electrical outage for a couple hours during the week.
Recom Actions:	Create CA for RP to include this CR in the annual radiological environmental operating report (AREOR).
additional Contacts	
Tag #:	
Equipment Location	
Equipment Description	
Plant System	

OP-AA-102 Review Reqd?	No
Operability Assesment	N/A
Operability Comments	
Functionality Assessment	N/A
Reportable Condition	No
Reportability Comments	
Is Equipment Important to Emergency Response WM-KW-100 values	No
O/R Comments	
Significance (screening)	3
Potential Repeat (screening)	Yes
Previous Issue	CR2314 Environmental air sampler found not running at location K-43
CRT Comments	CA986 (Kruse/Shannon) to include CR2438 in the annual radiological environmental operating report (AREOR).
Work Order #	
Comments	
Status	Pending

Content Type: Item
Version: 6.0
Created at 3/29/2023 12:38 PM by Mark Peroutka-ext
Last modified at 3/30/2023 6:58 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

Title	K-43 Environmental Air Sampler run hours was short by about 97 hours.
CA_ID	986
CR#	2438
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	Per Schedule
Due Date	5/2/2024
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	
Manager	
Additional Reviewer	
Detailed Assignment	Include CR2438 in the annual radiological environmental operating report (AREOR).
Response	
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	
Comments	
Email Notification 1	
Email Notification 2	
Due date -6	4/26/2024
Status	Perform Action
CR#:Description (location)	
Location	

CR Short description	K-43 Environmental Air Sampler run hours was short by about 97 hours.

Content Type: Item
Version: 2.0
Created at 3/29/2023 2:18 PM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 10/18/2023 10:14 AM by ☐ Rick Adams

Close

Print

CR_ID	2473
Short description	REMM Revision Request
Site	Kewaunee
Discovery Date/Time	5/25/2023 9:00 AM
Submitter	Daniel J. Shannon-ext
Submitters Dept	15. Technical Support
Supervisor	Darren J. Peterson
Unit 1 Mode	DEF
Unit ISFSI?	No
Revision #	

Long Description

In accordance with RP-KW-280, Revision and Control of the ODCM and REMM, this CR is submitted to request a revision to the Radiological Environmental Monitoring Manual (REMM). The following changes to the REMM are requested:

Section 3.6, Sample Descriptions, Ambient Radiation, revise this section as needed based on using Mirion Type 20 Environmental TLDs which replaced the use of ATI Environmental Inc. TLDs.

Section 3.6, Sample Descriptions, Well Water, add the new potable water supply well installed to support the trailer complex, and remove well K-1t (Gatehouse) which will be abandoned to support Phase 2 demolition.

Section 3.6, Sample Descriptions, Groundwater Monitoring Well Locations, change the number of wells from fourteen to thirteen, and delete "... and AB (Auxiliary Building)" because these wells are abandoned and no longer need to be labeled on Fig 2.

Tables 2.2.1-A, 2.2.1-B, and 2.2.1-C, add the new potable water supply well for the trailer complex (new location code K-1v) and remove the Gatehouse well (location K-1t).

Table Notation "c" to Table 2.2.1-A, revise as needed based on using Mirion Type 20 Environmental TLDs which replaced the use of ATI Environmental Inc. TLDs.

Figure 2, Well Locations, include the new deep and shallow monitoring well locations and delete the abandoned AB well locations; also add the new potable water supply well location and remove the Gatehouse well location.

Initial Actions	Reviewed REMM for changes needed due to recent changes to the Groundwater Monitoring Program, environmental TLDs, and potable water supply wells. Initiated CR to request the REMM revision as directed by RP-KW-280.
Recom Actions:	CA to RP (Shannon/Peterson) to revise REMM as requested in this CR. (10/19/23) CA to RP (Shannon/Peterson) to include a description of the changes made to the GWPP and a copy of this CR in the 2023 Annual Environmental Operating Report (AREOR). (5/23/24)
additional Contacts	
Tag #:	
Equipment Location	
Equipment Description	
Plant System	
OP-AA-102 Review Reqd?	No
Operability Assesment	N/A
Operability Comments	N/A
Functionality Assessment	N/A
Reportable Condition	No
Reportability Comments	N/A
Is Equipment Important to Emergency Response WM-KW-100 values	No
O/R Comments	
Significance (screening)	4
Potential Repeat (screening)	
Previous Issue	Tracking issue - no history required for Sig 4 issues
CRT Comments	CA1007 (Shannon/Peterson) to revise REMM as requested in CR2473. (10/19/23) CA1008 (Shannon/Peterson) to include a description of the changes made to the GWPP and a copy of CR2473 in the 2023 Annual Environmental Operating Report (AREOR). (5/2/24)
Work Order #	
Comments	Agree with actions.

Status Pending

Content Type: Item
Version: 5.0
Created at 5/25/2023 10:15 AM by Dan J Shannon (Dom Nuclear Projects, Inc - 4)
Last modified at 5/30/2023 7:56 AM by Timothy Olson-ext

Close

Print

Title	REMM Revision Request
CA_ID	1007
CR#	2473
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	N/A
Due Date	10/19/2023
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	
Manager	
Additional Reviewer	
Detailed Assignment	**Revise REMM as requested in CR2473**
Response	REMM Revision 25 was issued 10/12/23. This revision incorporated the changes recommended in CR2473 with the exception of Gatehouse Well K-1t location was maintained on Figure 2. Recommend closing to actions taken.
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	The action to update the REMM is completed and the Rev 25 was issued on 10/12/2023
Comments	DCAC review complete item may be closed with no further actions required. TPO 10/16/23
Email Notification 1	
Email Notification 2	
Due date -6	10/13/2023

Location

CR Short description REMM Revision Request

Content Type: Item
Version: 4.0
Created at 5/25/2023 2:07 PM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 11/1/2023 9:49 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

Title	REMM Revision Request
CA_ID	1008
CR#	2473
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	N/A
Due Date	5/2/2024
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	
Manager	
Additional Reviewer	
Detailed Assignment	**Include a description of the changes made to the GWPP and a copy of CR2473 in the 2023 Annual Environmental Operating Report (AREOR).**
Response	
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	
Comments	Changed priority to Per Schedule iaw PI-KW-200 Att E. TPO 10/16/23
Email Notification 1	
Email Notification 2	
Due date -6	4/26/2024
Status	Perform Action
CR#:Description (location)	

Status	Complete
CR#:Description (location)	
Location	
CR Short description	REMM Revision Request

Content Type: Item
Version: 5.0
Created at 5/25/2023 2:06 PM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 11/1/2023 9:49 AM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

CR_ID	2474
Short description	Environmental Air Sampler at Location K-8 Found Not Running
Site	Kewaunee
Discovery Date/Time	5/30/2023 11:30 AM
Submitter	☐ Dan J Shannon (Dom Nuclear Projects, Inc - 4)
Submitters Dept	15. Technical Support
Supervisor	☐ Darren J. Peterson
Unit 1 Mode	DEF
Unit ISFSI?	No
Revision #	
Long Description	During the weekly air sample filter change out, the environmental air sampler at location K-8 (St. Isadore the Farmer Church) was found not running. The air sampler run time meter reading was 142.36 (hours.min) which is about 26 hours less than the average weekly run time total of 168 hours. Investigation of the issue showed that the sampler electrical cord plug had become dislodged from the outlet, causing the sampler to stop. The plug was reinserted and secured, the sampler was restarted, and the air sample filter change out was completed. The filter collected was sent to the vendor laboratory for analysis with a reduced run time (i.e., reduced sample volume).
Initial Actions	Investigated and resolved the cause of the environmental air sampler not running. Initiated CR to document event.
Recom Actions:	CA to RP (Shannon/Peterson) to include a copy of this CR in the 2023 Annual Radiological Environmental Operating Report (AREOR)
additional Contacts	
Tag #:	
Equipment Location	
Equipment Description	
Plant System	
OP-AA-102 Review Reqd?	No

Operability Assesment	N/A
Operability Comments	
Functionality Assessment	N/A
Reportable Condition	No
Reportability Comments	
Is Equipment Important to Emergency Response WM-KW-100 values	No
O/R Comments	
Significance (screening)	3
Potential Repeat (screening)	Yes
Previous Issue	CR784 K-8 REMP ENVIRONMENTAL AIR SAMPLERS FOUND NOT RUNNING CR1285 K-8 ENVIROMENTAL AIR SAMPLER FOUND NOT RUNNING CR1904 K-8 environmental air sample pump found in degraded condition. CR1927 K-8 location environmental air sample pump found not running due to blown fuse CR1940 Environmental air sample pump found off at location K-8 CR1974 K-8 Location environmental air sample pump found not running due to breaker being open CR2025 K-8 Environmental air sampler found off with blown fuse CR2217 K-8 Environmental air sampler found off due to an open breaker. Most likely the breaker opened due to recent lighting storms.
CRT Comments	CA1010 (Kruse/Shannon) to include a copy of CR2474 in the 2023 Annual Radiological Environmental Operating Report (AREOR)
Work Order #	
Comments	
Status	Pending

Content Type: Item
Version: 4.0
Created at 5/30/2023 3:00 PM by Dan J Shannon (Dom Nuclear Projects, Inc - 4)
Last modified at 6/5/2023 10:26 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

Title	Environmental Air Sampler at Location K-8 Found Not Running
CA_ID	1010
CR#	2474
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	Per Schedule
Due Date	5/2/2024
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	
Manager	
Additional Reviewer	
Detailed Assignment	Include a copy of CR2474 in the 2023 Annual Radiological Environmental Operating Report (AREOR)
Response	
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	
Comments	
Email Notification 1	
Email Notification 2	
Due date -6	4/26/2024
Status	Perform Action
CR#:Description (location)	
Location	

CR Short description	Environmental Air Sampler at Location K-8 Found Not Running

Content Type: Item
Version: 2.0
Created at 6/5/2023 10:24 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 10/18/2023 10:14 AM by Rick Adams

Close

Print

CR_ID	2612
Short description	Environmental Air Sampler at Location K-2 Found Not Running
Site	Kewaunee
Discovery Date/Time	10/17/2023 11:05 AM
Submitter	Daniel J. Shannon-ext
Submitters Dept	15. Technical Support
Supervisor	Darren J. Peterson
Unit 1 Mode	DEF
Unit ISFSI?	No
Revision #	
Long Description	During the weekly air sample filter change out, the environmental air sampler at location K-2 (WPSC Operations building) was found not running. The air sampler run time meter reading was 140.48 (hours.minutes) which is about 27 hours less than the average weekly run time total of 168 hours. The air sample filter was collected and sent to the vendor laboratory for analysis with a reduced run time (i.e., reduced sample volume. The cause of the event is that WPSC secured power to the sampler to support a site electrical modification. Power was secured at approximately 0900 on 10/16/23 and is expected to be restored on 10/19/23. Due to the power outage extending through 10/19/23, the K-2 air sampler run time will also be reduced for the sample collection week ending 10/24/23.
Initial Actions	Investigated cause of the air sampler not running. Initiated CR to document the event.
Recom Actions:	Verify air sampler at location K-2 is restarted as expected when power is restored. CA to RP (Shannon/Peterson) to include a copy of this CR in the 2023 Annual Radiological Environmental

	Operating Report (AREOR).
additional Contacts	
Tag #:	
Equipment Location	
Equipment Description	
Plant System	
OP-AA-102 Review Reqd?	No
Operability Assesment	N/A
Operability Comments	
Functionality Assessment	N/A
Reportable Condition	No
Reportability Comments	
Is Equipment Important to Emergency Response WM-KW-100 values	No
O/R Comments	
Significance (screening)	3
Potential Repeat (screening)	Yes
Previous Issue	**CR88 K-2 Enviromental Air sampler found not working** **CR689 Power found off at K-2 Environmental air sampler** **CR1898 Environmental air sampler K-2 (WPS building) found off due to blown fuse**
CRT Comments	**CA1089 (Shannon/Peterson) to include a copy of CR2612 in the 2023 Annual Radiological Environmental Operating Report (AREOR).**
Work Order #	
Comments	
Status	Pending

Content Type: Item
Version: 5.0
Created at 10/17/2023 1:48 PM by Dan J Shannon (Dom Nuclear Projects, Inc - 4)
Last modified at 10/18/2023 7:32 AM by Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close

Print

Title	Environmental Air Sampler at Location K-2 Found Not Running
CA_ID	1089
CR#	2612
Short Description	
DCAC	Timothy Olson-ext
Assignment type	CA
Priority	Per Schedule
Due Date	5/2/2024
Evaluator	Daniel J. Shannon-ext
Assigned Dept	17. Facility Programs & Processes (Various)
Supervisor	Darren J. Peterson
Manager Review Required?	
Manager	
Additional Reviewer	
Detailed Assignment	Include a copy of CR2612 in the 2023 Annual Radiological Environmental Operating Report (AREOR).
Response	
Num Appr Ext	
Site	Kewaunee
is this CA Req'd to resore full qualification or functionality	No
Is this an a(1) corrective action ?	No
Review comments	
Comments	
Email Notification 1	
Email Notification 2	
Due date -6	4/26/2024
Status	Perform Action
CR#:Description (location)	
Location	

CR Short description	Environmental Air Sampler at Location K-2 Found Not Running

Content Type: Item
Version: 1.0
Created at 10/18/2023 7:30 AM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)
Last modified at 10/18/2023 7:30 AM by ☐ Timothy P Olson (Dom Nuclear Projects, Inc - 4)

Close