

**UNITED STATES DISTRICT COURT  
WESTERN DISTRICT OF LOUISIANA  
LAKE CHARLES DIVISION**

<b>HENNING MANAGEMENT LLC</b>	*	<b>CIVIL ACTION NO.: 2:20-CV-00004</b>
	*	
<b>VERSUS</b>	*	<b>JUDGE: JAMES D. CAIN, JR.</b>
	*	<b>DIVISION: "A"</b>
<b>CHEVRON U.S.A. INC., ET AL.</b>	*	
	*	<b>MAGISTRATE JUDGE:</b>
	*	<b>KATHLEEN KAY</b>

**EXPERT REPORT OF JOHN R. FRAZIER, Ph.D., CHP**

**I. INTRODUCTION**

I have been retained by counsel for Defendant Chevron U.S.A., Inc. in the matter of Henning Management LLC versus Chevron U.S.A., Inc., et al. (United States District Court, Western District of Louisiana, Lake Charles Division; Civil Action No.: 2:20-CV-00004; Judge James D. Cain, Jr., Division: "A"; Magistrate Judge: Kathleen Kay) to assess the radiological conditions of certain property in the Hayes Oil Field in Calcasieu and Jefferson Davis Parishes, Louisiana. Specifically, I have been asked to determine whether there is naturally occurring radioactive material (NORM) due to oil and gas operations on the Plaintiffs' property. I have been asked to review all available radiological data for the property. I have been asked to visit the property and perform gamma radiation measurements on the property. I have also been asked to review the September 30, 2021 report by Gregory W. Miller and Wayne Prejean, the October 15, 2021 report by Charles R. Norman, and the June 2, 2021 report by Walker Wilson in this matter and provide opinions within my areas of expertise regarding those reports.

**II. OPINIONS**

I have reached the following conclusions with a reasonable degree of scientific certainty:

1. Results of the radiation survey of the property by Plaintiffs' representatives and my radiation survey of the property show that there are two or more short pieces of NORM-containing flowlines on the property. These pieces of flowlines are not on the Chevron-operated portions of the property. Removal of those pieces of flowlines from the property is necessary before the property can be released for unrestricted use under Louisiana Department of Environmental Quality (LDEQ) regulations for NORM.

2. Twenty-eight groundwater samples were collected from twenty-eight wells on the subject property. Two surface water samples were also collected from the subject property. The ratios of concentrations of radium isotopes in the water from all twenty-eight wells and the two surface water samples are consistent with natural ratios and do not indicate the presence of aged produced water from oilfield operations.
3. Results of laboratory analysis by Plaintiff's laboratory (Pace) of the groundwater samples showed three wells ("H-9", "H-12", and "H-16") with concentrations of total radium greater than five picocuries per liter (pCi/L). Laboratory analysis by Eberline of the split samples from those three wells, however, showed total radium concentrations much less than five pCi/L.
4. The October 15, 2021 report of Charles R. Norman and the June 2, 2021 report of Walker Wilson do not include any radiological characterization measurements that they have made on the subject property. Their opinions regarding the nature and extent of NORM on the subject property are based on the radiological characterization data produced by ICON.
5. Based on my review of the radiological characterization data for the subject property and potential exposure locations, potential exposure pathways and potential exposure durations, I have concluded that no one on or near the subject property can reasonably be expected to receive a radiation dose greater than the range of radiation doses from natural background radiation in Louisiana.

### **III. QUALIFICATIONS**

My qualifications are detailed in Attachment A. My area of expertise is health physics – the scientific discipline of measuring radiation and protecting people from the harmful effects caused by high doses of radiation. My academic degrees include a B.A. in physics, M.S. in physics, and Ph.D. in physics (with emphasis in health physics and radiation protection). I have over forty-four (44) years of professional experience in health physics, primarily in the areas of radiation detection and measurement, radiation dose assessments, external and internal radiation dosimetry, and radiation safety standards and practice. I have extensive experience performing radiological characterization surveys of property, assessing external and internal radiation doses from natural and man-made radiation sources, and reviewing/assessing operational data generated by facilities that are licensed to possess and use radioactive materials and other radiation sources. Over the past twenty-six (26) years I have performed numerous radiological assessments of soil and groundwater on properties for oilfield NORM. I have also evaluated current and past radiation exposure conditions on properties impacted by oilfield NORM.

#### **IV. BASIS OF OPINIONS**

During preparation of my opinions presented in this report, I reviewed documents pertaining to the subject property and natural radiological conditions in the vicinity of the subject property and throughout the State of Louisiana. Specific documents that I reviewed in preparation of this report are listed in Attachment B. In forming my opinions, I am relying on the radiological characterization data acquired by Plaintiffs and Defendants to date. The following is a description of basic terminology and concepts of radiation and radioactive materials in the natural environment and associated with oil production.

##### **A. Naturally Occurring Radionuclides in Native Louisiana Soil and Sediment**

Naturally occurring radioactivity is present in essentially everything on, beneath, or above the earth's surface. These radioactive materials are present as primordial radioactivity (as they have been present since the earth was formed) or as naturally produced radioactivity (e.g., cosmogenic radioactivity) that continues to be formed from interactions of cosmic rays with the earth. The most abundant radionuclides on the earth are the primordial radionuclides in three natural decay series (thorium, uranium, and actinium) and the non-series primordial radionuclide, potassium-40. The concentrations and amounts of these natural radioactive materials that comprise the natural background radioactivity in substances on or in the earth have been described in detail in various reports. The NCRP, a council of 100 eminent independent scientists chartered by Congress, has published Report No. 160, "Ionizing Radiation Exposure of the Population of the United States" (NCR P 2009), that includes information on the sources and amounts of natural background radiation exposure being received by the U.S. public. NCRP Report No. 160 notes that concentrations of each of the primordial radionuclides vary with substance (rock, soil, sediment, etc.), location, and other factors. For surficial soil in the United States, each radionuclide in the uranium series and each radionuclide in the thorium series is present at a typical average concentration of one (1) picocurie per gram (pCi/g). The typical average concentration of potassium-40 in soil is in the range of approximately 10-25 pCi/g. However, the range of concentrations of these radionuclides in native soil varies with location, depending on the components of the soil (Myrick 1981; NCRP 2009).

Natural background concentrations of selected radionuclides, including radium-226 (Ra-226) and Ra-228, in soil and sediment in Louisiana are given in several publications (DeLaune 1986; Meriwether 1988; Meriwether 1991; Meriwether 1992). The range of concentrations of Ra-226 in native Louisiana soil is approximately 0.2 pCi/g to approximately 3 pCi/g, with an average concentration of approximately 1 pCi/g. The average and range of concentrations of Ra-228 in native Louisiana soil are approximately the same as the respective concentrations of Ra-226. In native soil, both Ra-226 and Ra-228 are continually being produced in the natural

radioactive decay series uranium and thorium, respectively. The environmental behavior of radium is described in various publications, such as Technical Reports of the International Atomic Energy Agency (IAEA) (IAEA 1990; IAEA 2014).

## **B. Natural Background Radioactive Material in Louisiana Groundwater**

Natural waters contain solids from contact with soils, rocks, and other natural materials. Some solids are suspended in the groundwater and some solids are dissolved (not removed by filtration) in the groundwater. The United States Geological Survey (USGS) has summarized the following points regarding dissolved solids in water:

The dissolved solids concentration in water is the sum of all the substances, organic and inorganic, dissolved in water. This also is referred to as “total dissolved solids”, or TDS. Calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, nitrate, and silica typically make up most of the dissolved solids in water. Combinations of these ions—sodium and chloride, for example—form salts, and salinity is another term commonly used to describe the dissolved solids content of water (USGS 2020).

Concentrations of dissolved solids in water can be so high that the water is unsuitable for drinking, irrigation, or other uses. Groundwater that contains natural solids (i.e., TDS) contains naturally occurring radioactive materials (NCRP 2009). Radium is a trace metal in groundwater that is usually present in the TDS as radium chloride (IAEA 1990). In general, greater concentrations of TDS and chlorides in groundwater correspond to greater concentrations of radium in that same water (Kraemer 1984; IAEA 1990; IAEA 2014). Elevated concentrations of chlorides in groundwater in contact with native soil, sediment, and rock can cause natural radium to pass from the soil, sediment, and rock into the groundwater as radium chloride (IAEA 1990; IAEA 2014). In Louisiana, groundwater sampling has shown that concentrations of Ra-228 are slightly greater than, or approximately equal to, the concentrations of Ra-226 in the groundwater (USGS 1988). This is a consequence of the approximate equal concentration of natural background uranium and thorium in the soil, sediment, and rock that is in contact with groundwater (IAEA 1990; IAEA 2014).

## **C. Natural Background External Radiation Levels in Louisiana**

Every person is exposed to external radiation from natural background radiation sources every day of their lives. Natural background sources of external radiation include cosmic rays (and the external radiation from the interactions of cosmic rays with the atmosphere) and naturally occurring radioactive materials in the earth (soil, rocks, building materials, etc.).



External radiation produces an external exposure rate that is often expressed in units of microrentgen per hour ( $\mu\text{R/hr}$ ). The external exposure rate from natural background radiation sources varies with altitude, latitude, and the natural radionuclide content of soil, rocks, building materials, etc. In the United States, the external exposure rate from natural background radiation varies from less than approximately 3  $\mu\text{R/hr}$  to well over 20  $\mu\text{R/hr}$  (Myrick 1981). In Louisiana, the nominal external exposure rate from natural background radiation sources has a range from less than 5  $\mu\text{R/hr}$  to over 14  $\mu\text{R/hr}$  (Beck 1986).

#### **D. Radiation Doses from Natural Background Sources**

Radiation doses to persons from natural background radiation have been studied extensively for many decades. The term "dose" is used to represent the amount of radiation energy deposited in tissue per unit mass of tissue of a person exposed to ionizing radiation. External radiation doses are produced by penetrating radiation (e.g., gamma rays or x-rays) from radiation sources outside the human body. Internal radiation doses are produced by radioactive material within the body following inhalation or ingestion of that radioactive material. Natural radiation and radioactivity in the environment provide the major source of external and internal radiation doses to humans. NCRP Report No. 160 describes the radiation doses received from natural background radiation sources in the U.S. (NCRP 2009).

The NCRP notes in Report No. 160 that the average radiation dose in the United States from cosmic radiation at ground level is 0.033 rem per year (NCRP 2009). [33 millirem; 1 rem equals 1,000 millirem.] The average external radiation doses from terrestrial radionuclides in the United States is 0.021 rem (21 millirem) per year. As with soil and other terrestrial matter, the human body also contains naturally occurring radionuclides, the most abundant of which is the primordial radionuclide potassium-40. The average internal dose from radionuclides (excluding radon and radon progeny) in the body is 0.029 rem (29 millirem) per year. Therefore, the NCRP concludes that the total natural background radiation dose (excluding radon and radon progeny) in the United States is approximately 0.083 rem (83 millirem) per year (NCRP 2009). In addition, the NCRP has determined that the average radiation dose from inhaled radon and radon progeny in the United States is approximately 0.228 rem (228 millirem) per year. Therefore, the total average annual radiation dose from natural background radiation sources in the United States is approximately 0.311 rem (311 millirem) per year (NCRP 2009). The total average annual radiation dose from natural background radiation sources in Louisiana is somewhat less than the average for the United States (NCRP 2009).

### **E. Radiation Doses from Ingestion of Ra-226 and Ra-228**

Every person ingests an average of approximately 1-2 pCi of Ra-226 in food and water every day of our lives (Carter 1988). Similarly, we also ingest an average of approximately 1-2 pCi of Ra-228 in food and water every day. Over a year, the radiation dose from ingestion of 1-2 pCi of Ra-226 and Ra-228 each day is approximately 1-2 millirem per year (EPA 1988), and this dose is included in the average total radiation dose from natural background radiation sources. The average annual dose from ingestion of natural background Ra-226 and Ra-228 in our food and water is less than 1 percent of the average annual dose we receive from natural background radiation sources.

### **F. Oilfield NORM**

During production of oil from underground geological formations, water that is co-mingled with the oil is transported to the ground surface. This water is generally referred to as “produced water”. There are concentrations of NORM in some oil-bearing geologic formations that exceed the natural background concentrations of the same radionuclides in native soil. The chemical compounds that are present in produced water include trace amounts of the natural element radium. Because radium is radioactive, produced water that contains radium compounds contains NORM. The principal radionuclides in affected produced water are Ra-226 and Ra-228 (NRC 1999). During oil production, some radium compounds in the produced water convert to sulfates or carbonates and are precipitated, or are otherwise deposited, onto surfaces as scale and sludge in tubulars, pipe, and other production equipment. The scale is primarily barium sulfate with trace amounts (by mass) of radium in the same mineral matrix (Smith 1996; NRC 1999). The chemical forms of scale that have been shown to contain oilfield NORM are highly insoluble and NORM radionuclides (i.e., Ra-226 and Ra-228) in the scale are not readily leached or transported from impacted pipe, other production equipment or soil by surface water or groundwater (IAEA 1990).

The presence (or absence) of oilfield NORM at the ground surface (in soil, pipe, or other production equipment) is determined by measurement of external radiation levels near the ground surface or production equipment (as NORM radionuclides emit measurable gamma radiation) and by analysis of soil samples and/or samples of the contents of production equipment (e.g., scale). The presence (or absence) of oilfield NORM in groundwater is determined by collection of representative samples of groundwater from suspect locations and analysis of the water samples for the concentrations of Ra-226, Ra-228, and TDS in the water.

### **G. Description of the Subject Property**

The property that is the subject of this radiological assessment is property owned by Plaintiffs in the Hayes Oil Field in Calcasieu and Jefferson Davis Parishes, Louisiana (Henning 2018). Descriptions of the location of the subject property are given in the Petition for Damages (Henning 2018) and in the September 30, 2021 report by Gregory W. Miller and Wayne Prejean (Miller 2021).

### **H. External Radiation Measurements on the Subject Property**

Gamma radiation measurements were performed on the subject property on May 24, 2021, by ICON Environmental Services (ICON) personnel on behalf of Plaintiff (Miller 2021 at Appendix E). Personnel (Michael Goodman) from Environmental Resources Management (ERM) representing Defendants observed ICON personnel on May 24, 2021 (Goodman 2021 and included in Attachment D). During the ICON surveys, radiation measurement readings were obtained and recorded in contact with oil production equipment on the property as indicated in the ICON field notes (Miller 2021 at Appendix E). The maximum ICON readings are listed in Table 7 of the September 30, 2021 ICON report (Miller 2021). The highest reading recorded by ICON personnel was 70  $\mu\text{R/hr}$  in contact with “a piece of tubing” and  $>50 \mu\text{R/hr}$  in contact with “2 feet of abandoned flowline) at the “Tank Battery” (Miller 2021 at Appendix E). Based on the gamma radiation readings reported by ICON personnel no areas of soil were determined to be NORM-impacted. No soil samples were collected for analysis (Miller 2021 at Appendix E).

At the request of counsel for Defendant Chevron U.S.A. I visited the site on January 12, 2022, and performed a gamma radiation survey of specific locations on the subject property. A copy of my field notes for my visit is given in Attachment D. As noted in my field notes, I found only natural background radiation levels at all locations except for gamma radiation readings in contact with two short pieces of tubing (one of which was the same as found by ICON) (Miller 2021 at Appendix E). Both pieces of tubing (pipe) were only a few feet long and the maximum gamma radiation reading in contact with each pipe was 70  $\mu\text{R/hr}$ , with only natural background radiation readings (10  $\mu\text{R/hr}$ ) one meter from each piece of pipe (Attachment D). These pieces of flowlines are not on the Chevron-operated portions of the property (ERM 2022).

### **I. Collection and Analysis of Groundwater Samples**

Sixteen groundwater samples were collected by ICON personnel from sixteen wells on the subject property from March 6, 2020 to August 23, 2021. The locations of those wells are described in the September 30, 2021 report by ICON (Miller 2021). Each sample was sealed in a sample container, marked with a unique sample identification code, and shipped under chain of custody to an offsite, commercial laboratory (Pace Analytical Services, LLC [Pace] in

Greensburg, Pennsylvania). The samples were analyzed by Pace to determine concentrations of Ra-226 and Ra-228 in each sample. Results of analysis of those samples are given in three reports of analysis (Pace 2020; Pace 2021a,b) and are summarized in Table 1.

Splits of the groundwater samples were collected by Defendants’ representatives with ERM, sealed in a sample container, marked with a unique sample identification code and shipped under chain of custody to Eberline Analytical Services (Eberline) in Oak Ridge, Tennessee, for analysis of concentrations of Ra-226, Ra-228, and total dissolved solids (TDS). Results of the analyses by Eberline of the split samples are given in three reports of analysis (Eberline 2020; Eberline 2021a,b). A copy of those reports of analysis are included as Attachments C1, C2, and C3. Results of the analyses of groundwater samples by Eberline are also summarized in Table 1.

**Table 1. Summary of Laboratory Measurements of Groundwater Samples Collected March 6, 2020 to August 23, 2021**

Sample	Eberline Lab					Pace Lab				
	Ra-226		Ra-228		TDS**	Ra-226		Ra-228		TDS***
	Result	CSU*	Result	CSU		Result	CSU	Result	CSU	
ID	(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	(mg/L)	(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	(mg/L)
H-1	1.26	0.57	1.92	0.69	1,977	0.606	0.396	1.47	0.541	3,370
H-2	0.26	0.22	0.42	0.53	2,767	0.340	0.255	0.517	0.390	3,230
H-3	0.17	0.20	0.45	0.52	239	0.279	0.330	0.287	0.307	590
H-9	0.39	0.83	0.39	0.58	38,386	5.20	1.23	11.8	2.28	32,700
H-10 Lab Dup	0.55	0.30	1.19	0.51	-	NS	-	NS	-	-
H-10	0.62	0.39	2.02	0.77	2,235	0.422	0.331	0.696	0.414	3,320
H-12	0.68	0.90	1.40	0.83	64,986	20.7	3.11	29.3	0.540	63,600
H-16	-0.03	0.09	0.10	0.39	23,589	0.837	0.342	4.55	1.01	24,900
H-18	1.15	0.50	0.48	0.66	6,427	1.25	0.513	2.11	0.605	7,600
H-20 Lab Dup	0.41	0.29	0.80	0.53	-	NS	-	NS	-	-
H-20	0.23	0.28	1.00	0.64	2,147	0.0621	0.322	1.23	0.568	2,060
H-22	0.20	0.21	0.45	0.44	1,724	0.304	0.598	1.36	0.522	1,810
H-23	0.53	0.36	0.67	0.52	1,963	0.000	0.283	1.02	0.453	1,840
H-24	0.20	0.24	-0.06	0.44	1,994	0.349	0.364	0.596	0.416	1,540
H-32A	0.08	0.20	0.34	0.38	807	0.0666	0.392	0.0954	0.349	795
H-32B	0.19	0.22	0.50	0.36	1,383	0.0701	0.363	0.242	0.385	1,120
H-33	0.28	0.26	0.26	0.39	1,130	0.0698	0.454	0.613	0.490	1,400
H-34 Lab Dup	0.22	0.25	0.44	0.44	-	NS	-	NS	-	-
H-34	0.39	0.29	0.63	0.50	982	0.125	0.301	0.854	0.494	995

NS – Not Sampled

\*CSU = Calculated Standard Uncertainty (2 sigma)

\*\*TDS = Total Dissolved Solids

\*\*\*TDS values for ICON samples taken from Table 4 of the September 30, 2021 ICON report (Miller 2021)

Twelve groundwater samples were collected from 12 monitoring wells and two surface water samples were collected from the “blow-out pond” by ERM personnel on the subject property on December 15 - 21, 2021 (ERM 2022). Each sample was sealed in a sample container, marked with a unique sample identification code, and shipped under chain of custody to Eberline to determine concentrations of Ra-226, Ra-228, and TDS in each sample. Results of analysis of those samples are given in one report of analysis (Eberline 2022) and are summarized in Table 2. A copy of the Eberline report of analysis is included as Attachment C4.

Splits of the groundwater samples and surface water samples were collected by ICON personnel on December 15-21, 2021. Each sample was sealed in a sample container, marked with a unique sample identification code and shipped under chain of custody to Pace Laboratory for analysis of concentrations of Ra-226 and Ra-228. Results of the analyses by Pace of the split samples are given in two reports of analysis (Pace 2022a-b). Results of the analyses of the split water samples by Pace are also summarized in Table 2.

**Table 2. Summary of Laboratory Measurements of Groundwater and Surface Water Samples Collected December 15-21, 2021**

Sample ID	Eberline Lab					Pace Lab				
	Ra-226		Ra-228		TDS**	Ra-226		Ra-228		TDS
	Result (pCi/L)	CSU* (pCi/L)	Result (pCi/L)	CSU* (pCi/L)		Result (pCi/L)	CSU* (pCi/L)	Result (pCi/L)	CSU* (pCi/L)	
MW-1 dup	0.23	0.23	1.16	0.60	1,233	-	-	-	-	-
MW-1	0.09	0.15	0.24	0.56	1,233	0.252	0.429	0.390	0.625	-
MW-2	0.48	0.24	0.98	0.66	1,085	0.666	0.616	0.358	0.392	-
MW-3	0.33	0.24	0.57	0.66	2,150	-0.116	0.395	0.551	0.348	-
MW-4	0.19	0.24	0.72	0.51	2,718	0.352	0.460	0.316	0.353	-
MW-5	0.58	0.40	2.10	0.79	3,412	0.188	0.407	-0.151	0.345	-
MW-6	0.52	0.35	1.71	0.65	4,075	0.356	0.437	2.27	0.983	-
MW-7	0.46	0.33	0.78	0.68	6,620	0.204	0.401	0.659	0.635	-
MW-8	0.12	0.14	0.47	0.57	1,443	-0.0567	0.509	0.792	0.704	-
MW-9	0.30	0.23	0.73	0.56	1,582	NS	NS	NS	NS	-
MW-9D	0.54	0.35	0.79	0.52	1,733	0.252	0.494	0.831	0.723	-
MW-10	0.20	0.17	0.37	0.66	1,979	0.473	0.810	-0.0747	1.14	-
MW-11	0.45	0.27	0.61	0.65	3,267	0.826	0.611	2.07	0.832	-
SW-BO 2	-0.03	0.11	0.14	0.58	100	0.171	0.434	0.119	0.771	-
SW-BO 13	0.09	0.10	0.46	0.50	38	0.117	0.398	0.536	0.728	-

NS – Not Sampled

\*CSU = Calculated Standard Uncertainty (2 sigma)

\*\*TDS = Total Dissolved Solids

## **J. Discussion of Results for Groundwater Samples**

The ratios of concentrations of radium isotopes in the water from all wells and sampled surface water are consistent with native soils and sediment and do not indicate the presence of aged produced water from oilfield operations. Results of laboratory analysis by Pace of groundwater samples from the subject property show only three wells (H-9, H-12, and H-16) with total radium (Ra-226 + Ra-228) concentration slightly greater than 5 pCi/L<sup>1</sup>. However, the split samples from these three wells (analyzed by Eberline) had total radium concentrations much less than 5 pCi/L.

The secondary standard for TDS in drinking water is 500 milligrams per liter (mg/L) (USEPA 1991). Groundwater samples from 15 of the 16 wells have TDS concentrations greater than 500 mg/L. Based on the high TDS concentration, the water from those wells is not considered to be potable.

## **K. Review of September 30, 2021 Report by Gregory W. Miller and Wayne Prejean**

I have reviewed the September 30, 2021 report by Gregory W. Miller and Wayne Prejean and have the following observations regarding that report. The report includes the results of a NORM survey that was performed by ICON personnel on May 24, 2021 (Miller 2021 at Appendix E). One location (“Tank Battery”) was noted as having above background radiation readings in contact with one piece of pipe. The maximum reading in contact with the one piece of pipe was 70  $\mu$ R/hr (Miller 2020 at Appendix E). This piece of flowline is not indicated to be on the Chevron-operated portions of the property. No soil samples were collected as part of the May 24, 2021 NORM survey.

## **L. Review of October 15, 2021 Report by Charles R. Norman and the June 2, 2021 Report by Walker Wilson**

I have reviewed the October 15, 2021 report by Charles R. Norman (Norman 2021) and the June 2, 2021 report by Walker Wilson (Wilson 2021) and find that those reports do not include any radiological characterization measurements that they made on the subject property. Their opinions regarding the nature and extent of NORM on the subject property are based on the radiological characterization data produced by ICON.

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<sup>1</sup> Listed for comparison, 5 pCi/L is the maximum contaminant level (MCL) issued by the U.S. Environmental Protection Agency for Ra-226 + Ra-228 in community water systems at the tap (USEPA 2000b). The MCL is not applicable to groundwater. Additionally, Louisiana NORM regulations do not apply to groundwater (LADEQ 2015).

#### **M. Hypothetical Dose Assessment**

There are several guidance documents on which I routinely rely for assessing potential radiation doses from environmental radiation sources. Some of these are listed in Attachment B (e.g., ICRP 1978; NCRP 1984; NRC 1995; USDOE 1984). Based on the guidance in these documents and on the radiological conditions on the subject property, I conclude that there is no reasonable potential for anyone on or near the subject property to receive a radiation dose from oilfield NORM on the property greater than the range of natural background radiation doses in Louisiana. This conclusion is based on a number of specific factors, including but not limited to the following:

- above-background external radiation exposure rates are relatively low and are limited to relatively small areas,
- reasonable durations of exposure to anyone from external radiation on the subject property are very short,
- reasonable exposure pathways and exposure parameter values would not lead to measurable internal radiation doses from oilfield NORM on the subject property.

#### **V. CLOSING REMARKS**

The observations, conclusions, and opinions noted in this report are based on my personal knowledge and experience and are consistent with accepted practice in the field of health physics. I reserve the right to amend this report should additional data or other information become available to me in the future.

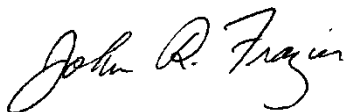
#### **VI. RATE OF COMPENSATION**

I am being compensated at a rate of \$250 per hour for my time to work on this project, including sworn testimony at deposition and trial.

#### **VII. PRIOR TESTIMONY**

A list of cases in which I have given sworn testimony at deposition or at trial during the past four years is included in Attachment E.

Prepared and submitted by:



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John R. Frazier, Ph.D., CHP

Date: March 3, 2022

**ATTACHMENT A**  
**CURRICULUM VITAE OF JOHN R. FRAZIER, PH.D.**



# JOHN R. FRAZIER, Ph.D., CHP

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## *Professional Qualifications*

Dr. Frazier has over 44 years of health physics experience in external and internal dosimetry, environmental dose assessment, radiation risk assessment, radiation spectroscopy, health physics training, bioassay, radiation detection and measurement, and radiological site characterization. Numerous federal agencies including the Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), U.S. Department of Defense (DOD), and U.S. Department of Justice (DOJ) have sought his advice on a wide range of health physics and radiation protection topics from operational health physics program design to environmental radiation dose and risk assessments. He has also served as a consultant to private companies and individuals on numerous health physics issues. He is a Distinguished Emeritus member of the National Council on Radiation Protection and Measurements (NCRP). Dr. Frazier has made presentations on introductory and advanced health physics and radiation protection topics for professional society meetings, student groups, and public interest forums. His publications are in the areas of fundamental interactions of radiation with matter, radiation detection instrumentation, radiological site assessments, and external and internal radiation dosimetry.

## *Education*

Ph.D., Physics, University of Tennessee, Knoxville, Tennessee; 1978.

M.S., Physics, University of Tennessee, Knoxville, Tennessee; 1973.

B.A., Physics, Berea College, Berea, Kentucky; 1970.

## *Registrations/Certifications*

Certification by the American Board of Health Physics since 1981; recertified through 2025.

## *Experience and Background*

2004 - *Independent Health Physics Consultant*  
*Present*

Dr. Frazier provides consultation services to individuals, private companies, and government agencies on a wide range of radiation protection topics. His principal areas of expertise are internal and external radiation exposure assessments, environmental radiation dose and radiological risk assessments from occupational

and environmental exposures, and evaluations and assessments of all aspects of operational health physics programs.

1993 - ***Senior Radiological Scientist, Auxier & Associates, Inc., Knoxville, Tennessee.***  
2004

Dr. Frazier served as senior consultant on radiation protection issues for private companies and government agencies. He performed assessments of internal and external radiation exposures, environmental radiation doses and radiological risks from occupational and environmental exposures. He also performed evaluations and assessments of all aspects of operational health physics programs. Dr. Frazier served as technical advisor to organizations that performed environmental radiological assessments and risk assessments and that provided occupational radiation protection services in government and industry.

1986 - ***Senior Radiological Scientist, Nuclear Sciences, IT Corporation, Knoxville, Tennessee.***  
1993

Dr. Frazier served as senior radiological scientist and technical manager of the health physics consulting group within IT. He was responsible for health physics professional services provided by IT for federal, state, and local agencies, contractors, and private companies. These services included development of all aspects of the health physics programs for nuclear facilities, technical assessments and evaluations of existing health physics programs, and environmental and occupational radiation dose assessments. He served as technical advisor and task manager for radiological aspects of remedial investigations and feasibility studies (RI/FSs). He also served as manager and technical director for specific projects in areas that included design and implementation of environmental monitoring and sampling programs, assessment of operational health physics programs, and radiation dose and risk assessments for occupational exposures and environmental releases. Previous responsibilities included serving as senior technical consultant for upgrading Environmental Health and Safety Programs at the Department of Energy Rocky Flats Plant, Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant.

1980 - ***Health Physicist, Oak Ridge Associated Universities, Oak Ridge, Tennessee.***  
1986

Dr. Frazier developed and coordinated Oak Ridge Associated Universities (ORAU) health physics training programs. He taught health physics and radiation protection courses for several hundred students each year at ORAU Professional Training Programs. He developed new lectures, laboratory exercises, and training materials for health physics training for the Nuclear Regulatory Commission, Department of Energy, and corporate clients. In addition to his training responsibilities, Dr. Frazier served as division health physicist for the Manpower Education, Research, and Training Division of ORAU. He served as technical consultant to federal and state agencies, other training institutions, and ORAU clientele on environmental, health and safety issues. He evaluated radiation measurement and radiation protection instrumentation equipment.

1978 -  
1980

***Chief Radiation Physics Section, Bureau of Radiological Health, Rockville, Maryland.***

Dr. Frazier supervised research and support activities of a staff of seven health physics professionals and technicians. He planned and implemented radiation research projects pertaining to ionizing radiation detection/ measurement. He scheduled personnel requirements in accordance with the scope of such projects. He coordinated support for external radiation dosimetry by the Radiation Physics Section for all other branches in the Division of Electronic Products. He supervised and performed multi-point calibrations of radiation detection/ measurement instruments per month. Dr. Frazier also assisted in planning radiation dosimetric surveys of large numbers and types of ionizing radiation sources to reduce population exposure. He coordinated environmental radiation dosimetry for extended geographical areas using external radiation dosimeters.

1977-  
1980

***Research Physicist, Bureau of Radiological Health, Rockville, Maryland.***

Dr. Frazier calibrated X-ray detection/measurement instruments. He maintained radiation calibration secondary standards traceable to the National Bureau of Standards. He evaluated new X-Ray detection/measurement instruments with radio-frequency fields under controlled environmental conditions and a wide range of ionizing radiation fields. He also developed external radiation dosimetry techniques with both active and passive dosimeters.

***Awards/Activities***

Joyce P. Davis Memorial Award, American Academy of Health Physics, 2016  
Fellow, Health Physics Society, 2000  
Elda E. Anderson Award, Health Physics Society, 1988  
John C. Villforth Lecture, Conference of Radiation Control Program Directors, 2007  
Distinguished Technical Associate, IT Corporation, 1990  
National Council on Radiation Protection and Measurements (NCRP)  
Distinguished Emeritus Member, 2014-2022  
Council Member, 2002-2014  
Scientific Committee 46, 1999-2006  
Scientific Committee 2-1, 2004-2006  
PAC-2 Committee 2006-2015

***Professional Affiliations***

Health Physics Society  
(Plenary Membership since 1981; President, 2002-3; President-Elect, 2001-2;  
Board of Directors, 1992-5; Treasurer-Elect, 1997-8; Treasurer, 1998-2000)  
American Academy of Health Physics (Past-president, 2013; President, 2012;  
President-elect, 2011; Secretary, 1996-1997; Director, 1998)  
East Tennessee Chapter of the Health Physics Society (Past President)  
International Radiation Protection Association (Plenary Membership since 1981)

## *Publications*

Dr. Frazier has prepared or contributed to over 100 reports and publications in the fields of health physics and environmental science.

### *List of Publications*

Frazier, J. R., "Negative Ion Resonances in the Fluorobenzenes and Biphenyl" Ph.D. Dissertation, University of Tennessee, Knoxville, Tennessee, 1978.

Frazier, J. R., "Low-Energy Electron Interactions with Organic Molecules: Negative Ion States of Fluorobenzenes," Journal of Chemical Physics, Vol. 69, No. 3807, 1978.

Frazier, J. R., "Performances of X-ray Measurement Instruments in RF Fields," HEW Publication (FDA) 78-8065 Rockville, Maryland, 1978.

Frazier, J. R., "A Dosimetry System for Evaluating Chest X-Ray Exposures," HEW Publication (FDA) 79-I 107, 1979.

Film Badge Dosimetry in Atmospheric Nuclear Tests, National Academy Press, Washington, D.C., 1989.

Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, NCRP Commentary No. 19, Bethesda, MD, December 31, 2005.

Radiation Protection in Educational Institutions, NCRP Report No. 157, National Council on Radiation Protection and Measurements, Bethesda, MD, June 25, 2007.

Self Assessment of Radiation-Safety Programs, NCRP Report No. 162, National Council on Radiation Protection and Measurements, Bethesda, MD, June 3, 2009.

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Investigation of Radiological Incidents, NCRP Report No. 173, National Council on Radiation Protection and Measurements, Bethesda, MD, September 14, 2012.

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Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced NORM (TENORM) from the Oil and Gas Industry, NCRP Commentary No. 29, National Council on Radiation Protection and Measurements, Bethesda, Maryland, April 22, 2020.

**ATTACHMENT B**  
**LIST OF DOCUMENTS REVIEWED**

## ATTACHMENT B

**Beck 1986** Beck, J.N., et al., “Environmental Radiation Exposure Rate in Louisiana,” Journal of Environmental Quality, Vol. 15, 1986.

**Carter 1988** Carter, M.W., et al., “Radionuclides in the Food Chain”, Springer-Verlag, New York, NY, 1988.

**DeLaune 1986** Delaune, R.D., et al., “Radionuclide Concentrations in Louisiana Soils and Sediments”, Health Physics, Vol. 51, August 1986.

**Eberline 2020** Eberline Analytical Corporation, “Final Report of Analysis,” Work Order No. 20-03062-OR, Oak Ridge, Tennessee, April 20, 2020.

**Eberline 2021a** Eberline Analytical Corporation, “Final Report of Analysis,” Work Order No. 21-04092-OR, Oak Ridge, Tennessee, May 25, 2021.

**Eberline 2021b** Eberline Analytical Corporation, “Final Report of Analysis,” Work Order No. 21-08094-OR, Oak Ridge, Tennessee, October 7, 2021.

**Eberline 2022** Eberline Analytical Corporation, “Final Report of Analysis,” Work Order No. 21-12077-OR, Oak Ridge, Tennessee, January 19, 2022.

**ERM 2022** Environmental Resources Management (ERM), “Figure 110 Monitoring Well and Surface Water Sample Locations,” March 2022.

**Henning 2018** Petition for Damages, Henning Management, LLC, Calcasieu Parish, Louisiana, November 9, 2018.

**IAEA 1990** International Atomic Energy Agency (IAEA), “The Environmental Behaviour of Radium, Volumes 1 & 2,” Technical Reports Series No. 310, Vienna, Austria, 1990.

**IAEA 2003** International Atomic Energy Agency (IAEA), “Extent of Environmental Contamination by Naturally Occurring Radioactive Material (NORM) and Technological Options for Mitigation,” Technical Reports Series No. 419, Vienna, Austria, 2003.

**IAEA 2014** International Atomic Energy Agency (IAEA), “The Environmental Behaviour of Radium: Revised Edition,” Technical Reports Series No. 476, Vienna, Austria, 2014.

**ICRP 1978** International Commission on Radiological Protection (ICRP), “Radionuclide Release into the Environment: Assessment of Doses to Man,” ICRP Publication 29, New York, New York, 1978.

**Kocher 1981** Kocher, David C., “Radioactive Decay Data Tables,” DOE/TIC-11026, U.S. Department of Energy, Washington, DC, 1981.

**Kraemer 1984** Kraemer, Thomas F., and David F. Reid, “The Occurrence and Behavior of Radium in Saline Formation Water of the U.S. Gulf Coast Region,” *Isotope Geoscience*, Vol. 2, pp. 153-174, Elsevier Science Publishers, Netherlands, 1984.

**LADEQ 2015** State of Louisiana Department of Environmental Quality, LAC Title 33, Environmental Quality, Part XV. Radiation Protection, Chapter 14. Regulations and Licensing of Naturally Occurring Radioactive Material (NORM), July 2015.

**LDEQ 2021** Louisiana Department of Environmental Quality, Office of Environmental Compliance, Letter to Matthew Rogenes (Stag Liuzza), Re; Romaine v. Freeport-McMoran Oil & Gas et al., Baton Rouge, Louisiana, August 18, 2021.

**LDNR 2020** State of Louisiana Department of Natural Resources, “Ground Water Resources Program Glossary of Terms,” accessed 2020.  
(<http://www.dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=477>)

**Meriwether 1988** Meriwether, J.R., et al., “Radionuclides in Louisiana Soils”, *Journal of Environmental Quality*, Vol. 17, 1988.

**Meriwether 1991** Meriwether, J.R., et al., “Distribution, Transport and Deposition of Radionuclides in Louisiana Soils, Final Report, LEQSF(1987-1990)-RD-A-27”, December 1991.

**Meriwether 1992** Meriwether, J.R., et al., “Distribution, Transport, and Deposition of Radionuclides in Louisiana Soils, Soil Survey Data Tables”, March 1992.

**Miller 2021** Miller, Gregory W., and Wayne Prejean, “Expert Report and Restoration Plan for the Landowners Henning Management, LLC v Chevron USA, Inc., et al.; Docket No. 73318; 31<sup>st</sup> JDC; Division “C, Jefferson Davis Parish, LA; Hayes Oil Field, Calcasieu and Jefferson Davis Parish, LA,” ICON Environmental Services, Inc., Port Allen, Louisiana, September 30, 2021.

**Myrick 1981** Myrick, T.E., et al., “State Background Radiation Levels: Results of Measurements Taken During 1975-1979,” ORNL/TM-7343, Oak Ridge National Laboratory, Oak Ridge, Tennessee, November 1981.

**NCRP 1984a** National Council on Radiation Protection and Measurements (NCRP), Report No. 77, “Exposures from the Uranium Series with Emphasis on Radon and Its Daughters,” Bethesda, Maryland, March 15, 1984.

**NCRP 1984b** National Council on Radiation Protection and Measurements (NCRP), Report No. 76, “Radiological Assessment: Predicting the Transport, Bioaccumulation, and Uptake by Man of Radionuclides Released to the Environment,” Bethesda, Maryland, March 15, 1984.

**NCRP 2009** National Council on Radiation Protection and Measurements, NCRP Report No. 160, “Ionizing Radiation Exposure of the Population of the United States,” Bethesda, Maryland, March 3, 2009.

**Norman 2021** Norman, Charles R., “Engineering and Operations Report on Henning Management, LLC vs Chevron USA et al.; Sections 16, 17, 18, 19, 20, & 21, T11S, R5W, and Section 24, T11S, R6W, Calcasieu & Jeff Davis Parish, LA,” 31<sup>st</sup> JDC for the Parish of Jeff Davis, State of Louisiana, No. C-733-18, Report No. 1,” Jeff Davis Parish, Louisiana, October 15, 2021.

**NRC 1995** National Research Council, “Radiation Dose Reconstruction for Epidemiological Uses,” Washington, DC, 1995.

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**Pace 2020** Pace Analytical Services, LLC, “Project: Henning II/9403-010-0100, Pace Project No.: 30355059,” Greensburg, Pennsylvania, April 3, 2020.

**Pace 2021a** Pace Analytical Services, LLC, “Project: Henning II/9403-010-0100, Pace Project No.: 30418740,” Greensburg, Pennsylvania, May 26, 2021.

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**Pace 2022b** Pace Analytical Services, LLC, “Project: Henning II/9403-010-0100, Pace Project No.: 30458869,” Greensburg, Pennsylvania, February 4, 2022.

**Smith 1996** Smith, K.P., et al., “Radiological Dose Assessment Related to Management of Naturally Occurring Radioactive Materials Generated by the Petroleum Industry,” ANL/EAD-2, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois, September 1996

**Snavely 1989** Snavely, Earl S., Jr., “Radionuclides in Produced Water: A Literature Review,” Arlington, Texas, August 1989.

**USDOE 1984** U.S. Department of Energy (DOE), “Models and Parameters for Environmental Radiological Assessments,” DOE/TIC-11468, Washington, DC, 1984.

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**USEPA 2000a** “Radionuclides Notice of Data Availability Technical Support Document”, US EPA Office of Ground Water and Drinking Water and Office of Indoor Air and Radiation, Washington, DC, March 2000.



**USEPA 2000b** National Primary Drinking Water Regulations; Radionuclides; Final Rule, 40 CFR Parts 9, 141, and 142, Federal Register 65 FR 76707, Vol. 65, No. 236, Washington, DC, December 7, 2000.

**USEPA 2002** “Implementation Guidance for Radionuclides,” EPA 816-F-00-002, Office of Ground Water and Drinking Water (4606M), Washington, DC, March 2002.

**USGS 1988** U.S. Geological Survey (USGS), “Radiochemical Analyses of Ground Water in Louisiana – Water Resources Technical Report No. 44,” by John L Snider and Fary N. Ryals (USGS), Published by Louisiana Department of Transportation and Development, Baton Rouge, Louisiana, 1988.

**USGS 2012** U.S. Geological Survey (USGS), “Principal Aquifers Can Contribute Radium to Sources of Drinking Water Under Certain Geochemical Conditions,” Fact Sheet 2010-3113, Washington, DC, 2012.

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**Wilson 2021** Wilson, Walker, “Assessment of the Environmental State of Sites Associated with Oil and Gas Activities on the Henning Management, LLC Property, Thornwell Field, Jefferson Davis and Calcasieu Parishes, Louisiana,” Coastal Environments, Inc., Baton Rouge, Louisiana, June 2, 2021.

**ATTACHMENT C1: EBERLINE WORK ORDER #20-03062-OR**  
**ATTACHMENT C2: EBERLINE WORK ORDER #21-04092-OR**  
**ATTACHMENT C3: EBERLINE WORK ORDER #21-08094-OR**  
**ATTACHMENT C4: EBERLINE WORK ORDER #22-12077-OR**

**(in separate electronic files)**

**ATTACHMENT D**

**FIELD NOTES**

Location Hayes, LA Date 5/24/21  
Project / Client 0526033 Henning  
Michael Goodman Overcast, 80's

1250 Arrive on site. Drive around a bit.  
No sight of ICON yet. Safety Meeting,  
review hasp.

1300 Duane C. > Hawkins representatives  
Jerry Fortner

Derek with ICON doing norm survey  
near well H-20 H-1

Drew arrived onsite (with ICON)  
Surveyors (Langlais) on site

1321 Derek is getting background values of  
9-10 nR/hr. He will record areas above  
15 and mark spots greater than 20

Drew is getting surveyors set up.

1425 Derek finished surveying everywhere around  
H-1. Drew out on 4-wheeler with  
surveyors

1435 Derek found some junk piles with elevated  
norm concentrations. going to mark it off.  
~2 feet of pipe above MR/hr, high of  
70 MR/hr. See pictures

(P-1) Location name ISR 0508338  
3327867

Michael Goodman

Location Hayes LA Date 5/24/21  
Project / Client 0526033  
Michael Goodman

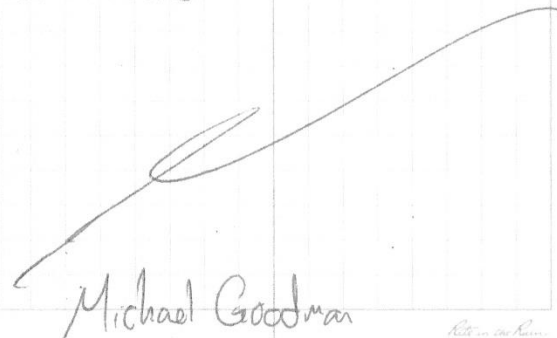
1503 at H-24 location for Norm  
Survey. Well pad under water  
No readings above ~6 MR/hr

1533 At H-20 location for NORM survey  
1550 Met up with Drew. They have surveyed  
and taken water levels at all the  
wells except the 3 on the far west.  
He is heading there now

1630 Finished norm survey around H-2, H-16,  
H-10, + H-22. Did not identify  
any areas above background.

1637 Drew has already taken off.  
Derek finished with Norm survey

1640 Offsite

  
Michael Goodman

Field Notes of John R. FRAZIER

Project: KEA/Henning

January 12, 2022 <sup>(1)</sup>

- ~ 9:30 AM Arrive at the site (west side of LA14) meeting location with Helen Connolly (ERM) - Very dry land. Mild temps
- ~ 9:45 AM Sargate safety meeting by ERM (Jody Shugart + Shawn Wiggins) also present Richard Kennedy, John Kind (CTEH), Shawn WNEK (CTEH), Victor Gregoire, and Lou Grossman + (2 others whose names I didn't get)

~ 10:00 AM I checked out my survey meter:

Ludlum Model 19 (S/N 144050) Calib. date: 12/21/2021

Battery: OK Check Source Reading: OK (80  $\mu$ R/h)

Survey all around meeting location. All readings at natural background: 6-10  $\mu$ R/h (with some locations over gravel low end of background and locations over native soil at upper end of background).

~ 10:15 AM Then, rode to several locations where ICON had installed monitoring wells and ERM had installed wells (groundwater). Rode on 4x4 vehicle. Got off vehicle and walked around each location where we stopped.

Made measurements at contact with ground surface and at a height of 1 meter above the ground surface.

All readings were at background: 6-10  $\mu$ R/h.

During the stops at the numerous locations, I walked and surveyed along and around the paths and weed-covered areas. All readings were at natural background: 6-10  $\mu$ R/h

1/12/2022

John R. Frazier

Field Note of John R. FRAZIER (bold) Jan. 12, 2022 <sup>(2)</sup>

I went to locations where there was some oil/gas equipment and old flowline. However, not much equipment and pieces of flowline was found. All readings at and near the equipment and pieces of pipe were at background - 6-10  $\mu\text{R/h}$ .

One of the locations of old pipe was at the side of the former "blowout" pond. All readings in contact with and near the old pipe were at background - 6-10  $\mu\text{R/h}$ .

I also surveyed the pipe gate on the east side of LA-14. All readings in contact with the pipe and in the area around the gate were at background - 6-10  $\mu\text{R/h}$ .

~ 1:10 PM I returned to the initial meeting location and surveyed from there to the location identified by ICON (Derek Perrain) as "abandoned O+G production" [May 24, 2021 field notes from ICON] [Baker No. Henning - ICON Report - 000877]

I surveyed all around the ground and equipment and found all readings were at background - 6-10  $\mu\text{R/h}$  except for the piece of flowline marked by ICON notes as location coordinates 15R 050833E / 3327867.

The readings I found in contact with the short (less than 3 feet) piece of black coated pipe was 70  $\mu\text{R/h}$ . The reading at 1 meter from this pipe was 10  $\mu\text{R/h}$  (background).

1/12/2022  
John R. Frazier

Field Notes of John R. Frazier (cont'd)

(3)

Jan. 12, 2022

near the piece of pipe having 70  $\mu\text{R}/\text{h}$  contact reading was another short piece of pipe (having a diameter of  $\approx 3 \frac{1}{2}$  ") The reading in contact with this pipe was also 70  $\mu\text{R}/\text{h}$ , with a reading of background (10  $\mu\text{R}/\text{h}$ ) 1 meter from the pipe.

I surveyed the other equipment and pieces of flowline in the area and did not find any readings greater than 10  $\mu\text{R}/\text{h}$ . There were weeds in the area but no standing water that I found. It was a very dry site except for a few damp spots.

The overall property that I visited was very dry.

The pipe that I found that had readings of 70  $\mu\text{R}/\text{h}$  in contact are shown in ICON report (color photographs)

Plate Nos: Henning - ICON Report - 000880 and 000881.

The standing water shown in those two photographs was not present during my survey. This allowed me to survey the remainder of the equipment and pieces of flowline where I found the one additional pipe reading (contact) of 70  $\mu\text{R}/\text{h}$  but no other readings greater than 10  $\mu\text{R}/\text{h}$ .

$\approx$  1:40 PM I returned to the meeting location & checked out the survey notes. Battery O.K.; Rad Source: 80  $\mu\text{R}/\text{h}$ .

1:45 PM I left the site with Richard Kennedy.

1/12/2022  
John R. Frazier



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

www.ludlum.com

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

10744 Dutchtown Road  
865-392-4601  
Knoxville, TN 37932, U.S.A.



CERT # 4084.02

Customer JOHN R FRAZIER ORDER NO. 20008285/10003818

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 144050

Mfg. \_\_\_\_\_ Model \_\_\_\_\_ Serial No. \_\_\_\_\_

Cal. Date 21-Dec-21 Cal Due Date 21-Dec-22 Cal. Interval 1 Year Meterface 202-016

Check mark  Applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 56 % Alt 667.0 mm Hg

New Instrument  Instrument Received  Within Toler. +-10%  10-20%  Out of Tol.  Requiring Repair  Other-See comments

Mechanical ck.  Meter Zeroed  Background Subtract  Input Sens. Linearity

F/S Resp. ck.  Reset ck.  Window Operation  Geotropism

Audio ck.  Alarm Setting ck.  Batt. ck.

Calibrated in accordance with LMI SOP 14.8  Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 600 V Input Sens. 33 mV Det. Oper. \_\_\_\_\_ V at \_\_\_\_\_ mV Threshold Dial Ratio \_\_\_\_\_ = \_\_\_\_\_ mV

HV Readout (2 points) Ref./Inst. 500 / N/A V Ref./Inst. 1000 / N/A V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.  
Multimeter uncertainty within 1.3% of reading. Gamma uncertainty within 5.0% of reading. Neutron uncertainty within 7.0% of reading. Count rate uncertainty within 5.4% of reading

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING
5000	4000 uR/hr	3900 uR/hr	4000 uR/hr
5000	1000 uR/hr	1000	1000
500	400 uR/hr = 77600 cpm	390	400
500	100 uR/hr	100	100
250	200 uR/hr = 37800 cpm	200	200
250	100 uR/hr	100	100
50	7760 cpm	41	40
50	1440 cpm	5	10
25	3780 cpm	19.5	20
25	945 cpm	5	5

50, 25 Range(s) Calibrated Electronically

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.  
All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors. ISO/IEC 17025:2017(E)  
Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2.  
The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323AB-2013. State of Tennessee Calibration License No. R-47214-K21

Reference Instruments and/or Sources: Cs-137 S/N:  5719CO  S-394  S-1054  5088/5171  
Other:  Pu-239 M6-460  Am-241 1637-72-1  Am-241 2047-84  I-129 1613-34  Tc-99 AC-1136  Tc-99 7263-11  Sr-90 7264-11  C-14 1576-2-1

Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_

m 500 S/N 296329  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N \_\_\_\_\_

Calibrator ISAAC BLANTON Isaac W Blanton Title calibrator Date 21 December 21

QC'd By Brittney Co Title Final QC Date 21 December 21

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.  
FORM C22A 01/07/2020 Page 1 of 1

AC Inst.  Passed Dielectric (Hi-Pot) and Continuity Test  
Only  Failed: \_\_\_\_\_



**ATTACHMENT E**

**LITIGATION IN WHICH DR. JOHN R. FRAZIER HAS PROVIDED  
SWORN TESTIMONY SINCE MARCH 3, 2018**

**LITIGATION IN WHICH DR. JOHN R. FRAZIER HAS PROVIDED SWORN  
TESTIMONY SINCE MARCH 3, 2018**

<u>FIRM</u>	<u>CASE</u>	<u>CLIENT</u>	<u>DATE</u>
Kean Miller	New 90, LLC and Louisiana Wetlands, LLC v. Grigsby Petroleum, Inc. and Chevron U.S.A., Inc.	Grigsby Petroleum, Inc. and Chevron U.S.A., Inc.	October 29, 2018
Jose	Estate of Jeffrey H. Ware v. Hospital of the University of Pennsylvania, et al.	Hospital of the University of Pennsylvania, et al.	December 18, 2018
Liskow & Lewis	Jack Anthony Devillier, et al. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A. Inc., et al.	July 8, 2020
Kean Miller	Hero Lands Company, L.L.C. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A. Inc., et al.	July 10, 2020
Shook Hardy & Bacon	Scott D. McClurg, et al. v. Mallinckrodt LLC, et al.	Mallinckrodt LLC, et al.	August 17, 2020
Kean Miller	Litel Explorations, LLC v. Aegis Development Company, L.L.C., et al.	Aegis Development Company, L.L.C., et al.	November 16, 2020
Kean Miller	Hero Lands Company, L.L.C. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A., Inc., et al.	December 21, 2020
Kean Miller	Louisiana Wetlands, LLC and New 90, LLC v. Energen Resources Corporation, et al.	Energen Resources Corporation, et al.	February 19, 2021
Kean Miller	Louisiana Wetlands, LLC and New 90, LLC v. Energen Resources Corporation, et al.	Energen Resources Corporation, et al.	February 25- 26, 2021
Kean Miller	James J. Martin Family, L.L.C. Consolidated with Robert Patricia Fleming, L.L.C. v. B.P. America Production Company, et al..	BP America Production Company, et al.	March 4, 2021

Holland &  
Knight

John J Jerue and Michael J. Feist, On  
behalf of themselves and all others  
similarly situated, v. The Drummond  
Company, Inc.

The Drummond  
Company, Inc.

March 23,  
2021

**ERM**

**0526033**

**Henning Management**

**STANDARD LEVEL IV  
REPORT OF ANALYSIS**

**WORK ORDER #20-03062-OR**

**April 20, 2020**

**EBERLINE ANALYTICAL/OAK RIDGE LABORATORY  
OAK RIDGE, TN**

## TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
I	Chain of Custody & pH Check	0004
II	Sample Acknowledgement	0010
III	Case Narrative	0013
IV	Analytical Results Summary	0017
V	Analytical Standard	0020
VI	Quality Control Sample Results Summary	0028
VII	Laboratory Technician's Notes	0033
VIII	Analytical Data (Radium-226)	0047
IX	Analytical Data (Radium-228)	0116
X	Barium-133 Analytical Tracer Data	0132
XI	Analytical Data (Total Dissolved Solids)	0198
	Last Page Number	0200



# STANDARD OPERATING PROCEDURE

Sample Receiving

MP-001, Rev. 20  
Effective: 1/15/19  
Page 14 of 15

## Eberline Services – Oak Ridge Laboratory LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline Services Work Order # 20-03062

The checklist items listed below are to be initialed by appropriate staff upon completion/verification.

Date for Partial	Initials	Date	Initials	Checklist Items
		3/12/20	JB	Sample Log-In
		3/24/20	JB	Data Compilation
		3/27/20	MT	First Technical Data Review
		3/30/20	JB	Second Technical Data Review
		4/15/20	CW	Data Entry/Electronic Deliverable
		4/15/20	CW	Case Narrative
		4/17/20	EJT	Electronic Deliverable Proof
		4/17/20	JB	Samples Analyzed within Holding Time Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>
		4/17/20	JB	QA/QC Review
		4/20/20	EJT	Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

Date package approved by:

Laboratory Manager

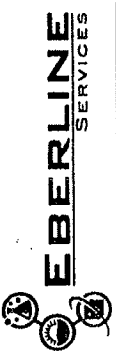
Date

**SECTION I**  
**CHAIN OF CUSTODY**  
**& pH CHECK**

# Chain of Custody Record

No.

Eberline Services  
 601 Scarboro Road  
 Oak Ridge, TN 37830  
 (865) 481-0683 Phone • (865) 483-4621 Fax



**EBERLINE SERVICES**

Project Name: MANAGER MORGAN Project Number: 0526033 Page 1 of 1  
 Send Report To: David Anale Sampler (Print Name): David Sangumata  
 Address: 800 W Sam Houston Pkwy Sampler (Print Name):  
HOUSTON, TX 77024 Shipment Method: Feet Ground  
 Airbill Number:  
 Laboratory Receiving:  
 Phone: 832-786-4781  
 Fax:

REC'D MAR 12 2020  
 Analysis Requested  
 Rod 226  
 Rod 228  
 Purchase Order #: 20F03062  
 Lab Sample ID (to be completed by lab)

Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
4 H-12 (50-60)	3/5/20	1105	W	1	X	
5 H-9 (50-55)	3/5/20	1335			X	
6 H-10 (35-40)	3/5/20	1530			X	
7 H-2 (30-35)	3/5/20	1155			X	
8 H-16 (35-40)	3/6/20	0815			X	
9 H-18 (35-40)	3/6/20	0950			X	
10 H-3 (22-27)	3/6/20	1315			X	
11 H-1 (35-40)	3/6/20	1110			X	

Relinquished by: (Signature) [Signature] Date: 3-14-20 Time: 1600  
 Received by: (Signature) [Signature] Date: 3/10/20  
 Relinquished by: (Signature) [Signature] Date: \_\_\_\_\_  
 Received by: (Signature) \_\_\_\_\_  
 Relinquished by: (Signature) \_\_\_\_\_  
 Received by: (Signature) \_\_\_\_\_

Sample Custodian Remarks (Completed By Laboratory):  
 QA/QC Level: Level I  Level II  Level III  Other   
 Turnaround: Routine  24 Hour  1 Week  Other \_\_\_\_\_  
 Total # Containers Received? \_\_\_\_\_  
 COC Seals Present? \_\_\_\_\_  
 COC Seals Intact? \_\_\_\_\_  
 Received Containers Intact? \_\_\_\_\_  
 Temperature? \_\_\_\_\_


0005









	<b>Sample Receiving Report</b> (Volumes, pH, & CPM)	Internal Work Order
		<b>20-03062</b>
		Received By <b>RSPENCER</b>

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	MM1.4		
02	BLANK	0		WA	MM1.4		
03	DUP	0		WA	MM1.4		
04	H-12 50-60	1		WA	MM1.4	3.76	50
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	50
05	H-9 50-55	1		WA	MM1.4	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
06	H-10 35-40	1		WA	MM1.4	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
07	H-2 30-35	1		WA	MM1.4	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
08	H-16 35-40	1		WA	MM1.4	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
09	H-18 35-40	1		WA	MM1.4	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
10	H-3 22-27	1		WA	MM1.4	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
11	H-1 35-40	1		WA	MM1.4	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30

*Q 3/12/20*

Received by: *Randolph Spencer* Date: *3-12-20*

**SECTION II**  
**SAMPLE ACKNOWLEDGEMENT**





**Eberline Services – Oak Ridge Laboratory**

**SAMPLE RECEIPT CHECKLIST**  
MP-001-2

WORK ORDER # 20F03062

SAMPLE MATRIX/MATRICES:

(CIRCLE ONE OR BOTH)

AQUEOUS      NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	<u>Y</u>	N	
If aqueous, properly preserved	<u>Y</u>	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	<u>Y</u>	N
Unbroken on outside of package?	<u>Y</u>	N
Present on samples?	<u>Y</u>	N
Unbroken on samples?	<u>Y</u>	N
Was chain of custody present upon sample receipt?	<u>Y</u>	N

IF THE RESPONSE TO ANY OF THE ABOVE IS NO, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SIGNATURE: *Spencer*      DATE: 3-12-20

**SECTION III**  
**CASE NARRATIVE**





EBS-OR-47097

April 20, 2020

Dave Angle  
ERM  
840 W Sam Houston Pkwy N #600  
Houston, TX 77478

CASE NARRATIVE  
Work Order # 20-03062-OR

SAMPLE RECEIPT

This work order contains eight water samples received 03/12/2020. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

<u>CLIENT ID</u>	<u>LAB ID</u>	<u>CLIENT ID</u>	<u>LAB ID</u>
H-12 50-60	20-03062-04	H-16 35-40	20-03062-08
H-9 50-55	20-03062-05	H-18 35-40	20-03062-09
H-10 35-40	20-03062-06	H-3 22-27	20-03062-10
H-2 30-35	20-03062-07	H-1 35-40	20-03062-11

ANALYTICAL METHODS

Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0. Total Dissolved Solids were performed using Standard Methods 2540C.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size and matrix type.

SPECIAL CIRCUMSTANCES

Chemical recovery for sample fraction -08 (Client ID: H-16 35-40) was low. Due to this circumstance, chemical recovery was estimated at 100 percent.

## ANALYTICAL RESULTS CONTINUED

### RADIUM-226

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. This was followed by precipitations of Radium/Barium Sulfate. Precipitates were dissolved in alkaline EDTA. Radium was selectively precipitated and then mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. The final result was corrected for inherent self-absorption from elemental Barium. Chemical recovery was calculated using a Barium-133 tracer, which was determined by HPGe gamma spectroscopy.

Samples demonstrated acceptable results for all Radium-226 analyses. Sample fractions -04 and -05 (Client ID: H-12 50-60 and H-9 50-55) demonstrated slightly high method detection limits. Chemical recovery was acceptable for all samples. The Radium-226 method blank demonstrated an acceptable result. Results for the Radium-226 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Radium-226 laboratory control sample demonstrated an acceptable percent recovery.

### RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-228 were then counted on a gas proportional counter. Chemical recovery was determined using a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all samples. The Radium-228 method blank demonstrated an acceptable result. Results for the Radium-228 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

### TOTAL DISSOLVED SOLIDS (TDS)

A volumetric aliquot of each sample was filtered through 0.45µm filter media into a tared 250 ml beaker. Samples were dried on a hot plate and allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated Total Dissolved Solids content that ranged from 239.0 to 64,986.0 mg/L.

CERTIFICATION OF ACCURACY

I certify that this data report is in compliance with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.



M.R. McDougall  
Laboratory Manager

Date: 4/20/2020

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit <http://eberlineanalytical.com/> to provide us with feedback on our services.

**SECTION IV**  
**ANALYTICAL RESULTS SUMMARY**

# Eberline Analytical

## Final Report of Analysis

**Report To:**  
 Dave Angle  
 ERM  
 840 W Sam Houston Pkwy N Suite 600  
 Houston, TX 77024

**Work Order Details:**  
 SDG: **20-03062**  
 Project: 0526033 Henning Management  
 Analysis Category: ENVIRONMENTAL  
 Sample Matrix: WA

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
20-03062-01	LCS	KNOWN	03/12/20 00:00	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	9.90E+00	4.56E-01			pCi/l
20-03062-01	LCS	SPIKE	03/12/20 00:00	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	9.65E+00	1.47E+00	2.52E+00	3.47E-01	pCi/l
20-03062-02	MBL	BLANK	03/12/20 00:00	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	2.34E-02	9.75E-02	9.76E-02	2.50E-01	pCi/l
20-03062-03	DUP	H-10 35-40	03/05/20 15:30	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	5.51E-01	2.74E-01	2.97E-01	1.45E-01	pCi/l
20-03062-04	TRG	H-12 50-60	03/05/20 11:05	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	6.79E-01	8.88E-01	9.00E-01	1.36E+00	pCi/l
20-03062-05	TRG	H-9 50-55	03/05/20 13:35	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	3.94E-01	8.22E-01	8.26E-01	1.57E+00	pCi/l
20-03062-06	DO	H-10 35-40	03/05/20 15:30	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	6.15E-01	3.71E-01	3.93E-01	3.87E-01	pCi/l
20-03062-07	TRG	H-2 30-35	03/05/20 16:55	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	2.56E-01	2.10E-01	2.16E-01	2.57E-01	pCi/l
20-03062-08	TRG	H-16 35-40	03/06/20 08:15	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	-2.69E-02	8.56E-02	8.58E-02	2.83E-01	pCi/l
20-03062-09	TRG	H-18 35-40	03/06/20 09:50	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	1.15E+00	4.32E-01	4.96E-01	2.44E-01	pCi/l
20-03062-10	TRG	H-3 22-27	03/06/20 13:15	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	1.74E-01	1.95E-01	1.99E-01	2.76E-01	pCi/l
20-03062-11	TRG	H-1 35-40	03/06/20 11:10	3/12/2020	3/18/2020	20-03062	Radium-226	EPA 903.0 Modified	1.26E+00	5.01E-01	5.67E-01	2.81E-01	pCi/l
20-03062-01	LCS	KNOWN	03/12/20 00:00	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	9.03E+00	4.60E-01			pCi/l
20-03062-01	LCS	SPIKE	03/12/20 00:00	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	9.42E+00	7.60E-01	2.26E+00	8.78E-01	pCi/l
20-03062-02	MBL	BLANK	03/12/20 00:00	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	1.83E-01	3.95E-01	3.97E-01	8.23E-01	pCi/l
20-03062-03	DUP	H-10 35-40	03/05/20 15:30	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	1.19E+00	4.38E-01	5.14E-01	8.05E-01	pCi/l
20-03062-04	TRG	H-12 50-60	03/05/20 11:05	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	1.40E+00	7.62E-01	8.26E-01	1.47E+00	pCi/l
20-03062-05	TRG	H-9 50-55	03/05/20 13:35	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	3.93E-01	5.69E-01	5.76E-01	1.17E+00	pCi/l
20-03062-06	DO	H-10 35-40	03/05/20 15:30	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	2.02E+00	6.18E-01	7.69E-01	1.10E+00	pCi/l
20-03062-07	TRG	H-2 30-35	03/05/20 16:55	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	4.16E-01	5.26E-01	5.34E-01	1.08E+00	pCi/l
20-03062-08	TRG	H-16 35-40	03/06/20 08:15	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	1.04E-01	3.90E-01	3.91E-01	8.25E-01	pCi/l
20-03062-09	TRG	H-18 35-40	03/06/20 09:50	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	4.81E-01	6.46E-01	6.55E-01	1.33E+00	pCi/l
20-03062-10	TRG	H-3 22-27	03/06/20 13:15	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	4.48E-01	5.10E-01	5.20E-01	1.04E+00	pCi/l
20-03062-11	TRG	H-1 35-40	03/06/20 11:10	3/12/2020	3/23/2020	20-03062	Radium-228	EPA 904.0	1.92E+00	5.32E-01	6.87E-01	9.25E-01	pCi/l

0018

CU=Counting Uncertainty; CSU=Combined Standard Uncertainty (1-sigma); MDA=Minimal Detected Activity; LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original



**EBERLINE**  
ANALYTICAL

EBERLINE ANALYTICAL CORPORATION

601 SCARBORO ROAD OAK RIDGE, TN 37830 865/481-0683 FAX 865/483-4621

# Eberline Analytical

## Final Report of Analysis

**Dave Angle**

**ERM**

**840 W Sam Houston Pkwy N Suite 600  
Houston, TX 77024**

**SDG: 20-03062**

**Project: 0526033 Henning Management**

**Analysis Category: ENVIRONMENTAL**

**Sample Matrix: WA**

Work Order Details:

Report To:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
20-03062-04	TRG	H-12 50-60	03/05/20 11:05	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	6.50E+04				mg/l
20-03062-05	TRG	H-9 50-55	03/05/20 13:35	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	3.84E+04				mg/l
20-03062-06	TRG	H-10 35-40	03/05/20 15:30	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	2.24E+03				mg/l
20-03062-07	TRG	H-2 30-35	03/05/20 16:55	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	2.77E+03				mg/l
20-03062-08	TRG	H-16 35-40	03/06/20 08:15	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	2.36E+04				mg/l
20-03062-09	TRG	H-18 35-40	03/06/20 09:50	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	6.43E+03				mg/l
20-03062-10	TRG	H-3 22-27	03/06/20 13:15	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	2.39E+02				mg/l
20-03062-11	TRG	H-1 35-40	03/06/20 11:10	3/12/2020	3/16/2020	20-03062	TDS	SM2540C	1.98E+03				mg/l



**SECTION V**  
**ANALYTICAL STANDARD**

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

<sup>Ra-226</sup>  
QA/QC REVIEWED  
Date 2/8/94 Initials W

Radionuclide: Ra-226 Customer: TMA EBERLINE  
Half Life: 1600 ± 7 years P.O.No.: VH1888  
Catalog No.: 7226 Reference Date: February 1 1994 12:00 PST.  
Source No.: 453-26 Contained Radioactivity: (Ra-226) 1.001 μCi.  
Contained Radioactivity: (Ra-226) 37.0 kBq.

Description of Solution  
a. Mass of solution: 5.1864 g (in a 5 ml Flame Sealed Ampoule)  
b. Chemical form: Ra(NO<sub>3</sub>)<sub>2</sub> in 1 N HNO<sub>3</sub>  
c. Carrier content: None added  
d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities None detected (other than daughters)

Radioactive Daughters  
Rn-222, Po-218, At-218, Pb-214, Bi-214, Po-214, Tl-210, Pb-210, Bi-210, Po-210 and Tl-206.

Radionuclide Concentration  
(Ra-226) 0.1929 μCi/g.

## Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:  
Energy peak(s) integrated under: 186 keV.  
Branching ratio(s) used: 0.0351 gamma rays per decay.

## Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: ±3.4%
- b. Random uncertainty in assay: ±3.1%
- c. Random uncertainty in weighing(s): ±0.2%
- d. Total uncertainty at the 99% confidence level: ±4.6%

## NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

## Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

## Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).



ISOTOPE PRODUCTS LABORATORIES  
1800 North Keystone Street  
Burbank, California 91504  
(818) 843 - 7000

Anna H. Kuen  
QUALITY CONTROL

Feb. 3, 1994  
Date Signed





QUALITY CONTROL PROGRAM  
MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE SOLUTIONS  
PRIMARY DILUTION RECERTIFICATION  
MP 009

SOLUTION REFERENCE # IPL 453-26 CURRENT DATE 9/12/2019 0:00  
SOLUTION # Ra-5

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Certified Activity 1.001E+00  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci}$  per gram

Ampoule /Solution Gross                      Weight, Grams  
Empty Ampoule                      Weight, Grams  
Solution Net                      Weight, Grams  
Total Activity in Ampoule 1.0010  $\mu\text{Ci}$

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0010  $\mu\text{Ci}$  Which Equals 2.222E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.222E+03 dpm/ml  
This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 9, 2020

Verified & Approved By 

Date: 9/12/2019

QC Approval 

Date: 9/16/19



QUALITY CONTROL PROGRAM

MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS  
SECONDARY DILUTION RECERTIFICATION

Solution Reference # MP 009 IPL-453-26 Date 9/12/2019 0:00  
Solution # Ra-5b

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide of Interest: <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Parent Solution Conc. 2.22E+03 dpm/ml

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml  
Total Activity: 4.4440E+04 dpm  
Final Volume: 1000.00 ml  
Final Activity Concentration: 4.4440E+01 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

NOTES:

Expiration Date: 9-Sep-20

Verified & Approved By [Signature]  
QC Approval [Signature]

Date: 9/12/2019 0:00

Date: 9/16/19

**ANALYTICS**

#411 Rec'd 2/15/06 *R. Prentiss*

1380 Seaboard Industrial Blvd.  
Atlanta, Georgia 30318 • U.S.A.

Phone (404) 352-8677  
Fax (404) 352-2837



# CERTIFICATE OF CALIBRATION

## Standard Radionuclide Source

72325-207

*Ra<sup>228</sup>*

Ra-228 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Ra-228
ACTIVITY (dps):	4.022 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	February 10, 2006 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	4.0%

Impurities:  $\gamma$ -impurities <0.1%

5.10721 grams 0.1M HCl solution with 50  $\mu$ g/g Ba carrier.

P O NUMBER 00003181, Item 1

SOURCE PREPARED BY:

*M. Taskaeva*  
M. Taskaeva, Radiochemist

Q A APPROVED:

*W.M. [Signature] 2-13-06*

0024



**QUALITY CONTROL PROGRAM**  
MP-009

Rev.8; 1/10/03  
Title: Radioactive Reference Standards Solutions & Records

**EBERLINE SERVICES - OAK RIDGE LABORATORY**  
**RADIOACTIVE REFERENCE SOLUTIONS**  
*RECERTIFICATION*  
**MP 009**

SOLUTION REFERENCE # Analytix 7235-207 CURRENT DATE 1/15/2020 0:00  
SOLUTION # Ra-12

Principal Radionuclide	Half Life, Years	Half Life, Days
<sup>228</sup> Ra	5.750E+00	2.100E+03

Radionuclide	<sup>228</sup> Ra	Reference Date	2/10/2006 0:00
Certified Activity	1.087E-01 $\mu$ Ci		
Certified Concentration	$\mu$ Ci per gram		

Ampoule /Solution Gross	9.0741	Weight, Grams
Empty Ampoule	3.9858	Weight, Grams
Solution Net	5.0883	Weight, Grams
Total Activity in Ampoule	0.1087	$\mu$ Ci

**Chemical Composition of Standard Solution**

<sup>228</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 0.5 M HCl

Dilution Instructions: Dilution Solvent Used 0.5 M HCl

Dilute to a volume of 991.00 Kg

Certified Total Activity of 0.1087  $\mu$ Ci Which Equals 2.413E+05 dpm at the date listed above

And after dilution the activity of this solution is 2.435E+02 dpm/ml. This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: January 15, 2021

Recertified By [Signature]

Date: 1/15/20

QC Approval [Signature]

Date: 1/15/20



Ba-6  
(#6a)

# National Institute of Standards & Technology

## Certificate

ORIGINAL

### Standard Reference Material 4251C Barium-133 Radioactivity Standard

ORIGINAL

This Standard Reference Material (SRM) consists of radioactive barium-133 chloride, non-radioactive barium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

#### Radiological Hazard

The SRM ampoule contains barium-133 with a total activity of approximately 2.5 MBq. Barium-133 decays by electron capture and during the decay process X-rays and gamma rays with energies from 4 to 400 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]\*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

#### Chemical Hazard

The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

#### Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least June 2004.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

#### Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group and D.B. Golas, Nuclear Energy Institute Research Associate.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899  
October 1994

Thomas E. Gills, Chief  
Standard Reference Materials Program



QUALITY CONTROL PROGRAM  
QCP-009

Rev.8; 11/10/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS  
SECONDARY DILUTION RECERTIFICATION

Solution Reference #		QCP-009-1-A NIST SRM4251C	Date	4/26/19
Solution #				Ba-6a
Principal Radionuclide	Half Life, Years	Half Life, Days		
<sup>133</sup> Ba	1.048E+01	3.828E+03		
Radionuclide of Interest	<sup>133</sup> Ba	Reference Date	9/1/1993 0:00	
Parent Solution Conc.	1.48E+05 dpm/ml			
Chemical Composition of Standard Solution				
<sup>133</sup> BaCl <sub>2</sub> in 1M HCl				

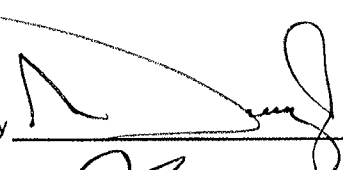

Dilution Instructions: Dilution Solvent Used 1M HCl

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution:	25.0000 ml	Final Activity Concentration:	3.6950E+03 dpm/ml
Total Activity:	3.6950E+06 dpm		
Final Volume:	1000.00 ml		

NOTES: This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: April 25, 2020

Verified & Approved By  Date: 4/26/19  
QC Approval  Date: 4/26/19

**SECTION VI**  
**QUALITY CONTROL SAMPLE RESULTS SUMMARY**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>20-03062</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226	97.45%	26.08%	100.00%	4.60%	9.90E+00	4.56E-01	9.65E+00	2.52E+00	Ra-5b	4.39E+01	4.60E+00	5.00E-01

**Matrix Spike**

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	0.26	11.06	6.15E-01	3.93E-01	5.51E-01	2.97E-01	0.97	OK			NA	OK

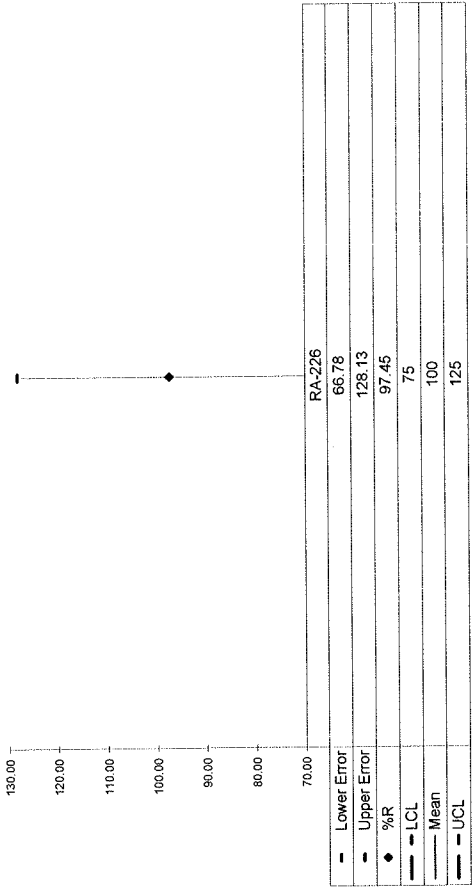
**QC Summary**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	0.26	11.06	6.15E-01	3.93E-01	5.51E-01	2.97E-01	0.97	OK			NA	OK

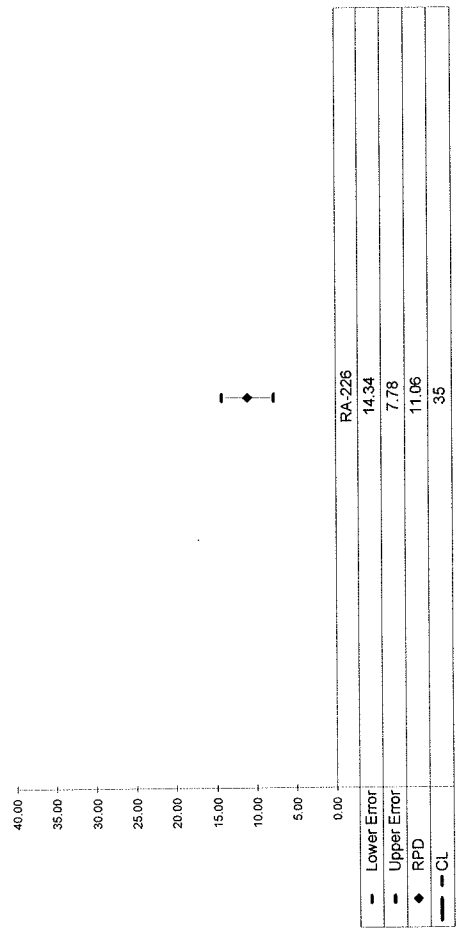


WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>20-03062</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

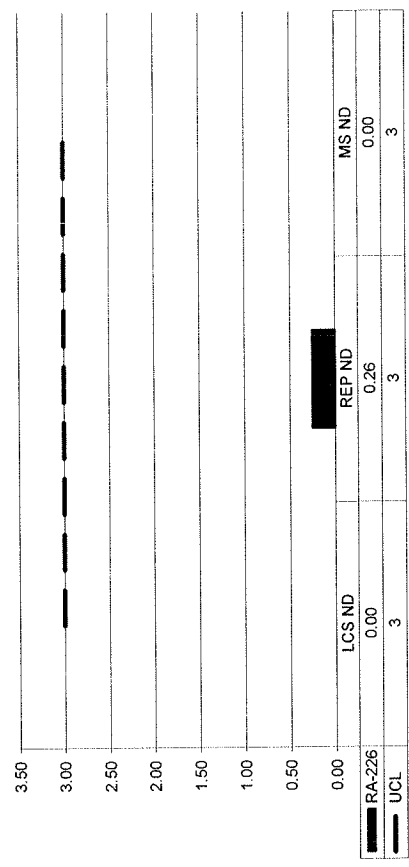
### LCS % Recovery



### Replicate Sample RPD



### Normalized Difference



No Matrix Spike

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>20-03062</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>1</b>	<b>ERM</b>

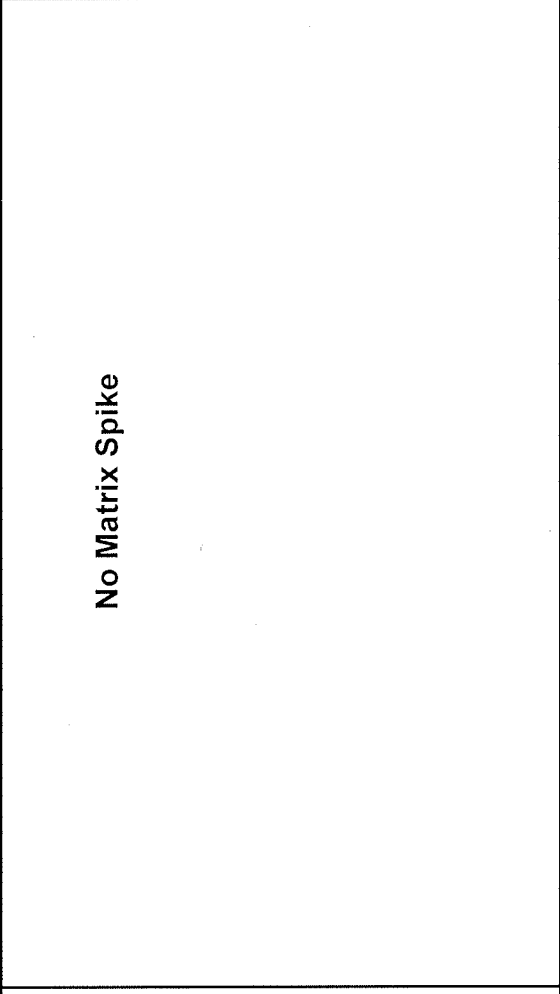
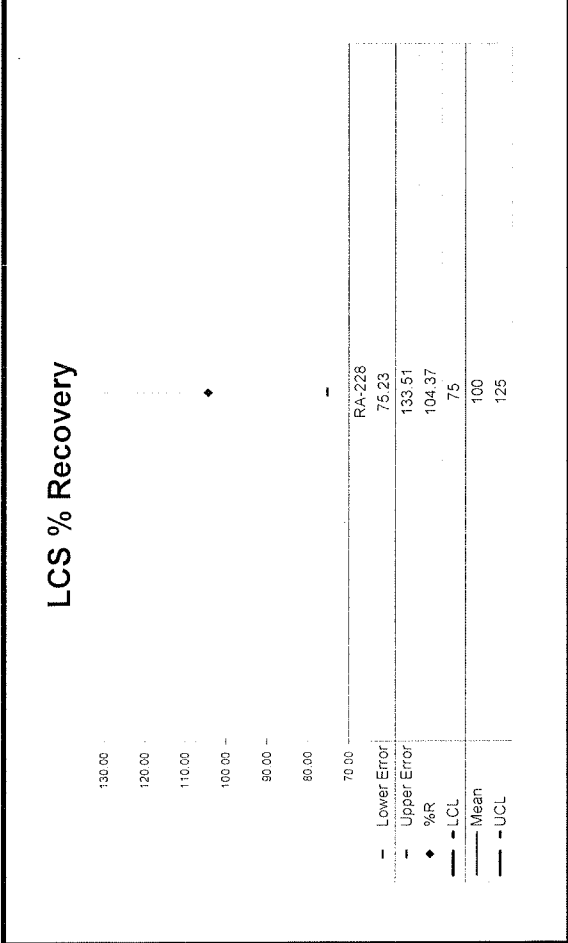
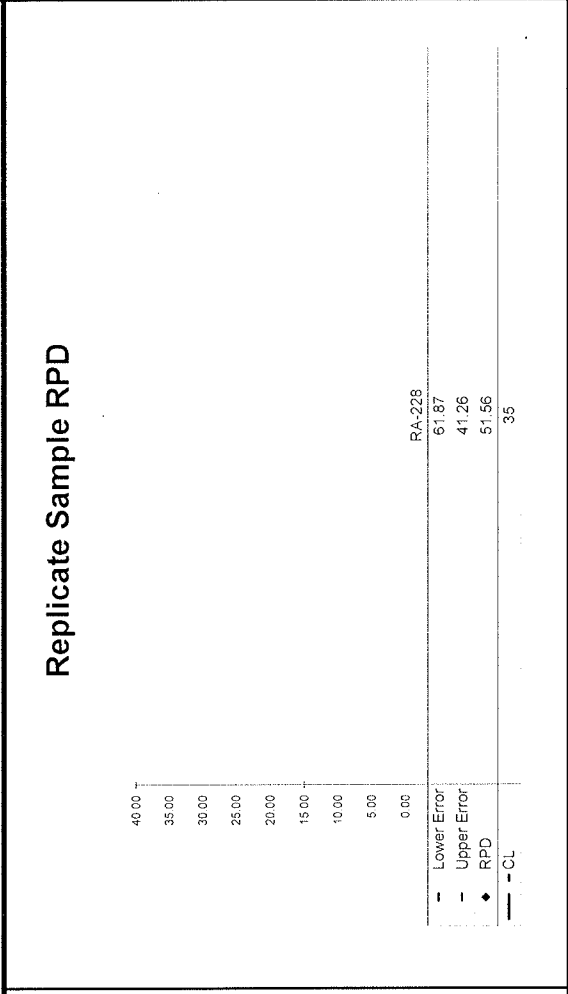
Laboratory Control Sample												
Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228	104.37%	24.04%	100.00%	5.10%	9.03E+00	4.60E-01	9.42E+00	2.26E+00	Ra-12	4.44E+01	5.10E+00	4.51E-01

Matrix Spike												
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ACT (dpm)	Standard Error %	Standard Added (g)

Replicate Sample												
Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-228	1.75	51.56	2.02E+00	7.69E-01	1.19E+00	5.14E-01	1.04	OK			NA	OK

QC Summary

W/O	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>20-03062</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>



No Matrix Spike

**SECTION VII**  
**LABORATORY TECHNICIAN'S NOTES**

**RA-226 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	20-03062
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	03/16/20 11:11	PREP	JHARVEY	ALIQUOTED AND FILTERED FRACTIONS 4 AND 5- ADDED SPIKE AND TRACER TO ALL SAMPLES- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

*J Harvey*  
 3/16/2020

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	20-03062
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	03/16/20 11:11	PREP	JHARVEY	ALIQUOTED AND FILTERED FRACTIONS 4 AND 5- ADDED SPIKE AND TRACER TO ALL SAMPLES- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	03/18/20 12:35	CHEM	DBUSH	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

*By Dan Bush*  
 3/18/20



Reagents Used in an Analysis

Internal Work Order

**20-03062**

Analysis Code

Run

**Ra226**

**1**

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
021318P	Ammonium Hydroxide	Reagent Grade	JHARVEY	3/16/2020
021302D07	Ammonium Sulfate	200 mg/ml	JHARVEY	3/16/2020
020921D15	Barium Carrier	1 mg/ml	JHARVEY	3/16/2020
021343D01	Lead Carrier	166 mg/ml	JHARVEY	3/16/2020
021951P	Nitric Acid	Reagent Grade	JHARVEY	3/16/2020
021557P	Acetic Acid	Reagent Grade	DBUSH	3/18/2020
021302D05	Ammonium Sulfate	200 mg/ml	DBUSH	3/18/2020
021573S	EDTA	0.25M	DBUSH	3/18/2020



Alpha Bank 3


Date	Sample #	Client	Load time	Count time	Analysis	Tech
3/16/20	2003052A(1-4)	UCOR	0814	2hr50min	Th	KP
3/16/20	2003052A(1-4)	UCOR	0815	2hr50min	UU	KP
3/16/20	2003052A(1)	UCOR	0815	2hr50min	Np	KP
3/16/20	2003052A(1-4)	UCOR	0815	2hr50min	Th <sup>2201</sup>	KP
3/16/20	Reagent 132A(1)	Lab	0817	1hr	UUNT	KP
3/16/20	Reagent 133A(1)	Lab	0817	1hr	UUNT	KP
3/16/20	2003056A(1-7)	Ucon	1114	2hr50-	Rate	KB
3/16/20	2003052A(1-2)	Ucon	1117	2hr50-	Pu <sup>242</sup>	KB
3/16/20	2003052A(1-2)	Ucon	1117	2hr50-	Pu	KB
3/16/20	2003052A(1-4)	Ucon	1137	2hr50-	Rate	KB
3/16/20	2003040A(1-4,6)	USA	1431	2hr50-	Rate	KB
3/17/20	Daily Pulser	Lab	0510	10min	NA	KP
3/17/20	2003056A(1-7)	UCOR	0830	2hr50min	Pu	KP
3/17/20	2003056A(1-7)	UCOR	0830	2hr50min	UU	KP
3/17/20	2003056A(1-7)	UCOR	0831	2hr50min	Np	KP
3/17/20	2003063A(1-5)	Ucon	1124	2hr50-	Rate	KB
3/17/20	2003063A(1-5)	Unitech	1127	2hr50-	UU	KB
3/17/20	2003056A(1-7)	UCOR	1128	2hr50-	Th	KB
3/17/20	2003040A(1-4)	USA	1129	2hr50-	UU	KB
3/17/20	2003040A(6)	USA	1422	2hr50-	UU	KB
3/17/20	2003048A(1-6)	DOE	1423	5hr30-	UU	KB
3/18/20	Daily Pulser	Lab	0517	10min	NA	KP
3/18/20	2003053A(5)	UCOR	0800	2hr50min	Th	KP
3/18/20	2003053A(1-3)	UCOR	0800	2hr50min	UU	KP
3/18/20	2003048A(1-6)	DOE	0802	5hr35min	Am <sup>241</sup>	KP
3/18/20	2003048A(1-6)	DOE	0803	5hr35min	Pu	KP
3/18/20	2003047A(1-4,6)	DOE	0804	5hr35min	UU	KP
3/18/20	2003053A(4-5)	UCOR	1052	2hr50-	UU	KB
3/18/20	2003062A(1-11)	ERM	1352	2hr50-	Rate	KB

**RA-228 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	20-03062
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	03/16/20 11:11	PREP	JHARVEY	ALIUQUOTED AND FILTERED FRACTIONS 4 AND 5- ADDED SPIKE AND TRACER TO ALL SAMPLES- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS


*J Harvey*  
 3/16/2020

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	20-03062
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	03/16/20 11:11	PREP	JHARVEY	ALIQUOTED AND FILTERED FRACTIONS 4 AND 5- ADDED SPIKE AND TRACER TO ALL SAMPLES- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	03/23/20 10:28	CHEM	DBUSH	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER, AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 1N HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

*Dylan Bush*

3/23/20

 <b>Reagents Used in an Analysis</b>		Internal Work Order		
		20-03062		
		Analysis Code		Run
		Ra228		1
Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
021318P	Ammonium Hydroxide	Reagent Grade	JHARVEY	3/16/2020
021302D07	Ammonium Sulfate	200 mg/ml	JHARVEY	3/16/2020
020921D15	Barium Carrier	1 mg/ml	JHARVEY	3/16/2020
021343D01	Lead Carrier	166 mg/ml	JHARVEY	3/16/2020
021951P	Nitric Acid	Reagent Grade	JHARVEY	3/16/2020
021198D01	Ammonium Oxalate	5%	DBUSH	3/23/2020
021573S	EDTA	0.25M	DBUSH	3/23/2020
020241D07	Nitric Acid	1N	DBUSH	3/23/2020
020774D19	Nitric Acid	6N	DBUSH	3/23/2020
021257D06	Sodium Hydroxide	10M	DBUSH	3/23/2020
021257D01	Sodium Hydroxide	18M	DBUSH	3/23/2020
021833S	Yttrium Carrier	9 mg/ml	DBUSH	3/23/2020



**EBERLINE**  
SERVICES

Reagents Used in an Analysis

Internal Work Order

**20-03062**

Analysis Code

Run

**Ra228**

**1**

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
021318P	Ammonium Hydroxide	Reagent Grade	JHARVEY	3/16/2020
021302D07	Ammonium Sulfate	200 mg/ml	JHARVEY	3/16/2020
020921D15	Barium Carrier	1 mg/ml	JHARVEY	3/16/2020
021343D01	Lead Carrier	166 mg/ml	JHARVEY	3/16/2020
021951P	Nitric Acid	Reagent Grade	JHARVEY	3/16/2020
021198D01	Ammonium Oxalate	5%	DBUSH	3/23/2020
021573S	EDTA	0.25M	DBUSH	3/23/2020
020241D07	Nitric Acid	1N	DBUSH	3/23/2020
020774D19	Nitric Acid	6N	DBUSH	3/23/2020
021257D06	Sodium Hydroxide	10M	DBUSH	3/23/2020
021257D01	Sodium Hydroxide	18M	DBUSH	3/23/2020
021833S	Yttrium Carrier	9 mg/ml	DBUSH	3/23/2020

Agua LB4110

Date	Sample #	Client	Load time	Count time	Analysis	Tech
3/23/20	2003084Sr (1)	UCOR	0716	30 min	Tot Sr	KP
3/23/20	2003084Sr (2-4,6)	UCOR	0716	1 hr	Tot Sr	KP
3/23/20	2003060AB (1-4)	Univ. of GA	0717	2 hrs	XB	KP
3/23/20	2003054Np (1-35)	UCOR.	0800	10 min	Np	KP
3/23/20	2003062Ra (1-11)	ERM	1222	2 hrs	Ra <sup>8</sup>	KP

**TDS NOTES**



 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	20-03062
		Analysis Code	TDS
		Run Number	1

#	Date	Dept	User	Notes
1	03/16/20 01:10	PREP	MHIGHTOWER	Filtered sample into tared beaker, dried, re-weighed

*MU 16 MAR 20*

**SECTION VIII**  
**ANALYTICAL DATA (RADIUM-226)**



















# Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
<b>20-03062</b>	<b>1</b>	<b>Ra226</b>	<b>liters</b>	<b>3/27/2020</b>	<b>DBUSH</b>

Lab Fraction	ERM Client ID	Sample Type	Muffle Data		Dilution Data			Aliquot Data			MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dilis	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq		
01	LCS	LCS				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
02	BLANK	MBL				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
03	H-10 35-40	DUP				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
04	H-12 50-60	TRG				1.00E+00	3.3333E-01	3.3333E-01	3.3333E-01					
05	H-9 50-55	TRG				1.00E+00	2.5000E-01	2.5000E-01	2.5000E-01					
06	H-10 35-40	DO				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
07	H-2 30-35	TRG				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
08	H-16 35-40	TRG				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
09	H-18 35-40	TRG				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
10	H-3 22-27	TRG				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					
11	H-1 35-40	TRG				1.00E+00	1.0000E+00	1.0000E+00	1.0000E+00					

Comments	
----------	--



CB  
3/18/20

# Apex-Alpha™

Sample Description: SPIKE  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 01  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_035  
 Chamber Serial Number: 04026477A  
 Detector Serial Number: 58771  
 Env. Background: System Bkgd 275078  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/18/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:28 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1441 +/- 0.0026 on 2/28/2020 7:44:08 AM  
 Effective Efficiency: 0.1441 +/- 0.0026

Control Certificate Name: Ra226\_Ra-5b  
 Chem. Recov. of Control: RA-226 0.324832 +/- 0.027115  
 Peak Match Tolerance: 0.350 MeV

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 ----- PEAK AREA REPORT -----  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.547	6.32	82.73	0.68	0.00E+000	3.0
RA-226	4.595	174.98	14.87	1.02	0.00E+000	3.2

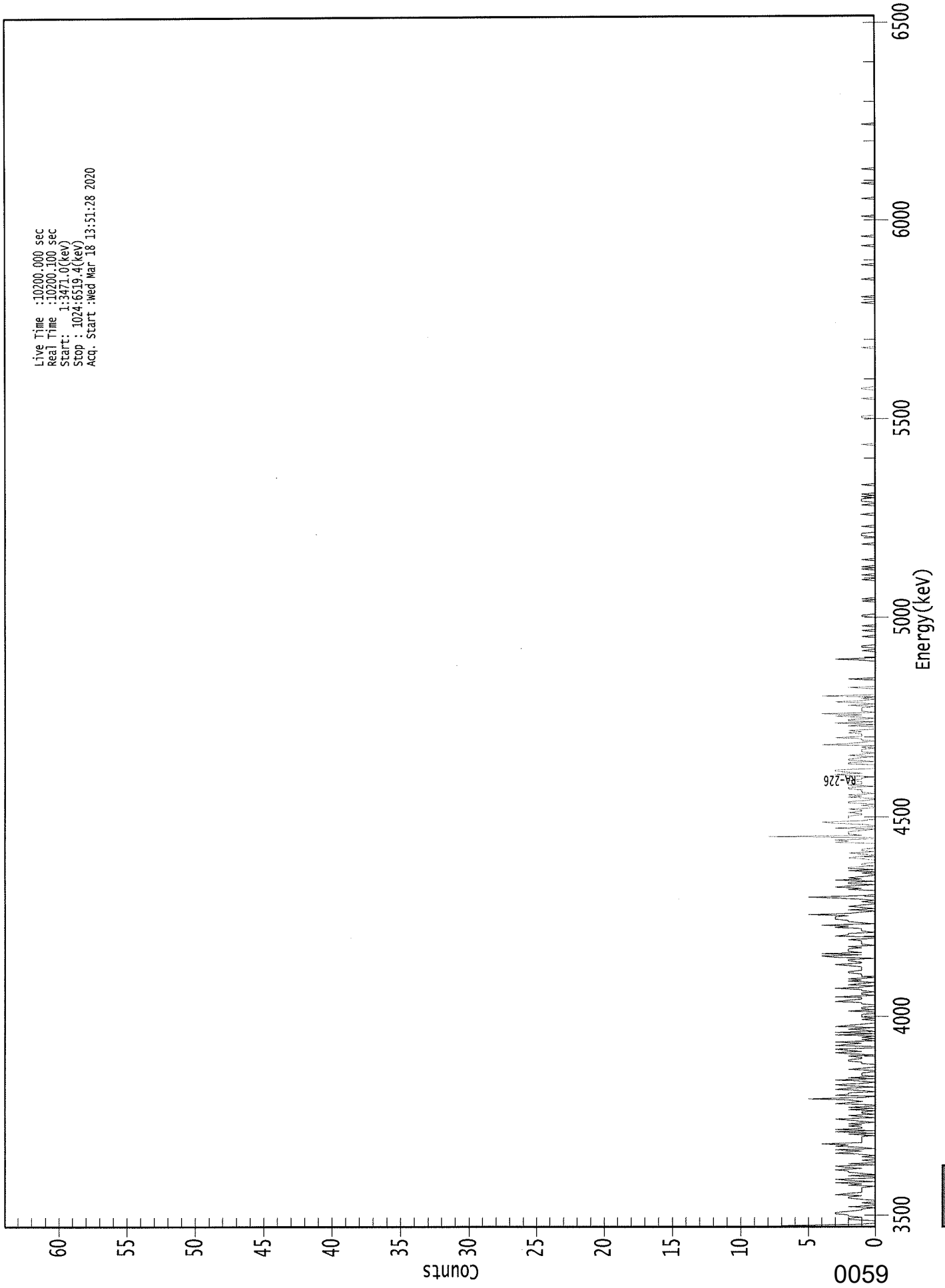
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.975	5685.50*	3.67E-001 +/- 3.03E-001	3.27E-001 +/- 1.14E-002
RA-226	0.954	4785.00*	9.65E+000 +/- 1.47E+000	3.47E-001 +/- 1.21E-002

AG  
 3/19/20

0000270320.CNF

Live Time : 10200.000 sec  
Real Time : 10200.100 sec  
Start : 1:3471.0(kev)  
Stop : 1024:6519.4(kev)  
Acq. Start : Wed Mar 18 13:51:28 2020



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 01

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	7	1	0	0	0	2	2
1:	1	7	1	0	0	0	2	2
9:	1	2	2	3	3	2	1	1
17:	0	2	0	0	1	0	0	1
25:	2	2	1	3	2	1	1	1
33:	1	1	0	2	1	3	0	2
41:	3	0	0	2	0	1	2	2
49:	3	1	2	3	0	2	0	0
57:	1	0	0	1	0	1	3	2
65:	1	3	0	1	3	2	4	1
73:	1	1	1	1	1	0	2	0
81:	3	0	3	1	1	2	1	2
89:	0	1	2	3	0	1	2	0
97:	1	1	0	2	0	2	0	0
105:	3	2	1	2	5	1	0	3
113:	2	2	0	1	3	2	0	2
121:	3	1	0	1	3	0	2	0
129:	1	1	1	0	0	2	1	0
137:	0	0	1	1	2	2	1	1
145:	2	0	2	3	1	2	3	0
153:	0	3	2	1	3	0	1	0
161:	1	0	3	0	3	0	1	2
169:	0	3	2	1	0	0	0	1
177:	0	1	1	1	0	0	2	0
185:	1	1	0	0	1	1	3	2
193:	1	1	3	0	1	1	0	1
201:	1	3	1	0	2	1	0	2
209:	1	2	0	1	1	1	2	2
217:	1	1	1	1	2	3	1	1
225:	2	2	0	3	4	1	4	1
233:	2	2	2	1	2	0	1	1
241:	1	1	2	0	0	3	2	2
249:	0	1	1	1	3	2	4	0
257:	1	2	2	3	3	3	2	5
265:	2	1	0	2	0	1	2	1
273:	0	0	1	0	1	3	5	1
281:	0	0	0	0	2	1	3	2
289:	0	2	2	0	3	1	2	1
297:	0	0	1	0	2	0	2	2
305:	0	1	1	0	0	0	1	2
313:	1	0	1	2	0	1	1	0
321:	0	0	0	0	3	2	3	0
329:	0	8	1	2	2	2	1	0
337:	3	0	0	1	3	4	1	0
345:	2	2	2	1	1	2	1	1
353:	2	0	0	1	0	2	2	1
361:	0	0	2	1	2	0	1	1

369: 1 2 2 0 2 1 1 1

Sample Title: 01

Channel	1	2	3	4	5	6	7	8
377:	2	1	1	0	2	3	1	2
385:	3	3	0	0	0	0	2	2
393:	0	2	2	1	0	2	1	0
401:	1	1	1	0	1	0	4	2
409:	1	0	1	1	3	1	1	1
417:	2	1	2	0	0	0	2	0
425:	3	0	2	2	0	1	3	1
433:	4	0	1	1	1	1	0	2
441:	0	1	3	1	0	1	0	4
449:	0	0	0	0	0	0	2	0
457:	0	0	0	0	0	2	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	1	3	0
481:	0	0	0	0	0	1	0	0
489:	1	1	0	0	0	0	0	0
497:	0	1	0	0	0	0	1	0
505:	0	0	1	0	0	0	0	0
513:	0	0	1	1	0	0	0	0
521:	0	0	0	0	0	0	0	1
529:	0	1	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	1	0	0	0	1	0	0
553:	0	0	1	0	1	0	0	0
561:	0	0	1	0	0	0	0	0
569:	0	0	0	0	0	0	0	1
577:	0	0	0	0	0	0	1	1
585:	1	0	0	0	0	0	1	0
593:	0	0	0	0	0	0	0	0
601:	1	0	0	0	0	0	0	0
609:	1	0	0	1	1	1	0	1
617:	0	1	0	0	0	0	0	0
625:	0	1	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	1	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	1	1	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	1	0	0	0	0	0
705:	0	0	1	1	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	1	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	1	0	0	0	0
785:	1	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	1



801: 0 0 0 0 0 0 0 0

Sample Title: 01

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	1	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	1	0	0	0	0
833:	0	0	0	1	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	1	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	1	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	1	0	0	0	0	0	0	0
889:	0	0	0	0	1	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



# Apex-Alpha™

KB  
3/18/20

Sample Description: BLANK  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 02  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_036  
 Chamber Serial Number: 04026477B  
 Detector Serial Number: 84167  
 Env. Background: System Bkgd 275079  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/18/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:30 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1666 +/- 0.0029 on 2/28/2020 7:44:09 AM  
 Effective Efficiency: 0.1666 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.388	-1.38	168.33	2.38	0.00E+000	3.0
RA-226	4.704	0.49	416.98	0.51	0.00E+000	3.0

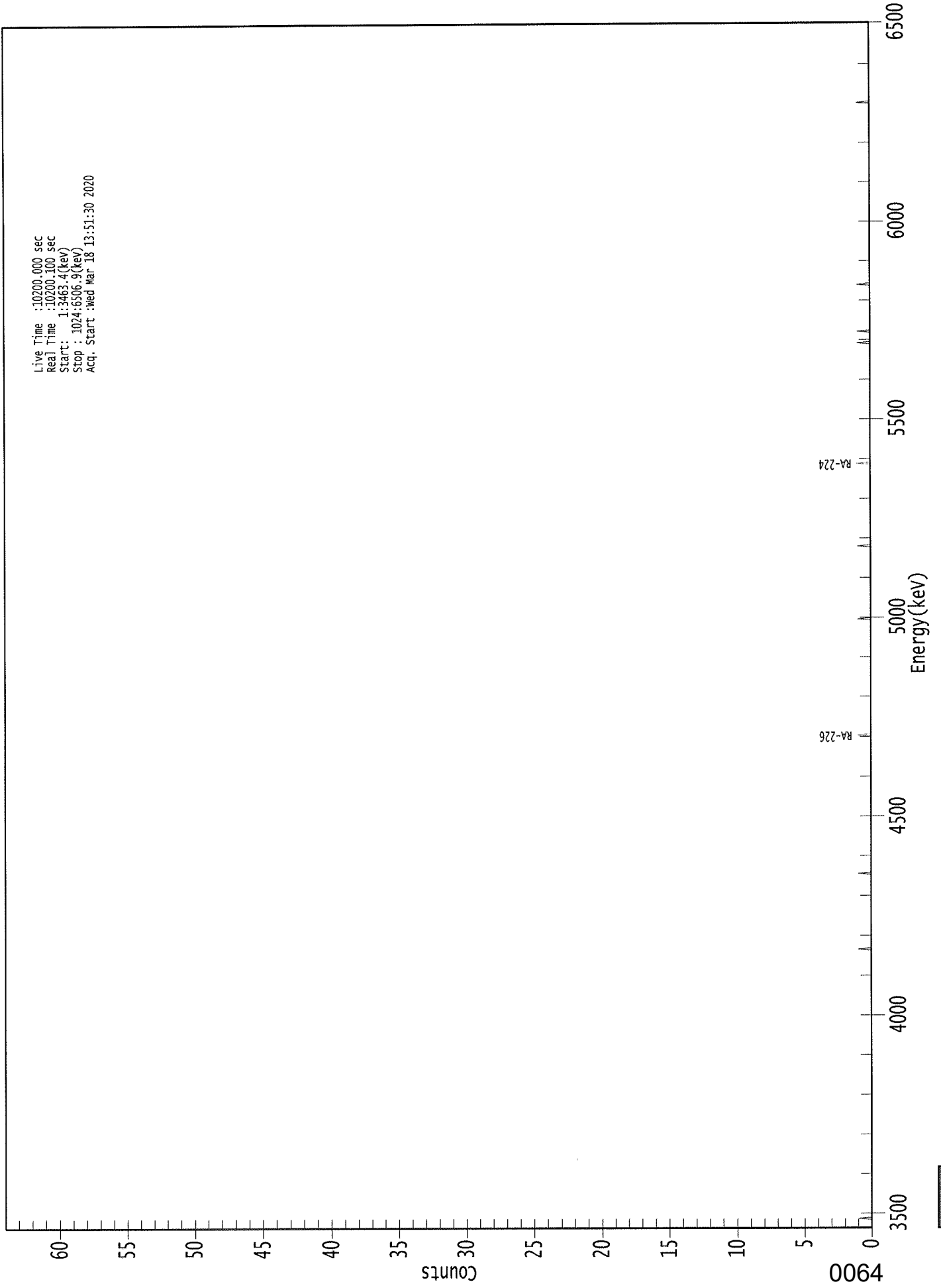
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.891	5685.50*	-6.92E-002 +/- 1.17E-001	4.11E-001 +/- 1.40E-002
RA-226	0.991	4785.00*	2.34E-002 +/- 9.75E-002	2.50E-001 +/- 8.52E-003

AG  
3/19/20

# 0000270319.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3463.4(kev)  
Stop : 1024:6506.9(kev)  
Acq. Start :Wed Mar 18 13:51:30 2020



ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 02

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	1	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	1	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	1	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0
417:	0	1	0	0	0	0	0
425:	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0
513:	0	0	0	1	0	0	0
521:	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0
577:	0	1	0	0	0	0	0
585:	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	1
649:	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0
745:	0	0	0	0	0	1	0
753:	0	0	0	0	0	0	1
761:	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	1

801: 0 0 0 0 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	1	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



78  
3/18/20

Sample Description: H-10 35-40 DUP  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 03  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_037  
 Chamber Serial Number: 04026478A  
 Detector Serial Number: 91133  
 Env. Background: System Bkgd 275080  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.860E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/5/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:32 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9852 +/- 0.0000  
 Counting Efficiency: 0.1438 +/- 0.0025 on 2/28/2020 7:44:10 AM  
 Effective Efficiency: 0.1417 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.453	5.32	91.11	0.68	0.00E+000	3.0
RA-226	4.591	15.83	49.57	0.17	0.00E+000	3.0

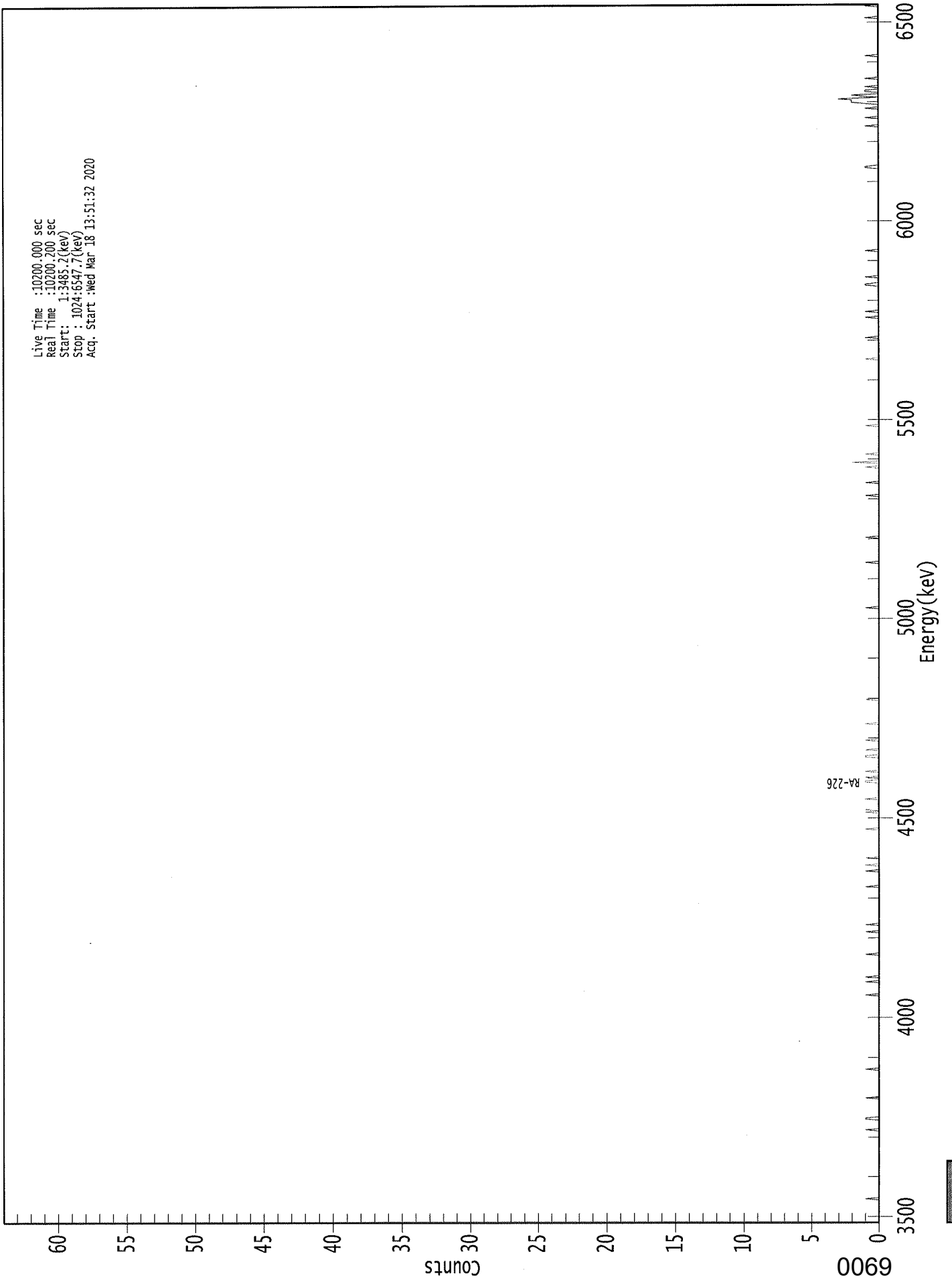
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.932	5685.50*	1.95E-001 +/- 1.78E-001	2.07E-001 +/- 7.19E-003
RA-226	0.952	4785.00*	5.51E-001 +/- 2.74E-001	1.45E-001 +/- 5.03E-003

AG  
3/19/20

0000270316.CNF

Live Time :10200.000 sec  
Real Time :10200.200 sec  
Start : 1:3485.2(kev)  
Stop : 1024:5547.7(kev)  
Acq. Start :Wed Mar 18 13:51:32 2020



ROI Type: 1





369: 0 1 1 0 0 1 0 0

Sample Title: 03

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	1	0	0	0	0	0
385:	0	0	0	0	0	0	1	1
393:	0	0	0	0	1	0	0	0
401:	0	0	0	0	1	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	1	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	1	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	1	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	1	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	1	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	1	0	0	0	0	0	0
617:	0	0	0	0	1	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	1	0	0	0	2	0	0
641:	0	0	0	0	1	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	1	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	1	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	1	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	1
761:	0	0	0	0	1	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	1	1	0	0	0	0
793:	0	1	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 03

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	1
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	1	1	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	1	0	0	0	0	0	0	1
929:	0	0	0	0	0	0	0	1
937:	0	0	0	1	2	2	2	3
945:	0	1	2	0	0	1	1	0
953:	0	1	0	0	0	0	0	0
961:	1	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	1	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	1	0	0	0	0
1017:	0	0	0	0	0	1	0	0



# Apex-Alpha™

K/S  
3/18/20

Sample Description: H-12 50-60  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 04  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_038  
 Chamber Serial Number: 04026478B  
 Detector Serial Number: 91134  
 Env. Background: System Bkgd 275081  
 Reagent Blank: <not performed>

Sample Size: 3.333E-001 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.720E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/5/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:34 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.6419 +/- 0.0000  
 Counting Efficiency: 0.1487 +/- 0.0026 on 2/28/2020 7:44:11 AM  
 Effective Efficiency: 0.0955 +/- 0.0017

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.530	-0.17	1169.4	0.17	0.00E+000	0.0
RA-226	4.645	3.00	130.67	0.00	0.00E+000	3.0

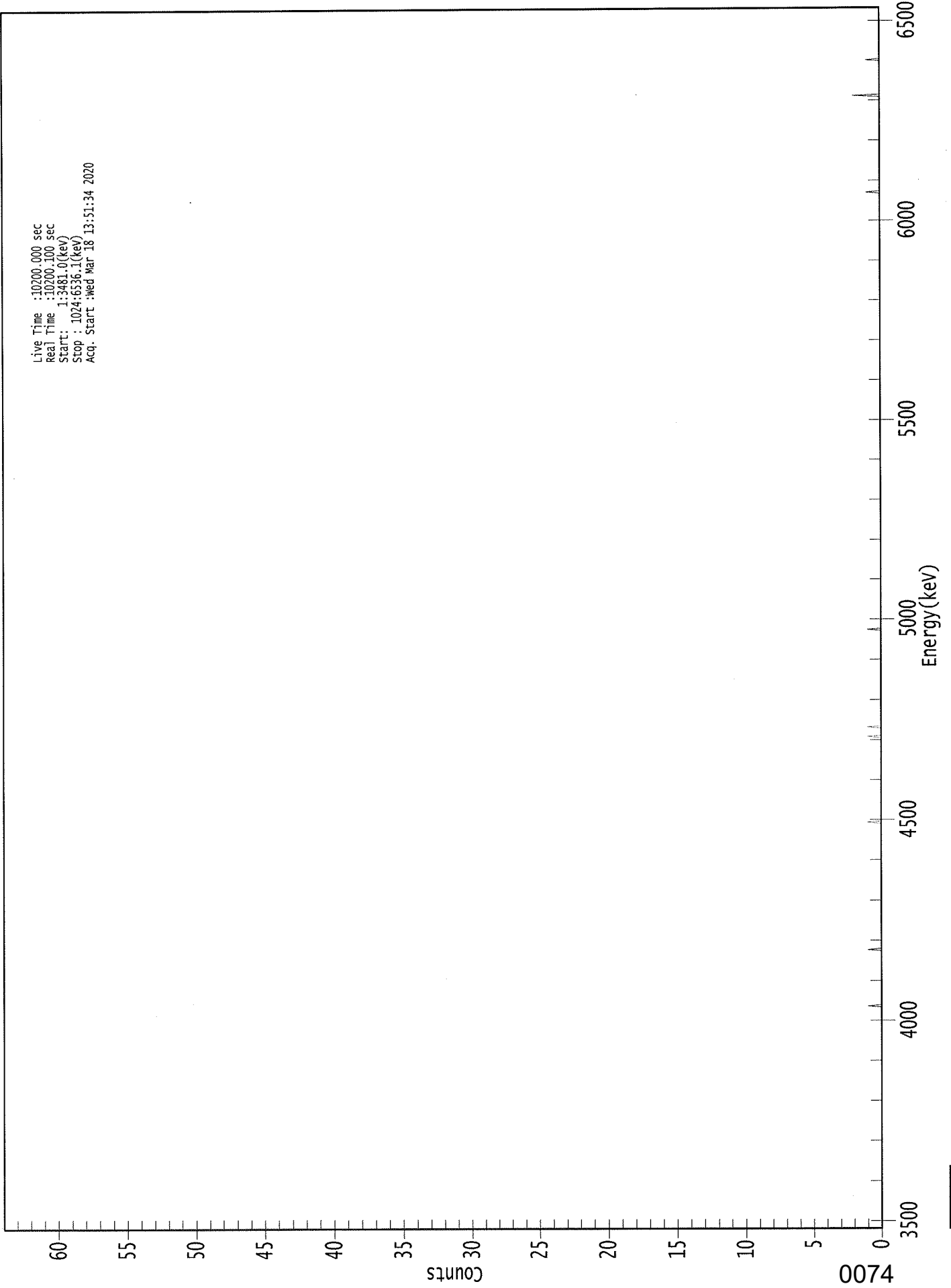
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.969	5685.50*	-4.07E-002 +/- 4.76E-001	9.98E-001 +/- 3.44E-002
RA-226	0.975	4785.00*	6.79E-001 +/- 8.88E-001	1.36E+000 +/- 4.68E-002

AG  
3/19/20

0000270315.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3481.0(kev)  
Stop : 1024:6536.1(kev)  
Acq. Start :Wed Mar 18 13:51:34 2020



ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 04

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	1	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	1	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	1	0	0	0	0
417:	0	0	0	1	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	1	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	1	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	2	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	1	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	1





YD  
3/18/20

Sample Description: H-9 50-55  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 05  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_039  
 Chamber Serial Number: 06027396A  
 Detector Serial Number: 83109  
 Env. Background: System Bkgd 275082  
 Reagent Blank: <not performed>

Sample Size: 2.500E-001 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.470E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/5/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:36 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8864 +/- 0.0000  
 Counting Efficiency: 0.1468 +/- 0.0026 on 2/28/2020 7:44:13 AM  
 Effective Efficiency: 0.1301 +/- 0.0023

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.497	2.47	163.78	1.53	0.00E+000	3.0
RA-226	4.579	1.96	208.49	2.04	0.00E+000	3.0

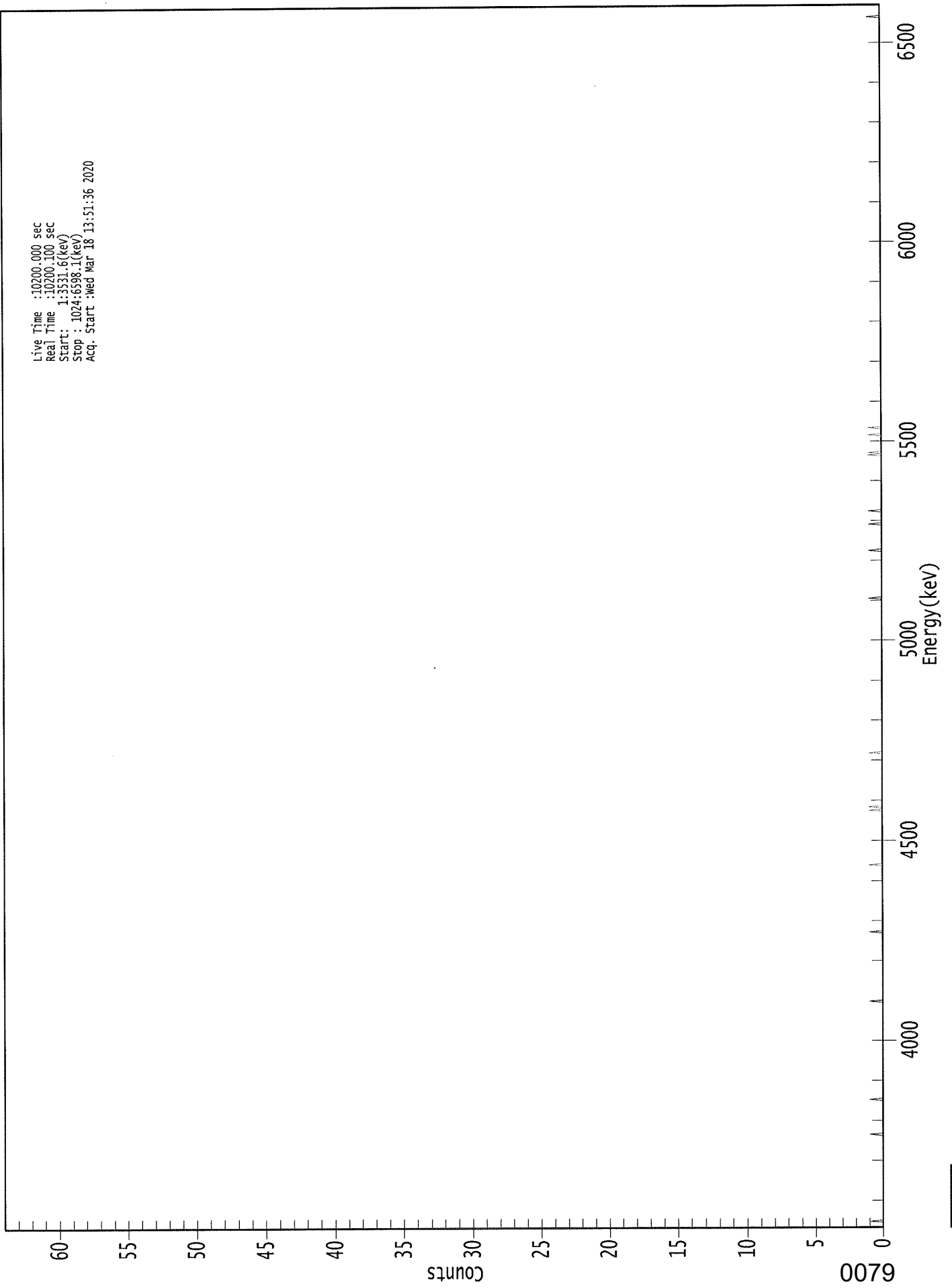
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.954	5685.50*	5.25E-001 +/- 8.60E-001	1.51E+000 +/- 5.22E-002
RA-226	0.946	4785.00*	3.94E-001 +/- 8.22E-001	1.57E+000 +/- 5.42E-002

AG  
3/19/20

0000270310.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3531.6(kev)  
Stop : 1024.6598.1(kev)  
Acq. Start :Wed Mar 18 13:51:36 2020



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 05

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	1	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	1	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	1	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	1	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	1
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	1
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	1	0	0	1
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	1	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	1	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	1	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	1	0	0	0	0
593:	0	0	0	0	0	0	1	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	1	0	1
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	1	0
665:	0	0	0	0	1	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 05

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	1	0	0	0
1017:	0	0	0	0	0	0	0	0



KB  
3/18/20

Sample Description: H-10 35-40  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 06  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_040  
 Chamber Serial Number: 06027396B  
 Detector Serial Number: 91135  
 Env. Background: System Bkgd 275083  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.400E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/5/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:38 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.7977 +/- 0.0000  
 Counting Efficiency: 0.1594 +/- 0.0032 on 2/29/2020 12:52:21 PM  
 Effective Efficiency: 0.1272 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.551	4.49	98.45	0.51	0.00E+000	3.0
RA-226	4.589	12.30	60.24	1.70	0.00E+000	3.0

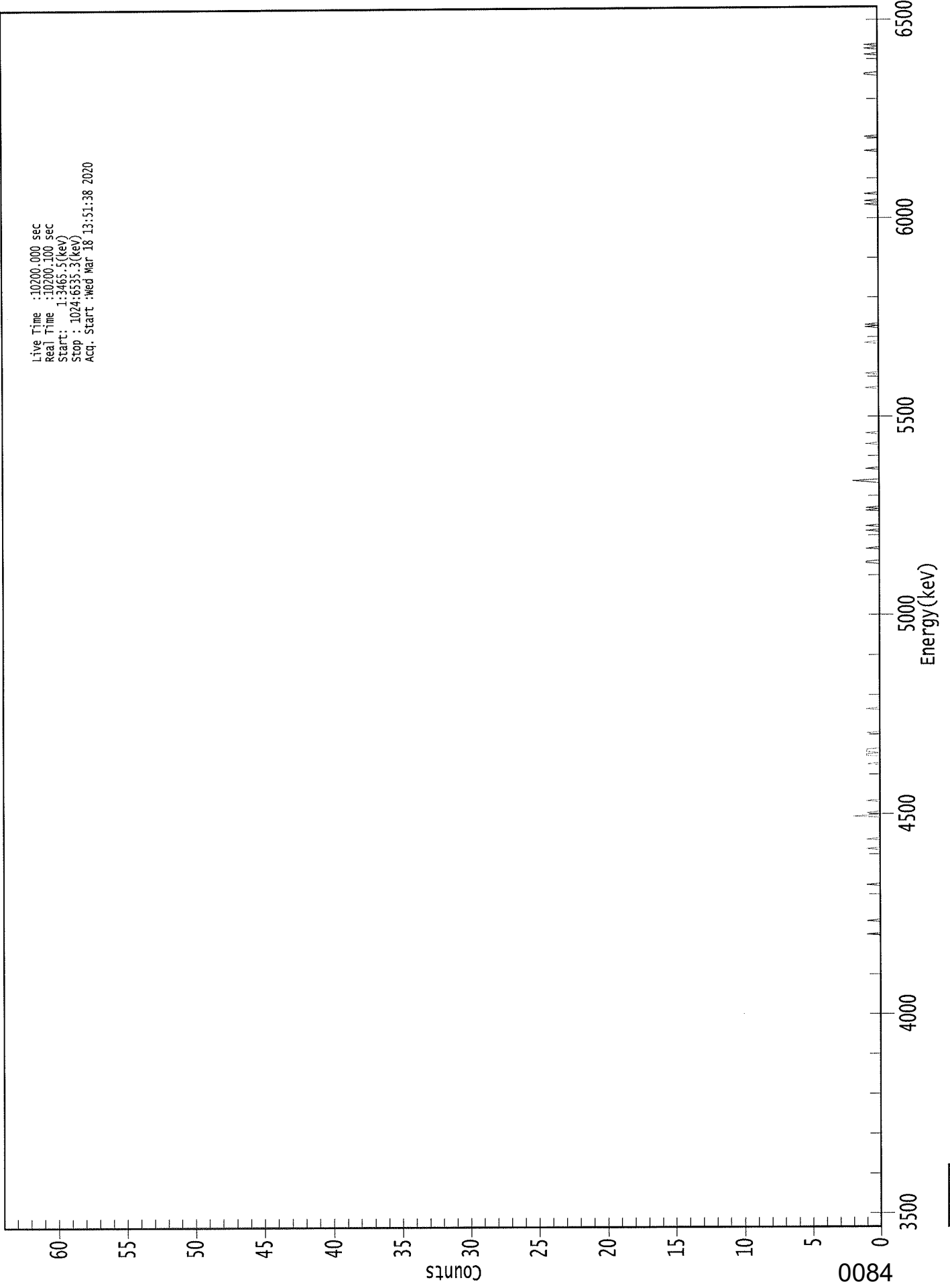
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.977	5685.50*	2.37E-001 +/- 2.34E-001	2.77E-001 +/- 1.09E-002
RA-226	0.951	4785.00*	6.15E-001 +/- 3.71E-001	3.67E-001 +/- 1.44E-002

AG  
3/19/20

0000270311.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3465.5(kev)  
Stop : 1024:6535.3(kev)  
Acq. Start :Wed Mar 18 13:51:38 2020



ROI Type: 1





369: 0 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	1	0	0	0	0
393:	0	0	1	1	0	1	1	1
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	1	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	1	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	1	1	0	0	0
561:	0	0	0	0	0	0	0	1
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	1	0
585:	0	0	1	0	0	0	0	0
593:	0	0	0	0	0	0	0	1
601:	0	1	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	1
625:	2	0	0	0	0	0	0	0
633:	0	0	1	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	1
657:	0	0	0	0	0	0	0	0
665:	1	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	1	0
705:	0	0	0	0	0	0	0	0
713:	0	0	1	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	1	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	1	0	1	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	1	0	0	1	0	0	0	0
865:	0	1	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	1	0	0
905:	0	0	0	0	0	0	0	0
913:	0	1	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	1	1	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	1	0
985:	0	0	0	1	0	0	1	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



# Apex-Alpha™

LB  
3/19/20

Sample Description: H-2 30-35  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 07  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_041  
 Chamber Serial Number: 05026930A  
 Detector Serial Number: 91087  
 Env. Background: System Bkgd 275084  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.040E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/5/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:41 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9085 +/- 0.0000  
 Counting Efficiency: 0.1698 +/- 0.0029 on 2/28/2020 7:44:04 AM  
 Effective Efficiency: 0.1543 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.525	9.49	65.59	0.51	0.00E+000	3.0
RA-226	4.673	7.30	81.83	1.70	0.00E+000	3.0

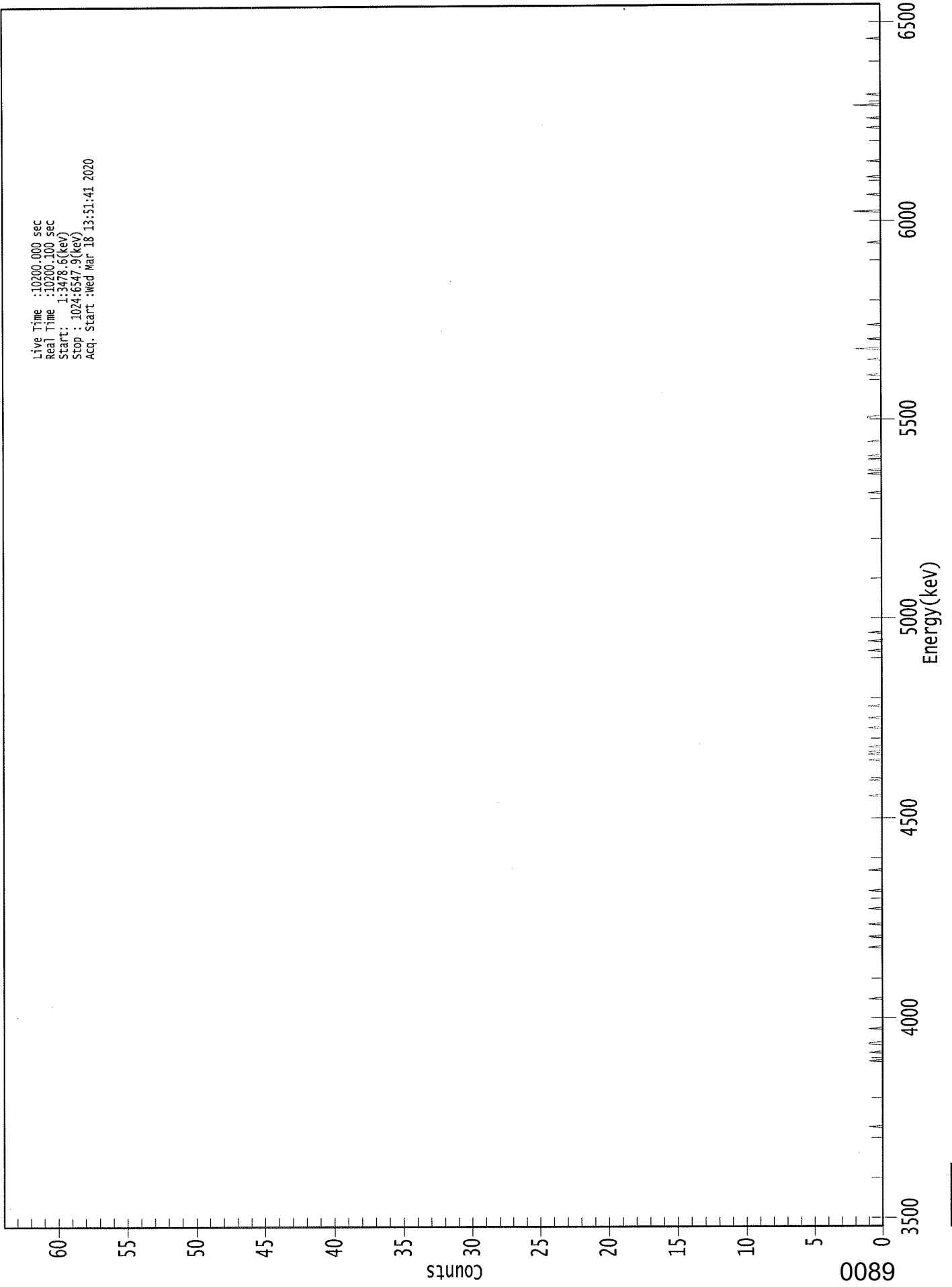
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.967	5685.50*	3.51E-001 +/- 2.31E-001	1.94E-001 +/- 6.58E-003
RA-226	0.984	4785.00*	2.56E-001 +/- 2.10E-001	2.57E-001 +/- 8.72E-003

AG  
3/19/20

0000270312.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3478.6(kev)  
Stop : 1024:6547.9(kev)  
Acq. Start :Wed Mar 18 13:51:41 2020



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 07

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	1	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	1	0	0	0	0	0
145:	0	1	0	0	0	0	0	0
153:	1	1	0	0	0	0	0	0
161:	0	0	0	0	0	1	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	1	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	0	0	0	0
241:	0	0	1	0	0	0	0	0
249:	0	0	0	0	1	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	1	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	1	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	1
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 1 0 0 0

Sample Title: 07

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	1	0	0
393:	0	0	1	0	1	0	0	0
401:	1	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	1	0	0	0	0	0	0	0
425:	1	0	0	0	0	0	0	0
433:	0	0	1	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	1	0	0	0	0	0	0	0
489:	1	0	0	0	0	0	0	1
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	1	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	1	0	0	1
633:	0	0	0	0	0	0	0	0
641:	1	0	0	1	0	0	0	0
649:	0	0	0	0	0	0	0	1
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	1	1	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	1
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	1	0	0	0
729:	0	0	0	0	0	2	0	0
737:	0	0	0	0	0	1	0	0
745:	0	0	0	0	0	0	0	0
753:	0	1	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 07

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	1	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	2	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	1	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	1	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	1	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	1	0
921:	0	0	0	0	0	0	1	0
929:	0	0	0	0	0	0	0	0
937:	0	2	0	0	0	0	0	0
945:	0	0	1	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	1	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



# Apex-Alpha™

Sample Description: H-16 35-40  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 08  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_042  
 Chamber Serial Number: 05026930B  
 Detector Serial Number: 84185  
 Env. Background: System Bkgd 275085  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.230E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/6/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:43 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1536 +/- 0.0027 on 2/28/2020 7:44:14 AM  
 Effective Efficiency: 0.1536 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.530	-1.19	180.60	1.19	0.00E+000	0.0
RA-226	4.698	-0.70	317.90	1.70	0.00E+000	3.0

-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

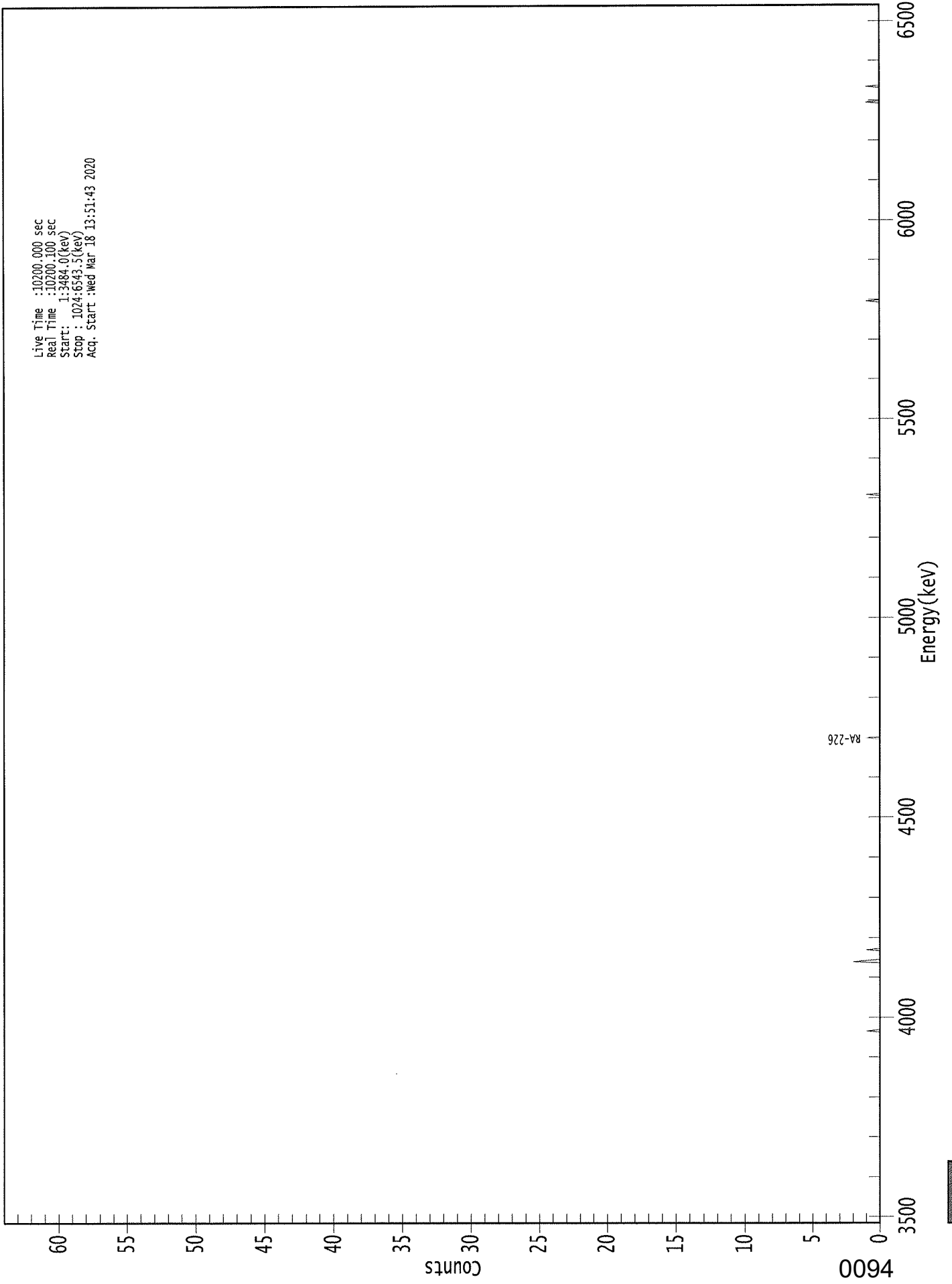
Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.969	5685.50*	-4.83E-002 +/- 8.73E-002	2.68E-001 +/- 9.16E-003
RA-226	0.990	4785.00*	-2.69E-002 +/- 8.56E-002	2.83E-001 +/- 9.67E-003

AG  
 3/19/20



0000270313.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3484.0(kev)  
Stop : 1024:6543.5(kev)  
Acq. Start :Wed Mar 18 13:51:43 2020





369: 0 0 0 0 0 0 0 0

Sample Title: 08

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	1	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	1	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	1	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	1	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	1	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KS  
3/18/20

Sample Description: H-18 35-40  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 09  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_043  
 Chamber Serial Number: 04026481A  
 Detector Serial Number: 91088  
 Env. Background: System Bkgd 275086  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.490E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/6/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:45 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.6490 +/- 0.0000  
 Counting Efficiency: 0.1495 +/- 0.0026 on 2/28/2020 7:44:05 AM  
 Effective Efficiency: 0.0970 +/- 0.0017

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.624	1.64	214.83	1.36	0.00E+000	3.0
RA-226	4.604	28.15	37.59	0.85	0.00E+000	3.0

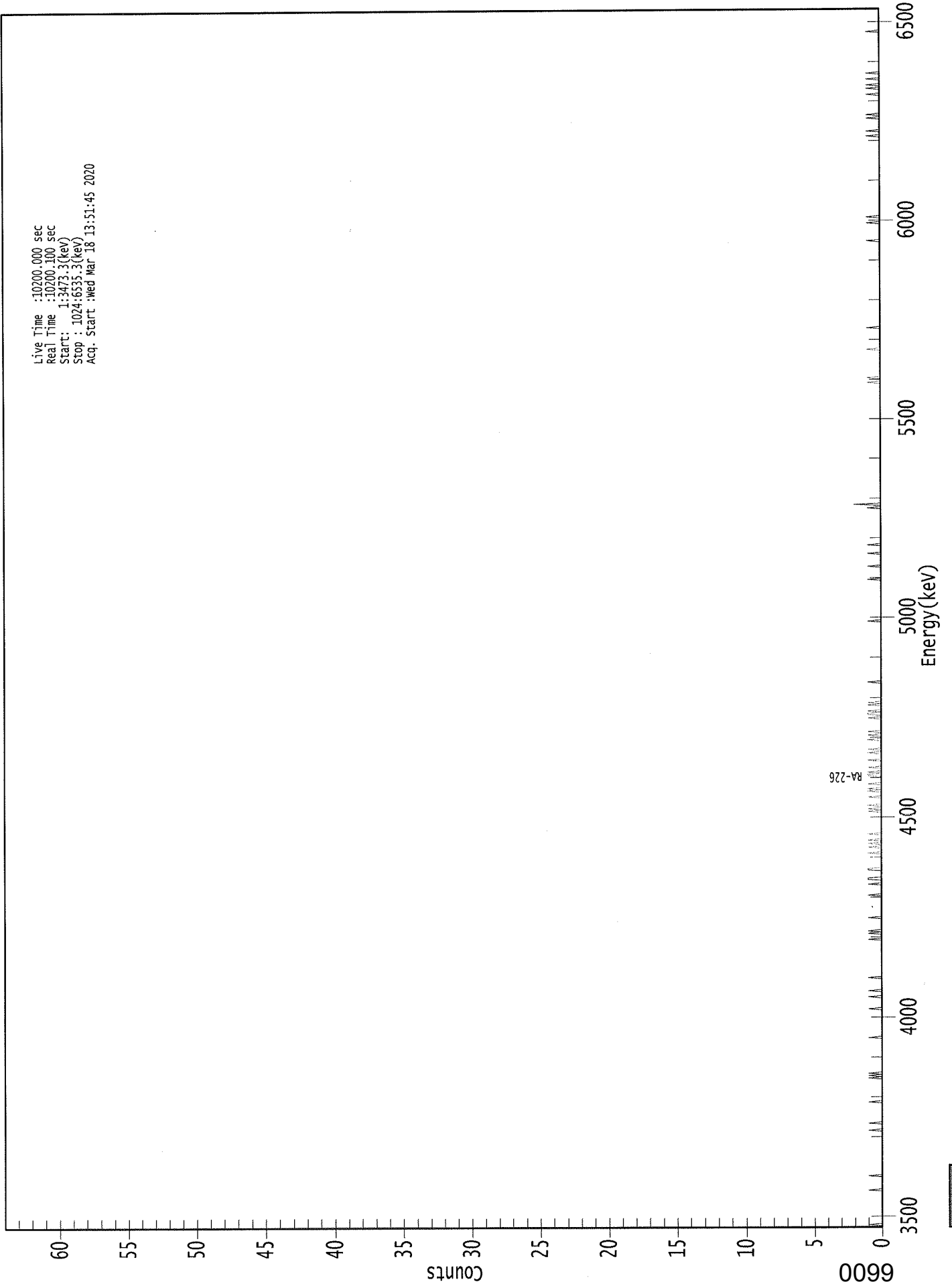
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.995	5685.50*	7.05E-002 +/- 1.51E-001	2.95E-001 +/- 1.02E-002
RA-226	0.958	4785.00*	1.15E+000 +/- 4.32E-001	2.44E-001 +/- 8.42E-003

AG  
3/19/20

0000270318.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3473.3(kev)  
Stop : 1024:6535.3(kev)  
Acq. Start :Wed Mar '18 13:51:45 2020



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 09

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	1	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	1
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	1	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	1	0	0	0	0	0	0	1
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	1	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	1	0	0	1
129:	0	1	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	1
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	1
185:	0	0	0	0	0	0	0	0	0
193:	0	1	0	0	0	0	1	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	1	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	1	0	0	0	0	1	0	0
249:	1	0	0	0	0	0	0	0	0
257:	0	0	0	1	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	1	0	0
281:	0	0	0	0	0	0	0	0	1
289:	0	0	0	1	1	0	0	0	0
297:	0	0	0	1	1	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	1	0	0	0	0	1	0	0
321:	0	1	0	0	1	0	0	0	0
329:	0	1	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	1	0	1	0	0
353:	0	1	0	0	0	0	0	0	0
361:	1	0	0	0	0	1	0	0	1

369: 0 0 0 1 0 0 0 0

Sample Title: 09

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	1	1	0	1	0	0
385:	0	1	0	0	0	0	0	1
393:	0	0	0	0	0	1	0	0
401:	1	0	0	0	0	0	0	0
409:	1	0	0	0	1	0	0	1
417:	0	0	0	0	0	0	0	0
425:	0	0	1	0	0	1	1	0
433:	1	0	0	0	0	1	0	1
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	1	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	1	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	1	0
545:	0	0	0	0	0	0	0	0
553:	0	1	0	0	0	0	0	0
561:	0	0	0	0	1	0	0	0
569:	0	0	0	1	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	1	0	0	2	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	1	0	0	0
713:	1	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	1	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	1	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0



801: 0 0 0 0 0 0 0 0

Sample Title: 09

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	1	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	1	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	1	0	0	0	1
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	1	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	1	0
953:	0	0	0	1	0	0	1	0
961:	0	0	0	1	0	0	0	0
969:	1	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	1	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB  
3/19/20

# Apex-Alpha™

Sample Description: H-3 22-27  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 10  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_044  
 Chamber Serial Number: 04026481B  
 Detector Serial Number: 84168  
 Env. Background: System Bkgd 275087  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.770E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/6/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:48 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9729 +/- 0.0000  
 Counting Efficiency: 0.1722 +/- 0.0030 on 2/28/2020 7:44:06 AM  
 Effective Efficiency: 0.1675 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.531	-1.53	143.80	1.53	0.00E+000	0.0
RA-226	4.562	3.98	112.01	1.02	0.00E+000	3.0

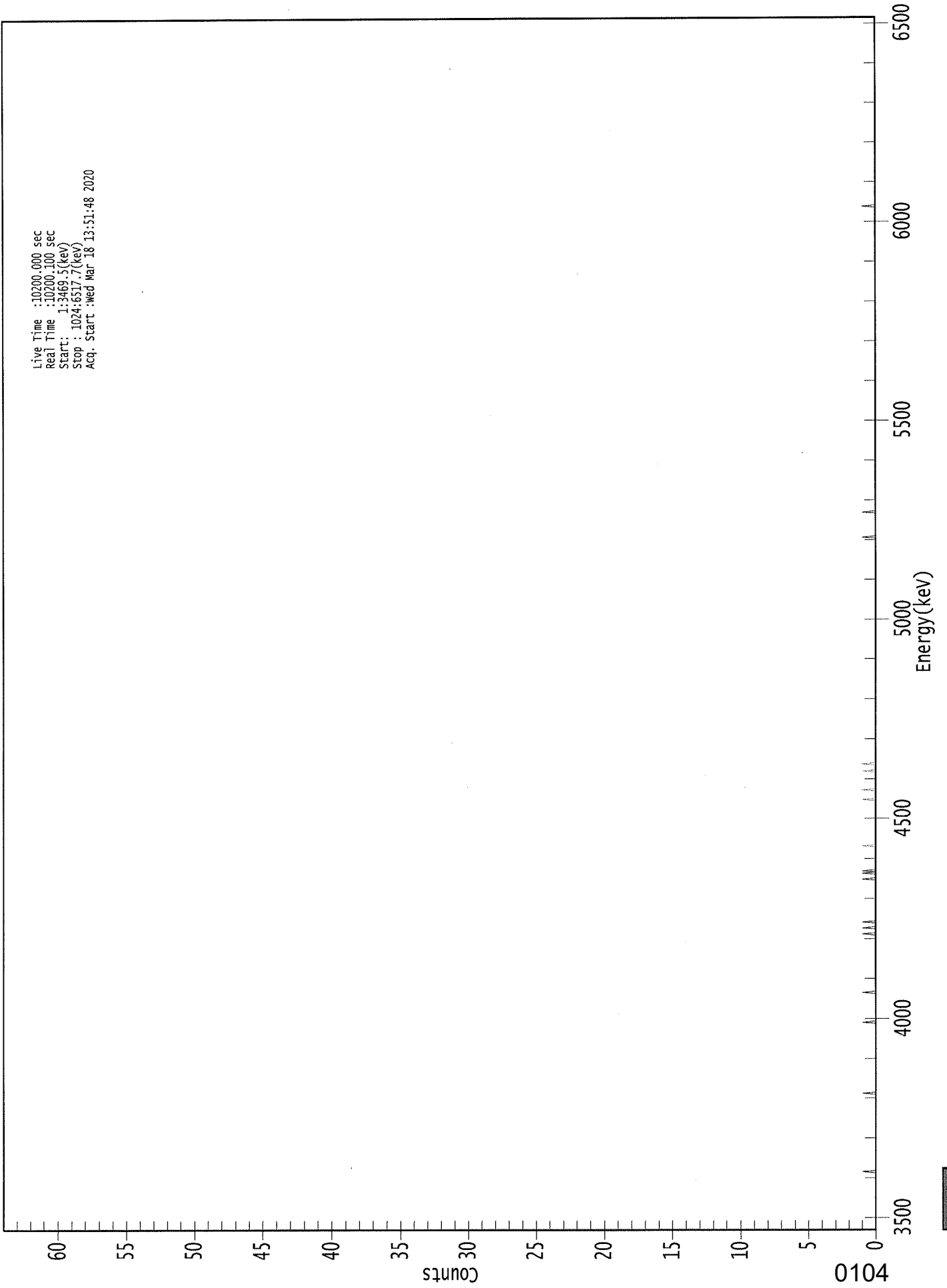
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.969	5685.50*	-7.08E-002 +/- 1.02E-001	3.29E-001 +/- 1.12E-002
RA-226	0.937	4785.00*	1.74E-001 +/- 1.95E-001	2.76E-001 +/- 9.37E-003

AG  
3/19/20

0000270317.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3469.5(kev)  
Stop : 1024:6517.7(kev)  
Acq. Start :Wed Mar 18 13:51:48 2020



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 10

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	1	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	1	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	1
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	1	0	0	0	0	1	0
257:	0	0	0	1	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	1
297:	0	0	0	0	1	0	1	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	1	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	1	0	0	0	0	0

369: 0 0 1 0 0 0 0 0

Sample Title: 10

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	1	0	0	0	0	0
393:	1	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	1
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	1	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 10

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	1	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



VB  
3/18/20

Sample Description: H-1 35-40  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002703  
 Batch Identification: 2003062A-RA  
 Sample Identification: 11  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_045  
 Chamber Serial Number: 04026482A  
 Detector Serial Number: 91131  
 Env. Background: System Bkgd 275088  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.580E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 3/6/2020 12:40:56 PM  
 Acquisition Date/Time: 3/18/2020 1:51:51 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8406 +/- 0.0000  
 Counting Efficiency: 0.1633 +/- 0.0028 on 2/28/2020 7:44:06 AM  
 Effective Efficiency: 0.1372 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.579	6.81	82.43	1.19	0.00E+000	3.0
RA-226	4.592	25.32	39.56	0.68	0.00E+000	3.0

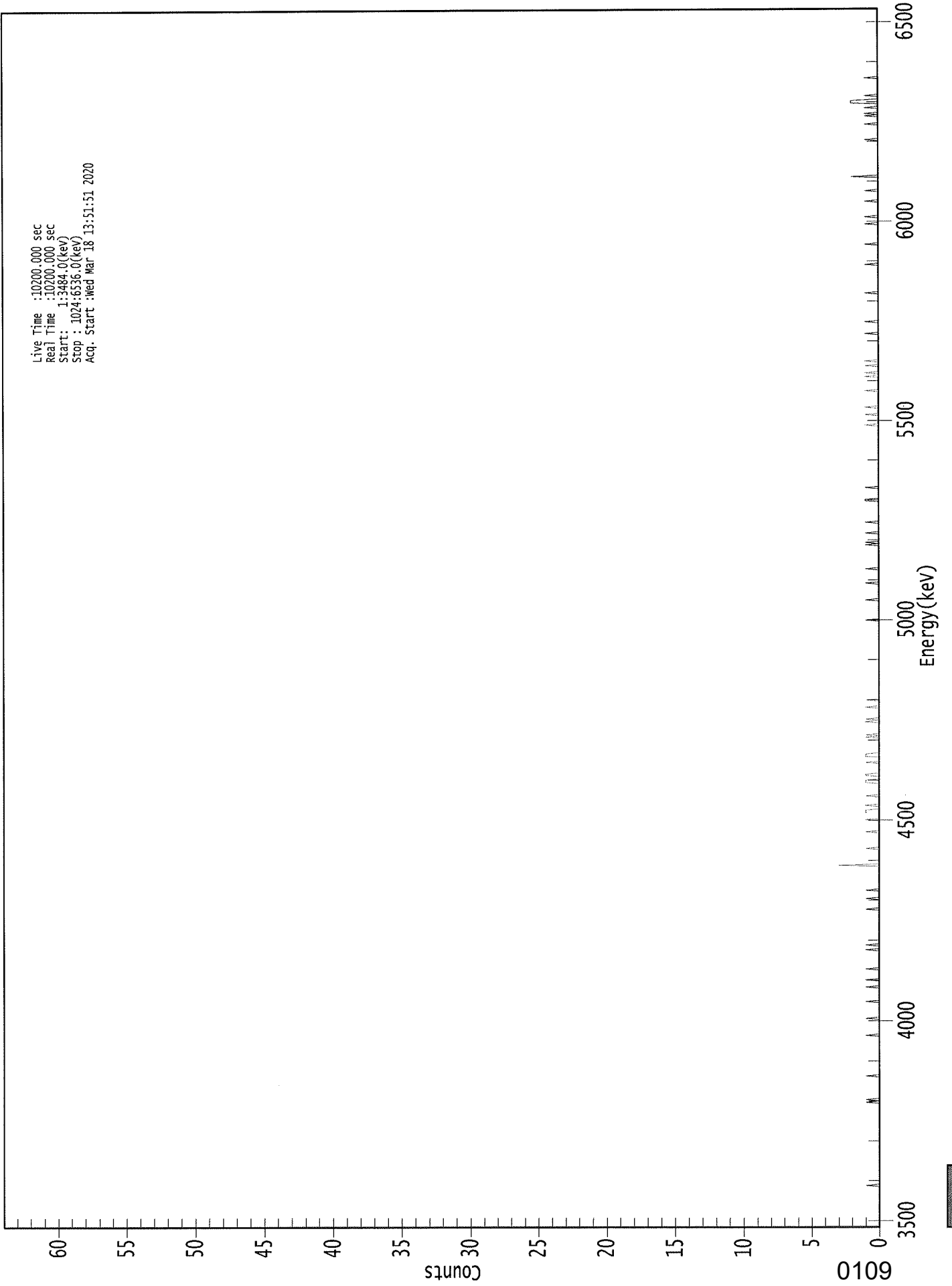
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.985	5685.50*	3.58E-001 +/- 2.95E-001	3.46E-001 +/- 1.18E-002
RA-226	0.952	4785.00*	1.26E+000 +/- 5.01E-001	2.81E-001 +/- 9.60E-003

AG  
3/19/20

0000270314.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3484.0(kev)  
Stop : 1024:6536.0(kev)  
Acq. start :Wed Mar 18 13:51:51 2020



ROI Type: 1



\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 11

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	1	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	1	0	1	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	1
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	1	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	1
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	1	0	0
193:	0	0	0	0	0	0	0	0
201:	0	1	0	0	0	0	0	1
209:	0	0	0	0	0	0	0	0
217:	1	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	1	0	0	0	1	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	1	0	0	0	0	0
273:	0	0	0	1	0	0	0	0
281:	0	0	1	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	3
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	1	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	1	0	0	0	0
337:	0	0	0	0	0	1	0	0
345:	0	0	0	1	1	1	0	0
353:	0	1	0	0	0	0	0	0
361:	0	1	0	0	0	0	0	0

369: 0 0 0 0 1 1 1 0

Sample Title: 11

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	1	1	0	0	0	0
385:	0	0	0	0	0	1	0	0
393:	0	0	1	1	1	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	1	0	1	0	0	0
417:	0	0	0	0	0	0	0	1
425:	0	1	0	0	0	0	0	0
433:	0	0	0	1	0	0	0	0
441:	0	1	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	1	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	1	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	1	0	0	0	0
545:	0	0	0	0	0	0	0	1
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	1	0	1	0	0
577:	0	0	0	0	0	1	0	0
585:	0	0	0	0	0	0	1	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	1	1	0	0	0	0	0	0
617:	0	0	0	1	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	1	0	0	0	0	0	0	0
681:	0	1	0	0	0	0	0	1
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	1	0	0
705:	0	0	0	0	0	0	0	0
713:	0	1	0	0	1	0	0	0
721:	0	0	1	0	0	0	1	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	1	0	0
753:	0	0	0	0	0	0	0	1
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	1
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 1

Sample Title: 11

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	1	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	1	0	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	1	0	0	0
865:	0	0	0	0	0	1	0	0
873:	0	0	0	0	0	0	0	0
881:	0	2	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	1	0	0	0	0	0	0	0
921:	0	0	0	0	0	1	0	0
929:	0	0	0	0	1	0	1	0
937:	0	0	0	1	0	0	0	2
945:	2	2	0	0	0	1	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	1	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



## QA SUMMARY REPORT

### Review Of QA Results - Pulser Check

Date : 3/18/2020  
Time : 5:39:00 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Not Done	
Alpha 004	21f	ALL	Not Done	
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Passed	3/18/2020 5:16:22 AM
Alpha 011	21f	ALL	Passed	3/12/2020 5:55:11 AM
Alpha 012	21f	ALL	Passed	3/18/2020 5:16:24 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Not Done	
Alpha 015	21f	ALL	Not Done	
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Not Done	
Alpha 034	Alpha Analyst100DC	ALL	Not Done	
Alpha 035	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:25 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:26 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:28 AM
Alpha 038	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:29 AM
Alpha 039	Alpha Analyst100DC	Peak FWHM	Action	3/18/2020 5:16:31 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:32 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:34 AM
Alpha 042	Alpha Analyst100DC	ALL	Not Done	
Alpha 043	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:37 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:39 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:41 AM
Alpha 046	Alpha Analyst100DC	ALL	Not Done	
Alpha 047	Alpha Analyst100DC	Peak FWHM	Action	3/18/2020 5:16:44 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:46 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:48 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:49 AM
Alpha 051	Alpha Analyst100DC	ALL	Not Done	
Alpha 052	Alpha Analyst100DC	ALL	Not Done	
Alpha 053	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:52 AM
Alpha 054	Alpha Analyst100DC	ALL	Not Done	
Alpha 055	Alpha Analyst100DC	ALL	Passed	3/13/2020 5:00:34 AM
Alpha 056	Alpha Analyst100DC	ALL	Not Done	
Alpha 057	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:54 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:56 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:16:59 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	3/18/2020 5:17:02 AM

APPROVED BY:     KP    

APPROVAL DATE:     3/18/20

\*\*\*\*\*  
\*\*\*\*\* LIBRARY LISTING REPORT \*\*\*\*\*  
\*\*\*\*\*

Nuclide Library Title: Radium

Nuclide Library Description: Ra-226, Po-218, Rn-222

Nuclide Name	Half-Life (Seconds)	Energy (keV )	Energy Uncert. (keV )	Yield (%)	Yield Uncert. (Abs.+)
PO-218	5.049E+010	6003.000*	0.000	99.9800	0.0000
RN-222	5.049E+010	5490.000*	0.000	99.9200	0.0000
RA-226	5.049E+010	4785.000*	0.000	100.0000	0.0000

\* = key line

TOTALS:            3    Nuclides            3    Energy Lines

**SECTION IX**  
**ANALYTICAL DATA (RADIUM-228)**

<b>Work Order</b>	<b>20-03062</b>
<b>Analysis Code</b>	<b>Ra228</b>
<b>Run</b>	<b>1</b>
<b>Date Received</b>	<b>3/12/2020</b>
<b>Lab Deadline</b>	<b>3/27/2020</b>
<b>Client</b>	ERM
<b>Project</b>	Henning Management
<b>Report Level</b>	4
<b>Activity Units</b>	pCi
<b>Aliquot Units</b>	I
<b>Matrix</b>	WA
<b>Method</b>	EPA 904.0
<b>Instrument Type</b>	Alpha/Beta GPC
<b>Radiometric Tracer</b>	Ba-133
<b>Radiometric Sol#</b>	Ba-6a
<b>Tracer Act (dpm/g)</b>	429.16
<b>Carrier</b>	Yttrium
<b>Carrier Conc (mg/ml)</b>	34.083

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		03/12/20 00:00	1.0000E+00
02	MBL	BLANK		03/12/20 00:00	1.0000E+00
03	DUP	H-10 35-40	20	03/05/20 15:30	1.0000E+00
04	TRG	H-12 50-60	50	03/05/20 11:05	1.0000E+00
05	TRG	H-9 50-55	20	03/05/20 13:35	1.0000E+00
06	DO	H-10 35-40	20	03/05/20 15:30	1.0000E+00
07	TRG	H-2 30-35	30	03/05/20 16:55	1.0000E+00
08	TRG	H-16 35-40	30	03/06/20 08:15	1.0000E+00
09	TRG	H-18 35-40	30	03/06/20 09:50	1.0000E+00
10	TRG	H-3 22-27	30	03/06/20 13:15	1.0000E+00
11	TRG	H-1 35-40	30	03/06/20 11:10	1.0000E+00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.



Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.2057	946.6	485.0	113.74	2.000	0.0713	0.1299	0.0586	85.97	94.56	1.00	1.00
02	MBL	2.1933	941.3	461.0	108.73	2.000	0.0711	0.1382	0.0671	98.44	107.03	1.00	1.00
03	DUP	2.1919	940.7	418.0	98.65	2.000	0.0704	0.1379	0.0675	99.02	97.68	1.00	1.00
04	TRG	2.1892	939.5	272.0	64.27	2.000	0.0705	0.1278	0.0573	84.06	54.03	1.00	1.00
05	TRG	2.1798	935.5	374.0	88.75	2.000	0.0713	0.1299	0.0586	85.97	76.30	1.00	1.00
06	DO	2.1827	936.7	337.0	79.87	2.000	0.0704	0.1337	0.0633	92.86	74.17	1.00	1.00
07	TRG	2.1781	934.8	383.0	90.96	2.000	0.0711	0.1331	0.0620	90.95	82.73	1.00	1.00
08	TRG	2.1771	934.3	425.0	100.98	2.000	0.0702	0.1344	0.0642	94.18	95.11	1.00	1.00
09	TRG	2.1731	932.6	273.0	64.99	2.000	0.0696	0.1332	0.0636	93.30	60.63	1.00	1.00
10	TRG	2.1720	932.1	409.0	97.41	2.000	0.0686	0.1334	0.0648	95.06	92.60	1.00	1.00
11	TRG	2.1633	928.4	352.0	84.17	2.000	0.0683	0.1348	0.0665	97.56	82.11	1.00	1.00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
02	MBL			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
03	DUP			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
04	TRG			03/23/20 10:25	DBUSH	03/18/20 12:12	DBUSH	03/23/20 10:37	DBUSH
05	TRG			03/23/20 10:25	DBUSH	03/18/20 12:12	DBUSH	03/23/20 10:37	DBUSH
06	DO			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
07	TRG			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
08	TRG			03/23/20 10:25	DBUSH	03/18/20 12:12	DBUSH	03/23/20 10:37	DBUSH
09	TRG			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
10	TRG			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH
11	TRG			03/23/20 10:25	DBUSH	03/18/20 10:37	DBUSH	03/23/20 10:37	DBUSH

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	9.42E+00	7.60E-01	8.78E-01	9.03E+00	104.37	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	1.83E-01	3.95E-01	8.23E-01					OK	OK
03	RA-228	DUP	H-10 35-40	pCi/l	1.19E+00	4.38E-01	8.05E-01				NA	OK	OK
04	RA-228	TRG	H-12 50-60	pCi/l	1.40E+00	7.62E-01	1.47E+00					OK	OK
05	RA-228	TRG	H-9 50-55	pCi/l	3.93E-01	5.69E-01	1.17E+00					OK	OK
06	RA-228	DO	H-10 35-40	pCi/l	2.02E+00	6.18E-01	1.10E+00					OK	OK
07	RA-228	TRG	H-2 30-35	pCi/l	4.16E-01	5.26E-01	1.08E+00					OK	OK
08	RA-228	TRG	H-16 35-40	pCi/l	1.04E-01	3.90E-01	8.25E-01					OK	OK
09	RA-228	TRG	H-18 35-40	pCi/l	4.81E-01	6.46E-01	1.33E+00					OK	OK
10	RA-228	TRG	H-3 22-27	pCi/l	4.48E-01	5.10E-01	1.04E+00					OK	OK
11	RA-228	TRG	H-1 35-40	pCi/l	1.92E+00	5.32E-01	9.25E-01					OK	OK

0120	Client	<b>ERM</b>	<b>20-03062</b>	<b>Ra228</b>	1	
Eberline Services Work Order						
Analysis Code						
Run						



Run

1

Analysis Code

**Ra228**

Eberline Services Work Order

**20-03062**

Client

**ERM**

0121

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	RA-228	LCS	03/12/20 00:00	1.00E+00	113.74	85.97	94.56	1.00	3/18/2020 10:37	3/23/2020 10:37
02	RA-228	MBL	03/12/20 00:00	1.00E+00	108.73	98.44	107.03	1.00	3/18/2020 10:37	3/23/2020 10:37
03	RA-228	DUP	03/05/20 15:30	1.00E+00	98.65	99.02	97.68	1.00	3/18/2020 10:37	3/23/2020 10:37
04	RA-228	TRG	03/05/20 11:05	1.00E+00	64.27	84.06	54.03	1.00	3/18/2020 12:12	3/23/2020 10:37
05	RA-228	TRG	03/05/20 13:35	1.00E+00	88.75	85.97	76.30	1.00	3/18/2020 12:12	3/23/2020 10:37
06	RA-228	DO	03/05/20 15:30	1.00E+00	79.87	92.86	74.17	1.00	3/18/2020 10:37	3/23/2020 10:37
07	RA-228	TRG	03/05/20 16:55	1.00E+00	90.96	90.95	82.73	1.00	3/18/2020 10:37	3/23/2020 10:37
08	RA-228	TRG	03/06/20 08:15	1.00E+00	100.98	94.18	95.11	1.00	3/18/2020 12:12	3/23/2020 10:37
09	RA-228	TRG	03/06/20 09:50	1.00E+00	64.99	93.30	60.63	1.00	3/18/2020 10:37	3/23/2020 10:37
10	RA-228	TRG	03/06/20 13:15	1.00E+00	97.41	95.06	92.60	1.00	3/18/2020 10:37	3/23/2020 10:37
11	RA-228	TRG	03/06/20 11:10	1.00E+00	84.17	97.56	82.11	1.00	3/18/2020 10:37	3/23/2020 10:37

0122	Client	ERM	Eberline Services Work Order	20-03062	Analysis Code	Ra228	Run	1
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Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	03/23/20 12:22		LB4110A	A1	120	1006	1.433333333	0.4803
02	RA-228	MBL	03/23/20 12:22		LB4110A	A2	120	206	1.566666667	0.4724
03	RA-228	DUP	03/23/20 12:22		LB4110A	A3	120	255	1.233333333	0.4719
04	RA-228	TRG	03/23/20 12:22		LB4110A	A4	120	207	1.166666667	0.4548
05	RA-228	TRG	03/23/20 12:22		LB4110A	B1	120	213	1.55	0.4626
06	RA-228	DO	03/23/20 12:22		LB4110A	B3	120	275	1.2	0.449
07	RA-228	TRG	03/23/20 12:22		LB4110A	B4	120	215	1.533333333	0.4619
08	RA-228	TRG	03/23/20 12:22		LB4110A	C1	120	153	1.2	0.4667
09	RA-228	TRG	03/23/20 12:22		LB4110A	C2	120	172	1.216666667	0.4578
10	RA-228	TRG	03/23/20 12:22		LB4110A	C3	120	262	1.866666667	0.4699
11	RA-228	TRG	03/23/20 12:22		LB4110A	C4	120	280	1.133333333	0.4692

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	03/12/20 00:00	1.0000	2.2057	946.5982	485.0000	113.74	1.00	1.00
02	MBL	BLANK	03/12/20 00:00	1.0000	2.1933	941.2766	461.0000	108.73	1.00	1.00
03	DUP	H-10 35-40	03/05/20 15:30	1.0000	2.1919	940.6758	418.0000	98.65	1.00	1.00
04	TRG	H-12 50-60	03/05/20 11:05	1.0000	2.1892	939.5171	272.0000	64.27	1.00	1.00
05	TRG	H-9 50-55	03/05/20 13:35	1.0000	2.1798	935.4830	374.0000	88.75	1.00	1.00
06	DO	H-10 35-40	03/05/20 15:30	1.0000	2.1827	936.7275	337.0000	79.87	1.00	1.00
07	TRG	H-2 30-35	03/05/20 16:55	1.0000	2.1781	934.7534	383.0000	90.96	1.00	1.00
08	TRG	H-16 35-40	03/06/20 08:15	1.0000	2.1771	934.3242	425.0000	100.98	1.00	1.00
09	TRG	H-18 35-40	03/06/20 09:50	1.0000	2.1731	932.6076	273.0000	64.99	1.00	1.00
10	TRG	H-3 22-27	03/06/20 13:15	1.0000	2.1720	932.1355	409.0000	97.41	1.00	1.00
11	TRG	H-1 35-40	03/06/20 11:10	1.0000	2.1633	928.4018	352.0000	84.17	1.00	1.00

Internal Work Order		Run	Analysis Code		Date		Technician		Technician Initials		Witness Initials		
20-03062		1	Ra228		3/23/2020 10:24		DBUSH		DB				
<b>LCS &amp; Matrix Spikes</b>													
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS Volume Used (g)	MS Volume Used (g)	LCS Volume Used (g)	MSD Volume Used (g)	LCS Known pCi	MS Added pCi	MSD Error Estimate	MSD Error Estimate	
Ra-228	Ra-12	44.430	3/23/2020	0.450	0.4511		9.03	0.460	0.00	0.00	0.000	0.000	
<b>Tracers</b>													
fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition	Tracer						LCS
01	Ba-133	Ba-6a	429.160	3/23/2020	2.2057	2.3600							
02	Ba-133	Ba-6a	429.160	3/23/2020	2.1933	2.3600							
03	Ba-133	Ba-6a	429.160	3/23/2020	2.1919	2.3600							
04	Ba-133	Ba-6a	429.160	3/23/2020	2.1892	2.3600							
05	Ba-133	Ba-6a	429.160	3/23/2020	2.1798	2.3600							
06	Ba-133	Ba-6a	429.160	3/23/2020	2.1827	2.3600							
07	Ba-133	Ba-6a	429.160	3/23/2020	2.1781	2.3600							
08	Ba-133	Ba-6a	429.160	3/23/2020	2.1771	2.3600							
09	Ba-133	Ba-6a	429.160	3/23/2020	2.1731	2.3600							
10	Ba-133	Ba-6a	429.160	3/23/2020	2.1720	2.3600							
11	Ba-133	Ba-6a	429.160	3/23/2020	2.1633	2.3600							
<b>Matrix Spike</b>													

# Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
<b>20-03062</b>	<b>1</b>	<b>Ra228</b>	<b>liters</b>	<b>3/27/2020</b>	<b>JHARVEY</b>

Lab Fraction	ERM Client ID	Sample Type	Muffle Data		Dilution Data			Aliquot Data			MS Aliquot Data		H-3 Solids Only		
			Ratio Post/Pre	No of Dilis	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist	Aliq		
01	LCS	LCS						1.0000E+00	1.0000E+00						
02	BLANK	MBL						1.0000E+00	1.0000E+00						
03	H-10 35-40	DUP						1.0000E+00	1.0000E+00						
04	H-12 50-60	TRG						1.0000E+00	1.0000E+00						
05	H-9 50-55	TRG						1.0000E+00	1.0000E+00						
06	H-10 35-40	DO						1.0000E+00	1.0000E+00						
07	H-2 30-35	TRG						1.0000E+00	1.0000E+00						
08	H-16 35-40	TRG						1.0000E+00	1.0000E+00						
09	H-18 35-40	TRG						1.0000E+00	1.0000E+00						
10	H-3 22-27	TRG						1.0000E+00	1.0000E+00						
11	H-1 35-40	TRG						1.0000E+00	1.0000E+00						

Comments
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Technician:  Date: 3/16/2020





100  
3/23/20

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A1	2003062-01	46	1006	120	1410	3/23/2020 12:22:47 PM
A2	2003062-02	29	206	120	1410	3/23/2020 12:22:47 PM
A3	2003062-03	15	255	120	1410	3/23/2020 12:22:48 PM
A4	2003062-04	36	207	120	1410	3/23/2020 12:22:48 PM
B1	2003062-05	24	213	120	1410	3/23/2020 12:22:48 PM
B3	2003062-06	24	275	120	1410	3/23/2020 12:22:48 PM
B4	2003062-07	22	215	120	1410	3/23/2020 12:22:49 PM
C1	2003062-08	25	153	120	1410	3/23/2020 12:22:49 PM
C2	2003062-09	20	172	120	1410	3/23/2020 12:22:49 PM
C3	2003062-10	16	262	120	1410	3/23/2020 12:22:49 PM
C4	2003062-11	24	280	120	1410	3/23/2020 12:22:49 PM

GPC Detector Report  
(ALL Backgrounds)

KP  
3/23/20

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	3/23/2020	1.83E-01	P	-3.98E-02	1.15E-01	2.70E-01
LB4110A - A2	Alpha	11/2/2017	3/23/2020	1.33E-01	P	-2.89E-02	1.23E-01	2.74E-01
LB4110A - A3	Alpha	11/2/2017	3/23/2020	5.00E-02	P	-3.45E-02	1.22E-01	2.79E-01
LB4110A - A4	Alpha	11/2/2017	3/23/2020	1.50E-01	P	-3.53E-02	1.23E-01	2.81E-01
LB4110A - B1	Alpha	11/2/2017	3/23/2020	1.67E-01	P	-3.65E-02	1.39E-01	3.14E-01
LB4110A - B2	Alpha	11/2/2017	3/23/2020	1.50E-01	P	-2.06E-02	1.67E-01	3.54E-01
LB4110A - B3	Alpha	11/2/2017	3/23/2020	1.50E-01	P	-4.54E-02	1.02E-01	2.50E-01
LB4110A - B4	Alpha	11/2/2017	3/23/2020	8.33E-02	P	-3.92E-02	1.00E-01	2.40E-01
LB4110A - C1	Alpha	11/2/2017	3/23/2020	8.33E-02	P	-5.23E-02	9.51E-02	2.43E-01
LB4110A - C2	Alpha	11/2/2017	3/23/2020	6.67E-02	P	-1.33E-01	1.00E-01	3.34E-01
LB4110A - C3	Alpha	11/2/2017	3/23/2020	1.67E-02	P	-4.98E-02	7.01E-02	1.90E-01
LB4110A - C4	Alpha	11/2/2017	3/23/2020	1.17E-01	P	-5.36E-02	1.29E-01	3.12E-01
LB4110A - D1	Alpha	11/2/2017	3/23/2020	1.00E-01	P	-5.70E-02	1.47E-01	3.51E-01
LB4110A - D2	Alpha	11/2/2017	3/23/2020	3.33E-02	P	-3.97E-02	1.04E-01	2.48E-01
LB4110A - D3	Alpha	11/2/2017	3/23/2020	1.33E-01	P	-4.71E-02	1.18E-01	2.83E-01
LB4110A - D4	Alpha	11/2/2017	3/23/2020	8.33E-02	P	-2.90E-03	1.65E-01	3.32E-01
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.29E-02	1.10E-01	2.62E-01
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-3.09E-02	6.37E-02	1.58E-01
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-8.81E-02	9.11E-02	2.70E-01
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.55E-02	7.04E-02	1.86E-01
LB4110A - F1	Alpha	11/2/2017	3/23/2020	5.00E-02	P	-4.48E-02	8.06E-02	2.06E-01
LB4110A - F2	Alpha	11/2/2017	3/23/2020	6.67E-02	P	-4.40E-02	5.47E-02	1.53E-01
LB4110A - F3	Alpha	11/2/2017	3/23/2020	1.00E-01	P	-4.80E-02	7.30E-02	1.94E-01
LB4110A - F4	Alpha	11/2/2017	3/23/2020	1.67E-01	P	-4.05E-02	6.81E-02	1.77E-01
LB4110A - G1	Alpha	11/2/2017	3/23/2020	1.33E-01	P	-4.32E-02	7.06E-02	1.84E-01
LB4110A - G2	Alpha	11/2/2017	3/23/2020	6.67E-02	P	-3.91E-02	8.08E-02	2.01E-01
LB4110A - G3	Alpha	11/2/2017	3/23/2020	1.17E-01	P	-3.99E-02	8.75E-02	2.15E-01
LB4110A - G4	Alpha	11/2/2017	3/23/2020	6.67E-02	P	-3.78E-02	8.64E-02	2.11E-01

GPC Detector Report  
(ALL Backgrounds)

RP  
3/23/20

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	3/23/2020	1.43E+00	P	8.81E-01	1.36E+00	1.83E+00
LB4110A - A2	Beta	11/2/2017	3/23/2020	1.57E+00	P	1.01E+00	1.58E+00	2.14E+00
LB4110A - A3	Beta	11/2/2017	3/23/2020	1.23E+00	P	9.99E-01	1.46E+00	1.93E+00
LB4110A - A4	Beta	11/2/2017	3/23/2020	1.17E+00	P	9.75E-01	1.44E+00	1.91E+00
LB4110A - B1	Beta	11/2/2017	3/23/2020	1.55E+00	P	1.01E+00	1.49E+00	1.97E+00
LB4110A - B2	Beta	11/2/2017	3/23/2020	1.20E+00	P	7.34E-01	1.43E+00	2.13E+00
LB4110A - B3	Beta	11/2/2017	3/23/2020	1.20E+00	P	9.14E-01	1.36E+00	1.80E+00
LB4110A - B4	Beta	11/2/2017	3/23/2020	1.53E+00	P	7.85E-01	1.34E+00	1.89E+00
LB4110A - C1	Beta	11/2/2017	3/23/2020	1.20E+00	P	-1.49E+00	1.60E+00	4.70E+00
LB4110A - C2	Beta	11/2/2017	3/23/2020	1.22E+00	P	-4.73E+00	1.91E+00	8.55E+00
LB4110A - C3	Beta	11/2/2017	3/23/2020	1.87E+00	P	3.24E-01	1.68E+00	3.03E+00
LB4110A - C4	Beta	11/2/2017	3/23/2020	1.13E+00	P	8.22E-01	1.27E+00	1.72E+00
LB4110A - D1	Beta	11/2/2017	3/23/2020	1.15E+00	P	1.01E-01	1.42E+00	2.73E+00
LB4110A - D2	Beta	11/2/2017	3/23/2020	1.83E+00	P	-1.93E+01	2.82E+00	2.50E+01
LB4110A - D3	Beta	11/2/2017	3/23/2020	1.07E+00	P	-2.04E+00	1.67E+00	5.38E+00
LB4110A - D4	Beta	11/2/2017	3/23/2020	1.33E+00	P	9.74E-01	1.47E+00	1.96E+00
LB4110A - E1	Beta	11/2/2017	3/23/2018	3.33E-02	P	7.66E-01	1.32E+00	1.88E+00
LB4110A - E2	Beta	11/2/2017	3/23/2018	1.67E-02	P	5.45E-01	9.58E-01	1.37E+00
LB4110A - E3	Beta	11/2/2017	3/23/2018	6.67E-02	P	4.98E-01	1.20E+00	1.91E+00
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.00E+00	P	5.67E-01	1.04E+00	1.50E+00
LB4110A - F1	Beta	11/2/2017	3/23/2020	1.22E+00	P	7.86E-01	1.29E+00	1.78E+00
LB4110A - F2	Beta	11/2/2017	3/23/2020	9.67E-01	P	4.39E-01	9.20E-01	1.40E+00
LB4110A - F3	Beta	11/2/2017	3/23/2020	1.12E+00	P	4.24E-01	1.17E+00	1.92E+00
LB4110A - F4	Beta	11/2/2017	3/23/2020	9.83E-01	P	1.77E-01	1.18E+00	2.18E+00
LB4110A - G1	Beta	11/2/2017	3/23/2020	1.32E+00	P	6.15E-01	1.23E+00	1.84E+00
LB4110A - G2	Beta	11/2/2017	3/23/2020	1.37E+00	P	1.04E+00	1.70E+00	2.36E+00
LB4110A - G3	Beta	11/2/2017	3/23/2020	1.20E+00	P	6.37E-01	1.31E+00	1.99E+00
LB4110A - G4	Beta	11/2/2017	3/23/2020	1.70E+00	P	-1.09E+00	1.39E+00	3.88E+00

GPC Detector Report  
(ALL Efficiencies)

KP  
3/23/20

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	3/23/2020	0.2346	P	0.2137	0.2286	0.2434
LB4110A - A2	Alpha	11/2/2017	3/23/2020	0.2027	P	0.1883	0.2068	0.2253
LB4110A - A3	Alpha	11/2/2017	3/23/2020	0.1967	P	0.1836	0.1981	0.2127
LB4110A - A4	Alpha	11/2/2017	3/23/2020	0.2295	P	0.2072	0.2259	0.2445
LB4110A - B1	Alpha	11/2/2017	3/23/2020	0.2063	P	0.1986	0.2204	0.2423
LB4110A - B2	Alpha	11/2/2017	3/23/2020	0.1851	F	0.1864	0.1994	0.2125
LB4110A - B3	Alpha	11/2/2017	3/23/2020	0.2351	P	0.2207	0.2348	0.2489
LB4110A - B4	Alpha	11/2/2017	3/23/2020	0.2168	P	0.2084	0.2236	0.2389
LB4110A - C1	Alpha	11/2/2017	3/23/2020	0.2008	P	0.1929	0.2058	0.2187
LB4110A - C2	Alpha	11/2/2017	3/23/2020	0.2055	P	0.0166	0.2170	0.4175
LB4110A - C3	Alpha	11/2/2017	3/23/2020	0.2286	P	0.2184	0.2376	0.2568
LB4110A - C4	Alpha	11/2/2017	3/23/2020	0.2200	P	0.2007	0.2158	0.2310
LB4110A - D1	Alpha	11/2/2017	3/23/2020	0.1994	P	0.1863	0.2154	0.2446
LB4110A - D2	Alpha	11/2/2017	3/23/2020	0.2269	P	0.2133	0.2411	0.2689
LB4110A - D3	Alpha	11/2/2017	3/23/2020	0.2403	P	0.2302	0.2483	0.2665
LB4110A - D4	Alpha	11/2/2017	3/23/2020	0.1858	P	0.1699	0.1913	0.2127
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1687	0.2258	0.2830
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1518	0.2051	0.2584
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1547	0.2075	0.2603
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1747	0.2355	0.2963
LB4110A - F1	Alpha	11/2/2017	3/23/2020	0.2155	P	0.1717	0.2134	0.2550
LB4110A - F2	Alpha	11/2/2017	3/23/2020	0.1799	P	0.1521	0.1813	0.2106
LB4110A - F3	Alpha	11/2/2017	3/23/2020	0.2252	P	0.1850	0.2273	0.2696
LB4110A - F4	Alpha	11/2/2017	3/23/2020	0.2136	P	0.1755	0.2125	0.2495
LB4110A - G1	Alpha	11/2/2017	3/23/2020	0.1878	P	0.1747	0.1919	0.2092
LB4110A - G2	Alpha	11/2/2017	3/23/2020	0.1844	P	0.1698	0.1930	0.2161
LB4110A - G3	Alpha	11/2/2017	3/23/2020	0.2119	P	0.2020	0.2188	0.2355
LB4110A - G4	Alpha	11/2/2017	3/23/2020	0.0401	F	0.1621	0.1891	0.2162

GPC Detector Report  
(ALL Efficiencies)

KP  
3/23/20

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	3/23/2020	0.5664	P	0.5085	0.5492	0.5898
LB4110A - A2	Beta	11/2/2017	3/23/2020	0.4411	P	0.3998	0.4533	0.5069
LB4110A - A3	Beta	11/2/2017	3/23/2020	0.4729	P	0.4396	0.4779	0.5161
LB4110A - A4	Beta	11/2/2017	3/23/2020	0.5526	P	0.5056	0.5457	0.5857
LB4110A - B1	Beta	11/2/2017	3/23/2020	0.4859	P	0.4654	0.5296	0.5937
LB4110A - B2	Beta	11/2/2017	3/23/2020	0.4666	F	0.4680	0.4977	0.5273
LB4110A - B3	Beta	11/2/2017	3/23/2020	0.5894	P	0.5537	0.5845	0.6152
LB4110A - B4	Beta	11/2/2017	3/23/2020	0.5479	P	0.5139	0.5500	0.5861
LB4110A - C1	Beta	11/2/2017	3/23/2020	0.4835	P	0.4506	0.4791	0.5076
LB4110A - C2	Beta	11/2/2017	3/23/2020	0.4897	P	0.4655	0.5116	0.5577
LB4110A - C3	Beta	11/2/2017	3/23/2020	0.5932	P	0.5398	0.5885	0.6372
LB4110A - C4	Beta	11/2/2017	3/23/2020	0.5273	P	0.4879	0.5237	0.5595
LB4110A - D1	Beta	11/2/2017	3/23/2020	0.5798	P	0.5542	0.6247	0.6951
LB4110A - D2	Beta	11/2/2017	3/23/2020	0.5839	P	0.5205	0.6106	0.7007
LB4110A - D3	Beta	11/2/2017	3/23/2020	0.5980	P	0.5710	0.6338	0.6965
LB4110A - D4	Beta	11/2/2017	3/23/2020	0.4841	P	0.4495	0.4946	0.5397
LB4110A - E1	Beta	11/2/2017	3/23/2018	0.0436	F	0.4162	0.5409	0.6655
LB4110A - E2	Beta	11/2/2017	3/23/2018	0.0428	F	0.3730	0.4913	0.6097
LB4110A - E3	Beta	11/2/2017	3/23/2018	0.0551	F	0.3852	0.4994	0.6137
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.0569	F	0.4534	0.5890	0.7247
LB4110A - F1	Beta	11/2/2017	3/23/2020	0.5237	P	0.4612	0.5332	0.6051
LB4110A - F2	Beta	11/2/2017	3/23/2020	0.4486	P	0.4175	0.4548	0.4922
LB4110A - F3	Beta	11/2/2017	3/23/2020	0.5766	P	0.4902	0.5868	0.6834
LB4110A - F4	Beta	11/2/2017	3/23/2020	0.5491	P	0.4671	0.5405	0.6140
LB4110A - G1	Beta	11/2/2017	3/23/2020	0.4516	P	0.4246	0.4512	0.4778
LB4110A - G2	Beta	11/2/2017	3/23/2020	0.4261	P	0.4019	0.4611	0.5203
LB4110A - G3	Beta	11/2/2017	3/23/2020	0.5231	P	0.4845	0.5274	0.5702
LB4110A - G4	Beta	11/2/2017	3/23/2020	0.1130	F	0.3880	0.4578	0.5276

**SECTION X**

**BARIUM-133 ANALYTICAL TRACER DATA**

*KP*  
*3/18/20*

Analysis Report for 2003062-01  
SPIKE

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-01  
 Sample Description : SPIKE  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 3/18/2020 10:32:04AM  
 Acquisition Started : 3/18/2020 12:39:40PM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.02 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 29 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :

Sample Number : 95608

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 12:54:43PM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-01

## SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.33	35 -	38	35.67	3.84E+02	57.58	3.35E+02	2.55
	2	52.60	49 -	57	52.91	6.77E+01	35.22	1.51E+02	2.12
M	3	61.85	58 -	73	62.16	1.68E+02	34.06	1.06E+02	1.78
m	4	65.91	58 -	73	66.21	7.72E+01	35.38	1.53E+02	1.93
	5	81.11	77 -	86	81.39	8.57E+02	70.89	2.23E+02	1.85
	6	92.78	90 -	96	93.05	3.45E+01	26.06	9.91E+01	1.96
	7	111.63	108 -	114	111.87	1.62E+02	39.13	1.61E+02	1.26
	8	160.88	159 -	164	161.07	3.02E+01	24.84	9.96E+01	2.11
	9	243.72	242 -	246	243.82	1.55E+01	13.21	2.50E+01	2.68
	10	276.37	275 -	280	276.44	6.06E+01	21.79	4.87E+01	1.74
M	11	302.99	299 -	315	303.03	1.38E+02	28.07	4.00E+01	1.58
m	12	306.96	299 -	315	307.00	1.22E+01	14.42	3.20E+01	1.44
m	13	312.08	299 -	315	312.11	1.06E+01	14.42	4.00E+01	1.59
	14	333.15	328 -	336	333.16	6.49E+01	24.39	4.63E+01	1.72
	15	355.96	352 -	359	355.94	5.63E+02	50.16	4.39E+01	1.38
M	16	383.91	380 -	397	383.86	9.20E+01	22.16	1.73E+01	1.67
m	17	387.09	380 -	397	387.05	1.52E+02	27.04	9.69E+00	1.67
m	18	391.90	380 -	397	391.85	1.75E+01	13.39	5.95E+00	1.68
M	19	414.79	410 -	423	414.72	2.25E+01	15.14	2.07E+01	2.26
m	20	418.91	410 -	423	418.83	1.31E+01	15.14	1.19E+01	2.27
	21	436.71	433 -	439	436.61	6.70E+01	18.02	1.01E+01	1.81
	22	502.29	499 -	505	502.13	6.50E+00	8.03	7.00E+00	1.28
	23	539.73	535 -	543	539.53	8.50E+00	9.62	9.00E+00	1.75

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 12:54:43PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095493.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.33	3.84E+02	57.58			3.84E+02	5.76E+01
	2	52.60	6.77E+01	35.22			6.77E+01	3.52E+01
M	3	61.85	1.68E+02	34.06	5.90E+00	2.40E+00	1.62E+02	3.41E+01
m	4	65.91	7.72E+01	35.38	1.33E+00	5.66E-01	7.59E+01	3.54E+01
	5	81.11	8.57E+02	70.89			8.57E+02	7.09E+01
	6	92.78	3.45E+01	26.06	1.27E+01	1.31E+00	2.17E+01	2.61E+01

0134

Analysis Report for 2003062-01

SPIKE

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	7	111.63	1.62E+02	39.13		1.62E+02	3.91E+01
	8	160.88	3.02E+01	24.84		3.02E+01	2.48E+01
	9	243.72	1.55E+01	13.21		1.55E+01	1.32E+01
	10	276.37	6.06E+01	21.79	0.00E+00	6.06E+01	2.18E+01
M	11	302.99	1.38E+02	28.07		1.38E+02	2.81E+01
m	12	306.96	1.22E+01	14.42		1.22E+01	1.44E+01
m	13	312.08	1.06E+01	14.42		1.06E+01	1.44E+01
	14	333.15	6.49E+01	24.39		6.49E+01	2.44E+01
	15	355.96	5.63E+02	50.16		5.63E+02	5.02E+01
M	16	383.91	9.20E+01	22.16		9.20E+01	2.22E+01
m	17	387.09	1.52E+02	27.04		1.52E+02	2.70E+01
m	18	391.90	1.75E+01	13.39		1.75E+01	1.34E+01
M	19	414.79	2.25E+01	15.14		2.25E+01	1.51E+01
m	20	418.91	1.31E+01	15.14		1.31E+01	1.51E+01
	21	436.71	6.70E+01	18.02		6.70E+01	1.80E+01
	22	502.29	6.50E+00	8.03		6.50E+00	8.03E+00
	23	539.73	8.50E+00	9.62		8.50E+00	9.62E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.96	255.12	1.93		
		391.69 *	61.90	1.15E+01	8.83E+00
BA-133	1.00	81.00 *	34.06	5.23E+02	6.87E+01
		302.84 *	18.33	4.91E+02	1.80E+02
		356.01 *	62.05	4.51E+02	6.44E+01
TH-234	0.94	63.29 *	3.80	3.35E+02	7.16E+01
AM-241	0.87	59.54 *	35.90	3.55E+01	7.58E+00

Analysis Report for 2003062-01

SPIKE

- \* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i><b>Nuclide Name</b></i>	<i><b>Nuclide Id Confidence</b></i>	<i><b>Wt mean Activity (pCi/units)</b></i>	<i><b>Wt mean Activity Uncertainty</b></i>	<i><b>Comments</b></i>
SN-113	0.964	1.15E+01	8.83E+00	
BA-133	1.000	4.85E+02	4.54E+01	
? TH-234	0.949	3.35E+02	7.16E+01	
? AM-241	0.872	3.55E+01	7.58E+00	

- ? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-01

SPIKE

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 12:54:43PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	35.33	4.27197E-01	7.49	Tol.	I-129
2	52.60	7.52137E-02	26.01		
m 4	65.91	8.43094E-02	23.32		
6	92.78	2.41453E-02	60.03		
7	111.63	1.79550E-01	12.11	Tol.	U-237
8	160.88	3.35764E-02	41.10	Sum	
9	243.72	1.72222E-02	42.61		
10	276.37	6.73660E-02	17.97		
m 12	306.96	1.35534E-02	59.12		
m 13	312.08	1.17840E-02	67.99		
14	333.15	7.20707E-02	18.80		
M 16	383.91	1.02175E-01	12.05	Sum	
m 17	387.09	1.68639E-01	8.91		
M 19	414.79	2.49995E-02	33.65		
m 20	418.91	1.46111E-02	57.57	Sum	
21	436.71	7.43982E-02	13.46	Sum	
22	502.29	7.22222E-03	61.78		
23	539.73	9.44444E-03	56.57		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2003062-01

SPIKE

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.18E+01	2.18E+01	-1.81E+01	1.00E+01
	136.48	10.60	2.06E+02		2.39E+01	9.47E+01
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.32E+02	2.32E+02	2.97E+01	1.06E+02
+ SN-113	255.12	1.93	1.12E+03	2.38E+01	-1.54E+02	5.02E+02
	391.69	* 61.90	2.38E+01		1.15E+01	1.10E+01
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.92E-03		0.00E+00	0.00E+00
I-129	29.78	57.00	4.86E-01	4.86E-01	1.34E+00	2.39E-01
	33.60	13.20	4.53E+00		7.79E-01	2.23E+00
	39.58	7.52	4.45E+00		-7.16E-01	2.06E+00
+ BA-133	81.00	* 34.06	4.18E+01	2.36E+01	5.23E+02	2.01E+01
	302.84	* 18.33	2.15E+02		4.91E+02	1.03E+02
	356.01	* 62.05	2.36E+01		4.51E+02	1.07E+01
CE-139	165.85	80.35	3.53E+01	3.53E+01	-4.38E+00	1.63E+01
CE-144	133.54	10.80	2.15E+02	2.15E+02	3.87E+00	9.94E+01
HG-203	279.19	77.30	3.33E+01	3.33E+01	-2.39E+00	1.54E+01
PB-210	46.50	4.25	1.79E+01	1.79E+01	2.67E+00	8.28E+00
TH-231	25.64	14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
	84.21	6.40	3.47E+02		6.92E+02	1.69E+02
PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93	23.75	2.63E+00		1.39E-01	1.27E+00
	131.42	20.40	1.18E+02		4.64E+01	5.48E+01
+ TH-234	63.29	* 3.80	2.01E+02	2.01E+02	3.35E+02	9.77E+01
NP-237	29.37	14.00	1.81E+00	1.81E+00	4.98E+00	8.89E-01
	86.50	12.60	7.14E+01		8.32E+00	3.30E+01
U-237	97.08	16.30	6.95E+01	5.53E+01	2.12E+01	3.19E+01
	101.07	26.30	5.53E+01		4.68E+01	2.57E+01
	114.00	12.30	2.80E+02		-2.74E+00	1.35E+02
	208.01	22.00	1.36E+02		1.09E+01	6.26E+01
+ AM-241	59.54	* 35.90	2.13E+01	2.13E+01	3.55E+01	1.03E+01
AM-243	74.67	66.00	1.00E+01	1.00E+01	2.67E+00	4.68E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2003062-02  
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## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-02  
 Sample Description : BLANK  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:32:13AM  
 Acquisition Started : 3/18/2020 12:39:48PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 901.8 seconds  
  
 Dead Time : 0.20 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 10 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95609

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 12:54:56PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-02

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	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.51	17 -	24	20.93	1.02E+02	45.74	2.82E+02	2.56
M	2	30.94	27 -	39	31.36	2.32E+03	102.86	2.71E+02	2.11
m	3	35.20	27 -	39	35.61	5.42E+02	85.66	1.67E+02	2.15
	4	52.41	49 -	56	52.81	5.30E+01	39.50	2.26E+02	1.35
M	5	61.86	58 -	70	62.26	2.50E+02	50.75	2.63E+02	2.30
m	6	66.14	58 -	70	66.53	1.04E+02	45.48	2.65E+02	2.16
	7	81.17	76 -	87	81.55	9.23E+02	82.27	3.86E+02	2.34
M	8	111.96	108 -	123	112.32	2.31E+02	46.04	1.83E+02	2.52
m	9	115.88	108 -	123	116.24	4.95E+01	44.45	1.63E+02	2.52
	10	161.25	158 -	165	161.58	3.87E+01	29.87	1.21E+02	2.02
	11	169.34	166 -	174	169.67	4.70E+01	28.16	8.99E+01	6.97
	12	276.63	272 -	281	276.89	5.78E+01	26.87	7.05E+01	2.58
M	13	303.14	293 -	317	303.39	1.56E+02	29.03	4.20E+01	2.22
m	14	308.06	293 -	317	308.30	2.85E+01	20.17	4.20E+01	2.50
	15	335.40	329 -	343	335.62	8.49E+01	34.45	8.61E+01	2.93
	16	356.41	351 -	363	356.62	5.08E+02	49.82	5.66E+01	2.28
M	17	373.80	373 -	398	374.00	1.53E+01	6.24	5.93E+00	1.92
m	18	384.31	373 -	398	384.50	1.08E+02	28.65	1.55E+01	2.24
m	19	387.31	373 -	398	387.50	1.87E+02	34.42	9.00E+00	2.18
m	20	391.45	373 -	398	391.64	6.54E+01	26.40	2.21E+00	2.46
	21	416.64	412 -	422	416.81	6.30E+01	23.32	4.00E+01	4.67
	22	437.35	431 -	444	437.51	9.14E+01	29.53	5.71E+01	2.27
	23	444.88	444 -	447	445.04	6.25E+00	6.93	3.50E+00	3.38
	24	493.40	491 -	496	493.53	6.31E+00	6.40	3.38E+00	1.59
	25	510.68	505 -	517	510.79	2.55E+01	12.58	6.97E+00	2.98
	26	678.78	674 -	682	678.80	6.72E+00	7.50	4.56E+00	6.55

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 12:54:56PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095494.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.51	1.02E+02	45.74			1.02E+02	4.57E+01
M	2	30.94	2.32E+03	102.86			2.32E+03	1.03E+02
m	3	35.20	5.42E+02	85.66			5.42E+02	8.57E+01

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Analysis Report for 2003062-02

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	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	4	52.41	5.30E+01	39.50			5.30E+01	3.95E+01
M	5	61.86	2.50E+02	50.75	1.39E+01	2.81E+00	2.36E+02	5.08E+01
m	6	66.14	1.04E+02	45.48			1.04E+02	4.55E+01
	7	81.17	9.23E+02	82.27			9.23E+02	8.23E+01
M	8	111.96	2.31E+02	46.04			2.31E+02	4.60E+01
m	9	115.88	4.95E+01	44.45			4.95E+01	4.45E+01
	10	161.25	3.87E+01	29.87			3.87E+01	2.99E+01
	11	169.34	4.70E+01	28.16			4.70E+01	2.82E+01
	12	276.63	5.78E+01	26.87			5.78E+01	2.69E+01
M	13	303.14	1.56E+02	29.03			1.56E+02	2.90E+01
m	14	308.06	2.85E+01	20.17			2.85E+01	2.02E+01
	15	335.40	8.49E+01	34.45			8.49E+01	3.45E+01
	16	356.41	5.08E+02	49.82			5.08E+02	4.98E+01
M	17	373.80	1.53E+01	6.24			1.53E+01	6.24E+00
m	18	384.31	1.08E+02	28.65			1.08E+02	2.86E+01
m	19	387.31	1.87E+02	34.42			1.87E+02	3.44E+01
m	20	391.45	6.54E+01	26.40			6.54E+01	2.64E+01
	21	416.64	6.30E+01	23.32			6.30E+01	2.33E+01
	22	437.35	9.14E+01	29.53			9.14E+01	2.95E+01
	23	444.88	6.25E+00	6.93			6.25E+00	6.93E+00
	24	493.40	6.31E+00	6.40			6.31E+00	6.40E+00
	25	510.68	2.55E+01	12.58	1.39E+01	1.20E+00	1.16E+01	1.26E+01
	26	678.78	6.72E+00	7.50			6.72E+00	7.50E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69 *	61.90	5.52E+01	2.32E+01
I-129	0.86	29.78 *	57.00	3.15E+01	1.40E+00
		33.60 *	13.20	5.32E+01	8.41E+00
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	4.57E+02	6.05E+01

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Analysis Report for 2003062-02

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<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	0.99	302.84 *	18.33	5.16E+02	1.77E+02
		356.01 *	62.05	4.58E+02	7.25E+01
TH-234	0.94	63.29 *	3.80	5.28E+02	1.17E+02
AM-241	0.87	59.54 *	35.90	5.59E+01	1.24E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.954	5.52E+01	2.32E+01	
I-129	0.868	3.21E+01	1.38E+00	
BA-133	0.997	4.61E+02	4.49E+01	
? TH-234	0.949	5.28E+02	1.17E+02	
X NP-237	0.745			
? AM-241	0.871	5.59E+01	1.24E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-02

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 12:54:56PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.51	1.13530E-01	22.38	Tol.	MO-93
4	52.41	5.88487E-02	37.29		
m 6	66.14	1.15401E-01	21.89	Sum	
M 8	111.96	2.56223E-01	9.98	Sum	
m 9	115.88	5.49586E-02	44.94	Sum	
10	161.25	4.29910E-02	38.60	Sum	
11	169.34	5.22585E-02	29.94		
12	276.63	6.41936E-02	23.25		
m 14	308.06	3.16173E-02	35.45		
15	335.40	9.43750E-02	20.28	Sum	
M 17	373.80	1.70069E-02	20.40		
m 18	384.31	1.19749E-01	13.29	Sum	
m 19	387.31	2.07870E-01	9.20	Sum	
21	416.64	6.99799E-02	18.51	Sum	
22	437.35	1.01611E-01	16.15	Sum	
23	444.88	6.94444E-03	55.43		
24	493.40	7.01389E-03	50.72		
25	510.68	1.28617E-02	54.58		
26	678.78	7.46914E-03	55.79		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0143

Analysis Report for 2003062-02

BLANK

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.81E+01	1.81E+01	1.67E+00	8.48E+00
	136.48	10.60	1.84E+02		-4.49E+01	8.66E+01
NI-59	6.92	29.80	1.59E-05	1.59E-05	0.00E+00	0.00E+00
MO-93	16.59	52.90	3.67E-02	3.67E-02	3.57E-03	1.73E-02
	18.60	10.00	4.38E-01		9.15E-02	2.09E-01
NB-93M	16.57	9.43	2.05E-01	2.05E-01	1.99E-02	9.66E-02
CD-109	88.03	3.72	2.98E+02	2.98E+02	-4.47E+01	1.42E+02
+ SN-113	255.12	1.93	1.05E+03	3.37E+01	-2.85E+02	4.79E+02
	391.69	*	61.90	3.37E+01	5.52E+01	1.57E+01
SN-119M	23.87	16.10	8.98E-01	7.64E-01	-4.05E-03	4.28E-01
	25.10	22.70	7.64E-01		-3.62E-03	3.63E-01
+ I-129	29.78	*	57.00	1.44E+00	3.15E+01	7.01E-01
	33.60	*	13.20	1.02E+01	5.32E+01	4.95E+00
	39.58	7.52	1.15E+01		2.24E+00	5.40E+00
+ BA-133	81.00	*	34.06	3.40E+01	4.57E+02	2.26E+01
	302.84	*	18.33	2.49E+02	5.16E+02	1.20E+02
	356.01	*	62.05	3.40E+01	4.58E+02	1.58E+01
CE-139	165.85	80.35	2.75E+01	2.75E+01	-1.62E+01	1.29E+01
CE-144	133.54	10.80	1.75E+02	1.75E+02	-1.12E+01	8.23E+01
HG-203	279.19	77.30	3.60E+01	3.60E+01	4.31E+01	1.69E+01
PB-210	46.50	4.25	3.67E+01	3.67E+01	-1.85E+00	1.72E+01
TH-231	25.64	14.70	1.30E+00	1.30E+00	-6.15E-03	6.18E-01
	84.21	6.40	3.36E+02		8.67E+02	1.64E+02
PA-234M	9.89	89.00	1.07E-03	1.07E-03	1.16E-03	5.04E-04
	21.72	64.90	1.61E-01		1.54E-01	7.74E-02
	37.93	23.75	6.65E+00		1.44E+01	3.23E+00
	131.42	20.40	9.20E+01		3.50E+01	4.34E+01
+ TH-234	63.29	*	3.80	2.38E+02	5.28E+02	1.16E+02
NP-237	29.37	*	14.00	5.86E+00	1.28E+02	2.86E+00
	86.50	12.60	8.73E+01		1.70E+01	4.16E+01
U-237	97.08	16.30	7.91E+01	5.46E+01	-4.64E+00	3.75E+01
	101.07	26.30	5.46E+01		1.56E+01	2.59E+01
	114.00	12.30	2.35E+02		6.18E+02	1.14E+02
	208.01	22.00	1.09E+02		-2.95E+01	5.07E+01
+ AM-241	59.54	*	35.90	2.52E+01	5.59E+01	1.23E+01
AM-243	74.67	66.00	1.08E+01	1.08E+01	-2.76E+00	5.11E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2003062-03  
H-10 35-40

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-03  
 Sample Description : H-10 35-40  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 3/18/2020 10:32:23AM  
 Acquisition Started : 3/18/2020 12:39:54PM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.4 seconds

Dead Time : 0.05 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 95610

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 12:55:07PM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-03

H-10 35-40

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.77	15 -	24	20.82	9.73E+01	54.23	3.63E+02	2.91
M	2	32.03	25 -	40	31.08	1.72E+03	92.60	1.50E+02	2.27
m	3	36.15	25 -	40	35.21	4.61E+02	70.07	9.75E+01	2.28
	4	54.33	50 -	57	53.39	8.79E+01	30.79	9.82E+01	2.71
M	5	62.96	58 -	69	62.03	2.20E+02	42.76	1.28E+02	2.81
m	6	66.62	58 -	69	65.69	6.46E+01	44.18	1.63E+02	2.82
M	7	77.63	75 -	87	76.70	2.77E+01	15.67	4.85E+01	2.83
m	8	82.18	75 -	87	81.26	7.58E+02	61.92	1.35E+02	2.29
M	9	112.63	107 -	123	111.72	1.84E+02	43.19	1.89E+02	2.89
m	10	117.19	107 -	123	116.28	3.64E+01	41.20	1.47E+02	2.89
	11	129.79	126 -	131	128.89	1.53E+01	20.17	6.94E+01	1.58
	12	222.34	217 -	226	221.49	4.27E+01	24.92	6.26E+01	6.71
	13	278.20	272 -	285	277.37	3.91E+01	33.94	1.06E+02	3.04
	14	304.58	297 -	309	303.76	1.36E+02	32.25	5.86E+01	2.56
M	15	334.57	329 -	341	333.77	4.94E+01	21.31	3.99E+01	3.10
m	16	339.10	329 -	341	338.31	1.77E+01	16.06	1.77E+01	2.93
	17	356.78	351 -	360	356.00	3.43E+02	37.97	9.94E+00	2.37
M	18	384.21	379 -	394	383.44	6.75E+01	24.49	2.73E+01	2.80
m	19	387.27	379 -	394	386.50	1.18E+02	28.64	2.00E+01	2.70
m	20	391.97	379 -	394	391.20	2.43E+01	16.65	8.27E+00	2.94
M	21	415.62	410 -	423	414.87	3.58E+01	14.76	1.00E+01	4.53
m	22	421.18	410 -	423	420.42	1.70E+01	12.81	8.00E+00	2.79
	23	437.84	433 -	441	437.10	4.67E+01	18.15	2.06E+01	2.71
	24	672.95	668 -	675	672.33	6.94E+00	7.21	4.11E+00	2.63
	25	743.18	740 -	744	742.60	5.00E+00	4.47	0.00E+00	1.00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 12:55:07PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095495.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.77	9.73E+01	54.23	1.41E+01	4.78E-01	8.32E+01	5.42E+01
M	2	32.03	1.72E+03	92.60			1.72E+03	9.26E+01
m	3	36.15	4.61E+02	70.07			4.61E+02	7.01E+01
	4	54.33	8.79E+01	30.79			8.79E+01	3.08E+01

0146

Analysis Report for 2003062-03

H-10 35-40

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	5	62.96	2.20E+02	42.76	1.23E+01	2.15E+00	2.08E+02	4.28E+01
m	6	66.62	6.46E+01	44.18	1.23E+01	2.15E+00	5.24E+01	4.42E+01
M	7	77.63	2.77E+01	15.67			2.77E+01	1.57E+01
m	8	82.18	7.58E+02	61.92			7.58E+02	6.19E+01
M	9	112.63	1.84E+02	43.19			1.84E+02	4.32E+01
m	10	117.19	3.64E+01	41.20			3.64E+01	4.12E+01
	11	129.79	1.53E+01	20.17			1.53E+01	2.02E+01
	12	222.34	4.27E+01	24.92			4.27E+01	2.49E+01
	13	278.20	3.91E+01	33.94			3.91E+01	3.39E+01
	14	304.58	1.36E+02	32.25			1.36E+02	3.23E+01
M	15	334.57	4.94E+01	21.31			4.94E+01	2.13E+01
m	16	339.10	1.77E+01	16.06			1.77E+01	1.61E+01
	17	356.78	3.43E+02	37.97			3.43E+02	3.80E+01
M	18	384.21	6.75E+01	24.49			6.75E+01	2.45E+01
m	19	387.27	1.18E+02	28.64			1.18E+02	2.86E+01
m	20	391.97	2.43E+01	16.65			2.43E+01	1.67E+01
M	21	415.62	3.58E+01	14.76			3.58E+01	1.48E+01
m	22	421.18	1.70E+01	12.81			1.70E+01	1.28E+01
	23	437.84	4.67E+01	18.15			4.67E+01	1.81E+01
	24	672.95	6.94E+00	7.21			6.94E+00	7.21E+00
	25	743.18	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.93	255.12	1.93		
		391.69	*	3.91E+01	2.77E+01
BA-133	0.96	81.00	*	3.97E+02	5.08E+01
		302.84	*	4.86E+02	1.98E+02
		356.01	*	4.68E+02	8.97E+01
HG-203	0.97	279.19	*	2.90E+01	2.66E+01
PA-234M	0.41	9.89			
		21.72	*	2.63E+01	1.74E+01

0147

Analysis Report for 2003062-03

H-10 35-40

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
PA-234M	0.41	37.93 *	23.75	3.18E+02	5.62E+01
		131.42 *	20.40	1.79E+01	2.37E+01
TH-234	0.99	63.29 *	3.80	8.91E+02	2.01E+02

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.931	3.91E+01	2.77E+01	
BA-133	0.969	4.18E+02	4.32E+01	
HC-203	0.975	2.90E+01	2.66E+01	
PA-234M	0.419	4.07E+01	1.36E+01	
TH-234	0.997	8.91E+02	2.01E+02	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-03

H-10 35-40

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 12:55:07PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide	
M	2	32.03	1.91302E+00	2.69	Tol.	I-129
						I-129
	4	54.33	9.76886E-02	17.51		
m	6	66.62	5.81826E-02	42.24		
M	7	77.63	3.08100E-02	28.25		
M	9	112.63	2.04980E-01	11.71	Tol.	U-237
m	10	117.19	4.04961E-02	56.53	Sum	
	12	222.34	4.74174E-02	29.20		
M	15	334.57	5.48614E-02	21.58		
m	16	339.10	1.96430E-02	45.43	Sum	
M	18	384.21	7.50518E-02	18.13		
m	19	387.27	1.31370E-01	12.11	Sum	
M	21	415.62	3.98136E-02	20.60	Sum	
m	22	421.18	1.88444E-02	37.75	Sum	
	23	437.84	5.19006E-02	19.42	Sum	
	24	672.95	7.71605E-03	51.92		
	25	743.18	5.55556E-03	44.72		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB



Analysis Report for 2003062-03

H-10 35-40

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	9.98E+00	9.98E+00	-8.04E+00	4.63E+00
	136.48	10.60	8.22E+01		-1.97E+01	3.79E+01
NI-59	6.92	29.80	4.62E+01	4.62E+01	-3.05E+01	1.96E+01
MO-93	16.59	52.90	2.85E+01	2.85E+01	4.20E+00	1.36E+01
	18.60	10.00	1.58E+02		1.13E+01	7.60E+01
NB-93M	16.57	9.43	1.60E+02	1.60E+02	2.36E+01	7.65E+01
CD-109	88.03	3.72	2.30E+02	2.30E+02	-8.99E+00	1.08E+02
+ SN-113	255.12	1.93	6.69E+02	5.29E+01	-2.73E+02	2.99E+02
	391.69	* 61.90	5.29E+01		3.91E+01	2.43E+01
SN-119M	23.87	16.10	8.57E+01	5.75E+01	-1.43E+01	4.12E+01
	25.10	22.70	5.75E+01		-1.79E+02	2.76E+01
I-129	29.78	57.00	6.22E+01	6.22E+01	4.78E+02	3.07E+01
	33.60	13.20	2.80E+02		2.41E+03	1.39E+02
	39.58	7.52	1.63E+02		2.54E+00	7.85E+01
+ BA-133	81.00	* 34.06	3.87E+01	2.25E+01	3.97E+02	1.87E+01
	302.84	* 18.33	1.41E+02		4.86E+02	6.57E+01
	356.01	* 62.05	2.25E+01		4.68E+02	9.38E+00
CE-139	165.85	80.35	1.65E+01	1.65E+01	1.50E+00	7.73E+00
CE-144	133.54	10.80	8.14E+01	8.14E+01	1.58E+01	3.77E+01
+ HG-203	279.19	* 77.30	4.05E+01	4.05E+01	2.90E+01	1.93E+01
PB-210	46.50	4.25	1.75E+02	1.75E+02	1.17E+02	8.22E+01
TH-231	25.64	14.70	8.53E+01	8.53E+01	-1.21E+03	4.09E+01
	84.21	6.40	3.84E+02		2.04E+03	1.88E+02
+ PA-234M	9.89	89.00	2.22E+01	2.22E+01	1.21E+01	1.04E+01
	21.72	* 64.90	2.75E+01		2.63E+01	1.33E+01
	37.93	* 23.75	6.27E+01		3.18E+02	3.04E+01
	131.42	* 20.40	3.90E+01		1.79E+01	1.79E+01
+ TH-234	63.29	* 3.80	2.92E+02	2.92E+02	8.91E+02	1.40E+02
NP-237	29.37	14.00	2.21E+02	8.77E+01	9.89E+02	1.09E+02
	86.50	12.60	8.77E+01		6.94E+00	4.19E+01
U 237	97.08	16.30	6.02E+01	3.55E+01	2.33E+01	2.84E+01
	101.07	26.30	3.55E+01		8.69E+00	1.67E+01
	114.00	12.30	1.37E+02		2.67E+02	6.59E+01
	208.01	22.00	6.22E+01		7.78E+00	2.87E+01
AM-241	59.54	35.90	3.18E+01	3.18E+01	5.61E+00	1.53E+01
AM-243	74.67	66.00	1.25E+01	1.25E+01	1.49E+00	5.90E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2003062-04  
H-12 50-60

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-04  
 Sample Description : H-12 50-60  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 3/18/2020 10:32:40AM  
 Acquisition Started : 3/18/2020 12:50:24PM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.03 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 19 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 95611

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:05:27PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-04  
H-12 50-60

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.78	27 -	39	31.27	1.39E+03	84.18	2.50E+02	2.18
m	2	35.09	27 -	39	35.57	3.28E+02	69.21	2.41E+02	2.29
M	3	61.94	58 -	71	62.40	1.55E+02	43.03	2.13E+02	2.40
m	4	66.25	58 -	71	66.71	6.16E+01	35.82	2.01E+02	1.99
	5	81.00	77 -	86	81.44	5.09E+02	63.57	2.89E+02	2.00
M	6	112.15	105 -	120	112.57	1.18E+02	34.35	1.15E+02	2.48
m	7	116.01	105 -	120	116.43	2.23E+01	31.12	1.18E+02	2.48
	8	210.29	200 -	220	210.64	8.74E+01	49.48	1.67E+02	16.56
	9	276.63	273 -	282	276.92	4.39E+01	26.44	7.41E+01	2.19
	10	302.30	287 -	311	302.58	1.19E+02	56.32	1.76E+02	2.48
	11	334.73	329 -	341	334.98	8.24E+01	31.42	7.51E+01	2.78
	12	356.18	350 -	362	356.41	3.51E+02	47.26	9.79E+01	2.26
M	13	384.51	379 -	397	384.71	1.04E+02	33.64	6.54E+01	2.97
m	14	387.54	379 -	397	387.75	9.44E+01	27.38	3.78E+01	1.81
m	15	390.96	379 -	397	391.16	2.96E+01	34.84	8.60E+01	3.63
	16	417.43	411 -	425	417.62	5.49E+01	24.03	3.83E+01	3.98
M	17	433.46	432 -	441	433.63	7.44E+00	7.48	1.20E+01	2.65
m	18	437.31	432 -	441	437.48	6.27E+01	20.59	2.40E+01	2.61
	19	467.79	463 -	471	467.94	1.30E+01	13.00	1.80E+01	2.10
	20	500.30	496 -	503	500.42	7.46E+00	10.00	1.11E+01	1.82
	21	614.01	612 -	616	614.05	7.00E+00	6.18	2.00E+00	1.89
	22	706.41	703 -	709	706.38	8.00E+00	5.66	0.00E+00	3.32
	23	935.20	932 -	937	935.00	5.00E+00	4.47	0.00E+00	2.98
	24	1101.52	1098 -	1103	1101.20	5.00E+00	4.47	0.00E+00	2.31

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:05:27PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095492.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.78	1.39E+03	84.18			1.39E+03	8.42E+01
m	2	35.09	3.28E+02	69.21			3.28E+02	6.92E+01
M	3	61.94	1.55E+02	43.03	2.65E+01	2.53E+00	1.28E+02	4.31E+01
m	4	66.25	6.16E+01	35.82			6.16E+01	3.58E+01
	5	81.00	5.09E+02	63.57			5.09E+02	6.36E+01

Analysis Report for 2003062-04

H-12 50-60

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	6	112.15	1.18E+02	34.35			1.18E+02	3.44E+01
m	7	116.01	2.23E+01	31.12			2.23E+01	3.11E+01
	8	210.29	8.74E+01	49.48			8.74E+01	4.95E+01
	9	276.63	4.39E+01	26.44			4.39E+01	2.64E+01
	10	302.30	1.19E+02	56.32			1.19E+02	5.63E+01
	11	334.73	8.24E+01	31.42			8.24E+01	3.14E+01
	12	356.18	3.51E+02	47.26			3.51E+02	4.73E+01
M	13	384.51	1.04E+02	33.64			1.04E+02	3.36E+01
m	14	387.54	9.44E+01	27.38			9.44E+01	2.74E+01
m	15	390.96	2.96E+01	34.84			2.96E+01	3.48E+01
	16	417.43	5.49E+01	24.03			5.49E+01	2.40E+01
M	17	433.46	7.44E+00	7.48			7.44E+00	7.48E+00
m	18	437.31	6.27E+01	20.59			6.27E+01	2.06E+01
	19	467.79	1.30E+01	13.00			1.30E+01	1.30E+01
	20	500.30	7.46E+00	10.00			7.46E+00	1.00E+01
	21	614.01	7.00E+00	6.18			7.00E+00	6.18E+00
	22	706.41	8.00E+00	5.66			8.00E+00	5.66E+00
	23	935.20	5.00E+00	4.47			5.00E+00	4.47E+00
	24	1101.52	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
SN-113	0.94	255.12	1.93		
		391.69 *	61.90	2.30E+01	2.71E+01
I-129	0.86	29.78 *	57.00	4.02E+01	2.47E+00
		33.60 *	13.20	6.10E+01	1.29E+01
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	2.62E+02	4.19E+01
		302.84 *	18.33	3.36E+02	1.85E+02
		356.01 *	62.05	2.82E+02	4.97E+01
TH-234	0.95	63.29 *	3.80	3.51E+02	1.20E+02
AM-241	0.86	59.54 *	35.90	3.72E+01	1.27E+01

0153

Analysis Report for 2003062-04  
H-12 50-60

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
SN-113	0.940	2.30E+01	2.71E+01	
I-129	0.864	4.09E+01	2.43E+00	
BA-133	0.998	<u>2.72E+02</u>	<u>3.16E+01</u>	
? TH-234	0.954	3.51E+02	1.20E+02	
X NP-237	0.661			
? AM-241	0.863	3.72E+01	1.27E+01	

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-04

H-12 50-60

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:05:27PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m	4	66.25	6.83894E-02	29.10	Sum
M	6	112.15	1.30814E-01	14.59	Sum
m	7	116.01	2.47235E-02	69.92	Sum
	8	210.29	9.71053E-02	28.31	Tol. U-237
	9	276.63	4.88272E-02	30.08	
	11	334.73	9.16111E-02	19.05	Sum
M	13	384.51	1.15616E-01	16.17	Sum
m	14	387.54	1.04860E-01	14.51	Sum
	16	417.43	6.09459E-02	21.90	Sum
M	17	433.46	8.27175E-03	50.26	
m	18	437.31	6.97024E-02	16.41	Sum
	19	467.79	1.44444E-02	50.00	
	20	500.30	8.29060E-03	67.01	
	21	614.01	7.77778E-03	44.18	
	22	706.41	8.88889E-03	35.36	
	23	935.20	5.55556E-03	44.72	
	24	1101.52	5.55556E-03	44.72	

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2003062-04

H-12 50-60

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.49E-04	1.49E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.41E+01	1.41E+01	-1.50E+00	6.56E+00
	136.48	10.60	1.38E+02		2.17E+00	6.44E+01
NI-59	6.92	29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	1.33E-01	1.33E-01	-1.20E-01	6.16E-02
	18.60	10.00	1.93E+00		-7.67E-01	9.26E-01
NB-93M	16.57	9.43	7.40E-01	7.40E-01	-6.70E-01	3.44E-01
CD-109	88.03	3.72	2.67E+02	2.67E+02	-3.95E+02	1.26E+02
+ SN-113	255.12	1.93	8.41E+02	5.19E+01	5.29E+01	3.84E+02
	391.69	* 61.90	5.19E+01		2.30E+01	2.49E+01
SN-119M	23.87	16.10	4.25E+00	3.42E+00	1.04E+01	2.07E+00
	25.10	22.70	3.42E+00		4.92E+00	1.66E+00
+ I-129	29.78	* 57.00	2.90E+00	2.90E+00	4.02E+01	1.41E+00
	33.60	* 13.20	1.86E+01		6.10E+01	9.03E+00
	39.58	7.52	3.05E+01		1.31E+01	1.46E+01
+ BA-133	81.00	* 34.06	3.93E+01	3.93E+01	2.62E+02	1.89E+01
	302.84	* 18.33	2.49E+02		3.36E+02	1.21E+02
	356.01	* 62.05	4.02E+01		2.82E+02	1.90E+01
CE-139	165.85	80.35	1.99E+01	1.99E+01	-1.48E+01	9.20E+00
CE-144	133.54	10.80	1.29E+02	1.29E+02	1.13E+01	5.99E+01
HG-203	279.19	77.30	2.71E+01	2.71E+01	2.25E+01	1.26E+01
PB-210	46.50	4.25	6.10E+01	6.10E+01	-4.85E+01	2.88E+01
TH-231	25.64	14.70	5.67E+00	5.67E+00	8.17E+00	2.75E+00
	84.21	6.40	2.74E+02		1.25E+01	1.33E+02
PA-234M	9.89	89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
	21.72	64.90	7.74E-01		2.79E+00	3.77E-01
	37.93	23.75	1.25E+01		7.15E-01	6.10E+00
	131.42	20.40	6.44E+01		7.99E+00	2.99E+01
+ TH-234	63.29	* 3.80	2.78E+02	2.78E+02	3.51E+02	1.36E+02
NP-237	29.37	* 14.00	1.18E+01	1.18E+01	1.64E+02	5.74E+00
	86.50	12.60	8.15E+01		-1.25E+01	3.86E+01
U-237	97.08	16.30	5.95E+01	3.88E+01	-9.46E+01	2.78E+01
	101.07	26.30	3.88E+01		1.54E+00	1.81E+01
	114.00	12.30	1.65E+02		2.67E+02	7.90E+01
	208.01	22.00	8.42E+01		-2.77E+01	3.91E+01
+ AM-241	59.54	* 35.90	2.95E+01	2.95E+01	3.72E+01	1.43E+01
AM-243	74.67	66.00	1.21E+01	1.21E+01	2.39E+00	5.76E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2003062-05  
H-9 50-55

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-05  
 Sample Description : H-9 50-55  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:32:51AM  
 Acquisition Started : 3/18/2020 12:55:23PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 29 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95613

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:10:27PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-05

H-9 50-55

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.43	35 -	40	35.77	3.09E+02	58.54	2.54E+02	2.58
	2	52.63	49 -	57	52.95	5.45E+01	35.22	1.57E+02	1.96
M	3	61.75	58 -	71	62.06	1.52E+02	33.20	9.62E+01	1.58
m	4	65.81	58 -	71	66.11	6.65E+01	28.81	1.08E+02	1.59
	5	81.01	77 -	85	81.29	6.56E+02	62.47	1.95E+02	1.84
	6	111.60	108 -	114	111.85	1.05E+02	33.06	1.22E+02	1.27
	7	116.81	116 -	120	117.05	2.47E+01	22.39	8.26E+01	1.10
	8	161.61	156 -	168	161.80	3.81E+01	43.06	1.96E+02	3.03
	9	186.42	183 -	190	186.59	3.15E+01	24.82	7.69E+01	3.02
	10	276.30	271 -	281	276.37	7.43E+01	21.47	2.14E+01	2.14
	11	285.78	282 -	290	285.84	2.31E+01	10.97	3.76E+00	3.36
m	12	302.82	291 -	311	302.86	1.18E+02	24.79	2.19E+01	1.58
m	13	306.94	291 -	311	306.98	1.42E+01	14.78	4.52E+01	1.58
	14	334.24	330 -	339	334.24	5.79E+01	24.88	5.62E+01	2.21
	15	355.98	352 -	359	355.96	4.33E+02	44.90	4.68E+01	1.42
	16	365.03	361 -	369	365.00	1.61E+01	14.47	2.17E+01	3.64
	17	374.61	370 -	378	374.57	1.64E+01	12.36	1.32E+01	3.32
M	18	384.26	380 -	394	384.22	8.72E+01	23.19	9.20E+00	1.84
m	19	387.03	380 -	394	386.98	1.20E+02	27.75	4.46E+00	1.84
m	20	391.37	380 -	394	391.32	3.00E+01	13.19	6.67E-01	1.84
	21	417.62	410 -	426	417.55	4.27E+01	20.90	2.45E+01	5.60
	22	436.76	433 -	439	436.66	6.83E+01	17.10	3.33E+00	1.51
M	23	507.29	506 -	515	507.12	4.87E+00	4.27	2.80E-01	2.38
	24	610.72	607 -	613	610.45	9.50E+00	8.75	7.00E+00	3.45
	25	1060.26	1056 -	1061	1059.60	5.00E+00	4.47	0.00E+00	1.00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:10:27PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095493.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.43	3.09E+02	58.54			3.09E+02	5.85E+01
	2	52.63	5.45E+01	35.22			5.45E+01	3.52E+01
M	3	61.75	1.52E+02	33.20	5.90E+00	2.40E+00	1.46E+02	3.33E+01
m	4	65.81	6.65E+01	28.81	1.33E+00	5.66E-01	6.52E+01	2.88E+01

0158

Analysis Report for 2003062-05

H-9 50-55

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	5	81.01	6.56E+02	62.47		6.56E+02	6.25E+01
	6	111.60	1.05E+02	33.06		1.05E+02	3.31E+01
	7	116.81	2.47E+01	22.39		2.47E+01	2.24E+01
	8	161.61	3.81E+01	43.06		3.81E+01	4.31E+01
	9	186.42	3.15E+01	24.82	6.38E+00	1.86E+00	2.52E+01
	10	276.30	7.43E+01	21.47	0.00E+00	0.00E+00	7.43E+01
	11	285.78	2.31E+01	10.97		2.31E+01	1.10E+01
m	12	302.82	1.18E+02	24.79		1.18E+02	2.48E+01
m	13	306.94	1.42E+01	14.78		1.42E+01	1.48E+01
	14	334.24	5.79E+01	24.88		5.79E+01	2.49E+01
	15	355.98	4.33E+02	44.90		4.33E+02	4.49E+01
	16	365.03	1.61E+01	14.47		1.61E+01	1.45E+01
	17	374.61	1.64E+01	12.36		1.64E+01	1.24E+01
M	18	384.26	8.72E+01	23.19		8.72E+01	2.32E+01
m	19	387.03	1.20E+02	27.75		1.20E+02	2.77E+01
m	20	391.37	3.00E+01	13.19		3.00E+01	1.32E+01
	21	417.62	4.27E+01	20.90		4.27E+01	2.09E+01
	22	436.76	6.83E+01	17.10		6.83E+01	1.71E+01
M	23	507.29	4.87E+00	4.27		4.87E+00	4.27E+00
	24	610.72	9.50E+00	8.75	2.59E+00	9.64E-01	6.91E+00
	25	1060.26	5.00E+00	4.47		5.00E+00	4.47E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty	
SN-113	0.96	255.12	1.93			
		391.69	*	61.90	1.97E+01	8.86E+00
BA-133	1.00	81.00	*	34.06	3.99E+02	5.55E+01
		302.84	*	18.33	4.20E+02	1.55E+02
		356.01	*	62.05	3.46E+02	5.28E+01
PA-234M	0.98	9.89		89.00		
		21.72		64.90		
		37.93	*	23.75	6.22E+00	1.18E+00

0159

Analysis Report for 2003062-05  
H-9 50-55

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
PA-234M	0.98	131.42	20.40		
TH-234	0.94	63.29 *	3.80	3.00E+02	6.92E+01
AM-241	0.88	59.54 *	35.90	3.17E+01	7.32E+00

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.962	1.97E+01	8.86E+00	
BA-133	1.000	3.74E+02	3.71E+01	
PA-234M	0.981	6.22E+00	1.18E+00	
? TH-234	0.941	3.00E+02	6.92E+01	
? AM-241	0.882	3.17E+01	7.32E+00	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-05

H-9 50-55

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:10:27PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	52.63	6.06057E-02		
m	4	65.81	7.24152E-02		
	6	111.60	1.16416E-01	Tol.	U-237
	7	116.81	2.74242E-02	Sum	
	8	161.61	4.23407E-02	Sum	
	9	186.42	2.79499E-02		
	10	276.30	8.25556E-02		
	11	285.78	2.56889E-02		
m	13	306.94	1.57972E-02		
	14	334.24	6.43411E-02		
	16	365.03	1.79424E-02	Sum	
	17	374.61	1.82367E-02		
M	18	384.26	9.68494E-02	Sum	
m	19	387.03	1.32926E-01		
	21	417.62	4.74950E-02	Sum	
	22	436.76	7.59286E-02	Sum	
M	23	507.29	5.40559E-03		
	24	610.72	7.67583E-03		
	25	1060.26	5.55556E-03		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0161

Analysis Report for 2003062-05

H-9 50-55

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.01E+01	2.01E+01	-3.82E+00	9.16E+00
	136.48	10.60	1.85E+02		-5.26E+01	8.40E+01
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.40E+02	2.40E+02	-8.44E+01	1.10E+02
+ SN-113	255.12	1.93	1.08E+03	1.33E+01	-2.83E+01	4.84E+02
	391.69	*	61.90	1.33E+01	1.97E+01	5.77E+00
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.92E-03		0.00E+00	0.00E+00
I-129	29.78	57.00	4.24E-01	4.24E-01	8.72E-01	2.08E-01
	33.60	13.20	4.02E+00		4.18E+00	1.97E+00
	39.58	7.52	4.30E+00		-1.01E+00	1.99E+00
+ BA-133	81.00	*	34.06	2.44E+01	3.99E+02	1.79E+01
	302.84	*	18.33		4.20E+02	9.90E+01
	356.01	*	62.05		3.46E+02	1.11E+01
CE-139	165.85	80.35	3.28E+01	3.28E+01	6.15E-01	1.50E+01
CE-144	133.54	10.80	1.94E+02	1.94E+02	8.44E+01	8.91E+01
HG-203	279.19	77.30	2.93E+01	2.93E+01	1.70E+01	1.34E+01
PB-210	46.50	4.25	1.72E+01	1.72E+01	-2.01E+00	7.94E+00
TH-231	25.64	14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
	84.21	6.40	3.04E+02		5.21E+02	1.47E+02
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93	*	23.75		6.22E+00	7.75E-01
	131.42	20.40	1.04E+02		2.46E+00	4.78E+01
+ TH-234	63.29	*	3.80	1.63E+02	3.00E+02	7.88E+01
NP-237	29.37	14.00	1.58E+00	1.58E+00	3.24E+00	7.73E-01
	86.50	12.60	6.73E+01		2.81E+01	3.09E+01
U-237	97.08	16.30	7.55E+01	5.12E+01	1.53E+01	3.49E+01
	101.07	26.30	5.12E+01		2.04E+01	2.36E+01
	114.00	12.30	2.32E+02		-4.69E+00	1.10E+02
	208.01	22.00	1.28E+02		-1.28E+01	5.84E+01
+ AM-241	59.54	*	35.90	1.73E+01	3.17E+01	8.34E+00
AM-243	74.67	66.00	9.73E+00	9.73E+00	-9.61E-01	4.54E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

KP  
3/18/20

Analysis Report for 2003062-06  
H-10 35-40

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-06  
 Sample Description : H-10 35-40  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:33:01AM  
 Acquisition Started : 3/18/2020 12:55:31PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 901.8 seconds  
  
 Dead Time : 0.20 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 10 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95614

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:10:40PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-06

H-10 35-40

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.24	17 -	24	20.66	4.78E+01	46.04	3.24E+02	3.10
M	2	30.94	26 -	41	31.35	1.52E+03	85.50	2.52E+02	2.13
m	3	35.30	26 -	41	35.71	3.81E+02	74.59	2.18E+02	2.24
M	4	61.92	58 -	69	62.32	2.02E+02	41.38	1.93E+02	1.95
m	5	66.26	58 -	69	66.65	9.76E+01	36.11	1.51E+02	2.01
	6	81.21	76 -	88	81.60	7.06E+02	76.58	3.58E+02	2.24
M	7	112.03	109 -	129	112.40	2.02E+02	39.40	1.18E+02	2.52
m	8	116.96	109 -	129	117.32	3.52E+01	29.93	7.38E+01	2.52
	9	209.22	204 -	217	209.52	3.90E+01	39.22	1.52E+02	5.42
M	10	277.22	273 -	284	277.49	3.55E+01	22.18	5.44E+01	2.72
m	11	281.58	273 -	284	281.84	1.19E+01	16.03	3.22E+01	2.66
M	12	303.15	299 -	310	303.40	9.35E+01	26.17	6.95E+01	2.07
m	13	307.38	299 -	310	307.62	2.35E+01	25.16	5.05E+01	2.36
	14	335.80	330 -	343	336.03	9.30E+01	29.53	5.41E+01	7.15
	15	356.48	353 -	362	356.69	3.63E+02	41.87	3.84E+01	2.21
M	16	383.88	381 -	392	384.08	5.85E+01	28.86	4.12E+01	2.23
m	17	387.21	381 -	392	387.40	1.19E+02	33.06	7.43E+01	2.33
M	18	414.68	409 -	424	414.85	2.23E+01	17.09	1.57E+01	2.58
m	19	417.81	409 -	424	417.98	1.93E+01	17.24	1.84E+01	2.35
	20	437.42	432 -	443	437.58	4.48E+01	24.74	5.45E+01	2.06
	21	467.99	464 -	471	468.14	1.84E+01	10.95	7.27E+00	2.23
	22	474.04	472 -	479	474.18	1.29E+01	10.95	1.03E+01	1.11
	23	609.17	605 -	612	609.22	9.00E+00	6.00	0.00E+00	2.98
	24	766.90	763 -	769	766.86	7.00E+00	5.29	0.00E+00	1.98
	25	889.72	885 -	891	889.60	5.00E+00	4.47	0.00E+00	1.00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:10:40PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095494.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.24	4.78E+01	46.04			4.78E+01	4.60E+01
M	2	30.94	1.52E+03	85.50			1.52E+03	8.55E+01
m	3	35.30	3.81E+02	74.59			3.81E+02	7.46E+01
M	4	61.92	2.02E+02	41.38	1.39E+01	2.81E+00	1.88E+02	4.15E+01

0164

Analysis Report for 2003062-06

H-10 35-40

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	5	66.26	9.76E+01	36.11		9.76E+01	3.61E+01
	6	81.21	7.06E+02	76.58		7.06E+02	7.66E+01
M	7	112.03	2.02E+02	39.40		2.02E+02	3.94E+01
m	8	116.96	3.52E+01	29.93		3.52E+01	2.99E+01
	9	209.22	3.90E+01	39.22		3.90E+01	3.92E+01
M	10	277.22	3.55E+01	22.18		3.55E+01	2.22E+01
m	11	281.58	1.19E+01	16.03		1.19E+01	1.60E+01
M	12	303.15	9.35E+01	26.17		9.35E+01	2.62E+01
m	13	307.38	2.35E+01	25.16		2.35E+01	2.52E+01
	14	335.80	9.30E+01	29.53		9.30E+01	2.95E+01
	15	356.48	3.63E+02	41.87		3.63E+02	4.19E+01
M	16	383.88	5.85E+01	28.86		5.85E+01	2.89E+01
m	17	387.21	1.19E+02	33.06		1.19E+02	3.31E+01
M	18	414.68	2.23E+01	17.09		2.23E+01	1.71E+01
m	19	417.81	1.93E+01	17.24		1.93E+01	1.72E+01
	20	437.42	4.48E+01	24.74		4.48E+01	2.47E+01
	21	467.99	1.84E+01	10.95		1.84E+01	1.10E+01
	22	474.04	1.29E+01	10.95		1.29E+01	1.10E+01
	23	609.17	9.00E+00	6.00	1.39E+00	8.91E-01	7.61E+00
	24	766.90	7.00E+00	5.29		7.00E+00	5.29E+00
	25	889.72	5.00E+00	4.47		5.00E+00	4.47E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.86	29.78 *	57.00	2.06E+01	1.16E+00
		33.60 *	13.20	3.78E+01	7.41E+00
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	3.50E+02	5.11E+01
		302.84 *	18.33	3.08E+02	1.24E+02
		356.01 *	62.05	3.27E+02	5.55E+01
HG-203	0.90	279.19 *	77.30	2.84E+01	1.97E+01
TH-234	0.95	63.29 *	3.80	4.23E+02	9.54E+01

0165



Analysis Report for 2003062-06  
H-10 35-40

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
AM-241	0.86	59.54 *	35.90	4.48E+01	1.01E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
I-129	0.867	2.10E+01	1.15E+00	
BA-133	0.996	<del>3.37E+02</del>	3.60E+01	
HG-203	0.906	<del>2.84E+01</del>	1.97E+01	
? TH-234	0.953	4.23E+02	9.54E+01	
X NP-237	0.746			
? AM-241	0.865	4.48E+01	1.01E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-06

H-10 35-40

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:10:40PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.24	5.31111E-02	48.16	Tol.	PA-234M
m	5	66.26	1.08428E-01	Sum	
M	7	112.03	2.24973E-01	Sum	
m	8	116.96	3.90920E-02	Sum	
	9	209.22	4.33043E-02	Tol.	U-237
m	11	281.58	1.31888E-02	Tol.	HG-203
m	13	307.38	2.61336E-02	Sum	
	14	335.80	1.03287E-01	Sum	
M	16	383.88	6.50000E-02	Sum	
m	17	387.21	1.31686E-01	Sum	
M	18	414.68	2.47390E-02		
m	19	417.81	2.14259E-02	Sum	
	20	437.42	4.97454E-02	Sum	
	21	467.99	2.04040E-02		
	22	474.04	1.42901E-02		
	23	609.17	8.45747E-03		
	24	766.90	7.77778E-03		
	25	889.72	5.55556E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0167

Analysis Report for 2003062-06

H-10 35-40

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.48E+01	1.48E+01	-1.05E+01	6.85E+00
	136.48	10.60	1.54E+02		-3.79E+01	7.17E+01
NI-59	6.92	29.80	1.59E-05	1.59E-05	0.00E+00	0.00E+00
MO-93	16.59	52.90	3.45E-02	3.45E-02	-2.56E-03	1.62E-02
	18.60	10.00	3.99E-01		4.10E-02	1.90E-01
NB-93M	16.57	9.43	1.92E-01	1.92E-01	-1.43E-02	9.04E-02
CD-109	88.03	3.72	2.71E+02	2.71E+02	-1.17E+02	1.28E+02
SN-113	255.12	1.93	9.20E+02	3.25E+01	2.53E+02	4.17E+02
	391.69	61.90	3.25E+01		4.68E+00	1.51E+01
SN-119M	23.87	16.10	8.71E-01	7.50E-01	-2.38E-01	4.15E-01
	25.10	22.70	7.50E-01		-4.93E+00	3.56E-01
+ I-129	29.78 *	57.00	1.69E+00	1.69E+00	2.06E+01	8.25E-01
	33.60 *	13.20	1.23E+01		3.78E+01	6.01E+00
	39.58	7.52	1.22E+01		-4.32E+01	5.75E+00
+ BA-133	81.00 *	34.06	4.63E+01	2.82E+01	3.50E+02	2.25E+01
	302.84 *	18.33	1.71E+02		3.08E+02	8.11E+01
	356.01 *	62.05	2.82E+01		3.27E+02	1.29E+01
CE-139	165.85	80.35	2.36E+01	2.36E+01	-1.66E+01	1.09E+01
CE-144	133.54	10.80	1.45E+02	1.45E+02	4.65E+01	6.74E+01
+ HG-203	279.19 *	77.30	3.38E+01	3.38E+01	2.84E+01	1.58E+01
PB-210	46.50	4.25	3.45E+01	3.45E+01	2.18E+00	1.61E+01
TH-231	25.64	14.70	1.27E+00	1.27E+00	-8.38E+00	6.06E-01
	84.21	6.40	2.97E+02		6.82E+02	1.44E+02
PA-234M	9.89	89.00	1.01E-03	1.01E-03	8.89E-04	4.75E-04
	21.72	64.90	1.47E-01		1.01E-01	7.04E-02
	37.93	23.75	6.04E+00		1.21E+01	2.92E+00
	131.42	20.40	6.49E+01		-1.79E+01	2.98E+01
+ TH-234	63.29 *	3.80	1.95E+02	1.95E+02	4.23E+02	9.43E+01
NP-237	29.37 *	14.00	6.87E+00	6.87E+00	8.38E+01	3.36E+00
	86.50	12.60	8.39E+01		-2.94E+00	3.99E+01
U-237	97.08	16.30	8.18E+01	4.80E+01	2.20E+01	3.88E+01
	101.07	26.30	4.80E+01		-1.40E+01	2.26E+01
	114.00	12.30	2.12E+02		4.91E+02	1.02E+02
	208.01	22.00	1.10E+02		3.36E+01	5.15E+01
+ AM-241	59.54 *	35.90	2.06E+01	2.06E+01	4.48E+01	9.98E+00
AM-243	74.67	66.00	1.06E+01	1.06E+01	-3.67E-01	5.01E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

UP  
3/18/20

Analysis Report for 2003062-07  
H-2 30-35

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-07  
 Sample Description : H-2 30-35  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:33:14AM  
 Acquisition Started : 3/18/2020 12:55:37PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.4 seconds  
  
 Dead Time : 0.04 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95615

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:10:51PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-07

H-2 30-35

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.76	17 -	24	20.80	6.78E+01	43.50	2.66E+02	1.49
M	2	32.00	25 -	39	31.05	1.75E+03	89.20	1.83E+02	2.40
m	3	36.24	25 -	39	35.30	4.29E+02	68.97	1.53E+02	2.49
	4	52.79	47 -	56	51.85	5.80E+01	38.63	1.80E+02	3.01
M	5	62.78	57 -	71	61.85	1.71E+02	40.89	1.44E+02	2.81
m	6	66.63	57 -	71	65.70	1.04E+02	41.09	1.44E+02	2.76
M	7	82.14	76 -	91	81.21	6.81E+02	58.11	1.21E+02	2.35
	8	102.14	99 -	104	101.23	2.04E+01	20.37	6.32E+01	1.53
	9	112.78	105 -	118	111.87	2.23E+02	52.09	2.01E+02	2.52
	10	276.48	270 -	279	275.65	3.41E+01	25.02	6.99E+01	2.65
M	11	303.63	299 -	309	302.81	1.18E+02	25.50	2.80E+01	2.91
m	12	308.10	299 -	309	307.28	2.15E+01	13.78	2.00E+01	2.30
M	13	334.57	329 -	343	333.77	4.12E+01	20.00	3.81E+01	2.57
m	14	339.93	329 -	343	339.14	2.29E+01	17.44	2.80E+01	2.57
	15	356.83	351 -	360	356.04	3.47E+02	37.70	4.95E+00	2.16
M	16	386.27	380 -	395	385.50	1.12E+02	28.31	3.30E+01	3.79
m	17	391.39	380 -	395	390.62	2.63E+01	26.71	3.30E+01	4.19
	18	417.93	412 -	425	417.17	4.36E+01	17.49	1.68E+01	4.80
	19	437.67	433 -	440	436.92	5.80E+01	16.73	8.00E+00	2.49
	20	468.31	463 -	470	467.58	5.88E+00	6.93	4.25E+00	2.71
	21	531.38	528 -	533	530.69	4.67E+00	5.74	2.67E+00	2.48
	22	583.06	579 -	584	582.40	5.13E+00	7.07	5.75E+00	1.88
	23	617.75	613 -	621	617.11	1.11E+01	8.50	3.85E+00	1.86

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:10:51PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095495.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.76	6.78E+01	43.50	1.41E+01	4.78E-01	5.37E+01	4.35E+01
M	2	32.00	1.75E+03	89.20			1.75E+03	8.92E+01
m	3	36.24	4.29E+02	68.97			4.29E+02	6.90E+01
	4	52.79	5.80E+01	38.63			5.80E+01	3.86E+01
M	5	62.78	1.71E+02	40.89	1.23E+01	2.15E+00	1.59E+02	4.09E+01
m	6	66.63	1.04E+02	41.09	1.23E+01	2.15E+00	9.19E+01	4.11E+01

0170

Analysis Report for 2003062-07

H-2 30-35

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M 7	82.14	6.81E+02	58.11			6.81E+02	5.81E+01
8	102.14	2.04E+01	20.37			2.04E+01	2.04E+01
9	112.78	2.23E+02	52.09			2.23E+02	5.21E+01
10	276.48	3.41E+01	25.02			3.41E+01	2.50E+01
M 11	303.63	1.18E+02	25.50			1.18E+02	2.55E+01
m 12	308.10	2.15E+01	13.78			2.15E+01	1.38E+01
M 13	334.57	4.12E+01	20.00			4.12E+01	2.00E+01
m 14	339.93	2.29E+01	17.44			2.29E+01	1.74E+01
15	356.83	3.47E+02	37.70			3.47E+02	3.77E+01
M 16	386.27	1.12E+02	28.31			1.12E+02	2.83E+01
m 17	391.39	2.63E+01	26.71			2.63E+01	2.67E+01
18	417.93	4.36E+01	17.49	6.84E-01	1.02E+00	4.29E+01	1.75E+01
19	437.67	5.80E+01	16.73			5.80E+01	1.67E+01
20	468.31	5.88E+00	6.93			5.88E+00	6.93E+00
21	531.38	4.67E+00	5.74			4.67E+00	5.74E+00
22	583.06	5.13E+00	7.07			5.13E+00	7.07E+00
23	617.75	1.11E+01	8.50			1.11E+01	8.50E+00

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.93	255.12	1.93		
		391.69 *	61.90	4.21E+01	4.35E+01
BA-133	0.97	81.00 *	34.06	3.57E+02	4.65E+01
		302.84 *	18.33	4.19E+02	1.66E+02
		356.01 *	62.05	4.73E+02	9.01E+01
TH-234	0.99	63.29 *	3.80	6.82E+02	1.86E+02

Analysis Report for 2003062-07

H-2 30-35

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
SN-113	0.931	4.21E+01	4.35E+01	
BA-133	0.978	3.83E+02	4.01E+01	
TH-234	0.993	6.82E+02	1.86E+02	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2003062-07

H-2 30-35

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:10:51PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide	
	1	21.76	5.96714E-02	40.50	Tol.	SN-119M PA-234M
M	2	32.00	1.94582E+00	2.55	Tol.	I-129 I-129
m	3	36.24	4.76723E-01	8.04	Tol.	PA-234M
	4	52.79	6.44444E-02	33.30		
m	6	66.63	1.02114E-01	22.38		
	8	102.14	2.26603E-02	49.94	Tol.	U-237
	9	112.78	2.47251E-01	11.70	Tol.	U-237
	10	276.48	3.78583E-02	36.72		
m	12	308.10	2.38546E-02	32.10		
M	13	334.57	4.58107E-02	24.25		
m	14	339.93	2.54887E-02	38.00		
M	16	386.27	1.24328E-01	12.65	Sum	
	18	417.93	4.76803E-02	20.42	Sum	
	19	437.67	6.44444E-02	14.43	Sum	
	20	468.31	6.52778E-03	58.96		
	21	531.38	5.18519E-03	61.55		
	22	583.06	5.69444E-03	68.99		
	23	617.75	1.23077E-02	38.37		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0173



Analysis Report for 2003062-07

H-2 30-35

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.02E+01	1.02E+01	-5.22E+00	4.75E+00
	136.48	10.60	9.73E+01		6.66E+01	4.55E+01
NI-59	6.92	29.80	3.59E+01	3.59E+01	-4.07E+01	1.45E+01
MO-93	16.59	52.90	2.78E+01	2.78E+01	7.69E-01	1.32E+01
	18.60	10.00	1.54E+02		9.22E+00	7.41E+01
NB-93M	16.57	9.43	1.56E+02	1.56E+02	4.32E+00	7.44E+01
CD-109	88.03	3.72	1.94E+02	1.94E+02	-1.48E+03	9.01E+01
+ SN-113	255.12	1.93	6.94E+02	6.03E+01	-1.24E+02	3.11E+02
	391.69	* 61.90	6.03E+01		4.21E+01	2.80E+01
SN-119M	23.87	16.10	7.71E+01	5.15E+01	-5.36E+00	3.69E+01
	25.10	22.70	5.15E+01		-1.69E+02	2.46E+01
I-129	29.78	57.00	6.01E+01	6.01E+01	4.40E+02	2.97E+01
	33.60	13.20	2.73E+02		2.26E+03	1.35E+02
	39.58	7.52	1.66E+02		9.83E+00	8.03E+01
+ BA-133	81.00	* 34.06	4.49E+01	1.70E+01	3.57E+02	2.17E+01
	302.84	* 18.33	1.11E+02		4.19E+02	5.06E+01
	356.01	* 62.05	1.70E+01		4.73E+02	6.63E+00
CE-139	165.85	80.35	1.63E+01	1.63E+01	7.39E+00	7.63E+00
CE-144	133.54	10.80	8.85E+01	8.85E+01	-4.81E+00	4.12E+01
HG-203	279.19	77.30	2.82E+01	2.82E+01	8.29E-02	1.31E+01
PB-210	46.50	4.25	1.66E+02	1.66E+02	-1.30E+01	7.80E+01
TH-231	25.64	14.70	7.31E+01	7.31E+01	-1.18E+03	3.48E+01
	84.21	6.40	3.56E+02		1.76E+03	1.74E+02
PA-234M	9.89	89.00	2.07E+01	2.07E+01	1.26E+01	9.68E+00
	21.72	64.90	2.08E+01		2.01E+01	9.98E+00
	37.93	23.75	7.28E+01		-1.15E+01	3.55E+01
	131.42	20.40	4.40E+01		-1.41E+01	2.04E+01
+ TH-234	63.29	* 3.80	3.55E+02	3.55E+02	6.82E+02	1.72E+02
NP-237	29.37	14.00	2.14E+02	6.90E+01	9.37E+02	1.05E+02
	86.50	12.60	6.90E+01		-5.74E+02	3.25E+01
U-237	97.08	16.30	5.02E+01	3.10E+01	2.22E+01	2.35E+01
	101.07	26.30	3.10E+01		-5.96E-01	1.45E+01
	114.00	12.30	1.33E+02		2.44E+02	6.40E+01
	208.01	22.00	6.68E+01		7.16E+00	3.10E+01
AM-241	59.54	35.90	3.05E+01	3.05E+01	2.51E+01	1.46E+01
AM-243	74.67	66.00	1.20E+01	1.20E+01	9.57E-01	5.64E+00

- + = Nuclide identified during the nuclide identification  
\* = Energy line found in the spectrum  
> = MDA value not calculated  
@ = Half-life too short to be able to perform the decay correction

163  
3/18/20

Analysis Report for 2003062-08  
H-16 35-40

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : 2003062-08  
 Sample Description : H-16 35-40  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 1:24:10PM  
 Acquisition Started : 3/18/2020 1:27:05PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 901.7 seconds  
  
 Dead Time : 0.19 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95626

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 3/18/2020 1:42:09PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-08

H-16 35-40

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	37.79	35 -	42	38.20	2.69E+01	25.30	9.02E+01	4.74
2	105.58	101 -	113	105.95	3.45E+01	26.28	6.50E+01	8.66
3	153.12	151 -	156	153.46	9.77E+00	8.89	6.46E+00	3.40
4	229.54	227 -	233	229.83	1.15E+01	9.19	7.00E+00	1.38
5	418.45	414 -	422	418.63	6.50E+00	9.19	9.00E+00	4.23
6	534.28	532 -	537	534.38	4.63E+00	7.07	6.75E+00	1.63
7	712.90	708 -	716	712.89	9.00E+00	6.00	0.00E+00	2.84
8	946.58	943 -	949	946.43	7.00E+00	5.29	0.00E+00	2.22

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:42:09PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095494.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	37.79	2.69E+01	25.30			2.69E+01	2.53E+01
2	105.58	3.45E+01	26.28			3.45E+01	2.63E+01
3	153.12	9.77E+00	8.89			9.77E+00	8.89E+00
4	229.54	1.15E+01	9.19			1.15E+01	9.19E+00
5	418.45	6.50E+00	9.19			6.50E+00	9.19E+00
6	534.28	4.63E+00	7.07			4.63E+00	7.07E+00
7	712.90	9.00E+00	6.00			9.00E+00	6.00E+00
8	946.58	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

Analysis Report for 2003062-08  
H-16 35-40

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## NUCLIDE IDENTIFICATION REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

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### IDENTIFIED NUCLIDES

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<i>Nuclide Name</i>	<i>Id Confidence</i>	<i>Energy (keV)</i>	<i>Yield(%)</i>	<i>Activity (pCi/units)</i>	<i>Activity Uncertainty</i>
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\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
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? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity  
 Errors quoted at 2.000sigma

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Analysis Report for 2003062-08

H-16 35-40

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:42:09PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	37.79	2.98765E-02	47.04	Tol.	I-129 PA-234M
2	105.58	3.83333E-02	38.08		
3	153.12	1.08547E-02	45.49		
4	229.54	1.27778E-02	39.97		
5	418.45	7.22222E-03	70.71		
6	534.28	5.13889E-03	76.44		
7	712.90	1.00000E-02	33.33		
8	946.58	7.77778E-03	37.80		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	8.97E+00	8.97E+00	1.42E+00	3.92E+00
	136.48	10.60	8.41E+01		9.37E+00	3.67E+01
NI-59	6.92	29.80	4.33E-05	4.33E-05	-1.41E-04	1.37E-05
MO-93	16.59	52.90	2.40E-02	2.40E-02	-1.33E-02	1.10E-02
	18.60	10.00	2.34E-01		-5.28E-03	1.07E-01
NB-93M	16.57	9.43	1.34E-01	1.34E-01	-7.40E-02	6.12E-02
CD-109	88.03	3.72	1.85E+02	1.85E+02	-2.14E+02	8.53E+01

0178

Analysis Report for 2003062-08

H-16 35-40

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
SN-113	255.12	1.93	6.47E+02	1.19E+01	1.74E+02	2.80E+02
	391.69	61.90	1.19E+01		-1.90E+00	4.81E+00
SN-119M	23.87	16.10	4.81E-01	4.45E-01	-1.31E-01	2.20E-01
	25.10	22.70	4.45E-01		-6.20E-02	2.04E-01
I-129	29.78	57.00	3.71E-01	3.71E-01	5.31E-02	1.70E-01
	33.60	13.20	2.37E+00		-3.22E-01	1.08E+00
	39.58	7.52	9.28E+00		6.10E-01	4.28E+00
BA-133	81.00	34.06	1.82E+01	1.70E+01	4.02E-01	8.42E+00
	302.84	18.33	5.50E+01		-1.69E+01	2.30E+01
	356.01	62.05	1.70E+01		5.98E+00	7.27E+00
CE-139	165.85	80.35	1.06E+01	1.06E+01	-9.80E+00	4.46E+00
CE-144	133.54	10.80	8.66E+01	8.66E+01	3.36E+01	3.82E+01
HG-203	279.19	77.30	1.50E+01	1.50E+01	6.65E-01	6.43E+00
PB-210	46.50	4.25	2.89E+01	2.89E+01	1.38E+01	1.33E+01
TH-231	25.64	14.70	7.57E-01	7.57E-01	-1.05E-01	3.47E-01
	84.21	6.40	1.05E+02		3.43E+01	4.89E+01
PA-234M	9.89	89.00	8.96E-04	8.96E-04	7.49E-04	4.19E-04
	21.72	64.90	8.16E-02		4.11E-02	3.75E-02
	37.93	23.75	2.79E+00		2.54E+00	1.30E+00
	131.42	20.40	4.59E+01		1.58E+01	2.03E+01
TH-234	63.29	3.80	8.41E+01	8.41E+01	5.29E+01	3.88E+01
NP-237	29.37	14.00	1.42E+00	1.42E+00	2.04E-01	6.52E-01
	86.50	12.60	5.43E+01		-1.94E+01	2.51E+01
U-237	97.08	16.30	5.20E+01	3.26E+01	-1.51E+01	2.40E+01
	101.07	26.30	3.26E+01		6.87E+00	1.50E+01
	114.00	12.30	6.20E+01		1.05E+00	2.74E+01
	208.01	22.00	6.20E+01		2.71E+01	2.74E+01
AM-241	59.54	35.90	6.67E+00	6.67E+00	-3.02E+00	3.05E+00
AM-243	74.67	66.00	7.95E+00	7.95E+00	-3.96E-01	3.69E+00

- + = Nuclide identified during the nuclide identification  
\* = Energy line found in the spectrum  
> = MDA value not calculated  
@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2003062-09  
H-18 35-40

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-09  
 Sample Description : H-18 35-40  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:33:35AM  
 Acquisition Started : 3/18/2020 1:11:22PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 29 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95618

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:26:25PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-09

H-18 35-40

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
	1	35.43	35 -	39	35.77	2.15E+02	44.43	1.31E+02	2.60
	2	53.50	50 -	57	53.81	3.16E+01	29.05	1.19E+02	2.63
M	3	61.71	58 -	69	62.01	1.01E+02	26.76	5.34E+01	1.44
m	4	65.83	58 -	69	66.13	3.03E+01	21.35	5.51E+01	1.45
	5	71.06	70 -	74	71.35	1.72E+01	20.54	7.96E+01	1.27
	6	81.01	77 -	86	81.29	4.73E+02	52.23	1.17E+02	1.84
	7	92.33	89 -	94	92.60	3.83E+01	20.95	5.73E+01	1.24
M	8	111.81	108 -	121	112.06	9.51E+01	26.21	6.92E+01	1.57
m	9	115.82	108 -	121	116.06	1.66E+01	19.47	7.29E+01	1.58
	10	255.18	251 -	260	255.27	1.86E+01	22.27	6.09E+01	3.20
	11	275.48	271 -	280	275.55	4.13E+01	21.93	4.54E+01	2.03
M	12	302.81	299 -	311	302.85	1.07E+02	22.80	1.97E+01	1.81
m	13	306.98	299 -	311	307.02	2.11E+01	15.97	1.42E+01	2.11
	14	324.69	321 -	329	324.71	1.65E+01	10.98	7.10E+00	1.66
M	15	331.14	330 -	345	331.15	9.28E+00	6.04	2.99E-01	1.61
m	16	338.85	330 -	345	338.85	1.42E+01	10.79	7.31E+00	1.62
	17	355.93	353 -	360	355.91	3.13E+02	38.88	4.29E+01	1.43
M	18	375.82	373 -	396	375.78	7.68E+00	9.90	2.00E+01	2.21
m	19	384.09	373 -	396	384.05	6.52E+01	28.11	2.80E+01	2.22
m	20	386.94	373 -	396	386.90	8.90E+01	26.12	2.00E+01	1.63
m	21	391.48	373 -	396	391.42	2.02E+01	16.19	2.80E+01	2.23
	22	415.27	409 -	420	415.20	2.30E+01	19.49	3.60E+01	4.14
	23	436.83	433 -	439	436.73	4.07E+01	16.66	2.06E+01	1.89
	24	467.79	463 -	470	467.66	1.18E+01	10.95	1.25E+01	1.64
	25	481.94	479 -	484	481.80	6.69E+00	6.40	2.63E+00	2.89
	26	703.96	701 -	706	703.60	5.00E+00	4.47	0.00E+00	1.24
	27	1002.82	999 -	1004	1002.20	5.00E+00	4.47	0.00E+00	2.32

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:26:25PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095493.CNF

<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
1	35.43	2.15E+02	44.43			2.15E+02	4.44E+01
2	53.50	3.16E+01	29.05			3.16E+01	2.91E+01

0181



Analysis Report for 2003062-09  
H-18 35-40

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M 3	61.71	1.01E+02	26.76	5.90E+00	2.40E+00	9.56E+01	2.69E+01
m 4	65.83	3.03E+01	21.35	1.33E+00	5.66E-01	2.89E+01	2.14E+01
5	71.06	1.72E+01	20.54			1.72E+01	2.05E+01
6	81.01	4.73E+02	52.23			4.73E+02	5.22E+01
7	92.33	3.83E+01	20.95	1.27E+01	1.31E+00	2.56E+01	2.10E+01
M 8	111.81	9.51E+01	26.21			9.51E+01	2.62E+01
m 9	115.82	1.66E+01	19.47			1.66E+01	1.95E+01
10	255.18	1.86E+01	22.27			1.86E+01	2.23E+01
11	275.48	4.13E+01	21.93	0.00E+00	0.00E+00	4.13E+01	2.19E+01
M 12	302.81	1.07E+02	22.80			1.07E+02	2.28E+01
m 13	306.98	2.11E+01	15.97			2.11E+01	1.60E+01
14	324.69	1.65E+01	10.98			1.65E+01	1.10E+01
M 15	331.14	9.28E+00	6.04			9.28E+00	6.04E+00
m 16	338.85	1.42E+01	10.79			1.42E+01	1.08E+01
17	355.93	3.13E+02	38.88			3.13E+02	3.89E+01
M 18	375.82	7.68E+00	9.90			7.68E+00	9.90E+00
m 19	384.09	6.52E+01	28.11			6.52E+01	2.81E+01
m 20	386.94	8.90E+01	26.12			8.90E+01	2.61E+01
m 21	391.48	2.02E+01	16.19			2.02E+01	1.62E+01
22	415.27	2.30E+01	19.49			2.30E+01	1.95E+01
23	436.83	4.07E+01	16.66			4.07E+01	1.67E+01
24	467.79	1.18E+01	10.95	3.98E-01	9.97E-01	1.14E+01	1.10E+01
25	481.94	6.69E+00	6.40			6.69E+00	6.40E+00
26	703.96	5.00E+00	4.47			5.00E+00	4.47E+00
27	1002.82	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.99	255.12 *	1.93	7.57E+02	9.51E+02
		391.69 *	61.90	1.32E+01	1.07E+01
BA-133	1.00	81.00 *	34.06	2.88E+02	4.32E+01
		302.84 *	18.33	3.81E+02	1.41E+02

Analysis Report for 2003062-09

H-18 35-40

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	1.00	356.01 *	62.05	2.50E+02	4.18E+01
PA-234M	0.98	9.89	89.00		
		21.72	64.90		
		37.93 *	23.75	4.34E+00	8.95E-01
		131.42	20.40		
TH-234	0.93	63.29 *	3.80	1.95E+02	5.54E+01
AM-241	0.88	59.54 *	35.90	2.07E+01	5.87E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.999	1.33E+01	1.07E+01	
BA-133	1.000	2.73E+02	2.94E+01	
PA-234M	0.981	4.34E+00	8.95E-01	
? TH-234	0.938	1.95E+02	5.54E+01	
? AM-241	0.886	2.07E+01	5.87E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2003062-09  
H-18 35-40

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 3/18/2020 1:26:25PM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	53.50	3.51038E-02	45.98	
m	4	65.83	3.21476E-02	36.92	
	5	71.06	1.90936E-02	59.75	Sum
	7	92.33	2.84686E-02	40.97	
M	8	111.81	1.05613E-01	13.79	Tol. U-237
m	9	115.82	1.84584E-02	58.59	Sum
	11	275.48	4.58854E-02	26.55	
m	13	306.98	2.34303E-02	37.86	
	14	324.69	1.82778E-02	33.37	
M	15	331.14	1.03091E-02	32.56	
m	16	338.85	1.57605E-02	38.05	Sum
M	18	375.82	8.53288E-03	64.45	
m	19	384.09	7.24018E-02	21.57	Sum
m	20	386.94	9.89387E-02	14.66	
	22	415.27	2.55556E-02	42.38	Sum
	23	436.83	4.52397E-02	20.46	Sum
	24	467.79	1.26139E-02	48.45	
	25	481.94	7.43056E-03	47.87	
	26	703.96	5.55556E-03	44.72	
	27	1002.82	5.55556E-03	44.72	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2003062-09

H-18 35-40

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.01E+01	2.01E+01	1.81E+00	9.16E+00
	136.48	10.60	1.77E+02		-9.22E+00	8.01E+01
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	1.95E+02	1.95E+02	2.14E+01	8.79E+01
+ SN-113	255.12 *	1.93	1.49E+03	3.93E+01	7.57E+02	6.89E+02
	391.69 *	61.90	3.93E+01		1.32E+01	1.88E+01
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.92E-03		0.00E+00	0.00E+00
I-129	29.78	57.00	3.63E-01	3.63E-01	6.06E-01	1.78E-01
	33.60	13.20	3.44E+00		2.87E+00	1.68E+00
	39.58	7.52	3.08E+00		-1.27E+00	1.38E+00
+ BA-133	81.00 *	34.06	3.05E+01	2.35E+01	2.88E+02	1.44E+01
	302.84 *	18.33	1.17E+02		3.81E+02	5.35E+01
	356.01 *	62.05	2.35E+01		2.50E+02	1.07E+01
CE-139	165.85	80.35	3.59E+01	3.59E+01	2.43E+01	1.66E+01
CE-144	133.54	10.80	1.61E+02	1.61E+02	-1.55E+02	7.23E+01
HG-203	279.19	77.30	2.34E+01	2.34E+01	-4.11E+00	1.04E+01
PB-210	46.50	4.25	1.79E+01	1.79E+01	1.42E+01	8.28E+00
TH-231	25.64	14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
	84.21	6.40	2.56E+02		3.66E+02	1.23E+02
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93 *	23.75	1.16E+00		4.34E+00	5.53E-01
	131.42	20.40	9.60E+01		5.76E+01	4.38E+01
+ TH-234	63.29 *	3.80	1.17E+02	1.17E+02	1.95E+02	5.60E+01
NP-237	29.37	14.00	1.35E+00	1.35E+00	2.25E+00	6.61E-01
	86.50	12.60	5.73E+01		6.01E+00	2.60E+01
U-237	97.08	16.30	6.81E+01	4.60E+01	3.53E+01	3.11E+01
	101.07	26.30	4.60E+01		-3.51E+01	2.10E+01
	114.00	12.30	2.27E+02		2.64E+02	1.08E+02
	208.01	22.00	1.12E+02		2.38E+00	5.06E+01
+ AM-241	59.54 *	35.90	1.24E+01	1.24E+01	2.07E+01	5.92E+00
AM-243	74.67	66.00	7.81E+00	7.81E+00	-5.61E-01	3.58E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

*LP*  
*3/18/20*

Analysis Report for 2003062-10  
H-3 22-27

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-10  
 Sample Description : H-3 22-27  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 3/18/2020 10:33:47AM  
 Acquisition Started : 3/18/2020 1:11:30PM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 901.9 seconds  
  
 Dead Time : 0.21 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 10 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 95619

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:26:38PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-10

H-3 22-27

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	20.86	17 -	40	21.28	9.11E+01	38.32	2.20E+02	2.32
m	2	30.94	17 -	40	31.36	1.84E+03	91.08	1.59E+02	2.07
m	3	34.46	17 -	40	34.87	3.36E+02	76.62	1.24E+02	1.95
	4	52.69	50 -	56	53.09	4.64E+01	39.26	2.49E+02	2.39
M	5	61.85	57 -	71	62.24	2.44E+02	46.69	2.36E+02	2.10
m	6	66.12	57 -	71	66.51	9.29E+01	46.29	2.46E+02	2.21
	7	81.25	76 -	86	81.63	8.00E+02	74.49	3.13E+02	2.40
	8	101.78	100 -	104	102.15	2.48E+01	24.73	1.12E+02	2.13
M	9	112.07	106 -	122	112.44	2.25E+02	45.83	1.76E+02	2.52
m	10	116.53	106 -	122	116.89	6.00E+01	41.13	1.33E+02	2.52
	11	276.85	273 -	280	277.11	3.93E+01	27.78	9.94E+01	1.85
	12	303.51	300 -	309	303.75	1.44E+02	32.71	7.21E+01	2.07
M	13	334.23	330 -	350	334.45	7.19E+01	21.40	2.60E+01	2.21
m	14	338.40	330 -	350	338.63	2.69E+01	21.17	2.67E+01	2.52
	15	356.46	351 -	363	356.67	4.63E+02	49.69	7.53E+01	2.40
M	16	386.47	380 -	402	386.67	2.66E+02	37.74	2.21E+01	4.12
m	17	391.32	380 -	402	391.51	6.51E+01	33.39	6.35E+00	3.42
	18	416.15	412 -	421	416.33	4.56E+01	20.76	3.69E+01	4.90
	19	437.63	434 -	441	437.79	9.10E+01	19.08	0.00E+00	2.53
	20	458.35	455 -	460	458.50	8.00E+00	5.66	0.00E+00	1.32
	21	528.29	525 -	531	528.40	5.00E+00	4.47	0.00E+00	1.00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:26:38PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095494.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	20.86	9.11E+01	38.32			9.11E+01	3.83E+01
m	2	30.94	1.84E+03	91.08			1.84E+03	9.11E+01
m	3	34.46	3.36E+02	76.62			3.36E+02	7.66E+01
	4	52.69	4.64E+01	39.26			4.64E+01	3.93E+01
M	5	61.85	2.44E+02	46.69	1.39E+01	2.81E+00	2.30E+02	4.68E+01
m	6	66.12	9.29E+01	46.29			9.29E+01	4.63E+01
	7	81.25	8.00E+02	74.49			8.00E+02	7.45E+01
	8	101.78	2.48E+01	24.73			2.48E+01	2.47E+01

0187

Analysis Report for 2003062-10

H-3 22-27

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	9	112.07	2.25E+02	45.83			2.25E+02	4.58E+01
m	10	116.53	6.00E+01	41.13			6.00E+01	4.11E+01
	11	276.85	3.93E+01	27.78			3.93E+01	2.78E+01
	12	303.51	1.44E+02	32.71			1.44E+02	3.27E+01
M	13	334.23	7.19E+01	21.40			7.19E+01	2.14E+01
m	14	338.40	2.69E+01	21.17			2.69E+01	2.12E+01
	15	356.46	4.63E+02	49.69			4.63E+02	4.97E+01
M	16	386.47	2.66E+02	37.74			2.66E+02	3.77E+01
m	17	391.32	6.51E+01	33.39			6.51E+01	3.34E+01
	18	416.15	4.56E+01	20.76			4.56E+01	2.08E+01
	19	437.63	9.10E+01	19.08			9.10E+01	1.91E+01
	20	458.35	8.00E+00	5.66			8.00E+00	5.66E+00
	21	528.29	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69 *	61.90	5.51E+01	2.89E+01
I-129	0.87	29.78 *	57.00	2.49E+01	1.24E+00
		33.60 *	13.20	3.04E+01	6.92E+00
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	3.97E+02	5.37E+01
		302.84 *	18.33	4.75E+02	1.74E+02
		356.01 *	62.05	4.18E+02	6.85E+01
HG-203	0.86	279.19 *	77.30	3.14E+01	2.42E+01
TH-234	0.94	63.29 *	3.80	5.15E+02	1.08E+02
AM-241	0.87	59.54 *	35.90	5.45E+01	1.14E+01

Analysis Report for 2003062-10

H-3 22-27

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
SN-113	0.952	5.51E+01	2.89E+01	
I-129	0.876	2.51E+01	1.22E+00	
BA-133	0.995	4.09E+02	4.11E+01	
HG-203	0.869	3.14E+01	2.42E+01	
? TH-234	0.948	5.15E+02	1.08E+02	
X NP-237	0.745			
? AM-241	0.872	5.45E+01	1.14E+01	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2003062-10

H-3 22-27

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 3/18/2020 1:26:38PM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M 1	20.86	1.01233E-01	21.03	Tol.	MO-93 PA-234M
	4	52.69	5.15757E-02		
m 6	66.12	1.03270E-01	24.90	Sum	
	8	101.78	2.75240E-02	Tol.	U-237
M 9	112.07	2.49487E-01	10.20	Sum	
m 10	116.53	6.66362E-02	34.29	Sum	
M 13	334.23	7.98663E-02	14.88	Sum	
m 14	338.40	2.98631E-02	39.38	Sum	
M 16	386.47	2.95516E-01	7.09	Sum	
	18	416.15	5.06250E-02	Sum	
	19	437.63	1.01111E-01	Sum	
	20	458.35	8.88889E-03		
	21	528.29	5.55556E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.73E+01	1.73E+01	1.47E+00	8.07E+00

0190

Analysis Report for 2003062-10

H-3 22-27

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CO-57	136.48	10.60	1.44E+02	1.73E+01	-1.02E+02	6.69E+01
NI-59	6.92	29.80	1.59E-05	1.59E-05	0.00E+00	0.00E+00
MO-93	16.59	52.90	3.67E-02	3.67E-02	4.38E-03	1.73E-02
	18.60	10.00	4.18E-01		-2.41E-02	1.99E-01
NB-93M	16.57	9.43	2.05E-01	2.05E-01	2.44E-02	9.66E-02
CD-109	88.03	3.72	2.48E+02	2.48E+02	-1.07E+02	1.17E+02
+ SN-113	255.12	1.93	9.20E+02	3.04E+01	-1.79E+02	4.17E+02
	391.69	* 61.90	3.04E+01		5.51E+01	1.41E+01
SN-119M	23.87	16.10	8.46E-01	7.09E-01	-5.21E-01	4.02E-01
	25.10	22.70	7.09E-01		-5.67E+00	3.36E-01
+ I-129	29.78	* 57.00	1.99E+00	1.99E+00	2.49E+01	9.75E-01
	33.60	* 13.20	1.32E+01		3.04E+01	6.47E+00
	39.58	7.52	1.16E+01		-4.21E-01	5.44E+00
+ BA-133	81.00	* 34.06	4.09E+01	3.92E+01	3.97E+02	1.98E+01
	302.84	* 18.33	1.29E+02		4.75E+02	6.03E+01
	356.01	* 62.05	3.92E+01		4.18E+02	1.84E+01
CE-139	165.85	80.35	2.59E+01	2.59E+01	-8.47E+00	1.21E+01
CE-144	133.54	10.80	1.46E+02	1.46E+02	-1.96E+01	6.79E+01
+ HG-203	279.19	* 77.30	3.48E+01	3.48E+01	3.14E+01	1.63E+01
PB-210	46.50	4.25	3.82E+01	3.82E+01	3.74E+00	1.80E+01
TH-231	25.64	14.70	1.21E+00	1.21E+00	-9.64E+00	5.71E-01
	84.21	6.40	3.15E+02		1.64E+01	1.53E+02
PA-234M	9.89	89.00	1.04E-03	1.04E-03	1.22E-03	4.89E-04
	21.72	64.90	1.55E-01		1.77E-01	7.40E-02
	37.93	23.75	6.11E+00		1.19E+01	2.96E+00
	131.42	20.40	7.86E+01		2.10E+01	3.66E+01
+ TH-234	63.29	* 3.80	2.61E+02	2.61E+02	5.15E+02	1.28E+02
NP-237	29.37	* 14.00	8.09E+00	8.09E+00	1.01E+02	3.97E+00
	86.50	12.60	7.47E+01		-1.72E+01	3.53E+01
U-237	97.08	16.30	7.41E+01	5.25E+01	-4.04E+01	3.50E+01
	101.07	26.30	5.25E+01		0.00E+00	2.49E+01
	114.00	12.30	2.35E+02		5.50E+02	1.14E+02
	208.01	22.00	1.05E+02		7.93E+00	4.88E+01
+ AM-241	59.54	* 35.90	2.76E+01	2.76E+01	5.45E+01	1.35E+01
AM-243	74.67	66.00	1.11E+01	1.11E+01	-1.27E+00	5.29E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

KP  
3/18/20

Analysis Report for 2003062-11  
H-1 35-40

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2003062-11  
 Sample Description : H-1 35-40  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 3/18/2020 10:33:56AM  
 Acquisition Started : 3/18/2020 1:11:38PM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.4 seconds

Dead Time : 0.04 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 95620

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/18/2020 1:26:49PM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2003062-11

H-1 35-40

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.99	18 -	24	21.04	4.91E+01	38.80	2.32E+02	1.96
M	2	32.03	25 -	39	31.08	1.62E+03	88.99	1.55E+02	2.27
m	3	36.15	25 -	39	35.21	3.71E+02	66.60	1.32E+02	2.28
M	4	53.85	49 -	74	52.91	4.19E+01	30.02	1.15E+02	3.07
m	5	63.04	49 -	74	62.11	1.91E+02	42.05	1.46E+02	2.61
m	6	67.09	49 -	74	66.16	9.75E+01	45.49	1.78E+02	2.97
	7	82.14	77 -	87	81.22	6.53E+02	65.11	2.24E+02	2.27
	8	112.67	107 -	116	111.76	1.45E+02	47.93	2.46E+02	1.74
	9	151.29	147 -	154	150.40	2.14E+01	24.82	8.92E+01	1.55
	10	162.93	158 -	167	162.04	3.46E+01	34.32	1.45E+02	5.04
	11	222.43	219 -	225	221.58	1.65E+01	20.90	6.90E+01	3.06
	12	277.07	272 -	281	276.24	4.09E+01	24.84	6.42E+01	2.02
	13	303.78	299 -	309	302.97	8.21E+01	32.93	1.06E+02	2.20
	14	334.45	329 -	338	333.65	4.49E+01	26.51	7.42E+01	1.65
	15	356.80	351 -	363	356.01	2.97E+02	42.88	7.21E+01	2.80
M	16	384.60	381 -	395	383.82	6.69E+01	22.93	1.47E+01	2.53
m	17	387.36	381 -	395	386.59	9.90E+01	27.74	2.13E+01	2.22
m	18	392.14	381 -	395	391.37	2.72E+01	22.75	3.41E+01	3.73
M	19	413.76	412 -	423	413.00	8.92E+00	0.50	1.00E+00	2.38
m	20	417.73	412 -	423	416.98	2.18E+01	14.01	4.02E+00	2.88
	21	437.98	432 -	440	437.23	5.45E+01	18.36	1.91E+01	2.40
	22	467.61	462 -	471	466.88	1.26E+01	13.71	1.87E+01	4.84

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/18/2020 1:26:49PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000095495.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.99	4.91E+01	38.80	1.41E+01	4.78E-01	3.50E+01	3.88E+01
M	2	32.03	1.62E+03	88.99			1.62E+03	8.90E+01
m	3	36.15	3.71E+02	66.60			3.71E+02	6.66E+01
M	4	53.85	4.19E+01	30.02			4.19E+01	3.00E+01
m	5	63.04	1.91E+02	42.05	1.23E+01	2.15E+00	1.79E+02	4.21E+01
m	6	67.09	9.75E+01	45.49			9.75E+01	4.55E+01
	7	82.14	6.53E+02	65.11			6.53E+02	6.51E+01

0193

Analysis Report for 2003062-11

H-1 35-40

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
8	112.67	1.45E+02	47.93			1.45E+02	4.79E+01
9	151.29	2.14E+01	24.82			2.14E+01	2.48E+01
10	162.93	3.46E+01	34.32			3.46E+01	3.43E+01
11	222.43	1.65E+01	20.90			1.65E+01	2.09E+01
12	277.07	4.09E+01	24.84			4.09E+01	2.48E+01
13	303.78	8.21E+01	32.93			8.21E+01	3.29E+01
14	334.45	4.49E+01	26.51			4.49E+01	2.65E+01
15	356.80	2.97E+02	42.88			2.97E+02	4.29E+01
M 16	384.60	6.69E+01	22.93			6.69E+01	2.29E+01
m 17	387.36	9.90E+01	27.74			9.90E+01	2.77E+01
m 18	392.14	2.72E+01	22.75			2.72E+01	2.27E+01
M 19	413.76	8.92E+00	0.50			8.92E+00	5.00E-01
m 20	417.73	2.18E+01	14.01	6.84E-01	1.02E+00	2.11E+01	1.40E+01
21	437.98	5.45E+01	18.36			5.45E+01	1.84E+01
22	467.61	1.26E+01	13.71			1.26E+01	1.37E+01

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.92	255.12	1.93		
		391.69	*	61.90	4.38E+01
BA-133	0.97	81.00	*	34.06	3.42E+02
		302.84	*	18.33	2.93E+02
		356.01	*	62.05	4.05E+02
HG-203	0.89	279.19	*	77.30	3.02E+01
TH-234	0.99	63.29	*	3.80	7.68E+02

Analysis Report for 2003062-11

H-1 35-40

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
SN-113	0.928	4.38E+01	3.75E+01	
BA-133	0.978	3.52E+02	4.04E+01	
HG-203	0.891	<del>3.02E+01</del>	<del>2.04E+01</del>	
TH-234	0.998	7.68E+02	1.94E+02	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2003062-11  
H-1 35-40

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 3/18/2020 1:26:49PM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide	
	1	21.99	3.88740E-02	55.45	Tol.	SN-119M PA-234M
M	2	32.03	1.79578E+00	2.75	Tol.	I-129 I-129
m	3	36.15	4.12471E-01	8.97	Tol.	PA-234M
M	4	53.85	4.65325E-02	35.84		
m	6	67.09	1.08346E-01	23.33		
	8	112.67	1.61045E-01	16.53	Tol.	U-237
	9	151.29	2.37542E-02	58.05		
	10	162.93	3.84216E-02	49.63	Sum	
	11	222.43	1.83115E-02	63.40		
	14	334.45	4.98713E-02	29.54		
M	16	384.60	7.43565E-02	17.14	Sum	
m	17	387.36	1.10021E-01	14.01	Sum	
M	19	413.76	9.91240E-03	2.80		
m	20	417.73	2.34381E-02	33.29	Sum	
	21	437.98	6.05208E-02	16.85	Sum	
	22	467.61	1.40404E-02	54.25		

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2003062-11

H-1 35-40

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.03E+01	1.03E+01	-5.61E+00	4.79E+00
	136.48	10.60	8.90E+01		3.68E+01	4.13E+01
NI-59	6.92	29.80	4.43E+01	4.43E+01	-8.91E+00	1.87E+01
MO-93	16.59	52.90	2.73E+01	2.73E+01	1.16E+01	1.30E+01
	18.60	10.00	1.49E+02		3.85E+01	7.11E+01
NB-93M	16.57	9.43	1.53E+02	1.53E+02	6.53E+01	7.31E+01
CD-109	88.03	3.72	2.18E+02	2.18E+02	-7.56E+01	1.03E+02
+ SN-113	255.12	1.93	6.69E+02	5.77E+01	-6.62E+01	2.99E+02
	391.69	* 61.90	5.77E+01		4.38E+01	2.67E+01
SN-119M	23.87	16.10	7.64E+01	5.15E+01	-4.09E+00	3.66E+01
	25.10	22.70	5.15E+01		-1.48E+02	2.46E+01
I-129	29.78	57.00	5.99E+01	5.99E+01	4.50E+02	2.95E+01
	33.60	13.20	2.67E+02		2.20E+03	1.32E+02
	39.58	7.52	1.59E+02		3.40E+00	7.64E+01
+ BA-133	81.00	* 34.06	3.62E+01	3.62E+01	3.42E+02	1.74E+01
	302.84	* 18.33	1.71E+02		2.93E+02	8.07E+01
	356.01	* 62.05	6.10E+01		4.05E+02	2.86E+01
CE-139	165.85	80.35	1.48E+01	1.48E+01	-4.68E+00	6.90E+00
CE-144	133.54	10.80	8.36E+01	8.36E+01	2.14E+00	3.87E+01
+ HG-203	279.19	* 77.30	2.79E+01	2.79E+01	3.02E+01	1.29E+01
PB-210	46.50	4.25	1.51E+02	1.51E+02	2.49E+01	7.04E+01
TH-231	25.64	14.70	7.60E+01	7.60E+01	-1.09E+03	3.63E+01
	84.21	6.40	3.54E+02		1.67E+03	1.73E+02
PA-234M	9.89	89.00	1.91E+01	1.91E+01	7.40E+00	8.86E+00
	21.72	64.90	1.98E+01		8.19E+00	9.48E+00
	37.93	23.75	6.91E+01		-3.21E+01	3.36E+01
	131.42	20.40	4.14E+01		-2.55E+01	1.91E+01
+ TH-234	63.29	* 3.80	5.86E+02	5.86E+02	7.68E+02	2.87E+02
NP-237	29.37	14.00	2.12E+02	7.91E+01	9.10E+02	1.04E+02
	86.50	12.60	7.91E+01		-9.07E+00	3.76E+01
U-237	97.08	16.30	5.13E+01	3.21E+01	-1.99E+01	2.40E+01
	101.07	26.30	3.21E+01		1.21E+01	1.50E+01
	114.00	12.30	1.31E+02		2.40E+02	6.33E+01
	208.01	22.00	6.85E+01		1.96E+01	3.19E+01
AM-241	59.54	35.90	2.98E+01	2.98E+01	-8.22E+00	1.43E+01
AM-243	74.67	66.00	1.13E+01	1.13E+01	9.16E-01	5.31E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction



**SECTION XI**  
**ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)**





**ERM**

**0526033**

**STANDARD LEVEL IV  
REPORT OF ANALYSIS**

**WORK ORDER #21-04092-OR**

**May 25, 2021**

**EBERLINE ANALYTICAL/OAK RIDGE LABORATORY  
OAK RIDGE, TN**

## TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
I	Chain of Custody & pH Check	0004
II	Sample Acknowledgement	0010
III	Case Narrative	0013
IV	Analytical Results Summary	0016
V	Analytical Standard	0018
VI	Quality Control Sample Results Summary	0026
VII	Laboratory Technician's Notes	0032
VIII	Analytical Data (Radium-226)	0045
IX	Analytical Data (Radium-228)	0095
X	Barium-133 Analytical Tracer Data	0111
XI	Analytical Data (Total Dissolved Solids)	0154
	Last Page Number	0156



**Eberline Services – Oak Ridge Laboratory  
LABORATORY DATA SUPPORT CHECKLIST**

MP-001-3

Eberline Services Work Order # 21-04092

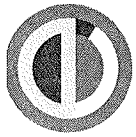
The checklist items listed below are to be initiated by appropriate staff upon completion/verification.

Date for Partial	Initials	Date	Initials	Checklist Items
		4/27/21	YB	Sample Log-In
		5/10/21	[Signature]	Data Compilation
		5/17/21	MM	First Technical Data Review
		5/18/21	MM	Second Technical Data Review
		5/21/21	aw	Data Entry/Electronic Deliverable
		5/21/21	aw	Case Narrative
		5/24/21	[Signature]	Electronic Deliverable Proof
		5/24/21	MM	Samples Analyzed within Holding Time Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>
		5/24/21	MM	QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

Date package approved by: [Signature] 5/25/21  
 Laboratory Manager Date

**SECTION I**  
**CHAIN OF CUSTODY**  
**& pH CHECK**



EBERLINE SERVICES  
-element™

REC'D APR 27 2021  
Chain of Custody

Laboratory Number: 21-04092

Client Information: ERM  
 Contact Name: LANCE COOPER  
 Address: 3638 N. LAUSEWAY BLD.  
 SUITE 3000  
 METABIE, LA 70002  
 Phone Number: 315-246-4499 Ext.  
 Fax Number: KUST.BOSCHINGER@ERM.COM  
 E-mail Address: LANCE.COOPER@ERM.COM

Billing Information: SAME

PO Number: 0526033  
 Quote Number:  
 Required QC Level

Project Name/Number: HENNING - 0526033  
 Sampler's Signature: *Lance Cooper*  
 Shipping Method: UPS / (FedEx) / Airborne  
 DHL / Element / Hand / Mail

Matrix Code  
 DW = Drinking Water  
 WW = Waste Water  
 GW = Ground Water  
 AQ = Aqueous  
 OT = Other  
 SL = Sludge  
 O = Oil  
 F = Food  
 NG = Natural Gas  
 NGL = Natural Gas Liquid  
 PW = Produced Water  
 CF = Completion Fluid

Sample ID/Description	Which Regulations Apply: <input type="checkbox"/> RCRA <input type="checkbox"/> POTW <input type="checkbox"/> NPDES <input type="checkbox"/> USDA/FDA <input type="checkbox"/> RECAP/RISC	Turnp Time <input checked="" type="checkbox"/> Standard <input type="checkbox"/> RUSH <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Day <input type="checkbox"/> Other	Collection Information		Rush turn times will incur a surcharge and must be pre-approved by lab.)	Container Type Quantity	Pres. HCl, HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> , NaOH, Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	Requested Tests				Comments		
			Date					Matrix	RA 226	RA 228	TDS			
			Date	Time										
H-20			4/19/21	1000	GRAB	GW	NONE	X	X					
H-22			4/19/21	1110	GRAB	GW	NONE	X	X					
H-23			4/19/21	1335	GRAB	GW	NONE	X	X					
H-24			4/19/21	1500	GRAB	GW	NONE	X	X					

Relinquished by: *Lance Cooper* Date/Time: 0900 / 4-22-2021  
 Received by: *Ronald Spencer* Date/Time: 4/27/21 / 0915  
 Field Notes: Received at lab on ice?  
 Yes  No Temp:

All samples submitted to Element Materials Technology for analysis are accepted on a custodial basis only. Ownership of the material remains with the client submitting the samples. Element Materials Technology reserves the right to return unused sample portions.

9301 Innovation Drive, Suite 115  
 Daleville, IN 47534-0569 USA  
 P 765-378-4103  
 F 765-378-4109

629 Washington St. Suite 300  
 Columbus, IN 47201-6231 USA  
 P 812-375-0531  
 F 812-375-0731

2121 East Washington Boulevard  
 Fort Wayne, IN 46803-1328 USA  
 P 260-471-7000  
 F 260-471-7777

560 South Zimmer Road  
 Warsaw, IN 46580-2368 USA  
 P 574-267-3305  
 F 574-269-6569

3371 Cleveland Road, Suite 100A  
 South Bend, IN 46628-9780 USA  
 P 574-277-0707  
 F 574-273-5699


2417 W. Pinhook Rd  
 Lafayette, LA 70508-3344 USA  
 P 337-235-0483  
 F 337-233-6540









	<b>Sample Receiving Report</b> (Volumes, pH, & CPM)	Internal Work Order
		<b>21-04092</b>
		Received By <b>RSPENCER</b>

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	MM1.2		
02	BLANK	0		WA	MM1.2		
03	DUP	0		WA	MM1.2		
04	H-20	1		WA	MM1.2	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
05	H-22	1		WA	MM1.2	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
06	H-23	1		WA	MM1.2	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
07	H-24	1		WA	MM1.2	3.76	50
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	50

Received by: *Randolph Spencer*

Date: 4-27-21

**SECTION II**  
**SAMPLE ACKNOWLEDGEMENT**





**Eberline Services – Oak Ridge Laboratory**

**SAMPLE RECEIPT CHECKLIST**  
MP-001-2

WORK ORDER # 21-04092

SAMPLE MATRIX/MATRICES:

(CIRCLE ONE OR BOTH)

AQUEOUS      NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	<u>Y</u>	N	
If aqueous, properly preserved	<u>Y</u>	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	<u>Y</u>	N
Unbroken on outside of package?	<u>Y</u>	N
Present on samples?	<u>Y</u>	N
Unbroken on samples?	<u>Y</u>	N
Was chain of custody present upon sample receipt?	<u>Y</u>	N

IF THE RESPONSE TO ANY OF THE ABOVE IS NO, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SIGNATURE: *Joseph Spencer*      DATE: 4-27-21

**SECTION III**  
**CASE NARRATIVE**





EBERLINE ANALYTICAL CORPORATION  
601 SCARBORO ROAD  
OAK RIDGE, TENNESSEE 37830  
PHONE (865) 481-0683  
FAX (865) 483-4621

EBS-OR-48518

May 25, 2021

Lance Cooper  
ERM  
3838 N Causeway Blvd #3000  
Metairie, LA 70002

CASE NARRATIVE  
Work Order # 21-04092-OR

SAMPLE RECEIPT

This work order contains four water samples received 04/27/2021. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

<u>CLIENT ID</u>	<u>LAB ID</u>	<u>CLIENT ID</u>	<u>LAB ID</u>
H-20	21-04092-04	H-23	21-04092-06
H-22	21-04092-05	H-24	21-04092-07

ANALYTICAL METHODS

Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0. Total Dissolved Solids were performed using Standard Methods 2540C.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size and matrix type.

RADIUM-226

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. This was followed by precipitations of Radium/Barium Sulfate. Precipitates were dissolved in alkaline EDTA. Radium was selectively precipitated and mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. Inherent self-absorption from elemental Barium was corrected for in the final result. Chemical recovery was calculated using a Barium-133 tracer, which was determined by HPGe gamma spectroscopy.

Samples demonstrated acceptable results for all Radium-226 analyses. Chemical recovery was acceptable for all analyses. The Radium-226 method blank demonstrated an acceptable result. Results for the Radium-226 duplicate demonstrated a high relative percent difference; however, normalized difference is

## ANALYTICAL RESULTS CONTINUED

### RADIUM-226 CONTINUED

within acceptable limits for the analytical technique. Results for the Radium-226 laboratory control sample demonstrated an acceptable percent recovery.

### RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-228 were counted on a gas proportional counter. Chemical recovery was determined using a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all analyses. The Radium-228 method blank demonstrated an acceptable result. Results for the Radium-228 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

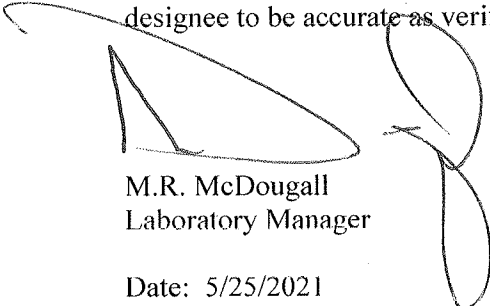
### TOTAL DISSOLVED SOLIDS

A volumetric aliquot of each sample was taken and filtered through 0.45µm filter media into a tared 250 ml beaker. Samples were dried on a hot plate and allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated results for Total Dissolved Solids content that ranged from 1,724.0 to 2,147.0 mg/L.

### CERTIFICATION OF ACCURACY

I certify that this data report complies with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.



M.R. McDougall  
Laboratory Manager

Date: 5/25/2021

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit <http://eberlineanalytical.com/> to provide us with feedback on our services.

**SECTION IV**  
**ANALYTICAL RESULTS SUMMARY**

# Eberline Analytical

## Final Report of Analysis

Lab ID		Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
21-04092-01	LCS	KNOWN		04/27/21 00:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	1.01E+01	4.63E-01			pCi/l
21-04092-01	LCS	SPIKE		04/27/21 00:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	1.09E+01	1.59E+00	2.80E+00	4.39E-01	pCi/l
21-04092-02	MBL	BLANK		04/27/21 00:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	-8.70E-03	1.02E-01	1.02E-01	2.13E-01	pCi/l
21-04092-03	DUP	H-20		04/19/21 10:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	4.12E-01	2.75E-01	2.88E-01	2.93E-01	pCi/l
21-04092-04	DO	H-20		04/19/21 10:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	2.31E-01	2.77E-01	2.81E-01	3.92E-01	pCi/l
21-04092-05	TRG	H-22		04/19/21 11:10	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	2.05E-01	2.10E-01	2.15E-01	2.23E-01	pCi/l
21-04092-06	TRG	H-23		04/19/21 13:35	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	5.27E-01	3.39E-01	3.57E-01	3.59E-01	pCi/l
21-04092-07	TRG	H-24		04/19/21 15:00	4/27/2021	5/3/2021	21-04092	Radium-226	EPA 903.0 Modified	2.01E-01	2.39E-01	2.43E-01	3.68E-01	pCi/l
21-04092-01	LCS	KNOWN		04/27/21 00:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	8.96E+00	4.57E-01			pCi/l
21-04092-01	LCS	SPIKE		04/27/21 00:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	7.97E+00	7.60E-01	1.96E+00	9.47E-01	pCi/l
21-04092-02	MBL	BLANK		04/27/21 00:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	5.89E-02	3.95E-01	3.96E-01	8.41E-01	pCi/l
21-04092-03	DUF	H-20		04/19/21 10:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	8.00E-01	4.96E-01	5.28E-01	9.68E-01	pCi/l
21-04092-04	DO	H-20		04/19/21 10:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	1.00E+00	5.99E-01	6.40E-01	1.17E+00	pCi/l
21-04092-05	TRG	H-22		04/19/21 11:10	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	4.53E-01	4.25E-01	4.38E-01	8.60E-01	pCi/l
21-04092-06	TRG	H-23		04/19/21 13:35	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	6.72E-01	5.00E-01	5.23E-01	9.99E-01	pCi/l
21-04092-07	TRG	H-24		04/19/21 15:00	4/27/2021	5/4/2021	21-04092	Radium-228	EPA 904.0	-5.80E-02	4.40E-01	4.41E-01	9.46E-01	pCi/l
21-04092-04	TRG	H-20		04/19/21 10:00	4/27/2021	4/28/2021	21-04092	TDS	SM2540C	2.15E+03				mg/L
21-04092-05	TRG	H-22		04/19/21 11:10	4/27/2021	4/28/2021	21-04092	TDS	SM2540C	1.72E+03				mg/L
21-04092-06	TRG	H-23		04/19/21 13:35	4/27/2021	4/28/2021	21-04092	TDS	SM2540C	1.96E+03				mg/L
21-04092-07	TRG	H-24		04/19/21 15:00	4/27/2021	4/28/2021	21-04092	TDS	SM2540C	1.99E+03				mg/L

Work Order Details:

SDG: **21-04092**

Purchase Order: 0526033

Analysis Category: ENVIRONMENTAL

Sample Matrix: WA

Report To:

Lance Cooper

ERM

3838 N Causeway Blvd Suite 3000

Metairie, LA 70002



**SECTION V**  
**ANALYTICAL STANDARD**

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

*Ra-5*  
QA/QC REVIEWED  
Date *2/8/94* Initials *WT*

Radionuclide: Ra-226  
Half Life: 1600 ± 7 years  
Catalog No.: 7226  
Source No.: 453-26

Customer: TMA EBERLINE  
P.O.No.: VH1888  
Reference Date: February 1 1994 12:00 PST.  
Contained Radioactivity: (Ra-226) 1.001 µCi.  
Contained Radioactivity: (Ra-226) 37.0 kBq.

Description of Solution  
a. Mass of solution: 5.1864 g (in a 5 ml Flame Sealed Ampoule)  
b. Chemical form: Ra(NO<sub>3</sub>)<sub>2</sub> in 1 N HNO<sub>3</sub>  
c. Carrier content: None added  
d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities: None detected (other than daughters)

Radioactive Daughters: Rn-222, Po-218, At-218, Pb-214, Bi-214, Po-214, Tl-210, Pb-210, Bi-210, Po-210 and Tl-206.

Radionuclide Concentration: (Ra-226) 0.1929 µCi/g.

## Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:  
Energy peak(s) integrated under: 186 keV.  
Branching ratio(s) used: 0.0351 gamma rays per decay.

## Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: ±3.4%
- b. Random uncertainty in assay: ±3.1%
- c. Random uncertainty in weighing(s): ±0.2%
- d. Total uncertainty at the 99% confidence level: ±4.6%

## NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

## Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

## Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).



ISOTOPE PRODUCTS LABORATORIES  
1800 North Keystone Street  
Burbank, California 91504  
(818) 843 - 7000

*Ana H. Kuen*  
QUALITY CONTROL

*Feb. 3, 1994*  
Date Signed



QUALITY CONTROL PROGRAM

MP 009

Rev.8; 11/01/03

Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE SOLUTIONS  
PRIMARY DILUTION RECERTIFICATION  
MP 009

SOLUTION REFERENCE # IPL 453-26 CURRENT DATE 8/28/2020 0:00  
SOLUTION # Ra-5

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Certified Activity 1.001E+00  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross                      Weight, Grams  
Empty Ampoule                      Weight, Grams  
Solution Net                      Weight, Grams  
Total Activity in Ampoule 1.0010  $\mu\text{Ci}$

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>



Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

Dilute to a volume of 1000.00 milliliters

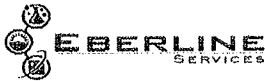
Certified Total Activity of 1.0010  $\mu\text{Ci}$  Which Equals 2.222E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.222E+03 dpm/ml  
This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 28, 2021

Verified & Approved By   
QC Approval 

Date: 8/28/2020  
Date: 8/28/20



QUALITY CONTROL PROGRAM

MP 009

Rev. 8; 11/01/03

Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS  
SECONDARY DILUTION RECERTIFICATION

Solution Reference # MP 009 IPL-453-26 Date 8/28/2020 0:00  
Solution # Ra-5b

Principal Radionuclide	Half Life, Years	Half Life, Days
<sup>226</sup> Radium	1.600E+03	5.844E+05

Radionuclide of Interest <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Parent Solution Conc. 2.22E+03 dpm/ml

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml  
Total Activity: 4.4440E+04 dpm  
Final Volume: 1000.00 ml  
Final Activity Concentration: 4.4440E+01 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

NOTES:

Expiration Date: 28-Aug-21

Verified & Approved By [Signature]

Date: 8/28/2020 0:00

QC Approval [Signature]

Date: 8/28/20



ANALYTICS #411 Rec'd 2/15/06 Presented

1380 Seaboard Industrial Blvd.  
Atlanta, Georgia 30318 · U.S.A.

Phone (404) 352-8677  
Fax (404) 352-2837

**CERTIFICATE OF CALIBRATION**  
Standard Radionuclide Source

72325-207

Ra<sup>228</sup>

Ra-228 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Ra-228
ACTIVITY (dps):	4.022 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	February 10, 2006 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	4.0%

Impurities:  $\gamma$ -impurities <0.1%

5.10721 grams 0.1M HCl solution with 50  $\mu$ g/g Ba carrier.

P O NUMBER 00003181, Item 1

SOURCE PREPARED BY: M. Taskaeva  
M. Taskaeva, Radiochemist

Q A APPROVED: W.M. [Signature] 2-13-06



# QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03

Title: Radioactive Reference Standards Solutions & Records

## EBERLINE SERVICES - OAK RIDGE LABORATORY RADIOACTIVE REFERENCE SOLUTIONS RECERTIFICATION MP 009

SOLUTION REFERENCE # Analytics 7235-207 CURRENT DATE 1/11/2021 0:00  
SOLUTION # Ra-12

Principal Radionuclide <sup>228</sup>Ra Half Life, Years 5.750E+00 Half Life, Days 2.100E+03

Radionuclide <sup>228</sup>Ra Reference Date 2/10/2006 0:00  
Certified Activity 1.087E-01  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross 9.0741 Weight, Grams  
Empty Ampoule 3.9858 Weight, Grams  
Solution Net 5.0883 Weight, Grams  
Total Activity in Ampoule 0.1087  $\mu\text{Ci}$

### Chemical Composition of Standard Solution

<sup>228</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 0.5 M HCl

Dilution Instructions: Dilution Solvent Used 0.5 M HCl

Dilute to a volume of 991.00 Kg

Certified Total Activity of 0.1087  $\mu\text{Ci}$  Which Equals 2.413E+05 dpm at the date listed above

And after dilution the activity of this solution is 2.435E+02 dpm/ml. This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: January 11, 2022

Recertified By [Signature]

Date: 1/11/21

QC Approval [Signature]

Date: 1/11/21



Ba-6  
(#6a)

# National Institute of Standards & Technology

## Certificate

Standard Reference Material 4251C  
Barium-133 Radioactivity Standard

ORIGINAL

This Standard Reference Material (SRM) consists of radioactive barium-133 chloride, non-radioactive barium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

#### Radiological Hazard

The SRM ampoule contains barium-133 with a total activity of approximately 2.5 MBq. Barium-133 decays by electron capture and during the decay process X-rays and gamma rays with energies from 4 to 400 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]\*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

#### Chemical Hazard

The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

#### Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least June 2004.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

#### Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group and D.B. Golas, Nuclear Energy Institute Research Associate.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899  
October 1994

Thomas E. Gills, Chief  
Standard Reference Materials Program



QUALITY CONTROL PROGRAM  
QCP-009

Rev. 8: 11/10/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS

Solution Reference # QCP-009-1-A  
NIST SRM4251C Date 4/23/21  
Solution # Ba-6a

Principal Radionuclide	Half Life, Years	Half Life, Days
<u><sup>133</sup>Ba</u>	<u>1.048E+01</u>	<u>3.828E+03</u>

Radionuclide of Interest <sup>133</sup>Ba Reference Date 9/1/1993 0:00  
Parent Solution Conc. 1.48E+05 dpm/ml

Chemical Composition of Standard Solution  
<sup>133</sup>BaCl<sub>2</sub> in 1M HCl

Dilution Instructions: Dilution Solvent Used 1M HCl

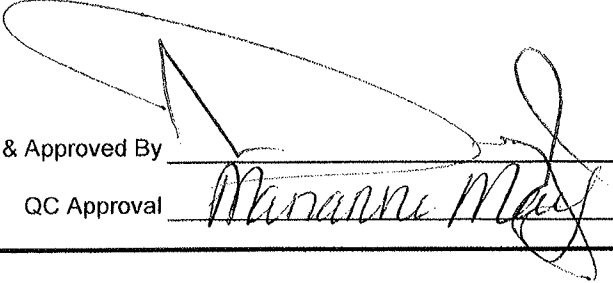
SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 25.0000 ml  
Total Activity: 3.6950E+06 dpm Final Activity Concentration: 3.6950E+03 dpm/ml  
Final Volume: 1000.00 ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: April 20, 2022

Verified & Approved By   
QC Approval

Date: 4/23/21  
Date: 4/26/21

**SECTION VI**  
**QUALITY CONTROL SAMPLE RESULTS SUMMARY**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-04092</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226	107.99%	25.71%	100.00%	4.60%	1.01E+01	4.63E-01	1.09E+01	2.80E+00	Ra-5b	4.39E+01	4.60E+00	5.09E-01

**Matrix Spike**

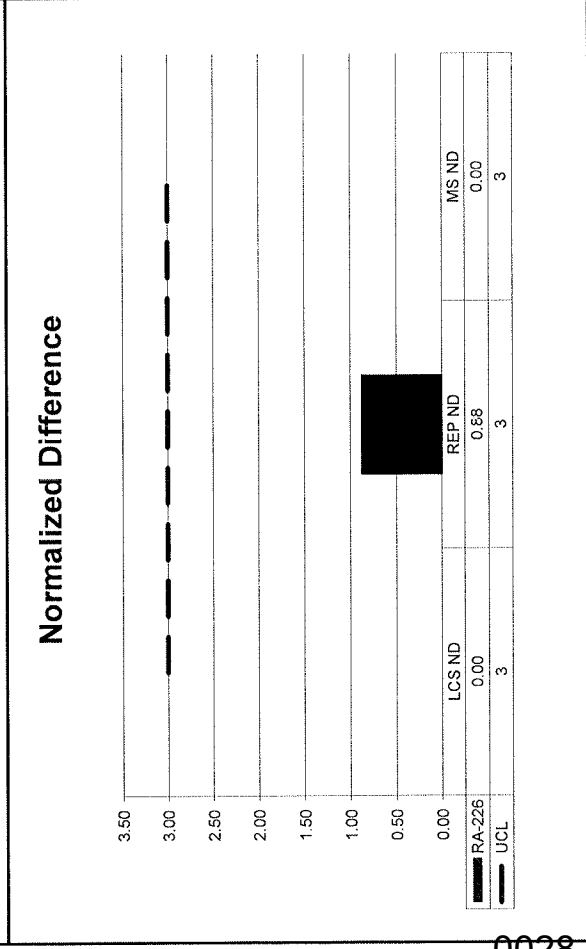
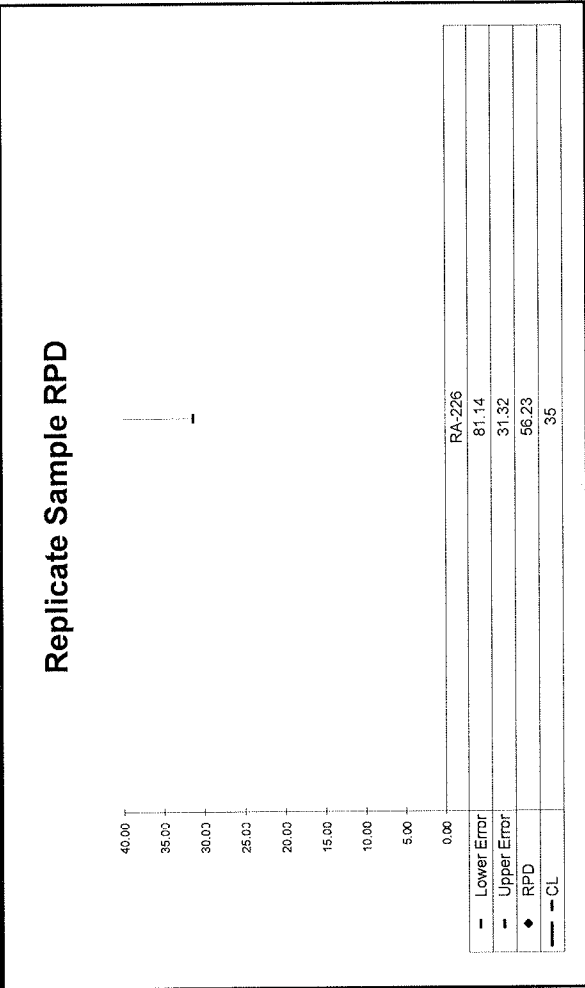
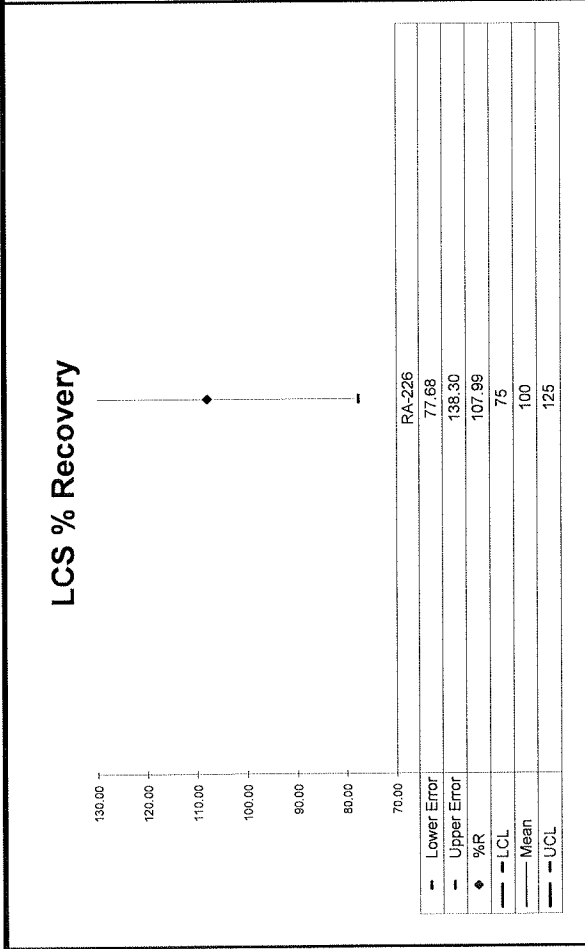
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	0.88	55.23	2.31E-01	2.81E-01	4.12E-01	2.88E-01	1.08	OK			NA	OK

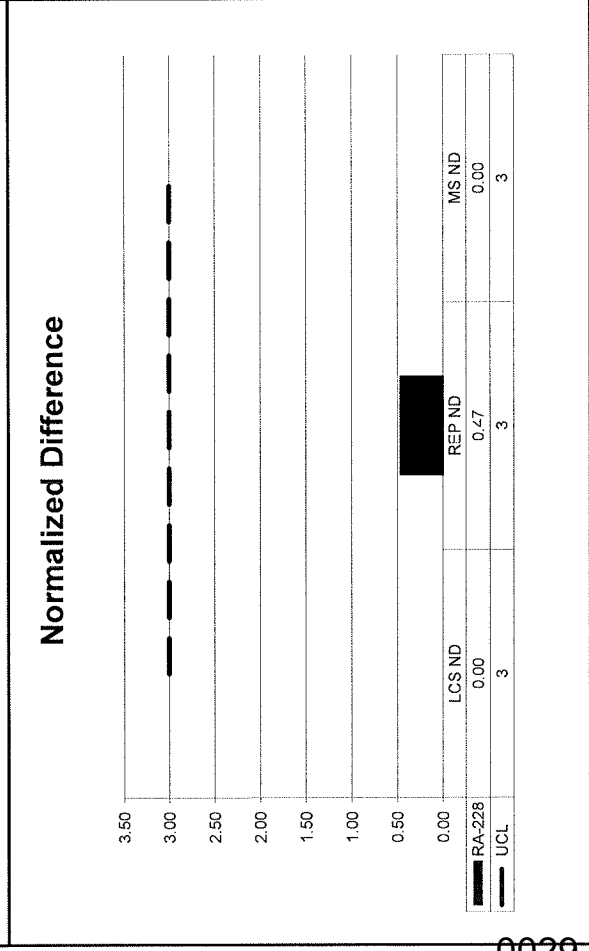
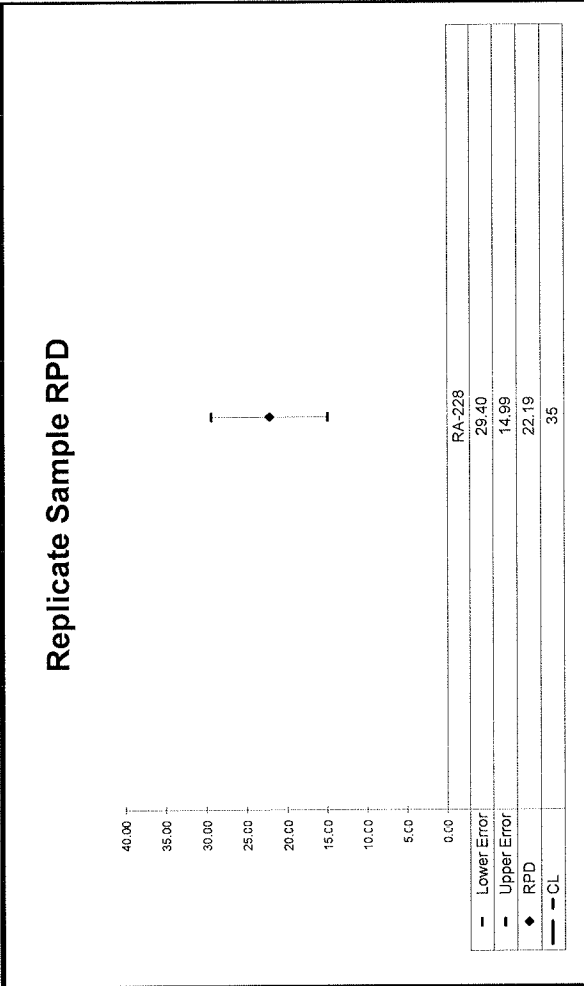
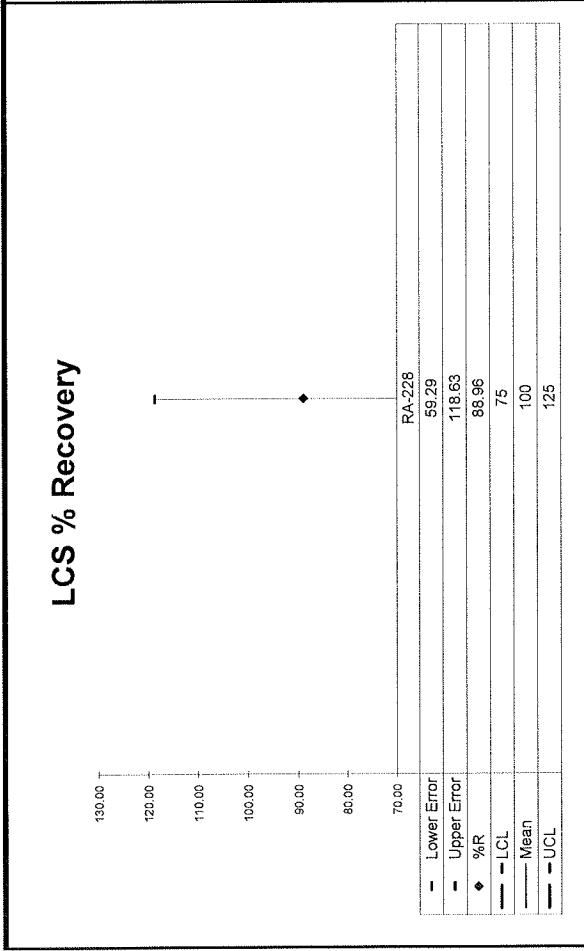
**QC Summary**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-04092</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>



**No Matrix Spike**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-04092</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>



**No Matrix Spike**



WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-04092</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

### Laboratory Control Sample

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228	88.96%	24.57%	100.00%	5.10%	8.96E+00	4.57E-01	7.97E+00	1.96E+00	Ra-12	3.88E+01	5.10E+00	5.12E-01

### Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

### Replicate Sample


Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS ND	Rep RPD	Rep ND
RA-228	0.47	22.19	1.00E+00	6.40E-01	8.00E-01	5.28E-01	0.89	OK		NA	OK

### QC Summary



**SECTION VII**  
**LABORATORY TECHNICIAN'S NOTES**

**RA-226 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com		Internal Work Order	21-04092
			Analysis Code	Ra226
			Run Number	1

#	Date	Dept	User	Notes
1	04/29/21 07:05	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES- AND CENTRIUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

*J Harvey*  
 4/29/21

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-04092
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	04/29/21 07:05	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES- AND CENTRIUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	05/03/21 10:32	CHEM	AYARBER	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

*Handwritten:* JHARVEY 5/3/21



Reagents Used in an Analysis

Internal Work Order

**21-04092**

Analysis Code

Run

**Ra226**

**1**

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022612P	Ammonium Hydroxide	Reagent Grade	JHARVEY	4/29/2021
022487D02	Ammonium Sulfate	200 mg/ml	JHARVEY	4/29/2021
022147D09	Barium Carrier	1 mg/ml	JHARVEY	4/29/2021
022385D02	Lead Carrier	166 mg/ml	JHARVEY	4/29/2021
022879P	Nitric Acid	Reagent Grade	JHARVEY	4/29/2021
023012P	Acetic Acid	Reagent Grade	AYARBER	5/3/2021
022142D03	Ammonium Sulfate	200 mg/ml	AYARBER	5/3/2021
022266S	EDTA	0.25M	AYARBER	5/3/2021

# Alpha Bank 3

83

Date	Sample #	Client	Lead time	Count time	Analysis	Tech
<del>4/30/21</del>	<del>2104095A (1-4)</del>	<del>UCOR</del>		<del>2hr 50min</del>	<del>Pu</del>	<del>KB</del>
4/30/21	2104071A (1-7)	UCOR	0948	2hr 50min	Pu	KB
4/30/21	System Biogel	Lab	1344	16.40 hrs	NA	KB
5/3/21	Daily Pulser	Lab	0607	10min	NA	KB
5/3/21	2104096A (1-4)	UCOR	0754	2hr 50min	Pu	KB
5/3/21	2104096A (1-4)	UCOR	0802	2hr 50min	Na	KB
5/3/21	2104074A (1-4)	UCOR	0954	2hr 50min	Rate	KB
5/3/21	2104092A (1-7)	ERM	1117	2hr 50min	Rate	KB



**RA-228 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-04092
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	04/29/21 07:05	PREP	JHARVEY	ALIQOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES- AND CENTRIUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

*J Harvey*  
 4/29/21

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-04092
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	04/29/21 07:05	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES- AND CENTRIUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	05/04/21 12:07	CHEM	AYARBER	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER, AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 1N HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

*Overly* 5/4/21



Reagents Used in an Analysis

Internal Work Order

**21-04092**

Analysis Code

Run

**Ra228**


**1**

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022612P	Ammonium Hydroxide	Reagent Grade	JHARVEY	4/29/2021
022487D02	Ammonium Sulfate	200 mg/ml	JHARVEY	4/29/2021
022147D09	Barium Carrier	1 mg/ml	JHARVEY	4/29/2021
022385D02	Lead Carrier	166 mg/ml	JHARVEY	4/29/2021
022879P	Nitric Acid	Reagent Grade	JHARVEY	4/29/2021
022277D01	Ammonium Oxalate	5%	AYARBER	5/4/2021
022128D01	EDTA	0.25M	AYARBER	5/4/2021
021951D10	Nitric Acid	1N	AYARBER	5/4/2021
022345D14	Nitric Acid	6N	AYARBER	5/4/2021
022254D02	Sodium Hydroxide	10M	AYARBER	5/4/2021
022254D01	Sodium Hydroxide	18M	AYARBER	5/4/2021
022255D01	Yttrium Carrier	9 mg/ml	AYARBER	5/4/2021

Red LB4110

Date	Sample #	Client	Loadtime	Counttime	Analysis	Tech
4/30/21	2104056 RAC(4,7,9,10)	USA	1229	2 hrs	Rad	ICB
5/1/21	Wkly Bkgd	Lab	1229	12 hrs	KB	KP
5/3/21	Daily Bkgd/QC	Lab	0618/0540	1hr/30min	KB	KP
5/3/21	Cross Talk	Lab	0720	5 min	KB	KP
5/3/21	Cross Talk	Lab	0730	5 min	KB	KP
5/3/21	2104087AB (4-11)	APTIM	0745	2 hrs	KB	KP
5/3/21	2104096 Np (1-4)	UCOR	0746	10 min	Np	KP
5/3/21	2104087AB (4-16)	APTIM	0950	2 hrs	KB	ICB
5/3/21	2105001AB (1-4)	UCOR	1454	1 hr	KB	ICB
5/3/21	2104069AB (2-4)	Hudson Ranch	1502	2 hrs	KB	ICB
5/4/21	Daily Bkgd/QC	Lab	0574/0444	1hr/30min	KB	KP
5/4/21	Cross Talk	Lab	0654	5 min	KB	KP
5/4/21	Cross Talk	Lab	0643	5 min	KB	KP
5/4/21	2104054AB (1-4)	Waypoint	0651	2 hrs	KB	KP
5/4/21	21040745X (2-46)	UCOR	0652	2 hrs	Sr90	KP
5/4/21	2104088AB (1-7)	APTIM	0856	1 hr	KB	ICB
5/4/21	2104068AB (7-14)	Hudson Ranch	0959	2 hrs	KB	ICB
5/4/21	2104092 RAC (1-7)	ERM	1218	2 hrs	Rad	ICB

**TDS NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com		Internal Work Order	21-04092
			Analysis Code	TDS
			Run Number	1

#	Date	Dept	User	Notes
1	04/27/21 22:56	PREP	MHIGHTOWER	Filtered sample into tared beaker, dried, re-weighed

MW 27APR21

**SECTION VIII**  
**ANALYTICAL DATA (RADIUM-226)**

























KB  
5/3/21

# Apex-Alpha™

Sample Description: SPIKE  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 01  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_033  
 Chamber Serial Number: 04026479A  
 Detector Serial Number: 91132  
 Env. Background: System Bkgd 297005  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 5/3/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:38 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1411 +/- 0.0026 on 9/25/2020 1:35:53 PM  
 Effective Efficiency: 0.1411 +/- 0.0026

Control Certificate Name: Ra226\_Ra-5b  
 Chem. Recov. of Control: RA-226 0.359963 +/- 0.028974  
 Peak Match Tolerance: 0.350 MeV

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 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.466	4.30	114.31	1.70	0.00E+000	3.0
RA-226	4.609	192.96	14.20	2.04	0.00E+000	5.0

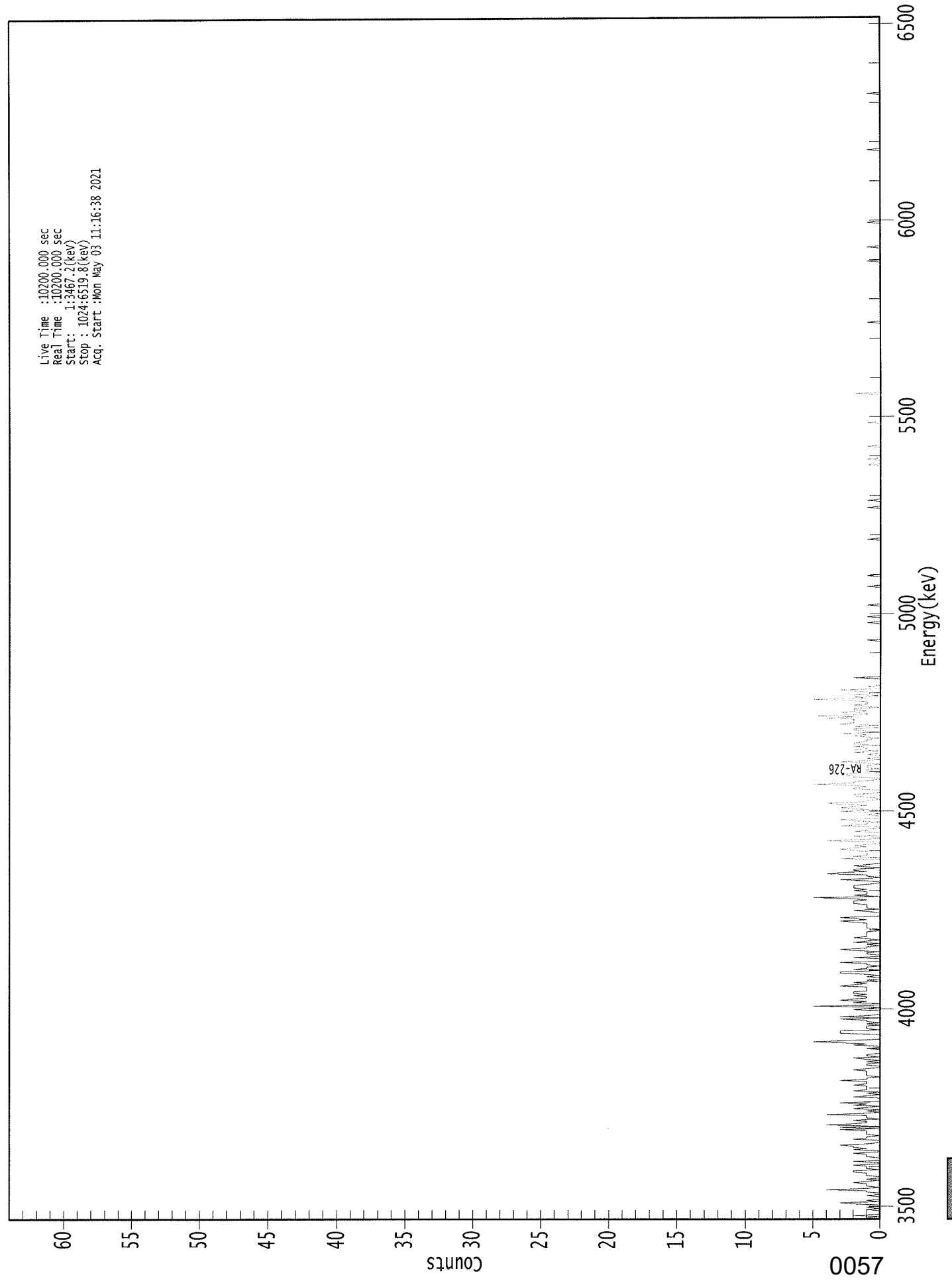
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 ----- NUCLIDE ANALYSIS RESULTS -----  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.939	5685.50*	2.55E-001 +/- 2.91E-001	4.35E-001 +/- 1.56E-002
RA-226	0.960	4785.00*	1.09E+001 +/- 1.59E+000	4.39E-001 +/- 1.57E-002

AG  
5/3/21

0000291385.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3467.2(kev)  
Stop : 1024:6519.8(kev)  
Acq. Start :Mon May 03 11:16:38 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 01

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	1	0	2	0	0	0	0	0
9:	1	0	1	0	0	2	3	0	0
17:	1	0	0	0	1	0	0	1	1
25:	1	4	1	0	1	1	1	2	2
33:	1	0	1	0	0	1	1	1	1
41:	2	2	0	1	1	1	2	0	0
49:	0	2	0	0	0	1	1	1	1
57:	2	0	0	2	1	2	2	3	3
65:	1	0	0	0	2	1	1	0	0
73:	1	1	1	1	3	0	3	0	0
81:	4	2	1	1	2	0	1	1	1
89:	1	4	1	0	1	0	2	1	1
97:	0	2	1	3	0	0	0	0	0
105:	2	1	0	1	0	2	1	1	1
113:	1	1	2	1	1	1	3	1	1
121:	1	0	1	1	1	1	1	2	2
129:	1	0	0	1	1	0	1	0	0
137:	1	2	0	1	1	0	0	0	0
145:	0	1	0	0	2	1	3	5	5
153:	2	0	0	0	0	0	3	3	3
161:	3	0	1	1	1	0	1	0	0
169:	1	1	3	0	3	1	0	0	0
177:	0	0	2	1	0	5	0	0	0
185:	2	1	3	2	1	1	2	1	1
193:	2	2	1	1	1	1	3	2	2
201:	1	2	0	1	0	0	1	0	0
209:	1	3	3	0	2	1	1	0	0
217:	1	1	3	0	0	0	2	0	0
225:	0	1	1	0	2	3	1	1	1
233:	0	1	0	2	1	0	1	2	2
241:	1	1	1	1	1	0	0	1	1
249:	1	1	1	1	2	3	1	2	2
257:	3	0	0	0	0	1	2	0	0
265:	1	1	1	1	2	2	2	1	1
273:	2	5	0	2	1	1	1	2	2
281:	1	2	2	2	1	0	0	1	1
289:	3	1	0	1	1	4	3	1	1
297:	2	2	0	1	2	1	0	0	0
305:	0	0	3	0	2	1	1	1	1
313:	1	2	3	2	1	2	1	0	0
321:	0	4	2	0	0	2	0	0	0
329:	0	2	1	1	0	0	3	1	1
337:	1	0	2	3	0	0	0	1	1
345:	0	1	3	0	2	3	2	1	1
353:	3	4	1	1	0	0	1	2	2
361:	2	1	0	0	0	2	2	1	1

369: 2 5 2 2 1 0 0 2

Sample Title: 01

Channel	1	2	3	4	5	6	7	8
377:	2	3	2	0	1	1	0	1
385:	1	1	0	1	3	1	0	1
393:	0	0	1	0	2	0	2	1
401:	1	2	0	2	2	1	1	1
409:	0	1	2	1	3	0	1	2
417:	2	0	2	0	3	2	2	2
425:	2	4	2	5	1	1	3	1
433:	2	2	0	1	2	1	1	1
441:	3	5	1	2	0	2	0	1
449:	2	3	0	0	1	0	0	0
457:	0	0	0	2	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	1	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	1	0	0	0	0	1
513:	0	0	0	0	0	0	0	0
521:	0	1	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	1	0	0	0	0	0	0
545:	0	0	1	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	1	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	1	0	0	0
609:	0	0	1	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	1	0	0	0	0	1	0	0
649:	0	0	0	0	0	0	0	0
657:	1	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	1	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	2	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	1	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 01

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	1	0
817:	0	0	0	0	0	0	0	0
825:	0	0	1	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	1	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	1	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



103  
5/3/21

Sample Description: BLANK  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 02  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_034  
 Chamber Serial Number: 04026479B  
 Detector Serial Number: 91136  
 Env. Background: System Bkgd 297006  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 5/3/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:40 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1554 +/- 0.0028 on 9/25/2020 10:10:36 AM  
 Effective Efficiency: 0.1554 +/- 0.0028

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.520	7.32	76.28	0.68	0.00E+000	3.0
RA-226	4.601	-0.17	1169.4	0.17	0.00E+000	0.0

-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

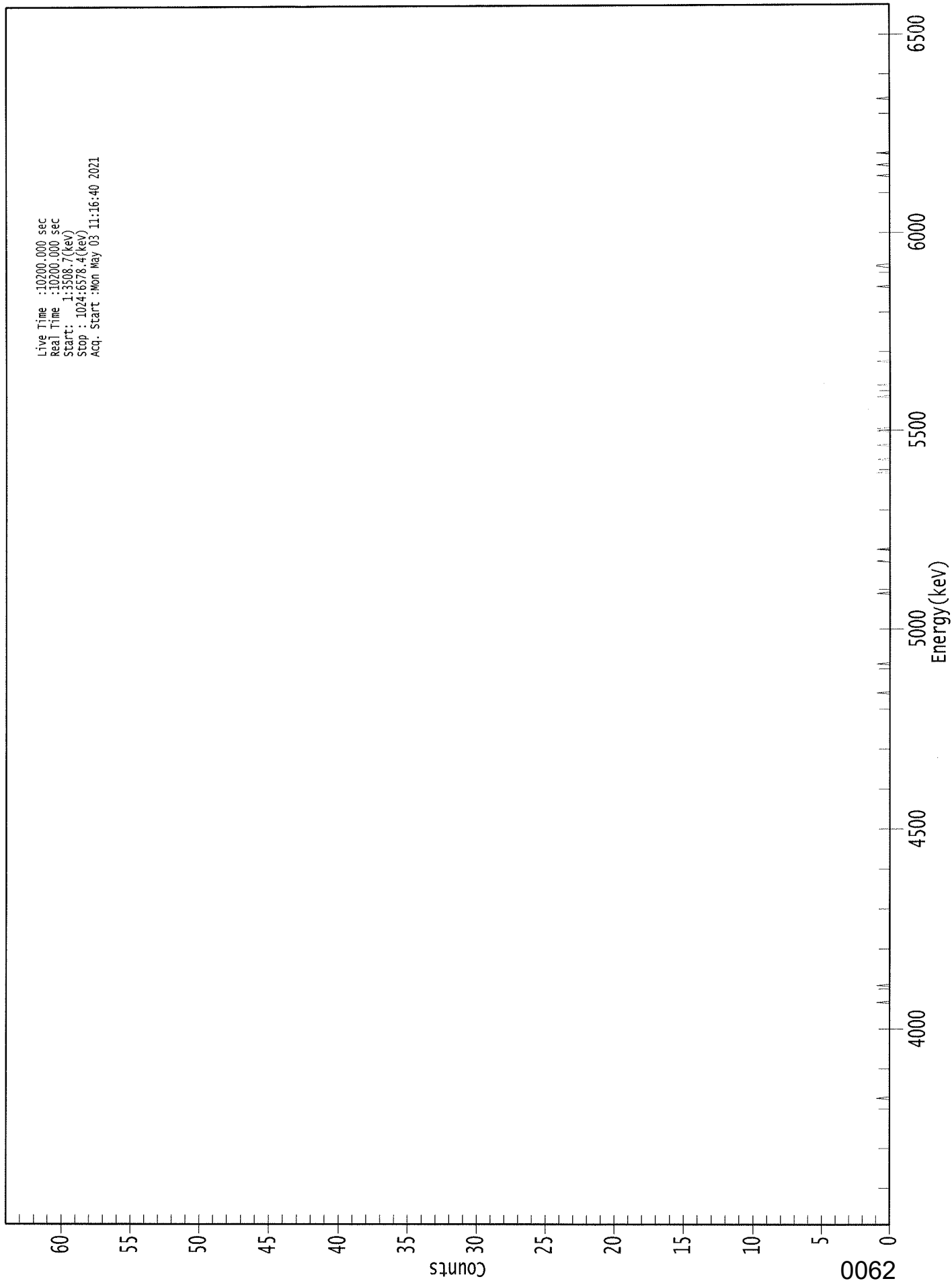
Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.965	5685.50*	3.94E-001 +/- 3.01E-001	3.03E-001 +/- 1.06E-002
RA-226	0.957	4785.00*	-8.70E-003 +/- 1.02E-001	2.13E-001 +/- 7.47E-003

AG  
5/3/21



0000291388.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3508.7(keV)  
Stop : 1024:6578.4(keV)  
Acq. Start :Mon May 03 11:16:40 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title:    02

Elapsed Live time:        10200

Elapsed Real Time:        10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	1	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	1	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0

Sample Title: 02

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	1	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	1	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	1	0	0	0	0	0
561:	0	0	0	0	1	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	1	0	0	0
633:	0	0	0	0	0	0	0	1
641:	0	0	0	0	0	0	0	0
649:	0	0	0	1	0	0	0	0
657:	0	0	0	0	0	0	0	1
665:	0	1	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	1	0	0	0
697:	0	0	0	0	0	0	1	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	1	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	1	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 1 1 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	1	0
881:	0	0	0	0	0	0	0	1
889:	0	0	0	0	0	0	0	0
897:	0	1	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	1
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KB  
5/3/21

Sample Description: H-20 DUP  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 03  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_036  
 Chamber Serial Number: 04026477B  
 Detector Serial Number: 84167  
 Env. Background: System Bkgd 297007  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.270E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:42 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8751 +/- 0.0000  
 Counting Efficiency: 0.1720 +/- 0.0030 on 4/28/2021 10:01:32 AM  
 Effective Efficiency: 0.1506 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.436	1.30	273.43	1.70	0.00E+000	3.0
RA-226	4.555	10.30	66.71	1.70	0.00E+000	3.0

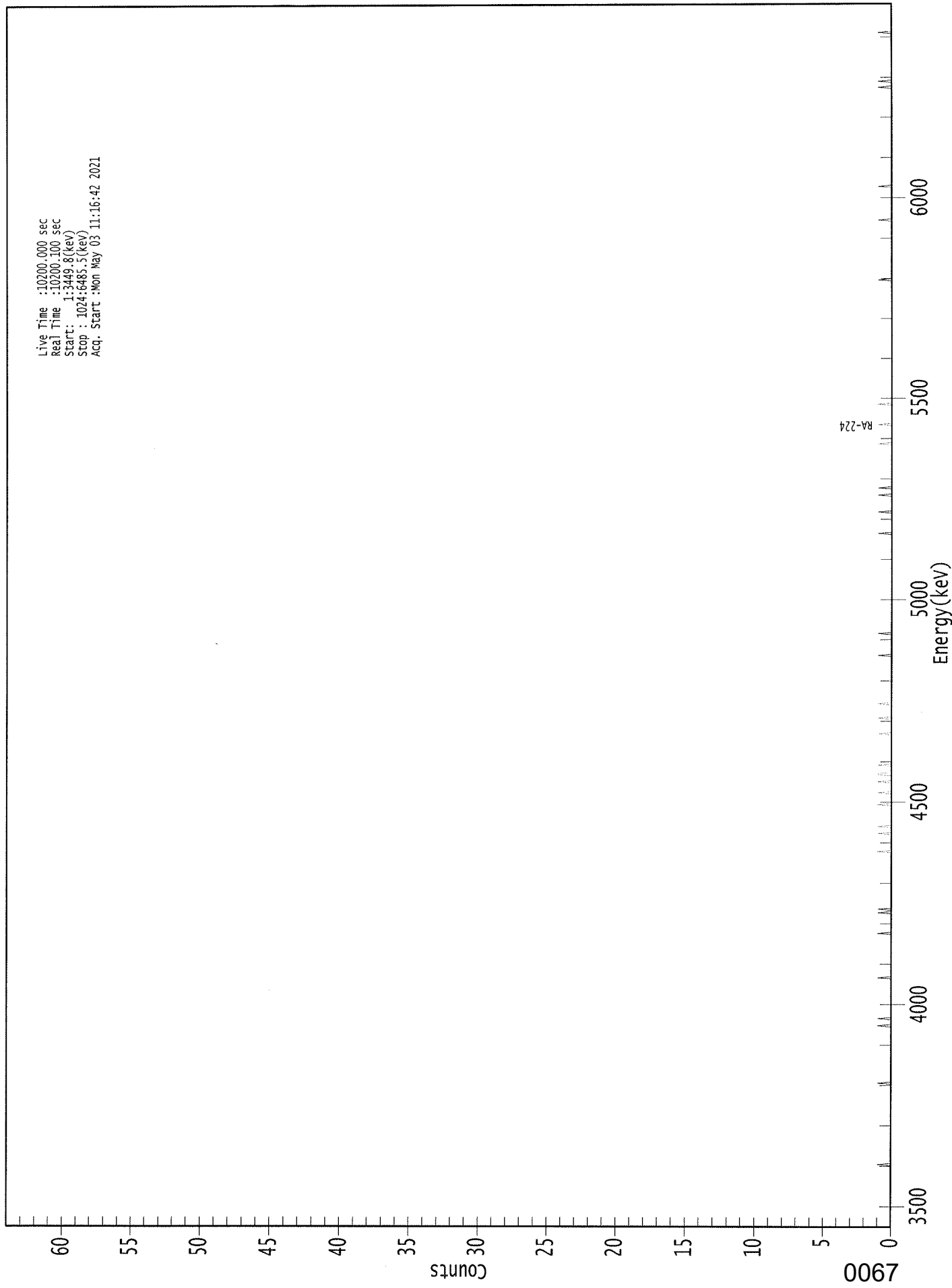
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.922	5685.50*	5.49E-002 +/- 1.50E-001	3.10E-001 +/- 1.07E-002
RA-226	0.933	4785.00*	4.12E-001 +/- 2.75E-001	2.93E-001 +/- 1.01E-002

AG  
5/3/21

0000291389.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:349.8(kev)  
Stop : 1024:6485.5(kev)  
Acq. Start :Mon May 03 11:16:42 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title:    03

Elapsed Live time:        10200

Elapsed Real Time:        10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	1	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	1	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	1	0	0	0	0	0	1	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	1	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	1	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	1	0
265:	0	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	1	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	1	0	0	0	0	0	1	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	1	0	0	0	0	0	0	0
361:	0	0	1	0	0	0	0	0

369: 0 0 0 1 0 0 0 0

Sample Title: 03

Channel	1	2	3	4	5	6	7	8
377:	0	1	1	0	0	0	0	0
385:	0	1	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	1	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	1	0	0	0	0	0	0	0
433:	0	0	0	0	1	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	1	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	1	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	1	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	1	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	1	0	0	0	0	0
617:	1	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	1	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	1	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	1	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	1
793:	0	0	0	0	0	0	0	0



801: 0 0 0 0 0 0 0 0

Sample Title: 03

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	1	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	1	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	1	0	0	0	0	1	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	1	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



# Apex-Alpha™

KB  
5/3/21

Sample Description: H-20  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 04  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_037  
 Chamber Serial Number: 04026478A  
 Detector Serial Number: 91133  
 Env. Background: System Bkgd 297008  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.910E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:44 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.7710 +/- 0.0000  
 Counting Efficiency: 0.1438 +/- 0.0025 on 2/28/2020 7:44:10 AM  
 Effective Efficiency: 0.1109 +/- 0.0020

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.558	1.15	249.59	0.85	0.00E+000	3.0
RA-226	4.662	3.32	119.77	0.68	0.00E+000	3.0

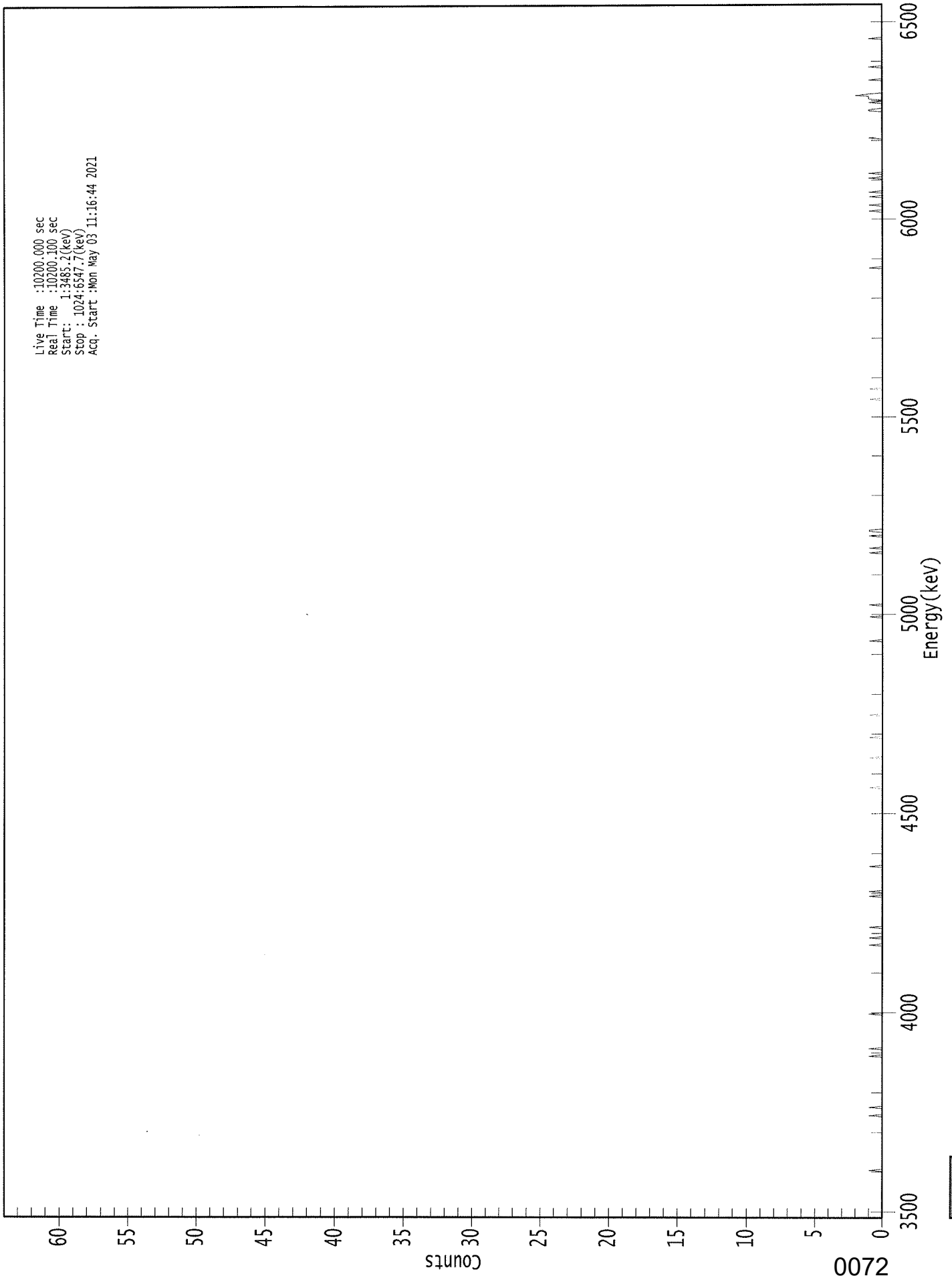
-----  
 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.979	5685.50*	8.45E-002 +/- 2.11E-001	4.40E-001 +/- 1.53E-002
RA-226	0.980	4785.00*	2.31E-001 +/- 2.77E-001	3.92E-001 +/- 1.36E-002

AG  
5/3/21

0000291390.CNF

Live Time : 10200.000 sec  
Real Time : 10200.100 sec  
Start : 1:3485.2(keV)  
Stop : 1024:6547.7(keV)  
Acq. Start : Mon May 03 11:16:44 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 04

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	1	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	1	0
89:	0	0	0	0	0	0	1	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	1	0	0	0	0	0	0	1	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	1	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	1	0	0
233:	0	0	0	1	0	0	0	0	0
241:	0	0	0	0	1	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	1	0
273:	0	0	1	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	1
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	1	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	1	2	3	4	5	6	7	8	9
377:	0	0	0	0	0	0	0	0	0
385:	0	0	1	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0	0
401:	0	0	0	1	0	0	0	0	0
409:	0	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	1	0	0
425:	0	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0	0
481:	0	0	0	0	1	0	0	0	0
489:	0	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0	0
505:	1	0	0	0	0	0	0	0	0
513:	0	0	1	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	1	0	0
561:	0	0	1	0	0	0	0	0	0
569:	0	0	0	0	1	0	0	0	0
577:	1	1	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0	0
689:	1	0	0	0	0	0	0	0	0
697:	0	1	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0	1

801: 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	1	2	3	4	5	6	7	8	9
809:	0	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0	1
849:	0	0	0	0	1	0	0	0	0
857:	0	0	0	1	0	0	0	0	1
865:	0	0	0	0	0	0	0	0	0
873:	0	0	0	1	0	0	0	0	1
881:	0	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	1	0	0
913:	0	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0	0
929:	0	0	0	0	1	1	0	0	0
937:	0	0	0	1	0	0	1	1	1
945:	1	2	1	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	1	0
961:	0	0	0	0	0	0	0	0	0
969:	0	1	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0	0
993:	0	1	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0	0



VB  
SB/21

Sample Description: H-22  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 05  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_038  
 Chamber Serial Number: 04026478B  
 Detector Serial Number: 91134  
 Env. Background: System Bkgd 297009  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:46 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1487 +/- 0.0026 on 2/28/2020 7:44:11 AM  
 Effective Efficiency: 0.1487 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.571	4.83	91.00	0.17	0.00E+000	3.0
RA-226	4.564	3.83	102.72	0.17	0.00E+000	3.0

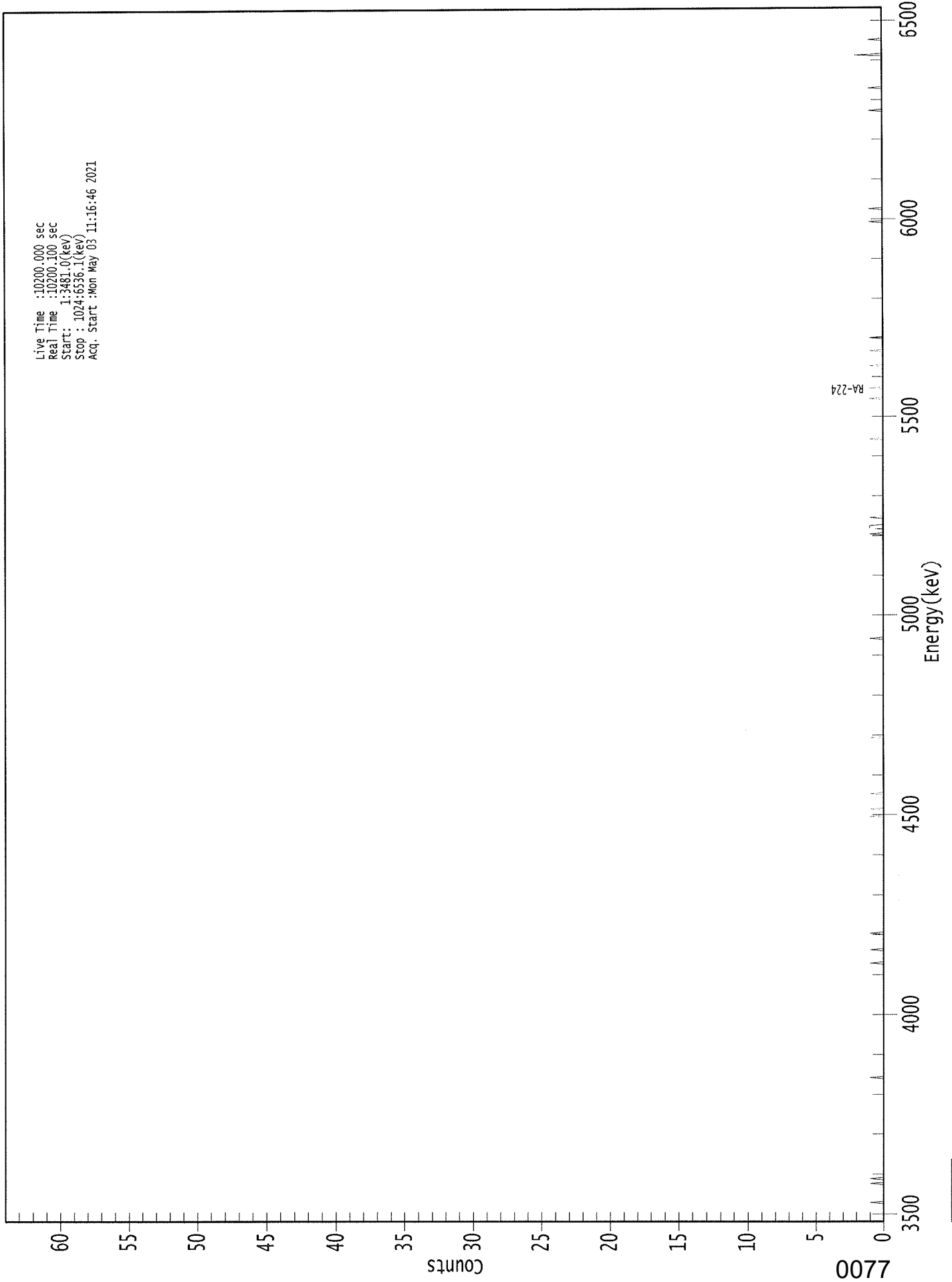
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.983	5685.50*	2.73E-001 +/- 2.48E-001	2.36E-001 +/- 8.13E-003
RA-226	0.938	4785.00*	2.05E-001 +/- 2.10E-001	2.23E-001 +/- 7.69E-003

Ag  
5/3/21

0000291391.CNF

Live Time : 10200.000 sec  
Real Time : 10200.100 sec  
Start : 1:3481.0(kev)  
Stop : 1024:6536.1(kev)  
Acq. Start : Mon May 03 11:16:46 2021



ROI Type: 1



\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title:    05

Elapsed Live time:        10200

Elapsed Real Time:        10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	1	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	1	0	0	0	1	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	1	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	1	0	0	0	0	0	0
225:	0	0	0	0	1	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	1	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	1	0	0	0
345:	0	0	1	0	0	0	0	0
353:	0	0	0	0	0	0	0	1
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0

Sample Title: 05

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	1	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	1	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	1	0	0	0	0	1	1
585:	1	0	0	0	0	0	0	1
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	1	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	1	0	0	0	0
697:	0	0	0	0	1	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	1
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	1	0	0	0
737:	0	0	0	0	0	0	0	1
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	1	0	0	0	0	0	0
849:	0	0	0	0	1	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	1
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	1	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	2	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	1	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

10/5/21

# Apex-Alpha™

Sample Description: H-23  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 06  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_039  
 Chamber Serial Number: 06027396A  
 Detector Serial Number: 83109  
 Env. Background: System Bkgd 297010  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.720E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:48 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1521 +/- 0.0027 on 6/23/2020 1:54:45 PM  
 Effective Efficiency: 0.1521 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.543	5.13	103.36	1.87	0.00E+000	3.0
RA-226	4.654	11.13	64.27	1.87	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.974	5685.50*	2.57E-001 +/- 2.66E-001	3.79E-001 +/- 1.33E-002
RA-226	0.978	4785.00*	5.27E-001 +/- 3.39E-001	3.59E-001 +/- 1.26E-002

AG  
5/3/21



Sample Description: H-23  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 06  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_039  
 Chamber Serial Number: 06027396A  
 Detector Serial Number: 83109  
 Env. Background: System Bkgd 297010  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.720E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:48 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1521 +/- 0.0027 on 6/23/2020 1:54:45 PM  
 Effective Efficiency: 0.1521 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

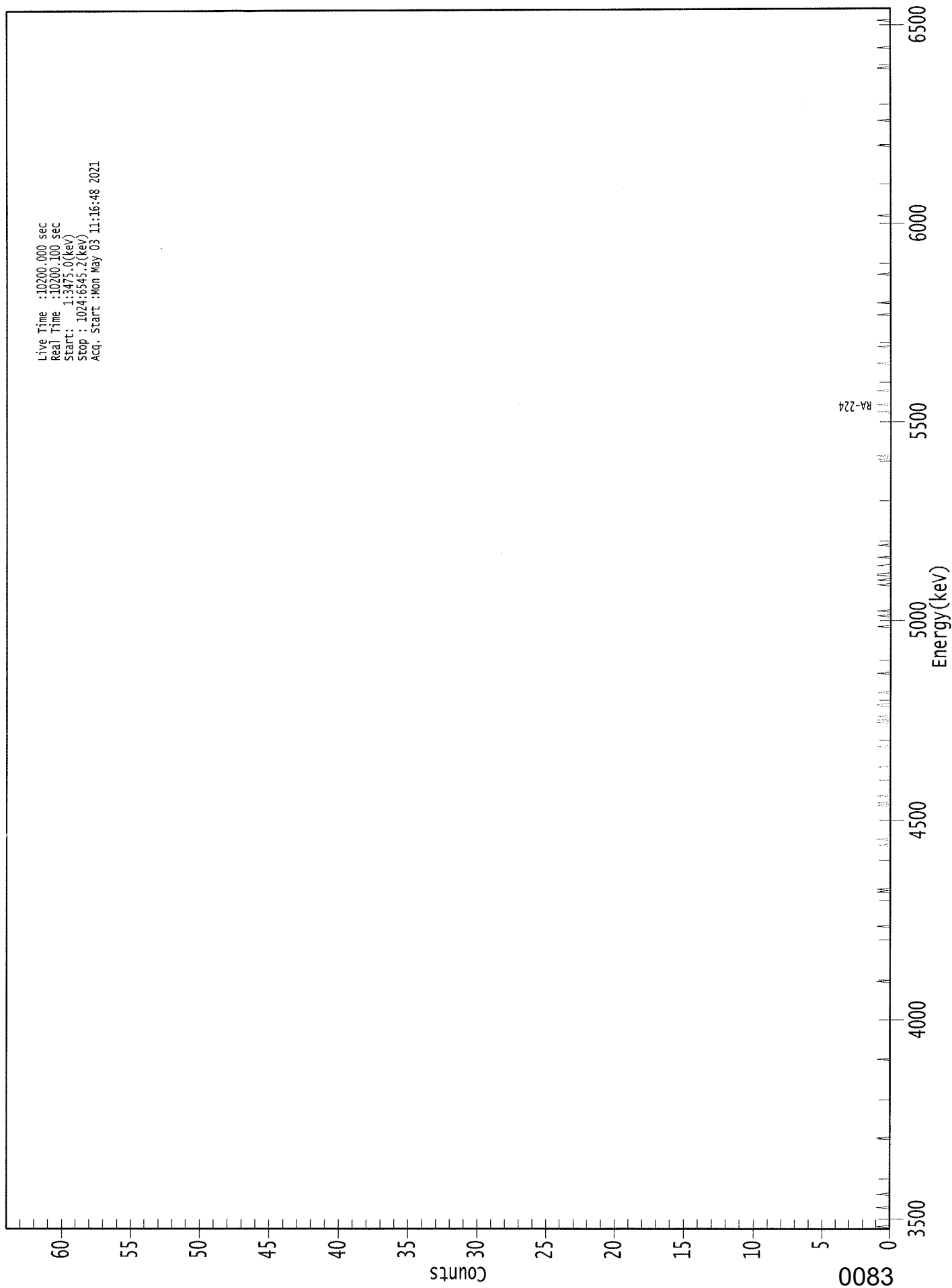
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.543	5.13	103.36	1.87	0.00E+000	3.0
RA-226	4.654	11.13	64.27	1.87	0.00E+000	3.0

-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.974	5685.50*	2.57E-001 +/- 2.66E-001	3.79E-001 +/- 1.33E-002
RA-226	0.978	4785.00*	5.27E-001 +/- 3.39E-001	3.59E-001 +/- 1.26E-002

0000291387.CNF

Live Time : 10200.000 sec  
Real Time : 10200.100 sec  
Start : 1:34:53.0 (keV)  
Stop : 1024:6545.2 (keV)  
Acq. Start : Mon May 03 11:16:48 2021



ROI Type: 1



369: 0 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	1	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	1	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	1
425:	0	1	0	0	1	0	0	0
433:	0	0	0	0	0	1	1	0
441:	0	0	0	0	0	0	0	0
449:	1	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	1	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	1
505:	0	0	0	0	0	0	0	0
513:	1	0	0	0	1	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	1	0	0	0	1	0
545:	0	0	1	1	0	0	0	0
553:	0	0	1	0	0	0	0	0
561:	0	1	0	0	0	0	0	0
569:	0	0	0	1	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	1	0	0	1	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	1	0	0	0	0
689:	0	1	0	0	0	0	0	0
697:	0	0	0	0	0	1	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	1	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	1	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	1	0	0
769:	0	0	0	0	0	0	0	1
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	1



801: 0 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	1	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	1	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	1	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	1	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	1	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	1	0	0	0
1017:	0	0	0	0	0	0	0	1

WJ  
5/3/21

# Apex-Alpha™

Sample Description: H-24  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002913  
 Batch Identification: 2104092A-RA  
 Sample Identification: 07  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_040  
 Chamber Serial Number: 06027396B  
 Detector Serial Number: 91135  
 Env. Background: System Bkgd 297011  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.720E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 4/19/2021 10:40:37 AM  
 Acquisition Date/Time: 5/3/2021 11:16:51 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1484 +/- 0.0027 on 6/23/2020 1:54:46 PM  
 Effective Efficiency: 0.1484 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.528	0.81	359.09	1.19	0.00E+000	3.0
RA-226	4.653	4.13	119.29	1.87	0.00E+000	3.0

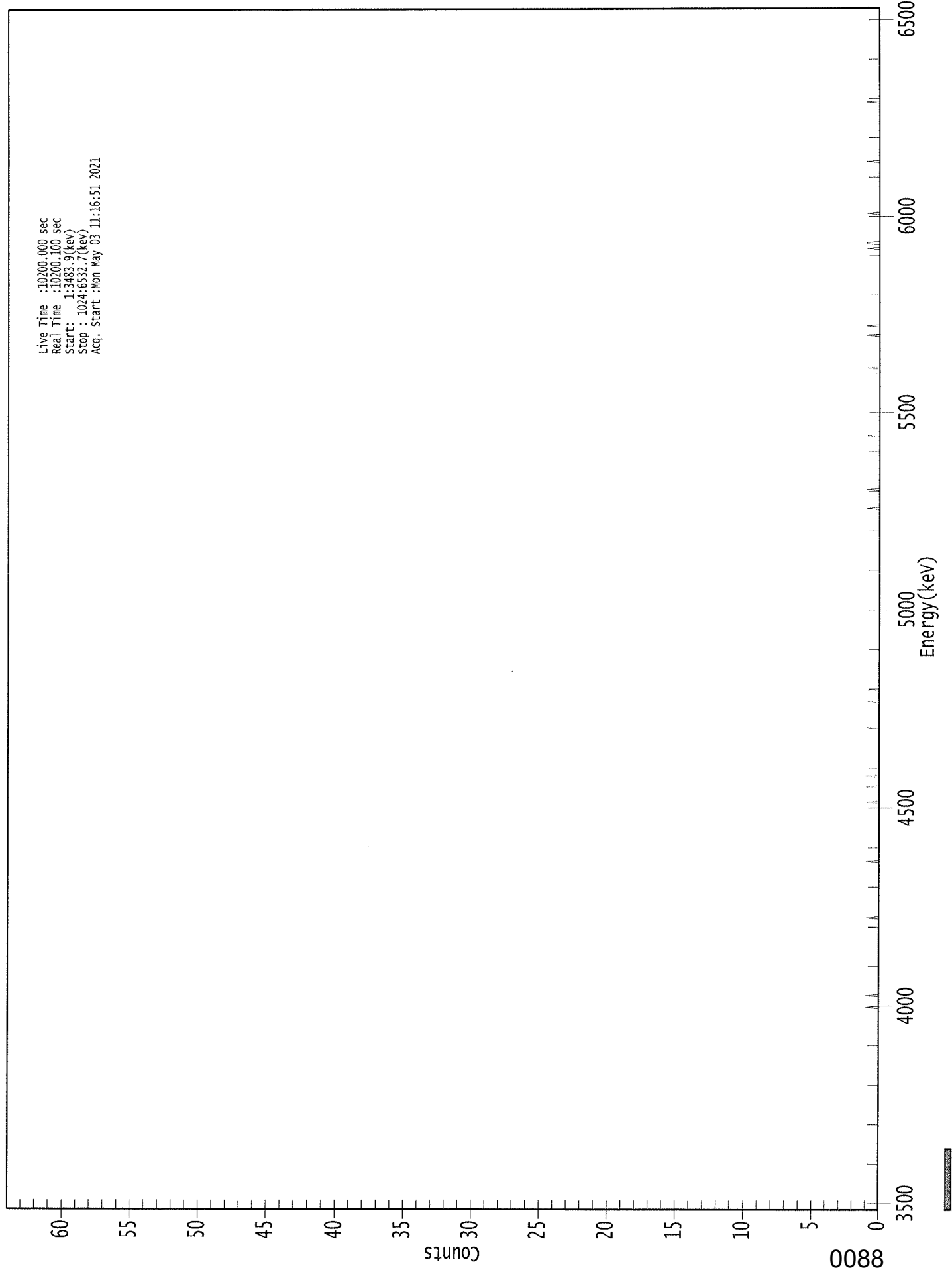
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.968	5685.50*	4.16E-002 +/- 1.49E-001	3.38E-001 +/- 1.19E-002
RA-226	0.978	4785.00*	2.01E-001 +/- 2.39E-001	3.68E-001 +/- 1.29E-002

AG  
 5/3/21

0000291386.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 1:3483.9(keV)  
Stop : 1024:6532.7(keV)  
Acq. Start :Mon May 03 11:16:51 2021



ROI Type: 1



369: 1 0 0 0 0 0 0 0

Sample Title: 07

Channel	1	2	3	4	5	6	7	8
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	1	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	1
433:	0	0	0	0	0	0	0	0
441:	0	1	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	1	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	1	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	1	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	1	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	1
745:	0	0	0	0	0	0	0	1
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 07

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	1	0	0	0	1	1	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	1	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	1	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



## QA SUMMARY REPORT

### Review Of QA Results - Pulser Check

Date : 5/3/2021

Time : 6:20:32 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Not Done	
Alpha 004	21f	ALL	Not Done	
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Passed	5/3/2021 6:05:22 AM
Alpha 011	21f	ALL	Passed	5/3/2021 6:05:23 AM
Alpha 012	21f	ALL	Passed	5/3/2021 6:05:23 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Not Done	
Alpha 015	21f	ALL	Not Done	
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:25 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:26 AM
Alpha 035	Alpha Analyst100DC	ALL	Not Done	
Alpha 036	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:28 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:29 AM
Alpha 038	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:31 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:33 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:34 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:36 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:38 AM
Alpha 043	Alpha Analyst100DC	ALL	Not Done	
Alpha 044	Alpha Analyst100DC	ALL	Not Done	
Alpha 045	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:39 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:41 AM
Alpha 047	Alpha Analyst100DC	Peak FWHM	Action	5/3/2021 6:05:43 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:45 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:46 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:48 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:50 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:51 AM
Alpha 053	Alpha Analyst100DC	ALL	Not Done	
Alpha 054	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:53 AM
Alpha 055	Alpha Analyst100DC	ALL	Not Done	
Alpha 056	Alpha Analyst100DC	ALL	Not Done	
Alpha 057	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:55 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:57 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:05:59 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	5/3/2021 6:06:01 AM

APPROVED BY:     KP    

APPROVAL DATE:     5/3/21



\*\*\*\*\*  
\*\*\*\*\* LIBRARY LISTING REPORT \*\*\*\*\*  
\*\*\*\*\*

Nuclide Library Title: Radium

Nuclide Library Description: Ra-226, Po-218, Rn-222

Nuclide Name	Half-Life (Seconds)	Energy (keV )	Energy Uncert. (keV )	Yield (%)	Yield Uncert. (Abs.+)
PO-218	5.049E+010	6003.000*	0.000	99.9800	0.0000
RN-222	5.049E+010	5490.000*	0.000	99.9200	0.0000
RA-226	5.049E+010	4785.000*	0.000	100.0000	0.0000

\* = key line

TOTALS:            3    Nuclides            3    Energy Lines

**SECTION IX**  
**ANALYTICAL DATA (RADIUM-228)**

<b>Work Order</b>	<b>21-04092</b>
<b>Analysis Code</b>	<b>Ra228</b>
<b>Run</b>	<b>1</b>
<b>Date Received</b>	<b>4/27/2021</b>
<b>Lab Deadline</b>	<b>5/11/2021</b>
<b>Client</b>	ERM
<b>Project</b>	526033
<b>Report Level</b>	4
<b>Activity Units</b>	pCi
<b>Aliquot Units</b>	I
<b>Matrix</b>	WA
<b>Method</b>	EPA 904.0
<b>Instrument Type</b>	Alpha/Beta GPC
<b>Radiometric Tracer</b>	Ba-133
<b>Radiometric Sol#</b>	Ba-6a
<b>Tracer Act (dpm/g)</b>	398.67
<b>Carrier</b>	Yttrium
<b>Carrier Conc (mg/ml)</b>	34.65

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		04/27/21 00:00	1.0000E+00
02	MBL	BLANK		04/27/21 00:00	1.0000E+00
03	DUP	H-20	40	04/19/21 10:00	1.0000E+00
04	DO	H-20	40	04/19/21 10:00	1.0000E+00
05	TRG	H-22	30	04/19/21 11:10	1.0000E+00
06	TRG	H-23	40	04/19/21 13:35	1.0000E+00
07	TRG	H-24	50	04/19/21 15:00	1.0000E+00

0096

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.1937	874.6	399.0	101.28	2.000	0.0878	0.1546	0.0668	96.39	97.63	1.00	1.00
02	MBL	2.2050	879.1	465.0	117.43	2.000	0.0882	0.1546	0.0664	95.82	105.40	1.00	1.00
03	DUP	2.2057	879.3	347.0	87.60	2.000	0.0884	0.1576	0.0692	99.86	87.48	1.00	1.00
04	DO	2.2006	877.3	305.0	77.18	2.000	0.0880	0.1566	0.0686	98.99	76.40	1.00	1.00
05	TRG	2.1982	876.4	430.0	108.93	2.010	0.0871	0.1566	0.0695	99.79	108.70	1.00	1.00
06	TRG	2.1927	874.2	418.0	106.15	2.000	0.0876	0.1549	0.0673	97.11	103.09	1.00	1.00
07	TRG	2.1920	873.9	427.0	108.47	2.010	0.0883	0.1577	0.0694	99.65	108.09	1.00	1.00

0097

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
 \*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.











Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	04/27/21 00:00	1.0000	2.1937	874.5624	399.0000	101.28	1.00	1.00
02	MBL	BLANK	04/27/21 00:00	1.0000	2.2050	879.0674	465.0000	117.43	1.00	1.00
03	DUP	H-20	04/19/21 10:00	1.0000	2.2057	879.3464	347.0000	87.60	1.00	1.00
04	DO	H-20	04/19/21 10:00	1.0000	2.2006	877.3132	305.0000	77.18	1.00	1.00
05	TRG	H-22	04/19/21 11:10	1.0000	2.1982	876.3564	430.0000	108.93	1.00	1.00
06	TRG	H-23	04/19/21 13:35	1.0000	2.1927	874.1637	418.0000	106.15	1.00	1.00
07	TRG	H-24	04/19/21 15:00	1.0000	2.1920	873.8846	427.0000	108.47	1.00	1.00

# Spike and Tracer Worksheet

Internal Work Order		Run	Analysis Code		Date		Technician		Technician Initials		Witness Initials		
<b>21-04092</b>		<b>1</b>	<b>Ra228</b>		<b>5/4/2021 9:58</b>		<b>AYARBER</b>		<b>AY</b>				
<b>LCS &amp; Matrix Spikes</b>													
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS Volume Used (g)	MS Volume Used (g)	MSD Volume Used (g)	LCS Known pCi	LCS Error Estimate	MS Added pCi	MS Error Estimate	MSD Added pCi	MSD Error Estimate
Ra-228	Ra-12	38.840	5/4/2021	0.510	0.5119			8.96	0.457	0.00	0.000	0.00	0.000

<b>Tracers</b>													
fraction	isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition	<b>Balance Printer Tapes</b>						
							<b>Tracer</b>						
							<b>LCS</b>						
01	Ba-133	Ba-6a	398.670	5/4/2021	2.1937	2.5400							
02	Ba-133	Ba-6a	398.670	5/4/2021	2.2050	2.5400							
03	Ba-133	Ba-6a	398.670	5/4/2021	2.2057	2.5400							
04	Ba-133	Ba-6a	398.670	5/4/2021	2.2006	2.5400							
05	Ba-133	Ba-6a	398.670	5/4/2021	2.1982	2.5400							
06	Ba-133	Ba-6a	398.670	5/4/2021	2.1927	2.5400							
07	Ba-133	Ba-6a	398.670	5/4/2021	2.1920	2.5400							
							<b>Matrix Spike</b>						



# Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
<b>21-04092</b>	<b>1</b>	<b>Ra228</b>	<b>Yttrium</b>	<b>34.6500</b>	<b>AYARBER</b>

TRetek Fraction	ERM Client ID	Sample Type	Carrier Data Carrier Added (ml)	Filter Data		Gravimetric % Recovery
				Filter Tare (g)	Filter Final (g)	
01	LCS	LCS	2.0000	0.0878	0.1546	96.39
02	BLANK	MBL	2.0000	0.0882	0.1546	95.82
03	DUP	DUP	2.0000	0.0884	0.1576	99.86
04	H-20	DO	2.0000	0.0880	0.1566	98.99
05	H-22	TRG	2.0100	0.0871	0.1566	99.79
06	H-23	TRG	2.0000	0.0876	0.1549	97.11
07	H-24	TRG	2.0100	0.0883	0.1577	99.65

AY

Technician: Craig Spam Date: 4/4/21

UP  
5/4/21

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
F1	2104092-01	34	803	120	1410	5/4/2021 12:18:25 PM
F2	2104092-02	17	149	120	1410	5/4/2021 12:18:25 PM
F3	2104092-03	17	191	120	1410	5/4/2021 12:18:25 PM
F4	2104092-04	15	217	120	1410	5/4/2021 12:18:25 PM
G1	2104092-05	16	204	120	1410	5/4/2021 12:18:26 PM
G2	2104092-06	15	254	120	1410	5/4/2021 12:18:26 PM
G3	2104092-07	31	185	120	1410	5/4/2021 12:18:26 PM

GPC Detector Report  
(ALL Backgrounds)

LP  
5/4/21

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	5/4/2021	2.17E-01	P	-4.28E-03	1.53E-01	3.11E-01
LB4110A - A2	Alpha	11/2/2019	5/4/2021	1.83E-01	P	1.04E-02	1.39E-01	2.67E-01
LB4110A - A3	Alpha	11/2/2019	5/4/2021	1.83E-01	P	7.99E-03	1.49E-01	2.90E-01
LB4110A - A4	Alpha	11/2/2019	5/4/2021	1.33E-01	P	1.06E-02	1.50E-01	2.90E-01
LB4110A - B1	Alpha	11/2/2019	5/4/2021	2.33E-01	P	-1.53E-02	1.31E-01	2.77E-01
LB4110A - B2	Alpha	11/2/2019	5/4/2021	2.33E-01	P	4.56E-02	2.02E-01	3.58E-01
LB4110A - B3	Alpha	11/2/2019	5/4/2021	2.33E-01	P	1.31E-02	1.63E-01	3.13E-01
LB4110A - B4	Alpha	11/2/2019	5/4/2021	6.67E-02	P	-1.24E-02	1.10E-01	2.32E-01
LB4110A - C1	Alpha	11/2/2019	5/4/2021	1.17E-01	P	-2.36E-02	1.04E-01	2.31E-01
LB4110A - C2	Alpha	11/2/2019	5/4/2021	2.00E-01	P	-2.14E-02	1.02E-01	2.25E-01
LB4110A - C3	Alpha	11/2/2019	5/4/2021	8.33E-02	P	-2.57E-02	8.44E-02	1.94E-01
LB4110A - C4	Alpha	11/2/2019	5/4/2021	1.83E-01	P	2.56E-02	2.07E-01	3.88E-01
LB4110A - D1	Alpha	11/2/2019	5/4/2021	6.67E-02	P	-2.53E-02	7.45E-02	1.74E-01
LB4110A - D2	Alpha	11/2/2019	5/4/2021	6.67E-02	P	-7.74E-03	1.02E-01	2.11E-01
LB4110A - D3	Alpha	11/2/2019	5/4/2021	1.50E-01	P	-6.91E-03	1.21E-01	2.50E-01
LB4110A - D4	Alpha	11/2/2019	5/4/2021	1.00E-01	P	2.54E-02	1.70E-01	3.15E-01
LB4110A - E1	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E2	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E3	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E4	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - F1	Alpha	11/2/2019	5/4/2021	1.00E-01	P	-1.93E-02	1.15E-01	2.49E-01
LB4110A - F2	Alpha	11/2/2019	5/4/2021	1.50E-01	P	-3.22E-02	1.02E-01	2.36E-01
LB4110A - F3	Alpha	11/2/2019	5/4/2021	1.17E-01	P	-1.80E-02	9.98E-02	2.18E-01
LB4110A - F4	Alpha	11/2/2019	5/4/2021	1.33E-01	P	-3.82E-02	6.64E-02	1.71E-01
LB4110A - G1	Alpha	11/2/2019	5/4/2021	8.33E-02	P	-2.30E-02	8.52E-02	1.93E-01
LB4110A - G2	Alpha	11/2/2019	5/4/2021	5.00E-02	P	-2.03E-02	8.43E-02	1.89E-01
LB4110A - G3	Alpha	11/2/2019	5/4/2021	1.00E-01	P	-1.16E-02	1.27E-01	2.65E-01
LB4110A - G4	Alpha	11/2/2019	5/4/2021	6.67E-02	P	-2.96E-02	9.70E-02	2.24E-01

GPC Detector Report  
(ALL Backgrounds)

KP  
5/4/21

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	5/4/2021	1.30E+00	P	-2.06E+00	1.41E+00	4.88E+00
LB4110A - A2	Beta	11/2/2019	5/4/2021	1.75E+00	P	-1.91E+00	1.69E+00	5.29E+00
LB4110A - A3	Beta	11/2/2019	5/4/2021	1.62E+00	P	-1.85E+00	1.49E+00	4.83E+00
LB4110A - A4	Beta	11/2/2019	5/4/2021	1.40E+00	P	-1.99E+00	1.53E+00	5.05E+00
LB4110A - B1	Beta	11/2/2019	5/4/2021	1.32E+00	P	1.02E+00	1.40E+00	1.78E+00
LB4110A - B2	Beta	11/2/2019	5/4/2021	1.83E+00	P	8.07E-01	1.42E+00	2.03E+00
LB4110A - B3	Beta	11/2/2019	5/4/2021	1.38E+00	P	9.34E-01	1.32E+00	1.71E+00
LB4110A - B4	Beta	11/2/2019	5/4/2021	2.08E+00	F	6.28E-01	1.51E+00	2.39E+00
LB4110A - C1	Beta	11/2/2019	5/4/2021	1.10E+00	P	8.00E-01	1.17E+00	1.55E+00
LB4110A - C2	Beta	11/2/2019	5/4/2021	9.83E-01	P	6.66E-01	1.02E+00	1.38E+00
LB4110A - C3	Beta	11/2/2019	5/4/2021	1.17E+00	P	7.81E-01	1.37E+00	1.95E+00
LB4110A - C4	Beta	11/2/2019	5/4/2021	1.50E+00	P	8.66E-01	1.30E+00	1.73E+00
LB4110A - D1	Beta	11/2/2019	5/4/2021	1.13E+00	P	6.67E-01	1.09E+00	1.51E+00
LB4110A - D2	Beta	11/2/2019	5/4/2021	3.00E+00	F	-1.23E+00	2.66E+00	6.55E+00
LB4110A - D3	Beta	11/2/2019	5/4/2021	1.15E+00	P	7.39E-01	1.13E+00	1.51E+00
LB4110A - D4	Beta	11/2/2019	5/4/2021	1.37E+00	P	1.04E+00	1.48E+00	1.92E+00
LB4110A - E1	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E2	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E3	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E4	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - F1	Beta	11/2/2019	5/4/2021	1.37E+00	P	5.15E-01	1.27E+00	2.03E+00
LB4110A - F2	Beta	11/2/2019	5/4/2021	1.20E+00	P	-2.42E-01	1.14E+00	2.51E+00
LB4110A - F3	Beta	11/2/2019	5/4/2021	1.12E+00	P	1.13E-01	1.17E+00	2.23E+00
LB4110A - F4	Beta	11/2/2019	5/4/2021	1.28E+00	P	-1.20E+00	1.54E+00	4.28E+00
LB4110A - G1	Beta	11/2/2019	5/4/2021	1.37E+00	P	7.39E-01	1.17E+00	1.60E+00
LB4110A - G2	Beta	11/2/2019	5/4/2021	1.65E+00	P	1.13E+00	1.59E+00	2.05E+00
LB4110A - G3	Beta	11/2/2019	5/4/2021	1.58E+00	P	7.52E-01	1.18E+00	1.61E+00
LB4110A - G4	Beta	11/2/2019	5/4/2021	8.33E-01	P	6.94E-01	1.25E+00	1.81E+00

GPC Detector Report  
(ALL Efficiencies)

KP  
5/4/21

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	5/4/2021	0.2358	P	0.2254	0.2334	0.2414
LB4110A - A2	Alpha	11/2/2019	5/4/2021	0.2047	P	0.1936	0.2024	0.2111
LB4110A - A3	Alpha	11/2/2019	5/4/2021	0.2050	W	0.1874	0.1970	0.2067
LB4110A - A4	Alpha	11/2/2019	5/4/2021	0.2266	P	0.2155	0.2265	0.2375
LB4110A - B1	Alpha	11/2/2019	5/4/2021	0.2119	P	0.1956	0.2103	0.2251
LB4110A - B2	Alpha	11/2/2019	5/4/2021	0.2008	P	0.1853	0.1984	0.2115
LB4110A - B3	Alpha	11/2/2019	5/4/2021	0.2292	P	0.2192	0.2345	0.2498
LB4110A - B4	Alpha	11/2/2019	5/4/2021	0.2252	P	0.2100	0.2272	0.2444
LB4110A - C1	Alpha	11/2/2019	5/4/2021	0.1998	P	0.1896	0.1999	0.2101
LB4110A - C2	Alpha	11/2/2019	5/4/2021	0.2001	P	0.1908	0.2020	0.2133
LB4110A - C3	Alpha	11/2/2019	5/4/2021	0.2280	P	0.2100	0.2275	0.2450
LB4110A - C4	Alpha	11/2/2019	5/4/2021	0.2151	P	0.1931	0.2123	0.2316
LB4110A - D1	Alpha	11/2/2019	5/4/2021	0.1950	P	0.1866	0.1983	0.2101
LB4110A - D2	Alpha	11/2/2019	5/4/2021	0.2326	P	0.2244	0.2362	0.2480
LB4110A - D3	Alpha	11/2/2019	5/4/2021	0.2365	P	0.2319	0.2426	0.2532
LB4110A - D4	Alpha	11/2/2019	5/4/2021	0.1822	P	0.1755	0.1858	0.1960
LB4110A - E1	Alpha	11/2/2017	5/19/2020	0.2075	P	0.1686	0.2257	0.2828
LB4110A - E2	Alpha	11/2/2017	5/19/2020	0.1778	P	0.1514	0.2049	0.2583
LB4110A - E3	Alpha	11/2/2017	5/19/2020	0.2234	P	0.1549	0.2076	0.2604
LB4110A - E4	Alpha	11/2/2017	5/19/2020	0.2155	P	0.1746	0.2353	0.2961
LB4110A - F1	Alpha	11/2/2019	5/4/2021	0.2161	P	0.1990	0.2129	0.2268
LB4110A - F2	Alpha	11/2/2019	5/4/2021	0.1770	P	0.1653	0.1781	0.1909
LB4110A - F3	Alpha	11/2/2019	5/4/2021	0.2238	P	0.2065	0.2218	0.2372
LB4110A - F4	Alpha	11/2/2019	5/4/2021	0.2206	P	0.2009	0.2159	0.2310
LB4110A - G1	Alpha	11/2/2019	5/4/2021	0.1870	P	0.1747	0.1869	0.1990
LB4110A - G2	Alpha	11/2/2019	5/4/2021	0.1808	P	0.1707	0.1833	0.1960
LB4110A - G3	Alpha	11/2/2019	5/4/2021	0.2130	P	0.2018	0.2152	0.2286
LB4110A - G4	Alpha	11/2/2019	5/4/2021	0.1829	P	0.1600	0.1831	0.2062

KP 5/4/21  
out of service



GPC Detector Report  
(ALL Efficiencies)

*KP*  
*5/4/21*

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	5/4/2021	0.5716	P	0.5446	0.5652	0.5857
LB4110A - A2	Beta	11/2/2019	5/4/2021	0.4429	P	0.4228	0.4438	0.4647
LB4110A - A3	Beta	11/2/2019	5/4/2021	0.4891	P	0.4562	0.4791	0.5021
LB4110A - A4	Beta	11/2/2019	5/4/2021	0.5627	P	0.5309	0.5536	0.5762
LB4110A - B1	Beta	11/2/2019	5/4/2021	0.4909	P	0.4572	0.4934	0.5295
LB4110A - B2	Beta	11/2/2019	5/4/2021	0.4994	P	0.4605	0.4944	0.5284
LB4110A - B3	Beta	11/2/2019	5/4/2021	0.5689	P	0.5494	0.5864	0.6233
LB4110A - B4	Beta	11/2/2019	5/4/2021	0.5528	P	0.5182	0.5617	0.6051
LB4110A - C1	Beta	11/2/2019	5/4/2021	0.4838	P	0.4581	0.4800	0.5019
LB4110A - C2	Beta	11/2/2019	5/4/2021	0.4884	P	0.4583	0.4833	0.5084
LB4110A - C3	Beta	11/2/2019	5/4/2021	0.5680	P	0.5271	0.5729	0.6188
LB4110A - C4	Beta	11/2/2019	5/4/2021	0.5230	P	0.4735	0.5175	0.5616
LB4110A - D1	Beta	11/2/2019	5/4/2021	0.5669	P	0.5499	0.5793	0.6087
LB4110A - D2	Beta	11/2/2019	5/4/2021	0.5972	P	0.5656	0.5948	0.6241
LB4110A - D3	Beta	11/2/2019	5/4/2021	0.6056	P	0.5791	0.6044	0.6298
LB4110A - D4	Beta	11/2/2019	5/4/2021	0.4822	P	0.4626	0.4846	0.5066
LB4110A - E1	Beta	11/2/2017	5/19/2020	0.5360	P	0.4167	0.5408	0.6649
LB4110A - E2	Beta	11/2/2017	5/19/2020	0.4520	P	0.3728	0.4910	0.6092
LB4110A - E3	Beta	11/2/2017	5/19/2020	0.5775	P	0.3848	0.5001	0.6154
LB4110A - E4	Beta	11/2/2017	5/19/2020	0.5466	P	0.4532	0.5887	0.7241
LB4110A - F1	Beta	11/2/2019	5/4/2021	0.5306	P	0.5129	0.5339	0.5549
LB4110A - F2	Beta	11/2/2019	5/4/2021	0.4411	P	0.4236	0.4467	0.4698
LB4110A - F3	Beta	11/2/2019	5/4/2021	0.5839	P	0.5445	0.5760	0.6074
LB4110A - F4	Beta	11/2/2019	5/4/2021	0.5588	P	0.5261	0.5529	0.5798
LB4110A - G1	Beta	11/2/2019	5/4/2021	0.4392	P	0.4161	0.4443	0.4724
LB4110A - G2	Beta	11/2/2019	5/4/2021	0.4378	P	0.4031	0.4344	0.4657
LB4110A - G3	Beta	11/2/2019	5/4/2021	0.5194	P	0.4887	0.5187	0.5487
LB4110A - G4	Beta	11/2/2019	5/4/2021	0.4414	P	0.3867	0.4395	0.4923

*out of service*  
*KP 5/4/21*

**SECTION X**

**BARIUM-133 ANALYTICAL TRACER DATA**

WB  
S13h1

Analysis Report for 2104092-01  
SPIKE

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-01  
 Sample Description : SPIKE  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:52:34AM  
 Acquisition Started : 5/3/2021 10:39:18AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110288

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 10:54:21AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-01

SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	51.45	49 -	55	51.92	3.55E+01	36.82	2.21E+02	1.51
M	2	60.88	56 -	69	61.34	2.02E+02	51.30	2.73E+02	2.64
m	3	64.88	56 -	69	65.34	1.10E+02	51.96	2.91E+02	2.65
	4	79.65	74 -	85	80.10	7.61E+02	73.13	2.88E+02	2.56
	5	110.47	106 -	114	110.89	1.15E+02	53.18	3.65E+02	1.78
M	6	275.82	270 -	290	276.11	6.68E+01	25.51	5.57E+01	2.91
M	7	301.89	297 -	310	302.16	1.31E+02	31.52	7.76E+01	2.42
m	8	306.51	297 -	310	306.78	1.93E+01	26.26	6.68E+01	2.42
M	9	333.29	326 -	344	333.53	6.86E+01	26.91	5.18E+01	2.69
m	10	337.19	326 -	344	337.44	3.56E+01	26.23	5.40E+01	2.69
	11	355.07	348 -	361	355.30	5.43E+02	53.54	7.72E+01	2.45
M	12	376.40	372 -	397	376.62	2.06E+01	17.32	5.22E+01	2.72
m	13	383.10	372 -	397	383.31	1.01E+02	33.31	3.34E+01	2.25
m	14	385.83	372 -	397	386.04	2.06E+02	37.68	2.50E+01	2.65
m	15	390.39	372 -	397	390.59	7.68E+01	26.26	5.09E+00	2.41
	16	415.47	409 -	423	415.66	5.39E+01	29.30	6.81E+01	6.20
	17	435.98	431 -	442	436.15	9.50E+01	24.98	3.20E+01	2.60
M	18	467.28	463 -	476	467.42	1.59E+01	12.02	1.10E+01	3.06
m	19	470.34	463 -	476	470.48	8.81E+00	11.66	5.82E+00	2.78
	20	510.23	506 -	514	510.35	2.60E+01	10.20	0.00E+00	4.99
	21	577.44	574 -	580	577.51	5.36E+00	6.34	3.29E+00	2.72
	22	863.40	860 -	866	863.25	8.00E+00	5.66	0.00E+00	2.22

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 10:54:21AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110262.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	51.45	3.55E+01	36.82			3.55E+01	3.68E+01
M	2	60.88	2.02E+02	51.30	2.30E+01	2.36E+00	1.79E+02	5.14E+01
m	3	64.88	1.10E+02	51.96			1.10E+02	5.20E+01
	4	79.65	7.61E+02	73.13			7.61E+02	7.31E+01
	5	110.47	1.15E+02	53.18			1.15E+02	5.32E+01
M	6	275.82	6.68E+01	25.51			6.68E+01	2.55E+01
M	7	301.89	1.31E+02	31.52			1.31E+02	3.15E+01

0113

Analysis Report for 2104092-01

SPIKE

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
m	8	306.51	1.93E+01	26.26			1.93E+01	2.63E+01
M	9	333.29	6.86E+01	26.91			6.86E+01	2.69E+01
m	10	337.19	3.56E+01	26.23			3.56E+01	2.62E+01
	11	355.07	5.43E+02	53.54			5.43E+02	5.35E+01
M	12	376.40	2.06E+01	17.32			2.06E+01	1.73E+01
m	13	383.10	1.01E+02	33.31			1.01E+02	3.33E+01
m	14	385.83	2.06E+02	37.68			2.06E+02	3.77E+01
m	15	390.39	7.68E+01	26.26			7.68E+01	2.63E+01
	16	415.47	5.39E+01	29.30			5.39E+01	2.93E+01
	17	435.98	9.50E+01	24.98			9.50E+01	2.50E+01
M	18	467.28	1.59E+01	12.02			1.59E+01	1.20E+01
m	19	470.34	8.81E+00	11.66			8.81E+00	1.17E+01
	20	510.23	2.60E+01	10.20	1.77E+01	1.47E+00	8.29E+00	1.03E+01
	21	577.44	5.36E+00	6.34			5.36E+00	6.34E+00
	22	863.40	8.00E+00	5.66			8.00E+00	5.66E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
SN-113	0.91	255.12	1.93		
		391.69	*	61.90	5.96E+01
BA-133	0.97	81.00	*	34.06	3.80E+02
		302.84	*	18.33	3.69E+02
		356.01	*	62.05	4.37E+02
TH-234	0.93	63.29	*	3.80	3.32E+02
AM-241	0.95	59.54	*	35.90	4.99E+01

Analysis Report for 2104092-01

SPIKE

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.912	5.96E+01	2.14E+01	
BA-133	0.971	3.99E+02	3.92E+01	
TH-234	0.937	3.32E+02	1.58E+02	
AM-241	0.955	4.99E+01	1.46E+01	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2104092-01  
SPIKE

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### UNIDENTIFIED PEAKS

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Peak Locate Performed on : 5/3/2021 10:54:21AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	51.45	3.94711E-02	51.82	
	5	110.47	1.27447E-01	23.18	
M	6	275.82	7.42256E-02	19.09	
m	8	306.51	2.14505E-02	68.01	
M	9	333.29	7.62144E-02	19.61	
m	10	337.19	3.95855E-02	36.81	
M	12	376.40	2.28426E-02	42.13	
m	13	383.10	1.11732E-01	16.56	Sum
m	14	385.83	2.28487E-01	9.16	
	16	415.47	5.99179E-02	27.16	Sum
	17	435.98	1.05571E-01	13.15	Sum
M	18	467.28	1.76145E-02	37.91	
m	19	470.34	9.79024E-03	66.18	Sum
	20	510.23	9.21075E-03	62.14	
	21	577.44	5.95238E-03	59.21	
	22	863.40	8.88889E-03	35.36	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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### NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2104092-01

SPIKE

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	8.60E-07	8.60E-07	0.00E+00	0.00E+00
	3.31	12.30	1.01E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.49E-04	1.49E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.71E+01	1.71E+01	-4.71E+00	8.06E+00
	136.48	10.60	1.54E+02		-1.63E+01	7.22E+01
NI-59	6.92	29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.33E-03	9.33E-03	0.00E+00	0.00E+00
	18.60	10.00	7.73E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.21E-02	5.21E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.79E+02	2.79E+02	-1.23E+02	1.32E+02
+ SN-113	255.12	1.93	7.88E+02	4.62E+01	1.16E+02	3.58E+02
	391.69	*	61.90		5.96E+01	2.21E+01
SN-119M	23.87	16.10	1.20E-01	1.01E-01	0.00E+00	0.00E+00
	25.10	22.70	1.01E-01		0.00E+00	0.00E+00
I-129	29.78	57.00	2.03E+00	2.03E+00	-9.77E-01	9.78E-01
	33.60	13.20	2.26E+01		1.22E+02	1.11E+01
	39.58	7.52	3.17E+01		-6.95E+01	1.52E+01
+ BA-133	81.00	*	34.06	3.70E+01	3.80E+02	1.97E+01
	302.84	*	18.33		3.69E+02	8.16E+01
	356.01	*	62.05		4.37E+02	1.74E+01
CE-139	165.85	80.35	2.56E+01	2.56E+01	4.83E+00	1.21E+01
CE-144	133.54	10.80	1.47E+02	1.47E+02	8.65E+00	6.89E+01
HG-203	279.19	77.30	3.07E+01	3.07E+01	2.84E+01	1.44E+01
PB-210	46.50	4.25	6.22E+01	6.22E+01	-1.81E+01	2.94E+01
TH-231	25.64	14.70	1.68E-01	1.68E-01	0.00E+00	0.00E+00
	84.21	6.40	1.90E+02		1.70E+01	9.09E+01
PA-234M	9.89	89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
	21.72	64.90	2.12E-02		0.00E+00	0.00E+00
	37.93	23.75	1.33E+01		1.60E+01	6.49E+00
+ TH-234	63.29	*	3.80	3.23E+02	3.32E+02	1.57E+02
NP-237	29.37	14.00	7.89E+00	7.89E+00	-3.81E+00	3.81E+00
	86.50	12.60	7.66E+01		-4.31E+01	3.62E+01
U-237	97.08	16.30	6.78E+01	4.39E+01	-4.13E+01	3.19E+01
	101.07	26.30	4.39E+01		-3.39E+01	2.06E+01
	114.00	12.30	1.85E+02		8.15E+01	8.91E+01
	208.01	22.00	9.32E+01		2.49E+01	4.36E+01
+ AM-241	59.54	*	35.90	3.01E+01	4.99E+01	1.47E+01
AM-243	74.67	66.00	1.35E+01	1.35E+01	-1.01E+00	6.44E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction



*KS  
5/3/21*

Analysis Report for 2104092-02  
BLANK

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-02  
 Sample Description : BLANK  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:52:44AM  
 Acquisition Started : 5/3/2021 10:39:24AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 29 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110289

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 10:54:33AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-02

BLANK

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.58	36 -	39	36.26	2.75E+02	56.46	2.33E+02	1.72
	2	52.70	50 -	56	53.38	8.47E+01	32.76	1.35E+02	1.81
	3	61.58	59 -	65	62.24	1.51E+02	44.56	2.55E+02	1.82
	4	81.12	78 -	85	81.76	8.03E+02	66.24	1.96E+02	1.35
M	5	111.82	110 -	121	112.43	1.62E+02	31.57	9.36E+01	1.76
m	6	115.92	110 -	121	116.53	5.11E+01	33.23	9.45E+01	2.24
	7	160.69	158 -	165	161.25	4.30E+01	30.20	1.22E+02	3.88
	8	276.85	274 -	280	277.29	3.05E+01	23.36	7.70E+01	1.30
M	9	302.73	299 -	317	303.15	1.31E+02	24.76	1.00E+01	1.65
m	10	307.56	299 -	317	307.97	3.63E+01	13.45	1.00E+01	1.65
m	11	311.74	299 -	317	312.15	9.49E+00	10.25	1.00E+01	1.66
M	12	333.70	330 -	341	334.09	5.53E+01	19.20	2.88E+01	1.68
m	13	338.47	330 -	341	338.85	2.23E+01	14.59	1.53E+01	1.69
	14	356.04	351 -	361	356.40	5.49E+02	50.26	4.40E+01	1.90
M	15	383.75	382 -	390	384.09	6.74E+01	23.83	3.71E+01	1.69
m	16	386.82	382 -	390	387.16	1.42E+02	31.68	6.85E+01	1.74
M	17	414.81	410 -	429	415.12	3.41E+01	16.52	1.64E+01	2.35
m	18	418.44	410 -	429	418.75	2.07E+01	17.35	1.25E+01	2.35
	19	437.33	433 -	442	437.61	7.62E+01	24.76	4.15E+01	2.02
	20	451.32	450 -	454	451.59	7.33E+00	6.50	3.33E+00	1.25
	21	468.35	466 -	470	468.60	6.79E+00	8.90	1.04E+01	1.62

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 10:54:33AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110263.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.58	2.75E+02	56.46			2.75E+02	5.65E+01
	2	52.70	8.47E+01	32.76			8.47E+01	3.28E+01
	3	61.58	1.51E+02	44.56	7.25E+00	7.41E-01	1.44E+02	4.46E+01
	4	81.12	8.03E+02	66.24			8.03E+02	6.62E+01
M	5	111.82	1.62E+02	31.57			1.62E+02	3.16E+01
m	6	115.92	5.11E+01	33.23			5.11E+01	3.32E+01
	7	160.69	4.30E+01	30.20			4.30E+01	3.02E+01
	8	276.85	3.05E+01	23.36			3.05E+01	2.34E+01

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Analysis Report for 2104092-02

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Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M 9	302.73	1.31E+02	24.76			1.31E+02	2.48E+01
m 10	307.56	3.63E+01	13.45			3.63E+01	1.35E+01
m 11	311.74	9.49E+00	10.25			9.49E+00	1.02E+01
M 12	333.70	5.53E+01	19.20			5.53E+01	1.92E+01
m 13	338.47	2.23E+01	14.59			2.23E+01	1.46E+01
	14	356.04	5.49E+02	50.26		5.49E+02	5.03E+01
M 15	383.75	6.74E+01	23.83			6.74E+01	2.38E+01
m 16	386.82	1.42E+02	31.68			1.42E+02	3.17E+01
M 17	414.81	3.41E+01	16.52			3.41E+01	1.65E+01
m 18	418.44	2.07E+01	17.35			2.07E+01	1.73E+01
	19	437.33	7.62E+01	24.76		7.62E+01	2.48E+01
	20	451.32	7.33E+00	6.50		7.33E+00	6.50E+00
	21	468.35	6.79E+00	8.90		6.79E+00	8.90E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
BA-133	1.00	81.00 *	34.06	4.90E+02	6.43E+01
		302.84 *	18.33	4.67E+02	1.67E+02
		356.01 *	62.05	4.40E+02	6.34E+01
HG-203	0.86	279.19 *	77.30	2.88E+01	2.41E+01
		PA-234M	0.98	9.89	89.00
		21.72	64.90		
		37.93 *	23.75	5.66E+00	1.16E+00
TH-234	0.92	63.29 *	3.80	2.92E+02	9.10E+01
AM-241	0.89	59.54 *	35.90	3.09E+01	9.63E+00

Analysis Report for 2104092-02

BLANK

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
BA-133	1.000	<del>4.65E+02</del>	4.36E+01	
HG-203	0.869	2.88E+01	2.41E+01	
PA-234M	0.981	5.66E+00	1.16E+00	
? TH-234	0.928	2.92E+02	9.10E+01	
? AM-241	0.899	3.09E+01	9.63E+00	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2104092-02

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 5/3/2021 10:54:33AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	52.70	9.41228E-02		
M	5	111.82	1.79691E-01	Tol.	U-237
m	6	115.92	5.68327E-02	Sum	
	7	160.69	4.77404E-02	Sum	
m	10	307.56	4.03036E-02		
m	11	311.74	1.05424E-02	Sum	
M	12	333.70	6.14291E-02		
m	13	338.47	2.47655E-02	Sum	
M	15	383.75	7.48606E-02	Sum	
m	16	386.82	1.58117E-01		
M	17	414.81	3.78844E-02		
m	18	418.44	2.29853E-02	Sum	
	19	437.33	8.46964E-02	Sum	
	20	451.32	8.14815E-03		
	21	468.35	7.54630E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
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Analysis Report for 2104092-02

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<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	1.84E-13	1.84E-13	0.00E+00	0.00E+00
	3.31	12.30	4.70E-12		0.00E+00	0.00E+00
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.90E+01	1.90E+01	3.58E+00	8.64E+00
	136.48	10.60	2.26E+02		-3.89E+01	1.04E+02
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.35E+02	2.35E+02	-9.76E+01	1.08E+02
SN-113	255.12	1.93	1.10E+03	2.06E+01	-2.98E+02	4.93E+02
	391.69	61.90	2.06E+01		1.61E+01	9.41E+00
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.92E-03		0.00E+00	0.00E+00
I-129	29.78	57.00	5.91E-01	5.91E-01	5.15E+00	2.92E-01
	33.60	13.20	5.19E+00		6.46E+00	2.56E+00
	39.58	7.52	4.41E+00		5.77E-01	2.04E+00
+ BA-133	81.00	* 34.06	3.61E+01	2.61E+01	4.90E+02	1.72E+01
	302.84	* 18.33	1.24E+02		4.67E+02	5.71E+01
	356.01	* 62.05	2.61E+01		4.40E+02	1.20E+01
CE-139	165.85	80.35	3.53E+01	3.53E+01	9.08E+00	1.63E+01
CE-144	133.54	10.80	2.11E+02	2.11E+02	-2.54E+01	9.74E+01
+ HG-203	279.19	* 77.30	3.45E+01	3.45E+01	2.88E+01	1.60E+01
PB-210	46.50	4.25	1.95E+01	1.95E+01	5.03E+00	9.07E+00
TH-231	25.64	14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
	84.21	6.40	1.80E+02		-3.98E+01	8.52E+01
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93	* 23.75	1.92E+00		5.66E+00	9.33E-01
+ TH-234	63.29	* 3.80	1.31E+02	1.31E+02	2.92E+02	6.26E+01
NP-237	29.37	14.00	2.20E+00	2.20E+00	1.91E+01	1.08E+00
	86.50	12.60	7.20E+01		-2.83E+01	3.33E+01
U-237	97.08	16.30	8.08E+01	6.00E+01	2.73E+01	3.75E+01
	101.07	26.30	6.00E+01		1.20E+01	2.80E+01
	114.00	12.30	2.42E+02		-8.92E+01	1.16E+02
	208.01	22.00	1.32E+02		4.97E+00	6.04E+01
+ AM-241	59.54	* 35.90	1.38E+01	1.38E+01	3.09E+01	6.62E+00
AM-243	74.67	66.00	9.38E+00	9.38E+00	-4.12E+00	4.37E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

*WB  
5/3/21*

Analysis Report for 2104092-03  
H-20

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-03  
 Sample Description : H-20  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:52:53AM  
 Acquisition Started : 5/3/2021 10:39:32AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 902.2 seconds  
  
 Dead Time : 0.25 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 10 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110290

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 10:54:42AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-03

H-20

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.79	18 -	25	21.22	5.12E+01	45.48	3.16E+02	1.85
M	2	31.00	27 -	40	31.42	1.67E+03	87.92	1.88E+02	1.92
m	3	35.27	27 -	40	35.69	3.98E+02	53.72	1.38E+02	1.91
	4	52.18	49 -	55	52.58	3.38E+01	30.43	1.44E+02	3.70
M	5	61.96	58 -	70	62.35	2.51E+02	41.96	1.44E+02	1.91
m	6	66.33	58 -	70	66.71	8.12E+01	33.24	1.53E+02	2.00
	7	81.18	76 -	87	81.54	6.96E+02	71.64	2.93E+02	2.06
	8	95.28	90 -	100	95.62	6.18E+01	38.46	1.62E+02	7.16
	9	111.64	106 -	115	111.97	2.04E+02	51.51	2.56E+02	2.01
	10	277.03	272 -	280	277.15	3.75E+01	23.65	6.30E+01	1.70
M	11	303.11	298 -	311	303.21	1.17E+02	26.83	5.35E+01	2.26
m	12	307.11	298 -	311	307.21	2.54E+01	22.97	4.49E+01	2.26
M	13	334.15	330 -	344	334.21	6.14E+01	22.15	4.03E+01	2.28
m	14	338.15	330 -	344	338.21	2.70E+01	20.26	2.28E+01	2.28
	15	356.47	352 -	362	356.50	3.81E+02	42.61	3.95E+01	2.20
M	16	384.23	382 -	396	384.23	8.54E+01	19.70	8.50E+00	1.88
m	17	387.29	382 -	396	387.28	1.78E+02	33.12	1.79E+01	2.43
m	18	392.22	382 -	396	392.20	3.76E+01	23.52	2.02E+01	2.48
M	19	415.04	411 -	428	415.00	2.79E+01	12.49	1.98E+01	2.12
m	20	419.04	411 -	428	419.00	3.23E+01	14.42	1.02E+01	2.12
	21	437.59	433 -	442	437.52	1.02E+02	24.10	2.45E+01	2.21
	22	468.33	465 -	470	468.23	1.95E+01	11.66	1.10E+01	1.46
	23	512.27	508 -	517	512.11	2.31E+01	11.36	5.73E+00	3.44
	24	1217.23	1213 -	1218	1216.20	5.00E+00	4.47	0.00E+00	2.75

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 10:54:42AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110264.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.79	5.12E+01	45.48			5.12E+01	4.55E+01
M	2	31.00	1.67E+03	87.92			1.67E+03	8.79E+01
m	3	35.27	3.98E+02	53.72			3.98E+02	5.37E+01
	4	52.18	3.38E+01	30.43	7.08E-01	6.90E-01	3.31E+01	3.04E+01
M	5	61.96	2.51E+02	41.96	1.48E+01	1.85E+00	2.36E+02	4.20E+01

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Analysis Report for 2104092-03

H-20

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	6	66.33	8.12E+01	33.24			8.12E+01	3.32E+01
	7	81.18	6.96E+02	71.64			6.96E+02	7.16E+01
	8	95.28	6.18E+01	38.46	2.07E+01	3.53E+00	4.11E+01	3.86E+01
	9	111.64	2.04E+02	51.51			2.04E+02	5.15E+01
	10	277.03	3.75E+01	23.65			3.75E+01	2.37E+01
M	11	303.11	1.17E+02	26.83			1.17E+02	2.68E+01
m	12	307.11	2.54E+01	22.97			2.54E+01	2.30E+01
M	13	334.15	6.14E+01	22.15			6.14E+01	2.21E+01
m	14	338.15	2.70E+01	20.26			2.70E+01	2.03E+01
	15	356.47	3.81E+02	42.61			3.81E+02	4.26E+01
M	16	384.23	8.54E+01	19.70			8.54E+01	1.97E+01
m	17	387.29	1.78E+02	33.12			1.78E+02	3.31E+01
m	18	392.22	3.76E+01	23.52			3.76E+01	2.35E+01
M	19	415.04	2.79E+01	12.49			2.79E+01	1.25E+01
m	20	419.04	3.23E+01	14.42			3.23E+01	1.44E+01
	21	437.59	1.02E+02	24.10			1.02E+02	2.41E+01
	22	468.33	1.95E+01	11.66			1.95E+01	1.17E+01
	23	512.27	2.31E+01	11.36	1.49E+01	1.29E+00	8.27E+00	1.14E+01
	24	1217.23	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12	1.93		
		391.69 *	61.90	3.17E+01	2.02E+01
I-129	0.86	29.78 *	57.00	2.28E+01	1.20E+00
		33.60 *	13.20	3.94E+01	5.32E+00
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	3.45E+02	4.89E+01
		302.84 *	18.33	3.86E+02	1.42E+02
		356.01 *	62.05	3.44E+02	5.74E+01
HG-203	0.88	279.19 *	77.30	3.00E+01	2.10E+01
TH-234	0.95	63.29 *	3.80	5.31E+02	9.80E+01

0126

Analysis Report for 2104092-03

H-20

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
AM-241	0.86	59.54 *	35.90	5.62E+01	1.04E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.949	3.17E+01	2.02E+01	
I-129	0.865	2.36E+01	1.17E+00	
BA-133	0.997	3.47E+02	3.60E+01	
HG-203	0.887	3.00E+01	2.10E+01	
? TH-234	0.956	5.31E+02	9.80E+01	
X NP-237	0.743			
? AM-241	0.861	5.62E+01	1.04E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2104092-03

H-20

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 5/3/2021 10:54:42AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

<i>Peak No.</i>	<i>Energy (keV)</i>	<i>Peak Size (CPS)</i>	<i>Peak CPS (%) Uncertainty</i>	<i>Peak Type</i>	<i>Tolerance Nuclide</i>
1	20.79	5.68607E-02	44.43	Tol.	PA-234M
4	52.18	3.67923E-02	45.97		
m 6	66.33	9.02032E-02	20.47	Sum	
8	95.28	4.56684E-02	46.99	Sum	
9	111.64	2.26687E-01	12.62	Sum	
m 12	307.11	2.82716E-02	45.14	Sum	
M 13	334.15	6.82041E-02	18.04	Sum	
m 14	338.15	3.00130E-02	37.50	Sum	
M 16	384.23	9.48863E-02	11.53	Sum	
m 17	387.29	1.97769E-01	9.31	Sum	
M 19	415.04	3.10127E-02	22.37		
m 20	419.04	3.59095E-02	22.31	Sum	
21	437.59	1.13046E-01	11.85	Sum	
22	468.33	2.16444E-02	29.93		
23	512.27	9.18740E-03	69.12		
24	1217.23	5.55556E-03	44.72		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2104092-03

H-20

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	8.48E-09	8.48E-09	0.00E+00	0.00E+00
	3.31	12.30	1.24E-07		0.00E+00	0.00E+00
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.78E+01	1.78E+01	-5.83E+00	8.31E+00
	136.48	10.60	1.68E+02		6.16E+00	7.85E+01
NI-59	6.92	29.80	1.71E-04	1.71E-04	1.47E-05	7.73E-05
MO-93	16.59	52.90	4.15E-02	4.15E-02	-2.29E-03	1.97E-02
	18.60	10.00	4.92E-01		3.43E-03	2.36E-01
NB-93M	16.57	9.43	2.32E-01	2.32E-01	-1.28E-02	1.10E-01
CD-109	88.03	3.72	2.30E+02	2.30E+02	2.63E+01	1.08E+02
+ SN-113	255.12	1.93	9.85E+02	2.72E+01	5.54E+01	4.49E+02
	391.69	*	61.90		3.17E+01	1.24E+01
SN-119M	23.87	16.10	1.03E+00	8.28E-01	-1.36E-01	4.96E-01
	25.10	22.70	8.28E-01		-2.20E+01	3.96E-01
+ I-129	29.78	*	57.00	1.35E+00	2.28E+01	6.55E-01
	33.60	*	13.20		3.94E+01	4.68E+00
	39.58		1.49E+01		5.61E-01	7.08E+00
+ BA-133	81.00	*	34.06	2.77E+01	3.45E+02	1.97E+01
	302.84	*	18.33		3.86E+02	7.87E+01
	356.01	*	62.05		3.44E+02	1.26E+01
CE-139	165.85	80.35	2.70E+01	2.70E+01	-1.41E+01	1.26E+01
CE-144	133.54	10.80	1.59E+02	1.59E+02	1.21E+01	7.44E+01
+ HG-203	279.19	*	77.30	2.88E+01	3.00E+01	1.33E+01
PB-210	46.50	4.25	3.52E+01	3.52E+01	1.10E+01	1.65E+01
TH-231	25.64	14.70	1.41E+00	1.41E+00	-3.75E+01	6.73E-01
	84.21	6.40	2.94E+02		8.22E+02	1.43E+02
PA-234M	9.89	89.00	1.10E-03	1.10E-03	1.27E-03	5.21E-04
	21.72	64.90	1.65E-01		1.54E-01	7.90E-02
	37.93	23.75	7.36E+00		2.17E+01	3.58E+00
+ TH-234	63.29	*	3.80	1.88E+02	5.31E+02	9.09E+01
NP-237	29.37	*	14.00	5.49E+00	9.29E+01	2.67E+00
	86.50	12.60	6.98E+01		7.48E+00	3.28E+01
U-237	97.08	16.30	7.13E+01	4.79E+01	-1.83E+01	3.36E+01
	101.07	26.30	4.79E+01		1.38E+01	2.26E+01
	114.00	12.30	2.24E+02		4.07E+01	1.08E+02
	208.01	22.00	1.16E+02		9.26E+00	5.44E+01
+ AM-241	59.54	*	35.90	1.99E+01	5.62E+01	9.63E+00
AM-243	74.67	66.00	9.64E+00	9.64E+00	1.93E+00	4.54E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

*RCB  
5/13/21*

Analysis Report for 2104092-04  
H-20

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-04  
 Sample Description : H-20  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:53:05AM  
 Acquisition Started : 5/3/2021 10:39:40AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 903.1 seconds  
  
 Dead Time : 0.35 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 8/25/2020  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110291

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 10:54:51AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-04

H-20

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.40	16 -	24	19.94	5.65E+01	47.38	3.11E+02	2.42
M	2	31.10	25 -	41	30.64	1.35E+03	80.82	1.87E+02	2.35
m	3	34.97	25 -	41	34.51	3.99E+02	87.06	1.62E+02	2.97
	4	53.52	49 -	56	53.06	5.29E+01	31.69	1.32E+02	1.49
M	5	61.76	57 -	68	61.29	1.20E+02	39.60	1.50E+02	3.03
m	6	66.11	57 -	68	65.64	7.15E+01	29.14	9.71E+01	2.06
	7	81.32	76 -	86	80.84	5.34E+02	62.83	2.41E+02	2.17
M	8	112.04	107 -	121	111.55	8.99E+01	31.56	1.15E+02	2.30
m	9	116.08	107 -	121	115.59	3.22E+01	34.35	1.13E+02	2.83
	10	176.20	167 -	182	175.68	5.73E+01	43.68	1.67E+02	9.78
	11	276.82	274 -	280	276.27	4.31E+01	19.97	3.99E+01	1.65
	12	303.53	298 -	309	302.98	1.00E+02	26.23	3.60E+01	2.28
	13	319.73	315 -	323	319.17	9.78E+00	12.37	1.64E+01	1.48
	14	334.93	330 -	339	334.36	4.46E+01	21.45	4.08E+01	2.08
	15	356.18	349 -	362	355.60	2.79E+02	36.99	2.87E+01	2.35
	16	386.15	379 -	392	385.56	1.40E+02	28.50	2.86E+01	2.39
	17	421.27	416 -	427	420.67	1.17E+01	13.71	1.65E+01	8.21
	18	437.04	431 -	440	436.44	3.80E+01	14.90	1.00E+01	2.32
	19	455.09	451 -	457	454.48	5.29E+00	6.34	3.43E+00	2.69
	20	866.94	861 -	868	866.20	5.00E+00	4.47	0.00E+00	2.31

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 10:54:51AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110265.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.40	5.65E+01	47.38			5.65E+01	4.74E+01
M	2	31.10	1.35E+03	80.82			1.35E+03	8.08E+01
m	3	34.97	3.99E+02	87.06			3.99E+02	8.71E+01
	4	53.52	5.29E+01	31.69			5.29E+01	3.17E+01
M	5	61.76	1.20E+02	39.60	1.41E+01	2.12E+00	1.05E+02	3.97E+01
m	6	66.11	7.15E+01	29.14			7.15E+01	2.91E+01
	7	81.32	5.34E+02	62.83			5.34E+02	6.28E+01
M	8	112.04	8.99E+01	31.56			8.99E+01	3.16E+01
m	9	116.08	3.22E+01	34.35			3.22E+01	3.44E+01

0131

Analysis Report for 2104092-04

H-20

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
10	176.20	5.73E+01	43.68			5.73E+01	4.37E+01
11	276.82	4.31E+01	19.97			4.31E+01	2.00E+01
12	303.53	1.00E+02	26.23			1.00E+02	2.62E+01
13	319.73	9.78E+00	12.37			9.78E+00	1.24E+01
14	334.93	4.46E+01	21.45			4.46E+01	2.14E+01
15	356.18	2.79E+02	36.99			2.79E+02	3.70E+01
16	386.15	1.40E+02	28.50			1.40E+02	2.85E+01
17	421.27	1.17E+01	13.71			1.17E+01	1.37E+01
18	437.04	3.80E+01	14.90			3.80E+01	1.49E+01
19	455.09	5.29E+00	6.34			5.29E+00	6.34E+00
20	866.94	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.00sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.80	29.78	*	57.00	4.07E+02
		33.60	*	13.20	4.98E+02
		39.58		7.52	
BA-133	0.99	81.00	*	34.06	2.78E+02
		302.84	*	18.33	3.56E+02
		356.01	*	62.05	3.79E+02
HG-203	0.86	279.19	*	77.30	3.17E+01
TH-234	0.94	63.29	*	3.80	4.51E+02
AM-241	0.88	59.54	*	35.90	4.77E+01

Analysis Report for 2104092-04  
H-20

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
I-129	0.800	4.19E+02	4.25E+01	
BA-133	0.997	<u>3.05E+02</u>	<u>3.63E+01</u>	
HG-203	0.866	3.17E+01	1.74E+01	
? TH-234	0.942	4.51E+02	1.74E+02	
? AM-241	0.881	4.77E+01	1.85E+01	

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma



Analysis Report for 2104092-04  
H-20

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 5/3/2021 10:54:51AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.40	6.27306E-02	41.96	Tol.	PA-234M
4	53.52	5.87628E-02	29.96		
m 6	66.11	7.94956E-02	20.36	Sum	
M 8	112.04	9.98675E-02	17.55	Sum	
m 9	116.08	3.57328E-02	53.41	Sum	
10	176.20	6.36879E-02	38.10		
13	319.73	1.08642E-02	63.25		
14	334.93	4.95385E-02	24.05	Sum	
16	386.15	1.55216E-01	10.20	Sum	
17	421.27	1.30278E-02	58.47		
18	437.04	4.22222E-02	19.60	Sum	
19	455.09	5.87302E-03	60.01		
20	866.94	5.55556E-03	44.72		

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.38E+01	1.38E+01	0.00E+00	0.00E+00
	3.31	12.30	6.90E+01		0.00E+00	0.00E+00

0134

Analysis Report for 2104092-04

H-20

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.05E+01	1.05E+01	-1.56E-01	4.91E+00
	136.48	10.60	9.46E+01		-1.77E+01	4.41E+01
NI-59	6.92	29.80	4.96E+01	4.96E+01	-1.91E+01	2.13E+01
MO-93	16.59	52.90	2.82E+01	2.82E+01	1.41E+00	1.34E+01
	18.60	10.00	1.50E+02		9.71E+01	7.17E+01
NB-93M	16.57	9.43	1.58E+02	1.58E+02	7.94E+00	7.54E+01
CD-109	88.03	3.72	2.08E+02	2.08E+02	-1.15E+02	9.72E+01
SN-113	255.12	1.93	5.74E+02	6.27E+01	-2.21E+02	2.52E+02
	391.69	61.90	6.27E+01		-2.41E+00	2.92E+01
SN-119M	23.87	16.10	7.58E+01	4.95E+01	-2.87E+01	3.63E+01
	25.10	22.70	4.95E+01		-8.50E+02	2.36E+01
+ I-129	29.78	*	57.00	3.17E+01	3.17E+01	4.07E+02
	33.60	*	13.20	1.31E+02		4.98E+02
	39.58		7.52	1.27E+02		-1.21E+02
+ BA-133	81.00	*	34.06	3.79E+01	3.79E+01	2.78E+02
	302.84	*	18.33	1.09E+02		3.56E+02
	356.01	*	62.05	3.93E+01		3.79E+02
CE-139	165.85		80.35	1.45E+01	1.45E+01	-1.16E+00
CE-144	133.54		10.80	8.57E+01	8.57E+01	-2.96E+01
+ HG-203	279.19	*	77.30	2.02E+01	2.02E+01	3.17E+01
PB-210	46.50		4.25	1.45E+02	1.45E+02	-3.30E+00
TH-231	25.64		14.70	7.55E+01	7.55E+01	-1.30E+03
	84.21		6.40	2.76E+02		7.55E+02
PA-234M	9.89		89.00	2.10E+01	2.03E+01	9.43E+00
	21.72		64.90	2.03E+01		1.09E+01
	37.93		23.75	6.42E+01		1.08E+02
+ TH-234	63.29	*	3.80	2.88E+02	2.88E+02	4.51E+02
NP-237	29.37		14.00	2.24E+02	6.51E+01	1.39E+03
	86.50		12.60	6.51E+01		-3.10E+00
U-237	97.08		16.30	4.94E+01	2.91E+01	-1.88E+01
	101.07		26.30	2.91E+01		1.53E+00
	114.00		12.30	1.19E+02		2.27E+02
	208.01		22.00	7.49E+01		1.33E+01
+ AM-241	59.54	*	35.90	3.05E+01	3.05E+01	4.77E+01
AM-243	74.67		66.00	1.15E+01	1.15E+01	-3.38E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

*RB  
5/3/21*

Analysis Report for 2104092-05  
H-22

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-05  
 Sample Description : H-22  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:53:16AM  
 Acquisition Started : 5/3/2021 10:55:20AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 29 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110293

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 11:10:23AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-05

H-22

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.58	36 -	40	36.27	3.09E+02	67.61	2.80E+02	1.75
	2	53.13	50 -	57	53.80	7.52E+01	33.76	1.40E+02	1.12
M	3	61.76	58 -	70	62.43	1.80E+02	37.27	1.18E+02	1.87
m	4	66.04	58 -	70	66.70	9.42E+01	33.60	1.35E+02	1.88
	5	81.08	78 -	85	81.72	7.59E+02	66.57	2.34E+02	1.37
	6	111.62	107 -	115	112.23	1.35E+02	43.77	2.12E+02	1.97
	7	116.73	116 -	120	117.34	3.64E+01	25.56	1.13E+02	1.10
	8	276.35	272 -	280	276.79	7.62E+01	22.58	3.15E+01	1.63
	9	302.88	297 -	306	303.29	1.37E+02	34.32	9.00E+01	1.95
	10	307.65	307 -	310	308.06	2.64E+01	13.42	1.52E+01	1.47
	11	333.60	331 -	336	333.99	4.69E+01	16.67	1.81E+01	1.72
	12	337.98	337 -	342	338.36	2.22E+01	13.82	1.96E+01	1.43
m	13	356.11	351 -	362	356.47	4.96E+02	44.97	7.58E+00	1.62
M	14	384.03	382 -	394	384.36	1.21E+02	22.00	1.39E+01	2.02
m	15	387.26	382 -	394	387.60	1.32E+02	27.63	1.06E+01	1.83
m	16	391.19	382 -	394	391.52	3.60E+01	16.03	7.05E+00	1.97
M	17	414.73	411 -	423	415.04	3.35E+01	13.53	7.68E+00	2.14
m	18	418.23	411 -	423	418.53	2.05E+01	16.34	9.96E+00	2.14
	19	437.11	433 -	441	437.40	7.58E+01	21.20	2.24E+01	1.74
	20	467.91	465 -	471	468.17	8.61E+00	9.63	1.08E+01	2.14
	21	511.04	508 -	516	511.25	4.00E+01	12.65	0.00E+00	3.82
	22	609.97	606 -	614	610.09	1.04E+01	10.02	9.20E+00	1.66
	23	719.71	716 -	724	719.73	1.10E+01	6.63	0.00E+00	3.22

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 11:10:23AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110263.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.58	3.09E+02	67.61			3.09E+02	6.76E+01
	2	53.13	7.52E+01	33.76			7.52E+01	3.38E+01
M	3	61.76	1.80E+02	37.27	7.25E+00	7.41E-01	1.72E+02	3.73E+01
m	4	66.04	9.42E+01	33.60	7.64E-01	2.89E-01	9.34E+01	3.36E+01
	5	81.08	7.59E+02	66.57			7.59E+02	6.66E+01
	6	111.62	1.35E+02	43.77			1.35E+02	4.38E+01

0137

Analysis Report for 2104092-05

H-22

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	7	116.73	3.64E+01	25.56			3.64E+01	2.56E+01
	8	276.35	7.62E+01	22.58			7.62E+01	2.26E+01
	9	302.88	1.37E+02	34.32			1.37E+02	3.43E+01
	10	307.65	2.64E+01	13.42			2.64E+01	1.34E+01
	11	333.60	4.69E+01	16.67			4.69E+01	1.67E+01
	12	337.98	2.22E+01	13.82			2.22E+01	1.38E+01
m	13	356.11	4.96E+02	44.97			4.96E+02	4.50E+01
M	14	384.03	1.21E+02	22.00			1.21E+02	2.20E+01
m	15	387.26	1.32E+02	27.63			1.32E+02	2.76E+01
m	16	391.19	3.60E+01	16.03			3.60E+01	1.60E+01
M	17	414.73	3.35E+01	13.53			3.35E+01	1.35E+01
m	18	418.23	2.05E+01	16.34			2.05E+01	1.63E+01
	19	437.11	7.58E+01	21.20			7.58E+01	2.12E+01
	20	467.91	8.61E+00	9.63			8.61E+00	9.63E+00
	21	511.04	4.00E+01	12.65	1.86E+01	1.24E+00	2.14E+01	1.27E+01
	22	609.97	1.04E+01	10.02	1.73E+00	9.16E-01	8.67E+00	1.01E+01
	23	719.71	1.10E+01	6.63			1.10E+01	6.63E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.00sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	2.37E+01
BA-133	1.00	81.00	*	34.06	4.63E+02
		302.84	*	18.33	4.87E+02
		356.01	*	62.05	3.97E+02
PA-234M	0.98	9.89		89.00	5.70E+01
		21.72		64.90	
		37.93	*	23.75	6.38E+00
TH-234	0.94	63.29	*	3.80	3.53E+02
AM-241	0.88	59.54	*	35.90	3.74E+01
					8.22E+00

Analysis Report for 2104092-05

H-22

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i><b>Nuclide Name</b></i>	<i><b>Nuclide Id Confidence</b></i>	<i><b>Wt mean Activity (pCi/units)</b></i>	<i><b>Wt mean Activity Uncertainty</b></i>	<i><b>Comments</b></i>
SN-113	0.959	2.37E+01	1.08E+01	
BA-133	1.000	4.30E+02	4.10E+01	
PA-234M	0.981	6.38E+00	1.40E+00	
? TH-234	0.942	3.53E+02	7.77E+01	
? AM-241	0.881	3.74E+01	8.22E+00	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2104092-05

H-22

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 5/3/2021 11:10:23AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	53.13	8.35364E-02		
m	4	66.04	1.03791E-01		
	6	111.62	1.49929E-01	Tol.	U-237
	7	116.73	4.04182E-02	Sum	
	8	276.35	8.46981E-02		
	10	307.65	2.93301E-02		
	11	333.60	5.21627E-02		
	12	337.98	2.46528E-02	Sum	
M	14	384.03	1.34785E-01	Sum	
m	15	387.26	1.46204E-01		
M	17	414.73	3.71963E-02		
m	18	418.23	2.27666E-02	Sum	
	19	437.11	8.42401E-02	Sum	
	20	467.91	9.56349E-03		
	21	511.04	2.38300E-02		
	22	609.97	9.63479E-03		
	23	719.71	1.22222E-02		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2104092-05

H-22

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	1.84E-13	1.84E-13	0.00E+00	0.00E+00
	3.31	12.30	4.70E-12		0.00E+00	0.00E+00
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.31E+01	2.31E+01	-1.21E-01	1.07E+01
	136.48	10.60	2.06E+02		-9.39E+01	9.47E+01
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.66E+02	2.66E+02	9.36E+01	1.23E+02
+ SN-113	255.12	1.93	1.18E+03	1.80E+01	-2.45E+02	5.37E+02
	391.69 *	61.90	1.80E+01		2.37E+01	8.12E+00
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.92E-03		0.00E+00	0.00E+00
I-129	29.78	57.00	5.84E-01	5.84E-01	4.99E+00	2.88E-01
	33.60	13.20	5.13E+00		1.33E+00	2.53E+00
	39.58	7.52	4.60E+00		7.73E-01	2.14E+00
+ BA-133	81.00 *	34.06	3.91E+01	1.68E+01	4.63E+02	1.87E+01
	302.84 *	18.33	1.56E+02		4.87E+02	7.34E+01
	356.01 *	62.05	1.68E+01		3.97E+02	7.31E+00
CE-139	165.85	80.35	3.94E+01	3.94E+01	1.20E+01	1.83E+01
CE-144	133.54	10.80	2.19E+02	2.19E+02	1.33E+02	1.01E+02
HG-203	279.19	77.30	2.55E+01	2.55E+01	2.80E+00	1.15E+01
PB-210	46.50	4.25	1.62E+01	1.62E+01	-9.21E+00	7.40E+00
TH-231	25.64	14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
	84.21	6.40	1.79E+02		-3.79E+01	8.48E+01
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93 *	23.75	2.02E+00		6.38E+00	9.80E-01
+ TH-234	63.29 *	3.80	1.56E+02	1.56E+02	3.53E+02	7.54E+01
NP-237	29.37	14.00	2.17E+00	2.17E+00	1.85E+01	1.07E+00
	86.50	12.60	8.06E+01		-4.54E+01	3.76E+01
U-237	97.08	16.30	8.02E+01	5.25E+01	-1.28E+01	3.72E+01
	101.07	26.30	5.25E+01		-2.69E+00	2.43E+01
	114.00	12.30	2.40E+02		-7.12E+00	1.14E+02
	208.01	22.00	1.29E+02		8.25E+01	5.90E+01
+ AM-241	59.54 *	35.90	1.66E+01	1.66E+01	3.74E+01	7.98E+00
AM-243	74.67	66.00	9.52E+00	9.52E+00	-1.68E+00	4.44E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction



*1025  
5/13/21*

Analysis Report for 2104092-06  
H-23

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-06  
 Sample Description : H-23  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 5/3/2021 8:53:28AM  
 Acquisition Started : 5/3/2021 10:55:26AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 902.1 seconds

Dead Time : 0.24 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 10 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :

Sample Number : 110294

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 11:10:35AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-06

H-23

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.74	17 -	24	21.17	1.08E+02	45.43	2.71E+02	2.21
M	2	30.98	25 -	40	31.40	1.99E+03	94.29	1.81E+02	1.99
m	3	35.30	25 -	40	35.72	4.91E+02	58.64	1.65E+02	2.00
m	4	53.22	43 -	56	53.62	7.00E+01	35.44	1.63E+02	2.22
M	5	62.05	58 -	69	62.44	2.78E+02	47.30	1.85E+02	2.26
m	6	66.12	58 -	69	66.51	1.25E+02	42.63	1.61E+02	2.06
	7	81.22	77 -	87	81.58	8.10E+02	70.69	2.28E+02	2.11
M	8	107.07	106 -	124	107.40	1.47E+01	15.30	5.73E+01	2.30
m	9	112.07	106 -	124	112.40	2.46E+02	40.64	1.18E+02	2.08
m	10	116.41	106 -	124	116.73	4.88E+01	37.92	1.44E+02	2.31
	11	276.90	273 -	280	277.03	4.57E+01	24.74	7.07E+01	1.30
M	12	303.20	296 -	316	303.30	1.54E+02	27.97	3.80E+01	2.37
m	13	307.52	296 -	316	307.61	4.19E+01	18.38	1.83E+01	1.99
	14	333.83	329 -	338	333.88	4.86E+01	35.76	1.55E+02	1.49
	15	356.37	350 -	361	356.40	4.78E+02	46.39	2.96E+01	2.10
	16	364.87	362 -	368	364.89	1.35E+01	16.94	4.29E+01	1.82
M	17	384.87	381 -	394	384.86	1.21E+02	36.00	2.84E+01	2.77
m	18	387.43	381 -	394	387.42	1.86E+02	32.48	1.03E+01	1.82
m	19	391.47	381 -	394	391.46	5.52E+01	25.00	2.73E+00	2.45
	20	406.85	403 -	410	406.82	1.02E+01	10.58	1.16E+01	3.12
M	21	415.19	411 -	421	415.15	3.06E+01	19.35	2.89E+01	2.33
m	22	418.26	411 -	421	418.21	2.49E+01	19.25	4.92E+01	2.33
	23	437.14	433 -	441	437.07	1.01E+02	21.55	9.75E+00	1.93

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 11:10:35AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110264.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.74	1.08E+02	45.43			1.08E+02	4.54E+01
M	2	30.98	1.99E+03	94.29			1.99E+03	9.43E+01
m	3	35.30	4.91E+02	58.64			4.91E+02	5.86E+01
m	4	53.22	7.00E+01	35.44	7.08E-01	6.90E-01	6.93E+01	3.55E+01
M	5	62.05	2.78E+02	47.30	1.48E+01	1.85E+00	2.63E+02	4.73E+01
m	6	66.12	1.25E+02	42.63			1.25E+02	4.26E+01

0143

Analysis Report for 2104092-06

H-23

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
	7	81.22	8.10E+02	70.69			8.10E+02	7.07E+01
M	8	107.07	1.47E+01	15.30			1.47E+01	1.53E+01
m	9	112.07	2.46E+02	40.64			2.46E+02	4.06E+01
m	10	116.41	4.88E+01	37.92			4.88E+01	3.79E+01
	11	276.90	4.57E+01	24.74			4.57E+01	2.47E+01
M	12	303.20	1.54E+02	27.97			1.54E+02	2.80E+01
m	13	307.52	4.19E+01	18.38			4.19E+01	1.84E+01
	14	333.83	4.86E+01	35.76			4.86E+01	3.58E+01
	15	356.37	4.78E+02	46.39			4.78E+02	4.64E+01
	16	364.87	1.35E+01	16.94			1.35E+01	1.69E+01
M	17	384.87	1.21E+02	36.00			1.21E+02	3.60E+01
m	18	387.43	1.86E+02	32.48			1.86E+02	3.25E+01
m	19	391.47	5.52E+01	25.00			5.52E+01	2.50E+01
	20	406.85	1.02E+01	10.58			1.02E+01	1.06E+01
M	21	415.19	3.06E+01	19.35			3.06E+01	1.94E+01
m	22	418.26	2.49E+01	19.25			2.49E+01	1.92E+01
	23	437.14	1.01E+02	21.55			1.01E+02	2.16E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	4.66E+01
I-129	0.86	29.78	*	57.00	2.71E+01
		33.60	*	13.20	4.87E+01
		39.58		7.52	5.83E+00
BA-133	0.99	81.00	*	34.06	4.02E+02
		302.84	*	18.33	5.07E+02
		356.01	*	62.05	4.31E+02
HG-203	0.87	279.19	*	77.30	3.65E+01
TH-234	0.96	63.29	*	3.80	5.93E+02
					1.11E+02

0144

Analysis Report for 2104092-06  
H-23

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.954	4.66E+01	2.18E+01	
I-129	0.865	2.81E+01	1.26E+00	
BA-133	0.997	4.18E+02	4.05E+01	
HG-203	0.875	3.65E+01	2.27E+01	
TH-234	0.961	5.93E+02	1.11E+02	
X NP-237	0.744			

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2104092-06

H-23

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 5/3/2021 11:10:35AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.74	1.20528E-01	20.94	Tol.	PA-234M
m 4	53.22	7.69706E-02	25.59		
m 6	66.12	1.38713E-01	17.07	Sum	
M 8	107.07	1.63102E-02	52.10		
m 9	112.07	2.73480E-01	8.26	Sum	
m 10	116.41	5.42431E-02	38.84	Sum	
m 13	307.52	4.65582E-02	21.94	Sum	
14	333.83	5.40079E-02	36.79	Sum	
16	364.87	1.50317E-02	62.61	Sum	
M 17	384.87	1.34603E-01	14.86	Sum	
m 18	387.43	2.07084E-01	8.71	Sum	
20	406.85	1.13542E-02	51.78		
M 21	415.19	3.40374E-02	31.59		
m 22	418.26	2.76896E-02	38.62	Sum	
23	437.14	1.12358E-01	10.66	Sum	

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2104092-06

H-23

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	8.48E-09	8.48E-09	0.00E+00	0.00E+00
	3.31	12.30	1.24E-07		0.00E+00	0.00E+00
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.76E+01	1.76E+01	-1.81E+01	8.25E+00
	136.48	10.60	1.64E+02		-7.41E+01	7.68E+01
NI-59	6.92	29.80	1.29E-04	1.29E-04	-5.00E-05	5.64E-05
MO-93	16.59	52.90	4.56E-02	4.56E-02	3.60E-03	2.18E-02
	18.60	10.00	5.34E-01		6.98E-01	2.57E-01
NB-93M	16.57	9.43	2.54E-01	2.54E-01	2.01E-02	1.21E-01
CD-109	88.03	3.72	2.43E+02	2.43E+02	-9.05E+01	1.14E+02
+ SN-113	255.12	1.93	1.01E+03	2.43E+01	-3.09E+02	4.61E+02
	391.69	*	61.90		4.66E+01	1.10E+01
SN-119M	23.87	16.10	1.11E+00	9.18E-01	-7.17E-01	5.33E-01
	25.10	22.70	9.18E-01		-2.46E+01	4.41E-01
+ I-129	29.78	*	57.00	1.48E+00	2.71E+01	7.20E-01
	33.60	*	13.20		4.87E+01	5.23E+00
	39.58		7.52		2.84E+00	8.11E+00
+ BA-133	81.00	*	34.06	2.54E+01	4.02E+02	1.71E+01
	302.84	*	18.33		5.07E+02	9.31E+01
	356.01	*	62.05		4.31E+02	1.15E+01
CE-139	165.85	80.35	2.85E+01	2.85E+01	-3.09E+00	1.34E+01
CE-144	133.54	10.80	1.62E+02	1.62E+02	-5.37E+01	7.59E+01
+ HG-203	279.19	*	77.30	2.94E+01	3.65E+01	1.36E+01
PB-210	46.50	4.25	4.35E+01	4.35E+01	-1.21E+01	2.06E+01
TH-231	25.64	14.70	1.56E+00	1.56E+00	-4.18E+01	7.49E-01
	84.21	6.40	3.02E+02		8.36E+02	1.47E+02
PA-234M	9.89	89.00	1.04E-03	1.04E-03	9.73E-04	4.89E-04
	21.72	64.90	1.78E-01		1.82E-01	8.58E-02
	37.93	23.75	8.12E+00		2.53E+01	3.96E+00
+ TH-234	63.29	*	3.80	1.86E+02	5.93E+02	8.98E+01
NP-237	29.37	*	14.00	6.01E+00	1.10E+02	2.93E+00
	86.50	12.60	7.09E+01		-6.31E+00	3.34E+01
U-237	97.08	16.30	7.35E+01	4.94E+01	-3.42E+01	3.47E+01
	101.07	26.30	4.94E+01		1.79E+01	2.33E+01
	114.00	12.30	2.42E+02		7.07E+02	1.18E+02
	208.01	22.00	1.16E+02		-5.48E+01	5.41E+01
AM-241	59.54	35.90	1.91E+01	1.91E+01	3.89E+01	9.24E+00
AM-243	74.67	66.00	1.04E+01	1.04E+01	1.79E+00	4.91E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

*26  
5/3/21*

Analysis Report for 2104092-07  
H-24

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2104092-07  
 Sample Description : H-24  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 5/3/2021 8:53:40AM  
 Acquisition Started : 5/3/2021 10:55:34AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 903.4 seconds  
  
 Dead Time : 0.38 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 8/25/2020  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :  
  
 Sample Number : 110295

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 5/3/2021 11:10:45AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2104092-07

H-24

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	20.57	17 -	40	20.12	6.93E+01	37.70	3.06E+02	2.55
m	2	31.14	17 -	40	30.68	1.94E+03	96.72	2.67E+02	2.43
m	3	35.47	17 -	40	35.01	4.49E+02	86.75	1.77E+02	2.35
	4	52.60	48 -	56	52.14	6.71E+01	37.97	1.82E+02	1.85
M	5	61.95	57 -	69	61.48	1.98E+02	45.17	1.99E+02	2.75
m	6	65.62	57 -	69	65.15	9.07E+01	47.75	2.19E+02	2.76
	7	81.42	74 -	87	80.94	7.78E+02	81.46	3.91E+02	2.46
M	8	112.26	105 -	119	111.77	1.72E+02	40.84	1.57E+02	2.57
m	9	117.26	105 -	119	116.77	4.05E+01	26.44	9.00E+01	2.57
	10	275.86	269 -	280	275.31	6.51E+01	30.53	8.38E+01	1.40
M	11	303.26	298 -	311	302.70	1.15E+02	28.43	4.91E+01	2.76
m	12	307.08	298 -	311	306.52	3.15E+01	27.78	3.87E+01	2.82
	13	334.25	328 -	339	333.68	6.97E+01	29.26	7.26E+01	2.20
	14	356.43	350 -	362	355.85	3.64E+02	45.99	7.66E+01	2.25
	15	386.51	379 -	394	385.92	2.34E+02	34.23	2.29E+01	4.94
M	16	413.97	409 -	431	413.37	2.01E+01	14.83	2.25E+01	3.39
m	17	419.69	409 -	431	419.09	2.54E+01	18.25	2.42E+01	3.39
	18	437.28	432 -	440	436.68	5.20E+01	18.03	1.80E+01	2.25
	19	467.29	463 -	470	466.67	1.90E+01	11.14	8.00E+00	2.64
	20	665.41	662 -	667	664.73	4.42E+00	5.74	3.17E+00	1.88
	21	921.95	917 -	923	921.20	5.00E+00	4.47	0.00E+00	2.75

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 5/3/2021 11:10:45AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000110265.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	20.57	6.93E+01	37.70			6.93E+01	3.77E+01
m	2	31.14	1.94E+03	96.72			1.94E+03	9.67E+01
m	3	35.47	4.49E+02	86.75			4.49E+02	8.68E+01
	4	52.60	6.71E+01	37.97			6.71E+01	3.80E+01
M	5	61.95	1.98E+02	45.17	1.41E+01	2.12E+00	1.84E+02	4.52E+01
m	6	65.62	9.07E+01	47.75	1.41E+01	2.12E+00	7.66E+01	4.78E+01
	7	81.42	7.78E+02	81.46			7.78E+02	8.15E+01
M	8	112.26	1.72E+02	40.84			1.72E+02	4.08E+01

0149



Analysis Report for 2104092-07

H-24

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
m	9	117.26	4.05E+01	26.44			4.05E+01	2.64E+01
	10	275.86	6.51E+01	30.53			6.51E+01	3.05E+01
M	11	303.26	1.15E+02	28.43			1.15E+02	2.84E+01
m	12	307.08	3.15E+01	27.78			3.15E+01	2.78E+01
	13	334.25	6.97E+01	29.26			6.97E+01	2.93E+01
	14	356.43	3.64E+02	45.99			3.64E+02	4.60E+01
	15	386.51	2.34E+02	34.23			2.34E+02	3.42E+01
M	16	413.97	2.01E+01	14.83			2.01E+01	1.48E+01
m	17	419.69	2.54E+01	18.25			2.54E+01	1.82E+01
	18	437.28	5.20E+01	18.03			5.20E+01	1.80E+01
	19	467.29	1.90E+01	11.14			1.90E+01	1.11E+01
	20	665.41	4.42E+00	5.74			4.42E+00	5.74E+00
	21	921.95	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
I-129	0.79	29.78 *	57.00	5.84E+02	6.24E+01
		33.60 *	13.20	5.60E+02	1.19E+02
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	4.06E+02	5.82E+01
		302.84 *	18.33	4.09E+02	1.70E+02
		356.01 *	62.05	4.95E+02	9.96E+01
PA-234M	0.33	9.89	89.00		
		21.72 *	64.90	2.28E+01	1.27E+01
		37.93 *	23.75	3.11E+02	6.64E+01
TH-234	0.95	63.29 *	3.80	7.86E+02	2.06E+02
AM-241	0.86	59.54 *	35.90	8.32E+01	2.18E+01

Analysis Report for 2104092-07  
H-24

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
I-129	0.791	5.71E+02	5.55E+01	
BA-133	0.996	4.27E+02	4.82E+01	
PA-234M	0.333	2.18E+01	1.25E+01	
? TH-234	0.955	7.86E+02	2.06E+02	
? AM-241	0.862	8.32E+01	2.18E+01	

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2104092-07

H-24

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 5/3/2021 11:10:45AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	4	52.60	7.45007E-02	28.32	Sum
m	6	65.62	8.51469E-02	31.19	Sum
M	8	112.26	1.91495E-01	11.85	Sum
m	9	117.26	4.49742E-02	32.66	Sum
	10	275.86	7.23365E-02	23.45	
m	12	307.08	3.50461E-02	44.05	
	13	334.25	7.74528E-02	20.99	Sum
	15	386.51	2.59515E-01	7.33	Sum
M	16	413.97	2.23812E-02	36.82	
m	17	419.69	2.81766E-02	35.98	Sum
	18	437.28	5.77778E-02	17.33	Sum
	19	467.29	2.11111E-02	29.30	
	20	665.41	4.90741E-03	65.03	
	21	921.95	5.55556E-03	44.72	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

---

**NUCLIDE MDA REPORT**


---

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.38E+01	1.38E+01	0.00E+00	0.00E+00
	3.31	12.30	6.90E+01		0.00E+00	0.00E+00

0152

Analysis Report for 2104092-07  
H-24

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.17E+01	1.17E+01	1.41E+00	5.47E+00
	136.48	10.60	1.07E+02		-3.53E+01	5.02E+01
NI-59	6.92	29.80	4.79E+01	4.79E+01	-3.18E+01	2.05E+01
MO-93	16.59	52.90	2.86E+01	2.86E+01	5.64E-02	1.37E+01
	18.60	10.00	1.62E+02		2.69E+01	7.81E+01
NB-93M	16.57	9.43	1.61E+02	1.61E+02	3.17E-01	7.67E+01
CD-109	88.03	3.72	2.29E+02	2.29E+02	-1.41E+02	1.08E+02
SN-113	255.12	1.93	8.90E+02	7.68E+01	-3.36E+02	4.10E+02
	391.69	61.90	7.68E+01		5.59E+01	3.62E+01
SN-119M	23.87	16.10	8.30E+01	5.66E+01	-8.45E+01	3.99E+01
	25.10	22.70	5.66E+01		-1.15E+03	2.72E+01
+ I-129	29.78 *	57.00	5.27E+01	5.27E+01	5.84E+02	2.60E+01
	33.60 *	13.20	2.17E+02		5.60E+02	1.07E+02
	39.58	7.52	1.51E+02		-7.72E+00	7.24E+01
+ BA-133	81.00 *	34.06	5.24E+01	5.24E+01	4.06E+02	2.55E+01
	302.84 *	18.33	1.63E+02		4.09E+02	7.67E+01
	356.01 *	62.05	6.13E+01		4.95E+02	2.88E+01
CE-139	165.85	80.35	1.81E+01	1.81E+01	7.81E+00	8.52E+00
CE-144	133.54	10.80	1.08E+02	1.08E+02	5.80E+01	5.11E+01
HG-203	279.19	77.30	3.29E+01	3.29E+01	-3.73E+00	1.54E+01
PB-210	46.50	4.25	1.55E+02	1.55E+02	6.78E+00	7.25E+01
TH-231	25.64	14.70	8.63E+01	8.63E+01	-1.76E+03	4.14E+01
	84.21	6.40	3.28E+02		1.12E+03	1.60E+02
+ PA-234M	9.89	89.00	2.30E+01	2.30E+01	2.18E+01	1.08E+01
	21.72 *	64.90	5.80E+01		2.28E+01	2.86E+01
	37.93 *	23.75	1.21E+02		3.11E+02	5.94E+01
+ TH-234	63.29 *	3.80	3.74E+02	3.74E+02	7.86E+02	1.81E+02
NP-237	29.37	14.00	2.67E+02	8.03E+01	2.11E+03	1.32E+02
	86.50	12.60	8.03E+01		-7.25E+00	3.82E+01
U-237	97.08	16.30	5.24E+01	3.23E+01	-2.50E+01	2.46E+01
	101.07	26.30	3.23E+01		-5.04E+00	1.51E+01
	114.00	12.30	1.45E+02		3.74E+02	7.02E+01
	208.01	22.00	8.02E+01		-1.35E+01	3.77E+01
+ AM-241	59.54 *	35.90	3.96E+01	3.96E+01	8.32E+01	1.92E+01
AM-243	74.67	66.00	1.25E+01	1.25E+01	-6.83E-01	5.90E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

**SECTION XI**  
**ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)**





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**ERM**

**0526033 HENNING**

**STANDARD LEVEL IV  
REPORT OF ANALYSIS**

**WORK ORDER #21-08094-OR**

**October 7, 2021**

**EBERLINE ANALYTICAL/OAK RIDGE LABORATORY  
OAK RIDGE, TN**



## TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
I	Chain of Custody & pH Check	0004
II	Sample Acknowledgement	0010
III	Case Narrative	0013
IV	Analytical Results Summary	0016
V	Analytical Standard	0018
VI	Quality Control Sample Results Summary	0026
VII	Laboratory Technician's Notes	0031
VIII	Analytical Data (Radium-226)	0044
IX	Analytical Data (Radium-228)	0093
X	Barium-133 Analytical Tracer Data	0109
XI	Analytical Data (Total Dissolved Solids)	0153
	Last Page Number	0155



Eberline Services – Oak Ridge Laboratory  
LABORATORY DATA SUPPORT CHECKLIST  
MP-001-3

Eberline Services Work Order # 21-08094

The checklist items listed below are to be initiated by appropriate staff upon completion/verification.

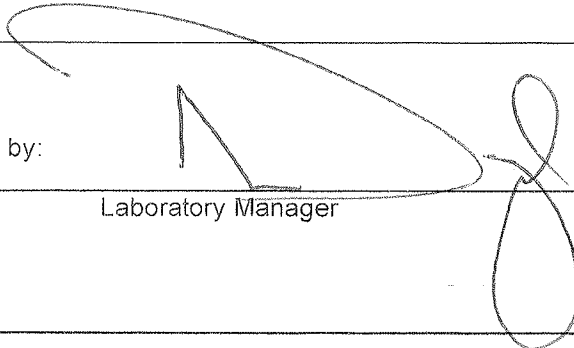
Date for Partial	Initials	Date	Initials	Checklist Items
		8/30/21	BRB	Sample Log-In
		9/13/21	[Signature]	Data Compilation
		9-14-21	MLT	First Technical Data Review
		9/15/21	MM	Second Technical Data Review
		10/5/21	CW	Data Entry/Electronic Deliverable
		10/5/21	CW	Case Narrative
		10/6/21	G	Electronic Deliverable Proof
		10/6/21	MM	Samples Analyzed within Holding Time Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>
		10/6/21	MM	QA/QC Review
		10/7/21	CW	Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

Date package approved by:

Laboratory Manager

Date

 10/7/21

Copy No. \_\_\_\_\_

Radiochemistry Services


**SECTION I**  
**CHAIN OF CUSTODY**  
**& pH CHECK**









 <b>EBERLINE</b> SERVICES	<b>Sample Receiving Report</b> (Volumes, pH, & CPM)	Internal Work Order
		<b>21-08094</b>
		Received By <b>RSPENCER</b>

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	EE1.3		
02	BLANK	0		WA	EE1.3		
03	DUP	0		WA	EE1.3		
04	H-34	1		WA	EE1.3	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
05	H-32A	1				3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
06	H- 32B	1				3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
07	H-33	1				0.00	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7		30

Received by: Bobby Bannister Date: 8-30-21



**SECTION II**  
**SAMPLE ACKNOWLEDGEMENT**





**Eberline Services – Oak Ridge Laboratory**

**SAMPLE RECEIPT CHECKLIST**

MP-001-2

WORK ORDER # 21-08094

SAMPLE MATRIX/MATRICES:

(CIRCLE ONE OR BOTH)

AQUEOUS NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	<u>Y</u>	N	
If aqueous, properly preserved	<u>Y</u>	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	<u>Y</u>	N
Unbroken on outside of package?	<u>Y</u>	N
Present on samples?	<u>Y</u>	N
Unbroken on samples?	<u>Y</u>	N
Was chain of custody present upon sample receipt?	<u>Y</u>	N

IF THE RESPONSE TO ANY OF THE ABOVE IS NO, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SIGNATURE: Bobby Bannister DATE: 08-30-21

**SECTION III**  
**CASE NARRATIVE**



EBERLINE ANALYTICAL CORPORATION  
601 SCARBORO ROAD  
OAK RIDGE, TENNESSEE 37830  
PHONE (865) 481-0683  
FAX (865) 483-4621

EBS-OR-48933

October 7, 2021

Shawn Wiggins  
ERM  
840 W Sam Houston Pkwy N #600  
Houston, TX 77024

CASE NARRATIVE  
Work Order # 21-08094-OR

SAMPLE RECEIPT

This work order contains four water samples received 08/30/2021. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

<u>CLIENT ID</u>	<u>LAB ID</u>
H-34	21-08094-04
H-32A	21-08094-05
H-32B	21-08094-06
H-33	21-08094-07

ANALYTICAL METHODS

Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0. Total Dissolved Solids were performed using Standard Methods 2540C.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size, and matrix type.

RADIUM-226

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. This was followed by precipitations of Radium/Barium Sulfate. Precipitates were dissolved in alkaline EDTA. Radium was selectively precipitated and mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. The final result was corrected for inherent self-absorption from elemental Barium. Chemical recovery was calculated using a Barium-133 tracer, which was determined by HPGe gamma spectroscopy.

## ANALYTICAL RESULTS CONTINUED

### RADIUM-226 CONTINUED

Samples demonstrated acceptable results for all Radium-226 analyses. Chemical recovery was acceptable for all analyses. The Radium-226 method blank demonstrated an acceptable result. Results for the Radium-226 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-226 laboratory control sample demonstrated an acceptable percent recovery.

### RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-228 were counted on a gas proportional counter. Chemical recovery was determined using a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all analyses. The Radium-228 method blank demonstrated an acceptable result. Results for the Radium-228 duplicate demonstrated a slightly high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

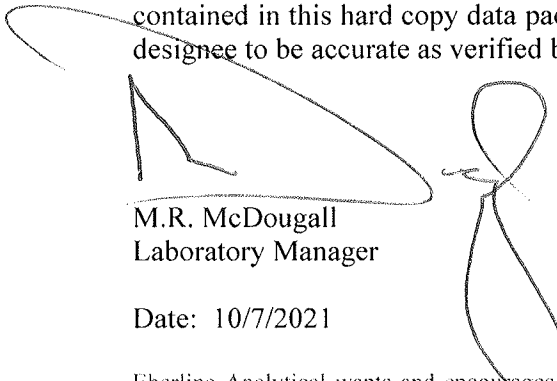
### TOTAL DISSOLVED SOLIDS (TDS)

A volumetric aliquot of each sample was filtered through 0.45µm filter media into a tared 250 ml beaker. Samples were then dried on a hot plate and were allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated results for Total Dissolved Solids content that ranged from 807.0 to 1,383.0 mg/L.

### CERTIFICATION OF ACCURACY

I certify that this data report complies with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.



M.R. McDougall  
Laboratory Manager

Date: 10/7/2021

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit <http://eberlineanalytical.com/> to provide us with feedback on our services.

**SECTION IV**  
**ANALYTICAL RESULTS SUMMARY**

# Eberline Analytical

## Final Report of Analysis

Shawn Wiggins  
ERM

840 W Sam Houston Parkway N #600  
Houston, TX 77024

SDG: **21-08094**

Purchase Order: 0526033

Analysis Category: ENVIRONMENTAL

Sample Matrix: WVA

Work Order Details:

Report To:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
21-08094-01	LCS	KNOWN	08/30/21 00:00	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	1.01E+01	4.63E-01			pCi/l
21-08094-01	LCS	SPIKE	08/30/21 00:00	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	1.11E+01	1.70E+00	2.89E+03	4.37E-01	pCi/l
21-08094-02	MBL	BLANK	08/30/21 00:00	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	-6.27E-02	1.41E-01	1.42E-01	4.15E-01	pCi/l
21-08094-03	DUP	H-34	08/23/21 10:55	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	2.19E-01	2.50E-01	2.54E-01	3.74E-01	pCi/l
21-08094-04	DO	H-34	08/23/21 10:55	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	3.87E-01	2.81E-01	2.92E-01	3.07E-01	pCi/l
21-08094-05	TRG	H-32A	08/23/21 12:00	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	7.93E-02	2.01E-01	2.02E-01	4.01E-01	pCi/l
21-08094-06	TRG	H-32B	08/23/21 13:50	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	1.93E-01	2.16E-01	2.20E-01	3.05E-01	pCi/l
21-08094-07	TRG	H-33	08/23/21 14:50	8/30/2021	9/7/2021	21-08094	Radium-226	EPA 903.0 Modified	2.84E-01	2.51E-01	2.58E-01	2.72E-01	pCi/l
21-08094-01	LCS	KNOWN	08/30/21 00:00	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	9.17E+00	4.67E-01			pCi/l
21-08094-01	LCS	SPIKE	08/30/21 00:00	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	9.64E+00	1.48E+00	2.64E+03	1.29E+00	pCi/l
21-08094-02	MBL	BLANK	08/30/21 00:00	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	2.66E-01	4.03E-01	4.08E-01	8.33E-01	pCi/l
21-08094-03	DUP	H-34	08/23/21 10:55	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	4.36E-01	4.30E-01	4.41E-01	8.71E-01	pCi/l
21-08094-04	DO	H-34	08/23/21 10:55	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	6.34E-01	4.77E-01	4.98E-01	9.56E-01	pCi/l
21-08094-05	TRG	H-32A	08/23/21 12:00	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	3.44E-01	3.71E-01	3.79E-01	7.56E-01	pCi/l
21-08094-06	TRG	H-32B	08/23/21 13:50	8/30/2021	9/9/2021	21-08094	Radium-228	EPA 904.0	4.95E-01	3.41E-01	3.59E-01	6.70E-01	pCi/l
21-08094-07	TRG	H-33	08/23/21 14:50	8/30/2021	9/7/2021	21-08094	Radium-228	EPA 904.0	2.65E-01	3.84E-01	3.89E-01	7.92E-01	pCi/l
21-08094-04	TRG	H-34	08/23/21 10:55	8/30/2021	8/31/2021	21-08094	TDS	SM 2540C	9.82E+02				mg/l
21-08094-05	TRG	H-32A	08/23/21 12:00	8/30/2021	8/31/2021	21-08094	TDS	SM 2540C	8.07E+02				mg/l
21-08094-06	TRG	H-32B	08/23/21 13:50	8/30/2021	8/31/2021	21-08094	TDS	SM 2540C	1.38E+03				mg/l
21-08094-07	TRG	H-33	08/23/21 14:50	8/30/2021	8/31/2021	21-08094	TDS	SM 2540C	1.13E+03				mg/l

0017

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (1-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original



**EBERLINE**  
ANALYTICAL

EBERLINE ANALYTICAL CORPORATION

601 SCARBORO ROAD OAK RIDGE, TN 37830 865/481-0683 FAX 865/483-4621



**SECTION V**  
**ANALYTICAL STANDARD**

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Pa-5  
QA/QC REVIEWED  
Date 2/8/94 Initials *W*

Radionuclide: Ra-226  
Half Life: 1600 ± 7 years  
Catalog No.: 7226  
Source No.: 453-26

Customer: TMA EBERLINE  
P.O.No.: VH1888  
Reference Date: February 1 1994 12:00 PST.  
Contained Radioactivity: (Ra-226) 1.001 μCi.  
Contained Radioactivity: (Ra-226) 37.0 kBq.

Description of Solution  
a. Mass of solution: 5.1864 g (in a 5 ml Flame Sealed Ampoule)  
b. Chemical form: Ra(NO<sub>3</sub>)<sub>2</sub> in 1 N HNO<sub>3</sub>  
c. Carrier content: None added  
d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities: None detected (other than daughters)

Radioactive Daughters: Rn-222, Po-218, At-218, Pb-214, Bi-214, Po-214, Tl-210, Pb-210, Bi-210, Po-210 and Tl-206.

Radionuclide Concentration: (Ra-226) 0.1929 μCi/g.

## Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:  
Energy peak(s) integrated under: 186 keV.  
Branching ratio(s) used: 0.0351 gamma rays per decay.

## Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: ±3.4%
- b. Random uncertainty in assay: ±3.1%
- c. Random uncertainty in weighing(s): ±0.2%
- d. Total uncertainty at the 99% confidence level: ±4.6%

## NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

## Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

## Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).



ISOTOPE PRODUCTS LABORATORIES  
1800 North Keystone Street  
Burbank, California 91504  
(818) 843 - 7000

*Ana H. Kuen*  
QUALITY CONTROL

*Feb. 3, 1994*  
Date Signed



QUALITY CONTROL PROGRAM  
MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE SOLUTIONS  
PRIMARY DILUTION RECERTIFICATION  
MP 009

SOLUTION REFERENCE # IPL 453-26 CURRENT DATE 8/18/2021 0:00  
SOLUTION # Ra-5

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Certified Activity 1.001E+00  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross                      Weight, Grams  
Empty Ampoule                      Weight, Grams  
Solution Net                      Weight, Grams  
Total Activity in Ampoule 1.0010  $\mu\text{Ci}$

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

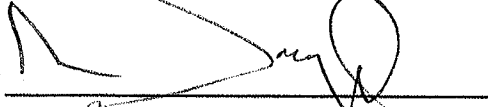
Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0010  $\mu\text{Ci}$  Which Equals 2.222E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.222E+03 dpm/ml  
This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 18, 2022

Verified & Approved By 

Date: 8/18/2021

QC Approval 

Date: 8-30-21



QUALITY CONTROL PROGRAM  
MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS  
SECONDARY DILUTION RECERTIFICATION

Solution Reference # MP 009 IPL-453-26 Date 8/18/2021 0:00  
Solution # Ra-5b

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide of Interest <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Parent Solution Conc. 2.22E+03 dpm/ml

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml  
Total Activity: 4.4440E+04 dpm Final Activity Concentration: 4.4440E+01 dpm/ml  
Final Volume: 1000.00 ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

NOTES:

Expiration Date: 18-Aug-22

Verified & Approved By [Signature]

Date: 8/18/2021 0:00

QC Approval Manarim Day

Date: 8-30-21



ANALYTICS #411 Rec'd 2/15/06 Printed

1380 Seaboard Industrial Blvd.  
Atlanta, Georgia 30318 • U.S.A.

Phone (404) 352-8677  
Fax (404) 352-2837

# CERTIFICATE OF CALIBRATION

## Standard Radionuclide Source

72325-207

*Ra<sup>228</sup>*

Ra-228 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Ra-228
ACTIVITY (dps):	4.022 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	February 10, 2006 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	4.0%

Impurities:  $\gamma$ -impurities <0.1%

5.10721 grams 0.1M HCl solution with 50  $\mu$ g/g Ba carrier.

P O NUMBER 00003181, Item 1

SOURCE PREPARED BY: *M. Taskaeva*  
M. Taskaeva, Radiochemist

Q A APPROVED: *W.M. M... 2-13-06*



QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03

Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE SOLUTIONS  
RECERTIFICATION  
MP 009

SOLUTION REFERENCE # Analytics 7235-207 CURRENT DATE 1/11/2021 0:00  
SOLUTION # Ra-12

Principal Radionuclide <sup>228</sup>Ra Half Life, Years 5.750E+00 Half Life, Days 2.100E+03

Radionuclide <sup>228</sup>Ra Reference Date 2/10/2006 0:00  
Certified Activity 1.087E-01  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross 9.0741 Weight, Grams  
Empty Ampoule 3.9858 Weight, Grams  
Solution Net 5.0883 Weight, Grams  
Total Activity in Ampoule 0.1087  $\mu\text{Ci}$

Chemical Composition of Standard Solution  
<sup>228</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 0.5 M HCl

Dilution Instructions: Dilution Solvent Used 0.5 M HCl

Dilute to a volume of 991.00 Kg

Certified Total Activity of 0.1087  $\mu\text{Ci}$  Which Equals 2.413E+05 dpm at the date listed above

And after dilution the activity of this solution is 2.435E+02 dpm/ml. This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: January 11, 2022

Recertified By [Signature]

Date: 1/11/21

QC Approval [Signature]

Date: 1/11/21



Ba-6  
(f 6a)

# National Institute of Standards & Technology Certificate

## Standard Reference Material 4251C Barium-133 Radioactivity Standard

ORIGINAL

This Standard Reference Material (SRM) consists of radioactive barium-133 chloride, non-radioactive barium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

### Radiological Hazard

The SRM ampoule contains barium-133 with a total activity of approximately 2.5 MBq. Barium-133 decays by electron capture and during the decay process X-rays and gamma-rays with energies from 4 to 400 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]\*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

### Chemical Hazard

The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

### Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least June 2004.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

### Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group and D.B. Golas, Nuclear Energy Institute Research Associate.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899  
October 1994

Thomas E. Gills, Chief  
Standard Reference Materials Program



QUALITY CONTROL PROGRAM  
QCP-009

Rev. 8; 11/10/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS

Solution Reference # QCP-009-1-A NIST SRM4251C Date 4/23/21  
Solution # Ba-6a

Principal Radionuclide	Half Life, Years	Half Life, Days
<u><sup>133</sup>Ba</u>	<u>1.048E+01</u>	<u>3.828E+03</u>

Radionuclide of Interest <sup>133</sup>Ba Reference Date 9/1/1993 0:00  
Parent Solution Conc. 1.48E+05 dpm/ml

Chemical Composition of Standard Solution  
<sup>133</sup>BaCl<sub>2</sub> in 1M HCl

Dilution Instructions: Dilution Solvent Used 1M HCl

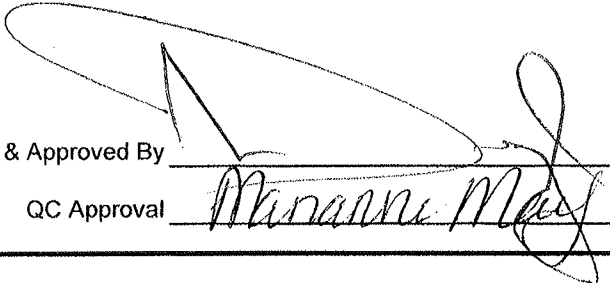
SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 25.0000 ml  
Total Activity: 3.6950E+06 dpm Final Activity Concentration: 3.6950E+03 dpm/ml  
Final Volume: 1000.00 ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: April 20, 2022

Verified & Approved By 

Date: 4/23/21

QC Approval 

Date: 4/26/21



**SECTION VI**  
**QUALITY CONTROL SAMPLE RESULTS SUMMARY**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-08094</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226	109.91%	26.14%	100.00%	4.60%	1.01E+01	4.63E-01	1.11E+01	2.89E+00	Ra-5b	4.39E+01	4.60E+00	5.09E-01

**Matrix Spike**

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

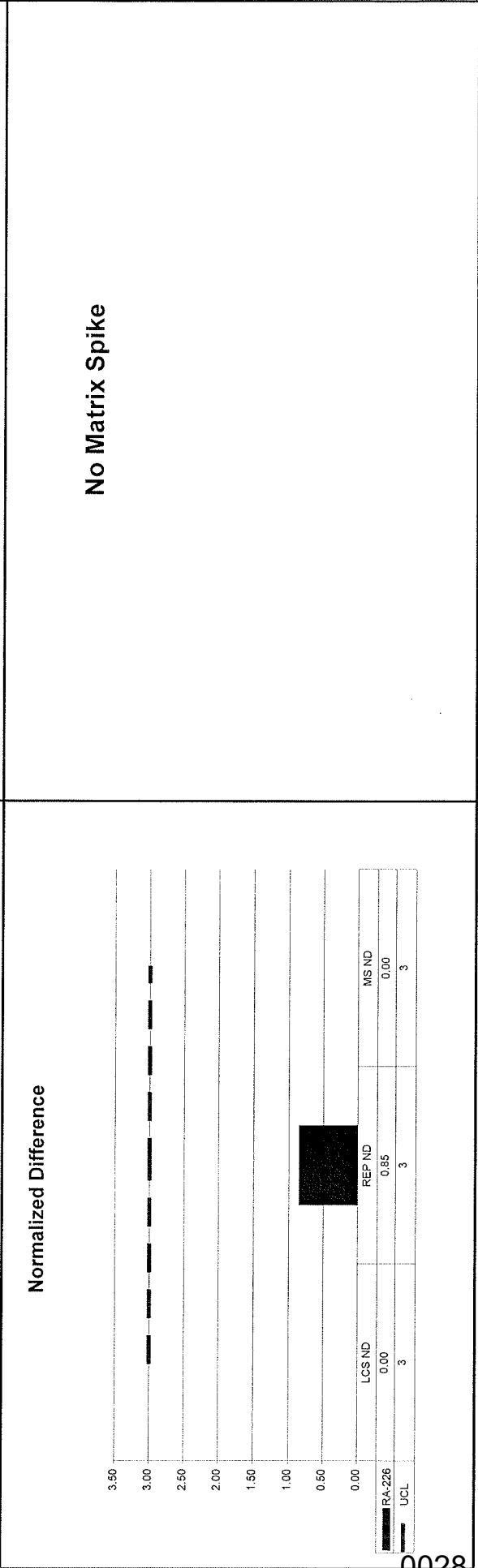
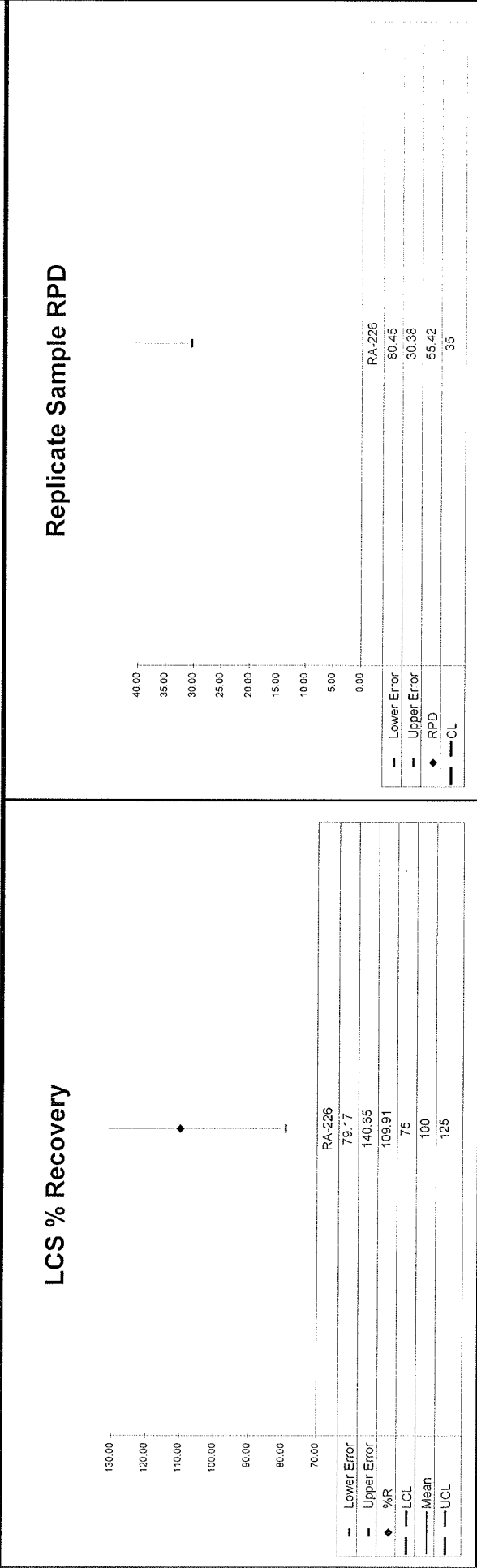
**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	0.85	55.42	3.87E-01	2.92E-01	2.19E-01	2.54E-01	1.10	OK			NA	OK

**QC Summary**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	0.85	55.42	3.87E-01	2.92E-01	2.19E-01	2.54E-01	1.10	OK			NA	OK

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-08094</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>1</b>	<b>ERM</b>



0028

WC	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-08094</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228	105.12%	27.37%	100.00%	5.10%	9.17E+00	4.67E-01	9.64E+00	2.64E+00	Ra-12	3.72E+01	5.10E+00	5.47E-01

**Matrix Spike**

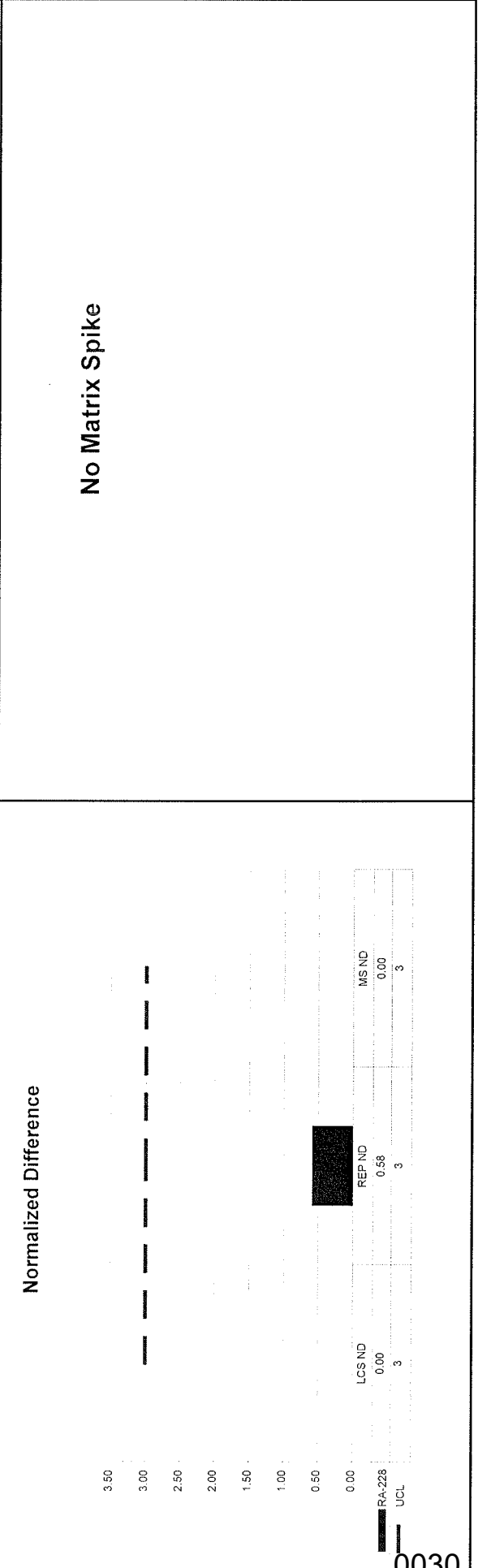
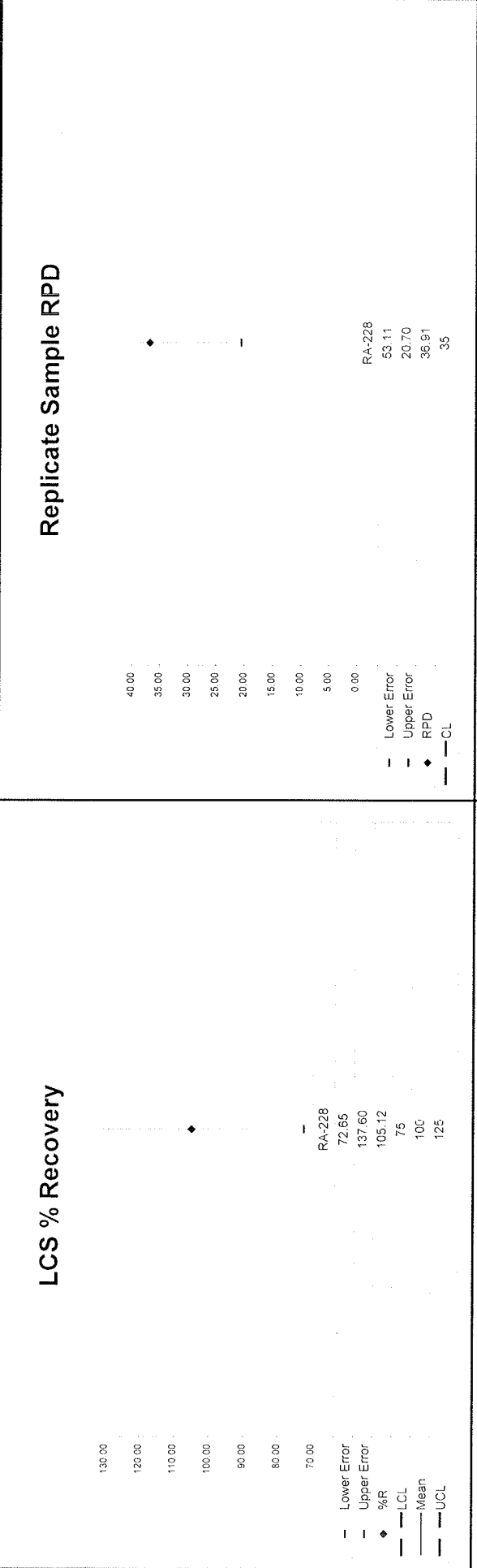
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS NC	Rep RPD	Rep ND
RA-228	0.58	36.91	6.34E-01	4.98E-01	4.36E-01	4.41E-01	1.05	OK			NA	OK


**QC Summary**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-08094</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>1</b>	<b>ERM</b>



**SECTION VII**  
**LABORATORY TECHNICIAN'S NOTES**


**RA-226 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-08094
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	08/31/21 10:40	PREP	JHARVEY	ALIUQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

*Jharvey*  
 8/31/21



 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-08094
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	08/31/21 10:40	PREP	JHARVEY	ALIQOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	09/07/21 07:57	CHEM	AYARBER	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

*Andrew J. Jacobs*

9/7/21



Reagents Used in an Analysis

Internal Work Order

21-08094

Analysis Code

Run

Ra226


1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022612P	Ammonium Hydroxide	Reagent Grade	JHARVEY	8/31/2021
023431D01	Ammonium Sulfate	200 mg/ml	JHARVEY	8/31/2021
023160D03	Barium Carrier	1 mg/ml	JHARVEY	8/31/2021
022880D01	Lead Carrier	166 mg/ml	JHARVEY	8/31/2021
023563P	Nitric Acid	Reagent Grade	JHARVEY	8/31/2021
023012P	Acetic Acid	Reagent Grade	AYARBER	9/7/2021
023495D01	Ammonium Sulfate	200 mg/ml	AYARBER	9/7/2021
023004D02	EDTA	0.25M	AYARBER	9/7/2021

Alpha Bank 3


Date	Sample #	Client	Loadtime	Counttime	Analysis	Tech
		KP	1107	2hr 50min		
9/1/21	2108052A (1-7)	TN Dept.	1107	16hrs	UU	KP
9/1/21	2108078A (3-15)	Warner Media	1203	2hr 50min	Ro <sup>6</sup>	KP
	<del>2108078A (16-18)</del>	<del>Warner Media</del>	<del>0730</del>	<del>KP</del>	<del>Ro<sup>6</sup></del>	<del>KP</del>
9/2/21	2108080A (1-4)	UCOR	0759	2hr 50min	Ro <sup>6</sup>	KP
9/2/21	2108080A (1-4)	UCOR	0759	2hr 50min	Am <sup>241</sup>	KP
9/2/21	2108080A (1-4)	UCOR	0800	2hr 50min	Am <sup>243</sup>	KP
9/2/21	2108080A (1-4)	UCOR	0800	2hr 50min	Np	KP
9/2/21	2108078A (16-18)	Warner Media	0801	2hr 50min	Ro <sup>6</sup>	KP
9/2/21	Daily Pulser	Lab	0730	10min	NA	KP
9/2/21	2108080A (2)	UCOR	1101	2hr 50min	Am <sup>241</sup>	KP
9/3/21	Daily Pulser	Lab	0930	10min	NA	KP
9/3/21	Cal Check (33-48)	Lab	0945	2hr 30min	NA	KP
9/3/21	2108083A (1-7)	PCC Structural	0949	2hr 50min	Th	KP
9/3/21	2108084A (1,2)	PCC Structural	0950	2hr 50min	Th	KP
9/3/21	2108084A (5)	PCC Structural	1221	2hr 50min	Th	KP
9/3/21	2108054A (1-10)	TN Dept	1222	2hr 50min	UU	KP
9/3/21	Cal Check (49-60)	Lab	1242	2hr 30min	NA	KP
9/3/21	2108054A (11)	TN Dept.	1516	2hr 50min	UU	KP
9/3/21	2108080A (1-4)	UCOR	1516	2hr 50min	UU	KP
9/3/21	2108080A (4)	UCOR	1517	2hr 50min	UUNT	KP
9/3/21	2108091A (1-4)	UCOR	1517	2hr 50min	UU	KP
9/4/21	System Bkgd	Lab	0738	16hr 40min	NA	KP
9/7/21	Daily Pulser	Lab	0408	10min	NA	KP
9/7/21	2108101A (3-9)	PCC Structural	0816	2hr 50min	Th	KP
9/7/21	2108080A (1-4)	UCOR	0817	2hr 50min	Th	KP
9/7/21	2108080A (1-4,7)	UCOR	0818	2hr 50min	Pu	KP
9/7/21	2108080A (1-4)	UCOR	0818	2hr 50min	Th <sup>232</sup>	KP
9/7/21	2108080A (1-4)	UCOR	1125	2hr 50min	Pu <sup>242</sup>	KP
9/7/21	2108094A (1-7)	ERM	1126	2hr 50min	Ro <sup>6</sup>	KP
9/7/21	2108098A (1-6)	ERM	1127	2hr 50min	Ro <sup>6</sup>	KP

**RA-228 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com		Internal Work Order	21-08094
			Analysis Code	Ra228
			Run Number	1


#	Date	Dept	User	Notes
1	08/31/21 10:40	PREP	JHARVEY	ALIQOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

*Jharvey*  
8/31/21

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-08094
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	08/31/21 10:40	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	09/09/21 09:45	CHEM	AYARBER	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER, AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 1N HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

*Andrew J. Surber 9/9/21*

 <b>Reagents Used in an Analysis</b>		Internal Work Order		
		21-08094		
		Analysis Code		Run
		Ra228		1
Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022612P	Ammonium Hydroxide	Reagent Grade	JHARVEY	8/31/2021
023431D01	Ammonium Sulfate	200 mg/ml	JHARVEY	8/31/2021
023160D03	Barium Carrier	1 mg/ml	JHARVEY	8/31/2021
022880D01	Lead Carrier	166 mg/ml	JHARVEY	8/31/2021
023563P	Nitric Acid	Reagent Grade	JHARVEY	8/31/2021
023118D01	Ammonium Oxalate	5%	AYARBER	9/9/2021
022128D01	EDTA	0.25M	AYARBER	9/9/2021
022763D07	Nitric Acid	1N	AYARBER	9/9/2021
022345D14	Nitric Acid	6N	AYARBER	9/9/2021
023120D02	Sodium Hydroxide	10M	AYARBER	9/9/2021
023120D01	Sodium Hydroxide	18M	AYARBER	9/9/2021
023151D01	Yttrium Carrier	9 mg/ml	AYARBER	9/9/2021

Aqua LB410

Date	Sample#	Client	Load time	Count time	Analysis	Tech
9/9/21	Daily Bkgd/OC	Lab	0650/0814	1hr/30min	XB	KP
9/9/21	Cross Talk	Lab	0853	5 min	XB	KP
9/9/21	Cross Talk	Lab	0859	5 min	XB	KP
9/9/21	2109027AB (1-4)	BR Waterwell	0920	2hrs	XB	KP
9/9/21	2108094Ra (1)	ERM	0951	30 min	Ra <sup>8</sup>	KP
9/9/21	2108094Ra (2-7)	ERM	0951	2hrs	Ra <sup>8</sup>	KP



**TDS NOTES**

 <b>EBERLINE</b> SERVICES <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-08094
		Analysis Code	TDS
		Run Number	1

#	Date	Dept	User	Notes
1	08/31/21 14:46	PREP	JPACHELLA	Samples were filtered, aliquoted into tared beakers, dried, and reweighed.

8-31-21 JPACHELLA

**SECTION VIII**  
**ANALYTICAL DATA (RADIUM-226)**

























KP  
9/8/21

Sample Description: SPIKE  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 01  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_035  
 Chamber Serial Number: 04026477A  
 Detector Serial Number: 58771  
 Env. Background: System Bkgd 304523  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 9/7/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:27 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1247 +/- 0.0023 on 5/21/2021 9:18:11 AM  
 Effective Efficiency: 0.1247 +/- 0.0023

Control Certificate Name: Ra226\_Ra-5b  
 Chem. Recov. of Control: RA-226 0.366343 +/- 0.030771  
 Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

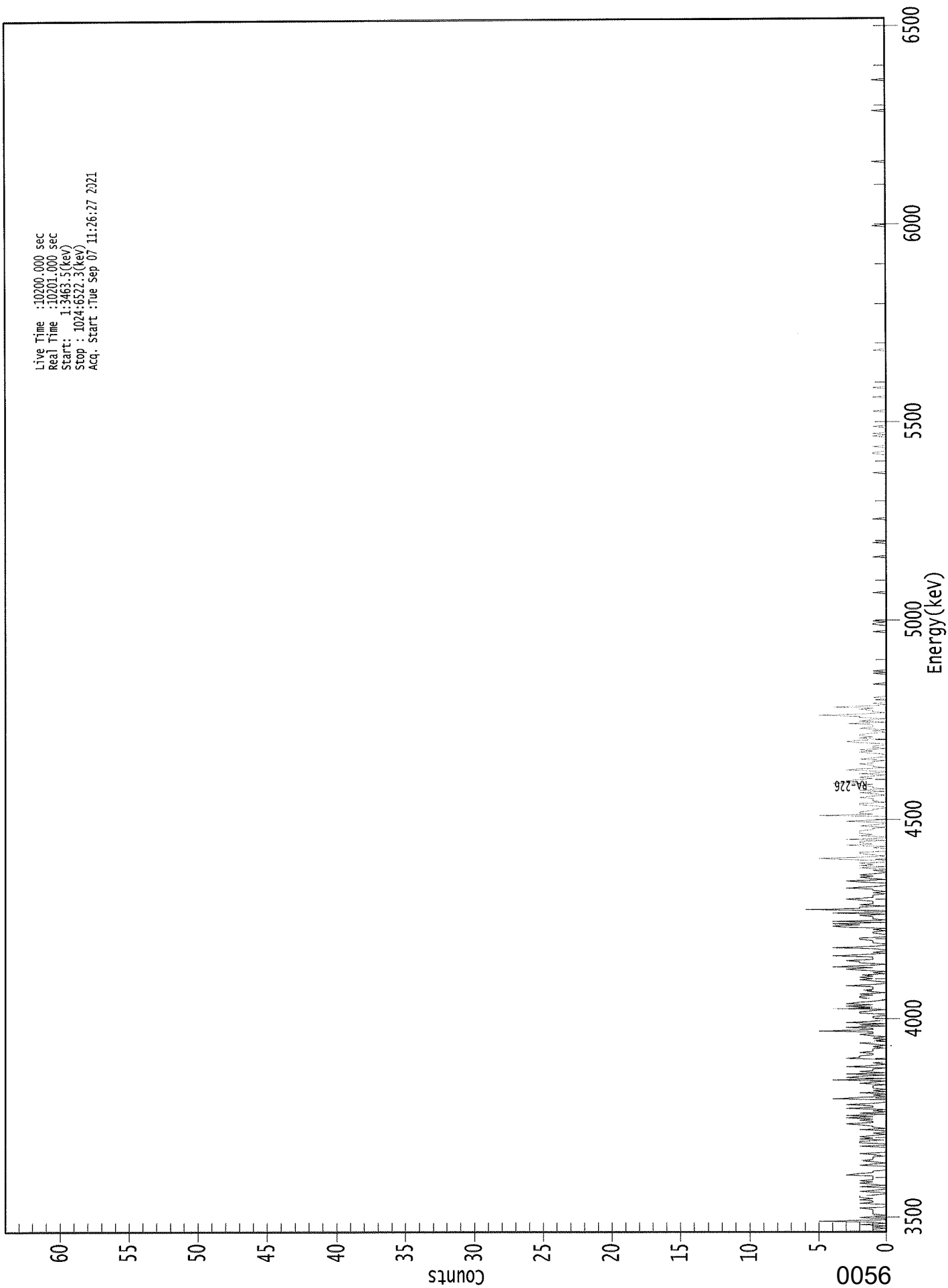
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.493	9.81	66.87	1.19	0.00E+000	3.0
RA-226	4.586	173.64	14.94	1.36	0.00E+000	6.0

-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.953	5685.50*	6.58E-001 +/- 4.40E-001	4.42E-001 +/- 1.60E-002
RA-226	0.950	4785.00*	1.11E+001 +/- 1.70E+000	4.37E-001 +/- 1.59E-002

0000298334.CNF

Live Time :10200.000 sec  
Real Time :10201.000 sec  
Start: 1:3463.5(kev)  
Stop : 1024:6322.3(kev)  
Acq. Start :Tue Sep 07 11:26:27 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 01

Elapsed Live time: 10200

Elapsed Real Time: 10201

Channel	1	5	10	15	20	25	30	35
1:	1	1	1	0	1	0	2	0
9:	1	5	0	0	2	1	0	1
17:	1	1	1	1	2	0	0	0
25:	2	1	1	2	1	2	2	1
33:	0	0	2	1	0	0	2	0
41:	1	2	1	2	1	1	1	1
49:	3	2	1	1	0	0	0	0
57:	2	1	0	1	2	1	1	1
65:	0	1	2	0	0	0	0	0
73:	2	0	0	2	2	0	2	1
81:	2	1	0	1	0	0	2	0
89:	1	1	2	3	1	1	2	1
97:	3	1	3	0	2	0	1	0
105:	3	1	1	3	1	0	0	0
113:	4	2	0	1	0	2	0	1
121:	0	1	1	1	0	2	1	0
129:	4	0	3	2	0	3	0	2
137:	1	1	0	3	1	0	1	0
145:	0	0	3	2	2	1	1	2
153:	1	1	1	0	1	0	1	2
161:	0	1	0	1	0	1	2	1
169:	1	5	1	1	3	0	2	0
177:	3	1	0	0	1	1	0	0
185:	2	2	1	0	4	1	3	1
193:	3	2	1	0	1	2	2	1
201:	2	0	1	2	1	1	1	3
209:	1	0	0	1	2	1	2	1
217:	2	0	1	0	2	3	1	4
225:	1	0	2	2	3	1	1	1
233:	4	2	0	1	0	0	1	4
241:	1	0	0	1	1	1	2	2
249:	0	0	0	1	1	0	1	0
257:	3	4	2	4	0	4	0	1
265:	1	1	2	0	4	0	0	6
273:	2	2	0	2	1	1	1	2
281:	3	1	1	1	0	1	0	1
289:	1	3	1	0	0	0	2	3
297:	0	1	2	1	2	1	0	0
305:	1	0	2	0	2	1	2	0
313:	0	3	5	2	0	1	2	2
321:	0	0	0	1	0	3	1	2
329:	2	0	3	0	0	2	1	2
337:	2	2	1	1	0	2	1	0
345:	0	3	1	0	0	0	5	1
353:	2	2	1	1	0	0	1	2
361:	2	0	1	1	1	2	1	0



369: 1 2 0 2 0 1 1 2

Sample Title: 01

Channel	1	2	3	4	5	6	7	8
377:	1	4	2	3	2	1	2	1
385:	0	2	0	0	3	2	0	1
393:	1	2	1	1	0	2	1	0
401:	0	0	1	2	1	2	0	1
409:	1	0	0	2	3	2	0	2
417:	1	2	2	1	0	1	0	2
425:	1	1	1	3	0	2	1	0
433:	2	2	5	2	0	1	1	2
441:	1	4	1	0	1	0	0	0
449:	0	1	0	0	0	0	0	0
457:	0	0	0	0	1	0	0	0
465:	0	0	0	0	0	1	0	1
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	1	0	0	0	0	0	1	1
513:	0	1	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	1	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	1
569:	0	0	0	0	0	0	0	0
577:	0	0	0	1	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	1
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	1	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	1	1
657:	0	0	0	0	1	0	0	0
665:	0	0	0	0	0	1	0	1
673:	0	0	0	0	0	1	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	1	0	0	0	0	0
697:	0	0	0	0	0	0	1	0
705:	0	0	0	0	0	0	1	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	1	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 01

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	1	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	1	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	1	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KP  
9/8/21

# Apex-Alpha™

Sample Description: BLANK  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 02  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_036  
 Chamber Serial Number: 04026477B  
 Detector Serial Number: 84167  
 Env. Background: System Bkgd 304524  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 9/7/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:28 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1776 +/- 0.0031 on 5/21/2021 9:18:09 AM  
 Effective Efficiency: 0.1776 +/- 0.0031

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

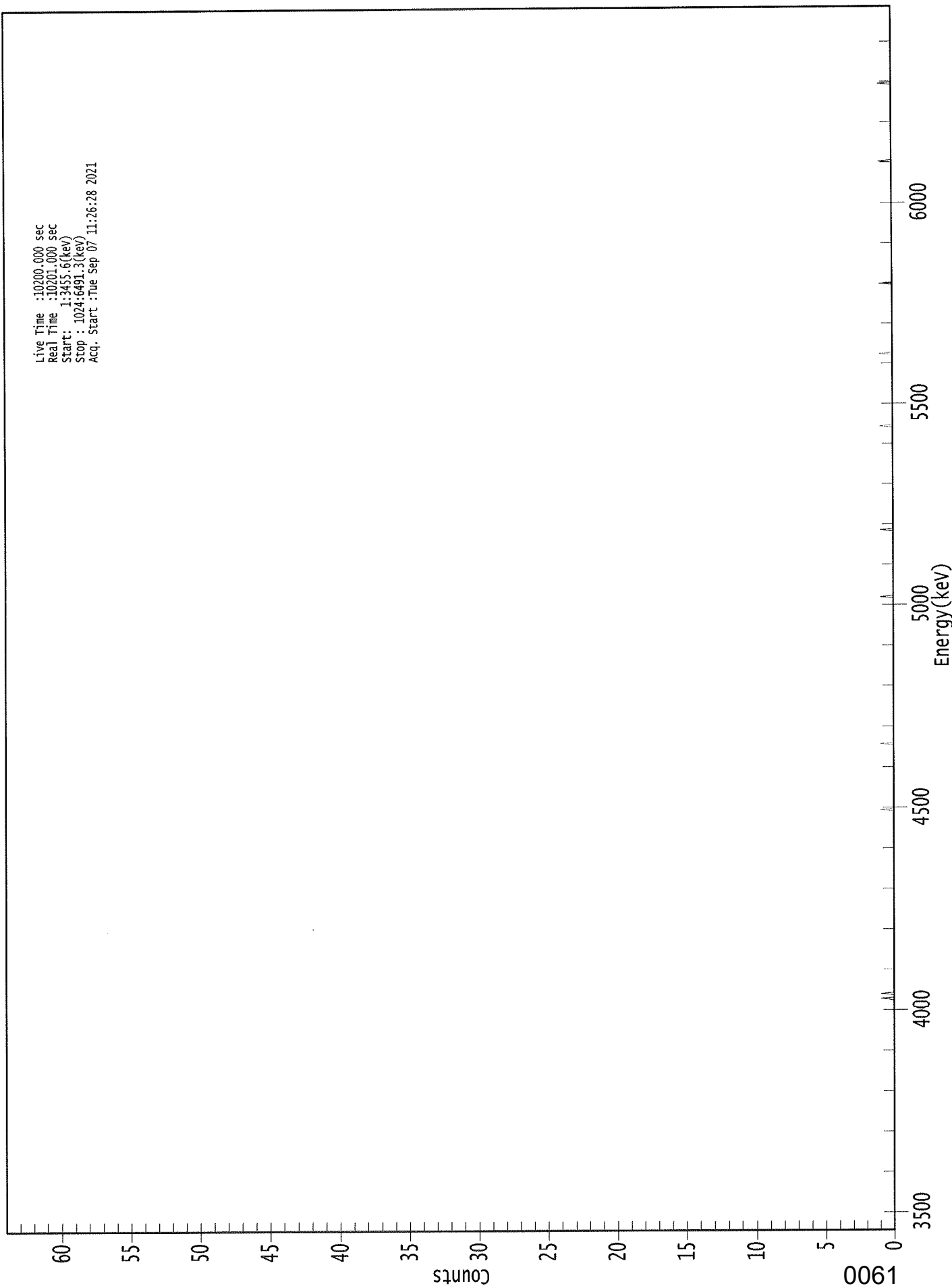
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.534	1.83	152.56	0.17	0.00E+000	3.0
RA-226	4.576	-1.40	224.79	3.40	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.971	5685.50*	8.61E-002 +/- 1.31E-001	1.96E-001 +/- 6.76E-003
RA-226	0.944	4785.00*	-6.27E-002 +/- 1.41E-001	4.15E-001 +/- 1.43E-002

# 0000298335.CNF

Live Time :10200.000 sec  
Real Time :10201.000 sec  
Start: 1:3455.6(kev)  
Stop : 1024:6491.3(kev)  
Acq. Start :Tue Sep 07 11:26:28 2021



ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 02

Elapsed Live time: 10200

Elapsed Real Time: 10201

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	1	0	0	0	0	1	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	1	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	1	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	1
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	1	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	1	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	1	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	1	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	1	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KP  
9/18/21

Sample Description: H-34 DUP  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 03  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_039  
 Chamber Serial Number: 06027396A  
 Detector Serial Number: 83109  
 Env. Background: System Bkgd 304527  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 8/23/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:30 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1562 +/- 0.0028 on 5/21/2021 9:18:04 AM  
 Effective Efficiency: 0.1562 +/- 0.0028

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.579	0.13	2295.4	1.87	0.00E+000	3.0
RA-226	4.537	4.30	114.31	1.70	0.00E+000	3.0

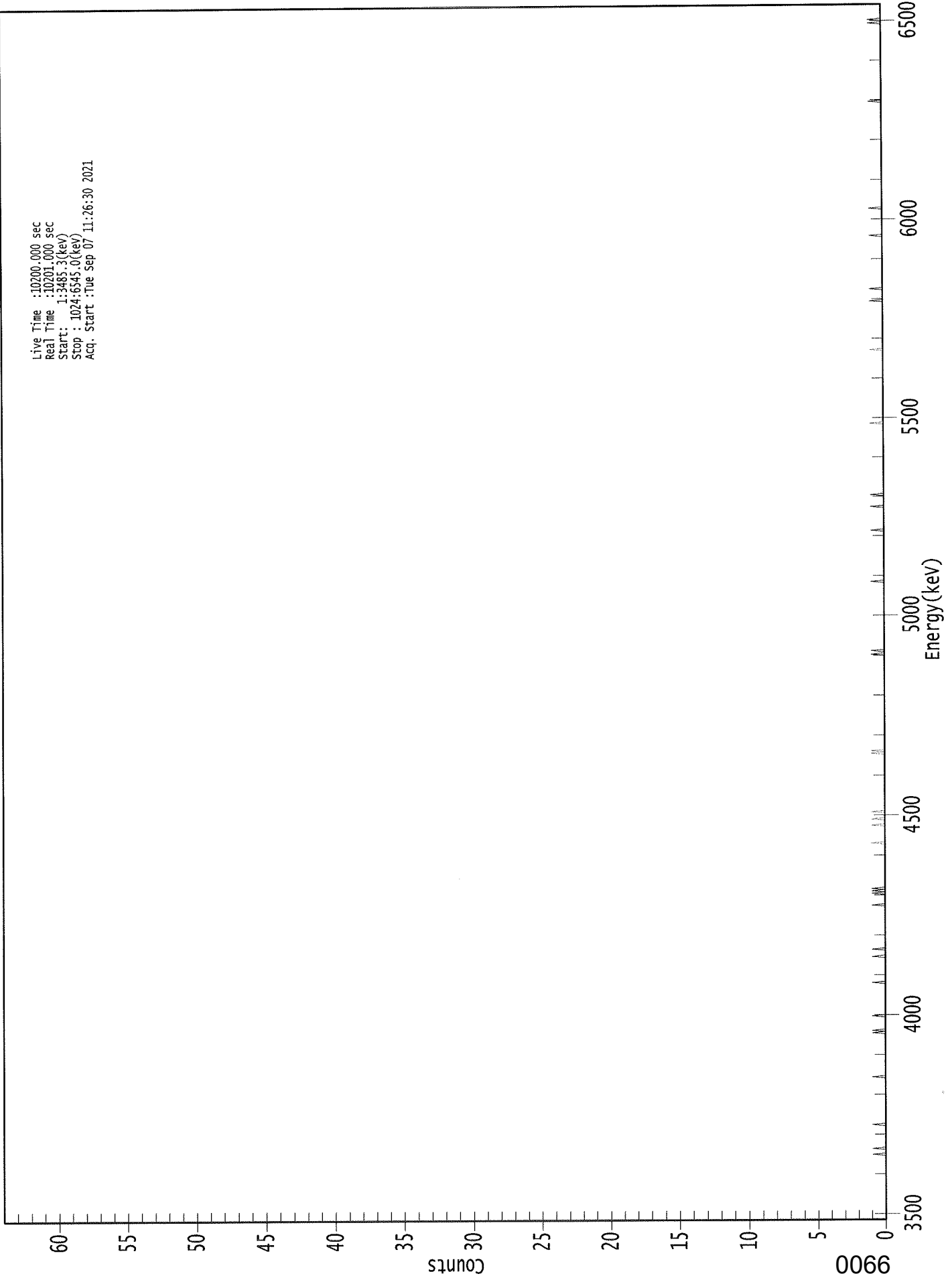
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.985	5685.50*	6.99E-003 +/- 1.60E-001	4.07E-001 +/- 1.43E-002
RA-226	0.923	4785.00*	2.19E-001 +/- 2.50E-001	3.74E-001 +/- 1.31E-002



0000298342.CNF

Live Time :10200.000 sec  
Real Time :10201.000 sec  
Start: 1:3485.3(kev)  
Stop : 1024:6545.0(kev)  
Acq. Start :Tue Sep 07 11:26:30 2021



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
 \*\*\*\*\*

Sample Title:    03

Elapsed Live time:        10200

Elapsed Real Time:        10201

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	1
57:	0	0	0	0	1	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	1	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	1	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	1	0	1
161:	0	0	0	0	0	0	0	0
169:	0	0	0	1	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	1
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	1	0	0
225:	0	0	0	1	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	1	0	0	0	0	0	0	0
273:	0	0	1	0	1	0	1	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	1	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	1	0	0	0	0
337:	1	0	0	0	0	0	1	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 03

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	1
393:	0	1	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	1	0	0	1	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	1
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	1	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	1	0
601:	0	0	0	0	0	0	0	0
609:	1	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	1	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	1	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	1	0	0	0
777:	0	0	0	0	0	0	1	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 03

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	1	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	1	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	1	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	1	0
1009:	0	1	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KP  
9/8/21

Sample Description: H-34  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 04  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_041  
 Chamber Serial Number: 05026930A  
 Detector Serial Number: 91087  
 Env. Background: System Bkgd 304528  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.960E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 8/23/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:32 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1753 +/- 0.0031 on 5/21/2021 9:18:01 AM  
 Effective Efficiency: 0.1753 +/- 0.0031

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

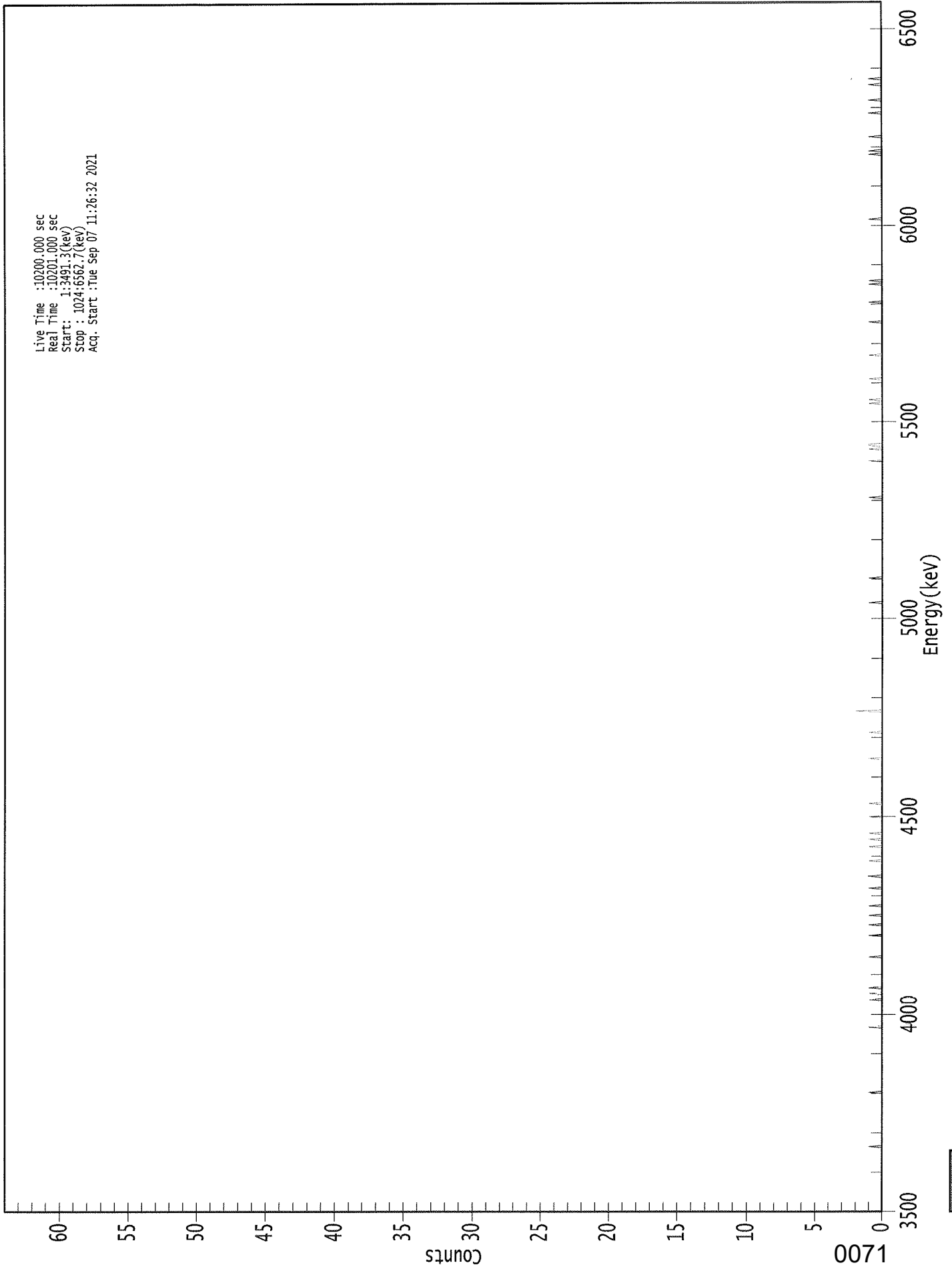
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.504	6.98	80.28	1.02	0.00E+000	3.0
RA-226	4.555	8.64	72.56	1.36	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.958	5685.50*	3.30E-001 +/- 2.65E-001	2.98E-001 +/- 1.02E-002
RA-226	0.933	4785.00*	3.87E-001 +/- 2.81E-001	3.07E-001 +/- 1.05E-002

0000298348.CNF

Live Time :10200.000 sec  
Real Time :10201.000 sec  
Start: 1:3491.3(kev)  
Stop : 1024:6562.7(kev)  
Acq. Start :Tue Sep 07 11:26:32 2021



ROI Type: 1



369: 0 0 0 0 0 0 0 0 0

Sample Title: 04

Channel								
377:	0	0	0	0	0	0	1	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	1	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	2	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	1	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	1	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	1	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	1	0	0	0	0	0	0
641:	0	0	0	1	0	0	1	1
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	1	0	0	1	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	1
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	1	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	1
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	1	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	1
785:	0	0	1	0	0	0	0	0
793:	0	0	0	0	0	0	0	0



801: 0 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	1	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	1	0	0
897:	1	0	0	0	0	0	0	0
905:	0	0	0	0	1	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	1	0	0	0	0	0	0	0
937:	0	0	0	1	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	1	0	0	0	0	1	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



11P  
9/18/21

Sample Description: H-32A  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 05  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_042  
 Chamber Serial Number: 05026930B  
 Detector Serial Number: 84185  
 Env. Background: System Bkgd 304529  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 8/23/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:33 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1624 +/- 0.0029 on 5/21/2021 9:17:59 AM  
 Effective Efficiency: 0.1624 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

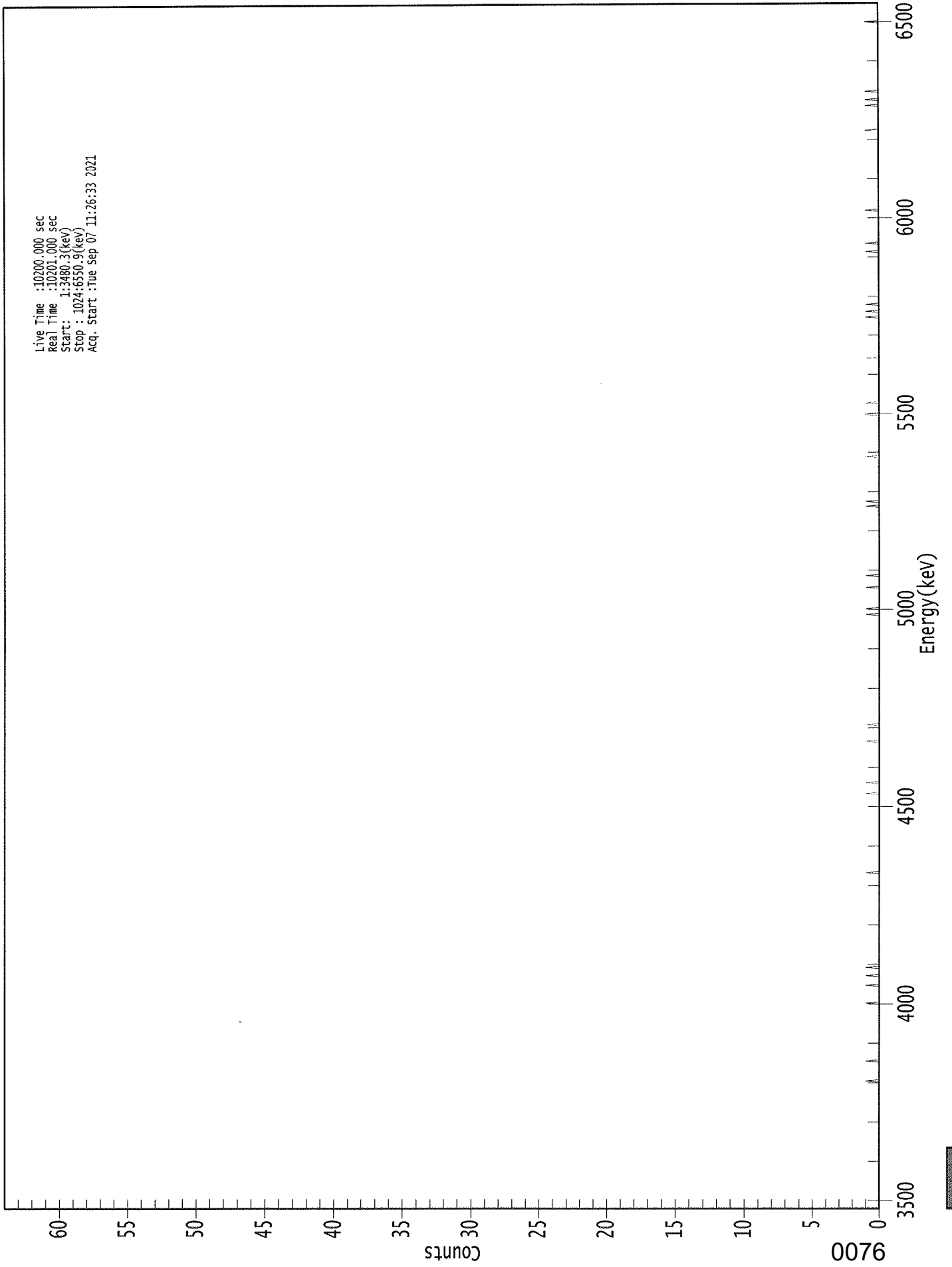
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.511	2.79	162.88	2.21	0.00E+000	3.0
RA-226	4.617	1.62	253.92	2.38	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.961	5685.50*	1.44E-001 +/- 2.35E-001	4.14E-001 +/- 1.44E-002
RA-226	0.964	4785.00*	7.93E-002 +/- 2.01E-001	4.01E-001 +/- 1.39E-002

# 0000298344.CNF

Live Time :10200.000 sec  
Real Time :10201.000 sec  
Start: 1:3480.3(kev)  
Stop : 1024:6550.9(kev)  
Acq. Start :Tue Sep 07 11:26:33 2021



ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 05

Elapsed Live time: 10200

Elapsed Real Time: 10201

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	1	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	1	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	1	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	1	0	0
193:	0	0	0	0	0	1	0	0
201:	0	0	0	0	1	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	1	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	1
353:	0	0	0	0	0	0	0	0
361:	1	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	1	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	1	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	1	0
505:	0	0	0	1	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	1	0	0
529:	0	0	0	0	0	0	0	1
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	1	0	0	0	1	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	1	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	1	1	0	0	0	0	0	0
681:	0	0	1	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	1	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	1	0	0	0	0
761:	1	0	0	0	0	0	1	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	1	0	0	0	0
817:	0	0	1	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	1	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	1	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	1
937:	0	0	0	0	1	0	0	0
945:	0	0	0	1	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	1	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KP  
9/18/21

Sample Description: H-32B  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 06  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_045  
 Chamber Serial Number: 04026482A  
 Detector Serial Number: 91131  
 Env. Background: System Bkgd 304530  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 8/23/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:35 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1642 +/- 0.0029 on 5/21/2021 9:18:20 AM  
 Effective Efficiency: 0.1642 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

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 -----  
 PEAK AREA REPORT  
 -----  
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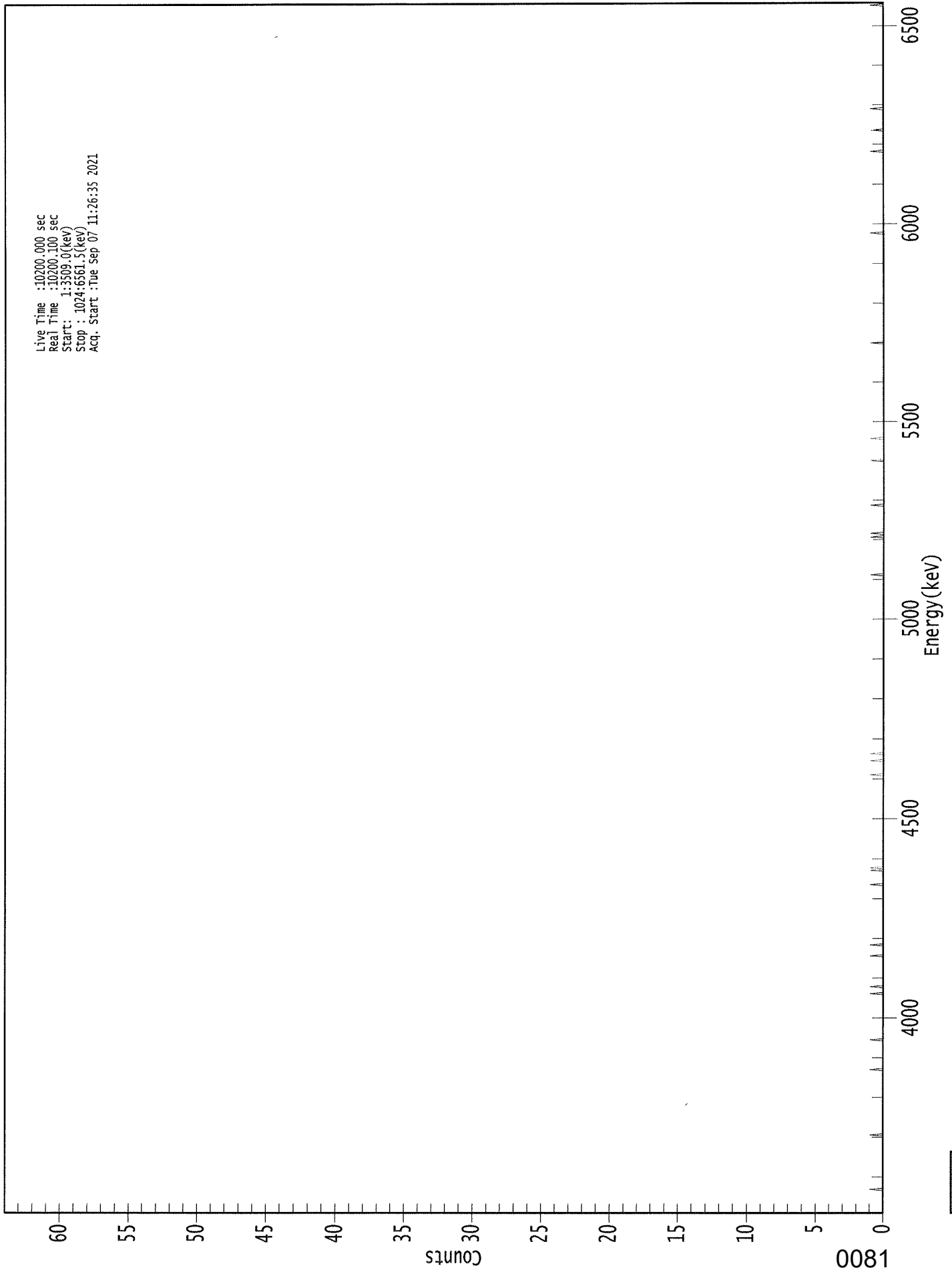
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.429	1.32	215.97	0.68	0.00E+000	3.0
RA-226	4.534	3.98	112.01	1.02	0.00E+000	3.0

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 -----  
 NUCLIDE ANALYSIS RESULTS  
 -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.918	5685.50*	6.75E-002 +/- 1.46E-001	2.89E-001 +/- 1.01E-002
RA-226	0.921	4785.00*	1.93E-001 +/- 2.16E-001	3.05E-001 +/- 1.06E-002

# 0000298345.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start: 11:35:09.0(kev)  
Stop : 1024:05:01.5(kev)  
Acq. Start :Tue Sep 07 11:26:35 2021



ROI Type: 1



\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 06

Elapsed Live time: 10200  
Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	1	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	1	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	1	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	1	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	1	0	0	0	0	0	0	1
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	1	0	0	0	0	0	0	0
225:	0	0	1	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	1	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	1	0	1	0	0	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 1 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	1	0	0
385:	0	0	0	1	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	1	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	1	0	0	1	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	1	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	1	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	1	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	1	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	1	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	1	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	1	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	1	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	1	0	0	0



KP  
9/8/21

Sample Description: H-33  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002983  
 Batch Identification: 2108094A-RA  
 Sample Identification: 07  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_046  
 Chamber Serial Number: 04026482B  
 Detector Serial Number: 58762  
 Env. Background: System Bkgd 304531  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 8/23/2021 8:25:10 AM  
 Acquisition Date/Time: 9/7/2021 11:26:37 AM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9858 +/- 0.0000  
 Counting Efficiency: 0.1557 +/- 0.0028 on 5/21/2021 9:18:19 AM  
 Effective Efficiency: 0.1535 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

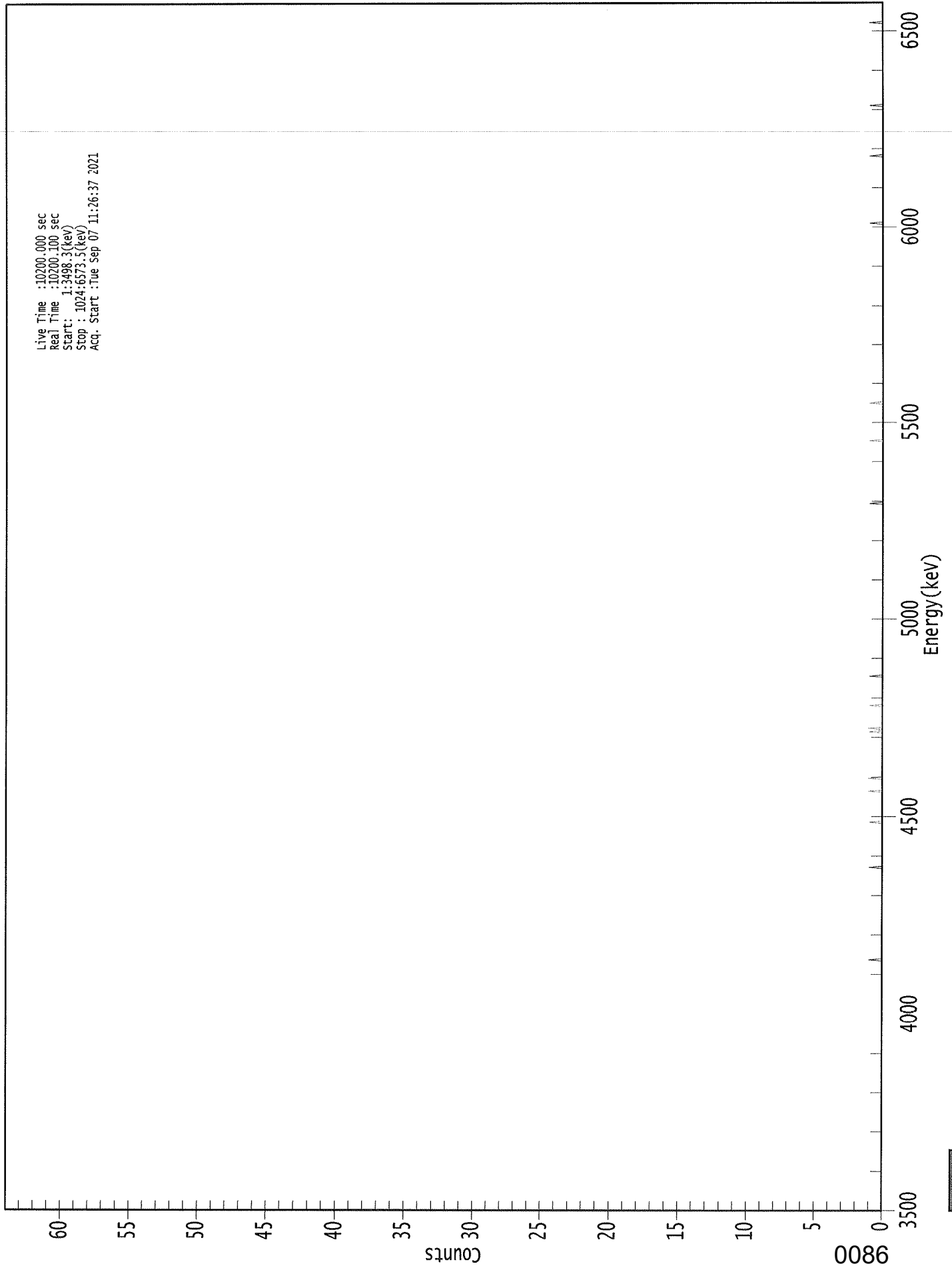
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.500	1.49	190.02	0.51	0.00E+000	3.0
RA-226	4.643	5.49	88.08	0.51	0.00E+000	3.0

-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.956	5685.50*	8.15E-002 +/- 1.55E-001	2.87E-001 +/- 1.01E-002
RA-226	0.974	4785.00*	2.84E-001 +/- 2.51E-001	2.72E-001 +/- 9.54E-003

# 0000298346.CNF

Live Time : 10200.000 sec  
Real Time : 10200.100 sec  
Start : 1:3498.3(kev)  
Stop : 1024:6573.5(kev)  
Acq. Start : Tue Sep 07 11:26:37 2021



ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L   D A T A   R E P O R T   \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 07

Elapsed Live time: 10200  
Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	1	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	1	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	1	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	1	0	0	0	0	0
361:	0	0	0	0	0	1	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 07

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	1	0	0	1
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	1	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	1	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	1	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	1	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	1	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	1	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	1	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	1
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	1	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0





## QA SUMMARY REPORT

### Review Of QA Results - Pulser Check

Date : 9/7/2021

Time : 4:22:27 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Not Done	
Alpha 004	21f	ALL	Not Done	
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Not Done	
Alpha 011	21f	ALL	Passed	9/7/2021 4:07:31 AM
Alpha 012	21f	ALL	Passed	9/7/2021 4:07:31 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Not Done	
Alpha 015	21f	ALL	Not Done	
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:32 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:34 AM
Alpha 035	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:35 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:37 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:38 AM
Alpha 038	Alpha Analyst100DC	Peak Energy	Action	9/7/2021 4:07:40 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:42 AM
Alpha 040	Alpha Analyst100DC	ALL	Not Done	
Alpha 041	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:43 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:45 AM
Alpha 043	Alpha Analyst100DC	ALL	Not Done	
Alpha 044	Alpha Analyst100DC	ALL	Not Done	
Alpha 045	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:46 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:48 AM
Alpha 047	Alpha Analyst100DC	ALL	Not Done	
Alpha 048	Alpha Analyst100DC	ALL	Not Done	
Alpha 049	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:50 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:51 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:53 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:55 AM
Alpha 053	Alpha Analyst100DC	ALL	Not Done	
Alpha 054	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:56 AM
Alpha 055	Alpha Analyst100DC	ALL	Not Done	
Alpha 056	Alpha Analyst100DC	ALL	Not Done	
Alpha 057	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:07:58 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:08:00 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:08:02 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	9/7/2021 4:08:04 AM

APPROVED BY:     KP    

APPROVAL DATE:     9/7/21

\*\*\*\*\*  
\*\*\*\*\* LIBRARY LISTING REPORT \*\*\*\*\*  
\*\*\*\*\*

Nuclide Library Title: Radium

Nuclide Library Description: Ra-226, Po-218, Rn-222

Nuclide Name	Half-Life (Seconds)	Energy (keV )	Energy Uncert. (keV )	Yield (%)	Yield Uncert. (Abs.+ -)
PO-218	5.049E+010	6003.000*	0.000	99.9800	0.0000
RN-222	5.049E+010	5490.000*	0.000	99.9200	0.0000
RA-226	5.049E+010	4785.000*	0.000	100.0000	0.0000

\* = key line

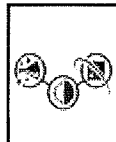
TOTALS:            3    Nuclides            3    Energy Lines

**SECTION IX**  
**ANALYTICAL DATA (RADIUM-228)**









Run

1

Analysis Code

Ra228

Eberline Services Work Order

21-08094

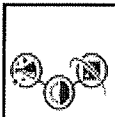
Client

ERM

7600

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	9.64E+00	1.48E+00	1.29E+00	9.17E+00	105.12	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	2.66E-01	4.03E-01	8.33E-01					OK	OK
03	RA-228	DUP	H-34	pCi/l	4.36E-01	4.30E-01	8.71E-01				NA	OK	
04	RA-228	DO	H-34	pCi/l	6.34E-01	4.77E-01	9.56E-01					OK	
05	RA-228	TRG	H-32A	pCi/l	3.44E-01	3.71E-01	7.55E-01					OK	
06	RA-228	TRG	H-32B	pCi/l	4.95E-01	3.41E-01	6.70E-01					OK	
07	RA-228	TRG	H-33	pCi/l	2.65E-01	3.84E-01	7.92E-01					OK	





Run

Analysts Code

Eberline Services Work Order

Client

8600

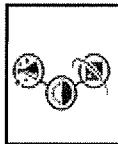
1

Ra228

21-08094

ERM

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Allquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	RA-228	LCS	08/30/21 00:00	1.00E+00	108.37	105.77	110.00	1.00	9/7/2021 7:32	9/9/2021 8:01
02	RA-228	MBL	08/30/21 00:00	1.00E+00	123.56	100.29	110.00	1.00	9/7/2021 7:32	9/9/2021 8:01
03	RA-228	DUP	08/23/21 10:55	1.00E+00	102.03	104.04	106.15	1.00	9/7/2021 7:32	9/9/2021 8:01
04	RA-228	DO	08/23/21 10:55	1.00E+00	103.42	103.03	106.55	1.00	9/7/2021 7:32	9/9/2021 8:01
05	RA-228	TRG	08/23/21 12:00	1.00E+00	105.45	104.47	110.00	1.00	9/7/2021 7:32	9/9/2021 8:01
06	RA-228	TRG	08/23/21 13:50	1.00E+00	112.37	110.39	110.00	1.00	9/7/2021 7:32	9/9/2021 8:01
07	RA-228	TRG	08/23/21 14:50	1.00E+00	98.73	110.25	108.60	1.00	9/7/2021 7:32	9/9/2021 8:01



Run

Analysis Code

Eberline Services Work Order

Client

6900

1

Ra228

21-08094

ERM

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	09/09/21 09:51		LB4110A	A4	30	277	1.583333333	0.4548
02	RA-228	MBL	09/09/21 09:51		LB4110A	B1	120	216	1.583333333	0.4626
03	RA-228	DUP	09/09/21 09:51		LB4110A	B3	120	222	1.516666667	0.449
04	RA-228	DO	09/09/21 09:51		LB4110A	B4	120	296	1.966666667	0.4619
05	RA-228	TRG	09/09/21 09:51		LB4110A	C1	120	192	1.316666667	0.4667
06	RA-228	TRG	09/09/21 09:51		LB4110A	C2	120	166	0.983333333	0.4578
07	RA-228	TRG	09/09/21 09:51		LB4110A	C3	120	198	1.433333333	0.4699



# Spike and Tracer Worksheet

Internal Work Order		Run	Analysis Code		Date		Technician		Technician Initials		Witness Initials				
<b>21-08094</b>		<b>1</b>	<b>Ra228</b>		<b>9/9/2021 7:52</b>		<b>AYARBER</b>		<b>AY</b>						
LCS & Matrix Spikes															
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS Volume Used (g)	MS Volume Used (g)	LCSD Volume Used (g)	LCS Known pCi	LCS Error Estimate	MS Added pCi	MS Error Estimate	LCSD Known pCi	LCSD Error Estimate	Added pCi	Error Estimate
Ra-228	Ra-12	37.230	9/9/2021	0.540	0.5466			9.17	0.467	0.00	0.000	0.00	0.000	0.00	0.000
Balance Printer Tapes															
Tracers															
fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition									
01	Ba-133	Ba-6a	389.530	9/9/2021	2.2350	2.6000									
02	Ba-133	Ba-6a	389.530	9/9/2021	2.2233	2.6000									
03	Ba-133	Ba-6a	389.530	9/9/2021	2.2064	2.6000									
04	Ba-133	Ba-6a	389.530	9/9/2021	2.2208	2.6000									
05	Ba-133	Ba-6a	389.530	9/9/2021	2.2160	2.6000									
06	Ba-133	Ba-6a	389.530	9/9/2021	2.2164	2.6000									
07	Ba-133	Ba-6a	389.530	9/9/2021	2.2109	2.6000									
Matrix Spike															





KP  
9/9/21

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A4	2108094-01	11	277	30	1410	9/9/2021 9:51:20 AM
B1	2108094-02	25	216	120	1410	9/9/2021 9:51:20 AM
B3	2108094-03	39	222	120	1410	9/9/2021 9:51:20 AM
B4	2108094-04	33	296	120	1410	9/9/2021 9:51:21 AM
C1	2108094-05	20	192	120	1410	9/9/2021 9:51:21 AM
C2	2108094-06	16	166	120	1410	9/9/2021 9:51:21 AM
C3	2108094-07	14	198	120	1410	9/9/2021 9:51:21 AM

GPC Detector Report  
(ALL Backgrounds)

kp  
9/9/21

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	9/9/2021	1.17E-01	P	1.52E-03	1.57E-01	3.13E-01
LB4110A - A2	Alpha	11/2/2019	9/9/2021	2.17E-01	P	8.86E-03	1.44E-01	2.80E-01
LB4110A - A3	Alpha	11/2/2019	9/9/2021	1.50E-01	P	1.06E-02	1.56E-01	3.00E-01
LB4110A - A4	Alpha	11/2/2019	9/9/2021	1.33E-01	P	1.37E-02	1.56E-01	2.98E-01
LB4110A - B1	Alpha	11/2/2019	9/9/2021	1.00E-01	P	-1.33E-02	1.35E-01	2.83E-01
LB4110A - B2	Alpha	11/2/2019	9/9/2021	2.33E-01	P	4.83E-02	2.08E-01	3.69E-01
LB4110A - B3	Alpha	11/2/2019	9/9/2021	1.50E-01	P	1.63E-02	1.69E-01	3.22E-01
LB4110A - B4	Alpha	11/2/2019	9/9/2021	1.67E-01	P	-9.35E-03	1.14E-01	2.37E-01
LB4110A - C1	Alpha	11/2/2019	9/9/2021	8.33E-02	P	-1.87E-02	1.07E-01	-2.33E-01
LB4110A - C2	Alpha	11/2/2019	9/9/2021	8.33E-02	P	-1.94E-02	1.07E-01	2.33E-01
LB4110A - C3	Alpha	11/2/2019	9/9/2021	1.17E-01	P	-2.33E-02	8.45E-02	1.92E-01
LB4110A - C4	Alpha	11/2/2019	9/9/2021	2.67E-01	P	2.83E-02	2.13E-01	3.98E-01
LB4110A - D1	Alpha	11/2/2019	9/9/2021	6.67E-02	P	-2.64E-02	7.35E-02	1.73E-01
LB4110A - D2	Alpha	11/2/2019	9/9/2021	8.33E-02	P	-1.01E-02	1.03E-01	2.15E-01
LB4110A - D3	Alpha	11/2/2019	9/9/2021	1.33E-01	P	-2.57E-03	1.24E-01	2.51E-01
LB4110A - D4	Alpha	11/2/2019	9/9/2021	1.17E-01	P	2.80E-02	1.68E-01	3.08E-01
LB4110A - E1	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E2	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E3	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E4	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - F1	Alpha	11/2/2019	9/9/2021	1.67E-01	P	-1.62E-02	1.23E-01	2.62E-01
LB4110A - F2	Alpha	11/2/2019	9/9/2021	1.17E-01	P	-3.80E-02	1.13E-01	2.65E-01
LB4110A - F3	Alpha	11/2/2019	9/9/2021	1.50E-01	P	-1.49E-02	1.01E-01	2.18E-01
LB4110A - F4	Alpha	11/2/2019	9/9/2021	1.67E-02	P	-3.52E-02	6.81E-02	1.71E-01
LB4110A - G1	Alpha	11/2/2019	9/9/2021	1.67E-01	P	-2.15E-02	8.50E-02	1.92E-01
LB4110A - G2	Alpha	11/2/2019	9/9/2021	8.33E-02	P	-1.98E-02	8.53E-02	1.90E-01
LB4110A - G3	Alpha	11/2/2019	9/9/2021	1.17E-01	P	-1.08E-02	1.37E-01	2.64E-01
LB4110A - G4	Alpha	11/2/2019	9/9/2021	1.00E-01	P	-2.52E-02	9.74E-02	2.20E-01



GPC Detector Report  
(ALL Backgrounds)

LP  
9/9/21

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	9/9/2021	1.35E+00	P	-1.75E+00	1.39E+00	4.52E+00
LB4110A - A2	Beta	11/2/2019	9/9/2021	1.47E+00	P	-1.57E+00	1.68E+00	4.92E+00
LB4110A - A3	Beta	11/2/2019	9/9/2021	1.30E+00	P	-1.54E+00	1.47E+00	4.48E+00
LB4110A - A4	Beta	11/2/2019	9/9/2021	1.58E+00	P	-1.67E+00	1.51E+00	4.68E+00
LB4110A - B1	Beta	11/2/2019	9/9/2021	1.58E+00	P	1.02E+00	1.40E+00	1.77E+00
LB4110A - B2	Beta	11/2/2019	9/9/2021	1.42E+00	P	8.16E-01	1.41E+00	2.00E+00
LB4110A - B3	Beta	11/2/2019	9/9/2021	1.52E+00	P	9.29E-01	1.33E+00	1.72E+00
LB4110A - B4	Beta	11/2/2019	9/9/2021	1.97E+00	P	6.84E-01	1.56E+00	2.44E+00
LB4110A - C1	Beta	11/2/2019	9/9/2021	1.32E+00	P	8.02E-01	1.17E+00	1.54E+00
LB4110A - C2	Beta	11/2/2019	9/9/2021	9.83E-01	P	6.71E-01	1.02E+00	1.37E+00
LB4110A - C3	Beta	11/2/2019	9/9/2021	1.43E+00	P	7.81E-01	1.35E+00	1.92E+00
LB4110A - C4	Beta	11/2/2019	9/9/2021	1.18E+00	P	8.62E-01	1.25E+00	1.71E+00
LB4110A - D1	Beta	11/2/2019	9/9/2021	9.67E-01	P	6.70E-01	1.08E+00	1.48E+00
LB4110A - D2	Beta	11/2/2019	9/9/2021	1.25E+00	P	-1.34E+00	2.48E+00	6.30E+00
LB4110A - D3	Beta	11/2/2019	9/9/2021	9.67E-01	P	7.39E-01	1.12E+00	1.50E+00
LB4110A - D4	Beta	11/2/2019	9/9/2021	1.35E+00	P	1.04E+00	1.47E+00	1.90E+00
LB4110A - E1	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E2	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E3	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E4	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - F1	Beta	11/2/2019	9/9/2021	1.20E+00	P	2.63E-01	1.29E+00	2.32E+00
LB4110A - F2	Beta	11/2/2019	9/9/2021	2.18E+00	F	-4.67E-01	1.19E+00	2.84E+00
LB4110A - F3	Beta	11/2/2019	9/9/2021	1.02E+00	P	-2.14E-01	1.20E+00	2.61E+00
LB4110A - F4	Beta	11/2/2019	9/9/2021	3.15E+00	F	-1.27E+00	1.60E+00	4.46E+00
LB4110A - G1	Beta	11/2/2019	9/9/2021	1.23E+00	P	7.58E-01	1.17E+00	1.59E+00
LB4110A - G2	Beta	11/2/2019	9/9/2021	1.53E+00	P	1.13E+00	1.58E+00	2.04E+00
LB4110A - G3	Beta	11/2/2019	9/9/2021	9.83E-01	P	7.54E-01	1.17E+00	1.59E+00
LB4110A - G4	Beta	11/2/2019	9/9/2021	1.37E+00	P	7.21E-01	1.25E+00	1.77E+00

GPC Detector Report  
(ALL Efficiencies)

LP  
9/9/21

LP

LP 9/9/21  
out of service

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	9/9/2021	0.2304	P	0.2049	0.2329	0.2610
LB4110A - A2	Alpha	11/2/2019	9/9/2021	0.2032	P	0.1771	0.2019	0.2268
LB4110A - A3	Alpha	11/2/2019	9/9/2021	0.1961	P	0.1720	0.1966	0.2212
LB4110A - A4	Alpha	11/2/2019	9/9/2021	0.2255	P	0.1978	0.2259	0.2540
LB4110A - B1	Alpha	11/2/2019	9/9/2021	0.2106	P	0.1824	0.2106	0.2388
LB4110A - B2	Alpha	11/2/2019	9/9/2021	0.2049	P	0.1724	0.1984	0.2244
LB4110A - B3	Alpha	11/2/2019	9/9/2021	0.2358	P	0.2034	0.2343	0.2652
LB4110A - B4	Alpha	11/2/2019	9/9/2021	0.2376	P	0.1965	0.2276	0.2587
LB4110A - C1	Alpha	11/2/2019	9/9/2021	0.1945	P	0.1736	0.1988	0.2239
LB4110A - C2	Alpha	11/2/2019	9/9/2021	0.1930	P	0.1748	0.2008	0.2267
LB4110A - C3	Alpha	11/2/2019	9/9/2021	0.2130	P	0.1934	0.2255	0.2577
LB4110A - C4	Alpha	11/2/2019	9/9/2021	0.1954	P	0.1786	0.2105	0.2423
LB4110A - D1	Alpha	11/2/2019	9/9/2021	0.1976	P	0.1720	0.1976	0.2233
LB4110A - D2	Alpha	11/2/2019	9/9/2021	0.2350	P	0.2059	0.2354	0.2650
LB4110A - D3	Alpha	11/2/2019	9/9/2021	0.2433	P	0.2114	0.2415	0.2716
LB4110A - D4	Alpha	11/2/2019	9/9/2021	0.1839	P	0.1611	0.1848	0.2086
LB4110A - E1	Alpha	11/2/2017	5/19/2020	0.2075	P	0.1686	0.2257	0.2828
LB4110A - E2	Alpha	11/2/2017	5/19/2020	0.1778	P	0.1514	0.2049	0.2583
LB4110A - E3	Alpha	11/2/2017	5/19/2020	0.2234	P	0.1549	0.2076	0.2604
LB4110A - E4	Alpha	11/2/2017	5/19/2020	0.2155	P	0.1746	0.2353	0.2961
LB4110A - F1	Alpha	11/2/2019	9/9/2021	0.1950	P	0.1807	0.2114	0.2422
LB4110A - F2	Alpha	11/2/2019	9/9/2021	0.1620	P	0.1521	0.1768	0.2014
LB4110A - F3	Alpha	11/2/2019	9/9/2021	0.2173	P	0.1907	0.2206	0.2505
LB4110A - F4	Alpha	11/2/2019	9/9/2021	0.2093	P	0.1864	0.2153	0.2441
LB4110A - G1	Alpha	11/2/2019	9/9/2021	0.1867	P	0.1756	0.1868	0.1981
LB4110A - G2	Alpha	11/2/2019	9/9/2021	0.1844	P	0.1717	0.1833	0.1950
LB4110A - G3	Alpha	11/2/2019	9/9/2021	0.2148	P	0.2027	0.2152	0.2276
LB4110A - G4	Alpha	11/2/2019	9/9/2021	0.1859	P	0.1622	0.1832	0.2042

0.2716

GPC Detector Report  
(ALL Efficiencies)

KP  
9/9/21

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	9/9/2021	0.5736	P	0.4966	0.5651	0.6336
LB4110A - A2	Beta	11/2/2019	9/9/2021	0.4408	P	0.3882	0.4432	0.4981
LB4110A - A3	Beta	11/2/2019	9/9/2021	0.4777	P	0.4194	0.4790	0.5386
LB4110A - A4	Beta	11/2/2019	9/9/2021	0.5645	P	0.4858	0.5535	0.6213
LB4110A - B1	Beta	11/2/2019	9/9/2021	0.4971	P	0.4273	0.4944	0.5615
LB4110A - B2	Beta	11/2/2019	9/9/2021	0.5034	P	0.4291	0.4944	0.5596
LB4110A - B3	Beta	11/2/2019	9/9/2021	0.5910	P	0.5094	0.5860	0.6627
LB4110A - B4	Beta	11/2/2019	9/9/2021	0.5767	P	0.4853	0.5631	0.6408
LB4110A - C1	Beta	11/2/2019	9/9/2021	0.4777	P	0.4192	0.4781	0.5371
LB4110A - C2	Beta	11/2/2019	9/9/2021	0.4610	P	0.4205	0.4811	0.5417
LB4110A - C3	Beta	11/2/2019	9/9/2021	0.5447	P	0.4898	0.5700	0.6502
LB4110A - C4	Beta	11/2/2019	9/9/2021	0.4983	P	0.4397	0.5143	0.5889
LB4110A - D1	Beta	11/2/2019	9/9/2021	0.5780	P	0.5052	0.5782	0.6513
LB4110A - D2	Beta	11/2/2019	9/9/2021	0.5971	P	0.5200	0.5943	0.6685
LB4110A - D3	Beta	11/2/2019	9/9/2021	0.6091	P	0.5295	0.6036	0.6778
LB4110A - D4	Beta	11/2/2019	9/9/2021	0.4876	P	0.4238	0.4836	0.5433
LB4110A - E1	Beta	11/2/2017	5/19/2020	0.5360	P	0.4167	0.5408	0.6649
LB4110A - E2	Beta	11/2/2017	5/19/2020	0.4520	P	0.3728	0.4910	0.6092
LB4110A - E3	Beta	11/2/2017	5/19/2020	0.5775	P	0.3848	0.5001	0.6154
LB4110A - E4	Beta	11/2/2017	5/19/2020	0.5466	P	0.4532	0.5887	0.7241
LB4110A - F1	Beta	11/2/2019	9/9/2021	0.5076	P	0.4743	0.5319	0.5895
LB4110A - F2	Beta	11/2/2019	9/9/2021	0.4175	P	0.3930	0.4436	0.4941
LB4110A - F3	Beta	11/2/2019	9/9/2021	0.5645	P	0.5086	0.5737	0.6388
LB4110A - F4	Beta	11/2/2019	9/9/2021	0.5424	P	0.4918	0.5530	0.6143
LB4110A - G1	Beta	11/2/2019	9/9/2021	0.4447	P	0.4181	0.4440	0.4699
LB4110A - G2	Beta	11/2/2019	9/9/2021	0.4392	P	0.4059	0.4346	0.4633
LB4110A - G3	Beta	11/2/2019	9/9/2021	0.5155	P	0.4914	0.5189	0.5464
LB4110A - G4	Beta	11/2/2019	9/9/2021	0.4371	P	0.3918	0.4396	0.4873

out of service  
KP 9/9/21

**SECTION X**  
**BARIUM-133 ANALYTICAL TRACER DATA**



LP  
9/7/21

Analysis Report for 2108094-01  
SPIKE

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-01  
 Sample Description : SPIKE  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:04AM  
 Acquisition Started : 9/7/2021 10:04:32AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.03 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 114537

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:19:35AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-01

SPIKE

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	52.95	49 -	57	53.41	5.32E+01	44.58	2.70E+02	2.17
2	62.63	58 -	69	63.09	3.25E+02	67.32	4.10E+02	2.50
3	80.82	76 -	85	81.27	8.21E+02	74.77	3.29E+02	2.32
M 4	111.65	106 -	121	112.07	1.77E+02	46.09	2.22E+02	2.72
m 5	116.22	106 -	121	116.64	2.76E+01	35.27	1.75E+02	2.11
6	274.43	261 -	280	274.72	8.01E+01	44.81	1.44E+02	2.23
M 7	302.95	297 -	311	303.22	1.58E+02	31.06	6.28E+01	2.42
m 8	306.95	297 -	311	307.22	2.10E+01	25.54	6.85E+01	2.42
M 9	333.53	327 -	346	333.78	6.18E+01	21.32	3.03E+01	2.44
m 10	338.53	327 -	346	338.78	2.54E+01	19.35	4.14E+01	2.45
M 11	356.15	349 -	363	356.39	5.30E+02	48.70	4.30E+01	2.61
m 12	360.98	349 -	363	361.21	1.51E+01	22.16	4.16E+01	2.71
M 13	384.31	379 -	398	384.52	1.39E+02	39.01	4.06E+01	3.00
m 14	387.14	379 -	398	387.35	1.91E+02	37.06	2.13E+01	2.28
15	391.33	379 -	398	391.53	5.03E+01	26.26	1.04E+01	2.39
M 16	414.93	410 -	424	415.12	3.61E+01	19.15	4.02E+01	2.50
m 17	418.82	410 -	424	419.00	3.23E+01	19.67	3.67E+01	2.27
18	436.84	431 -	442	437.01	9.31E+01	23.75	2.38E+01	2.51
M 19	464.62	463 -	474	464.77	7.49E+00	7.75	1.48E+01	2.53
m 20	468.08	463 -	474	468.23	2.61E+01	15.23	2.08E+01	2.53
21	529.07	525 -	531	529.17	6.00E+00	4.90	0.00E+00	2.74
22	602.84	600 -	605	602.88	5.38E+00	7.07	5.25E+00	2.85
23	610.00	607 -	612	610.03	6.45E+00	8.43	9.09E+00	2.16

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:19:35AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114498.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	52.95	5.32E+01	44.58			5.32E+01	4.46E+01
2	62.63	3.25E+02	67.32	2.45E+01	2.35E+00	3.00E+02	6.74E+01
3	80.82	8.21E+02	74.77			8.21E+02	7.48E+01
M 4	111.65	1.77E+02	46.09	1.10E+00	1.84E+00	1.76E+02	4.61E+01
m 5	116.22	2.76E+01	35.27			2.76E+01	3.53E+01
6	274.43	8.01E+01	44.81			8.01E+01	4.48E+01

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Analysis Report for 2108094-01

SPIKE

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M 7	302.95	1.58E+02	31.06			1.58E+02	3.11E+01
m 8	306.95	2.10E+01	25.54			2.10E+01	2.55E+01
M 9	333.53	6.18E+01	21.32			6.18E+01	2.13E+01
m 10	338.53	2.54E+01	19.35			2.54E+01	1.94E+01
M 11	356.15	5.30E+02	48.70			5.30E+02	4.87E+01
m 12	360.98	1.51E+01	22.16			1.51E+01	2.22E+01
M 13	384.31	1.39E+02	39.01			1.39E+02	3.90E+01
m 14	387.14	1.91E+02	37.06			1.91E+02	3.71E+01
m 15	391.33	5.03E+01	26.26			5.03E+01	2.63E+01
M 16	414.93	3.61E+01	19.15			3.61E+01	1.92E+01
m 17	418.82	3.23E+01	19.67			3.23E+01	1.97E+01
	18	436.84	9.31E+01	23.75		9.31E+01	2.37E+01
M 19	464.62	7.49E+00	7.75			7.49E+00	7.75E+00
m 20	468.08	2.61E+01	15.23			2.61E+01	1.52E+01
	21	529.07	6.00E+00	4.90		6.00E+00	4.90E+00
	22	602.84	5.38E+00	7.07		5.38E+00	7.07E+00
	23	610.00	6.45E+00	8.43		6.45E+00	8.43E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty	
SN-113	0.95	255.12	1.93			
		391.69	*	61.90	3.90E+01	2.08E+01
BA-133	0.99	81.00	*	34.06	4.21E+02	5.67E+01
		302.84	*	18.33	4.47E+02	1.53E+02
		356.01	*	62.05	4.26E+02	6.23E+01
TH-234	0.98	63.29	*	3.80	8.41E+02	1.95E+02

Analysis Report for 2108094-01

SPIKE

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
SN-113	0.950	3.90E+01	2.08E+01	
BA-133	0.999	<del>4.25E+02</del>	<del>4.04E+01</del>	
TH-234	0.989	8.41E+02	1.95E+02	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2108094-01

SPIKE

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 9/7/2021 10:19:35AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	52.95	5.90751E-02		
M	4	111.65	1.95743E-01		
m	5	116.22	3.06238E-02	Tol.	U-237
	6	274.43	8.90205E-02		
m	8	306.95	2.33334E-02		
M	9	333.53	6.87158E-02		
m	10	338.53	2.81999E-02		
m	12	360.98	1.68229E-02		
M	13	384.31	1.54778E-01	Sum	
m	14	387.14	2.12705E-01		
M	16	414.93	4.01336E-02		
m	17	418.82	3.58626E-02	Sum	
	18	436.84	1.03429E-01	Sum	
M	19	464.62	8.31828E-03		
m	20	468.08	2.89793E-02		
	21	529.07	6.66667E-03		
	22	602.84	5.97222E-03		
	23	610.00	7.17172E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2108094-01

SPIKE

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	8.60E-07	8.60E-07	0.00E+00	0.00E+00
	3.31	12.30	1.01E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.49E-04	1.49E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.69E+01	1.69E+01	-1.40E+00	7.97E+00
	136.48	10.60	1.50E+02		-4.71E+01	7.04E+01
NI-59	6.92	29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.33E-03	9.33E-03	0.00E+00	0.00E+00
	18.60	10.00	7.73E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.21E-02	5.21E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	3.05E+02	3.05E+02	-3.71E+02	1.45E+02
+ SN-113	255.12	1.93	9.08E+02	3.63E+01	3.75E+01	4.18E+02
	391.69	*	61.90	3.63E+01	3.90E+01	1.71E+01
SN-119M	23.87	16.10	1.20E-01	1.01E-01	0.00E+00	0.00E+00
	25.10	22.70	1.01E-01		0.00E+00	0.00E+00
I-129	29.78	57.00	1.78E+00	1.78E+00	7.46E-01	8.53E-01
	33.60	13.20	2.18E+01		1.10E+02	1.07E+01
	39.58	7.52	3.40E+01		-7.18E+01	1.64E+01
+ BA-133	81.00	*	34.06	3.73E+01	4.21E+02	2.02E+01
	302.84	*	18.33	1.64E+02	4.47E+02	7.83E+01
	356.01	*	62.05	3.73E+01	4.26E+02	1.75E+01
CE-139	165.85	80.35	2.36E+01	2.36E+01	-1.73E+01	1.11E+01
CE-144	133.54	10.80	1.37E+02	1.37E+02	-4.68E+01	6.41E+01
HG-203	279.19	77.30	3.02E+01	3.02E+01	-2.13E+00	1.42E+01
PB-210	46.50	4.25	6.47E+01	6.47E+01	-1.88E+01	3.07E+01
TH-231	25.64	14.70	1.68E-01	1.68E-01	0.00E+00	0.00E+00
	84.21	6.40	3.05E+02		9.72E+00	1.49E+02
PA-234M	9.89	89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
	21.72	64.90	2.12E-02		0.00E+00	0.00E+00
	37.93	23.75	1.48E+01		3.66E+01	7.24E+00
+ TH-234	63.29	*	3.80	2.74E+02	8.41E+02	1.33E+02
NP-237	29.37	14.00	6.92E+00	6.92E+00	2.91E+00	3.32E+00
	86.50	12.60	9.38E+01		-5.90E+01	4.48E+01
U-237	97.08	16.30	6.81E+01	4.71E+01	-5.76E+01	3.21E+01
	101.07	26.30	4.71E+01		1.01E+01	2.23E+01
	114.00	12.30	2.00E+02		4.00E+02	9.67E+01
	208.01	22.00	8.93E+01		-2.17E+01	4.16E+01
AM-241	59.54	35.90	2.30E+01	2.30E+01	3.49E+01	1.12E+01
AM-243	74.67	66.00	1.20E+01	1.20E+01	-2.75E+00	5.69E+00

- † = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

KP  
9/7/21

Analysis Report for 2108094-02  
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## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-02  
 Sample Description : BLANK  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:11AM  
 Acquisition Started : 9/7/2021 10:04:39AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.03 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 28 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :

Sample Number : 114538

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:19:49AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-02

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Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	36.74	37 - 41	37.43	4.09E+02	69.53	3.12E+02	2.19
	2	53.75	51 - 58	54.42	7.96E+01	34.12	1.43E+02	1.64
M	3	63.25	59 - 74	63.91	1.95E+02	37.39	1.12E+02	1.70
m	4	67.16	59 - 74	67.82	1.01E+02	33.13	1.23E+02	1.71
	5	82.29	79 - 86	82.93	8.18E+02	67.59	2.16E+02	1.22
M	6	109.51	109 - 125	110.13	1.38E+01	11.22	3.37E+01	1.38
m	7	113.34	109 - 125	113.95	1.55E+02	31.62	6.14E+01	1.38
m	8	117.27	109 - 125	117.87	3.60E+01	21.26	5.57E+01	1.39
M	9	183.60	183 - 190	184.14	1.34E+01	11.62	3.43E+01	1.50
	10	241.11	238 - 247	241.59	2.50E+01	25.69	8.00E+01	2.17
M	11	273.55	273 - 281	274.00	7.48E+00	5.83	4.38E+00	1.47
m	12	277.41	273 - 281	277.85	6.42E+01	19.76	2.36E+01	1.62
M	13	303.82	301 - 320	304.23	1.50E+02	26.93	3.70E+01	1.63
m	14	308.38	301 - 320	308.79	2.32E+01	16.16	2.36E+01	1.82
	15	324.44	321 - 328	324.83	1.30E+01	14.00	2.40E+01	1.00
	16	335.20	331 - 340	335.59	5.30E+01	29.65	9.60E+01	1.58
	17	356.86	352 - 360	357.23	5.57E+02	49.09	3.09E+01	1.68
	18	364.62	362 - 368	364.98	2.15E+01	11.16	7.00E+00	4.07
M	19	374.65	374 - 400	375.00	7.45E+00	5.74	3.06E+00	1.57
m	20	384.93	374 - 400	385.26	1.07E+02	24.49	8.93E+00	1.91
m	21	387.81	374 - 400	388.14	1.46E+02	27.44	1.15E+01	1.60
m	22	392.00	374 - 400	392.33	2.89E+01	19.90	1.67E+01	1.92
	23	416.67	411 - 421	416.97	5.76E+01	22.80	3.87E+01	5.04
	24	423.30	422 - 427	423.59	1.22E+01	12.61	2.36E+01	2.59
	25	437.80	433 - 441	438.08	8.77E+01	20.99	1.47E+01	1.56
	26	468.12	465 - 470	468.38	7.46E+00	9.38	1.11E+01	1.73
	27	481.79	479 - 484	482.04	6.56E+00	6.40	2.88E+00	1.61
	28	518.18	516 - 521	518.39	5.88E+00	7.07	4.25E+00	1.03
	29	579.45	576 - 582	579.60	6.50E+00	8.03	7.00E+00	2.99

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:19:49AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114499.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
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Analysis Report for 2108094-02

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Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	36.74	4.09E+02	69.53		4.09E+02	6.95E+01
	2	53.75	7.96E+01	34.12		7.96E+01	3.41E+01
M	3	63.25	1.95E+02	37.39	5.84E+00	2.00E+00	1.90E+02
m	4	67.16	1.01E+02	33.13		1.01E+02	3.31E+01
	5	82.29	8.18E+02	67.59		8.18E+02	6.76E+01
M	6	109.51	1.38E+01	11.22		1.38E+01	1.12E+01
m	7	113.34	1.55E+02	31.62		1.55E+02	3.16E+01
m	8	117.27	3.60E+01	21.26		3.60E+01	2.13E+01
M	9	183.60	1.34E+01	11.62		1.34E+01	1.16E+01
	10	241.11	2.50E+01	25.69	3.40E+00	1.65E+00	2.16E+01
M	11	273.55	7.48E+00	5.83		7.48E+00	5.83E+00
m	12	277.41	6.42E+01	19.76		6.42E+01	1.98E+01
M	13	303.82	1.50E+02	26.93		1.50E+02	2.69E+01
m	14	308.38	2.32E+01	16.16		2.32E+01	1.62E+01
	15	324.44	1.30E+01	14.00		1.30E+01	1.40E+01
	16	335.20	5.30E+01	29.65		5.30E+01	2.96E+01
	17	356.86	5.57E+02	49.09		5.57E+02	4.91E+01
	18	364.62	2.15E+01	11.16		2.15E+01	1.12E+01
M	19	374.65	7.45E+00	5.74		7.45E+00	5.74E+00
m	20	384.93	1.07E+02	24.49		1.07E+02	2.45E+01
m	21	387.81	1.46E+02	27.44		1.46E+02	2.74E+01
m	22	392.00	2.89E+01	19.90		2.89E+01	1.99E+01
	23	416.67	5.76E+01	22.80		5.76E+01	2.28E+01
	24	423.30	1.22E+01	12.61		1.22E+01	1.26E+01
	25	437.80	8.77E+01	20.99		8.77E+01	2.10E+01
	26	468.12	7.46E+00	9.38		7.46E+00	9.38E+00
	27	481.79	6.56E+00	6.40		6.56E+00	6.40E+00
	28	518.18	5.88E+00	7.07		5.88E+00	7.07E+00
	29	579.45	6.50E+00	8.03		6.50E+00	8.03E+00

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
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Analysis Report for 2108094-02

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<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
SN-113	0.96	255.12	1.93		
		391.69 *	61.90	1.89E+01	1.31E+01
BA-133	0.97	81.00 *	34.06	5.22E+02	7.04E+01
		302.84 *	18.33	5.31E+02	1.86E+02
		356.01 *	62.05	4.44E+02	6.28E+01
HG-203	0.92	279.19 *	77.30	6.05E+01	2.78E+01
PA-234M	0.99	9.89	89.00		
		21.72	64.90		
		37.93 *	23.75	1.02E+01	1.74E+00
TH-234	1.00	63.29 *	3.80	4.28E+02	8.64E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.963	1.89E+01	1.31E+01	
BA-133	0.974	<del>4.82E+02</del>	4.55E+01	
HG-203	0.922	6.05E+01	2.78E+01	
PA-234M	0.995	1.02E+01	1.74E+00	
TH-234	1.000	4.28E+02	8.64E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2108094-02

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 UNIDENTIFIED PEAKS
 

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Peak Locate Performed on : 9/7/2021 10:19:49AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	53.75	8.84032E-02		
m	4	67.16	1.12354E-01		
M	6	109.51	1.53627E-02		
m	7	113.34	1.72496E-01	Tol.	U-237
m	8	117.27	3.99783E-02	Sum	
M	9	183.60	1.48731E-02		
	10	241.11	2.40050E-02		
M	11	273.55	8.31637E-03		
m	14	308.38	2.58191E-02		
	15	324.44	1.44444E-02		
	16	335.20	5.88999E-02		
	18	364.62	2.38889E-02	Sum	
M	19	374.65	8.28245E-03		
m	20	384.93	1.19385E-01	Sum	
m	21	387.81	1.62348E-01	Sum	
	23	416.67	6.40476E-02		
	24	423.30	1.35417E-02		
	25	437.80	9.73977E-02	Sum	
	26	468.12	8.29060E-03		
	27	481.79	7.29167E-03		
	28	518.18	6.52778E-03		
	29	579.45	7.22222E-03	Sum	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

Analysis Report for 2108094-02

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## NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.84E-13	1.84E-13	0.00E+00	0.00E+00
	3.31	12.30	4.70E-12		0.00E+00	0.00E+00
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.25E+01	2.25E+01	-3.42E-01	1.04E+01
	136.48	10.60	2.36E+02		-2.70E+01	1.09E+02
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.77E+02	2.77E+02	1.38E+01	1.29E+02
+ SN-113	255.12	1.93	1.13E+03	3.15E+01	4.56E+02	5.11E+02
	391.69	* 61.90	3.15E+01		1.89E+01	1.49E+01
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	5.14E-02		-6.56E-02	2.28E-02
I-129	29.78	57.00	3.07E-01	3.07E-01	-6.01E+00	1.50E-01
	33.60	13.20	5.66E+00		1.82E+01	2.79E+00
	39.58	7.52	9.08E+00		-7.96E-01	4.38E+00
+ BA-133	81.00	* 34.06	3.95E+01	1.99E+01	5.22E+02	1.89E+01
	302.84	* 18.33	2.25E+02		5.31E+02	1.08E+02
	356.01	* 62.05	1.99E+01		4.44E+02	8.87E+00
CE-139	165.85	80.35	3.17E+01	3.17E+01	-8.12E+00	1.45E+01
CE-144	133.54	10.80	2.35E+02	2.35E+02	1.19E+02	1.10E+02
+ HG-203	279.19	* 77.30	2.70E+01	2.70E+01	6.05E+01	1.22E+01
PB-210	46.50	4.25	1.81E+01	1.81E+01	1.22E+01	8.36E+00
TH-231	25.64	14.70	9.24E-02	9.24E-02	-1.18E-01	4.09E-02
	84.21	6.40	4.76E+02		2.39E+03	2.33E+02
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93	* 23.75	2.39E+00		1.02E+01	1.16E+00
+ TH-234	63.29	* 3.80	2.18E+02	2.18E+02	4.28E+02	1.06E+02
NP-237	29.37	14.00	1.14E+00	1.14E+00	-2.23E+01	5.55E-01
	86.50	12.60	8.00E+01		2.00E+00	3.73E+01
U-237	97.08	16.30	7.01E+01	5.57E+01	-6.19E+01	3.22E+01
	101.07	26.30	5.57E+01		2.20E+01	2.59E+01
	114.00	12.30	2.95E+02		2.67E+02	1.42E+02
	208.01	22.00	1.57E+02		1.01E+02	7.31E+01
AM-241	59.54	35.90	7.92E+00	7.92E+00	-2.15E+01	3.71E+00
AM-243	74.67	66.00	1.03E+01	1.03E+01	3.84E+00	4.84E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction



Analysis Report for 2108094-02  
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Analysis Report for 2108094-03  
H-34

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-03  
 Sample Description : H-34  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:18AM  
 Acquisition Started : 9/7/2021 10:04:47AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 908.4 seconds

Dead Time : 0.93 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 8 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :

Sample Number : 114539

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:20:11AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-03

H-34

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	31.00	17 -	45	31.43	2.04E+03	109.87	3.36E+02	3.28
m	2	35.07	17 -	45	35.49	5.37E+02	113.07	3.22E+02	3.87
	3	52.05	49 -	56	52.45	4.41E+01	40.25	2.42E+02	1.95
M	4	61.38	57 -	71	61.77	1.90E+02	62.02	3.75E+02	3.23
m	5	64.97	57 -	71	65.35	1.29E+02	63.80	4.07E+02	3.27
	6	81.31	75 -	87	81.67	8.14E+02	82.74	4.21E+02	3.59
M	7	112.09	106 -	123	112.42	2.72E+02	56.41	2.64E+02	3.71
m	8	116.85	106 -	123	117.17	4.50E+01	42.94	1.72E+02	2.68
M	9	242.03	240 -	248	242.20	1.49E+01	17.05	5.01E+01	2.22
m	10	245.63	240 -	248	245.80	2.29E+01	21.56	6.21E+01	2.22
	11	277.11	272 -	284	277.23	8.63E+01	28.99	5.74E+01	3.88
M	12	300.46	299 -	311	300.56	2.34E+01	11.84	1.47E+01	1.83
m	13	303.34	299 -	311	303.43	9.18E+01	26.58	3.16E+01	2.49
	14	335.92	329 -	348	335.98	9.10E+01	39.55	1.00E+02	5.84
	15	356.35	351 -	363	356.38	4.52E+02	48.09	6.15E+01	4.02
	16	387.18	380 -	398	387.17	3.04E+02	45.37	6.10E+01	4.58
	17	416.80	410 -	426	416.75	6.08E+01	30.82	6.44E+01	3.43
	18	437.12	431 -	442	437.06	9.91E+01	24.25	2.37E+01	3.50
	19	467.97	464 -	473	467.86	1.65E+01	15.65	2.70E+01	3.48
	20	540.48	538 -	542	540.29	7.00E+00	5.29	0.00E+00	1.16

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:20:11AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114496.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	31.00	2.04E+03	109.87			2.04E+03	1.10E+02
m	2	35.07	5.37E+02	113.07			5.37E+02	1.13E+02
	3	52.05	4.41E+01	40.25			4.41E+01	4.02E+01
M	4	61.38	1.90E+02	62.02	1.24E+01	2.62E+00	1.78E+02	6.21E+01
m	5	64.97	1.29E+02	63.80	1.24E+01	2.62E+00	1.16E+02	6.39E+01
	6	81.31	8.14E+02	82.74			8.14E+02	8.27E+01
M	7	112.09	2.72E+02	56.41			2.72E+02	5.64E+01
m	8	116.85	4.50E+01	42.94			4.50E+01	4.29E+01
M	9	242.03	1.49E+01	17.05			1.49E+01	1.71E+01

0124

Analysis Report for 2108094-03

H-34

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m 10	245.63	2.29E+01	21.56			2.29E+01	2.16E+01
11	277.11	8.63E+01	28.99			8.63E+01	2.90E+01
M 12	300.46	2.34E+01	11.84			2.34E+01	1.18E+01
m 13	303.34	9.18E+01	26.58			9.18E+01	2.66E+01
14	335.92	9.10E+01	39.55			9.10E+01	3.95E+01
15	356.35	4.52E+02	48.09			4.52E+02	4.81E+01
16	387.18	3.04E+02	45.37			3.04E+02	4.54E+01
17	416.80	6.08E+01	30.82			6.08E+01	3.08E+01
18	437.12	9.91E+01	24.25			9.91E+01	2.42E+01
19	467.97	1.65E+01	15.65			1.65E+01	1.57E+01
20	540.48	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.86	29.78	*	57.00	1.51E+00
		33.60	*	13.20	1.09E+01
		39.58		7.52	
BA-133	0.99	81.00	*	34.06	5.72E+01
		302.84	*	18.33	1.24E+02
		356.01	*	62.05	6.67E+01
		279.19	*	77.30	3.12E+01
HG-203	0.89	279.19	*	6.90E+01	1.64E+02
TH-234	0.93	63.29	*	2.97E+02	1.45E+01
AM-241	0.91	59.54	*	4.12E+01	

Analysis Report for 2108094-03

H-34

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
I-129	0.867	2.84E+01	1.49E+00	
BA-133	0.997	<del>3.95E+02</del>	<del>4.10E+01</del>	
HG-203	0.895	6.90E+01	3.12E+01	
TH-234	0.931	2.97E+02	1.64E+02	
X NP-237	0.743			
AM-241	0.917	4.12E+01	1.45E+01	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity  
 Errors quoted at 2.000sigma

Analysis Report for 2108094-03  
H-34

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/7/2021 10:20:11AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	52.05	4.89899E-02		
M	7	112.09	3.01925E-01	Sum	
m	8	116.85	5.00524E-02	Sum	
M	9	242.03	1.65139E-02		
m	10	245.63	2.54910E-02		
M	12	300.46	2.60177E-02		
	14	335.92	1.01111E-01	Sum	
	16	387.18	3.37232E-01	Sum	
	17	416.80	6.75448E-02	Sum	
	18	437.12	1.10160E-01	Sum	
	19	467.97	1.83333E-02		
	20	540.48	7.77778E-03		

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	8.48E-09	8.48E-09	0.00E+00	0.00E+00
	3.31	12.30	1.24E-07		0.00E+00	0.00E+00
FE-55	5.89	24.50	3.15E-05	3.15E-05	-1.18E-04	1.27E-05
CO-57	122.06	85.51	2.04E+01	2.04E+01	9.09E-01	9.64E+00

0127

Analysis Report for 2108094-03

H-34

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CO-57	136.48	10.60	1.92E+02	2.04E+01	5.05E+01	9.04E+01
NI-59	6.92	29.80	2.15E-04	2.15E-04	7.14E-05	9.95E-05
MO-93	16.59	52.90	5.41E-02	5.41E-02	6.09E-03	2.60E-02
	18.60	10.00	5.42E-01		1.85E-01	2.61E-01
NB-93M	16.57	9.43	3.02E-01	3.02E-01	3.39E-02	1.45E-01
CD-109	88.03	3.72	3.09E+02	3.09E+02	4.06E+00	1.47E+02
SN-113	255.12	1.93	1.12E+03	3.79E+01	-1.54E+01	5.18E+02
	391.69	61.90	3.79E+01		-6.99E+00	1.78E+01
SN-119M	23.87	16.10	1.10E+00	1.10E+00	-4.44E+00	5.28E-01
	25.10	22.70	1.18E+00		-1.62E+01	5.71E-01
+ I-129	29.78	*	57.00	2.78E+00	2.79E+01	1.37E+00
	33.60	*	13.20	1.97E+01	5.19E+01	9.73E+00
	39.58		7.52	2.04E+01	-1.87E+01	9.82E+00
+ BA-133	81.00	*	34.06	5.03E+01	3.57E+01	4.05E+02
	302.84	*	18.33	1.23E+02		3.03E+02
	356.01	*	62.05	3.57E+01		4.08E+02
CE-139	165.85		80.35	2.96E+01	2.96E+01	-5.13E+00
CE-144	133.54		10.80	1.74E+02	1.74E+02	3.37E+01
+ HG-203	279.19	*	77.30	3.14E+01	3.14E+01	6.90E+01
PB-210	46.50		4.25	4.24E+01	4.24E+01	1.21E+01
TH-231	25.64		14.70	2.01E+00	2.01E+00	-2.75E+01
	84.21		6.40	3.14E+02		5.76E+02
PA-234M	9.89		89.00	1.31E-03	1.31E-03	1.23E-03
	21.72		64.90	1.79E-01		7.24E-02
	37.93		23.75	7.81E+00		-7.35E-01
+ TH-234	63.29	*	3.80	3.14E+02	3.14E+02	2.97E+02
NP-237	29.37	*	14.00	1.13E+01	1.13E+01	1.14E+02
	86.50		12.60	1.03E+02		1.13E+01
U-237	97.08		16.30	7.89E+01	5.43E+01	-3.28E+01
	101.07		26.30	5.43E+01		1.23E+01
	114.00		12.30	2.36E+02		4.66E+02
	208.01		22.00	1.04E+02		3.61E+00
+ AM-241	59.54	*	35.90	2.82E+01	2.82E+01	4.12E+01
AM-243	74.67		66.00	1.23E+01	1.23E+01	1.61E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

LP  
9/7/21

Analysis Report for 2108094-04  
H-34

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : 2108094-04  
 Sample Description : H-34  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:27AM  
 Acquisition Started : 9/7/2021 10:04:53AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.4 seconds

Dead Time : 0.05 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 8/25/2020  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 114540

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/7/2021 10:20:00AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-04

H-34

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	31.24	25 -	40	30.78	1.79E+03	91.41	1.76E+02	2.45
m	2	35.49	25 -	40	35.03	4.56E+02	84.85	1.44E+02	2.44
	3	52.97	47 -	56	52.51	8.40E+01	41.22	1.94E+02	3.31
	4	63.36	57 -	69	62.89	2.73E+02	58.96	2.83E+02	2.24
	5	81.40	75 -	88	80.92	7.28E+02	75.39	3.08E+02	2.68
M	6	112.15	105 -	118	111.66	1.96E+02	40.94	1.32E+02	2.74
m	7	115.93	105 -	118	115.44	4.38E+01	33.12	9.70E+01	2.03
	8	232.72	226 -	238	232.19	3.66E+01	31.08	9.28E+01	9.47
	9	276.79	270 -	280	276.24	5.38E+01	28.87	8.25E+01	5.21
	10	303.30	298 -	308	302.74	1.11E+02	31.39	7.33E+01	2.45
	11	334.42	331 -	338	333.85	3.44E+01	24.33	7.52E+01	1.61
	12	356.33	349 -	361	355.75	3.45E+02	40.01	2.64E+01	2.66
	13	386.87	379 -	393	386.28	2.21E+02	33.12	2.27E+01	4.78
	14	417.85	411 -	424	417.25	4.68E+01	20.88	2.64E+01	5.57
	15	436.84	431 -	440	436.23	5.24E+01	17.75	1.51E+01	2.27
	16	589.29	586 -	591	588.63	5.36E+00	6.08	3.29E+00	3.29

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:20:00AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114497.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	31.24	1.79E+03	91.41			1.79E+03	9.14E+01
m	2	35.49	4.56E+02	84.85			4.56E+02	8.49E+01
	3	52.97	8.40E+01	41.22			8.40E+01	4.12E+01
	4	63.36	2.73E+02	58.96	1.14E+01	2.11E+00	2.62E+02	5.90E+01
	5	81.40	7.28E+02	75.39			7.28E+02	7.54E+01
M	6	112.15	1.96E+02	40.94			1.96E+02	4.09E+01
m	7	115.93	4.38E+01	33.12			4.38E+01	3.31E+01
	8	232.72	3.66E+01	31.08			3.66E+01	3.11E+01
	9	276.79	5.38E+01	28.87			5.38E+01	2.89E+01
	10	303.30	1.11E+02	31.39			1.11E+02	3.14E+01
	11	334.42	3.44E+01	24.33			3.44E+01	2.43E+01
	12	356.33	3.45E+02	40.01			3.45E+02	4.00E+01
	13	386.87	2.21E+02	33.12			2.21E+02	3.31E+01

0130

Analysis Report for 2108094-04

H-34

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
14	417.85	4.68E+01	20.88			4.68E+01	2.09E+01
15	436.84	5.24E+01	17.75			5.24E+01	1.77E+01
16	589.29	5.36E+00	6.08			5.36E+00	6.08E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.78	29.78	*	57.00	5.37E+02	5.76E+01
		33.60	*	13.20	5.68E+02	1.18E+02
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.80E+02	5.42E+01
		302.84	*	18.33	3.96E+02	1.73E+02
		356.01	*	62.05	4.69E+02	9.13E+01
HG-203	0.86	279.19	*	77.30	3.96E+01	2.43E+01
TH-234	1.00	63.29	*	3.80	1.13E+03	2.73E+02

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

0131

Analysis Report for 2108094-04  
H-34

<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
I-129	0.786	5.43E+02	5.18E+01	
BA-133	0.996	<del>4.03E+02</del>	4.50E+01	
HG-203	0.863	<del>3.96E+01</del>	2.43E+01	
TH-234	1.000	1.13E+03	2.73E+02	

- ? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2108094-04

H-34

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 9/7/2021 10:20:00AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	52.97	9.33763E-02		
M	6	112.15	2.17846E-01	Sum	
m	7	115.93	4.86820E-02	Sum	
	8	232.72	4.06827E-02		
	11	334.42	3.82485E-02	Sum	
	13	386.87	2.45163E-01	Sum	
	14	417.85	5.20000E-02	Sum	
	15	436.84	5.82778E-02	Sum	
	16	589.29	5.95238E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.38E+01	1.38E+01	0.00E+00	0.00E+00
	3.31	12.30	6.90E+01		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.10E+01	1.10E+01	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.21E+01	1.21E+01	-6.02E+00	5.67E+00
	136.48	10.60	1.19E+02		4.51E+00	5.64E+01
NI-59	6.92	29.80	4.43E+01	4.43E+01	-3.44E+01	1.87E+01
MO-93	16.59	52.90	2.91E+01	2.91E+01	-2.77E+01	1.39E+01
	18.60	10.00	1.55E+02		5.16E+01	2.43E+01

0133

Analysis Report for 2108094-04

H-34

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
NB-93M	16.57	9.43	1.63E+02	1.63E+02	-1.56E+02	7.80E+01
CD-109	88.03	3.72	2.15E+02	2.15E+02	-6.26E+01	1.01E+02
SN-113	255.12	1.93	7.72E+02	8.23E+01	-6.68E+01	3.51E+02
	391.69	61.90	8.23E+01		-2.68E+00	3.90E+01
SN-119M	23.87	16.10	7.88E+01	5.21E+01	6.37E+01	3.77E+01
	25.10	22.70	5.21E+01		-3.31E+00	2.49E+01
+ I-129	29.78 *	57.00	2.97E+01	2.97E+01	5.37E+02	1.44E+01
	33.60 *	13.20	1.22E+02		5.68E+02	5.94E+01
	39.58	7.52	1.51E+02		-3.42E+00	7.26E+01
+ BA-133	81.00 *	34.06	4.66E+01	3.70E+01	3.80E+02	2.26E+01
	302.84 *	18.33	1.46E+02		3.96E+02	6.80E+01
	356.01 *	62.05	3.70E+01		4.69E+02	1.67E+01
CE-139	165.85	80.35	1.70E+01	1.70E+01	-2.20E+00	8.02E+00
CE-144	133.54	10.80	1.16E+02	1.16E+02	6.78E+00	5.48E+01
+ HG-203	279.19 *	77.30	3.21E+01	3.21E+01	3.96E+01	1.51E+01
PB-210	46.50	4.25	1.68E+02	1.68E+02	-4.62E+00	7.90E+01
TH-231	25.64	14.70	7.95E+01	7.95E+01	-5.05E+00	3.80E+01
	84.21	6.40	3.13E+02		9.82E+02	1.52E+02
PA-234M	9.89	89.00	2.07E+01	2.07E+01	5.13E+00	9.68E+00
	21.72	64.90	2.12E+01		1.58E+01	1.01E+01
	37.93	23.75	7.33E+01		8.82E+01	3.57E+01
+ TH-234	63.29 *	3.80	3.61E+02	3.61E+02	1.13E+03	1.74E+02
NP-237	29.37	14.00	2.55E+02	7.73E+01	1.91E+03	1.26E+02
	86.50	12.60	7.73E+01		-5.37E+02	3.67E+01
U-237	97.08	16.30	4.94E+01	3.32E+01	-2.92E+01	2.31E+01
	101.07	26.30	3.32E+01		1.30E+01	1.56E+01
	114.00	12.30	1.46E+02		3.57E+02	7.07E+01
	208.01	22.00	7.49E+01		1.01E+01	3.50E+01
AM-241	59.54	35.90	3.16E+01	3.16E+01	1.68E+01	1.52E+01
AM-243	74.67	66.00	1.18E+01	1.18E+01	1.94E+00	5.54E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

Analysis Report for 2108094-05  
H-32A

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-05  
 Sample Description : H-32A  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:35AM  
 Acquisition Started : 9/7/2021 10:20:20AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.02 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Used Done On : 10/12/2019  
 Efficiency Calibration Description :

Sample Number : 114541

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:35:24AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-05

H-32A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	52.01	49 -	56	52.48	4.99E+01	35.83	1.82E+02	3.08
M	2	61.53	57 -	69	61.99	2.25E+02	48.66	2.17E+02	2.64
m	3	65.65	57 -	69	66.11	1.22E+02	46.49	1.77E+02	2.49
	4	80.93	75 -	87	81.37	8.01E+02	76.45	3.07E+02	2.26
	5	91.50	89 -	96	91.94	6.14E+01	35.89	1.77E+02	3.62
	6	111.60	107 -	117	112.03	1.67E+02	56.47	3.38E+02	1.95
	7	173.47	170 -	177	173.85	2.48E+01	27.35	1.08E+02	1.44
	8	184.13	180 -	188	184.49	4.68E+01	33.53	1.44E+02	5.38
M	9	276.10	272 -	290	276.39	4.54E+01	23.52	4.86E+01	3.20
m	10	280.71	272 -	290	281.00	1.17E+01	16.07	2.74E+01	2.19
m	11	285.13	272 -	290	285.41	1.19E+01	19.72	3.42E+01	3.21
M	12	302.80	297 -	311	303.08	1.25E+02	30.69	8.13E+01	2.42
m	13	307.95	297 -	311	308.22	2.19E+01	22.93	7.77E+01	2.43
	14	334.14	327 -	341	334.39	5.64E+01	38.79	1.33E+02	3.03
	15	356.01	349 -	362	356.24	5.25E+02	54.01	8.96E+01	2.29
M	16	383.90	381 -	396	384.11	1.21E+02	24.46	3.62E+01	2.50
m	17	386.81	381 -	396	387.02	2.00E+02	38.50	3.60E+01	2.38
m	18	391.00	381 -	396	391.21	7.01E+01	38.19	3.15E+01	3.63
M	19	414.94	411 -	424	415.13	3.92E+01	16.55	1.87E+01	2.50
m	20	418.82	411 -	424	419.00	3.33E+01	17.71	2.90E+01	2.27
	21	437.50	433 -	442	437.67	6.18E+01	25.69	5.65E+01	1.74
	22	636.98	633 -	639	637.00	5.00E+00	4.47	0.00E+00	2.98
	23	841.24	837 -	843	841.11	5.57E+00	6.34	2.86E+00	2.68

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:35:24AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114498.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	52.01	4.99E+01	35.83			4.99E+01	3.58E+01
M	2	61.53	2.25E+02	48.66	2.45E+01	2.35E+00	2.00E+02	4.87E+01
m	3	65.65	1.22E+02	46.49			1.22E+02	4.65E+01
	4	80.93	8.01E+02	76.45			8.01E+02	7.64E+01
	5	91.50	6.14E+01	35.89	3.29E+01	1.58E+00	2.85E+01	3.59E+01
	6	111.60	1.67E+02	56.47	1.10E+00	1.84E+00	1.66E+02	5.65E+01

0136

Analysis Report for 2108094-05

H-32A

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	7	173.47	2.48E+01			2.48E+01	2.73E+01
	8	184.13	4.68E+01	1.30E+01	1.90E+00	3.38E+01	3.36E+01
M	9	276.10	4.54E+01			4.54E+01	2.35E+01
m	10	280.71	1.17E+01			1.17E+01	1.61E+01
m	11	285.13	1.19E+01			1.19E+01	1.97E+01
M	12	302.80	1.25E+02			1.25E+02	3.07E+01
m	13	307.95	2.19E+01			2.19E+01	2.29E+01
	14	334.14	5.64E+01			5.64E+01	3.88E+01
	15	356.01	5.25E+02			5.25E+02	5.40E+01
M	16	383.90	1.21E+02			1.21E+02	2.45E+01
m	17	386.81	2.00E+02			2.00E+02	3.85E+01
m	18	391.00	7.01E+01			7.01E+01	3.82E+01
M	19	414.94	3.92E+01			3.92E+01	1.65E+01
m	20	418.82	3.33E+01			3.33E+01	1.77E+01
	21	437.50	6.18E+01			6.18E+01	2.57E+01
	22	636.98	5.00E+00			5.00E+00	4.47E+00
	23	841.24	5.57E+00			5.57E+00	6.34E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12	1.93		
		391.69	*	61.90	5.43E+01
BA-133	1.00	81.00	*	34.06	4.11E+02
		302.84	*	18.33	3.52E+02
		356.01	*	62.05	4.22E+02
HG-203	0.94	279.19	*	77.30	7.89E+00
TH-234	0.92	63.29	*	3.80	5.40E+02
AM-241	0.90	59.54	*	35.90	5.72E+01



Analysis Report for 2108094-05  
H-32A

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.942	5.43E+01	3.02E+01	
BA-133	1.000	4.10E+02	4.06E+01	
HG-203	0.943	7.89E+00	1.10E+01	
? TH-234	0.924	5.40E+02	1.35E+02	
? AM-241	0.903	5.72E+01	1.43E+01	

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2108094-05  
H-32A

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 9/7/2021 10:35:24AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	52.01	5.54374E-02	35.91	
m	3	65.65	1.35182E-01	19.11	
	5	91.50	3.16712E-02	63.01	
	6	111.60	1.84368E-01	17.03	Tol. U-237
	7	173.47	2.75949E-02	55.06	
	8	184.13	3.76050E-02	49.61	
M	9	276.10	5.04651E-02	25.89	
m	11	285.13	1.32652E-02	82.60	
m	13	307.95	2.43085E-02	52.40	
	14	334.14	6.26603E-02	34.39	
M	16	383.90	1.34417E-01	10.11	Sum
m	17	386.81	2.21959E-01	9.64	
M	19	414.94	4.35568E-02	21.10	
m	20	418.82	3.70048E-02	26.59	Sum
	21	437.50	6.86296E-02	20.80	Sum
	22	636.98	5.55556E-03	44.72	Sum
	23	841.24	6.19048E-03	56.94	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2108094-05

H-32A

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	8.60E-07	8.60E-07	0.00E+00	0.00E+00
	3.31	12.30	1.01E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.49E-04	1.49E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.69E+01	1.69E+01	-7.59E+00	7.97E+00
	136.48	10.60	1.28E+02		-1.38E+02	5.93E+01
NI-59	6.92	29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.33E-03	9.33E-03	0.00E+00	0.00E+00
	18.60	10.00	7.73E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.21E-02	5.21E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.68E+02	2.68E+02	-1.01E+03	1.27E+02
+ SN-113	255.12	1.93	8.99E+02	3.59E+01	2.55E+02	4.13E+02
	391.69	*	61.90	3.59E+01	5.43E+01	1.69E+01
SN-119M	23.87	16.10	1.20E-01	1.01E-01	0.00E+00	0.00E+00
	25.10	22.70	1.01E-01		0.00E+00	0.00E+00
I-129	29.78	57.00	1.62E+00	1.62E+00	-5.02E-02	7.73E-01
	33.60	13.20	2.10E+01		9.61E+01	1.03E+01
	39.58	7.52	3.34E+01		-4.37E+01	1.61E+01
+ BA-133	81.00	*	34.06	3.99E+01	4.11E+02	2.17E+01
	302.84	*	18.33	1.85E+02	3.52E+02	8.86E+01
	356.01	*	62.05	3.99E+01	4.22E+02	1.89E+01
CE-139	165.85	80.35	2.21E+01	2.21E+01	-7.94E+00	1.03E+01
CE-144	133.54	10.80	1.33E+02	1.33E+02	2.45E+01	6.23E+01
+ HG-203	279.19	*	77.30	3.44E+01	7.89E+00	1.63E+01
PB-210	46.50	4.25	5.41E+01	5.41E+01	1.76E+01	2.54E+01
TH-231	25.64	14.70	1.68E-01	1.68E-01	0.00E+00	0.00E+00
	84.21	6.40	2.75E+02		2.24E+02	1.34E+02
PA-234M	9.89	89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
	21.72	64.90	2.12E-02		0.00E+00	0.00E+00
	37.93	23.75	1.49E+01		4.50E+01	7.26E+00
+ TH-234	63.29	*	3.80	2.41E+02	5.40E+02	1.17E+02
NP-237	29.37	14.00	6.30E+00	6.30E+00	-1.96E-01	3.01E+00
	86.50	12.60	8.12E+01		-5.88E+02	3.85E+01
U-237	97.08	16.30	6.82E+01	4.51E+01	-5.19E+00	3.21E+01
	101.07	26.30	4.51E+01		9.89E+00	2.12E+01
	114.00	12.30	1.93E+02		3.90E+02	9.32E+01
	208.01	22.00	9.01E+01		1.73E+01	4.20E+01
+ AM-241	59.54	*	35.90	2.55E+01	5.72E+01	1.24E+01
AM-243	74.67	66.00	1.27E+01	1.27E+01	1.83E+00	6.03E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction



LP  
9/7/21

Analysis Report for 2108094-06  
H-32B

### GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-06  
 Sample Description : H-32B  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:46AM  
 Acquisition Started : 9/7/2021 10:20:27AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.02 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 28 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 9/14/2019  
 Efficiency Calibration Description :

Sample Number : 114542

### PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:35:37AM

Peak Analysis From Channel : 1  
Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-06

H-32B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	36.74	37 -	41	37.43	3.94E+02	68.72	2.97E+02	1.94
	2	54.24	51 -	58	54.91	5.48E+01	32.92	1.44E+02	1.47
M	3	63.19	59 -	72	63.85	2.01E+02	37.51	1.24E+02	1.55
m	4	67.29	59 -	72	67.95	9.88E+01	31.22	1.44E+02	1.56
	5	82.27	80 -	86	82.91	7.79E+02	65.60	2.20E+02	1.23
M	6	113.25	109 -	122	113.86	1.51E+02	32.19	8.56E+01	1.52
m	7	117.13	109 -	122	117.73	4.24E+01	25.54	7.93E+01	1.53
	8	222.95	219 -	226	223.45	3.38E+01	21.07	5.03E+01	1.28
	9	277.41	275 -	281	277.85	6.24E+01	22.97	5.32E+01	1.23
	10	282.88	281 -	285	283.32	1.39E+01	10.84	1.23E+01	1.20
M	11	303.80	299 -	311	304.21	1.45E+02	25.81	2.01E+01	1.62
m	12	308.27	299 -	311	308.68	1.79E+01	13.64	1.58E+01	1.82
M	13	331.56	331 -	342	331.95	7.93E+00	1.22	2.00E+00	1.68
m	14	334.77	331 -	342	335.15	5.86E+01	18.48	1.44E+01	1.68
m	15	338.62	331 -	342	339.00	1.81E+01	13.32	1.86E+01	1.54
	16	356.82	352 -	361	357.18	4.84E+02	47.81	4.97E+01	1.74
	17	377.17	373 -	382	377.51	1.39E+01	16.19	2.82E+01	5.57
M	18	384.52	382 -	390	384.86	9.61E+01	24.72	2.96E+01	1.87
m	19	387.49	382 -	390	387.82	1.66E+02	32.18	6.20E+01	1.72
	20	392.13	391 -	395	392.46	3.84E+01	15.76	1.93E+01	1.92
M	21	415.22	412 -	427	415.53	1.35E+01	14.46	3.61E+01	2.14
m	22	420.70	412 -	427	421.00	1.63E+01	13.43	1.56E+01	1.61
	23	437.61	433 -	442	437.90	6.80E+01	21.95	3.01E+01	1.44
	24	467.82	464 -	472	468.07	1.20E+01	12.85	1.80E+01	3.85
	25	570.70	568 -	574	570.86	7.00E+00	5.29	0.00E+00	1.16
	26	897.36	894 -	900	897.22	9.00E+00	6.00	0.00E+00	3.24

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:35:37AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114499.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	36.74	3.94E+02	68.72			3.94E+02	6.87E+01
	2	54.24	5.48E+01	32.92			5.48E+01	3.29E+01
M	3	63.19	2.01E+02	37.51	5.84E+00	2.00E+00	1.95E+02	3.76E+01

0142

Analysis Report for 2108094-06

H-32B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	4	67.29	9.88E+01	31.22			9.88E+01	3.12E+01
	5	82.27	7.79E+02	65.60			7.79E+02	6.56E+01
M	6	113.25	1.51E+02	32.19			1.51E+02	3.22E+01
m	7	117.13	4.24E+01	25.54			4.24E+01	2.55E+01
	8	222.95	3.38E+01	21.07			3.38E+01	2.11E+01
	9	277.41	6.24E+01	22.97			6.24E+01	2.30E+01
	10	282.88	1.39E+01	10.84			1.39E+01	1.08E+01
M	11	303.80	1.45E+02	25.81			1.45E+02	2.58E+01
m	12	308.27	1.79E+01	13.64			1.79E+01	1.36E+01
M	13	331.56	7.93E+00	1.22			7.93E+00	1.22E+00
m	14	334.77	5.86E+01	18.48			5.86E+01	1.85E+01
m	15	338.62	1.81E+01	13.32			1.81E+01	1.33E+01
	16	356.82	4.84E+02	47.81			4.84E+02	4.78E+01
	17	377.17	1.39E+01	16.19			1.39E+01	1.62E+01
M	18	384.52	9.61E+01	24.72			9.61E+01	2.47E+01
m	19	387.49	1.66E+02	32.18			1.66E+02	3.22E+01
	20	392.13	3.84E+01	15.76			3.84E+01	1.58E+01
M	21	415.22	1.35E+01	14.46			1.35E+01	1.45E+01
m	22	420.70	1.63E+01	13.43			1.63E+01	1.34E+01
	23	437.61	6.80E+01	21.95			6.80E+01	2.20E+01
	24	467.82	1.20E+01	12.85			1.20E+01	1.28E+01
	25	570.70	7.00E+00	5.29			7.00E+00	5.29E+00
	26	897.36	9.00E+00	6.00			9.00E+00	6.00E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty	
SN-113	0.96	255.12	1.93			
		391.69	*	61.90	2.51E+01	1.06E+01
BA-133	0.97	81.00	*	34.06	4.97E+02	6.75E+01
		302.84	*	18.33	5.14E+02	1.79E+02
		356.01	*	62.05	3.86E+02	5.73E+01
HG-203	0.92	279.19	*	77.30	5.88E+01	2.95E+01

0143

Analysis Report for 2108094-06  
H-32B

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
PA-234M	0.99	9.89 21.72	89.00 64.90		
		37.93 *	23.75	9.84E+00	1.72E+00
TH-234	1.00	63.29 *	3.80	4.39E+02	8.65E+01

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.960	2.51E+01	1.06E+01	
BA-133	0.975	<del>4.37E+02</del>	4.24E+01	
HG-203	0.922	5.88E+01	<del>2.95E+01</del>	
PA-234M	0.995	9.84E+00	1.72E+00	
TH-234	1.000	4.39E+02	8.65E+01	

? = nuclide is part of an undetermined solution  
X = nuclide rejected by the interference analysis  
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2108094-06  
H-32B

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### UNIDENTIFIED PEAKS

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Peak Locate Performed on : 9/7/2021 10:35:37AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	54.24	6.09011E-02	30.03	
m	4	67.29	1.09759E-01	15.80	
M	6	113.25	1.67460E-01	10.68	
m	7	117.13	4.70593E-02	30.16	Sum
	8	222.95	3.75895E-02	31.14	
	10	282.88	1.53889E-02	39.13	
m	12	308.27	1.99365E-02	38.00	
M	13	331.56	8.80698E-03	7.73	
m	14	334.77	6.50660E-02	15.78	
m	15	338.62	2.00735E-02	36.87	Sum
	17	377.17	1.54365E-02	58.25	
M	18	384.52	1.06723E-01	12.87	Sum
m	19	387.49	1.84307E-01	9.70	Sum
M	21	415.22	1.49685E-02	53.66	
m	22	420.70	1.80764E-02	41.26	Sum
	23	437.61	7.55154E-02	16.15	Sum
	24	467.82	1.33333E-02	53.52	
	25	570.70	7.77778E-03	37.80	
	26	897.36	1.00000E-02	33.33	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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### NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB



Analysis Report for 2108094-06

H-32B

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.84E-13	1.84E-13	0.00E+00	0.00E+00
	3.31	12.30	4.70E-12		0.00E+00	0.00E+00
FE-55	5.89	24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
CO-57	122.06	85.51	2.13E+01	2.13E+01	-5.97E-02	9.78E+00
	136.48	10.60	2.04E+02		-1.01E+02	9.36E+01
NI-59	6.92	29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
MO-93	16.59	52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
	18.60	10.00	1.34E-03		0.00E+00	0.00E+00
NB-93M	16.57	9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.72E+02	2.72E+02	-2.30E+01	1.26E+02
+ SN-113	255.12	1.93	8.21E+02	1.22E+01	-5.07E+02	3.55E+02
	391.69	*	61.90	1.22E+01	2.51E+01	5.24E+00
SN-119M	23.87	16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
	25.10	22.70	3.97E-02		-1.12E-01	1.69E-02
I-129	29.78	57.00	2.99E-01	2.99E-01	-6.45E+00	1.46E-01
	33.60	13.20	5.62E+00		1.79E+01	2.77E+00
	39.58	7.52	8.50E+00		1.91E+00	4.09E+00
+ BA-133	81.00	*	34.06	2.67E+01	4.97E+02	1.81E+01
	302.84	*	18.33	1.23E+02	5.14E+02	5.66E+01
	356.01	*	62.05	2.67E+01	3.86E+02	1.23E+01
CE-139	165.85	80.35	3.69E+01	3.69E+01	1.05E+01	1.71E+01
CE-144	133.54	10.80	1.90E+02	1.90E+02	-4.45E+00	8.69E+01
+ HG-203	279.19	*	77.30	3.27E+01	5.88E+01	1.51E+01
PB-210	46.50	4.25	1.89E+01	1.89E+01	-9.08E-01	8.76E+00
TH-231	25.64	14.70	7.13E-02	7.13E-02	-2.00E-01	3.03E-02
	84.21	6.40	4.69E+02		2.32E+03	2.30E+02
+ PA-234M	9.89	89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
	21.72	64.90	7.08E-04		0.00E+00	0.00E+00
	37.93	*	23.75	2.37E+00	9.84E+00	1.15E+00
+ TH-234	63.29	*	3.80	2.01E+02	4.39E+02	9.74E+01
NP-237	29.37	14.00	1.11E+00	1.11E+00	-2.40E+01	5.41E-01
	86.50	12.60	8.12E+01		-2.34E+01	3.79E+01
U-237	97.08	16.30	8.02E+01	5.39E+01	-2.82E+00	3.72E+01
	101.07	26.30	5.39E+01		9.96E+00	2.50E+01
	114.00	12.30	2.87E+02		2.06E+02	1.38E+02
	208.01	22.00	1.52E+02		9.88E+01	7.08E+01
AM-241	59.54	35.90	7.67E+00	7.67E+00	-2.36E+01	3.58E+00
AM-243	74.67	66.00	1.04E+01	1.04E+01	2.24E-01	4.87E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2108094-07  
H-33

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2108094-07  
 Sample Description : H-33  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 9/7/2021 8:24:53AM  
 Acquisition Started : 9/7/2021 10:20:34AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 908.1 seconds

Dead Time : 0.89 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 8 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 6/6/2020  
 Efficiency Calibration Used Done On : 10/19/2019  
 Efficiency Calibration Description :

Sample Number : 114543

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 9/7/2021 10:35:59AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2108094-07

H-33

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	22.06	18 -	41	22.49	1.34E+02	48.23	2.68E+02	4.59
m	2	30.78	18 -	41	31.21	1.78E+03	102.07	2.52E+02	3.34
m	3	34.39	18 -	41	34.81	5.57E+02	110.76	3.15E+02	4.25
	4	52.00	49 -	56	52.39	3.88E+01	44.00	2.98E+02	3.23
M	5	62.23	58 -	72	62.61	2.58E+02	60.84	3.80E+02	3.60
m	6	65.86	58 -	72	66.24	9.31E+01	69.35	4.85E+02	3.61
	7	73.02	72 -	75	73.39	2.90E+01	23.83	1.06E+02	1.88
	8	81.25	76 -	90	81.62	7.99E+02	83.72	4.16E+02	3.21
M	9	112.14	106 -	121	112.47	2.24E+02	55.95	3.18E+02	3.37
m	10	116.28	106 -	121	116.60	3.64E+01	41.90	1.96E+02	2.31
	11	184.57	182 -	188	184.81	3.35E+01	26.67	1.05E+02	3.78
	12	191.85	189 -	195	192.08	3.77E+01	24.62	8.07E+01	3.10
	13	278.31	272 -	285	278.43	3.26E+01	34.41	1.35E+02	8.98
	14	304.19	298 -	310	304.28	1.49E+02	38.31	9.89E+01	4.05
	15	334.49	327 -	341	334.55	9.10E+01	26.63	6.00E+01	6.93
	16	356.54	351 -	362	356.57	3.95E+02	45.87	6.46E+01	2.95
	17	386.68	380 -	394	386.68	2.67E+02	48.46	1.33E+02	3.74
	18	420.92	419 -	425	420.87	1.43E+01	16.46	3.34E+01	1.37
M	19	435.05	432 -	451	434.99	1.59E+01	11.34	5.00E+00	3.12
m	20	438.02	432 -	451	437.96	7.03E+01	20.51	9.00E+00	2.84
m	21	449.10	432 -	451	449.02	9.79E+00	8.03	7.00E+00	3.13
	22	470.80	464 -	477	470.70	2.58E+01	15.03	1.25E+01	4.15
	23	653.59	650 -	655	653.26	5.64E+00	6.08	2.71E+00	2.07
	24	701.87	698 -	703	701.48	4.75E+00	5.74	2.50E+00	1.79
	25	1191.39	1186 -	1192	1190.40	5.00E+00	4.47	0.00E+00	1.24

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/7/2021 10:35:59AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000114496.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	22.06	1.34E+02	48.23	4.27E+00	2.93E+00	1.30E+02	4.83E+01
m	2	30.78	1.78E+03	102.07			1.78E+03	1.02E+02
m	3	34.39	5.57E+02	110.76			5.57E+02	1.11E+02
	4	52.00	3.88E+01	44.00			3.88E+01	4.40E+01

0148

Analysis Report for 2108094-07

H-33

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	5	62.23	2.58E+02	60.84	1.24E+01	2.62E+00	2.45E+02	6.09E+01
m	6	65.86	9.31E+01	69.35	1.24E+01	2.62E+00	8.07E+01	6.94E+01
	7	73.02	2.90E+01	23.83			2.90E+01	2.38E+01
	8	81.25	7.99E+02	83.72			7.99E+02	8.37E+01
M	9	112.14	2.24E+02	55.95			2.24E+02	5.59E+01
m	10	116.28	3.64E+01	41.90			3.64E+01	4.19E+01
	11	184.57	3.35E+01	26.67	6.99E+00	1.68E+00	2.65E+01	2.67E+01
	12	191.85	3.77E+01	24.62			3.77E+01	2.46E+01
	13	278.31	3.26E+01	34.41			3.26E+01	3.44E+01
	14	304.19	1.49E+02	38.31			1.49E+02	3.83E+01
	15	334.49	9.10E+01	26.63			9.10E+01	2.66E+01
	16	356.54	3.95E+02	45.87			3.95E+02	4.59E+01
	17	386.68	2.67E+02	48.46			2.67E+02	4.85E+01
	18	420.92	1.43E+01	16.46			1.43E+01	1.65E+01
M	19	435.05	1.59E+01	11.34			1.59E+01	1.13E+01
m	20	438.02	7.03E+01	20.51			7.03E+01	2.05E+01
m	21	449.10	9.79E+00	8.03			9.79E+00	8.03E+00
	22	470.80	2.58E+01	15.03			2.58E+01	1.50E+01
	23	653.59	5.64E+00	6.08			5.64E+00	6.08E+00
	24	701.87	4.75E+00	5.74			4.75E+00	5.74E+00
	25	1191.39	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.88	29.78 *	57.00	2.36E+01	1.36E+00
		33.60 *	13.20	4.99E+01	9.93E+00
		39.58	7.52		
BA-133	0.98	81.00 *	34.06	3.96E+02	5.69E+01
		302.84 *	18.33	4.89E+02	1.88E+02
		356.01 *	62.05	3.56E+02	6.05E+01
HG-203	0.98	279.19 *	77.30	2.60E+01	2.86E+01
TH-234	0.97	63.29 *	3.80	5.58E+02	1.41E+00

0149

Analysis Report for 2108094-07  
H-33

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
AM-243	0.93	74.67 *	66.00	5.76E+00	4.76E+00

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
I-129	0.883	2.41E+01	1.34E+00	
BA-133	0.988	3.83E+02	4.05E+01	
HG-203	0.980	<del>2.60E+01</del>	<del>2.86E+01</del>	
TH-234	0.972	5.58E+02	1.41E+02	
X NP-237	0.752			
AM-243	0.932	5.76E+00	4.76E+00	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2108094-07  
H-33

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## UNIDENTIFIED PEAKS

---

Peak Locate Performed on : 9/7/2021 10:35:59AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

	<i>Peak No.</i>	<i>Energy (keV)</i>	<i>Peak Size (CPS)</i>	<i>Peak CPS (%) Uncertainty</i>	<i>Peak Type</i>	<i>Tolerance Nuclide</i>
M	1	22.06	1.44383E-01	18.59	Tol.	SN-119M PA-234M
	4	52.00	4.31442E-02	56.66		
m	6	65.86	8.96499E-02	43.01	Sum	
M	9	112.14	2.48472E-01	12.51	Sum	
m	10	116.28	4.04914E-02	57.49	Sum	
	11	184.57	2.94504E-02	50.42		
	12	191.85	4.18376E-02	32.69		
	15	334.49	1.01133E-01	14.63	Sum	
	17	386.68	2.97033E-01	9.06	Sum	
	18	420.92	1.58961E-02	57.53	Sum	
M	19	435.05	1.76922E-02	35.60		
m	20	438.02	7.80784E-02	14.59	Sum	
m	21	449.10	1.08724E-02	41.04		
	22	470.80	2.86111E-02	29.19		
	23	653.59	6.26984E-03	53.90		
	24	701.87	5.27778E-03	60.47		
	25	1191.39	5.55556E-03	44.72		

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2108094-07

H-33

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	8.48E-09	8.48E-09	0.00E+00	0.00E+00
	3.31	12.30	1.24E-07		0.00E+00	0.00E+00
FE-55	5.89	24.50	3.35E-05	3.35E-05	-1.11E-04	1.37E-05
CO-57	122.06	85.51	1.97E+01	1.97E+01	2.21E+00	9.29E+00
	136.48	10.60	1.76E+02		2.59E+01	8.26E+01
NI-59	6.92	29.80	2.31E-04	2.31E-04	1.49E-04	1.08E-04
MO-93	16.59	52.90	4.29E-02	4.29E-02	-2.81E-03	2.04E-02
	18.60	10.00	4.70E-01		-7.50E-04	2.25E-01
NB-93M	16.57	9.43	2.39E-01	2.39E-01	-1.57E-02	1.14E-01
CD-109	88.03	3.72	3.06E+02	3.06E+02	-1.13E+03	1.46E+02
SN-113	255.12	1.93	1.03E+03	3.56E+01	-3.03E+02	4.73E+02
	391.69	61.90	3.56E+01		-3.03E+01	1.67E+01
SN-119M	23.87	16.10	1.08E+00	1.08E+00	-4.50E+00	5.18E-01
	25.10	22.70	1.19E+00		-1.46E+01	5.77E-01
+ I-129	29.78	* 57.00	1.95E+00	1.95E+00	2.36E+01	9.57E-01
	33.60	* 13.20	1.33E+01		4.99E+01	6.52E+00
	39.58	7.52	1.91E+01		-1.11E+00	9.19E+00
+ BA-133	81.00	* 34.06	5.18E+01	3.64E+01	3.96E+02	2.52E+01
	302.84	* 18.33	1.69E+02		4.89E+02	8.01E+01
	356.01	* 62.05	3.64E+01		3.56E+02	1.70E+01
CE-139	165.85	80.35	2.68E+01	2.68E+01	-4.09E+00	1.25E+01
CE-144	133.54	10.80	1.64E+02	1.64E+02	5.17E+01	7.69E+01
+ HG-203	279.19	* 77.30	5.41E+01	5.41E+01	2.60E+01	2.60E+01
PB-210	46.50	4.25	4.68E+01	4.68E+01	5.57E+00	2.23E+01
TH-231	25.64	14.70	2.03E+00	2.03E+00	-2.48E+01	9.82E-01
	84.21	6.40	3.07E+02		5.03E+02	1.50E+02
PA-234M	9.89	89.00	1.31E-03	1.31E-03	1.96E-03	6.23E-04
	21.72	64.90	1.69E-01		1.64E-01	8.12E-02
	37.93	23.75	7.49E+00		1.98E+00	3.65E+00
+ TH-234	63.29	* 3.80	2.87E+02	2.87E+02	5.58E+02	1.41E+02
NP-237	29.37	* 14.00	7.94E+00	7.94E+00	9.60E+01	3.90E+00
	86.50	12.60	1.02E+02		-4.41E+02	4.87E+01
U-237	97.08	16.30	7.97E+01	5.56E+01	-4.65E+01	3.78E+01
	101.07	26.30	5.56E+01		9.49E+00	2.64E+01
	114.00	12.30	2.38E+02		5.75E+02	1.15E+02
	208.01	22.00	1.16E+02		4.50E+01	5.44E+01
AM-241	59.54	35.90	1.88E+01	1.88E+01	2.08E+01	9.13E+00
+ AM-243	74.67	* 66.00	7.50E+00	7.50E+00	5.76E+00	3.48E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

**SECTION XI**  
**ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)**







**ERM**

**0526033 HENNING**

**STANDARD LEVEL IV  
REPORT OF ANALYSIS**

**WORK ORDER #21-12077-OR**

**January 19, 2022**

**EBERLINE ANALYTICAL/OAK RIDGE LABORATORY  
OAK RIDGE, TN**

## TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
I	Chain of Custody & pH Check	0004
II	Sample Acknowledgement	0010
III	Case Narrative	0013
IV	Analytical Results Summary	0016
V	Analytical Standard	0019
VI	Quality Control Sample Results Summary	0027
VII	Laboratory Technician's Notes	0032
VIII	Analytical Data (Radium-226)	0046
IX	Analytical Data (Radium-228)	0145
X	Barium-133 Analytical Tracer Data	0161
XI	Analytical Data (Total Dissolved Solids)	0266
	Last Page Number	0268



**Eberline Services – Oak Ridge Laboratory  
LABORATORY DATA SUPPORT CHECKLIST**

MP-001-3

Eberline Services Work Order # 21-12077

The checklist items listed below are to be initialed by appropriate staff upon completion/verification.

Date for Partial	Initials	Date	Initials	Checklist Items
		12/27/21	YSS	Sample Log-In
		1/13/22	[Signature]	Data Compilation
		1-14-22	MMT	First Technical Data Review
		1/14/22	[Signature]	Second Technical Data Review
		1/18/22	[Signature]	Data Entry/Electronic Deliverable
		1/18/22	[Signature]	Case Narrative
		1/19/22	[Signature]	Electronic Deliverable Proof
		1/19/22	MMT	Samples Analyzed within Holding Time Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>
		1/19/22	MMT	QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

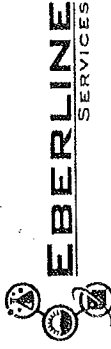
Date package approved by: [Signature] 1/19/22  
 Laboratory Manager [Signature] Date

**SECTION I**  
**CHAIN OF CUSTODY**  
**& pH CHECK**

# Chain of Custody Record

No.

Eberline Services  
 601 Scarboro Road  
 Oak Ridge, TN 37830  
 (865) 481-0683 Phone • (865) 483-4621 Fax



Project Name: Hennings Management Project Number: 0520033  
 Send Report To: ERM - Sharon Wilgus Sampler (Print Name): Sharon Wilgus  
 Address: Hovscon, TX Shipper (Print Name):  
Sharon.wilgus@erm.com Shipment Method: Fedex  
 Airbill Number:  
 Laboratory Receiving:  
 Phone: 971-303-2385

REC'D DEC 27 2011  
 Analysis Requested  
Estim 226 & 228  
 Page 1 of 1  
3 Coolers  
 Purchase Order # 21-12077

Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
MW-11	12/15	0800	water	1		
MW-1		1345				
MW-8		1630				
MW-7	12/10	0750				
MW-9		0820				
MW-9D		0840				
SW-80 13'		1335				
SW-80 2'		1230				
MW-6	12/17	0830				
MW-10	12/20	1045				
MW-5		1330				
MW-4		1505				
MW-3		1630				
MW-2	12/21	0955				

Relinquished by: (Signature) [Signature] Date: 12/21/11 Time: 0800  
 Received by: (Signature) Fedex Date: 12/27/11 Time: 0951Z  
 Relinquished by: (Signature) Fedex Date: 12/27/11 Time: 0951Z  
 Received by: (Signature) [Signature] Date: 12/27/11 Time: 0951Z

Sample Custodian Remarks (Completed By Laboratory):  
 Turnaround:  Routine  24 Hour  1 Week  Other  
 Total # Containers Received?   
 COC Seals Present?   
 COC Seals Intact?   
 Received Containers Intact?   
 Temperature?



**EBERLINE**  
SERVICES  
Oak Ridge Laboratory

# Internal Chain of Custody

Work Order #

**21-12077**

Lab Deadline

**1/10/2022**

Analysis

**Ra226 - Level 4**

Sample Matrix

**Water**

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	30	V1.5
	05	20	V1.5
	06	30	V1.5
	07	30	V1.5
	08	50	V1.5
	09	20	V1.5
	10	40	V1.5
	11	20	V1.5
	12	20	V1.5
	13	40	V1.5
	14	60	V1.5
	15	40	V1.5
	16	40	V1.5
	17	20	V1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JH	1/4/22 0930
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JH	1/5/22 0815
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/5/22 0815
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/10/22 0953
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KP	1/10/22 0954
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KBS	1/10/22 1738
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		





**EBERLINE**  
SERVICES  
Oak Ridge Laboratory

# Internal Chain of Custody

Work Order #

**21-12077**

Lab Deadline

**1/10/2022**

Analysis

**Ra228 - Level 4**

Sample Matrix

**Water**

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	30	V1.5
	05	20	V1.5
	06	30	V1.5
	07	30	V1.5
	08	50	V1.5
	09	20	V1.5
	10	40	V1.5
	11	20	V1.5
	12	20	V1.5
	13	40	V1.5
	14	60	V1.5
	15	40	V1.5
	16	40	V1.5
	17	20	V1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	J. Henry	1/4/22 0930
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	J. Henry	1/5/22 0815
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/5/22 0815
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/10/22 0953
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KP	1/10/22 0954
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	1/10/22 1738
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/10/22 1738
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MB	1/12/22 1140
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KP	1/12/22 1140
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	1/12/22 1543
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		



**EBERLINE**  
SERVICES  
Oak Ridge Laboratory

# Internal Chain of Custody

Work Order #

**21-12077**

Lab Deadline

**1/4/2022**

Analysis


**TDS - Level 4**

Sample Matrix

**Water**

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	30	V1.5
	05	20	V1.5
	06	30	V1.5
	07	30	V1.5
	08	50	V1.5
	09	20	V1.5
	10	40	V1.5
	11	20	V1.5
	12	20	V1.5
	13	40	V1.5
	14	60	V1.5
	15	40	V1.5
	16	40	V1.5
	17	20	V1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	<i>J. Achelle</i>	1-3-22
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	<i>My</i>	4 JAN 22 0345
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

	<b>Sample Receiving Report</b> (Volumes, pH, & CPM)	<b>Internal Work Order</b>
		<b>21-12077</b>
		Received By <b>RSPENCER</b>

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	V1.5		
02	BLANK	0		WA	V1.5		
03	DUP	0		WA	V1.5		
04	MW-11	1		WA	V1.5	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
05	MW-1	1		WA	V1.5	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
06	MW-8	1		WA	V1.5	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
07	MW-7	1		WA	V1.5	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
08	MW-9	1		WA	V1.5	3.76	50
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	50
09	MW-9D	1		WA	V1.5	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
10	SW-BO 13	1		WA	V1.5	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
11	SW-BO 2	1		WA	V1.5	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
12	MW-6	1		WA	V1.5	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
13	MW-10	1		WA	V1.5	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
14	MW-5	1		WA	V1.5	3.76	60
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	60
15	MW-4	1		WA	V1.5	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
16	MW-3	1		WA	V1.5	3.76	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	40
17	MW-2	1		WA	V1.5	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20

Received by: *Randolph Spencer* Date: 12-27-21

**SECTION II**  
**SAMPLE ACKNOWLEDGEMENT**





**Eberline Services – Oak Ridge Laboratory**

**SAMPLE RECEIPT CHECKLIST**  
MP-001-2

WORK ORDER # 21-12077

SAMPLE MATRIX/MATRICES:

(CIRCLE ONE OR BOTH)

AQUEOUS NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	<input checked="" type="radio"/> Y	N	
If aqueous, properly preserved	<input checked="" type="radio"/> Y	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	<input checked="" type="radio"/> Y	N
Unbroken on outside of package?	<input checked="" type="radio"/> Y	N
Present on samples?	<input checked="" type="radio"/> Y	N
Unbroken on samples?	<input checked="" type="radio"/> Y	N
Was chain of custody present upon sample receipt?	<input checked="" type="radio"/> Y	N

IF THE RESPONSE TO ANY OF THE ABOVE IS **NO**, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SIGNATURE: *Kimberly Spencer* DATE: 12-27-21

**SECTION III**  
**CASE NARRATIVE**



EBERLINE ANALYTICAL CORPORATION  
601 SCARBORO ROAD  
OAK RIDGE, TENNESSEE 37830  
PHONE (865) 481-0683  
FAX (865) 483-4621

EBS-OR-49255

January 19, 2022

Shawn Wiggins  
ERM  
840 W Sam Houston Pkwy N #600  
Houston, TX 77478

CASE NARRATIVE  
Work Order # 21-12077-OR

SAMPLE RECEIPT

This work order contains fourteen water samples received 12/27/2021. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

<u>CLIENT ID</u>	<u>LAB ID</u>	<u>CLIENT ID</u>	<u>LAB ID</u>
MW-11	21-12077-04	SW-BO 2	21-12077-11
MW-1	21-12077-05	MW-6	21-12077-12
MW-8	21-12077-06	MW-10	21-12077-13
MW-7	21-12077-07	MW-5	21-12077-14
MW-9	21-12077-08	MW-4	21-12077-15
MW-9D	21-12077-09	MW-3	21-12077-16
SW-BO 13	21-12077-10	MW-2	21-12077-17

ANALYTICAL METHODS

Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0. Total Dissolved Solids were performed using Standard Methods 2540C.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size, and matrix type.

RADIUM-226

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. This was followed by precipitations of Radium/Barium Sulfate. Precipitates were dissolved in alkaline EDTA. Radium was selectively precipitated and mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. The final result was corrected for inherent self-absorption from elemental Barium. Chemical recovery was calculated using a Barium-133 tracer, which was determined by HPGe gamma spectroscopy.



## ANALYTICAL RESULTS CONTINUED

### RADIUM-226 CONTINUED

Samples demonstrated acceptable results for all Radium-226 analyses. Chemical recovery was acceptable for all analyses. The Radium-226 method blank demonstrated an acceptable result. Results for the Radium-226 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-226 laboratory control sample demonstrated an acceptable percent recovery.

### RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-228 were counted on a gas proportional counter. Chemical recovery was determined using a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all analyses. The Radium-228 method blank demonstrated an acceptable result. Results for the Radium-228 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

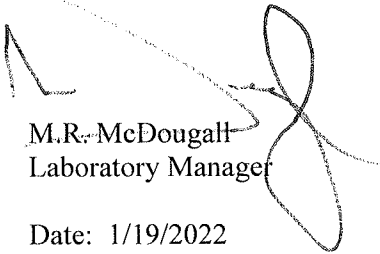
### TOTAL DISSOLVED SOLIDS (TDS)

A volumetric aliquot of each sample was filtered through 0.45µm filter media into a tared 250 ml beaker. Samples were dried on a hot plate and allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated Total Dissolved Solids content that ranged from 38.0 to 6,620.0 mg/L.

### CERTIFICATION OF ACCURACY

I certify that this data report complies with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.



M.R. McDougall  
Laboratory Manager

Date: 1/19/2022

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit <http://eberlineanalytical.com/> to provide us with feedback on our services.

**SECTION IV**  
**ANALYTICAL RESULTS SUMMARY**

# Eberline Analytical

## Final Report of Analysis

Shawn Wiggins  
ERM

840 W Sam Houston Parkway N #600  
Houston, TX 77024

SDG: **21-12077**  
Project: 0526033 Henning  
Analysis Category: ENVIRONMENTAL  
Sample Matrix: VVA

Report To:

Work Order Details:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
21-12077-01	LCS	KNOWN	12/28/21 00:00	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	1.00E+01	4.61E-01			pCi/l
21-12077-01	LCS	SPIKE	12/28/21 00:00	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	1.03E+01	1.37E+00	2.57E+00	1.84E-01	pCi/l
21-12077-02	MBL	BLANK	12/28/21 00:00	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	5.65E-02	1.22E-01	1.23E-01	2.41E-01	pCi/l
21-12077-03	DUP	MW-1	12/15/21 13:45	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	2.32E-01	2.27E-01	2.33E-01	2.94E-01	pCi/l
21-12077-04	TRG	MW-11	12/15/21 08:00	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	4.49E-01	2.48E-01	2.65E-01	1.46E-01	pCi/l
21-12077-05	DO	MW-1	12/15/21 13:45	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	8.73E-02	1.48E-01	1.49E-01	2.62E-01	pCi/l
21-12077-06	TRG	MW-8	12/15/21 16:30	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	1.17E-01	1.40E-01	1.42E-01	1.98E-01	pCi/l
21-12077-07	TRG	MW-7	12/16/21 07:50	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	4.59E-01	3.14E-01	3.28E-01	3.00E-01	pCi/l
21-12077-08	TRG	MW-9	12/16/21 08:20	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	3.01E-01	2.21E-01	2.30E-01	2.25E-01	pCi/l
21-12077-09	TRG	MW-9D	12/16/21 08:40	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	5.43E-01	3.27E-01	3.47E-01	2.09E-01	pCi/l
21-12077-10	TRG	SW-BO 13	12/16/21 11:35	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	9.11E-02	9.99E-02	1.02E-01	1.37E-01	pCi/l
21-12077-11	TRG	SW-BO 2	12/17/21 08:30	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	-2.79E-02	1.12E-01	1.12E-01	2.87E-01	pCi/l
21-12077-12	TRG	MW-6	12/20/21 08:30	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	5.20E-01	3.30E-01	3.47E-01	3.17E-01	pCi/l
21-12077-13	TRG	MW-10	12/20/21 10:45	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	1.98E-01	1.69E-01	1.74E-01	1.67E-01	pCi/l
21-12077-14	TRG	MW-5	12/20/21 13:30	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	5.78E-01	3.76E-01	3.98E-01	3.47E-01	pCi/l
21-12077-15	TRG	MW-4	12/20/21 15:05	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	1.90E-01	2.37E-01	2.40E-01	3.73E-01	pCi/l
21-12077-16	TRG	MW-3	12/20/21 16:30	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	3.30E-01	2.30E-01	2.40E-01	2.04E-01	pCi/l
21-12077-17	TRG	MW-2	12/21/21 09:55	12/28/2021	1/10/2022	21-12077	Radium-226	EPA 903.0 Modified	4.79E-01	2.15E-01	2.38E-01	1.59E-01	pCi/l

0017

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (1-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original



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601 SCARBORO ROAD OAK RIDGE, TN 37830 865/481-0683 FAX 865/483-4621

# Eberline Analytical

## Final Report of Analysis

**Shawn Wiggins**  
ERM

840 W Sam Houston Parkway N #600  
Houston, TX 77024

SDG: **21-12077**  
Project: 0526033 Henning  
Analysis Category: ENVIRONMENTAL  
Sample Matrix: WA

Work Order Details:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
21-12077-01	LCS	KNOWN	12/28/21 00:00	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	8.84E+00	4.51E-01			pCi/l
21-12077-01	LCS	SPIKE	12/28/21 00:00	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	9.61E+00	9.95E-01	2.39E+00	1.24E+00	pCi/l
21-12077-02	MBL	BLANK	12/28/21 00:00	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	1.92E-01	8.16E-01	8.17E-01	1.72E+00	pCi/l
21-12077-03	DUP	MW-1	12/15/21 13:45	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	1.16E+00	5.44E-01	6.05E-01	1.03E+00	pCi/l
21-12077-04	TRG	MW-11	12/15/21 08:00	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	6.08E-01	6.35E-01	6.49E-01	1.29E+00	pCi/l
21-12077-05	DO	MW-1	12/15/21 13:45	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	2.36E-01	5.61E-01	5.64E-01	1.17E+00	pCi/l
21-12077-06	TRG	MW-8	12/15/21 16:30	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	4.66E-01	5.88E-01	5.68E-01	1.14E+00	pCi/l
21-12077-07	TRG	MW-7	12/16/21 07:50	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	7.77E-01	6.57E-01	6.80E-01	1.32E+00	pCi/l
21-12077-08	TRG	MW-9	12/16/21 08:20	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	7.34E-01	5.33E-01	5.58E-01	1.05E+00	pCi/l
21-12077-09	TRG	MW-9D	12/16/21 08:40	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	7.86E-01	4.86E-01	5.17E-01	9.47E-01	pCi/l
21-12077-10	TRG	SW-BO 13	12/16/21 11:35	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	4.62E-01	4.92E-01	5.03E-01	1.00E+00	pCi/l
21-12077-11	TRG	SW-BO 2	12/16/21 12:30	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	1.40E-01	5.79E-01	5.79E-01	1.23E+00	pCi/l
21-12077-12	TRG	MW-6	12/17/21 08:30	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	1.71E+00	5.24E-01	6.51E-01	9.07E-01	pCi/l
21-12077-13	TRG	MW-10	12/20/21 10:45	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	3.70E-01	6.57E-01	6.63E-01	1.37E+00	pCi/l
21-12077-14	TRG	MW-5	12/20/21 13:30	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	2.10E+00	6.38E-01	7.95E-01	1.13E+00	pCi/l
21-12077-15	TRG	MW-4	12/20/21 15:05	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	7.19E-01	4.79E-01	5.06E-01	9.42E-01	pCi/l
21-12077-16	TRG	MW-3	12/20/21 16:30	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	5.68E-01	6.48E-01	6.61E-01	1.32E+00	pCi/l
21-12077-17	TRG	MW-2	12/21/21 09:55	12/28/2021	1/12/2022	21-12077	Radium-228	EPA 904.0	9.83E-01	6.22E-01	6.60E-01	1.21E+00	pCi/l
21-12077-04	TRG	MW-11	12/15/21 08:00	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	3.27E+03				mg/l
21-12077-05	TRG	MW-1	12/15/21 13:45	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.23E+03				mg/l
21-12077-06	TRG	MW-8	12/15/21 16:30	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.44E+03				mg/l
21-12077-07	TRG	MW-7	12/16/21 07:50	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	6.62E+03				mg/l
21-12077-08	TRG	MW-9	12/16/21 08:20	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.58E+03				mg/l
21-12077-09	TRG	MW-9D	12/16/21 08:40	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.73E+03				mg/l
21-12077-10	TRG	SW-BO 13	12/16/21 11:35	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	3.80E+01				mg/l
21-12077-11	TRG	SW-BO 2	12/16/21 12:30	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.00E+02				mg/l
21-12077-12	TRG	MW-6	12/17/21 08:30	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	4.08E+03				mg/l
21-12077-13	TRG	MW-10	12/20/21 10:45	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.98E+03				mg/l
21-12077-14	TRG	MW-5	12/20/21 13:30	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	3.41E+03				mg/l
21-12077-15	TRG	MW-4	12/20/21 15:05	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	2.72E+03				mg/l
21-12077-16	TRG	MW-3	12/20/21 16:30	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	2.15E+03				mg/l
21-12077-17	TRG	MW-2	12/21/21 09:55	12/28/2021	1/4/2022	21-12077	TDS	SM2540C	1.09E+03				mg/l

CU=Counting Uncertainty; CSU=Combined Standard Uncertainty (1-sigma); MDA=Minimal Detected Activity; LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original



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**SECTION V**  
**ANALYTICAL STANDARD**



13a-b  
(f 6a)

# National Institute of Standards & Technology Certificate

## Standard Reference Material 4251C Barium-133 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive barium-133 chloride, non-radioactive barium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

### Radiological Hazard

The SRM ampoule contains barium-133 with a total activity of approximately 2.5 MBq. Barium-133 decays by electron capture and during the decay process X-rays and gamma rays with energies from 4 to 400 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]\*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

### Chemical Hazard

The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

### Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least June 2004.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

### Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group and D.B. Golas, Nuclear Energy Institute Research Associate.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899  
October 1994

Thomas E. Gills, Chief  
Standard Reference Materials Program



**QUALITY CONTROL PROGRAM**  
QCP-009

Rev.8; 11/10/03  
Title: Radioactive Reference Standards Solutions & Records

**EBERLINE SERVICES - OAK RIDGE LABORATORY**  
**RADIOACTIVE REFERENCE STANDARD SOLUTIONS**

Solution Reference #		QCP-009-1-A NIST SRM4251C	Date	4/23/21
Solution #				Ba-6a
Principal Radionuclide	Half Life, Years		Half Life, Days	
<sup>133</sup> Ba	1.048E+01		3.828E+03	
Radionuclide of Interest	Parent Solution Conc.		Reference Date	
<sup>133</sup> Ba	1.48E+05 dpm/ml		9/1/1993 0:00	
Chemical Composition of Standard Solution				
<sup>133</sup> BaCl <sub>2</sub> in 1M HCl				

Dilution Instructions: Dilution Solvent Used 1M HCl

**SECONDARY VOLUMETRIC DILUTION**

Vol. Parent Solution:	25.0000 ml	Final Activity Concentration:	3.6950E+03 dpm/ml
Total Activity:	3.6950E+06 dpm		
Final Volume:	1000.00 ml		

**NOTES:**

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: April 20, 2022

Verified & Approved By 

Date: 4/23/21

QC Approval 

Date: 4/26/21

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

<sup>Ra-5</sup>  
QA/QC REVIEWED  
Date 2/8/94 Initials WR

Radionuclide: Ra-226 Customer: TMA EBERLINE  
Half Life: 1600 ± 7 years P.O.No.: VH1888  
Catalog No.: 7226 Reference Date: February 1 1994 12:00 PST.  
Source No.: 453-26 Contained Radioactivity: (Ra-226) 1.001 μCi.  
Contained Radioactivity: (Ra-226) 37.0 kBq.

Description of Solution  
a. Mass of solution: 5.1864 g (in a 5 ml Flame Sealed Ampoule)  
b. Chemical form: Ra(NO<sub>3</sub>)<sub>2</sub> in 1 N HNO<sub>3</sub>  
c. Carrier content: None added  
d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities: None detected (other than daughters)

Radioactive Daughters: Rn-222, Po-218, At-218, Pb-214, Bi-214, Po-214, Tl-210, Pb-210, Bi-210, Po-210 and Tl-206.

Radionuclide Concentration: (Ra-226) 0.1929 μCi/g.

## Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:

Energy peak(s) integrated under: 186 keV.

Branching ratio(s) used: 0.0351 gamma rays per decay.

## Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: ±3.4%
- b. Random uncertainty in assay: ±3.1%
- c. Random uncertainty in weighing(s): ±0.2%
- d. Total uncertainty at the 99% confidence level: ±4.6%

## NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

## Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

## Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).



ISOTOPE PRODUCTS LABORATORIES  
1800 North Keystone Street  
Burbank, California 91504  
(818) 843 - 7000

Anna U. Kwan  
QUALITY CONTROL

Feb. 3, 1994  
Date Signed





QUALITY CONTROL PROGRAM  
MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE SOLUTIONS  
PRIMARY DILUTION RECERTIFICATION  
MP 009

SOLUTION REFERENCE # IPL 453-26 CURRENT DATE 8/18/2021 0:00  
SOLUTION # Ra-5

Principal Radionuclide <sup>226</sup>Radium Half Life, Years 1.600E+03 Half Life, Days 5.844E+05

Radionuclide <sup>226</sup>Radium Reference Date 2/1/1994 0:00  
Certified Activity 1.001E+00  $\mu\text{Ci}$   
Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross                      Weight, Grams  
Empty Ampoule                      Weight, Grams  
Solution Net                      Weight, Grams  
Total Activity in Ampoule 1.0010  $\mu\text{Ci}$

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0010  $\mu\text{Ci}$  Which Equals 2.222E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.222E+03 dpm/ml  
This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 18, 2022

Verified & Approved By 

Date: 8/18/2021

QC Approval 

Date: 8-30-21



QUALITY CONTROL PROGRAM  
MP 009

Rev.8; 11/01/03  
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY  
RADIOACTIVE REFERENCE STANDARD SOLUTIONS  
SECONDARY DILUTION RECERTIFICATION

Solution Reference # MP 009 IPL-453-26 Date 8/18/2021 0:00  
Solution # Ra-5b

Principal Radionuclide	Half Life, Years	Half Life, Days
<sup>226</sup> Radium	1.600E+03	5.844E+05

Radionuclide of Interest: <sup>226</sup>Radium Reference Date: 2/1/1994 0:00  
Parent Solution Conc. 2.22E+03 dpm/ml

Chemical Composition of Standard Solution  
<sup>226</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 1M HNO<sub>3</sub>

Dilution Instructions: Dilution Solvent Used 1M HNO<sub>3</sub>

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml  
Total Activity: 4.4440E+04 dpm  
Final Volume: 1000.00 ml

Final Activity Concentration: 4.4440E+01 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

NOTES:

Expiration Date: 18-Aug-22

Verified & Approved By [Signature]  
QC Approval Manarim May

Date: 8/18/2021 0:00  
Date: 8-30-21

**CERTIFICATE OF CALIBRATION**  
Standard Radionuclide Source

72325-207

Ra<sup>228</sup>

Ra-228 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Ra-228
ACTIVITY (dps):	4.022 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	February 10, 2006 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	4.0%

Impurities:  $\gamma$ -impurities <0.1%

5.10721 grams 0.1M HCl solution with 50  $\mu$ g/g Ba carrier.

P O NUMBER 00003181, Item 1

SOURCE PREPARED BY:

M. Taskaeva  
M. Taskaeva, Radiochemist

Q A APPROVED:

W.M. Ryz 2-13-06



# QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03

Title: Radioactive Reference Standards Solutions & Records

## EBERLINE SERVICES - OAK RIDGE LABORATORY RADIOACTIVE REFERENCE SOLUTIONS RECERTIFICATION MP 009

SOLUTION REFERENCE # Analytics 7235-207

CURRENT DATE 1/11/2021 0:00

SOLUTION # Ra-12

Principal Radionuclide

Half Life, Years

Half Life, Days

<sup>228</sup>Ra

5.750E+00

2.100E+03

Radionuclide <sup>228</sup>Ra

Reference Date 2/10/2006 0:00

Certified Activity 1.087E-01  $\mu\text{Ci}$

Certified Concentration                       $\mu\text{Ci per gram}$

Ampoule /Solution Gross 9.0741 Weight, Grams

Empty Ampoule 3.9858 Weight, Grams

Solution Net 5.0883 Weight, Grams

Total Activity in Ampoule 0.1087  $\mu\text{Ci}$

### Chemical Composition of Standard Solution

<sup>228</sup>Ra(NO<sub>3</sub>)<sub>2</sub> in 0.5 M HCl

Dilution Instructions:

Dilution Solvent Used

0.5 M HCl

Dilute to a volume of 991.00 Kg

Certified Total Activity of 0.1087  $\mu\text{Ci}$

Which Equals

2.413E+05 dpm at the date listed above

And after dilution the activity of this solution is 2.435E+02 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: January 11, 2022

Recertified By [Signature]

Date: 1/11/21

QC Approval [Signature]

Date: 1/11/21

**SECTION VI**  
**QUALITY CONTROL SAMPLE RESULTS SUMMARY**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-12077</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226	102.70%	24.98%	100.00%	4.60%	1.00E+01	4.61E-01	1.03E+01	2.57E+00	Ra-5b	4.39E+01	4.60E+00	5.07E-01

**Matrix Spike**

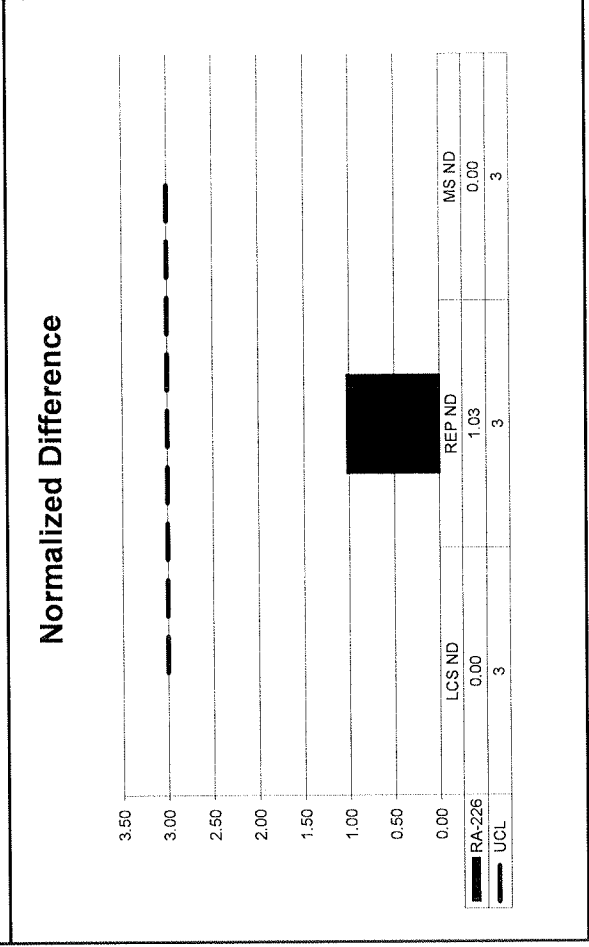
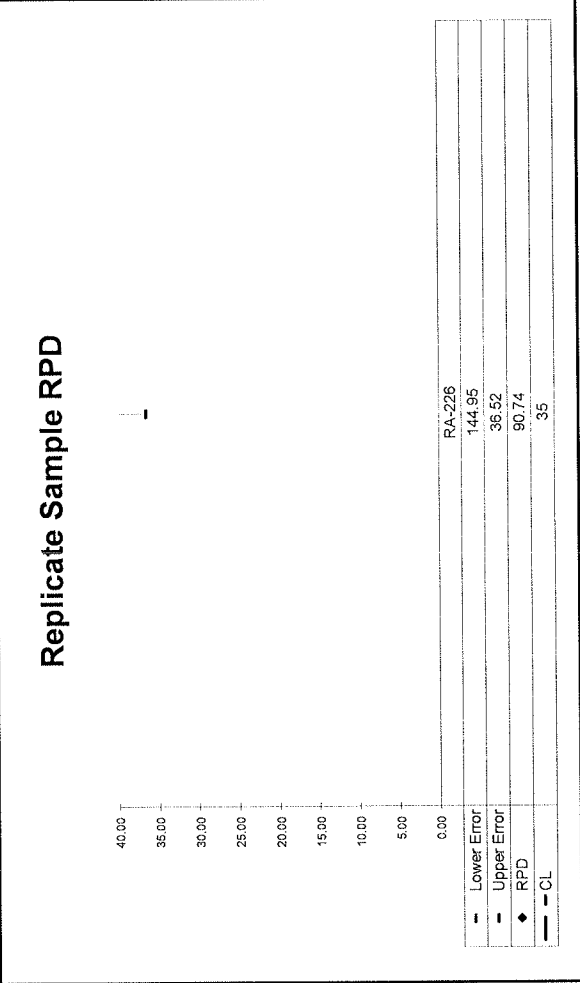
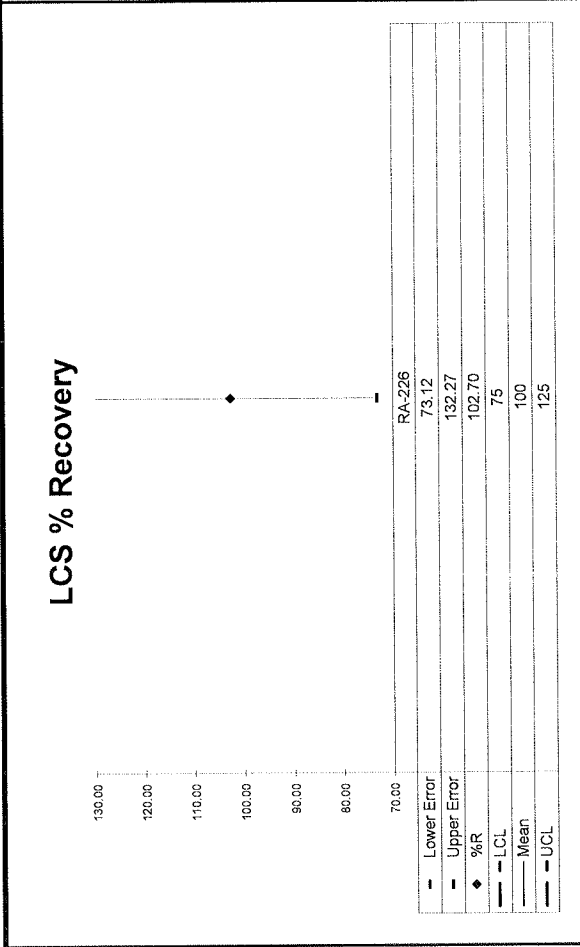
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
RA-226	1.03	90.74	8.73E-02	1.49E-01	2.32E-01	2.33E-01	1.03	OK			NA	OK

**QC Summary**

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-12077</b>	<b>Ra226</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>



**No Matrix Spike**

WFO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-12077</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>

**Laboratory Control Sample**

Analyte	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228	108.69%	24.90%	100.00%	5.10%	8.84E+00	4.51E-01	9.61E+00	2.39E+00	Ra-12	3.57E+01	5.10E+00	5.49E-01

**Matrix Spike**

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

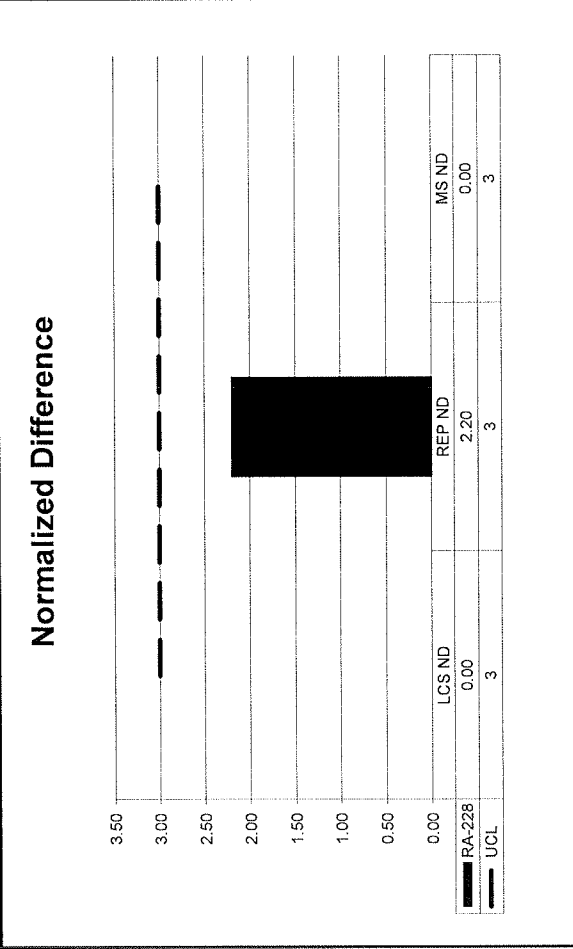
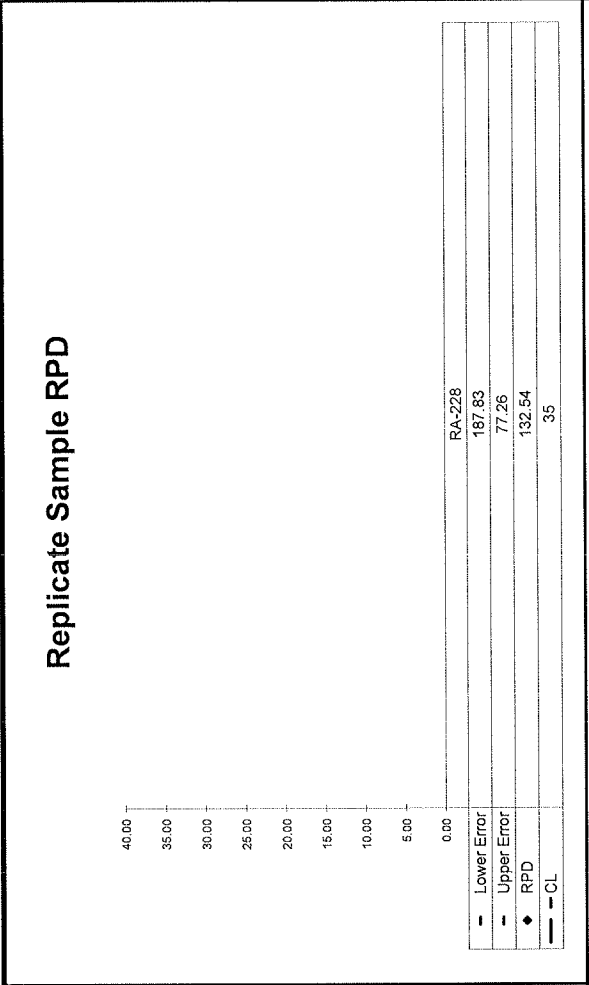
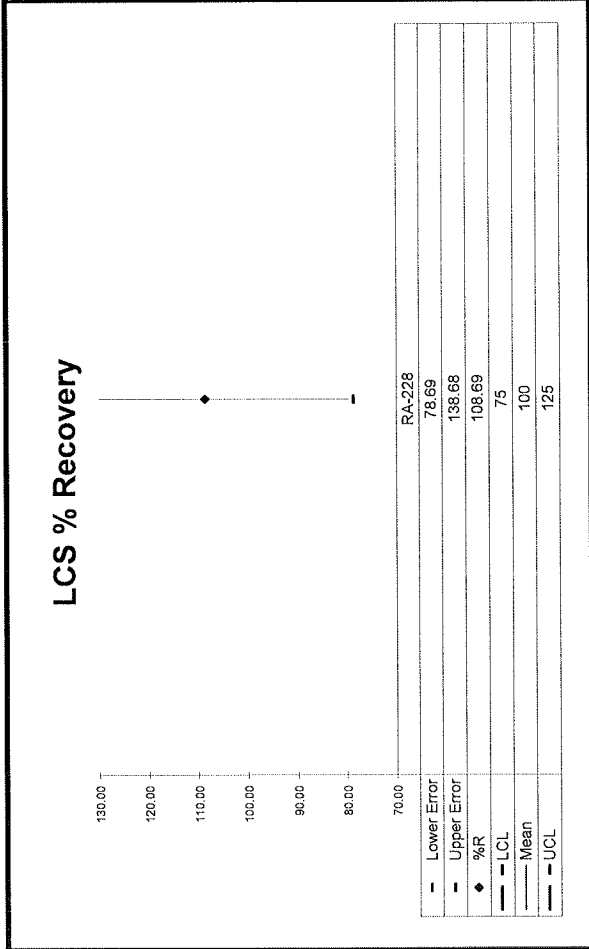
**Replicate Sample**

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS MD	Rep RPD	Rep ND
RA-228	2.20	132.54	2.36E-01	5.64E-01	1.16E+00	6.05E-01	1.09	OK			NA	OK

**QC Summary**



WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
<b>21-12077</b>	<b>Ra228</b>	<b>1</b>	<b>pCi</b>	<b>I</b>	<b>ERM</b>



**No Matrix Spike**


**SECTION VII**  
**LABORATORY TECHNICIAN'S NOTES**

**RA-226 NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-12077
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	01/04/22 09:45	PREP	JHARVEY	ALIQOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	01/04/22 13:46	PREP	JHARVEY	FRACTIONS 10,13 AND 17 WERE FILTERED

*JL Harvey*  
1/4/22

 <b>EBERLINE</b> SERVICES <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-12077
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	01/04/22 09:45	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	01/04/22 13:46	PREP	JHARVEY	FRACTIONS 10,13 AND 17 WERE FILTERED
3	01/10/22 09:50	CHEM	MDAVIS	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

MD  
1/10/22



Reagents Used in an Analysis

Internal Work Order

**21-12077**

Analysis Code

Run

**Ra226**

**1**

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
023319P	Ammonium Hydroxide	Reagent Grade	JHARVEY	1/4/2022
023495D05	Ammonium Sulfate	200 mg/ml	JHARVEY	1/4/2022
023160D04	Barium Carrier	1 mg/ml	JHARVEY	1/4/2022
022880D01	Lead Carrier	166 mg/ml	JHARVEY	1/4/2022
023824P	Nitric Acid	Reagent Grade	JHARVEY	1/4/2022
023196P	Acetic Acid	Reagent Grade	MDAVIS	1/10/2022
023495D01	Ammonium Sulfate	200 mg/ml	MDAVIS	1/10/2022
023837D01	EDTA	0.25M	MDAVIS	1/10/2022


Alpha Banks

53

Date	Sample #	Client	Load time	Count time	Analysis	Tech
1/10/22	2112073A(3-7)	PEC Structural	06:08	2hr 50min	Th	KP
1/10/22	2201007A(3,4)	UCOR	0811	2hr 50min	UU	KP
1/10/22	2112091A(1-47)	UCOR	0811	2hr 50min	Pu	KP
1/10/22	2112091A(1-4)	UCOR	0812	2hr 50min	Pu242	KP
1/10/22	2112079A(1-6)	USA	0813	2hr 50min	UU	KP
1/10/22	Reagent 301A(1)	Lab	0815	1hr	UUNT	KP
1/10/22	2112091A(1,2)	UCOR	0908	2hr 50min	UU	KP
1/10/22	2112079A(7-14)	USA	0909	2hr 50min	UU	KP
1/10/22	2112091A(3,4)	UCOR	1108	2hr 50min	Th	KP
1/10/22	2112091A(1-4)	UCOR	1109	2hr 50min	Th229	KP
1/10/22	2201001A(1-4)	PEC Structural	1110	2hr 50min	Th	KP
1/10/22	2112057A(1-8)	Weston	1110	2hr 50min	Th	KP
1/10/22	2112057A(9-14)	Weston	1202	2hr 50min	Th	KP
1/10/22	2112079A(15-18)	USA	1203	2hr 50min	UU	KP
1/10/22	2112077A(1-7)	ERM	1408	2hr 50min	Pale	KB


**RA-228 NOTES**



 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-12077
		Analysis Code	Ra228
		Run Number	1


#	Date	Dept	User	Notes
1	01/04/22 09:45	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	01/04/22 13:46	PREP	JHARVEY	FRACTIONS 10,13 AND 17 WERE FILTERED

*J Harvey*  
 1/4/22

 <b>EBERLINE</b> SERVICES <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-12077
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	01/04/22 09:45	PREP	JHARVEY	ALIUQUOTED AND ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	01/04/22 13:46	PREP	JHARVEY	FRACTIONS 10,13 AND 17 WERE FILTERED
3	01/12/22 11:10	CHEM	MDAVIS	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUED AND DISCARDED SUPERNTANT. ADDED IN HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

MB  
1/12/22

 <b>Reagents Used in an Analysis</b>		Internal Work Order		
		21-12077		
		Analysis Code		Run
		Ra228		1
Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
023319P	Ammonium Hydroxide	Reagent Grade	JHARVEY	1/4/2022
023495D05	Ammonium Sulfate	200 mg/ml	JHARVEY	1/4/2022
023160D04	Barium Carrier	1 mg/ml	JHARVEY	1/4/2022
022880D01	Lead Carrier	166 mg/ml	JHARVEY	1/4/2022
023824P	Nitric Acid	Reagent Grade	JHARVEY	1/4/2022
023118D01	Ammonium Oxalate	5%	MDAVIS	1/12/2022
023837D01	EDTA	0.25M	MDAVIS	1/12/2022
023055D12	Nitric Acid	1N	MDAVIS	1/12/2022
023055D11	Nitric Acid	6N	MDAVIS	1/12/2022
023120D02	Sodium Hydroxide	10M	MDAVIS	1/12/2022
023120D01	Sodium Hydroxide	18M	MDAVIS	1/12/2022
023128D01	Yttrium Carrier	9 mg/ml	MDAVIS	1/12/2022

Red LB41K

75


Date	Sample #	Client	Lead time	Count time	Analysis	Tech
1/11/22	Cross Talk	Lab	0728	5 min	αB	KP
1/12/22	21120915V (4.6)	UCOR	0824	2 hrs	Sr <sup>90</sup>	KP
1/12/22	Daily Bkgd/Qc	Lab	061/0520	1 hr/30 min	αB	KP
1/12/22	Cross Talk	Lab	0710	5 min	αB	KP
1/12/22	Cross Talk	Lab	0716	5 min	αB	KP
1/12/22	2112077Ra (15-17)	ERM	1141	2 hrs	Ra <sup>8</sup>	KP

Aqua LB4110

19

Date	Sample #	Client	Leadtime	Counttime	Analysis	Tech
1/7/22	2201007Sr(1-4c)	UCOR	0922	2hrs	Tot Sr	KP
1/7/22	2112054SV(2-4c)	UCOR	0923	2hrs	Sr <sup>90</sup>	KP
1/7/22	2112003SV(1)	Access	1030	30min	Sr <sup>90</sup>	KP
1/7/22	2112003Sr(1)	Access	1101	30min	Tot Sr	KP
1/7/22	2112003Sr(2-4)	Access	1125	2hrs	Tot Sr	KP
1/7/22	2201010AB(2-5)	Parsons	1125	8hrs	XB	KP
1/8/22	WKly Bkgd	Lab	1026	12hrs	XB	KP
1/10/22	Daily Bkgd/QC	Lab	0555/6704	1hr/30min	XB	KP
1/10/22	Cross Talk	Lab	0744	5min	XB	KP
1/10/22	Cross Talk	Lab	0820	5min	XB	KP
1/10/22	2112007CL(1-3.5)	UCOR	1450	30mins	CL <sup>36</sup>	KP
1/11/22	Daily Bkgd/QC	Lab	0558/6707	1hr/30min	XB	KP
1/11/22	Cross Talk	Lab	0745	5min	XB	KP
1/11/22	Cross Talk	Lab	0801	5min	XB	KP
1/11/22	2112091Np(1-4)	UCOR	0822	10min	Np	KP
1/11/22	2112067SV(1-4c)	UCOR	0823	2hrs	Sr <sup>90</sup>	KP
1/11/22	2112091SV(1-3)	UCOR	0824	2hrs	Sr <sup>90</sup>	KP
1/11/22	2201020AB(1-4)	UCOR	0833	1hr	XB	KP
1/11/22	2112067Pb(1-4)	UCOR	0936	2hrs	Pb	KP
1/11/22	2112091CL <sup>36</sup> (1-3.5)	UCOR	1419	30mins	CL <sup>36</sup>	KP
1/12/22	Daily Bkgd/QC	Lab	0529/6042	1hr/30min	XB	KP
1/12/22	Cross Talk	Lab	0717	5min	XB	KP
1/12/22	Cross Talk	Lab	0727	5min	XB	KP
1/12/22	2112091Pb(1-4)	UCOR	0735	2hrs	Pb	KP
1/12/22	2112077Ra(3-14)	ERM	1141	2hrs	Ra <sup>8</sup>	KP
1/12/22	2112077Ra(1+2)	ERM	1343	2hrs	Ra <sup>8</sup>	KP

**TDS NOTES**

 <b>EBERLINE</b> <small>SERVICES</small> <b>Work Order Analysis Notes</b>	<b>Oak Ridge Laboratory</b> 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	21-12077
		Analysis Code	TDS
		Run Number	1

#	Date	Dept	User	Notes
1	01/03/22 14:00	PREP	JPACHELLA	Samples were filtered, aliquoted into tared beakers, dried, and reweighed.

*1-3-22 JPachella*

**SECTION VIII**  
**ANALYTICAL DATA (RADIUM-226)**



<b>Work Order</b>	<b>21-12077</b>
<b>Analysis Code</b>	<b>Ra226</b>
<b>Run</b>	<b>1</b>
<b>Date Received</b>	<b>12/28/2021</b>
<b>Lab Deadline</b>	<b>1/10/2022</b>
<b>Client</b>	ERM
<b>Project</b>	526033
<b>Report Level</b>	4
<b>Activity Units</b>	pCi
<b>Aliquot Units</b>	l
<b>Matrix</b>	WA
<b>Method</b>	EPA 903.0 Modified
<b>Instrument Type</b>	Alpha Spectroscopy
<b>Radiometric Tracer</b>	Ba-133
<b>Radiometric Sol#</b>	Ba-6a
<b>Tracer Act (dpm/g)</b>	381.37
<b>Carrier</b>	
<b>Carrier Conc (mg/ml)</b>	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		12/28/21 00:00	1.0000E+00
02	MBL	BLANK		12/28/21 00:00	1.0000E+00
03	DUP	MW-1	20	12/15/21 13:45	1.0000E+00
04	TRG	MW-11	30	12/15/21 08:00	1.0000E+00
05	DO	MW-1	20	12/15/21 13:45	1.0000E+00
06	TRG	MW-8	30	12/15/21 16:30	1.0000E+00
07	TRG	MW-7	30	12/16/21 07:50	1.0000E+00
08	TRG	MW-9	50	12/16/21 08:20	1.0000E+00
09	TRG	MW-9D	20	12/16/21 08:40	1.0000E+00
10	TRG	SW-BO 13	40	12/16/21 11:35	1.0000E+00
11	TRG	SW-BO 2	20	12/16/21 12:30	1.0000E+00
12	TRG	MW-6	20	12/17/21 08:30	1.0000E+00
13	TRG	MW-10	40	12/20/21 10:45	1.0000E+00
14	TRG	MW-5	60	12/20/21 13:30	1.0000E+00
15	TRG	MW-4	40	12/20/21 15:05	1.0000E+00
16	TRG	MW-3	40	12/20/21 16:30	1.0000E+00
17	TRG	MW-2	20	12/21/21 09:55	1.0000E+00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.2142	844.4	399.0	104.90		0.0199	0.0267	0.0068		104.90	2.44	1.00
02	MBL	2.1944	836.9	344.0	91.25		0.0198	0.0263	0.0065		91.25	2.34	1.00
03	DUP	2.1947	837.0	380.0	100.79		0.0200	0.0285	0.0085		100.79	2.89	1.00
04	TRG	2.1917	835.8	350.0	92.96		0.0200	0.0254	0.0054		92.96	1.91	1.00
05	DO	2.1893	834.9	382.0	101.57		0.0199	0.0280	0.0081		101.57	2.79	1.00
06	TRG	2.1852	833.4	359.0	95.63		0.0200	0.0270	0.0070		95.63	2.50	1.00
07	TRG	2.1808	831.7	344.0	91.82		0.0200	0.0281	0.0081		91.82	2.79	1.00
08	TRG	2.1345	814.0	364.0	99.27		0.0199	0.0257	0.0058		99.27	2.08	1.00
09	TRG	2.0902	797.1	379.0	105.55		0.0201	0.0271	0.0070		105.55	2.50	1.00
10	TRG	2.1139	806.2	356.0	98.03		0.0197	0.0243	0.0046		98.03	1.49	1.00
11	TRG	2.5654	978.4	385.0	87.36		0.0201	0.0269	0.0068		87.36	2.44	1.00
12	TRG	2.1965	837.7	369.0	97.79		0.0198	0.0275	0.0077		97.79	2.69	1.00
13	TRG	2.1726	828.6	330.0	88.42		0.0200	0.0250	0.0050		88.42	1.71	1.00
14	TRG	2.1706	827.8	310.0	83.14		0.0201	0.0312	0.0111		83.14	3.00^	1.00
15	TRG	2.1742	829.2	401.0	107.36		0.0203	0.0276	0.0073		107.36	2.58	1.00
16	TRG	2.1695	827.4	350.0	93.91		0.0201	0.0270	0.0069		93.91	2.47	1.00
17	TRG	2.1716	828.2	304.0	81.49		0.0199	0.0241	0.0042		81.49	1.25	1.00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
 \*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
02	MBL			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
03	DUP			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
04	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
05	DO			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
06	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
07	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
08	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
09	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
10	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
11	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
12	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
13	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
14	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
15	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
16	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		
17	TRG			01/04/22 14:03	JHARVEY	01/10/22 08:08	MDAVIS		

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
 \*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations  
**Work Order: 21-12077-Ra226-1**

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-226	LCS	LCS	pCi/l	1.03E+01	1.37E+00	1.84E-01	1.00E+01	102.70	OK		OK	
02	RA-226	MBL	BLANK	pCi/l	5.65E-02	1.22E-01	2.41E-01					OK	OK
03	RA-226	DUP	MW-1	pCi/l	2.32E-01	2.27E-01	2.94E-01				NA	OK	
04	RA-226	TRG	MW-11	pCi/l	4.49E-01	2.48E-01	1.46E-01					OK	
05	RA-226	DO	MW-1	pCi/l	8.73E-02	1.48E-01	2.62E-01					OK	
06	RA-226	TRG	MW-8	pCi/l	1.17E-01	1.40E-01	1.98E-01					OK	
07	RA-226	TRG	MW-7	pCi/l	4.59E-01	3.14E-01	3.00E-01					OK	
08	RA-226	TRG	MW-9	pCi/l	3.01E-01	2.21E-01	2.25E-01					OK	
09	RA-226	TRG	MW-9D	pCi/l	5.43E-01	3.27E-01	2.09E-01					OK	
10	RA-226	TRG	SW-BO 13	pCi/l	9.11E-02	9.99E-02	1.37E-01					OK	
11	RA-226	TRG	SW-BO 2	pCi/l	-2.79E-02	1.12E-01	2.87E-01					OK	
12	RA-226	TRG	MW-6	pCi/l	5.20E-01	3.30E-01	3.17E-01					OK	
13	RA-226	TRG	MW-10	pCi/l	1.98E-01	1.69E-01	1.67E-01					OK	
14	RA-226	TRG	MW-5	pCi/l	5.78E-01	3.76E-01	3.47E-01					OK	
15	RA-226	TRG	MW-4	pCi/l	1.90E-01	2.37E-01	3.73E-01					OK	
16	RA-226	TRG	MW-3	pCi/l	3.30E-01	2.30E-01	2.04E-01					OK	
17	RA-226	TRG	MW-2	pCi/l	4.79E-01	2.15E-01	1.59E-01					OK	

	Run	1
	Analysis Code	Ra226
Eberline Services Work Order	21-12077	
Client	ERM	

Preliminary Data Report & Analytical Calculations  
**Work Order: 21-12077-Ra226-1**

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep to Date/Time	Sep to Date/Time
01	RA-226	LCS	12/28/21 00:00	1.00E+00	100.00	0.00	104.90		1/10/2022 8:08	
02	RA-226	MBL	12/28/21 00:00	1.00E+00	91.25	0.00	91.25		1/10/2022 8:08	
03	RA-226	DUP	12/15/21 13:45	1.00E+00	100.00	0.00	100.79		1/10/2022 8:08	
04	RA-226	TRG	12/15/21 08:00	1.00E+00	92.96	0.00	92.96		1/10/2022 8:08	
05	RA-226	DO	12/15/21 13:45	1.00E+00	100.00	0.00	101.57		1/10/2022 8:08	
06	RA-226	TRG	12/15/21 16:30	1.00E+00	95.63	0.00	95.63		1/10/2022 8:08	
07	RA-226	TRG	12/16/21 07:50	1.00E+00	91.82	0.00	91.82		1/10/2022 8:08	
08	RA-226	TRG	12/16/21 08:20	1.00E+00	99.27	0.00	99.27		1/10/2022 8:08	
09	RA-226	TRG	12/16/21 08:40	1.00E+00	100.00	0.00	105.55		1/10/2022 8:08	
10	RA-226	TRG	12/16/21 11:35	1.00E+00	98.03	0.00	98.03		1/10/2022 8:08	
11	RA-226	TRG	12/16/21 12:30	1.00E+00	87.36	0.00	87.36		1/10/2022 8:08	
12	RA-226	TRG	12/17/21 08:30	1.00E+00	97.79	0.00	97.79		1/10/2022 8:08	
13	RA-226	TRG	12/20/21 10:45	1.00E+00	88.42	0.00	88.42		1/10/2022 8:08	
14	RA-226	TRG	12/20/21 13:30	1.00E+00	83.14	0.00	83.14		1/10/2022 8:08	
15	RA-226	TRG	12/20/21 15:05	1.00E+00	100.00	0.00	107.36		1/10/2022 8:08	
16	RA-226	TRG	12/20/21 16:30	1.00E+00	93.91	0.00	93.91		1/10/2022 8:08	
17	RA-226	TRG	12/21/21 09:55	1.00E+00	81.49	0.00	81.49		1/10/2022 8:08	

	Run	1
	Analysis Code	Ra226
Eberline Services Work Order	21-12077	
Client	ERM	

Preliminary Data Report & Analytical Calculations  
**Work Order: 21-12077-Ra226-1**

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-226	LCS	01/10/22 14:07		A_Spec	Alpha_043	170	2.34 E+02	1.00 E-03	14.7
02	RA-226	MBL	01/10/22 14:07		A_Spec	Alpha_044	170	1.32 E+00	4.00 E-03	15.9
03	RA-226	DUP	01/10/22 14:07		A_Spec	Alpha_045	170	4.98 E+00	6.00 E-03	16.4
04	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_046	170	1.28 E+01	1.00 E-03	15.6
05	RA-226	DO	01/10/22 14:07		A_Spec	Alpha_047	170	2.00 E+00	0.00 E+00	16.9
06	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_048	170	3.32 E+00	4.00 E-03	19.7
07	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_049	170	9.15 E+00	5.00 E-03	16.1
08	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_050	170	8.00 E+00	0.00 E+00	14.8
09	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_051	170	1.08 E+01	1.00 E-03	13.2
10	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_052	170	4.00 E+00	0.00 E+00	17.7
11	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_053	170	-5.10 E-01	3.00 E-03	13.5
12	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_054	170	1.08 E+01	7.00 E-03	15.2
13	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_055	170	5.66 E+00	2.00 E-03	14.7
14	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_056	170	1.00 E+01	0.00 E+00	16.5
15	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_057	170	3.96 E+00	1.20 E-02	14.3
16	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_058	170	8.49 E+00	3.00 E-03	17.9
17	RA-226	TRG	01/10/22 14:07		A_Spec	Alpha_059	170	2.06 E+01	8.00 E-03	17.5

	Run	1
	Analysis Code	Ra226
Eberline Services Work Order	21-12077	
Client	ERM	

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	12/28/21 00:00	1.0000	2.2142	844.4295	399.0000	104.90	2.44	1.00
02	MBL	BLANK	12/28/21 00:00	1.0000	2.1944	836.8783	344.0000	91.25	2.34	1.00
03	DUP	MW-1	12/15/21 13:45	1.0000	2.1947	836.9927	380.0000	100.79	2.89	1.00
04	TRG	MW-11	12/15/21 08:00	1.0000	2.1917	835.8486	350.0000	92.96	1.91	1.00
05	DO	MW-1	12/15/21 13:45	1.0000	2.1893	834.9333	382.0000	101.57	2.79	1.00
06	TRG	MW-8	12/15/21 16:30	1.0000	2.1852	833.3697	359.0000	95.63	2.50	1.00
07	TRG	MW-7	12/16/21 07:50	1.0000	2.1808	831.6917	344.0000	91.82	2.79	1.00
08	TRG	MW-9	12/16/21 08:20	1.0000	2.1345	814.0343	364.0000	99.27	2.08	1.00
09	TRG	MW-9D	12/16/21 08:40	1.0000	2.0902	797.1396	379.0000	105.55	2.50	1.00
10	TRG	SW-BO 13	12/16/21 11:35	1.0000	2.1139	806.1780	356.0000	98.03	1.49	1.00
11	TRG	SW-BO 2	12/16/21 12:30	1.0000	2.5654	978.3666	385.0000	87.36	2.44	1.00
12	TRG	MW-6	12/17/21 08:30	1.0000	2.1965	837.6792	369.0000	97.79	2.69	1.00
13	TRG	MW-10	12/20/21 10:45	1.0000	2.1726	828.5645	330.0000	88.42	1.71	1.00
14	TRG	MW-5	12/20/21 13:30	1.0000	2.1706	827.8017	310.0000	83.14	3.00^	1.00
15	TRG	MW-4	12/20/21 15:05	1.0000	2.1742	829.1747	401.0000	107.36	2.58	1.00
16	TRG	MW-3	12/20/21 16:30	1.0000	2.1695	827.3822	350.0000	93.91	2.47	1.00
17	TRG	MW-2	12/21/21 09:55	1.0000	2.1716	828.1831	304.0000	81.49	1.25	1.00





# Aliquot Worksheet

Work Order		Run		Analysis Code		Rpt Units		Lab Deadline		Technician	
<b>21-12077</b>		<b>1</b>		<b>Ra226</b>		<b>liters</b>		<b>1/10/2022</b>		<b>JHARVEY</b>	

Lab Fraction	ERM Client ID	Sample Type	Muffle Data		Dilution Data			Aliquot Data			MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq		
01	LCS	LCS							1.0000E+00	1.0000E+00				
02	BLANK	MBL							1.0000E+00	1.0000E+00				
03	MW-1	DUP							1.0000E+00	1.0000E+00				
04	MW-11	TRG							1.0000E+00	1.0000E+00				
05	MW-1	DO							1.0000E+00	1.0000E+00				
06	MW-8	TRG							1.0000E+00	1.0000E+00				
07	MW-7	TRG							1.0000E+00	1.0000E+00				
08	MW-9	TRG							1.0000E+00	1.0000E+00				
09	MW-9D	TRG							1.0000E+00	1.0000E+00				
10	SW-BO 13	TRG							1.0000E+00	1.0000E+00				
11	SW-BO 2	TRG							1.0000E+00	1.0000E+00				
12	MW-6	TRG							1.0000E+00	1.0000E+00				
13	MW-10	TRG							1.0000E+00	1.0000E+00				
14	MW-5	TRG							1.0000E+00	1.0000E+00				
15	MW-4	TRG							1.0000E+00	1.0000E+00				
16	MW-3	TRG							1.0000E+00	1.0000E+00				
17	MW-2	TRG							1.0000E+00	1.0000E+00				

Comments
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Technician: Jharvey Date: 1/4/22

# Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
<b>21-12077</b>	<b>1</b>	<b>Ra226</b>			<b>MDAVIS</b>

TRetec Fraction	ERM Client ID	Sample Type	Carrier Data		Filter Data			Gravimetric % Recovery
			Carrier Added (ml)	Carrier Conc (mg/ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	
01	LCS	LCS			0.0199	0.0267	0.0068	
02	BLANK	MBL			0.0198	0.0263	0.0065	
03	DUP	DUP			0.0200	0.0285	0.0085	
04	MW-11	TRG			0.0200	0.0254	0.0054	
05	MW-1	DO			0.0199	0.0280	0.0081	
06	MW-8	TRG			0.0200	0.0270	0.0070	
07	MW-7	TRG			0.0200	0.0281	0.0081	
08	MW-9	TRG			0.0199	0.0257	0.0058	
09	MW-9D	TRG			0.0201	0.0271	0.0070	
10	SW-BO 13	TRG			0.0197	0.0243	0.0046	
11	SW-BO 2	TRG			0.0201	0.0269	0.0068	
12	MW-6	TRG			0.0198	0.0275	0.0077	
13	MW-10	TRG			0.0200	0.0250	0.0050	
14	MW-5	TRG			0.0201	0.0312	0.0111	
15	MW-4	TRG			0.0203	0.0276	0.0073	
16	MW-3	TRG			0.0201	0.0270	0.0069	
17	MW-2	TRG			0.0199	0.0241	0.0042	

Technician: Megan Davis Date: 1/10/22



KB  
1/10/22

Sample Description: SPIKE  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 01  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_043  
 Chamber Serial Number: 04026481A  
 Detector Serial Number: 91088  
 Env. Background: System Bkgd 311325  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.440E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 1/10/2022 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:10 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1469 +/- 0.0027 on 11/30/2021 2:02:38 PM  
 Effective Efficiency: 0.1469 +/- 0.0027

Control Certificate Name: Ra226\_Ra-5b  
 Chem. Recov. of Control: RA-226 0.420923 +/- 0.031233  
 Peak Match Tolerance: 0.350 MeV

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 PEAK AREA REPORT  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.498	23.81	41.33	1.19	0.00E+000	3.0
RA-226	4.624	233.83	12.82	0.17	0.00E+000	3.5

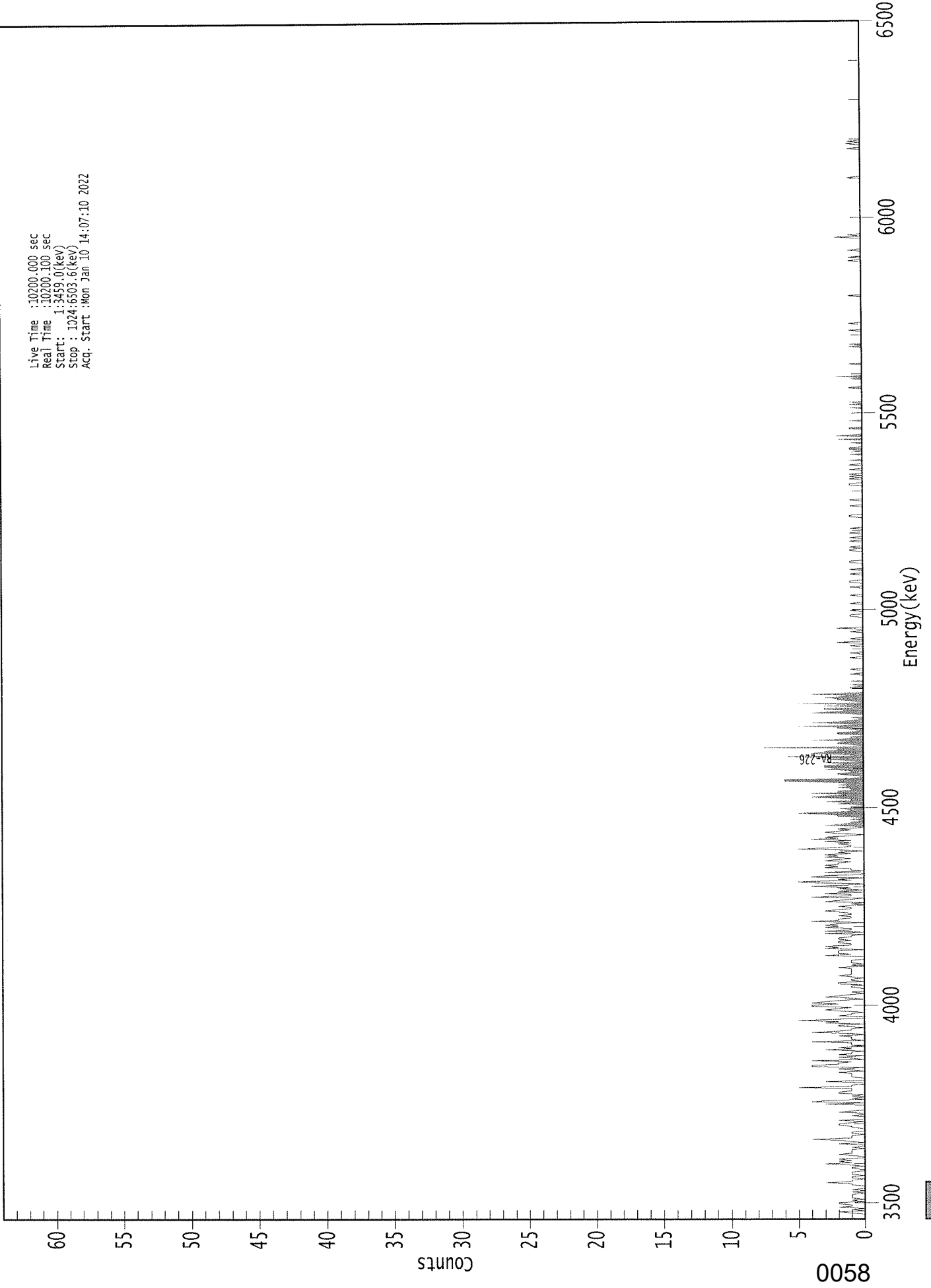
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 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.955	5685.50*	1.10E+000 +/- 4.57E-001	3.05E-001 +/- 1.08E-002
RA-226	0.967	4785.00*	1.03E+001 +/- 1.37E+000	1.84E-001 +/- 6.50E-003

AG  
1/11/22

0000304878.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3459.0(Rev)  
Stop : 1024:6503.6(keV)  
Acq. Start :Mon Jan 10 14:07:10 2022



0058

ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 01

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	1	2	0
9:	1	0	2	1	1	1	2	2	0
17:	1	0	1	1	1	1	1	0	1
25:	0	1	0	0	0	0	1	1	3
33:	1	1	0	1	1	1	0	1	1
41:	1	0	0	1	1	1	0	1	3
49:	1	2	1	2	0	0	0	1	2
57:	1	1	1	1	0	0	1	0	0
65:	2	0	1	2	4	1	1	1	1
73:	0	1	1	0	0	0	0	1	1
81:	2	2	1	0	2	0	0	0	0
89:	1	0	0	2	1	0	0	0	0
97:	0	0	3	0	4	3	0	0	1
105:	0	1	0	2	2	1	1	1	1
113:	5	1	1	0	0	3	0	0	0
121:	0	1	1	1	1	2	0	0	1
129:	2	0	4	4	2	2	1	1	4
137:	0	1	2	0	2	1	1	1	0
145:	3	1	2	0	1	1	1	1	4
153:	0	1	1	1	2	0	1	1	4
161:	2	1	1	0	2	2	0	0	3
169:	2	5	2	0	0	2	1	1	1
177:	0	2	3	2	1	4	4	4	2
185:	4	3	2	0	1	3	2	2	1
193:	0	1	0	0	0	1	1	1	0
201:	2	2	0	1	1	0	1	1	2
209:	1	1	1	1	1	1	1	2	0
217:	1	0	1	1	1	0	0	0	0
225:	3	1	2	2	2	0	3	3	2
233:	3	1	1	2	2	1	2	2	2
241:	1	1	0	3	0	3	1	1	1
249:	3	2	3	2	0	4	2	2	2
257:	1	1	2	1	1	2	3	3	2
265:	1	1	2	0	1	0	3	3	2
273:	1	0	4	1	1	3	0	0	2
281:	0	2	1	4	1	0	4	4	5
289:	1	2	0	4	3	0	0	0	3
297:	0	1	1	3	2	3	2	2	2
305:	1	3	2	1	3	2	3	3	1
313:	2	0	2	5	2	1	1	1	2
321:	1	3	1	4	2	3	1	1	0
329:	2	3	2	1	2	0	1	1	3
337:	2	1	1	0	1	0	2	2	2
345:	3	5	4	1	1	2	1	1	1
353:	0	2	1	3	1	1	3	3	4
361:	3	1	4	2	2	1	1	1	2

369: 1 2 1 2 6 6 6 1

Sample Title: 01

Channel	1	2	1	2	6	6	6	1
377:	0	1	2	2	1	1	3	2
385:	3	3	3	1	3	0	2	3
393:	2	6	0	3	4	3	3	2
401:	2	8	0	1	2	2	1	4
409:	2	1	1	0	2	2	2	0
417:	1	2	2	5	0	2	4	2
425:	1	0	1	0	0	1	4	3
433:	1	3	3	0	3	0	5	0
441:	1	2	2	3	2	1	4	2
449:	0	0	0	1	1	0	1	0
457:	0	1	0	0	0	0	0	1
465:	0	0	0	1	0	0	0	0
473:	0	0	0	0	0	1	0	0
481:	0	1	0	0	0	0	0	1
489:	0	0	2	0	0	1	0	0
497:	0	0	0	1	0	0	2	0
505:	0	0	0	0	0	0	0	0
513:	1	1	0	0	0	1	0	0
521:	0	0	0	1	0	0	0	0
529:	0	0	1	0	0	0	0	0
537:	0	1	0	0	0	1	1	0
545:	0	0	0	0	1	0	0	0
553:	1	0	0	0	0	0	1	1
561:	0	0	0	0	0	0	0	0
569:	1	1	0	1	0	0	0	0
577:	1	0	0	1	0	0	0	1
585:	0	0	0	1	0	0	0	0
593:	0	0	0	0	0	1	1	0
601:	0	0	0	0	0	0	1	0
609:	0	0	0	1	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	1	1	0	0	0	1	0	1
633:	0	1	0	0	0	1	0	0
641:	0	1	0	0	0	1	0	0
649:	0	0	1	0	0	0	1	1
657:	1	0	0	0	1	0	0	2
665:	0	0	2	1	0	0	0	0
673:	1	1	0	0	0	0	0	1
681:	0	0	0	0	0	0	0	0
689:	0	0	1	0	0	1	0	1
697:	0	0	0	0	0	0	0	0
705:	0	0	0	1	1	0	0	0
713:	0	0	0	1	0	2	0	0
721:	0	0	0	0	0	0	0	0
729:	1	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	1
745:	0	1	0	0	0	0	0	0
753:	0	0	0	0	0	1	0	0
761:	0	0	0	1	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	1	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 01

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	1	0	0	1	0	0	0
825:	0	0	1	0	0	0	0	0
833:	0	0	0	0	0	2	0	1
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	1	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	1	0	0	0	1	0	1
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KB  
1/10/22

Sample Description: BLANK  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 02  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_044  
 Chamber Serial Number: 04026481B  
 Detector Serial Number: 84168  
 Env. Background: System Bkgd 311326  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.340E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 1/10/2022 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:12 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9125 +/- 0.0000  
 Counting Efficiency: 0.1589 +/- 0.0028 on 11/30/2021 2:02:39 PM  
 Effective Efficiency: 0.1450 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.443	0.30	988.46	1.70	0.00E+000	6.0
RA-226	4.637	1.32	215.97	0.68	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

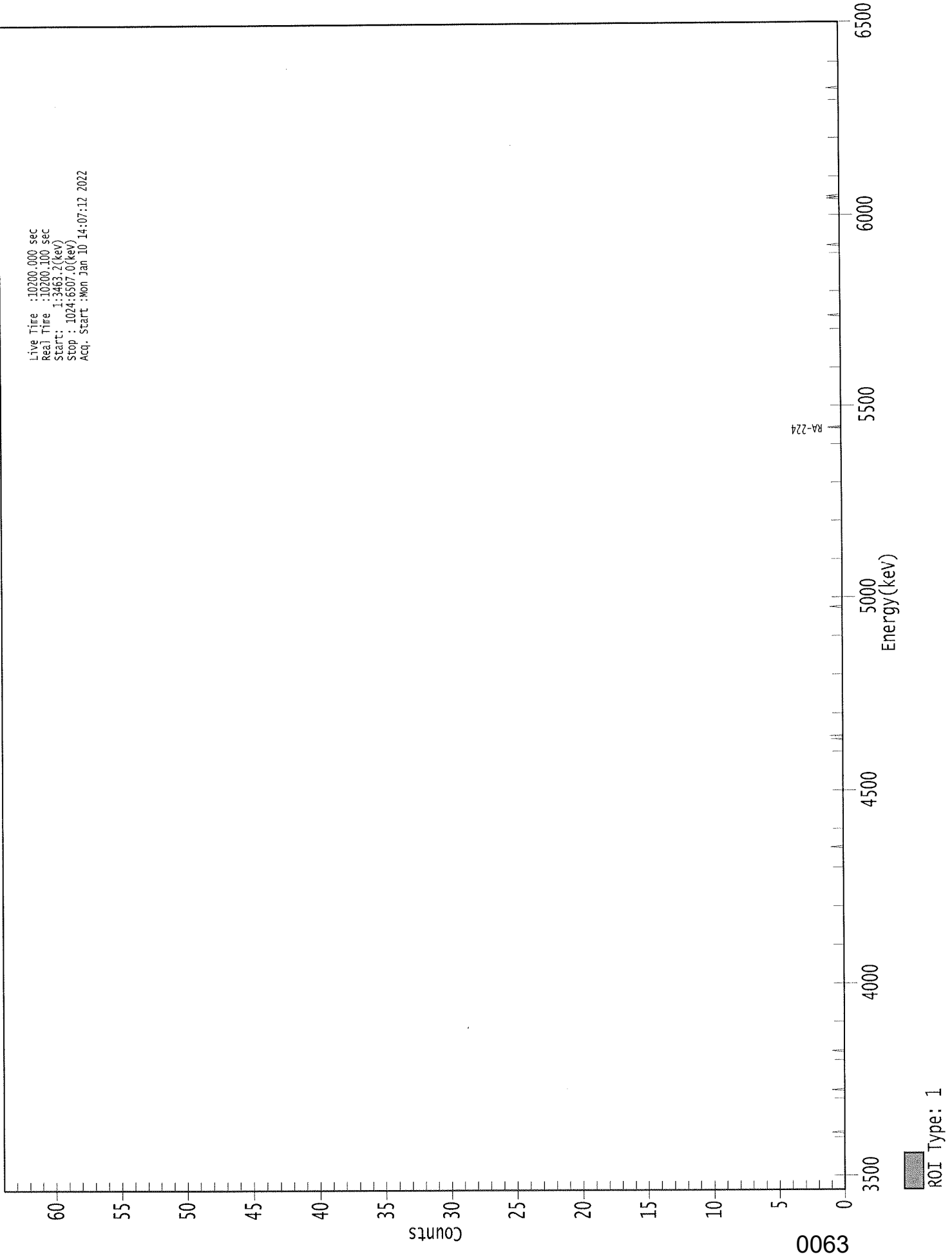
Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.926	5685.50*	1.35E-002 +/- 1.33E-001	3.30E-001 +/- 1.16E-002
RA-226	0.972	4785.00*	5.65E-002 +/- 1.22E-001	2.41E-001 +/- 8.44E-003

AGP  
1/11/22



0000304862.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3463.2(kev)  
Stop : 1024:6507.0(kev)  
Acq. Start :Mon Jan 10 14:07:12 2022



0063

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 02

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	1	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	1
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	1	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	1	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 02

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	1	0	0	1	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	1	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	1	1	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	1	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	1	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	1	0	1	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	1	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

CB  
1/10/22

Sample Description: MW-1 DUP  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 03  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_045  
 Chamber Serial Number: 04026482A  
 Detector Serial Number: 91131  
 Env. Background: System Bkgd 311327  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.890E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/15/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:14 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1642 +/- 0.0029 on 5/21/2021 9:18:20 AM  
 Effective Efficiency: 0.1642 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.505	2.15	161.66	0.85	0.00E+000	3.0
RA-226	4.609	4.98	97.79	1.02	0.00E+000	3.0

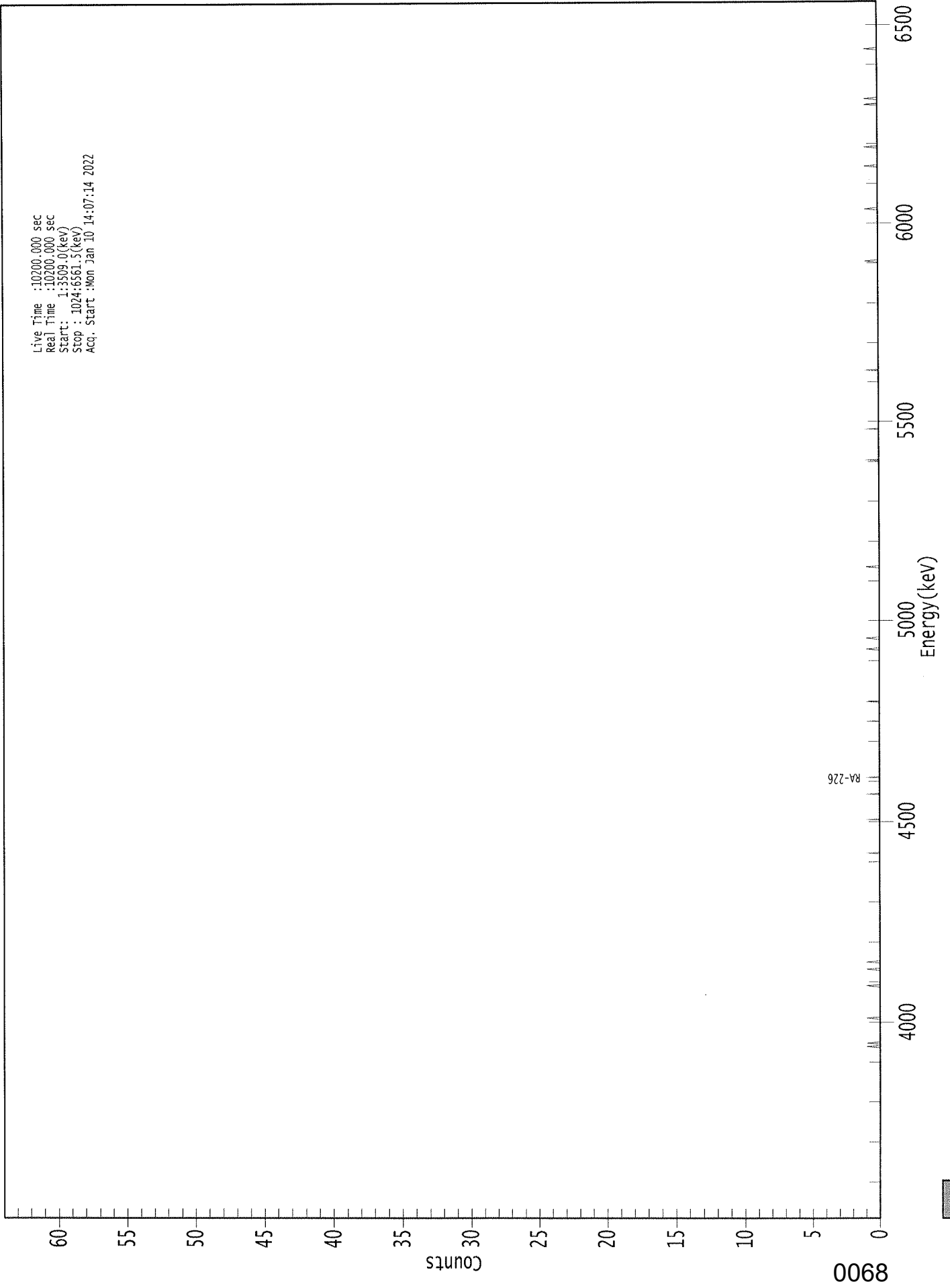
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.958	5685.50*	1.06E-001 +/- 1.72E-001	2.96E-001 +/- 1.04E-002
RA-226	0.960	4785.00*	2.32E-001 +/- 2.27E-001	2.94E-001 +/- 1.02E-002

AG  
1/11/22

0000304868.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3509.0(kev)  
Stop : 1024:6561.5(kev)  
Acq. Start :Mon Jan 10 14:07:14 2022



ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 03

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	1	0	0	1	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	1	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	1	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	1	0	0	0	0	0	1
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	1	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	1	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	1	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 1 0 0 0 0 0 0

Sample Title: 03

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	1	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	1	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	1	0	0	0
481:	0	0	0	0	0	1	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	1	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	1	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	1
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0



801: 0 0 0 1 0 0 0 0

Sample Title: 03

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	1	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	1	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	1
937:	0	0	0	0	1	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	1	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KB  
1/10/22

Sample Description: MW-11  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 04  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_046  
 Chamber Serial Number: 04026482B  
 Detector Serial Number: 58762  
 Env. Background: System Bkgd 311328  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.910E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/15/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:16 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9296 +/- 0.0000  
 Counting Efficiency: 0.1557 +/- 0.0028 on 5/21/2021 9:18:19 AM  
 Effective Efficiency: 0.1447 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.541	2.49	138.29	0.51	0.00E+000	3.0
RA-226	4.614	12.83	55.14	0.17	0.00E+000	3.0

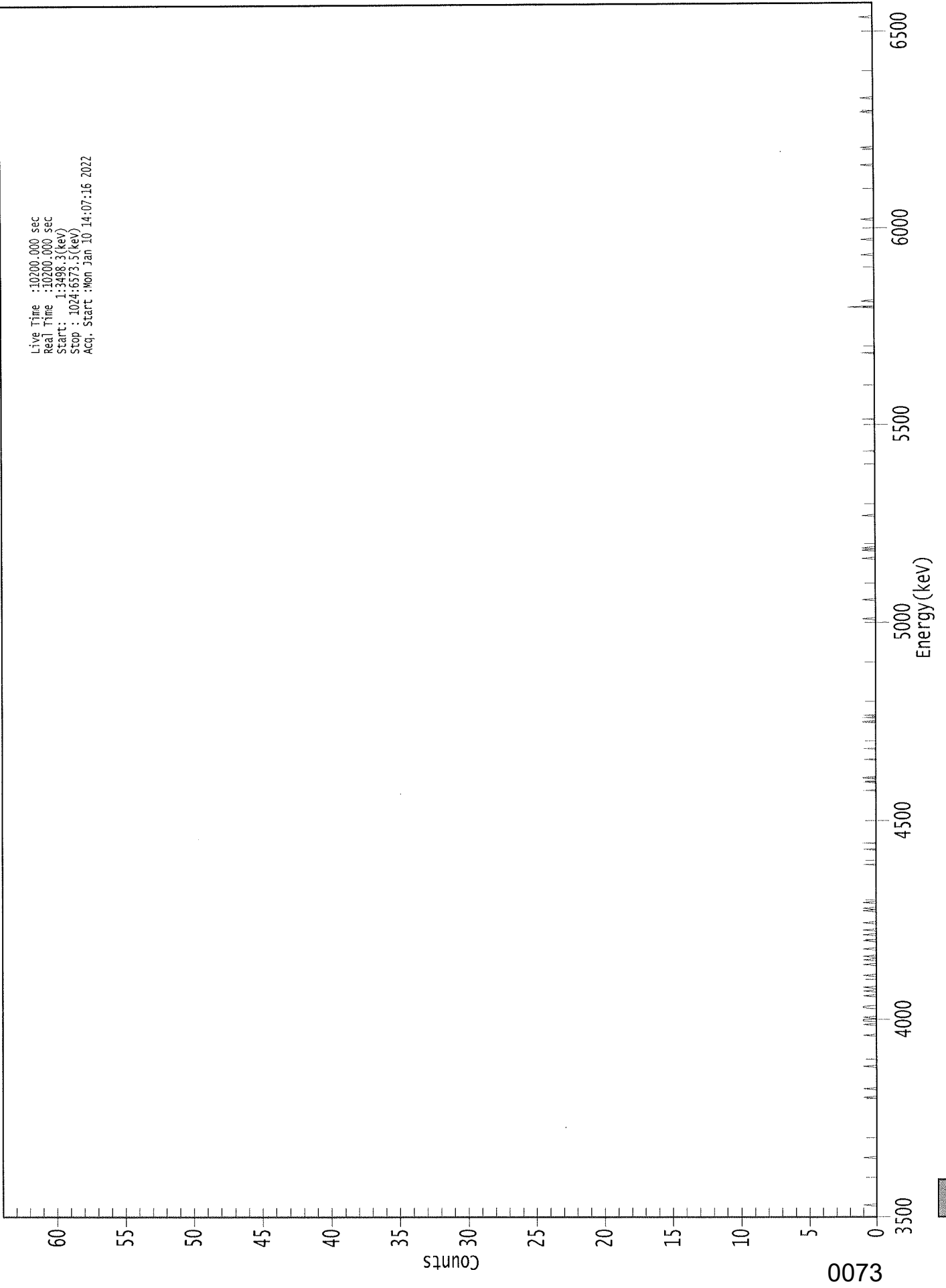
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.973	5685.50*	9.23E-002 +/- 1.28E-001	1.95E-001 +/- 6.85E-003
RA-226	0.963	4785.00*	4.49E-001 +/- 2.48E-001	1.46E-001 +/- 5.12E-003

AG  
1/11/22

0000304869.CNF

Live Time :10200.000 sec  
Real Time :10200.000 Sec  
Start: 1:3498.3(kev)  
Stop : 1024:6573.5(kev)  
Acq. Start :Mon Jan 10 14:07:16 2022



ROI Type: 1

0073

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 04

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	1	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	1	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	1	0	0
105:	0	0	0	0	1	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	1
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	1	0	0	0	0	0	0	0
161:	0	0	1	0	0	0	1	1	0
169:	1	0	0	0	0	0	0	0	0
177:	1	1	0	0	0	0	0	0	0
185:	0	0	1	0	0	0	0	1	0
193:	0	1	0	0	0	0	0	0	0
201:	0	0	0	1	0	0	0	0	0
209:	0	0	0	0	1	0	0	0	0
217:	1	0	0	1	0	0	0	0	0
225:	0	1	0	0	0	0	0	0	0
233:	1	0	0	0	0	0	1	0	0
241:	0	1	0	0	0	0	0	0	1
249:	0	0	0	0	0	0	0	0	0
257:	0	1	0	1	0	0	0	0	0
265:	1	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	1	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	1	0	0
313:	0	0	1	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	1	0
361:	0	0	0	0	0	0	1	0	0

369: 1 1 0 0 0 0 0 0

Sample Title: 04

Channel								
377:	0	0	0	0	0	0	0	0
385:	1	0	0	0	0	0	0	0
393:	0	1	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	1
417:	1	0	0	1	0	1	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	1	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	1	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	1	0	0	0	0	0	0
561:	1	0	1	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	1	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	1	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	1	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	1	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	2	0	0
769:	0	0	1	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 04

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	1	0	0	0	0	0	0
817:	0	0	0	0	0	0	1	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	1
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	1	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	1	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	1	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	1	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



11/10/22

Sample Description: MW-1  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 05  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_047  
 Chamber Serial Number: 10006125A  
 Detector Serial Number: 91086  
 Env. Background: System Bkgd 311329  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.790E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/15/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:18 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1694 +/- 0.0030 on 12/3/2021 12:28:26 PM  
 Effective Efficiency: 0.1694 +/- 0.0030

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.530	-0.34	592.90	0.34	0.00E+000	0.0
RA-226	4.629	2.00	169.74	0.00	0.00E+000	2.9

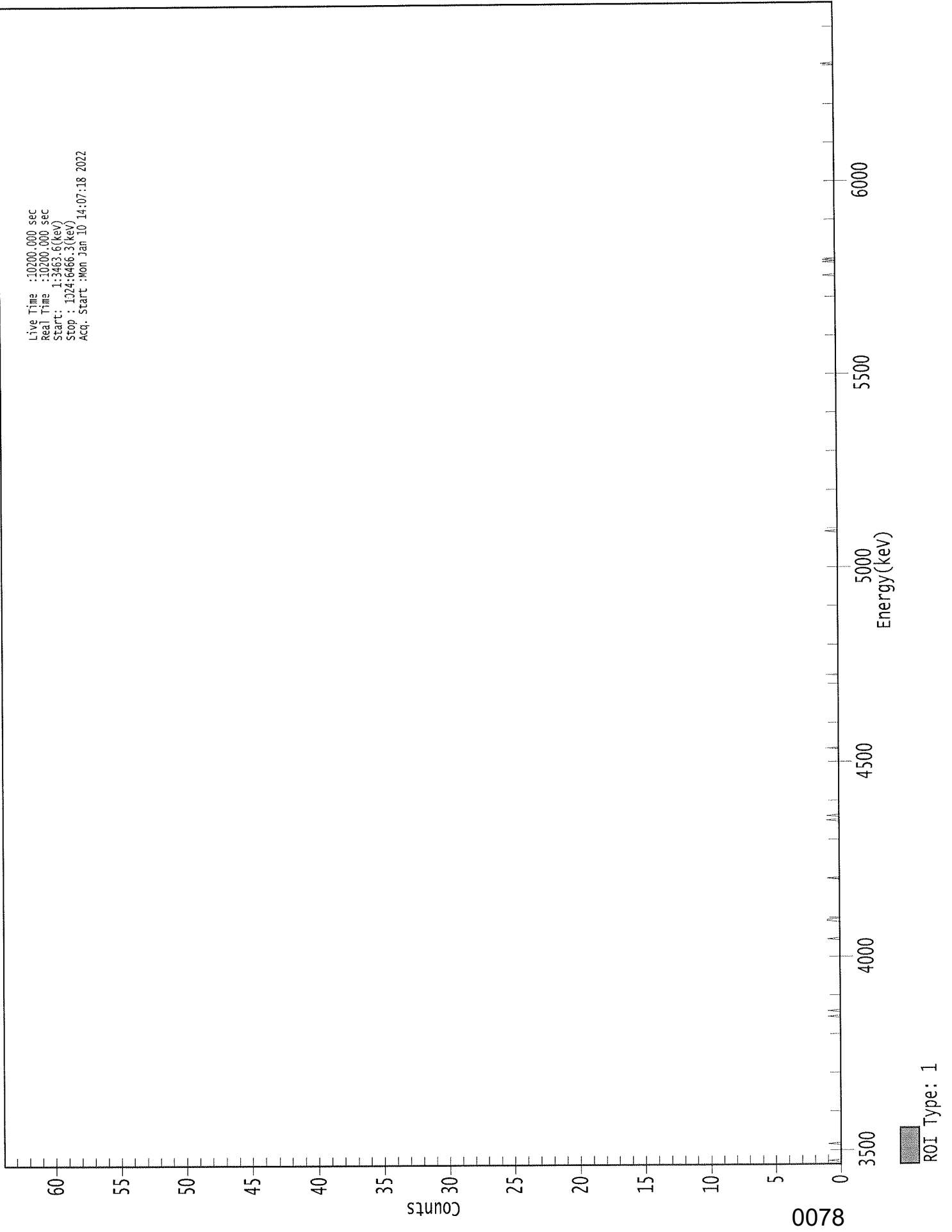
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.969	5685.50*	-1.57E-002 +/- 9.33E-002	2.21E-001 +/- 7.70E-003
RA-226	0.969	4785.00*	8.73E-002 +/- 1.48E-001	2.62E-001 +/- 9.08E-003

AG  
 1/11/22

0000304870.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3463.6(keV)  
Stop : 1024:6466.3(keV)  
Acq. Start :Mon Jan 10 14:07:18 2022





\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
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Sample Title: 05

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	1	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	1	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	1	0	0	0	0	0	1
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	1	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	1	1	1
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	1	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	1	0	0
305:	0	0	1	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	1	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	1	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	1	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	1	0	0
785:	0	0	0	0	0	0	0	0
793:	0	1	0	1	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	1	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB  
1/10/22

# Apex-Alpha™

Sample Description: MW-8  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 06  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_048  
 Chamber Serial Number: 10006125B  
 Detector Serial Number: 83111  
 Env. Background: System Bkgd 311330  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.500E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/15/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:20 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9563 +/- 0.0000  
 Counting Efficiency: 0.1973 +/- 0.0034 on 12/3/2021 12:28:22 PM  
 Effective Efficiency: 0.1887 +/- 0.0033

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.493	4.66	94.59	0.34	0.00E+000	2.9
RA-226	4.520	3.32	119.77	0.68	0.00E+000	2.9

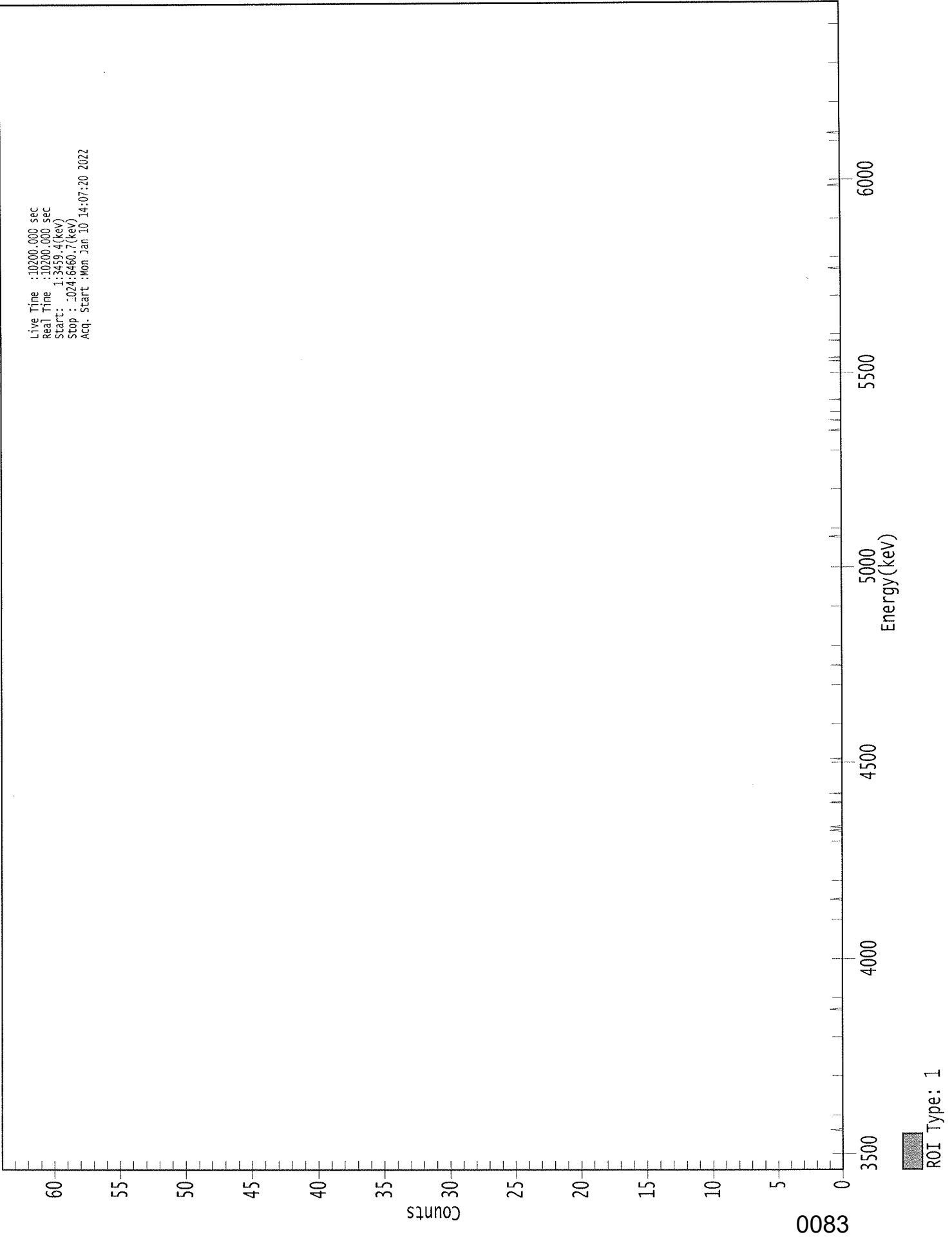
-----  
 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.953	5685.50*	1.74E-001 +/- 1.64E-001	1.78E-001 +/- 6.07E-003
RA-226	0.912	4785.00*	1.17E-001 +/- 1.40E-001	1.98E-001 +/- 6.72E-003

AG  
 1/11/22

0000304867.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:34:59.4{(kev)  
Stop : :024:6460.7{(kev)  
Acq. Start :Mon Jan 10 14:07:20 2022



0083

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\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
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Sample Title: 06

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	1	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	1	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	1	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	1	0	0	1	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	1	0	0	0	0	0	0	0	0
329:	1	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	1	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 06

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	1	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	1	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	1	0	0
649:	0	0	0	0	0	0	1	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	1	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	1	0	0	1	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	1	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	1	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 06

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	1	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	1	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0





# Apex-Alpha™

CS  
1/10/22

Sample Description: MW-7  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 07  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_049  
 Chamber Serial Number: 10006121A  
 Detector Serial Number: 49  
 Env. Background: System Bkgd 311331  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.790E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/16/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:22 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9182 +/- 0.0000  
 Counting Efficiency: 0.1605 +/- 0.0029 on 5/21/2021 3:25:40 PM  
 Effective Efficiency: 0.1474 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.528	2.32	149.12	0.68	0.00E+000	3.0
RA-226	4.590	9.15	68.23	0.85	0.00E+000	3.0

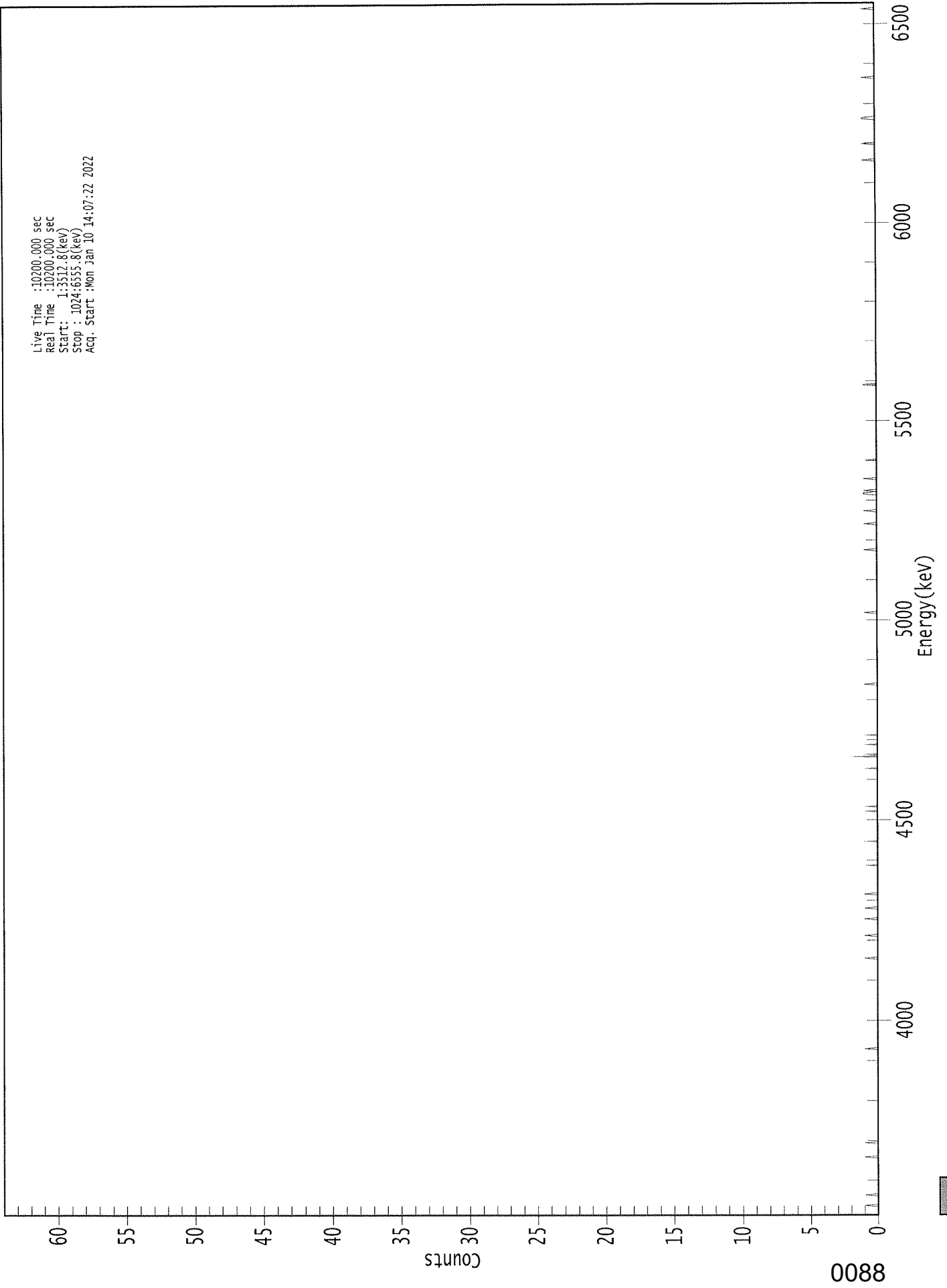
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.968	5685.50*	1.23E-001 +/- 1.84E-001	3.00E-001 +/- 1.06E-002
RA-226	0.951	4785.00*	4.59E-001 +/- 3.14E-001	3.00E-001 +/- 1.05E-002

AG  
1/11/22

0000304871.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3512.8(kev)  
Stop : 1024:6555.8(kev)  
Acq. Start :Mon Jan 10 14:07:22 2022



ROI Type: 1

0088

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 07

Elapsed Live time: 10200  
Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	1	0	0	0	0	0	0	0	0
17:	0	1	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	1	0	0	0	0	0	0	0
57:	0	0	0	0	0	1	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	1	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	1	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	1	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	1	0	0	0	0	0	0	0
257:	0	0	1	0	0	0	0	0	0
265:	0	0	0	0	0	0	1	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	1	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	1	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	1	0	0	0	0	1
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 1

Sample Title: 07

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	2	0	1	0	0	0	0
393:	0	0	0	1	0	0	0	0
401:	0	0	0	1	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	1	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	1	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	1
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	1	0	0
585:	0	0	0	0	0	0	0	0
593:	1	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	1	1
609:	0	1	0	0	0	0	0	0
617:	0	0	0	1	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	1	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	1	1	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	1	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	1
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	1	1	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	1
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	1	0	0	0	0	0	0



# Apex-Alpha™

KB  
1/10/22

Sample Description: MW-9  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 08  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_050  
 Chamber Serial Number: 10006121B  
 Detector Serial Number: 50  
 Env. Background: System Bkgd 311332  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.080E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/16/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:24 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9927 +/- 0.0000  
 Counting Efficiency: 0.1477 +/- 0.0027 on 5/26/2021 3:37:09 PM  
 Effective Efficiency: 0.1466 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.621	2.83	120.53	0.17	0.00E+000	3.0
RA-226	4.570	8.00	73.50	0.00	0.00E+000	3.0

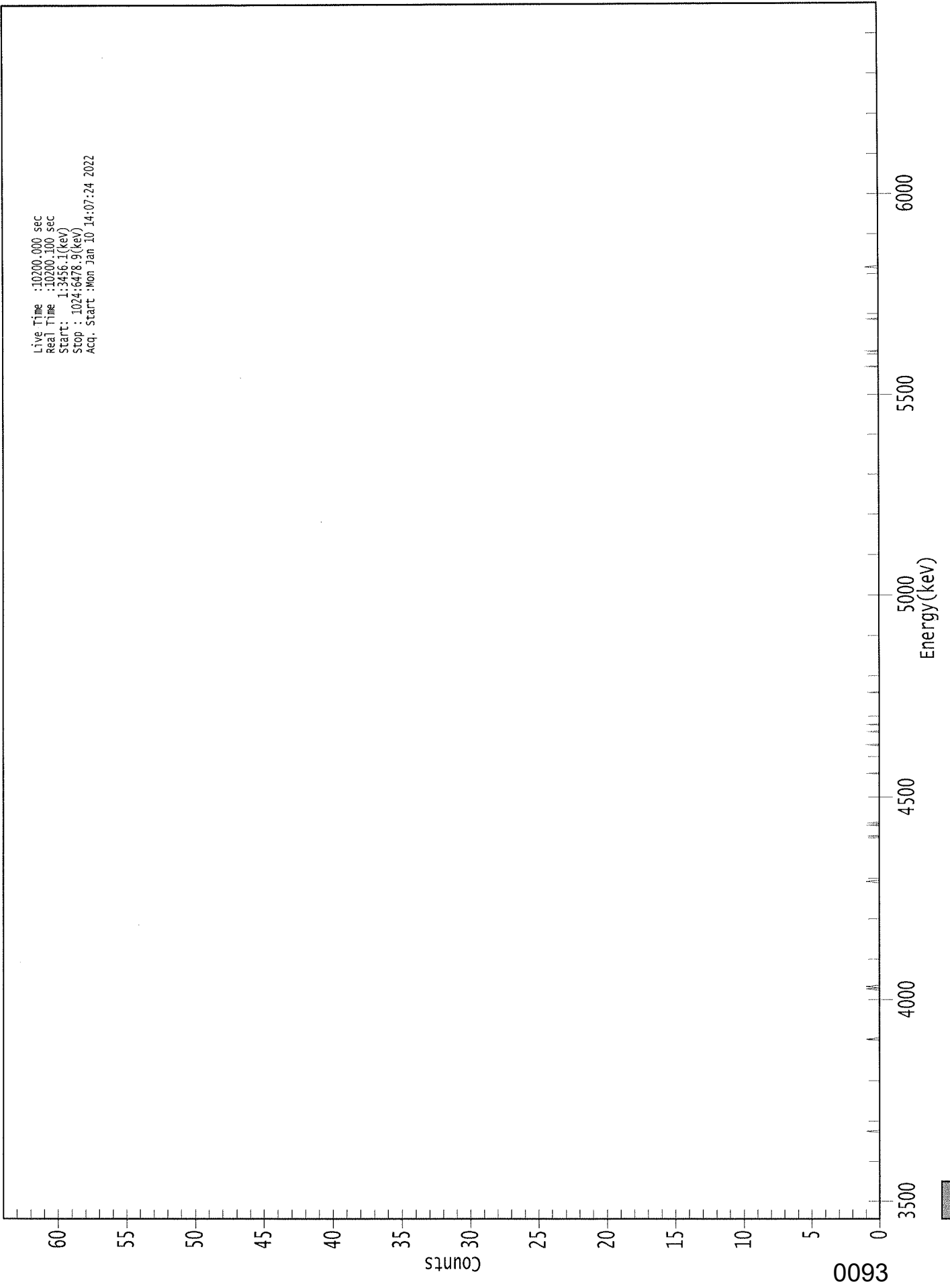
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.995	5685.50*	1.13E-001 +/- 1.36E-001	1.66E-001 +/- 5.88E-003
RA-226	0.941	4785.00*	3.01E-001 +/- 2.21E-001	2.25E-001 +/- 7.95E-003

AG  
1/11/22

0000304872.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3456.1(kev)  
Stop : 1024:6478.9(kev)  
Acq. Start :Mon Jan 10 14:07:24 2022



0093

ROI Type: 1

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 08

Elapsed Live time: 10200  
Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	1	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	1
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	1	0	1	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	1	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	1	0	0	0	0	0	0	0
329:	0	0	1	0	1	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0



369: 0 0 0 0 0 1 0 0

Sample Title: 08

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	1	0	0
401:	0	0	0	0	0	0	0	0
409:	1	0	0	0	0	0	1	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	1	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	1	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	1	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	1	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	1

801: 0 0 0 0 0 0 0 0 0

Sample Title: 08

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



KB  
1/10/22

Sample Description: MW-9D  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 09  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_051  
 Chamber Serial Number: 10006123A  
 Detector Serial Number: 51  
 Env. Background: System Bkgd 311333  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.500E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/16/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:26 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1321 +/- 0.0024 on 5/21/2021 3:25:39 PM  
 Effective Efficiency: 0.1321 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.663	0.83	239.53	0.17	0.00E+000	3.0
RA-226	4.582	10.83	60.10	0.17	0.00E+000	3.0

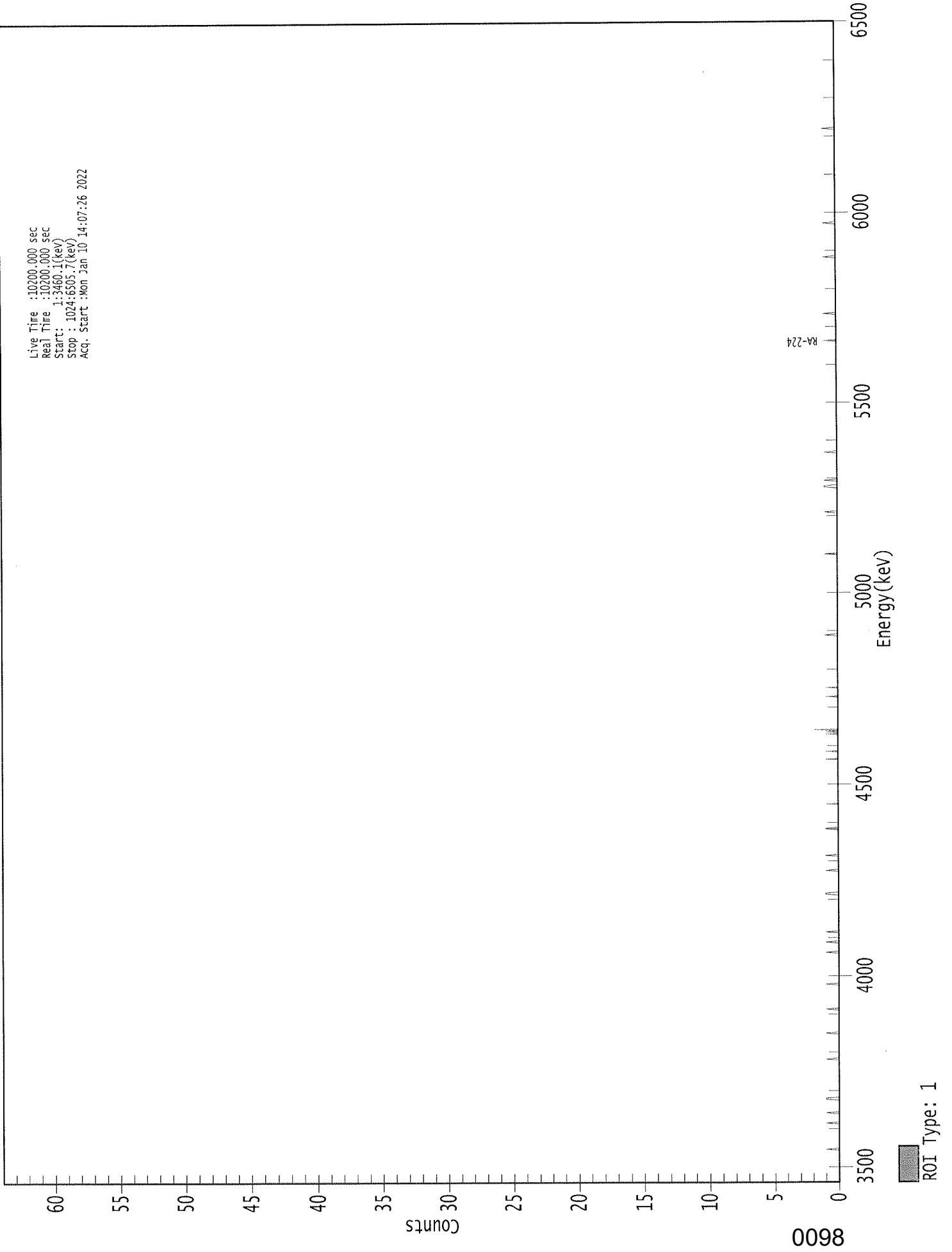
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.999	5685.50*	4.41E-002 +/- 1.06E-001	2.22E-001 +/- 8.00E-003
RA-226	0.947	4785.00*	5.43E-001 +/- 3.27E-001	2.09E-001 +/- 7.52E-003

AG  
1/11/22

0000304863.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3460.1(kev)  
Stop : 1024:6505.7(kev)  
Acq. Start :Mon Jan 10 14:07:26 2022



RA-224

ROI Type: 1

8600

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 09

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	1	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	1	0	0	0	0
57:	0	0	0	0	0	1	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	1	1	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	1	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	1	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	1	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	1	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	1	0	0	0	0	0	0
209:	0	0	0	1	0	0	0	0	0
217:	0	0	0	0	1	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	1	1	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	1	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	1
289:	0	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	1	1	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	1	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 1 0 0 0 0

Sample Title: 09

Channel								
377:	0	0	1	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	1	0	1	0	2	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	1	0	0	0	0	0
433:	0	0	1	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	1	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	1
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	1	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	1	1	0	0	0	0
617:	1	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	1	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	1	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	1	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 09

Channel								
809:	0	0	0	0	0	0	1	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	1	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	1
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB  
1/10/22

# Apex-Alpha™

Sample Description: SW-BO 13  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 10  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_052  
 Chamber Serial Number: 10006123B  
 Detector Serial Number: 52  
 Env. Background: System Bkgd 311334  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.490E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/16/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:28 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9803 +/- 0.0000  
 Counting Efficiency: 0.1768 +/- 0.0031 on 5/21/2021 3:25:37 PM  
 Effective Efficiency: 0.1733 +/- 0.0030

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.532	-0.34	592.90	0.34	0.00E+000	0.0
RA-226	4.651	4.00	109.57	0.00	0.00E+000	3.0

-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

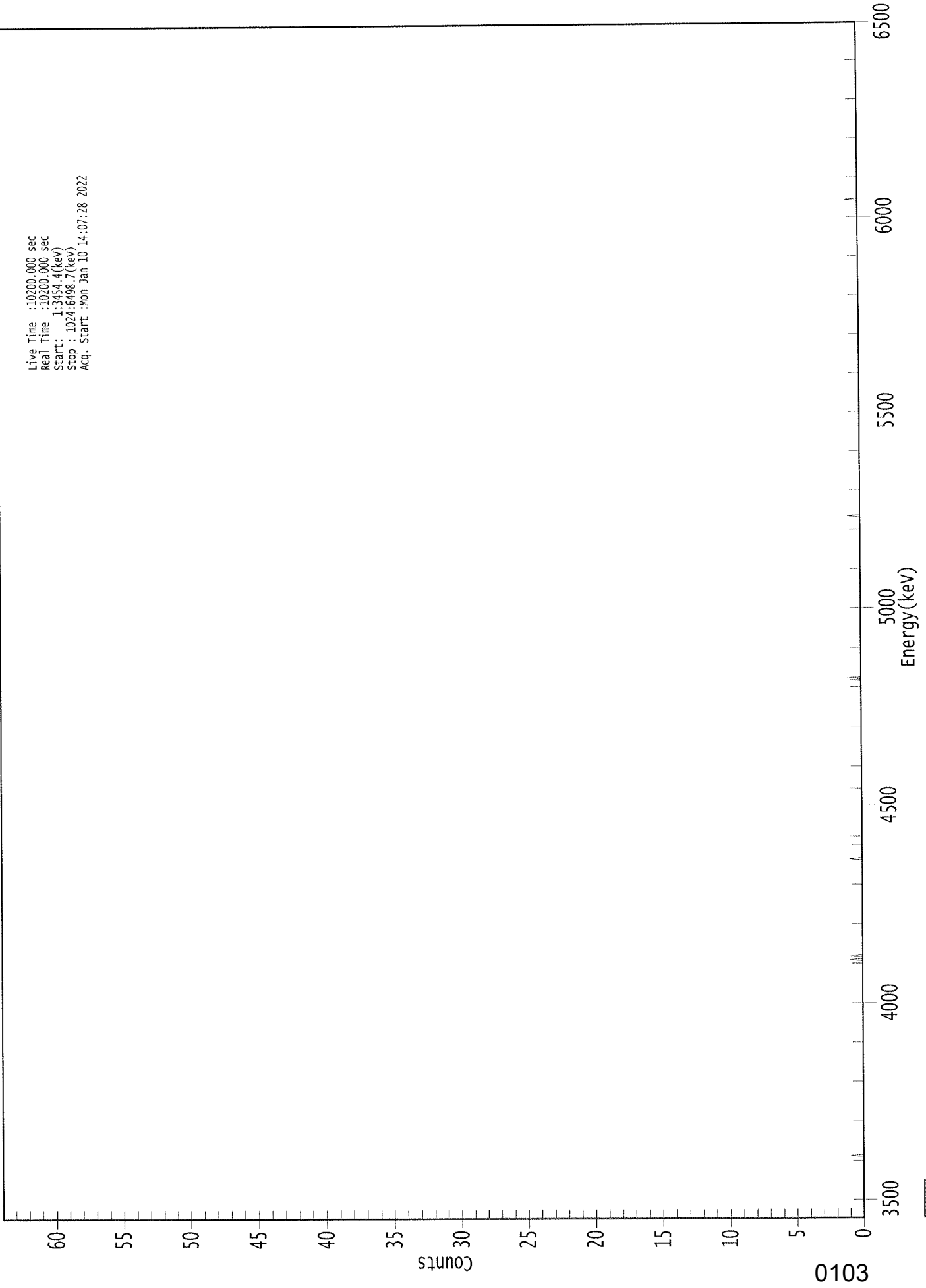
Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.970	5685.50*	-8.21E-003 +/- 4.87E-002	1.15E-001 +/- 3.99E-003
RA-226	0.977	4785.00*	9.11E-002 +/- 9.99E-002	1.37E-001 +/- 4.70E-003

AG  
 1/11/22



0000304864.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3454.4(kev)  
Stop : 1024:6498.7(kev)  
Acq. Start : Mon Jan 10 14:07:28 2022



0103

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 10

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	1	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	1	0	0	1
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	1	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	1	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	1	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 10

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	1	0	1	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	1	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 10

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	1	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



# Apex-Alpha™

KS  
1/10/22

Sample Description: SW-BO 2  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 11  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_053  
 Chamber Serial Number: 10006122A  
 Detector Serial Number: 53  
 Env. Background: System Bkgd 311335  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.440E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/16/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:30 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8736 +/- 0.0000  
 Counting Efficiency: 0.1353 +/- 0.0025 on 5/25/2021 4:02:23 PM  
 Effective Efficiency: 0.1182 +/- 0.0022

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.530	-0.34	592.90	0.34	0.00E+000	0.0
RA-226	4.626	-0.51	400.63	0.51	0.00E+000	0.0

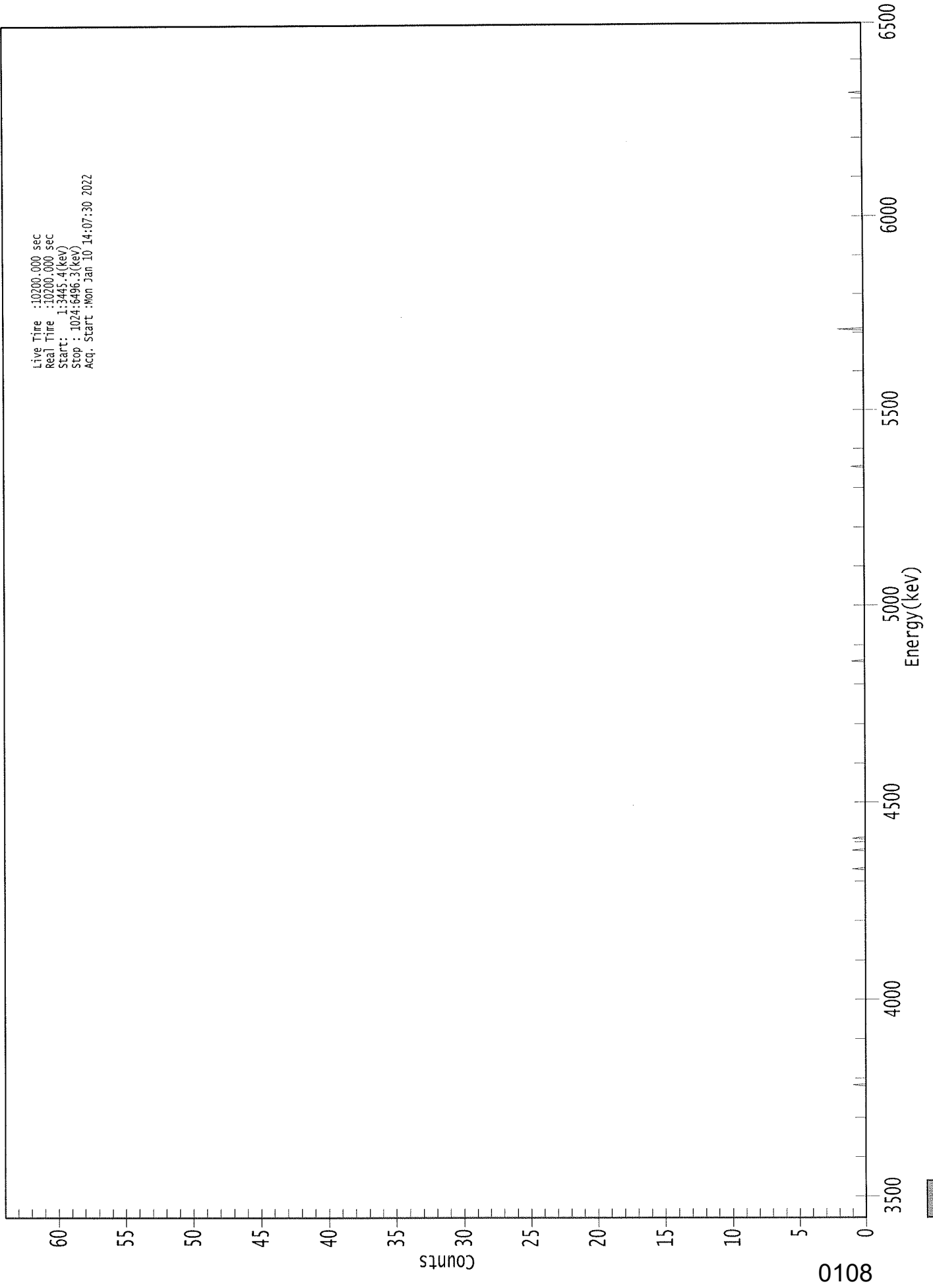
-----  
 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.969	5685.50*	-1.97E-002 +/- 1.17E-001	2.77E-001 +/- 9.95E-003
RA-226	0.968	4785.00*	-2.79E-002 +/- 1.12E-001	2.87E-001 +/- 1.03E-002

AG  
1/11/22

0000304879.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3445.4(kev)  
Stop : 1024:6496.3(kev)  
Acq. Start :Mon Jan 10 14:07:30 2022



ROI Type: 1

0108

\*\*\*\*\*  
\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
\*\*\*\*\*

Sample Title: 11

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	1	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0	0
297:	0	1	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	1	0	0	0	0	0	0	0
321:	0	0	0	1	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 11

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	1	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	1	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	2
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0



801: 0 0 0 0 0 0 0 0 0

Sample Title: 11

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	1	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB  
1/10/22

Sample Description: MW-6  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 12  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_054  
 Chamber Serial Number: 10006122B  
 Detector Serial Number: 54  
 Env. Background: System Bkgd 311336  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.690E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/17/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:32 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9779 +/- 0.0000  
 Counting Efficiency: 0.1516 +/- 0.0027 on 5/21/2021 3:25:35 PM  
 Effective Efficiency: 0.1483 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

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 PEAK AREA REPORT  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.594	3.49	113.53	0.51	0.00E+000	3.0
RA-226	4.632	10.81	63.34	1.19	0.00E+000	3.0

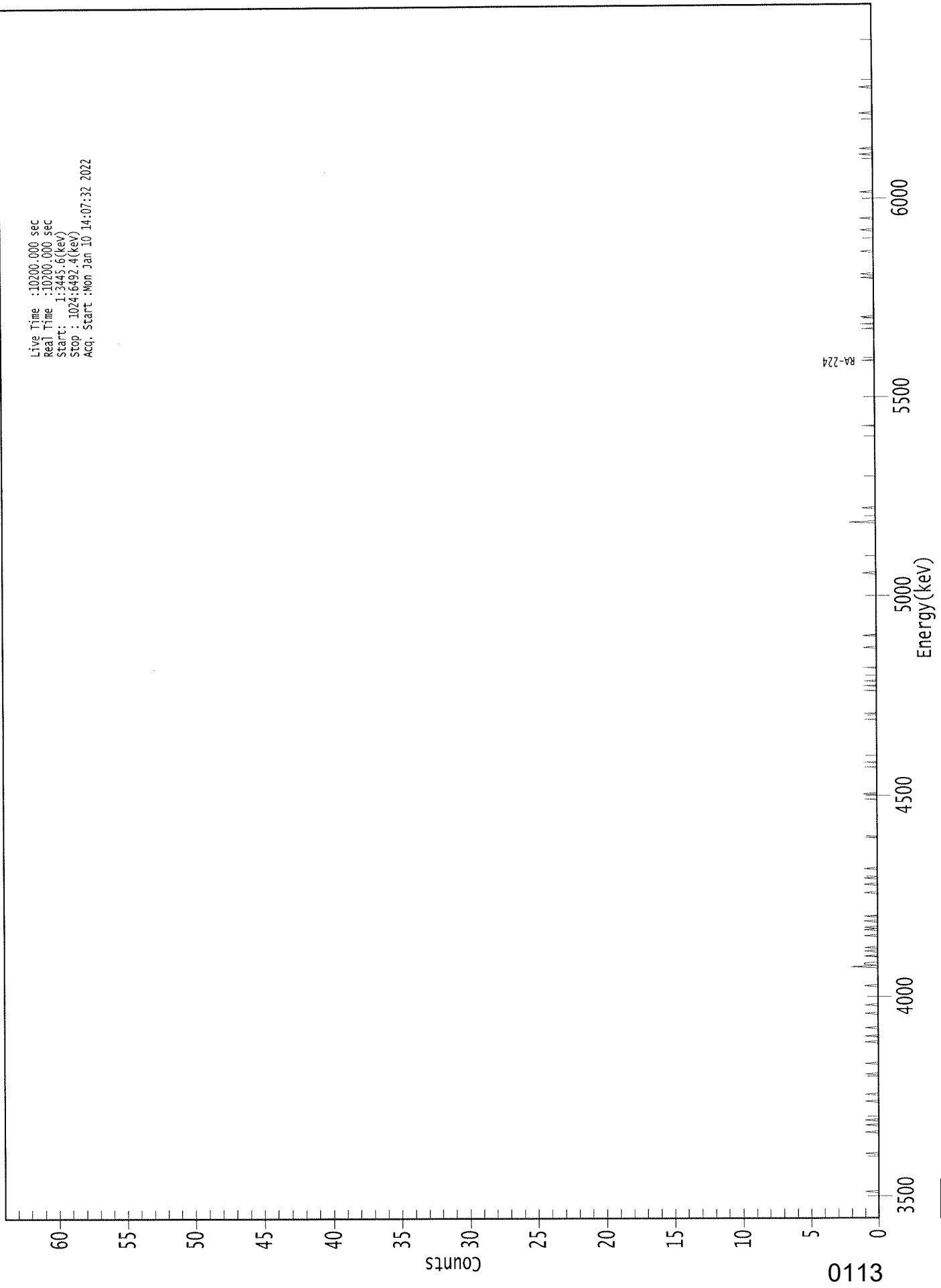
-----  
 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.989	5685.50*	1.78E-001 +/- 2.02E-001	2.67E-001 +/- 9.40E-003
RA-226	0.970	4785.00*	5.20E-001 +/- 3.30E-001	3.17E-001 +/- 1.11E-002

AG  
1/11/22

0000304874.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start : 1:3445.6(Rev)  
Stop : 1024:6492.4(keV)  
Acq. Start :Mon Jan 10 14:07:32 2022



RA-224

0113

ROI Type: 1

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\*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
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Sample Title: 12

Elapsed Live time: 10200  
Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	1	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	1	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	1	0	0	0	0	0	0	1	0
81:	0	0	1	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	1	0	0	0	0	0	0
105:	1	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	1	0	0	0	0	0	0	0
129:	0	0	1	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	1	0	0	0	0
153:	0	1	0	0	0	0	0	0	0
161:	1	0	0	0	0	0	0	0	0
169:	0	0	0	0	1	0	0	0	0
177:	0	0	0	1	0	0	0	0	0
185:	0	0	0	0	0	0	0	0	0
193:	0	0	0	1	0	0	0	0	0
201:	0	0	0	0	0	0	0	0	0
209:	0	0	0	2	0	1	1	0	0
217:	0	0	0	0	1	0	0	0	0
225:	1	0	0	1	0	0	0	0	0
233:	0	0	0	0	0	1	0	0	0
241:	0	0	1	0	1	0	0	0	0
249:	0	1	0	0	0	1	0	0	0
257:	0	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	1	0	0	0	0	0	0	0
281:	1	0	0	0	0	1	0	0	0
289:	0	0	0	0	0	1	0	0	0
297:	0	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0	1
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0	1
353:	0	0	0	1	1	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 12

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	1	0	0	0	1	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	1	0	0	0	0	1
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	1	0	0	0	1	0
449:	0	0	1	0	0	0	0	0
457:	0	0	0	0	0	1	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	1	0
481:	0	0	0	0	0	0	0	0
489:	1	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	1	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	2	0	0	0	0	0	0	0
593:	0	0	0	0	1	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	1	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	1	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	1	0	0	0
753:	1	0	0	0	0	0	1	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	1
793:	0	0	1	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 12

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	1	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	1
833:	0	0	0	0	0	0	0	0
841:	0	1	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	1
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	1
897:	0	0	0	0	1	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	1	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

*KB  
1/10/22*

Sample Description: MW-10  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 13  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_055  
 Chamber Serial Number: 10006124A  
 Detector Serial Number: 55  
 Env. Background: System Bkgd 311337  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.710E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/20/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:34 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8842 +/- 0.0000  
 Counting Efficiency: 0.1467 +/- 0.0026 on 11/29/2021 5:27:30 PM  
 Effective Efficiency: 0.1298 +/- 0.0023

Peak Match Tolerance: 0.350 MeV

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 PEAK AREA REPORT  
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Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.504	4.83	91.00	0.17	0.00E+000	3.0
RA-226	4.724	5.66	85.23	0.34	0.00E+000	3.0

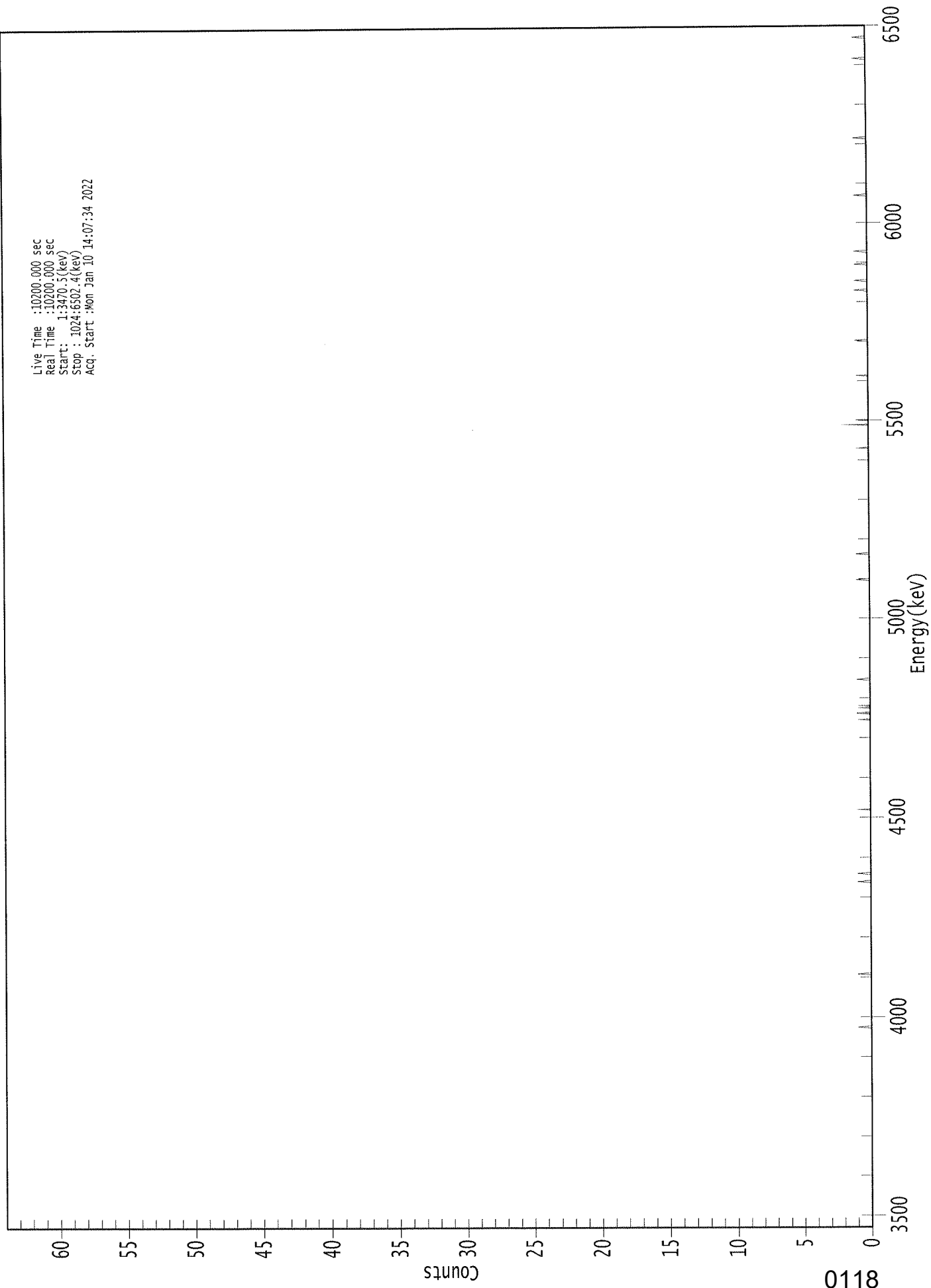
-----  
 NUCLIDE ANALYSIS RESULTS  
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Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.958	5685.50*	1.79E-001 +/- 1.63E-001	1.54E-001 +/- 5.46E-003
RA-226	0.995	4785.00*	1.98E-001 +/- 1.69E-001	1.67E-001 +/- 5.90E-003

*AG  
1/11/22*

0000304875.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3470.5(kev)  
Stop : 1024:6502.4(kev)  
Acq. Start :Mon Jan 10 14:07:34 2022



0118

ROI Type: 1



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 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
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Sample Title: 13

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	1	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	1
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	1	0	0
297:	0	0	0	0	1	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	1	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 13

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	1	0
433:	0	0	0	1	1	0	0	0
441:	1	0	1	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	1	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	1	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	1	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	2	0	0	0	1	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	1	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	1	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	1	0	0	0

801: 0 0 0 0 1 0 0 0

Sample Title: 13

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	1	0	0	0	0	0
825:	0	0	0	0	0	1	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	1	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	1	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	1	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	1	0	0	0
1017:	0	0	0	0	0	0	0	0



16  
1/10/22

Sample Description: MW-5  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 14  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_056  
 Chamber Serial Number: 10006124B  
 Detector Serial Number: 56  
 Env. Background: System Bkgd 311338  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/20/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:36 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8314 +/- 0.0000  
 Counting Efficiency: 0.1654 +/- 0.0029 on 11/29/2021 5:27:51 PM  
 Effective Efficiency: 0.1375 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.473	3.00	130.67	0.00	0.00E+000	3.0
RA-226	4.561	10.00	65.01	0.00	0.00E+000	3.0

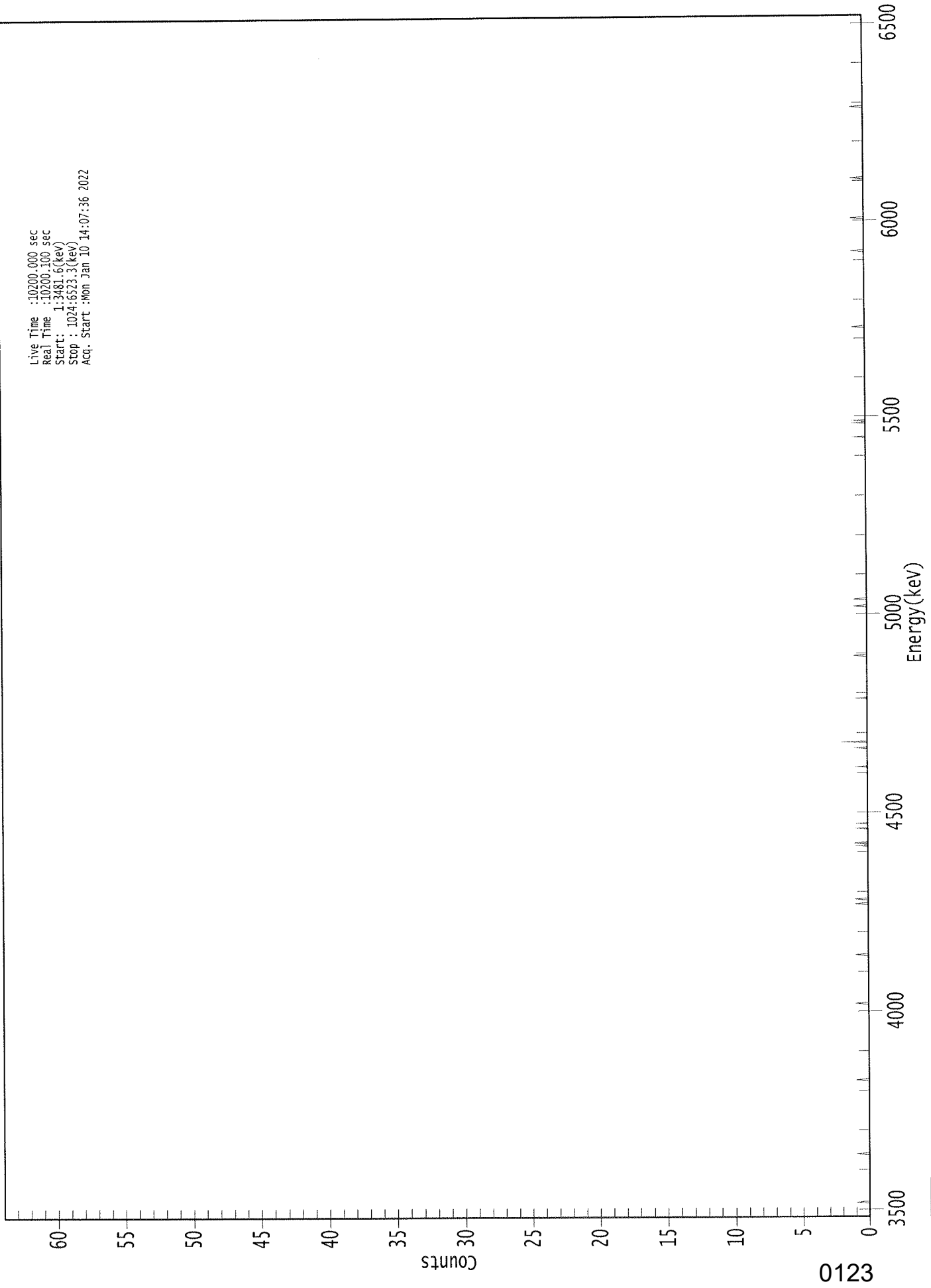
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.943	5685.50*	1.84E-001 +/- 2.40E-001	3.67E-001 +/- 1.27E-002
RA-226	0.937	4785.00*	5.78E-001 +/- 3.76E-001	3.47E-001 +/- 1.20E-002

AG  
1/11/22

0000304876.CNF

Live Time :10200.000 sec  
Real Time :10200.100 sec  
Start : 1:3481.6(keV)  
Stop : 1024:6523.3(keV)  
Acq. Start :Mon Jan 10 14:07:36 2022



0123

ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 14

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	1	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	1	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	1	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	1	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	1	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	1	0	0	0	1	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	1	0	1	1	0	0
321:	0	0	0	0	0	0	0	0
329:	0	1	0	0	0	1	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 14

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	1	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	1	0	0
401:	0	0	2	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	1
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	1	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	1	0	0
521:	0	0	0	1	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	0	0	0	0	0
673:	0	1	0	1	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	1	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 14

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	1	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	1	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	1	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	1	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0





# Apex-Alpha™

VB  
1/10/22

Sample Description: MW-4  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 15  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_057  
 Chamber Serial Number: 01017326A  
 Detector Serial Number: 57  
 Env. Background: System Bkgd 311339  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.580E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/20/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:38 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000  
 Counting Efficiency: 0.1426 +/- 0.0026 on 5/21/2021 3:25:34 PM  
 Effective Efficiency: 0.1426 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.522	3.47	129.55	1.53	0.00E+000	3.0
RA-226	4.526	3.96	124.69	2.04	0.00E+000	3.0

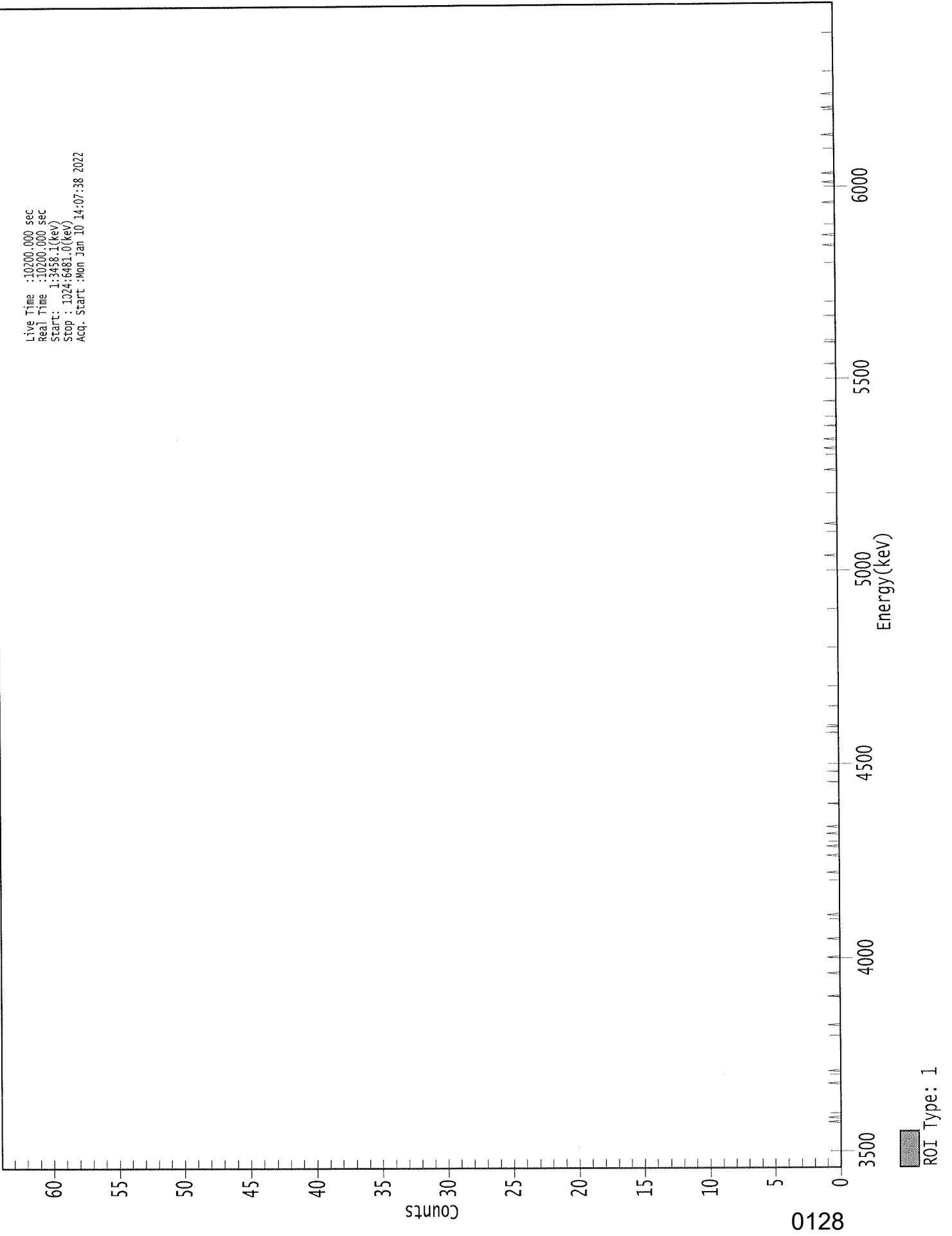
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.966	5685.50*	1.76E-001 +/- 2.28E-001	3.61E-001 +/- 1.28E-002
RA-226	0.916	4785.00*	1.90E-001 +/- 2.37E-001	3.73E-001 +/- 1.32E-002

AG  
1/11/22

0000304877.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3458.1(kev)  
Stop : 1024:6481.0(kev)  
Acq. Start :Mon Jan 10 14:07:38 2022



0128

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 15

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	1	2	3	4	5	6	7	8	9
1:	0	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	1	0	0	0	1	0	0	0	0
49:	0	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	1	0	0	0	0	0	0
81:	0	0	0	0	0	1	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	1	0	0	0
129:	0	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	1	0	0
153:	0	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0	0
169:	0	0	1	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0	0
185:	1	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	1	0	0	0
225:	0	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0	0
257:	0	0	1	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0	0
273:	0	1	0	0	0	0	0	0	0
281:	0	1	0	0	0	0	0	0	0
289:	0	0	0	0	1	0	0	0	0
297:	0	0	1	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	1	0	0
321:	0	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0	0
337:	0	1	0	0	0	0	0	0	0
345:	0	0	1	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	0

369: 0 0 0 0 0 0 0 0 0

Sample Title: 15

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	1	0	0	0
385:	0	1	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	1	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	1
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	1	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	1	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	1	0	0
633:	0	0	0	0	0	1	0	0
641:	0	0	0	0	0	0	0	0
649:	0	1	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	1
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	1	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	1	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	1	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 15

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	1	0	0	0	0	0	0	0
817:	0	1	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	1	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	1	0	0	0	0	0	0	0
873:	1	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	1	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	1	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KCS  
1/10/22

# Apex-Alpha™

Sample Description: MW-3  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 16  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_058  
 Chamber Serial Number: 01017326B  
 Detector Serial Number: 58  
 Env. Background: System Bkgd 311340  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 2.470E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/20/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:40 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9391 +/- 0.0000  
 Counting Efficiency: 0.1794 +/- 0.0031 on 5/21/2021 3:25:32 PM  
 Effective Efficiency: 0.1685 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

-----  
 PEAK AREA REPORT  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.537	0.98	294.85	1.02	0.00E+000	3.0
RA-226	4.624	8.49	69.59	0.51	0.00E+000	3.0

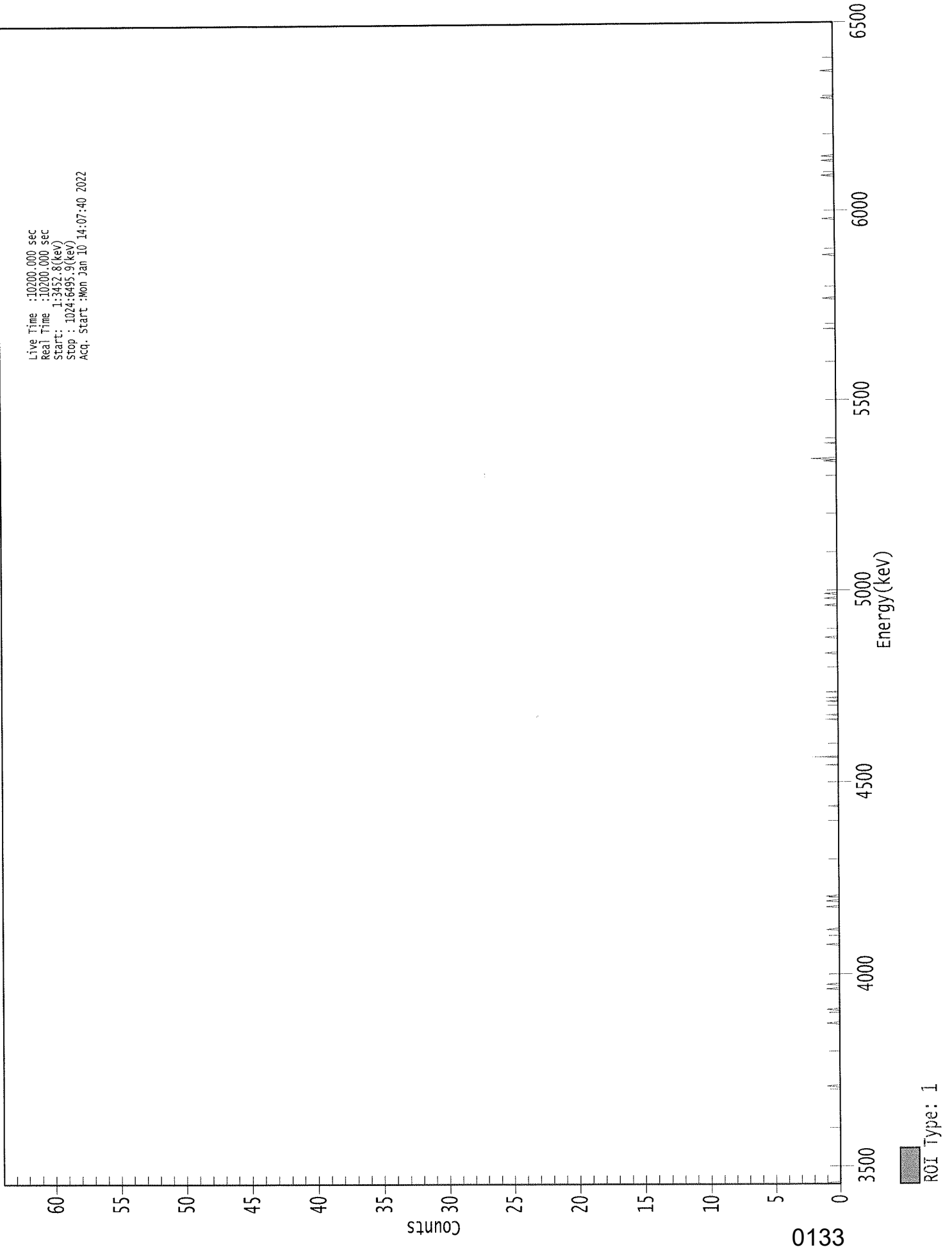
-----  
 NUCLIDE ANALYSIS RESULTS  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.971	5685.50*	4.03E-002 +/- 1.19E-001	2.59E-001 +/- 8.89E-003
RA-226	0.967	4785.00*	3.30E-001 +/- 2.30E-001	2.04E-001 +/- 6.97E-003

AG  
 1/11/22

0000304865.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3452.8(keV)  
Stop : 1024:6495.9(keV)  
Acq. Start :Mon Jan 10 14:07:40 2022



0133

ROI Type: 1





369: 0 0 0 0 0 0 2 0

Sample Title: 16

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	1
409:	0	0	0	1	0	0	0	0
417:	0	0	0	0	0	0	0	1
425:	0	0	1	0	0	0	0	1
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	1	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	1
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	1	0	0	0	0
513:	0	1	0	0	0	1	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	1	0	2	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	1	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	1
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	1	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0

Sample Title: 16

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	0	0	0	0	0	0
817:	0	1	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	1	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	1
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	1	0	0	0
905:	1	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	1	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	1	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

10B  
11/10/22

# Apex-Alpha™

Sample Description: MW-2  
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00003048  
 Batch Identification: 2112077A-RA  
 Sample Identification: 17  
 Sample Geometry: Shelf 2  
 Procedure Description: Ra

Detector Name: Alpha\_059  
 Chamber Serial Number: 02030596A  
 Detector Serial Number: 59  
 Env. Background: System Bkgd 311341  
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter  
 Generic Mult. Factor: 1.250E+000 Generic Div. Factor: 1.000E+000  
 Sample Date/Time: 12/21/2021 9:59:21 AM  
 Acquisition Date/Time: 1/10/2022 2:07:42 PM  
 Acquisition Live Time: 170.0 minutes  
 Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8149 +/- 0.0000  
 Counting Efficiency: 0.1752 +/- 0.0031 on 5/21/2021 3:25:31 PM  
 Effective Efficiency: 0.1428 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

-----  
 ----- PEAK AREA REPORT -----  
 -----

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.589	1.32	215.97	0.68	0.00E+000	3.0
RA-226	4.584	20.64	44.77	1.36	0.00E+000	3.0

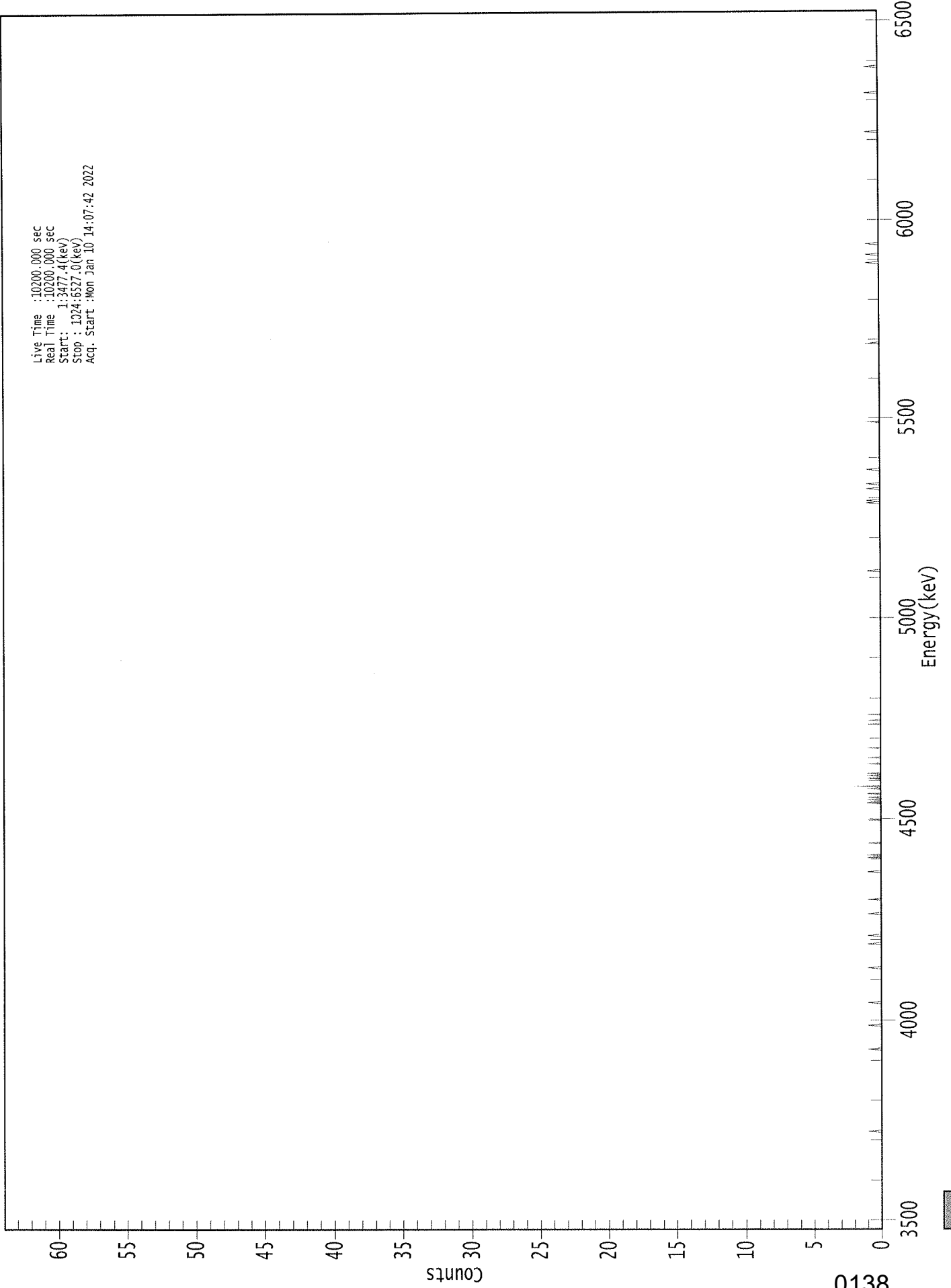
-----  
 ----- NUCLIDE ANALYSIS RESULTS -----  
 -----

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
RA-224	0.988	5685.50*	3.24E-002 +/- 7.00E-002	1.39E-001 +/- 4.79E-003
RA-226	0.949	4785.00*	4.79E-001 +/- 2.15E-001	1.59E-001 +/- 5.49E-003

AG  
 1/11/22

0000304866.CNF

Live Time :10200.000 sec  
Real Time :10200.000 sec  
Start: 1:3477.4(keV)  
Stop : 1024:6527.0(keV)  
Acq. Start :Mon Jan 10 14:07:42 2022



0138

ROI Type: 1

\*\*\*\*\*  
 \*\*\*\*\* S P E C T R A L D A T A R E P O R T \*\*\*\*\*  
 \*\*\*\*\*

Sample Title: 17

Elapsed Live time: 10200  
 Elapsed Real Time: 10200

Channel	-----	-----	-----	-----	-----	-----	-----	-----
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	1	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	1
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	1	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	1	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	1	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	1
241:	0	0	0	0	0	0	1	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	1	0	0	0	0	0	0	0
273:	0	0	0	0	1	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	1	0	0	0	0
305:	0	0	0	0	0	0	0	1
313:	0	1	0	0	0	0	0	0
321:	0	0	0	1	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	1	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	1	1	0	1
361:	0	1	0	0	1	0	0	0

369: 1 0 2 0 0 0 0 1

Sample Title: 17

Channel	1	2	3	4	5	6	7	8
377:	0	1	0	1	0	1	0	0
385:	0	0	0	0	0	1	0	0
393:	0	0	1	0	0	0	0	0
401:	0	0	1	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	1	0
425:	0	1	0	0	0	0	1	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	1	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	1
609:	0	1	0	0	0	0	0	0
617:	0	0	0	1	0	0	0	1
625:	0	0	0	0	0	0	0	0
633:	0	0	0	1	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	1	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	1	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801: 0 0 0 0 0 0 0 0 0

Sample Title: 17

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	1	0	0	0	0	0
817:	0	1	0	0	0	0	0	0
825:	0	0	1	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	1	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	1	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	1
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



## QA SUMMARY REPORT

### Review Of QA Results - Pulser Check

Date : 1/10/2022  
Time : 6:08:49 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Not Done	
Alpha 004	21f	ALL	Not Done	
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Not Done	
Alpha 011	21f	ALL	Passed	1/10/2022 5:52:17 AM
Alpha 012	21f	ALL	Passed	1/10/2022 5:52:18 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Not Done	
Alpha 015	21f	ALL	Not Done	
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:19 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:21 AM
Alpha 035	Alpha Analyst100DC	Peak Energy	Action	1/10/2022 5:52:22 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:24 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:26 AM
Alpha 038	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:29 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:31 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:34 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:36 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:38 AM
Alpha 043	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:41 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:44 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:46 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:49 AM
Alpha 047	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:51 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:54 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:52:57 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:00 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:02 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:05 AM
Alpha 053	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:08 AM
Alpha 054	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:11 AM
Alpha 055	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:14 AM
Alpha 056	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:17 AM
Alpha 057	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:19 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:23 AM



CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:26 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	1/10/2022 5:53:29 AM

APPROVED BY: ICP

APPROVAL DATE: 1/10/22

\*\*\*\*\*  
 \*\*\*\*\* LIBRARY LISTING REPORT \*\*\*\*\*  
 \*\*\*\*\*

Nuclide Library Title: Radium

Nuclide Library Description: Ra-226, Po-218, Rn-222

Nuclide Name	Half-Life (Seconds)	Energy (keV)	Energy Uncert. (keV)	Yield (%)	Yield Uncert. (Abs.+)
PO-218	5.049E+010	6003.000*	0.000	99.9800	0.0000
RN-222	5.049E+010	5490.000*	0.000	99.9200	0.0000
RA-226	5.049E+010	4785.000*	0.000	100.0000	0.0000

\* = key line

TOTALS: 3 Nuclides 3 Energy Lines

**SECTION IX**  
**ANALYTICAL DATA (RADIUM-228)**

Work Order	<b>21-12077</b>
Analysis Code	<b>Ra228</b>
Run	<b>1</b>
Date Received	<b>12/28/2021</b>
Lab Deadline	<b>1/10/2022</b>
Client	ERM
Project	526033
Report Level	<b>4</b>
Activity Units	pCi
Aliquot Units	I
Matrix	WA
Method	EPA 904.0
Instrument Type	Alpha/Beta GPC
Radiometric Tracer	Ba-133
Radiometric Sol#	Ba-6a
Tracer Act (dpm/g)	380.81
Carrier	Yttrium
Carrier Conc (mg/ml)	35.15

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		12/28/21 00:00	1.0000E+00
02	MBL	BLANK		12/28/21 00:00	1.0000E+00
03	DUP	MW-1	20	12/15/21 13:45	1.0000E+00
04	TRG	MW-11	30	12/15/21 08:00	1.0000E+00
05	DO	MW-1	20	12/15/21 13:45	1.0000E+00
06	TRG	MW-8	30	12/15/21 16:30	1.0000E+00
07	TRG	MW-7	30	12/16/21 07:50	1.0000E+00
08	TRG	MW-9	50	12/16/21 08:20	1.0000E+00
09	TRG	MW-9D	20	12/16/21 08:40	1.0000E+00
10	TRG	SW-BO 13	40	12/16/21 11:35	1.0000E+00
11	TRG	SW-BO 2	20	12/16/21 12:30	1.0000E+00
12	TRG	MW-6	20	12/17/21 08:30	1.0000E+00
13	TRG	MW-10	40	12/20/21 10:45	1.0000E+00
14	TRG	MW-5	60	12/20/21 13:30	1.0000E+00
15	TRG	MW-4	40	12/20/21 15:05	1.0000E+00
16	TRG	MW-3	40	12/20/21 16:30	1.0000E+00
17	TRG	MW-2	20	12/21/21 09:55	1.0000E+00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.2142	843.2	399.0	105.05	2.000	0.0883	0.1447	0.0564	80.23	84.28	1.00	1.00
02	MBL	2.1944	835.6	344.0	91.39	2.000	0.0888	0.1448	0.0560	79.66	72.80	1.00	1.00
03	DUP	2.1947	835.8	380.0	100.94	2.000	0.0886	0.1449	0.0563	80.09	80.84	1.00	1.00
04	TRG	2.1917	834.6	350.0	93.10	2.000	0.0883	0.1467	0.0584	83.07	77.34	1.00	1.00
05	DO	2.1893	833.7	382.0	101.72	2.000	0.0881	0.1450	0.0569	80.94	82.33	1.00	1.00
06	TRG	2.1852	832.1	359.0	95.77	2.000	0.0881	0.1428	0.0547	77.81	74.52	1.00	1.00
07	TRG	2.1808	830.5	344.0	91.96	2.000	0.0877	0.1419	0.0542	77.10	70.90	1.00	1.00
08	TRG	2.1345	812.8	364.0	99.41	2.000	0.0885	0.1448	0.0563	80.09	79.62	1.00	1.00
09	TRG	2.0902	796.0	379.0	105.71	2.000	0.0883	0.1454	0.0571	81.22	85.86	1.00	1.00
10	TRG	2.1139	805.0	356.0	98.18	2.000	0.0887	0.1458	0.0571	81.22	79.74	1.00	1.00
11	TRG	2.5654	976.9	385.0	87.49	2.000	0.0891	0.1440	0.0549	78.09	68.32	1.00	1.00
12	TRG	2.1965	836.4	369.0	97.94	2.000	0.0887	0.1434	0.0547	77.81	76.20	1.00	1.00
13	TRG	2.1726	827.3	330.0	88.55	2.000	0.0885	0.1345	0.0460	65.43	57.94	1.00	1.00
14	TRG	2.1706	826.6	310.0	83.26	2.000	0.0880	0.1511	0.0631	89.76	74.73	1.00	1.00
15	TRG	2.1742	828.0	401.0	107.52	2.000	0.0880	0.1456	0.0576	81.93	88.10	1.00	1.00
16	TRG	2.1695	826.2	350.0	94.05	2.000	0.0874	0.1460	0.0586	83.36	78.40	1.00	1.00
17	TRG	2.1716	827.0	304.0	81.61	2.000	0.0882	0.1457	0.0575	81.79	66.75	1.00	1.00

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
\*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
02	MBL			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
03	DUP			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
04	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
05	DO			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
06	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
07	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
08	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
09	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
10	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
11	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
12	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
13	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
14	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
15	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
16	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS
17	TRG			01/12/22 08:58	MDAVIS	01/10/22 08:08	MDAVIS	01/12/22 09:09	MDAVIS

\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.  
 \*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations  
**Work Order: 21-12077-Ra228-1**

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	9.61E+00	9.95E-01	1.24E+00	8.84E+00	103.69	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	1.92E-01	8.16E-01	1.72E+00					OK	OK
03	RA-228	DUP	MW-1	pCi/l	1.16E+00	5.44E-01	1.03E+00				NA	OK	
04	RA-228	TRG	MW-11	pCi/l	6.08E-01	6.35E-01	1.29E+00					OK	
05	RA-228	DO	MW-1	pCi/l	2.36E-01	5.61E-01	1.17E+00					OK	
06	RA-228	TRG	MW-8	pCi/l	4.66E-01	5.58E-01	1.14E+00					OK	
07	RA-228	TRG	MW-7	pCi/l	7.77E-01	6.57E-01	1.32E+00					OK	
08	RA-228	TRG	MW-9	pCi/l	7.34E-01	5.33E-01	1.05E+00					OK	
09	RA-228	TRG	MW-9D	pCi/l	7.86E-01	4.86E-01	9.47E-01					OK	
10	RA-228	TRG	SW-BO 13	pCi/l	4.62E-01	4.92E-01	1.00E+00					OK	
11	RA-228	TRG	SW-BO 2	pCi/l	1.40E-01	5.79E-01	1.23E+00					OK	
12	RA-228	TRG	MW-6	pCi/l	1.71E+00	5.24E-01	9.07E-01					OK	
13	RA-228	TRG	MW-10	pCi/l	3.70E-01	6.57E-01	1.37E+00					OK	
14	RA-228	TRG	MW-5	pCi/l	2.10E+00	6.38E-01	1.13E+00					OK	
15	RA-228	TRG	MW-4	pCi/l	7.19E-01	4.79E-01	9.42E-01					OK	
16	RA-228	TRG	MW-3	pCi/l	5.68E-01	6.48E-01	1.32E+00					OK	
17	RA-228	TRG	MW-2	pCi/l	9.83E-01	6.22E-01	1.21E+00					OK	

	Run	1
	Analysis Code	Ra228
Eberline Services Work Order		21-12077
	Client	ERM
		0149

Preliminary Data Report & Analytical Calculations  
**Work Order: 21-12077-Ra228-1**

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	RA-228	LCS	12/28/21 00:00	1.00E+00	105.05	80.23	84.28	1.00	1/10/2022 8:08	1/12/2022 9:09
02	RA-228	MBL	12/28/21 00:00	1.00E+00	91.39	79.66	72.80	1.00	1/10/2022 8:08	1/12/2022 9:09
03	RA-228	DUP	12/15/21 13:45	1.00E+00	100.94	80.09	80.84	1.00	1/10/2022 8:08	1/12/2022 9:09
04	RA-228	TRG	12/15/21 08:00	1.00E+00	93.10	83.07	77.34	1.00	1/10/2022 8:08	1/12/2022 9:09
05	RA-228	DO	12/15/21 13:45	1.00E+00	101.72	80.94	82.33	1.00	1/10/2022 8:08	1/12/2022 9:09
06	RA-228	TRG	12/15/21 16:30	1.00E+00	95.77	77.81	74.52	1.00	1/10/2022 8:08	1/12/2022 9:09
07	RA-228	TRG	12/16/21 07:50	1.00E+00	91.96	77.10	70.90	1.00	1/10/2022 8:08	1/12/2022 9:09
08	RA-228	TRG	12/16/21 08:20	1.00E+00	99.41	80.09	79.62	1.00	1/10/2022 8:08	1/12/2022 9:09
09	RA-228	TRG	12/16/21 08:40	1.00E+00	105.71	81.22	85.86	1.00	1/10/2022 8:08	1/12/2022 9:09
10	RA-228	TRG	12/16/21 11:35	1.00E+00	98.18	81.22	79.74	1.00	1/10/2022 8:08	1/12/2022 9:09
11	RA-228	TRG	12/16/21 12:30	1.00E+00	87.49	78.09	68.32	1.00	1/10/2022 8:08	1/12/2022 9:09
12	RA-228	TRG	12/17/21 08:30	1.00E+00	97.94	77.81	76.20	1.00	1/10/2022 8:08	1/12/2022 9:09
13	RA-228	TRG	12/20/21 10:45	1.00E+00	88.55	65.43	57.94	1.00	1/10/2022 8:08	1/12/2022 9:09
14	RA-228	TRG	12/20/21 13:30	1.00E+00	83.26	89.76	74.73	1.00	1/10/2022 8:08	1/12/2022 9:09
15	RA-228	TRG	12/20/21 15:05	1.00E+00	107.52	81.93	88.10	1.00	1/10/2022 8:08	1/12/2022 9:09
16	RA-228	TRG	12/20/21 16:30	1.00E+00	94.05	83.36	78.40	1.00	1/10/2022 8:08	1/12/2022 9:09
17	RA-228	TRG	12/21/21 09:55	1.00E+00	81.61	81.79	66.75	1.00	1/10/2022 8:08	1/12/2022 9:09

	Run	1
	Analysis Code	Ra228
Eberline Services Work Order	21-12077	
	ERM	
Client	0150	





Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	12/28/21 00:00	1.0000	2.2142	843.1895	399.0000	105.05	1.00	1.00
02	MBL	BLANK	12/28/21 00:00	1.0000	2.1944	835.6495	344.0000	91.39	1.00	1.00
03	DUP	MW-1	12/15/21 13:45	1.0000	2.1947	835.7637	380.0000	100.94	1.00	1.00
04	TRG	MW-11	12/15/21 08:00	1.0000	2.1917	834.6213	350.0000	93.10	1.00	1.00
05	DO	MW-1	12/15/21 13:45	1.0000	2.1893	833.7073	382.0000	101.72	1.00	1.00
06	TRG	MW-8	12/15/21 16:30	1.0000	2.1852	832.1460	359.0000	95.77	1.00	1.00
07	TRG	MW-7	12/16/21 07:50	1.0000	2.1808	830.4704	344.0000	91.96	1.00	1.00
08	TRG	MW-9	12/16/21 08:20	1.0000	2.1345	812.8389	364.0000	99.41	1.00	1.00
09	TRG	MW-9D	12/16/21 08:40	1.0000	2.0902	795.9691	379.0000	105.71	1.00	1.00
10	TRG	SW-BO 13	12/16/21 11:35	1.0000	2.1139	804.9943	356.0000	98.18	1.00	1.00
11	TRG	SW-BO 2	12/16/21 12:30	1.0000	2.5654	976.9300	385.0000	87.49	1.00	1.00
12	TRG	MW-6	12/17/21 08:30	1.0000	2.1965	836.4492	369.0000	97.94	1.00	1.00
13	TRG	MW-10	12/20/21 10:45	1.0000	2.1726	827.3478	330.0000	88.55	1.00	1.00
14	TRG	MW-5	12/20/21 13:30	1.0000	2.1706	826.5862	310.0000	83.26	1.00	1.00
15	TRG	MW-4	12/20/21 15:05	1.0000	2.1742	827.9571	401.0000	107.52	1.00	1.00
16	TRG	MW-3	12/20/21 16:30	1.0000	2.1695	826.1673	350.0000	94.05	1.00	1.00
17	TRG	MW-2	12/21/21 09:55	1.0000	2.1716	826.9670	304.0000	81.61	1.00	1.00

# Spike and Tracer Worksheet

Internal Work Order		Run	Analysis Code		Date		Technician		Technician Initials		Witness Initials	
<b>21-12077</b>		<b>1</b>	<b>Ra228</b>		<b>1/12/2022 8:57</b>		<b>MDAVIS</b>		<b>MDP</b>			
<b>LCS &amp; Matrix Spikes</b>												
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS Volume Used (g)	MS Volume Used (g)	LCS Volume Used (g)	MSD Volume Used (g)	LCS Known pCi	MS Error Estimate	LCS Error Estimate	MSD Added pCi
Ra-228	Ra-12	35.730	1/12/2022	0.560	0.5493				8.84	0.000	0.000	0.00

<b>Tracers</b>													
fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition	Balance Printer Tapes						
							Tracer						LCS
01	Ba-133	Ba-6a	380.810	1/12/2022	2.2142	2.6600							
02	Ba-133	Ba-6a	380.810	1/12/2022	2.1944	2.6600							
03	Ba-133	Ba-6a	380.810	1/12/2022	2.1947	2.6600							
04	Ba-133	Ba-6a	380.810	1/12/2022	2.1917	2.6600							
05	Ba-133	Ba-6a	380.810	1/12/2022	2.1893	2.6600							
06	Ba-133	Ba-6a	380.810	1/12/2022	2.1852	2.6600							
07	Ba-133	Ba-6a	380.810	1/12/2022	2.1808	2.6600							
08	Ba-133	Ba-6a	380.810	1/12/2022	2.1345	2.6600							
09	Ba-133	Ba-6a	380.810	1/12/2022	2.0902	2.6600							
10	Ba-133	Ba-6a	380.810	1/12/2022	2.1139	2.6600							
11	Ba-133	Ba-6a	380.810	1/12/2022	2.5654	2.6600							
12	Ba-133	Ba-6a	380.810	1/12/2022	2.1965	2.6600							
13	Ba-133	Ba-6a	380.810	1/12/2022	2.1726	2.6600							
14	Ba-133	Ba-6a	380.810	1/12/2022	2.1706	2.6600							
15	Ba-133	Ba-6a	380.810	1/12/2022	2.1742	2.6600							
16	Ba-133	Ba-6a	380.810	1/12/2022	2.1695	2.6600							
17	Ba-133	Ba-6a	380.810	1/12/2022	2.1716	2.6600							
<b>Matrix Spike</b>													

# Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
<b>21-12077</b>	<b>1</b>	<b>Ra228</b>	<b>liters</b>	<b>1/10/2022</b>	<b>JHARVEY</b>

Lab Fraction	ERM Client ID	Sample Type	Muffle Data		Dilution Data			Aliquot Data			MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq		
01	LCS	LCS							1.0000E+00	1.0000E+00				
02	BLANK	MBL							1.0000E+00	1.0000E+00				
03	MW-1	DUP							1.0000E+00	1.0000E+00				
04	MW-11	TRG							1.0000E+00	1.0000E+00				
05	MW-1	DO							1.0000E+00	1.0000E+00				
06	MW-8	TRG							1.0000E+00	1.0000E+00				
07	MW-7	TRG							1.0000E+00	1.0000E+00				
08	MW-9	TRG							1.0000E+00	1.0000E+00				
09	MW-9D	TRG							1.0000E+00	1.0000E+00				
10	SW-BO 13	TRG							1.0000E+00	1.0000E+00				
11	SW-BO 2	TRG							1.0000E+00	1.0000E+00				
12	MW-6	TRG							1.0000E+00	1.0000E+00				
13	MW-10	TRG							1.0000E+00	1.0000E+00				
14	MW-5	TRG							1.0000E+00	1.0000E+00				
15	MW-4	TRG							1.0000E+00	1.0000E+00				
16	MW-3	TRG							1.0000E+00	1.0000E+00				
17	MW-2	TRG							1.0000E+00	1.0000E+00				

Comments
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Technician: J Harvey Date: 1-14-22

# Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
<b>21-12077</b>	<b>1</b>	<b>Ra228</b>	<b>Yttrium</b>	<b>35.1500</b>	<b>MDAVIS</b>

TRetek Fraction	ERM Client ID	Sample Type	Carrier Data		Filter Data			Gravimetric	
			Carrier Added (ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	% Recovery		
01	LCS	LCS	2.0000	0.0883	0.1447	0.0564	80.23		
02	BLANK	MBL	2.0000	0.0888	0.1448	0.0560	79.66		
03	DUP	DUP	2.0000	0.0886	0.1449	0.0563	80.09		
04	MW-11	TRG	2.0000	0.0883	0.1467	0.0584	83.07		
05	MW-1	DO	2.0000	0.0881	0.1450	0.0569	80.94		
06	MW-8	TRG	2.0000	0.0881	0.1428	0.0547	77.81		
07	MW-7	TRG	2.0000	0.0877	0.1419	0.0542	77.10		
08	MW-9	TRG	2.0000	0.0885	0.1448	0.0563	80.09		
09	MW-9D	TRG	2.0000	0.0883	0.1454	0.0571	81.22		
10	SW-BO 13	TRG	2.0000	0.0887	0.1458	0.0571	81.22		
11	SW-BO 2	TRG	2.0000	0.0891	0.1440	0.0549	78.09		
12	MW-6	TRG	2.0000	0.0887	0.1434	0.0547	77.81		
13	MW-10	TRG	2.0000	0.0885	0.1345	0.0460	65.43		
14	MW-5	TRG	2.0000	0.0880	0.1511	0.0631	89.76		
15	MW-4	TRG	2.0000	0.0880	0.1456	0.0576	81.93		
16	MW-3	TRG	2.0000	0.0874	0.1460	0.0586	83.36		
17	MW-2	TRG	2.0000	0.0882	0.1457	0.0575	81.79		

Technician: Megan Owen Date: 1/12/22

1/12/2022

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A3	2112077-01	55	679	120	1410	1/12/2022 1:42:57 PM
A4	2112077-02	30	195	120	1410	1/12/2022 1:42:57 PM
A3	2112077-03	23	217	120	1410	1/12/2022 11:41:22 AM
A4	2112077-04	36	224	120	1410	1/12/2022 11:41:22 AM
B1	2112077-05	15	196	120	1410	1/12/2022 11:41:23 AM
B2	2112077-06	18	171	120	1410	1/12/2022 11:41:23 AM
B3	2112077-07	18	202	120	1410	1/12/2022 11:41:23 AM
B4	2112077-08	20	182	120	1410	1/12/2022 11:41:23 AM
C1	2112077-09	23	184	120	1410	1/12/2022 11:41:23 AM
C2	2112077-10	23	148	120	1410	1/12/2022 11:41:23 AM
C3	2112077-11	15	146	120	1410	1/12/2022 11:41:23 AM
D1	2112077-12	24	216	120	1410	1/12/2022 11:41:24 AM
D3	2112077-13	22	142	120	1410	1/12/2022 11:41:24 AM
D4	2112077-14	29	276	120	1410	1/12/2022 11:41:24 AM
G1	2112077-15	14	189	120	1410	1/12/2022 11:41:24 AM
G2	2112077-16	22	251	120	1410	1/12/2022 11:41:24 AM
G4	2112077-17	26	185	120	1410	1/12/2022 11:41:24 AM

GPC Detector Report  
(ALL Backgrounds)

UP  
1/12/22

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	1/12/2022	2.83E-01	P	5.44E-03	1.64E-01	3.23E-01
LB4110A - A2	Alpha	11/2/2019	1/12/2022	2.50E-01	P	8.03E-03	1.47E-01	2.87E-01
LB4110A - A3	Alpha	11/2/2019	1/12/2022	1.83E-01	P	1.36E-02	1.60E-01	3.06E-01
LB4110A - A4	Alpha	11/2/2019	1/12/2022	1.67E-01	P	1.37E-02	1.62E-01	3.10E-01
LB4110A - B1	Alpha	11/2/2019	1/12/2022	1.33E-01	P	-2.63E-02	1.43E-01	3.13E-01
LB4110A - B2	Alpha	11/2/2019	1/12/2022	5.00E-02	P	1.94E-02	2.10E-01	4.01E-01
LB4110A - B3	Alpha	11/2/2019	1/12/2022	2.00E-01	P	1.52E-02	1.71E-01	3.27E-01
LB4110A - B4	Alpha	11/2/2019	1/12/2022	6.67E-02	P	-9.03E-03	1.17E-01	2.43E-01
LB4110A - C1	Alpha	11/2/2019	1/12/2022	8.33E-02	P	-1.63E-02	1.10E-01	2.37E-01
LB4110A - C2	Alpha	11/2/2019	1/12/2022	6.67E-02	P	-1.93E-02	1.08E-01	2.36E-01
LB4110A - C3	Alpha	11/2/2019	1/12/2022	1.33E-01	P	-2.35E-02	8.59E-02	1.95E-01
LB4110A - C4	Alpha	11/2/2019	1/12/2022	3.00E-01	P	3.02E-02	2.19E-01	4.08E-01
LB4110A - D1	Alpha	11/2/2019	1/12/2022	6.67E-02	P	-2.65E-02	7.23E-02	1.71E-01
LB4110A - D2	Alpha	11/2/2019	1/12/2022	5.00E-02	P	-1.03E-02	1.06E-01	2.22E-01
LB4110A - D3	Alpha	11/2/2019	1/12/2022	1.17E-01	P	-2.49E-03	1.25E-01	2.52E-01
LB4110A - D4	Alpha	11/2/2019	1/12/2022	1.50E-01	P	2.86E-02	1.67E-01	3.05E-01
LB4110A - E1	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E2	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E3	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E4	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - F1	Alpha	11/2/2019	1/10/2022	0.00E+00	P	-3.26E-02	1.31E-01	2.95E-01
LB4110A - F2	Alpha	11/2/2019	1/10/2022	0.00E+00	P	-3.95E-02	1.19E-01	2.77E-01
LB4110A - F3	Alpha	11/2/2019	1/10/2022	0.00E+00	P	-2.28E-02	1.05E-01	2.34E-01
LB4110A - F4	Alpha	11/2/2019	1/10/2022	0.00E+00	P	-4.44E-02	7.07E-02	1.86E-01
LB4110A - G1	Alpha	11/2/2019	1/12/2022	1.17E-01	P	-2.14E-02	8.74E-02	1.96E-01
LB4110A - G2	Alpha	11/2/2019	1/12/2022	8.33E-02	P	-2.07E-02	8.93E-02	1.99E-01
LB4110A - G3	Alpha	11/2/2019	1/12/2022	8.33E-02	P	-3.05E-02	1.52E-01	3.34E-01
LB4110A - G4	Alpha	11/2/2019	1/12/2022	1.83E-01	P	-2.35E-02	1.01E-01	2.26E-01

GPC Detector Report  
(ALL Backgrounds)

UP  
1/12/22

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	1/12/2022	1.20E+00	P	-1.58E+00	1.37E+00	4.32E+00
LB4110A - A2	Beta	11/2/2019	1/12/2022	1.75E+00	P	-1.35E+00	1.66E+00	4.67E+00
LB4110A - A3	Beta	11/2/2019	1/12/2022	1.15E+00	P	-1.33E+00	1.46E+00	4.25E+00
LB4110A - A4	Beta	11/2/2019	1/12/2022	1.55E+00	P	-1.44E+00	1.50E+00	4.44E+00
LB4110A - B1	Beta	11/2/2019	1/12/2022	1.50E+00	P	1.02E+00	1.39E+00	1.77E+00
LB4110A - B2	Beta	11/2/2019	1/12/2022	1.18E+00	P	8.07E-01	1.39E+00	1.98E+00
LB4110A - B3	Beta	11/2/2019	1/12/2022	1.32E+00	P	9.17E-01	1.32E+00	1.72E+00
LB4110A - B4	Beta	11/2/2019	1/12/2022	1.12E+00	P	6.16E-01	1.55E+00	2.49E+00
LB4110A - C1	Beta	11/2/2019	1/12/2022	1.07E+00	P	7.90E-01	1.16E+00	1.54E+00
LB4110A - C2	Beta	11/2/2019	1/12/2022	9.83E-01	P	6.58E-01	1.01E+00	1.37E+00
LB4110A - C3	Beta	11/2/2019	1/12/2022	1.15E+00	P	7.54E-01	1.33E+00	1.90E+00
LB4110A - C4	Beta	11/2/2019	1/12/2022	1.22E+00	P	8.64E-01	1.29E+00	1.71E+00
LB4110A - D1	Beta	11/2/2019	1/12/2022	8.50E-01	P	6.69E-01	1.07E+00	1.47E+00
LB4110A - D2	Beta	11/2/2019	1/12/2022	1.62E+00	P	-1.34E+00	2.33E+00	6.00E+00
LB4110A - D3	Beta	11/2/2019	1/12/2022	1.03E+00	P	7.39E-01	1.12E+00	1.50E+00
LB4110A - D4	Beta	11/2/2019	1/12/2022	1.20E+00	P	1.04E+00	1.47E+00	1.90E+00
LB4110A - E1	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E2	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E3	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E4	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - F1	Beta	11/2/2019	1/10/2022	1.67E-02	P	2.10E-01	1.28E+00	2.35E+00
LB4110A - F2	Beta	11/2/2019	1/10/2022	0.00E+00	P	-5.04E-01	1.19E+00	2.88E+00
LB4110A - F3	Beta	11/2/2019	1/10/2022	0.00E+00	P	-2.58E-01	1.18E+00	2.62E+00
LB4110A - F4	Beta	11/2/2019	1/10/2022	0.00E+00	P	-1.30E+00	1.60E+00	4.50E+00
LB4110A - G1	Beta	11/2/2019	1/12/2022	1.13E+00	P	7.45E-01	1.18E+00	1.61E+00
LB4110A - G2	Beta	11/2/2019	1/12/2022	1.78E+00	P	1.12E+00	1.58E+00	2.04E+00
LB4110A - G3	Beta	11/2/2019	1/12/2022	1.13E+00	P	7.63E-01	1.17E+00	1.58E+00
LB4110A - G4	Beta	11/2/2019	1/12/2022	1.08E+00	P	7.39E-01	1.24E+00	1.75E+00



GPC Detector Report  
(ALL Efficiencies)

RP  
1/12/22

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	1/12/2022	0.2347	P	0.2070	0.2331	0.2591
LB4110A - A2	Alpha	11/2/2019	1/12/2022	0.1983	P	0.1788	0.2019	0.2250
LB4110A - A3	Alpha	11/2/2019	1/12/2022	0.2008	P	0.1738	0.1967	0.2195
LB4110A - A4	Alpha	11/2/2019	1/12/2022	0.2241	P	0.1998	0.2259	0.2520
LB4110A - B1	Alpha	11/2/2019	1/12/2022	0.2142	P	0.1847	0.2112	0.2377
LB4110A - B2	Alpha	11/2/2019	1/12/2022	0.1864	P	0.1733	0.1981	0.2230
LB4110A - B3	Alpha	11/2/2019	1/12/2022	0.2106	W	0.2038	0.2338	0.2637
LB4110A - B4	Alpha	11/2/2019	1/12/2022	0.2158	P	0.1979	0.2275	0.2572
LB4110A - C1	Alpha	11/2/2019	1/12/2022	0.1979	P	0.1744	0.1982	0.2220
LB4110A - C2	Alpha	11/2/2019	1/12/2022	0.1891	P	0.1750	0.1999	0.2248
LB4110A - C3	Alpha	11/2/2019	1/12/2022	0.2080	P	0.1931	0.2244	0.2556
LB4110A - C4	Alpha	11/2/2019	1/12/2022	0.1954	P	0.1781	0.2093	0.2406
LB4110A - D1	Alpha	11/2/2019	1/12/2022	0.1925	P	0.1733	0.1973	0.2213
LB4110A - D2	Alpha	11/2/2019	1/12/2022	0.2316	P	0.2075	0.2351	0.2627
LB4110A - D3	Alpha	11/2/2019	1/12/2022	0.2354	P	0.2129	0.2410	0.2692
LB4110A - D4	Alpha	11/2/2019	1/12/2022	0.1819	P	0.1622	0.1844	0.2066
LB4110A - E1	Alpha	11/2/2017	5/19/2020	0.2075	P	0.1686	0.2257	0.2828
LB4110A - E2	Alpha	11/2/2017	5/19/2020	0.1778	P	0.1514	0.2049	0.2583
LB4110A - E3	Alpha	11/2/2017	5/19/2020	0.2234	P	0.1549	0.2076	0.2604
LB4110A - E4	Alpha	11/2/2017	5/19/2020	0.2155	P	0.1746	0.2353	0.2961
LB4110A - F1	Alpha	11/2/2019	1/10/2022	0.0000	F	0.1419	0.2082	0.2746
LB4110A - F2	Alpha	11/2/2019	1/10/2022	0.0000	F	0.1190	0.1738	0.2286
LB4110A - F3	Alpha	11/2/2019	1/10/2022	0.0000	F	0.1494	0.2173	0.2853
LB4110A - F4	Alpha	11/2/2019	1/10/2022	0.0000	F	0.1457	0.2123	0.2788
LB4110A - G1	Alpha	11/2/2019	1/12/2022	0.1924	P	0.1761	0.1869	0.1977
LB4110A - G2	Alpha	11/2/2019	1/12/2022	0.1764	P	0.1722	0.1833	0.1945
LB4110A - G3	Alpha	11/2/2019	1/12/2022	0.2125	P	0.2032	0.2150	0.2268
LB4110A - G4	Alpha	11/2/2019	1/12/2022	0.1809	P	0.1637	0.1832	0.2027

RP  
1/12/22  
out of service

GPC Detector Report  
(ALL Efficiencies)

MP  
1/12/22

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	1/12/2022	0.5734	P	0.5022	0.5658	0.6295
LB4110A - A2	Beta	11/2/2019	1/12/2022	0.4468	P	0.3923	0.4434	0.4944
LB4110A - A3	Beta	11/2/2019	1/12/2022	0.4889	P	0.4239	0.4796	0.5352
LB4110A - A4	Beta	11/2/2019	1/12/2022	0.5496	P	0.4912	0.5541	0.6171
LB4110A - B1	Beta	11/2/2019	1/12/2022	0.4876	P	0.4326	0.4953	0.5581
LB4110A - B2	Beta	11/2/2019	1/12/2022	0.4299	W	0.4211	0.4918	0.5625
LB4110A - B3	Beta	11/2/2019	1/12/2022	0.5258	P	0.5073	0.5839	0.6606
LB4110A - B4	Beta	11/2/2019	1/12/2022	0.5144	P	0.4840	0.5616	0.6392
LB4110A - C1	Beta	11/2/2019	1/12/2022	0.4885	P	0.4217	0.4772	0.5327
LB4110A - C2	Beta	11/2/2019	1/12/2022	0.4447	P	0.4213	0.4793	0.5373
LB4110A - C3	Beta	11/2/2019	1/12/2022	0.5407	P	0.4913	0.5681	0.6449
LB4110A - C4	Beta	11/2/2019	1/12/2022	0.4784	P	0.4400	0.5122	0.5844
LB4110A - D1	Beta	11/2/2019	1/12/2022	0.5640	P	0.5096	0.5779	0.6461
LB4110A - D2	Beta	11/2/2019	1/12/2022	0.5765	P	0.5252	0.5942	0.6631
LB4110A - D3	Beta	11/2/2019	1/12/2022	0.6001	P	0.5346	0.6035	0.6723
LB4110A - D4	Beta	11/2/2019	1/12/2022	0.4724	P	0.4277	0.4832	0.5388
LB4110A - E1	Beta	11/2/2017	5/19/2020	0.5360	P	0.4167	0.5408	0.6649
LB4110A - E2	Beta	11/2/2017	5/19/2020	0.4520	P	0.3728	0.4910	0.6092
LB4110A - E3	Beta	11/2/2017	5/19/2020	0.5775	P	0.3848	0.5001	0.6154
LB4110A - E4	Beta	11/2/2017	5/19/2020	0.5466	P	0.4532	0.5887	0.7241
LB4110A - F1	Beta	11/2/2019	1/10/2022	0.0044	F	0.3744	0.5247	0.6751
LB4110A - F2	Beta	11/2/2019	1/10/2022	0.0009	F	0.3099	0.4365	0.5632
LB4110A - F3	Beta	11/2/2019	1/10/2022	0.0002	F	0.4027	0.5661	0.7294
LB4110A - F4	Beta	11/2/2019	1/10/2022	0.0003	F	0.3883	0.5461	0.7040
LB4110A - G1	Beta	11/2/2019	1/12/2022	0.4667	W	0.4188	0.4439	0.4690
LB4110A - G2	Beta	11/2/2019	1/12/2022	0.4128	W	0.4065	0.4343	0.4620
LB4110A - G3	Beta	11/2/2019	1/12/2022	0.5111	P	0.4926	0.5186	0.5446
LB4110A - G4	Beta	11/2/2019	1/12/2022	0.4349	P	0.3950	0.4394	0.4837

out of service  
MP 1/12/22

**SECTION X**  
**BARIUM-133 ANALYTICAL TRACER DATA**

Analysis Report for 2112077-01  
SPIKE

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-01  
 Sample Description : SPIKE  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:56:03AM  
 Acquisition Started : 1/10/2022 9:56:11AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE5  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 1026.8 seconds  
  
 Dead Time : 12.35 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 2 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118873

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:13:20AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-01

## SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	5.74	43 -	55	49.47	2.53E+01	14.39	1.54E+01	0.76
	2	20.96	195 -	209	202.96	6.80E+01	31.64	1.02E+02	0.71
	3	25.23	232 -	260	245.90	3.16E+01	31.93	7.29E+01	2.64
	4	30.76	287 -	315	301.69	2.35E+03	112.49	2.81E+02	0.76
M	5	34.96	329 -	360	343.97	6.10E+02	56.60	8.90E+01	0.78
m	6	35.77	329 -	360	352.14	9.75E+01	49.25	5.70E+01	0.71
	7	53.00	514 -	537	525.81	5.63E+01	34.06	8.35E+01	0.54
M	8	61.15	597 -	622	608.00	1.16E+02	39.69	8.31E+01	0.78
m	9	61.76	597 -	622	614.15	1.44E+02	35.79	6.08E+01	0.70
M	10	65.42	641 -	669	651.00	4.40E+01	24.69	3.53E+01	0.79
m	11	65.81	641 -	669	654.95	4.33E+01	23.42	2.33E+01	0.57
m	12	66.75	641 -	669	664.41	3.23E+01	13.92	2.75E+00	0.71
M	13	79.52	785 -	818	793.11	5.89E+01	22.27	5.48E+01	0.71
m	14	80.91	785 -	818	807.14	9.48E+02	64.14	4.54E+01	0.62
	15	92.71	915 -	938	926.10	2.56E+01	17.09	2.28E+01	1.61
	16	111.68	1104 -	1126	1117.27	1.75E+02	36.48	8.37E+01	0.72
M	17	115.42	1137 -	1171	1155.00	3.68E+01	25.50	5.20E+01	0.87
m	18	116.61	1137 -	1171	1167.00	3.69E+01	12.88	2.00E+01	0.87
	19	160.53	1597 -	1619	1609.68	3.82E+01	16.95	1.77E+01	0.90
	20	276.18	2760 -	2784	2775.54	3.25E+01	19.16	3.10E+01	0.73
M	21	302.12	3029 -	3054	3037.00	1.14E+01	20.41	2.14E+00	1.07
m	22	302.71	3029 -	3054	3043.00	2.06E+02	25.42	9.46E+00	1.07
	23	333.77	3341 -	3367	3356.10	4.51E+01	16.20	1.18E+01	0.59
	24	355.90	3563 -	3592	3579.27	4.03E+02	41.86	1.64E+01	0.93
M	25	383.55	3842 -	3870	3858.00	1.06E+02	20.45	9.17E+00	1.13
m	26	384.34	3842 -	3870	3866.00	1.21E+01	12.81	7.19E+00	1.13
M	27	385.85	3875 -	3900	3881.23	1.75E+01	11.29	8.91E+00	0.92
m	28	386.73	3875 -	3900	3890.15	1.08E+02	22.85	9.54E+00	1.24

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:13:20AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118843.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	5.74	2.53E+01	14.39			2.53E+01	1.44E+01

0163

Analysis Report for 2112077-01

SPIKE

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	2	20.96	6.80E+01	31.64	8.71E+00	6.63E-01	5.93E+01	3.16E+01
	3	25.23	3.16E+01	31.93	1.87E+00	3.83E-01	2.97E+01	3.19E+01
	4	30.76	2.35E+03	112.49	6.35E+00	8.10E-01	2.34E+03	1.12E+02
M	5	34.96	6.10E+02	56.60	1.59E+00	6.48E-01	6.09E+02	5.66E+01
m	6	35.77	9.75E+01	49.25	1.59E+00	6.48E-01	9.59E+01	4.93E+01
	7	53.00	5.63E+01	34.06			5.63E+01	3.41E+01
M	8	61.15	1.16E+02	39.69	3.32E+00	6.94E-01	1.13E+02	3.97E+01
m	9	61.76	1.44E+02	35.79	3.32E+00	6.94E-01	1.41E+02	3.58E+01
M	10	65.42	4.40E+01	24.69			4.40E+01	2.47E+01
m	11	65.81	4.33E+01	23.42			4.33E+01	2.34E+01
m	12	66.75	3.23E+01	13.92			3.23E+01	1.39E+01
M	13	79.52	5.89E+01	22.27			5.89E+01	2.23E+01
m	14	80.91	9.48E+02	64.14			9.48E+02	6.41E+01
	15	92.71	2.56E+01	17.09			2.56E+01	1.71E+01
	16	111.68	1.75E+02	36.48	7.94E-01	4.65E-01	1.74E+02	3.65E+01
M	17	115.42	3.68E+01	25.50			3.68E+01	2.55E+01
m	18	116.61	3.69E+01	12.88			3.69E+01	1.29E+01
	19	160.53	3.82E+01	16.95			3.82E+01	1.69E+01
	20	276.18	3.25E+01	19.16			3.25E+01	1.92E+01
M	21	302.12	1.14E+01	20.41			1.14E+01	2.04E+01
m	22	302.71	2.06E+02	25.42			2.06E+02	2.54E+01
	23	333.77	4.51E+01	16.20			4.51E+01	1.62E+01
	24	355.90	4.03E+02	41.86			4.03E+02	4.19E+01
M	25	383.55	1.06E+02	20.45			1.06E+02	2.04E+01
m	26	384.34	1.21E+01	12.81			1.21E+01	1.28E+01
M	27	385.85	1.75E+01	11.29			1.75E+01	1.13E+01
m	28	386.73	1.08E+02	22.85			1.08E+02	2.29E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
FE-55	0.99	5.89	* 24.50	1.15E-04	6.51E-05
NI-59	0.96	6.92	* 29.80	9.42E-05	5.35E-05

0164

Analysis Report for 2112077-01

SPIKE

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
I-129	0.87	29.78 *		57.00	3.25E+01	1.57E+00
		33.60 *		13.20	5.88E+01	5.48E+00
		39.58		7.52		
BA-133	1.00	81.00 *		34.06	4.01E+02	3.12E+01
		302.84 *		18.33	6.25E+02	8.34E+01
		356.01 *		62.05	3.46E+02	3.88E+01
TH-231	0.89	25.64 *		14.70	7.23E-01	7.78E-01
		84.21		6.40		
TH-234	0.94	63.29 *		3.80	2.79E+02	7.13E+01
AM-241	0.93	59.54 *		35.90	2.32E+01	8.13E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

	<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
?	FE-55	0.999	1.15E-04	6.51E-05	
?	NI-59	0.965	9.42E-05	5.35E-05	
	I-129	0.875	3.45E+01	1.51E+00	
	BA-133	1.000	3.99E+02	2.33E+01	
	TH-231	0.895	7.23E-01	7.78E-01	
	TH-234	0.942	2.79E+02	7.13E+01	
X	NP-237	0.730			
	AM-241	0.936	2.32E+01	8.13E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-01

SPIKE

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:13:20AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
2	20.96	6.59093E-02	26.67	Tol.	PA-234M
m 6	35.77	1.06522E-01	25.69	Sum	
7	53.00	6.25095E-02	30.27		
M 10	65.42	4.88708E-02	28.07	Sum	
m 11	65.81	4.81122E-02	27.04	Sum	
m 12	66.75	3.59038E-02	21.54	Sum	
M 13	79.52	6.54690E-02	18.90	Tol.	BA-133
15	92.71	2.84685E-02	33.35	Sum	
16	111.68	1.93713E-01	10.46	Sum	
M 17	115.42	4.09333E-02	34.60	Sum	
m 18	116.61	4.10123E-02	17.45	Sum	
19	160.53	4.24054E-02	22.20	Sum	
20	276.18	3.61389E-02	29.45		
M 21	302.12	1.26723E-02	89.47	Tol.	BA-133
23	333.77	5.01046E-02	17.96	Sum	
M 25	383.55	1.17878E-01	9.64	Sum	
m 26	384.34	1.34704E-02	52.82	Sum	
M 27	385.85	1.94359E-02	32.28	Sum	
m 28	386.73	1.20164E-01	10.57	Sum	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0166



Analysis Report for 2112077-01

SPIKE

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	4.91E-07	4.91E-07	-3.47E-07	2.28E-07
	3.31	12.30	6.33E-06		-2.65E-06	2.93E-06
+ FE-55	5.89 *	24.50	8.88E-05	8.88E-05	1.15E-04	3.83E-05
CO-57	122.06	85.51	8.86E+00	8.86E+00	2.23E+00	3.95E+00
	136.48	10.60	9.79E+01		5.06E+01	4.44E+01
+ NI-59	6.92 *	29.80	7.30E-05	7.30E-05	9.42E-05	3.15E-05
MO-93	16.59	52.90	2.67E-02	2.67E-02	-1.55E-02	1.20E-02
	18.60	10.00	2.80E-01		-1.87E-01	1.27E-01
NB-93M	16.57	9.43	1.49E-01	1.49E-01	-8.62E-02	6.69E-02
CD-109	88.03	3.72	9.00E+01	9.00E+01	-2.86E+01	3.87E+01
SN-113	255.12	1.93	4.77E+02	2.25E+01	-1.44E+02	2.00E+02
	391.69	61.90	2.25E+01		2.08E+01	1.01E+01
SN-119M	23.87	16.10	6.16E-01	5.45E-01	-5.28E-02	2.84E-01
	25.10	22.70	5.45E-01		1.60E-01	2.52E-01
+ I-129	29.78 *	57.00	1.35E+00	1.35E+00	3.25E+01	6.57E-01
	33.60 *	13.20	6.29E+00		5.88E+01	3.01E+00
	39.58	7.52	5.89E+00		1.85E+00	2.59E+00
+ BA-133	81.00 *	34.06	2.10E+01	1.91E+01	4.01E+02	9.92E+00
	302.84 *	18.33	5.08E+01		6.25E+02	2.13E+01
	356.01 *	62.05	1.91E+01		3.46E+02	8.39E+00
CE-139	165.85	80.35	1.51E+01	1.51E+01	3.46E+00	6.80E+00
CE-144	133.54	10.80	8.67E+01	8.67E+01	0.00E+00	3.91E+01
HG-203	279.19	77.30	9.47E+00	9.47E+00	-2.07E+01	3.76E+00
PB-210	46.50	4.25	1.58E+01	1.58E+01	-1.58E+01	6.83E+00
+ TH-231	25.64 *	14.70	1.27E+00	1.27E+00	7.23E-01	6.01E-01
	84.21	6.40	7.41E+01		4.44E+01	3.37E+01
PA-234M	9.89	89.00	1.13E-03	1.13E-03	4.32E-04	5.13E-04
	21.72	64.90	1.49E-01		-8.32E-02	7.04E-02
	37.93	23.75	1.49E+00		-1.08E+00	6.46E-01
+ TH-234	63.29 *	3.80	1.07E+02	1.07E+02	2.79E+02	5.06E+01
NP-237	29.37 *	14.00	5.50E+00	5.50E+00	1.32E+02	2.67E+00
	86.50	12.60	2.56E+01		-4.65E+00	1.10E+01
U-237	97.08	16.30	3.06E+01	2.53E+01	9.55E-01	1.36E+01
	101.07	26.30	2.53E+01		2.09E+00	1.15E+01
	114.00	12.30	7.22E+01		-8.67E+01	3.31E+01
	208.01	22.00	4.85E+01		-1.52E+01	2.11E+01
+ AM-241	59.54 *	35.90	1.12E+01	1.12E+01	2.32E+01	5.34E+00
AM-243	74.67	66.00	4.47E+00	4.47E+00	1.58E-01	1.99E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

LP  
1/10/22

Analysis Report for 2112077-02  
BLANK

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-02  
 Sample Description : BLANK  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:56:29AM  
 Acquisition Started : 1/10/2022 10:14:12AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE5  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 1019.9 seconds  
  
 Dead Time : 11.75 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 2 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118874

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:31:15AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-02

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	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	5.13	35 -	50	43.33	1.31E+01	16.93	3.18E+01	1.17
	2	20.76	187 -	211	200.92	9.51E+01	34.01	7.58E+01	0.50
	3	30.75	288 -	314	301.55	2.12E+03	106.49	2.58E+02	0.74
M	4	34.83	331 -	358	342.69	4.11E+02	45.48	3.40E+01	0.57
m	5	35.67	331 -	358	351.12	1.02E+02	42.90	3.40E+01	0.64
	6	41.95	405 -	422	414.49	1.00E+01	11.66	1.20E+01	0.12
	7	43.12	422 -	432	426.28	7.80E+00	7.31	4.40E+00	0.43
	8	52.82	511 -	534	524.03	3.45E+01	30.59	7.89E+01	0.31
	9	59.23	579 -	596	588.61	2.00E+01	13.27	1.20E+01	0.41
	10	61.66	600 -	626	613.15	1.77E+02	31.67	2.67E+01	0.55
M	11	64.72	640 -	670	644.00	4.04E+01	10.33	1.82E+00	0.79
m	12	65.82	640 -	670	655.00	8.34E+01	30.20	4.73E+01	0.79
M	13	79.41	778 -	817	791.98	1.12E+02	38.88	4.00E+01	0.98
m	14	80.90	778 -	817	807.00	8.38E+02	58.96	1.90E+01	0.66
	15	101.51	1001 -	1024	1014.78	2.65E+01	12.33	5.00E+00	1.17
	16	111.78	1108 -	1128	1118.23	1.05E+02	32.50	8.39E+01	0.50
	17	160.36	1595 -	1617	1607.98	2.15E+01	18.82	3.50E+01	1.10
M	18	276.23	2760 -	2785	2776.00	8.69E+01	14.00	0.00E+00	1.04
m	19	277.01	2760 -	2785	2783.85	9.76E+00	6.00	0.00E+00	0.75
	20	302.80	3027 -	3055	3043.86	1.41E+02	24.69	6.72E+00	0.83
	21	355.91	3563 -	3593	3579.35	3.60E+02	39.25	1.17E+01	1.01
	22	383.71	3841 -	3870	3859.68	5.87E+01	19.39	1.65E+01	0.32
M	23	386.32	3876 -	3902	3886.00	1.21E+01	20.69	2.76E+01	1.14
m	24	387.02	3876 -	3902	3893.00	1.02E+02	21.54	2.23E+01	1.14

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:31:15AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118843.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	5.13	1.31E+01	16.93			1.31E+01	1.69E+01
	2	20.76	9.51E+01	34.01	8.71E+00	6.63E-01	8.64E+01	3.40E+01
	3	30.75	2.12E+03	106.49	6.35E+00	8.10E-01	2.11E+03	1.06E+02
M	4	34.83	4.11E+02	45.48	1.59E+00	6.48E-01	4.10E+02	4.55E+01
m	5	35.67	1.02E+02	42.90	1.59E+00	6.48E-01	1.00E+02	4.29E+01

0169

Analysis Report for 2112077-02

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Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
6	41.95	1.00E+01	11.66	9.37E-01	5.02E-01	9.06E+00	1.17E+01
7	43.12	7.80E+00	7.31			7.80E+00	7.31E+00
8	52.82	3.45E+01	30.59			3.45E+01	3.06E+01
9	59.23	2.00E+01	13.27	3.32E+00	6.94E-01	1.67E+01	1.33E+01
10	61.66	1.77E+02	31.67	3.32E+00	6.94E-01	1.73E+02	3.17E+01
M 11	64.72	4.04E+01	10.33			4.04E+01	1.03E+01
m 12	65.82	8.34E+01	30.20			8.34E+01	3.02E+01
M 13	79.41	1.12E+02	38.88			1.12E+02	3.89E+01
m 14	80.90	8.38E+02	58.96			8.38E+02	5.90E+01
15	101.51	2.65E+01	12.33			2.65E+01	1.23E+01
16	111.78	1.05E+02	32.50	7.94E-01	4.65E-01	1.04E+02	3.25E+01
17	160.36	2.15E+01	18.82			2.15E+01	1.88E+01
M 18	276.23	8.69E+01	14.00			8.69E+01	1.40E+01
m 19	277.01	9.76E+00	6.00			9.76E+00	6.00E+00
20	302.80	1.41E+02	24.69			1.41E+02	2.47E+01
21	355.91	3.60E+02	39.25			3.60E+02	3.93E+01
22	383.71	5.87E+01	19.39			5.87E+01	1.94E+01
M 23	386.32	1.21E+01	20.69			1.21E+01	2.07E+01
m 24	387.02	1.02E+02	21.54			1.02E+02	2.15E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
FE-55	0.98	5.89	*	24.50	2.75E-05	3.56E-05
NI-59	0.92	6.92	*	29.80	2.26E-05	2.92E-05
I-129	0.96	29.78	*	57.00	2.93E+01	1.48E+00
		33.60	*	13.20	3.91E+01	4.34E+00
		39.58	*	7.52	2.89E+00	3.72E+00
BA-133	1.00	81.00	*	34.06	3.54E+02	2.84E+01
		302.84	*	18.33	4.27E+02	7.80E+01
		356.01	*	62.05	3.10E+02	3.61E+01
HG-203	0.88	279.19	*	77.30	7.05E+00	4.35E+00
TH-234	0.94	63.29	*	3.80	9.04E+01	2.32E+01

0170

Analysis Report for 2112077-02

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<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
NP-237	0.73	29.37 *	14.00	1.19E+02	6.02E+00
		86.50	12.60		
AM-241	0.99	59.54 *	35.90	3.13E+00	2.50E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
? FE-55	0.985	2.75E-05	3.56E-05	
? NI-59	0.921	2.26E-05	2.92E-05	
I-129	0.963	1.82E+01	2.82E+00	
BA-133	1.000	3.44E+02	2.15E+01	
HG-203	0.885	7.05E+00	4.35E+00	
TH-234	0.949	9.04E+01	2.32E+01	
NP-237	0.731	4.53E+01	1.30E+01	
AM-241	0.998	3.13E+00	2.50E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-02

BLANK

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:31:15AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

<i>Peak No.</i>	<i>Energy (keV)</i>	<i>Peak Size (CPS)</i>	<i>Peak CPS (%) Uncertainty</i>	<i>Peak Type</i>	<i>Tolerance Nuclide</i>	
	2	20.76	9.59732E-02	19.69	Tol.	MO-93
						PA-234M
m	5	35.67	1.11487E-01	21.38	Sum	
	7	43.12	8.66667E-03	46.86		
	8	52.82	3.83784E-02	44.29		
	10	61.66	1.92580E-01	9.14	Sum	
m	12	65.82	9.26405E-02	18.11	Sum	
M	13	79.41	1.24978E-01	17.29		
	15	101.51	2.94444E-02	23.26	Sum	
	16	111.78	1.15851E-01	15.59	Sum	
	17	160.36	2.39031E-02	43.75	Sum	
M	18	276.23	9.66045E-02	8.05		
	22	383.71	6.52736E-02	16.50	Sum	
M	23	386.32	1.34885E-02	85.21	Sum	
m	24	387.02	1.13136E-01	10.58	Sum	

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2112077-02

BLANK

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	4.87E-07	4.87E-07	-1.86E-06	2.26E-07
	3.31	12.30	5.88E-06		-4.51E-06	2.71E-06
+ FE-55	5.89 *	24.50	5.86E-05	5.86E-05	2.75E-05	2.64E-05
CO-57	122.06	85.51	6.90E+00	6.90E+00	6.51E-01	2.97E+00
	136.48	10.60	7.09E+01		-3.25E+01	3.09E+01
+ NI-59	6.92 *	29.80	4.81E-05	4.81E-05	2.26E-05	2.17E-05
MO-93	16.59	52.90	2.21E-02	2.21E-02	-1.19E-02	9.70E-03
	18.60	10.00	3.01E-01		-1.92E-02	1.38E-01
NB-93M	16.57	9.43	1.23E-01	1.23E-01	-6.62E-02	5.41E-02
CD-109	88.03	3.72	1.13E+02	1.13E+02	5.83E+01	5.04E+01
SN-113	255.12	1.93	5.20E+02	2.10E+01	4.87E+01	2.21E+02
	391.69	61.90	2.10E+01		1.98E+01	9.38E+00
SN-119M	23.87	16.10	5.19E-01	4.79E-01	-1.86E-01	2.35E-01
	25.10	22.70	4.79E-01		1.14E-01	2.19E-01
+ I-129	29.78 *	57.00	1.37E+00	1.37E+00	2.93E+01	6.67E-01
	33.60 *	13.20	4.09E+00		3.91E+01	1.92E+00
	39.58 *	7.52	6.10E+00		2.89E+00	2.62E+00
+ BA-133	81.00 *	34.06	1.57E+01	1.57E+01	3.54E+02	7.28E+00
	302.84 *	18.33	4.24E+01		4.27E+02	1.71E+01
	356.01 *	62.05	1.65E+01		3.10E+02	7.08E+00
CE-139	165.85	80.35	1.22E+01	1.22E+01	-7.24E-01	5.36E+00
CE-144	133.54	10.80	8.24E+01	8.24E+01	2.91E+01	3.69E+01
+ HG-203	279.19 *	77.30	1.95E+00	1.95E+00	7.05E+00	0.00E+00
PB-210	46.50	4.25	1.72E+01	1.72E+01	-1.49E+00	7.52E+00
TH-231	25.64	14.70	7.98E-01	7.98E-01	-3.20E-01	3.64E-01
	84.21	6.40	7.01E+01		4.91E+01	3.17E+01
PA-234M	9.89	89.00	1.00E-03	1.00E-03	-2.43E-04	4.49E-04
	21.72	64.90	1.36E-01		-2.56E-03	6.43E-02
	37.93	23.75	1.35E+00		-1.16E+00	5.78E-01
+ TH-234	63.29 *	3.80	9.96E+01	9.96E+01	9.04E+01	4.68E+01
+ NP-237	29.37 *	14.00	5.59E+00	5.59E+00	1.19E+02	2.72E+00
	86.50	12.60	2.65E+01		-1.45E+01	1.15E+01
U-237	97.08	16.30	2.72E+01	2.40E+01	-7.66E+00	1.19E+01
	101.07	26.30	2.40E+01		-2.83E-01	1.08E+01
	114.00	12.30	5.57E+01		-1.59E+02	2.48E+01
	208.01	22.00	5.74E+01		-4.01E+00	2.55E+01
+ AM-241	59.54 *	35.90	3.74E+00	3.74E+00	3.13E+00	1.62E+00
AM-243	74.67	66.00	4.90E+00	4.90E+00	2.04E+00	2.20E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-03  
MW-1

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-03  
 Sample Description : MW-1  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:56:37AM  
 Acquisition Started : 1/10/2022 10:20:00AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.03 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 31 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/14/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118875

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:35:03AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-03

MW-1

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	61.99	57 -	73	61.68	2.59E+02	44.58	1.61E+02	2.36
m	2	66.22	57 -	73	65.91	1.20E+02	47.29	1.84E+02	2.70
m	3	70.48	57 -	73	70.17	4.20E+01	39.80	1.84E+02	2.71
	4	81.28	75 -	86	80.97	7.36E+02	73.76	3.11E+02	2.11
	5	91.83	87 -	95	91.51	6.62E+01	38.97	1.92E+02	4.19
M	6	102.35	98 -	121	102.03	3.36E+01	35.72	2.33E+02	2.52
m	7	112.24	98 -	121	111.92	1.78E+02	44.90	2.04E+02	2.53
	8	276.72	272 -	281	276.38	5.69E+01	27.48	7.62E+01	2.12
M	9	299.92	298 -	309	299.58	9.95E+00	12.33	2.48E+01	1.92
m	10	303.50	298 -	309	303.16	1.35E+02	28.63	5.24E+01	2.31
	11	312.57	310 -	315	312.23	2.16E+01	17.52	4.28E+01	3.17
M	12	334.12	330 -	342	333.77	6.28E+01	22.25	4.15E+01	2.45
m	13	338.12	330 -	342	337.77	2.69E+01	24.17	5.85E+01	2.51
	14	356.42	350 -	362	356.07	4.93E+02	55.99	1.39E+02	2.39
M	15	384.47	380 -	394	384.12	1.06E+02	35.10	3.54E+01	2.52
m	16	387.51	380 -	394	387.16	2.09E+02	37.45	3.62E+01	2.17
m	17	391.95	380 -	394	391.60	5.05E+01	26.12	4.08E+01	2.23
M	18	414.48	409 -	421	414.13	2.81E+01	20.55	4.20E+01	3.10
m	19	417.95	409 -	421	417.60	2.38E+01	21.31	3.86E+01	3.11
	20	437.48	431 -	442	437.12	8.91E+01	23.41	2.39E+01	2.11
	21	468.26	463 -	474	467.90	2.23E+01	15.36	1.95E+01	2.89
	22	519.39	517 -	521	519.03	7.06E+00	6.18	1.88E+00	2.61
	23	525.99	523 -	528	525.63	8.00E+00	5.66	0.00E+00	3.48

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:35:03AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118839.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	61.99	2.59E+02	44.58	2.33E+01	2.32E+00	2.36E+02	4.46E+01
m	2	66.22	1.20E+02	47.29			1.20E+02	4.73E+01
m	3	70.48	4.20E+01	39.80			4.20E+01	3.98E+01
	4	81.28	7.36E+02	73.76			7.36E+02	7.38E+01
	5	91.83	6.62E+01	38.97	3.30E+01	1.50E+00	3.32E+01	3.90E+01
M	6	102.35	3.36E+01	35.72			3.36E+01	3.57E+01

0175

Analysis Report for 2112077-03

MW-1

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	7	112.24	1.78E+02	44.90			1.78E+02	4.49E+01
	8	276.72	5.69E+01	27.48			5.69E+01	2.75E+01
M	9	299.92	9.95E+00	12.33			9.95E+00	1.23E+01
m	10	303.50	1.35E+02	28.63			1.35E+02	2.86E+01
	11	312.57	2.16E+01	17.52			2.16E+01	1.75E+01
M	12	334.12	6.28E+01	22.25			6.28E+01	2.23E+01
m	13	338.12	2.69E+01	24.17	1.69E+00	1.30E+00	2.52E+01	2.42E+01
	14	356.42	4.93E+02	55.99			4.93E+02	5.60E+01
M	15	384.47	1.06E+02	35.10			1.06E+02	3.51E+01
m	16	387.51	2.09E+02	37.45			2.09E+02	3.74E+01
m	17	391.95	5.05E+01	26.12			5.05E+01	2.61E+01
M	18	414.48	2.81E+01	20.55			2.81E+01	2.05E+01
m	19	417.95	2.38E+01	21.31			2.38E+01	2.13E+01
	20	437.48	8.91E+01	23.41			8.91E+01	2.34E+01
	21	468.26	2.23E+01	15.36	0.00E+00	0.00E+00	2.23E+01	1.54E+01
	22	519.39	7.06E+00	6.18			7.06E+00	6.18E+00
	23	525.99	8.00E+00	5.66			8.00E+00	5.66E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	3.80E+01
BA-133	0.99	81.00	*	34.06	3.77E+02
		302.84	*	18.33	3.76E+02
		356.01	*	62.05	3.86E+02
HG-203	0.85	279.19	*	77.30	3.78E+01
TH-234	0.95	63.29	*	3.80	6.33E+02
AM-241	0.85	59.54	*	35.90	6.70E+01

Analysis Report for 2112077-03

MW-1

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
SN-113	0.952	3.80E+01	1.97E+01	
BA-133	0.995	3.80E+02	2.87E+01	
HG-203	0.856	<del>3.78E+01</del>	1.84E+01	
? TH-234	0.958	6.33E+02	1.21E+02	
? AM-241	0.857	6.70E+01	1.28E+01	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2112077-03

MW-1

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:35:03AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

<i>Peak No.</i>	<i>Energy (keV)</i>	<i>Peak Size (CPS)</i>	<i>Peak CPS (%) Uncertainty</i>	<i>Peak Type</i>	<i>Tolerance Nuclide</i>
m	2	66.22	1.33480E-01	19.68	
m	3	70.48	4.66307E-02	47.42	
	5	91.83	3.69021E-02	58.71	
M	6	102.35	3.73051E-02	53.20	Tol. U-237
m	7	112.24	1.97684E-01	12.62	Tol. U-237
M	9	299.92	1.10555E-02	61.95	
	11	312.57	2.40181E-02	40.53	
M	12	334.12	6.98139E-02	17.71	
m	13	338.12	2.80276E-02	47.97	Sum
M	15	384.47	1.17310E-01	16.62	Sum
m	16	387.51	2.31727E-01	8.98	
M	18	414.48	3.11985E-02	36.59	
m	19	417.95	2.64972E-02	44.69	Sum
	20	437.48	9.89549E-02	13.14	Sum
	21	468.26	2.47222E-02	34.52	
	22	519.39	7.84722E-03	43.79	
	23	525.99	8.88889E-03	35.36	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2112077-03

MW-1

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	5.44E-07	5.44E-07	0.00E+00	0.00E+00
	3.31	12.30	6.51E-06		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.09E-04	1.09E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.60E+01	1.60E+01	6.01E-01	7.52E+00
	136.48	10.60	1.50E+02		-4.36E+01	7.04E+01
NI-59	6.92	29.80	2.19E-04	2.19E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	8.08E-03	8.08E-03	0.00E+00	0.00E+00
	18.60	10.00	6.79E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	4.51E-02	4.51E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.82E+02	2.82E+02	-4.32E+02	1.34E+02
+ SN-113	255.12	1.93	8.12E+02	3.34E+01	1.28E+02	3.70E+02
	391.69	*	61.90	3.34E+01	3.80E+01	1.57E+01
SN-119M	23.87	16.10	1.08E-01	9.18E-02	0.00E+00	0.00E+00
	25.10	22.70	9.18E-02		0.00E+00	0.00E+00
I-129	29.78	57.00	1.15E+00	1.15E+00	-7.20E-01	5.42E-01
	33.60	13.20	2.02E+01		7.35E+01	9.87E+00
	39.58	7.52	4.64E+01		5.73E+01	2.26E+01
+ BA-133	81.00	*	34.06	4.34E+01	4.34E+01	3.77E+02
	302.84	*	18.33			3.76E+02
	356.01	*	62.05			3.86E+02
CE-139	165.85	80.35	2.32E+01	2.32E+01	-1.56E+01	1.09E+01
CE-144	133.54	10.80	1.46E+02	1.46E+02	1.66E+01	6.84E+01
+ HG-203	279.19	*	77.30	2.69E+01	2.69E+01	3.78E+01
PB-210	46.50	4.25	6.19E+01	6.19E+01	1.09E+00	2.93E+01
TH-231	25.64	14.70	1.53E-01	1.53E-01	0.00E+00	0.00E+00
	84.21	6.40	3.42E+02		1.26E+03	1.67E+02
PA-234M	9.89	89.00	4.64E-04	4.64E-04	0.00E+00	0.00E+00
	21.72	64.90	1.90E-02		0.00E+00	0.00E+00
	37.93	23.75	1.58E+01		5.75E+01	7.72E+00
+ TH-234	63.29	*	3.80	2.77E+02	2.77E+02	6.33E+02
NP-237	29.37	14.00	4.47E+00	4.47E+00	-2.80E+00	2.11E+00
	86.50	12.60	8.53E+01		-8.78E+02	4.06E+01
U-237	97.08	16.30	6.45E+01	4.64E+01	2.59E+00	3.03E+01
	101.07	26.30	4.64E+01		1.78E+01	2.19E+01
	114.00	12.30	1.90E+02		3.83E+02	9.16E+01
	208.01	22.00	8.79E+01		-5.38E+01	4.09E+01
+ AM-241	59.54	*	35.90	2.93E+01	2.93E+01	6.70E+01
AM-243	74.67	66.00	1.17E+01	1.17E+01	-2.62E+01	5.56E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-04  
MW-11

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : 2112077-04  
 Sample Description : MW-11  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:56:46AM  
 Acquisition Started : 1/10/2022 10:31:31AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE5  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 1016.7 seconds  
  
 Dead Time : 11.48 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 2 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118876

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 1/10/2022 10:48:30AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-04

MW-11

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.79	193 -	212	201.23	5.43E+01	37.05	1.33E+02	0.50
	2	24.70	230 -	248	240.59	2.64E+01	16.26	1.93E+01	0.43
	3	30.73	284 -	319	301.42	2.10E+03	105.19	1.87E+02	0.72
M	4	34.86	330 -	358	343.01	4.51E+02	48.01	4.43E+01	0.64
m	5	35.68	330 -	358	351.23	1.05E+02	40.33	9.38E+00	0.72
	6	52.97	518 -	532	525.48	5.13E+01	20.35	2.94E+01	0.72
	7	61.59	598 -	626	612.43	2.35E+02	45.46	9.67E+01	0.87
M	8	65.61	641 -	664	652.92	1.15E+02	35.67	8.74E+01	0.94
m	9	66.19	641 -	664	658.79	2.28E+01	24.38	6.08E+01	0.84
	10	80.82	790 -	817	806.21	7.90E+02	67.60	1.66E+02	0.59
M	11	108.97	1074 -	1130	1089.99	5.69E+01	24.82	3.43E+01	1.26
m	12	110.17	1074 -	1130	1102.00	3.09E+01	25.80	3.03E+01	0.86
m	13	111.54	1074 -	1130	1115.87	2.70E+02	37.14	4.57E+01	0.95
	14	116.00	1147 -	1171	1160.83	4.29E+01	20.77	3.21E+01	0.76
	15	127.48	1268 -	1285	1276.56	1.89E+01	10.21	4.14E+00	0.24
	16	275.97	2759 -	2784	2773.35	4.60E+01	13.56	0.00E+00	0.21
	17	302.64	3024 -	3058	3042.25	1.43E+02	25.24	7.28E+00	0.40
M	18	306.68	3069 -	3094	3083.00	1.18E+01	14.18	1.40E+01	1.07
m	19	307.28	3069 -	3094	3089.08	2.84E+01	10.97	9.07E+00	0.96
	20	333.28	3336 -	3362	3351.21	4.52E+01	17.19	1.37E+01	0.65
	21	355.76	3559 -	3596	3577.86	4.15E+02	41.64	7.63E+00	0.71
	22	383.56	3841 -	3871	3858.18	9.96E+01	21.22	6.83E+00	0.70
M	23	385.76	3874 -	3902	3880.33	2.74E+01	14.11	6.17E+00	0.83
m	24	386.52	3874 -	3902	3888.00	1.14E+02	26.18	2.20E+01	1.14
	25	390.65	3915 -	3940	3929.66	4.38E+01	15.81	1.04E+01	0.51

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:48:30AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118843.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.79	5.43E+01	37.05	8.71E+00	6.63E-01	4.56E+01	3.71E+01
	2	24.70	2.64E+01	16.26	1.87E+00	3.83E-01	2.45E+01	1.63E+01
	3	30.73	2.10E+03	105.19	6.35E+00	8.10E-01	2.09E+03	1.05E+02
M	4	34.86	4.51E+02	48.01	1.59E+00	6.48E-01	4.49E+02	4.80E+01

0181

Analysis Report for 2112077-04

MW-11

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	5	35.68	1.05E+02	40.33	1.59E+00	6.48E-01	1.03E+02	4.03E+01
	6	52.97	5.13E+01	20.35			5.13E+01	2.03E+01
	7	61.59	2.35E+02	45.46	3.32E+00	6.94E-01	2.31E+02	4.55E+01
M	8	65.61	1.15E+02	35.67			1.15E+02	3.57E+01
m	9	66.19	2.28E+01	24.38			2.28E+01	2.44E+01
	10	80.82	7.90E+02	67.60			7.90E+02	6.76E+01
M	11	108.97	5.69E+01	24.82	7.94E-01	4.65E-01	5.61E+01	2.48E+01
m	12	110.17	3.09E+01	25.80	7.94E-01	4.65E-01	3.02E+01	2.58E+01
m	13	111.54	2.70E+02	37.14	7.94E-01	4.65E-01	2.69E+02	3.71E+01
	14	116.00	4.29E+01	20.77			4.29E+01	2.08E+01
	15	127.48	1.89E+01	10.21			1.89E+01	1.02E+01
	16	275.97	4.60E+01	13.56			4.60E+01	1.36E+01
	17	302.64	1.43E+02	25.24			1.43E+02	2.52E+01
M	18	306.68	1.18E+01	14.18			1.18E+01	1.42E+01
m	19	307.28	2.84E+01	10.97			2.84E+01	1.10E+01
	20	333.28	4.52E+01	17.19			4.52E+01	1.72E+01
	21	355.76	4.15E+02	41.64			4.15E+02	4.16E+01
	22	383.56	9.96E+01	21.22			9.96E+01	2.12E+01
M	23	385.76	2.74E+01	14.11			2.74E+01	1.41E+01
m	24	386.52	1.14E+02	26.18			1.14E+02	2.62E+01
	25	390.65	4.38E+01	15.81			4.38E+01	1.58E+01

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty	
SN-113	0.92	255.12	1.93			
		391.69	*	61.90	3.61E+01	1.31E+01
I-129	0.87	29.78	*	57.00	2.90E+01	1.46E+00
		33.60	*	13.20	4.30E+01	4.60E+00
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.33E+02	3.12E+01
		302.84	*	18.33	4.35E+02	7.97E+01
		356.01	*	62.05	3.57E+02	3.88E+01



Analysis Report for 2112077-04

MW-11

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
TH-231	0.88	25.64 * 84.21	14.70 6.40	5.46E-01	3.63E-01
TH-234	0.92	63.29 *	3.80	4.56E+02	9.00E+01
AM-241	0.89	59.54 *	35.90	4.82E+01	9.53E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.927	3.61E+01	1.31E+01	
I-129	0.877	3.03E+01	1.39E+00	
BA-133	0.999	3.50E+02	2.33E+01	
TH-231	0.882	5.46E-01	3.63E-01	
? TH-234	0.929	4.56E+02	9.00E+01	
X NP-237	0.731			
? AM-241	0.898	4.82E+01	9.53E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-04

MW-11

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:48:30AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.79	5.06961E-02	40.61	Tol.	MO-93
m 5	35.68	1.14612E-01	19.55		
6	52.97	5.69809E-02	19.84	Sum	
M 8	65.61	1.27918E-01	15.49	Sum	
m 9	66.19	2.53721E-02	53.39	Sum	
M 11	108.97	6.23353E-02	22.12		
m 12	110.17	3.35031E-02	42.78	Sum	
m 13	111.54	2.99144E-01	6.90	Sum	
14	116.00	4.77072E-02	24.18	Sum	
15	127.48	2.10317E-02	26.97		
16	275.97	5.11111E-02	14.74		
M 18	306.68	1.31624E-02	59.86		
m 19	307.28	3.15893E-02	19.29		
20	333.28	5.01752E-02	19.03	Sum	
22	383.56	1.10652E-01	10.66	Sum	
M 23	385.76	3.04141E-02	25.77	Sum	
m 24	386.52	1.26443E-01	11.50	Sum	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0184

Analysis Report for 2112077-04

MW-11

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	4.83E-07	4.83E-07	-3.44E-06	2.24E-07
	3.31	12.30	6.33E-06		-6.53E-06	2.93E-06
FE-55	5.89	24.50	1.64E-04	1.64E-04	9.02E-07	7.45E-05
CO-57	122.06	85.51	9.68E+00	9.68E+00	-3.05E+00	4.36E+00
	136.48	10.60	9.65E+01		1.30E+01	4.38E+01
NI-59	6.92	29.80	3.92E-04	3.92E-04	6.18E-05	1.78E-04
MO-93	16.59	52.90	2.53E-02	2.53E-02	-8.21E-03	1.13E-02
	18.60	10.00	2.73E-01		-5.77E-02	1.24E-01
NB-93M	16.57	9.43	1.41E-01	1.41E-01	-4.58E-02	6.29E-02
CD-109	88.03	3.72	1.11E+02	1.11E+02	-5.85E+00	4.92E+01
+ SN-113	255.12	1.93	5.94E+02	1.40E+01	-2.45E+01	2.58E+02
	391.69	*	61.90	1.40E+01	3.61E+01	5.87E+00
SN-119M	23.87	16.10	5.46E-01	5.08E-01	1.09E-01	2.49E-01
	25.10	22.70	5.08E-01		9.93E-03	2.33E-01
+ I-129	29.78	*	57.00	1.22E+00	2.90E+01	5.93E-01
	33.60	*	13.20	4.29E+00	4.30E+01	2.02E+00
	39.58		7.52	6.30E+00	-1.27E-01	2.80E+00
+ BA-133	81.00	*	34.06	2.72E+01	1.44E+01	3.33E+02
	302.84	*	18.33	4.80E+01		4.35E+02
	356.01	*	62.05	1.44E+01		3.57E+02
CE-139	165.85	80.35	1.25E+01	1.25E+01	-4.44E-01	5.50E+00
CE-144	133.54	10.80	8.09E+01	8.09E+01	-2.42E+01	3.62E+01
HG-203	279.19	77.30	1.20E+01	1.20E+01	-5.32E+00	5.04E+00
PB-210	46.50	4.25	2.00E+01	2.00E+01	-8.87E-01	8.94E+00
+ TH-231	25.64	*	14.70	5.34E-01	5.46E-01	2.37E-01
	84.21		6.40	7.31E+01	3.53E+01	3.32E+01
PA-234M	9.89	89.00	1.00E-03	1.00E-03	-7.72E-04	4.49E-04
	21.72	64.90	1.33E-01		-9.07E-03	6.25E-02
	37.93	23.75	1.61E+00		-8.28E-01	7.08E-01
+ TH-234	63.29	*	3.80	1.15E+02	4.56E+02	5.47E+01
NP-237	29.37	*	14.00	4.98E+00	1.18E+02	2.41E+00
	86.50	12.60	3.09E+01		-4.60E-01	1.37E+01
U-237	97.08	16.30	3.76E+01	2.54E+01	2.25E+01	1.71E+01
	101.07	26.30	2.54E+01		1.02E+01	1.16E+01
	114.00	12.30	5.78E+01		-4.27E+01	2.59E+01
	208.01	22.00	6.41E+01		1.80E+01	2.89E+01
+ AM-241	59.54	*	35.90	1.22E+01	4.82E+01	5.79E+00
AM-243	74.67	66.00	4.74E+00	4.74E+00	-8.15E-01	2.12E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-05  
MW-1

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-05  
 Sample Description : MW-1  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 1/10/2022 9:56:54AM  
 Acquisition Started : 1/10/2022 10:35:39AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.4 seconds

Dead Time : 0.04 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/14/2021  
 Efficiency Calibration Description :

Sample Number : 118877

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:50:42AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-05

MW-1

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	52.63	48 -	56	52.32	4.62E+01	44.63	2.76E+02	3.28
M	2	62.10	57 -	73	61.79	2.25E+02	47.58	2.09E+02	2.60
m	3	66.43	57 -	73	66.12	1.57E+02	48.46	1.92E+02	2.70
	4	81.51	76 -	85	81.20	7.37E+02	74.20	3.65E+02	2.32
M	5	112.15	107 -	123	111.83	1.74E+02	42.35	1.99E+02	2.18
m	6	116.19	107 -	123	115.87	4.63E+01	40.91	1.74E+02	2.31
	7	185.66	181 -	189	185.34	4.40E+01	32.86	1.38E+02	3.55
	8	239.55	233 -	245	239.21	4.87E+01	38.76	1.47E+02	9.29
	9	277.49	273 -	282	277.15	5.59E+01	28.58	8.42E+01	2.45
M	10	303.57	299 -	314	303.23	1.34E+02	30.02	8.27E+01	2.49
m	11	307.57	299 -	314	307.23	2.76E+01	29.07	5.31E+01	2.49
M	12	333.97	328 -	342	333.62	6.49E+01	22.24	3.50E+01	2.35
	13	356.46	350 -	361	356.12	4.93E+02	51.61	9.40E+01	2.33
	14	366.12	362 -	371	365.77	3.61E+01	21.38	4.39E+01	4.00
M	15	384.58	379 -	404	384.23	1.14E+02	33.70	3.82E+01	2.54
m	16	387.54	379 -	404	387.19	1.70E+02	35.53	3.10E+01	2.21
m	17	391.58	379 -	404	391.23	4.84E+01	30.85	3.33E+01	2.55
	18	416.55	410 -	421	416.20	3.00E+01	33.53	1.24E+02	1.81
	19	437.59	432 -	442	437.24	7.51E+01	22.52	2.78E+01	2.57
	20	468.70	465 -	472	468.34	2.58E+01	12.17	6.48E+00	2.23
	21	498.04	494 -	500	497.68	6.38E+00	6.65	3.25E+00	2.66
	22	538.26	534 -	540	537.90	8.75E+00	9.63	1.05E+01	2.60
	23	670.50	666 -	673	670.13	8.00E+00	5.66	0.00E+00	1.16
	24	693.87	689 -	695	693.50	6.00E+00	4.90	0.00E+00	1.16

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:50:42AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118839.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	52.63	4.62E+01	44.63			4.62E+01	4.46E+01
M	2	62.10	2.25E+02	47.58	2.33E+01	2.32E+00	2.02E+02	4.76E+01
m	3	66.43	1.57E+02	48.46			1.57E+02	4.85E+01
	4	81.51	7.37E+02	74.20			7.37E+02	7.42E+01
M	5	112.15	1.74E+02	42.35			1.74E+02	4.24E+01

0187

Analysis Report for 2112077-05

MW-1

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	6	116.19	4.63E+01	40.91			4.63E+01	4.09E+01
	7	185.66	4.40E+01	32.86	1.72E+01	2.03E+00	2.68E+01	3.29E+01
	8	239.55	4.87E+01	38.76	4.91E+00	1.64E+00	4.38E+01	3.88E+01
	9	277.49	5.59E+01	28.58			5.59E+01	2.86E+01
M	10	303.57	1.34E+02	30.02			1.34E+02	3.00E+01
m	11	307.57	2.76E+01	29.07			2.76E+01	2.91E+01
M	12	333.97	6.49E+01	22.24			6.49E+01	2.22E+01
	13	356.46	4.93E+02	51.61			4.93E+02	5.16E+01
	14	366.12	3.61E+01	21.38			3.61E+01	2.14E+01
M	15	384.58	1.14E+02	33.70			1.14E+02	3.37E+01
m	16	387.54	1.70E+02	35.53			1.70E+02	3.55E+01
m	17	391.58	4.84E+01	30.85			4.84E+01	3.09E+01
	18	416.55	3.00E+01	33.53			3.00E+01	3.35E+01
	19	437.59	7.51E+01	22.52			7.51E+01	2.25E+01
	20	468.70	2.58E+01	12.17	0.00E+00	0.00E+00	2.58E+01	1.22E+01
	21	498.04	6.38E+00	6.65			6.38E+00	6.65E+00
	22	538.26	8.75E+00	9.63			8.75E+00	9.63E+00
	23	670.50	8.00E+00	5.66			8.00E+00	5.66E+00
	24	693.87	6.00E+00	4.90			6.00E+00	4.90E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	3.65E+01
BA-133	0.99	81.00	*	34.06	3.79E+02
		302.84	*	18.33	3.72E+02
		356.01	*	62.05	3.87E+02
HG-203	0.92	279.19	*	77.30	3.72E+01
TH-234	0.96	63.29	*	3.80	5.42E+02

Analysis Report for 2112077-05

MW-1

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i><b>Nuclide Name</b></i>	<i><b>Nuclide Id Confidence</b></i>	<i><b>Wt mean Activity (pCi/units)</b></i>	<i><b>Wt mean Activity Uncertainty</b></i>	<i><b>Comments</b></i>
SN-113	0.953	3.65E+01	2.33E+01	
BA-133	0.993	3.82E+02	2.82E+01	
HG-203	0.929	3.72E+01	1.91E+01	
TH-234	0.965	5.42E+02	1.29E+02	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2112077-05

MW-1

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:50:42AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	52.63	5.13647E-02	48.27	
m	3	66.43	1.74396E-01	15.44	
M	5	112.15	1.93316E-01	12.17	Tol. U-237
m	6	116.19	5.14912E-02	44.14	Tol. U-237
	7	185.66	2.97636E-02	61.45	
	8	239.55	4.86701E-02	44.28	
m	11	307.57	3.06216E-02	52.74	
M	12	333.97	7.21141E-02	17.13	
	14	366.12	4.00670E-02	29.64	Sum
M	15	384.58	1.26634E-01	14.79	Sum
m	16	387.54	1.88424E-01	10.48	Sum
	18	416.55	3.32790E-02	55.97	Sum
	19	437.59	8.34332E-02	15.00	Sum
	20	468.70	2.86207E-02	23.61	
	21	498.04	7.08333E-03	52.17	
	22	538.26	9.72222E-03	55.03	
	23	670.50	8.88889E-03	35.36	Sum
	24	693.87	6.66667E-03	40.82	Sum

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB



Analysis Report for 2112077-05

MW-1

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	5.44E-07	5.44E-07	0.00E+00	0.00E+00
	3.31	12.30	6.51E-06		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.09E-04	1.09E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.66E+01	1.66E+01	3.90E+00	7.81E+00
	136.48	10.60	1.54E+02		-7.68E+00	7.26E+01
NI-59	6.92	29.80	2.19E-04	2.19E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	8.08E-03	8.08E-03	0.00E+00	0.00E+00
	18.60	10.00	6.79E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	4.51E-02	4.51E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.95E+02	2.95E+02	-4.39E+01	1.40E+02
+ SN-113	255.12	1.93	9.18E+02	5.14E+01	5.51E+02	4.23E+02
	391.69	*	61.90	5.14E+01	3.65E+01	2.47E+01
SN-119M	23.87	16.10	1.08E-01	9.18E-02	0.00E+00	0.00E+00
	25.10	22.70	9.18E-02		0.00E+00	0.00E+00
I-129	29.78	57.00	1.09E+00	1.09E+00	-1.56E+00	5.12E-01
	33.60	13.20	2.24E+01		6.08E+01	1.10E+01
	39.58	7.52	6.05E+01		1.64E+02	2.97E+01
+ BA-133	81.00	*	34.06	4.42E+01	3.79E+02	2.14E+01
	302.84	*	18.33	1.81E+02	3.72E+02	8.68E+01
	356.01	*	62.05	4.98E+01	3.87E+02	2.38E+01
CE-139	165.85	80.35	2.40E+01	2.40E+01	-3.55E+00	1.13E+01
CE-144	133.54	10.80	1.46E+02	1.46E+02	-2.64E+01	6.84E+01
+ HG-203	279.19	*	77.30	2.84E+01	3.72E+01	1.33E+01
PB-210	46.50	4.25	6.29E+01	6.29E+01	-7.72E+00	2.98E+01
TH-231	25.64	14.70	1.53E-01	1.53E-01	0.00E+00	0.00E+00
	84.21	6.40	3.63E+02		-8.92E+00	1.77E+02
PA-234M	9.89	89.00	4.64E-04	4.64E-04	0.00E+00	0.00E+00
	21.72	64.90	1.90E-02		0.00E+00	0.00E+00
	37.93	23.75	1.99E+01		1.06E+02	9.79E+00
+ TH-234	63.29	*	3.80	2.91E+02	5.42E+02	1.42E+02
NP-237	29.37	14.00	4.24E+00	4.24E+00	-6.06E+00	1.99E+00
	86.50	12.60	1.03E+02		1.57E+01	4.93E+01
U-237	97.08	16.30	6.49E+01	4.67E+01	-6.65E+01	3.05E+01
	101.07	26.30	4.67E+01		5.72E+00	2.20E+01
	114.00	12.30	1.99E+02		4.15E+02	9.60E+01
	208.01	22.00	9.24E+01		0.00E+00	4.32E+01
AM-241	59.54	35.90	2.03E+01	2.03E+01	1.63E+01	9.78E+00
AM-243	74.67	66.00	1.22E+01	1.22E+01	1.13E+00	5.78E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-06  
MW-8

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-06  
 Sample Description : MW-8  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:57:04AM  
 Acquisition Started : 1/10/2022 10:42:50AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 27 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118878

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:57:54AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-06

MW-8

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.39	36 -	40	36.99	4.08E+02	54.83	2.06E+02	1.26
	2	53.20	52 -	58	54.77	5.65E+01	30.94	1.33E+02	1.25
M	3	61.81	59 -	70	63.36	1.86E+02	37.23	1.14E+02	1.96
m	4	66.24	59 -	70	67.77	9.77E+01	32.47	1.14E+02	1.98
	5	81.12	78 -	87	82.63	6.90E+02	65.04	2.09E+02	1.53
M	6	112.01	109 -	121	113.45	1.74E+02	34.59	1.07E+02	1.76
m	7	116.38	109 -	121	117.81	1.85E+01	23.93	1.09E+02	1.77
	8	266.55	264 -	270	267.69	1.83E+01	13.01	1.73E+01	3.31
	9	276.65	274 -	281	277.77	4.60E+01	20.88	3.80E+01	2.08
	10	285.68	282 -	293	286.78	3.32E+01	18.11	2.56E+01	6.87
m	11	302.84	294 -	306	303.91	1.41E+02	25.01	1.50E+01	1.68
	12	307.82	308 -	311	308.87	2.53E+01	15.49	3.33E+01	1.31
M	13	333.85	330 -	344	334.85	7.27E+01	18.85	1.32E+01	1.63
m	14	338.08	330 -	344	339.08	1.86E+01	11.97	1.07E+01	1.64
	15	356.09	352 -	361	357.06	4.82E+02	45.11	1.50E+01	1.43
	16	364.77	364 -	368	365.72	1.00E+01	10.94	1.79E+01	1.95
M	17	384.13	383 -	390	385.04	8.24E+01	18.06	1.98E+01	1.77
m	18	386.98	383 -	390	387.88	1.61E+02	29.57	4.85E+01	1.52
	19	391.40	391 -	395	392.29	4.74E+01	18.10	2.53E+01	1.29
M	20	414.66	413 -	426	415.51	2.22E+01	10.39	4.00E+00	2.07
m	21	418.38	413 -	426	419.22	2.36E+01	14.07	6.00E+00	2.08
m	22	422.00	413 -	426	422.84	1.05E+01	11.05	6.00E+00	2.08
	23	437.00	433 -	441	437.81	1.01E+02	22.83	1.84E+01	1.53
	24	467.36	464 -	471	468.11	1.30E+01	10.00	8.00E+00	2.49
	25	499.34	497 -	503	500.03	6.50E+00	6.65	3.00E+00	2.06
	26	608.39	606 -	612	608.87	9.00E+00	7.50	4.00E+00	1.59
	27	882.45	879 -	885	882.43	7.00E+00	5.29	0.00E+00	2.75
	28	1141.07	1137 -	1143	1140.60	5.00E+00	4.47	0.00E+00	1.24

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:57:54AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118840.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	35.39	4.08E+02		54.83		4.08E+02	5.48E+01

Analysis Report for 2112077-06

MW-8

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	2	53.20	5.65E+01	30.94	2.30E-01	1.75E+00	5.63E+01	3.10E+01
M	3	61.81	1.86E+02	37.23	1.58E+00	1.58E+00	1.85E+02	3.73E+01
m	4	66.24	9.77E+01	32.47	1.35E+00	1.47E+00	9.63E+01	3.25E+01
	5	81.12	6.90E+02	65.04			6.90E+02	6.50E+01
M	6	112.01	1.74E+02	34.59			1.74E+02	3.46E+01
m	7	116.38	1.85E+01	23.93			1.85E+01	2.39E+01
	8	266.55	1.83E+01	13.01			1.83E+01	1.30E+01
	9	276.65	4.60E+01	20.88			4.60E+01	2.09E+01
	10	285.68	3.32E+01	18.11			3.32E+01	1.81E+01
m	11	302.84	1.41E+02	25.01			1.41E+02	2.50E+01
	12	307.82	2.53E+01	15.49			2.53E+01	1.55E+01
M	13	333.85	7.27E+01	18.85			7.27E+01	1.88E+01
m	14	338.08	1.86E+01	11.97			1.86E+01	1.20E+01
	15	356.09	4.82E+02	45.11			4.82E+02	4.51E+01
	16	364.77	1.00E+01	10.94			1.00E+01	1.09E+01
M	17	384.13	8.24E+01	18.06			8.24E+01	1.81E+01
m	18	386.98	1.61E+02	29.57			1.61E+02	2.96E+01
	19	391.40	4.74E+01	18.10			4.74E+01	1.81E+01
M	20	414.66	2.22E+01	10.39			2.22E+01	1.04E+01
m	21	418.38	2.36E+01	14.07			2.36E+01	1.41E+01
m	22	422.00	1.05E+01	11.05			1.05E+01	1.10E+01
	23	437.00	1.01E+02	22.83			1.01E+02	2.28E+01
	24	467.36	1.30E+01	10.00			1.30E+01	1.00E+01
	25	499.34	6.50E+00	6.65			6.50E+00	6.65E+00
	26	608.39	9.00E+00	7.50	3.38E+00	1.03E+00	5.62E+00	7.57E+00
	27	882.45	7.00E+00	5.29			7.00E+00	5.29E+00
	28	1141.07	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69 *	61.90	3.45E+01	1.33E+01

Analysis Report for 2112077-06

MW-8

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	1.00	81.00 *		34.06	3.56E+02	3.66E+01
		302.84 *		18.33	3.64E+02	6.75E+01
		356.01 *		62.05	3.60E+02	3.68E+01
TH-234	0.94	63.29 *		3.80	5.36E+02	1.09E+02
AM-241	0.87	59.54 *		35.90	5.68E+01	1.15E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.950	3.45E+01	1.33E+01	
BA-133	1.000	3.59E+02	2.42E+01	
? TH-234	0.946	5.36E+02	1.09E+02	
? AM-241	0.876	5.68E+01	1.15E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-06

MW-8

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:57:54AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	35.39	4.53249E-01	6.72	Tol.	I-129
2	53.20	6.25220E-02	27.54		
m 4	66.24	1.07026E-01	16.87		
M 6	112.01	1.93550E-01	9.93	Tol.	U-237
m 7	116.38	2.05721E-02	64.63	Tol.	U-237
8	266.55	2.03704E-02	35.48		
9	276.65	5.10855E-02	22.71		
10	285.68	3.68841E-02	27.28		
12	307.82	2.81658E-02	30.56		
M 13	333.85	8.07807E-02	12.96		
m 14	338.08	2.06764E-02	32.16		
16	364.77	1.11404E-02	54.57	Sum	
M 17	384.13	9.15951E-02	10.96	Sum	
m 18	386.98	1.79439E-01	9.15		
M 20	414.66	2.46312E-02	23.44		
m 21	418.38	2.61750E-02	29.87	Sum	
m 22	422.00	1.16738E-02	52.57		
23	437.00	1.11980E-01	11.32	Sum	
24	467.36	1.44444E-02	38.46		
25	499.34	7.22222E-03	51.17		
26	608.39	6.24249E-03	67.37		
27	882.45	7.77778E-03	37.80		
28	1141.07	5.55556E-03	44.72		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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Analysis Report for 2112077-06

MW-8

## NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	5.55E-06	5.55E-06	0.00E+00	0.00E+00
	3.31	12.30	5.93E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	5.43E-04	5.43E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.24E+01	1.24E+01	5.98E+00	5.74E+00
	136.48	10.60	9.50E+01		-4.92E+01	4.32E+01
NI-59	6.92	29.80	9.37E-04	9.37E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	1.70E-02	1.70E-02	0.00E+00	0.00E+00
	18.60	10.00	1.33E-01		0.00E+00	0.00E+00
NB-93M	16.57	9.43	9.52E-02	9.52E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	1.95E+02	1.95E+02	3.41E+01	9.02E+01
+ SN-113	255.12	1.93	5.83E+02	1.61E+01	-2.20E+01	2.59E+02
	391.69	*	61.90	1.61E+01	3.45E+01	7.04E+00
SN-119M	23.87	16.10	1.81E-01	1.81E-01	0.00E+00	0.00E+00
	25.10	22.70	1.44E+00		-1.97E-01	6.43E-01
I-129	29.78	57.00	7.26E+00	7.26E+00	6.05E+01	3.58E+00
	33.60	13.20	3.99E+01		1.56E+02	1.97E+01
	39.58	7.52	1.75E+01		-3.39E+00	8.00E+00
+ BA-133	81.00	*	34.06	1.46E+01	3.56E+02	1.62E+01
	302.84	*	18.33	7.86E+01	3.64E+02	3.58E+01
	356.01	*	62.05	1.46E+01	3.60E+02	6.30E+00
CE-139	165.85	80.35	1.64E+01	1.64E+01	2.42E+00	7.57E+00
CE-144	133.54	10.80	9.48E+01	9.48E+01	-2.13E+01	4.33E+01
HG-203	279.19	77.30	1.78E+01	1.78E+01	1.53E+00	8.06E+00
PB-210	46.50	4.25	5.66E+01	5.66E+01	2.75E+01	2.64E+01
TH-231	25.64	14.70	3.11E+00	3.11E+00	-2.77E+00	1.43E+00
	84.21	6.40	1.25E+02		-1.71E+03	5.84E+01
PA-234M	9.89	89.00	1.45E-03	1.45E-03	0.00E+00	0.00E+00
	21.72	64.90	3.37E-02		0.00E+00	0.00E+00
	37.93	23.75	7.71E+00		-5.92E-01	3.64E+00
+ TH-234	63.29	*	3.80	1.99E+02	5.36E+02	9.56E+01
	NP-237	29.37	14.00	2.84E+01	2.84E+01	2.37E+02
U-237	86.50	12.60	5.75E+01		2.46E+01	2.67E+01
	97.08	16.30	5.20E+01	3.31E+01	-4.88E+00	2.41E+01
	101.07	26.30	3.31E+01		-1.08E+01	1.53E+01
	114.00	12.30	1.61E+02		1.83E+02	7.72E+01
+ AM-241	208.01	22.00	6.24E+01		-5.36E+01	2.85E+01
	59.54	*	35.90	2.11E+01	5.68E+01	1.01E+01
AM-243	74.67	66.00	8.95E+00	8.95E+00	2.87E+00	4.16E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-06  
MW-8



16P  
1/10/22

Analysis Report for 2112077-07  
MW-7

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-07  
 Sample Description : MW-7  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 1/10/2022 9:57:12AM  
 Acquisition Started : 1/10/2022 10:43:14AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 913.2 seconds

Dead Time : 1.44 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 8 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :

Sample Number : 118879

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:58:29AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-07

MW-7

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	20.62	18 -	40	21.27	8.03E+01	41.21	2.85E+02	3.62
m	2	31.29	18 -	40	31.93	2.53E+03	124.82	5.80E+02	5.38
M	3	61.51	53 -	70	62.13	2.17E+02	60.72	4.11E+02	3.06
m	4	65.84	53 -	70	66.45	1.04E+02	59.92	3.70E+02	3.09
	5	81.12	73 -	90	81.73	8.02E+02	99.03	5.87E+02	3.22
	6	112.58	106 -	122	113.17	3.39E+02	73.26	3.79E+02	3.54
	7	276.27	270 -	285	276.74	7.39E+01	37.68	1.14E+02	4.51
	8	302.81	296 -	310	303.27	1.17E+02	42.67	1.42E+02	2.78
	9	334.71	328 -	342	335.15	8.90E+01	29.22	5.20E+01	3.98
	10	356.29	347 -	362	356.71	3.61E+02	52.23	1.31E+02	3.74
	11	386.91	380 -	398	387.31	3.03E+02	47.73	8.14E+01	7.23
	12	415.99	409 -	422	416.37	3.00E+01	32.60	1.04E+02	2.11
	13	436.91	431 -	446	437.28	9.12E+01	30.46	5.76E+01	4.13
	14	469.93	462 -	477	470.28	2.90E+01	10.77	0.00E+00	12.80
	15	701.46	698 -	706	701.67	6.39E+00	7.50	5.22E+00	0.95

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.00sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:58:29AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118841.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	1	20.62	8.03E+01	41.21			8.03E+01	4.12E+01
m	2	31.29	2.53E+03	124.82	8.55E+01	2.11E-01	2.44E+03	1.25E+02
M	3	61.51	2.17E+02	60.72	5.73E+01	6.61E-01	1.60E+02	6.07E+01
m	4	65.84	1.04E+02	59.92			1.04E+02	5.99E+01
	5	81.12	8.02E+02	99.03			8.02E+02	9.90E+01
	6	112.58	3.39E+02	73.26			3.39E+02	7.33E+01
	7	276.27	7.39E+01	37.68			7.39E+01	3.77E+01
	8	302.81	1.17E+02	42.67			1.17E+02	4.27E+01
	9	334.71	8.90E+01	29.22			8.90E+01	2.92E+01
	10	356.29	3.61E+02	52.23			3.61E+02	5.22E+01
	11	386.91	3.03E+02	47.73			3.03E+02	4.77E+01
	12	415.99	3.00E+01	32.60			3.00E+01	3.26E+01
	13	436.91	9.12E+01	30.46			9.12E+01	3.05E+01
	14	469.93	2.90E+01	10.77			2.90E+01	1.08E+01

0200

Analysis Report for 2112077-07

MW-7

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
15	701.46	6.39E+00	7.50			6.39E+00	7.50E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.60	29.78	*	57.00	8.10E+01	4.16E+00
		33.60		13.20		
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.53E+02	4.55E+01
		302.84	*	18.33	3.53E+02	1.30E+02
		356.01	*	62.05	3.33E+02	5.01E+01
TH-234	0.92	63.29	*	3.80	3.80E+02	1.45E+02
NP-237	0.60	29.37	*	14.00	3.30E+02	1.69E+01
		86.50		12.60		
AM-241	0.90	59.54	*	35.90	4.02E+01	1.53E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

Analysis Report for 2112077-07  
MW-7

<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
? I-129	0.600	8.10E+01	4.16E+00	
BA-133	0.999	<del>3.44E+02</del>	<del>3.26E+01</del>	
? TH-234	0.922	3.80E+02	1.45E+02	
? NP-237	0.603	3.30E+02	1.69E+01	
? AM-241	0.906	4.02E+01	1.53E+01	

- ? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-07

MW-7

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:58:29AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M 1	20.62	8.92325E-02	25.66	Tol.	PA-234M
m 4	65.84	1.15171E-01	28.91		
6	112.58	3.77132E-01	10.79	Sum	
7	276.27	8.20950E-02	25.50		
9	334.71	9.88647E-02	16.42	Sum	
11	386.91	3.37022E-01	7.87	Sum	
12	415.99	3.33469E-02	54.32	Sum	
13	436.91	1.01333E-01	16.70	Sum	
14	469.93	3.22222E-02	18.57		
15	701.46	7.09877E-03	58.70		

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.41E-04	1.41E-04	1.54E-04	6.70E-05
	3.31	12.30	1.45E-03		1.59E-03	6.89E-04
FE-55	5.89	24.50	1.53E-02	1.53E-02	3.03E-02	7.36E-03
CO-57	122.06	85.51	2.29E+01	2.29E+01	-3.74E+00	1.10E+01
	136.48	10.60	1.83E+02		9.43E+01	8.75E+01

0203

Analysis Report for 2112077-07  
MW-7

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
NI-59	6.92	29.80	2.70E-02	2.70E-02	6.04E-02	1.30E-02
MO-93	16.59	52.90	5.68E-01	5.68E-01	7.52E-01	2.77E-01
	18.60	10.00	4.09E+00		6.37E-01	1.99E+00
NB-93M	16.57	9.43	3.17E+00	3.17E+00	4.20E+00	1.55E+00
CD-109	88.03	3.72	5.75E+02	5.75E+02	2.10E+02	2.81E+02
SN-113	255.12	1.93	1.11E+03	6.95E+01	-3.23E+02	5.21E+02
	391.69	61.90	6.95E+01		1.37E+02	3.35E+01
SN-119M	23.87	16.10	1.14E+01	1.00E+01	5.17E+01	5.62E+00
	25.10	22.70	1.00E+01		6.34E+01	4.95E+00
+ I-129	29.78	* 57.00	5.86E+00	5.86E+00	8.10E+01	2.88E+00
	33.60	13.20	4.22E+01		4.17E+02	2.09E+01
	39.58	7.52	7.22E+01		-4.54E+01	3.55E+01
+ BA-133	81.00	* 34.06	6.00E+01	5.70E+01	3.53E+02	2.94E+01
	302.84	* 18.33	1.91E+02		3.53E+02	9.13E+01
	356.01	* 62.05	5.70E+01		3.33E+02	2.73E+01
CE-139	165.85	80.35	2.88E+01	2.88E+01	9.72E-01	1.38E+01
CE-144	133.54	10.80	1.67E+02	1.67E+02	-4.60E+01	7.98E+01
HG-203	279.19	77.30	3.68E+01	3.68E+01	2.98E+01	1.74E+01
PB-210	46.50	4.25	9.81E+01	9.81E+01	-2.07E+02	4.75E+01
TH-231	25.64	14.70	1.65E+01	1.65E+01	1.04E+02	8.13E+00
	84.21	6.40	3.78E+02		1.88E+00	1.86E+02
PA-234M	9.89	89.00	4.23E-02	4.23E-02	7.22E-02	2.05E-02
	21.72	64.90	1.17E+00		-2.08E-01	5.69E-01
	37.93	23.75	2.48E+01		-9.90E+00	1.22E+01
+ TH-234	63.29	* 3.80	3.66E+02	3.66E+02	3.80E+02	1.80E+02
+ NP-237	29.37	* 14.00	2.38E+01	2.38E+01	3.30E+02	1.17E+01
	86.50	12.60	1.97E+02		2.56E+01	9.67E+01
U-237	97.08	16.30	9.92E+01	6.38E+01	8.61E+01	4.80E+01
	101.07	26.30	6.38E+01		-3.76E+00	3.08E+01
	114.00	12.30	2.18E+02		6.29E+02	1.06E+02
	208.01	22.00	1.17E+02		1.84E+01	5.59E+01
+ AM-241	59.54	* 35.90	3.87E+01	3.87E+01	4.02E+01	1.90E+01
AM-243	74.67	66.00	2.80E+01	2.80E+01	-4.37E-02	1.37E+01

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

KP  
1/10/22

Analysis Report for 2112077-08  
MW-9

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-08  
 Sample Description : MW-9  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:57:20AM  
 Acquisition Started : 1/10/2022 10:43:57AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 920.4 seconds  
  
 Dead Time : 2.22 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 8 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/22/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118880

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 10:59:20AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-08

MW-9

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	20.91	17 -	41	20.88	1.12E+02	41.86	2.46E+02	2.59
m	2	30.75	17 -	41	30.72	1.95E+03	97.65	2.20E+02	2.54
m	3	35.15	17 -	41	35.11	4.00E+02	64.82	1.72E+02	2.36
	4	53.11	49 -	56	53.06	5.24E+01	32.37	1.39E+02	2.23
M	5	61.69	57 -	71	61.63	2.14E+02	46.24	1.70E+02	2.86
m	6	66.24	57 -	71	66.18	1.08E+02	51.08	2.24E+02	3.30
m	7	81.01	75 -	87	80.94	7.68E+02	61.58	1.11E+02	2.29
M	8	111.55	108 -	120	111.46	1.78E+02	34.18	1.01E+02	2.66
m	9	116.26	108 -	120	116.17	4.65E+01	43.54	1.49E+02	3.36
	10	248.29	244 -	252	248.12	2.11E+01	19.46	4.59E+01	4.58
	11	275.52	271 -	280	275.33	3.45E+01	27.75	9.09E+01	1.85
	12	303.30	297 -	309	303.09	1.24E+02	30.63	5.26E+01	2.35
	13	333.99	329 -	339	333.76	4.93E+01	29.33	8.95E+01	1.88
	14	355.94	349 -	362	355.70	3.20E+02	45.12	8.40E+01	2.23
	15	386.56	380 -	394	386.30	2.27E+02	32.32	1.25E+01	4.32
M	16	414.30	410 -	425	414.02	1.56E+01	11.49	6.29E+00	3.91
m	17	418.80	410 -	425	418.53	3.29E+01	14.87	3.28E+00	3.23
	18	436.82	432 -	441	436.53	5.30E+01	14.56	0.00E+00	2.31
	19	466.70	461 -	470	466.39	1.54E+01	9.85	5.11E+00	1.37
	20	473.88	471 -	476	473.57	7.00E+00	5.29	0.00E+00	3.00
	21	509.37	502 -	515	509.04	2.66E+01	13.00	6.77E+00	4.71
	22	873.52	869 -	875	873.00	5.00E+00	4.47	0.00E+00	2.98

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 10:59:20AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118842.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	1	20.91	1.12E+02	41.86			1.12E+02	4.19E+01
m	2	30.75	1.95E+03	97.65			1.95E+03	9.77E+01
m	3	35.15	4.00E+02	64.82			4.00E+02	6.48E+01
	4	53.11	5.24E+01	32.37			5.24E+01	3.24E+01
M	5	61.69	2.14E+02	46.24	1.20E+01	2.36E+00	2.02E+02	4.63E+01
m	6	66.24	1.08E+02	51.08			1.08E+02	5.11E+01
m	7	81.01	7.68E+02	61.58			7.68E+02	6.16E+01

0206



Analysis Report for 2112077-08

MW-9

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	8	111.55	1.78E+02	34.18			1.78E+02	3.42E+01
m	9	116.26	4.65E+01	43.54			4.65E+01	4.35E+01
	10	248.29	2.11E+01	19.46			2.11E+01	1.95E+01
	11	275.52	3.45E+01	27.75			3.45E+01	2.77E+01
	12	303.30	1.24E+02	30.63			1.24E+02	3.06E+01
	13	333.99	4.93E+01	29.33			4.93E+01	2.93E+01
	14	355.94	3.20E+02	45.12			3.20E+02	4.51E+01
	15	386.56	2.27E+02	32.32			2.27E+02	3.23E+01
M	16	414.30	1.56E+01	11.49			1.56E+01	1.15E+01
m	17	418.80	3.29E+01	14.87			3.29E+01	1.49E+01
	18	436.82	5.30E+01	14.56			5.30E+01	1.46E+01
	19	466.70	1.54E+01	9.85			1.54E+01	9.85E+00
	20	473.88	7.00E+00	5.29			7.00E+00	5.29E+00
	21	509.37	2.66E+01	13.00	1.28E+01	1.26E+00	1.38E+01	1.31E+01
	22	873.52	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.86	29.78 *	57.00	3.95E+01	1.98E+00
		33.60 *	13.20	5.47E+01	8.88E+00
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	3.70E+02	3.29E+01
		302.84 *	18.33	4.43E+02	1.12E+02
		356.01 *	62.05	3.36E+02	4.94E+01
TH-234	0.93	63.29 *	3.80	4.75E+02	1.09E+02
AM-241	0.88	59.54 *	35.90	5.02E+01	1.16E+01

Analysis Report for 2112077-08

MW-9

\* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity  
 Energy Tolerance : 2.500 keV  
 Nuclide confidence index threshold = 0.30  
 Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
I-129	0.868	4.02E+01	1.93E+00	
BA-133	0.999	3.64E+02	2.66E+01	
? TH-234	0.936	4.75E+02	1.09E+02	
X NP-237	0.701			
? AM-241	0.888	5.02E+01	1.16E+01	

? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2112077-08

MW-9

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 10:59:20AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M 1	20.91	1.24500E-01	18.68	Tol.	PA-234M
	4	53.11	5.82286E-02		
m 6	66.24	1.20360E-01	23.58	Sum	
M 8	111.55	1.97969E-01	9.59	Sum	
m 9	116.26	5.16730E-02	46.81	Sum	
	10	248.29	2.34091E-02		
	11	275.52	3.83889E-02		
	13	333.99	5.47281E-02	Sum	
	15	386.56	2.51955E-01	Sum	
M 16	414.30	1.72944E-02	36.91		
m 17	418.80	3.65209E-02	22.61	Sum	
	18	436.82	5.88889E-02	Sum	
	19	466.70	1.71605E-02		
	20	473.88	7.77778E-03		
	21	509.37	1.53324E-02		
	22	873.52	5.55556E-03		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.00sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2112077-08

MW-9

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	2.38E-07	2.38E-07	0.00E+00	0.00E+00
	3.31	12.30	2.92E-06		0.00E+00	0.00E+00
FE-55	5.89	24.50	6.35E-04	6.35E-04	2.28E-04	2.89E-04
CO-57	122.06	85.51	1.67E+01	1.67E+01	-7.44E-01	7.83E+00
	136.48	10.60	1.50E+02		-3.58E+01	6.99E+01
NI-59	6.92	29.80	1.58E-03	1.58E-03	4.85E-04	7.32E-04
MO-93	16.59	52.90	1.45E-01	1.45E-01	7.81E-03	6.96E-02
	18.60	10.00	1.24E+00		-9.48E-02	5.97E-01
NB-93M	16.57	9.43	8.06E-01	8.06E-01	4.36E-02	3.88E-01
CD-109	88.03	3.72	2.50E+02	2.50E+02	-2.52E+01	1.18E+02
SN-113	255.12	1.93	1.14E+03	5.02E+01	4.15E+01	5.24E+02
	391.69	61.90	5.02E+01		3.90E+01	2.37E+01
SN-119M	23.87	16.10	2.30E+00	2.30E+00	-5.67E+01	1.11E+00
	25.10	22.70	2.49E+00		-4.98E+01	1.21E+00
+ I-129	29.78	* 57.00	3.22E+00	3.22E+00	3.95E+01	1.58E+00
	33.60	* 13.20	2.17E+01		5.47E+01	1.06E+01
	39.58	7.52	2.53E+01		-6.90E-01	1.22E+01
+ BA-133	81.00	* 34.06	3.32E+01	3.32E+01	3.70E+02	1.59E+01
	302.84	* 18.33	1.34E+02		4.43E+02	6.20E+01
	356.01	* 62.05	5.03E+01		3.36E+02	2.37E+01
CE-139	165.85	80.35	2.81E+01	2.81E+01	6.94E+00	1.32E+01
CE-144	133.54	10.80	1.42E+02	1.42E+02	1.64E+01	6.62E+01
HG-203	279.19	77.30	3.35E+01	3.35E+01	-1.48E+00	1.56E+01
PB-210	46.50	4.25	4.78E+01	4.78E+01	1.75E+01	2.25E+01
TH-231	25.64	14.70	6.04E+00	6.04E+00	-2.17E+01	2.97E+00
	84.21	6.40	3.72E+02		1.81E+03	1.82E+02
PA-234M	9.89	89.00	5.25E-03	5.25E-03	6.23E-03	2.49E-03
	21.72	64.90	3.73E-01		1.33E-01	1.80E-01
	37.93	23.75	1.02E+01		5.05E+00	4.97E+00
+ TH-234	63.29	* 3.80	2.08E+02	2.08E+02	4.75E+02	1.01E+02
NP-237	29.37	* 14.00	1.31E+01	1.31E+01	1.61E+02	6.45E+00
	86.50	12.60	1.21E+02		8.80E-01	5.85E+01
U-237	97.08	16.30	7.52E+01	5.19E+01	-4.27E+00	3.57E+01
	101.07	26.30	5.19E+01		3.48E+01	2.47E+01
	114.00	12.30	2.02E+02		5.13E+02	9.76E+01
	208.01	22.00	1.15E+02		-5.26E+00	5.38E+01
+ AM-241	59.54	* 35.90	2.20E+01	2.20E+01	5.02E+01	1.07E+01
AM-243	74.67	66.00	1.33E+01	1.33E+01	-1.88E+00	6.35E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

*106  
1/10/22*

Analysis Report for 2112077-09  
MW-9D

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-09  
 Sample Description : MW-9D  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:57:30AM  
 Acquisition Started : 1/10/2022 10:48:46AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE5  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 1018.0 seconds  
  
 Dead Time : 11.59 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 2 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118881

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:05:47AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-09  
MW-9D

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	9.95	85 - 99	91.92	1.71E+01	16.67	2.98E+01	0.51
	2	20.85	192 - 209	201.81	7.44E+01	34.00	1.05E+02	0.64
	3	30.73	286 - 321	301.35	2.22E+03	110.53	2.22E+02	0.78
M	4	34.89	327 - 360	343.33	4.83E+02	51.94	5.87E+01	0.72
m	5	35.95	327 - 360	354.00	1.35E+02	29.43	3.73E+01	0.72
	6	52.79	511 - 537	523.67	5.50E+01	28.53	5.40E+01	0.53
	7	61.56	600 - 622	612.06	2.47E+02	42.46	8.45E+01	0.83
	8	65.88	640 - 669	655.63	1.12E+02	43.36	1.15E+02	0.44
	9	70.95	700 - 714	706.75	1.39E+01	15.00	2.22E+01	0.82
M	10	79.47	779 - 821	792.63	4.73E+01	23.39	4.90E+01	0.68
m	11	80.88	779 - 821	806.84	8.83E+02	61.86	3.39E+01	0.65
m	12	81.98	779 - 821	817.92	1.62E+01	11.31	8.08E+00	0.80
	13	87.92	867 - 886	877.81	1.45E+01	15.26	2.51E+01	0.32
	14	91.91	899 - 928	917.96	2.30E+01	25.81	6.20E+01	0.18
	15	100.45	995 - 1013	1004.09	1.40E+01	16.67	3.19E+01	1.23
	16	111.74	1108 - 1126	1117.84	1.84E+02	36.25	8.54E+01	0.72
	17	115.78	1143 - 1171	1158.59	7.33E+01	26.37	4.35E+01	0.94
	18	160.24	1590 - 1618	1606.70	4.30E+01	17.58	1.59E+01	0.19
	19	276.18	2761 - 2785	2775.53	5.53E+01	17.15	1.13E+01	0.75
M	20	302.01	3027 - 3053	3035.92	1.31E+01	21.78	1.61E+00	1.09
m	21	302.63	3027 - 3053	3042.15	1.54E+02	24.15	4.68E+00	1.00
	22	333.55	3339 - 3365	3353.94	6.42E+01	19.38	1.56E+01	1.23
	23	355.82	3562 - 3593	3578.45	4.25E+02	42.50	1.28E+01	1.03
	24	383.60	3840 - 3871	3858.50	8.97E+01	21.49	1.06E+01	0.57
	25	386.61	3873 - 3901	3888.86	1.63E+02	28.89	2.32E+01	0.76
	26	390.79	3916 - 3941	3931.02	2.38E+01	15.37	1.65E+01	0.69

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:05:47AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118843.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	9.95	1.71E+01	16.67	2.26E+00	5.77E-01	1.49E+01	1.67E+01
2	20.85	7.44E+01	34.00	8.71E+00	6.63E-01	6.57E+01	3.40E+01
3	30.73	2.22E+03	110.53	6.35E+00	8.10E-01	2.22E+03	1.11E+02

Analysis Report for 2112077-09

MW-9D

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	4	34.89	4.83E+02	51.94	1.59E+00	6.48E-01	4.81E+02	5.19E+01
m	5	35.95	1.35E+02	29.43	1.59E+00	6.48E-01	1.34E+02	2.94E+01
	6	52.79	5.50E+01	28.53			5.50E+01	2.85E+01
	7	61.56	2.47E+02	42.46	3.32E+00	6.94E-01	2.43E+02	4.25E+01
	8	65.88	1.12E+02	43.36			1.12E+02	4.34E+01
	9	70.95	1.39E+01	15.00			1.39E+01	1.50E+01
M	10	79.47	4.73E+01	23.39			4.73E+01	2.34E+01
m	11	80.88	8.83E+02	61.86			8.83E+02	6.19E+01
m	12	81.98	1.62E+01	11.31			1.62E+01	1.13E+01
	13	87.92	1.45E+01	15.26	8.71E-01	5.07E-01	1.36E+01	1.53E+01
	14	91.91	2.30E+01	25.81			2.30E+01	2.58E+01
	15	100.45	1.40E+01	16.67			1.40E+01	1.67E+01
	16	111.74	1.84E+02	36.25	7.94E-01	4.65E-01	1.84E+02	3.63E+01
	17	115.78	7.33E+01	26.37			7.33E+01	2.64E+01
	18	160.24	4.30E+01	17.58			4.30E+01	1.76E+01
	19	276.18	5.53E+01	17.15			5.53E+01	1.71E+01
M	20	302.01	1.31E+01	21.78			1.31E+01	2.18E+01
m	21	302.63	1.54E+02	24.15			1.54E+02	2.41E+01
	22	333.55	6.42E+01	19.38			6.42E+01	1.94E+01
	23	355.82	4.25E+02	42.50			4.25E+02	4.25E+01
	24	383.60	8.97E+01	21.49			8.97E+01	2.15E+01
	25	386.61	1.63E+02	28.89			1.63E+02	2.89E+01
	26	390.79	2.38E+01	15.37			2.38E+01	1.54E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
CD-109	1.00	88.03	*	3.72	6.26E+01
SN-113	0.93	255.12		1.93	
		391.69	*	61.90	1.96E+01
I-129	0.87	29.78	*	57.00	3.07E+01
		33.60	*	13.20	4.62E+01
		39.58		7.52	

0213

Analysis Report for 2112077-09

MW-9D

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	0.99	81.00 *		34.06	3.73E+02	2.98E+01
		302.84 *		18.33	4.67E+02	7.70E+01
		356.01 *		62.05	3.65E+02	3.96E+01
PA-234M	0.98	9.89 *		89.00	5.81E-04	6.52E-04
		21.72 *		64.90	1.58E-01	8.21E-02
		37.93 *		23.75	7.95E+00	1.75E+00
TH-234	0.92	63.29 *		3.80	4.79E+02	8.40E+01
AM-241	0.90	59.54 *		35.90	5.07E+01	8.90E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
CD-109	1.000	6.26E+01	7.04E+01	
SN-113	0.933	1.96E+01	1.27E+01	
I-129	0.877	3.20E+01	1.46E+00	
BA-133	0.999	3.79E+02	2.27E+01	
PA-234M	0.980	5.92E-04	6.52E-04	
? TH-234	0.926	4.79E+02	8.40E+01	
X NP-237	0.952			
? AM-241	0.901	5.07E+01	8.90E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma



Analysis Report for 2112077-09  
MW-9D

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### UNIDENTIFIED PEAKS

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Peak Locate Performed on : 1/10/2022 11:05:47AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	6	52.79	6.11111E-02	25.94	Sum
	8	65.88	1.24749E-01	19.31	Sum
	9	70.95	1.54667E-02	53.88	Sum
M	10	79.47	5.25703E-02	24.72	
m	12	81.98	1.79760E-02	34.97	Sum
	14	91.91	2.55453E-02	56.12	Sum
	15	100.45	1.56019E-02	59.36	Sum
	16	111.74	2.03895E-01	9.88	Sum
	17	115.78	8.13889E-02	18.00	Sum
	18	160.24	4.78214E-02	20.43	Sum
	19	276.18	6.14973E-02	15.49	
M	20	302.01	1.45487E-02	83.18	
	22	333.55	7.13457E-02	15.09	Sum
	24	383.60	9.96702E-02	11.98	Sum
	25	386.61	1.81556E-01	8.84	Sum

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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### NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2112077-09

MW-9D

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	6.63E-07	6.63E-07	-4.77E-06	3.14E-07
	3.31	12.30	7.64E-06		-2.15E-05	3.59E-06
FE-55	5.89	24.50	1.48E-04	1.48E-04	3.16E-05	6.66E-05
CO-57	122.06	85.51	9.68E+00	9.68E+00	1.07E+00	4.36E+00
	136.48	10.60	8.79E+01		-3.85E+00	3.94E+01
NI-59	6.92	29.80	3.55E-04	3.55E-04	2.81E-05	1.60E-04
MO-93	16.59	52.90	2.85E-02	2.85E-02	3.19E-03	1.29E-02
	18.60	10.00	2.87E-01		-2.03E-01	1.31E-01
NB-93M	16.57	9.43	1.59E-01	1.59E-01	1.78E-02	7.18E-02
+ CD-109	88.03	* 3.72	1.14E+02	1.14E+02	6.26E+01	5.07E+01
+ SN-113	255.12	1.93	5.39E+02	1.83E+01	-1.65E+02	2.31E+02
	391.69	* 61.90	1.83E+01		1.96E+01	8.06E+00
SN-119M	23.87	16.10	5.19E-01	4.61E-01	1.14E-01	2.35E-01
	25.10	22.70	4.61E-01		-1.61E-02	2.10E-01
+ I-129	29.78	* 57.00	1.36E+00	1.36E+00	3.07E+01	6.59E-01
	33.60	* 13.20	5.62E+00		4.62E+01	2.68E+00
	39.58	7.52	6.93E+00		-1.27E-01	3.11E+00
+ BA-133	81.00	* 34.06	2.17E+01	1.70E+01	3.73E+02	1.03E+01
	302.84	* 18.33	3.92E+01		4.67E+02	1.55E+01
	356.01	* 62.05	1.70E+01		3.65E+02	7.33E+00
CE-139	165.85	80.35	1.53E+01	1.53E+01	-3.62E-01	6.92E+00
CE-144	133.54	10.80	9.08E+01	9.08E+01	2.34E+01	4.11E+01
HG-203	279.19	77.30	1.26E+01	1.26E+01	-8.60E+00	5.31E+00
PB-210	46.50	4.25	2.04E+01	2.04E+01	3.42E+00	9.12E+00
TH-231	25.64	14.70	8.47E-01	8.47E-01	-4.91E-02	3.88E-01
	84.21	6.40	8.48E+01		7.37E+01	3.91E+01
+ PA-234M	9.89	* 89.00	1.06E-03	1.06E-03	5.81E-04	4.76E-04
	21.72	* 64.90	1.25E-01		1.58E-01	5.94E-02
	37.93	* 23.75	3.42E+00		7.95E+00	1.63E+00
+ TH-234	63.29	* 3.80	9.85E+01	9.85E+01	4.79E+02	4.66E+01
NP-237	29.37	* 14.00	5.52E+00	5.52E+00	1.25E+02	2.68E+00
	86.50	* 12.60	3.36E+01		1.85E+01	1.50E+01
U-237	97.08	16.30	3.26E+01	2.92E+01	-1.46E+01	1.46E+01
	101.07	26.30	2.92E+01		3.59E+00	1.35E+01
	114.00	12.30	6.83E+01		-1.52E+02	3.11E+01
	208.01	22.00	6.20E+01		2.46E+01	2.78E+01
+ AM-241	59.54	* 35.90	1.04E+01	1.04E+01	5.07E+01	4.93E+00
AM-243	74.67	66.00	5.22E+00	5.22E+00	-5.59E-01	2.36E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

*KB*  
*1/10/22*

Analysis Report for 2112077-10  
SW-BO 13

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-10  
 Sample Description : SW-BO 13  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:57:41AM  
 Acquisition Started : 1/10/2022 10:51:14AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/14/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118882

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:06:17AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-10

SW-BO 13

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	52.71	48 -	56	52.40	6.14E+01	40.64	2.17E+02	3.44
M	2	62.11	57 -	71	61.80	2.18E+02	45.01	1.87E+02	2.23
m	3	66.39	57 -	71	66.08	1.03E+02	41.15	1.93E+02	2.23
	4	81.51	75 -	86	81.19	7.11E+02	73.40	3.18E+02	1.98
	5	102.52	98 -	106	102.20	3.13E+01	35.01	1.65E+02	5.33
M	6	112.26	107 -	119	111.94	2.23E+02	39.90	1.17E+02	2.78
m	7	116.86	107 -	119	116.55	4.85E+01	31.86	9.89E+01	2.25
	8	277.03	272 -	280	276.69	5.42E+01	28.80	9.37E+01	1.87
M	9	303.50	298 -	311	303.16	1.19E+02	32.50	1.09E+02	2.50
m	10	307.82	298 -	311	307.48	2.06E+01	29.46	1.23E+02	2.58
M	11	334.21	327 -	342	333.87	7.50E+01	24.00	3.64E+01	2.51
m	12	338.10	327 -	342	337.76	2.48E+01	25.50	3.80E+01	2.93
	13	356.58	351 -	361	356.24	4.47E+02	51.45	1.12E+02	2.31
	14	366.37	362 -	372	366.02	3.04E+01	22.01	4.52E+01	2.70
M	15	386.86	379 -	395	386.51	2.03E+02	36.28	2.30E+01	2.80
m	16	391.86	379 -	395	391.51	4.34E+01	29.87	3.03E+01	2.80
	17	397.38	395 -	399	397.03	1.05E+01	8.65	7.00E+00	2.32
M	18	418.64	411 -	427	418.28	2.93E+01	20.73	3.18E+01	3.11
m	19	422.09	411 -	427	421.74	1.45E+01	19.84	3.38E+01	3.11
m	20	425.43	411 -	427	425.08	1.03E+01	12.29	2.36E+01	2.70
	21	437.29	431 -	441	436.94	8.28E+01	22.29	2.23E+01	2.35
	22	468.49	463 -	473	468.13	2.55E+01	11.93	5.04E+00	6.38
	23	555.39	551 -	557	555.02	7.11E+00	6.95	3.78E+00	1.90
	24	561.40	559 -	563	561.04	6.07E+00	5.85	1.86E+00	1.90
	25	843.72	840 -	846	843.33	4.25E+00	6.02	3.50E+00	1.09
	26	943.59	940 -	945	943.20	5.00E+00	4.47	0.00E+00	2.75
	27	1002.22	998 -	1004	1001.83	6.00E+00	4.90	0.00E+00	2.74

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:06:17AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118839.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	52.71	6.14E+01	40.64			6.14E+01	4.06E+01
M	2	62.11	2.18E+02	45.01	2.33E+01	2.32E+00	1.94E+02	4.51E+01

0218

Analysis Report for 2112077-10

SW-BO 13

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	3	66.39	1.03E+02	41.15			1.03E+02	4.12E+01
	4	81.51	7.11E+02	73.40			7.11E+02	7.34E+01
	5	102.52	3.13E+01	35.01			3.13E+01	3.50E+01
M	6	112.26	2.23E+02	39.90			2.23E+02	3.99E+01
m	7	116.86	4.85E+01	31.86			4.85E+01	3.19E+01
	8	277.03	5.42E+01	28.80			5.42E+01	2.88E+01
M	9	303.50	1.19E+02	32.50			1.19E+02	3.25E+01
m	10	307.82	2.06E+01	29.46			2.06E+01	2.95E+01
M	11	334.21	7.50E+01	24.00			7.50E+01	2.40E+01
m	12	338.10	2.48E+01	25.50	1.69E+00	1.30E+00	2.31E+01	2.55E+01
	13	356.58	4.47E+02	51.45			4.47E+02	5.15E+01
	14	366.37	3.04E+01	22.01			3.04E+01	2.20E+01
M	15	386.86	2.03E+02	36.28			2.03E+02	3.63E+01
m	16	391.86	4.34E+01	29.87			4.34E+01	2.99E+01
	17	397.38	1.05E+01	8.65			1.05E+01	8.65E+00
M	18	418.64	2.93E+01	20.73			2.93E+01	2.07E+01
m	19	422.09	1.45E+01	19.84			1.45E+01	1.98E+01
m	20	425.43	1.03E+01	12.29			1.03E+01	1.23E+01
	21	437.29	8.28E+01	22.29			8.28E+01	2.23E+01
	22	468.49	2.55E+01	11.93	0.00E+00	0.00E+00	2.55E+01	1.19E+01
	23	555.39	7.11E+00	6.95			7.11E+00	6.95E+00
	24	561.40	6.07E+00	5.85			6.07E+00	5.85E+00
	25	843.72	4.25E+00	6.02			4.25E+00	6.02E+00
	26	943.59	5.00E+00	4.47			5.00E+00	4.47E+00
	27	1002.22	6.00E+00	4.90	1.18E+00	7.15E-01	4.82E+00	4.95E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	3.27E+01
BA-133	0.99	81.00	*	34.06	3.66E+02
		302.84	*	18.33	3.29E+02
					2.25E+01
					4.06E+01
					9.19E+01

0219

Analysis Report for 2112077-10  
SW-BO 13

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	0.99	356.01	*	62.05	3.51E+02	4.28E+01
HG-203	0.88	279.19	*	77.30	3.60E+01	1.93E+01
TH-234	0.96	63.29	*	3.80	5.23E+02	1.22E+02

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.953	3.27E+01	2.25E+01	
BA-133	0.992	3.56E+02	2.81E+01	
HG-203	0.887	3.60E+01	1.93E+01	
TH-234	0.965	5.23E+02	1.22E+02	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-10  
SW-BO 13

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 1/10/2022 11:06:17AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	52.71	6.81699E-02	33.12	
m	3	66.39	1.14145E-01	20.03	
	5	102.52	3.47466E-02	55.97	Tol. U-237
M	6	112.26	2.47612E-01	8.95	Tol. U-237
m	7	116.86	5.39163E-02	32.83	
m	10	307.82	2.29268E-02	71.39	
M	11	334.21	8.33297E-02	16.00	
m	12	338.10	2.56377E-02	55.33	Sum
	14	366.37	3.37631E-02	36.21	Sum
M	15	386.86	2.25022E-01	8.96	Sum
	17	397.38	1.16667E-02	41.17	
M	18	418.64	3.25616E-02	35.37	Sum
m	19	422.09	1.60634E-02	68.63	
m	20	425.43	1.14511E-02	59.62	
	21	437.29	9.20449E-02	13.46	Sum
	22	468.49	2.83135E-02	23.40	
	23	555.39	7.90123E-03	48.84	Sum
	24	561.40	6.74603E-03	48.20	
	25	843.72	4.72222E-03	70.83	
	26	943.59	5.55556E-03	44.72	
	27	1002.22	5.35427E-03	51.37	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

0221

Analysis Report for 2112077-10  
SW-BO 13

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	5.44E-07	5.44E-07	0.00E+00	0.00E+00
	3.31	12.30	6.51E-06		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.09E-04	1.09E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.56E+01	1.56E+01	1.13E+00	7.31E+00
	136.48	10.60	1.42E+02		4.47E+00	6.63E+01
NI-59	6.92	29.80	2.19E-04	2.19E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	8.08E-03	8.08E-03	0.00E+00	0.00E+00
	18.60	10.00	6.79E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	4.51E-02	4.51E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.79E+02	2.79E+02	-7.81E+01	1.32E+02
+ SN-113	255.12	1.93	8.12E+02	2.96E+01	6.34E+01	3.70E+02
	391.69	* 61.90	2.96E+01		3.27E+01	1.38E+01
SN-119M	23.87	16.10	1.08E-01	9.18E-02	0.00E+00	0.00E+00
	25.10	22.70	9.18E-02		0.00E+00	0.00E+00
I-129	29.78	57.00	1.06E+00	1.06E+00	-1.57E+00	4.96E-01
	33.60	13.20	1.99E+01		7.79E+01	9.76E+00
	39.58	7.52	4.48E+01		3.67E+01	2.18E+01
+ BA-133	81.00	* 34.06	4.41E+01	3.99E+01	3.66E+02	2.13E+01
	302.84	* 18.33	1.90E+02		3.29E+02	9.11E+01
	356.01	* 62.05	3.99E+01		3.51E+02	1.89E+01
CE-139	165.85	80.35	2.33E+01	2.33E+01	-5.86E+00	1.09E+01
CE-144	133.54	10.80	1.29E+02	1.29E+02	-1.67E+01	6.03E+01
+ HG-203	279.19	* 77.30	2.89E+01	2.89E+01	3.60E+01	1.35E+01
PB-210	46.50	4.25	5.91E+01	5.91E+01	-9.58E-01	2.79E+01
TH-231	25.64	14.70	1.53E-01	1.53E-01	0.00E+00	0.00E+00
	84.21	6.40	3.47E+02		1.25E+03	1.70E+02
PA-234M	9.89	89.00	4.64E-04	4.64E-04	0.00E+00	0.00E+00
	21.72	64.90	1.90E-02		0.00E+00	0.00E+00
	37.93	23.75	1.50E+01		4.51E+01	7.36E+00
+ TH-234	63.29	* 3.80	2.69E+02	2.69E+02	5.23E+02	1.31E+02
NP-237	29.37	14.00	4.12E+00	4.12E+00	-6.11E+00	1.93E+00
	86.50	12.60	9.43E+01		7.23E+00	4.51E+01
U-237	97.08	16.30	6.61E+01	4.58E+01	-1.49E+01	3.11E+01
	101.07	26.30	4.58E+01		2.38E+01	2.16E+01
	114.00	12.30	1.95E+02		4.70E+02	9.42E+01
	208.01	22.00	9.37E+01		4.17E+01	4.39E+01
AM-241	59.54	35.90	2.08E+01	2.08E+01	1.86E+01	1.01E+01
AM-243	74.67	66.00	1.15E+01	1.15E+01	-3.25E-01	5.43E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction



Analysis Report for 2112077-11  
SW-BO 2

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : 2112077-11  
 Sample Description : SW-BO 2  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:57:54AM  
 Acquisition Started : 1/10/2022 10:58:29AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 27 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118883

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 1/10/2022 11:13:32AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-11

SW-BO 2

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.61	37 -	41	37.21	3.04E+02	67.43	2.57E+02	1.65
	2	52.66	51 -	57	54.22	4.73E+01	31.66	1.49E+02	1.33
M	3	61.89	59 -	71	63.43	1.90E+02	36.84	1.29E+02	1.78
m	4	66.11	59 -	71	67.65	8.54E+01	31.13	1.33E+02	1.80
	5	81.13	78 -	87	82.64	7.65E+02	71.06	2.82E+02	1.48
M	6	111.94	108 -	131	113.38	1.72E+02	32.10	8.52E+01	1.84
m	7	116.71	108 -	131	118.15	3.05E+01	28.92	1.12E+02	2.36
	8	186.39	183 -	193	187.68	4.58E+01	38.29	1.72E+02	2.66
	9	219.35	218 -	223	220.58	2.20E+01	19.70	6.00E+01	2.59
	10	276.43	274 -	281	277.55	5.01E+01	25.22	7.37E+01	1.34
M	11	303.02	300 -	312	304.08	1.45E+02	26.86	3.06E+01	1.60
m	12	307.80	300 -	312	308.85	1.57E+01	15.27	5.30E+01	1.60
M	13	333.85	331 -	341	334.85	4.97E+01	19.80	4.00E+01	1.63
m	14	337.15	331 -	341	338.15	1.09E+01	15.87	4.00E+01	1.63
M	15	352.18	351 -	361	353.15	2.20E+01	12.23	1.03E+01	1.65
m	16	356.13	351 -	361	357.09	5.09E+02	45.97	1.59E+01	1.63
	17	364.31	363 -	368	365.26	1.22E+01	14.66	3.35E+01	1.12
	18	376.54	374 -	380	377.46	1.15E+01	12.71	2.10E+01	1.14
M	19	383.94	381 -	398	384.85	8.92E+01	21.71	1.42E+01	1.68
m	20	387.19	381 -	398	388.09	1.75E+02	28.41	1.17E+01	1.69
m	21	391.95	381 -	398	392.85	1.93E+01	13.24	1.03E+01	1.69
M	22	415.15	410 -	426	416.00	2.15E+01	13.99	2.06E+01	1.56
m	23	421.84	410 -	426	422.67	8.74E+00	12.77	8.82E+00	1.89
	24	437.16	434 -	440	437.96	7.82E+01	19.31	1.16E+01	1.39
	25	457.79	456 -	461	458.56	9.00E+00	6.00	0.00E+00	3.75
	26	468.05	465 -	471	468.80	1.95E+01	13.16	1.71E+01	1.30
	27	476.88	474 -	481	477.61	6.60E+00	8.49	6.80E+00	2.50
	28	512.22	509 -	519	512.89	3.51E+01	13.35	3.84E+00	3.13
	29	530.72	528 -	534	531.35	5.43E+00	6.34	3.14E+00	1.90

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:13:32AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118840.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
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0224

Analysis Report for 2112077-11

SW-BO 2

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.61	3.04E+02	67.43			3.04E+02	6.74E+01
	2	52.66	4.73E+01	31.66	2.30E-01	1.75E+00	4.71E+01	3.17E+01
M	3	61.89	1.90E+02	36.84	1.58E+00	1.58E+00	1.89E+02	3.69E+01
m	4	66.11	8.54E+01	31.13	1.35E+00	1.47E+00	8.40E+01	3.12E+01
	5	81.13	7.65E+02	71.06			7.65E+02	7.11E+01
M	6	111.94	1.72E+02	32.10			1.72E+02	3.21E+01
m	7	116.71	3.05E+01	28.92			3.05E+01	2.89E+01
	8	186.39	4.58E+01	38.29	1.06E+01	1.75E+00	3.53E+01	3.83E+01
	9	219.35	2.20E+01	19.70			2.20E+01	1.97E+01
	10	276.43	5.01E+01	25.22			5.01E+01	2.52E+01
M	11	303.02	1.45E+02	26.86			1.45E+02	2.69E+01
m	12	307.80	1.57E+01	15.27			1.57E+01	1.53E+01
M	13	333.85	4.97E+01	19.80			4.97E+01	1.98E+01
m	14	337.15	1.09E+01	15.87			1.09E+01	1.59E+01
M	15	352.18	2.20E+01	12.23	4.22E+00	1.28E+00	1.77E+01	1.23E+01
m	16	356.13	5.09E+02	45.97			5.09E+02	4.60E+01
	17	364.31	1.22E+01	14.66			1.22E+01	1.47E+01
	18	376.54	1.15E+01	12.71			1.15E+01	1.27E+01
M	19	383.94	8.92E+01	21.71			8.92E+01	2.17E+01
m	20	387.19	1.75E+02	28.41			1.75E+02	2.84E+01
m	21	391.95	1.93E+01	13.24			1.93E+01	1.32E+01
M	22	415.15	2.15E+01	13.99			2.15E+01	1.40E+01
m	23	421.84	8.74E+00	12.77			8.74E+00	1.28E+01
	24	437.16	7.82E+01	19.31			7.82E+01	1.93E+01
	25	457.79	9.00E+00	6.00			9.00E+00	6.00E+00
	26	468.05	1.95E+01	13.16			1.95E+01	1.32E+01
	27	476.88	6.60E+00	8.49			6.60E+00	8.49E+00
	28	512.22	3.51E+01	13.35	1.96E+01	1.28E+00	1.55E+01	1.34E+01
	29	530.72	5.43E+00	6.34			5.43E+00	6.34E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
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0225

Analysis Report for 2112077-11  
SW-BO 2

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
SN-113	0.95	255.12	1.93		
		391.69 *	61.90	1.41E+01	9.66E+00
BA-133	1.00	81.00 *	34.06	3.94E+02	4.00E+01
		302.84 *	18.33	3.74E+02	7.22E+01
		356.01 *	62.05	3.80E+02	3.77E+01
PA-234M	0.98	9.89	89.00		
		21.72	64.90		
		37.93 *	23.75	4.19E+01	9.30E+00
TH-234	0.95	63.29 *	3.80	5.49E+02	1.08E+02
AM-241	0.86	59.54 *	35.90	5.81E+01	1.14E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.951	1.41E+01	9.66E+00	
BA-133	1.000	3.85E+02	2.57E+01	
PA-234M	0.982	4.19E+01	9.30E+00	
? TH-234	0.951	5.49E+02	1.08E+02	
? AM-241	0.868	5.81E+01	1.14E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-11

SW-BO 2

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 11:13:32AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	52.66	5.23217E-02	33.67	
m	4	66.11	9.33819E-02	18.54	
M	6	111.94	1.91213E-01	9.33	Tol. U-237
m	7	116.71	3.38664E-02	47.44	Sum
	8	186.39	3.92105E-02	54.30	
	9	219.35	2.44444E-02	44.77	
	10	276.43	5.57088E-02	25.15	
m	12	307.80	1.74771E-02	48.55	
M	13	333.85	5.52216E-02	19.92	
m	14	337.15	1.21034E-02	72.87	Sum
M	15	352.18	1.97067E-02	34.66	
	17	364.31	1.36015E-02	59.89	Sum
	18	376.54	1.27778E-02	55.25	
M	19	383.94	9.91221E-02	12.17	Sum
m	20	387.19	1.94357E-01	8.12	
M	22	415.15	2.39336E-02	32.48	
m	23	421.84	9.70683E-03	73.07	
	24	437.16	8.68849E-02	12.35	Sum
	25	457.79	1.00000E-02	33.33	
	26	468.05	2.16270E-02	33.81	
	27	476.88	7.33333E-03	64.28	
	28	512.22	1.72352E-02	43.23	
	29	530.72	6.03175E-03	58.43	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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Analysis Report for 2112077-11

SW-BO 2

## NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	5.55E-06	5.55E-06	0.00E+00	0.00E+00
	3.31	12.30	5.93E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	5.43E-04	5.43E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.29E+01	1.29E+01	-1.59E+00	5.96E+00
	136.48	10.60	1.22E+02		7.57E+01	5.66E+01
NI-59	6.92	29.80	9.37E-04	9.37E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	1.70E-02	1.70E-02	0.00E+00	0.00E+00
	18.60	10.00	1.33E-01		0.00E+00	0.00E+00
NB-93M	16.57	9.43	9.52E-02	9.52E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	1.90E+02	1.90E+02	-9.80E+00	8.76E+01
+ SN-113	255.12	1.93	5.45E+02	2.67E+01	2.70E+01	2.40E+02
	391.69	*	61.90	2.67E+01	1.41E+01	1.24E+01
SN-119M	23.87	16.10	1.81E-01	1.81E-01	0.00E+00	0.00E+00
	25.10	22.70	1.65E+00		4.45E-01	7.50E-01
I-129	29.78	57.00	7.49E+00	7.49E+00	6.39E+01	3.70E+00
	33.60	13.20	4.13E+01		-5.30E+00	2.04E+01
	39.58	7.52	2.24E+01		4.78E+00	1.04E+01
+ BA-133	81.00	*	34.06	2.00E+01	3.94E+02	1.89E+01
	302.84	*	18.33	1.12E+02	3.74E+02	5.25E+01
	356.01	*	62.05	2.00E+01	3.80E+02	8.97E+00
CE-139	165.85	80.35	1.86E+01	1.86E+01	4.53E+00	8.66E+00
CE-144	133.54	10.80	1.02E+02	1.02E+02	-6.38E+01	4.72E+01
HG-203	279.19	77.30	2.43E+01	2.43E+01	2.06E+01	1.13E+01
PB-210	46.50	4.25	5.58E+01	5.58E+01	1.45E+01	2.59E+01
TH-231	25.64	14.70	3.29E+00	3.29E+00	-2.16E+00	1.52E+00
	84.21	6.40	1.36E+02		-2.15E+03	6.40E+01
+ PA-234M	9.89	89.00	1.45E-03	1.45E-03	0.00E+00	0.00E+00
	21.72	64.90	3.37E-02		0.00E+00	0.00E+00
	37.93	*	23.75	1.35E+01	4.19E+01	6.55E+00
+ TH-234	63.29	*	3.80	2.45E+02	5.49E+02	1.19E+02
	NP-237	29.37	14.00	2.94E+01	2.94E+01	2.50E+02
U-237	86.50	12.60	6.12E+01		2.74E+01	2.85E+01
	97.08	16.30	5.07E+01	3.31E+01	5.44E+00	2.35E+01
	101.07	26.30	3.31E+01		-4.62E+00	1.53E+01
	114.00	12.30	1.57E+02		2.61E+02	7.55E+01
+ AM-241	208.01	22.00	6.62E+01		1.71E+01	3.04E+01
	59.54	*	35.90	2.60E+01	2.60E+01	5.81E+01
AM-243	74.67	66.00	9.63E+00	9.63E+00	-6.04E+00	4.50E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-11  
SW-BO 2

*KP*  
*1/10/22*

Analysis Report for 2112077-12  
MW-6

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-12  
 Sample Description : MW-6  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:58:02AM  
 Acquisition Started : 1/10/2022 10:58:49AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 913.9 seconds  
  
 Dead Time : 1.53 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118884

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:14:06AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-12

MW-6

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
m	1	31.29	16 -	42	31.93	2.43E+03	124.18	5.66E+02	5.38
M	2	63.12	45 -	89	63.74	3.83E+02	94.30	7.19E+02	5.86
m	3	81.18	45 -	89	81.79	8.45E+02	78.68	3.44E+02	3.58
	4	113.08	106 -	122	113.67	2.60E+02	80.09	5.20E+02	4.05
	5	160.72	158 -	166	161.27	2.87E+01	35.41	1.75E+02	2.98
	6	275.65	272 -	280	276.12	2.66E+01	25.23	8.27E+01	2.03
	7	303.64	296 -	314	304.09	1.40E+02	45.69	1.33E+02	4.28
	8	335.03	324 -	343	335.46	1.02E+02	43.03	1.21E+02	3.90
	9	356.35	350 -	363	356.77	3.88E+02	49.91	1.02E+02	3.81
	10	387.27	379 -	398	387.67	2.82E+02	51.46	1.11E+02	5.19
M	11	415.03	410 -	428	415.42	5.34E+01	23.92	4.62E+01	4.59
m	12	421.04	410 -	428	421.42	1.97E+01	25.67	3.74E+01	4.59
	13	437.38	433 -	444	437.75	8.14E+01	27.57	5.51E+01	2.69
	14	468.20	461 -	479	468.55	4.65E+01	20.21	2.10E+01	1.58
	15	511.61	505 -	517	511.94	3.10E+01	11.14	0.00E+00	3.66
	16	554.01	548 -	560	554.31	1.18E+01	10.11	6.33E+00	5.11
	17	585.15	582 -	589	585.43	7.00E+00	5.29	0.00E+00	2.74

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.00sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:14:06AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118841.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	1	31.29	2.43E+03	124.18	8.55E+01	2.11E-01	2.34E+03	1.24E+02
M	2	63.12	3.83E+02	94.30	5.73E+01	6.61E-01	3.26E+02	9.43E+01
m	3	81.18	8.45E+02	78.68			8.45E+02	7.87E+01
	4	113.08	2.60E+02	80.09			2.60E+02	8.01E+01
	5	160.72	2.87E+01	35.41			2.87E+01	3.54E+01
	6	275.65	2.66E+01	25.23			2.66E+01	2.52E+01
	7	303.64	1.40E+02	45.69	5.24E-01	4.63E-01	1.39E+02	4.57E+01
	8	335.03	1.02E+02	43.03			1.02E+02	4.30E+01
	9	356.35	3.88E+02	49.91			3.88E+02	4.99E+01
	10	387.27	2.82E+02	51.46			2.82E+02	5.15E+01
M	11	415.03	5.34E+01	23.92			5.34E+01	2.39E+01
m	12	421.04	1.97E+01	25.67			1.97E+01	2.57E+01

Analysis Report for 2112077-12

MW-6

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
13	437.38	8.14E+01	27.57			8.14E+01	2.76E+01
14	468.20	4.65E+01	20.21			4.65E+01	2.02E+01
15	511.61	3.10E+01	11.14	1.43E+01	1.43E+00	1.67E+01	1.12E+01
16	554.01	1.18E+01	10.11			1.18E+01	1.01E+01
17	585.15	7.00E+00	5.29	0.00E+00	0.00E+00	7.00E+00	5.29E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.59	29.78	*	57.00	7.77E+01	4.14E+00
		33.60		13.20		
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.72E+02	3.74E+01
		302.84	*	18.33		
		356.01	*	62.05		
TH-234	0.99	63.29	*	3.80	8.16E+02	2.37E+02
NP-237	0.60	29.37	*	14.00	3.16E+02	1.68E+01
		86.50		12.60		

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

Analysis Report for 2112077-12

MW-6

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## INTERFERENCE CORRECTED REPORT

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	<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
?	I-129	0.599	7.77E+01	4.14E+00	
	BA-133	0.996	3.69E+02	<del>2.89E+01</del>	
	TH-234	0.999	8.16E+02	2.37E+02	
?	NP-237	0.603	3.16E+02	1.68E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2112077-12

MW-6

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 11:14:06AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	4	113.08	2.88764E-01	15.41	Sum
	5	160.72	3.18582E-02	61.75	Sum
	6	275.65	2.96078E-02	47.34	
	8	335.03	1.13708E-01	21.03	Sum
	10	387.27	3.13030E-01	9.13	Sum
M	11	415.03	5.92792E-02	22.41	
m	12	421.04	2.18608E-02	65.24	Sum
	13	437.38	9.04944E-02	16.92	Sum
	14	468.20	5.16569E-02	21.74	
	15	511.61	1.85125E-02	33.69	
	16	554.01	1.31481E-02	42.73	
	17	585.15	7.77778E-03	37.80	

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.29E-04	1.29E-04	1.36E-04	6.08E-05
	3.31	12.30	1.33E-03		1.40E-03	6.25E-04
FE-55	5.89	24.50	1.38E-02	1.38E-02	1.99E-02	6.62E-03
CO-57	122.06	85.51	2.50E+01	2.50E+01	6.65E+00	1.21E+01

0234

Analysis Report for 2112077-12

MW-6

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CO-57	136.48	10.60	1.82E+02	2.50E+01	-7.95E+01	8.70E+01
NI-59	6.92	29.80	2.43E-02	2.43E-02	3.77E-02	1.17E-02
MO-93	16.59	52.90	5.61E-01	5.61E-01	5.42E-01	2.73E-01
	18.60	10.00	4.19E+00		7.34E-01	2.04E+00
NB-93M	16.57	9.43	3.14E+00	3.14E+00	3.03E+00	1.53E+00
CD-109	88.03	3.72	5.74E+02	5.74E+02	4.11E+01	2.81E+02
SN-113	255.12	1.93	1.30E+03	7.02E+01	7.93E+02	6.14E+02
	391.69	61.90	7.02E+01		1.64E+02	3.38E+01
SN-119M	23.87	16.10	1.12E+01	9.98E+00	4.57E+01	5.53E+00
	25.10	22.70	9.98E+00		6.00E+01	4.93E+00
+ I-129	29.78	* 57.00	6.69E+00	6.69E+00	7.77E+01	3.30E+00
	33.60	13.20	4.19E+01		4.03E+02	2.07E+01
	39.58	7.52	7.43E+01		3.83E+00	3.66E+01
+ BA-133	81.00	* 34.06	1.41E+02	4.91E+01	3.72E+02	6.98E+01
	302.84	* 18.33	2.03E+02		4.20E+02	9.72E+01
	356.01	* 62.05	4.91E+01		3.58E+02	2.33E+01
CE-139	165.85	80.35	2.91E+01	2.91E+01	-1.18E+00	1.39E+01
CE-144	133.54	10.80	1.76E+02	1.76E+02	-9.35E+01	8.40E+01
HG-203	279.19	77.30	3.23E+01	3.23E+01	-1.58E+00	1.52E+01
PB-210	46.50	4.25	1.01E+02	1.01E+02	9.88E+00	4.87E+01
TH-231	25.64	14.70	1.64E+01	1.64E+01	9.85E+01	8.09E+00
	84.21	6.40	3.82E+02		6.42E+00	1.88E+02
PA-234M	9.89	89.00	3.99E-02	3.99E-02	5.36E-02	1.93E-02
	21.72	64.90	1.21E+00		-2.38E+01	5.90E-01
	37.93	23.75	2.51E+01		1.09E+00	1.24E+01
+ TH-234	63.29	* 3.80	8.11E+02	8.11E+02	8.16E+02	4.02E+02
+ NP-237	29.37	* 14.00	2.72E+01	2.72E+01	3.16E+02	1.34E+01
	86.50	12.60	2.00E+02		2.32E+01	9.80E+01
U-237	97.08	16.30	9.47E+01	6.28E+01	2.63E+01	4.57E+01
	101.07	26.30	6.28E+01		-1.69E+00	3.03E+01
	114.00	12.30	2.15E+02		4.94E+02	1.05E+02
	208.01	22.00	1.14E+02		-6.36E+01	5.40E+01
AM-241	59.54	35.90	2.94E+01	2.94E+01	7.24E+01	1.44E+01
AM-243	74.67	66.00	2.79E+01	2.79E+01	-3.87E+00	1.37E+01

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

KP  
1/10/22

Analysis Report for 2112077-13  
MW-10

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-13  
 Sample Description : MW-10  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:58:10AM  
 Acquisition Started : 1/10/2022 10:59:37AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE4  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 920.3 seconds  
  
 Dead Time : 2.21 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/22/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118885

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:15:00AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-13

MW-10

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.90	15 -	24	20.87	6.55E+01	55.84	4.03E+02	2.11
M	2	30.71	25 -	40	30.68	1.67E+03	87.77	1.72E+02	2.46
m	3	34.98	25 -	40	34.94	4.40E+02	80.77	1.37E+02	2.51
	4	53.05	49 -	57	53.00	7.12E+01	34.46	1.38E+02	2.35
M	5	61.30	57 -	69	61.25	1.97E+02	42.76	1.61E+02	2.72
m	6	65.31	57 -	69	65.25	1.14E+02	46.39	1.98E+02	2.73
	7	80.81	74 -	85	80.74	6.69E+02	67.88	2.45E+02	2.25
	8	102.23	100 -	104	102.15	1.85E+01	20.54	7.69E+01	2.16
	9	112.18	106 -	118	112.09	1.91E+02	54.03	2.53E+02	2.20
	10	276.29	270 -	280	276.10	3.23E+01	24.18	6.13E+01	1.46
	11	303.11	298 -	308	302.90	1.00E+02	35.06	1.12E+02	1.96
	12	355.94	350 -	360	355.70	3.24E+02	38.77	2.76E+01	2.44
	13	364.64	361 -	369	364.40	2.58E+01	13.74	1.24E+01	3.90
	14	386.29	378 -	396	386.03	2.35E+02	35.48	2.35E+01	5.00
	15	415.65	408 -	419	415.38	2.23E+01	20.59	4.14E+01	4.91
	16	437.03	432 -	441	436.75	5.10E+01	14.28	0.00E+00	2.38
	17	467.08	462 -	469	466.78	1.07E+01	11.83	1.65E+01	2.48
	18	750.13	745 -	753	749.67	9.00E+00	6.00	0.00E+00	2.88
	19	804.63	800 -	807	804.14	7.00E+00	5.29	0.00E+00	1.16

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:15:00AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118842.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.90	6.55E+01	55.84			6.55E+01	5.58E+01
M	2	30.71	1.67E+03	87.77			1.67E+03	8.78E+01
m	3	34.98	4.40E+02	80.77			4.40E+02	8.08E+01
	4	53.05	7.12E+01	34.46			7.12E+01	3.45E+01
M	5	61.30	1.97E+02	42.76	1.20E+01	2.36E+00	1.85E+02	4.28E+01
m	6	65.31	1.14E+02	46.39	1.20E+01	2.36E+00	1.02E+02	4.64E+01
	7	80.81	6.69E+02	67.88			6.69E+02	6.79E+01
	8	102.23	1.85E+01	20.54			1.85E+01	2.05E+01
	9	112.18	1.91E+02	54.03			1.91E+02	5.40E+01
	10	276.29	3.23E+01	24.18			3.23E+01	2.42E+01

0237

Analysis Report for 2112077-13

MW-10

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
11	303.11	1.00E+02	35.06			1.00E+02	3.51E+01
12	355.94	3.24E+02	38.77			3.24E+02	3.88E+01
13	364.64	2.58E+01	13.74			2.58E+01	1.37E+01
14	386.29	2.35E+02	35.48			2.35E+02	3.55E+01
15	415.65	2.23E+01	20.59			2.23E+01	2.06E+01
16	437.03	5.10E+01	14.28			5.10E+01	1.43E+01
17	467.08	1.07E+01	11.83			1.07E+01	1.18E+01
18	750.13	9.00E+00	6.00			9.00E+00	6.00E+00
19	804.63	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.87	29.78 *	57.00	3.37E+01	1.77E+00
		33.60 *	13.20	5.93E+01	1.09E+01
		39.58	7.52		
BA-133	0.99	81.00 *	34.06	3.21E+02	3.48E+01
		302.84 *	18.33	3.58E+02	1.27E+02
		356.01 *	62.05	3.40E+02	4.31E+01
TH-234	0.90	63.29 *	3.80	4.28E+02	9.97E+01
AM-241	0.92	59.54 *	35.90	4.53E+01	1.06E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma



Analysis Report for 2112077-13  
MW-10

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## INTERFERENCE CORRECTED REPORT

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<i>Nuclide Name</i>	<i>Nuclide Id Confidence</i>	<i>Wt mean Activity (pCi/units)</i>	<i>Wt mean Activity Uncertainty</i>	<i>Comments</i>
I-129	0.872	3.44E+01	1.75E+00	
BA-133	0.999	3.30E+02	2.65E+01	
? TH-234	0.904	4.28E+02	9.97E+01	
X NP-237	0.702			
? AM-241	0.924	4.53E+01	1.06E+01	

- ? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

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Analysis Report for 2112077-13  
MW-10

**UNIDENTIFIED PEAKS**

Peak Locate Performed on : 1/10/2022 11:15:00AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
1	20.90	7.27591E-02	42.64	Tol.	PA-234M
m 4	53.05	7.90556E-02	24.22		
m 6	65.31	1.13125E-01	22.81	Sum	
8	102.23	2.05848E-02	55.43	Tol.	U-237
9	112.18	2.12753E-01	14.11	Sum	
10	276.29	3.59259E-02	37.39		
13	364.64	2.86458E-02	26.64	Sum	
14	386.29	2.61368E-01	7.54	Sum	
15	415.65	2.47804E-02	46.16	Sum	
16	437.03	5.66667E-02	14.00	Sum	
17	467.08	1.19298E-02	55.10		
18	750.13	1.00000E-02	33.33		
19	804.63	7.77778E-03	37.80		

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

**NUCLIDE MDA REPORT**

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	2.38E-07	2.38E-07	0.00E+00	0.00E+00
	3.31	12.30	2.92E-06		0.00E+00	0.00E+00

0240

Analysis Report for 2112077-13

MW-10

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
FE-55	5.89	24.50	5.57E-04	5.57E-04	5.99E-05	2.50E-04
CO-57	122.06	85.51	1.75E+01	1.75E+01	-1.02E+01	8.24E+00
	136.48	10.60	1.53E+02		-5.38E+01	7.14E+01
NI-59	6.92	29.80	1.51E-03	1.51E-03	4.03E-04	6.97E-04
MO-93	16.59	52.90	1.51E-01	1.51E-01	1.76E-02	7.28E-02
	18.60	10.00	1.29E+00		1.06E+00	6.24E-01
NB-93M	16.57	9.43	8.42E-01	8.42E-01	9.84E-02	4.06E-01
CD-109	88.03	3.72	2.38E+02	2.38E+02	-1.76E+01	1.12E+02
SN-113	255.12	1.93	1.03E+03	4.95E+01	1.05E+02	4.71E+02
	391.69	61.90	4.95E+01		4.56E+01	2.33E+01
SN-119M	23.87	16.10	2.29E+00	2.29E+00	-4.72E+01	1.11E+00
	25.10	22.70	2.39E+00		-4.48E+01	1.16E+00
+ I-129	29.78	* 57.00	1.96E+00	1.96E+00	3.37E+01	9.51E-01
	33.60	* 13.20	1.29E+01		5.93E+01	6.29E+00
	39.58	7.52	2.35E+01		-1.49E+00	1.13E+01
+ BA-133	81.00	* 34.06	3.59E+01	2.77E+01	3.21E+02	1.73E+01
	302.84	* 18.33	1.79E+02		3.58E+02	8.47E+01
	356.01	* 62.05	2.77E+01		3.40E+02	1.24E+01
CE-139	165.85	80.35	2.53E+01	2.53E+01	-1.03E+01	1.19E+01
CE-144	133.54	10.80	1.48E+02	1.48E+02	1.98E+01	6.91E+01
HG-203	279.19	77.30	3.04E+01	3.04E+01	-1.73E+00	1.41E+01
PB-210	46.50	4.25	4.53E+01	4.53E+01	7.65E+00	2.13E+01
TH-231	25.64	14.70	5.79E+00	5.79E+00	-1.74E+01	2.84E+00
	84.21	6.40	3.44E+02		1.71E+01	1.68E+02
PA-234M	9.89	89.00	5.40E-03	5.40E-03	5.42E-03	2.57E-03
	21.72	64.90	3.69E-01		-1.83E-01	1.78E-01
	37.93	23.75	1.02E+01		7.26E-01	4.96E+00
+ TH-234	63.29	* 3.80	1.88E+02	1.88E+02	4.28E+02	9.10E+01
NP-237	29.37	* 14.00	7.97E+00	7.97E+00	1.37E+02	3.87E+00
	86.50	12.60	1.07E+02		-1.97E+01	5.16E+01
U-237	97.08	16.30	7.15E+01	4.62E+01	3.43E+00	3.38E+01
	101.07	26.30	4.62E+01		-9.44E+00	2.18E+01
	114.00	12.30	1.95E+02		4.13E+02	9.41E+01
	208.01	22.00	1.07E+02		-1.57E-01	4.99E+01
+ AM-241	59.54	* 35.90	1.99E+01	1.99E+01	4.53E+01	9.64E+00
AM-243	74.67	66.00	1.36E+01	1.36E+01	-1.92E+00	6.51E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-14  
MW-5

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-14  
 Sample Description : MW-5  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:58:20AM  
 Acquisition Started : 1/10/2022 11:06:25AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE5  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 1019.6 seconds  
  
 Dead Time : 11.73 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 2 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118886

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:23:27AM

Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-14

MW-5

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	16.64	153 -	164	159.35	1.11E+01	11.83	1.59E+01	0.49
	2	20.91	192 -	209	202.40	7.66E+01	33.47	1.01E+02	0.52
	3	30.74	288 -	317	301.49	2.07E+03	109.91	3.04E+02	0.65
M	4	34.84	330 -	363	342.83	4.57E+02	51.22	6.49E+01	0.65
m	5	35.78	330 -	363	352.27	1.13E+02	53.07	4.86E+01	0.80
	6	53.10	513 -	536	526.83	5.01E+01	27.57	5.58E+01	0.34
	7	61.52	598 -	621	611.70	2.52E+02	36.44	3.20E+01	0.70
	8	65.71	642 -	666	653.94	9.70E+01	43.04	1.42E+02	0.44
M	9	79.55	774 -	819	793.46	5.50E+01	67.22	9.75E+01	1.44
m	10	80.88	774 -	819	806.87	8.49E+02	60.25	5.00E+01	0.65
	11	111.79	1108 -	1129	1118.34	1.75E+02	37.12	8.23E+01	0.58
	12	115.89	1152 -	1169	1159.72	3.11E+01	24.98	7.78E+01	0.19
	13	276.31	2763 -	2787	2776.83	4.16E+01	15.30	8.78E+00	0.46
M	14	302.41	3027 -	3053	3040.00	1.41E+02	23.28	1.04E+01	1.07
m	15	303.19	3027 -	3053	3047.83	1.92E+01	17.42	4.80E+00	0.67
	16	307.12	3074 -	3096	3087.41	3.20E+01	11.31	0.00E+00	0.88
M	17	333.26	3339 -	3365	3351.00	6.21E+01	18.03	3.13E+00	1.09
m	18	333.98	3339 -	3365	3358.27	3.45E+01	16.03	4.37E+00	0.88
	19	355.89	3563 -	3590	3579.20	4.18E+02	42.82	1.87E+01	0.83
M	20	383.23	3843 -	3871	3854.86	1.56E+01	20.35	5.85E+00	1.25
m	21	383.94	3843 -	3871	3862.00	1.60E+02	20.20	9.61E+00	1.13
M	22	386.12	3875 -	3901	3884.00	1.21E+01	22.20	1.59E+01	1.14
m	23	386.74	3875 -	3901	3890.18	1.12E+02	27.41	2.41E+01	0.93
	24	390.87	3915 -	3943	3931.89	3.64E+01	18.07	2.32E+01	1.34

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:23:27AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118843.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	16.64	1.11E+01	11.83			1.11E+01	1.18E+01
	2	20.91	7.66E+01	33.47	8.71E+00	6.63E-01	6.79E+01	3.35E+01
	3	30.74	2.07E+03	109.91	6.35E+00	8.10E-01	2.06E+03	1.10E+02
M	4	34.84	4.57E+02	51.22	1.59E+00	6.48E-01	4.55E+02	5.12E+01
m	5	35.78	1.13E+02	53.07	1.59E+00	6.48E-01	1.11E+02	5.31E+01

0243

Analysis Report for 2112077-14

MW-5

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	6	53.10	5.01E+01	27.57			5.01E+01	2.76E+01
	7	61.52	2.52E+02	36.44	3.32E+00	6.94E-01	2.49E+02	3.64E+01
	8	65.71	9.70E+01	43.04			9.70E+01	4.30E+01
M	9	79.55	5.50E+01	67.22			5.50E+01	6.72E+01
m	10	80.88	8.49E+02	60.25			8.49E+02	6.02E+01
	11	111.79	1.75E+02	37.12	7.94E-01	4.65E-01	1.74E+02	3.71E+01
	12	115.89	3.11E+01	24.98			3.11E+01	2.50E+01
	13	276.31	4.16E+01	15.30			4.16E+01	1.53E+01
M	14	302.41	1.41E+02	23.28			1.41E+02	2.33E+01
m	15	303.19	1.92E+01	17.42			1.92E+01	1.74E+01
	16	307.12	3.20E+01	11.31			3.20E+01	1.13E+01
M	17	333.26	6.21E+01	18.03			6.21E+01	1.80E+01
m	18	333.98	3.45E+01	16.03			3.45E+01	1.60E+01
	19	355.89	4.18E+02	42.82			4.18E+02	4.28E+01
M	20	383.23	1.56E+01	20.35			1.56E+01	2.03E+01
m	21	383.94	1.60E+02	20.20			1.60E+02	2.02E+01
M	22	386.12	1.21E+01	22.20			1.21E+01	2.22E+01
m	23	386.74	1.12E+02	27.41			1.12E+02	2.74E+01
	24	390.87	3.64E+01	18.07			3.64E+01	1.81E+01

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
MO-93	0.79	16.59	*	52.90	1.13E-02	1.21E-02
		18.60		10.00		
NB-93M	1.00	16.57	*	9.43	6.37E-02	6.80E-02
SN-113	0.93	255.12		1.93		
		391.69	*	61.90	3.00E+01	1.49E+01
I-129	0.87	29.78	*	57.00	2.86E+01	1.53E+00
		33.60	*	13.20	4.35E+01	4.90E+00
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.59E+02	2.89E+01
		302.84	*	18.33	5.82E+01	5.29E+01

0244

Analysis Report for 2112077-14  
MW-5

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
BA-133	0.99	356.01 *	62.05	3.59E+02	3.97E+01
TH-234	0.92	63.29 *	3.80	4.88E+02	7.22E+01
AM-241	0.90	59.54 *	35.90	5.17E+01	7.64E+00

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
? MO-93	0.799	1.13E-02	1.21E-02	
? NB-93M	1.000	6.37E-02	6.80E-02	
SN-113	0.937	3.00E+01	1.49E+01	
I-129	0.877	2.99E+01	1.46E+00	
BA-133	0.999	3.10E+02	2.14E+01	
? TH-234	0.923	4.88E+02	7.22E+01	
X NP-237	0.731			
? AM-241	0.904	5.17E+01	7.64E+00	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-14

MW-5

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 11:23:27AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide	
	2	20.91	7.54147E-02	24.66	Tol.	MO-93 PA-234M
m	5	35.78	1.23633E-01	23.85	Tol.	PA-234M
	6	53.10	5.56553E-02	27.52	Sum	
	8	65.71	1.07751E-01	22.19	Sum	
M	9	79.55	6.11657E-02	61.06	Sum	
	11	111.79	1.93404E-01	10.66	Sum	
	12	115.89	3.45635E-02	40.16	Sum	
	13	276.31	4.62319E-02	18.38		
M	14	302.41	1.56403E-01	8.27	Tol.	BA-133
	16	307.12	3.55556E-02	17.68		
M	17	333.26	6.90188E-02	14.51	Sum	
m	18	333.98	3.83246E-02	23.24	Sum	
M	20	383.23	1.73294E-02	65.24	Sum	
m	21	383.94	1.78112E-01	6.30	Sum	
M	22	386.12	1.34867E-02	91.44	Sum	
m	23	386.74	1.24421E-01	12.24	Sum	

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB



Analysis Report for 2112077-14

MW-5

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	1.25E-06	1.25E-06	-1.07E-05	6.06E-07
	3.31	12.30	1.13E-05		-6.30E-05	5.40E-06
FE-55	5.89	24.50	1.64E-04	1.64E-04	1.52E-05	7.45E-05
CO-57	122.06	85.51	9.36E+00	9.36E+00	6.02E+00	4.20E+00
	136.48	10.60	9.65E+01		2.64E+01	4.38E+01
NI-59	6.92	29.80	3.32E-04	3.32E-04	-2.28E-04	1.49E-04
+ MO-93	16.59	* 52.90	1.93E-02	1.93E-02	1.13E-02	8.25E-03
	18.60	10.00	2.84E-01		-1.16E-01	1.29E-01
+ NB-93M	16.57	* 9.43	1.08E-01	1.08E-01	6.37E-02	4.63E-02
CD-109	88.03	3.72	1.38E+02	1.38E+02	2.16E+01	6.26E+01
+ SN-113	255.12	1.93	5.58E+02	2.05E+01	5.64E+01	2.40E+02
	391.69	* 61.90	2.05E+01		3.00E+01	9.12E+00
SN-119M	23.87	16.10	4.89E-01	4.49E-01	-2.62E-02	2.21E-01
	25.10	22.70	4.49E-01		1.22E-02	2.03E-01
+ I-129	29.78	* 57.00	1.45E+00	1.45E+00	2.86E+01	7.06E-01
	33.60	* 13.20	5.91E+00		4.35E+01	2.82E+00
	39.58	7.52	6.56E+00		4.55E+00	2.93E+00
+ BA-133	81.00	* 34.06	2.74E+01	2.04E+01	3.59E+02	1.31E+01
	302.84	* 18.33	4.93E+01		5.82E+01	2.06E+01
	356.01	* 62.05	2.04E+01		3.59E+02	9.03E+00
CE-139	165.85	80.35	1.38E+01	1.38E+01	-1.51E+00	6.19E+00
CE-144	133.54	10.80	7.46E+01	7.46E+01	-2.68E+01	3.30E+01
HG-203	279.19	77.30	1.58E+01	1.58E+01	-1.30E+01	6.93E+00
PB-210	46.50	4.25	1.67E+01	1.67E+01	-6.66E+00	7.30E+00
TH-231	25.64	14.70	7.57E-01	7.57E-01	-5.55E-01	3.43E-01
	84.21	6.40	7.21E+01		1.59E+01	3.27E+01
PA-234M	9.89	89.00	1.17E-03	1.17E-03	8.70E-04	5.35E-04
	21.72	64.90	1.38E-01		-6.32E-02	6.50E-02
	37.93	23.75	1.76E+00		-1.52E-01	7.83E-01
+ TH-234	63.29	* 3.80	6.43E+01	6.43E+01	4.88E+02	2.95E+01
NP-237	29.37	* 14.00	5.91E+00	5.91E+00	1.16E+02	2.88E+00
	86.50	12.60	3.42E+01		-4.14E+00	1.53E+01
U-237	97.08	16.30	4.02E+01	2.48E+01	1.67E+01	1.84E+01
	101.07	26.30	2.48E+01		1.24E+00	1.12E+01
	114.00	12.30	6.84E+01		-1.69E+02	3.12E+01
	208.01	22.00	5.53E+01		-4.79E+00	2.44E+01
+ AM-241	59.54	* 35.90	6.81E+00	6.81E+00	5.17E+01	3.12E+00
AM-243	74.67	66.00	5.44E+00	5.44E+00	-3.58E-01	2.47E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

LP  
1/10/22

Analysis Report for 2112077-15  
MW-4

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-15  
 Sample Description : MW-4  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:58:29AM  
 Acquisition Started : 1/10/2022 11:06:35AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE1  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds  
  
 Dead Time : 0.02 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 32 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/14/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118887

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:21:38AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-15

MW-4

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	52.93	48 -	73	52.62	5.64E+01	39.95	1.84E+02	2.68
m	2	61.93	48 -	73	61.62	2.58E+02	50.60	2.31E+02	2.70
m	3	66.75	48 -	73	66.44	8.42E+01	49.40	2.64E+02	2.71
	4	81.39	76 -	86	81.07	7.80E+02	75.34	3.41E+02	1.89
M	5	112.35	107 -	120	112.03	2.25E+02	45.49	1.69E+02	3.06
m	6	116.76	107 -	120	116.44	3.47E+01	36.77	1.58E+02	2.54
	7	133.60	129 -	138	133.28	3.52E+01	34.01	1.46E+02	5.74
	8	160.43	155 -	164	160.11	3.78E+01	39.29	1.96E+02	4.39
	9	227.85	222 -	233	227.52	3.84E+01	36.00	1.39E+02	5.62
	10	240.19	234 -	246	239.86	4.28E+01	32.43	1.02E+02	3.93
M	11	265.56	264 -	281	265.22	1.07E+01	8.43	2.06E+01	2.45
m	12	271.11	264 -	281	270.78	1.84E+01	17.41	4.53E+01	2.46
m	13	276.56	264 -	281	276.22	7.53E+01	21.33	3.95E+01	2.46
	14	303.68	296 -	310	303.34	1.73E+02	38.40	8.28E+01	2.65
	15	325.92	323 -	328	325.58	1.43E+01	11.53	1.54E+01	3.59
M	16	332.10	329 -	360	331.75	3.61E+01	17.12	1.59E+01	3.03
m	17	356.56	329 -	360	356.21	4.99E+02	47.62	5.37E+01	2.22
M	18	384.31	380 -	398	383.96	1.26E+02	29.83	3.12E+01	2.48
m	19	387.40	380 -	398	387.06	2.15E+02	38.23	2.42E+01	2.41
m	20	391.81	380 -	398	391.46	3.77E+01	23.62	1.57E+01	2.30
	21	418.22	410 -	426	417.87	9.18E+01	26.85	3.24E+01	8.82
	22	437.34	432 -	440	436.99	1.07E+02	23.35	1.87E+01	2.17
M	23	468.59	464 -	479	468.24	1.77E+01	12.17	1.62E+01	2.60
m	24	472.59	464 -	479	472.24	1.14E+01	12.49	7.90E+00	2.60
	25	1024.19	1020 -	1025	1023.80	5.00E+00	4.47	0.00E+00	1.16
	26	1076.53	1072 -	1079	1076.14	7.11E+00	7.21	3.78E+00	2.86

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:21:38AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118839.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	52.93	5.64E+01	39.95			5.64E+01	3.99E+01
m	2	61.93	2.58E+02	50.60	2.33E+01	2.32E+00	2.35E+02	5.06E+01
m	3	66.75	8.42E+01	49.40			8.42E+01	4.94E+01

Analysis Report for 2112077-15

MW-4

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	4	81.39	7.80E+02	75.34			7.80E+02	7.53E+01
M	5	112.35	2.25E+02	45.49			2.25E+02	4.55E+01
m	6	116.76	3.47E+01	36.77			3.47E+01	3.68E+01
	7	133.60	3.52E+01	34.01			3.52E+01	3.40E+01
	8	160.43	3.78E+01	39.29			3.78E+01	3.93E+01
	9	227.85	3.84E+01	36.00			3.84E+01	3.60E+01
	10	240.19	4.28E+01	32.43	4.91E+00	1.64E+00	3.79E+01	3.25E+01
M	11	265.56	1.07E+01	8.43			1.07E+01	8.43E+00
m	12	271.11	1.84E+01	17.41			1.84E+01	1.74E+01
m	13	276.56	7.53E+01	21.33			7.53E+01	2.13E+01
	14	303.68	1.73E+02	38.40			1.73E+02	3.84E+01
	15	325.92	1.43E+01	11.53			1.43E+01	1.15E+01
M	16	332.10	3.61E+01	17.12			3.61E+01	1.71E+01
m	17	356.56	4.99E+02	47.62			4.99E+02	4.76E+01
M	18	384.31	1.26E+02	29.83			1.26E+02	2.98E+01
m	19	387.40	2.15E+02	38.23			2.15E+02	3.82E+01
m	20	391.81	3.77E+01	23.62			3.77E+01	2.36E+01
	21	418.22	9.18E+01	26.85			9.18E+01	2.69E+01
	22	437.34	1.07E+02	23.35			1.07E+02	2.33E+01
M	23	468.59	1.77E+01	12.17	0.00E+00	0.00E+00	1.77E+01	1.22E+01
m	24	472.59	1.14E+01	12.49			1.14E+01	1.25E+01
	25	1024.19	5.00E+00	4.47			5.00E+00	4.47E+00
	26	1076.53	7.11E+00	7.21			7.11E+00	7.21E+00

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.00sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12	1.93		
		391.69	*	61.90	2.84E+01
BA-133	0.99	81.00	*	34.06	4.00E+02
		302.84	*	18.33	4.79E+02
		356.01	*	62.05	3.91E+02
CE-144	1.00	133.54	*	10.80	1.15E+02
					1.11E+02

0250

Analysis Report for 2112077-15

MW-4

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/units)</b>	<b>Activity Uncertainty</b>
TH-234	0.95	63.29 *	3.80	6.28E+02	1.36E+02
AM-241	0.86	59.54 *	35.90	6.65E+01	1.44E+01

\* = Energy line found in the spectrum.

- = Manually added nuclide.

? = Manually edited nuclide.

@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.953	2.84E+01	1.78E+01	
BA-133	0.992	4.01E+02	2.82E+01	
CE-144	1.000	1.15E+02	1.11E+02	
? TH-234	0.954	6.28E+02	1.36E+02	
? AM-241	0.863	6.65E+01	1.44E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-15

MW-4

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 11:21:38AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M	1	52.93	6.26893E-02	35.40	
m	3	66.75	9.35790E-02	29.33	
M	5	112.35	2.50467E-01	10.09	
m	6	116.76	3.85835E-02	52.94	
	8	160.43	4.19608E-02	52.02	Sum
	9	227.85	4.26852E-02	46.85	
	10	240.19	4.20621E-02	42.89	
M	11	265.56	1.19319E-02	39.23	Sum
m	12	271.11	2.04289E-02	47.34	
m	13	276.56	8.36333E-02	14.17	
	15	325.92	1.58838E-02	40.34	
M	16	332.10	4.01127E-02	23.72	
M	18	384.31	1.40531E-01	11.79	Sum
m	19	387.40	2.39118E-01	8.88	Sum
	21	418.22	1.02016E-01	14.62	Sum
	22	437.34	1.18496E-01	10.95	Sum
M	23	468.59	1.96167E-02	34.45	
m	24	472.59	1.26715E-02	54.76	Sum
	25	1024.19	5.55556E-03	44.72	
	26	1076.53	7.90123E-03	50.70	

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M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 2112077-15  
MW-4

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	5.44E-07	5.44E-07	0.00E+00	0.00E+00
	3.31	12.30	6.51E-06		0.00E+00	0.00E+00
FE-55	5.89	24.50	1.09E-04	1.09E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.64E+01	1.64E+01	4.10E+00	7.71E+00
	136.48	10.60	1.48E+02		3.32E+01	6.95E+01
NI-59	6.92	29.80	2.19E-04	2.19E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	8.08E-03	8.08E-03	0.00E+00	0.00E+00
	18.60	10.00	6.79E-02		0.00E+00	0.00E+00
NB-93M	16.57	9.43	4.51E-02	4.51E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	2.78E+02	2.78E+02	-1.76E+02	1.32E+02
+ SN-113	255.12	1.93	7.92E+02	3.39E+01	-2.65E+01	3.60E+02
	391.69	*	61.90	3.39E+01	2.84E+01	1.59E+01
SN-119M	23.87	16.10	1.08E-01	9.19E-02	0.00E+00	0.00E+00
	25.10	22.70	9.19E-02		0.00E+00	0.00E+00
I-129	29.78	57.00	1.05E+00	1.05E+00	-8.82E-01	4.93E-01
	33.60	13.20	1.85E+01		6.85E+01	9.05E+00
	39.58	7.52	3.91E+01		1.66E+01	1.89E+01
+ BA-133	81.00	* 34.06	4.41E+01	4.41E+01	4.00E+02	2.13E+01
	302.84	* 18.33	1.35E+02		4.79E+02	6.40E+01
	356.01	* 62.05	7.78E+01		3.91E+02	3.78E+01
CE-139	165.85	80.35	2.43E+01	2.43E+01	3.97E+00	1.14E+01
+ CE-144	133.54	* 10.80	1.80E+02	1.80E+02	1.15E+02	8.57E+01
HG-203	279.19	77.30	2.79E+01	2.79E+01	3.10E+01	1.30E+01
PB-210	46.50	4.25	5.54E+01	5.54E+01	2.32E+00	2.61E+01
TH-231	25.64	14.70	1.53E-01	1.53E-01	0.00E+00	0.00E+00
PA-234M	84.21	6.40	3.66E+02		1.58E+03	1.79E+02
	9.89	89.00	4.64E-04	4.64E-04	0.00E+00	0.00E+00
	21.72	64.90	1.90E-02		0.00E+00	0.00E+00
+ TH-234	37.93	23.75	1.37E+01		3.86E+01	6.67E+00
	63.29	* 3.80	4.55E+02	4.55E+02	6.28E+02	2.24E+02
	NP-237	29.37	14.00	4.09E+00	4.09E+00	-3.43E+00
U-237	86.50	12.60	9.32E+01		-3.12E+01	4.45E+01
	97.08	16.30	6.83E+01	4.13E+01	-4.11E+01	3.22E+01
	101.07	26.30	4.13E+01		-1.87E+00	1.94E+01
	114.00	12.30	1.99E+02		4.22E+02	9.61E+01
+ AM-241	208.01	22.00	8.55E+01		-5.15E+01	3.97E+01
	59.54	* 35.90	4.81E+01	4.81E+01	6.65E+01	2.37E+01
AM-243	74.67	66.00	1.26E+01	1.26E+01	2.31E+00	6.01E+00

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

KP  
1/10/22

Analysis Report for 2112077-16  
MW-3

## GAMMA SPECTRUM ANALYSIS

Sample Identification : 2112077-16  
 Sample Description : MW-3  
 Sample Type : RA RECOVERY

Sample Size : 1.000E+00 units  
 Facility : Countroom

Sample Taken On : 1/10/2022 9:58:36AM  
 Acquisition Started : 1/10/2022 11:14:19AM

Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE2  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 900.2 seconds

Dead Time : 0.02 %

Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 27 - 4096  
 Identification Energy Tolerance : 2.500 keV

Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :

Sample Number : 118888

## PEAK ANALYSIS REPORT

Peak Analysis Performed on : 1/10/2022 11:29:22AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-16

MW-3

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.56	37 - 39	37.16	2.22E+02	47.81	2.66E+02	1.62
	2	52.62	50 - 57	54.18	5.47E+01	33.65	1.53E+02	1.15
M	3	62.08	61 - 70	63.62	1.59E+02	31.89	9.41E+01	1.78
m	4	66.23	61 - 70	67.77	9.78E+01	28.86	8.45E+01	1.77
	5	81.10	78 - 86	82.61	6.87E+02	61.42	1.57E+02	1.52
	6	111.58	108 - 116	113.03	7.97E+01	42.81	2.31E+02	1.75
	7	276.52	274 - 284	277.64	5.15E+01	28.20	8.30E+01	1.88
	8	285.83	284 - 291	286.93	2.10E+01	15.10	2.40E+01	3.16
	9	302.81	302 - 307	303.87	1.19E+02	29.55	8.51E+01	1.27
	10	333.54	330 - 338	334.55	3.11E+01	26.09	8.59E+01	1.47
	11	356.13	353 - 360	357.10	4.75E+02	47.79	6.41E+01	1.40
M	12	384.24	382 - 395	385.15	7.99E+01	23.45	2.22E+01	1.68
m	13	387.25	382 - 395	388.15	8.24E+01	23.71	1.80E+01	1.69
m	14	390.98	382 - 395	391.88	2.33E+01	15.81	1.57E+01	1.69
	15	414.94	413 - 420	415.79	1.79E+01	20.88	6.23E+01	1.34
	16	437.05	434 - 441	437.86	7.19E+01	20.20	2.02E+01	1.43
	17	451.16	450 - 454	451.94	5.50E+00	5.85	3.00E+00	2.38
	18	468.02	465 - 470	468.77	9.69E+00	10.00	1.26E+01	1.18
	19	481.99	480 - 485	482.71	7.00E+00	5.29	0.00E+00	3.32
	20	804.88	802 - 808	805.00	8.00E+00	5.66	0.00E+00	3.88
	21	857.77	855 - 860	857.80	5.00E+00	4.47	0.00E+00	2.76

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:29:22AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118840.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	2.22E+02	47.81			2.22E+02	4.78E+01
	2	5.47E+01	33.65	2.30E-01	1.75E+00	5.45E+01	3.37E+01
M	3	1.59E+02	31.89	1.58E+00	1.58E+00	1.57E+02	3.19E+01
m	4	9.78E+01	28.86	1.35E+00	1.47E+00	9.64E+01	2.89E+01
	5	6.87E+02	61.42			6.87E+02	6.14E+01
	6	7.97E+01	42.81			7.97E+01	4.28E+01
	7	5.15E+01	28.20			5.15E+01	2.82E+01
	8	2.10E+01	15.10			2.10E+01	1.51E+01

0255

Analysis Report for 2112077-16

MW-3

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
9	302.81	1.19E+02	29.55			1.19E+02	2.95E+01
10	333.54	3.11E+01	26.09			3.11E+01	2.61E+01
11	356.13	4.75E+02	47.79			4.75E+02	4.78E+01
M 12	384.24	7.99E+01	23.45			7.99E+01	2.35E+01
m 13	387.25	8.24E+01	23.71			8.24E+01	2.37E+01
m 14	390.98	2.33E+01	15.81			2.33E+01	1.58E+01
15	414.94	1.79E+01	20.88			1.79E+01	2.09E+01
16	437.05	7.19E+01	20.20			7.19E+01	2.02E+01
17	451.16	5.50E+00	5.85			5.50E+00	5.85E+00
18	468.02	9.69E+00	10.00			9.69E+00	1.00E+01
19	481.99	7.00E+00	5.29			7.00E+00	5.29E+00
20	804.88	8.00E+00	5.66	6.93E-01	5.82E-01	7.31E+00	5.69E+00
21	857.77	5.00E+00	4.47			5.00E+00	4.47E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12	1.93		
		391.69 *	61.90	1.70E+01	1.15E+01
BA-133	1.00	81.00 *	34.06	3.54E+02	3.48E+01
		302.84 *	18.33	3.09E+02	7.81E+01
		356.01 *	62.05	3.55E+02	3.86E+01
PA-234M	0.98	9.89	89.00		
		21.72	64.90		
		37.93 *	23.75	3.05E+01	6.57E+00
TH-234	0.96	63.29 *	3.80	4.60E+02	9.42E+01

Analysis Report for 2112077-16

MW-3

- \* = Energy line found in the spectrum.  
 - = Manually added nuclide.  
 ? = Manually edited nuclide.  
 @ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 2.500 keV

Nuclide confidence index threshold = 0.30

Errors quoted at 2.000sigma

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
SN-113	0.940	1.70E+01	1.15E+01	
BA-133	1.000	3.50E+02	2.45E+01	
PA-234M	0.981	3.05E+01	6.57E+00	
TH-234	0.963	4.60E+02	9.42E+01	

- ? = nuclide is part of an undetermined solution  
 X = nuclide rejected by the interference analysis  
 @ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-16  
MW-3

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 1/10/2022 11:29:22AM  
Peak Locate From Channel : 1  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	52.62	6.05585E-02	30.91	
m	4	66.23	1.07155E-01	14.98	
	6	111.58	8.85385E-02	26.86	Tol. U-237
	7	276.52	5.72222E-02	27.38	
	8	285.83	2.33333E-02	35.95	
	10	333.54	3.45270E-02	41.98	
M	12	384.24	8.87725E-02	14.68	Sum
m	13	387.25	9.15144E-02	14.39	
	15	414.94	1.98413E-02	58.47	
	16	437.05	7.98916E-02	14.05	Sum
	17	451.16	6.11111E-03	53.20	Sum
	18	468.02	1.07639E-02	51.61	
	19	481.99	7.77778E-03	37.80	
	20	804.88	8.11893E-03	38.91	
	21	857.77	5.55556E-03	44.72	

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

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## NUCLIDE MDA REPORT

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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
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Analysis Report for 2112077-16

MW-3

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
CA-41	3.00	77.00	5.55E-06	5.55E-06	0.00E+00	0.00E+00
	3.31	12.30	5.93E-05		0.00E+00	0.00E+00
FE-55	5.89	24.50	5.43E-04	5.43E-04	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.13E+01	1.13E+01	-4.03E+00	5.20E+00
	136.48	10.60	1.07E+02		9.22E+00	4.90E+01
NI-59	6.92	29.80	9.37E-04	9.37E-04	0.00E+00	0.00E+00
MO-93	16.59	52.90	1.70E-02	1.70E-02	0.00E+00	0.00E+00
	18.60	10.00	1.33E-01		0.00E+00	0.00E+00
NB-93M	16.57	9.43	9.52E-02	9.52E-02	0.00E+00	0.00E+00
CD-109	88.03	3.72	1.93E+02	1.93E+02	6.39E+01	8.94E+01
+ SN-113	255.12	1.93	5.45E+02	2.67E+01	2.68E+02	2.40E+02
	391.69	* 61.90	2.67E+01		1.70E+01	1.23E+01
SN-119M	23.87	16.10	1.81E-01	1.81E-01	0.00E+00	0.00E+00
	25.10	22.70	1.49E+00		-1.78E-01	6.68E-01
I-129	29.78	57.00	6.93E+00	6.93E+00	5.30E+01	3.41E+00
	33.60	13.20	3.90E+01		1.04E+01	1.92E+01
	39.58	7.52	1.90E+01		1.03E+00	8.72E+00
+ BA-133	81.00	* 34.06	2.85E+01	2.61E+01	3.54E+02	1.35E+01
	302.84	* 18.33	9.15E+01		3.09E+02	4.23E+01
	356.01	* 62.05	2.61E+01		3.55E+02	1.20E+01
CE-139	165.85	80.35	1.69E+01	1.69E+01	3.42E+00	7.81E+00
CE-144	133.54	10.80	1.11E+02	1.11E+02	1.67E+01	5.12E+01
HG-203	279.19	77.30	2.18E+01	2.18E+01	1.02E+01	1.01E+01
PB-210	46.50	4.25	4.55E+01	4.55E+01	-5.27E+00	2.08E+01
TH-231	25.64	14.70	3.26E+00	3.26E+00	-1.12E+00	1.51E+00
	84.21	6.40	1.10E+02		-1.38E-01	5.10E+01
+ PA-234M	9.89	89.00	1.45E-03	1.45E-03	0.00E+00	0.00E+00
	21.72	64.90	3.37E-02		0.00E+00	0.00E+00
	37.93	* 23.75	1.26E+01		3.05E+01	6.13E+00
+ TH-234	63.29	* 3.80	1.67E+02	1.67E+02	4.60E+02	7.97E+01
NP-237	29.37	14.00	2.71E+01	2.71E+01	2.08E+02	1.34E+01
	86.50	12.60	5.31E+01		2.99E+01	2.45E+01
U-237	97.08	16.30	4.70E+01	3.49E+01	-3.95E+01	2.16E+01
	101.07	26.30	3.49E+01		2.41E+01	1.62E+01
	114.00	12.30	1.39E+02		1.59E+02	6.66E+01
	208.01	22.00	6.10E+01		4.61E+00	2.78E+01
AM-241	59.54	35.90	1.50E+01	1.50E+01	4.50E-01	7.14E+00
AM-243	74.67	66.00	8.95E+00	8.95E+00	1.24E-01	4.16E+00

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

@ = Half-life too short to be able to perform the decay correction

Analysis Report for 2112077-17  
MW-2

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : 2112077-17  
 Sample Description : MW-2  
 Sample Type : RA RECOVERY  
  
 Sample Size : 1.000E+00 units  
 Facility : Countroom  
  
 Sample Taken On : 1/10/2022 9:58:44AM  
 Acquisition Started : 1/10/2022 11:14:27AM  
  
 Procedure : BAFIL  
 Operator : Administrator  
 Detector Name : GE3  
 Geometry : BAFIL  
 Live Time : 900.0 seconds  
 Real Time : 913.5 seconds  
  
 Dead Time : 1.48 %  
  
 Peak Locate Threshold : 2.50  
 Peak Locate Range (in channels) : 1 - 4096  
 Peak Area Range (in channels) : 9 - 4096  
 Identification Energy Tolerance : 2.500 keV  
  
 Energy Calibration Used Done On : 11/20/2021  
 Efficiency Calibration Used Done On : 12/13/2021  
 Efficiency Calibration Description :  
  
 Sample Number : 118889

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 1/10/2022 11:29:43AM  
 Peak Analysis From Channel : 1  
 Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
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Analysis Report for 2112077-17

MW-2

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	20.93	17 -	41	21.57	9.96E+01	44.15	2.92E+02	4.33
m	2	31.29	17 -	41	31.93	2.05E+03	112.59	4.18E+02	5.38
	3	63.62	55 -	72	64.24	2.68E+02	94.16	6.98E+02	4.91
	4	80.96	75 -	88	81.56	6.45E+02	76.12	3.58E+02	3.41
	5	112.88	104 -	125	113.46	1.25E+02	100.21	7.18E+02	2.38
	6	141.36	137 -	149	141.92	5.70E+01	44.68	2.08E+02	6.53
	7	276.61	269 -	284	277.08	3.40E+01	37.63	1.28E+02	3.36
	8	303.75	294 -	313	304.20	1.20E+02	46.48	1.40E+02	3.46
	9	335.70	330 -	341	336.13	4.10E+01	31.11	9.61E+01	7.38
	10	356.49	351 -	363	356.91	3.60E+02	45.22	7.09E+01	3.20
	11	386.90	378 -	400	387.30	2.65E+02	47.69	7.73E+01	5.08
M	12	417.22	410 -	444	417.60	3.13E+01	24.08	4.50E+01	6.72
m	13	437.71	410 -	444	438.08	7.41E+01	24.23	2.90E+01	4.29
	14	468.32	461 -	474	468.67	2.63E+01	13.00	7.37E+00	7.41
	15	508.52	502 -	514	508.84	1.75E+01	13.44	1.30E+01	5.33

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 1/10/2022 11:29:43AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000118841.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	20.93	9.96E+01	44.15			9.96E+01	4.42E+01
m	2	31.29	2.05E+03	112.59	8.55E+01	2.11E-01	1.97E+03	1.13E+02
	3	63.62	2.68E+02	94.16	5.73E+01	6.61E-01	2.11E+02	9.42E+01
	4	80.96	6.45E+02	76.12			6.45E+02	7.61E+01
	5	112.88	1.25E+02	100.21			1.25E+02	1.00E+02
	6	141.36	5.70E+01	44.68	1.94E+00	1.62E+00	5.51E+01	4.47E+01
	7	276.61	3.40E+01	37.63			3.40E+01	3.76E+01
	8	303.75	1.20E+02	46.48	5.24E-01	4.63E-01	1.19E+02	4.65E+01
	9	335.70	4.10E+01	31.11			4.10E+01	3.11E+01
	10	356.49	3.60E+02	45.22			3.60E+02	4.52E+01
	11	386.90	2.65E+02	47.69			2.65E+02	4.77E+01
M	12	417.22	3.13E+01	24.08			3.13E+01	2.41E+01
m	13	437.71	7.41E+01	24.23			7.41E+01	2.42E+01
	14	468.32	2.63E+01	13.00			2.63E+01	1.30E+01

Analysis Report for 2112077-17

MW-2

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
15	508.52	1.75E+01	13.44			1.75E+01	1.34E+01

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet  
Errors quoted at 2.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.59	29.78	*	57.00	6.53E+01	3.75E+00
		33.60		13.20		
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	2.83E+02	3.50E+01
		302.84	*	18.33	3.61E+02	1.42E+02
		356.01	*	62.05	3.32E+02	4.39E+01
TH-234	0.99	63.29	*	3.80	5.36E+02	2.40E+02
NP-237	0.60	29.37	*	14.00	2.66E+02	1.53E+01
		86.50		12.60		

\* = Energy line found in the spectrum.  
- = Manually added nuclide.  
? = Manually edited nuclide.  
@ = Energy line not used for Weighted Mean Activity  
Energy Tolerance : 2.500 keV  
Nuclide confidence index threshold = 0.30  
Errors quoted at 2.000sigma

## INTERFERENCE CORRECTED REPORT



Analysis Report for 2112077-17

MW-2

	<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/units)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
?	I-129	0.599	6.53E+01	3.75E+00	
	BA-133	0.993	3.04E+02	2.69E+01	
	TH-234	0.997	5.36E+02	2.40E+02	
?	NP-237	0.603	2.66E+02	1.53E+01	

? = nuclide is part of an undetermined solution

X = nuclide rejected by the interference analysis

@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 2112077-17

MW-2

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**UNIDENTIFIED PEAKS**


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Peak Locate Performed on : 1/10/2022 11:29:43AM  
 Peak Locate From Channel : 1  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M 1	20.93	1.10674E-01	22.16	Tol.	MO-93 PA-234M
5	112.88	1.38991E-01	40.06	Sum	
6	141.36	6.11791E-02	40.60		
7	276.61	3.77778E-02	55.34		
9	335.70	4.55181E-02	37.97	Sum	
11	386.90	2.94857E-01	8.98	Sum	
M 12	417.22	3.47941E-02	38.45		
m 13	437.71	8.23763E-02	16.34	Sum	
14	468.32	2.92407E-02	24.70		
15	508.52	1.94444E-02	38.39		

M = First peak in a multiplet region  
 m = Other peak in a multiplet region  
 F = Fitted singlet  
 Errors quoted at 2.000sigma

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**NUCLIDE MDA REPORT**


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Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
CA-41	3.00	77.00	1.04E-04	1.04E-04	7.35E-05	4.84E-05
	3.31	12.30	1.07E-03		7.56E-04	4.98E-04
FE-55	5.89	24.50	1.14E-02	1.14E-02	1.36E-02	5.41E-03
CO-57	122.06	85.51	2.16E+01	2.16E+01	-4.51E-01	1.04E+01
	136.48	10.60	1.74E+02		-3.57E+01	8.28E+01

0264

Analysis Report for 2112077-17

MW-2

<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Line MDA (pCi/units)</b>	<b>Nuclide MDA (pCi/units)</b>	<b>Activity (pCi/units)</b>	<b>Dec. Level (pCi/units)</b>
NI-59	6.92	29.80	2.03E-02	2.03E-02	2.76E-02	9.66E-03
MO-93	16.59	52.90	4.82E-01	4.82E-01	3.55E-01	2.34E-01
	18.60	10.00	3.62E+00		3.11E-01	1.75E+00
NB-93M	16.57	9.43	2.70E+00	2.70E+00	1.98E+00	1.31E+00
CD-109	88.03	3.72	5.27E+02	5.27E+02	5.93E+00	2.57E+02
SN-113	255.12	1.93	1.13E+03	6.40E+01	1.05E+02	5.29E+02
	391.69	61.90	6.40E+01		1.16E+02	3.07E+01
SN-119M	23.87	16.10	1.05E+01	9.27E+00	4.73E+01	5.20E+00
	25.10	22.70	9.27E+00		5.54E+01	4.58E+00
+ I-129	29.78	* 57.00	5.40E+00	5.40E+00	6.53E+01	2.65E+00
	33.60	13.20	3.89E+01		3.54E+02	1.92E+01
	39.58	7.52	6.66E+01		-1.39E+01	3.27E+01
+ BA-133	81.00	* 34.06	4.21E+01	3.99E+01	2.83E+02	2.04E+01
	302.84	* 18.33	2.12E+02		3.61E+02	1.02E+02
	356.01	* 62.05	3.99E+01		3.32E+02	1.87E+01
CE-139	165.85	80.35	2.55E+01	2.55E+01	-8.94E+00	1.21E+01
CE-144	133.54	10.80	1.61E+02	1.61E+02	-6.52E+01	7.68E+01
HG-203	279.19	77.30	3.19E+01	3.19E+01	1.33E+00	1.50E+01
PB-210	46.50	4.25	9.14E+01	9.14E+01	-7.99E+01	4.41E+01
TH-231	25.64	14.70	1.52E+01	1.52E+01	9.10E+01	7.51E+00
	84.21	6.40	3.44E+02		-8.99E+00	1.69E+02
PA-234M	9.89	89.00	3.31E-02	3.31E-02	3.34E-02	1.59E-02
	21.72	64.90	1.12E+00		-5.18E-02	5.44E-01
	37.93	23.75	2.27E+01		-4.34E+00	1.12E+01
+ TH-234	63.29	* 3.80	3.82E+02	3.82E+02	5.36E+02	1.87E+02
+ NP-237	29.37	* 14.00	2.20E+01	2.20E+01	2.66E+02	1.08E+01
	86.50	12.60	1.79E+02		-7.55E+00	8.77E+01
U-237	97.08	16.30	9.39E+01	5.93E+01	5.72E+01	4.53E+01
	101.07	26.30	5.93E+01		1.48E+01	2.86E+01
	114.00	12.30	1.94E+02		4.33E+02	9.45E+01
	208.01	22.00	1.12E+02		1.16E+01	5.34E+01
AM-241	59.54	35.90	2.64E+01	2.64E+01	1.53E+00	1.29E+01
AM-243	74.67	66.00	2.49E+01	2.49E+01	-1.83E+00	1.22E+01

- + = Nuclide identified during the nuclide identification  
 \* = Energy line found in the spectrum  
 > = MDA value not calculated  
 @ = Half-life too short to be able to perform the decay correction

**SECTION XI**  
**ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)**

# TDS / TSS Worksheet

Work Order	Run	Analysis Code	Technician
<b>21-12077</b>	<b>1</b>	<b>TDS</b>	<b>MHIGHTOWER</b>

TRetec Fraction	ERM Client ID	Filter Data			TDS/TSS (mg/L)	Maximum Aliq (mL)
		Filter Tare (g)	Filter Final (g)	Filter Net (g)		
04	MW-11	78.9350	79.2617	0.3267	3267.0000	30.61
05	MW-1	80.8204	80.9437	0.1233	1233.0000	81.10
06	MW-8	79.0351	79.1794	0.1443	1443.0000	69.30
07	MW-7	122.7568	123.4188	0.6620	6620.0000	15.11
08	MW-9	82.7099	82.8681	0.1582	1582.0000	63.21
09	MW-9D	78.7647	78.9380	0.1733	1733.0000	57.70
10	SW-BO 13	122.7370	122.7408	0.0038	38.0000	2631.58
11	SW-BO 2	80.5372	80.5472	0.0100	100.0000	1000.00
12	MW-6	80.2330	80.6405	0.4075	4075.0000	24.54
13	MW-10	83.5245	83.7224	0.1979	1979.0000	50.53
14	MW-5	124.5341	124.8753	0.3412	3412.0000	29.31
15	MW-4	81.6316	81.9034	0.2718	2718.0000	36.79
16	MW-3	78.2393	78.4543	0.2150	2150.0000	46.51
17	MW-2	79.0508	79.1593	0.1085	1085.0000	92.17

Technician: MG Date: 1/4/22

# Aliquot Worksheet

Work Order		Run		Analysis Code		Rpt Units		Lab Deadline		Technician	
<b>21-12077</b>		<b>1</b>		<b>TDS</b>		<b>liters</b>		<b>1/10/2022</b>		<b>JPACHELLA</b>	

Lab Fraction	ERM Client ID	Sample Type	Muffle Data		Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq	
01	LCS	LCS						1.0000E+00	1.0000E+00				
02	BLANK	MBL						1.0000E+00	1.0000E+00				
03	DUP	DUP						1.0000E-01	1.0000E-01				
04	MW-11	TRG						1.0000E-01	1.0000E-01				
05	MW-1	TRG						1.0000E-01	1.0000E-01				
06	MW-8	TRG						1.0000E-01	1.0000E-01				
07	MW-7	TRG						1.0000E-01	1.0000E-01				
08	MW-9	TRG						1.0000E-01	1.0000E-01				
09	MW-9D	TRG						1.0000E-01	1.0000E-01				
10	SW-BO 13	TRG						1.0000E-01	1.0000E-01				
11	SW-BO 2	TRG						1.0000E-01	1.0000E-01				
12	MW-6	TRG						1.0000E-01	1.0000E-01				
13	MW-10	TRG						1.0000E-01	1.0000E-01				
14	MW-5	TRG						1.0000E-01	1.0000E-01				
15	MW-4	TRG						1.0000E-01	1.0000E-01				
16	MW-3	TRG						1.0000E-01	1.0000E-01				
17	MW-2	TRG						1.0000E-01	1.0000E-01				

Comments
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Technician: J. Pachella Date: 1/3/22