ZION SOLUTIONS LLC
An EnergySolutions Company

ZION STATION RESTORATION PROJECT
FINAL STATUS SURVEY RELEASE RECORD

NORTH BEACH AREA
SURVEY UNIT 10222

Revision 1

June 2019

Summary of Changes in this Revision:

- Rev. 1: Revised Release Record. Changes include the following;
  - Added additional acronyms to "List of Acronyms and Abbreviations
  - Corrected spelling errors
  - Corrected version of NAD.
  - Spelled out acronyms used 1st time in text
  - Added statement pertaining to subsurface soil sampling during FSS
  - Added statement pertaining to selection of reported values for results <MDC
  - Corrected use of MARSSIM 2000 software
  - Added units to header for Tables 9 and 10
  - Corrected sample ID number presentation in Tables 9 and 10
  - Corrected sample ID number presentation in text.
  - Changed investigation level for scanning to be consistent with Table 11
  - Added clarifying language for inferring HTD concentrations
  - Corrected title to Table H.1 of NUREG-1757
  - Renumbered the Attachments such that the gamma spec and Eberline reports were last.

PREPARED BY / DATE:		20 June 2019
	R. F. Yetter III, Junior Technical Assistant	**Date**
REVIEWED BY / DATE:		20 June 2019
	J. Graham, Radiological Engineer	**Date**
APPROVED BY / DATE:		20 June 2019
	D. Wojtkowiak, C/LT Manager	**Date**

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
AMCG	Average Member of the Critical Group
CoC	Chain-of-Custody
cpm	Counts per minute
DQA	Data Quality Assessment
DQO	Data Quality Objective
DCGL	Derived Concentration Guideline Level
EMC	Elevated Measurement Comparison
FSS	Final Status Survey
GPS	Global Positioning System
HTD	Hard to Detect
IC	Insignificant Dose Contributor
LBGR	Lower Bound of the Gray Region
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MDCR	Minimum Detectable Count Rate
NAD	North American Datum
NaI	Sodium Iodide
OpDCGL	Operational Derived Concentration Guideline Level
QAPP	Quality Assurance Project Plan (for Characterization and FSS)
QC	Quality Control
RE	Radiological Engineer
ROC	Radionuclides of Concern
SOF	Sum-of-Fraction
TEDE	Total Effective Dose Equivalent
TSD	Technical Support Documents

UBGR	Upper Bound of the Gray Region
UCL	Upper Confidence Level
VSP	Visual Sample Plan
ZNPS	Zion Nuclear Power Station
ZSRP	Zion Station Restoration Project

1. EXECUTIVE SUMMARY

This Final Status Survey (FSS) Release Record for survey unit 10222, "North Beach Area," has been generated for the Zion Station Restoration Project (ZSRP) in accordance with Zion*Solutions* procedure ZS-LT-300-001-005, *"Final Status Survey Data Reporting"* (Reference 1) and satisfies the requirements of Section 5.11 of the *"Zion Station Restoration Project License Termination Plan"* (LTP) (Reference 2).

A Final Status Survey (FSS) package (L3-10222A-F) was developed in accordance with Zion*Solutions* procedure ZS-LT-300-001-001, *"Final Status Survey Package Development"* (Reference 3), the ZSRP LTP, and with guidance from NUREG-1575, Revision 1, "*Multi-Agency Radiation Survey and Site Investigation Manual"* (MARSSIM) (Reference 4).

This open land survey unit has a MARSSIM classification of 3. A survey plan was designed based upon use of the Sign Test as the nonparametric statistical test for compliance. Both the Type I (α) and Type II (β) decision error rates were set at 0.05. Fifteen (15) randomly located surface soil samples were acquired from the survey unit. In addition, surface scanning was performed on 5% of the total surface area in the survey unit. The analytical results for all soil samples taken in survey unit 10222 indicate that the Sum-of-Fraction (SOF) for each sample, considering the concentration of all applicable Radionuclides of Concern (ROC), either by direct measurement or by inference, is less than 0.5 when applying the respective Operational Derived Concentration Guideline Levels (OpDCGL). Therefore, the null hypothesis is rejected and survey unit 10222 is acceptable for unrestricted release.

2. SURVEY UNIT DESCRIPTION

North Beach Area, survey unit 10222, is an impacted Class 3 open land survey unit. It is bounded to the west by Class 3 survey units 10212B and 10212A and Class 1 survey units 10201A, 10201B, 10201C, and 10201D; Class 3 survey unit 10223 to the south; Lake Michigan to the east; and to the north by Hosah Park. The area of the survey unit is 21,778 m^2.

The topography of the survey unit is mainly flat with some small dips and depressions. The soil is loam and beach sand. The terrain consists of thick underbrush, beach sand, beach grass, and small trees. Solid physical items such as rocks, driftwood, and chain-link fencing are present in the area.

The boundary of the survey unit was defined using a Global Positioning System (GPS) based on the Illinois State Plane System North American Datum (NAD) 1983 East. The reference coordinates associated with this survey unit are denoted on Figure 1 located in Attachment 1.

Picture 1 – Survey Unit 10222

3. CLASSIFICATION BASIS

Survey unit 10222 was classified in accordance with Zion*Solutions* procedure ZS-LT-300-001-002, "*Survey Unit Classification*" (Reference 5).

Impacted Class 3 open land survey unit 10222 was originally identified as non-impacted by the *"Historical Site Assessment"* (HSA) (Reference 6). Because of the survey unit's proximity to impacted survey units, it was reclassified as a Class 3 survey unit. The HSA does not cite any processes and/or incidents involving the use and/or handling of radioactive material in this open land survey unit and an inspection of the survey unit did not identify any visual indications that there are any subsurface burial sites present in this area.

Characterization surveys were performed in this survey unit from July 24, 2013, through August 12, 2013. The survey design for this survey unit called for the acquisition of eleven (11) surface soil samples taken at random locations and eighteen (18) surface soil samples taken at judgmental locations. The survey design also required the acquisition of subsurface soil samples at three (3) random locations and seven (7) judgmental locations to a depth of three meters.

Twelve-thousand one-hundred and twelve (12,112) square meters or approximately 56% of the total surface area in the survey unit was scanned using a Ludlum Model 2350-1 and a Model 44-10 Sodium Iodide (NaI) detector. For the area scanned, the average observed background in the survey unit was 1,806 counts per minute (cpm). The average observed scan measurement was 2,139 cpm with a maximum observed measurement of 4,316 cpm. One-hundred and two (102) scan alarms were observed in this survey unit with the scan alarm set-point set at the Minimum Detectable Count Rate (MDCR) plus background. The area where the elevated activity was observed was investigated by additional scans. A majority of the scan alarms occurred at the location of "black sand" deposits observed on the beach which appeared to be grit blasting media. The area was investigated by additional scans and one (1) investigative surface soil sample and five (5) investigative subsurface soil samples were acquired at the location were the scan alarms were observed.

Thirty (30) surface soil samples and two (2) Quality Control (QC) split samples were acquired and analyzed by the on-site gamma spectroscopy system. Fifteen (15) subsurface samples were taken to a depth of three-meters. Subsurface soil samples were composited and analyzed in one-meter intervals, resulting in forty-five (45) subsurface soil samples. All subsurface soil samples were analyzed by the on-site gamma spectroscopy system. No plant-derived radionuclides greater that the respective Minimum Detectable Concentration (MDC) of the instrument was detected in any sample in this survey unit. The samples taken around the "black sand" deposits exhibited natural radioactive material in the Uranium and Thorium decay chains, confirming that the material is most likely grit blasting media.

The locations of scan areas and surface soil samples taken during characterization in survey unit 10222 are illustrated on Figure 2 in Attachment 1. A summary of the analysis results for the surface soil samples taken during site characterization are presented in Table 1.

Table 1 - Statistical Quantities for Cs-137 and Co-60 from the 2013 Characterization Survey

Statistical Quantities	Cs-137 (pCi/g)	Co-60 (pCi/g)
Minimum Value :	0.03	0.02
Maximum Value :	0.09	0.08
Mean :	0.06	0.05
Median :	0.06	0.05
Standard Deviation :	0.0139	0.0172

A Radiological Engineer (RE) performed a visual inspection and walk-down of the survey unit on 02/08/2017 prior to performing FSS. The purpose of the walk-down was to assess the physical condition of the survey unit, evaluate access points and travel paths and identify potentially hazardous conditions. A final classification assessment was performed in accordance with procedure ZS-LT-300-001-002, "*Survey Unit Classification*" as part of the survey design for FSS.

Based upon completion of Survey Unit Classification Basis for final classification, which included a review of the historic information, the results of the Characterization Survey data and, completion of a final Survey Unit Classification Worksheet, it was concluded that there was a low probability for the presence of residual radioactivity in soils in concentrations greater than 50% of the OpDCGLs, justifying a final survey unit classification of Class 3.

4. DATA QUALITY OBJECTIVES (DQO)

Final Status Survey planning and design hinges on coherence with the Data Quality Objective (DQO) process to ensure, through compliance with explicitly defined inputs and boundaries, that the primary objective of the survey is satisfied. The DQO process is described in the ZSRP LTP in accordance with MARSSIM. The appropriate design for a given survey will be developed using the DQO process as outlined in Appendix D of MARSSIM.

The DQO process incorporated hypothesis testing and probabilistic sampling distributions to control decision errors during data analysis. Hypothesis testing is a process based on the scientific method that compares a baseline condition to an alternate condition. The baseline condition is technically known as the null hypothesis. Hypothesis testing rests on the premise that the null hypothesis is true and that sufficient evidence must be provided for rejection. In designing the survey plan, the underlying assumption, or null hypothesis was that residual activity in the survey unit exceeded the release criteria. Rejection of the null hypothesis would indicate that residual activity within the survey unit does not exceed the release criteria. Therefore, the survey unit would satisfy the primary objective of the FSS sample plan.

The primary objective of the FSS sample plan is to demonstrate that the level of residual radioactivity in survey unit 10222 did not exceed the release criteria specified in the LTP and that the potential dose from residual radioactivity is As Low As Reasonably Achievable (ALARA).

Zion*Solutions* TSD 11-001, *"Potential Radionuclides of Concern During the Decommissioning of Zion Station"* (Reference 7) established the basis for an initial suite of potential ROC for the decommissioning of the Zion Nuclear Power Station (ZNPS). LTP Chapter 2 provides detailed characterization data that describes the results of surveys taken of soils. Surface and subsurface soil samples were taken in each impacted open land survey units and analyzed for the presence of plant-derived radionuclides. The results of surface and subsurface soil characterization in the impacted area surrounding ZNPS indicate that there is minimal residual radioactivity in soil. Consequently, due to the absence of any significant source term in soil, the suite of ROC and radionuclide mixture derived for non-activated concrete was considered as a reasonably conservative mixture to apply to soils for FSS planning and implementation.

LTP Chapter 6, section 6.5.2 discusses the process used to derive the ROC for the decommissioning of ZNPS, including the elimination of insignificant dose contributors (IC) from the initial suite. Based upon the analysis of the mixture, it was determined that Co-60, Ni-63, Sr-90, Cs-134 and Cs-137 accounted for 99.5% of all dose in the non-activated contaminated concrete mixes.

Table 2 presents the ROC for the decommissioning of soils at ZNPS and the normalized mixture fractions based on the radionuclide mixture.

Table 2 - Dose Significant Radionuclides and Mixture

Radionuclide	% of Total Activity (normalized)(1)(2)
Co-60	0.92%
Cs-134	0.01%
Cs-137	75.32%
Ni-63	23.71%
Sr-90	0.05%

(1) Based on maximum percent of total activity from Table 20 of TSD 14-019, normalized to one for the dose significant radionuclides.
(2) Does not include dose significant radionuclides for activated concrete (H-3, Eu-152, Eu-154).

A fundamental precursor to survey design is to establish a relationship between the release criteria and some measurable quantity. This is done through the development of DCGLs. The DCGLs represent average levels of radioactivity above background levels and are presented in terms of surface or mass activity concentrations. Chapter 6 of the LTP describes in detail the modeling used to develop the DCGLs for soils.

Surface soil is defined as soil residing in the first 0.15 m layer of soil. A subsurface soil category, which is defined as a layer of soil beginning at the surface but extending to a depth of 1 m is also assessed to allow for flexibility in compliance demonstration if contamination deeper than 0.15 m is encountered. Site-specific DCGLs for soil were calculated for both the 0.15 m and 1 m thicknesses. Based on characterization data and historic information, there are no expectations of encountering a source term geometry that is comprised of a clean surface layer of soil over a contaminated subsurface soil layer. Zion*Solutions* TSD 14-011, *"Soil Area Factors"* (Reference 8) and LTP Chapter 6, section 6.8 provides the exposure scenarios and modeling parameters that were used to calculate the site-specific DCGLs for soils (referred to as Base Case Soil DCGLs [BcDCGL] in this Release Record).

At ZNPS, compliance is demonstrated through the summation of dose from four distinct source terms for the end-state (basements, soils, buried pipe and groundwater). Basements are comprised of the summation of four structural source terms (surfaces, embedded pipe, penetrations and fill). When applied to soil, the DCGLs are expressed in units of activity per unit of mass (pCi/g). The "unity rule" is applied when there is more than one ROC. The measurement results for each singular ROC present in the mixture are compared against their respective DCGL to derive a dose fraction.

The surface and subsurface soil BcDCGLs for the unrestricted release of open land survey units are provided in Table 3 and Table 4, respectively. The IC dose percentage of 10% was used to adjust the DCGLs in soils to account for the dose from the eliminated IC radionuclides.

Table 3 - Base Case DCGLs for Surface Soils ($BcDCGL_{SS}$)

Radionuclide	Surface Soil DCGL (pCi/g)
Co-60	4.26
Cs-134	6.77
Cs-137	14.18
Ni-63	3,572.10
Sr-90	12.09

Table 4 - Base Case DCGLs for Subsurface Soils ($BcDCGL_{SB}$)

Radionuclide	Subsurface Soil DCGL (pCi/g)
Co-60	3.44
Cs-134	4.44
Cs-137	7.75
Ni-63	763.02
Sr-90	1.66

Each radionuclide-specific BcDCGL is equivalent to the level of residual radioactivity (above background levels) that could, when considered independently, result in a Total Effective Dose Equivalent (TEDE) of 25 mrem per year to an Average Member of the Critical Group (AMCG). To ensure that the summation of dose from each source term is 25 mrem/year or less after all FSS is completed, the BcDCGLs are reduced based on an expected, or *a priori*, fraction of the 25 mrem/year dose limit from each source term. The reduced DCGLs, or "Operational" DCGLs can be related to the BcDCGLs as an expected fraction of dose based on an *a priori* assessment of what the expected dose should be based on the results of site characterization, process knowledge and the extent of planned remediation. The OpDCGL is then used as the DCGL for the FSS design of the survey unit (calculation of surrogate DCGLs, investigations levels, etc.). Details of the OpDCGLs derived for each dose component and the basis for the applied *a priori* dose fractions are provided in Zion*Solutions* TSD 17-004, *"Operational Derived Concentration Guideline Levels for Final Status Survey"* (Reference 9). The OpDCGLs for the FSS of surface and subsurface soils are presented in Table 5 and Table 6, respectively.

Table 5 - Operational DCGLs for Surface Soils ($OpDCGL_{SS}$)

Radionuclide	Surface Soil DCGL (pCi/g)
Co-60	1.091
Cs-134	1.733
Cs-137	3.630
Ni-63	914.458
Sr-90	3.095

Table 6 - Operational DCGLs for Subsurface Soils ($OpDCGL_{SB}$)

Radionuclide	Subsurface Soil DCGL (pCi/g)
Co-60	0.881
Cs-134	1.137
Cs-137	1.984
Ni-63	195.333
Sr-90	0.425

In accordance with NUREG-1757, Appendix G, if the HSA indicates that there is no likelihood of substantial subsurface residual radioactivity, subsurface surveys are not necessary. The HSA as well as the results of the extensive characterization of subsurface soils in the impacted area surrounding the Zion facility have shown that there is minimal residual radioactivity in subsurface soil. Consequently, Zion proposes to perform minimal subsurface sampling during FSS.

Instrument DQOs included a verification of the ability of the survey instrument to detect the radiation(s) of interest relative to the OpDCGL. Survey instrument response checks were required prior to issuance and after the instrument had been used. Control and accountability of survey instruments was required to assure the quality and prevent the loss of data.

As part of the DQOs applied to laboratory processes, analysis results were reported as actual calculated results. The actual recorded value was used as the recorded FSS result for measurement and/or sample values that are less than MDC. Negative values were recorded as "zero". For radionuclides less than MDC, the value representing the highest abundance was selected. Results were not reported as "less than MDC". Sample report summaries included unique sample identification, analytical method, radionuclide, result, uncertainty, laboratory data qualifiers, units, and the observed MDC.

In accordance with the LTP, for laboratory analysis, MDCs less than 10% of the OpDCGL were preferable while MDCs up to 50% of the OpDCGL were acceptable. The minimum acceptable MDC for measurements obtained using field instruments was 50 percent of the applicable OpDCGL.

5. SURVEY DESIGN

The level of effort associated with planning a survey is based on the complexity of the survey and nature of the hazards. Guidance for preparing FSS plans is provided in procedure ZS-LT-300-001-001 "*Final Status Survey Package Development*." The FSS plan uses an integrated sample design that combines scanning surveys and sampling which can be either random or judgmental.

The DQO process determined that Co-60, Ni-63, Sr-90, Cs-134 and Cs-137 would be the ROC in survey unit 10222. During FSS, concentrations for Hard-to-Detect (HTD) ROC Ni-63 and Sr-90 are inferred using a surrogate approach. Cs-137 is the principle surrogate radionuclide for Sr-90 and Co-60 is the principle surrogate radionuclide for Ni-63. The mean, maximum and 95% Upper Confidence Level (UCL) of the surrogate ratios for concrete core samples taken in the Auxiliary Building basement were calculated in Zion*Solutions* TSD 14-019, *"Radionuclides of Concern for Soil and Basement Fill Model Source Terms"* (Reference 10) and are presented in Table 7. The maximum ratios will be used in the surrogate calculations during FSS unless area specific ratios are determined by continuing characterization.

Table 7 - Surrogate Ratios

Ratios	Auxiliary Building		
	Mean	Max	95% UCL
Ni-63/Co-60	44.143	180.450	154.632
Sr-90/Cs-137	0.001	0.002	0.002

For the FSS of survey unit 10222, the surrogate OpDCGLs for Co-60 and Cs-137 were computed based on the maximum ratios from Table 7.

The equation for calculating a surrogate DCGL is as follows:

Equation 1

$$Surrogate_{DCGL} = \frac{1}{\left[\left(\frac{1}{DCGL_{Sur}}\right) + \left(\frac{R_2}{DCGL_2}\right) + \left(\frac{R_3}{DCGL_3}\right) + \cdots \left(\frac{R_n}{DCGL_n}\right)\right]}$$

Where: $DCGL_{Sur}$ = Surrogate radionuclide DCGL

$DCGL_{2,3...n}$ = DCGL for radionuclides to be represented by the surrogate

R_n = Ratio of concentration (or nuclide mixture fraction) of radionuclide "n" to surrogate radionuclide

Using the OpDCGLs presented in Table 5 and the maximum ratios from Table 7, the following surrogate calculations were performed:

Equation 2

$$Surrogate_{DCGL\,(Cs-137)} = \frac{1}{\left[\left(\frac{1}{3.630_{(Cs-137)}}\right) + \left(\frac{0.002}{3.095_{(Sr-90)}}\right)\right]} = 3.622\,pCi/g$$

The surrogate OpDCGL that was used for Cs-137 in this survey unit for direct comparison of sample results to demonstrate compliance is 3.622 pCi/g.

Equation 3

$$Surrogate_{DCGL\,(Co-60)} = \frac{1}{\left[\left(\frac{1}{1.091_{(Co-60)}}\right) + \left(\frac{180.45}{914.458_{(Ni-63)}}\right)\right]} = 0.898\,pCi/g$$

The surrogate OpDCGL that was used for Co-60 in this survey unit for direct comparison of sample results to demonstrate compliance is 0.898 pCi/g.

The action level for investigation in a Class 3 open land survey unit is 50% of the OpDCGL. The surrogate DCGL for Co-60 while inferring Ni-63 is 0.898 pCi/g, and the surrogate DCGL for Cs-137 while inferring Sr-90 is 3.622 pCi/g. Using the normalized mixture for gamma-emitting ROC from Table 2, the surrogate adjusted gamma DCGL is then calculated as follows:

Equation 4

$$Surrogate_{DCGL\,(gamma)} = \frac{1}{\left[\left(\frac{0.012}{0.898_{(Co-60)}}\right) + \left(\frac{0.00001}{1.733_{Cs-134}}\right) + \left(\frac{0.988}{3.622_{(Ni-63)}}\right)\right]} = 3.494\,pCi/g$$

The surrogate adjusted gamma DCGL equals 3.494 pCi/g.

The action levels for survey unit 10222 are based on 50% of the DCGL and are presented in Table 8.

Table 8 - Action Levels for Survey Unit 10222

ROC	DCGL (pCi/g)
Co-60 (1)	0.449
Cs-134 (2)	0.867
Cs-137 (3)	1.811
Gross Gamma (4)	1.747

(1) Based on 50% of surrogate adjusted DCGL of 0.898 pCi/g for Co-60 while inferring Ni-63
(2) Based on 50% of OpDCGL
(3) Based on 50% of surrogate adjusted DCGL of 3.622 pCi/g for Cs-137 while inferring Sr-90
(4) Based on 50% of normalized surrogate adjusted DCGLs of 3.494 pCi/g for gamma-emitting ROC

The Sign Test was selected as the non-parametric statistical test. The use of the Sign Test did not require the selection or use of a background reference area, which simplified survey design and implementation. This approach was conservative since it included background Cs-137 as part of the sample set.

The Elevated Measurement Comparison (EMC) did not apply to this survey unit since it is a Class 3 survey unit and discrete, elevated areas of contamination were not expected.

The number of soil samples for FSS was determined in accordance with procedure ZS-LT-300-001-001 "*Final Status Survey Package Development*." The relative shift (Δ/σ) for the survey unit data set is defined as shift (Δ), which is the Upper Bound of the Gray Region (UBGR), or the DCGL (SOF of 1) minus the Lower Bound of the Gray Region (LBGR) (SOF of 0.5), divided by sigma (σ), which is the standard deviation of the data set used for survey design. The optimal value for Δ/σ should range between 1 and 3. The largest value the Δ/σ can have is 3. If the Δ/σ exceeds 3, then the value of 3 will be used for Δ/σ. In accordance with MARSSIM, because the standard deviation was not recorded for characterization data (all data below MDC), a coefficient of variation on the order of 30% was used to calculate Δ/σ. The Δ/σ for survey unit 10222 was calculated as follows:

Equation 5

$$\Delta/\sigma \quad = \quad 0.5/0.014 \quad = \quad 36$$

As the calculated relative shift (36) was greater than 3, then a value of 3 was used as the adjusted Δ/σ. Both the Type I error, or α value and the Type II error, or β value was set at 0.05. The sample size from Table 5.5 of MARSSIM that equates to the Type I and Type II error of 0.05 for use with the Sign Test is an N value of 14. One (1) sample location was added to the random sample population (N = 15) as a measure to ensure enough survey coverage as a large portion of the survey unit was inaccessible due to the changing water level.

A Prospective Power Curve was generated using MARSSIM 2000, a software package developed for implementation of the MARSSIM in support of the decommissioning license termination rule (10CFR20, Subpart E). The result of the MARSSIM 2000 computer run showed adequate power for the survey design. The survey design specified fifteen (15) surface soil samples for non-parametric statistical testing.

As the survey unit was classified as Class 3, sample locations were selected at random. The random locations of the surface soil samples were selected using Visual Sample Plan (VSP), in accordance with ZS-LT-300-001-001. Input parameters included use of Bing or Google Maps aerial photographs and the random sampling tool set with a predetermined number (15) of sample points. These coordinates were integrated with a GPS to locate sample locations in the field. Sample measurement locations for the surface soil samples taken for random design are listed with the GPS coordinates in Table 9.

ZSRP LTP Chapter 5, section 5.1 states that soil samples will be collected during FSS to confirm the HTD to surrogate radionuclide ratios (Table 7). Ten percent (10%) of the FSS samples collected from open land survey units will be analyzed for HTD ROC. Only HTD radionuclides included as ROC (Ni-63 and Sr-90 for soils) will be analyzed in the FSS confirmatory samples. For soil samples with positive results for both a HTD ROC and the corresponding surrogate radionuclide (Cs-137 or Co-60), the HTD surrogate ratio will be derived and compared against the maximum ratio (see Table 7). The maximum ratios (Table 7) will be used unless specific survey information supports the use of a surrogate ratio that is specific to the area. In these cases, the survey unit-specific radiological data and the derived surrogate ratios will be submitted to the NRC for approval. If approved, then the survey unit-specific ratios used and the survey data serving as the basis for the surrogate ratios will be documented in the release record for the survey unit.

Table 9 – Random Sample Locations

MEASUREMENT ID	NORTHING (meters)	EASTING (meters)
L3-10222A-FRGS-001-SS	641889.0990	343828.8030
L3-10222A-FRGS-002-SS	641916.3860	343832.9420
L3-10222A-FRGS-003-SS	642054.0295	343833.0504
L3-10222A-FRGS-004-SS	641945.5180	343837.7630
L3-10222A-FRGS-005-SS	642018.5290	343830.2145
L3-10222A-FRGS-006-SS	642063.1801	343848.3206
L3-10222A-FRGS-007-SS	642080.5815	343852.4818
L3-10222A-FRGS-008-SS	642095.3349	343858.1562
L3-10222A-FRGS-009-SS	642110.5747	343846.5962
L3-10222A-FRGS-010-SS	642141.2566	343840.1118
L3-10222A-FRGS-011-SS	642168.8497	343858.8707
L3-10222A-FRGS-012-SS	642212.8477	343856.4934
L3-10222A-FRGS-013-SS	642234.9248	343863.4103
L3-10222A-FRGS-014-SS	642258.8706	343872.8751
L3-10222A-FRGS-015-SS	642046.6317	343843.8107

Fourteen (14) surface soil samples were originally required for the non-parametric statistical test (sample size N = 14). One (1) sample was added to the random sample population. In total, fifteen (15) surface soil samples were collected for the FSS of this survey unit. A map of the surface soil sample locations is provided in Figure 4 in Attachment 1.

The selection of two (2) soil sample met the requirement that 10% of the samples collected for the FSS of survey unit 10222 be analyzed for HTD ROC. Sample numbers L3-10222A-FRGS-001-SS and L3-10222A-FRGS-004-SS were selected. Each selected sample was sent off-site (Eberline Analytical) for analysis of the HTD ROC as specified in LTP Chapter 5, section 5.1.

The implementation of quality control measures as referenced by LTP Chapter 5, section 5.9 and Zion*Solutions* ZS-LT-01, "*Quality Assurance Project Plan (for Characterization and FSS)*" (QAPP) (Reference 11) includes the collection of a soil sample for "split sample" analysis on 5% of the soil samples taken in a survey unit with the locations selected at random. One (1) surface soil sample, L3-10222A-FQGS-007-SS was selected randomly for split sample analysis for the FSS of this survey unit.

LTP Chapter 5, section 5.6.4.4 and Table 5-24 specifies that for Class 3 survey units, judgmental (biased) surface scans will be performed on areas with the greatest potential of contamination. For open land areas, this may include surface drainage areas and collection points. The fraction of scanning coverage required for survey unit 10222 was determined during the DQO process with the total amount and location(s) based on the likelihood of finding elevated activity during FSS. Based on the HSA, the results of the characterization survey, and the operational use of this survey unit, fifteen (15) different scan areas representing 1,205 m^2, or approximately 5% of the survey unit, of surface area was chosen at random. A map of the scan grid locations are provided in Figure 3.

For this Class 3 open land survey unit, the "Investigation Levels" for area scanning and soil sample measurement results are those levels specified in LTP Chapter 5, Table 5-25 and are reproduced below in Table 10.

Table 10 – Investigation Levels

Classification	Scan Investigation Levels	Direct Investigation Levels
Class 3	>Operational DCGL or >MDC_{scan} if MDC_{scan} is greater than Operational DCGL	>0.5 Operational DCGL

Table 11 provides a synopsis of the survey design for survey unit 10222.

Table 11 – Synopsis of Survey Design

FEATURE	DESIGN CRITERIA	BASIS
Survey Unit Land Area	21,778 m^2	GPS measurements of area
Number of Measurements (N)	15 (random)	• σ = 0.014 • UBGR = SOF of 1 • LBGR = SOF of 0.5 • Type I error = 0.05 • Type II error = 0.05 • Δ/σ = 3 (adjusted) (MARSSIM Table 5.5)
Grid Spacing	Random	(LTP Chapter 5, section 5.6.4.5.2)
DCGLs	• Co-60 – 1.091 pCi/g • Cs-134 – 1.733 pCi/g • Cs-137 – 3.630 pCi/g • Ni-63 – 914.458 pCi/g • Sr-90 – 3.095 pCi/g	Operational DCGLs for Surface Soils, (LTP Chapter 5, Table 5-7)
HTD ROC Analysis	Two (2) surface soil samples selected for HTD ROC analysis	(LTP Chapter 5, section 5.1)
Soil Investigation Level	>0.5 Operational DCGL	(LTP Chapter 5, Table 5-25)
Scan Survey Area Coverage	1,205 m^2 or ~5% areal coverage	(LTP Chapter 5, Table 5-24)
Scan Investigation Level	>Operational DCGL or >MDC_{scan} if MDC_{scan} is greater than Operational DCGL	(LTP Chapter 5, Table 5-25)
QC	One (1) surface soil sample selected randomly for split sample analysis	(LTP Chapter 5, section 5.9)

6. SURVEY IMPLEMENTATION

For survey unit 10222, compliance with the unrestricted release criteria was demonstrated through a combination of surface scanning with a Ludlum Model 44-10 gamma detector and the sampling of surface soil for isotopic analysis. In accordance with the LTP Chapter 5, section 5.7.1.6.2, no subsurface soil sample(s) will be taken as part of the survey design in Class 3 open land survey units. However, if during the performance of FSS, the analysis of a surface soil sample, or the results of a surface gamma scan indicated the potential presence of residual radioactivity at a concentration of 75% of a subsurface OpDCGL, then a biased subsurface soil sample(s) would have been taken to the appropriate depth within the area of concern as part of the investigation. This threshold was not encountered during the FSS of survey unit 10222. Consequently, no subsurface soil samples were collected during FSS.

In addition, LTP Chapter 5, section 5.1 states that if levels of residual gamma radioactivity in an individual soil sample exceed a SOF of 0.1, then the sample(s) will be analyzed for HTD ROC. One sample, L3-10222A-FRGS-001-SS had an OpSOF in excess of 0.1. This sample was included as one of the two samples selected for HTD radionuclide analysis.

FSS field activities were conducted under FSS Sample Plan L3-10222A-F. FSS Sample Plan L3-10222A-F included DQOs, survey design, detailed FSS instructions, job safety analysis, and related procedures for reference. A "Field Log" (ZS-LT-300-001-001 Attachment 14) was used to document field activities and other information pertaining to the performance of the FSS.

FSS field activities were projected to take eight (8) working days to complete. Daily briefings were conducted to discuss the expectations for job performance and to review safety aspects of the job. The survey required field activities were performed during normal working hours starting on February 21, 2017 and concluding on February 28, 2017.

The fifteen (15) random surface soil sample locations were marked with flags based on GPS coordinates provided by VSP. Around each surface soil sample location, an approximately 80 m^2 scan area was marked out. A total of fifteen (15) different scan areas were established, constituting an areal scan coverage of 1,205 m^2, or approximately 5% of the surface area in survey unit 10222. Background was assessed in the survey unit and it was determined that, using a Ludlum 2350-1 paired with a Model 44-10 (2"x 2") NaI detector, background ranged from 1,595 cpm up to 1,959 cpm.

All designated scan areas as denoted on Figure 3 in Attachment 1 were scanned using a Ludlum 2350-1 paired with a Model 44-10 (2" x 2") NaI detector operated in the rate-meter mode and using audio response. The probe was positioned as close to the ground as

possible and was moved at a scan speed of approximately 0.25 meters per second. In accordance with Zion*Solutions* TSD 11-004, "*Ludlum Model 44-10 Detector Sensitivity*" (Reference 12), scan MDC was sufficient to detect residual radioactivity at the action level (adjusted gross gamma DCGL of 1.747 pCi/g, which was based on 50% of the normalized surrogate adjusted OpDCGLs for gamma emitting ROC). Complete scan results are provided in Attachment 2.

In accordance with FSS design, fifteen (15) surface soil samples were collected at random locations. Each surface soil sample consisted of 1 liter of soil. The sample media was sifted to remove stones and other media larger than 1 centimeter in diameter. All collected soil samples were controlled, transported, stored, and transferred to the on-site laboratory using Chain-of-Custody (CoC) process from Zion*Solutions* procedure ZS-LT-100-001-004, "*Sample Media Preparation*" (Reference 13).

Two (2) samples (L3-10222A-FRGS-001-SS and L3-10222A-FRGS-004-SS) were selected for HTD radionuclide analysis.

The implementation of survey specific QC measures included the collection of one (1) sample (L3-10222A-FQGS-007-SS) for "split sample" analysis.

7. SURVEY RESULTS

The scan areas identified in the FSS plan were scanned for elevated radiation levels. Several alarms were noted during the scanning of the survey unit, but no areas alarmed upon rescan. Table 12 provides an overview of the scan results. Complete scan results are provided in Attachment 2.

Table 12 – Synopsis of Scan Results

Scan Area	Highest Logged Reading (cpm)	Action Level[(1)] (cpm)	# of Scan Alarms	Investigation Samples
GS001	2140	2080	1	None
GS002	2270	2250	2	None
GS003	2060	2080	None	None
GS004	2500	2250	1	None

Table 12 (continued) – Synopsis of Scan Results

Scan Area	Highest Logged Reading (cpm)	Action Level[1] (cpm)	# of Scan Alarms	Investigation Samples
GS004	2690	2327	1	None
GS005	2430	2433	None	None
GS006	2380	2433	None	None
GS007	2210	2433	None	None
GS008	2240	2433	None	None
GS009	2070	2080	None	None
GS010	2100	2127	None	None
GS011	2250	2433	None	None
GS012	2070	2069	1	None
GS013	2350	2433	None	None
GS014	2060	2069	None	None
GS015	2240	2080	1	None

1) The action level is based on the measurement Minimum Detectable Count Rate (MDCR) plus background in accordance with the FSS plan

The on-site laboratory analyzed the fifteen (15) soil samples taken for non-parametric statistical testing using the on-site gamma spectroscopy system. A summary of the fifteen (15) samples collected for non-parametric statistical testing results is provided in Table 13. The results for the gamma emitting ROC (Co-60, Cs-134 and Cs-137) presented in Table 13 are the measured values from gamma spectroscopy analysis. The results for HTD ROC were inferred using the ratios presented in Table 7. Gamma spectroscopy results (summarized in Table 13) revealed no samples above MDC for any ROC. The mean of the gamma spectroscopic analysis results for the sample population indicated that Cs-137 was present at levels lower than the concentrations of Cs-137 expected to be found in off-site soil at within the vicinity of the ZNPS as presented in Zion*Solutions* TSD 13-004, "*Examination of Cs-137 Global Fallout in Soils at Zion Station*" (Reference 14). The complete gamma spectroscopy reports are presented in Attachment 6. The basic statistics for the random sample population are summarized in Table 14.

Table 13 – Summary of Gamma Spectroscopy Results for Surface Soil Samples Comprising the Random Sample Population

MEASUREMENT ID	Co-60[1] (pCi/g)	Cs-134[1] (pCi/g)	Cs-137[1] (pCi/g)	Ni-63[2] (pCi/g)	Sr-90[2] (pCi/g)
L3-10222A-FRGS-001-SS	3.02E-02	1.77E-01	0.00E+00	5.45E+00	0.00E+00
L3-10222A-FRGS-002-SS	0.00E+00	4.60E-03	2.51E-02	0.00E+00	5.02E-05
L3-10222A-FRGS-003-SS	4.71E-02	0.00E+00	5.95E-04	8.50E+00	1.19E-06
L3-10222A-FRGS-004-SS	2.17E-02	3.12E-02	1.76E-02	3.92E+00	3.52E-05
L3-10222A-FRGS-005-SS	3.98E-02	2.04E-02	1.28E-02	7.18E+00	2.56E-05
L3-10222A-FRGS-006-SS	3.24E-02	5.48E-03	1.58E-02	5.85E+00	3.16E-05
L3-10222A-FRGS-007-SS	1.60E-02	8.30E-04	2.83E-02	2.89E+00	5.66E-05
L3-10222A-FRGS-008-SS	9.48E-03	2.37E-02	1.17E-04	1.71E+00	2.34E-07
L3-10222A-FRGS-009-SS	1.00E-02	5.64E-02	0.00E+00	1.80E+00	0.00E+00
L3-10222A-FRGS-010-SS	0.00E+00	6.83E-02	2.60E-03	0.00E+00	5.20E-06
L3-10222A-FRGS-011-SS	1.60E-02	5.90E-02	0.00E+00	2.89E+00	0.00E+00
L3-10222A-FRGS-012-SS	5.58E-04	7.20E-02	2.27E-02	1.01E-01	4.54E-05
L3-10222A-FRGS-013-SS	0.00E+00	0.00E+00	9.92E-03	0.00E+00	1.98E-05
L3-10222A-FRGS-014-SS	8.66E-03	8.22E-02	0.00E+00	1.56E+00	0.00E+00
L3-10222A-FRGS-015-SS	1.50E-02	4.72E-02	9.82E-03	2.71E+00	1.96E-05

Note: 1. Bold font indicates ROC positively detected at concentration greater than MDC.
2. Ni-63 and Sr-90 are inferred concentrations using the maximum HTD ratio.

Table 14 – Basic Statistical Properties of Random Sample Population

ROC	Mean (pCi/g)	Median (pCi/g)	Max (pCi/g)	Min (pCi/g)	Std. Dev.	BcDCGL (pCi/g)	Avg. SOF per ROC	Avg. Dose Per ROC
Co-60	1.65E-02	1.50E-02	4.71E-02	0.00E+00	1.51E-02	4.26	3.86E-03	9.66E-02
Cs-134	4.32E-02	3.12E-02	1.77E-01	0.00E+00	4.69E-02	6.77	6.38E-03	1.60E-01
Cs-137	9.69E-03	9.82E-03	2.83E-02	0.00E+00	1.02E-02	14.18	6.83E-04	1.71E-02
Ni-63	2.97E+00	2.71E+00	8.50E+00	0.00E+00	2.72E+00	3572.1	8.31E-04	2.08E-02
Sr-90	1.94E-05	1.96E-05	5.66E-05	0.00E+00	2.04E-05	12.09	1.60E-06	4.01E-05

The off-site laboratory, Eberline Analytical, processed the two (2) samples selected for HTD ROC analysis as specified in the survey design. Sample numbers L3-10222A-FRGS-001-SS and L3-10222A-FRGS-004-SS were selected. Only HTD radionuclides included as ROC (Ni-63 and Sr-90 for soils) were included in the analysis. All analyses met the required MDC. LTP Chapter 5, section 5.1 states that for soil samples or concrete cores with positive results for both a HTD ROC and the corresponding surrogate radionuclide (Cs-137 or Co-60), the HTD to surrogate ratio will be derived. This threshold was not encountered during the FSS of survey unit 10222. No ROC were positively detected at concentrations greater than MDC for both samples. The results are provided in Table 15.

Table 15 – Off-Site Analysis Results (Eberline Analytical) for Sample ID #sL3-10222A-FRGS-001-SS and L3-10222A-FRGS-004-SS

Sample # L3-10222A-FRGS-001-SS

ROC	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC
Co-60	1.02E-02	2.21E-02	2.64E-02	No
Cs-134	-6.12E-04	1.14E-02	3.32E-02	No
Cs-137	1.63E-02	2.08E-02	3.34E-02	No
Ni-63	-3.70E-01	2.77E-01	4.89E-01	No
Sr-90	2.82E-01	1.54E-01	2.95E-01	No

Sample # L3-10222A-FRGS-004-SS

ROC	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC
Co-60	-6.99E-04	2.58E-02	2.90E-02	No
Cs-134	-4.44E-03	9.41E-03	2.36E-02	No
Cs-137	-6.65E-03	2.01E-02	3.18E-02	No
Ni-63	-2.03E-02	2.97E-01	5.09E-01	No
Sr-90	-1.80E-02	1.55E-01	3.34E-01	No

The implementation of survey specific QC measures included the collection of one (1) sample (L3-10222A-FQGS-007-SS) for “split sample” analysis. The on-site laboratory analyzed the designated QC sample using the on-site gamma spectroscopy system. A summary of the analytical results for the QC sample is provided in Table 16. Gamma

spectroscopy results (summarized in Table 18) indicate that concentrations for Cs-137, Co-60 and Cs-134 were less than MDC in the sample. The concentration for Ni-63 and Sr-90 are inferred based on the maximum ratios as specified in Table 7.

Table 16 – Summary of Gamma Spectroscopy Results for QC Surface Soil Sample

MEASUREMENT ID	Co-60[1] (pCi/g)	Cs-134[1] (pCi/g)	Cs-137[1] (pCi/g)	Ni-63[2] (pCi/g)	Sr-90[2] (pCi/g)
L3-10222A-FQGS-007-SS	1.43E-03	1.77E-01	1.90E-02	2.58E-01	3.80E-05

Note: 1. Bold font indicates ROC positively detected at concentration greater than MDC.
2. Ni-63 and Sr-90 are inferred concentrations using the maximum HTD ratio.

The SOF or "unity rule" is the mathematical test used to evaluate compliance with radiological criteria for license termination when more than one radionuclide has been determined to be potentially present. The equation for the unity rule is:

Equation 6

$$\frac{C_1}{DCGL_1}+\frac{C_2}{DCGL_2}+\ldots\ldots\ldots\frac{C_n}{DCGL_n}\le 1$$

Where: C_n = concentration of radionuclide *n*

$DCGL_n$ = DCGL of radionuclide *n*.

The results of the unity rule calculation for the ROC in the random sample population as well as the judgmental samples for survey unit 10222 are provided in Table 17.

Table 17 – Sum-of-Fractions for Individual Surface Soil Samples (Random)

MEASUREMENT ID	FRACTION OF OpDCGL					OpSOF
	Co-60	Cs-134	Cs-137	Ni-63	Sr-90	
L3-10222A-FRGS-001-SS	0.0277	0.1021	0.0000	0.0060	0.0000	0.1358
L3-10222A-FRGS-002-SS	0.0000	0.0027	0.0069	0.0000	0.0000	0.0096
L3-10222A-FRGS-003-SS	0.0432	0.0000	0.0002	0.0093	0.0000	0.0526
L3-10222A-FRGS-004-SS	0.0199	0.0180	0.0048	0.0043	0.0000	0.0470
L3-10222A-FRGS-005-SS	0.0365	0.0118	0.0035	0.0079	0.0000	0.0596
L3-10222A-FRGS-006-SS	0.0297	0.0032	0.0044	0.0064	0.0000	0.0436
L3-10222A-FRGS-007-SS	0.0147	0.0005	0.0078	0.0032	0.0000	0.0261

Table 17 (continued) – Sum-of-Fractions for Individual Surface Soil Samples (Random)

MEASUREMENT ID	FRACTION OF OpDCGL					OpSOF
	Co-60	Cs-134	Cs-137	Ni-63	Sr-90	
L3-10222A-FRGS-008-SS	0.0087	0.0137	0.0000	0.0019	0.0000	0.0243
L3-10222A-FRGS-009-SS	0.0092	0.0325	0.0000	0.0020	0.0000	0.0437
L3-10222A-FRGS-010-SS	0.0000	0.0394	0.0007	0.0000	0.0000	0.0401
L3-10222A-FRGS-011-SS	0.0147	0.0340	0.0000	0.0032	0.0000	0.0519
L3-10222A-FRGS-012-SS	0.0005	0.0415	0.0063	0.0001	0.0000	0.0484
L3-10222A-FRGS-013-SS	0.0000	0.0000	0.0027	0.0000	0.0000	0.0027
L3-10222A-FRGS-014-SS	0.0079	0.0474	0.0000	0.0017	0.0000	0.0571
L3-10222A-FRGS-015-SS	0.0137	0.0272	0.0027	0.0030	0.0000	0.0467

Random Measurements

Number of Random Measurements =	15
# of Random Measurements with OpSOF $\geq$ 1 =	0
# of Random Measurements with OpSOF > 0.1 (HTD Assessment) =	1
Max Individual Random Measurement OpSOF =	0.1358
Mean Random Measurement OpSOF =	0.0459

Table 18 – Sum-of-Fractions for QC Surface Soil Samples

MEASUREMENT ID	FRACTION OF OpDCGL					OpSOF
	Co-60	Cs-134	Cs-137	Ni-63	Sr-90	
L3-10222A-FQGS-007-SS	0.0013	0.1021	0.0052	0.0003	0.0000	0.1090

The mean BcSOF for survey unit 10222 is 0.0118 which equates to a dose of 0.2941 mrem/yr TEDE.

The mean of all identified isotopes are less than the Consultation Triggers for Residential and Commercial/Industrial Soil Contamination depicted in Table H.1 of NUREG 1757, Vol.1, Rev. 2 (MOU Table 1). The full table is included in Attachment 3 of this Release Record.

8. QUALITY CONTROL

The on-site laboratory processed one (1) split sample, L3-10222A-FQGS-007-SS, using gamma spectroscopy analysis. The data was evaluated using USNRC acceptance criteria specified in Inspection Procedure No. 84750, *"Radioactive Waste Treatment, and Effluent and Environmental Monitoring"* (Reference 15). There was acceptable agreement between field split results. Refer to Attachment 4 for data and quality control analysis results.

9. INVESTIGATIONS AND RESULTS

No investigations were performed in survey unit 10222.

10. REMEDIATION AND RESULTS

Historically, no radiological remedial action as described by MARSSIM Section 5.4 was performed in this survey unit prior to or as a result of the FSS. Chapter 4 of the ZSRP LTP determined that remediation beyond that required to meet the release criteria is unnecessary and that the remaining residual radioactivity in soil was ALARA.

11. CHANGES FROM THE FINAL STATUS SURVEY PLAN

Procedure ZS-LT-300-001-001, "*Final Status Survey Package Development*" states, "If a selected location is found to be either inaccessible or unsuitable, then the location will be adjusted to the closest adjacent suitable location. In these cases, a notation will be made in Attachment 14, "FSS Field Log," and the coordinates of the new location documented." Nine (9) sample locations were relocated due to the elevated lake level. Approximately half of the survey unit was covered in water during FSS. Details of the surface soil sample locations and the water level is provided in Figure 4 on Attachment 1.

12. DATA QUALITY ASSESSMENT (DQA)

The DQO sample design and data were reviewed in accordance with Zion*Solutions* procedure ZS-LT-300-001-004, *"Final Status Survey Data Assessment"* (Reference 16) for completeness and consistency. Documentation was complete and legible. Surveys and sample collection were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 3. The sampling design had adequate power as indicated by the Retrospective Power Curve.

The analytical results of all samples were less than a SOF of one. Additionally, the maximum activity for each ROC did not exceed 10% of their respective OpDCGL for surface soils.

Although MARSSIM states that the Sign Test need not be performed in the instance that no measurements surpass the DCGL, the test was conducted to demonstrate coherence to the statistical principles of the DQO process. The Sign Test was performed on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign Test results clearly demonstrates that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

The preliminary data review consisted of calculating basic statistical quantities (e.g., mean, median, standard deviation). All data was considered valid including negative values, zeros, values reported below the MDC, and values with uncertainties greater than two standard deviations. The mean and median values for each ROC were well below the respective OpDCGLs. Also, the retrospective power curve shows that a sufficient number of samples were collected to achieve the desired power. Therefore, the survey unit meets the unrestricted release criteria with adequate power as required by the DQOs.

The data for Co-60 and Cs-137 is represented graphically through a frequency plot and a quantile plot. All graphical representations are provided in Attachment 5.

13. ANOMALIES

No anomalies were observed during the performance or analyses of the survey.

14. CONCLUSION

Survey unit 10222 has met the DQOs of the FSS plan. The ALARA criteria for soils as specified in Chapter 4 of the LTP were achieved. The EMC for soils was not applicable and remediation was not required.

All identified ROC were used for statistical testing to determine the adequacy of the survey unit for FSS. Evaluation of the data shows that none of the ROC concentration values exceeds the OpDCGL or any investigational levels; therefore, in accordance with the LTP Section 5.10, the survey unit meets the release criterion.

The sample data passed the Sign Test. The null hypothesis was rejected. The Retrospective Power Curve showed that adequate power was achieved. The survey unit is properly classified as Class 3.

The mean SOF, when the analytical results were compared to the Base Case DCGLs, was 0.0118, which results in a dose contribution from soil in survey unit 10222 of 0.2941 mrem/yr TEDE, based on the average concentration of the ROC in samples used for non-parametric statistical sampling.

Survey unit 10222 is acceptable for unrestricted release.

15. REFERENCES

1. Zion*Solutions* procedure ZS-LT-300-001-005, "Final Status Survey Data Reporting"
2. "Zion Station Restoration Project License Termination Plan"
3. Zion*Solutions* procedure ZS-LT-300-001-001, "Final Status Survey Package Development"
4. NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
5. Zion*Solutions* procedure ZS-LT-300-001-002, "Survey Unit Classification"
6. "Historical Site Assessment" (HSA)
7. Zion*Solutions* TSD 11-001, "Potential Radionuclides of Concern during the Decommissioning of Zion Station"
8. Zion*Solutions* TSD 14-011, "Soil Area Factors"
9. Zion*Solutions* TSD 17-004, "Operational Derived Concentration Guideline Levels for Final Status Survey"
10. Zion*Solutions* TSD 14-019, "Radionuclides of Concern for Soil and Basement Fill Model Source Terms"
11. Zion*Solutions* ZS-LT-01, "Quality Assurance Project Plan (for Characterization and FSS)" (QAPP)
12. Zion*Solutions* TSD 11-004, "Ludlum Model 44-10 Detector Sensitivity"
13. Zion*Solutions* procedure ZS-LT-100-001-004, "Sample Media Preparation"
14. Zion*Solutions* TSD 13-004, "Examination of Cs-137 Global Fallout in Soils at Zion Station"
15. U.S. NRC Inspection Procedure No. 84750, "Radioactive Waste Treatment, and Effluent and Environmental Monitoring"
16. Zion*Solutions* procedure ZS-LT-300-001-004, "Final Status Survey Data Assessment"

16. ATTACHMENTS

Attachment 1 - Figures and Maps

Attachment 2 - Scan Data

Attachment 3 - Consultation Triggers for Residential and Commercial/Industrial Soil Contamination

Attachment 4 - QC Sample Assessment

Attachment 5 - Graphical Presentations

Attachment 6 - Sample Analytical Reports

Attachment 7 - Eberline Analytical Reports

ATTACHMENT 1
FIGURES AND MAPS

Figure 1 Survey Unit 10222 Boundary

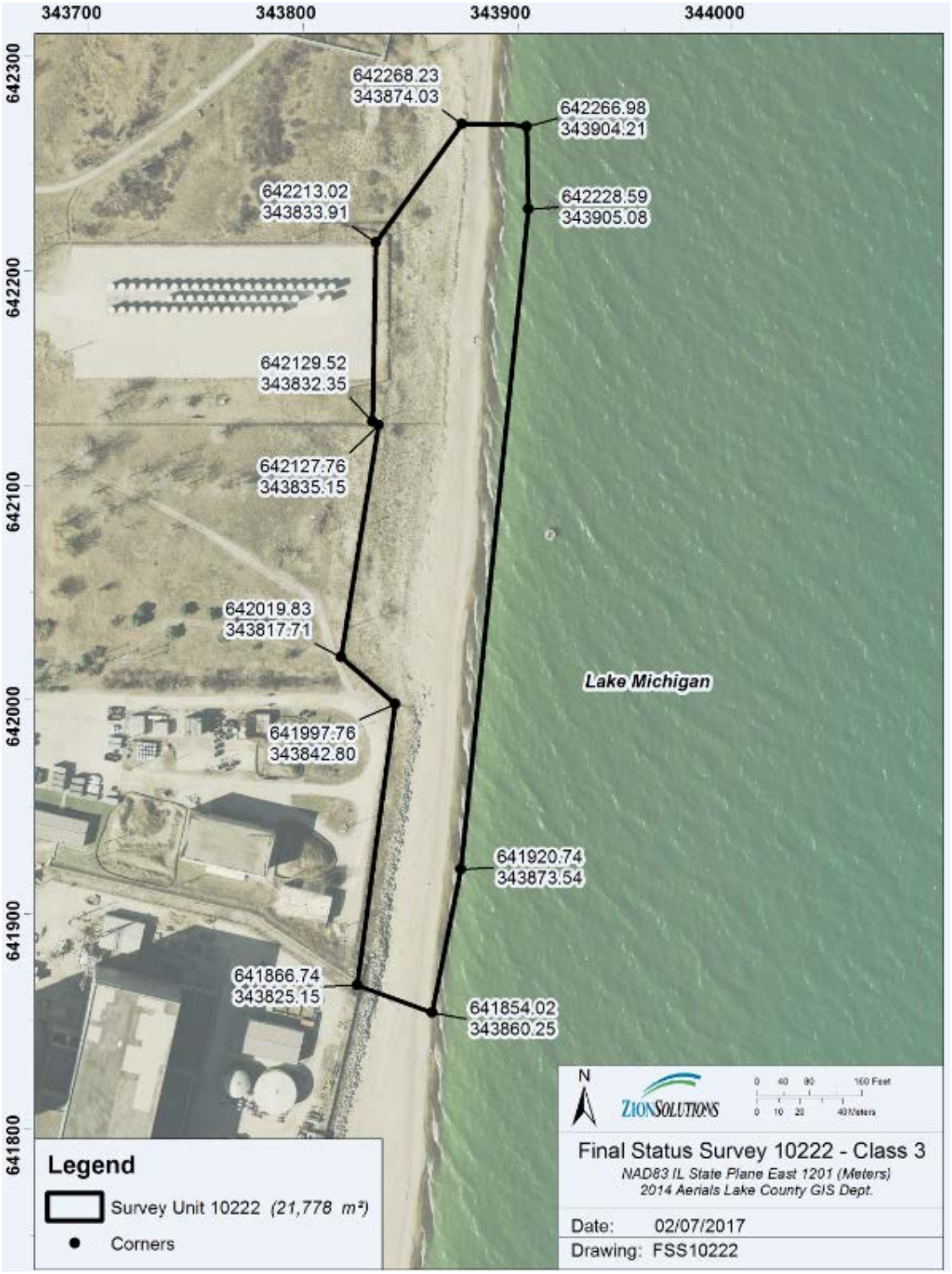


Figure 2 Survey Unit 10222 Characterization Survey Scan Areas

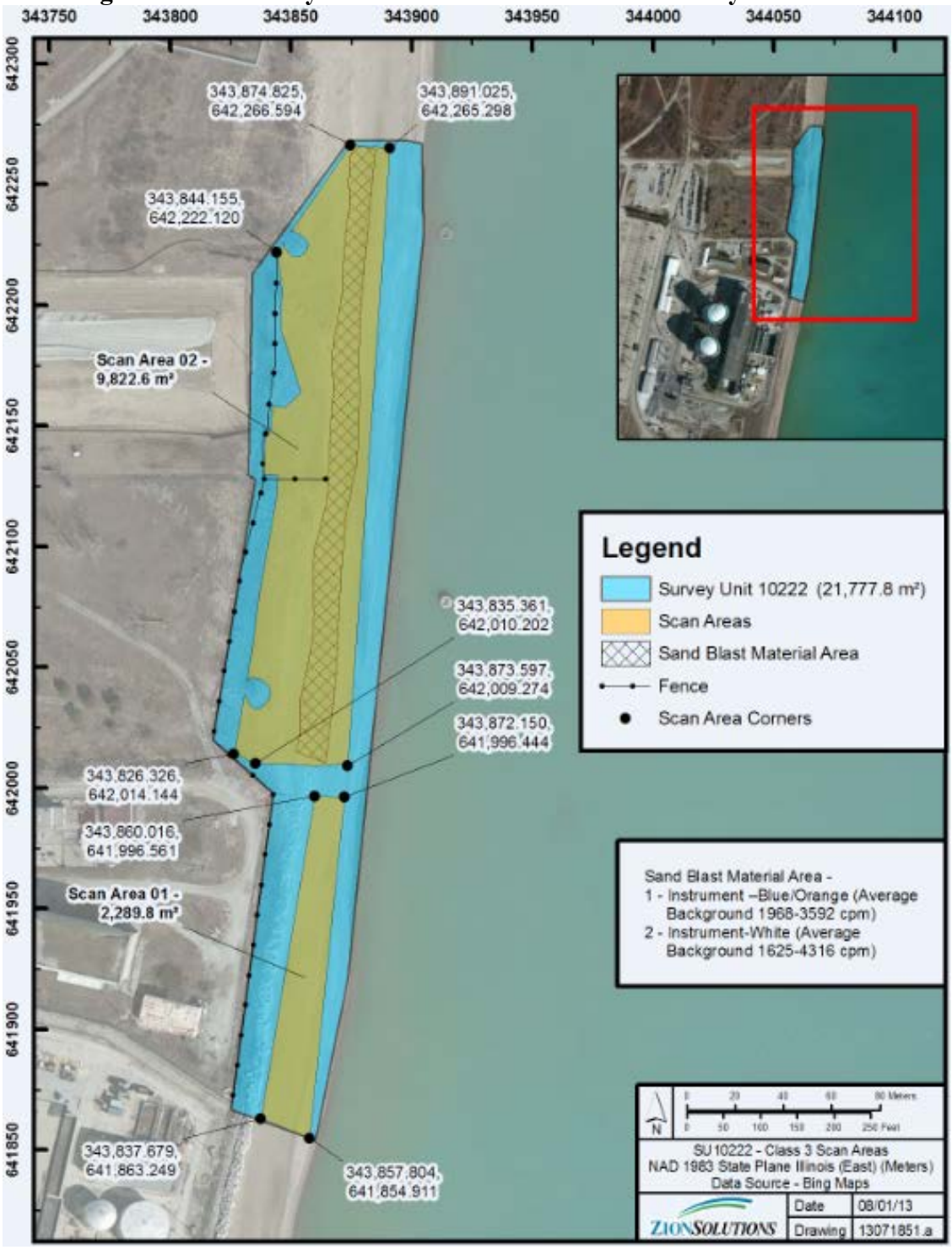


Figure 3 Survey Unit 10222 Characterization Survey Sample Locations

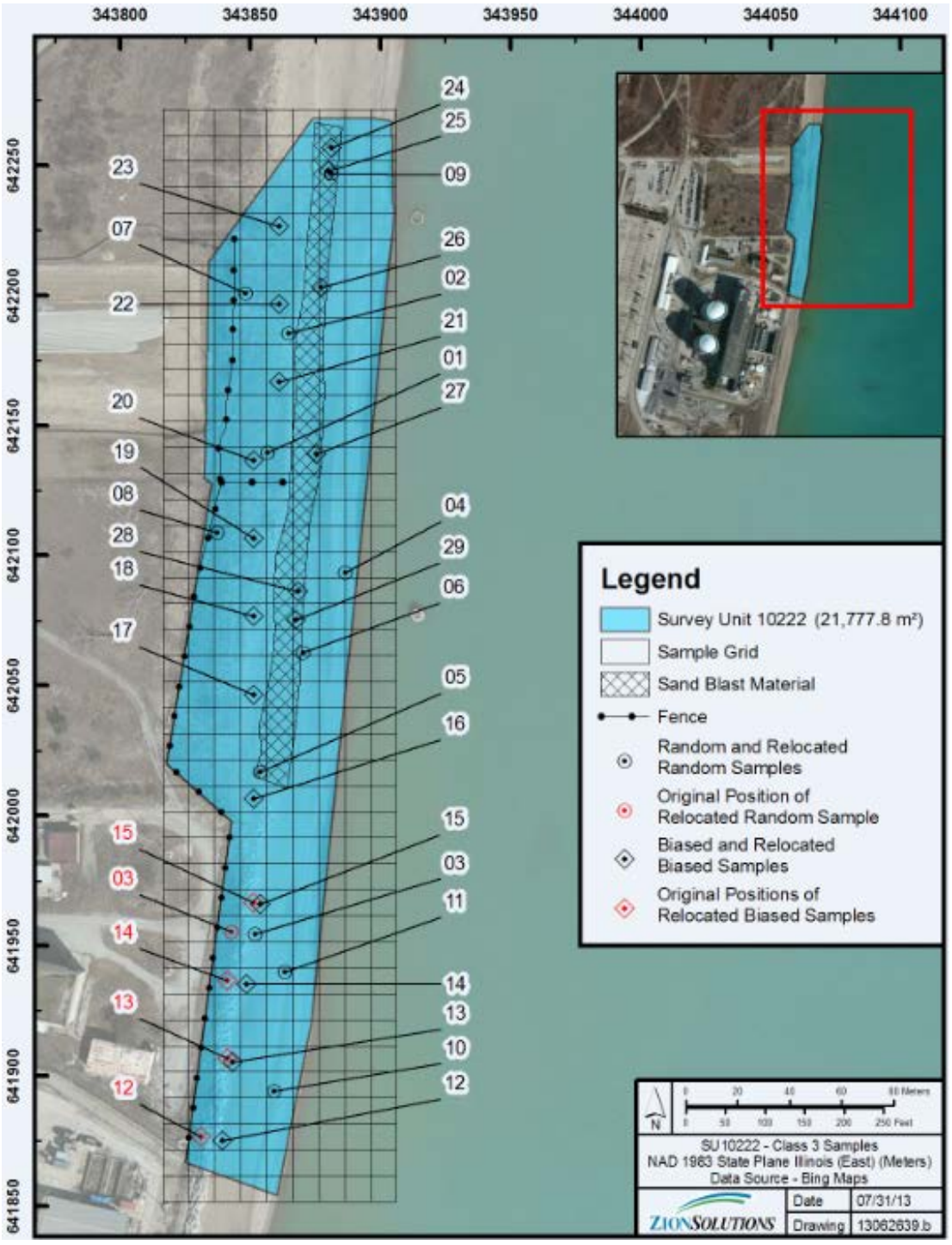


Figure 4 Survey Unit 10222 Final Status Survey

ATTACHMENT 2
SCAN DATA

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:46	1750	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:47	1760	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:48	1510	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:49	1680	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:49	1790	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:50	1620	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:51	2070	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:51	2040	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:52	1580	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:52	2050	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:53	1820	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:53	1880	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:54	2000	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:54	1670	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:55	1800	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:55	1720	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:56	1620	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:56	1820	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:57	1960	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:57	1820	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:58	1910	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:58	1860	1646	2080	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:59	1850	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 9:59	1580	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 10:00	1810	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 10:00	1580	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 10:01	1980	1646	2080	No
44-10	PR311786	304713	10222	GS009	2/22/2017, 10:01	1810	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:07	1610	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10 :08	2040	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:08	1800	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:09	1920	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:09	1660	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:10	1890	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:10	1780	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:11	1520	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:12	1670	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:12	1710	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:14	1980	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:14	1920	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:15	1700	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:15	1760	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:16	1920	1646	2080	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:16	1870	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:16	1830	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:17	1680	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:18	1920	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:18	2240	1646	2080	Yes
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:19	2030	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:19	1570	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:20	2030	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:20	1770	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:21	1560	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:21	1730	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:22	1720	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:22	1920	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:23	2070	1646	2080	No
44-10	PR311786	304713	10222	GS015	2/22/2017, 10:23	1810	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:24	1750	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:25	1930	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:25	1710	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:26	1760	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:26	1630	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:27	1660	1646	2080	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:27	2020	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:28	1940	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:28	1690	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:28	1720	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:28	1890	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:29	1850	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:29	1590	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:30	2040	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:30	1810	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:30	1870	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:30	1890	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:31	2010	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:31	1950	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:32	1870	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:32	1620	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:33	1690	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:33	1730	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:33	1920	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:33	1920	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:34	1720	1646	2080	No
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:34	2060	1646	2080	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS003	2/22/2017, 10:35	1720	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:04	1540	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:05	1850	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:05	2040	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:05	1800	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:06	1860	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:07	2040	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:07	1970	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:07	1760	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:08	1650	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:08	1850	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:09	1710	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:10	1960	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:10	1740	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:11	1620	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:12	1680	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:12	1590	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:12	1700	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:13	1880	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:14	2010	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/ 2017, 13:15	1850	1646	2080	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:15	1820	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:17	2040	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:20	1590	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:21	2140	1646	2080	Yes
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:22	1830	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:22	1920	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:23	1910	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:23	1960	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:24	1680	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:24	1560	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:25	1860	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:25	1670	1646	2080	No
44-10	PR311786	304713	10222	GS001	2/22/2017, 13:26	1770	1646	2080	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:52	1770	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:53	2050	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:53	2170	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:53	1940	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:54	2010	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:55	2190	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:55	1710	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:56	1740	1797	2250	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:57	2000	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:57	2060	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:58	1940	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:58	2150	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:58	2110	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:59	2250	1797	2250	Yes
44-10	PR311786	304713	10222	GS002	2/22/2017, 13:59	2020	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:00	2210	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/ 22/2017, 14:00	1910	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:01	2000	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:01	2270	1797	2250	Yes
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:02	2180	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:02	2150	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:02	1740	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:02	1500	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:03	2190	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:04	1920	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:04	1760	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:04	2100	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:04	1980	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:04	1900	1797	2250	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:05	1900	1797	2250	No
44-10	PR311786	304713	10222	GS002	2/22/2017, 14:06	1870	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:11	1780	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:12	1840	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:12	2190	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:12	2110	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:13	2110	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:13	2240	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:14	1860	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:14	1800	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:14	2120	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:15	1820	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:15	1710	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:16	2070	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:16	2020	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:16	2240	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:17	1770	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:17	2230	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:17	1670	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:18	1900	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:18	2110	1797	2250	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:19	2070	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:19	1910	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:19	2500	1797	2250	Yes
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:20	2100	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:20	2100	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:20	1850	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:20	1660	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:21	1860	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:21	1740	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:21	1830	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:22	1940	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:22	1870	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:22	1650	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:23	1900	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:23	1910	1797	2250	No
44-10	PR311786	304713	10222	GS004	2/22/2017, 14:23	1830	1797	2250	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:25	1870	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:26	1950	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:27	1970	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:27	2690	1865	2327	Yes
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:28	1790	1865	2327	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:29	1730	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:29	2300	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:29	2260	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:30	2260	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:30	1930	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:30	1730	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:31	2130	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:31	2060	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:32	1810	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:32	1730	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:32	2260	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:33	2080	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:33	1860	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:34	1940	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:34	2230	1865	2327	No
44-10	PR321896	304730	10222	GS004	2/28/2017, 15:35	2210	1865	2327	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:47	1620	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:48	1950	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:48	1880	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:49	1940	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:50	1780	1595	2022	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:51	1920	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:52	1980	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:53	1700	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:54	1890	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:55	1910	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:56	1930	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:56	1790	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:58	1940	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 14:59	1890	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:00	1850	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:02	1870	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:03	1950	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:05	1880	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15 :07	1880	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:07	1990	1595	2022	No
44-10	PR311750	266656	10222	QGS007	2/23/2017, 15:09	2020	1595	2022	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:10	1980	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:11	2180	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:11	1910	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:12	2170	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:12	2060	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS013	2/23/2017, 9: 13	2050	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:13	1990	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:14	2280	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:14	2240	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:15	2350	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:15	2350	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:15	2020	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:16	1980	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:16	2170	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:16	1910	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:17	2030	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9: 17	1860	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:17	1970	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:17	1700	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:18	1750	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:18	1530	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:19	1860	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:19	1590	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:19	1700	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:19	1310	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:20	2020	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:20	2180	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:21	1950	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:21	1750	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:21	1930	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:21	2300	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:22	2180	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:22	1770	1959	2433	No
44-10	PR311786	304713	10222	GS013	2/23/2017, 9:23	2270	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:29	2250	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:29	2090	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:29	1760	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:30	1800	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:30	1640	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:31	1880	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:31	1670	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:31	1880	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:31	1940	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:32	1920	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:32	1860	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:33	2050	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:33	1840	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:33	1720	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:34	1960	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:34	1960	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:34	1450	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:35	1980	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:35	1990	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:35	1950	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:36	1940	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:36	2000	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:36	1640	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:37	2010	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:37	1560	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:38	2010	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:38	1410	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:38	1710	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:38	1730	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:39	1790	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:39	1730	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:39	1970	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:39	1400	1959	2433	No
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:40	1970	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS011	2/23/2017, 9:41	1670	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:45	2130	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:45	1810	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/ 23/2017, 9:46	1570	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:46	1770	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:46	1450	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:47	1880	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:47	1590	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:47	1950	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:47	1710	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:48	1820	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:48	1780	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:49	1970	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:49	1670	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:49	2040	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:49	1710	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:50	1860	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:50	1570	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:51	1890	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:51	1690	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:51	1940	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:51	1500	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:52	2140	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:52	1740	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:52	1910	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:52	2050	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:53	1920	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:53	2070	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:53	1690	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:53	1500	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:54	1640	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:54	2160	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:54	2210	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:54	1700	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:55	1840	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:55	1750	1959	2433	No
44-10	PR311786	304713	10222	GS007	2/23/2017, 9:55	2130	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 9:58	2090	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 9:58	1970	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 9:59	2380	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 9:59	2000	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 9:59	1730	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:00	2160	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:00	1420	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:01	2020	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:01	1580	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:01	1970	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:01	1800	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:02	2140	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:02	1610	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:02	1850	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:03	1380	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:03	1850	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:03	1870	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:04	1930	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:04	2060	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:04	2150	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:04	1340	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:05	1790	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:05	1510	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:05	1660	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:06	1840	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:06	1710	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:06	1300	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:07	1880	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:07	1510	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:07	2000	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:07	1710	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:08	1890	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:08	1780	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:08	1630	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:08	1560	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:09	2010	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:09	1600	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:09	1890	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:09	1450	1959	2433	No
44-10	PR311786	304713	10222	GS006	2/23/2017, 10:10	2210	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:15	2360	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:17	2430	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:17	2130	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:18	2080	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:18	2080	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10: 19	2340	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:19	1980	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:20	2110	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:20	2350	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:21	2150	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:21	2210	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:22	2220	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:22	2090	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:23	2120	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:23	2090	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:24	1910	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:24	1900	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:24	2190	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:24	1590	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:25	2020	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:25	2160	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:26	1730	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:26	1740	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:26	2290	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:26	1610	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:27	1890	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:27	1920	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:27	1820	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:27	2000	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:28	1810	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:28	1820	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:28	1480	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:28	2030	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:28	2000	1959	2433	No
44-10	PR311786	304713	10222	GS005	2/23/2017, 10:29	2300	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:52	2010	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:53	2130	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:54	1720	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:54	1960	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:54	1690	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:55	2070	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:55	2040	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:55	1970	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:56	1840	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:56	1970	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:56	1980	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:57	1820	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:57	1610	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:57	1720	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:58	1910	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:58	1780	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:59	1910	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 12:59	1790	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:00	1720	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:00	2020	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:00	1810	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:01	1990	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:01	1760	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:02	1690	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:02	2070	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:02	1950	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:02	2010	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:03	2070	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:03	1960	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:04	1910	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:04	1970	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:05	2240	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:06	1690	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:06	1780	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:06	2120	1959	2433	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:07	1740	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:07	1790	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:07	1700	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:07	1580	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:08	1770	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:08	1980	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:08	1900	1959	2433	No
44-10	PR311786	304713	10222	GS008	2/23/2017, 13:09	2040	1959	2433	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:54	2000	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:54	1920	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:54	1810	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:55	2060	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:55	1800	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:56	1960	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:56	1620	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:57	1730	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:58	1970	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:58	2050	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 13:58	1910	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 14:00	1750	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 14:00	1820	1637	2069	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS014	2/21/2017, 14:01	1990	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 14:02	1920	1637	2069	No
44-10	PR311786	304713	10222	GS014	2/21/2017, 14:02	1870	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:07	1860	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:08	2050	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:08	1940	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:09	1590	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:09	2070	1637	2069	Yes
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:09	1940	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:09	1650	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:10	1930	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:10	1370	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:10	2010	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:10	1600	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:11	1920	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:11	1750	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:12	1880	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:13	1860	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:14	2010	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:14	1900	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:16	1780	1637	2069	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:17	1950	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:18	1780	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:18	1990	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:19	1790	1637	2069	No
44-10	PR311786	304713	10222	GS012	2/21/2017, 14:20	1820	1637	2069	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:49	1990	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:50	2080	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:50	1530	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:50	2030	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:51	2030	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:51	1720	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:52	2100	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:52	1700	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:52	1840	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:53	2020	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:53	1850	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:54	2010	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:55	1650	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:55	1650	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:55	2020	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:58	2040	1688	2127	No

Detector Type	Detector ID	M2350-1 ID	Survey Unit	Location	Date/Time	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:59	2040	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:59	1900	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 14:59	1930	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 15:00	1890	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 15:01	1660	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 15:03	2090	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 15:03	1860	1688	2127	No
44-10	PR311786	304713	10222	GS010	2/21/2017, 15:04	1730	1688	2127	No

ATTACHMENT 3
CONSULTATION TRIGGERS FOR RESIDENTIAL AND COMMERCIAL/INDUSTRIAL SOIL CONTAMINATION

Table H.1 Consultation Triggers for Residential and Commercial/Industrial Soil Contamination (MOU Table 1)

Except for radium-226, thorium-232, or total uranium, concentrations should be aggregated using a sum of the fraction approach to determine site-specific consultation trigger concentrations. This table is based on single contaminant concentrations for residential and commercial/industrial land use when using generally accepted exposure parameters. Table users should select the appropriate column based on the site's reasonably anticipated land use.

Radionuclide	Residential Soil Concentration	Industrial/Commercial Soil Concentration
H-3	228 pCi/g	423 pCi/g
C-14	46 pCi/g	123,000 pCi/g
Na-22	9 pCi/g	14 pCi/g
S-35	19,600 pCi/g	32,200,000 pCi/g
Cl-36	6 pCi/g	10,700 pCi/g
Ca-45	13,500 pCi/g	3,740,000 pCi/g
Sc-46	105 pCi/g	169 pCi/g
Mn-54	69 pCi/g	112 pCi/g
Fe-55	269,000 pCi/g	2,210,000 pCi/g
Co-57	873 pCi/g	1,420 pCi/g
Co-60	4 pCi/g	6 pCi/g
Ni-59	20,800 pCi/g	1,230,000 pCi/g
Ni-63	9,480 pCi/g	555,000 pCi/g
Sr-90+D	23 pCi/g	1,070 pCi/g
Nb-94	2 pCi/g	3 pCi/g
Tc-99	25 pCi/g	89,400 pCi/g
I-129	60 pCi/g	1,080 pCi/g
Cs-134	16 pCi/g	26 pCi/g
Cs-137+D	6 pCi/g	11 pCi/g
Eu-152	4 pCi/g	7 pCi/g
Eu-154	5 pCi/g	8 pCi/g
Ir-192	336 pCi/g	544 pCi/g
Pb-210+D	15 pCi/g	123 pCi/g
Ra-226	5 pCi/g	5 pCi/g
Ac-227+D	10 pCi/g	21 pCi/g
Th-228+D	15 pCi/g	25 pCi/g
Th-232	5 pCi/g	5 pCi/g
U-234	401 pCi/g	3,310 pCi/g
U-235+D	20 pCi/g	39 pCi/g
U-238+D	74 pCi/g	179 pCi/g
total uranium	47 mg/kg	1230 mg/kg
Pu-238	297 pCi/g	1,640 pCi/g
Pu-239	259 pCi/g	1,430 pCi/g
Pu-241	40,600 pCi/g	172,000 pCi/g
Am-241	187 pCi/g	568 pCi/g
Cm-242	32,200 pCi/g	344,000 pCi/g
Cm-243	35 pCi/g	67 pCi/g

ATTACHMENT 4
QC SAMPLE ASSESSMENT

Duplicate Sample Assessment

Survey Unit # 10222 Survey Unit Name North Beach Area

Sample Plan # L3-10222F

Sample Description: Comparison of split samples collected from surface soil samples from location #7 and analyzed using gamma spectroscopy by on-site HpGe System. The standard samples were L3-10222A-FRGS-007-SS and comparison sample L3-10222A-FQGS-007-SS.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
K-40	3.55E+00	3.49E-01	4.86	0.5-2.0	4.39E+00	3.88E-01	0.88	Y

Comments/Corrective Actions: There was acceptable agreement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

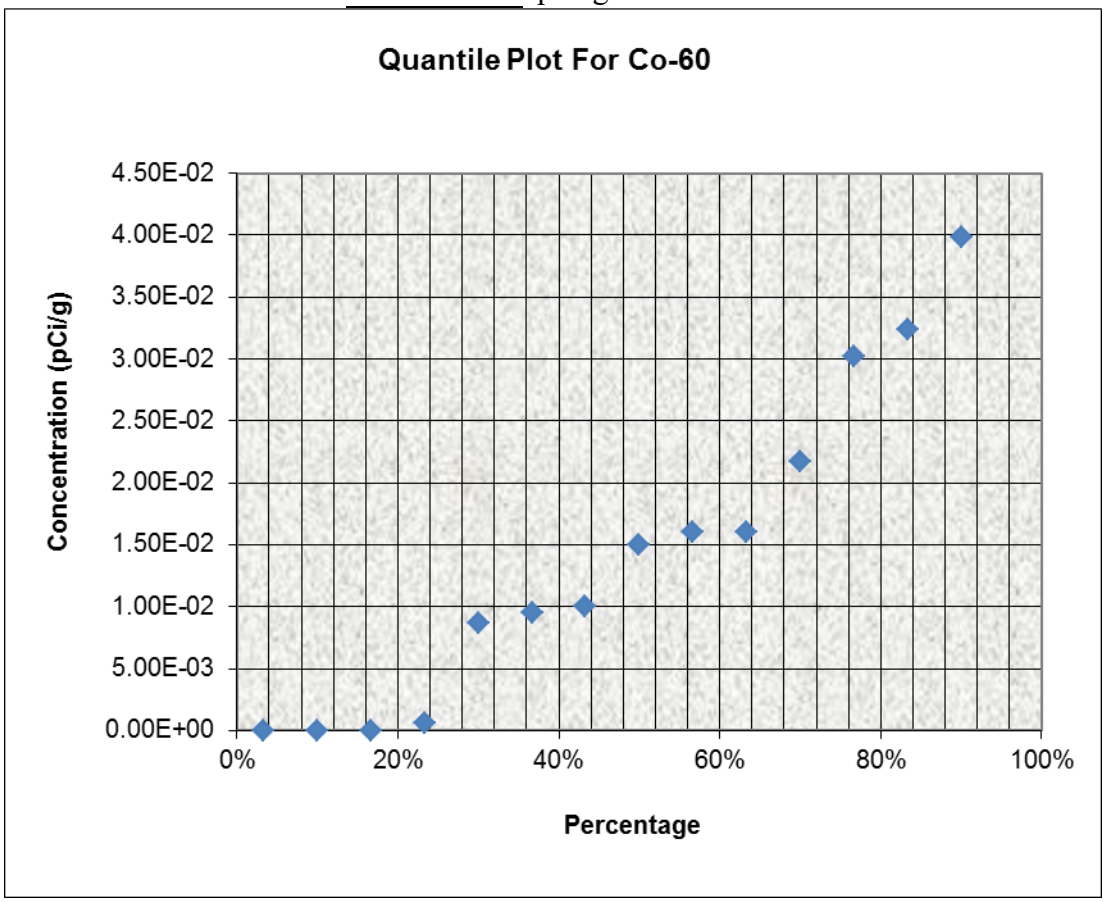
Performed By: Date: 06/20/2019 Reviewed by: Date: 06/20/2019

RF Yetter III J. Graham

ATTACHMENT 5
GRAPHICAL PRESENTATIONS

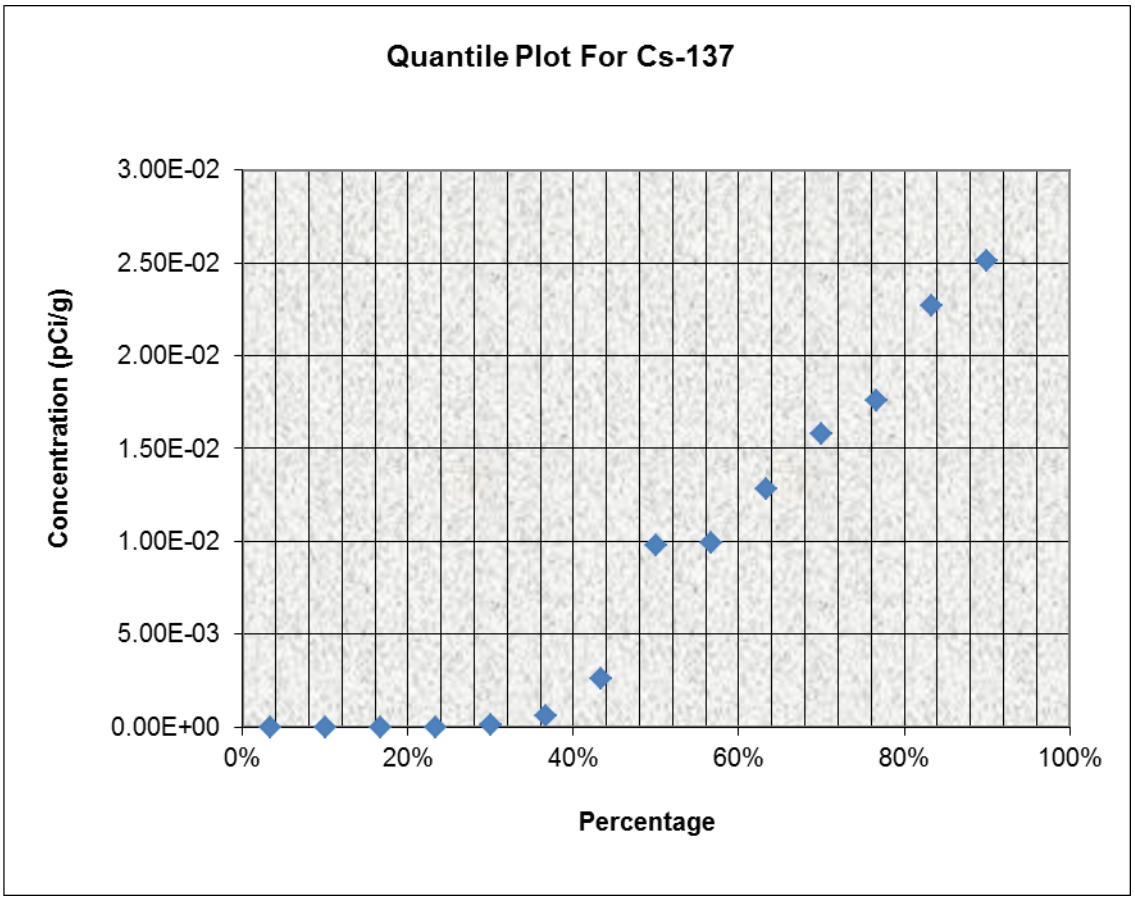
Quantile Plot for Co-60

Survey Unit: 10222
Survey Unit Name: Open Land - North Beach Area
Mean: 1.65E-02 pCi/g



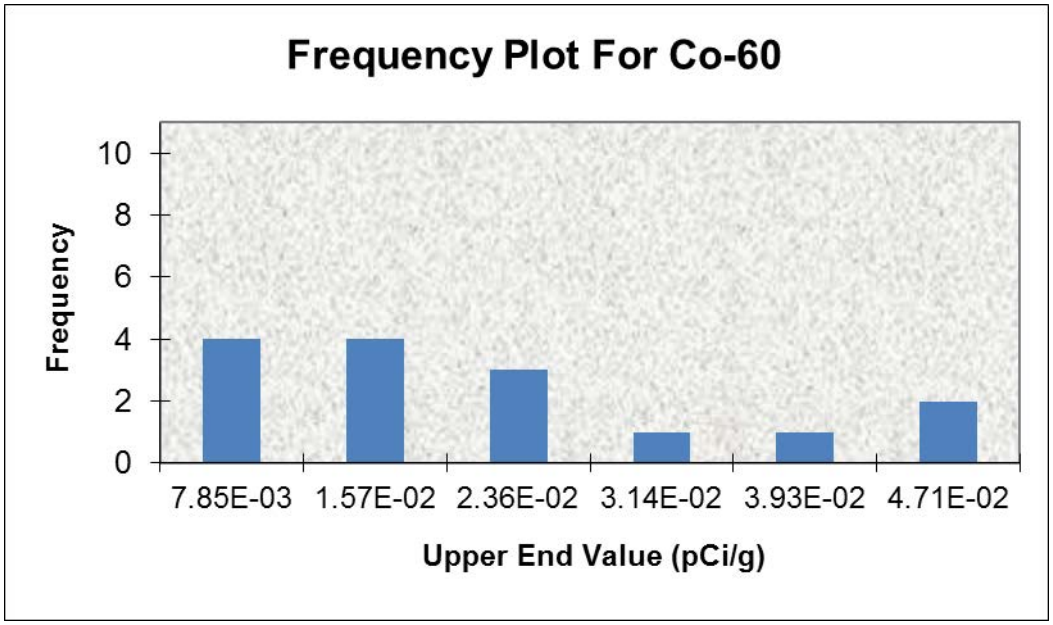
Quantile Plot for Cs-137

Survey Unit: 10222
Survey Unit Name: Open Land - North Beach Area
Mean: 9.69E-03 pCi/g



Histogram for Co-60

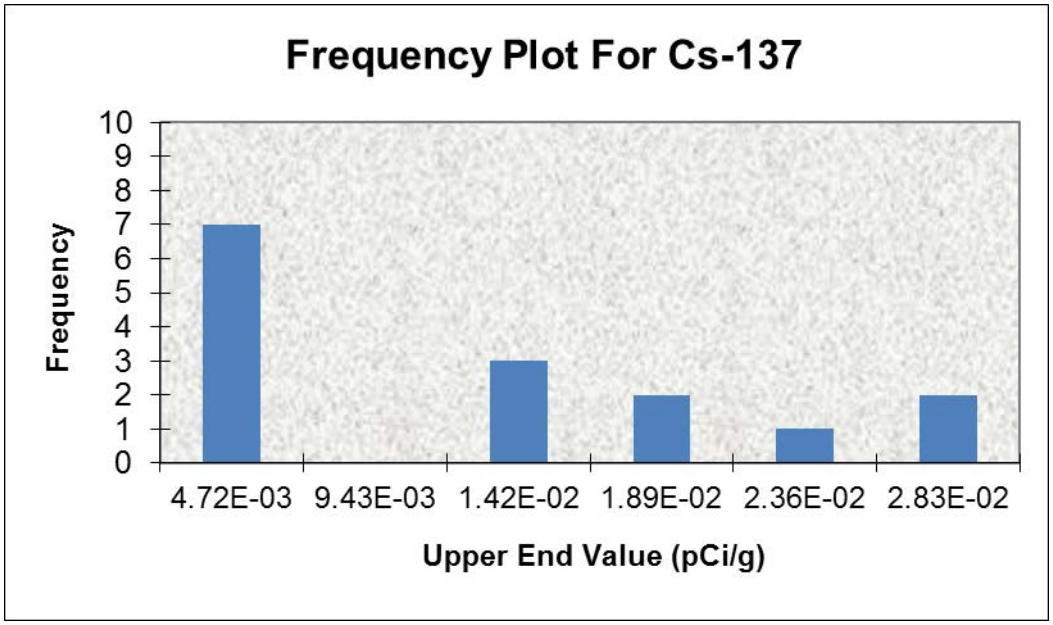
Survey Unit:	10222	
Survey Unit Name:	Open Land - North Beach Area	
Mean:	1.65E-02	pCi/g
Median:	1.50E-02	pCi/g
ST DEV:	0.01505563	
Skew:	0.71923483	



Upper Value	Observation Frequency	Observation %
7.85E-03	4	27%
1.57E-02	4	27%
2.36E-02	3	20%
3.14E-02	1	7%
3.93E-02	1	7%
4.71E-02	2	13%
TOTAL	15	

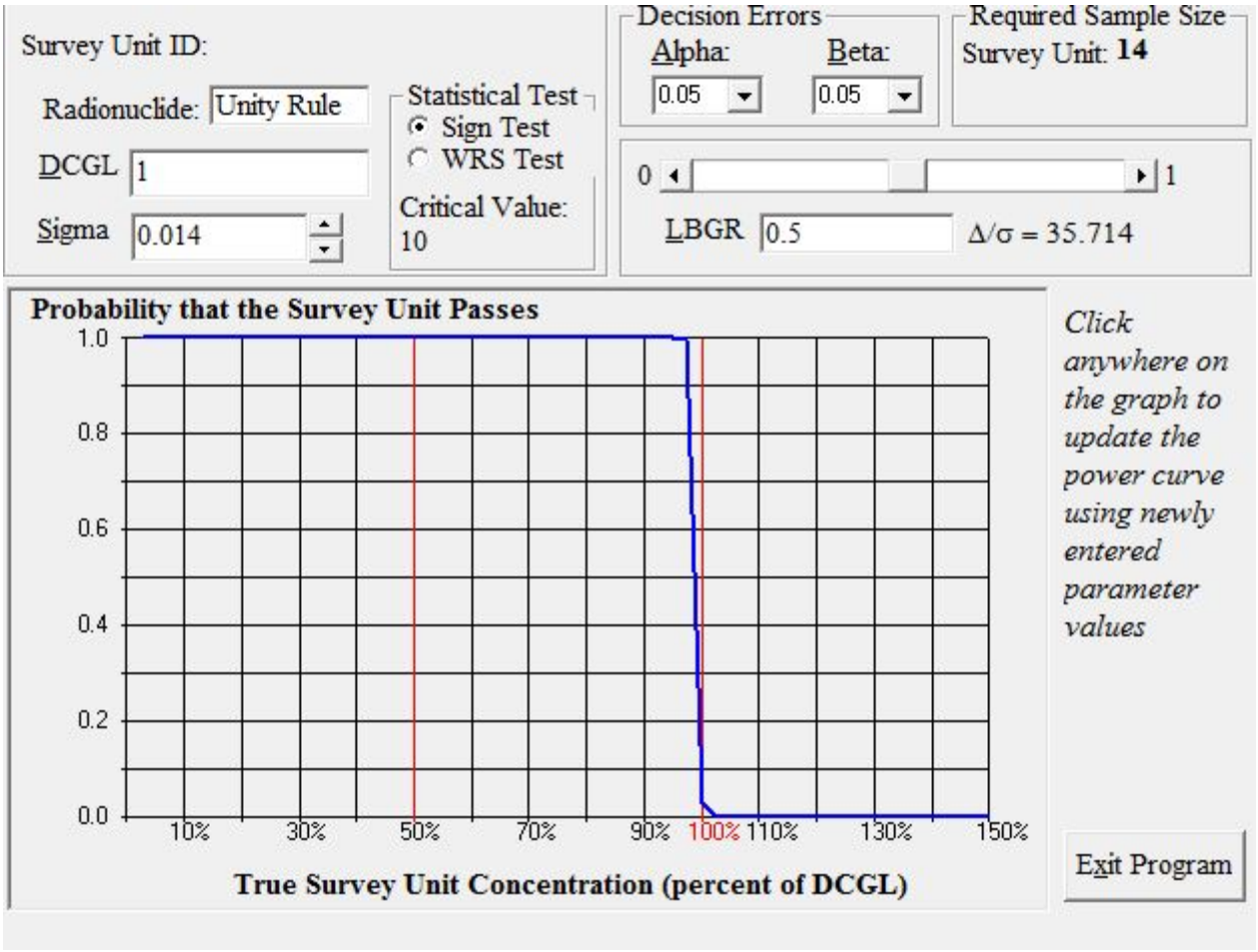
Histogram for Cs-137

Survey Unit:	10222	
Survey Unit Name:	Open Land - North Beach Area	
Mean:	9.69E-03	pCi/g
Median:	9.82E-03	pCi/g
ST DEV:	0.01022223	
Skew:	0.57357829	



Upper Value	Observation Frequency	Observation %
4.72E-03	7	47%
9.43E-03	0	0%
1.42E-02	3	20%
1.89E-02	2	13%
2.36E-02	1	7%
2.83E-02	2	13%
TOTAL	15	

Retrospective Power Curve for Survey Unit 10222



ATTACHMENT 6
SAMPLE ANALYTICAL REPORTS

Apex-Gamma

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10027
Sample Description	: L310222AFRGS001SS DRIED
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.727E+03 grams
Facility	: Default
Sample Taken On	: 2/27/2017 1:05:00PM
Acquisition Started	: 3/1/2017 2:35:09PM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.4 seconds
Dead Time	: 0.07 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2156
Fill Height	: 1726.98 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3/6/17

3-3-17

3-1-17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 2:45:12PM

Peak Analysis From Channel : 120

Peak Analysis To Channel : 8192

DATA VALIDATED

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.23	305 -	313	309.46	3.76E+01	12.77	5.84E+01	0.95
2	238.63	948 -	958	954.08	1.05E+02	14.92	4.92E+01	0.87
3	295.27	1173 -	1186	1180.38	6.44E+01	12.37	3.16E+01	0.79
4	311.98	1244 -	1251	1247.11	7.87E+00	4.74	7.13E+00	0.57
5	352.00	1401 -	1414	1407.00	1.06E+02	13.71	2.95E+01	1.15
6	510.92	2036 -	2048	2042.02	2.30E+01	8.40	1.80E+01	0.38
7	583.08	2325 -	2336	2330.44	3.07E+01	7.89	1.23E+01	0.80
8	609.25	2427 -	2442	2435.03	1.05E+02	11.62	1.00E+01	1.15
9	911.23	3636 -	3648	3642.39	3.38E+01	6.50	3.25E+00	0.44
10	1461.07	5831 -	5852	5842.21	2.25E+02	15.35	2.75E+00	1.70

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	7.36E+00	5.94E-01
Tl-208	0.99	583.19	*	85.00	6.78E-02	1.79E-02
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	2.45E-01	4.00E-02
		300.09		3.30		
Pb212-XR	0.99	74.82		10.28		
		77.11	*	17.10	3.49E-01	1.24E-01

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Pb212-XR	0.99	87.35		3.97		
		89.78		1.46		
Bi-214	1.00	609.32	*	45.49	4.46E-01	5.61E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	4.05E-01	8.42E-02
		351.93	*	35.60	3.94E-01	5.97E-02
		785.96		1.06		
Pb214-XR	0.99	74.82		5.80		
		77.11	*	9.70	6.16E-01	2.20E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	1.00	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	3.31E-01	6.54E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.990	7.36E+00	5.94E-01	
	Tl-208	0.998	6.78E-02	1.79E-02	
X	Bi-211	0.872			
	Pb-212	1.000	2.45E-01	4.00E-02	
?	Pb212-XR	0.999	3.49E-01	1.24E-01	
	Bi-214	1.000	4.46E-01	5.61E-02	
	Pb-214	0.999	3.97E-01	4.87E-02	
?	Pb214-XR	0.999	6.16E-01	2.20E-01	
	Ac-228	1.000	3.31E-01	6.54E-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 1.000sigma

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 2:45:12PM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
4	311.98	1.31111E-02	60.29		NRPT
6	510.92	3.83943E-02	36.45		Rad511

3-3-17

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-2.11E-01	4.25E-01	4.25E-01
+	K-40	1460.82	*	10.66	7.36E+00	4.50E-01	4.50E-01
	Co-60	1173.23		99.85	3.02E-02	6.77E-02	8.32E-02
		1332.49		99.98	-7.43E-03		6.77E-02
	Nb-94	702.65		99.81	-8.97E-03	5.82E-02	5.82E-02
		871.09		99.89	2.39E-02		5.97E-02
	Ag-108m	79.13		6.60	-5.60E-01	4.62E-02	1.44E+00
		433.94		90.50	-2.48E-02		4.62E-02
		614.28		89.80	-4.41E-02		9.30E-02
		722.94		90.80	-8.35E-03		6.41E-02
	Sb-125	176.31		6.84	-2.71E-01	1.47E-01	5.80E-01
		380.45		1.52	-1.53E+00		2.88E+00
		427.87		29.60	4.72E-02		1.47E-01
		463.36		10.49	3.78E-02		4.72E-01
		600.60		17.65	1.63E-02		2.64E-01
		606.71		4.98	3.98E+00		2.19E+00
		635.95		11.22	4.26E-01		4.68E-01

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

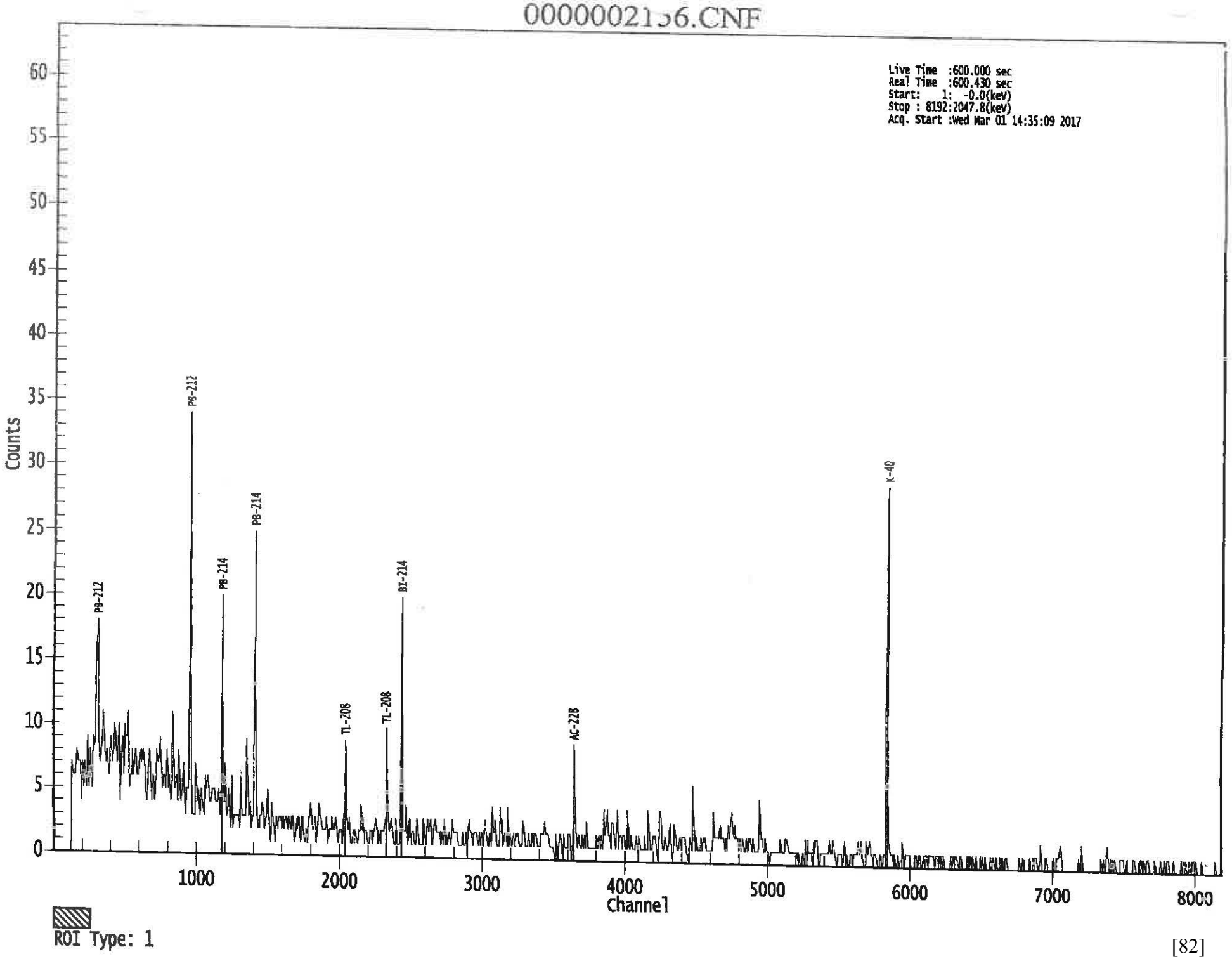
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Sb-125	671.44	1.79	-6.23E-01	1.47E-01	3.15E+00
Ba-133	79.61	2.65	-1.96E+00	1.00E-01	3.47E+00
	81.00	32.90	-1.10E-01		2.31E-01
	276.40	7.16	3.94E-01		6.64E-01
	302.85	18.34	-1.71E-01		2.39E-01
	356.01	62.05	-3.85E-02		1.00E-01
	383.85	8.94	-9.23E-02		4.84E-01
Cs-134	475.36	1.48	6.44E-01	6.59E-02	3.13E+00
	563.25	8.34	-1.23E-01		6.12E-01
	569.33	15.37	1.77E-01		3.17E-01
	604.72	97.62	-4.15E-02		9.08E-02
	795.86	85.46	-3.09E-02		6.59E-02
	801.95	8.69	-4.59E-02		6.65E-01
	1038.61	0.99	3.42E+00		7.77E+00
	1167.97	1.79	2.50E-01		4.48E+00
	1365.19	3.02	1.55E+00		2.61E+00
Cs-137	661.66	85.10	-1.75E-02	6.67E-02	6.67E-02
Eu-152	121.78	28.67	-9.93E-02	1.56E-01	1.56E-01
	244.70	7.61	-8.96E-01		6.14E-01
	295.94	0.45	1.44E+01		1.50E+01
	344.28	26.60	-3.61E-02		1.62E-01
	367.79	0.86	-2.37E+00		5.06E+00
	411.12	2.24	1.94E+00		2.19E+00
	443.96	2.83	-7.53E-01		1.45E+00
	488.68	0.42	-1.04E+00		1.08E+01
	563.99	0.49	-2.11E+00		1.04E+01
	586.26	0.46	-6.95E+00		1.70E+01
	678.62	0.47	-1.81E+00		1.09E+01
	688.67	0.86	3.48E+00		6.44E+00
	719.35	0.28	8.35E-01		1.71E+01
	778.90	12.96	-3.51E-01		4.37E-01
	810.45	0.32	6.99E+00		1.81E+01
	867.37	4.26	-1.21E+00		1.33E+00
	919.33	0.43	-3.02E+00		1.42E+01
	964.08	14.65	-1.85E-01		4.99E-01
	1085.87	10.24	-4.23E-02		7.04E-01
	1089.74	1.73	2.54E+00		4.09E+00
	1112.07	13.69	-1.16E-01		4.90E-01
	1212.95	1.43	-4.50E+00		6.05E+00
	1249.94	0.19	2.88E+00		3.43E+01
	1299.14	1.63	-5.90E-01		3.69E+00
	1408.01	21.07	-2.74E-01		3.35E-01
	1457.64	0.50	1.60E+02		5.25E+01
	1528.10	0.28	5.11E+00		1.59E+01
Eu-154	123.07	40.40	-1.21E-02	1.18E-01	1.18E-01
	247.93	6.89	2.20E-01		6.10E-01
	591.76	4.95	4.40E-01		1.12E+00
	692.42	1.78	-2.72E+00		2.62E+00
	723.30	20.06	0.00E+00		3.00E-01
	756.80	4.52	4.42E-01		1.33E+00
	873.18	12.08	-3.76E-01		4.10E-01

Analysis Report for 01-Mar-17-10027

L310222AFRGS001SS DRIED

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	996.29	10.48	3.32E-01	1.18E-01	6.77E-01
	1004.76	18.01	1.61E-01		3.81E-01
	1274.43	34.80	5.67E-02		2.16E-01
	1596.48	1.80	-1.00E+00		2.32E+00
Eu-155	45.30	1.31	1.24E+00	2.41E-01	1.28E+01
	60.01	1.22	-2.22E+00		1.38E+01
	86.55	30.70	1.06E-01		2.41E-01
	105.31	21.10	9.99E-02		2.66E-01
Ra-226	186.21	3.64	2.96E-01	1.33E+00	1.33E+00
Pa-231	27.36	10.30	0.00E+00	1.07E-01	1.07E-01
	283.69	1.70	-3.49E-01		2.33E+00
	300.07	2.47	5.16E-01		1.94E+00
	302.65	2.20	-2.42E+00		1.99E+00
	330.06	1.40	1.97E+00		3.39E+00
U-235	143.76	10.96	1.37E-01	8.48E-02	4.12E-01
	163.33	5.08	-5.03E-01		7.99E-01
	185.71	57.20	5.15E-02		8.48E-02
	202.11	1.08	1.29E+00		3.92E+00
	205.31	5.01	-1.33E+00		8.01E-01
Am-241	59.54	35.90	6.01E-02	4.87E-01	4.87E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021s6.CNF
Live Time :600.000 sec
Real Time :600.430 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 14:35:09 2017
Counts
Channel
PB-212
PB-212
PB-214
PB-214
TL-208
TL-208
BI-214
AC-228
K-40
ROI Type: 1

[82]

Apex-Gamma

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10028
Sample Description	: L310222AFRGS002SSS DRIED
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.548E+03 grams
Facility	: Default
Sample Taken On	: 2/27/2017 12:55:00PM
Acquisition Started	: 3/2/2017 7:52:33AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.4 seconds
Dead Time	: 0.06 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/2/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2166
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3/6/17

3-3-17

3-3-17

3-3-17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/2/2017 8:02:36AM

Peak Analysis From Channel : 120

Peak Analysis To Channel : 8192

DATA VALIDATED

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	74.67	297 -	313	299.23	2.18E+01	11.52	3.53E+01	0.65
m	2	77.14	297 -	313	309.07	6.06E+01	22.22	6.09E+01	0.65
	3	238.68	949 -	960	954.30	3.24E+01	14.18	4.26E+01	0.82
	4	295.15	1173 -	1185	1179.90	8.03E+01	12.38	2.77E+01	0.80
	5	351.91	1402 -	1413	1406.64	1.32E+02	12.79	1.26E+01	1.27
	6	583.11	2324 -	2338	2330.57	5.38E+01	8.28	5.16E+00	0.36
	7	609.25	2427 -	2443	2435.03	1.01E+02	10.70	4.32E+00	0.76
	8	911.06	3636 -	3648	3641.70	3.17E+01	6.56	4.29E+00	1.39
	9	1460.80	5831 -	5852	5841.13	1.91E+02	14.46	5.09E+00	1.62

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	4.95E+00	4.32E-01
Tl-208	0.99	583.19	*	85.00	9.18E-02	1.52E-02
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.62E-01	2.81E-02
		300.09		3.30		
Bi-214	1.00	609.32	*	45.49	3.31E-01	4.04E-02
		768.36		4.89		
		806.18		1.26		

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	1.00	241.99		7.25		
		295.22	*	18.42	3.82E-01	6.64E-02
		351.93	*	35.60	3.73E-01	4.68E-02
		785.96		1.06		
Pb214-XR	0.99	74.82	*	5.80	4.76E-01	2.57E-01
		77.11	*	9.70	7.29E-01	2.79E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	2.44E-01	5.15E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	1.000	4.95E+00	4.32E-01	
	Tl-208	0.999	9.18E-02	1.52E-02	
X	Bi-211	0.894			
	Pb-212	1.000	1.62E-01	2.81E-02	
X	Pb212-XR	0.999			
	Bi-214	1.000	3.31E-01	4.04E-02	
	Pb-214	1.000	3.76E-01	3.82E-02	
	Pb214-XR	0.999	5.92E-01	1.89E-01	
	Ac-228	0.999	2.44E-01	5.15E-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 1.000sigma

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/2/2017 8:02:36AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	1.27E-01	3.29E-01	3.29E-01
+	K-40	1460.82	*	10.66	4.95E+00	4.50E-01	4.50E-01
	Co-60	1173.23		99.85	-1.78E-02	4.45E-02	5.88E-02
		1332.49		99.98	-7.73E-03		4.45E-02
	Nb-94	702.65		99.81	-1.91E-03	4.28E-02	4.28E-02
		871.09		99.89	2.64E-02		5.06E-02
	Ag-108m	79.13		6.60	-2.65E-01	3.08E-02	1.01E+00
		433.94		90.50	-2.89E-02		3.08E-02
		614.28		89.80	-5.57E-02		6.80E-02
		722.94		90.80	1.83E-03		4.09E-02
	Sb-125	176.31		6.84	-3.63E-02	1.11E-01	4.14E-01
		380.45		1.52	9.08E-01		2.31E+00
		427.87		29.60	-4.91E-02		1.11E-01
		463.36		10.49	-2.64E-02		3.09E-01
		600.60		17.65	-5.60E-02		1.85E-01
		606.71		4.98	-1.93E-01		1.62E+00
		635.95		11.22	-3.44E-02		3.12E-01
		671.44		1.79	4.48E-02		2.18E+00
	Ba-133	79.61		2.65	-6.29E-01	7.34E-02	2.40E+00

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

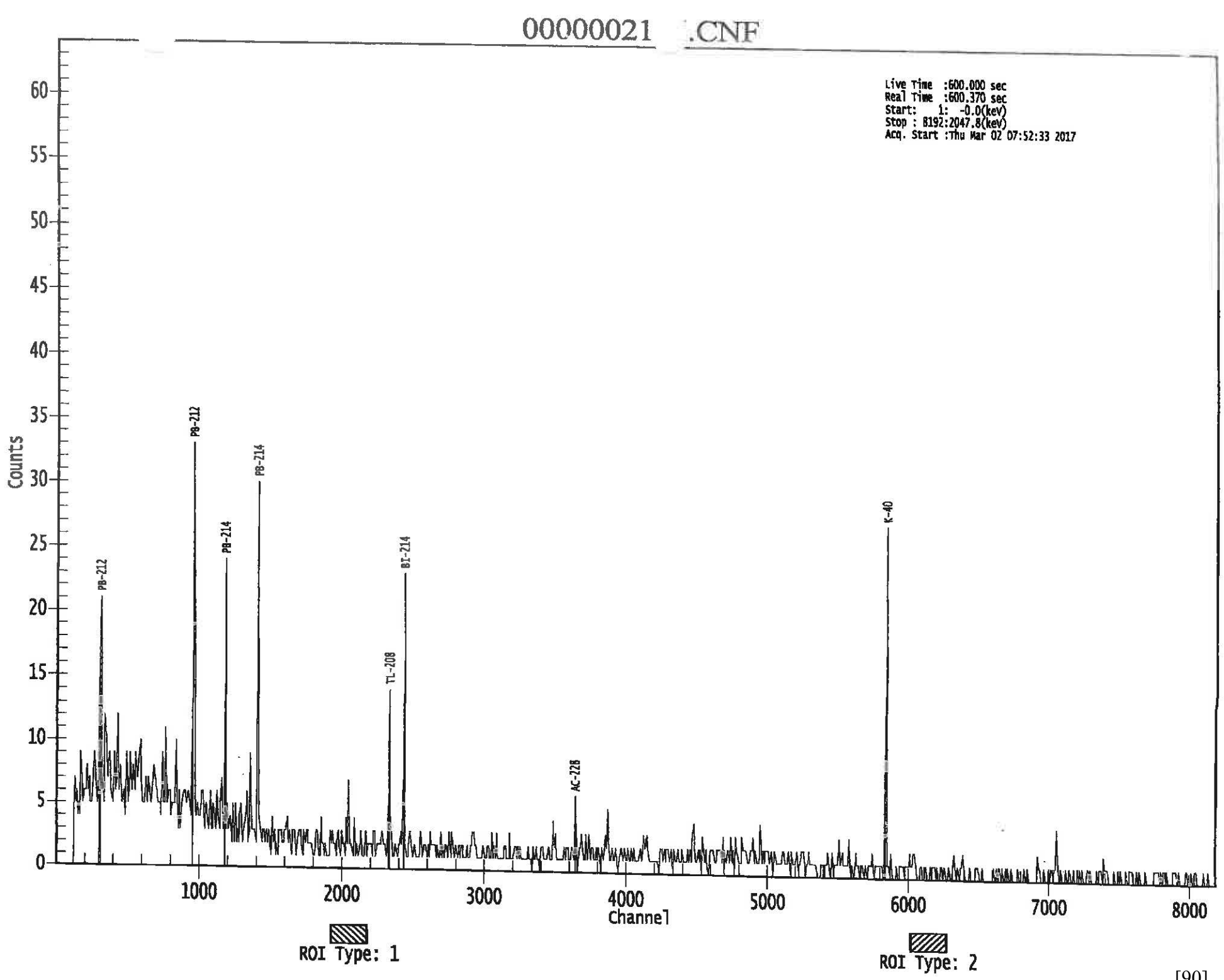
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-2.55E-01	7.34E-02	1.37E-01
	276.40	7.16	-1.41E-01		4.44E-01
	302.85	18.34	8.65E-02		1.73E-01
	356.01	62.05	-3.63E-02		7.34E-02
	383.85	8.94	-1.22E-01		3.39E-01
Cs-134	475.36	1.48	6.95E-01	4.91E-02	2.28E+00
	563.25	8.34	-4.31E-01		4.31E-01
	569.33	15.37	6.57E-02		2.71E-01
	604.72	97.62	4.60E-03		6.78E-02
	795.86	85.46	2.72E-02		4.91E-02
	801.95	8.69	-2.68E-02		4.48E-01
	1038.61	0.99	4.40E+00		5.35E+00
	1167.97	1.79	1.64E+00		3.47E+00
	1365.19	3.02	4.79E-01		1.64E+00
Cs-137	661.66	85.10	2.51E-02	5.67E-02	5.67E-02
Eu-152	121.78	28.67	4.36E-02	1.11E-01	1.11E-01
	244.70	7.61	3.59E-01		5.15E-01
	295.94	0.45	1.64E+01		1.18E+01
	344.28	26.60	-1.93E-02		1.22E-01
	367.79	0.86	-2.66E+00		3.66E+00
	411.12	2.24	2.52E-01		1.63E+00
	443.96	2.83	-3.27E-02		1.19E+00
	488.68	0.42	5.50E+00		7.86E+00
	563.99	0.49	-5.34E-01		7.60E+00
	586.26	0.46	-1.91E+00		1.36E+01
	678.62	0.47	-6.37E-01		8.67E+00
	688.67	0.86	-7.78E-01		5.10E+00
	719.35	0.28	1.66E+00		1.21E+01
	778.90	12.96	8.72E-02		2.57E-01
	810.45	0.32	6.93E-01		1.25E+01
	867.37	4.26	3.02E-01		1.16E+00
	919.33	0.43	8.40E+00		1.08E+01
	964.08	14.65	1.69E-02		4.84E-01
	1085.87	10.24	-1.86E-01		4.69E-01
	1089.74	1.73	2.08E+00		2.86E+00
	1112.07	13.69	1.71E-01		4.13E-01
	1212.95	1.43	1.27E+00		5.08E+00
	1249.94	0.19	2.03E+01		3.31E+01
	1299.14	1.63	2.80E+00		3.62E+00
	1408.01	21.07	-4.46E-02		2.10E-01
	1457.64	0.50	1.05E+02		3.89E+01
	1528.10	0.28	8.13E+00		1.67E+01
Eu-154	123.07	40.40	-2.25E-02	7.72E-02	7.72E-02
	247.93	6.89	-1.14E-01		4.31E-01
	591.76	4.95	-6.53E-01		6.53E-01
	692.42	1.78	1.16E+00		2.56E+00
	723.30	20.06	-6.42E-02		1.90E-01
	756.80	4.52	1.78E-01		9.37E-01
	873.18	12.08	1.45E-03		4.04E-01
	996.29	10.48	2.67E-01		4.79E-01
	1004.76	18.01	-1.42E-01		2.60E-01
	1274.43	34.80	-4.66E-02		1.71E-01

Analysis Report for 01-Mar-17-10028

L310222AFRGS002SSS DRIED

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-1.39E+00	7.72E-02	2.42E+00
Eu-155	45.30	1.31	3.06E-01	1.63E-01	8.68E+00
	60.01	1.22	-4.57E+00		8.52E+00
	86.55	30.70	9.45E-02		1.63E-01
	105.31	21.10	2.47E-03		1.95E-01
Ra-226	186.21	3.64	2.89E-01	8.76E-01	8.76E-01
Pa-231	27.36	10.30	0.00E+00	7.75E-02	7.75E-02
	283.69	1.70	1.48E+00		1.98E+00
	300.07	2.47	-1.17E+00		1.31E+00
	302.65	2.20	9.29E-01		1.48E+00
	330.06	1.40	1.53E+00		2.58E+00
U-235	143.76	10.96	8.06E-02	5.62E-02	3.01E-01
	163.33	5.08	-7.89E-02		5.92E-01
	185.71	57.20	2.78E-02		5.62E-02
	202.11	1.08	2.56E-01		2.64E+00
	205.31	5.01	1.68E-03		6.16E-01
Am-241	59.54	35.90	-1.44E-01	3.01E-01	3.01E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.370 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Thu Mar 02 07:52:33 2017
Counts
Channel
PB-212
PB-212
PB-214
PB-214
TL-208
BI-214
AC-228
K-40
ROI Type: 1
ROI Type: 2

[90]

Apex-Gamma

Analysis Report for 01-Mar-17-10003
L310222AFRGS003SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10003
Sample Description	: L310222AFRGS003SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.731E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 2:00:00PM
Acquisition Started	: 3/1/2017 7:15:34AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 601.0 seconds
Dead Time	: 0.17 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2133
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 7:25:37AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION 3/1/17

Analysis Report for 01-Mar-17-10003

L310222AFRGS003SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.56	949 -	960	954.33	8.56E+01	14.73	5.24E+01	0.89
2	295.21	1176 -	1186	1180.76	3.24E+01	10.31	3.06E+01	1.17
3	351.82	1402 -	1414	1407.03	6.83E+01	9.93	1.17E+01	0.80
4	583.25	2327 -	2337	2332.20	3.90E+01	6.97	4.05E+00	0.50
5	609.27	2429 -	2442	2436.26	5.90E+01	8.90	7.05E+00	0.78
6	911.37	3640 -	3649	3644.45	1.86E+01	5.79	6.42E+00	0.53
7	1460.79	5833 -	5852	5842.99	1.90E+02	15.02	1.01E+01	1.62

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	4.91E+00	4.43E-01
Tl-208	0.99	583.19	*	85.00	6.61E-02	1.25E-02
Pb-212	0.99	115.18		0.60		
		238.63	*	43.60	1.52E-01	2.88E-02
		300.09		3.30		
Bi-214	1.00	609.32	*	45.49	1.93E-01	3.13E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		

Analysis Report for 01-Mar-17-10003
L310222AFRGS003SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.54E-01	5.06E-02
		351.93	*	35.60	1.92E-01	3.18E-02
		785.96		1.06		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	1.42E-01	4.46E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Analysis Report for 01-Mar-17-10003

L310222AFRGS003SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	1.000	4.91E+00	4.43E-01	
	Tl-208	0.999	6.61E-02	1.25E-02	
X	Bi-211	0.913			
	Pb-212	0.999	1.52E-01	2.88E-02	
	Bi-214	1.000	1.93E-01	3.13E-02	
	Pb-214	0.999	1.81E-01	2.69E-02	
	Ac-228	0.999	1.42E-01	4.46E-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 1.000sigma

Analysis Report for 01-Mar-17-10003
L310222AFRGS003SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 7:25:37AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-2.31E-01	3.76E-01	3.76E-01
+	K-40	1460.82	*	10.66	4.91E+00	5.99E-01	5.99E-01
	Co-60	1173.23		99.85	4.71E-02	4.64E-02	5.73E-02
		1332.49		99.98	-2.19E-02		4.64E-02
	Nb-94	702.65		99.81	-7.18E-03	4.21E-02	4.42E-02
		871.09		99.89	-6.56E-04		4.21E-02
	Ag-108m	79.13		6.60	1.32E+00	3.92E-02	1.55E+00
		433.94		90.50	-1.39E-02		3.92E-02
		614.28		89.80	-4.00E-02		5.83E-02
		722.94		90.80	5.09E-02		5.77E-02
	Sb-125	176.31		6.84	4.01E-03	1.30E-01	5.22E-01
		380.45		1.52	5.62E-01		2.25E+00
		427.87		29.60	1.18E-01		1.30E-01
		463.36		10.49	-1.18E-01		3.80E-01
		600.60		17.65	1.52E-01		2.36E-01
		606.71		4.98	1.90E+00		1.37E+00
		635.95		11.22	-1.90E-01		2.57E-01
		671.44		1.79	-1.34E-01		2.07E+00
	Ba-133	79.61		2.65	1.96E+00	7.45E-02	3.66E+00

Analysis Report for 01-Mar-17-10003

L310222AFRGS003SS

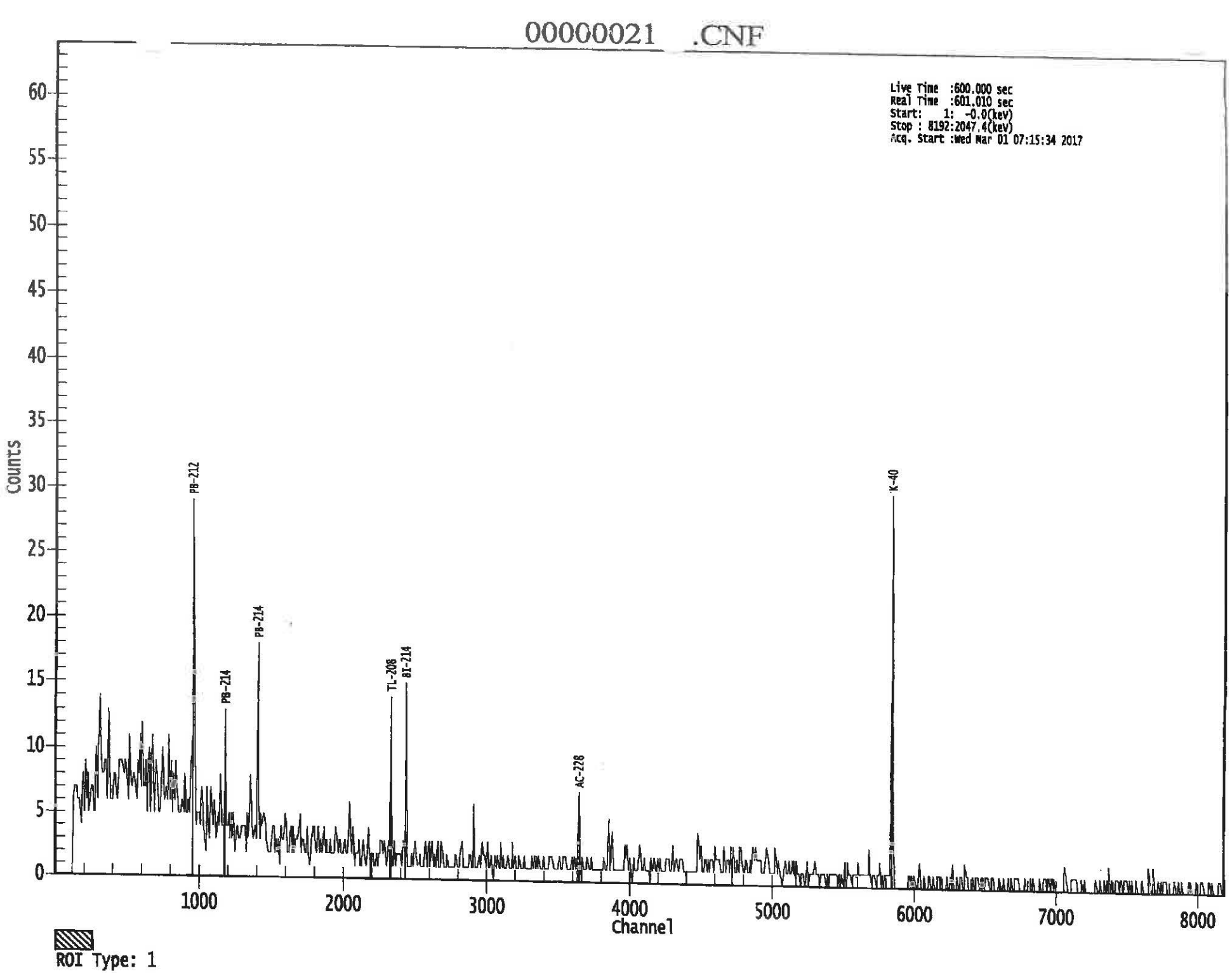
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-2.06E-01	7.45E-02	2.46E-01
	276.40	7.16	2.42E-01		5.07E-01
	302.85	18.34	6.11E-02		1.94E-01
	356.01	62.05	1.30E-02		7.45E-02
	383.85	8.94	1.10E-01		3.83E-01
Cs-134	475.36	1.48	-8.26E-01	5.12E-02	2.61E+00
	563.25	8.34	2.27E-01		4.79E-01
	569.33	15.37	-1.88E-01		2.58E-01
	604.72	97.62	-2.94E-02		6.37E-02
	795.86	85.46	-1.05E-03		5.12E-02
	801.95	8.69	-1.41E-01		4.34E-01
	1038.61	0.99	-3.95E+00		4.28E+00
	1167.97	1.79	1.41E+00		3.40E+00
	1365.19	3.02	-7.26E-03		1.27E+00
Cs-137	661.66	85.10	5.95E-04	4.60E-02	4.60E-02
Eu-152	121.78	28.67	2.66E-02	1.32E-01	1.36E-01
	244.70	7.61	3.60E-01		5.27E-01
	295.94	0.45	4.76E+00		9.97E+00
	344.28	26.60	-5.29E-02		1.32E-01
	367.79	0.86	-2.24E+00		3.55E+00
	411.12	2.24	1.59E-02		1.63E+00
	443.96	2.83	4.11E-01		1.26E+00
	488.68	0.42	-9.08E-01		9.08E+00
	563.99	0.49	7.02E+00		8.24E+00
	586.26	0.46	1.24E+01		1.20E+01
	678.62	0.47	1.70E-01		8.27E+00
	688.67	0.86	2.39E+00		4.38E+00
	719.35	0.28	8.35E-01		1.42E+01
	778.90	12.96	-8.46E-02		3.24E-01
	810.45	0.32	1.31E-01		1.18E+01
	867.37	4.26	6.88E-02		1.04E+00
	919.33	0.43	-9.63E+00		9.36E+00
	964.08	14.65	2.94E-01		4.44E-01
	1085.87	10.24	7.75E-02		5.41E-01
	1089.74	1.73	1.49E+00		3.34E+00
	1112.07	13.69	4.14E-03		3.23E-01
	1212.95	1.43	2.92E-01		4.61E+00
	1249.94	0.19	-1.03E+01		3.09E+01
	1299.14	1.63	3.23E-01		3.03E+00
	1408.01	21.07	-7.75E-02		2.57E-01
	1457.64	0.50	1.11E+02		3.98E+01
	1528.10	0.28	3.04E+00		1.13E+01
Eu-154	123.07	40.40	-3.37E-03	9.43E-02	9.43E-02
	247.93	6.89	-8.57E-02		4.70E-01
	591.76	4.95	4.87E-01		7.47E-01
	692.42	1.78	8.93E-01		2.23E+00
	723.30	20.06	1.74E-01		2.61E-01
	756.80	4.52	3.95E-01		8.68E-01
	873.18	12.08	2.11E-02		3.68E-01
	996.29	10.48	1.16E-01		4.99E-01
	1004.76	18.01	4.40E-02		2.52E-01
	1274.43	34.80	4.09E-03		1.49E-01

Analysis Report for 01-Mar-17-10003

L310222AFRGS003SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	9.89E-01	9.43E-02	2.41E+00
Eu-155	45.30	1.31	-7.29E+00	2.21E-01	2.01E+01
	60.01	1.22	-7.94E+00		2.11E+01
	86.55	30.70	2.10E-02		2.28E-01
	105.31	21.10	-4.84E-02		2.21E-01
Ra-226	186.21	3.64	2.19E-01	9.64E-01	9.64E-01
Pa-231	27.36	10.30	0.00E+00	1.84E-01	1.84E-01
	283.69	1.70	8.14E-01		2.09E+00
	300.07	2.47	-9.22E-02		1.47E+00
	302.65	2.20	1.23E-01		1.60E+00
	330.06	1.40	-2.41E-01		2.55E+00
U-235	143.76	10.96	7.11E-02	6.12E-02	3.61E-01
	163.33	5.08	1.92E-01		7.60E-01
	185.71	57.20	9.84E-03		6.12E-02
	202.11	1.08	-1.07E+00		3.35E+00
	205.31	5.01	-8.82E-01		7.11E-01
Am-241	59.54	35.90	-6.83E-01	7.33E-01	7.33E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :601.010 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 07:15:34 2017
COUNTS
Channel
PB-212
PB-214
PB-214
TL-208
BI-214
AC-228
K-40
ROI Type: 1

[98]

Apex-Gamma

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10029
Sample Description	: L310222AFRGS004SS DRIED
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.637E+03 grams
Facility	: Default
Sample Taken On	: 2/27/2017 12:45:00PM
Acquisition Started	: 3/1/2017 3:02:36PM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 601.1 seconds
Dead Time	: 0.18 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2158
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-3-17

3-1-17

3/6/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 3:12:40PM

Peak Analysis From Channel : 120

Peak Analysis To Channel : 8192

DATA VALIDATED

1/6/17

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.03	305 -	315	308.86	2.16E+01	13.63	6.74E+01	0.45
2	238.60	949 -	959	954.48	8.57E+01	14.57	5.33E+01	0.83
3	295.23	1175 -	1185	1180.84	5.40E+01	10.36	2.20E+01	0.85
4	351.87	1401 -	1415	1407.22	1.06E+02	13.15	2.34E+01	0.89
5	582.86	2323 -	2335	2330.66	3.29E+01	7.76	1.01E+01	1.44
6	609.26	2429 -	2443	2436.22	9.77E+01	10.89	7.35E+00	1.15
7	911.03	3636 -	3652	3643.07	4.14E+01	7.92	6.60E+00	0.43
8	968.63	3868 -	3879	3873.50	2.26E+01	6.42	7.44E+00	0.81
9	1460.59	5832 -	5853	5842.19	1.69E+02	14.10	8.08E+00	1.88

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
-40	0.99	1460.82	*	10.66	4.62E+00	4.34E-01
-1-208	0.98	583.19	*	85.00	5.90E-02	1.43E-02
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.61E-01	3.02E-02
		300.09		3.30		
Pb212-XR	1.00	74.82		10.28		
		77.11	*	17.10	2.43E-01	1.55E-01
		87.35		3.97		

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Pb212-XR	1.00	89.78		1.46		
Bi-214	1.00	609.32	*	45.49	3.37E-01	4.27E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	1.00	241.99		7.25		
		295.22	*	18.42	2.72E-01	5.64E-02
		351.93	*	35.60	3.14E-01	4.64E-02
		785.96		1.06		
Pb214-XR	1.00	74.82		5.80		
		77.11	*	9.70	4.28E-01	2.74E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	3.34E-01	6.56E-02
		964.77		4.99		
		968.97	*	15.80	3.11E-01	8.94E-02
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.991	4.62E+00	4.34E-01	
	Tl-208	0.983	5.90E-02	1.43E-02	
X	Bi-211	0.902			
	Pb-212	1.000	1.61E-01	3.02E-02	
?	Pb212-XR	1.000	2.43E-01	1.55E-01	
	Bi-214	1.000	3.37E-01	4.27E-02	
	Pb-214	1.000	2.97E-01	3.58E-02	
?	Pb214-XR	1.000	4.28E-01	2.74E-01	
	Ac-228	0.995	3.26E-01	5.29E-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 1.000sigma

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 3:12:40PM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-2.83E-02	4.46E-01	4.46E-01
+	K-40	1460.82	*	10.66	4.62E+00	5.86E-01	5.86E-01
	Co-60	1173.23		99.85	4.36E-02	4.46E-02	7.03E-02
		1332.49		99.98	2.17E-02		4.46E-02
	Nb-94	702.65		99.81	-3.01E-02	4.14E-02	4.14E-02
		871.09		99.89	4.82E-03		4.91E-02
	Ag-108m	79.13		6.60	-3.50E-01	4.58E-02	1.54E+00
		433.94		90.50	-1.44E-02		4.58E-02
		614.28		89.80	-3.59E-02		7.52E-02
		722.94		90.80	3.56E-02		5.94E-02
	Sb-125	176.31		6.84	-1.89E-01	1.31E-01	5.28E-01
		380.45		1.52	5.84E-01		2.46E+00
		427.87		29.60	-4.63E-02		1.31E-01
		463.36		10.49	2.60E-01		3.81E-01
		600.60		17.65	-7.00E-02		2.37E-01
		606.71		4.98	3.25E+00		1.73E+00
		635.95		11.22	2.46E-01		4.21E-01
		671.44		1.79	7.76E-01		2.98E+00
	Ba-133	79.61		2.65	-2.21E-01	8.36E-02	3.62E+00

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

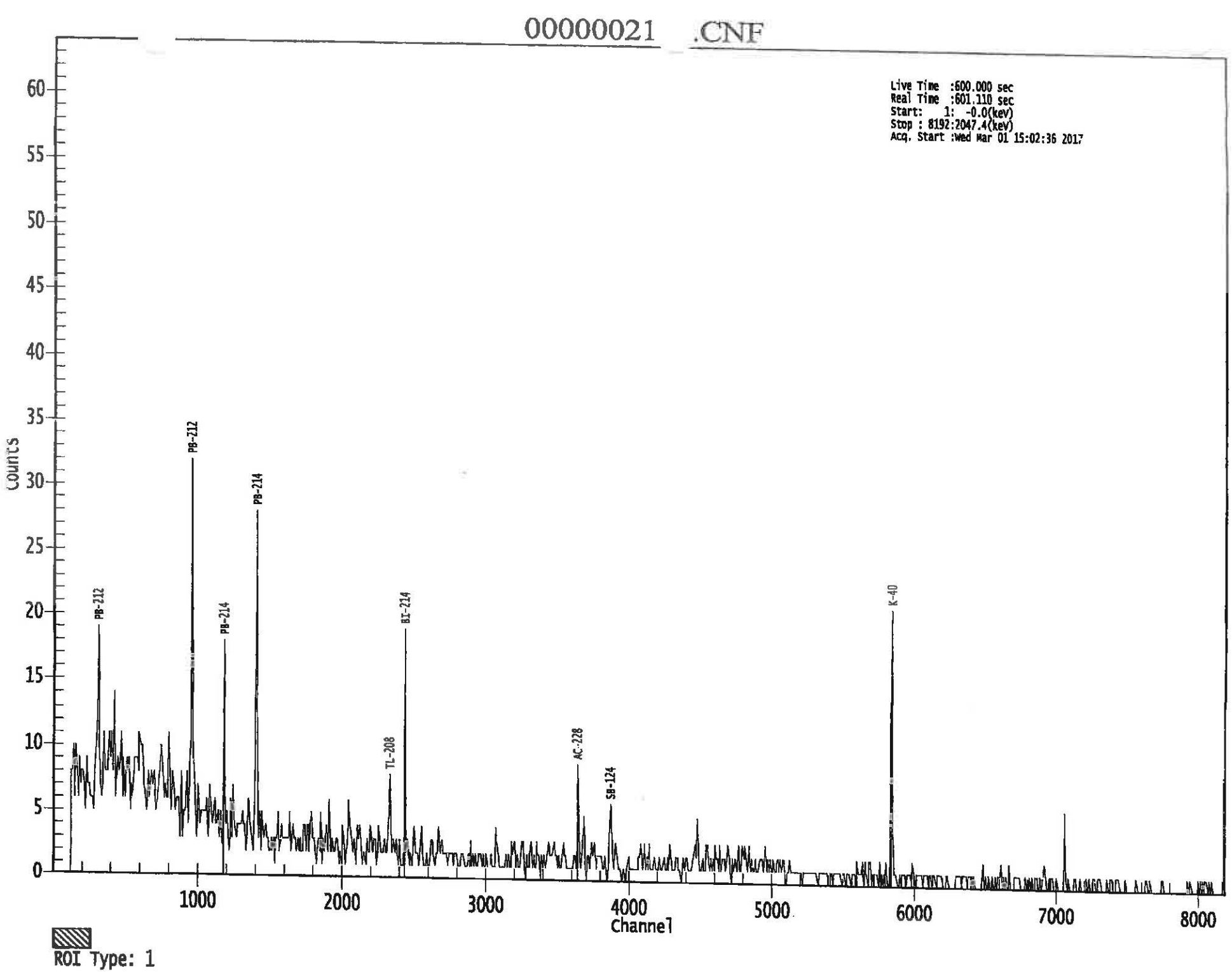
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.18E-01	8.36E-02	2.38E-01
	276.40	7.16	-5.89E-02		5.63E-01
	302.85	18.34	-1.62E-01		2.01E-01
	356.01	62.05	1.81E-02		8.36E-02
	383.85	8.94	-4.31E-01		3.90E-01
Cs-134	475.36	1.48	1.09E+00	5.96E-02	3.07E+00
	563.25	8.34	-3.48E-01		5.65E-01
	569.33	15.37	1.59E-01		3.21E-01
	604.72	97.62	-2.18E-02		7.84E-02
	795.86	85.46	3.12E-02		5.96E-02
	801.95	8.69	-6.28E-02		5.10E-01
	1038.61	0.99	-5.85E+00		5.62E+00
	1167.97	1.79	1.04E+00		4.16E+00
	1365.19	3.02	2.27E-01		1.58E+00
Cs-137	661.66	85.10	1.76E-02	5.96E-02	5.96E-02
Eu-152	121.78	28.67	-3.32E-02	1.36E-01	1.46E-01
	244.70	7.61	2.53E-01		5.62E-01
	295.94	0.45	1.05E+01		1.13E+01
	344.28	26.60	-9.81E-02		1.36E-01
	367.79	0.86	-1.64E+00		4.45E+00
	411.12	2.24	-5.13E-01		1.80E+00
	443.96	2.83	-9.35E-02		1.55E+00
	488.68	0.42	1.87E+00		1.01E+01
	563.99	0.49	3.41E+00		9.95E+00
	586.26	0.46	-9.35E+00		1.41E+01
	678.62	0.47	-1.09E-01		9.30E+00
	688.67	0.86	2.64E+00		5.16E+00
	719.35	0.28	6.65E+00		1.70E+01
	778.90	12.96	1.19E-01		3.00E-01
	810.45	0.32	-1.39E+01		1.42E+01
	867.37	4.26	-7.20E-01		1.20E+00
	919.33	0.43	5.02E+00		1.24E+01
	964.08	14.65	-1.22E-01		5.24E-01
	1085.87	10.24	4.30E-01		5.95E-01
	1089.74	1.73	7.04E-01		3.39E+00
	1112.07	13.69	-1.33E-02		4.70E-01
	1212.95	1.43	1.57E+00		4.87E+00
	1249.94	0.19	-1.03E+01		3.19E+01
	1299.14	1.63	7.12E-01		3.08E+00
	1408.01	21.07	1.25E-01		2.97E-01
	1457.64	0.50	8.54E+01		3.89E+01
	1528.10	0.28	-7.23E+00		1.67E+01
Eu-154	123.07	40.40	5.47E-02	1.05E-01	1.05E-01
	247.93	6.89	-1.98E-01		5.42E-01
	591.76	4.95	8.30E-02		9.97E-01
	692.42	1.78	4.02E-01		2.60E+00
	723.30	20.06	2.10E-01		2.73E-01
	756.80	4.52	-2.46E-01		8.43E-01
	873.18	12.08	1.33E-02		3.79E-01
	996.29	10.48	-4.72E-02		3.98E-01
	1004.76	18.01	2.11E-01		2.81E-01
	1274.43	34.80	-1.19E-01		1.52E-01

Analysis Report for 01-Mar-17-10029

L310222AFRGS004SS DRIED

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	7.83E-01	1.05E-01	3.27E+00
Eu-155	45.30	1.31	4.00E+00	2.47E-01	2.35E+01
	60.01	1.22	-1.05E+01		2.19E+01
	86.55	30.70	8.74E-02		2.47E-01
	105.31	21.10	1.62E-01		2.67E-01
Ra-226	186.21	3.64	3.20E-01	1.15E+00	1.15E+00
Pa-231	27.36	10.30	0.00E+00	1.95E-01	1.95E-01
	283.69	1.70	7.53E-01		2.30E+00
	300.07	2.47	-1.68E+00		1.62E+00
	302.65	2.20	-1.11E+00		1.69E+00
	330.06	1.40	6.73E-02		2.74E+00
U-235	143.76	10.96	-1.16E-01	7.26E-02	3.93E-01
	163.33	5.08	3.03E-01		7.79E-01
	185.71	57.20	6.72E-03		7.26E-02
	202.11	1.08	-9.21E-01		3.69E+00
	205.31	5.01	-4.13E-01		7.62E-01
Am-241	59.54	35.90	-3.06E-01	7.87E-01	7.87E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :601.110 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 15:02:36 2017
Counts
Channel
PB-212
PB-214
TL-208
BI-214
AC-228
SB-124
K-40
ROI Type: 1

[106]

Apex-Gamma

Analysis Report for 01-Mar-17-10004
L310222AFRGS005SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10004
Sample Description	: L310222AFRGS005SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.637E+03 mL
Facility	: Default
Sample Taken On	: 2/23/2017 1:52:00PM
Acquisition Started	: 3/1/2017 7:15:42AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.4 seconds
Dead Time	: 0.07 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2134
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 7:25:45AM

Peak Analysis From Channel : 120
Peak Analysis To Channel : 8192

DATA VALIDATION

Analysis Report for 01-Mar-17-10004

L310222AFRGS005SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.12	305 -	313	309.00	1.88E+01	11.40	5.12E+01	0.51
2	238.58	945 -	959	953.91	1.16E+02	14.92	3.70E+01	0.65
3	295.17	1174 -	1186	1179.98	4.55E+01	9.84	1.95E+01	1.28
4	351.85	1401 -	1415	1406.40	7.11E+01	9.85	8.95E+00	0.72
5	583.13	2324 -	2336	2330.65	4.25E+01	7.72	6.50E+00	1.16
6	609.36	2429 -	2443	2435.47	4.90E+01	8.30	7.02E+00	0.52
7	1460.90	5831 -	5852	5841.52	2.20E+02	15.16	2.59E+00	1.34

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/mL)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	5.41E+00	4.40E-01
Tl-208	1.00	583.19	*	85.00	6.85E-02	1.31E-02
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.93E-01	2.93E-02
		300.09		3.30		
Pb212-XR	1.00	74.82		10.28		
		77.11	*	17.10	1.21E-01	7.46E-02
		87.35		3.97		
		89.78		1.46		
Bi-214	1.00	609.32	*	45.49	1.52E-01	2.74E-02

Analysis Report for 01-Mar-17-10004
L310222AFRGS005SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/mL)	Activity Uncertainty
Bi-214	1.00	768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	2.05E-01	4.72E-02
		351.93	*	35.60	1.89E-01	3.03E-02
		785.96		1.06		
Pb214-XR	1.00	74.82		5.80		
		77.11	*	9.70	2.14E-01	1.32E-01
		87.35		2.24		
		89.78		0.82		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/mL)	Wt mean Activity Uncertainty	Comments
K-40	0.999	5.41E+00	4.40E-01	[109]
Tl-208	1.000	6.85E-02	1.31E-02	

Analysis Report for 01-Mar-17-10004

L310222AFRGS005SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/mL)	Wt mean Activity Uncertainty	Comments
X	Bi-211	0.908			
	Pb-212	1.000	1.93E-01	2.93E-02	
?	Pb212-XR	1.000	1.21E-01	7.46E-02	
	Bi-214	1.000	1.52E-01	2.74E-02	
	Pb-214	0.999	1.94E-01	2.55E-02	
?	Pb214-XR	1.000	2.14E-01	1.32E-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 1.000sigma

Analysis Report for 01-Mar-17-10004
L310222AFRGS005SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 7:25:45AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/mL)	Nuclide MDA (pCi/mL)	Line MDA (pCi/mL)
	BE-7	477.60		10.44	8.97E-02	3.05E-01	3.05E-01
+	K-40	1460.82	*	10.66	5.41E+00	3.25E-01	3.25E-01
	Co-60	1173.23		99.85	3.98E-02	3.80E-02	5.91E-02
		1332.49		99.98	-6.53E-03		3.80E-02
	Nb-94	702.65		99.81	-3.42E-03	3.45E-02	3.45E-02
		871.09		99.89	1.70E-02		3.90E-02
	Ag-108m	79.13		6.60	1.63E-02	3.57E-02	8.89E-01
		433.94		90.50	-1.18E-02		3.57E-02
		614.28		89.80	-3.15E-02		4.95E-02
		722.94		90.80	6.50E-03		4.27E-02
	Sb-125	176.31		6.84	1.21E-01	1.10E-01	4.28E-01
		380.45		1.52	-1.03E+00		1.97E+00
		427.87		29.60	4.60E-02		1.10E-01
		463.36		10.49	-3.48E-01		3.56E-01
		600.60		17.65	1.49E-01		2.25E-01
		606.71		4.98	-3.17E-01		1.25E+00
		635.95		11.22	9.77E-02		3.86E-01
		671.44		1.79	1.01E+00		1.92E+00
	Ba-133	79.61		2.65	9.07E-02	5.58E-02	2.19E+00

Analysis Report for 01-Mar-17-10004

L310222AFRGS005SS

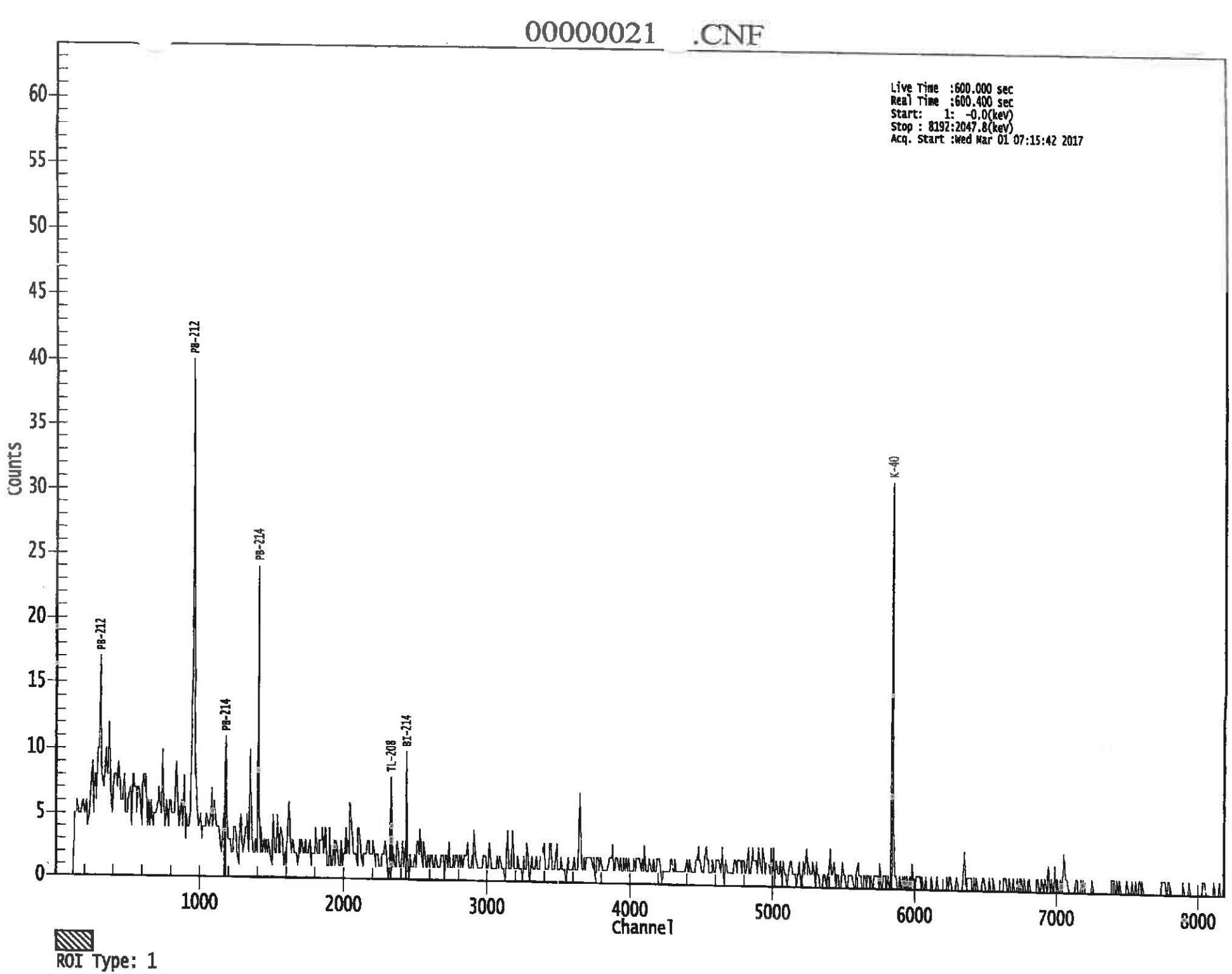
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/mL)	Nuclide MDA (pCi/mL)	Line MDA (pCi/mL)
Ba-133	81.00	32.90	-5.18E-02	5.58E-02	1.52E-01
	276.40	7.16	1.78E-01		4.81E-01
	302.85	18.34	-1.67E-02		1.48E-01
	356.01	62.05	1.81E-02		5.58E-02
	383.85	8.94	-1.44E-01		3.31E-01
Cs-134	475.36	1.48	2.20E-01	4.98E-02	2.00E+00
	563.25	8.34	-9.34E-02		3.65E-01
	569.33	15.37	7.03E-02		2.41E-01
	604.72	97.62	-9.99E-03		5.42E-02
	795.86	85.46	2.04E-02		4.98E-02
	801.95	8.69	-1.90E-01		4.37E-01
	1038.61	0.99	2.61E-01		5.29E+00
	1167.97	1.79	1.03E+00		3.04E+00
	1365.19	3.02	4.96E-01		1.21E+00
Cs-137	661.66	85.10	1.28E-02	3.99E-02	3.99E-02
Eu-152	121.78	28.67	-9.74E-03	1.03E-01	1.03E-01
	244.70	7.61	1.27E-01		4.53E-01
	295.94	0.45	7.32E+00		9.02E+00
	344.28	26.60	3.09E-02		1.14E-01
	367.79	0.86	1.54E+00		3.47E+00
	411.12	2.24	2.66E-01		1.49E+00
	443.96	2.83	-3.42E-01		1.09E+00
	488.68	0.42	2.88E-01		8.13E+00
	563.99	0.49	-3.82E+00		6.18E+00
	586.26	0.46	-6.29E+00		1.21E+01
	678.62	0.47	-5.46E+00		7.51E+00
	688.67	0.86	9.96E-01		4.37E+00
	719.35	0.28	-4.33E+00		1.26E+01
	778.90	12.96	-5.23E-01		2.44E-01
	810.45	0.32	5.28E+00		1.12E+01
	867.37	4.26	-1.27E+00		7.98E-01
	919.33	0.43	1.43E+00		1.29E+01
	964.08	14.65	1.86E-01		4.06E-01
	1085.87	10.24	8.15E-02		5.14E-01
	1089.74	1.73	-1.79E+00		2.71E+00
	1112.07	13.69	-1.54E-01		3.83E-01
	1212.95	1.43	-3.26E+00		5.01E+00
	1249.94	0.19	2.96E+00		3.00E+01
	1299.14	1.63	1.10E+00		3.16E+00
	1408.01	21.07	-8.81E-02		1.64E-01
	1457.64	0.50	1.12E+02		3.89E+01
	1528.10	0.28	-5.05E+00		1.08E+01
Eu-154	123.07	40.40	-4.42E-02	7.01E-02	7.01E-02
	247.93	6.89	-2.41E-01		4.25E-01
	591.76	4.95	4.45E-01		7.39E-01
	692.42	1.78	3.99E-01		2.07E+00
	723.30	20.06	9.35E-02		2.02E-01
	756.80	4.52	1.87E-01		9.06E-01
	873.18	12.08	-3.64E-02		3.23E-01
	996.29	10.48	-6.68E-02		4.54E-01
	1004.76	18.01	-1.04E-01		2.66E-01
	1274.43	34.80	-1.91E-02		1.37E-01

Analysis Report for 01-Mar-17-10004

L310222AFRGS005SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/mL)	Nuclide MDA (pCi/mL)	Line MDA (pCi/mL)
Eu-154	1596.48	1.80	6.70E-02	7.01E-02	2.43E+00
Eu-155	45.30	1.31	2.07E+00	1.55E-01	8.34E+00
	60.01	1.22	3.79E+00		8.40E+00
	86.55	30.70	-1.42E-02		1.55E-01
	105.31	21.10	-1.09E-01		1.73E-01
Ra-226	186.21	3.64	4.55E-01	8.37E-01	8.37E-01
Pa-231	27.36	10.30	0.00E+00	7.33E-02	7.33E-02
	283.69	1.70	-6.39E-01		1.63E+00
	300.07	2.47	-2.87E-01		1.23E+00
	302.65	2.20	-2.59E-02		1.28E+00
	330.06	1.40	3.80E-01		2.31E+00
U-235	143.76	10.96	-6.48E-02	5.35E-02	2.68E-01
	163.33	5.08	-1.83E-02		5.53E-01
	185.71	57.20	2.57E-02		5.35E-02
	202.11	1.08	-1.84E+00		2.61E+00
	205.31	5.01	-3.89E-01		5.64E-01
Am-241	59.54	35.90	9.26E-02	2.87E-01	2.87E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.400 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 07:15:42 2017
Counts
Channel
PB-212
PB-214
TL-208
BI-214
K-40
ROI Type: 1

[114]

Apex-Gamma

Analysis Report for 01-Mar-17-10005
L310222AFRGS006SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10005
Sample Description	: L310222AFRGS006SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.762E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 1:36:00PM
Acquisition Started	: 3/1/2017 7:35:35AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.9 seconds
Dead Time	: 0.14 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2135
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 7:45:38AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION 1.1 Pete 1.17

Analysis Report for 01-Mar-17-10005

L310222AFRGS006SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.63	949 -	959	954.61	8.90E+01	12.94	3.30E+01	0.71
2	295.13	1175 -	1186	1180.41	3.46E+01	9.91	2.54E+01	0.65
3	351.85	1398 -	1413	1407.14	6.68E+01	10.49	1.42E+01	0.73
4	609.34	2430 -	2444	2436.52	5.93E+01	8.37	3.75E+00	1.19
5	910.81	3638 -	3647	3642.19	1.63E+01	5.86	7.73E+00	0.71
6	1460.45	5833 -	5849	5841.62	1.02E+02	10.73	4.25E+00	1.27

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.97	1460.82	*	10.66	2.58E+00	2.94E-01
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.55E-01	2.58E-02
		300.09		3.30		
i-214	1.00	609.32	*	45.49	1.90E-01	2.92E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		

Analysis Report for 01-Mar-17-10005
L310222AFRGS006SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.62E-01	4.81E-02
		351.93	*	35.60	1.84E-01	3.25E-02
		785.96		1.06		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	1.22E-01	4.43E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments

Analysis Report for 01-Mar-17-10005

L310222AFRGS006SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.978	2.58E+00	2.94E-01	
X	Bi-211	0.907			
	Pb-212	1.000	1.55E-01	2.58E-02	
	Bi-214	1.000	1.90E-01	2.92E-02	
	Pb-214	0.999	1.77E-01	2.69E-02	
	Ac-228	0.992	1.22E-01	4.43E-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 1.000sigma

Analysis Report for 01-Mar-17-10005
L310222AFRGS006SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 7:45:38AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	1.44E-01	4.11E-01	4.11E-01
+	K-40	1460.82	*	10.66	2.58E+00	3.87E-01	3.87E-01
	Co-60	1173.23		99.85	3.24E-02	3.93E-02	5.63E-02
		1332.49		99.98	-1.45E-02		3.93E-02
	Nb-94	702.65		99.81	-6.35E-02	3.65E-02	3.75E-02
		871.09		99.89	1.41E-03		3.65E-02
	Ag-108m	79.13		6.60	1.16E+00	3.53E-02	1.45E+00
		433.94		90.50	-3.86E-02		3.58E-02
		614.28		89.80	-1.72E-02		5.96E-02
		722.94		90.80	-2.11E-02		3.53E-02
	Sb-125	176.31		6.84	2.62E-01	1.12E-01	4.75E-01
		380.45		1.52	5.17E-02		2.34E+00
		427.87		29.60	6.49E-02		1.12E-01
		463.36		10.49	1.32E-01		3.35E-01
		600.60		17.65	1.49E-01		2.50E-01
		606.71		4.98	1.16E+00		1.31E+00
		635.95		11.22	6.73E-03		3.28E-01
		671.44		1.79	-9.64E-01		1.77E+00
	Ba-133	79.61		2.65	3.78E-01	6.30E-02	3.40E+00

Analysis Report for 01-Mar-17-10005

L310222AFRGS006SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-5.74E-02	6.30E-02	2.38E-01
	276.40	7.16	2.41E-02		4.63E-01
	302.85	18.34	-9.36E-03		1.86E-01
	356.01	62.05	-3.60E-02		6.30E-02
	383.85	8.94	-2.91E-01		3.57E-01
Cs-134	475.36	1.48	3.10E-01	4.69E-02	2.57E+00
	563.25	8.34	2.12E-01		4.22E-01
	569.33	15.37	5.91E-02		2.44E-01
	604.72	97.62	5.48E-03		6.12E-02
	795.86	85.46	-5.57E-03		4.69E-02
	801.95	8.69	6.14E-02		3.99E-01
	1038.61	0.99	-1.20E+00		4.20E+00
	1167.97	1.79	-2.14E+00		2.69E+00
	1365.19	3.02	-1.34E-01		1.41E+00
Cs-137	661.66	85.10	1.58E-02	3.67E-02	3.67E-02
Eu-152	121.78	28.67	-5.44E-02	1.18E-01	1.23E-01
	244.70	7.61	6.75E-02		4.61E-01
	295.94	0.45	9.48E+00		9.56E+00
	344.28	26.60	-1.57E-01		1.18E-01
	367.79	0.86	-2.21E+00		3.28E+00
	411.12	2.24	6.99E-01		1.46E+00
	443.96	2.83	-8.84E-01		1.11E+00
	488.68	0.42	1.88E+00		7.84E+00
	563.99	0.49	7.04E-01		7.00E+00
	586.26	0.46	1.34E+01		1.11E+01
	678.62	0.47	3.09E+00		7.94E+00
	688.67	0.86	-1.20E+00		3.74E+00
	719.35	0.28	-3.47E+00		8.00E+00
	778.90	12.96	-4.26E-02		2.61E-01
	810.45	0.32	-4.16E+00		1.12E+01
	867.37	4.26	-3.37E-02		8.85E-01
	919.33	0.43	2.54E+00		8.56E+00
	964.08	14.65	3.07E-01		3.76E-01
	1085.87	10.24	-1.61E-01		4.59E-01
	1089.74	1.73	6.66E-01		2.87E+00
	1112.07	13.69	-2.27E-01		2.93E-01
	1212.95	1.43	7.62E-01		3.55E+00
	1249.94	0.19	-3.51E+00		2.30E+01
	1299.14	1.63	4.80E-01		2.75E+00
	1408.01	21.07	9.99E-02		2.05E-01
	1457.64	0.50	5.97E+01		2.87E+01
	1528.10	0.28	4.98E+00		1.35E+01
Eu-154	123.07	40.40	-4.13E-02	8.69E-02	8.69E-02
	247.93	6.89	2.70E-01		4.75E-01
	591.76	4.95	2.59E-01		6.38E-01
	692.42	1.78	1.27E+00		2.14E+00
	723.30	20.06	7.15E-02		1.76E-01
	756.80	4.52	-2.14E-01		6.50E-01
	873.18	12.08	8.59E-02		2.80E-01
	996.29	10.48	3.45E-02		3.97E-01
	1004.76	18.01	-1.25E-02		2.47E-01
	1274.43	34.80	-6.56E-02		1.21E-01

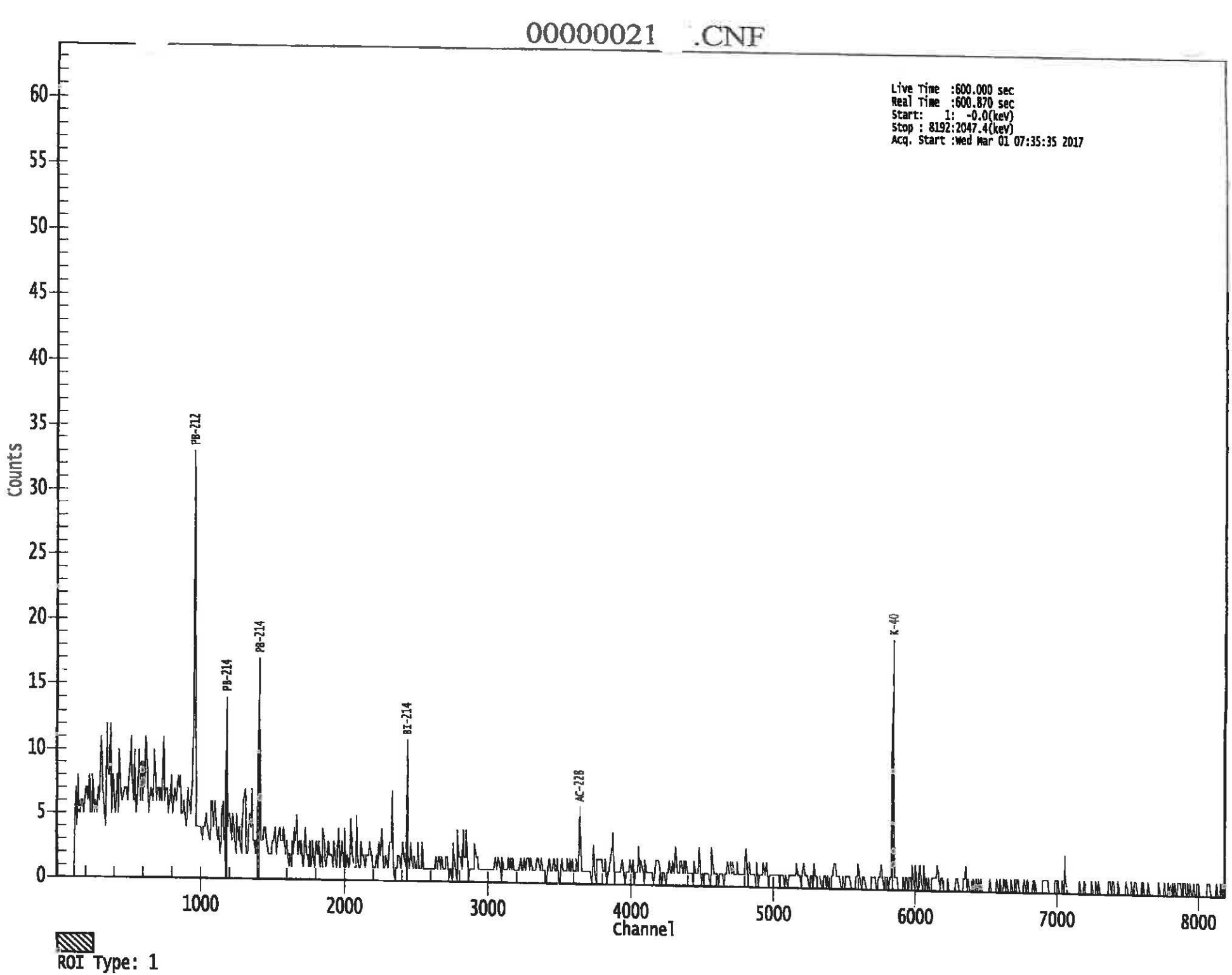
[120]

Analysis Report for 01-Mar-17-10005

L310222AFRGS006SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-2.51E+00	8.69E-02	1.81E+00
Eu-155	45.30	1.31	-1.80E+00	2.02E-01	1.91E+01
	60.01	1.22	6.00E-01		2.18E+01
	86.55	30.70	-3.35E-02		2.02E-01
	105.31	21.10	-1.22E-01		2.04E-01
Ra-226	186.21	3.64	1.75E-01	9.24E-01	9.24E-01
Pa-231	27.36	10.30	0.00E+00	1.81E-01	1.81E-01
	283.69	1.70	2.64E-01		1.73E+00
	300.07	2.47	-3.40E-02		1.34E+00
	302.65	2.20	-5.73E-01		1.53E+00
	330.06	1.40	-4.50E-01		2.37E+00
U-235	143.76	10.96	3.31E-02	5.96E-02	3.41E-01
	163.33	5.08	3.57E-02		6.97E-01
	185.71	57.20	2.14E-02		5.96E-02
	202.11	1.08	6.70E-01		2.87E+00
	205.31	5.01	1.67E-01		6.62E-01
Am-241	59.54	35.90	-1.36E-01	7.53E-01	7.53E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.870 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 07:35:35 2017
Counts
Channel
PB-212
PB-214
PB-214
BI-214
AC-228
K-40
ROI Type: 1

[122]

Apex-Gamma

Analysis Report for 01-Mar-17-10006
L310222AFRGS007SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10006
Sample Description	: L310222AFRGS007SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.742E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 2:45:00PM
Acquisition Started	: 3/1/2017 7:35:41AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.3 seconds
Dead Time	: 0.05 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2136
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 7:45:43AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION

Analysis Report for 01-Mar-17-10006
L310222AFRGS007SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.26	306 -	313	309.57	2.40E+01	9.63	3.30E+01	0.76
2	238.61	947 -	960	954.00	6.21E+01	13.63	4.39E+01	0.73
3	295.30	1174 -	1187	1180.49	3.99E+01	9.77	2.01E+01	0.79
4	352.01	1400 -	1413	1407.04	7.72E+01	11.00	1.58E+01	0.40
5	609.54	2428 -	2441	2436.20	5.17E+01	8.94	1.03E+01	0.66
6	1461.05	5831 -	5852	5842.14	1.54E+02	13.57	8.13E+00	1.36

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	3.55E+00	3.49E-01
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	9.70E-02	2.27E-02
		300.09		3.30		
Pb212-XR	0.99	74.82		10.28		
		77.11	*	17.10	1.45E-01	6.00E-02
		87.35		3.97		
		89.78		1.46		
Bi-214	0.99	609.32	*	45.49	1.51E-01	2.76E-02
		768.36		4.89		
		806.18		1.26		

Analysis Report for 01-Mar-17-10006

L310222AFRGS007SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.69E-01	4.35E-02
		351.93	*	35.60	1.93E-01	3.16E-02
		785.96		1.06		
Pb214-XR	0.99	74.82		5.80		
		77.11	*	9.70	2.56E-01	1.06E-01
		87.35		2.24		
		89.78		0.82		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.992	3.55E+00	3.49E-01	
X	Bi-211	0.869			
	Pb-212	1.000	9.70E-02	2.27E-02	[125]
?	Pb212-XR	0.998	1.45E-01	6.00E-02	

Analysis Report for 01-Mar-17-10006

L310222AFRGS007SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	Bi-214	0.997	1.51E-01	2.76E-02	
	Pb-214	0.999	1.85E-01	2.56E-02	
?	Pb214-XR	0.998	2.56E-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 1.000sigma

Analysis Report for 01-Mar-17-10006
L310222AFRGS007SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 7:45:43AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-1.34E-01	3.03E-01	3.03E-01
+	K-40	1460.82	*	10.66	3.55E+00	4.96E-01	4.96E-01
	Co-60	1173.23		99.85	2.40E-03	3.57E-02	4.38E-02
		1332.49		99.98	1.60E-02		3.57E-02
	Nb-94	702.65		99.81	-2.22E-02	3.33E-02	3.33E-02
		871.09		99.89	-1.62E-02		3.76E-02
	Ag-108m	79.13		6.60	-2.64E-01	2.92E-02	7.74E-01
		433.94		90.50	-1.28E-03		2.92E-02
		614.28		89.80	-2.71E-02		5.91E-02
		722.94		90.80	2.26E-02		4.10E-02
	Sb-125	176.31		6.84	4.93E-02	9.71E-02	3.49E-01
		380.45		1.52	-1.94E+00		1.65E+00
		427.87		29.60	3.32E-02		9.71E-02
		463.36		10.49	3.77E-02		3.43E-01
		600.60		17.65	6.14E-02		1.97E-01
		606.71		4.98	7.13E-01		1.24E+00
		635.95		11.22	-3.06E-02		2.77E-01
		671.44		1.79	-5.25E-01		1.55E+00
	Ba-133	79.61		2.65	-3.12E-01	5.81E-02	1.91E+00

Analysis Report for 01-Mar-17-10006

L310222AFRGS007SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.25E-01	5.81E-02	1.23E-01
	276.40	7.16	3.17E-01		3.91E-01
	302.85	18.34	2.43E-02		1.54E-01
	356.01	62.05	-4.79E-03		5.81E-02
	383.85	8.94	-8.07E-02		3.11E-01
Cs-134	475.36	1.48	9.14E-01	4.37E-02	2.21E+00
	563.25	8.34	1.05E-01		3.25E-01
	569.33	15.37	1.26E-01		2.18E-01
	604.72	97.62	8.30E-04		5.05E-02
	795.86	85.46	2.41E-02		4.37E-02
	801.95	8.69	-1.27E-01		3.76E-01
	1038.61	0.99	-2.45E-01		3.54E+00
	1167.97	1.79	-6.26E-01		2.29E+00
	1365.19	3.02	5.43E-01		1.21E+00
Cs-137	661.66	85.10	2.83E-02	4.20E-02	4.20E-02
Eu-152	121.78	28.67	6.37E-02	9.96E-02	9.96E-02
	244.70	7.61	2.06E-02		3.96E-01
	295.94	0.45	4.24E+00		8.07E+00
	344.28	26.60	-2.80E-02		1.07E-01
	367.79	0.86	1.25E+00		2.77E+00
	411.12	2.24	5.74E-01		1.36E+00
	443.96	2.83	-7.31E-03		1.12E+00
	488.68	0.42	-2.99E+00		5.96E+00
	563.99	0.49	2.18E+00		5.81E+00
	586.26	0.46	4.70E+00		1.08E+01
	678.62	0.47	5.92E+00		8.01E+00
	688.67	0.86	1.84E+00		4.19E+00
	719.35	0.28	-7.41E-01		1.08E+01
	778.90	12.96	-2.04E-01		2.10E-01
	810.45	0.32	8.59E+00		1.15E+01
	867.37	4.26	-2.82E-01		7.50E-01
	919.33	0.43	-4.77E+00		7.79E+00
	964.08	14.65	6.17E-02		3.60E-01
	1085.87	10.24	-1.46E-02		3.65E-01
	1089.74	1.73	1.02E+00		2.47E+00
	1112.07	13.69	1.93E-01		3.60E-01
	1212.95	1.43	6.79E-01		3.66E+00
	1249.94	0.19	-1.71E+01		2.34E+01
	1299.14	1.63	1.32E+00		3.05E+00
	1408.01	21.07	1.02E-01		1.96E-01
	1457.64	0.50	7.85E+01		3.14E+01
	1528.10	0.28	-4.74E+00		1.13E+01
Eu-154	123.07	40.40	-3.39E-02	6.47E-02	6.47E-02
	247.93	6.89	3.31E-01		3.86E-01
	591.76	4.95	-2.09E-01		4.94E-01
	692.42	1.78	4.76E-01		2.20E+00
	723.30	20.06	1.37E-01		1.90E-01
	756.80	4.52	4.37E-01		8.86E-01
	873.18	12.08	-1.06E-01		3.04E-01
	996.29	10.48	7.24E-02		3.62E-01
	1004.76	18.01	-1.28E-01		2.31E-01
	1274.43	34.80	-8.35E-02		1.10E-01

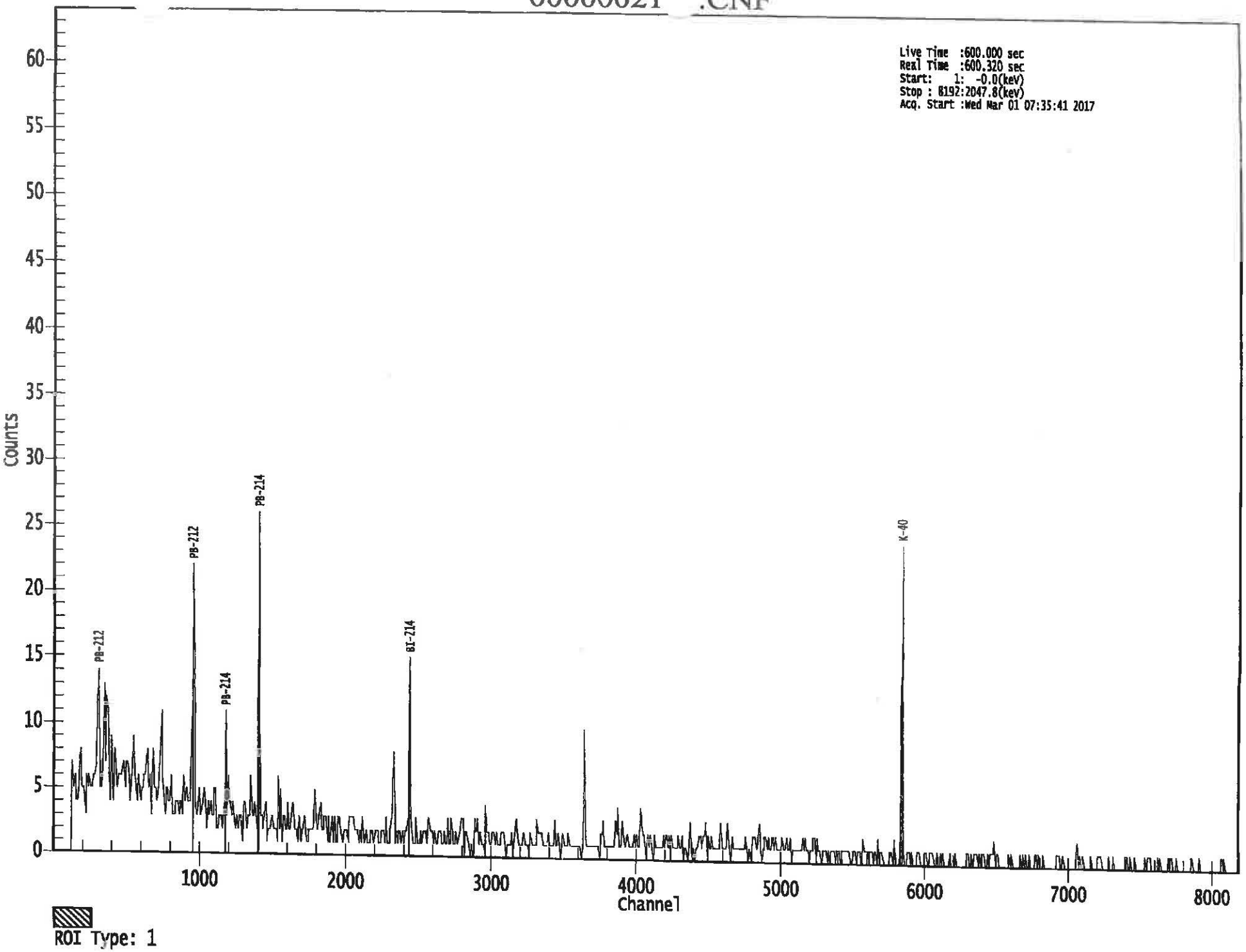
Analysis Report for 01-Mar-17-10006

L310222AFRGS007SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-1.43E+00	6.47E-02	1.83E+00
Eu-155	45.30	1.31	2.90E+00	1.40E-01	7.43E+00
	60.01	1.22	-2.00E+00		7.71E+00
	86.55	30.70	1.51E-01		1.40E-01
	105.31	21.10	-6.11E-02		1.43E-01
Ra-226	186.21	3.64	3.96E-01	7.57E-01	7.57E-01
Pa-231	27.36	10.30	0.00E+00	6.88E-02	6.88E-02
	283.69	1.70	-1.87E-01		1.40E+00
	300.07	2.47	6.39E-02		1.12E+00
	302.65	2.20	6.13E-01		1.28E+00
	330.06	1.40	4.36E-01		2.23E+00
U-235	143.76	10.96	-1.92E-02	4.84E-02	2.38E-01
	163.33	5.08	3.95E-01		5.04E-01
	185.71	57.20	2.22E-02		4.84E-02
	202.11	1.08	5.18E-01		2.22E+00
	205.31	5.01	-4.06E-01		4.68E-01
Am-241	59.54	35.90	-1.67E-01	2.65E-01	2.65E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

00000021 .CNF



[130]

Apex-Gamma

Analysis Report for 01-Mar-17-10008
L310222AFRGS008SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10008
Sample Description	: L310222AFRGS008SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.790E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 1:30:00PM
Acquisition Started	: 3/1/2017 7:52:04AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	600.0 seconds
Real Time	600.4 seconds
Dead Time	0.06 %
Peak Locate Threshold	3.00
Peak Locate Range (in channels)	120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2138
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:02:06AM

Peak Analysis From Channel : 120
Peak Analysis To Channel : 8192

VALIDATION

Analysis Report for 01-Mar-17-10008

L310222AFRGS008SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.62	948 -	960	954.08	6.90E+01	11.70	2.50E+01	0.96
2	295.25	1177 -	1186	1180.28	2.15E+01	8.43	2.15E+01	0.63
3	352.01	1401 -	1414	1407.05	6.17E+01	8.88	6.28E+00	0.84
4	609.51	2429 -	2441	2436.08	4.21E+01	7.42	4.89E+00	0.85
5	1460.84	5830 -	5852	5841.30	1.83E+02	13.53	0.00E+00	1.04

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	4.10E+00	3.52E-01
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.05E-01	1.97E-02
		300.09		3.30		
Bi-214	0.99	609.32	*	45.49	1.20E-01	2.23E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		

Analysis Report for 01-Mar-17-10008
L310222AFRGS008SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	8.86E-02	3.54E-02
		351.93	*	35.60	1.50E-01	2.48E-02
		785.96		1.06		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	1.000	4.10E+00	3.52E-01	
X	Bi-211	0.868			
	Pb-212	1.000	1.05E-01	1.97E-02	
	Bi-214	0.998	1.20E-01	2.23E-02	
	Pb-214	0.999	1.30E-01	2.03E-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 1.000sigma

Analysis Report for 01-Mar-17-10008

L310222AFRGS008SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:02:06AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	2.23E-01	3.17E-01	3.17E-01
+	K-40	1460.82	*	10.66	4.10E+00	6.45E-02	6.45E-02
	Co-60	1173.23		99.85	-1.11E-03	3.67E-02	4.76E-02
		1332.49		99.98	9.48E-03		3.67E-02
	Nb-94	702.65		99.81	-8.87E-03	3.41E-02	3.41E-02
		871.09		99.89	2.49E-03		3.56E-02
	Ag-108m	79.13		6.60	4.55E-01	2.90E-02	7.79E-01
		433.94		90.50	-1.35E-02		2.90E-02
		614.28		89.80	-2.15E-02		4.92E-02
		722.94		90.80	1.56E-02		4.23E-02
	Sb-125	176.31		6.84	1.81E-02	7.30E-02	3.47E-01
		380.45		1.52	7.50E-01		1.64E+00
		427.87		29.60	-1.04E-01		7.30E-02
		463.36		10.49	2.45E-02		2.68E-01
		600.60		17.65	9.25E-02		1.69E-01
		606.71		4.98	1.36E+00		1.03E+00
		635.95		11.22	-1.73E-01		2.56E-01
		671.44		1.79	-1.16E-01		1.80E+00
	Ba-133	79.61		2.65	9.93E-01	4.80E-02	1.87E+00

Analysis Report for 01-Mar-17-10008

L310222AFRGS008SS

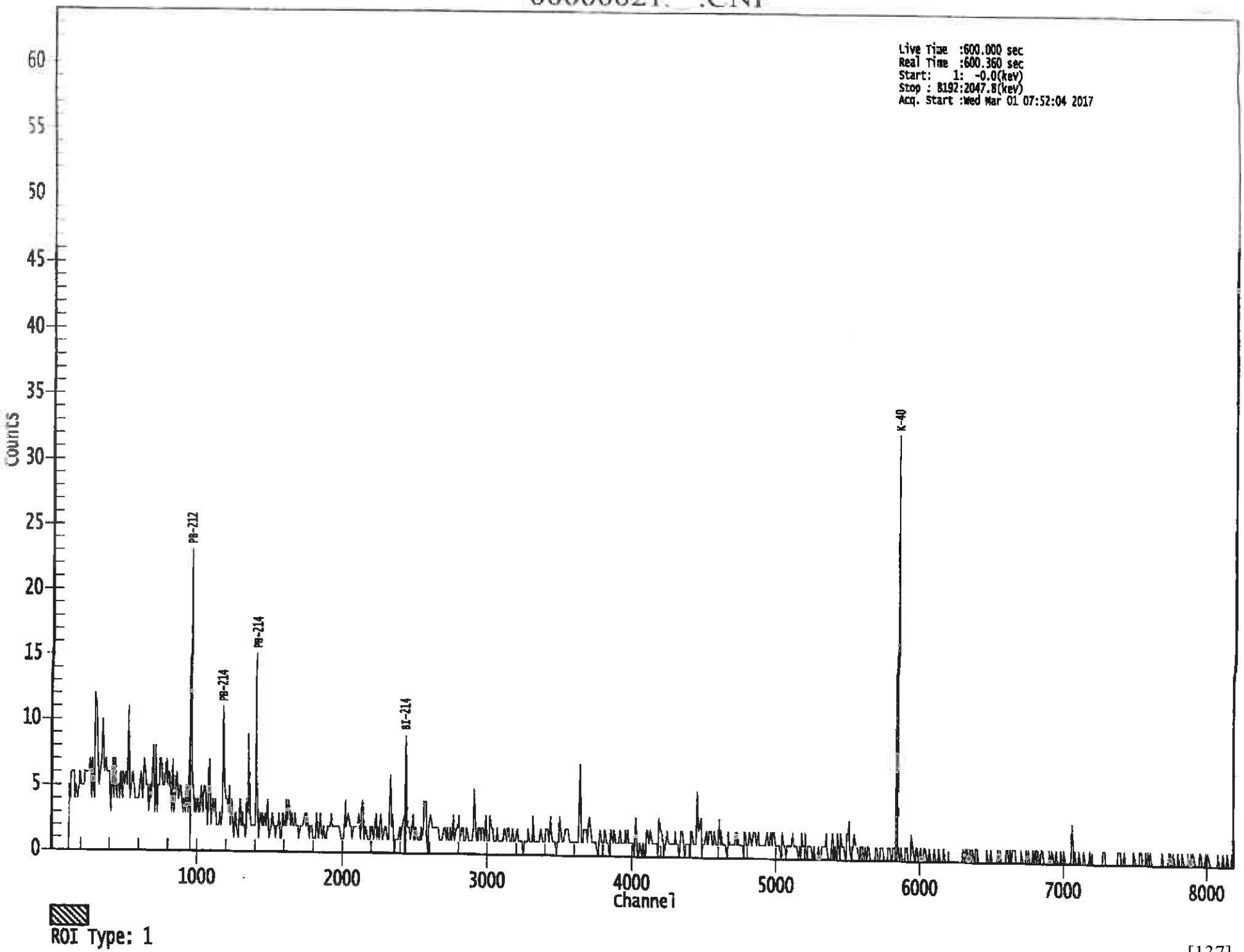
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.12E-01	4.80E-02	1.22E-01
	276.40	7.16	1.44E-02		3.30E-01
	302.85	18.34	1.11E-01		1.52E-01
	356.01	62.05	-1.94E-02		4.80E-02
	383.85	8.94	-8.21E-02		2.69E-01
Cs-134	475.36	1.48	7.17E-01	4.14E-02	2.05E+00
	563.25	8.34	-1.17E-01		3.74E-01
	569.33	15.37	-1.53E-02		1.96E-01
	604.72	97.62	-2.85E-02		4.14E-02
	795.86	85.46	2.37E-02		4.26E-02
	801.95	8.69	1.40E-01		4.21E-01
	1038.61	0.99	1.47E-01		3.85E+00
	1167.97	1.79	4.24E-01		2.38E+00
	1365.19	3.02	5.29E-01		1.18E+00
Cs-137	661.66	85.10	1.17E-04	4.25E-02	4.25E-02
Eu-152	121.78	28.67	-2.14E-02	8.27E-02	8.27E-02
	244.70	7.61	8.47E-03		3.49E-01
	295.94	0.45	5.43E+00		7.49E+00
	344.28	26.60	5.23E-03		9.21E-02
	367.79	0.86	3.91E-01		2.90E+00
	411.12	2.24	8.97E-01		1.33E+00
	443.96	2.83	-8.86E-01		7.81E-01
	488.68	0.42	2.81E+00		6.94E+00
	563.99	0.49	4.01E+00		6.58E+00
	586.26	0.46	1.17E+01		1.03E+01
	678.62	0.47	3.03E+00		7.20E+00
	688.67	0.86	-1.40E+00		3.08E+00
	719.35	0.28	4.04E+00		1.21E+01
	778.90	12.96	-3.81E-02		2.39E-01
	810.45	0.32	3.55E+00		9.92E+00
	867.37	4.26	-4.52E-01		6.39E-01
	919.33	0.43	-1.41E+00		9.60E+00
	964.08	14.65	2.04E-01		3.45E-01
	1085.87	10.24	8.00E-02		3.55E-01
	1089.74	1.73	1.57E+00		2.34E+00
	1112.07	13.69	1.63E-01		3.42E-01
	1212.95	1.43	1.09E+00		3.56E+00
	1249.94	0.19	-1.23E+01		2.49E+01
	1299.14	1.63	-3.70E-01		2.43E+00
	1408.01	21.07	9.06E-03		1.72E-01
	1457.64	0.50	8.83E+01		3.24E+01
	1528.10	0.28	2.64E+00		9.83E+00
Eu-154	123.07	40.40	-5.91E-03	5.81E-02	5.81E-02
	247.93	6.89	-1.14E-02		3.49E-01
	591.76	4.95	-4.98E-01		4.99E-01
	692.42	1.78	-1.77E+00		1.55E+00
	723.30	20.06	1.52E-01		1.95E-01
	756.80	4.52	1.89E-01		8.29E-01
	873.18	12.08	2.01E-02		3.12E-01
	996.29	10.48	-3.41E-01		2.87E-01
	1004.76	18.01	-3.29E-02		1.76E-01
	1274.43	34.80	7.45E-02		1.21E-01

Analysis Report for 01-Mar-17-10008

L310222AFRGS008SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	7.15E-01	5.81E-02	1.94E+00
Eu-155	45.30	1.31	-6.78E+00	1.26E-01	6.03E+00
	60.01	1.22	2.51E+00		7.38E+00
	86.55	30.70	6.85E-02		1.26E-01
	105.31	21.10	9.27E-03		1.37E-01
Ra-226	186.21	3.64	1.58E-01	7.45E-01	7.45E-01
Pa-231	27.36	10.30	0.00E+00	6.70E-02	6.70E-02
	283.69	1.70	-3.57E-01		1.27E+00
	300.07	2.47	-2.08E-01		1.12E+00
	302.65	2.20	7.02E-01		1.28E+00
	330.06	1.40	-1.08E-01		1.58E+00
U-235	143.76	10.96	1.24E-01	4.63E-02	2.13E-01
	163.33	5.08	2.41E-01		4.72E-01
	185.71	57.20	1.30E-04		4.63E-02
	202.11	1.08	4.75E-01		2.40E+00
	205.31	5.01	-5.12E-01		4.39E-01
Am-241	59.54	35.90	1.15E-01	2.54E-01	2.54E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021. .CNF
Live Time :600.000 sec
Real Time :600.360 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 07:52:04 2017
Counts
Channel
PB-212
PB-214
PB-214
BI-214
K-40
ROI Type: 1

[137]

Apex-Gamma

Analysis Report for 01-Mar-17-10009
L310222AFRGS009SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10009
Sample Description	: L310222AFRGS009SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.772E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 10:30:00AM
Acquisition Started	: 3/1/2017 8:04:39AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 601.0 seconds
Dead Time	: 0.16 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2139
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:14:42AM

Peak Analysis From Channel : 120
Peak Analysis To Channel : 8192

DATA VALIDATION

Analysis Report for 01-Mar-17-10009

L310222AFRGS009SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.52	949 -	959	954.17	9.46E+01	14.88	5.34E+01	1.05
2	338.44	1349 -	1357	1353.53	2.23E+01	7.34	1.47E+01	0.68
3	351.93	1401 -	1414	1407.44	7.31E+01	10.21	1.09E+01	0.92
4	583.20	2324 -	2338	2331.99	4.88E+01	9.01	1.13E+01	1.47
5	609.48	2428 -	2443	2437.07	7.10E+01	9.75	8.00E+00	0.90
6	911.08	3638 -	3650	3643.27	2.86E+01	5.66	1.40E+00	0.32
7	968.88	3869 -	3880	3874.51	1.31E+01	5.58	6.90E+00	1.04
8	1460.90	5833 -	5853	5843.43	1.10E+02	12.26	1.08E+01	0.63

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	2.78E+00	3.32E-01
Tl-208	1.00	583.19	*	85.00	8.08E-02	1.57E-02
Pb-211	0.88	351.07	*	13.02	5.49E-01	8.84E-02
Pb-212	0.99	115.18		0.60		
		238.63	*	43.60	1.64E-01	2.90E-02
		300.09		3.30		
Bi-214	0.99	609.32	*	45.49	2.27E-01	3.40E-02
		768.36		4.89		
		806.18		1.26		

Analysis Report for 01-Mar-17-10009
L310222AFRGS009SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	1.00	241.99		7.25		
		295.22		18.42		
		351.93	*	35.60	2.01E-01	3.23E-02
		785.96		1.06		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32	*	11.27	1.87E-01	6.36E-02
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	2.13E-01	4.33E-02
		964.77		4.99		
		968.97	*	15.80	1.67E-01	7.14E-02
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Analysis Report for 01-Mar-17-10009

L310222AFRGS009SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.999	2.78E+00	3.32E-01	
	Tl-208	1.000	8.08E-02	1.57E-02	
?	Bi-211	0.889	5.49E-01	8.84E-02	
	Pb-212	0.998	1.64E-01	2.90E-02	
	Bi-214	0.998	2.27E-01	3.40E-02	
?	Pb-214	1.000	2.01E-01	3.23E-02	
	Ac-228	0.999	1.98E-01	3.20E-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 1.000sigma

Analysis Report for 01-Mar-17-10009
L310222AFRGS009SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:14:42AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-1.54E-01	3.39E-01	3.39E-01
+	K-40	1460.82	*	10.66	2.78E+00	6.16E-01	6.16E-01
	Co-60	1173.23		99.85	6.82E-03	3.13E-02	4.79E-02
		1332.49		99.98	1.00E-02		3.13E-02
	Nb-94	702.65		99.81	-4.03E-02	4.22E-02	4.32E-02
		871.09		99.89	1.07E-02		4.22E-02
	Ag-108m	79.13		6.60	-4.11E-01	3.99E-02	1.50E+00
		433.94		90.50	-3.68E-03		3.99E-02
		614.28		89.80	-2.45E-02		6.90E-02
		722.94		90.80	1.71E-02		5.25E-02
	Sb-125	176.31		6.84	-1.04E-01	1.13E-01	4.92E-01
		380.45		1.52	-9.61E-01		2.03E+00
		427.87		29.60	-3.01E-02		1.13E-01
		463.36		10.49	2.23E-01		3.66E-01
		600.60		17.65	-6.22E-02		2.20E-01
		606.71		4.98	1.77E+00		1.39E+00
		635.95		11.22	-4.38E-02		3.33E-01
		671.44		1.79	3.57E-01		2.26E+00
	Ba-133	79.61		2.65	-2.06E+00	6.46E-02	3.53E+00

Analysis Report for 01-Mar-17-10009

L310222AFRGS009SS

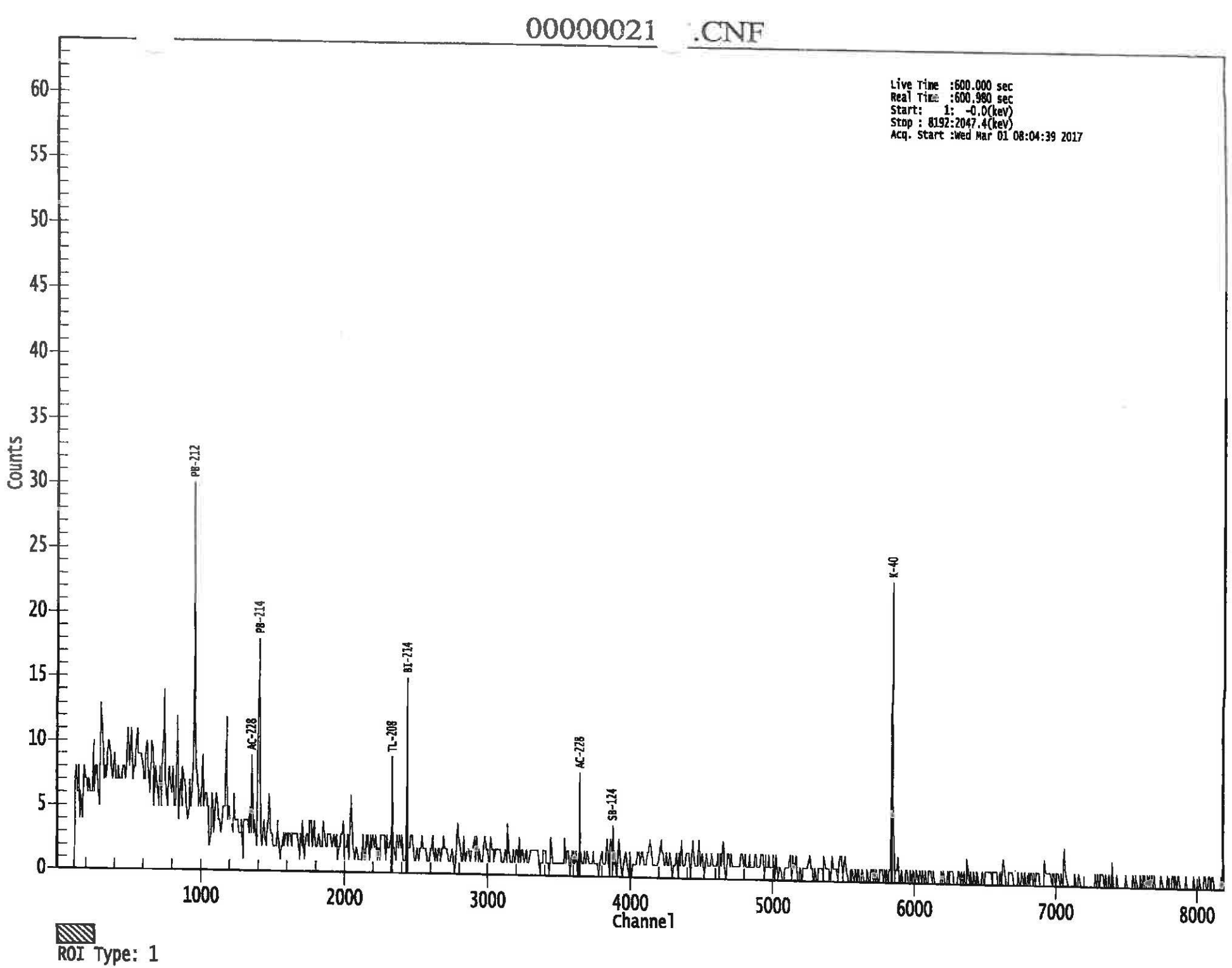
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.89E-01	6.46E-02	2.50E-01
	276.40	7.16	7.11E-02		5.38E-01
	302.85	18.34	6.91E-02		1.91E-01
	356.01	62.05	-4.31E-02		6.46E-02
	383.85	8.94	5.60E-02		3.60E-01
Cs-134	475.36	1.48	-7.56E-01	4.66E-02	2.30E+00
	563.25	8.34	-5.59E-02		4.68E-01
	569.33	15.37	5.64E-02		2.83E-01
	604.72	97.62	-3.88E-02		6.22E-02
	795.86	85.46	-1.58E-02		4.66E-02
	801.95	8.69	7.27E-04		5.06E-01
	1038.61	0.99	5.36E-01		4.98E+00
	1167.97	1.79	-2.08E+00		2.83E+00
	1365.19	3.02	-2.82E-01		1.40E+00
Cs-137	661.66	85.10	-1.00E-02	4.30E-02	4.30E-02
Eu-152	121.78	28.67	6.46E-02	1.25E-01	1.35E-01
	244.70	7.61	9.52E-02		5.30E-01
	295.94	0.45	3.48E+00		9.54E+00
	344.28	26.60	-2.27E-02		1.25E-01
	367.79	0.86	5.86E-01		3.71E+00
	411.12	2.24	4.27E-01		1.68E+00
	443.96	2.83	1.44E-02		1.46E+00
	488.68	0.42	-5.39E+00		8.08E+00
	563.99	0.49	-9.81E-01		8.17E+00
	586.26	0.46	-6.15E+00		1.34E+01
	678.62	0.47	-1.61E+00		7.90E+00
	688.67	0.86	-1.09E+00		3.84E+00
	719.35	0.28	-8.65E-01		1.54E+01
	778.90	12.96	-3.04E-01		2.68E-01
	810.45	0.32	1.13E+01		1.48E+01
	867.37	4.26	-1.89E+00		9.36E-01
	919.33	0.43	-1.90E+00		9.72E+00
	964.08	14.65	-1.23E-01		4.39E-01
	1085.87	10.24	-1.08E-01		4.14E-01
	1089.74	1.73	1.04E+00		2.63E+00
	1112.07	13.69	-8.36E-02		3.26E-01
	1212.95	1.43	-9.09E-01		3.32E+00
	1249.94	0.19	-6.39E+00		2.72E+01
	1299.14	1.63	-2.81E+00		2.36E+00
	1408.01	21.07	-4.97E-03		1.69E-01
	1457.64	0.50	5.87E+01		3.07E+01
	1528.10	0.28	5.94E+00		1.45E+01
Eu-154	123.07	40.40	1.82E-02	9.63E-02	9.63E-02
	247.93	6.89	1.08E-01		5.36E-01
	591.76	4.95	-3.45E-01		8.00E-01
	692.42	1.78	1.34E-01		2.27E+00
	723.30	20.06	-5.90E-02		2.31E-01
	756.80	4.52	5.52E-01		1.01E+00
	873.18	12.08	-1.76E-02		3.41E-01
	996.29	10.48	2.35E-01		3.82E-01
	1004.76	18.01	-1.87E-01		2.15E-01
	1274.43	34.80	-6.83E-02		1.41E-01

Analysis Report for 01-Mar-17-10009

L310222AFRGS009SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-1.41E-01	9.63E-02	2.65E+00
Eu-155	45.30	1.31	-5.88E-01	2.11E-01	2.02E+01
	60.01	1.22	-7.53E-01		2.28E+01
	86.55	30.70	9.18E-03		2.31E-01
	105.31	21.10	-1.04E-01		2.11E-01
Ra-226	186.21	3.64	7.05E-01	1.13E+00	1.13E+00
Pa-231	27.36	10.30	0.00E+00	1.80E-01	1.80E-01
	283.69	1.70	-1.64E+00		1.72E+00
	300.07	2.47	-2.50E+00		1.35E+00
	302.65	2.20	9.57E-01		1.62E+00
	330.06	1.40	1.17E-01		2.58E+00
U-235	143.76	10.96	2.66E-02	7.23E-02	3.67E-01
	163.33	5.08	-1.35E-01		6.84E-01
	185.71	57.20	4.55E-02		7.23E-02
	202.11	1.08	-1.30E+00		2.98E+00
	205.31	5.01	-4.03E-01		6.62E-01
Am-241	59.54	35.90	1.47E-02	7.95E-01	7.95E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.980 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 08:04:39 2017
Counts
Channel
PB-212
PB-214
AC-228
TL-208
BI-214
AC-228
SB-124
K-40
ROI Type: 1

[145]

Apex-Gamma

Analysis Report for 01-Mar-17-10010
L310222AFRGS010SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10010
Sample Description	: L310222AFRGS010SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.635E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 2:15:00PM
Acquisition Started	: 3/1/2017 8:04:46AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.3 seconds
Dead Time	: 0.06 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2140
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:14:50AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION

3/1/17

Analysis Report for 01-Mar-17-10010

L310222AFRGS010SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.71	949 -	959	954.41	1.10E+02	13.10	2.59E+01	0.94
2	295.13	1175 -	1184	1179.80	2.95E+01	7.59	1.25E+01	0.87
3	351.90	1400 -	1412	1406.62	6.15E+01	8.86	6.50E+00	0.66
4	583.43	2327 -	2337	2331.85	2.43E+01	6.34	6.70E+00	0.95
5	609.39	2429 -	2443	2435.58	5.19E+01	8.83	9.13E+00	0.53
6	1120.72	4475 -	4486	4480.28	1.90E+01	5.16	3.00E+00	1.20
7	1460.84	5831 -	5851	5841.29	1.54E+02	12.41	0.00E+00	1.65

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	3.78E+00	3.46E-01
Tl-208	0.99	583.19	*	85.00	3.92E-02	1.05E-02
Pb-212	0.99	115.18		0.60		
		238.63	*	43.60	1.83E-01	2.63E-02
		300.09		3.30		
Bi-214	0.99	609.32	*	45.49	1.61E-01	2.91E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29	*	14.92	2.76E-01	7.57E-02

Analysis Report for 01-Mar-17-10010

L310222AFRGS010SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.33E-01	3.58E-02
		351.93	*	35.60	1.64E-01	2.70E-02
		785.96		1.06		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	1.000	3.78E+00	3.46E-01	
	Tl-208	0.990	3.92E-02	1.05E-02	
X	Bi-211	0.895			
	Pb-212	0.999	1.83E-01	2.63E-02	
	Bi-214	0.996	1.76E-01	2.72E-02	
	Pb-214	0.999	1.53E-01	2.16E-02	

Analysis Report for 01-Mar-17-10010

L310222AFRGS010SS

? = 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 1.000sigma

Analysis Report for 01-Mar-17-10010
L310222AFRGS010SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:14:50AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	1.26E-01	3.52E-01	3.52E-01
+	K-40	1460.82	*	10.66	3.78E+00	7.06E-02	7.06E-02
	Co-60	1173.23		99.85	-5.14E-02	4.76E-02	5.21E-02
		1332.49		99.98	-1.49E-02		4.76E-02
	Nb-94	702.65		99.81	1.50E-02	3.26E-02	3.26E-02
		871.09		99.89	-1.64E-02		3.79E-02
	Ag-108m	79.13		6.60	3.16E-01	3.63E-02	8.52E-01
		433.94		90.50	-5.35E-03		3.63E-02
		614.28		89.80	1.02E-02		5.61E-02
		722.94		90.80	-2.00E-02		4.55E-02
	Sb-125	176.31		6.84	4.09E-02	8.86E-02	3.88E-01
		380.45		1.52	-4.00E-01		1.85E+00
		427.87		29.60	-5.00E-02		8.86E-02
		463.36		10.49	4.35E-03		2.88E-01
		600.60		17.65	2.88E-02		2.06E-01
		606.71		4.98	-1.09E-03		1.26E+00
		635.95		11.22	-1.85E-01		2.88E-01
		671.44		1.79	-1.61E-01		2.20E+00
	Ba-133	79.61		2.65	1.09E+00	5.53E-02	2.08E+00

Analysis Report for 01-Mar-17-10010

L310222AFRGS010SS

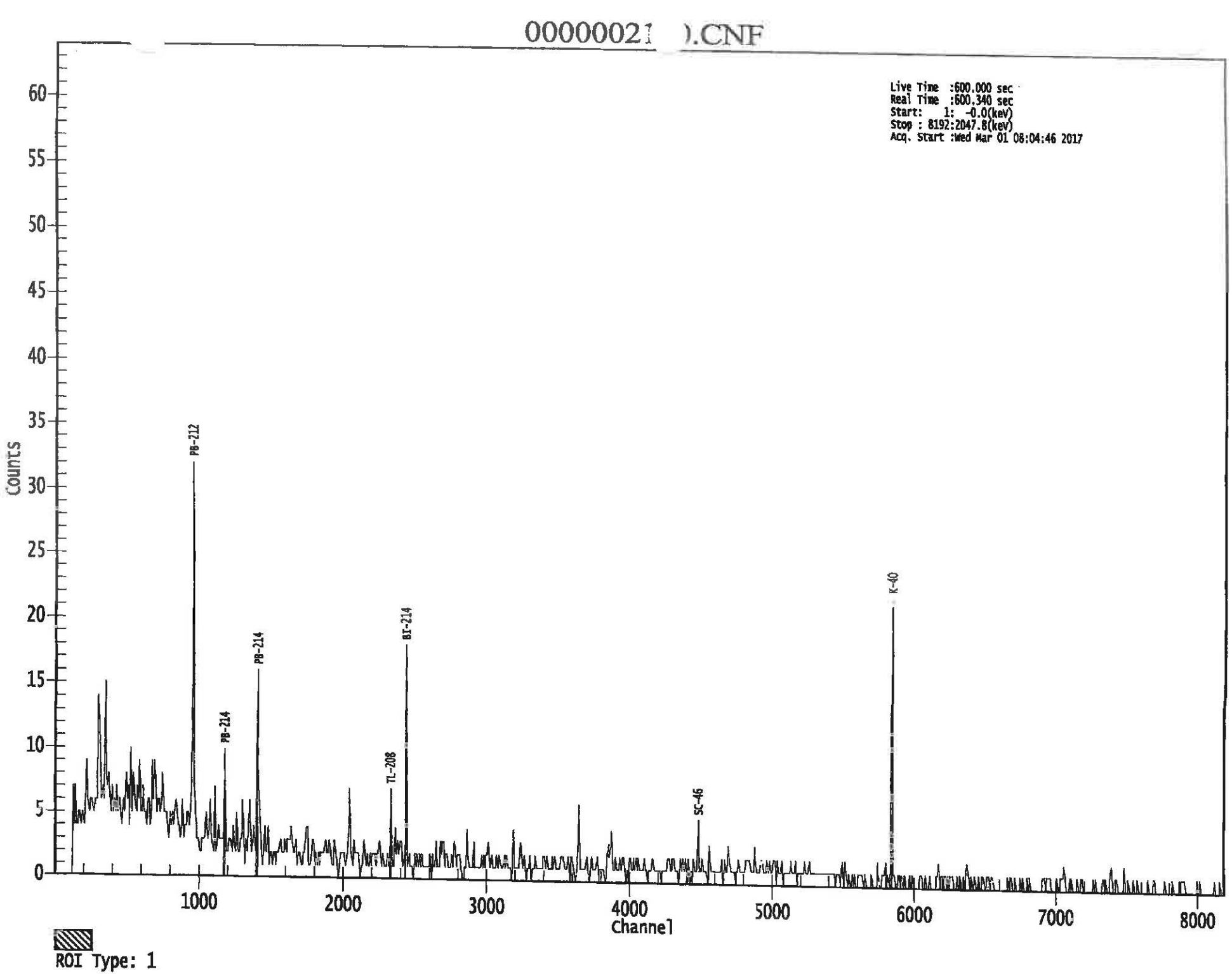
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.16E-01	5.53E-02	1.43E-01
	276.40	7.16	2.24E-01		3.78E-01
	302.85	18.34	9.92E-02		1.55E-01
	356.01	62.05	-3.94E-02		5.53E-02
	383.85	8.94	-1.29E-01		3.16E-01
Cs-134	475.36	1.48	-3.02E-01	4.43E-02	2.38E+00
	563.25	8.34	3.10E-01		4.26E-01
	569.33	15.37	6.83E-02		2.00E-01
	604.72	97.62	-1.36E-02		5.13E-02
	795.86	85.46	-9.03E-03		4.43E-02
	801.95	8.69	-1.77E-02		4.13E-01
	1038.61	0.99	1.07E+00		4.61E+00
	1167.97	1.79	1.59E+00		2.97E+00
	1365.19	3.02	1.71E-01		1.36E+00
Cs-137	661.66	85.10	2.60E-03	4.20E-02	4.20E-02
Eu-152	121.78	28.67	-1.66E-02	9.81E-02	9.81E-02
	244.70	7.61	7.32E-02		3.91E-01
	295.94	0.45	1.51E+00		7.55E+00
	344.28	26.60	4.13E-02		1.15E-01
	367.79	0.86	2.12E+00		3.65E+00
	411.12	2.24	1.98E-01		1.51E+00
	443.96	2.83	-1.27E+00		1.03E+00
	488.68	0.42	-1.44E-02		6.18E+00
	563.99	0.49	-3.54E-01		6.93E+00
	586.26	0.46	6.15E+00		1.06E+01
	678.62	0.47	-4.68E+00		7.34E+00
	688.67	0.86	1.71E+00		3.86E+00
	719.35	0.28	-2.57E+00		1.45E+01
	778.90	12.96	-1.15E-01		2.70E-01
	810.45	0.32	-1.45E+00		1.25E+01
	867.37	4.26	1.66E-01		9.13E-01
	919.33	0.43	-6.74E+00		9.20E+00
	964.08	14.65	2.68E-01		3.95E-01
	1085.87	10.24	2.59E-02		4.18E-01
	1089.74	1.73	2.77E-01		2.56E+00
	1112.07	13.69	9.89E-02		2.96E-01
	1212.95	1.43	8.02E-02		4.31E+00
	1249.94	0.19	2.31E+01		3.32E+01
	1299.14	1.63	-2.60E+00		2.30E+00
	1408.01	21.07	-1.12E-02		1.88E-01
	1457.64	0.50	7.12E+01		3.26E+01
	1528.10	0.28	-4.45E+00		9.30E+00
Eu-154	123.07	40.40	-1.40E-02	7.11E-02	7.11E-02
	247.93	6.89	2.40E-01		3.75E-01
	591.76	4.95	4.44E-01		7.53E-01
	692.42	1.78	-8.14E-01		1.87E+00
	723.30	20.06	4.38E-02		2.18E-01
	756.80	4.52	-2.94E-01		7.36E-01
	873.18	12.08	-1.03E-01		3.24E-01
	996.29	10.48	-4.20E-01		3.85E-01
	1004.76	18.01	1.90E-01		2.53E-01
	1274.43	34.80	-2.28E-01		1.23E-01

Analysis Report for 01-Mar-17-10010

L310222AFRGS010SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	1.10E+00	7.11E-02	2.44E+00
Eu-155	45.30	1.31	-8.02E-01	1.48E-01	7.12E+00
	60.01	1.22	-8.31E-01		8.34E+00
	86.55	30.70	3.98E-02		1.57E-01
	105.31	21.10	-6.57E-02		1.48E-01
Ra-226	186.21	3.64	1.77E-01	8.02E-01	8.02E-01
Pa-231	27.36	10.30	0.00E+00	7.33E-02	7.33E-02
	283.69	1.70	-4.15E-01		1.41E+00
	300.07	2.47	-1.18E+00		1.06E+00
	302.65	2.20	8.55E-01		1.29E+00
	330.06	1.40	-1.38E+00		2.17E+00
U-235	143.76	10.96	2.33E-02	5.19E-02	2.49E-01
	163.33	5.08	1.32E-01		5.34E-01
	185.71	57.20	2.83E-02		5.19E-02
	202.11	1.08	6.41E-01		2.47E+00
	205.31	5.01	-3.66E-02		5.56E-01
Am-241	59.54	35.90	-5.75E-02	2.90E-01	2.90E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021).CNF
Live Time :600.000 sec
Real Time :600.340 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 08:04:46 2017
Counts
Channel
PB-212
PB-214
PB-214
TL-208
BI-214
SC-46
K-40
ROI Type: 1

[153]

Apex-Gamma

Analysis Report for 01-Mar-17-10011
L310222AFRGS011SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10011
Sample Description	: L310222AFRGS011SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.768E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 10:10:00AM
Acquisition Started	: 3/1/2017 8:16:24AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.9 seconds
Dead Time	: 0.15 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2141
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:26:27AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION
3/1/17

Analysis Report for 01-Mar-17-10011
L310222AFRGS011SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.61	947 -	961	954.54	6.20E+01	14.51	4.90E+01	0.74
2	295.05	1173 -	1185	1180.11	3.97E+01	9.53	1.93E+01	0.87
3	351.82	1399 -	1412	1407.01	5.50E+01	10.09	1.70E+01	0.80
4	582.89	2326 -	2335	2330.75	1.75E+01	5.87	7.50E+00	0.35
5	609.23	2430 -	2441	2436.07	3.97E+01	7.63	7.32E+00	0.76
6	1460.53	5833 -	5851	5841.94	1.40E+02	12.13	2.23E+00	1.61

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.98	1460.82	*	10.66	3.54E+00	3.43E-01
Tl-208	0.98	583.19	*	85.00	2.90E-02	9.89E-03
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.08E-01	2.66E-02
		300.09		3.30		
Bi-214	0.99	609.32	*	45.49	1.27E-01	2.56E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		

Analysis Report for 01-Mar-17-10011
L310222AFRGS011SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.85E-01	4.68E-02
		351.93	*	35.60	1.51E-01	3.03E-02
		785.96		1.06		

* = Energy line found in the spectrum.
- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.986	3.54E+00	3.43E-01	
	Tl-208	0.986	2.90E-02	9.89E-03	
X	Bi-211	0.914			
	Pb-212	1.000	1.08E-01	2.66E-02	
	Bi-214	0.999	1.27E-01	2.56E-02	
	Pb-214	0.997	1.61E-01	2.54E-02	

Analysis Report for 01-Mar-17-10011

L310222AFRGS011SS

? = 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 1.000sigma

Analysis Report for 01-Mar-17-10011

L310222AFRGS011SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:26:27AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-1.58E-01	3.28E-01	3.28E-01
+	K-40	1460.82	*	10.66	3.54E+00	3.04E-01	3.04E-01
	Co-60	1173.23		99.85	-1.10E-02	4.91E-02	5.49E-02
		1332.49		99.98	1.60E-02		4.91E-02
	Nb-94	702.65		99.81	9.71E-03	3.51E-02	3.92E-02
		871.09		99.89	-4.67E-04		3.51E-02
	Ag-108m	79.13		6.60	6.78E-01	4.09E-02	1.35E+00
		433.94		90.50	1.97E-02		4.09E-02
		614.28		89.80	-5.49E-02		5.89E-02
		722.94		90.80	1.83E-02		4.94E-02
	Sb-125	176.31		6.84	6.65E-02	1.13E-01	4.69E-01
		380.45		1.52	4.98E-01		2.06E+00
		427.87		29.60	-6.74E-02		1.13E-01
		463.36		10.49	-2.36E-03		3.53E-01
		600.60		17.65	-5.17E-03		2.04E-01
		606.71		4.98	9.56E-01		1.16E+00
		635.95		11.22	8.77E-02		3.34E-01
		671.44		1.79	7.51E-01		2.26E+00
	Ba-133	79.61		2.65	-9.67E-01	6.28E-02	3.17E+00

Analysis Report for 01-Mar-17-10011

L310222AFRGS011SS

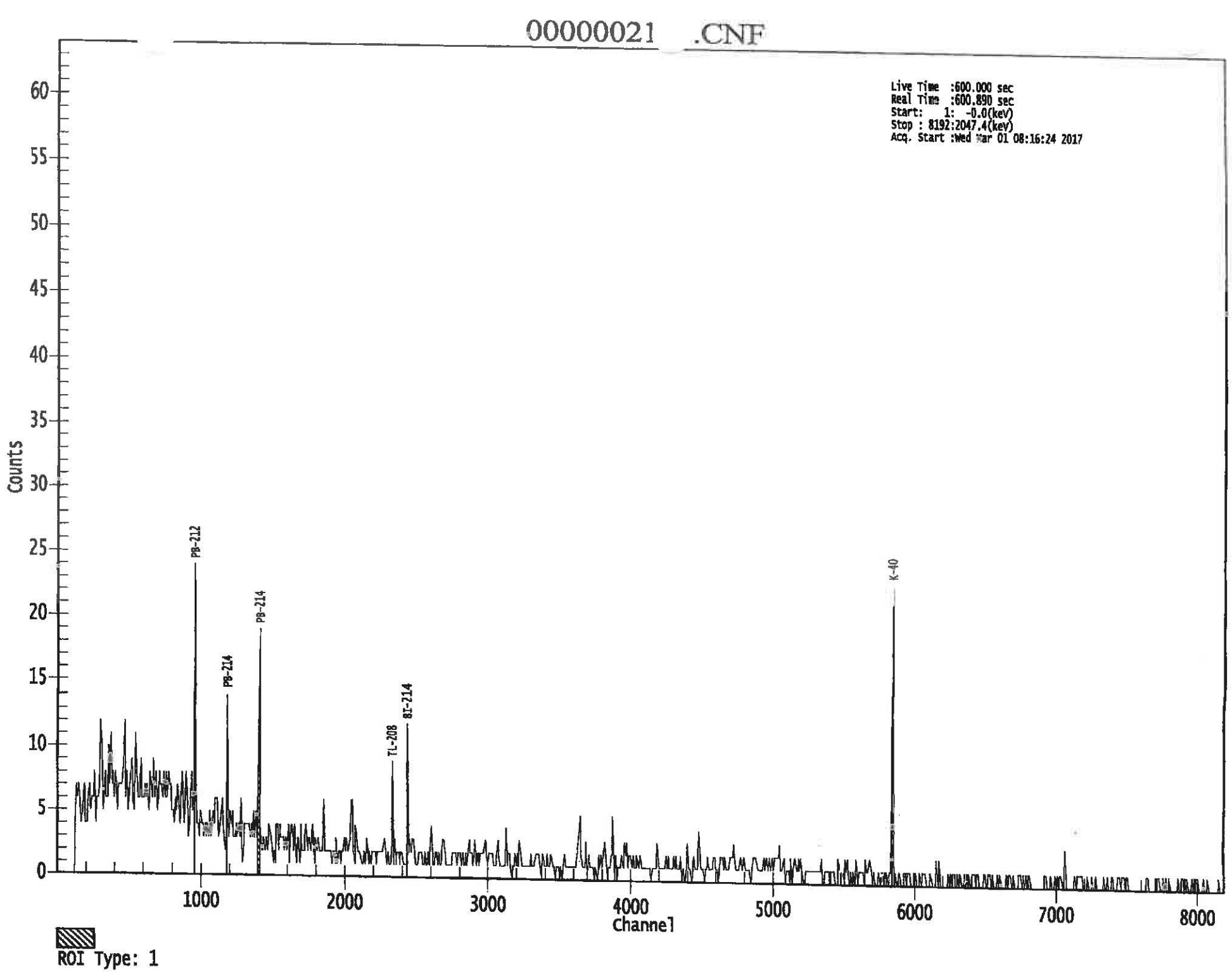
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.66E-01	6.28E-02	2.33E-01
	276.40	7.16	-9.52E-02		4.51E-01
	302.85	18.34	1.10E-01		1.88E-01
	356.01	62.05	-1.10E-02		6.28E-02
	383.85	8.94	7.88E-02		3.70E-01
Cs-134	475.36	1.48	-1.22E-01	4.02E-02	2.15E+00
	563.25	8.34	2.52E-01		4.46E-01
	569.33	15.37	5.90E-02		2.44E-01
	604.72	97.62	-1.53E-02		5.43E-02
	795.86	85.46	-3.48E-03		4.02E-02
	801.95	8.69	4.39E-02		4.74E-01
	1038.61	0.99	5.37E-02		4.19E+00
	1167.97	1.79	-4.54E+00		2.68E+00
	1365.19	3.02	6.82E-01		1.40E+00
Cs-137	661.66	85.10	-1.97E-02	3.78E-02	3.78E-02
Eu-152	121.78	28.67	4.23E-02	1.22E-01	1.22E-01
	244.70	7.61	-2.90E-01		4.62E-01
	295.94	0.45	4.54E+00		8.94E+00
	344.28	26.60	7.25E-04		1.33E-01
	367.79	0.86	-3.83E+00		3.21E+00
	411.12	2.24	1.95E-01		1.48E+00
	443.96	2.83	-4.82E-01		1.23E+00
	488.68	0.42	4.48E-01		7.67E+00
	563.99	0.49	-1.33E+00		7.27E+00
	586.26	0.46	1.08E-01		1.08E+01
	678.62	0.47	-2.10E+00		6.93E+00
	688.67	0.86	5.97E-01		4.78E+00
	719.35	0.28	1.29E+01		1.49E+01
	778.90	12.96	-8.67E-02		2.78E-01
	810.45	0.32	-8.34E+00		1.22E+01
	867.37	4.26	2.01E-01		9.38E-01
	919.33	0.43	-5.16E+00		8.53E+00
	964.08	14.65	2.02E-01		3.75E-01
	1085.87	10.24	-2.45E-01		3.32E-01
	1089.74	1.73	8.85E-01		1.97E+00
	1112.07	13.69	-1.21E-01		2.66E-01
	1212.95	1.43	-1.73E+00		3.44E+00
	1249.94	0.19	-4.45E+00		3.23E+01
	1299.14	1.63	6.65E-01		2.96E+00
	1408.01	21.07	-1.34E-01		2.05E-01
	1457.64	0.50	7.83E+01		3.26E+01
	1528.10	0.28	1.98E+00		9.59E+00
Eu-154	123.07	40.40	-7.06E-02	8.38E-02	8.38E-02
	247.93	6.89	3.16E-02		4.57E-01
	591.76	4.95	-6.87E-01		6.70E-01
	692.42	1.78	-8.97E-01		2.37E+00
	723.30	20.06	-8.08E-02		2.12E-01
	756.80	4.52	4.07E-01		9.89E-01
	873.18	12.08	1.39E-01		2.68E-01
	996.29	10.48	2.54E-01		5.18E-01
	1004.76	18.01	-2.86E-01		2.54E-01
	1274.43	34.80	-7.82E-02		1.21E-01

Analysis Report for 01-Mar-17-10011

L310222AFRGS011SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-7.39E-01	8.38E-02	1.80E+00
Eu-155	45.30	1.31	-1.03E+00	2.00E-01	1.90E+01
	60.01	1.22	-3.82E+00		2.00E+01
	86.55	30.70	-1.32E-01		2.00E-01
	105.31	21.10	2.24E-02		2.06E-01
Ra-226	186.21	3.64	-1.14E-01	8.22E-01	8.22E-01
Pa-231	27.36	10.30	0.00E+00	1.81E-01	1.81E-01
	283.69	1.70	-1.39E+00		1.69E+00
	300.07	2.47	1.33E-02		1.39E+00
	302.65	2.20	7.52E-01		1.57E+00
	330.06	1.40	1.06E+00		2.54E+00
U-235	143.76	10.96	5.75E-02	5.35E-02	3.17E-01
	163.33	5.08	-1.12E-01		6.31E-01
	185.71	57.20	1.77E-03		5.35E-02
	202.11	1.08	-1.78E+00		2.78E+00
	205.31	5.01	-4.25E-02		6.34E-01
Am-241	59.54	35.90	-1.55E-02	7.12E-01	7.12E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.890 sec
Start: 1: -0.0(keV)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 08:16:24 2017
Counts
Channel
PB-212
PB-214
PB-214
TL-208
BI-214
K-40
ROI Type: 1

[161]

Apex-Gamma

Analysis Report for 01-Mar-17-10012
L310222AFRGS012SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10012
Sample Description	: L310222AFRGS012SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.790E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 9:50:00AM
Acquisition Started	: 3/1/2017 8:16:30AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.4 seconds
Dead Time	: 0.06 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2142
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17

3-1-17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:26:33AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION

Analysis Report for 01-Mar-17-10012

L310222AFRGS012SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.05	305 -	314	308.73	3.04E+01	13.94	7.16E+01	0.76
2	238.64	948 -	960	954.14	1.83E+02	17.43	4.57E+01	0.94
3	295.15	1175 -	1187	1179.88	7.46E+01	10.54	1.34E+01	0.64
4	351.88	1399 -	1412	1406.55	1.00E+02	12.76	2.27E+01	1.16
5	583.32	2324 -	2338	2331.42	6.45E+01	9.28	7.50E+00	0.90
6	609.37	2430 -	2443	2435.53	7.63E+01	10.88	1.37E+01	1.16
7	911.12	3636 -	3649	3641.93	3.81E+01	6.62	1.94E+00	0.71
8	1460.85	5833 -	5851	5841.34	1.20E+02	11.56	4.34E+00	1.04

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	2.68E+00	2.84E-01
1-208	0.99	583.19	*	85.00	9.51E-02	1.48E-02
.b-212	1.00	115.18		0.60		
		238.63	*	43.60	2.79E-01	3.47E-02
		300.09		3.30		
Pb212-XR	1.00	74.82		10.28		
		77.11	*	17.10	1.80E-01	8.45E-02
		87.35		3.97		
		89.78		1.46		

Analysis Report for 01-Mar-17-10012

L310222AFRGS012SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	609.32	*	45.49	2.17E-01	3.36E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	1.00	241.99		7.25		
		295.22	*	18.42	3.07E-01	4.98E-02
		351.93	*	35.60	2.44E-01	3.67E-02
		785.96		1.06		
Pb214-XR	1.00	74.82		5.80		
		77.11	*	9.70	3.17E-01	1.50E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	1.00	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	2.53E-01	4.54E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

Analysis Report for 01-Mar-17-10012

L310222AFRGS012SS

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	1.000	2.68E+00	2.84E-01	
	Tl-208	0.997	9.51E-02	1.48E-02	
X	Bi-211	0.899			
	Pb-212	1.000	2.79E-01	3.47E-02	
?	Pb212-XR	1.000	1.80E-01	8.45E-02	
	Bi-214	1.000	2.17E-01	3.36E-02	
	Pb-214	1.000	2.66E-01	2.96E-02	
?	Pb214-XR	1.000	3.17E-01	1.50E-01	
	Ac-228	1.000	2.53E-01	4.54E-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 1.000sigma

Analysis Report for 01-Mar-17-10012
L310222AFRGS012SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:26:33AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-4.21E-03	3.56E-01	3.56E-01
+	K-40	1460.82	*	10.66	2.68E+00	3.49E-01	3.49E-01
	Co-60	1173.23		99.85	-1.33E-02	4.50E-02	4.64E-02
		1332.49		99.98	5.58E-04		4.50E-02
	Nb-94	702.65		99.81	1.70E-02	3.56E-02	4.17E-02
		871.09		99.89	-1.68E-02		3.56E-02
	Ag-108m	79.13		6.60	1.63E-01	3.59E-02	9.52E-01
		433.94		90.50	2.83E-02		3.59E-02
		614.28		89.80	-2.48E-02		6.23E-02
		722.94		90.80	1.11E-02		5.15E-02
	Sb-125	176.31		6.84	1.98E-01	9.30E-02	4.35E-01
		380.45		1.52	5.26E-02		1.85E+00
		427.87		29.60	-8.57E-02		9.30E-02
		463.36		10.49	2.52E-01		3.45E-01
		600.60		17.65	-7.04E-03		1.88E-01
		606.71		4.98	-1.26E+00		1.35E+00
		635.95		11.22	1.42E-01		3.37E-01
		671.44		1.79	-5.51E-01		1.93E+00
	Ba-133	79.61		2.65	6.54E-01	6.39E-02	2.33E+00

Analysis Report for 01-Mar-17-10012

L310222AFRGS012SS

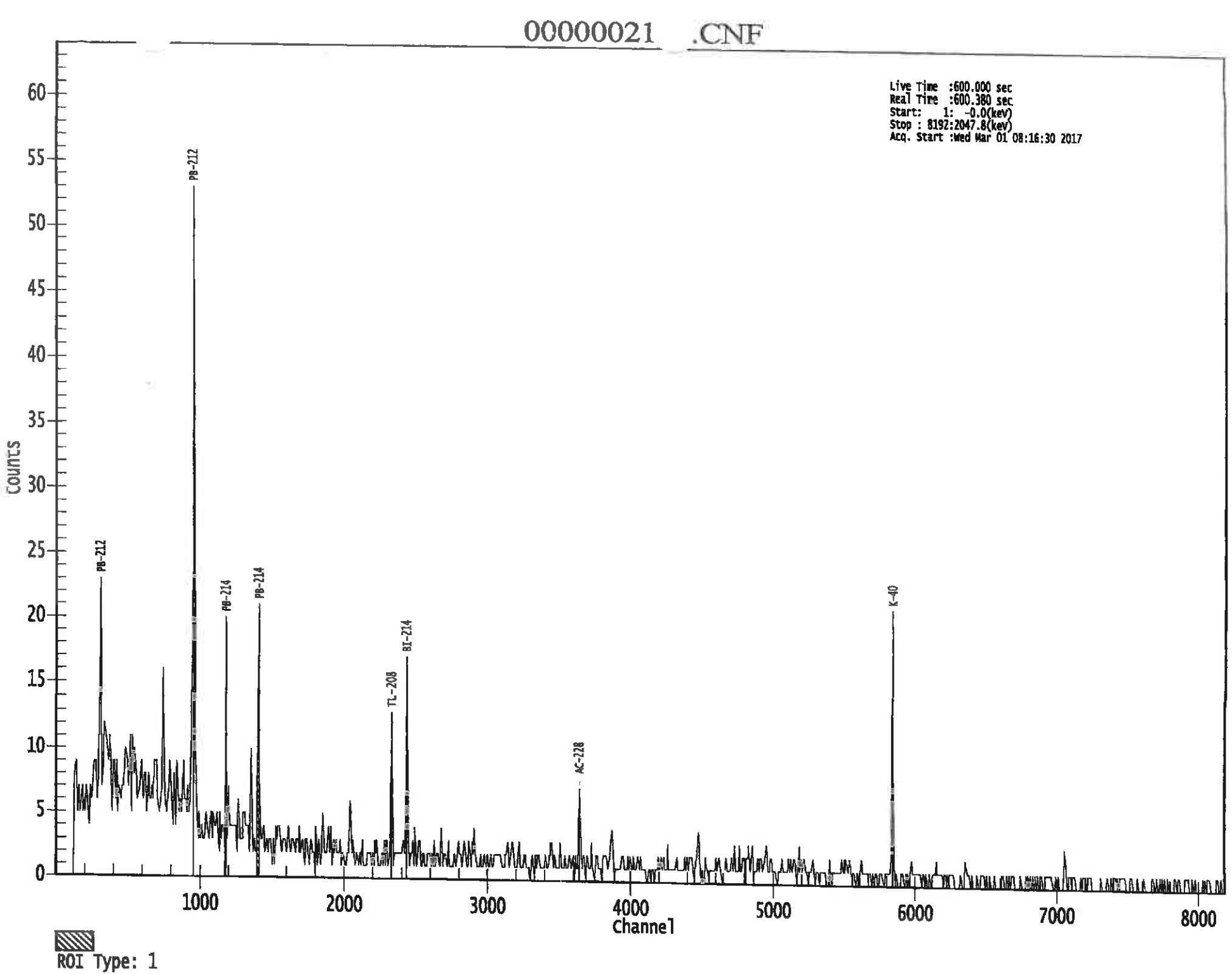
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.36E-01	6.39E-02	1.54E-01
	276.40	7.16	1.71E-01		4.19E-01
	302.85	18.34	5.66E-02		1.78E-01
	356.01	62.05	-2.29E-02		6.39E-02
	383.85	8.94	-1.07E-01		3.11E-01
Cs-134	475.36	1.48	9.32E-01	4.75E-02	2.42E+00
	563.25	8.34	8.57E-02		3.59E-01
	569.33	15.37	7.20E-02		2.42E-01
	604.72	97.62	-6.77E-02		5.38E-02
	795.86	85.46	-2.75E-03		4.75E-02
	801.95	8.69	1.49E-01		4.60E-01
	1038.61	0.99	-8.11E-01		2.97E+00
	1167.97	1.79	8.70E-01		2.30E+00
	1365.19	3.02	-5.67E-02		1.47E+00
Cs-137	661.66	85.10	2.27E-02	4.25E-02	4.25E-02
Eu-152	121.78	28.67	-1.83E-02	1.00E-01	1.05E-01
	244.70	7.61	1.16E-01		4.60E-01
	295.94	0.45	2.32E+00		9.06E+00
	344.28	26.60	-6.18E-02		1.00E-01
	367.79	0.86	8.12E-01		2.94E+00
	411.12	2.24	7.96E-01		1.50E+00
	443.96	2.83	4.19E-01		1.05E+00
	488.68	0.42	-5.92E-01		6.94E+00
	563.99	0.49	-1.92E+00		6.07E+00
	586.26	0.46	-5.53E+00		1.30E+01
	678.62	0.47	7.69E+00		8.09E+00
	688.67	0.86	5.75E-01		4.25E+00
	719.35	0.28	9.25E+00		1.47E+01
	778.90	12.96	-1.92E-01		2.23E-01
	810.45	0.32	2.05E-01		1.14E+01
	867.37	4.26	-6.67E-01		8.34E-01
	919.33	0.43	-9.57E+00		8.91E+00
	964.08	14.65	6.06E-02		4.14E-01
	1085.87	10.24	-1.04E-01		3.82E-01
	1089.74	1.73	-3.37E-01		2.34E+00
	1112.07	13.69	-3.44E-02		3.17E-01
	1212.95	1.43	-5.75E-01		3.56E+00
	1249.94	0.19	1.53E+01		2.68E+01
	1299.14	1.63	1.02E+00		2.72E+00
	1408.01	21.07	8.83E-02		1.81E-01
	1457.64	0.50	5.73E+01		2.73E+01
	1528.10	0.28	4.40E+00		1.20E+01
Eu-154	123.07	40.40	2.05E-02	7.67E-02	7.67E-02
	247.93	6.89	-8.65E-02		4.04E-01
	591.76	4.95	3.81E-01		6.63E-01
	692.42	1.78	-2.32E-01		1.98E+00
	723.30	20.06	-7.95E-02		2.30E-01
	756.80	4.52	-7.57E-01		6.94E-01
	873.18	12.08	-1.08E-01		2.96E-01
	996.29	10.48	-2.81E-02		3.85E-01
	1004.76	18.01	9.80E-02		2.19E-01
	1274.43	34.80	-5.93E-02		1.41E-01

Analysis Report for 01-Mar-17-10012

L310222AFRGS012SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-5.36E-01	7.67E-02	2.09E+00
Eu-155	45.30	1.31	1.48E+00	1.55E-01	7.95E+00
	60.01	1.22	1.75E+00		8.72E+00
	86.55	30.70	1.63E-02		1.56E-01
	105.31	21.10	-1.91E-02		1.55E-01
Ra-226	186.21	3.64	7.24E-01	9.24E-01	9.24E-01
Pa-231	27.36	10.30	0.00E+00	6.70E-02	6.70E-02
	283.69	1.70	-1.27E+00		1.46E+00
	300.07	2.47	2.20E-01		1.33E+00
	302.65	2.20	9.39E-01		1.50E+00
	330.06	1.40	-1.79E-01		2.38E+00
U-235	143.76	10.96	-7.39E-02	5.94E-02	2.69E-01
	163.33	5.08	-1.55E-01		5.24E-01
	185.71	57.20	4.03E-02		5.94E-02
	202.11	1.08	-2.37E+00		2.60E+00
	205.31	5.01	1.11E-01		5.63E-01
Am-241	59.54	35.90	1.09E-01	3.00E-01	3.00E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.380 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 08:16:30 2017
PB-212
PB-212
PB-214
PB-214
TL-208
BI-214
AC-228
K-40
COUNTS
Channel
ROI Type: 1

[169]

Apex-Gamma

Analysis Report for 01-Mar-17-10013
L310222AFRGS013SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10013
Sample Description	: L310222AFRGS013SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.790E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 9:35:00AM
Acquisition Started	: 3/1/2017 8:30:00AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 601.0 seconds
Dead Time	: 0.16 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2143
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:40:03AM

Peak Analysis From Channel : 120
Peak Analysis To Channel : 8192

[1170]

Analysis Report for 01-Mar-17-10013

L310222AFRGS013SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.13	305 -	312	309.26	2.44E+01	9.22	2.96E+01	0.35
2	238.61	948 -	959	954.53	9.60E+01	13.91	3.90E+01	1.05
3	295.15	1175 -	1186	1180.49	4.11E+01	9.99	2.29E+01	1.03
4	352.02	1402 -	1413	1407.83	5.89E+01	10.58	2.11E+01	0.76
5	609.20	2428 -	2443	2435.97	7.20E+01	9.49	5.98E+00	1.32
6	911.08	3637 -	3649	3643.28	3.40E+01	7.09	5.95E+00	0.61
7	1460.65	5833 -	5851	5842.43	9.56E+01	10.20	2.43E+00	1.25

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	2.39E+00	2.75E-01
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.64E-01	2.73E-02
		300.09		3.30		
Pb212-XR	1.00	74.82		10.28		
		77.11	*	17.10	2.50E-01	9.78E-02
		87.35		3.97		
		89.78		1.46		
Bi-214	0.99	609.32	*	45.49	2.27E-01	3.29E-02
		768.36		4.89		

Analysis Report for 01-Mar-17-10013
L310222AFRGS013SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	0.99	806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.89E-01	4.83E-02
		351.93	*	35.60	1.60E-01	3.15E-02
		785.96		1.06		
Pb214-XR	1.00	74.82		5.80		
		77.11	*	9.70	4.41E-01	1.74E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	2.52E-01	5.35E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

Analysis Report for 01-Mar-17-10013

L310222AFRGS013SS

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.995	2.39E+00	2.75E-01	
X	Bi-211	0.864			
	Pb-212	1.000	1.64E-01	2.73E-02	
?	Pb212-XR	1.000	2.50E-01	9.78E-02	
	Bi-214	0.999	2.27E-01	3.29E-02	
	Pb-214	0.999	1.69E-01	2.64E-02	
?	Pb214-XR	1.000	4.41E-01	1.74E-01	
	Ac-228	0.999	2.52E-01	5.35E-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 1.000sigma

Analysis Report for 01-Mar-17-10013
L310222AFRGS013SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:40:03AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-9.38E-02	3.96E-01	3.96E-01
+	K-40	1460.82	*	10.66	2.39E+00	3.18E-01	3.18E-01
	Co-60	1173.23		99.85	-6.19E-03	4.49E-02	4.89E-02
		1332.49		99.98	-1.95E-02		4.49E-02
	Nb-94	702.65		99.81	-1.86E-03	3.78E-02	3.78E-02
		871.09		99.89	1.35E-02		4.87E-02
	Ag-108m	79.13		6.60	-3.12E-01	4.14E-02	1.30E+00
		433.94		90.50	-3.04E-03		4.14E-02
		614.28		89.80	-2.48E-02		5.92E-02
		722.94		90.80	8.03E-03		4.79E-02
	Sb-125	176.31		6.84	7.11E-02	1.18E-01	5.01E-01
		380.45		1.52	-1.16E-01		2.18E+00
		427.87		29.60	1.77E-02		1.18E-01
		463.36		10.49	1.84E-01		4.05E-01
		600.60		17.65	3.07E-02		1.88E-01
		606.71		4.98	2.37E+00		1.38E+00
		635.95		11.22	-7.68E-02		3.00E-01
		671.44		1.79	-2.30E+00		2.14E+00
	Ba-133	79.61		2.65	-1.25E+00	7.25E-02	3.12E+00

Analysis Report for 01-Mar-17-10013

L310222AFRGS013SS

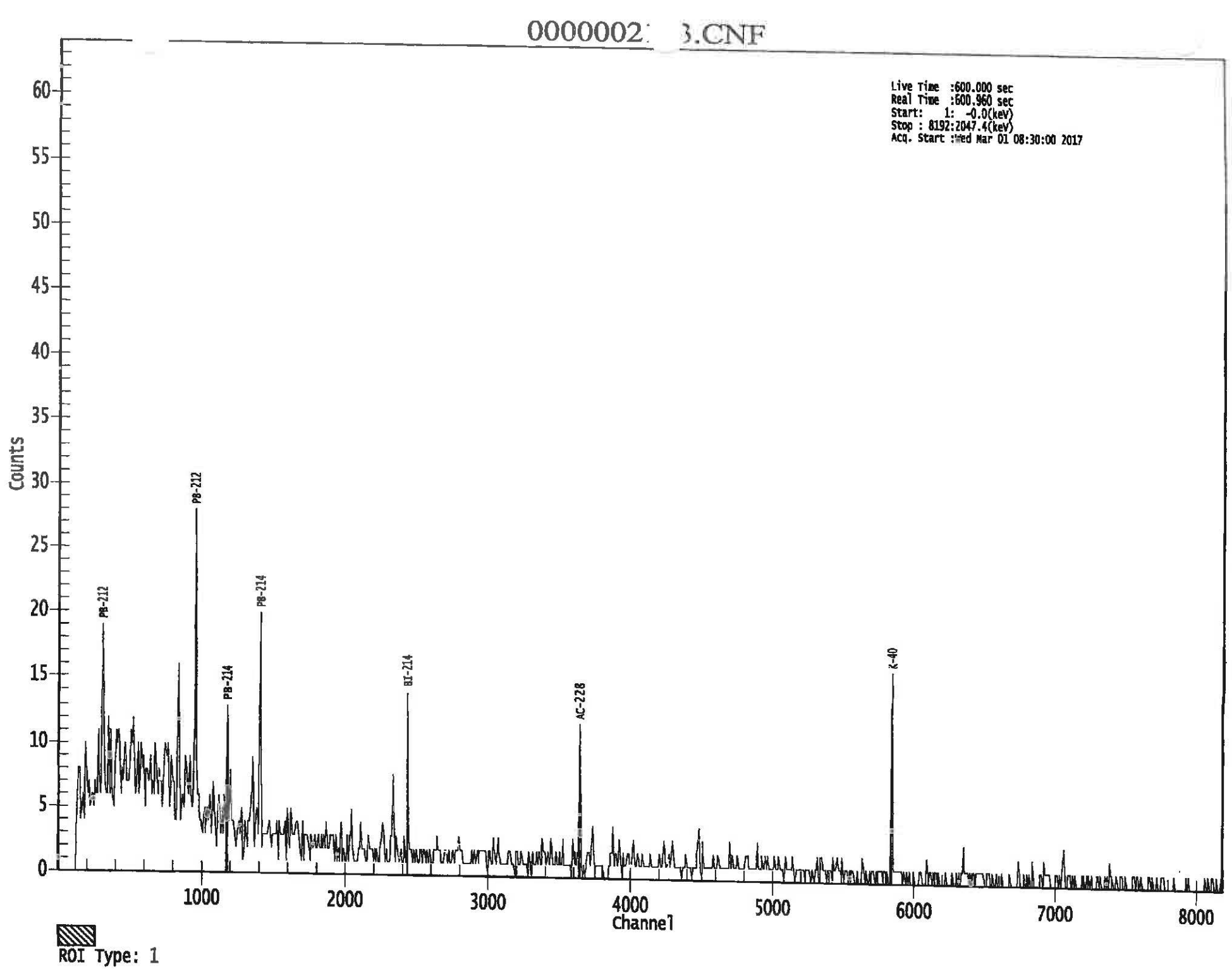
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	5.56E-03	7.25E-02	2.21E-01
	276.40	7.16	-9.83E-02		4.27E-01
	302.85	18.34	6.39E-02		1.80E-01
	356.01	62.05	-3.26E-02		7.25E-02
	383.85	8.94	-2.62E-01		3.21E-01
Cs-134	475.36	1.48	1.36E+00	4.11E-02	2.75E+00
	563.25	8.34	-8.82E-02		4.85E-01
	569.33	15.37	-7.19E-02		2.41E-01
	604.72	97.62	-2.26E-02		6.20E-02
	795.86	85.46	-6.78E-03		4.11E-02
	801.95	8.69	1.36E-01		4.56E-01
	1038.61	0.99	2.21E+00		4.68E+00
	1167.97	1.79	-1.96E+00		2.48E+00
	1365.19	3.02	-5.00E-01		1.39E+00
Cs-137	661.66	85.10	9.92E-03	4.90E-02	4.90E-02
Eu-152	121.78	28.67	3.51E-02	1.12E-01	1.30E-01
	244.70	7.61	2.65E-01		5.00E-01
	295.94	0.45	-3.60E+00		9.27E+00
	344.28	26.60	-6.89E-02		1.12E-01
	367.79	0.86	-8.99E-01		3.43E+00
	411.12	2.24	3.66E-01		1.63E+00
	443.96	2.83	3.68E-01		1.27E+00
	488.68	0.42	-7.36E+00		7.86E+00
	563.99	0.49	7.19E+00		8.67E+00
	586.26	0.46	1.56E+01		1.28E+01
	678.62	0.47	5.13E+00		8.83E+00
	688.67	0.86	9.58E-01		3.92E+00
	719.35	0.28	-5.65E+00		1.24E+01
	778.90	12.96	-4.16E-02		2.91E-01
	810.45	0.32	1.62E+00		1.33E+01
	867.37	4.26	-1.41E+00		1.05E+00
	919.33	0.43	-1.23E+00		8.74E+00
	964.08	14.65	9.99E-02		3.30E-01
	1085.87	10.24	-1.02E-01		3.28E-01
	1089.74	1.73	-9.37E-02		2.25E+00
	1112.07	13.69	-7.49E-02		3.33E-01
	1212.95	1.43	-2.04E+00		3.18E+00
	1249.94	0.19	1.78E+01		3.06E+01
	1299.14	1.63	-1.04E+00		3.03E+00
	1408.01	21.07	6.15E-02		1.67E-01
	1457.64	0.50	5.15E+01		2.70E+01
	1528.10	0.28	5.88E+00		1.43E+01
Eu-154	123.07	40.40	1.04E-02	9.21E-02	9.21E-02
	247.93	6.89	-3.51E-01		4.27E-01
	591.76	4.95	-3.08E-01		7.37E-01
	692.42	1.78	-2.21E-01		2.06E+00
	723.30	20.06	9.45E-02		2.21E-01
	756.80	4.52	9.26E-02		9.59E-01
	873.18	12.08	1.04E-01		3.96E-01
	996.29	10.48	2.63E-02		4.04E-01
	1004.76	18.01	-5.56E-02		2.21E-01
	1274.43	34.80	-3.68E-02		1.44E-01

Analysis Report for 01-Mar-17-10013

L310222AFRGS013SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-1.23E+00	9.21E-02	2.33E+00
Eu-155	45.30	1.31	1.09E+01	2.18E-01	2.06E+01
	60.01	1.22	1.07E+01		2.23E+01
	86.55	30.70	1.08E-01		2.18E-01
	105.31	21.10	-2.87E-02		2.25E-01
Ra-226	186.21	3.64	8.94E-01	9.98E-01	9.98E-01
Pa-231	27.36	10.30	0.00E+00	1.78E-01	1.78E-01
	283.69	1.70	-5.30E-01		1.82E+00
	300.07	2.47	2.25E-01		1.32E+00
	302.65	2.20	7.32E-01		1.50E+00
	330.06	1.40	-1.90E+00		2.28E+00
U-235	143.76	10.96	-4.76E-02	6.32E-02	3.45E-01
	163.33	5.08	-5.17E-02		7.07E-01
	185.71	57.20	4.84E-02		6.32E-02
	202.11	1.08	-6.87E-01		2.98E+00
	205.31	5.01	-3.30E-01		6.34E-01
Am-241	59.54	35.90	1.38E-01	7.72E-01	7.72E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


0000002: 3.CNF
Live Time :600.000 sec
Real Time :600.960 sec
Start: 1: -0.0(keV)
Stop : 8192:2047.4(keV)
Acq. Start :Wed Mar 01 08:30:00 2017
Counts
Channel
PB-212
PB-212
PB-214
PB-214
BI-214
AC-228
K-40
ROI Type: 1

[177]

Apex-Gamma

Analysis Report for 01-Mar-17-10014
L310222AFRGS014SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10014
Sample Description	: L310222AFRGS014SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.803E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 9:20:00AM
Acquisition Started	: 3/1/2017 8:30:06AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P11314
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 600.4 seconds
Dead Time	: 0.06 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 11/10/2016
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	: initial 11/16/16
Sample Number	: 2144
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 12/22/2008 12:00:00PM

3-1-17 3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:40:08AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION

Analysis Report for 01-Mar-17-10014

L310222AFRGS014SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.62	948 -	959	954.08	9.40E+01	13.29	3.30E+01	1.04
2	295.29	1175 -	1185	1180.43	3.07E+01	9.21	2.23E+01	0.46
3	352.13	1401 -	1412	1407.53	4.95E+01	8.70	1.05E+01	0.98
4	609.31	2429 -	2441	2435.29	4.73E+01	8.10	6.71E+00	0.54
5	1460.87	5831 -	5852	5841.44	1.85E+02	14.28	5.24E+00	1.38

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	1.00	1460.82	*	10.66	4.11E+00	3.65E-01
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.42E-01	2.31E-02
		300.09		3.30		
i-214	1.00	609.32	*	45.49	1.33E-01	2.42E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		

Analysis Report for 01-Mar-17-10014

L310222AFRGS014SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.25E-01	3.90E-02
		351.93	*	35.60	1.20E-01	2.31E-02
		785.96		1.06		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	1.000	4.11E+00	3.65E-01	
Pb-212	1.000	1.42E-01	2.31E-02	
Bi-214	1.000	1.33E-01	2.42E-02	
Pb-214	0.996	1.21E-01	1.99E-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 1.000sigma

Analysis Report for 01-Mar-17-10014
L310222AFRGS014SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:40:08AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	1.68E-01	2.89E-01	2.89E-01
+	K-40	1460.82	*	10.66	4.11E+00	3.95E-01	3.95E-01
	Co-60	1173.23		99.85	9.29E-03	4.16E-02	5.05E-02
		1332.49		99.98	8.66E-03		4.16E-02
	Nb-94	702.65		99.81	1.50E-02	3.33E-02	3.38E-02
		871.09		99.89	-1.24E-02		3.33E-02
	Ag-108m	79.13		6.60	2.13E-01	3.04E-02	8.14E-01
		433.94		90.50	-1.12E-02		3.04E-02
		614.28		89.80	-2.06E-02		4.94E-02
		722.94		90.80	1.65E-02		4.20E-02
	Sb-125	176.31		6.84	2.37E-01	1.01E-01	3.64E-01
		380.45		1.52	-7.71E-01		1.60E+00
		427.87		29.60	-1.20E-02		1.01E-01
		463.36		10.49	1.46E-01		2.99E-01
		600.60		17.65	3.61E-02		2.04E-01
		606.71		4.98	1.66E+00		1.14E+00
		635.95		11.22	-1.41E-01		2.75E-01
		671.44		1.79	-5.59E-01		1.96E+00
	Ba-133	79.61		2.65	-1.60E-01	5.25E-02	1.94E+00

Analysis Report for 01-Mar-17-10014

L310222AFRGS014SS

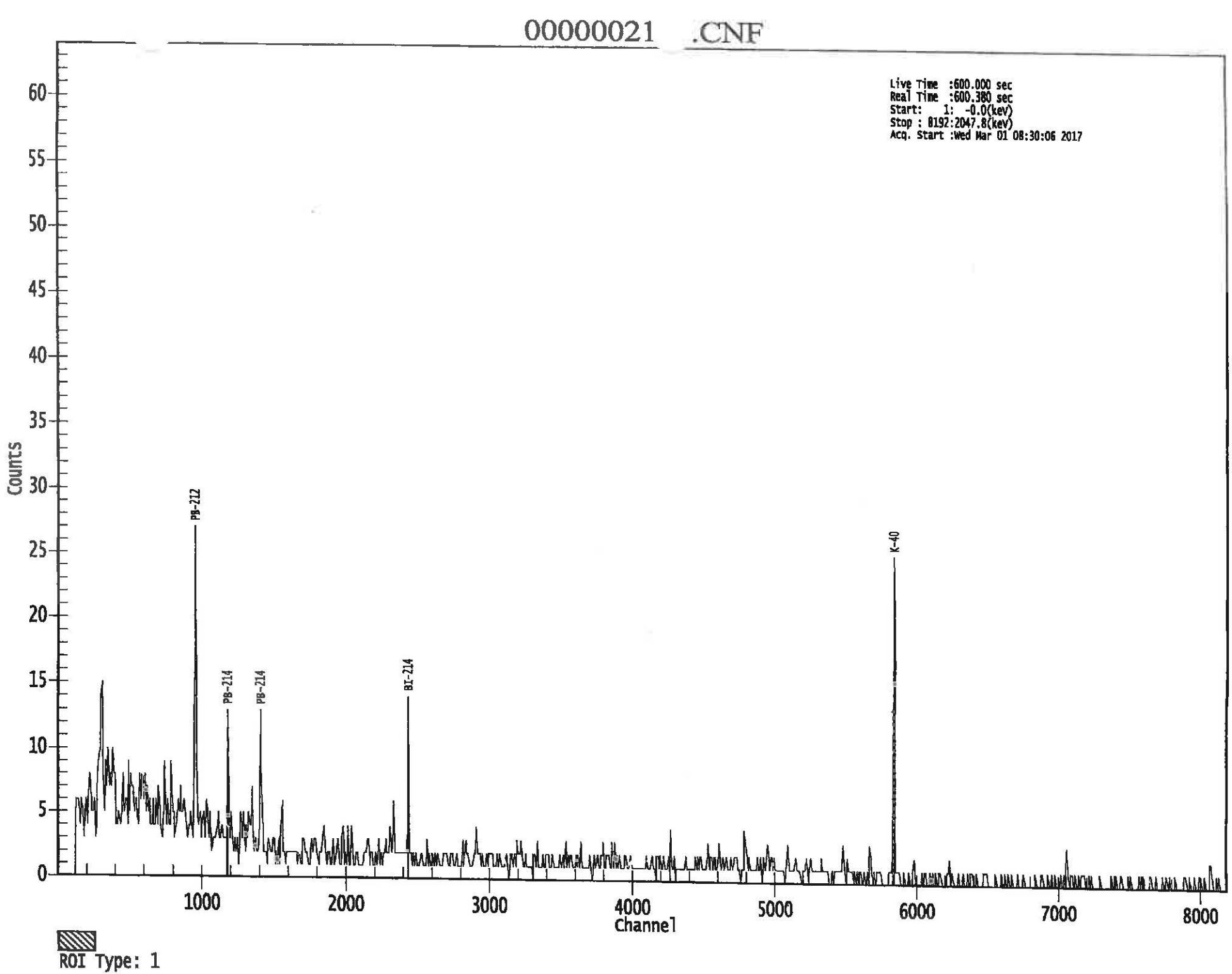
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-1.42E-01	5.25E-02	1.26E-01
	276.40	7.16	6.79E-02		3.85E-01
	302.85	18.34	5.55E-02		1.41E-01
	356.01	62.05	-3.58E-02		5.25E-02
	383.85	8.94	-1.77E-01		2.67E-01
Cs-134	475.36	1.48	-1.02E+00	4.12E-02	1.82E+00
	563.25	8.34	-2.51E-01		3.48E-01
	569.33	15.37	8.22E-02		2.11E-01
	604.72	97.62	-2.65E-02		4.97E-02
	795.86	85.46	-9.32E-03		4.12E-02
	801.95	8.69	-6.75E-02		3.97E-01
	1038.61	0.99	1.42E-01		3.69E+00
	1167.97	1.79	5.67E-02		2.99E+00
	1365.19	3.02	8.55E-02		1.30E+00
Cs-137	661.66	85.10	-2.69E-02	3.23E-02	3.23E-02
Eu-152	121.78	28.67	3.42E-02	9.16E-02	9.16E-02
	244.70	7.61	2.08E-01		3.93E-01
	295.94	0.45	3.90E+00		7.98E+00
	344.28	26.60	6.09E-03		9.83E-02
	367.79	0.86	4.65E-01		2.87E+00
	411.12	2.24	3.37E-01		1.20E+00
	443.96	2.83	-1.45E-01		1.07E+00
	488.68	0.42	-5.49E+00		6.21E+00
	563.99	0.49	-3.26E+00		5.89E+00
	586.26	0.46	3.95E+00		9.91E+00
	678.62	0.47	-8.68E-01		7.45E+00
	688.67	0.86	-3.47E+00		3.29E+00
	719.35	0.28	1.94E+00		1.08E+01
	778.90	12.96	9.91E-02		2.37E-01
	810.45	0.32	1.09E+00		1.11E+01
	867.37	4.26	-5.37E-01		7.25E-01
	919.33	0.43	-1.00E+00		8.35E+00
	964.08	14.65	-2.79E-01		3.25E-01
	1085.87	10.24	-3.84E-01		3.24E-01
	1089.74	1.73	1.53E+00		2.77E+00
	1112.07	13.69	-4.71E-02		3.55E-01
	1212.95	1.43	1.78E+00		3.46E+00
	1249.94	0.19	1.28E+01		2.66E+01
	1299.14	1.63	-5.02E-01		2.31E+00
	1408.01	21.07	7.67E-02		1.71E-01
	1457.64	0.50	9.29E+01		3.31E+01
	1528.10	0.28	3.49E+00		1.09E+01
Eu-154	123.07	40.40	-3.37E-02	6.21E-02	6.21E-02
	247.93	6.89	2.77E-01		3.64E-01
	591.76	4.95	-8.19E-02		6.83E-01
	692.42	1.78	-5.33E-02		1.60E+00
	723.30	20.06	2.53E-02		1.91E-01
	756.80	4.52	-1.85E-01		8.23E-01
	873.18	12.08	3.52E-02		2.85E-01
	996.29	10.48	-9.73E-02		3.72E-01
	1004.76	18.01	-2.03E-03		1.83E-01
	1274.43	34.80	2.74E-02		1.40E-01

Analysis Report for 01-Mar-17-10014

L310222AFRGS014SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	9.46E-02	6.21E-02	2.08E+00
Eu-155	45.30	1.31	-5.68E+00	1.27E-01	5.55E+00
	60.01	1.22	-9.45E-02		7.21E+00
	86.55	30.70	-1.03E-02		1.27E-01
	105.31	21.10	2.67E-02		1.35E-01
Ra-226	186.21	3.64	3.92E-01	7.48E-01	7.48E-01
Pa-231	27.36	10.30	0.00E+00	6.65E-02	6.65E-02
	283.69	1.70	-6.48E-02		1.33E+00
	300.07	2.47	-1.11E-01		1.14E+00
	302.65	2.20	2.18E-01		1.17E+00
	330.06	1.40	-1.80E-01		2.11E+00
U-235	143.76	10.96	-2.53E-03	4.73E-02	2.47E-01
	163.33	5.08	5.06E-02		4.62E-01
	185.71	57.20	1.42E-02		4.73E-02
	202.11	1.08	-5.27E-01		2.08E+00
	205.31	5.01	-2.21E-01		4.64E-01
Am-241	59.54	35.90	3.74E-02	2.61E-01	2.61E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.380 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.8(kev)
Acq. Start :Wed Mar 01 08:30:06 2017
Counts
Channel
PB-212
PB-214
PB-214
BI-214
K-40
ROI Type: 1

[184]

Apex-Gamma

Analysis Report for 01-Mar-17-10015
L310222AFRGS015SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10015
Sample Description	: L310222AFRGS015SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.698E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 1:43:00PM
Acquisition Started	: 3/1/2017 8:43:08AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	600.0 seconds
Real Time	: 600.9 seconds
Dead Time	: 0.15 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2145
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:53:11AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION 1.1.17

Analysis Report for 01-Mar-17-10015

L310222AFRGS015SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	238.74	946 -	960	955.04	9.76E+01	15.37	4.74E+01	0.96
2	295.53	1176 -	1186	1182.03	3.88E+01	8.39	1.32E+01	0.83
3	351.95	1401 -	1414	1407.53	5.50E+01	11.20	2.50E+01	0.63
4	510.57	2036 -	2046	2041.63	1.67E+01	6.78	1.23E+01	0.80
5	583.20	2328 -	2337	2332.02	1.70E+01	5.34	5.00E+00	0.35
6	609.36	2431 -	2442	2436.62	4.84E+01	8.23	7.62E+00	0.59
7	911.34	3639 -	3649	3644.33	1.37E+01	5.16	5.30E+00	0.58
8	1460.72	5831 -	5852	5842.72	1.43E+02	12.37	2.65E+00	1.41

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	3.78E+00	3.65E-01
Tl-208	1.00	583.19	*	85.00	2.94E-02	9.40E-03
Pb-212	0.99	115.18		0.60		
		238.63	*	43.60	1.76E-01	3.12E-02
		300.09		3.30		
Bi-214	1.00	609.32	*	45.49	1.61E-01	2.91E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		

Analysis Report for 01-Mar-17-10015
L310222AFRGS015SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.88E-01	4.34E-02
		351.93	*	35.60	1.58E-01	3.45E-02
		785.96		1.06		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	1.07E-01	4.04E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

INTERFERENCE CORRECTED REPORT

Analysis Report for 01-Mar-17-10015

L310222AFRGS015SS

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.998	3.78E+00	3.65E-01	
	Tl-208	1.000	2.94E-02	9.40E-03	
X	Bi-211	0.884			
	Pb-212	0.998	1.76E-01	3.12E-02	
	Bi-214	1.000	1.61E-01	2.91E-02	
	Pb-214	0.995	1.70E-01	2.70E-02	
	Ac-228	0.999	1.07E-01	4.04E-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 1.000sigma

Analysis Report for 01-Mar-17-10015
L310222AFRGS015SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:53:11AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
4	510.57	2.78736E-02	40.52		Ag110-54

JPW 3-1-17

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	4.01E-01	4.28E-01	4.28E-01
+	K-40	1460.82	*	10.66	3.78E+00	3.54E-01	3.54E-01
	Co-60	1173.23		99.85	1.50E-02	4.31E-02	5.16E-02
		1332.49		99.98	-1.25E-02		4.31E-02
	Nb-94	702.65		99.81	2.01E-02	3.79E-02	3.90E-02
		871.09		99.89	2.33E-02		3.79E-02
	Ag-108m	79.13		6.60	1.03E+00	4.16E-02	1.61E+00
		433.94		90.50	-1.02E-02		4.16E-02
		614.28		89.80	-2.35E-02		6.25E-02
		722.94		90.80	-9.60E-03		4.26E-02
	Sb-125	176.31		6.84	2.64E-01	1.33E-01	5.51E-01
		380.45		1.52	2.10E-02		2.53E+00
		427.87		29.60	-6.92E-02		1.33E-01
		463.36		10.49	6.30E-02		3.78E-01
		600.60		17.65	5.99E-02		2.25E-01
		606.71		4.98	1.80E+00		1.41E+00
		635.95		11.22	4.19E-02		3.17E-01
		671.44		1.79	-4.09E-01		1.95E+00

Analysis Report for 01-Mar-17-10015

L310222AFRGS015SS

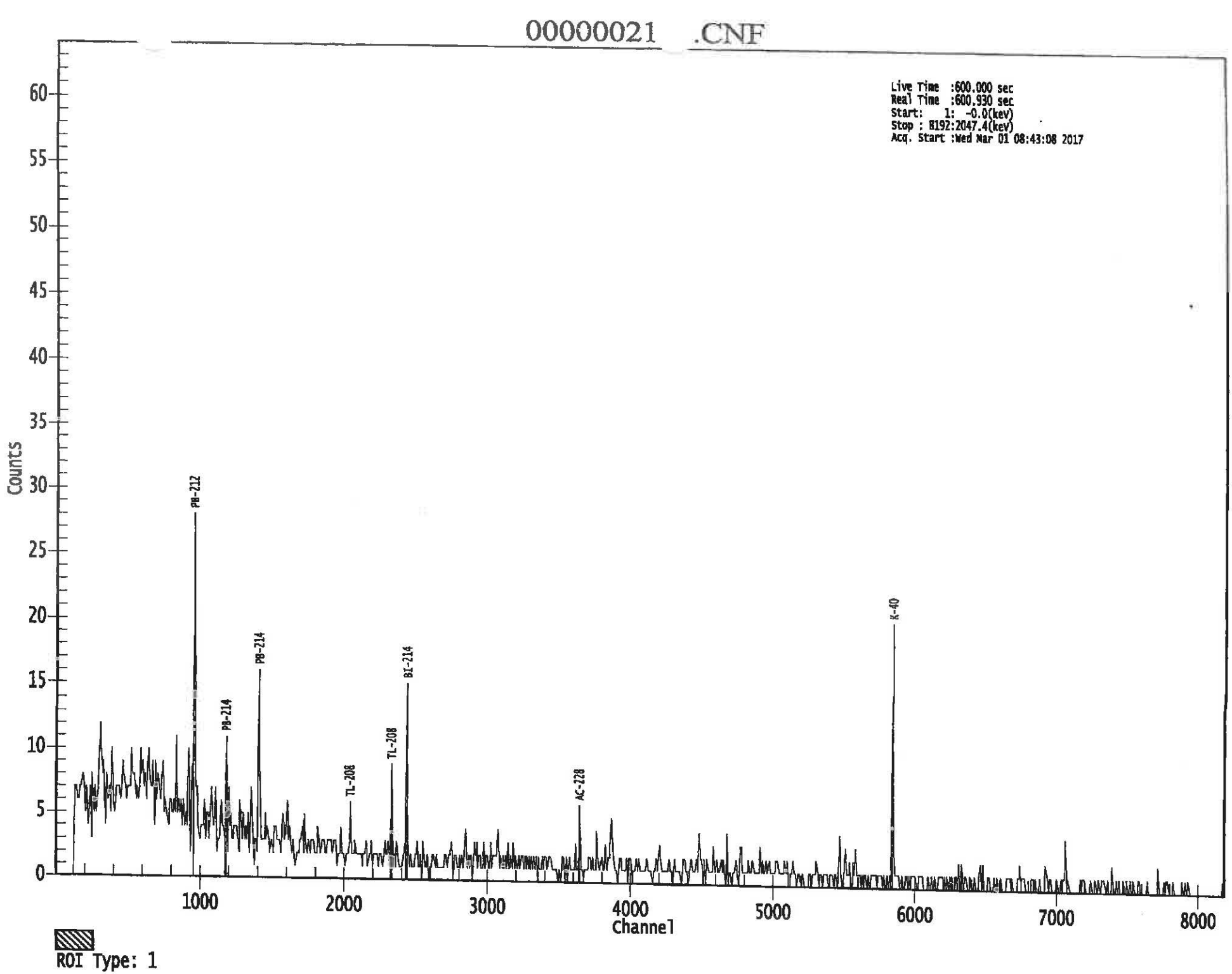
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	!_Line MDA (pCi/grams)
Ba-133	79.61	2.65	3.90E-02	7.28E-02	3.78E+00
	81.00	32.90	-1.96E-02		2.63E-01
	276.40	7.16	-7.21E-02		4.50E-01
	302.85	18.34	1.14E-01		1.91E-01
	356.01	62.05	-1.58E-02		7.28E-02
	383.85	8.94	2.07E-01		4.48E-01
Cs-134	475.36	1.48	3.95E-01	6.07E-02	2.71E+00
	563.25	8.34	-5.28E-02		4.21E-01
	569.33	15.37	-1.38E-01		2.49E-01
	604.72	97.62	-2.55E-02		6.50E-02
	795.86	85.46	4.72E-02		6.07E-02
	801.95	8.69	1.83E-02		4.69E-01
	1038.61	0.99	-4.05E+00		3.68E+00
	1167.97	1.79	-9.94E-01		3.11E+00
	1365.19	3.02	8.88E-01		1.60E+00
Cs-137	661.66	85.10	9.82E-03	4.05E-02	4.05E-02
Eu-152	121.78	28.67	7.52E-04	1.19E-01	1.30E-01
	244.70	7.61	1.88E-01		4.87E-01
	295.94	0.45	3.36E+00		9.15E+00
	344.28	26.60	-5.38E-02		1.19E-01
	367.79	0.86	2.21E+00		3.92E+00
	411.12	2.24	8.99E-01		1.54E+00
	443.96	2.83	3.89E-01		1.36E+00
	488.68	0.42	3.78E+00		8.31E+00
	563.99	0.49	-1.41E+00		6.80E+00
	586.26	0.46	3.21E-01		1.04E+01
	678.62	0.47	2.24E+00		8.62E+00
	688.67	0.86	-1.01E+00		4.58E+00
	719.35	0.28	-6.11E+00		1.23E+01
	778.90	12.96	7.99E-02		3.06E-01
	810.45	0.32	-8.42E+00		1.12E+01
	867.37	4.26	8.45E-02		9.48E-01
	919.33	0.43	-3.25E+00		8.89E+00
	964.08	14.65	1.09E-01		4.29E-01
	1085.87	10.24	1.60E-01		4.33E-01
	1089.74	1.73	-1.38E+00		2.66E+00
	1112.07	13.69	1.64E-01		3.82E-01
	1212.95	1.43	1.36E-01		4.09E+00
	1249.94	0.19	2.03E+01		3.29E+01
	1299.14	1.63	1.74E+00		2.97E+00
	1408.01	21.07	1.19E-02		1.90E-01
	1457.64	0.50	7.58E+01		3.43E+01
	1528.10	0.28	6.20E+00		1.51E+01
Eu-154	123.07	40.40	-3.82E-02	9.07E-02	9.07E-02
	247.93	6.89	2.41E-01		4.87E-01
	591.76	4.95	6.91E-01		7.77E-01
	692.42	1.78	4.90E-01		2.32E+00
	723.30	20.06	-1.48E-01		1.88E-01
	756.80	4.52	9.51E-02		1.01E+00
	873.18	12.08	-4.03E-03		3.03E-01
	996.29	10.48	-1.80E-01		4.51E-01

Analysis Report for 01-Mar-17-10015

L310222AFRGS015SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1004.76	18.01	-1.54E-01	9.07E-02	2.41E-01
	1274.43	34.80	-5.47E-03		1.42E-01
	1596.48	1.80	6.72E-01		2.09E+00
Eu-155	45.30	1.31	9.44E+00	2.13E-01	2.17E+01
	60.01	1.22	-1.17E+01		1.92E+01
	86.55	30.70	6.42E-02		2.13E-01
	105.31	21.10	1.11E-01		2.39E-01
Ra-226	186.21	3.64	1.68E-01	9.64E-01	9.64E-01
Pa-231	27.36	10.30	0.00E+00	1.88E-01	1.88E-01
	283.69	1.70	1.01E+00		1.92E+00
	300.07	2.47	-1.05E+00		1.35E+00
	302.65	2.20	1.17E+00		1.60E+00
	330.06	1.40	7.19E-01		2.62E+00
U-235	143.76	10.96	-2.55E-01	6.10E-02	3.26E-01
	163.33	5.08	-7.51E-02		7.17E-01
	185.71	57.20	2.79E-03		6.10E-02
	202.11	1.08	8.40E-01		2.98E+00
	205.31	5.01	-6.41E-01		6.40E-01
Am-241	59.54	35.90	-6.19E-01	6.68E-01	6.68E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 .CNF
Live Time :600.000 sec
Real Time :600.930 sec
Start: 1: -0.0(kev)
Stop : 8192:2047.4(kev)
Acq. Start :Wed Mar 01 08:43:08 2017
Counts
Channel
PB-212
PB-214
PB-214
TL-208
TL-208
BI-214
AC-228
K-40
ROI Type: 1

[192]

Apex-Gamma

Analysis Report for 01-Mar-17-10007
L310222AFQGS007SS

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 01-Mar-17-10007
Sample Description	: L310222AFQGS007SS
Sample Type	: Sand
Unit	:
Sample Point	:
Sample Size	: 1.816E+03 grams
Facility	: Default
Sample Taken On	: 2/23/2017 2:45:00PM
Acquisition Started	: 3/1/2017 7:51:58AM
Procedure	: 130G_Sand
Operator	: Administrator
Detector Name	: P40818B
Geometry	: 130G_Sand
Live Time	: 600.0 seconds
Real Time	: 601.0 seconds
Dead Time	: 0.16 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 120 - 8192
Peak Area Range (in channels)	: 120 - 8192
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 1/18/2017
Efficiency Calibration Used Done On	: 3/1/2017
Efficiency Calibration Description	:
Sample Number	: 2137
Fill Height	: 1000.00 gram
Certificate Name	: Eu155-Na22
Certificate Date	: 1/30/2012 12:00:00PM

J.P. Mikel 3-1-17

3/1/17

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/1/2017 8:02:01AM

Peak Analysis From Channel	: 120
Peak Analysis To Channel	: 8192

DATA VALIDATION 3/17/17

Analysis Report for 01-Mar-17-10007

L310222AFQGS007SS

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
1	77.24	306 -	314	309.68	2.57E+01	10.47	3.83E+01	0.47
2	238.68	947 -	959	954.83	1.11E+02	13.98	3.22E+01	0.94
3	295.31	1177 -	1187	1181.16	3.46E+01	9.77	2.54E+01	0.58
4	351.86	1402 -	1415	1407.16	6.57E+01	10.11	1.33E+01	0.61
5	583.20	2327 -	2337	2331.99	3.75E+01	7.11	5.50E+00	0.78
6	609.26	2429 -	2444	2436.20	6.37E+01	8.89	5.26E+00	1.41
7	910.95	3636 -	3649	3642.76	2.72E+01	7.62	1.08E+01	0.85
8	1460.66	5832 -	5853	5842.49	1.78E+02	13.72	2.67E+00	1.60

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

No background subtract performed on this spectrum.

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.99	1460.82	*	10.66	4.39E+00	3.88E-01
Tl-208	1.00	583.19	*	85.00	6.06E-02	1.21E-02
Pb-212	1.00	115.18		0.60		
		238.63	*	43.60	1.87E-01	2.80E-02
		300.09		3.30		
Pb212-XR	0.99	74.82		10.28		
		77.11	*	17.10	2.58E-01	1.08E-01
		87.35		3.97		
		89.78		1.46		

Analysis Report for 01-Mar-17-10007

L310222AFQGS007SS

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
Bi-214	1.00	609.32	*	45.49	1.98E-01	3.01E-02
		768.36		4.89		
		806.18		1.26		
		934.06		3.11		
		1120.29		14.92		
		1155.21		1.63		
		1238.12		5.83		
		1280.98		1.43		
		1377.67		3.99		
		1385.31		0.79		
		1401.52		1.33		
		1407.99		2.39		
		1509.21		2.13		
		1661.27		1.05		
		1729.59		2.88		
		1764.49		15.30		
		1847.43		2.03		
		2118.51		1.16		
Pb-214	0.99	241.99		7.25		
		295.22	*	18.42	1.57E-01	4.60E-02
		351.93	*	35.60	1.76E-01	3.05E-02
		785.96		1.06		
Pb214-XR	0.99	74.82		5.80		
		77.11	*	9.70	4.55E-01	1.92E-01
		87.35		2.24		
		89.78		0.82		
Ac-228	0.99	129.07		2.42		
		209.25		3.89		
		270.24		3.46		
		328.00		2.95		
		338.32		11.27		
		409.46		1.92		
		463.00		4.40		
		794.95		4.25		
		911.20	*	25.80	1.98E-01	5.61E-02
		964.77		4.99		
		968.97		15.80		
		1588.20		3.22		

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000sigma

Analysis Report for 01-Mar-17-10007

L310222AFQGS007SS

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/grams)	Wt mean Activity Uncertainty	Comments
	K-40	0.996	4.39E+00	3.88E-01	
	Tl-208	1.000	6.06E-02	1.21E-02	
X	Bi-211	0.905			
	Pb-212	1.000	1.87E-01	2.80E-02	
?	Pb212-XR	0.999	2.58E-01	1.08E-01	
	Bi-214	1.000	1.98E-01	3.01E-02	
	Pb-214	0.999	1.70E-01	2.54E-02	
?	Pb214-XR	0.999	4.55E-01	1.92E-01	
	Ac-228	0.997	1.98E-01	5.61E-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 1.000sigma

Analysis Report for 01-Mar-17-10007
L310222AFQGS007SS

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/1/2017 8:02:01AM
Peak Locate From Channel : 120
Peak Locate To Channel : 8192

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide

All peaks were identified.

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 1.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Default\Library\ZION LIB-BNL.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	BE-7	477.60		10.44	-4.48E-02	3.47E-01	3.47E-01
+	K-40	1460.82	*	10.66	4.39E+00	3.33E-01	3.33E-01
	Co-60	1173.23		99.85	-2.15E-03	3.58E-02	5.09E-02
		1332.49		99.98	1.43E-03		3.58E-02
	Nb-94	702.65		99.81	-1.30E-02	4.01E-02	4.29E-02
		871.09		99.89	-5.29E-03		4.01E-02
	Ag-108m	79.13		6.60	-3.55E-01	3.84E-02	1.26E+00
		433.94		90.50	-1.87E-02		3.84E-02
		614.28		89.80	-2.79E-02		5.73E-02
		722.94		90.80	4.80E-03		4.81E-02
	Sb-125	176.31		6.84	-1.49E-01	1.17E-01	4.68E-01
		380.45		1.52	-1.66E+00		1.83E+00
		427.87		29.60	-3.28E-02		1.17E-01
		463.36		10.49	1.65E-01		3.30E-01
		600.60		17.65	1.32E-01		2.36E-01
		606.71		4.98	2.20E+00		1.36E+00
		635.95		11.22	-2.52E-01		2.36E-01
		671.44		1.79	-1.18E+00		2.33E+00
	Ba-133	79.61		2.65	-6.89E-01	6.31E-02	3.05E+00

Analysis Report for 01-Mar-17-10007

L310222AFQGS007SS

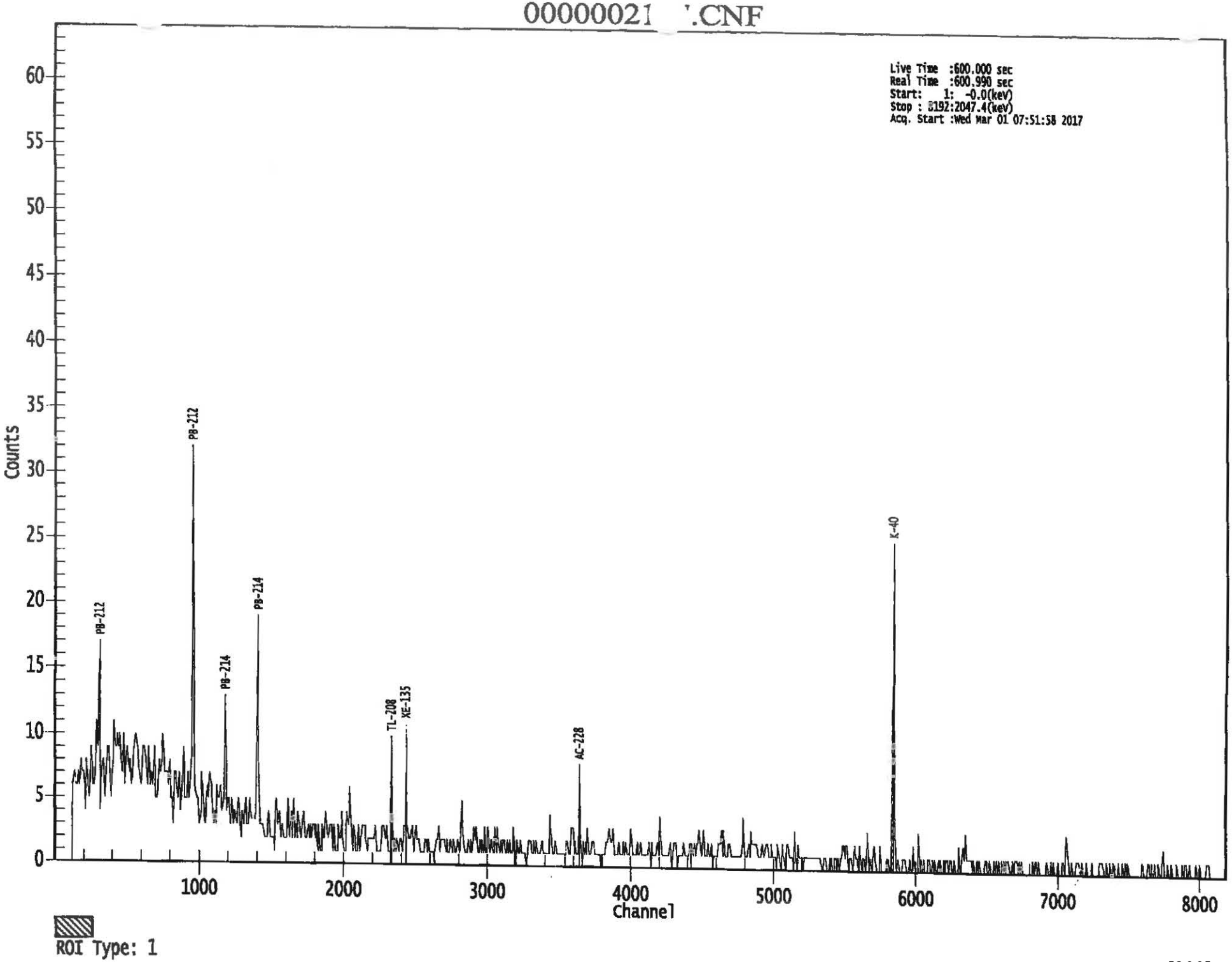
Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Ba-133	81.00	32.90	-7.89E-02	6.31E-02	2.05E-01
	276.40	7.16	-3.84E-01		4.09E-01
	302.85	18.34	3.60E-03		1.90E-01
	356.01	62.05	-1.78E-02		6.31E-02
	383.85	8.94	-7.66E-02		3.83E-01
Cs-134	475.36	1.48	-1.03E+00	4.78E-02	2.39E+00
	563.25	8.34	-7.64E-02		4.10E-01
	569.33	15.37	1.77E-01		2.72E-01
	604.72	97.62	-3.33E-02		6.20E-02
	795.86	85.46	-1.93E-02		4.78E-02
	801.95	8.69	-2.20E-01		4.38E-01
	1038.61	0.99	-1.36E+00		4.74E+00
	1167.97	1.79	2.76E+00		3.18E+00
	1365.19	3.02	-1.86E+00		1.29E+00
Cs-137	661.66	85.10	1.90E-02	4.57E-02	4.57E-02
Eu-152	121.78	28.67	-7.62E-02	1.21E-01	1.21E-01
	244.70	7.61	3.70E-02		4.71E-01
	295.94	0.45	5.08E+00		9.46E+00
	344.28	26.60	-7.65E-02		1.27E-01
	367.79	0.86	-1.15E+00		3.80E+00
	411.12	2.24	3.39E-01		1.64E+00
	443.96	2.83	-5.91E-01		1.28E+00
	488.68	0.42	-3.45E+00		6.86E+00
	563.99	0.49	-2.74E+00		6.80E+00
	586.26	0.46	1.22E+01		1.19E+01
	678.62	0.47	-4.16E-01		8.23E+00
	688.67	0.86	-2.90E-01		4.57E+00
	719.35	0.28	7.95E+00		1.36E+01
	778.90	12.96	2.78E-02		3.61E-01
	810.45	0.32	2.39E+00		1.34E+01
	867.37	4.26	-8.28E-01		9.89E-01
	919.33	0.43	-8.87E+00		9.49E+00
	964.08	14.65	3.74E-01		3.78E-01
	1085.87	10.24	-5.24E-01		3.74E-01
	1089.74	1.73	2.77E-01		2.56E+00
	1112.07	13.69	-7.16E-02		3.29E-01
	1212.95	1.43	3.54E+00		4.54E+00
	1249.94	0.19	-1.17E+01		2.33E+01
	1299.14	1.63	1.01E+00		3.08E+00
	1408.01	21.07	-3.91E-01		1.77E-01
	1457.64	0.50	9.65E+01		3.56E+01
	1528.10	0.28	4.83E+00		1.31E+01
Eu-154	123.07	40.40	-6.96E-02	8.34E-02	8.34E-02
	247.93	6.89	1.92E-01		4.65E-01
	591.76	4.95	9.83E-02		7.27E-01
	692.42	1.78	-7.86E-01		1.98E+00
	723.30	20.06	4.39E-02		2.18E-01
	756.80	4.52	-6.78E-01		8.27E-01
	873.18	12.08	-1.32E-02		2.94E-01
	996.29	10.48	-1.24E-01		4.22E-01
	1004.76	18.01	3.08E-02		2.33E-01
	1274.43	34.80	-4.65E-02		1.28E-01

Analysis Report for 01-Mar-17-10007

L310222AFQGS007SS

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
Eu-154	1596.48	1.80	-4.94E-01	8.34E-02	2.45E+00
Eu-155	45.30	1.31	1.65E+00	1.95E-01	2.00E+01
	60.01	1.22	-1.21E+01		1.87E+01
	86.55	30.70	3.20E-02		1.95E-01
	105.31	21.10	6.49E-02		2.41E-01
Ra-226	186.21	3.64	4.70E-02	1.01E+00	1.01E+00
Pa-231	27.36	10.30	0.00E+00	1.76E-01	1.76E-01
	283.69	1.70	-8.37E-01		2.02E+00
	300.07	2.47	-4.90E-01		1.46E+00
	302.65	2.20	-3.67E-01		1.58E+00
	330.06	1.40	1.84E+00		2.52E+00
U-235	143.76	10.96	-1.28E-01	6.60E-02	3.47E-01
	163.33	5.08	-1.08E-01		6.50E-01
	185.71	57.20	4.26E-02		6.60E-02
	202.11	1.08	5.70E-01		2.79E+00
	205.31	5.01	-2.20E-01		5.95E-01
Am-241	59.54	35.90	1.19E-02	6.88E-01	6.88E-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
? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level


00000021 '.CNF
Live Time :600.000 sec
Real Time :600.990 sec
Start: 1: -0.0(keV)
Stop : 8192:2047.4(keV)
Acq. Start :Wed Mar 01 07:51:58 2017
Counts
Channel
PB-212
PB-212
PB-214
PB-214
TL-208
XE-135
AC-228
K-40
ROI Type: 1

[200]

ATTACHMENT 7
EBERLINE ANALYTICAL REPORTS

Eberline Analytical
Final Report of Analysis

Report To:

Patricia Giza
Zion Solutions
101 Shiloh Blvd
Zion, IL 60099

Work Order Details:

SDG:	**17-05091**
Purchase Order:	671498
Analysis Category:	ENVIRONMENTAL
Sample Matrix:	SO

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Qualifier	Report Units
17-05091-01	LCS	KNOWN	05/17/17 00:00	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	1.58E+03	4.74E+01				pCi/g
17-05091-01	LCS	SPIKE	05/17/17 00:00	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	1.47E+03	9.92E+00	8.69E+01	2.56E+00		pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	-2.31E-01	3.03E-01	3.04E-01	5.28E-01	U	pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	0.00E+00	2.75E-01	2.75E-01	4.71E-01	U	pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	-3.70E-01	2.77E-01	2.78E-01	4.89E-01	U	pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	-2.03E-02	2.97E-01	2.97E-01	5.09E-01	U	pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/30/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	-2.08E-01	3.00E-01	3.00E-01	5.21E-01	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/31/2017	17-05091	Nickel-63	ASTM 3500-Ni Modified	-7.58E-02	2.76E-01	2.76E-01	4.76E-01	U	pCi/g
17-05091-01	LCS	KNOWN	05/17/17 00:00	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	5.43E+01	3.04E-01				pCi/g
17-05091-01	LCS	SPIKE	05/17/17 00:00	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	6.74E+01	1.59E+00	9.30E+00	6.91E-01		pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	2.68E-01	1.48E-01	1.52E-01	2.82E-01	U	pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	1.37E-01	1.66E-01	1.67E-01	3.39E-01	U	pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	2.82E-01	1.54E-01	1.59E-01	2.95E-01	U	pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	-1.80E-02	1.55E-01	1.55E-01	3.34E-01	U	pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	3.30E-02	1.94E-01	1.94E-01	4.10E-01	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	6/16/2017	17-05091	Strontium-90	ElChroM SRW01 Modified	-4.48E-02	1.61E-01	1.62E-01	3.50E-01	U	pCi/g
17-05091-01	LCS	KNOWN	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	1.35E+02	5.27E+00				pCi/g
17-05091-01	LCS	KNOWN	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	8.44E+01	3.38E+00				pCi/g
17-05091-01	LCS	SPIKE	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	1.26E+02	7.53E+00	9.93E+00	1.04E+00		pCi/g
17-05091-01	LCS	SPIKE	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	8.25E+01	7.49E+00	8.61E+00	1.30E+00		pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	1.67E-02	4.38E-02	4.38E-02	7.49E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	1.11E-02	3.16E-02	3.16E-02	4.55E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	3.11E-03	1.24E-02	1.24E-02	2.02E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	-4.51E-03	1.41E-02	1.41E-02	1.80E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	5.29E-04	1.26E-02	1.26E-02	2.11E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	1.74E-01	1.29E-01	1.29E-01	1.90E-01	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	1.51E-02	2.21E-02	2.21E-02	3.15E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	7.01E-03	3.46E-02	3.46E-02	4.67E-02	U	pCi/g
17-05091-02	MBL	BLANK	05/17/17 00:00	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	9.11E-03	4.15E-02	4.15E-02	5.91E-02	U	pCi/g

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (2-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original

Eberline Analytical
Final Report of Analysis

Report To:
Patricia Giza
Zion Solutions
101 Shiloh Blvd
Zion, IL 60099

Work Order Details:

SDG:	17-05091
Purchase Order:	671498
Analysis Category:	ENVIRONMENTAL
Sample Matrix:	SO

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Qualifier	Report Units
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	2.89E-01	8.11E-02	8.25E-02	1.63E-01		pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	2.56E-01	6.80E-02	6.92E-02	9.25E-02		pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	3.85E-02	1.97E-02	1.98E-02	3.39E-02	U	pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	1.15E-03	1.08E-02	1.08E-02	3.12E-02	U	pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	9.95E-03	2.01E-02	2.01E-02	3.15E-02	U	pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	7.85E+00	9.34E-01	1.02E+00	6.57E-01		pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	4.14E-01	7.66E-02	7.95E-02	1.06E-01		pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	3.12E-01	5.91E-02	6.13E-02	1.04E-01		pCi/g
17-05091-03	DUP	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	2.77E-01	6.02E-02	6.18E-02	7.50E-02		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	4.24E-01	9.56E-02	9.80E-02	1.84E-01		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	3.06E-01	5.59E-02	5.80E-02	8.40E-02		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	1.02E-02	2.21E-02	2.21E-02	2.64E-02	U	pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	-6.12E-04	1.14E-02	1.14E-02	3.32E-02	U	pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	1.63E-02	2.08E-02	2.08E-02	3.34E-02	U	pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	8.43E+00	9.35E-01	1.03E+00	4.18E-01		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	3.67E-01	5.10E-02	5.44E-02	8.94E-02		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	3.20E-01	5.20E-02	5.45E-02	7.02E-02		pCi/g
17-05091-04	DO	L310222AFRGS001SS-B	02/27/17 13:05	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	3.23E-01	6.22E-02	6.43E-02	6.65E-02		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	3.20E-01	7.05E-02	7.24E-02	1.36E-01		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	2.97E-01	6.07E-02	6.26E-02	8.22E-02		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	-6.99E-04	2.58E-02	2.58E-02	2.90E-02	U	pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	-4.44E-03	9.41E-03	9.41E-03	2.36E-02	U	pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	-6.65E-03	2.01E-02	2.01E-02	3.18E-02	U	pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	8.26E+00	9.79E-01	1.07E+00	3.18E-01		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	2.72E-01	6.07E-02	6.22E-02	8.70E-02		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	3.34E-01	5.60E-02	5.86E-02	8.83E-02		pCi/g
17-05091-05	TRG	L310222AFRGS004SS-B	02/27/17 12:45	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	2.07E-01	5.15E-02	5.26E-02	5.30E-02		pCi/g

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (2-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original

Eberline Analytical
Final Report of Analysis

Report To:

Patricia Giza
Zion Solutions
101 Shiloh Blvd
Zion, IL 60099

Work Order Details:

SDG:	**17-05091**
Purchase Order:	671498
Analysis Category:	ENVIRONMENTAL
Sample Matrix:	SO

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Qualifier	Report Units
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	3.78E-01	1.49E-01	1.51E-01	2.58E-01		pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	6.26E-01	1.16E-01	1.21E-01	1.56E-01		pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	1.36E-02	4.80E-02	4.80E-02	6.56E-02	U	pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	-3.10E-01	9.64E-02	9.77E-02	7.98E-02	U	pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	3.90E-02	4.03E-02	4.04E-02	6.69E-02	U	pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	1.17E+01	1.38E+00	1.51E+00	7.26E-01		pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	4.96E-01	1.04E-01	1.07E-01	1.49E-01		pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	5.23E-01	9.23E-02	9.61E-02	1.47E-01		pCi/g
17-05091-06	TRG	L310205AFRGS004SS-B	04/13/16 13:20	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	4.11E-01	1.10E-01	1.12E-01	2.00E-01	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Actinium-228	EPA 901.1 Modified	2.84E-01	1.12E-01	1.13E-01	2.09E-01		pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Bismuth-214	EPA 901.1 Modified	1.30E-01	6.35E-02	6.39E-02	1.16E-01	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Cobalt-60	EPA 901.1 Modified	-1.23E-02	3.07E-02	3.07E-02	5.30E-02	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Cesium-134	EPA 901.1 Modified	-5.44E-02	4.59E-02	4.60E-02	4.94E-02	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Cesium-137	EPA 901.1 Modified	5.61E-02	3.84E-02	3.85E-02	1.46E-01	U	pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Potassium-40	EPA 901.1 Modified	5.54E+00	8.85E-01	9.29E-01	4.62E-01		pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Lead-212	EPA 901.1 Modified	2.01E-01	6.30E-02	6.38E-02	1.49E-01		pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Lead-214	EPA 901.1 Modified	1.56E-01	7.81E-02	7.85E-02	1.22E-01		pCi/g
17-05091-07	TRG	L310205AFRGC011CV-B	03/24/17 09:45	5/15/2017	5/19/2017	17-05091	Thallium-208	EPA 901.1 Modified	3.15E-01	9.67E-02	9.80E-02	1.09E-01		pCi/g

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (2-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original