



**LA CROSSE BOILING WATER REACTOR  
FINAL STATUS SURVEY RELEASE RECORD**

**SURVEY UNIT L1-SUB-CDR  
STACK, PIPE TUNNEL, RPGPA EXCAVATION**



FSS RELEASE RECORD  
SURVEY UNIT L1-SUB-CDR  
STACK, PIPE TUNNEL, RPGPA EXCAVATION



PREPARED BY / DATE: *R. F. Yetter III* 1/23/20  
R. F. Yetter III, FSS Specialist

REVIEWED BY / DATE: *Mitchell* 1/27/20  
M. D. Uz, FSS Specialist

REVIEWED BY / DATE: *[Signature]* 1/27/20  
R. Yetter, Director, Radiological Site Closure

REVIEWED BY / DATE: *P. Hollenbeck* 1/27/20  
P. Hollenbeck, Radiological Engineer

APPROVED BY / DATE: *S. Zoller* 01/27/2020  
S. Zoller, FSS Manager



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**LIST OF ACRONYMS AND ABBREVIATIONS**

ALARA	As Low As Reasonably Achievable
DQA	Data Quality Assessment
DQO	Data Quality Objective
DCGL	Derived Concentration Guideline Level
DCGLs	Soil Derived Concentration Guideline Level
FSS	Final Status Survey
GPS	Global Positioning System
HSA	Historical Site Assessment
HTD	Hard-to-Detect
IC	Insignificant Contributors
LACBWR	La Crosse Boiling Water Reactor
LBGR	Lower Bound of the Gray Region
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NaI	Sodium Iodide
OpDCGLs	Soil Operational Derived Concentration Guideline Level
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Radiological Assessment
ROC	Radionuclides of Concern
SOF	Sum-of-Fractions
TEDE	Total Effective Dose Equivalent
UBGR	Upper Bound of the Gray Region
UCL	Upper Confidence Limit



## 1. EXECUTIVE SUMMARY

This Final Status Survey (FSS) Release Record for survey unit L1-SUB-CDR, Stack, Pipe Tunnel, Reactor Plant Generator Plant Area (RPGPA) Excavation, has been generated in accordance with LaCrosseSolutions procedure LC-FS-PR-009, *Final Status Survey Data Reporting* (Reference 1) and satisfies the requirements of Section 5.11 of the *La Crosse Boiling Water Reactor License Termination Plan* (LACBWR LTP) (Reference 2).

An FSS sample plan for this survey unit was developed in accordance with LaCrosseSolutions procedure LC-FS-PR-002, *Final Status Survey Package Development* (Reference 3), the LACBWR LTP, and with guidance from NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Reference 4).

Survey unit L1-SUB-CDR has a MARSSIM classification of 1. A survey plan was designed based upon use of the Sign Test as the nonparametric statistical test for compliance. Both the Type I ( $\alpha$ ) and Type II ( $\beta$ ) decision error rates were set at 0.05. As a systematic sample population, fourteen (14) soil samples were acquired from the survey unit. In addition, soil scanning was performed on 100% of the total surface area in the survey unit. The analytical results for all soil samples taken in survey unit L1-SUB-CDR indicate that the maximum Sum-of-Fractions (SOF), considering the concentration of all applicable Radionuclides of Concern (ROC) either by direct measurement or by inference, is equal to 0.4594 when applying the respective Operational Derived Concentration Guideline Levels (OpDCGLs) for soil. Therefore, the null hypothesis is rejected and survey unit L1-SUB-CDR is acceptable for unrestricted release. The mean SOF when applying the respective Base Case DCGLs (DCGLs) for soil is 0.0408. This SOF equates to a dose for the survey unit of 1.0190 mrem/yr.

## 2. SURVEY UNIT DESCRIPTION

Survey Unit L1-SUB-CDR is an impacted Class 1 excavation survey unit within open land survey unit L1-010-101. The survey unit consists of the underlying soil post-removal of the Pipe Tunnel, RPGPA, and Stack foundations. The surface area of the survey unit is 431 m<sup>2</sup>.

The boundary of the survey unit and the location of the soil samples were defined using a Global Positioning System (GPS). Refer to Attachment 1 of this report for figures and maps depicting survey unit L1-SUB-CDR.

### 3. CLASSIFICATION BASIS

Based on the Historical Site Assessment (HSA) (Reference 5), survey unit L1-010-101 was identified as a Class 1 area. As survey unit L1-SUB-CDR consists of the underlying soils from L1-010-101, it is also designated as Class 1. The following summarizes the results of the characterization survey for survey unit L1-010-101.

The initial site characterization surveys performed by EnergySolutions were conducted between October 9, 2014, and August 6, 2015. In total, twelve (12) surface soil samples and eighteen (18) subsurface soil samples were collected in the survey unit. All samples were analyzed by the on-site gamma spectroscopy system. For surface soil samples, Cs-137 was detected at concentrations above Minimum Detectable Concentration (MDC) in all twelve (12) samples, at a maximum concentration of 1.07E+00 pCi/g, and Co-60 was detected at concentrations above MDC in two (2) samples, at a maximum concentration of 2.87E-01 pCi/g. For subsurface soil samples, Cs-137 was detected at concentrations above MDC in eight (8) of the samples, at a maximum concentration of 1.61E-01 pCi/g. Co-60 was not detected at concentrations above MDC for subsurface soil samples. A summary of the analyses for the surface soil and subsurface soil samples taken during site characterization are presented in Table 3-1.

Five (5) surface soil samples and two (2) subsurface soil samples from characterization were sent to Test America Laboratories for off-site analysis. A summary of the off-site analyses is presented in Table 3-2.

**Table 3-1 - Statistical Quantities for Cs-137 and Co-60 from the Characterization Survey**

<b>Surface Soil</b>	<b>Co-60</b>	<b>Cs-137</b>
# of Samples	12	
# >MDC	2	12
Mean (pCi/g)	8.00E-02	2.15E-01
Median (pCi/g)	5.80E-02	1.00E-01
Max (pCi/g)	2.87E-01	1.07E+00
Min (pCi/g)	4.80E-02	3.20E-02
Standard Deviation (pCi/g)	6.60E-02	2.96E-01
<b>Subsurface Soil</b>	<b>Co-60</b>	<b>Cs-137</b>
# of Samples	18	
# >MDC	0	8
Mean (pCi/g)	7.80E-02	6.60E-02
Median (pCi/g)	5.20E-02	5.40E-02
Max (pCi/g)	5.16E-01	1.61E-01
Min (pCi/g)	4.70E-02	3.30E-02
Standard Deviation (pCi/g)	1.09E-01	3.50E-02



**Table 3-2 – Off-site Analysis for Characterization Samples**

Radionuclide	L1010101- CJ-GS- 002-SS	L1010101- CJ-GS- 009-SS	L1010101- CJ-GS- 010-SS	L1010101- QJ-GS- 001-SB	L1010101- QJ-GS- 001-SS	L1010101- QJ-GS- 002-SB	L1010101- QJ-GS- 002-SS
H-3				3.64E-01	<b>4.41E-01</b>	3.77E-01	<b>1.38E+00</b>
C-14				<b>8.96E-01</b>	6.76E-01	6.79E-01	6.77E-01
Fe-55				<b>2.43E+00</b>	2.19E+00	2.15E+00	4.19E+00
Ni-59				1.85E+00	1.90E+00	1.75E+00	2.01E+00
Co-60	2.40E-02	4.00E-02	2.86E-01	2.40E-02	1.80E-02	1.70E-02	1.50E-02
Ni-63				3.04E+00	3.04E+00	2.93E+00	3.32E+00
Sr-90				3.35E-01	4.40E-01	3.38E-01	3.57E-01
Nb-94	2.00E-02	2.00E-02	2.50E-02	1.50E-02	1.20E-02	1.10E-02	1.00E-02
Tc-99				5.79E-01	5.87E-01	6.20E-01	5.21E-01
Cs-137	<b>2.33E-01</b>	<b>1.85E-01</b>	<b>4.13E-01</b>	2.00E-02	<b>1.47E-01</b>	<b>1.49E-01</b>	<b>5.90E-02</b>
Pm-147				8.00E-01	3.17E+00	7.72E-01	9.78E-01
Eu-152	5.60E-02	5.60E-02	6.20E-02	5.00E-02	3.40E-02	4.00E-02	3.30E-02
Eu-154	1.61E-01	1.81E-01	2.47E-01	1.43E-01	1.12E-01	1.09E-01	9.60E-02
Eu-155	6.60E-02	5.00E-02	5.70E-02	4.40E-02	4.40E-02	4.00E-02	3.60E-02
Np-237				1.90E-02	6.00E-03	1.90E-02	1.60E-02
Pu-238				4.60E-02	3.90E-02	4.10E-02	4.00E-02
Pu-239/240				2.30E-02	2.30E-02	2.20E-02	1.60E-02
Pu-241				1.97E+00	1.83E+00	1.95E+00	2.09E+00
Am-241	5.80E-02	4.20E-02	5.10E-02	1.50E-02	1.60E-02	1.70E-02	2.00E-02
Am-243				2.30E-02	2.10E-02	2.90E-02	1.70E-02
Cm-243/244				2.10E-02	1.90E-02	1.40E-02	2.20E-02

Note: Bold values indicate concentration greater than MDC. Unbolded values indicate the MDC value. All values in pCi/g. Blank cells indicate that a particular radionuclide was not included in the analysis.

Section 5.1 of the LTP states that the actual Insignificant Contributor (IC) dose will be calculated for each individual sample result using the DCGLs from Table 4 of TSD RS-TD-313196-004, *LACBWR Soil DCGL, Basement Concrete DCGL, and Buried Pipe DCGL* (Reference 6) for soil. If the IC dose calculated is less than the IC dose assigned for DCGL adjustment, then no further action will be taken. If the actual IC dose calculated from the sample result is greater than the IC dose assigned for DCGL adjustment, then a minimum of five (5) additional investigation samples will be taken around the original sample location. Each investigation sample will be analyzed by the on-site gamma spectroscopy system and sent for HTD analysis (full suite of radionuclides from LTP Table 5-1). As with the original sample, the actual IC dose will be calculated for each investigation sample. In this case, the actual calculated maximum IC dose from an individual sample observed in the survey unit will be used to readjust the DCGLs in that survey unit. If the maximum IC dose exceeds 10%, then the additional radionuclides that were the cause of the IC dose exceeding 10% will be added as additional ROC for that survey unit. The survey unit-specific DCGLs used for compliance, the ROC for that survey unit, and the survey data serving as the basis for the IC dose adjustment will be documented in the release record for the survey unit.

An assessment of the results of continuing characterization confirmed that the IC dose is unchanged (dose fraction less than 10%).

Based upon review of the historical information, the results of the characterization survey data, and completion of a final Survey Unit Classification Worksheet, the correct final classification of survey unit L1-SUB-CDR was determined to be Class 1.

#### **4. DATA QUALITY OBJECTIVES (DQO)**

FSS planning and design relies on a properly executed 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, utilized in accordance with MARSSIM, is described in the LACBWR LTP. The appropriate design for a given survey was developed using the DQO process as outlined in Appendix D of MARSSIM. A summary of seven steps of the DQO process are outlined as follows.

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 L1-SUB-CDR 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).

EnergySolutions TSD RS-TD-313196-001, *Radionuclides of Concern during LACBWR Decommissioning* (Reference 7) established the basis for an initial suite of potential ROC for decommissioning. LTP Chapter 2 provides detailed characterization data that describes the results of surveys taken of soil. 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 LACBWR indicate that there is minimal residual radioactivity in soil.

IC were determined consistent with the guidance contained in Section 3.3 of NUREG-1757, Volume 2, Revision 1, *Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria, Final Report* (Reference 8). In all soil and concrete scenarios, Cs-137, Co-60, Sr-90, Eu-152 and Eu-154 contribute nearly 100% of the total dose. The remaining radionuclides were designated as IC and are eliminated from further detailed evaluation. Therefore, the final ROCs for LACBWR soil, basement concrete and buried piping are Cs-137, Co-60, Sr-90, Eu-152 and Eu-154.

LTP, Section 6.14.1 discusses the process used to derive the ROC for the decommissioning of LACBWR, including the elimination of IC from the initial suite. Table 4-1 presents the ROC for the decommissioning of soil at LACBWR and the normalized mixture fractions based on the radionuclide mixture.



**Table 4-1 - Dose Significant Radionuclides and Mixture for Soil**

Radionuclide	Fraction of Total Activity (normalized) <sup>(1)</sup>
Co-60	0.064
Sr-90	0.098
Cs-137	0.829
Eu-152	0.005
Eu-154	0.003

(1) Based on maximum percent of total activity from Table 22 of RS-TD-313196-001, normalized to one for the dose significant radionuclides.

The LTP, Section 5.2 states that each radionuclide-specific Base Case DCGL 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/yr to an Average Member of the Critical Group. To ensure that the summation of dose from each source term is 25 mrem/yr or less after all FSS is completed, the Base Case DCGLs are reduced based on an expected, or *a priori*, fraction of the 25 mrem/yr dose limit from each source term. The reduced DCGLs (i.e., Operational DCGLs) can be related to the Base Case DCGLs 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 Operational DCGL is then used as the DCGL for the FSS design of the survey unit (e.g., calculation of surrogate DCGLs, investigation levels). Details of the Operational DCGLs derived for each dose component and the basis for the applied *a priori* dose fractions are provided in LC-FS-TSD-002, *Operational Derived Concentration Guideline Levels for Final Status Survey* (Reference 9).

Multiple ROCs are known to be present at LACBWR. The dose contribution from each ROC is accounted for using the SOF to ensure that the total dose from all ROC does not exceed the dose criterion. A Base Case DCGL that is established for the average residual radioactivity in a survey unit is equivalent to a DCGL<sub>w</sub>. In Class 1 land survey units, the DCGL<sub>w</sub> can be multiplied by Area Factors to obtain a Base Case DCGL that represents the same dose to an individual for residual radioactivity over a smaller area within a survey unit.

At LACBWR, compliance is demonstrated through the summation of dose from five (5) distinct source terms (i.e., basements, soils, buried pipe, above-ground structures, and groundwater) for the end-state. When applied to soil, the DCGLs are expressed in units of activity per unit of mass (pCi/g).

For LACBWR, soil is defined as a layer of soil beginning at the surface but extending to a depth of 1 m to allow for flexibility in compliance demonstration if contamination deeper than 0.15 m is encountered. Based on characterization data and historical 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. EnergySolutions TSD RS-TD-313196-004 and LTP, Section 6.8 provide the exposure scenarios and modeling parameters that were used to calculate the site-specific soil DCGLs. The adjusted soil DCGLs for the unrestricted release of open land survey units as provided in Chapter 6, Section 6.16.1 are reproduced in Table 4-2. The IC percentages for the most limiting basement scenario were used to adjust the DCGLs for soil to account for the dose from the eliminated IC radionuclides.

**Table 4-2 - Base Case DCGLs for Soil**

<b>Radionuclide</b>	<b>DCGLs (pCi/g)</b>
Co-60	10.6
Sr-90	5470
Cs-137	48.3
Eu-152	23.6
Eu-154	21.9

The Operational DCGLs are then used as the DCGL for the FSS design of the survey unit (e.g., calculation of surrogate DCGLs, investigation levels). The OpDCGLs for the unrestricted release of soil are provided in Table 4-3.

**Table 4-3 - Operational DCGLs for Soil**

<b>Radionuclide</b>	<b>OpDCGLs (pCi/g)</b>
Co-60	3.83
Sr-90	1970.45
Cs-137	17.39
Eu-152	8.51
Eu-154	7.89

Instrument DQOs included a verification of the ability of the survey instrument to detect the radiation(s) of interest relative to the Operational DCGL. 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 reported 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.” Results were not reported as “less than MDC” ( $< \text{MDC}$ ). 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 Operational DCGL were preferable while MDCs up to 50% of the Operational DCGL were acceptable. The minimum acceptable MDC for measurements obtained using field instruments was 50% of the applicable Operational DCGL.

## 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 LC-FS-PR-002, *Final Status Survey Package Development*.

The DQO process validated that Co-60, Sr-90, Cs-137, Eu-152, and Eu-154 would be the ROC in survey unit L1-SUB-CDR as presented in LTP Section 5.1. During the data analysis of the FSS results, concentrations for the HTD ROC Sr-90 are inferred using a surrogate approach. Cs-137 is the principle surrogate radionuclide for Sr-90. During characterization, both Sr-90 and Cs-137 was positively detected in all thirty (30) concrete core samples assessed in the Reactor Building, Tunnel, and Waste Treatment Building. The 95% Upper Confidence Limit (UCL) of the Cs-137 fractions was chosen to represent the overall nuclide mix for soils/buried pipe, the Reactor Building, and the Waste Gas Tank Vault. The surrogate ratio for soil is given in Table 5-1.

**Table 5-1 – Soil Surrogate Ratio**

Radionuclides	Ratio
Sr-90/Cs-137	0.502

The equation for calculating a surrogate DCGL is as follows:



### Equation 1

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

Where:  $DCGL_{Sur}$  = Surrogate radionuclide DCGL  
 $DCGL_{2,3\dots n}$  = 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 Operational DCGLs presented in Table 4-3 and the ratio from Table 5-1, the following surrogate calculation was performed:

### Equation 2

$$Surrogate_{DCGL (Cs-137)} = \frac{1}{\left[\left(\frac{1}{17.39_{(Cs-137)}}\right) + \left(\frac{0.502}{1970.45_{(Sr-90)}}\right)\right]} = 17.31 \text{ pCi/g}$$

The surrogate Operational DCGL that was used for Cs-137 in this survey unit for direct comparison of sample results to demonstrate compliance was 17.31 pCi/g.

The action levels for survey unit L1-SUB-CDR are based on the Operational DCGL and are presented in Table 5-2.

**Table 5-2 – Action Levels for Survey Unit L1-SUB-CDR**

ROC	Action Level (pCi/g)
Co-60	3.83 <sup>(1)</sup>
Cs-137	17.31 <sup>(2)</sup>
Eu-152	8.51 <sup>(1)</sup>
Eu-154	7.89 <sup>(1)</sup>

- (1) Based on the Operational DCGL.  
 (2) Based on the surrogate adjusted DCGL of Cs-137 while inferring Sr-90.

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 number of soil samples for FSS was determined in accordance with procedure LC-FS-PR-002. The relative shift ( $\Delta/\sigma$ ) for the survey unit data set is defined as shift ( $\Delta$ ), which is the Upper Boundary 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 ( $\sigma$ ), which is the standard deviation of the data set used for survey design. The optimal value for  $\Delta/\sigma$  should range between one (1) and three (3). The largest value the  $\Delta/\sigma$  can have is three (3). If the calculated value of  $\Delta/\sigma$  exceeds three (3), an adjusted value of three (3) will be used for  $\Delta/\sigma$ . The  $\Delta/\sigma$  for survey unit L1-SUB-CDR, based on Cs-137 and Co-60 data for subsurface soil samples collected during characterization of L1-010-101 (standard deviation of 0.03), was calculated as follows:

**Equation 3**

$$\Delta/\sigma = (1-0.5) / 0.03 = 16.67$$

As the calculated relative shift was greater than three (3), a value of three (3) was used as the adjusted  $\Delta/\sigma$ . Both the Type I error (i.e.,  $\alpha$  value) and the Type II error (i.e.,  $\beta$  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 fourteen (14).

A Prospective Power Curve was generated using COMPASS, a software package developed under the sponsorship of the United States Nuclear Regulatory Commission (USNRC) for implementation of the MARSSIM in support of the decommissioning license termination rule (10CFR20, Subpart E). The result of the COMPASS computer run showed adequate power for the survey design.

As the survey unit was classified as Class 1, sample locations were selected based on a systematic triangular grid with a random starting point. The systematic locations of the soil samples were selected using Visual Sample Plan (VSP), in accordance with LC-FS-PR-002. Input parameters included use of aerial photographs and the GPS route of the boundary of the excavation. The systematic coordinates generated with VSP were integrated with a GPS to identify sample locations in the field. Table 5-3 lists the systematic samples collected for FSS and the corresponding GPS coordinates, based on the Wisconsin State Plane North American Datum 1983 coordinate system.

**Table 5-3 – Systematic Sample Locations**

Sample ID	Northing	Easting
L1-SUB-CDR-FSGS-001-SB	570930.6618	1642154.6934
L1-SUB-CDR-FSGS-002-SB	570930.6618	1642175.6046
L1-SUB-CDR-FSGS-003-SB	570948.7714	1642165.1490
L1-SUB-CDR-FSGS-004-SB	570948.7714	1642186.0602
L1-SUB-CDR-FSGS-005-SB	570966.8811	1642154.6934
L1-SUB-CDR-FSGS-006-SB	570966.8811	1642196.5159
L1-SUB-CDR-FSGS-007-SB	570966.8811	1642217.4271
L1-SUB-CDR-FSGS-008-SB	570984.9908	1642081.5040
L1-SUB-CDR-FSGS-009-SB	570984.9908	1642186.0602
L1-SUB-CDR-FSGS-010-SB	571003.1004	1642091.9596
L1-SUB-CDR-FSGS-011-SB	571003.1004	1642112.8709
L1-SUB-CDR-FSGS-012-SB	571003.1004	1642154.6934
L1-SUB-CDR-FSGS-013-SB	571021.2101	1642102.4153
L1-SUB-CDR-FSGS-014-SB	571021.2101	1642123.3265

Six (6) investigational samples were collected at locations of scanning alarms. In total, twenty (20) soil samples were collected for the FSS of survey unit L1-SUB-CDR. Inadvertently, the investigational samples were not labeled correctly, the coordinates were not collected, and the locations were not marked on the survey maps. Descriptions of where the investigational samples were collected (i.e., in what scan lanes) and how they were labeled were provided in the Field Logs. The collection of the investigational samples is described in detail in Section 6 of this Release Record.

The LACBWR LTP, Section 5.1 states that soil samples will be collected during FSS to confirm the HTD to surrogate radionuclide ratio. Ten percent (10%) of the FSS samples collected from open land survey units will be analyzed for HTD ROC. Only the HTD radionuclide included as ROC (Sr-90) will be analyzed in the FSS confirmatory samples. In addition, if any sample has a SOF of 10% of the Operational DCGL or more, it must be sent for HTD ROC analysis. For samples with positive results for both the HTD ROC and the corresponding surrogate radionuclide (Cs-137), the HTD surrogate ratio will be derived and compared against the 95% UCL ratio (see Table 5-1). If the derived ratio from the confirmatory samples exceeds the 95% UCL ratio, then the area-specific ratio as determined by actual survey data will be used.

The selection of five (5) soil samples (L1-SUB-CDR-FSGS-008-SS, L1-SUB-CDR-FSGS-009-SS, L1-SUB-CDR-FSGS-011-SS, L1-SUB-CDR-FSGS-012-SS, and L1-SUB-CDR-FSGS-014-SS) met the requirement that a minimum of 10% of the samples collected for the FSS of survey unit L1-SUB-CDR be analyzed for HTD ROC. Four (4) of the five (5) total samples sent for off-site HTD analysis were selected because of a sample SOF greater than the 10% threshold described in the LTP.

The implementation of quality control measures as referenced by LTP Chapter 5, Section 5.9 and LaCrosseSolutions LC-QA-PN-001, *Final Status Survey Quality Assurance Project Plan* (QAPP) (Reference 10) 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) soil sample, L1-SUB-CDR-QSGS-014-SS, was designated for split sample QC analysis for the FSS of this survey unit.

The LTP, Section 5.6.4.4 and Table 5-15, specifies that for Class 1 open land survey units, surface scans will be performed on 100% of the surface area in the survey unit. For survey unit L1-SUB-CDR, 100% scan coverage equates to 431 m<sup>2</sup>. To encapsulate the entire area of the survey unit, one hundred (100) half-meter wide scan lanes were established in the survey unit. A map of survey unit is provided in Attachment 1.

For this Class 1 excavation survey unit, the “Investigation Levels” for area scanning and soil sample measurement results are those levels specified in LTP Chapter 5, Table 5-16, and are reproduced below in Table 5-5.

**Table 5-4 – Investigation Levels**

<b>Classification</b>	<b>Scan Investigation Levels</b>	<b>Direct Investigation Levels</b>
Class 1	>Operational DCGL or >MDC <sub>scan</sub> if MDC <sub>scan</sub> is greater than Operational DCGL	>Operational DCGL

Table 5-6 provides a synopsis of the survey design for survey unit L1-SUB-CDR.

**Table 5-5 – Synopsis of Survey Design**

Feature	Design Criteria	Basis
Survey Unit Surface Area	431 m <sup>2</sup>	GPS
Number of Systematic Samples (N)	14	<ul style="list-style-type: none"> <li>• <math>\sigma = 0.03</math></li> <li>• UBGR = SOF of 1</li> <li>• LBGR = SOF of 0.5</li> <li>• Type I &amp; II error = 0.05</li> <li>• <math>\Delta/\sigma = 3</math> (adjusted)</li> <li>• MARSSIM Table 5.5</li> </ul>
DCGLS and Action Levels	<ul style="list-style-type: none"> <li>• Co-60: 3.83 pCi/g</li> <li>• Sr-90: 1970.45 pCi/g</li> <li>• Cs-137: 17.39 pCi/g (Surrogate Cs-137 DCGL: 17.31 pCi/g)</li> <li>• Eu-152: 8.51 pCi/g</li> <li>• Eu-154: 7.89 pCi/g</li> </ul>	Operational DCGLs for soil, LTP Chapter 5, Table 5-6, Release Record Table 5-2
Scan and Direct Investigation Levels	>Operational DCGL	LTP Chapter 5, Table 5-16
Scan Areal Coverage	431 m <sup>2</sup> , 100% areal coverage	LTP Chapter 5, Table 5-15
HTD ROC Analysis	1 sample 5 (4 with SOF > 0.1)	LTP Chapter 5, Section 5.1 Actual Number Obtained
QC	1 split sample selected at random	LTP Chapter 5, Section 5.9

## 6. SURVEY IMPLEMENTATION

For survey unit L1-SUB-CDR, compliance with the unrestricted release criteria was demonstrated through a combination of soil scanning with a Ludlum Model 44-10 gamma detector and the sampling of soil for isotopic analysis.

An FSS Supervisor performed a visual inspection and walk-down of the survey unit on September 11, 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. At the time of survey, the soil in the survey unit was dry and free of any considerable constraint for the collection of samples and scan measurements.

FSS field activities were conducted under the FSS Sample Plan, which included DQOs, survey design, detailed FSS instructions, job safety analysis, and related procedures for reference. FSS field activities were projected to take four (4) working days to complete. Daily briefings were conducted to discuss the expectations for job performance and to review safety aspects of the job. A “Field Log” was used to document field activities and other information pertaining to the performance of the FSS. FSS field activities commenced on September 13, 2017, and were concluded on September 18, 2017.

A total of one hundred (100) different scan lanes, constituting an areal coverage of 431 m<sup>2</sup>, were scanned using a Ludlum 2350-1 paired with a Ludlum Model 44-10 (2”x 2”) sodium iodide (NaI) detector. The background was established as the average of five (5) 1-minute static measurements, while maintaining the detector 6” from the soil. In survey unit L1-SUB-CDR, background ranged from 4,995 cpm up to 5,641 cpm.

All designated scan areas 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 no more than 3” from the ground and was moved at a scan speed of approximately 0.5 meters per second. In accordance with RS-TD-313196-006, *Ludlum Model 44-10 Detector Sensitivity* (Reference 11), scan MDC was sufficient to detect residual radioactivity at the action level (adjusted surrogate DCGL of 17.31 pCi/g, which was based on the surrogate adjusted DCGL of Cs-137 while inferring Sr-90). Complete scan results are provided in Attachment 2.

Six (6) investigational samples were collected at locations of scanning alarms in scan lanes CDR14 through CDR18 and W11, W16, and W17 (see Table 7-1). Inadvertently, the investigational samples were not labeled correctly, the coordinates were not collected, and the locations were not marked on the survey maps. The six (6) investigational samples were labeled as NRC #4 through NRC #9.

The fourteen (14) systematic sample locations were marked with flags based on GPS coordinates provided. Each soil sample consisted of approximately one (1) liter of soil. The soil sample media was sifted to remove stones and other media larger than one (1) centimeter in diameter. All soil samples were collected, controlled, transported, stored, and transferred to the on-site laboratory using the Chain-of-Custody process from LC-FS-PR-012, *Chain of Custody Protocol* (Reference 12), and in accordance with LC-FS-PR-004, *Sample Media Collection for Site Characterization and Final Status Survey* (Reference 13), LC-FS-PR-005, *Sample Media Preparation for Site Characterization and Final Status Survey* (Reference 14), and LC-FS-PR-001, *Sample Storage* (Reference 15).



The survey design specified that a minimum of one (1) sample was required for HTD ROC analysis. In total, five (5) samples (L1-SUB-CDR-FSGS-008-SS, L1-SUB-CDR-FSGS-009-SS, L1-SUB-CDR-FSGS-011-SS, L1-SUB-CDR-FSGS-012-SS, and L1-SUB-CDR-FSGS-014-SS) were selected for HTD radionuclide analysis. Four (4) of the five (5) total samples sent for off-site HTD analysis were selected because of a sample SOF greater than the 10% threshold described in the LTP.

The implementation of survey specific QC measures included the collection of one (1) sample (L1-SUB-CDR-QSGS-014-SS) for duplicate sample analysis.

## 7. SURVEY RESULTS

All areas identified in the FSS sample plan were scanned for elevated activity levels. A total of eight (8) alarms were verified during scanning, which prompted the collection of six (6) investigational soil samples. Table 7-1 provides an overview of the scan results for all scan lanes (identified as CDR01 through W43) and QC locations (identified with a “QC”). Complete scan results are provided in Attachment 2.

**Table 7-1 – Synopsis of Scan Results**

Scan Area	Highest Logged Reading (cpm)	Action Level <sup>(1)</sup> (cpm)	# of Scan Alarms	Investigation Samples
CDR01	18,429	27,196	0	0
CDR02	17,420	27,196	0	0
CDR03	16,956	27,196	0	0
CDR04	18,267	27,196	0	0
CDR05	17,404	27,196	0	0
CDR06	17,423	27,196	0	0
CDR07	19,271	27,196	0	0
CDR08	18,921	27,196	0	0
CDR09	16,520	27,196	0	0
CDR10	12,365	27,196	0	0
CDR11	4,845	27,196	0	0
CDR12	5,149	27,196	0	0
CDR13	4,529	27,196	0	0
CDR14	30,902	27,196	1	3
CDR15	35,749	27,196	1	

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Scan Area	Highest Logged Reading (cpm)	Action Level <sup>(1)</sup> (cpm)	# of Scan Alarms	Investigation Samples
CDR16	38,108	27,196	1	
CDR17	46,676	27,196	1	
CDR18	48,247	27,196	1	
CDR19	12,203	27,196	0	0
CDR20	11,497	27,196	0	0
CDR21	12,321	27,196	0	0
CDR22	12,103	27,196	0	0
E01	10,325	27,423	0	0
E02	11,475	27,423	0	0
E03	9,392	27,423	0	0
E04	10,213	27,423	0	0
E05	10,154	27,423	0	0
E06	10,211	27,423	0	0
E07	10,541	27,423	0	0
E08	10,554	27,423	0	0
E09	10,566	27,423	0	0
E10	11,682	27,423	0	0
E11	11,012	27,423	0	0
E12	12,262	27,423	0	0
E13	11,733	27,423	0	0
E14	12,026	27,423	0	0
E15	12,594	27,423	0	0
E16	18,572	27,423	0	0
E17	15,775	27,423	0	0
E18	13,118	27,423	0	0
E19	13,103	27,423	0	0
E20	13,015	27,423	0	0
E21	12,904	27,423	0	0
E22	11,783	27,139	0	0
E23	12,448	27,139	0	0
E24	12,350	27,139	0	0
E25	14,924	27,139	0	0

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Scan Area	Highest Logged Reading (cpm)	Action Level <sup>(1)</sup> (cpm)	# of Scan Alarms	Investigation Samples
E26	14,183	27,139	0	0
E27	15,003	27,139	0	0
E28	13,785	27,139	0	0
E29	13,991	27,139	0	0
E30	15,243	27,139	0	0
E31	15,963	27,139	0	0
E31 QC	15,709	27,781	0	0
E32	20,983	27,139	0	0
E32 QC	16,641	27,781	0	0
E33	21,026	27,139	0	0
E33 QC	19,820	27,781	0	0
E34	19,800	27,139	0	0
E34 QC	20,269	27,781	0	0
E35	16,245	27,139	0	0
W01	14,744	27,139	0	0
W01 QC	12,971	27,781	0	0
W02	13,623	27,139	0	0
W02 QC	14,665	27,781	0	0
W03	15,236	27,139	0	0
W03 QC	15,339	27,781	0	0
W04	17,457	27,139	0	0
W04 QC	15,495	27,781	0	0
W05	14,765	27,234	0	0
W06	23,801	27,139	0	0
W07	15,830	27,139	0	0
W08	20,737	27,139	0	0
W09	26,142	27,139	0	0
W10	26,458	27,139	0	0
W11	36,821	27,139	1	1
W12	19,633	27,234	0	0
W13	26,792	27,234	0	0
W14	24,176	27,234	0	0

Scan Area	Highest Logged Reading (cpm)	Action Level <sup>(1)</sup> (cpm)	# of Scan Alarms	Investigation Samples
W15	23,172	27,234	0	0
W16	29,183	27,234	1	1
W17	30,449	27,234	1	1
W18	23,237	27,234	0	0
W19	20,961	27,234	0	0
W20	16,876	27,234	0	0
W21	17,718	27,234	0	0
W22	15,917	27,234	0	0
W23	14,901	27,234	0	0
W24	16,234	27,135	0	0
W25	18,184	27,135	0	0
W26	18,609	27,135	0	0
W27	18,213	27,135	0	0
W28	18,088	27,135	0	0
W29	17,300	27,135	0	0
W30	17,452	27,135	0	0
W31	16,810	27,135	0	0
W32	16,995	27,135	0	0
W33	15,805	27,135	0	0
W34	16,613	27,135	0	0
W35	16,549	27,135	0	0
W36	18,195	27,423	0	0
W37	18,677	27,423	0	0
W38	17,445	27,423	0	0
W39	20,117	27,423	0	0
W40	20,136	27,423	0	0
W41	21,127	27,423	0	0
W42	21,625	27,423	0	0
W43	21,518	27,423	0	0

(1) Action Level based on the average background plus 22,140 cpm (from RS-TD-313196-006).

The Action Level for scanning was established as the average background plus 22,140 cpm. The 22,140 cpm value is equal to the scanning instrumentation response to a Cs-137

concentration of 12 pCi/g. This value is equivalent to 22% of the adjusted DCGL for soil that was used before Operational DCGLs were established. Typically, the 25% IC adjusted DCGL value (13 pCi/g) is used for the Action Level calculation, but a more conservative value was selected for this survey unit.

Evaluating the logged scan data to the correct and current Action Levels based on the Operational DCGL shows that nearly all the scan measurements would have produced alarms, and in turn would have triggered the collection of additional investigational soil samples. It was discovered that background values for the scan grids for this survey unit were erroneously collected in the environmental lab and were not representative of actual background levels. The lab backgrounds ranged from 4,995 cpm to 5,641 cpm. These backgrounds are lower than the activity of scan measurements collected for FSS, which ranged from 4,529 cpm to 48,247 cpm (as shown in Table 7-1 above). If the average background for the sample locations (17,440 cpm) was applied to the scan grids, and the scan data was evaluated against the current Action Levels based on the Operational DCGL, only the same eight (8) alarms from the original survey (shown in Table 7-1) would be reproduced. Because 100% of the soil in the survey unit was scanned and no soil samples collected for FSS resulted in ROC concentrations above the Operational DCGLs, the probability of discovering an elevated soil sample is very low, even had additional investigational samples been collected.

The on-site laboratory analyzed the fourteen (14) soil samples taken for non-parametric statistical testing using the on-site gamma spectroscopy system. A summary of the results for the fourteen (14) samples collected for non-parametric statistical testing is provided in Table 7-2. Gamma spectroscopy results revealed that Cs-137 was positively identified in thirteen (13) of the systematic samples, at a maximum concentration of 6.25E+00 pCi/g. Co-60 was identified in three (3) of the systematic samples, at a maximum concentration of 3.42E-01 pCi/g. The concentration for Sr-90 was inferred based on the ratio specified in Table 5-1. The complete gamma spectroscopy reports are presented in Attachment 7. The basic statistics for the systematic sample population are summarized in Table 7-3.

**Table 7-2 - Summary of Gamma Spectroscopy Results for Samples Comprising the Statistical Sample Population**

Sample ID	Co-60 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)	Sr-90 (pCi/g)
L1-SUB-CDR-FSGS-001-SB	8.39E-02	3.70E-02	1.14E-01	5.54E-02	1.86E-02
L1-SUB-CDR-FSGS-002-SB	6.28E-02	<b>1.77E-01</b>	0.00E+00	3.05E-02	8.89E-02
L1-SUB-CDR-FSGS-003-SB	8.26E-02	<b>3.30E-01</b>	1.65E-01	2.12E-02	1.66E-01

Sample ID	Co-60 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)	Sr-90 (pCi/g)
L1-SUB-CDR-FSGS-004-SB	8.76E-02	<b>2.44E-01</b>	8.55E-02	2.49E-02	1.22E-01
L1-SUB-CDR-FSGS-005-SB	5.95E-02	<b>7.85E-01</b>	5.48E-02	0.00E+00	3.94E-01
L1-SUB-CDR-FSGS-006-SB	5.29E-02	<b>6.35E-01</b>	5.26E-02	2.30E-01	3.19E-01
L1-SUB-CDR-FSGS-007-SB	1.01E-01	<b>3.44E-01</b>	3.28E-02	4.24E-03	1.73E-01
L1-SUB-CDR-FSGS-008-SB	7.16E-02	<b>6.94E-01</b>	0.00E+00	3.03E-03	3.48E-01
L1-SUB-CDR-FSGS-009-SB	<b>3.42E-01</b>	<b>6.25E+00</b>	0.00E+00	7.19E-02	3.14E+00
L1-SUB-CDR-FSGS-010-SB	5.26E-02	<b>1.11E+00</b>	5.67E-03	9.21E-02	5.57E-01
L1-SUB-CDR-FSGS-011-SB	<b>1.83E-01</b>	<b>2.80E+00</b>	7.91E-02	6.47E-02	1.41E+00
L1-SUB-CDR-FSGS-012-SB	1.37E-01	<b>1.60E+00</b>	1.36E-02	5.59E-02	8.03E-01
L1-SUB-CDR-FSGS-013-SB	2.88E-02	<b>7.18E-02</b>	1.32E-01	1.58E-01	3.60E-02
L1-SUB-CDR-FSGS-014-SB	<b>1.03E-01</b>	<b>2.28E+00</b>	5.35E-02	5.64E-02	1.14E+00

Note: Bold values indicate concentrations greater than MDC.

**Table 7-3 - Basic Statistical Properties of Systematic Sample Population**

ROC	Mean (pCi/g)	Median (pCi/g)	Max (pCi/g)	Min (pCi/g)	Std. Dev. (pCi/g)	BcDCGL (pCi/g)	Avg. SOF per ROC	Avg. Dose Per ROC
Co-60	1.03E-01	8.33E-02	3.42E-01	2.88E-02	7.88E-02	1.06E+01	0.0098	0.2440
Cs-137	1.24E+00	6.65E-01	6.25E+00	3.70E-02	1.67E+00	4.83E+01	0.0257	0.6417
Eu-152	5.63E-02	5.31E-02	1.65E-01	0.00E+00	5.31E-02	2.36E+01	0.0024	0.0597
Eu-154	6.20E-02	5.57E-02	2.30E-01	0.00E+00	6.40E-02	2.19E+01	0.0028	0.0708
Sr-90	6.22E-01	3.34E-01	3.14E+00	1.86E-02	8.38E-01	5.47E+03	0.0001	0.0028

The off-site laboratory, GEL Laboratories, processed the five (5) samples selected for HTD ROC analysis. Samples L1-SUB-CDR-FSGS-008-SS, L1-SUB-CDR-FSGS-009-SS, L1-SUB-CDR-FSGS-011-SS, L1-SUB-CDR-FSGS-012-SS, and L1-SUB-CDR-FSGS-014-SS were selected. The initial full suite of ROC was included in the analysis, although only Sr-90 was required to be analyzed. All analyses met the required MDC.

Sr-90 was not detected in the off-site analysis of samples L1-SUB-CDR-FSGS-008-SS, L1-SUB-CDR-FSGS-009-SS, L1-SUB-CDR-FSGS-011-SS, L1-SUB-CDR-FSGS-012-SS, and L1-SUB-CDR-FSGS-014-SS. The results are provided in Table 7-4.

**Table 7-4 - Off-Site Analysis Results**

Sample ID	ROC	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC
L1-SUB-CDR-FSGS-008-SS	Sr-90	2.48E-01	1.80E-01	2.76E-01	No
L1-SUB-CDR-FSGS-009-SS	Sr-90	-1.78E-01	1.33E-01	3.06E-01	No
L1-SUB-CDR-FSGS-011-SS	Sr-90	7.87E-02	1.41E-01	2.51E-01	No
L1-SUB-CDR-FSGS-012-SS	Sr-90	1.63E-01	1.93E-01	3.25E-01	No
L1-SUB-CDR-FSGS-014-SS	Sr-90	7.95E-02	1.59E-01	2.86E-01	No

The on-site laboratory analyzed the six (6) investigational soil samples using the on-site gamma spectroscopy system. A summary of the analytical results for the investigational soil samples is provided in Table 7-5. Gamma spectroscopy results revealed that Cs-137 was positively identified in all six (6) of the investigational samples, at a maximum concentration of 1.57E+00 pCi/g. Co-60 was identified in four (4) of the investigational samples, at a maximum concentration of 8.11E-02 pCi/g. Inadvertently, Eu-152 was not included in the gamma spectroscopy analysis of the investigational samples. The concentrations for Sr-90 were inferred based on the ratio specified in Table 5-1. The complete gamma spectroscopy reports are presented in Attachment 7.

**Table 7-5 - Summary of Gamma Spectroscopy Results for Investigational Samples**

Sample ID	Co-60 (pCi/g)	Cs-137 (pCi/g)	Eu-154 (pCi/g)	Sr-90 (pCi/g)
NRC #4	<b>7.68E-02</b>	<b>1.52E+00</b>	1.78E-02	7.63E-01
NRC #5	<b>8.11E-02</b>	<b>7.16E-01</b>	1.58E-02	3.59E-01
NRC #6	<b>4.80E-02</b>	<b>7.31E-01</b>	8.92E-03	3.67E-01
NRC #7	1.06E-02	<b>3.87E-02</b>	2.59E-02	1.94E-02
NRC #8	0.00E+00	<b>1.59E-01</b>	7.94E-04	7.98E-02
NRC #9	<b>7.29E-02</b>	<b>1.57E+00</b>	2.32E-02	7.88E-01

**Note: Bold values indicate concentrations greater than MDC.**

The implementation of survey specific QC measures included the collection of one (1) sample (L1-SUB-CDR-QSGS-014-SS) for duplicate sample analysis. The on-site laboratory analyzed the QC sample using the on-site gamma spectroscopy system. A summary of the analytical results for the QC sample is provided in Table 7-6. Gamma spectroscopy results revealed that Cs-137 was positively identified in the QC sample. The concentration for Sr-90 was inferred based on the ratio specified in Table 5-1.



**Table 7-6 - Summary of Gamma Spectroscopy Results for the QC Sample**

Sample ID	Co-60 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)	Sr-90 (pCi/g)
L1-SUB-CDR-QSGS-014-SS	7.49E-02	<b>2.88E-01</b>	1.18E-01	0.00E+00	1.45E-01

Note: Bold values indicate concentrations greater than MDC.

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 4**

$$\frac{C_1}{DCGL_1} + \frac{C_2}{DCGL_2} + \dots + \frac{C_n}{DCGL_n} \leq 1$$

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 systematic sample population for survey unit L1-SUB-CDR are provided in Table 7-7.

**Table 7-7 - Sum-of-Fractions for Systematic and QC Samples**

Sample ID	Fraction of Operational DCGL					SOF
	Co-60	Cs-137	Eu-152	Eu-154	Sr-90	
L1-SUB-CDR-FSGS-001-SB	0.0219	0.0021	0.0134	0.0070	0.0000	0.0445
L1-SUB-CDR-FSGS-002-SB	0.0164	0.0102	0.0000	0.0039	0.0000	0.0305
L1-SUB-CDR-FSGS-003-SB	0.0216	0.0190	0.0194	0.0027	0.0001	0.0627
L1-SUB-CDR-FSGS-004-SB	0.0229	0.0140	0.0100	0.0032	0.0001	0.0502
L1-SUB-CDR-FSGS-005-SB	0.0155	0.0451	0.0064	0.0000	0.0002	0.0673
L1-SUB-CDR-FSGS-006-SB	0.0138	0.0365	0.0062	0.0292	0.0002	0.0858
L1-SUB-CDR-FSGS-007-SB	0.0264	0.0198	0.0039	0.0005	0.0001	0.0506
L1-SUB-CDR-FSGS-008-SB	0.0187	0.0399	0.0000	0.0004	0.0002	0.0592
L1-SUB-CDR-FSGS-009-SB	0.0893	0.3594	0.0000	0.0091	0.0016	0.4594
L1-SUB-CDR-FSGS-010-SB	0.0137	0.0638	0.0007	0.0117	0.0003	0.0902
L1-SUB-CDR-FSGS-011-SB	0.0478	0.1610	0.0093	0.0082	0.0007	0.2270
L1-SUB-CDR-FSGS-012-SB	0.0358	0.0920	0.0016	0.0071	0.0004	0.1369
L1-SUB-CDR-FSGS-013-SB	0.0075	0.0041	0.0155	0.0200	0.0000	0.0472
L1-SUB-CDR-FSGS-014-SB	0.0269	0.1311	0.0063	0.0071	0.0006	0.1720

Sample ID	Fraction of Operational DCGL					SOF
	Co-60	Cs-137	Eu-152	Eu-154	Sr-90	
L1-SUB-CDR-QSGS-014-SS	0.0196	0.0166	0.0139	0.0000	0.0001	0.0501

#### Systematic Samples

Number of Systematic Samples =	14
# of Systematic Samples with SOF $\geq 1$ =	0
# of Systematic Samples with SOF > 0.1 (HTD Assessment) =	4
Max Individual Systematic Sample SOF =	0.4594
Mean Systematic Sample SOF =	0.1131

The results of the unity rule calculation for the ROC in the investigational sample population for survey unit L1-SUB-CDR are provided in Table 7-8.

**Table 7-8 – Sum-of-Fractions for Investigational Samples**

Sample ID	Fraction of Operational DCGL				SOF
	Co-60	Cs-137	Eu-154	Sr-90	
NRC #4	0.0201	0.0874	0.0023	0.0004	0.1101
NRC #5	0.0212	0.0412	0.0020	0.0002	0.0645
NRC #6	0.0125	0.0420	0.0011	0.0002	0.0559
NRC #7	0.0028	0.0022	0.0033	0.0000	0.0083
NRC #8	0.0000	0.0091	0.0001	0.0000	0.0093
NRC #9	0.0190	0.0903	0.0029	0.0004	0.1127

#### Investigational Samples

Number of Investigational Samples =	6
# of Investigational Samples with SOF $\geq 1$ =	0
Max Individual Investigational Sample SOF =	0.1127

## 8. QUALITY CONTROL

The on-site laboratory processed one (1) duplicate sample (L1-SUB-CDR-QSGS-014-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 16). There was not an acceptable agreement between standard and duplicate results; however, due to the concentrations of

Cs-137 reported well below the Operational DCGL, no further action was taken. Refer to Attachment 4 for data and quality control analysis results.

## **9. INVESTIGATIONS AND RESULTS**

Six (6) soil samples were collected to investigate alarms in scan lanes CDR14 through CDR18 and W11, W16, and W17. The investigational samples were analyzed using the on-site gamma spectroscopy system. Gamma spectroscopy results revealed that Cs-137 was positively identified in all six (6) of the investigational samples, at a maximum concentration of 1.57E+00 pCi/g. Co-60 was identified in four (4) of the investigational samples, at a maximum concentration of 8.11E-02 pCi/g. The maximum SOF for investigational samples, when compared to the Operational DCGL, is 0.1127.

## **10. REMEDIATION AND RESULTS**

No radiological remedial action as described by MARSSIM Section 5.4 was performed in this survey unit as a result of the FSS. Chapter 4 of the 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**

There were no addendums to the FSS plan.

## **12. DATA QUALITY ASSESSMENT (DQA)**

The DQO sample design and data were reviewed in accordance with LC-FS-PR-008, *Final Status Survey Data Assessment* (Reference 17) for completeness and consistency. Documentation was complete and legible. Surveys and the collection of samples were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 1. The survey design had adequate power as indicated by the Retrospective Power Curve (see Attachment 6).

The measurement results indicated that all samples were less than a SOF of one (1) when compared to the OpDCGL<sub>S</sub>.

Although MARSSIM states that the Sign Test need not be performed in the instance that no measurements surpass the Operational 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 results of the Sign Test are presented in Attachment 3.

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 that exceeded two standard deviations. The mean and median values for each ROC were well below the respective Operational DCGLs. 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 mean of all identified isotopes are less than the Consultation Triggers for Residential Soil Concentration depicted in Table H.1 of NUREG 1757, Vol.1, Rev. 2 (MOU Table 1). The full table is included in Attachment 5 of this release record.

The data for Cs-137 is presented graphically through a frequency plot and quantile plot. All graphical presentations are provided in Attachment 6.

### **13. ANOMALIES**

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

### **14. CONCLUSION**

Survey unit L1-SUB-CDR has met the DQOs of the FSS plan. The ALARA criteria as specified in Chapter 4 of the LTP were achieved. The Elevated Measurement Comparison for soils was not used 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 systematic ROC concentration values exceeds the OpDCGLs; therefore, in accordance with LTP Section 5.11, the survey unit meets the release criteria.

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 1.

The dose contribution from soil in survey unit L1-SUB-CDR is 1.0190 mrem/yr TEDE, based on the average concentration of the ROC in samples used for non-parametric statistical sampling.

Survey unit L1-SUB-CDR is acceptable for unrestricted release.

## 15. REFERENCES

1. LC-FS-PR-009, Final Status Survey Data Reporting
2. *La Crosse Boiling Water Reactor License Termination Plan*
3. LC-FS-PR-002, *Final Status Survey Package Development*
4. NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*
5. *La Crosse Boiling Water Reactor Historical Site Assessment*
6. RS-TD-313196-004, *LACBWR Soil DCGL, Basement Concrete DCGL, and Buried Pipe DCGL*
7. RS-TD-313196-001, *Radionuclides of Concern during LACBWR Decommissioning*
8. NUREG-1757, Volume 2, Revision 1, *Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria, Final Report*
9. LC-FS-TSD-002, *Operational Derived Concentration Guideline Levels for Final Status Survey*
10. LC-QA-PN-001, *Final Status Survey Quality Assurance Project Plan*
11. RS-TD-313196-006, *Ludlum Model 44-10 Detector Sensitivity*
12. LC-FS-PR-012, *Chain of Custody Protocol*
13. LC-FS-PR-004, *Sample Media Collection for Site Characterization and Final Status Survey*
14. LC-FS-PR-005, *Sample Media Preparation for Site Characterization and Final Status Survey*
15. LC-FS-PR-001, *Sample Storage*
16. USNRC Inspection Procedure No. 84750, *Radioactive Waste Treatment, and Effluent and Environmental Monitoring*
17. LC-FS-PR-008, *Final Status Survey Data Assessment*

## 16. ATTACHMENTS

- Attachment 1 – Figure
- Attachment 2 – Scan Data
- Attachment 3 – Sign Test
- Attachment 4 – Quality Control Assessment
- Attachment 5 – Consultation Triggers for Residential Soil Concentrations
- Attachment 6 – Graphical Presentations
- Attachment 7 – Sample Analytical Reports

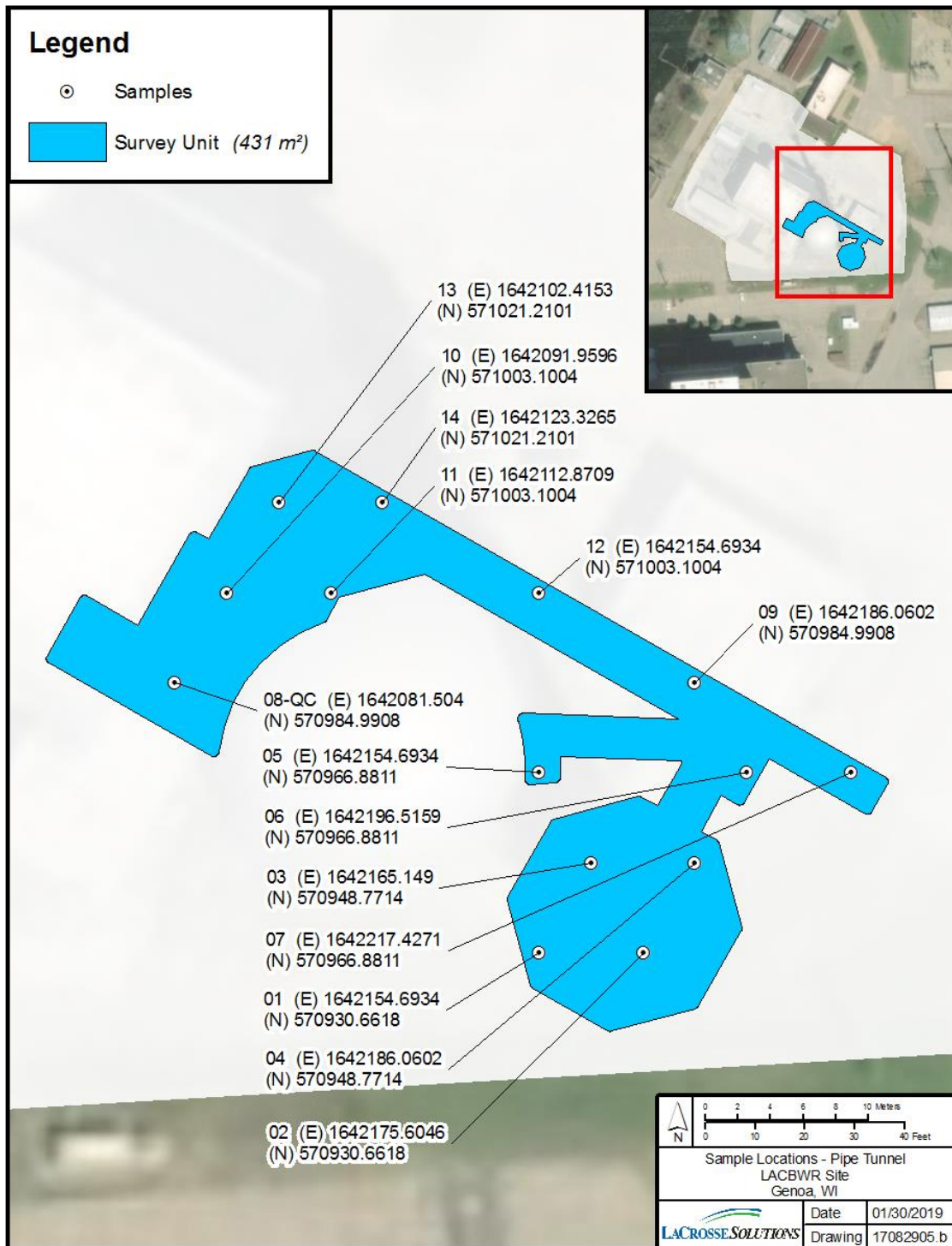
Attachment 8 – GEL Laboratories Analytical Reports

# **ATTACHMENT 1**

## **FIGURE**



**Figure 16-1 – Survey Unit L1-SUB-CDR Systematic Sample Locations Map**



# **ATTACHMENT 2**

## **SCAN DATA**

**Table 16-1 – Survey Unit L1-SUB-CDR Complete Scan Data**

<b>Detector Type</b>	<b>Detector ID</b>	<b>M2350-1 ID</b>	<b>Location</b>	<b>Scan Logged Result (cpm)</b>	<b>Avg Background (cpm)</b>	<b>Action Level (cpm)</b>	<b>Scan Alarms</b>
44-10	318218	120636	CDR01	18,429	5,056	27,196	0
44-10	318218	120636	CDR02	17,420	5,056	27,196	0
44-10	318218	120636	CDR03	16,956	5,056	27,196	0
44-10	318218	120636	CDR04	18,267	5,056	27,196	0
44-10	318218	120636	CDR05	17,404	5,056	27,196	0
44-10	318218	120636	CDR06	17,423	5,056	27,196	0
44-10	318218	120636	CDR07	19,271	5,056	27,196	0
44-10	318218	120636	CDR08	18,921	5,056	27,196	0
44-10	318218	120636	CDR09	16,520	5,056	27,196	0
44-10	318218	120636	CDR10	12,365	5,056	27,196	0
44-10	318218	120636	CDR11	4,845	5,056	27,196	0
44-10	318218	120636	CDR12	5,149	5,056	27,196	0
44-10	318218	120636	CDR13	4,529	5,056	27,196	0
44-10	318218	120636	CDR14	30,902	5,056	27,196	1
44-10	318218	120636	CDR15	35,749	5,056	27,196	1
44-10	318218	120636	CDR16	38,108	5,056	27,196	1
44-10	318218	120636	CDR17	46,676	5,056	27,196	1
44-10	318218	120636	CDR18	48,247	5,056	27,196	1
44-10	318218	120636	CDR19	12,203	5,056	27,196	0
44-10	318218	120636	CDR20	11,497	5,056	27,196	0
44-10	318218	120636	CDR21	12,321	5,056	27,196	0
44-10	318218	120636	CDR22	12,103	5,056	27,196	0
44-10	162398	126195	E01	10,325	5,283	27,423	0
44-10	162398	126195	E02	11,475	5,283	27,423	0
44-10	162398	126195	E03	9,392	5,283	27,423	0
44-10	162398	126195	E04	10,213	5,283	27,423	0
44-10	162398	126195	E05	10,154	5,283	27,423	0
44-10	162398	126195	E06	10,211	5,283	27,423	0
44-10	162398	126195	E07	10,541	5,283	27,423	0
44-10	162398	126195	E08	10,554	5,283	27,423	0
44-10	162398	126195	E09	10,566	5,283	27,423	0

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Detector Type	Detector ID	M2350-1 ID	Location	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	162398	126195	E10	11,682	5,283	27,423	0
44-10	162398	126195	E11	11,012	5,283	27,423	0
44-10	162398	126195	E12	12,262	5,283	27,423	0
44-10	162398	126195	E13	11,733	5,283	27,423	0
44-10	162398	126195	E14	12,026	5,283	27,423	0
44-10	162398	126195	E15	12,594	5,283	27,423	0
44-10	162398	126195	E16	18,572	5,283	27,423	0
44-10	162398	126195	E17	15,775	5,283	27,423	0
44-10	162398	126195	E18	13,118	5,283	27,423	0
44-10	162398	126195	E19	13,103	5,283	27,423	0
44-10	162398	126195	E20	13,015	5,283	27,423	0
44-10	162398	126195	E21	12,904	5,283	27,423	0
44-10	357776	325246	E22	11,783	4,999	27,139	0
44-10	357776	325246	E23	12,448	4,999	27,139	0
44-10	357776	325246	E24	12,350	4,999	27,139	0
44-10	357776	325246	E25	14,924	4,999	27,139	0
44-10	357776	325246	E26	14,183	4,999	27,139	0
44-10	357776	325246	E27	15,003	4,999	27,139	0
44-10	357776	325246	E28	13,785	4,999	27,139	0
44-10	357776	325246	E29	13,991	4,999	27,139	0
44-10	357776	325246	E30	15,243	4,999	27,139	0
44-10	357776	325246	E31	15,963	4,999	27,139	0
44-10	357783	325261	E31 QC	15,709	5,641	27,781	0
44-10	357776	325246	E32	20,983	4,999	27,139	0
44-10	357783	325261	E32 QC	16,641	5,641	27,781	0
44-10	357776	325246	E33	21,026	4,999	27,139	0
44-10	357783	325261	E33 QC	19,820	5,641	27,781	0
44-10	357776	325246	E34	19,800	4,999	27,139	0
44-10	357783	325261	E34 QC	20,269	5,641	27,781	0
44-10	357776	325246	E35	16,245	4,999	27,139	0
44-10	357776	325246	W01	14,744	4,999	27,139	0
44-10	357783	325261	W01 QC	12,971	5,641	27,781	0

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Detector Type	Detector ID	M2350-1 ID	Location	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	357776	325246	W02	13,623	4,999	27,139	0
44-10	357783	325261	W02 QC	14,665	5,641	27,781	0
44-10	357776	325246	W03	15,236	4,999	27,139	0
44-10	357783	325261	W03 QC	15,339	5,641	27,781	0
44-10	357776	325246	W04	17,457	4,999	27,139	0
44-10	357783	325261	W04 QC	15,495	5,641	27,781	0
44-10	162398	126195	W05	14,765	5,094	27,234	0
44-10	162398	126195	W06	14,925	5,094	27,234	0
44-10	357776	325246	W06	23,801	4,999	27,139	0
44-10	162398	126195	W07	15,131	5,094	27,234	0
44-10	357776	325246	W07	15,830	4,999	27,139	0
44-10	162398	126195	W08	14,682	5,094	27,234	0
44-10	357776	325246	W08	20,737	4,999	27,139	0
44-10	162398	126195	W09	17,438	5,094	27,234	0
44-10	357776	325246	W09	26,142	4,999	27,139	0
44-10	162398	126195	W10	17,516	5,094	27,234	0
44-10	162398	126195	W10	18,419	5,094	27,234	0
44-10	357776	325246	W10	26,458	4,999	27,139	0
44-10	162398	126195	W11	17,978	5,094	27,234	0
44-10	357776	325246	W11	36,821	4,999	27,139	1
44-10	162398	126195	W12	19,633	5,094	27,234	0
44-10	162398	126195	W13	26,792	5,094	27,234	0
44-10	162398	126195	W14	24,176	5,094	27,234	0
44-10	162398	126195	W15	23,172	5,094	27,234	0
44-10	162398	126195	W16	29,183	5,094	27,234	1
44-10	162398	126195	W17	30,449	5,094	27,234	1
44-10	162398	126195	W18	23,237	5,094	27,234	0
44-10	162398	126195	W19	20,961	5,094	27,234	0
44-10	162398	126195	W20	16,876	5,094	27,234	0
44-10	162398	126195	W21	17,718	5,094	27,234	0
44-10	162398	126195	W22	15,917	5,094	27,234	0
44-10	162398	126195	W23	14,901	5,094	27,234	0

FSS RELEASE RECORD  
 SURVEY UNIT L1-SUB-CDR  
 NORTH LOADING AREA



Detector Type	Detector ID	M2350-1 ID	Location	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level (cpm)	Scan Alarms
44-10	357776	325246	W24	16,234	4,995	27,135	0
44-10	357776	325246	W25	18,184	4,995	27,135	0
44-10	357776	325246	W26	18,609	4,995	27,135	0
44-10	357776	325246	W27	18,213	4,995	27,135	0
44-10	357776	325246	W28	18,088	4,995	27,135	0
44-10	357776	325246	W29	17,300	4,995	27,135	0
44-10	357776	325246	W30	17,452	4,995	27,135	0
44-10	357776	325246	W31	16,810	4,995	27,135	0
44-10	357776	325246	W32	16,995	4,995	27,135	0
44-10	357776	325246	W33	15,805	4,995	27,135	0
44-10	357776	325246	W34	16,613	4,995	27,135	0
44-10	357776	325246	W35	16,549	4,995	27,135	0
44-10	162398	126195	W36	18,195	5,283	27,423	0
44-10	162398	126195	W37	18,677	5,283	27,423	0
44-10	162398	126195	W38	17,445	5,283	27,423	0
44-10	162398	126195	W39	20,117	5,283	27,423	0
44-10	162398	126195	W40	20,136	5,283	27,423	0
44-10	162398	126195	W41	21,127	5,283	27,423	0
44-10	162398	126195	W42	21,625	5,283	27,423	0
44-10	162398	126195	W43	21,518	5,283	27,423	0

# **ATTACHMENT 3**

## **SIGN TEST**



**Table 16-2 – Survey Unit L1-SUB-CDR Sign Test**

#	SOF (W <sub>s</sub> )	1-W <sub>s</sub>	Sign
1	0.0445	0.96	+1
2	0.0305	0.97	+1
3	0.0627	0.94	+1
4	0.0502	0.95	+1
5	0.0673	0.93	+1
6	0.0858	0.91	+1
7	0.0506	0.95	+1
8	0.0592	0.94	+1
9	0.4594	0.54	+1
10	0.0902	0.91	+1
11	0.2270	0.77	+1
12	0.1369	0.86	+1
13	0.0472	0.95	+1
14	0.1720	0.83	+1

Number of positive differences (S+) 14

Critical Value 10

Survey Unit Meets  
 the Acceptance  
 Criteria

# **ATTACHMENT 4**

## **QUALITY CONTROL ASSESSMENT**

**Table 16-3 – Survey Unit L1-SUB-CDR QC Assessment**

STANDARD							COMPARISON			
Sample ID	Radionuclide	Activity Value	Standard Error	Resolution	Agreement Range (Low to High)		Sample ID	Activity Value	Comparison Ratio	Acceptable (Y/N)
L1-SUB-CDR-FSGS-014-SB	Cs-137	2.28E+00	7.68E-02	30	0.75	1.33	L1-SUB-CDR-QSGS-014-SB	2.88E-01	0.13	N
Comments/Corrective Actions: The comparison ratio is not within the agreement range. Both samples have activity below the OpDCGL, though, and no further action is necessary.							Table is provided to show acceptance criteria used to assess split samples.			
							Resolution		Acceptable Ratio	
							<4		0.4-2.5	
							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								

# **ATTACHMENT 5**

## **CONSULTATION TRIGGERS FOR RESIDENTIAL SOIL CONCENTRATION**

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

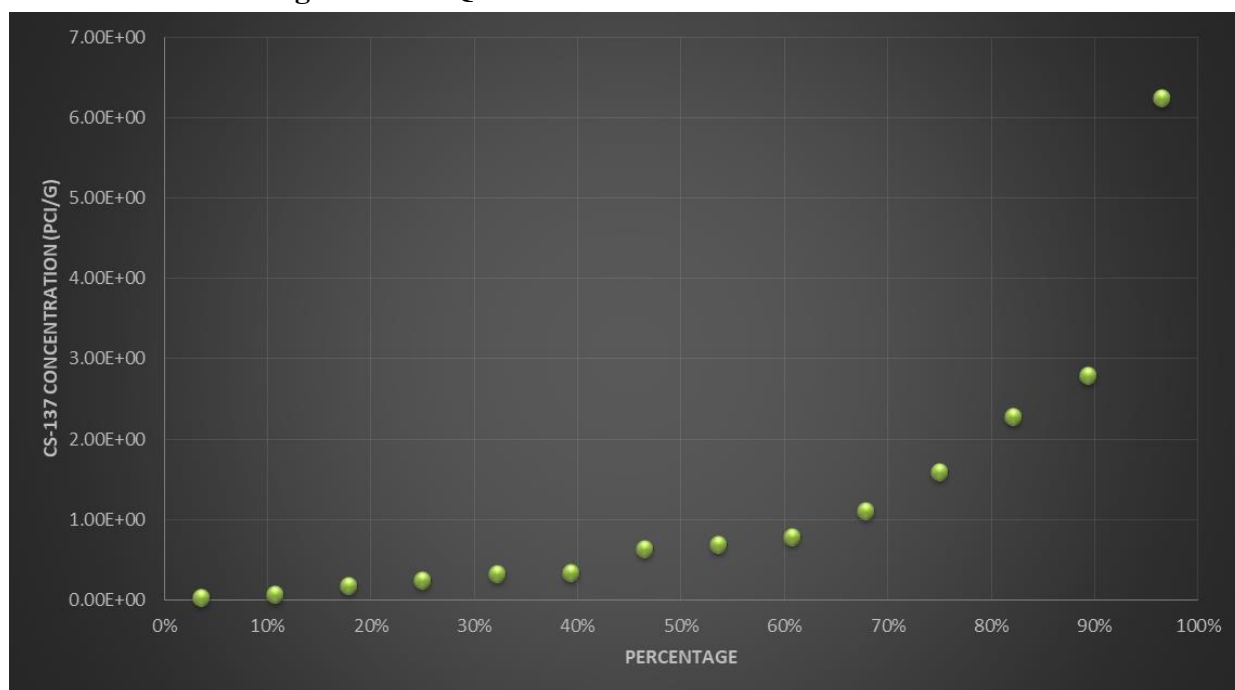
Except for radium-226, thorium-232, or total uranium, concentrations should be aggregated using a sum of the fraction approach to determine site-specific consultation trigger concentrations. This table is based on single contaminant concentrations for residential and commercial/industrial land use when 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 6**

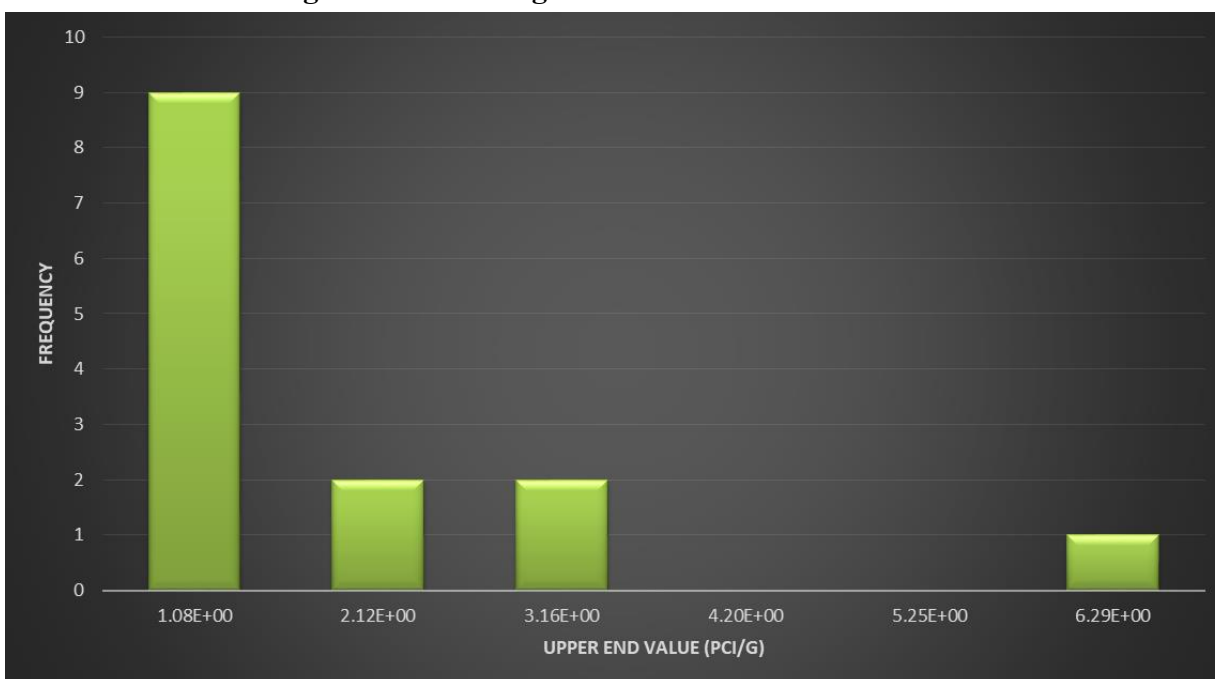
## **GRAPHICAL PRESENTATIONS**

**Figure 16-2 - Quantile Plot for Cs-137 Concentration**

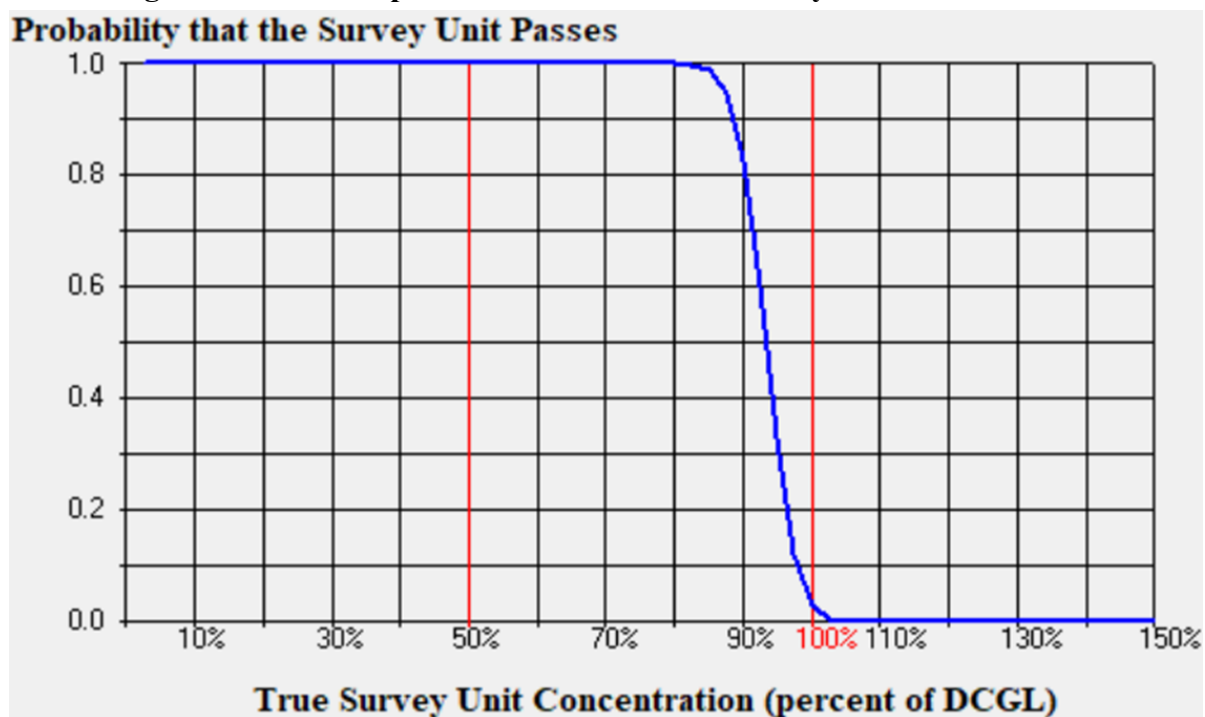




**Figure 16-3 - Histogram for Cs-137 Concentration**



**Figure 16-4 - Retrospective Power Curve for Survey Unit L1-SUB-CDR**



# **ATTACHMENT 7**

## **SAMPLE ANALYTICAL REPORTS**

Analysis Report for L1-SUB-CDR-FSGS-001-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-001-SB  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :  
  
Sample Size : 8.577E+02 grams  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/13/2017 11:02:00AM  
Acquisition Started : 9/14/2017 12:35:19PM  
  
Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds  
Real Time : 3609.3 seconds  
  
Dead Time : 0.26 %  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3388

REVIEWED  
Joe O'Jah  
9/14/17

---

## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 1:35:31PM  
Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-001-SB  
UNIT L1-SUB CDR 09/13/17

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
F	1	58.14	114 -	119	116.83	3.82E+01	13.06	2.13E+02	0.71
F	2	238.55	469 -	485	477.58	3.45E+02	26.41	4.10E+02	2.69
F	3	338.50	671 -	683	677.44	7.04E+01	14.67	1.72E+02	2.05
F	4	352.18	699 -	710	704.78	2.10E+02	18.69	1.24E+02	2.65
F	5	583.30	1160 -	1176	1166.94	8.62E+01	12.49	9.21E+01	2.27
F	6	609.70	1211 -	1228	1219.73	1.73E+02	16.42	1.08E+02	2.86
F	7	662.08	1318 -	1330	1324.47	1.13E+02	14.30	8.31E+01	2.57
F	8	911.94	1818 -	1830	1824.11	7.80E+01	10.90	3.45E+01	2.88
F	9	1461.72	2914 -	2933	2923.55	6.26E+02	25.40	1.50E+01	3.18

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 1:35:31PM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
F	1	58.14	3.82E+01	13.06			3.82E+01	1.31E+01
F	2	238.55	3.45E+02	26.41			3.45E+02	2.64E+01
F	3	338.50	7.04E+01	14.67			7.04E+01	1.47E+01
F	4	352.18	2.10E+02	18.69	8.36E+01	1.86E+01	1.26E+02	2.64E+01
F	5	583.30	8.62E+01	12.49			8.62E+01	1.25E+01
F	6	609.70	1.73E+02	16.42	4.12E+01	1.21E+01	1.32E+02	2.04E+01
F	7	662.08	1.13E+02	14.30	6.61E+01	1.27E+01	4.69E+01	1.91E+01
F	8	911.94	7.80E+01	10.90			7.80E+01	1.09E+01
F	9	1461.72	6.26E+02	25.40			6.26E+02	2.54E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-001-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daivland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.86	1460.75	*	10.67	7.96E-06	3.91E-07
CS-137	0.97	661.65	*	85.12	3.70E-08	1.51E-08
PB-212	0.56	77.11		17.50		
		238.63	*	44.60	2.07E-07	1.68E-08
BI-214	0.33	609.31	*	46.30	1.77E-07	2.79E-08
		1120.29		15.10		
		1238.11		5.94		
		1377.67		4.11		
		1407.98		2.48		
		1509.19		2.19		
		1764.49		15.80		
AC-228	0.30	209.28		4.40		
		338.32	*	11.40	2.23E-07	4.69E-08
		794.70		4.60		
		911.60	*	27.70	2.52E-07	3.57E-08
		964.60		5.20		
		969.11		16.60		

\* = 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 L1-SUB-CDR-FSGS-001-SB

UNIT L1-SUB CDR 09/13/17

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	0.861	7.96E-06	3.91E-07	
<del>CS-137</del>	0.971	3.70E-08	1.51E-08	
PB-212	0.560	2.07E-07	1.68E-08	
BI-214	0.338	1.77E-07	2.79E-08	
AC-228	0.303	2.42E-07	2.84E-08	

? = 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

L max

Joe O'Jude  
9/14/17



Analysis Report for L1-SUB-CDR-FSGS-001-SB

UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 1:35:31PM  
 Peak Locate From Channel : 100  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 1	58.14	1.06097E-02	34.18		11230
F 4	352.18	3.50660E-02	20.89	Tol.	PB-214 ✓
F 5	583.30	2.39550E-02	14.49		76200

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

Joe G  
 9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	*	10.67	7.96E-06	3.38E-07
+	AR-41	1293.64		99.16	1.30E-04	1.09E-03
+	CO-60	1173.22	100.00	8.39E-08	5.45E-08	6.56E-08
		1332.49	100.00	4.05E-08		5.45E-08
+	KR-85	513.99	0.43	4.92E-06	9.61E-06	9.61E-06
+	Y-88	898.04	93.70	2.18E-08	3.45E-08	4.52E-08
		1836.06	99.20	-3.05E-10		3.45E-08
+	NB-94	702.63	100.00	-1.74E-08	4.13E-08	4.27E-08
		871.10	100.00	-3.26E-08		4.13E-08
+	I-131	284.30	6.06	-4.03E-07	4.41E-08	5.87E-07
		364.48	81.20	9.14E-09		4.41E-08
		636.97	7.27	-2.61E-07		5.69E-07
+	CS-134	604.70	97.60	-1.74E-08	5.28E-08	5.56E-08
		795.84	85.40	6.11E-08		5.28E-08
+	CS-137	661.65	*	85.12	3.70E-08	5.69E-08

## Analysis Report for L1-SUB-CDR-FSGS-001-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CE-144	80.12	1.36	1.86E-06	2.79E-07	3.49E-06
		133.51	11.09	3.27E-07		2.79E-07
+	✓ EU-152	121.78	28.40	-6.26E-08	1.03E-07	1.03E-07
		244.69	7.49	-1.53E-07		5.04E-07
		964.00	14.44	3.11E-07		4.03E-07
+	✓ EU-154	1408.00	20.74	1.14E-07		2.40E-07
		123.07	40.40	-5.32E-08	7.23E-08	7.23E-08
		247.94	6.60	-5.36E-07		5.10E-07
		723.30	19.70	5.54E-08		2.06E-07
		873.20	11.50	-2.01E-07		3.53E-07
		1004.76	17.90	-1.12E-07		2.71E-07
		1274.51	35.50	-1.82E-08		1.57E-07
+	EU-155	86.54	32.80	-9.33E-08	1.20E-07	1.20E-07
		105.31	21.80	-1.28E-08		1.43E-07
+	BI-214	609.31	* 46.30	1.77E-07	1.06E-07	1.06E-07
		1120.29	15.10	3.46E-07		4.37E-07
		1238.11	5.94	4.46E-07		1.14E-06
		1377.67	4.11	-4.69E-07		1.10E-06
		1407.98	2.48	9.53E-07		2.00E-06
		1509.19	2.19	7.48E-07		1.56E-06
		1764.49	15.80	2.74E-07		3.68E-07
+	PB-214	77.11	10.70	7.93E-07	1.09E-07	4.81E-07
		295.21	19.20	1.31E-07		1.93E-07
		351.92	37.20	1.68E-07		1.09E-07
+	PA-228	89.95	22.00	6.42E-07	2.32E-07	3.95E-07
		93.35	35.00	1.05E-07		2.32E-07
		105.00	16.30	-2.78E-08		4.33E-07
		129.22	2.97	-1.18E-06		2.27E-06
		338.32	5.30	9.37E-07		1.53E-06
		463.00	13.80	2.77E-07		6.15E-07
		911.23	16.70	4.12E-07		7.79E-07
+	✓ AM-241	59.54	36.30	-9.00E-08	2.10E-07	2.10E-07
+	CM-243	103.76	23.00	7.47E-09	1.37E-07	1.37E-07
		228.18	10.60	-1.82E-07		2.85E-07
		277.60	14.00	-1.46E-07		2.32E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-002-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-002-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 9.262E+02 grams ✓  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 11:06:00AM ✓  
Acquisition Started : 9/14/2017 1:36:26PM ✓

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3609.5 seconds

Dead Time : 0.26 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3389

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 2:36:38PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

*REVIEWED*  
*Joe O'Neil*  
*9/14/17*

Analysis Report for L1-SUB-CDR-FSGS-002-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.84	470 -	486	478.15	4.38E+02	28.22	4.00E+02	2.77
F	2	352.33	699 -	712	705.09	2.08E+02	20.29	1.97E+02	2.71
F	3	583.91	1159 -	1176	1168.16	1.24E+02	14.93	9.40E+01	3.48
F	4	609.60	1213 -	1228	1219.53	1.56E+02	15.38	8.94E+01	2.63
F	5	662.02	1317 -	1331	1324.36	3.09E+02	19.56	6.38E+01	2.73
F	6	911.77	1817 -	1829	1823.78	6.41E+01	10.53	4.05E+01	2.62
F	7	1461.79	2914 -	2934	2923.68	7.04E+02	27.02	2.25E+01	3.21

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 2:36:38PM

Env. Background File : C:\Canberra\Apex\Root\ Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.84	4.38E+02	28.22			4.38E+02	2.82E+01
F	2	352.33	2.08E+02	20.29	8.36E+01	1.86E+01	1.24E+02	2.75E+01
F	3	583.91	1.24E+02	14.93			1.24E+02	1.49E+01
F	4	609.60	1.56E+02	15.38	4.12E+01	1.21E+01	1.15E+02	1.96E+01
F	5	662.02	3.09E+02	19.56	6.61E+01	1.27E+01	2.43E+02	2.33E+01
F	6	911.77	6.41E+01	10.53			6.41E+01	1.05E+01
F	7	1461.79	7.04E+02	27.02			7.04E+02	2.70E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-002-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
CS-137	0.97	661.65 *	85.12	1.77E-07	1.77E-08
PB-212	0.55	77.11	17.50		
		238.63 *	44.60	2.44E-07	1.69E-08
BI-214	0.34	609.31 *	46.30	1.43E-07	2.47E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
✓ CS-137	0.978	1.77E-07	1.77E-08	
PB-212	0.555	2.44E-07	1.69E-08	
BI-214	0.343	1.43E-07	2.47E-08	

Analysis Report for L1-SUB-CDR-FSGS-002-SB

UNIT L1-SUB CDR 09/13/17

- ? = 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 L1-SUB-CDR-FSGS-002-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 2:36:38PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 2	352.33	3.44610E-02	22.19	To1.	PB-214 ✓
F 3	583.91	3.44740E-02	12.03		TI-208 ✓
F 6	911.77	1.78149E-02	16.41	To1.	AC-228 ✓ PA-228
F 7	1461.79	1.95541E-01	3.84		Pc-231

*John*  
9/14/17

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\Daistryland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	8.35E-06	1.53E-06	1.53E-06
+	AR-41	1293.64	99.16	-6.26E-04	1.55E-03	1.55E-03
+	CO-60	1173.22	100.00	6.28E-08	5.55E-08	6.78E-08
		1332.49	100.00	5.29E-08		5.55E-08
+	KR-85	513.99	0.43	1.07E-05	9.76E-06	9.76E-06
+	Y-88	898.04	93.70	2.10E-09	3.29E-08	4.55E-08
		1836.06	99.20	-1.43E-08		3.29E-08
+	NB-94	702.63	100.00	-1.04E-08	3.89E-08	3.89E-08
		871.10	100.00	3.90E-08		4.58E-08
+	I-131	284.30	6.06	-4.61E-07	4.20E-08	5.65E-07
		364.48	81.20	-1.92E-08		4.20E-08
		636.97	7.27	-7.41E-08		5.46E-07



## Analysis Report for L1-SUB-CDR-FSGS-002-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CS-134	604.70		97.60	4.48E-09	4.97E-08	5.11E-08
		795.84		85.40	-1.88E-09		4.97E-08
+	✓ CS-137	661.65	*	85.12	1.77E-07	5.06E-08	5.06E-08
+	CE-144	80.12		1.36	-1.27E-07	2.62E-07	3.23E-06
		133.51		11.09	-4.05E-09		2.62E-07
+	✓ EU-152	121.78		28.40	-6.33E-08	1.03E-07	1.03E-07
		244.69		7.49	-2.55E-07		4.93E-07
		964.00		14.44	6.84E-07		3.86E-07
		1408.00		20.74	-2.18E-08		1.99E-07
+	✓ EU-154	123.07		40.40	-4.57E-08	7.21E-08	7.21E-08
		247.94		6.60	-8.44E-07		4.86E-07
		723.30		19.70	2.70E-07		2.14E-07
		873.20		11.50	-7.24E-08		3.83E-07
		1004.76		17.90	-2.13E-07		2.56E-07
		1274.51		35.50	3.05E-08		1.56E-07
+	EU-155	86.54		32.80	5.48E-10	1.15E-07	1.15E-07
		105.31		21.80	2.54E-08		1.39E-07
+	BI-214	609.31	*	46.30	1.43E-07	9.13E-08	9.13E-08
		1120.29		15.10	-8.56E-08		3.81E-07
		1238.11		5.94	-1.63E-07		1.16E-06
		1377.67		4.11	6.80E-07		1.10E-06
		1407.98		2.48	-1.82E-07		1.66E-06
		1509.19		2.19	-1.18E-07		1.61E-06
		1764.49		15.80	2.50E-07		2.96E-07
+	PB-214	77.11		10.70	4.69E-07	1.08E-07	4.41E-07
		295.21		19.20	1.84E-07		1.76E-07
		351.92		37.20	2.95E-07		1.08E-07
+	PA-228	89.95		22.00	3.43E-07	2.35E-07	3.94E-07
		93.35		35.00	1.39E-07		2.35E-07
		105.00		16.30	3.02E-08		4.36E-07
		129.22		2.97	3.56E-07		2.30E-06
		338.32		5.30	8.45E-07		1.46E-06
		463.00		13.80	6.33E-08		6.22E-07
		911.23		16.70	1.02E-06		7.55E-07
+	✓ AM-241	59.54		36.30	6.14E-08	2.05E-07	2.05E-07
+	CM-243	103.76		23.00	-8.59E-08	1.32E-07	1.32E-07
		228.18		10.60	-1.97E-07		2.62E-07
		277.60		14.00	1.94E-07		2.35E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-002-SB  
UNIT L1-SUB CDR 09/13/17

Analysis Report for L1-SUB-CDR-FSGS-003-SB  
UNIT L1-SUB-CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-003-SB  
Sample Description : UNIT L1-SUB-CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.792E+02 grams ✓  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 11:08:00AM  
Acquisition Started : 9/14/2017 2:37:25PM ✓

Procedure : 500ml Marinelli ✓  
Operator : Administrator ✓  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3609.5 seconds

Dead Time : 0.26 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3390

*REMOVED  
2 P. Jones  
9/14/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 3:37:37PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-003-SB

UNIT L1-SUB-CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.96	472 -	486	478.40	4.07E+02	27.98	3.63E+02	3.10
F	2	296.02	587 -	597	592.49	5.09E+01	12.53	2.04E+02	1.07
F	3	351.80	696 -	712	704.04	2.02E+02	19.92	2.16E+02	2.79
F	4	583.42	1161 -	1174	1167.18	8.85E+01	12.63	8.15E+01	2.21
F	5	609.72	1212 -	1228	1219.77	1.36E+02	14.50	7.15E+01	3.09
F	6	662.17	1318 -	1334	1324.65	4.95E+02	23.77	7.05E+01	2.83
F	7	1461.73	2913 -	2934	2923.57	6.27E+02	25.56	2.73E+01	3.06

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 3:37:37PM

Env. Background File : C:\Canberra\Apex\Root\ Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.96	4.07E+02	27.98			4.07E+02	2.80E+01
F	2	296.02	5.09E+01	12.53			5.09E+01	1.25E+01
F	3	351.80	2.02E+02	19.92	8.36E+01	1.86E+01	1.19E+02	2.73E+01
F	4	583.42	8.85E+01	12.63			8.85E+01	1.26E+01
F	5	609.72	1.36E+02	14.50	4.12E+01	1.21E+01	9.49E+01	1.89E+01
F	6	662.17	4.95E+02	23.77	6.61E+01	1.27E+01	4.29E+02	2.69E+01
F	7	1461.73	6.27E+02	25.56			6.27E+02	2.56E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-003-SB  
UNIT L1-SUB-CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.85	1460.75 *	10.67	7.77E-06	3.83E-07
CS-137	0.95	661.65 *	85.12	3.30E-07	2.26E-08
PB-212	0.54	77.11	17.50		
		238.63 *	44.60	2.39E-07	1.76E-08
BI-214	0.33	609.31 *	46.30	1.24E-07	2.50E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.69	77.11	10.70		
		295.21 *	19.20	8.30E-08	2.05E-08
		351.92 *	37.20	1.17E-07	2.69E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	0.858	7.77E-06	3.83E-07	
CS-137	0.958	3.30E-07	2.26E-08	

Analysis Report for L1-SUB-CDR-FSGS-003-SB

UNIT L1-SUB-CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
PB-212	0.547	2.39E-07	1.76E-08	
BI-214	0.337	1.24E-07	2.50E-08	
PB-214	0.691	9.54E-08	1.63E-08	

? = 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 L1-SUB-CDR-FSGS-003-SB  
UNIT L1-SUB-CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 3:37:37PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 4	583.42	2.45775E-02	14.27		<i>TLW8</i>

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

*20 Jan*  
*9/14/17*

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daivland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	* 10.67	7.77E-06	4.45E-07	4.45E-07
+	AR-41	1293.64	99.16	-8.71E-04	1.97E-03	1.97E-03
+	CO-60	1173.22	100.00	8.26E-08	5.93E-08	6.69E-08
		1332.49	100.00	6.49E-08		5.93E-08
+	KR-85	513.99	0.43	1.74E-05	1.03E-05	1.03E-05
+	Y-88	898.04	93.70	8.03E-09	3.99E-08	4.86E-08
		1836.06	99.20	-6.43E-09		3.99E-08
+	NB-94	702.63	100.00	4.94E-09	3.99E-08	3.99E-08
		871.10	100.00	-1.88E-08		4.49E-08
+	I-131	284.30	6.06	-1.36E-07	4.32E-08	6.07E-07
		364.48	81.20	-4.40E-08		4.32E-08
		636.97	7.27	-1.31E-07		6.04E-07
+	CS-134	604.70	97.60	3.64E-09	5.00E-08	5.00E-08
		795.84	85.40	-1.52E-08		5.00E-08
+	CS-137	661.65	* 85.12	3.30E-07	5.60E-08	5.60E-08
+	CE-144	80.12	1.36	1.01E-06	2.79E-07	3.45E-06
		133.51	11.09	1.85E-07		2.79E-07

## Analysis Report for L1-SUB-CDR-FSGS-003-SB

UNIT L1-SUB-CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	EU-152	121.78	28.40	-7.42E-08	1.04E-07	1.04E-07
		244.69	7.49	-3.95E-07		4.98E-07
		964.00	14.44	3.71E-07		4.13E-07
		1408.00	20.74	1.65E-07		2.01E-07
+	EU-154	123.07	40.40	2.12E-08	7.40E-08	7.40E-08
		247.94	6.60	-3.68E-07		5.10E-07
		723.30	19.70	2.28E-07		2.12E-07
		873.20	11.50	6.58E-08		3.80E-07
		1004.76	17.90	4.93E-08		2.89E-07
		1274.51	35.50	-3.84E-08		1.52E-07
+	EU-155	86.54	32.80	-6.28E-08	1.20E-07	1.20E-07
		105.31	21.80	-7.60E-09		1.46E-07
+	BI-214	609.31	* 46.30	1.24E-07	9.11E-08	9.11E-08
		1120.29	15.10	2.86E-07		4.06E-07
		1238.11	5.94	1.65E-07		1.12E-06
		1377.67	4.11	6.51E-07		1.08E-06
		1407.98	2.48	1.38E-06		1.68E-06
		1509.19	2.19	-6.36E-07		2.00E-06
		1764.49	15.80	2.01E-07		3.19E-07
+	PB-214	77.11	10.70	7.99E-07	1.10E-07	4.72E-07
		295.21	* 19.20	8.30E-08		1.23E-07
		351.92	* 37.20	1.17E-07		1.10E-07
+	PA-228	89.95	22.00	5.72E-07	2.45E-07	4.19E-07
		93.35	35.00	2.97E-08		2.45E-07
		105.00	16.30	7.68E-08		4.72E-07
		129.22	2.97	1.36E-08		2.48E-06
		338.32	5.30	1.25E-06		1.67E-06
		463.00	13.80	1.24E-07		6.81E-07
		911.23	16.70	8.55E-07		7.78E-07
+	AM-241	59.54	36.30	9.01E-08	2.13E-07	2.13E-07
+	CM-243	103.76	23.00	9.42E-08	1.40E-07	1.40E-07
		228.18	10.60	3.37E-08		2.91E-07
		277.60	14.00	1.10E-08		2.40E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level



Analysis Report for L1-SUB-CDR-FSGS-004-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-004-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 9.107E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 11:12:00AM ✓  
Acquisition Started : 9/14/2017 3:39:34PM

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3609.5 seconds

Dead Time : 0.26 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3391

*rechecked  
Jon D. Jones  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 4:39:46PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-004-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.84	470 -	486	478.15	3.64E+02	27.72	4.64E+02	2.75
F	2	352.14	696 -	713	704.71	2.37E+02	20.51	2.07E+02	2.89
F	3	583.44	1160 -	1176	1167.23	9.66E+01	13.29	8.86E+01	2.77
F	4	609.81	1213 -	1228	1219.96	1.25E+02	14.23	8.36E+01	2.63
F	5	662.13	1315 -	1333	1324.58	3.95E+02	21.64	7.36E+01	3.05
F	6	911.67	1816 -	1831	1823.57	8.00E+01	11.21	4.62E+01	2.80
F	7	1333.32	2662 -	2672	2666.77	4.32E+01	7.48	1.22E+01	1.88
F	8	1461.79	2912 -	2933	2923.68	6.45E+02	25.68	1.13E+01	3.24

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 4:39:46PM

Env. Background File : C:\Canberra\Apex\Root\Daairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.84	3.64E+02	27.72			3.64E+02	2.77E+01
F	2	352.14	2.37E+02	20.51	8.36E+01	1.86E+01	1.54E+02	2.77E+01
F	3	583.44	9.66E+01	13.29			9.66E+01	1.33E+01
F	4	609.81	1.25E+02	14.23	4.12E+01	1.21E+01	8.39E+01	1.87E+01
F	5	662.13	3.95E+02	21.64	6.61E+01	1.27E+01	3.29E+02	2.51E+01
F	6	911.67	8.00E+01	11.21			8.00E+01	1.12E+01
F	7	1333.32	4.32E+01	7.48			4.32E+01	7.48E+00
F	8	1461.79	6.45E+02	25.68			6.45E+02	2.57E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-004-SB

UNIT L1-SUB CDR 09/13/17

- ? = 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

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Analysis Report for L1-SUB-CDR-FSGS-004-SB

UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
CS-137	0.96	661.65 *	85.12	2.44E-07	1.98E-08
PB-212	0.55	77.11	17.50		
		238.63 *	44.60	2.07E-07	1.66E-08
BI-214	0.33	609.31 *	46.30	1.06E-07	2.38E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
CS-137	0.964	2.44E-07	1.98E-08	
PB-212	0.555	2.07E-07	1.66E-08	
BI-214	0.330	1.06E-07	2.38E-08	

Analysis Report for L1-SUB-CDR-FSGS-004-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 4:39:46PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 2	352.14	4.27238E-02	18.00	Tol.	PB-214 ✓
F 3	583.44	2.68269E-02	13.77		
F 6	911.67	2.22318E-02	14.00	Tol.	AC-228 ✓ PA-228
F 7	1333.32	1.20098E-02	17.30	Tol.	CO-60
F 8	1461.79	1.79075E-01	3.98		

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

*Handwritten notes:*  
Likely mis ID  
1173 keV  
A-206  
J. Ogden  
9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daivland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	7.75E-06	1.48E-06	1.48E-06
+	AR-41	1293.64	99.16	2.98E-03	3.29E-03	3.29E-03
+	CO-60	1173.22	100.00	8.76E-08	5.56E-08	7.13E-08
		1332.49	100.00	4.98E-08		5.56E-08
+	KR-85	513.99	0.43	1.01E-05	1.01E-05	1.01E-05
+	Y-88	898.04	93.70	-8.35E-09	3.43E-08	4.92E-08
		1836.06	99.20	1.06E-08		3.43E-08
+	NB-94	702.63	100.00	2.16E-08	4.11E-08	4.11E-08
		871.10	100.00	5.52E-09		4.12E-08
+	I-131	284.30	6.06	-5.78E-07	4.39E-08	5.84E-07
		364.48	81.20	-5.69E-09		4.39E-08

## Analysis Report for L1-SUB-CDR-FSGS-004-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	I-131	636.97	7.27	8.18E-08	4.39E-08	5.61E-07
+	CS-134	604.70	97.60	1.13E-09	4.74E-08	4.96E-08
		795.84	85.40	-4.69E-08		4.74E-08
+	CS-137	661.65	* 85.12	2.44E-07	5.53E-08	5.53E-08
+	CE-144	80.12	1.36	1.02E-06	2.59E-07	3.33E-06
		133.51	11.09	2.31E-08		2.59E-07
+	EU-152	121.78	28.40	-5.91E-08	1.02E-07	1.02E-07
		244.69	7.49	-2.36E-07		4.98E-07
		964.00	14.44	4.16E-07		4.00E-07
		1408.00	20.74	8.55E-08		1.92E-07
+	EU-154	123.07	40.40	-7.55E-08	7.10E-08	7.10E-08
		247.94	6.60	-5.32E-07		5.16E-07
		723.30	19.70	5.33E-08		2.17E-07
		873.20	11.50	7.60E-08		3.57E-07
		1004.76	17.90	-7.16E-10		2.50E-07
		1274.51	35.50	2.49E-08		1.50E-07
+	EU-155	86.54	32.80	-4.65E-08	1.16E-07	1.16E-07
		105.31	21.80	7.85E-08		1.42E-07
+	BI-214	609.31	* 46.30	1.06E-07	9.07E-08	9.07E-08
		1120.29	15.10	6.40E-08		4.04E-07
		1238.11	5.94	5.24E-07		1.24E-06
		1377.67	4.11	2.01E-07		1.13E-06
		1407.98	2.48	7.15E-07		1.60E-06
		1509.19	2.19	-5.91E-08		1.81E-06
		1764.49	15.80	1.99E-07		3.04E-07
+	PB-214	77.11	10.70	7.83E-07	1.08E-07	4.57E-07
		295.21	19.20	2.95E-07		1.87E-07
		351.92	37.20	2.14E-07		1.08E-07
+	PA-228	89.95	22.00	2.95E-07	2.44E-07	4.17E-07
		93.35	35.00	3.99E-08		2.44E-07
		105.00	16.30	-2.66E-08		4.69E-07
		129.22	2.97	3.33E-07		2.40E-06
		338.32	5.30	1.65E-06		1.62E-06
		463.00	13.80	1.42E-07		6.91E-07
		911.23	16.70	1.37E-06		8.62E-07
+	AM-241	59.54	36.30	-5.21E-08	2.09E-07	2.09E-07
+	CM-243	103.76	23.00	-1.12E-07	1.32E-07	1.32E-07
		228.18	10.60	1.05E-07		2.81E-07
		277.60	14.00	-1.58E-07		2.31E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-004-SB  
UNIT L1-SUB CDR 09/13/17

Analysis Report for L1-SUB-CDR-FSGS-005-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-005-SB  
Sample Description : UNIT L1-SUB CDR 09/13/17 ✓  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :  
  
Sample Size : 9.672E+02 grams ✓  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/13/2017 11:16:00AM  
Acquisition Started : 9/14/2017 4:40:27PM ✓  
  
Procedure : 500ml Marinelli ✓  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3610.0 seconds  
  
Dead Time : 0.28 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3392

REVIEWED  
J. O. J. ✓  
9/15/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 5:40:40PM  
Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096



Analysis Report for L1-SUB-CDR-FSGS-005-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.75	470 -	485	477.98	4.22E+02	30.12	5.62E+02	2.38
F	2	294.95	582 -	598	590.36	1.65E+02	22.56	3.20E+02	3.65
F	3	338.84	673 -	685	678.12	7.20E+01	15.27	2.17E+02	1.79
F	4	352.19	696 -	712	704.82	2.11E+02	20.69	2.75E+02	2.39
F	5	583.36	1157 -	1175	1167.06	1.43E+02	14.96	1.05E+02	2.65
F	6	609.43	1213 -	1226	1219.20	1.42E+02	14.95	8.65E+01	2.32
F	7	662.00	1316 -	1333	1324.32	1.19E+03	36.23	9.52E+01	2.60
F	8	727.90	1450 -	1463	1456.10	4.38E+01	9.20	4.24E+01	2.46
F	9	911.41	1818 -	1827	1823.06	4.21E+01	9.01	3.62E+01	2.02
F	10	969.91	1934 -	1946	1940.04	3.00E+01	8.33	5.10E+01	1.83
F	11	1333.30	2662 -	2672	2666.75	3.00E+01	7.21	2.39E+01	1.87
F	12	1461.84	2914 -	2934	2923.80	6.96E+02	27.07	2.31E+01	2.99

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 5:40:40PM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.75	4.22E+02	30.12			4.22E+02	3.01E+01
F	2	294.95	1.65E+02	22.56			1.65E+02	2.26E+01
F	3	338.84	7.20E+01	15.27			7.20E+01	1.53E+01
F	4	352.19	2.11E+02	20.69	8.36E+01	1.86E+01	1.27E+02	2.78E+01
F	5	583.36	1.43E+02	14.96			1.43E+02	1.50E+01
F	6	609.43	1.42E+02	14.95	4.12E+01	1.21E+01	1.01E+02	1.92E+01
F	7	662.00	1.19E+03	36.23	6.61E+01	1.27E+01	1.12E+03	3.84E+01
F	8	727.90	4.38E+01	9.20			4.38E+01	9.20E+00
F	9	911.41	4.21E+01	9.01			4.21E+01	9.01E+00
F	10	969.91	3.00E+01	8.33			3.00E+01	8.33E+00
F	11	1333.30	3.00E+01	7.21			3.00E+01	7.21E+00
F	12	1461.84	6.96E+02	27.07			6.96E+02	2.71E+01

Analysis Report for L1-SUB-CDR-FSGS-005-SB  
UNIT L1-SUB CDR 09/13/17

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

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (uCi/grams)	Activity Uncertainty
CS-137	0.98	661.65	*	85.12	7.85E-07	3.42E-08
BI-212	0.54	727.17	*	11.80	2.41E-07	5.09E-08
		785.42		2.00		
		1620.56		2.75		
PB-212	0.55	77.11		17.50		
		238.63	*	44.60	2.25E-07	1.71E-08
BI-214	0.34	609.31	*	46.30	1.20E-07	2.32E-08
		1120.29		15.10		
		1238.11		5.94		
		1377.67		4.11		
		1407.98		2.48		
		1509.19		2.19		
		1764.49		15.80		
PB-214	0.71	77.11		10.70		
		295.21	*	19.20	2.43E-07	3.39E-08
		351.92	*	37.20	1.14E-07	2.50E-08
AC-228	0.60	209.28		4.40		
		338.32	*	11.40	2.03E-07	4.33E-08
		794.70		4.60		
		911.60	*	27.70	1.21E-07	2.60E-08
		964.60		5.20		
		969.11	*	16.60	1.52E-07	4.23E-08

\* = 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 L1-SUB-CDR-FSGS-005-SB  
UNIT L1-SUB CDR 09/13/17

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
/ CS-137	0.981	7.85E-07	3.42E-08	
BI-212	0.546	2.41E-07	5.09E-08	
PB-212	0.558	2.25E-07	1.71E-08	
BI-214	0.348	1.20E-07	2.32E-08	
PB-214	0.712	1.60E-07	2.01E-08	
AC-228	0.600	1.45E-07	1.97E-08	

? = 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

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Analysis Report for L1-SUB-CDR-FSGS-005-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 5:40:40PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 5	583.36	3.95875E-02	10.50		Tl-208
F 11	1333.30	8.32204E-03	24.08		B-222
F 12	1461.84	1.93391E-01	3.89		Pb-234

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

*Joe O'Neil*  
9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daairyland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	8.13E-06	1.46E-06	1.46E-06
+	AR-41	1293.64	99.16	-3.51E-03	4.15E-03	4.15E-03
+	CO-60	1173.22	100.00	4.61E-08	5.77E-08	6.12E-08
		1332.49	100.00	5.95E-08		5.77E-08
+	KR-85	513.99	0.43	1.13E-05	1.01E-05	1.01E-05
+	Y-88	898.04	93.70	-7.97E-11	3.47E-08	4.65E-08
		1836.06	99.20	-1.18E-08		3.47E-08
+	NB-94	702.63	100.00	3.54E-08	3.85E-08	3.85E-08
		871.10	100.00	2.27E-08		4.54E-08
+	I-131	284.30	6.06	-7.11E-08	4.55E-08	5.99E-07
		364.48	81.20	2.98E-08		4.55E-08
		636.97	7.27	1.10E-07		5.94E-07
+	CS-134	604.70	97.60	1.16E-08	4.78E-08	5.09E-08
		795.84	85.40	-7.01E-09		4.78E-08
+	CS-137	661.65	* 85.12	7.85E-07	5.53E-08	5.53E-08

## Analysis Report for L1-SUB-CDR-FSGS-005-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CE-144	80.12	1.36	-2.51E-06	2.73E-07	3.22E-06
		133.51	11.09	1.56E-07		2.73E-07
+	EU-152	121.78	28.40	-1.24E-08	1.06E-07	1.06E-07
		244.69	7.49	-3.26E-07		5.11E-07
		964.00	14.44	-2.34E-07		3.57E-07
		1408.00	20.74	5.48E-08		1.78E-07
+	EU-154	123.07	40.40	-1.04E-08	7.42E-08	7.42E-08
		247.94	6.60	-6.05E-07		5.28E-07
		723.30	19.70	-7.88E-08		2.10E-07
		873.20	11.50	-7.62E-08		3.84E-07
		1004.76	17.90	1.29E-07		2.76E-07
		1274.51	35.50	-5.76E-08		1.37E-07
+	EU-155	86.54	32.80	2.61E-08	1.17E-07	1.17E-07
		105.31	21.80	9.66E-08		1.44E-07
+	BI-214	609.31	* 46.30	1.20E-07	8.41E-08	8.41E-08
		1120.29	15.10	2.42E-07		3.70E-07
		1238.11	5.94	1.69E-06		1.17E-06
		1377.67	4.11	4.89E-07		1.09E-06
		1407.98	2.48	4.58E-07		1.49E-06
		1509.19	2.19	5.36E-07		1.59E-06
		1764.49	15.80	3.32E-07		3.05E-07
+	PB-214	77.11	10.70	7.01E-07	1.08E-07	4.45E-07
		295.21	* 19.20	2.43E-07		1.58E-07
		351.92	* 37.20	1.14E-07		1.08E-07
+	PA-228	89.95	22.00	7.81E-07	2.54E-07	4.38E-07
		93.35	35.00	-1.70E-07		2.54E-07
		105.00	16.30	2.98E-07		4.96E-07
		129.22	2.97	6.87E-07		2.61E-06
		338.32	5.30	1.14E-06		1.75E-06
		463.00	13.80	5.65E-07		8.05E-07
		911.23	16.70	6.33E-07		7.53E-07
+	AM-241	59.54	36.30	-6.38E-09	2.10E-07	2.10E-07
+	CM-243	103.76	23.00	9.48E-08	1.38E-07	1.38E-07
		228.18	10.60	-1.21E-07		2.86E-07
		277.60	14.00	1.83E-07		2.44E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-006-SB  
LI-SUB CDR

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-006-SB  
Sample Description : LI-SUB CDR  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :  
  
Sample Size : 8.500E+02 grams ✓  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/15/2017 8:55:00AM  
Acquisition Started : 9/15/2017 11:30:47AM ✓  
  
Procedure : 500ml Marinelli  
Operator : Administrator ✓  
Detector Name : HOTLAB ✓  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3610.1 seconds  
  
Dead Time : 0.28 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3402

*Reviewed  
for  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 12:30:59PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-006-SB

LI-SUB CDR

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.68	469 -	485	477.84	2.94E+02	23.86	4.06E+02	2.14
F	2	295.63	587 -	598	591.70	1.00E+02	15.90	1.97E+02	1.73
F	3	352.09	700 -	710	704.61	1.69E+02	17.18	1.32E+02	1.97
F	4	583.42	1158 -	1171	1167.17	1.08E+02	12.41	5.64E+01	2.07
F	5	609.71	1212 -	1225	1219.75	1.27E+02	14.21	8.16E+01	2.12
F	6	662.11	1316 -	1333	1324.53	8.64E+02	31.11	7.72E+01	2.17
F	7	1121.14	2234 -	2247	2242.47	2.97E+01	7.60	3.69E+01	1.92
F	8	1333.46	2661 -	2672	2667.05	2.61E+01	6.94	2.36E+01	2.04
F	9	1461.79	2913 -	2933	2923.69	5.03E+02	22.72	1.83E+01	2.71

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 12:30:59PM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.68	2.94E+02	23.86			2.94E+02	2.39E+01
F	2	295.63	1.00E+02	15.90			1.00E+02	1.59E+01
F	3	352.09	1.69E+02	17.18	8.36E+01	1.86E+01	8.52E+01	2.53E+01
F	4	583.42	1.08E+02	12.41			1.08E+02	1.24E+01
F	5	609.71	1.27E+02	14.21	4.12E+01	1.21E+01	8.61E+01	1.87E+01
F	6	662.11	8.64E+02	31.11	6.61E+01	1.27E+01	7.98E+02	3.36E+01
F	7	1121.14	2.97E+01	7.60			2.97E+01	7.60E+00
F	8	1333.46	2.61E+01	6.94			2.61E+01	6.94E+00
F	9	1461.79	5.03E+02	22.72			5.03E+02	2.27E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-006-SB  
LI-SUB CDR

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daityland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
CS-137	0.96	661.65 *	85.12	6.35E-07	3.18E-08
PB-212	0.56	77.11	17.50		
		238.63 *	44.60	1.78E-07	1.52E-08
BI-214	0.55	609.31 *	46.30	1.17E-07	2.55E-08
		1120.29 *	15.10	2.14E-07	5.49E-08
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.71	77.11	10.70		
		295.21 *	19.20	1.68E-07	2.71E-08
		351.92 *	37.20	8.66E-08	2.58E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
✓ CS-137	0.967	6.35E-07	3.18E-08	
PB-212	0.560	1.78E-07	1.52E-08	
BI-214	0.554	1.34E-07	2.31E-08	



Analysis Report for L1-SUB-CDR-FSGS-006-SB

LI-SUB CDR

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
PB-214	0.711	1.26E-07	1.87E-08	

? = 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 L1-SUB-CDR-FSGS-006-SB

LI-SUB CDR

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 12:30:59PM  
 Peak Locate From Channel : 100  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 4	583.42	2.99132E-02	11.53		<i>Tl 206</i>
F 8	1333.46	7.25996E-03	26.54		<i>Bi 206</i>
F 9	1461.79	1.39626E-01	4.52		<i>Pb 214</i>

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

*209mu*  
*9/15/17*

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daistryland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	6.65E-06	1.42E-06	1.42E-06
+	AR-41	1293.64	99.16	7.74E-08	1.87E-07	1.87E-07
+	CO-60	1173.22	100.00	5.29E-08	5.83E-08	7.21E-08
		1332.49	100.00	1.35E-08		5.83E-08
+	KR-85	513.99	0.43	8.27E-06	1.08E-05	1.08E-05
+	Y-88	898.04	93.70	2.43E-08	3.03E-08	4.84E-08
		1836.06	99.20	-9.56E-09		3.03E-08
+	NB-94	702.63	100.00	1.48E-08	4.01E-08	4.01E-08
		871.10	100.00	-5.17E-08		4.49E-08
+	I-131	284.30	6.06	-1.38E-07	4.42E-08	5.60E-07
		364.48	81.20	2.52E-08		4.42E-08
		636.97	7.27	1.48E-07		5.68E-07
+	CS-134	604.70	97.60	-8.86E-10	4.95E-08	5.27E-08
		795.84	85.40	-5.11E-08		4.95E-08
+	CS-137	661.65	* 85.12	6.35E-07	5.95E-08	5.95E-08

## Analysis Report for L1-SUB-CDR-FSGS-006-SB

## LI-SUB CDR

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CE-144	80.12	1.36	-2.79E-07	2.82E-07	3.40E-06
		133.51	11.09	5.60E-08		2.82E-07
+	EU-152	121.78	28.40	-2.46E-08	1.09E-07	1.09E-07
		244.69	7.49	8.37E-09		5.03E-07
		964.00	14.44	1.94E-07		3.77E-07
		1408.00	20.74	5.26E-08		2.01E-07
+	EU-154	123.07	40.40	-4.10E-08	7.62E-08	7.62E-08
		247.94	6.60	-5.97E-07		5.14E-07
		723.30	19.70	2.30E-07		2.30E-07
		873.20	11.50	1.89E-09		3.96E-07
		1004.76	17.90	4.43E-08		2.84E-07
		1274.51	35.50	-1.41E-07		1.41E-07
+	EU-155	86.54	32.80	2.80E-08	1.23E-07	1.23E-07
		105.31	21.80	7.19E-08		1.46E-07
+	BI-214	609.31	* 46.30	1.17E-07	9.42E-08	9.42E-08
		1120.29	* 15.10	2.14E-07		2.58E-07
		1238.11	5.94	5.45E-07		1.10E-06
		1377.67	4.11	-1.02E-06		9.69E-07
		1407.98	2.48	4.40E-07		1.68E-06
		1509.19	2.19	3.55E-07		1.81E-06
		1764.49	15.80	2.57E-07		2.86E-07
+	PB-214	77.11	10.70	3.17E-07	9.41E-08	4.61E-07
		295.21	* 19.20	1.68E-07		1.28E-07
		351.92	* 37.20	8.66E-08		9.41E-08
+	PA-228	89.95	22.00	1.67E-07	1.14E-07	1.96E-07
		93.35	35.00	-3.96E-08		1.14E-07
		105.00	16.30	1.40E-07		2.15E-07
		129.22	2.97	1.02E-07		1.17E-06
		338.32	5.30	-9.93E-08		7.59E-07
		463.00	13.80	9.87E-09		3.31E-07
		911.23	16.70	2.27E-07		3.78E-07
+	AM-241	59.54	36.30	8.64E-08	2.13E-07	2.13E-07
+	CM-243	103.76	23.00	6.43E-08	1.40E-07	1.40E-07
		228.18	10.60	6.11E-08		2.99E-07
		277.60	14.00	1.69E-08		2.46E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-007-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-007-SB  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.848E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 1:50:00PM  
Acquisition Started : 9/14/2017 5:41:23PM

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds  
Real Time : 3609.3 seconds

Dead Time : 0.26 %

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3393

*ASG 10/30  
J. O. J.  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 6:41:35PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-007-SB  
UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	76.14	147 -	157	152.82	1.56E+02	29.13	5.89E+02	2.98
F	2	238.73	469 -	485	477.93	3.74E+02	26.91	3.99E+02	2.73
F	3	295.04	582 -	597	590.52	1.20E+02	17.56	2.42E+02	2.31
F	4	352.24	697 -	709	704.91	1.34E+02	16.08	1.66E+02	1.86
F	5	583.66	1160 -	1176	1167.66	1.10E+02	13.42	7.85E+01	2.71
F	6	609.56	1213 -	1228	1219.45	1.20E+02	14.12	8.84E+01	2.51
F	7	662.00	1314 -	1333	1324.31	5.17E+02	24.42	8.47E+01	2.73
F	8	911.76	1818 -	1830	1823.75	6.41E+01	9.91	3.03E+01	2.76
F	9	1333.32	2659 -	2673	2666.78	6.21E+01	9.65	2.62E+01	2.88
F	10	1461.75	2914 -	2933	2923.61	5.50E+02	23.86	1.71E+01	3.12

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

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 6:41:35PM

Env. Background File : C:\Canberra\Apex\Root\Daairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	76.14	1.56E+02	29.13			1.56E+02	2.91E+01
F	2	238.73	3.74E+02	26.91			3.74E+02	2.69E+01
F	3	295.04	1.20E+02	17.56			1.20E+02	1.76E+01
F	4	352.24	1.34E+02	16.08	8.36E+01	1.86E+01	5.05E+01	2.46E+01
F	5	583.66	1.10E+02	13.42			1.10E+02	1.34E+01
F	6	609.56	1.20E+02	14.12	4.12E+01	1.21E+01	7.86E+01	1.86E+01
F	7	662.00	5.17E+02	24.42	6.61E+01	1.27E+01	4.51E+02	2.75E+01
F	8	911.76	6.41E+01	9.91			6.41E+01	9.91E+00
F	9	1333.32	6.21E+01	9.65			6.21E+01	9.65E+00
F	10	1461.75	5.50E+02	23.86			5.50E+02	2.39E+01

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

Analysis Report for L1-SUB-CDR-FSGS-007-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.85	1460.75 *	10.67	6.78E-06	3.49E-07
CS-137	0.98	661.65 *	85.12	3.44E-07	2.30E-08
PB-212	0.95	77.11 *	17.50	2.53E-07	4.81E-08
		238.63 *	44.60	2.18E-07	1.67E-08
BI-214	0.34	609.31 *	46.30	1.02E-07	2.44E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.96	77.11 *	10.70	4.15E-07	7.86E-08
		295.21 *	19.20	1.93E-07	2.88E-08
		351.92 *	37.20	4.94E-08	2.41E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
✓ K-40	0.852	6.78E-06	3.49E-07	
✓ CS-137	0.981	3.44E-07	2.30E-08	

Analysis Report for L1-SUB-CDR-FSGS-007-SB

UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
PB-212	0.957	2.15E-07	1.58E-08	
BI-214	0.345	1.02E-07	2.44E-08	
PB-214	0.966	1.06E-07	1.80E-08	

? = 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 L1-SUB-CDR-FSGS-007-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 6:41:35PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F	5	583.66	3.06596E-02		TL-208
F	8	911.76	1.78176E-02	Tol.	AC-228 PA-228
F	9	1333.32	1.72450E-02		Bi-206

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

Joe D. J. 9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daistryland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	*	10.67	6.78E-06	3.46E-07
+	AR-41	1293.64		99.16	2.07E-03	2.49E-03
+	CO-60	1173.22	100.00	9.23E-08	6.70E-08	7.83E-08
		1332.49	100.00	1.01E-07		6.70E-08
+	KR-85	513.99	0.43	1.24E-05	9.79E-06	9.79E-06
+	Y-88	898.04	93.70	2.30E-08	3.25E-08	4.89E-08
		1836.06	99.20	-2.70E-08		3.25E-08
+	NB-94	702.63	100.00	-8.87E-09	3.86E-08	3.86E-08
		871.10	100.00	-4.61E-08		4.37E-08
+	I-131	284.30	6.06	2.12E-08	4.57E-08	5.80E-07
		364.48	81.20	-4.20E-09		4.57E-08
		636.97	7.27	2.45E-08		5.97E-07
+	CS-134	604.70	97.60	-1.42E-08	4.93E-08	4.93E-08



## Analysis Report for L1-SUB-CDR-FSGS-007-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	CS-134	795.84		85.40	2.81E-08	4.93E-08	5.13E-08
+	CS-137	661.65	*	85.12	3.44E-07	5.96E-08	5.96E-08
+	CE-144	80.12		1.36	-3.86E-06	2.64E-07	3.32E-06
		133.51		11.09	1.49E-07		2.64E-07
+	EU-152	121.78		28.40	-7.32E-08	1.02E-07	1.02E-07
		244.69		7.49	-2.71E-07		4.93E-07
		964.00		14.44	4.44E-07		3.86E-07
		1408.00		20.74	3.28E-08		1.83E-07
+	EU-154	123.07		40.40	-2.02E-08	7.24E-08	7.24E-08
		247.94		6.60	-4.63E-07		5.11E-07
		723.30		19.70	2.51E-07		2.21E-07
		873.20		11.50	3.14E-07		3.93E-07
		1004.76		17.90	1.31E-07		2.80E-07
		1274.51		35.50	4.24E-09		1.42E-07
+	EU-155	86.54		32.80	-1.22E-08	1.18E-07	1.18E-07
		105.31		21.80	3.66E-08		1.46E-07
+	BI-214	609.31	*	46.30	1.02E-07	9.57E-08	9.57E-08
		1120.29		15.10	2.29E-07		4.16E-07
		1238.11		5.94	1.41E-07		1.09E-06
		1377.67		4.11	3.15E-07		9.99E-07
		1407.98		2.48	2.74E-07		1.53E-06
		1509.19		2.19	3.28E-07		1.77E-06
		1764.49		15.80	1.50E-07		2.79E-07
+	PB-214	77.11	*	10.70	4.15E-07	9.73E-08	3.34E-07
		295.21	*	19.20	1.93E-07		1.48E-07
		351.92	*	37.20	4.94E-08		9.73E-08
+	PA-228	89.95		22.00	6.25E-07	2.47E-07	4.21E-07
		93.35		35.00	6.83E-08		2.47E-07
		105.00		16.30	1.57E-07		4.78E-07
		129.22		2.97	1.21E-06		2.41E-06
		338.32		5.30	4.22E-07		1.64E-06
		463.00		13.80	3.62E-07		7.14E-07
		911.23		16.70	4.32E-07		7.73E-07
+	AM-241	59.54		36.30	-7.45E-08	2.14E-07	2.14E-07
+	CM-243	103.76		23.00	7.88E-08	1.40E-07	1.40E-07
		228.18		10.60	6.22E-08		2.89E-07
		277.60		14.00	-4.27E-08		2.29E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-007-SB  
UNIT L1-SUB CDR 09/13/17

Analysis Report for L1-SUB-CDR-FSGS-008-SB  
L1-SUB CDR

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-008-SB ✓  
Sample Description : L1-SUB CDR  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.417E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/15/2017 9:05:00AM ✓  
Acquisition Started : 9/15/2017 12:32:58PM ✓

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB ✓  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds  
Real Time : 3609.9 seconds

Dead Time : 0.28 %

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3403

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 1:33:11PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

*Revised  
Jm dpu  
9/15/17*

Analysis Report for L1-SUB-CDR-FSGS-008-SB

L1-SUB CDR

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	76.78	147 -	158	154.10	1.41E+02	25.19	5.91E+02	1.96
F	2	238.80	473 -	485	478.07	2.60E+02	23.22	3.28E+02	2.07
F	3	295.58	586 -	595	591.61	6.40E+01	14.50	1.92E+02	1.42
F	4	352.12	697 -	712	704.66	1.58E+02	17.20	2.21E+02	1.83
F	5	583.83	1162 -	1176	1168.01	4.93E+01	10.56	8.02E+01	2.10
F	6	609.64	1213 -	1226	1219.62	8.09E+01	12.37	7.19E+01	2.43
F	7	662.05	1317 -	1333	1324.41	9.30E+02	31.87	6.99E+01	2.23
F	8	1120.67	2237 -	2248	2241.53	4.58E+01	8.59	2.69E+01	2.49
F	9	1174.27	2344 -	2357	2348.72	6.28E+01	9.41	3.09E+01	2.32
F	10	1332.99	2660 -	2674	2666.13	5.11E+01	8.05	1.34E+01	2.70
F	11	1461.76	2914 -	2933	2923.63	5.10E+02	22.78	7.41E+00	2.94

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 1:33:11PM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	76.78	1.41E+02	25.19			1.41E+02	2.52E+01
F	2	238.80	2.60E+02	23.22			2.60E+02	2.32E+01
F	3	295.58	6.40E+01	14.50			6.40E+01	1.45E+01
F	4	352.12	1.58E+02	17.20	8.36E+01	1.86E+01	7.41E+01	2.53E+01
F	5	583.83	4.93E+01	10.56			4.93E+01	1.06E+01
F	6	609.64	8.09E+01	12.37	4.12E+01	1.21E+01	3.97E+01	1.73E+01
F	7	662.05	9.30E+02	31.87	6.61E+01	1.27E+01	8.64E+02	3.43E+01
F	8	1120.67	4.58E+01	8.59			4.58E+01	8.59E+00
F	9	1174.27	6.28E+01	9.41			6.28E+01	9.41E+00
F	10	1332.99	5.11E+01	8.05			5.11E+01	8.05E+00
F	11	1461.76	5.10E+02	22.78			5.10E+02	2.28E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-008-SB  
L1-SUB CDR

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daityland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
CS-137	0.97	661.65 *	85.12	6.94E-07	3.33E-08
PB-212	0.99	77.11 *	17.50	2.38E-07	4.31E-08
		238.63 *	44.60	1.60E-07	1.48E-08
BI-214	0.57	609.31 *	46.30	5.43E-08	2.37E-08
		1120.29 *	15.10	3.33E-07	6.29E-08
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.98	77.11 *	10.70	3.89E-07	7.06E-08
		295.21 *	19.20	1.09E-07	2.48E-08
		351.92 *	37.20	7.61E-08	2.61E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
CS-137	0.975	6.94E-07	3.33E-08	

Analysis Report for L1-SUB-CDR-FSGS-008-SB

L1-SUB CDR

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
PB-212	0.992	1.62E-07	1.41E-08	
BI-214	0.572	8.91E-08	2.22E-08	
PB-214	0.988	9.52E-08	1.75E-08	

? = 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 L1-SUB-CDR-FSGS-008-SB  
L1-SUB CDR

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 1:33:11PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 5	583.83	1.37029E-02	21.41		
F 9	1174.27	1.74501E-02	14.97		
F 10	1332.99	1.41832E-02	15.77		
F 11	1461.76	1.41547E-01	4.47		

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\Daityland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	6.74E-06	1.42E-06	1.42E-06
+	AR-41	1293.64	99.16	9.13E-08	2.26E-07	2.26E-07
+	CO-60	1173.22	100.00	4.02E-08	6.13E-08	6.82E-08
		1332.49	100.00	7.16E-08		6.13E-08
+	KR-85	513.99	0.43	6.15E-06	1.03E-05	1.03E-05
+	Y-88	898.04	93.70	-2.59E-08	2.68E-08	4.65E-08
		1836.06	99.20	-1.13E-08		2.68E-08
+	NB-94	702.63	100.00	-1.06E-08	3.98E-08	3.98E-08
		871.10	100.00	-1.95E-08		4.34E-08
+	I-131	284.30	6.06	-1.97E-07	4.45E-08	5.84E-07
		364.48	81.20	8.39E-09		4.45E-08
		636.97	7.27	-1.57E-07		5.82E-07
+	CS-134	604.70	97.60	-2.36E-08	4.74E-08	4.74E-08
		795.84	85.40	-3.68E-08		5.14E-08

## Analysis Report for L1-SUB-CDR-FSGS-008-SB

## L1-SUB CDR

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CS-137	661.65	*	85.12	6.94E-07	5.81E-08	5.81E-08
+	CE-144	80.12		1.36	-1.82E-06	2.75E-07	3.32E-06
		133.51		11.09	1.35E-07		2.75E-07
+	EU-152	121.78		28.40	-5.97E-09	1.07E-07	1.07E-07
		244.69		7.49	-3.93E-07		5.03E-07
		964.00		14.44	9.76E-08		3.77E-07
		1408.00		20.74	-4.52E-08		1.87E-07
+	EU-154	123.07		40.40	3.03E-09	7.59E-08	7.59E-08
		247.94		6.60	-5.71E-07		5.26E-07
		723.30		19.70	1.25E-07		2.15E-07
		873.20		11.50	-4.25E-08		3.83E-07
		1004.76		17.90	-1.54E-07		2.73E-07
		1274.51		35.50	-1.84E-08		1.45E-07
+	EU-155	86.54		32.80	-8.37E-08	1.16E-07	1.16E-07
		105.31		21.80	-1.90E-08		1.48E-07
+	BI-214	609.31	*	46.30	5.43E-08	9.22E-08	9.22E-08
		1120.29	*	15.10	3.33E-07		2.17E-07
		1238.11		5.94	6.83E-07		1.09E-06
		1377.67		4.11	1.28E-07		1.06E-06
		1407.98		2.48	-3.78E-07		1.57E-06
		1509.19		2.19	6.79E-08		1.74E-06
		1764.49		15.80	1.82E-07		2.56E-07
+	PB-214	77.11	*	10.70	3.89E-07	1.14E-07	3.56E-07
		295.21	*	19.20	1.09E-07		1.21E-07
		351.92	*	37.20	7.61E-08		1.14E-07
+	PA-228	89.95		22.00	2.75E-07	1.15E-07	1.93E-07
		93.35		35.00	7.12E-08		1.15E-07
		105.00		16.30	4.89E-08		2.25E-07
		129.22		2.97	6.63E-07		1.16E-06
		338.32		5.30	-1.54E-07		8.07E-07
		463.00		13.80	1.79E-07		3.59E-07
		911.23		16.70	3.04E-07		3.66E-07
+	AM-241	59.54		36.30	3.31E-08	2.19E-07	2.19E-07
+	CM-243	103.76		23.00	1.12E-07	1.43E-07	1.43E-07
		228.18		10.60	-1.22E-07		3.00E-07
		277.60		14.00	-6.00E-08		2.51E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level



Analysis Report for L1-SUB-CDR-FSGS-008-SB  
L1-SUB CDR

Analysis Report for L1-SUB-CDR-FSGS-009-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-009-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 9.393E+02 grams ✓  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 1:54:00AM  
Acquisition Started : 9/14/2017 6:46:59PM

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3610.7 seconds

Dead Time : 0.30 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3394

*Reviewed by [Signature]  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/14/2017 7:47:13PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-009-SB  
UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	609.33	1212 -	1227	1219.00	1.66E+02	18.42	1.64E+02	3.43
F	2	662.02	1316 -	1333	1324.36	8.76E+03	95.22	1.78E+02	2.77
F	3	1173.89	2337 -	2357	2347.95	3.56E+02	20.99	9.19E+01	3.12
F	4	1333.30	2658 -	2677	2666.73	3.17E+02	18.48	2.28E+01	3.26
F	5	1461.80	2913 -	2934	2923.72	5.33E+02	23.70	2.75E+01	3.19

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

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/14/2017 7:47:13PM

Env. Background File : C:\Canberra\Apex\Root\ Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	609.33	1.66E+02	18.42	4.12E+01	1.21E+01	1.25E+02	2.20E+01
F	2	662.02	8.76E+03	95.22	6.61E+01	1.27E+01	8.69E+03	9.61E+01
F	3	1173.89	3.56E+02	20.99	4.55E+01	8.62E+00	3.10E+02	2.27E+01
F	4	1333.30	3.17E+02	18.48			3.17E+02	1.85E+01
F	5	1461.80	5.33E+02	23.70			5.33E+02	2.37E+01

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

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

IDENTIFIED NUCLIDES

Analysis Report for L1-SUB-CDR-FSGS-009-SB  
UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Activity Uncertainty</b>
CO-60	0.91	1173.22 *	100.00	3.18E-07	2.45E-08
		1332.49 *	100.00	3.63E-07	2.31E-08
CS-137	0.97	661.65 *	85.12	6.25E-06	1.83E-07
BI-214	0.35	609.31 *	46.30	1.54E-07	2.74E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		

\* = 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

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
//CO-60	0.915	3.42E-07	1.68E-08	
CS-137	0.978	6.25E-06	1.83E-07	
BI-214	0.350	1.54E-07	2.74E-08	

? = 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 L1-SUB-CDR-FSGS-009-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/14/2017 7:47:13PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 5	1461.80	1.48055E-01	4.45		P231

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

*J. Ogden*  
9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	10.67	6.69E-06	1.34E-06	1.34E-06
+	AR-41	1293.64	99.16	2.79E-02	3.47E-01	3.47E-01
+	CO-60	1173.22	* 100.00	3.18E-07	3.71E-08	7.45E-08
		1332.49	* 100.00	3.63E-07		3.71E-08
+	KR-85	513.99	0.43	1.16E-05	1.52E-05	1.52E-05
+	Y-88	898.04	93.70	2.04E-08	3.07E-08	5.73E-08
		1836.06	99.20	1.28E-08		3.07E-08
+	NB-94	702.63	100.00	-4.37E-08	4.09E-08	4.09E-08
		871.10	100.00	-1.93E-08		5.12E-08
+	I-131	284.30	6.06	5.10E-07	8.86E-08	1.03E-06
		364.48	81.20	5.95E-08		8.86E-08
		636.97	7.27	5.36E-07		9.33E-07
+	CS-134	604.70	97.60	-1.33E-08	5.73E-08	6.32E-08
		795.84	85.40	-2.11E-08		5.73E-08
+	CS-137	661.65	* 85.12	6.25E-06	6.86E-08	6.86E-08
+	CE-144	80.12	1.36	8.10E-07	3.97E-07	4.12E-06
		133.51	11.09	5.78E-07		3.97E-07

Analysis Report for L1-SUB-CDR-FSGS-009-SB  
UNIT L1-SUB CDR 09/13/17

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	EU-152	121.78	28.40	-1.70E-07	1.48E-07	1.48E-07
		244.69	7.49	-9.98E-08		6.88E-07
		964.00	14.44	2.52E-07		4.06E-07
		1408.00	20.74	-3.37E-09		1.96E-07
+	EU-154	123.07	40.40	-4.01E-08	1.05E-07	1.05E-07
		247.94	6.60	-1.68E-06		7.97E-07
		723.30	19.70	1.02E-07		2.26E-07
		873.20	11.50	-2.72E-07		4.40E-07
		1004.76	17.90	6.26E-08		3.05E-07
		1274.51	35.50	7.19E-08		1.50E-07
+	EU-155	86.54	32.80	-1.20E-07	1.52E-07	1.52E-07
		105.31	21.80	-5.75E-08		2.02E-07
+	BI-214	609.31	* 46.30	1.54E-07	1.09E-07	1.09E-07
		1120.29	15.10	4.51E-07		4.35E-07
		1238.11	5.94	6.14E-07		1.13E-06
		1377.67	4.11	3.62E-07		1.03E-06
		1407.98	2.48	-2.82E-08		1.64E-06
		1509.19	2.19	1.01E-06		1.91E-06
		1764.49	15.80	3.09E-08		2.47E-07
+	PB-214	77.11	10.70	4.55E-07	1.70E-07	5.53E-07
		295.21	19.20	2.56E-07		2.89E-07
		351.92	37.20	1.91E-07		1.70E-07
+	PA-228	89.95	22.00	5.80E-07	4.96E-07	8.19E-07
		93.35	35.00	-4.02E-08		4.96E-07
		105.00	16.30	-2.78E-07		9.95E-07
		129.22	2.97	2.64E-06		5.37E-06
		338.32	5.30	1.32E-07		4.09E-06
		463.00	13.80	9.46E-08		2.21E-06
		911.23	16.70	1.11E-06		1.37E-06
+	AM-241	59.54	36.30	3.13E-07	2.94E-07	2.94E-07
+	CM-243	103.76	23.00	-3.04E-08	1.92E-07	1.92E-07
		228.18	10.60	-1.39E-07		4.58E-07
		277.60	14.00	2.99E-07		3.92E-07

+ = 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

Analysis Report for L1-SUB-CDR-FSGS-010-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-010-SB  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 9.582E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 2:00:00PM ✓  
Acquisition Started : 9/15/2017 5:06:46AM

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3609.2 seconds

Dead Time : 0.26 %

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3396

*reviewed*  
*2092*  
*9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 6:06:58AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-010-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.84	472 -	485	478.16	3.11E+02	27.83	4.46E+02	2.98
F	2	352.22	698 -	713	704.88	2.17E+02	20.56	2.25E+02	2.64
F	3	609.79	1210 -	1227	1219.92	1.52E+02	15.26	9.22E+01	2.77
F	4	661.93	1314 -	1333	1324.17	1.64E+03	41.86	8.75E+01	2.81
F	5	1333.44	2661 -	2674	2667.02	4.98E+01	8.58	2.26E+01	2.66
F	6	1461.52	2915 -	2932	2923.15	5.31E+02	23.52	2.01E+01	3.06

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 6:06:58AM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.84	3.11E+02	27.83			3.11E+02	2.78E+01
F	2	352.22	2.17E+02	20.56	8.36E+01	1.86E+01	1.34E+02	2.77E+01
F	3	609.79	1.52E+02	15.26	4.12E+01	1.21E+01	1.11E+02	1.95E+01
F	4	661.93	1.64E+03	41.86	6.61E+01	1.27E+01	1.57E+03	4.37E+01
F	5	1333.44	4.98E+01	8.58			4.98E+01	8.58E+00
F	6	1461.52	5.31E+02	23.52	5.63E+01	8.57E+00	4.74E+02	2.50E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma



Analysis Report for L1-SUB-CDR-FSGS-010-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daityland\_NPPLibrary\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.91	1460.75 *	10.67	5.40E-06	3.22E-07
CS-137	0.98	661.65 *	85.12	1.11E-06	4.30E-08
PB-212	0.55	77.11	17.50		
		238.63 *	44.60	1.67E-07	1.56E-08
BI-214	0.33	609.31 *	46.30	1.34E-07	2.37E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	0.910	5.40E-06	3.22E-07	
CS-137	0.988	1.11E-06	4.30E-08	
PB-212	0.555	1.67E-07	1.56E-08	
BI-214	0.331	1.34E-07	2.37E-08	

Analysis Report for L1-SUB-CDR-FSGS-010-SB  
UNIT L1-SUB CDR 09/13/17

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

Errors quoted at 1.000sigma

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Analysis Report for L1-SUB-CDR-FSGS-010-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 6:06:58AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 2	352.22	3.70855E-02	20.77	Tol.	PB-214
F 5	1333.44	1.38397E-02	17.21	Tol.	CO-60

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

*Handwritten notes:*  
I O N O  
100%  
1173.22  
2/8/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daistryland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	* 10.67	5.40E-06	5.48E-07	5.48E-07
+	AR-41	1293.64	99.16	9.25E-02	1.58E-01	1.58E-01
+	CO-60	1173.22	100.00	5.26E-08	5.78E-08	6.40E-08
		1332.49	100.00	5.05E-08		5.78E-08
+	KR-85	513.99	0.43	1.06E-05	1.01E-05	1.01E-05
+	Y-88	898.04	93.70	-2.38E-09	2.61E-08	4.51E-08
		1836.06	99.20	-1.74E-08		2.61E-08
+	NB-94	702.63	100.00	-4.46E-08	3.53E-08	3.53E-08
		871.10	100.00	-1.68E-08		3.97E-08
+	I-131	284.30	6.06	3.66E-07	4.99E-08	6.46E-07
		364.48	81.20	4.26E-09		4.99E-08
		636.97	7.27	-1.59E-07		6.33E-07
+	CS-134	604.70	97.60	1.91E-09	4.86E-08	4.90E-08
		795.84	85.40	2.08E-08		4.86E-08
+	CS-137	661.65	* 85.12	1.11E-06	5.55E-08	5.55E-08
+	CE-144	80.12	1.36	2.21E-06	2.67E-07	3.26E-06

Analysis Report for L1-SUB-CDR-FSGS-010-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	CE-144	133.51	11.09	-1.66E-07	2.67E-07	2.67E-07
+	EU-152	121.78	28.40	-1.16E-07	1.04E-07	1.04E-07
		244.69	7.49	-2.40E-07		4.86E-07
		964.00	14.44	2.05E-07		3.42E-07
		1408.00	20.74	5.67E-09		1.82E-07
+	EU-154	123.07	40.40	-4.52E-08	7.33E-08	7.33E-08
		247.94	6.60	-4.44E-07		5.22E-07
		723.30	19.70	1.09E-07		1.86E-07
		873.20	11.50	-1.89E-07		3.38E-07
		1004.76	17.90	1.08E-07		2.50E-07
		1274.51	35.50	9.21E-08		1.30E-07
+	EU-155	86.54	32.80	-1.34E-07	1.14E-07	1.14E-07
		105.31	21.80	3.56E-08		1.44E-07
+	BI-214	609.31	* 46.30	1.34E-07	9.06E-08	9.06E-08
		1120.29	15.10	8.57E-08		3.77E-07
		1238.11	5.94	2.52E-07		8.96E-07
		1377.67	4.11	-7.27E-08		9.22E-07
		1407.98	2.48	4.74E-08		1.52E-06
		1509.19	2.19	-1.26E-07		1.45E-06
		1764.49	15.80	2.53E-07		2.96E-07
+	PB-214	77.11	10.70	2.34E-07	1.08E-07	4.34E-07
		295.21	19.20	2.27E-07		1.86E-07
		351.92	37.20	1.28E-07		1.08E-07
+	PA-228	89.95	22.00	3.70E-07	3.38E-07	5.74E-07
		93.35	35.00	1.42E-07		3.38E-07
		105.00	16.30	7.97E-08		6.72E-07
		129.22	2.97	2.53E-07		3.47E-06
		338.32	5.30	2.12E-07		2.32E-06
		463.00	13.80	3.47E-07		1.12E-06
		911.23	16.70	1.18E-06		1.06E-06
+	AM-241	59.54	36.30	7.51E-08	2.02E-07	2.02E-07
+	CM-243	103.76	23.00	1.61E-08	1.38E-07	1.38E-07
		228.18	10.60	1.10E-08		2.93E-07
		277.60	14.00	3.57E-08		2.47E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-011-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-011-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :  
  
Sample Size : 7.883E+02 grams  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/13/2017 2:05:00PM ✓  
Acquisition Started : 9/15/2017 6:21:38AM  
  
Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3610.1 seconds  
  
Dead Time : 0.28 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3397

REVIEWED  
Jm Agui  
9/15/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 7:21:51AM  
Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-011-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.84	473 -	485	478.15	3.15E+02	29.68	5.68E+02	2.81
F	2	295.23	587 -	596	590.91	7.78E+01	18.86	3.06E+02	1.81
F	3	352.20	696 -	713	704.82	1.85E+02	22.06	3.78E+02	2.68
F	4	609.55	1213 -	1228	1219.44	1.24E+02	15.17	1.15E+02	2.69
F	5	661.94	1314 -	1333	1324.19	3.33E+03	59.39	1.33E+02	2.82
F	6	1173.79	2339 -	2358	2347.75	1.72E+02	14.95	5.91E+01	2.99
F	7	1333.24	2657 -	2675	2666.61	1.51E+02	13.16	1.90E+01	3.76
F	8	1461.53	2915 -	2933	2923.17	5.35E+02	23.49	1.08E+01	3.20

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 7:21:51AM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.84	3.15E+02	29.68			3.15E+02	2.97E+01
F	2	295.23	7.78E+01	18.86			7.78E+01	1.89E+01
F	3	352.20	1.85E+02	22.06	8.36E+01	1.86E+01	1.01E+02	2.89E+01
F	4	609.55	1.24E+02	15.17	4.12E+01	1.21E+01	8.27E+01	1.94E+01
F	5	661.94	3.33E+03	59.39	6.61E+01	1.27E+01	3.27E+03	6.07E+01
F	6	1173.79	1.72E+02	14.95	4.55E+01	8.62E+00	1.26E+02	1.73E+01
F	7	1333.24	1.51E+02	13.16			1.51E+02	1.32E+01
F	8	1461.53	5.35E+02	23.49	5.63E+01	8.57E+00	4.79E+02	2.50E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-011-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.90	1460.75 *	10.67	6.62E-06	3.92E-07
CO-60	0.93	1173.22 *	100.00	1.54E-07	2.14E-08
		1332.49 *	100.00	2.06E-07	1.87E-08
CS-137	0.98	661.65 *	85.12	2.80E-06	9.19E-08
PB-212	0.55	77.11	17.50		
		238.63 *	44.60	2.06E-07	2.02E-08
BI-214	0.34	609.31 *	46.30	1.21E-07	2.86E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.71	77.11	10.70		
		295.21 *	19.20	1.41E-07	3.44E-08
		351.92 *	37.20	1.11E-07	3.18E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
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Analysis Report for L1-SUB-CDR-FSGS-011-SB

UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
✓ K-40	0.908	6.62E-06	3.92E-07	
✓ CO-60	0.931	1.83E-07	1.41E-08	
CS-137	0.987	2.80E-06	9.19E-08	
PB-212	0.555	2.06E-07	2.02E-08	
BI-214	0.345	1.21E-07	2.86E-08	
PB-214	0.715	1.25E-07	2.33E-08	

? = 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 L1-SUB-CDR-FSGS-011-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 7:21:51AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
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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\Daityland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	*	10.67	6.62E-06	6.21E-07	6.21E-07
+	AR-41	1293.64		99.16	1.38E-01	3.23E-01	3.23E-01
+	✓ CO-60	1173.22	*	100.00	1.54E-07	3.96E-08	7.57E-08
		1332.49	*	100.00	2.06E-07		3.96E-08
+	KR-85	513.99		0.43	5.04E-06	1.43E-05	1.43E-05
+	Y-88	898.04		93.70	1.92E-09	4.55E-08	5.61E-08
		1836.06		99.20	-1.13E-08		4.55E-08
+	NB-94	702.63		100.00	7.51E-09	4.88E-08	4.88E-08
		871.10		100.00	-2.87E-08		5.14E-08
+	I-131	284.30		6.06	-1.16E-06	7.28E-08	8.81E-07
		364.48		81.20	4.82E-09		7.28E-08
		636.97		7.27	-2.75E-07		7.94E-07
+	CS-134	604.70		97.60	-1.81E-08	6.26E-08	6.26E-08
		795.84		85.40	4.63E-08		6.26E-08
+	✓ CS-137	661.65	*	85.12	2.80E-06	7.66E-08	7.66E-08
+	CE-144	80.12		1.36	2.13E-06	3.50E-07	4.13E-06
		133.51		11.09	3.71E-07		3.50E-07
+	EU-152	121.78		28.40	-1.20E-07	1.33E-07	1.33E-07

## Analysis Report for L1-SUB-CDR-FSGS-011-SB

UNIT L1-SUB CDR 09/13/17

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
✓	EU-152	244.69	7.49	-3.35E-07	1.33E-07	6.68E-07
		964.00	14.44	3.07E-07		4.29E-07
+	✓ EU-154	1408.00	20.74	7.91E-08		2.43E-07
		123.07	40.40	-2.97E-08	9.38E-08	9.38E-08
		247.94	6.60	-6.59E-07		7.29E-07
		723.30	19.70	-4.97E-08		2.51E-07
		873.20	11.50	-2.00E-07		4.46E-07
		1004.76	17.90	-1.20E-07		3.07E-07
		1274.51	35.50	6.47E-08		1.70E-07
+	EU-155	86.54	32.80	4.09E-08	1.47E-07	1.47E-07
		105.31	21.80	-1.58E-07		1.82E-07
+	BI-214	609.31	* 46.30	1.21E-07	1.15E-07	1.15E-07
		1120.29	15.10	5.16E-07		4.95E-07
		1238.11	5.94	1.03E-06		1.30E-06
		1377.67	4.11	8.69E-07		1.32E-06
		1407.98	2.48	6.61E-07		2.03E-06
		1509.19	2.19	-5.43E-07		1.92E-06
		1764.49	15.80	2.48E-07		3.22E-07
+	PB-214	77.11	10.70	7.45E-07	1.50E-07	5.57E-07
		295.21	* 19.20	1.41E-07		1.62E-07
		351.92	* 37.20	1.11E-07		1.50E-07
+	PA-228	89.95	22.00	7.94E-07	4.49E-07	7.58E-07
		93.35	35.00	-5.05E-08		4.49E-07
		105.00	16.30	-6.42E-07		8.81E-07
		129.22	2.97	2.92E-06		4.66E-06
		338.32	5.30	4.66E-07		3.37E-06
		463.00	13.80	1.15E-06		1.78E-06
+	✓ AM-241	911.23	16.70	1.73E-06		1.40E-06
		59.54	36.30	8.77E-08	2.77E-07	2.77E-07
+	CM-243	103.76	23.00	8.19E-08	1.76E-07	1.76E-07
		228.18	10.60	-2.83E-07		4.04E-07
		277.60	14.00	1.92E-07		3.30E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-012-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-012-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.660E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 2:08:00PM ✓  
Acquisition Started : 9/15/2017 7:22:54AM ✓

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds  
Real Time : 3610.0 seconds

Dead Time : 0.28 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3398

REVIEWED  
JAG  
9/15/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 8:23:07AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-012-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.73	469 -	485	477.94	4.50E+02	31.83	5.75E+02	3.05
F	2	352.00	698 -	712	704.42	1.88E+02	21.45	2.87E+02	2.65
F	3	583.39	1160 -	1176	1167.12	1.11E+02	13.88	1.19E+02	2.10
F	4	609.31	1211 -	1228	1218.95	1.17E+02	13.95	9.40E+01	2.69
F	5	662.02	1314 -	1332	1324.36	2.11E+03	47.42	1.29E+02	2.41
F	6	911.94	1818 -	1832	1824.11	7.48E+01	10.99	4.46E+01	2.88
F	7	1173.73	2341 -	2355	2347.63	9.84E+01	12.56	5.63E+01	2.88
F	8	1333.55	2661 -	2677	2667.23	1.03E+02	11.32	2.14E+01	3.22
F	9	1461.69	2915 -	2932	2923.49	7.92E+02	28.73	1.75E+01	3.05

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 8:23:07AM

Env. Background File : C:\Canberra\Apex\Root\ Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.73	4.50E+02	31.83			4.50E+02	3.18E+01
F	2	352.00	1.88E+02	21.45	8.36E+01	1.86E+01	1.05E+02	2.84E+01
F	3	583.39	1.11E+02	13.88			1.11E+02	1.39E+01
F	4	609.31	1.17E+02	13.95	4.12E+01	1.21E+01	7.59E+01	1.85E+01
F	5	662.02	2.11E+03	47.42	6.61E+01	1.27E+01	2.04E+03	4.91E+01
F	6	911.94	7.48E+01	10.99			7.48E+01	1.10E+01
F	7	1173.73	9.84E+01	12.56	4.55E+01	8.62E+00	5.29E+01	1.52E+01
F	8	1333.55	1.03E+02	11.32			1.03E+02	1.13E+01
F	9	1461.69	7.92E+02	28.73			7.92E+02	2.87E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-012-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.86	1460.75 *	10.67	9.97E-06	4.55E-07
CS-137	0.97	661.65 *	85.12	1.60E-06	5.77E-08
PB-212	0.55	77.11	17.50		
		238.63 *	44.60	2.68E-07	2.02E-08
BI-214	0.35	609.31 *	46.30	1.01E-07	2.47E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
✓ K-40	0.869	9.97E-06	4.55E-07	
✓ CS-137	0.978	1.60E-06	5.77E-08	
PB-212	0.559	2.68E-07	2.02E-08	
BI-214	0.350	1.01E-07	2.47E-08	

Analysis Report for L1-SUB-CDR-FSGS-012-SB  
UNIT L1-SUB CDR 09/13/17

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

Errors quoted at 1.000sigma

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## Analysis Report for L1-SUB-CDR-FSGS-012-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	I-131	364.48	81.20	7.69E-09	6.12E-08	6.12E-08
		636.97	7.27	-1.72E-07		7.24E-07
+	CS-134	604.70	97.60	-1.70E-08	5.30E-08	5.30E-08
		795.84	85.40	3.58E-09		5.57E-08
+	CS-137	661.65	* 85.12	1.60E-06	6.84E-08	6.84E-08
+	CE-144	80.12	1.36	1.42E-07	3.22E-07	3.78E-06
		133.51	11.09	1.86E-07		3.22E-07
+	EU-152	121.78	28.40	-9.95E-08	1.21E-07	1.21E-07
		244.69	7.49	-3.77E-07		5.82E-07
		964.00	14.44	2.73E-07		4.11E-07
		1408.00	20.74	1.36E-08		2.21E-07
+	EU-154	123.07	40.40	-7.36E-08	8.58E-08	8.58E-08
		247.94	6.60	-9.60E-07		6.15E-07
		723.30	19.70	5.95E-08		2.33E-07
		873.20	11.50	2.32E-07		4.22E-07
		1004.76	17.90	-1.18E-07		2.81E-07
		1274.51	35.50	5.59E-08		1.72E-07
+	EU-155	86.54	32.80	-1.09E-07	1.33E-07	1.33E-07
		105.31	21.80	-6.36E-08		1.63E-07
+	BI-214	609.31	* 46.30	1.01E-07	1.01E-07	1.01E-07
		1120.29	15.10	3.84E-07		4.68E-07
		1238.11	5.94	-7.38E-07		1.25E-06
		1377.67	4.11	2.66E-07		1.11E-06
		1407.98	2.48	1.13E-07		1.85E-06
		1509.19	2.19	-1.87E-07		1.55E-06
		1764.49	15.80	1.30E-07		2.97E-07
+	PB-214	77.11	10.70	7.43E-07	1.29E-07	5.18E-07
		295.21	19.20	1.40E-07		2.30E-07
		351.92	37.20	1.70E-07		1.29E-07
+	PA-228	89.95	22.00	7.12E-07	4.29E-07	7.23E-07
		93.35	35.00	1.92E-07		4.29E-07
		105.00	16.30	-2.66E-07		8.14E-07
		129.22	2.97	1.17E-06		4.45E-06
		338.32	5.30	1.46E-06		3.10E-06
		463.00	13.80	-1.27E-07		1.44E-06
		911.23	16.70	1.14E-06		1.33E-06
+	AM-241	59.54	36.30	1.46E-07	2.46E-07	2.46E-07
+	CM-243	103.76	23.00	-7.96E-08	1.56E-07	1.56E-07
		228.18	10.60	-3.09E-07		3.37E-07
		277.60	14.00	-2.48E-07		2.83E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level



Analysis Report for L1-SUB-CDR-FSGS-012-SB  
UNIT L1-SUB CDR 09/13/17

Analysis Report for L1-SUB-CDR-FSGS-013-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-013-SB  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.979E+02 grams  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 2:10:00PM  
Acquisition Started : 9/15/2017 8:25:17AM

Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds  
Real Time : 3609.4 seconds

Dead Time : 0.26 %

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3399

*Reviewed*  
*Joe O'Neil*  
*9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 9:25:29AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-013-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	76.54	148 -	160	153.62	1.70E+02	29.95	6.33E+02	3.99
F	2	238.79	471 -	485	478.06	2.89E+02	25.01	3.74E+02	2.47
F	3	338.50	669 -	682	677.43	7.62E+01	13.81	1.49E+02	1.97
F	4	351.86	698 -	710	704.15	1.52E+02	16.68	1.48E+02	2.00
F	5	583.62	1161 -	1173	1167.57	8.75E+01	12.82	6.84E+01	2.69
F	6	609.57	1211 -	1227	1219.47	1.39E+02	14.54	7.02E+01	3.01
F	7	661.98	1315 -	1331	1324.28	1.62E+02	15.14	8.25E+01	2.36
F	8	912.02	1816 -	1833	1824.29	7.60E+01	10.86	4.15E+01	3.06
F	9	1461.63	2912 -	2934	2923.37	5.47E+02	23.75	2.81E+00	3.05

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 9:25:29AM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	76.54	1.70E+02	29.95			1.70E+02	3.00E+01
F	2	238.79	2.89E+02	25.01			2.89E+02	2.50E+01
F	3	338.50	7.62E+01	13.81			7.62E+01	1.38E+01
F	4	351.86	1.52E+02	16.68	8.36E+01	1.86E+01	6.81E+01	2.50E+01
F	5	583.62	8.75E+01	12.82			8.75E+01	1.28E+01
F	6	609.57	1.39E+02	14.54	4.12E+01	1.21E+01	9.78E+01	1.89E+01
F	7	661.98	1.62E+02	15.14	6.61E+01	1.27E+01	9.54E+01	1.98E+01
F	8	912.02	7.60E+01	10.86			7.60E+01	1.09E+01
F	9	1461.63	5.47E+02	23.75	5.63E+01	8.57E+00	4.91E+02	2.52E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-013-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dalryland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.88	1460.75 *	10.67	5.96E-06	3.48E-07
CS-137	0.98	661.65 *	85.12	7.18E-08	1.50E-08
PB-212	0.98	77.11 *	17.50	2.71E-07	4.84E-08
		238.63 *	44.60	1.66E-07	1.50E-08
BI-214	0.34	609.31 *	46.30	1.25E-07	2.45E-08
		1120.29	15.10		
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.51	77.11 *	10.70	4.43E-07	7.91E-08
		295.21	19.20		
		351.92 *	37.20	6.56E-08	2.41E-08

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	0.884	5.96E-06	3.48E-07	
CS-137	0.983	7.18E-08	1.50E-08	

Analysis Report for L1-SUB-CDR-FSGS-013-SB

UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
PB-212	0.982	1.72E-07	1.44E-08	
BI-214	0.344	1.25E-07	2.45E-08	
PB-214	0.518	7.37E-08	2.31E-08	

? = 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 L1-SUB-CDR-FSGS-013-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 9:25:29AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 3	338.50	2.11770E-02	18.11	Tol.	AC-228 ✓ PA-228
F 5	583.62	2.43182E-02	14.64		✓
F 8	912.02	2.11087E-02	14.29	Tol.	AC-228 ✓ PA-228

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

*J. D. G. J.*  
9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daistryland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	*	10.67	5.96E-06	5.06E-07
+	AR-41	1293.64	99.16	-3.82E-01	5.32E-01	5.32E-01
+	✓ CO-60	1173.22	100.00	2.88E-08	5.46E-08	6.48E-08
		1332.49	100.00	2.66E-08		5.46E-08
+	KR-85	513.99	0.43	1.01E-05	8.97E-06	8.97E-06
+	Y-88	898.04	93.70	2.62E-08	3.21E-08	4.57E-08
		1836.06	99.20	-6.56E-10		3.21E-08
+	NB-94	702.63	100.00	1.07E-08	3.76E-08	3.76E-08
		871.10	100.00	-2.99E-08		4.18E-08
+	I-131	284.30	6.06	-4.18E-07	4.41E-08	5.55E-07
		364.48	81.20	6.11E-09		4.41E-08

## Analysis Report for L1-SUB-CDR-FSGS-013-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	I-131	636.97	7.27	2.41E-07	4.41E-08	5.90E-07
+	CS-134	604.70	97.60	2.36E-10	4.59E-08	4.86E-08
		795.84	85.40	-1.05E-08		4.59E-08
+	✓ CS-137	661.65	* 85.12	7.18E-08	5.66E-08	5.66E-08
+	✓ CE-144	80.12	1.36	-6.14E-07	2.57E-07	3.20E-06
		133.51	11.09	-6.28E-09		2.57E-07
+	✓ EU-152	121.78	28.40	-1.23E-07	1.00E-07	1.00E-07
		244.69	7.49	-4.69E-08		4.64E-07
		964.00	14.44	3.36E-07		3.52E-07
		1408.00	20.74	1.32E-07		1.85E-07
+	✓ EU-154	123.07	40.40	-4.44E-08	7.08E-08	7.08E-08
		247.94	6.60	-5.13E-07		4.65E-07
		723.30	19.70	1.58E-07		2.09E-07
		873.20	11.50	-1.08E-07		3.58E-07
		1004.76	17.90	1.11E-07		2.63E-07
		1274.51	35.50	-1.41E-07		1.51E-07
+	EU-155	86.54	32.80	-1.91E-09	1.11E-07	1.11E-07
		105.31	21.80	-5.65E-08		1.34E-07
+	BI-214	609.31	* 46.30	1.25E-07	8.88E-08	8.88E-08
		1120.29	15.10	1.79E-07		3.71E-07
		1238.11	5.94	1.17E-06		1.17E-06
		1377.67	4.11	-1.07E-07		9.63E-07
		1407.98	2.48	1.11E-06		1.55E-06
		1509.19	2.19	3.15E-07		1.55E-06
		1764.49	15.80	3.84E-07		3.08E-07
+	PB-214	77.11	* 10.70	4.43E-07	9.32E-08	3.57E-07
		295.21	19.20	1.36E-07		1.73E-07
		351.92	* 37.20	6.56E-08		9.32E-08
+	PA-228	89.95	22.00	2.43E-07	3.60E-07	6.10E-07
		93.35	35.00	-9.87E-08		3.60E-07
		105.00	16.30	-4.21E-07		6.87E-07
		129.22	2.97	3.39E-06		3.70E-06
		338.32	5.30	3.55E-07		2.37E-06
		463.00	13.80	-4.01E-07		9.19E-07
		911.23	16.70	1.17E-06		1.23E-06
+	✓ AM-241	59.54	36.30	1.43E-07	2.02E-07	2.02E-07
+	CM-243	103.76	23.00	-1.50E-08	1.28E-07	1.28E-07
		228.18	10.60	5.74E-08		2.78E-07
		277.60	14.00	4.50E-08		2.20E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-FSGS-013-SB  
UNIT L1-SUB CDR 09/13/17



Analysis Report for L1-SUB-CDR-FSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-FSGS-014-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :

Sample Size : 8.284E+02 grams ✓  
Facility : Dairyland\_NPP

Sample Taken On : 9/13/2017 2:18:00PM ✓  
Acquisition Started : 9/15/2017 9:27:51AM

Procedure : 500ml Marinelli ✓  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds ✓  
Real Time : 3610.4 seconds

Dead Time : 0.29 % ✓

Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV

Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :

Sample Number : 3400

*REMOVED*  
*2 DO*  
*8/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 10:28:04AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-FSGS-014-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	238.76	470 -	486	478.00	3.11E+02	27.98	6.67E+02	2.19
F	2	295.05	587 -	596	590.55	8.61E+01	17.43	2.98E+02	1.43
F	3	338.78	673 -	681	678.00	6.13E+01	15.26	2.00E+02	1.42
F	4	351.85	698 -	711	704.14	1.66E+02	20.87	3.07E+02	2.31
F	5	583.54	1162 -	1173	1167.42	8.78E+01	13.60	1.07E+02	1.99
F	6	609.41	1211 -	1226	1219.16	9.92E+01	14.18	1.32E+02	2.20
F	7	662.03	1315 -	1333	1324.39	2.86E+03	54.78	1.40E+02	2.38
F	8	911.80	1816 -	1831	1823.83	7.58E+01	10.69	5.18E+01	2.18
F	9	1173.87	2341 -	2357	2347.91	1.03E+02	12.73	6.50E+01	2.64
F	10	1333.37	2660 -	2674	2666.87	9.75E+01	10.96	2.27E+01	2.35
F	11	1461.72	2916 -	2933	2923.55	7.56E+02	28.40	3.15E+01	2.80

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 10:28:04AM

Env. Background File : C:\Canberra\Apex\Root\Daivyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	238.76	3.11E+02	27.98			3.11E+02	2.80E+01
F	2	295.05	8.61E+01	17.43			8.61E+01	1.74E+01
F	3	338.78	6.13E+01	15.26			6.13E+01	1.53E+01
F	4	351.85	1.66E+02	20.87	8.36E+01	1.86E+01	8.22E+01	2.80E+01
F	5	583.54	8.78E+01	13.60			8.78E+01	1.36E+01
F	6	609.41	9.92E+01	14.18	4.12E+01	1.21E+01	5.80E+01	1.86E+01
F	7	662.03	2.86E+03	54.78	6.61E+01	1.27E+01	2.79E+03	5.62E+01
F	8	911.80	7.58E+01	10.69			7.58E+01	1.07E+01
F	9	1173.87	1.03E+02	12.73	4.55E+01	8.62E+00	5.80E+01	1.54E+01
F	10	1333.37	9.75E+01	10.96			9.75E+01	1.10E+01
F	11	1461.72	7.56E+02	28.40			7.56E+02	2.84E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for L1-SUB-CDR-FSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
K-40	0.861	9.96E-06	4.65E-07	
CO-60	0.908	1.03E-07	1.13E-08	
CS-137	0.977	2.28E-06	7.68E-08	
PB-212	0.558	1.94E-07	1.81E-08	
BI-214	0.349	8.06E-08	2.60E-08	
PB-214	0.720	1.16E-07	2.10E-08	
AC-228	0.303	2.36E-07	2.94E-08	

? = 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 L1-SUB-CDR-FSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\ Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.86	1460.75	*	10.67	9.96E-06	4.65E-07
CO-60	0.90	1173.22	*	100.00	6.73E-08	1.79E-08
		1332.49	*	100.00	1.27E-07	1.46E-08
CS-137	0.97	661.65	*	85.12	2.28E-06	7.68E-08
PB-212	0.55	77.11		17.50		
		238.63	*	44.60	1.94E-07	1.81E-08
BI-214	0.34	609.31	*	46.30	8.06E-08	2.60E-08
		1120.29		15.10		
		1238.11		5.94		
		1377.67		4.11		
		1407.98		2.48		
		1509.19		2.19		
		1764.49		15.80		
PB-214	0.72	77.11		10.70		
		295.21	*	19.20	1.49E-07	3.03E-08
		351.92	*	37.20	8.57E-08	2.92E-08
AC-228	0.30	209.28		4.40		
		338.32	*	11.40	2.01E-07	5.04E-08
		794.70		4.60		
		911.60	*	27.70	2.54E-07	3.62E-08
		964.60		5.20		
		969.11		16.60		

\* = 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 L1-SUB-CDR-FSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 10:28:04AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 5	583.54	2.43916E-02	15.49		TL 208

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

208  
9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	* 10.67	9.96E-06	4.78E-07	4.78E-07
+	AR-41	1293.64	99.16	1.80E-01	1.02E+00	1.02E+00
+	CO-60	1173.22	* 100.00	6.73E-08	3.83E-08	7.20E-08
		1332.49	* 100.00	1.27E-07		3.83E-08
+	KR-85	513.99	0.43	1.18E-05	1.27E-05	1.27E-05
+	Y-88	898.04	93.70	-4.01E-09	2.75E-08	5.88E-08
		1836.06	99.20	-2.92E-08		2.75E-08
+	NB-94	702.63	100.00	-2.58E-08	4.21E-08	4.21E-08
		871.10	100.00	-3.88E-08		4.91E-08
+	I-131	284.30	6.06	-3.91E-07	6.98E-08	8.40E-07
		364.48	81.20	3.36E-09		6.98E-08
		636.97	7.27	-2.23E-07		7.77E-07
+	CS-134	604.70	97.60	8.74E-09	5.72E-08	5.72E-08
		795.84	85.40	9.54E-10		6.05E-08
+	CS-137	661.65	* 85.12	2.28E-06	7.31E-08	7.31E-08
+	CE-144	80.12	1.36	3.13E-06	3.41E-07	4.06E-06
		133.51	11.09	7.06E-08		3.41E-07

## Analysis Report for L1-SUB-CDR-FSGS-014-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	EU-152	121.78	28.40	-3.73E-08	1.33E-07	1.33E-07
		244.69	7.49	-1.17E-07		6.26E-07
		964.00	14.44	5.40E-07		4.82E-07
		1408.00	20.74	5.35E-08		2.03E-07
+	EU-154	123.07	40.40	5.64E-08	9.41E-08	9.41E-08
		247.94	6.60	-2.76E-07		6.72E-07
		723.30	19.70	3.52E-08		2.51E-07
		873.20	11.50	7.42E-08		4.36E-07
		1004.76	17.90	-8.54E-08		3.28E-07
		1274.51	35.50	-1.08E-07		1.70E-07
+	EU-155	86.54	32.80	-1.02E-07	1.41E-07	1.41E-07
		105.31	21.80	-6.00E-08		1.74E-07
+	BI-214	609.31	* 46.30	8.06E-08	1.14E-07	1.14E-07
		1120.29	15.10	2.73E-08		4.57E-07
		1238.11	5.94	3.61E-07		1.36E-06
		1377.67	4.11	-1.66E-07		1.15E-06
		1407.98	2.48	4.48E-07		1.70E-06
		1509.19	2.19	6.90E-07		1.89E-06
		1764.49	15.80	1.70E-07		3.23E-07
+	PB-214	77.11	10.70	9.62E-07	1.26E-07	5.50E-07
		295.21	* 19.20	1.49E-07		1.53E-07
		351.92	* 37.20	8.57E-08		1.26E-07
+	PA-228	89.95	22.00	1.17E-06	4.78E-07	8.15E-07
		93.35	35.00	-2.61E-08		4.78E-07
		105.00	16.30	9.42E-08		9.22E-07
		129.22	2.97	1.74E-07		5.03E-06
		338.32	5.30	1.32E-07		3.57E-06
		463.00	13.80	1.86E-06		1.73E-06
		911.23	16.70	9.56E-07		1.51E-06
+	✓AM-241	59.54	36.30	1.18E-07	2.63E-07	2.63E-07
+	CM-243	103.76	23.00	6.08E-08	1.66E-07	1.66E-07
		228.18	10.60	-2.69E-08		3.70E-07
		277.60	14.00	-2.78E-07		3.17E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for L1-SUB-CDR-QSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : L1-SUB-CDR-QSGS-014-SB ✓  
Sample Description : UNIT L1-SUB CDR 09/13/17  
Sample Type : 500 ml Marinelli  
Unit :  
Sample Point :  
  
Sample Size : 8.946E+02 grams ✓  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/13/2017 2:30:00PM ✓  
Acquisition Started : 9/15/2017 10:29:18AM ✓  
  
Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3610.1 seconds  
  
Dead Time : 0.28 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3401

*Handwritten:*  
254 CUBS  
J. P. Jones  
9/15/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 11:29:31AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for L1-SUB-CDR-QSGS-014-SB

UNIT L1-SUB CDR 09/13/17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	209.15	415 -	426	418.79	6.42E+01	17.89	3.40E+02	1.82
F	2	238.68	472 -	485	477.83	3.63E+02	26.51	4.34E+02	1.98
F	3	295.03	582 -	596	590.51	9.36E+01	17.09	2.74E+02	1.97
F	4	352.22	697 -	710	704.87	1.75E+02	17.64	1.86E+02	1.92
F	5	583.62	1158 -	1174	1167.57	1.25E+02	14.25	1.13E+02	2.09
F	6	609.57	1210 -	1226	1219.48	1.28E+02	14.35	1.04E+02	2.17
F	7	662.07	1318 -	1333	1324.45	4.47E+02	22.78	7.93E+01	2.43
F	8	911.96	1818 -	1830	1824.15	8.23E+01	11.64	4.68E+01	2.59
F	9	969.83	1935 -	1945	1939.89	3.28E+01	8.82	5.30E+01	1.71
F	10	1121.23	2236 -	2248	2242.65	3.44E+01	8.57	4.80E+01	1.77
F	11	1461.73	2913 -	2933	2923.58	8.39E+02	29.32	1.05E+01	2.75

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 11:29:31AM

Env. Background File : C:\Canberra\Apex\Root\Daifland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	209.15	6.42E+01	17.89			6.42E+01	1.79E+01
F	2	238.68	3.63E+02	26.51			3.63E+02	2.65E+01
F	3	295.03	9.36E+01	17.09			9.36E+01	1.71E+01
F	4	352.22	1.75E+02	17.64	8.36E+01	1.86E+01	9.10E+01	2.56E+01
F	5	583.62	1.25E+02	14.25			1.25E+02	1.43E+01
F	6	609.57	1.28E+02	14.35	4.12E+01	1.21E+01	8.72E+01	1.88E+01
F	7	662.07	4.47E+02	22.78	6.61E+01	1.27E+01	3.81E+02	2.61E+01
F	8	911.96	8.23E+01	11.64			8.23E+01	1.16E+01
F	9	969.83	3.28E+01	8.82			3.28E+01	8.82E+00
F	10	1121.23	3.44E+01	8.57			3.44E+01	8.57E+00
F	11	1461.73	8.39E+02	29.32			8.39E+02	2.93E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma



Analysis Report for L1-SUB-CDR-QSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
✓ K-40	0.856	1.02E-05	4.56E-07	
CS-137	0.973	2.88E-07	2.12E-08	
PB-212	0.560	2.09E-07	1.62E-08	
BI-214	0.556	1.30E-07	2.25E-08	
PB-214	0.712	1.16E-07	1.85E-08	
AC-228	0.416	2.37E-07	2.79E-08	

- ? = 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 L1-SUB-CDR-QSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.85	1460.75 *	10.67	1.02E-05	4.56E-07
CS-137	0.97	661.65 *	85.12	2.88E-07	2.12E-08
PB-212	0.56	77.11	17.50		
		238.63 *	44.60	2.09E-07	1.62E-08
BI-214	0.55	609.31 *	46.30	1.12E-07	2.44E-08
		1120.29 *	15.10	2.35E-07	5.89E-08
		1238.11	5.94		
		1377.67	4.11		
		1407.98	2.48		
		1509.19	2.19		
		1764.49	15.80		
PB-214	0.71	77.11	10.70		
		295.21 *	19.20	1.50E-07	2.76E-08
		351.92 *	37.20	8.79E-08	2.49E-08
AC-228	0.41	209.28 *	4.40	3.40E-07	9.52E-08
		338.32	11.40		
		794.70	4.60		
		911.60 *	27.70	2.55E-07	3.65E-08
		964.60	5.20		
		969.11 *	16.60	1.79E-07	4.84E-08

\* = 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 L1-SUB-CDR-QSGS-014-SB  
UNIT L1-SUB CDR 09/13/17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 11:29:31AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 5	583.62	3.47497E-02	11.39		TL 208

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

9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daivland\_NPPLibrary\HOTLAB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	* 10.67	1.02E-05	2.80E-07	2.80E-07
+	AR-41	1293.64	99.16	9.08E-02	1.37E+00	1.37E+00
+	CO-60	1173.22	100.00	-1.70E-08	5.80E-08	7.06E-08
		1332.49	100.00	7.49E-08		5.80E-08
+	KR-85	513.99	0.43	1.12E-05	1.03E-05	1.03E-05
+	Y-88	898.04	93.70	2.02E-08	3.32E-08	5.52E-08
		1836.06	99.20	-1.71E-08		3.32E-08
+	NB-94	702.63	100.00	-2.12E-08	4.00E-08	4.00E-08
		871.10	100.00	-1.34E-08		4.44E-08
+	I-131	284.30	6.06	9.01E-08	4.78E-08	6.24E-07
		364.48	81.20	1.44E-08		4.78E-08
		636.97	7.27	2.35E-07		6.78E-07
+	CS-134	604.70	97.60	-6.17E-09	5.20E-08	5.25E-08
		795.84	85.40	1.48E-08		5.20E-08
+	CS-137	661.65	* 85.12	2.88E-07	5.59E-08	5.59E-08
+	CE-144	80.12	1.36	3.69E-06	2.85E-07	3.47E-06
		133.51	11.09	2.93E-08		2.85E-07

## Analysis Report for L1-SUB-CDR-QSGS-014-SB

UNIT L1-SUB CDR 09/13/17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	EU-152	121.78	28.40	-1.50E-07	1.08E-07	1.08E-07
		244.69	7.49	-2.35E-07		5.28E-07
		964.00	14.44	-2.29E-07		4.12E-07
		1408.00	20.74	1.18E-07		1.93E-07
+	EU-154	123.07	40.40	-1.11E-07	7.54E-08	7.54E-08
		247.94	6.60	-5.39E-07		5.32E-07
		723.30	19.70	-1.37E-07		2.13E-07
		873.20	11.50	-9.33E-08		3.77E-07
		1004.76	17.90	8.06E-08		3.01E-07
		1274.51	35.50	-9.11E-08		1.70E-07
+	EU-155	86.54	32.80	-4.64E-08	1.20E-07	1.20E-07
		105.31	21.80	1.30E-07		1.48E-07
+	BI-214	609.31	* 46.30	1.12E-07	9.96E-08	9.96E-08
		1120.29	* 15.10	2.35E-07		2.74E-07
		1238.11	5.94	8.11E-07		1.26E-06
		1377.67	4.11	-7.59E-07		9.99E-07
		1407.98	2.48	9.90E-07		1.61E-06
		1509.19	2.19	9.15E-08		1.50E-06
		1764.49	15.80	3.37E-08		2.46E-07
+	PB-214	77.11	10.70	4.71E-07	1.00E-07	4.66E-07
		295.21	* 19.20	1.50E-07		1.52E-07
		351.92	* 37.20	8.79E-08		1.00E-07
+	PA-228	89.95	22.00	5.69E-08	4.21E-07	7.03E-07
		93.35	35.00	3.27E-07		4.21E-07
		105.00	16.30	3.02E-07		8.00E-07
		129.22	2.97	4.40E-06		4.31E-06
		338.32	5.30	4.30E-07		2.70E-06
		463.00	13.80	8.51E-08		1.15E-06
		911.23	16.70	2.67E-06		1.54E-06
+	AM-241	59.54	36.30	-1.40E-08	2.17E-07	2.17E-07
+	CM-243	103.76	23.00	-5.86E-08	1.41E-07	1.41E-07
		228.18	10.60	4.56E-08		2.92E-07
		277.60	14.00	1.35E-07		2.37E-07

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR # 4  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : CDR # 4 ✓  
Sample Description : SOIL  
Sample Type : Silt  
Unit :  
Sample Point :  
  
Sample Size : 2.916E+03 grams ✓  
Facility : Diaryland\_NPP  
  
Sample Taken On : 9/15/2017 11:00:00AM ✓  
Acquisition Started : 9/15/2017 12:43:35PM  
  
Procedure : Silt  
Operator : Administrator  
Detector Name : DET01-ENV  
Geometry : 1.5L Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3626.3 seconds  
  
Dead Time : 0.72 %  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 6/3/2014  
Efficiency Calibration Used Done On : 6/3/2014  
Efficiency Calibration Description : 1.5 Marinelli  
  
Sample Number : 3406

REVIEWED  
JAN 09  
9/15/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 1:44:07PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR # 4

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	75.84	146 -	194	152.52	6.13E+02	47.50	1.91E+03	3.08
m	2	83.67	146 -	194	168.20	1.57E+02	40.98	2.38E+03	3.10
m	3	87.48	146 -	194	175.82	2.20E+02	41.82	2.37E+03	3.11
m	4	92.32	146 -	194	185.49	4.33E+02	44.29	2.25E+03	3.12
F	5	185.65	367 -	376	372.22	2.39E+02	35.12	1.31E+03	1.40
F	6	209.29	413 -	428	419.51	1.81E+02	38.84	1.85E+03	2.20
F	7	238.33	468 -	486	477.61	1.17E+03	43.90	1.77E+03	1.52
F	8	294.96	586 -	605	590.92	3.96E+02	30.35	1.54E+03	1.27
F	9	351.56	696 -	710	704.15	8.61E+02	36.92	9.09E+02	1.49
F	10	510.41	1013 -	1029	1021.97	2.37E+02	25.97	6.37E+02	2.15
F	11	582.78	1135 -	1172	1166.77	3.91E+02	25.44	9.19E+02	1.74
F	12	608.94	1207 -	1226	1219.10	6.07E+02	30.06	5.52E+02	1.84
F	13	661.17	1313 -	1334	1323.60	1.31E+04	115.77	4.67E+02	1.89
F	14	726.97	1450 -	1460	1455.25	8.83E+01	13.80	1.09E+02	1.91
F	15	768.00	1532 -	1542	1537.35	6.13E+01	12.63	1.51E+02	1.33
M	16	785.61	1564 -	1595	1572.57	3.84E+01	11.20	1.34E+02	1.81
m	17	794.64	1564 -	1595	1590.65	4.53E+01	11.79	1.17E+02	1.82
F	18	859.77	1711 -	1726	1720.96	5.87E+01	11.71	1.40E+02	1.61
F	19	910.62	1814 -	1833	1822.70	3.34E+02	21.98	2.16E+02	2.43
F	20	933.14	1860 -	1875	1867.76	4.46E+01	13.47	1.83E+02	2.23
F	21	968.26	1926 -	1948	1938.03	1.93E+02	19.34	2.72E+02	2.95
F	22	1119.78	2232 -	2247	2241.18	1.84E+02	18.32	1.80E+02	2.49
F	23	1172.67	2334 -	2357	2347.01	5.19E+02	25.74	2.37E+02	2.42
F	24	1237.19	2471 -	2488	2476.10	4.79E+01	11.15	2.16E+02	1.58
F	25	1331.84	2653 -	2675	2665.49	4.62E+02	23.72	1.44E+02	2.69
F	26	1460.12	2908 -	2933	2922.16	4.11E+03	64.78	8.77E+01	2.83
F	27	1728.96	3454 -	3466	3460.08	2.74E+01	7.37	2.25E+01	2.79
F	28	1763.88	3520 -	3538	3529.95	1.40E+02	12.93	2.63E+01	3.16

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

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 1:44:06PM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003388.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	1	75.84	6.13E+02	47.50			6.13E+02	4.75E+01

Analysis Report for CDR #4

SOIL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	2	83.67	1.57E+02	40.98			1.57E+02	4.10E+01
m	3	87.48	2.20E+02	41.82			2.20E+02	4.18E+01
m	4	92.32	4.33E+02	44.29	5.07E+01	8.63E+00	3.82E+02	4.51E+01
F	5	185.65	2.39E+02	35.12	3.67E+01	8.25E+00	2.03E+02	3.61E+01
F	6	209.29	1.81E+02	38.84			1.81E+02	3.88E+01
F	7	238.33	1.17E+03	43.90	3.14E+01	6.41E+00	1.14E+03	4.44E+01
F	8	294.96	3.96E+02	30.35	1.00E+01	5.91E+00	3.86E+02	3.09E+01
F	9	351.56	8.61E+02	36.92	2.24E+01	5.47E+00	8.39E+02	3.73E+01
F	10	510.41	2.37E+02	25.97	1.52E+02	8.10E+00	8.55E+01	2.72E+01
F	11	582.78	3.91E+02	25.44	2.14E+01	4.78E+00	3.69E+02	2.59E+01
F	12	608.94	6.07E+02	30.06	2.18E+01	4.83E+00	5.86E+02	3.04E+01
F	13	661.17	1.31E+04	115.77	1.38E+01	4.37E+00	1.31E+04	1.16E+02
F	14	726.97	8.83E+01	13.80			8.83E+01	1.38E+01
F	15	768.00	6.13E+01	12.63			6.13E+01	1.26E+01
M	16	785.61	3.84E+01	11.20			3.84E+01	1.12E+01
m	17	794.64	4.53E+01	11.79			4.53E+01	1.18E+01
F	18	859.77	5.87E+01	11.71			5.87E+01	1.17E+01
F	19	910.62	3.34E+02	21.98	1.35E+01	3.68E+00	3.20E+02	2.23E+01
F	20	933.14	4.46E+01	13.47			4.46E+01	1.35E+01
F	21	968.26	1.93E+02	19.34			1.93E+02	1.93E+01
F	22	1119.78	1.84E+02	18.32	1.09E+01	3.21E+00	1.73E+02	1.86E+01
F	23	1172.67	5.19E+02	25.74			5.19E+02	2.57E+01
F	24	1237.19	4.79E+01	11.15			4.79E+01	1.11E+01
F	25	1331.84	4.62E+02	23.72			4.62E+02	2.37E+01
F	26	1460.12	4.11E+03	64.78	5.78E+01	4.59E+00	4.06E+03	6.49E+01
F	27	1728.96	2.74E+01	7.37			2.74E+01	7.37E+00
F	28	1763.88	1.40E+02	12.93	1.38E+01	2.34E+00	1.27E+02	1.31E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.92	1460.81	*	10.67	6.62E+00	2.12E-01
CO-60	0.94	1173.22	*	100.00	7.78E-02	4.28E-03

Analysis Report for CDR # 4

SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
CO-60	0.94	1332.49 *		100.00	7.58E-02	4.35E-03
CS-137	0.96	661.65 *		85.12	1.52E+00	4.33E-02
BI-212	0.78	727.17 *		11.80	7.86E-02	1.24E-02
		785.42 *		2.00	2.13E-01	6.24E-02
		1620.56		2.75		
PB-212	0.57	77.11		17.50		
		87.20 *		6.30	2.96E-01	5.70E-02
		89.80		1.75		
		238.63 *		44.60	1.48E-01	6.91E-03
		300.09		3.41		
BI-214	0.74	609.31 *		46.30	1.18E-01	6.95E-03
		768.36 *		5.04	1.33E-01	2.75E-02
		806.17		1.23		
		934.06 *		3.21	1.75E-01	5.31E-02
		1120.29 *		15.10	1.66E-01	1.82E-02
		1155.19		1.69		
		1238.11 *		5.94	1.26E-01	2.94E-02
		1280.96		1.47		
		1377.67		4.11		
		1401.50		1.39		
		1407.98		2.48		
		1509.19		2.19		
		1661.28		1.15		
		1729.60 *		3.05	1.71E-01	4.63E-02
		1764.49 *		15.80	1.54E-01	1.67E-02
		1847.44		2.12		
PB-214	0.56	74.81		6.33		
		77.11		10.70		
		87.20 *		3.70	5.04E-01	9.71E-02
		89.80		1.03		
		241.98		7.49		
		295.21 *		19.20	1.26E-01	1.06E-02
		351.92 *		37.20	1.53E-01	7.80E-03
		785.91 *		1.10	3.88E-01	1.13E-01
RA-226	0.95	186.21 *		3.28	3.35E-01	6.03E-02

\* = 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

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**INTERFERENCE CORRECTED REPORT**

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Analysis Report for CDR # 4

SOIL

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
<del>K-40</del>	0.927	6.62E+00	2.12E-01	
✓ CO-60	0.945	7.68E-02	3.05E-03	
X <del>CD-109</del>	0.953			
✓ CS-137	0.964	1.52E+00	4.33E-02	
BI-212	0.785	8.07E-02	1.22E-02	
PB-212	0.577	1.48E-01	6.86E-03	
BI-214	0.743	1.29E-01	5.72E-03	
PB-214	0.563	1.45E-01	6.25E-03	
RA-226	0.951	3.35E-01	6.03E-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 CDR # 4

SOIL

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 1:44:06PM  
 Peak Locate From Channel : 100  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
M 1	75.84	1.70261E-01	7.75	Tol.	TL-208 ✓
m 2	83.67	4.35682E-02	26.13		
m 4	92.32	1.06140E-01	11.81	Tol.	TH-234 ✓ TH-234
F 6	209.29	5.01650E-02	21.51	Tol.	AC-228 ✓ TL-208
F 10	510.41	2.37633E-02	31.80		
F 11	582.78	1.02623E-01	7.01	Tol.	TL-208 ✓
m 17	794.64	1.25842E-02	26.03	Sum	
F 18	859.77	1.62969E-02	19.96	Tol.	TL-208 ✓
F 19	910.62	8.89174E-02	6.96	Tol.	AC-228 ✓
F 21	968.26	5.36037E-02	10.02	Tol.	AC-228 ✓

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

*J. O. Jones*  
 9/15/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	K-40	1460.81	* 10.67	6.62E+00	1.20E-01	1.20E-01
+	MN-54	834.83	99.97	7.04E-03	1.25E-02	1.25E-02
+	CO-60	1173.22	* 100.00	7.78E-02	1.32E-02	1.56E-02
		1332.49	* 100.00	7.58E-02		1.32E-02

## Analysis Report for CDR #4

## SOIL

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	ZN-65	1115.52		50.75	5.17E-02	3.64E-02	3.64E-02
+	KR-85	513.99		0.43	3.78E+00	3.76E+00	3.76E+00
+	CD-109	88.03	*	3.72	5.01E-01	5.22E-01	5.22E-01
+	CS-134	604.70		97.60	6.77E-02	1.47E-02	1.81E-02
		795.84		85.40	-3.86E-04		1.47E-02
+	CS-137	661.65	*	85.12	1.52E+00	1.63E-02	1.63E-02
+	EU-154	123.07		40.40	-3.09E-02	4.09E-02	4.09E-02
		722.30		20.00	4.82E-02		5.98E-02
		873.20		12.09	5.84E-02		1.05E-01
		996.30		10.34	3.74E-02		1.36E-01
		1004.76		17.90	7.97E-03		7.99E-02
		1274.51		34.40	1.78E-02		4.57E-02
+	EU-155	86.54		32.80	2.25E-02	8.03E-02	8.03E-02
		105.31		21.80	-4.75E-02		8.44E-02
+	TL-208	72.80		2.02	-1.98E+11	4.17E+09	4.08E+11
		74.97		3.41	-7.84E+10		2.24E+11
		84.90		1.51	-1.49E+12		3.67E+11
		277.36		6.31	-9.98E+08		5.34E+10
		583.19		84.50	-8.66E+08		4.17E+09
		763.13		1.81	1.42E+11		1.60E+11
		860.56		12.42	1.57E+10		2.44E+10
		1093.90		0.40	-1.40E+11		8.72E+11
+	BI-214	609.31	*	46.30	1.18E-01	3.00E-02	3.00E-02
		768.36	*	5.04	1.33E-01		1.41E-01
		806.17		1.23	-5.23E-01		9.40E-01
		934.06	*	3.21	1.75E-01		3.15E-01
		1120.29	*	15.10	1.66E-01		7.75E-02
		1155.19		1.69	1.11E+00		1.03E+00
		1238.11	*	5.94	1.26E-01		2.38E-01
		1280.96		1.47	-2.58E-02		1.01E+00
		1377.67		4.11	2.51E-01		3.08E-01
		1401.50		1.39	9.18E-01		8.78E-01
		1407.98		2.48	5.49E-01		5.06E-01
		1509.19		2.19	-1.15E-01		4.81E-01
		1661.28		1.15	7.15E-02		6.54E-01
		1729.60	*	3.05	1.71E-01		1.75E-01
		1764.49	*	15.80	1.54E-01		4.49E-02
		1847.44		2.12	1.65E-01		4.00E-01
+	PB-214	74.81		6.33	-1.89E-01	3.16E-02	5.40E-01
		77.11		10.70	-6.07E-02		2.96E-01
		87.20	*	3.70	5.04E-01		5.25E-01
		89.80		1.03	6.53E+00		2.41E+00
		241.98		7.49	-2.16E-01		2.41E-01
		295.21	*	19.20	1.26E-01		8.06E-02
		351.92	*	37.20	1.53E-01		3.16E-02
		785.91	*	1.10	3.88E-01		5.72E-01
+	RA-223	81.07		15.00	4.66E-02	1.03E-01	1.90E-01
		83.78		24.80	-4.02E-01		1.03E-01
		94.90		11.30	-1.32E-03		1.97E-01
		122.31		1.19	-5.76E-01		1.40E+00

## Analysis Report for CDR # 4

## SOIL

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Nuclide MDA (pCi/grams)</b>	<b>Line MDA (pCi/grams)</b>
	RA-223	144.20		3.26	2.71E-01	1.03E-01	4.80E-01
		154.19		5.59	8.74E-02		2.72E-01
		269.41		13.60	9.56E-02		1.11E-01
		323.89		3.90	4.19E-01		3.81E-01
		338.32		2.78	-2.69E-01		5.50E-01
		444.94		1.27	-5.49E-02		1.29E+00
+	RA-226	186.21	*	3.28	3.35E-01	3.06E-01	3.06E-01
+	AC-228	129.08		2.80	2.35E-02	6.10E-02	5.80E-01
		209.28		4.40	2.28E-01		3.64E-01
		270.23		3.60	4.69E-01		4.19E-01
		327.64		3.20	-1.48E+00		4.56E-01
		338.32		11.40	-6.52E-02		1.33E-01
		409.51		2.13	-2.91E-01		7.49E-01
		463.00		4.40	1.25E-01		4.06E-01
		794.70		4.60	-9.10E-02		2.72E-01
		911.60		27.70	1.81E-01		6.10E-02
		964.60		5.20	7.01E-01		3.25E-01
		969.11		16.60	1.32E-01		1.00E-01
		1587.90		3.71	3.47E-01		2.87E-01
+	Th-230	12.30		8.43	0.00E+00	1.12E+01	9.04E+10
		67.60		0.37	-1.53E+01		1.12E+01
		168.10		0.07	-1.80E+01		2.13E+01
+	PA-234M	766.36		0.29	8.50E-01	1.68E+00	4.30E+00
		1001.03		0.84	-9.96E-02		1.68E+00
+	TH-234	63.29		4.50	-5.89E-01	8.98E-01	1.17E+00
		92.38		2.60	-4.28E-02		9.03E-01
		92.80		2.60	5.55E-02		8.98E-01
+	AM-241	59.54		36.30	-4.43E-02	1.88E-01	1.88E-01
+	CM-243	99.55		14.30	4.73E-02	8.12E-02	1.42E-01
		103.76		23.00	-4.81E-03		8.12E-02
		117.00		10.80	6.37E-02		1.58E-01
		228.18		10.60	-2.09E-02		1.46E-01
		277.60		14.00	-6.39E-02		1.07E-01

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-5  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : CDR-NRC-5  
Sample Description : SOIL  
Sample Type : Silt  
Unit :  
Sample Point :  
  
Sample Size : 3.141E+03 grams ✓  
Facility : Diaryland\_NPP  
  
Sample Taken On : 9/15/2017 1:00:00PM ✓  
Acquisition Started : 9/15/2017 2:39:28PM  
  
Procedure : Silt  
Operator : Administrator  
Detector Name : DET01-ENV  
Geometry : 1.5L Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3625.3 seconds  
  
Dead Time : 0.70 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 6/3/2014  
Efficiency Calibration Used Done On : 6/3/2014  
Efficiency Calibration Description : 1.5 Marinelli  
  
Sample Number : 3408

*Reviewed  
Jim D. Galt  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 3:31:34PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR-NRC-5

## SOIL

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
F	1	76.56	146 -	160	153.96	4.64E+02	40.86	1.68E+03	2.09
M	2	86.73	166 -	190	174.32	1.43E+02	29.09	1.23E+03	1.60
m	3	92.42	166 -	190	185.71	2.77E+02	35.25	1.30E+03	1.61
F	4	185.72	364 -	381	372.35	2.78E+02	32.30	1.79E+03	1.49
F	5	208.87	415 -	427	418.68	1.39E+02	30.50	1.22E+03	1.74
M	6	238.29	468 -	489	477.54	1.24E+03	42.78	7.07E+02	1.48
m	7	241.31	468 -	489	483.58	3.03E+02	27.27	7.52E+02	1.49
F	8	270.16	535 -	559	541.31	1.54E+02	28.25	1.54E+03	2.01
F	9	294.88	582 -	596	590.76	4.26E+02	31.11	9.76E+02	1.45
F	10	337.88	666 -	686	676.78	2.84E+02	27.12	1.01E+03	1.74
F	11	351.56	697 -	708	704.15	8.40E+02	35.87	6.00E+02	1.54
F	12	463.05	923 -	933	927.22	8.39E+01	16.74	4.34E+02	0.94
F	13	510.51	1015 -	1032	1022.18	2.70E+02	25.58	5.07E+02	2.49
F	14	582.80	1158 -	1173	1166.81	4.10E+02	25.28	3.40E+02	1.70
F	15	608.95	1209 -	1228	1219.13	6.96E+02	31.15	4.41E+02	1.95
F	16	661.17	1312 -	1332	1323.61	6.69E+03	83.05	3.32E+02	1.94
F	17	726.44	1449 -	1460	1454.20	7.94E+01	14.17	1.72E+02	1.57
M	18	785.03	1567 -	1595	1571.42	5.58E+01	11.48	1.04E+02	1.48
m	19	794.59	1567 -	1595	1590.54	5.78E+01	11.66	1.15E+02	1.48
F	20	860.18	1716 -	1730	1721.79	5.54E+01	13.78	1.59E+02	2.43
F	21	910.61	1814 -	1831	1822.68	3.89E+02	23.72	2.22E+02	2.32
F	22	968.51	1933 -	1946	1938.52	1.79E+02	17.96	2.15E+02	1.62
F	23	1119.80	2234 -	2248	2241.23	1.24E+02	16.42	2.33E+02	1.75
F	24	1172.71	2336 -	2354	2347.08	5.80E+02	28.30	2.81E+02	2.37
F	25	1237.59	2471 -	2485	2476.90	6.78E+01	15.04	2.06E+02	2.20
F	26	1331.93	2654 -	2674	2665.67	5.35E+02	25.18	1.13E+02	2.55
F	27	1377.06	2748 -	2762	2755.96	5.87E+01	10.47	5.41E+01	2.59
F	28	1460.14	2908 -	2931	2922.20	4.26E+03	66.08	7.84E+01	2.84
F	29	1728.88	3453 -	3468	3459.92	3.64E+01	7.53	1.47E+01	3.39
F	30	1763.78	3519 -	3539	3529.75	1.78E+02	14.22	2.61E+01	3.35
F	31	1846.75	3689 -	3702	3695.76	2.31E+01	5.98	1.75E+01	1.78

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

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 3:31:34PM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003388.CNF

Analysis Report for CDR-NRC-5

SOIL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
F	1	76.56	4.64E+02	40.86			4.64E+02	4.09E+01
M	2	86.73	1.43E+02	29.09			1.43E+02	2.91E+01
m	3	92.42	2.77E+02	35.25	5.07E+01	8.63E+00	2.26E+02	3.63E+01
F	4	185.72	2.78E+02	32.30	3.67E+01	8.25E+00	2.42E+02	3.33E+01
F	5	208.87	1.39E+02	30.50			1.39E+02	3.05E+01
M	6	238.29	1.24E+03	42.78	3.14E+01	6.41E+00	1.21E+03	4.33E+01
m	7	241.31	3.03E+02	27.27			3.03E+02	2.73E+01
F	8	270.16	1.54E+02	28.25			1.54E+02	2.82E+01
F	9	294.88	4.26E+02	31.11	1.00E+01	5.91E+00	4.16E+02	3.17E+01
F	10	337.88	2.84E+02	27.12	9.67E+00	5.86E+00	2.74E+02	2.77E+01
F	11	351.56	8.40E+02	35.87	2.24E+01	5.47E+00	8.17E+02	3.63E+01
F	12	463.05	8.39E+01	16.74			8.39E+01	1.67E+01
F	13	510.51	2.70E+02	25.58	1.52E+02	8.10E+00	1.18E+02	2.68E+01
F	14	582.80	4.10E+02	25.28	2.14E+01	4.78E+00	3.89E+02	2.57E+01
F	15	608.95	6.96E+02	31.15	2.18E+01	4.83E+00	6.74E+02	3.15E+01
F	16	661.17	6.69E+03	83.05	1.38E+01	4.37E+00	6.67E+03	8.32E+01
F	17	726.44	7.94E+01	14.17			7.94E+01	1.42E+01
M	18	785.03	5.58E+01	11.48			5.58E+01	1.15E+01
m	19	794.59	5.78E+01	11.66			5.78E+01	1.17E+01
F	20	860.18	5.54E+01	13.78			5.54E+01	1.38E+01
F	21	910.61	3.89E+02	23.72	1.35E+01	3.68E+00	3.76E+02	2.40E+01
F	22	968.51	1.79E+02	17.96			1.79E+02	1.80E+01
F	23	1119.80	1.24E+02	16.42	1.09E+01	3.21E+00	1.13E+02	1.67E+01
F	24	1172.71	5.80E+02	28.30			5.80E+02	2.83E+01
F	25	1237.59	6.78E+01	15.04			6.78E+01	1.50E+01
F	26	1331.93	5.35E+02	25.18			5.35E+02	2.52E+01
F	27	1377.06	5.87E+01	10.47			5.87E+01	1.05E+01
F	28	1460.14	4.26E+03	66.08	5.78E+01	4.59E+00	4.20E+03	6.62E+01
F	29	1728.88	3.64E+01	7.53			3.64E+01	7.53E+00
F	30	1763.78	1.78E+02	14.22	1.38E+01	2.34E+00	1.64E+02	1.44E+01
F	31	1846.75	2.31E+01	5.98			2.31E+01	5.98E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES

## Analysis Report for CDR-NRC-5

## SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.93	1460.81	*	10.67	6.37E+00	2.03E-01
CO-60	0.95	1173.22	*	100.00	8.07E-02	4.39E-03
		1332.49	*	100.00	8.15E-02	4.37E-03
CS-137	0.96	661.65	*	85.12	7.16E-01	2.14E-02
BI-212	0.72	727.17	*	11.80	6.56E-02	1.18E-02
		785.42	*	2.00	2.87E-01	5.95E-02
		1620.56		2.75		
PB-212	0.86	77.11	*	17.50	2.78E-01	2.63E-02
		87.20	*	6.30	1.81E-01	3.74E-02
		89.80		1.75		
		238.63	*	44.60	1.45E-01	6.43E-03
		300.09		3.41		
BI-214	0.69	609.31	*	46.30	1.26E-01	6.86E-03
		768.36		5.04		
		806.17		1.23		
		934.06		3.21		
		1120.29	*	15.10	1.01E-01	1.51E-02
		1155.19		1.69		
		1238.11	*	5.94	1.65E-01	3.69E-02
		1280.96		1.47		
		1377.67	*	4.11	2.23E-01	4.01E-02
		1401.50		1.39		
		1407.98		2.48		
		1509.19		2.19		
		1661.28		1.15		
		1729.60	*	3.05	2.11E-01	4.41E-02
		1764.49	*	15.80	1.85E-01	1.73E-02
		1847.44	*	2.12	1.97E-01	5.16E-02
PB-214	0.86	74.81		6.33		
		77.11	*	10.70	4.55E-01	4.30E-02
		87.20	*	3.70	3.08E-01	6.36E-02
		89.80		1.03		
		241.98	*	7.49	2.18E-01	2.04E-02
		295.21	*	19.20	1.26E-01	1.01E-02
		351.92	*	37.20	1.39E-01	7.04E-03
		785.91	*	1.10	5.22E-01	1.08E-01
RA-226	0.96	186.21	*	3.28	3.70E-01	5.21E-02
AC-228	0.62	129.08		2.80		
		209.28	*	4.40	1.62E-01	3.60E-02
		270.23	*	3.60	2.39E-01	4.45E-02
		327.64		3.20		
		338.32	*	11.40	1.49E-01	1.55E-02
		409.51		2.13		
		463.00	*	4.40	1.39E-01	2.81E-02
		794.70	*	4.60	1.30E-01	2.65E-02
		911.60	*	27.70	1.56E-01	1.05E-02
		964.60		5.20		
		969.11	*	16.60	1.30E-01	1.33E-02
		1587.90		3.71		



Analysis Report for CDR-NRC-5

SOIL

\* = 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

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## INTERFERENCE CORRECTED REPORT

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	<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
	✓ K-40	0.931	6.37E+00	2.03E-01	
	✓ CO-60	0.956	8.11E-02	3.09E-03	
	✓ CS-137	0.964	7.16E-01	2.14E-02	
X	EU-155	0.303			
	BI-212	0.729	7.10E-02	1.16E-02	
	PB-212	0.862	1.46E-01	6.16E-03	
	BI-214	0.699	1.34E-01	5.66E-03	
	PB-214	0.863	1.42E-01	5.49E-03	
	RA-226	0.961	3.70E-01	5.21E-02	
	AC-228	0.629	1.48E-01	6.63E-03	

? = 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 CDR-NRC-5  
SOIL

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 3:31:34PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m 3	92.42	6.27712E-02	16.06	Tol.	TH-234 ✓
F 13	510.51	3.27971E-02	22.73	Sum	TH-234
F 14	582.80	1.08031E-01	6.61		TL 208
F 20	860.18	1.53864E-02	24.87		TL 208

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

*J. O. J. H.*  
9/18/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+ K-40	1460.81	* 10.67	6.37E+00	1.05E-01	1.05E-01
+ MN-54	834.83	99.97	9.27E-03	1.20E-02	1.20E-02
+ CO-60	1173.22	* 100.00	8.07E-02	1.06E-02	1.45E-02
	1332.49	* 100.00	8.15E-02		1.06E-02
+ ZN-65	1115.52	50.75	6.71E-02	3.48E-02	3.48E-02
+ KR-85	513.99	0.43	4.94E+00	3.17E+00	3.17E+00
+ CD-109	88.03	3.72	-9.33E-02	6.09E-01	6.09E-01
+ CS-134	604.70	97.60	6.18E-02	1.41E-02	1.63E-02
	795.84	85.40	6.70E-04		1.41E-02
+ CS-137	661.65	* 85.12	7.16E-01	1.27E-02	1.27E-02
+ EU-154	123.07	40.40	-5.76E-03	3.56E-02	3.56E-02
	722.30	20.00	5.97E-02		5.83E-02
	873.20	12.09	6.08E-02		1.02E-01

## Analysis Report for CDR-NRC-5

## SOIL

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	EU-154	996.30		10.34	-1.34E-02	3.56E-02	1.30E-01
		1004.76		17.90	-8.41E-03		7.63E-02
		1274.51		34.40	1.58E-02		4.38E-02
+	EU-155	86.54	*	32.80	3.47E-02	4.03E-02	4.03E-02
		105.31		21.80	-8.66E-02		7.37E-02
+	TL-208	72.80		2.02	-6.84E+10	1.47E+09	1.42E+11
		74.97		3.41	2.39E+11		7.85E+10
		84.90		1.51	-1.67E+10		1.26E+11
		277.36		6.31	2.88E+09		1.76E+10
		583.19		84.50	4.38E+09		1.47E+09
		763.13		1.81	-1.19E+10		5.63E+10
		860.56		12.42	-4.48E+09		8.85E+09
		1093.90		0.40	8.67E+10		3.27E+11
+	BI-214	609.31	*	46.30	1.26E-01	2.50E-02	2.50E-02
		768.36		5.04	-1.24E-02		2.29E-01
		806.17		1.23	1.21E-01		9.24E-01
		934.06		3.21	2.58E-01		4.26E-01
		1120.29	*	15.10	1.01E-01		7.94E-02
		1155.19		1.69	2.79E-01		9.55E-01
		1238.11	*	5.94	1.65E-01		2.02E-01
		1280.96		1.47	1.20E+00		1.02E+00
		1377.67	*	4.11	2.23E-01		1.66E-01
		1401.50		1.39	6.98E-01		8.45E-01
		1407.98		2.48	5.63E-01		4.77E-01
		1509.19		2.19	-6.26E-02		4.12E-01
		1661.28		1.15	3.86E-01		6.29E-01
		1729.60	*	3.05	2.11E-01		1.42E-01
		1764.49	*	15.80	1.85E-01		4.27E-02
		1847.44	*	2.12	1.97E-01		2.18E-01
+	PB-214	74.81		6.33	1.47E+00	2.25E-02	4.82E-01
		77.11	*	10.70	4.55E-01		2.27E-01
		87.20	*	3.70	3.08E-01		3.57E-01
		89.80		1.03	-7.13E-02		2.14E+00
		241.98	*	7.49	2.18E-01		9.36E-02
		295.21	*	19.20	1.26E-01		5.42E-02
		351.92	*	37.20	1.39E-01		2.25E-02
		785.91	*	1.10	5.22E-01		4.69E-01
+	RA-223	81.07		15.00	-2.11E-02	9.03E-02	1.69E-01
		83.78		24.80	-1.19E-02		9.03E-02
		94.90		11.30	-9.60E-02		1.75E-01
		122.31		1.19	1.62E-01		1.22E+00
		144.20		3.26	-2.55E-01		4.07E-01
		154.19		5.59	-1.13E-01		2.30E-01
		269.41		13.60	-3.69E-03		9.23E-02
		323.89		3.90	3.34E-01		3.21E-01
		338.32		2.78	4.43E-01		4.79E-01
		444.94		1.27	-3.66E-01		1.00E+00
+	RA-226	186.21	*	3.28	3.70E-01	3.93E-01	3.93E-01
+	AC-228	129.08		2.80	1.67E-01	3.85E-02	5.06E-01
		209.28	*	4.40	1.62E-01		2.22E-01
		270.23	*	3.60	2.39E-01		4.14E-01

## Analysis Report for CDR-NRC-5

## SOIL

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Nuclide MDA (pCi/grams)</b>	<b>Line MDA (pCi/grams)</b>
	AC-228	327.64		3.20	-3.64E-02	3.85E-02	3.86E-01
		338.32	*	11.40	1.49E-01		1.10E-01
		409.51		2.13	2.80E-01		5.72E-01
		463.00	*	4.40	1.39E-01		1.81E-01
		794.70	*	4.60	1.30E-01		1.19E-01
		911.60	*	27.70	1.56E-01		3.85E-02
		964.60		5.20	8.35E-01		3.13E-01
		969.11	*	16.60	1.30E-01		6.09E-02
		1587.90		3.71	6.90E-02		2.55E-01
+	Th-230	12.30		8.43	0.00E+00	1.00E+01	8.40E+10
		67.60		0.37	-8.74E+00		1.00E+01
		168.10		0.07	9.74E+00		1.81E+01
+	PA-234M	766.36		0.29	4.58E-01	1.62E+00	3.93E+00
		1001.03		0.84	-7.97E-02		1.62E+00
+	TH-234	63.29		4.50	2.59E-01	7.95E-01	1.03E+00
		92.38		2.60	-2.22E-02		8.04E-01
		92.80		2.60	-1.39E-01		7.95E-01
+	✓ AM-241	59.54		36.30	-1.10E-03	1.62E-01	1.62E-01
+	CM-243	99.55		14.30	-1.20E-01	7.11E-02	1.26E-01
		103.76		23.00	-8.41E-02		7.11E-02
		117.00		10.80	4.03E-05		1.36E-01
		228.18		10.60	-6.94E-02		1.21E-01
		277.60		14.00	-1.71E-02		8.92E-02

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-6  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification	: CDR-NRC-6
Sample Description	: SOIL
Sample Type	: Silt
Unit	:
Sample Point	:
Sample Size	: 3.087E+03 grams ✓
Facility	: Diaryland_NPP
Sample Taken On	: 9/15/2017 1:05:00PM ✓
Acquisition Started	: 9/15/2017 3:32:19PM ✓
Procedure	: Silt
Operator	: Administrator
Detector Name	: DET01-ENV ✓
Geometry	: 1.5L Marinelli ✓
Live Time	: 3600.0 seconds
Real Time	: 3625.2 seconds
Dead Time	: 0.70 % ✓
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 100 - 4096
Peak Area Range (In channels)	: 100 - 4096
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 6/3/2014
Efficiency Calibration Used Done On	: 6/3/2014
Efficiency Calibration Description	: 1.5 Marinelli
Sample Number	: 3409

*Reviewed  
JmD  
9/15/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 4:32:48PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR-NRC-6

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	74.55	143 -	160	149.95	2.62E+02	28.86	9.64E+02	1.32
m	2	76.90	143 -	160	154.64	3.23E+02	30.62	9.54E+02	1.33
M	3	87.01	171 -	191	174.88	1.05E+02	26.70	9.93E+02	1.27
m	4	92.53	171 -	191	185.92	2.60E+02	31.79	9.13E+02	1.28
F	5	185.59	365 -	380	372.10	3.32E+02	31.29	1.58E+03	1.24
F	6	238.29	468 -	486	477.54	1.11E+03	41.84	1.69E+03	1.34
F	7	269.72	535 -	549	540.42	1.74E+02	29.82	9.19E+02	2.28
F	8	294.81	585 -	597	590.62	4.52E+02	31.32	8.41E+02	1.45
M	9	327.86	653 -	686	656.74	7.76E+01	19.59	4.67E+02	1.56
m	10	338.02	653 -	686	677.06	2.60E+02	25.56	4.68E+02	1.57
F	11	351.55	699 -	709	704.14	9.17E+02	36.18	4.64E+02	1.60
F	12	462.67	921 -	931	926.45	9.02E+01	21.68	4.82E+02	1.65
F	13	510.59	1014 -	1029	1022.33	2.91E+02	26.02	4.46E+02	2.58
F	14	582.75	1157 -	1171	1166.71	4.14E+02	25.64	3.51E+02	1.75
F	15	608.86	1210 -	1225	1218.94	7.16E+02	31.00	3.24E+02	1.94
F	16	661.16	1313 -	1332	1323.59	6.71E+03	83.27	3.37E+02	1.94
F	17	726.75	1450 -	1460	1454.81	9.37E+01	15.05	1.45E+02	1.89
F	18	793.79	1582 -	1594	1588.93	3.54E+01	11.72	1.72E+02	1.46
F	19	910.67	1814 -	1831	1822.79	3.54E+02	22.09	2.02E+02	2.05
F	20	968.21	1925 -	1945	1937.92	2.17E+02	19.36	2.18E+02	2.89
F	21	1119.86	2233 -	2251	2241.34	1.95E+02	18.85	1.97E+02	2.82
F	22	1172.62	2340 -	2355	2346.92	3.12E+02	22.28	2.22E+02	2.36
F	23	1237.66	2471 -	2482	2477.05	4.87E+01	13.30	1.77E+02	1.63
F	24	1331.94	2653 -	2675	2665.67	3.36E+02	20.47	1.38E+02	2.49
F	25	1460.06	2908 -	2931	2922.03	4.29E+03	66.26	6.95E+01	2.86
F	26	1587.51	3169 -	3183	3177.04	3.60E+01	8.53	3.36E+01	3.14
F	27	1729.18	3455 -	3466	3460.52	2.97E+01	6.46	8.52E+00	2.93
F	28	1763.93	3521 -	3539	3530.05	1.58E+02	12.98	9.25E+00	3.39

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 4:32:48PM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003388.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	1	74.55	2.62E+02	28.86	7.82E+01	9.57E+00	1.84E+02	3.04E+01

Analysis Report for CDR-NRC-6

SOIL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	2	76.90	3.23E+02	30.62			3.23E+02	3.06E+01
M	3	87.01	1.05E+02	26.70			1.05E+02	2.67E+01
m	4	92.53	2.60E+02	31.79	5.07E+01	8.63E+00	2.09E+02	3.29E+01
F	5	185.59	3.32E+02	31.29	3.67E+01	8.25E+00	2.95E+02	3.24E+01
F	6	238.29	1.11E+03	41.84	3.14E+01	6.41E+00	1.08E+03	4.23E+01
F	7	269.72	1.74E+02	29.82			1.74E+02	2.98E+01
F	8	294.81	4.52E+02	31.32	1.00E+01	5.91E+00	4.42E+02	3.19E+01
M	9	327.86	7.76E+01	19.59			7.76E+01	1.96E+01
m	10	338.02	2.60E+02	25.56	9.67E+00	5.86E+00	2.51E+02	2.62E+01
F	11	351.55	9.17E+02	36.18	2.24E+01	5.47E+00	8.95E+02	3.66E+01
F	12	462.67	9.02E+01	21.68			9.02E+01	2.17E+01
F	13	510.59	2.91E+02	26.02	1.52E+02	8.10E+00	1.39E+02	2.73E+01
F	14	582.75	4.14E+02	25.64	2.14E+01	4.78E+00	3.92E+02	2.61E+01
F	15	608.86	7.16E+02	31.00	2.18E+01	4.83E+00	6.94E+02	3.14E+01
F	16	661.16	6.71E+03	83.27	1.38E+01	4.37E+00	6.69E+03	8.34E+01
F	17	726.75	9.37E+01	15.05			9.37E+01	1.51E+01
F	18	793.79	3.54E+01	11.72			3.54E+01	1.17E+01
F	19	910.67	3.54E+02	22.09	1.35E+01	3.68E+00	3.41E+02	2.24E+01
F	20	968.21	2.17E+02	19.36			2.17E+02	1.94E+01
F	21	1119.86	1.95E+02	18.85	1.09E+01	3.21E+00	1.84E+02	1.91E+01
F	22	1172.62	3.12E+02	22.28			3.12E+02	2.23E+01
F	23	1237.66	4.87E+01	13.30			4.87E+01	1.33E+01
F	24	1331.94	3.36E+02	20.47			3.36E+02	2.05E+01
F	25	1460.06	4.29E+03	66.26	5.78E+01	4.59E+00	4.23E+03	6.64E+01
F	26	1587.51	3.60E+01	8.53			3.60E+01	8.53E+00
F	27	1729.18	2.97E+01	6.46			2.97E+01	6.46E+00
F	28	1763.93	1.58E+02	12.98	1.38E+01	2.34E+00	1.44E+02	1.32E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)	Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.91	1460.81	* 10.67	6.53E+00	2.08E-01
CO-60	0.94	1173.22	* 100.00	4.42E-02	3.33E-03

## Analysis Report for CDR-NRC-6

## SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
CO-60	0.94	1332.49 *		100.00	5.21E-02	3.44E-03
CS-137	0.96	661.65 *		85.12	7.31E-01	2.18E-02
BI-212	0.57	727.17 *		11.80	7.88E-02	1.28E-02
		785.42		2.00		
		1620.56		2.75		
PB-212	0.87	77.11 *		17.50	1.95E-01	1.96E-02
		87.20 *		6.30	1.34E-01	3.45E-02
		89.80		1.75		
		238.63 *		44.60	1.32E-01	6.22E-03
		300.09		3.41		
BI-214	0.63	609.31 *		46.30	1.32E-01	7.01E-03
		768.36		5.04		
		806.17		1.23		
		934.06		3.21		
		1120.29 *		15.10	1.67E-01	1.78E-02
		1155.19		1.69		
		1238.11 *		5.94	1.21E-01	3.31E-02
		1280.96		1.47		
		1377.67		4.11		
		1401.50		1.39		
		1407.98		2.48		
		1509.19		2.19		
		1661.28		1.15		
		1729.60 *		3.05	1.75E-01	3.85E-02
		1764.49 *		15.80	1.65E-01	1.60E-02
		1847.44		2.12		
PB-214	0.79	74.81 *		6.33	3.33E-01	5.62E-02
		77.11 *		10.70	3.20E-01	3.21E-02
		87.20 *		3.70	2.28E-01	5.88E-02
		89.80		1.03		
		241.98		7.49		
		295.21 *		19.20	1.36E-01	1.04E-02
		351.92 *		37.20	1.55E-01	7.37E-03
		785.91		1.10		
RA-226	0.94	186.21 *		3.28	4.60E-01	5.21E-02
AC-228	0.62	129.08		2.80		
		209.28		4.40		
		270.23 *		3.60	2.76E-01	4.78E-02
		327.64 *		3.20	1.51E-01	3.82E-02
		338.32 *		11.40	1.39E-01	1.49E-02
		409.51		2.13		
		463.00 *		4.40	1.53E-01	3.69E-02
		794.70 *		4.60	8.13E-02	2.70E-02
		911.60 *		27.70	1.44E-01	9.96E-03
		964.60		5.20		
		969.11 *		16.60	1.60E-01	1.47E-02
		1587.90 *		3.71	1.68E-01	4.00E-02



Analysis Report for CDR-NRC-6

SOIL

\* = 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

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
/ K-40	0.913	6.53E+00	2.08E-01	
/ CO-60	0.949	4.80E-02	2.39E-03	
/ CS-137	0.963	7.31E-01	2.18E-02	
BI-212	0.573	7.88E-02	1.28E-02	
PB-212	0.874	1.28E-01	5.86E-03	
BI-214	0.630	1.41E-01	5.87E-03	
PB-214	0.793	1.48E-01	5.86E-03	
RA-226	0.940	4.60E-01	5.21E-02	
AC-228	0.629	1.46E-01	6.58E-03	

? = 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 CDR-NRC-6  
SOIL

### UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 4:32:48PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m 4	92.53	5.81850E-02	15.73	Tol.	TH-234 ✓ TH-234 u208 n208
F 13	510.59	3.85520E-02	19.64		
F 14	582.75	1.09028E-01	6.65		

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

*Joe O'Neil*  
9/15/17

### NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	K-40	1460.81	* 10.67	6.53E+00	1.01E-01	1.01E-01
+	MN-54	834.83	99.97	9.19E-03	1.18E-02	1.18E-02
+	CO-60	1173.22	* 100.00	4.42E-02	1.23E-02	1.25E-02
		1332.49	* 100.00	5.21E-02		1.23E-02
+	ZN-65	1115.52	50.75	3.51E-02	3.43E-02	3.43E-02
+	KR-85	513.99	0.43	6.72E+00	3.18E+00	3.18E+00
+	CD-109	88.03	3.72	6.23E-02	6.12E-01	6.12E-01
+	CS-134	604.70	97.60	7.64E-02	1.39E-02	1.66E-02
		795.84	85.40	-1.44E-02		1.39E-02
+	CS-137	661.65	* 85.12	7.31E-01	1.28E-02	1.28E-02
+	EU-154	123.07	40.40	-1.56E-02	3.59E-02	3.59E-02
		722.30	20.00	8.65E-02		5.87E-02
		873.20	12.09	-2.99E-01		1.01E-01
		996.30	10.34	-4.05E-02		1.24E-01

## Analysis Report for CDR-NRC-6

## SOIL

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	EU-154	1004.76	17.90	1.48E-02	3.59E-02	7.51E-02
		1274.51	34.40	8.92E-03		4.28E-02
+	EU-155	86.54	32.80	-4.60E-03	7.11E-02	7.11E-02
		105.31	21.80	-9.02E-03		7.46E-02
+	TL-208	72.80	2.02	5.46E+14	7.79E+13	7.43E+15
		74.97	3.41	1.02E+16		4.07E+15
		84.90	1.51	-4.78E+14		6.64E+15
		277.36	6.31	6.57E+13		9.30E+14
		583.19	84.50	2.00E+14		7.79E+13
		763.13	1.81	4.15E+15		3.01E+15
		860.56	12.42	3.44E+14		4.58E+14
		1093.90	0.40	9.66E+14		1.62E+16
+	BI-214	609.31	* 46.30	1.32E-01	2.05E-02	2.05E-02
		768.36	5.04	9.72E-02		2.32E-01
		806.17	1.23	2.39E-01		9.21E-01
		934.06	3.21	2.36E-01		4.07E-01
		1120.29	* 15.10	1.67E-01		8.06E-02
		1155.19	1.69	2.71E-02		9.60E-01
		1238.11	* 5.94	1.21E-01		1.79E-01
		1280.96	1.47	6.64E-01		9.83E-01
		1377.67	4.11	2.80E-01		2.95E-01
		1401.50	1.39	5.24E-01		8.24E-01
		1407.98	2.48	2.53E-01		4.59E-01
		1509.19	2.19	-6.92E-01		4.13E-01
		1661.28	1.15	1.52E-01		5.72E-01
		1729.60	* 3.05	1.75E-01		1.05E-01
		1764.49	* 15.80	1.65E-01		2.98E-02
		1847.44	2.12	2.10E-01		3.57E-01
+	PB-214	74.81	* 6.33	3.33E-01	1.98E-02	2.78E-01
		77.11	* 10.70	3.20E-01		1.45E-01
		87.20	* 3.70	2.28E-01		3.26E-01
		89.80	1.03	4.71E+00		2.13E+00
		241.98	7.49	-2.31E-01		2.17E-01
		295.21	* 19.20	1.36E-01		4.96E-02
		351.92	* 37.20	1.55E-01		1.98E-02
		785.91	1.10	8.02E-01		1.09E+00
+	RA-223	81.07	15.00	-1.16E-02	9.15E-02	1.69E-01
		83.78	24.80	-6.54E-03		9.15E-02
		94.90	11.30	-2.93E-02		1.75E-01
		122.31	1.19	-3.00E-01		1.23E+00
		144.20	3.26	1.92E-01		4.19E-01
		154.19	5.59	3.28E-02		2.36E-01
		269.41	13.60	7.78E-03		9.39E-02
		323.89	3.90	-2.54E-01		3.25E-01
		338.32	2.78	3.03E-02		4.77E-01
		444.94	1.27	-7.10E-01		1.03E+00
+	RA-226	186.21	* 3.28	4.60E-01	3.62E-01	3.62E-01
+	AC-228	129.08	2.80	-4.01E-02	3.74E-02	5.06E-01
		209.28	4.40	-8.86E-02		3.03E-01
		270.23	* 3.60	2.76E-01		2.73E-01
		327.64	* 3.20	1.51E-01		2.01E-01

## Analysis Report for CDR-NRC-6

## SOIL

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Nuclide MDA (pCi/grams)</b>	<b>Line MDA (pCi/grams)</b>
	AC-228	338.32	*	11.40	1.39E-01	3.74E-02	5.85E-02
		409.51		2.13	2.23E-02		5.94E-01
		463.00	*	4.40	1.53E-01		1.93E-01
		794.70	*	4.60	8.13E-02		1.67E-01
		911.60	*	27.70	1.44E-01		3.74E-02
		964.60		5.20	6.74E-01		3.07E-01
		969.11	*	16.60	1.60E-01		7.03E-02
		1587.90	*	3.71	1.68E-01		1.64E-01
+	Th-230	12.30		8.43	0.00E+00	9.95E+00	8.54E+10
		67.60		0.37	-4.56E+00		9.95E+00
		168.10		0.07	2.26E+00		1.84E+01
+	PA-234M	766.36		0.29	1.29E+00	1.56E+00	3.96E+00
		1001.03		0.84	-4.63E-01		1.56E+00
+	TH-234	63.29		4.50	3.00E-01	7.96E-01	1.05E+00
		92.38		2.60	-4.59E-02		8.03E-01
		92.80		2.60	-4.74E-02		7.96E-01
+	AM-241	59.54		36.30	1.89E-02	1.69E-01	1.69E-01
+	CM-243	99.55		14.30	6.11E-03	7.21E-02	1.27E-01
		103.76		23.00	4.86E-02		7.21E-02
		117.00		10.80	2.52E-02		1.37E-01
		228.18		10.60	-2.04E-02		1.24E-01
		277.60		14.00	-2.16E-02		9.04E-02

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-7  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification	: CDR-NRC-7
Sample Description	: SOIL
Sample Type	: Silt
Unit	:
Sample Point	:
Sample Size	: 3.139E+03 grams ✓
Facility	: Diaryland_NPP
Sample Taken On	: 9/15/2017 1:15:00PM ✓
Acquisition Started	: 9/15/2017 4:34:00PM
Procedure	: Silt
Operator	: Administrator
Detector Name	: DET01-ENV ✓
Geometry	: 1.5L Marinelli ✓
Live Time	: 3600.0 seconds
Real Time	: 3624.9 seconds
Dead Time	: 0.69 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 100 - 4096
Peak Area Range (in channels)	: 100 - 4096
Identification Energy Tolerance	: 1.000 keV
Energy Calibration Used Done On	: 6/3/2014
Efficiency Calibration Used Done On	: 6/3/2014
Efficiency Calibration Description	: 1.5 Marinelli
Sample Number	: 3410

RECEIVED  
J. Ogilvie  
9/19/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/15/2017 5:34:31PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR-NRC-7

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	50.30	98 -	108	101.43	8.43E+01	22.78	8.57E+02	0.98
M	2	74.48	144 -	160	149.82	2.46E+02	26.24	7.47E+02	1.32
m	3	76.78	144 -	160	154.40	3.45E+02	28.97	7.37E+02	1.33
F	4	185.67	363 -	378	372.26	1.95E+02	23.70	1.02E+03	1.03
F	5	238.32	469 -	486	477.61	1.19E+03	40.94	9.46E+02	1.47
F	6	270.04	535 -	547	541.06	1.05E+02	20.01	5.21E+02	1.40
M	7	294.83	586 -	609	590.67	4.42E+02	27.07	3.17E+02	1.60
m	8	299.61	586 -	609	600.21	1.32E+02	17.88	3.41E+02	1.61
M	9	327.95	652 -	681	656.91	4.54E+01	14.06	2.67E+02	1.25
m	10	337.92	652 -	681	676.86	2.33E+02	21.29	2.54E+02	1.27
F	11	351.55	697 -	714	704.13	8.43E+02	32.85	4.24E+02	1.52
F	12	462.91	921 -	932	926.93	1.02E+02	15.71	1.94E+02	1.65
F	13	510.42	1015 -	1031	1022.00	3.39E+02	23.68	2.58E+02	2.72
F	14	582.72	1159 -	1172	1166.63	4.11E+02	24.09	1.99E+02	1.68
F	15	608.83	1212 -	1224	1218.89	6.15E+02	28.56	2.00E+02	1.93
F	16	661.22	1319 -	1328	1323.70	3.74E+02	23.31	1.60E+02	1.78
F	17	726.75	1449 -	1462	1454.81	1.02E+02	14.29	1.47E+02	1.77
F	18	767.48	1532 -	1542	1536.31	3.45E+01	11.50	1.43E+02	1.43
F	19	794.12	1581 -	1598	1589.60	4.82E+01	11.76	1.80E+02	1.67
F	20	859.83	1709 -	1728	1721.08	9.29E+01	14.48	1.53E+02	2.94
F	21	910.67	1815 -	1831	1822.79	3.55E+02	21.90	1.55E+02	2.36
F	22	932.46	1858 -	1875	1866.40	6.66E+01	13.25	1.50E+02	2.47
M	23	963.98	1923 -	1946	1929.46	5.57E+01	11.42	1.31E+02	1.90
m	24	968.41	1923 -	1946	1938.32	1.72E+02	16.86	1.47E+02	1.90
F	25	1119.68	2230 -	2248	2240.97	1.70E+02	17.11	2.04E+02	2.07
F	26	1376.66	2747 -	2762	2755.16	6.25E+01	10.29	3.79E+01	3.99
F	27	1460.03	2908 -	2932	2921.97	3.95E+03	63.68	9.56E+01	2.78
F	28	1508.39	3014 -	3025	3018.73	1.59E+01	5.26	2.68E+01	1.62
F	29	1728.74	3453 -	3465	3459.63	2.45E+01	6.25	1.94E+01	1.64
F	30	1763.90	3521 -	3538	3529.99	1.22E+02	12.09	2.70E+01	2.52

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/15/2017 5:34:31PM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003388.CNF

Analysis Report for CDR-NRC-7

SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	50.30	8.43E+01	22.78			8.43E+01	2.28E+01
M	2	74.48	2.46E+02	26.24	7.82E+01	9.57E+00	1.68E+02	2.79E+01
m	3	76.78	3.45E+02	28.97			3.45E+02	2.90E+01
F	4	185.67	1.95E+02	23.70	3.67E+01	8.25E+00	1.59E+02	2.51E+01
F	5	238.32	1.19E+03	40.94	3.14E+01	6.41E+00	1.16E+03	4.14E+01
F	6	270.04	1.05E+02	20.01			1.05E+02	2.00E+01
M	7	294.83	4.42E+02	27.07	1.00E+01	5.91E+00	4.32E+02	2.77E+01
m	8	299.61	1.32E+02	17.88			1.32E+02	1.79E+01
M	9	327.95	4.54E+01	14.06			4.54E+01	1.41E+01
m	10	337.92	2.33E+02	21.29	9.67E+00	5.86E+00	2.23E+02	2.21E+01
F	11	351.55	8.43E+02	32.85	2.24E+01	5.47E+00	8.21E+02	3.33E+01
F	12	462.91	1.02E+02	15.71			1.02E+02	1.57E+01
F	13	510.42	3.39E+02	23.68	1.52E+02	8.10E+00	1.87E+02	2.50E+01
F	14	582.72	4.11E+02	24.09	2.14E+01	4.78E+00	3.90E+02	2.46E+01
F	15	608.83	6.15E+02	28.56	2.18E+01	4.83E+00	5.93E+02	2.90E+01
F	16	661.22	3.74E+02	23.31	1.38E+01	4.37E+00	3.60E+02	2.37E+01
F	17	726.75	1.02E+02	14.29			1.02E+02	1.43E+01
F	18	767.48	3.45E+01	11.50			3.45E+01	1.15E+01
F	19	794.12	4.82E+01	11.76			4.82E+01	1.18E+01
F	20	859.83	9.29E+01	14.48			9.29E+01	1.45E+01
F	21	910.67	3.55E+02	21.90	1.35E+01	3.68E+00	3.42E+02	2.22E+01
F	22	932.46	6.66E+01	13.25			6.66E+01	1.32E+01
M	23	963.98	5.57E+01	11.42			5.57E+01	1.14E+01
m	24	968.41	1.72E+02	16.86			1.72E+02	1.69E+01
F	25	1119.68	1.70E+02	17.11	1.09E+01	3.21E+00	1.59E+02	1.74E+01
F	26	1376.66	6.25E+01	10.29			6.25E+01	1.03E+01
F	27	1460.03	3.95E+03	63.68	5.78E+01	4.59E+00	3.89E+03	6.39E+01
F	28	1508.39	1.59E+01	5.26			1.59E+01	5.26E+00
F	29	1728.74	2.45E+01	6.25			2.45E+01	6.25E+00
F	30	1763.90	1.22E+02	12.09	1.38E+01	2.34E+00	1.08E+02	1.23E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES

## Analysis Report for CDR-NRC-7

## SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.90	1460.81	*	10.67	5.90E+00	1.90E-01
CS-137	0.97	661.65	*	85.12	3.87E-02	2.75E-03
BI-212	0.57	727.17	*	11.80	8.44E-02	1.20E-02
		785.42		2.00		
		1620.56		2.75		
PB-212	0.82	77.11	*	17.50	2.06E-01	1.86E-02
		87.20		6.30		
		89.80		1.75		
		238.63	*	44.60	1.39E-01	6.16E-03
		300.09	*	3.41	2.26E-01	3.13E-02
BI-214	0.64	609.31	*	46.30	1.11E-01	6.24E-03
		768.36	*	5.04	6.94E-02	2.32E-02
		806.17		1.23		
		934.06		3.21		
		1120.29	*	15.10	1.41E-01	1.58E-02
		1155.19		1.69		
		1238.11		5.94		
		1280.96		1.47		
		1377.67		4.11		
		1401.50		1.39		
		1407.98		2.48		
		1509.19	*	2.19	1.20E-01	3.98E-02
		1661.28		1.15		
		1729.60	*	3.05	1.42E-01	3.65E-02
		1764.49	*	15.80	1.22E-01	1.44E-02
		1847.44		2.12		
PB-214	0.72	74.81	*	6.33	3.00E-01	5.09E-02
		77.11	*	10.70	3.36E-01	3.05E-02
		87.20		3.70		
		89.80		1.03		
		241.98		7.49		
		295.21	*	19.20	1.31E-01	9.01E-03
		351.92	*	37.20	1.40E-01	6.61E-03
		785.91		1.10		
RA-226	0.95	186.21	*	3.28	2.43E-01	3.91E-02
AC-228	0.67	129.08		2.80		
		209.28		4.40		
		270.23	*	3.60	1.63E-01	3.15E-02
		327.64	*	3.20	8.68E-02	2.70E-02
		338.32	*	11.40	1.22E-01	1.24E-02
		409.51		2.13		
		463.00	*	4.40	1.69E-01	2.65E-02
		794.70	*	4.60	1.09E-01	2.67E-02
		911.60	*	27.70	1.42E-01	9.73E-03
		964.60	*	5.20	1.29E-01	2.65E-02
		969.11	*	16.60	1.25E-01	1.25E-02
		1587.90		3.71		



Analysis Report for CDR-NRC-7

SOIL

\* = 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

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## INTERFERENCE CORRECTED REPORT

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<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
K-40	0.906	5.90E+00	1.90E-01	
✓ CS-137	0.970	3.87E-02	2.75E-03	
BI-212	0.573	8.44E-02	1.20E-02	
PB-212	0.826	1.40E-01	5.76E-03	
BI-214	0.643	1.14E-01	5.15E-03	
PB-214	0.729	1.38E-01	5.23E-03	
RA-226	0.954	2.43E-01	3.91E-02	
AC-228	0.672	1.31E-01	5.77E-03	

? = 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 CDR-NRC-7  
SOIL

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/15/2017 5:34:31PM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 1	50.30	2.34229E-02	27.02		
F 13	510.42	5.18751E-02	13.40		
F 14	582.72	1.08335E-01	6.30		
F 20	859.83	2.58107E-02	15.59		
F 22	932.46	1.84862E-02	19.90		
F 26	1376.66	1.73669E-02	16.46	Sum	

*Handwritten notes:*  
T<sub>1/2</sub> 228  
5/208  
T<sub>1/2</sub> 208  
7/208  
3/204  
3/204

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

*Handwritten signature:*  
9/19/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	K-40	1460.81	*	10.67	5.90E+00	1.14E-01
+	MN-54	834.83		99.97	-3.78E-04	1.07E-02
+	CO-60	1173.22		100.00	-8.66E-03	1.22E-02
		1332.49		100.00	1.06E-02	1.22E-02
+	ZN-65	1115.52		50.75	2.90E-02	3.33E-02
+	KR-85	513.99		0.43	7.35E+00	2.61E+00
+	CD-109	88.03		3.72	1.11E+00	5.30E-01
+	CS-134	604.70		97.60	6.21E-02	1.24E-02
		795.84		85.40	-2.29E-03	1.24E-02
+	CS-137	661.65	*	85.12	3.87E-02	7.31E-03
+	EU-154	123.07		40.40	-2.66E-03	2.97E-02
		722.30		20.00	2.59E-02	5.44E-02

## Analysis Report for CDR-NRC-7

## SOIL

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
	EU-154	873.20	12.09	-5.03E-02	2.97E-02	8.77E-02
		996.30	10.34	-3.25E-02		1.19E-01
		1004.76	17.90	9.87E-03		6.92E-02
		1274.51	34.40	-1.65E-02		4.16E-02
+	EU-155	86.54	32.80	6.11E-02	6.14E-02	6.14E-02
		105.31	21.80	-2.56E-02		6.21E-02
+	TL-208	72.80	2.02	-1.07E+20	8.38E+18	8.35E+20
		74.97	3.41	1.10E+21		4.56E+20
		84.90	1.51	2.14E+20		7.33E+20
		277.36	6.31	2.84E+19		9.15E+19
		583.19	84.50	2.40E+19		8.38E+18
		763.13	1.81	5.91E+20		3.52E+20
		860.56	12.42	5.69E+18		5.31E+19
		1093.90	0.40	-3.60E+20		1.90E+21
+	BI-214	609.31	*	46.30	1.52E-02	1.52E-02
		768.36	*	5.04		1.28E-01
		806.17		7.79E-02		7.80E-01
		934.06		8.64E-02		3.69E-01
		1120.29	*	15.10		8.06E-02
		1155.19		3.79E-01		8.98E-01
		1238.11		1.92E-01		2.88E-01
		1280.96		3.65E-01		9.95E-01
		1377.67		1.93E-01		2.66E-01
		1401.50		4.89E-01		7.85E-01
		1407.98		-2.02E-01		4.41E-01
		1509.19	*	2.19		2.24E-01
		1661.28		5.14E-01		6.38E-01
		1729.60	*	3.05		1.53E-01
		1764.49	*	15.80		4.15E-02
		1847.44		2.24E-01		3.21E-01
+	PB-214	74.81	*	6.33	2.17E-02	2.44E-01
		77.11	*	10.70		1.26E-01
		87.20		8.53E-01		5.41E-01
		89.80		3.43E+00		1.84E+00
		241.98		-2.08E-01		1.85E-01
		295.21	*	19.20		2.69E-02
		351.92	*	37.20		2.17E-02
		785.91		7.38E-01		1.00E+00
+	RA-223	81.07		-2.31E-02	7.54E-02	1.52E-01
		83.78		6.91E-02		8.10E-02
		94.90		5.59E-02		1.49E-01
		122.31		-3.41E-01		1.02E+00
		144.20		1.16E-01		3.41E-01
		154.19		-8.69E-02		1.92E-01
		269.41		9.54E-02		7.54E-02
		323.89		-1.23E-01		2.48E-01
		338.32		-1.33E-01		3.83E-01
		444.94		-8.08E-02		7.01E-01
+	RA-226	186.21	*	3.28	2.88E-01	2.88E-01
+	AC-228	129.08		3.31E-01	3.21E-02	4.20E-01
		209.28		1.32E-01		2.37E-01

## Analysis Report for CDR-NRC-7

## SOIL

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Nuclide MDA (pCi/grams)</b>	<b>Line MDA (pCi/grams)</b>
	AC-228	270.23	*	3.60	1.63E-01	3.21E-02	1.95E-01
		327.64	*	3.20	8.68E-02		1.50E-01
		338.32	*	11.40	1.22E-01		4.36E-02
		409.51		2.13	2.23E-01		4.21E-01
		463.00	*	4.40	1.69E-01		1.25E-01
		794.70	*	4.60	1.09E-01		1.86E-01
		911.60	*	27.70	1.42E-01		3.21E-02
		964.60	*	5.20	1.29E-01		1.29E-01
		969.11	*	16.60	1.25E-01		4.29E-02
		1587.90		3.71	4.55E-01		2.56E-01
+	Th-230	12.30		8.43	0.00E+00	8.87E+00	8.40E+10
		67.60		0.37	-3.48E-01		8.87E+00
		168.10		0.07	1.14E+01		1.52E+01
+	PA-234M	766.36		0.29	-1.73E+00	1.46E+00	3.69E+00
		1001.03		0.84	9.24E-01		1.46E+00
+	TH-234	63.29		4.50	4.53E-01	6.84E-01	9.14E-01
		92.38		2.60	7.27E-01		6.90E-01
		92.80		2.60	6.98E-01		6.84E-01
+	AM-241	59.54		36.30	-3.05E-02	1.43E-01	1.43E-01
+	CM-243	99.55		14.30	4.14E-02	5.97E-02	1.05E-01
		103.76		23.00	-3.21E-02		5.97E-02
		117.00		10.80	-7.80E-02		1.14E-01
		228.18		10.60	2.10E-02		9.81E-02
		277.60		14.00	2.03E-02		7.11E-02

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-8  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : CDR-NRC-8 ✓  
Sample Description : SOIL  
Sample Type : Silt  
Unit :  
Sample Point :  
  
Sample Size : 3.179E+03 grams ✓  
Facility : Maryland\_NPP  
  
Sample Taken On : 9/15/2017 1:20:00PM ✓  
Acquisition Started : 9/16/2017 6:33:33AM ✓  
  
Procedure : Silt ✓  
Operator : Administrator  
Detector Name : DET01-ENV ✓  
Geometry : 1.5L Marinelli ✓  
Live Time : 3600.0 seconds ✓  
Real Time : 3624.9 seconds  
  
Dead Time : 0.69 %  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 6/3/2014  
Efficiency Calibration Used Done On : 6/3/2014  
Efficiency Calibration Description : 1.5 Marinelli  
  
Sample Number : 3412

*Handwritten:*  
Reviewed  
J. O. J.  
9/19/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/16/2017 7:34:03AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR-NRC-8

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	74.56	141 -	193	149.98	2.81E+02	28.58	8.00E+02	1.33
m	2	76.78	141 -	193	154.41	4.00E+02	33.58	7.93E+02	1.33
m	3	86.85	141 -	193	174.56	1.91E+02	25.25	7.72E+02	1.36
m	4	92.47	141 -	193	185.81	2.27E+02	27.47	7.60E+02	1.38
F	5	185.51	366 -	380	371.94	3.04E+02	30.40	1.02E+03	1.64
F	6	209.05	415 -	424	419.04	1.11E+02	24.12	6.69E+02	1.31
M	7	238.24	469 -	491	477.43	1.28E+03	41.50	5.75E+02	1.50
m	8	241.43	469 -	491	483.82	2.91E+02	24.48	5.17E+02	1.50
M	9	269.83	536 -	559	540.65	7.95E+01	18.02	3.70E+02	1.13
m	10	277.24	536 -	559	555.46	6.36E+01	16.59	3.02E+02	1.14
M	11	294.85	585 -	610	590.69	4.76E+02	28.03	3.64E+02	1.47
m	12	299.66	585 -	610	600.32	7.47E+01	15.93	3.40E+02	1.48
M	13	327.42	633 -	683	655.86	8.10E+01	17.27	3.27E+02	1.47
m	14	338.00	633 -	683	677.04	2.90E+02	23.04	2.99E+02	1.48
F	15	351.52	697 -	710	704.08	8.41E+02	33.71	4.02E+02	1.66
F	16	409.11	814 -	824	819.30	4.70E+01	14.97	2.86E+02	1.35
F	17	462.34	920 -	935	925.80	8.83E+01	16.19	3.60E+02	1.46
F	18	510.52	1014 -	1032	1022.19	2.96E+02	22.87	3.47E+02	2.27
F	19	582.75	1161 -	1174	1166.70	4.41E+02	24.64	2.03E+02	1.82
F	20	608.78	1212 -	1226	1218.78	6.49E+02	28.96	2.20E+02	1.81
F	21	661.16	1316 -	1333	1323.59	1.51E+03	40.96	2.39E+02	1.80
F	22	726.80	1445 -	1462	1454.92	1.23E+02	15.65	1.91E+02	2.12
F	23	859.80	1712 -	1728	1721.02	9.23E+01	14.10	1.23E+02	2.67
F	24	910.60	1816 -	1834	1822.66	3.34E+02	21.46	1.98E+02	2.02
M	25	963.96	1922 -	1945	1929.43	9.25E+01	12.93	1.16E+02	2.02
m	26	968.42	1922 -	1945	1938.35	1.72E+02	16.29	1.21E+02	2.02
F	27	1119.62	2228 -	2247	2240.87	1.88E+02	17.59	1.83E+02	2.17
F	28	1376.51	2749 -	2761	2754.86	4.45E+01	10.12	5.34E+01	2.71
F	29	1459.96	2908 -	2935	2921.84	4.07E+03	64.31	7.53E+01	2.96
M	30	1619.55	3234 -	3267	3241.15	2.97E+01	6.23	9.47E+00	2.41
m	31	1629.92	3234 -	3267	3261.90	2.49E+01	6.07	1.24E+01	2.41
F	32	1763.62	3519 -	3539	3529.43	1.63E+02	13.62	2.05E+01	3.70
F	33	1846.41	3690 -	3701	3695.09	2.24E+01	5.46	7.68E+00	1.79
F	34	1992.64	3981 -	3994	3987.68	1.03E+01	4.01	1.11E+01	1.16

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

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/16/2017 7:34:03AM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003388.CNF

## Analysis Report for CDR-NRC-8

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
M	1	74.56	2.81E+02	28.58	7.82E+01	9.57E+00	2.03E+02	3.01E+01
m	2	76.78	4.00E+02	33.58			4.00E+02	3.36E+01
m	3	86.85	1.91E+02	25.25			1.91E+02	2.53E+01
m	4	92.47	2.27E+02	27.47	5.07E+01	8.63E+00	1.76E+02	2.88E+01
F	5	185.51	3.04E+02	30.40	3.67E+01	8.25E+00	2.67E+02	3.15E+01
F	6	209.05	1.11E+02	24.12			1.11E+02	2.41E+01
M	7	238.24	1.28E+03	41.50	3.14E+01	6.41E+00	1.25E+03	4.20E+01
m	8	241.43	2.91E+02	24.48			2.91E+02	2.45E+01
M	9	269.83	7.95E+01	18.02			7.95E+01	1.80E+01
m	10	277.24	6.36E+01	16.59			6.36E+01	1.66E+01
M	11	294.85	4.76E+02	28.03	1.00E+01	5.91E+00	4.66E+02	2.86E+01
m	12	299.66	7.47E+01	15.93			7.47E+01	1.59E+01
M	13	327.42	8.10E+01	17.27			8.10E+01	1.73E+01
m	14	338.00	2.90E+02	23.04	9.67E+00	5.86E+00	2.80E+02	2.38E+01
F	15	351.52	8.41E+02	33.71	2.24E+01	5.47E+00	8.19E+02	3.41E+01
F	16	409.11	4.70E+01	14.97			4.70E+01	1.50E+01
F	17	462.34	8.83E+01	16.19			8.83E+01	1.62E+01
F	18	510.52	2.96E+02	22.87	1.52E+02	8.10E+00	1.44E+02	2.43E+01
F	19	582.75	4.41E+02	24.64	2.14E+01	4.78E+00	4.20E+02	2.51E+01
F	20	608.78	6.49E+02	28.96	2.18E+01	4.83E+00	6.27E+02	2.94E+01
F	21	661.16	1.51E+03	40.96	1.38E+01	4.37E+00	1.50E+03	4.12E+01
F	22	726.80	1.23E+02	15.65			1.23E+02	1.56E+01
F	23	859.80	9.23E+01	14.10			9.23E+01	1.41E+01
F	24	910.60	3.34E+02	21.46	1.35E+01	3.68E+00	3.20E+02	2.18E+01
M	25	963.96	9.25E+01	12.93			9.25E+01	1.29E+01
m	26	968.42	1.72E+02	16.29			1.72E+02	1.63E+01
F	27	1119.62	1.88E+02	17.59	1.09E+01	3.21E+00	1.77E+02	1.79E+01
F	28	1376.51	4.45E+01	10.12			4.45E+01	1.01E+01
F	29	1459.96	4.07E+03	64.31	5.78E+01	4.59E+00	4.01E+03	6.45E+01
M	30	1619.55	2.97E+01	6.23			2.97E+01	6.23E+00
m	31	1629.92	2.49E+01	6.07			2.49E+01	6.07E+00
F	32	1763.62	1.63E+02	13.62	1.38E+01	2.34E+00	1.49E+02	1.38E+01
F	33	1846.41	2.24E+01	5.46			2.24E+01	5.46E+00
F	34	1992.64	1.03E+01	4.01			1.03E+01	4.01E+00

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for CDR-NRC-8  
SOIL

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/grams)	Activity Uncertainty
K-40	0.89	1460.81	*	10.67	6.02E+00	1.92E-01
CS-137	0.96	661.65	*	85.12	1.59E-01	6.13E-03
BI-212	0.57	727.17	*	11.80	1.00E-01	1.30E-02
		785.42		2.00		
		1620.56		2.75		
PB-212	0.94	77.11	*	17.50	2.35E-01	2.13E-02
		87.20	*	6.30	2.38E-01	3.25E-02
		89.80		1.75		
		238.63	*	44.60	1.48E-01	6.30E-03
		300.09	*	3.41	1.27E-01	2.73E-02
BI-214	0.50	609.31	*	46.30	1.16E-01	6.31E-03
		768.36		5.04		
		806.17		1.23		
		934.06		3.21		
		1120.29	*	15.10	1.56E-01	1.61E-02
		1155.19		1.69		
		1238.11		5.94		
		1280.96		1.47		
		1377.67		4.11		
		1401.50		1.39		
		1407.98		2.48		
		1509.19		2.19		
		1661.28		1.15		
		1729.60		3.05		
		1764.49	*	15.80	1.66E-01	1.63E-02
		1847.44		2.12		
PB-214	0.94	74.81	*	6.33	3.56E-01	5.43E-02
		77.11	*	10.70	3.85E-01	3.48E-02
		87.20	*	3.70	4.06E-01	5.54E-02
		89.80		1.03		
		241.98	*	7.49	2.07E-01	1.82E-02
		295.21	*	19.20	1.40E-01	9.24E-03
		351.92	*	37.20	1.37E-01	6.65E-03
		785.91		1.10		
RA-226	0.92	186.21	*	3.28	4.04E-01	4.90E-02
AC-228	0.73	129.08		2.80		
		209.28	*	4.40	1.28E-01	2.81E-02
		270.23	*	3.60	1.23E-01	2.79E-02
		327.64	*	3.20	1.53E-01	3.28E-02
		338.32	*	11.40	1.51E-01	1.33E-02
		409.51	*	2.13	1.49E-01	4.76E-02
		463.00	*	4.40	1.45E-01	2.69E-02



Analysis Report for CDR-NRC-8

SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
AC-228	0.73	794.70	4.60		
		911.60 *	27.70	1.31E-01	9.37E-03
		964.60 *	5.20	2.11E-01	2.98E-02
		969.11 *	16.60	1.23E-01	1.20E-02
		1587.90	3.71		

\* = 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

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
/ K-40	0.891	6.02E+00	1.92E-01	
CS-137	0.963	1.59E-01	6.13E-03	
BI-212	0.578	1.00E-01	1.30E-02	
PB-212	0.943	1.47E-01	5.82E-03	
BI-214	0.502	1.26E-01	5.53E-03	
PB-214	0.942	1.46E-01	5.08E-03	
RA-226	0.924	4.04E-01	4.90E-02	
AC-228	0.737	1.37E-01	5.73E-03	

? = 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 CDR-NRC-8  
SOIL

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/16/2017 7:34:03AM  
Peak Locate From Channel : 100  
Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m 4	92.47	4.89595E-02	16.34		
m 10	277.24	1.76578E-02	26.10	Tol.	
F 18	510.52	4.00530E-02	16.83	Sum	
F 19	582.75	1.16657E-01	5.98		
F 23	859.80	2.56501E-02	15.27		
F 28	1376.51	1.23710E-02	22.71		
M 30	1619.55	8.24303E-03	20.98		
m 31	1629.92	6.91759E-03	24.36	Sum	
F 33	1846.41	6.22989E-03	24.36	Sum	
F 34	1992.64	2.86066E-03	38.90		

7A234  
100%  
CM-243  
228  
1208  
1208  
1208  
3.24  
Pc 234  
9.214

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

Jan 09  
9/19/17

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	K-40	1460.81	* 10.67	6.02E+00	1.04E-01	1.04E-01
+	MN-54	834.83	99.97	6.36E-03	1.09E-02	1.09E-02
+	CO-60	1173.22	100.00	-9.16E-05	1.22E-02	1.54E-02
		1332.49	100.00	-1.05E-02		1.22E-02
+	ZN-65	1115.52	50.75	6.66E-02	3.24E-02	3.24E-02
+	KR-85	513.99	0.43	6.41E+00	2.68E+00	2.68E+00

## Analysis Report for CDR-NRC-8

## SOIL

	Nuclide Name	Energy (keV)	Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	CD-109	88.03	3.72	1.46E+00	5.40E-01	5.40E-01
+	CS-134	604.70	97.60	5.47E-02	1.28E-02	1.44E-02
		795.84	85.40	-3.95E-03		1.28E-02
+	CS-137	661.65	* 85.12	1.59E-01	1.03E-02	1.03E-02
+	EU-154	123.07	40.40	7.94E-04	3.07E-02	3.07E-02
		722.30	20.00	1.56E-02		5.48E-02
		873.20	12.09	4.83E-02		8.88E-02
		996.30	10.34	-3.45E-03		1.20E-01
		1004.76	17.90	4.81E-03		6.94E-02
		1274.51	34.40	9.76E-03		4.03E-02
+	EU-155	86.54	32.80	-7.72E-02	6.23E-02	6.23E-02
		105.31	21.80	3.78E-02		6.43E-02
+	@ TL-208	72.80	2.02	1.00E+26	1.00E+26	1.00E+26
	@	74.97	3.41	1.00E+26		1.00E+26
	@	84.90	1.51	1.00E+26		1.00E+26
	@	277.36	6.31	1.00E+26		1.00E+26
	@	583.19	84.50	1.00E+26		1.00E+26
	@	763.13	1.81	1.00E+26		1.00E+26
	@	860.56	12.42	1.00E+26		1.00E+26
	@	1093.90	0.40	1.00E+26		1.00E+26
+	BI-214	609.31	* 46.30	1.16E-01	1.63E-02	1.63E-02
		768.36	5.04	1.20E-01		2.10E-01
		806.17	1.23	-2.21E+00		7.96E-01
		934.06	3.21	5.77E-02		3.72E-01
		1120.29	* 15.10	1.56E-01		7.66E-02
		1155.19	1.69	-3.84E-01		8.96E-01
		1238.11	5.94	2.81E-01		2.91E-01
		1280.96	1.47	3.50E-01		9.46E-01
		1377.67	4.11	4.27E-01		2.92E-01
		1401.50	1.39	4.01E-02		7.81E-01
		1407.98	2.48	9.78E-02		4.39E-01
		1509.19	2.19	8.18E-02		4.36E-01
		1661.28	1.15	3.11E-01		6.34E-01
		1729.60	3.05	8.80E-02		2.55E-01
		1764.49	* 15.80	1.66E-01		3.84E-02
		1847.44	2.12	-4.45E-02		3.53E-01
+	PB-214	74.81	* 6.33	3.56E-01	1.93E-02	2.48E-01
		77.11	* 10.70	3.85E-01		1.29E-01
		87.20	* 3.70	4.06E-01		2.81E-01
		89.80	1.03	4.78E+00		1.88E+00
		241.98	* 7.49	2.07E-01		7.71E-02
		295.21	* 19.20	1.40E-01		2.82E-02
		351.92	* 37.20	1.37E-01		1.93E-02
		785.91	1.10	9.17E-01		9.93E-01
+	RA-223	81.07	15.00	-4.12E-02	8.17E-02	1.57E-01
		83.78	24.80	-2.87E-01		8.34E-02
		94.90	11.30	5.30E-02		1.59E-01
		122.31	1.19	6.89E-01		1.10E+00
		144.20	3.26	2.02E-02		3.66E-01
		154.19	5.59	-9.31E-02		2.03E-01

## Analysis Report for CDR-NRC-8

## SOIL

	<b>Nuclide Name</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Nuclide MDA (pCi/grams)</b>	<b>Line MDA (pCi/grams)</b>
	RA-223	269.41		13.60	9.39E-03	8.17E-02	8.17E-02
		323.89		3.90	2.23E-03		2.67E-01
		338.32		2.78	9.04E-02		3.98E-01
		444.94		1.27	-2.61E-01		7.66E-01
+	RA-226	186.21	*	3.28	4.04E-01	2.80E-01	2.80E-01
+	AC-228	129.08		2.80	-1.93E-01	3.68E-02	4.32E-01
		209.28	*	4.40	1.28E-01		1.51E-01
		270.23	*	3.60	1.23E-01		1.42E-01
		327.64	*	3.20	1.53E-01		1.64E-01
		338.32	*	11.40	1.51E-01		4.63E-02
		409.51	*	2.13	1.49E-01		2.82E-01
		463.00	*	4.40	1.45E-01		1.82E-01
		794.70		4.60	6.42E-02		2.42E-01
		911.60	*	27.70	1.31E-01		3.68E-02
		964.60	*	5.20	2.11E-01		1.21E-01
		969.11	*	16.60	1.23E-01		3.86E-02
		1587.90		3.71	1.59E-01		2.46E-01
+	Th-230	12.30		8.43	0.00E+00	9.07E+00	8.30E+10
		67.60		0.37	3.19E+00		9.07E+00
		168.10		0.07	1.15E+00		1.55E+01
+	PA-234M	766.36		0.29	2.43E+00	1.49E+00	3.63E+00
		1001.03		0.84	-1.89E-01		1.49E+00
+	TH-234	63.29		4.50	1.34E-01	7.17E-01	9.44E-01
		92.38		2.60	2.31E-02		7.22E-01
		92.80		2.60	5.63E-02		7.17E-01
+	AM-241	59.54		36.30	-8.57E-02	1.47E-01	1.47E-01
+	CM-243	99.55		14.30	1.51E-02	6.16E-02	1.09E-01
		103.76		23.00	-2.51E-02		6.16E-02
		117.00		10.80	-1.26E-02		1.17E-01
		228.18		10.60	3.07E-02		1.02E-01
		277.60		14.00	-2.21E-02		7.49E-02

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-9  
SOIL

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : CDR-NRC-9 ✓  
Sample Description : SOIL ✓  
Sample Type : Silt ✓  
Unit :  
Sample Point :  
  
Sample Size : 3.156E+03 grams ✓  
Facility : Diaryland\_NPP ✓  
  
Sample Taken On : 9/15/2017 2:30:00PM ✓  
Acquisition Started : 9/19/2017 4:03:54PM ✓  
  
Procedure : Silt ✓  
Operator : Administrator ✓  
Detector Name : DET01-ENV ✓  
Geometry : 1.5L Marinelli ✓  
Live Time : 21600.0 seconds ✓  
Real Time : 21760.9 seconds ✓  
  
Dead Time : 0.74 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 6/3/2014  
Efficiency Calibration Used Done On : 6/3/2014  
Efficiency Calibration Description : 1.5 Marinelli  
  
Sample Number : 3421

REVIEWED  
Joh 09/20/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/19/2017 10:06:38PM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for CDR-NRC-9

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
M	1	74.51	141 -	204	149.88	2.13E+03	85.38	9.09E+03	1.36
m	2	76.85	141 -	204	154.55	1.94E+03	116.59	9.15E+03	1.37
m	3	84.09	141 -	204	169.03	4.54E+02	57.73	1.03E+04	1.39
m	4	86.86	141 -	204	174.57	1.61E+03	100.28	9.36E+03	1.40
m	5	89.54	141 -	204	179.95	1.47E+03	121.41	1.05E+04	1.40
m	6	92.53	141 -	204	185.93	1.83E+03	93.91	1.05E+04	1.41
m	7	99.31	141 -	204	199.49	2.83E+02	77.30	9.61E+03	1.43
F	8	128.73	250 -	266	258.34	5.43E+02	84.96	1.84E+04	1.20
F	9	185.64	365 -	378	372.19	1.85E+03	99.96	1.43E+04	1.53
F	10	208.86	414 -	422	418.65	8.50E+02	85.03	8.63E+03	1.27
M	11	238.26	470 -	493	477.48	1.12E+04	132.04	7.40E+03	1.47
m	12	241.31	470 -	493	483.57	2.11E+03	79.88	7.08E+03	1.47
M	13	269.85	524 -	564	540.69	9.51E+02	80.62	7.14E+03	1.73
m	14	277.00	524 -	564	554.98	5.20E+02	68.55	7.38E+03	1.74
M	15	294.85	585 -	610	590.71	3.54E+03	90.41	5.76E+03	1.53
m	16	299.81	585 -	610	600.62	7.41E+02	62.37	6.14E+03	1.54
M	17	327.52	652 -	683	656.07	4.53E+02	57.39	4.77E+03	1.44
m	18	337.92	652 -	683	676.87	2.33E+03	78.87	5.06E+03	1.45
F	19	351.52	694 -	711	704.07	6.48E+03	102.11	8.51E+03	1.54
F	20	408.96	808 -	825	819.00	3.48E+02	58.59	7.73E+03	1.39
F	21	462.57	922 -	932	926.25	4.97E+02	64.80	4.97E+03	1.58
F	22	510.30	1012 -	1032	1021.76	2.14E+03	74.04	6.09E+03	2.19
F	23	582.65	1157 -	1172	1166.51	4.20E+03	78.63	3.22E+03	1.77
F	24	608.78	1212 -	1226	1218.79	5.25E+03	85.24	2.89E+03	1.85
F	25	641.73	1279 -	1294	1284.72	2.70E+02	51.13	2.75E+03	2.90
F	26	661.06	1312 -	1334	1323.38	8.82E+04	299.66	3.34E+03	1.92
F	27	726.77	1448 -	1463	1454.85	8.72E+02	44.69	1.67E+03	2.02
M	28	754.73	1505 -	1601	1510.79	8.65E+01	29.03	1.29E+03	1.97
m	29	767.79	1505 -	1601	1536.92	5.90E+02	40.09	1.34E+03	1.99
m	30	771.79	1505 -	1601	1544.93	1.20E+02	21.44	1.32E+03	1.99
m	31	785.11	1505 -	1601	1571.59	4.09E+02	51.24	1.26E+03	2.00
m	32	794.40	1505 -	1601	1590.16	6.62E+02	43.31	1.22E+03	2.01
F	33	859.80	1713 -	1728	1721.02	5.39E+02	41.53	1.41E+03	2.53
F	34	910.50	1813 -	1832	1822.46	3.18E+03	66.64	2.00E+03	2.21
F	35	933.62	1860 -	1875	1868.72	3.16E+02	40.14	1.53E+03	2.59
M	36	949.22	1887 -	1945	1899.92	2.38E+02	32.45	1.45E+03	2.32
m	37	964.08	1887 -	1945	1929.66	7.17E+02	39.23	1.38E+03	2.33
m	38	968.27	1887 -	1945	1938.05	2.00E+03	55.56	1.33E+03	2.33
F	39	1000.28	1996 -	2009	2002.09	1.49E+02	33.86	1.37E+03	1.91
F	40	1119.48	2227 -	2249	2240.58	1.38E+03	52.77	2.32E+03	2.56
F	41	1172.45	2333 -	2356	2346.57	3.16E+03	68.71	2.73E+03	2.50
F	42	1237.49	2468 -	2488	2476.70	5.51E+02	43.67	2.52E+03	2.15
F	43	1331.58	2651 -	2678	2664.96	2.98E+03	61.58	1.43E+03	2.83
M	44	1376.69	2742 -	2825	2755.23	3.83E+02	30.04	5.98E+02	2.82
m	45	1384.22	2742 -	2825	2770.29	8.57E+01	19.79	5.78E+02	2.83
m	46	1401.01	2742 -	2825	2803.88	1.22E+02	20.95	5.45E+02	2.84
m	47	1407.29	2742 -	2825	2816.46	1.41E+02	21.92	5.32E+02	2.84
F	48	1459.86	2908 -	2935	2921.63	4.14E+04	204.57	6.53E+02	2.82
M	49	1494.79	2979 -	3033	2991.52	1.13E+02	17.73	3.07E+02	3.38
m	50	1500.86	2979 -	3033	3003.67	7.76E+01	16.00	2.88E+02	3.38
m	51	1508.69	2979 -	3033	3019.33	1.99E+02	20.04	2.62E+02	3.39
F	52	1587.53	3168 -	3190	3177.08	2.90E+02	23.62	3.37E+02	3.26
M	53	1620.09	3232 -	3269	3242.24	1.44E+02	17.23	2.03E+02	3.00

## Analysis Report for CDR-NRC-9

## SOIL

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
m	54	1629.68	3232 -	3269	3261.44	1.28E+02	16.44	1.84E+02	3.01
F	55	1728.53	3446 -	3468	3459.22	2.59E+02	19.42	1.46E+02	3.28
F	56	1763.47	3514 -	3540	3529.13	1.13E+03	35.99	1.85E+02	3.27
F	57	1788.44	3574 -	3586	3579.09	2.53E+01	7.81	7.31E+01	1.18
F	58	1846.46	3685 -	3703	3695.20	1.54E+02	16.45	1.28E+02	3.26

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/19/2017 10:06:38PM

Env. Background File : C:\Canberra\Apex\Root\Diaryland\_NPP\Data\0000003420.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	74.51	2.13E+03	85.38	1.84E+02	2.40E+01	1.95E+03	8.87E+01
m	2	76.85	1.94E+03	116.59			1.94E+03	1.17E+02
m	3	84.09	4.54E+02	57.73	1.13E+02	1.96E+01	3.41E+02	6.10E+01
m	4	86.86	1.61E+03	100.28			1.61E+03	1.00E+02
m	5	89.54	1.47E+03	121.41			1.47E+03	1.21E+02
m	6	92.53	1.83E+03	93.91	3.83E+02	2.77E+01	1.44E+03	9.79E+01
m	7	99.31	2.83E+02	77.30			2.83E+02	7.73E+01
F	8	128.73	5.43E+02	84.96			5.43E+02	8.50E+01
F	9	185.64	1.85E+03	99.96	1.98E+02	5.08E+01	1.66E+03	1.12E+02
F	10	208.86	8.50E+02	85.03			8.50E+02	8.50E+01
M	11	238.26	1.12E+04	132.04	2.91E+02	4.48E+01	1.09E+04	1.39E+02
m	12	241.31	2.11E+03	79.88			2.11E+03	7.99E+01
M	13	269.85	9.51E+02	80.62			9.51E+02	8.06E+01
m	14	277.00	5.20E+02	68.55			5.20E+02	6.86E+01
M	15	294.85	3.54E+03	90.41			3.54E+03	9.04E+01
m	16	299.81	7.41E+02	62.37			7.41E+02	6.24E+01
M	17	327.52	4.53E+02	57.39			4.53E+02	5.74E+01
m	18	337.92	2.33E+03	78.87	5.95E+01	3.00E+01	2.27E+03	8.44E+01
F	19	351.52	6.48E+03	102.11	9.74E+01	3.12E+01	6.38E+03	1.07E+02
F	20	408.96	3.48E+02	58.59			3.48E+02	5.86E+01
F	21	462.57	4.97E+02	64.80			4.97E+02	6.48E+01
F	22	510.30	2.14E+03	74.04	9.66E+02	5.02E+01	1.17E+03	8.95E+01
F	23	582.65	4.20E+03	78.63	1.35E+02	3.10E+01	4.06E+03	8.45E+01
F	24	608.78	5.25E+03	85.24	1.49E+02	3.31E+01	5.10E+03	9.15E+01



## Analysis Report for CDR-NRC-9

## SOIL

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	25	641.73	2.70E+02	51.13			2.70E+02	5.11E+01
F	26	661.06	8.82E+04	299.66	1.09E+02	2.71E+01	8.81E+04	3.01E+02
F	27	726.77	8.72E+02	44.69			8.72E+02	4.47E+01
M	28	754.73	8.65E+01	29.03			8.65E+01	2.90E+01
m	29	767.79	5.90E+02	40.09			5.90E+02	4.01E+01
m	30	771.79	1.20E+02	21.44			1.20E+02	2.14E+01
m	31	785.11	4.09E+02	51.24			4.09E+02	5.12E+01
m	32	794.40	6.62E+02	43.31			6.62E+02	4.33E+01
F	33	859.80	5.39E+02	41.53			5.39E+02	4.15E+01
F	34	910.50	3.18E+03	66.64	7.09E+01	2.13E+01	3.11E+03	7.00E+01
F	35	933.62	3.16E+02	40.14			3.16E+02	4.01E+01
M	36	949.22	2.38E+02	32.45			2.38E+02	3.24E+01
m	37	964.08	7.17E+02	39.23			7.17E+02	3.92E+01
m	38	968.27	2.00E+03	55.56			2.00E+03	5.56E+01
F	39	1000.28	1.49E+02	33.86	2.43E+01	1.55E+01	1.25E+02	3.73E+01
F	40	1119.48	1.38E+03	52.77			1.38E+03	5.28E+01
F	41	1172.45	3.16E+03	68.71	5.68E+01	1.85E+01	3.10E+03	7.12E+01
F	42	1237.49	5.51E+02	43.67			5.51E+02	4.37E+01
F	43	1331.58	2.98E+03	61.58	4.08E+01	1.68E+01	2.94E+03	6.38E+01
M	44	1376.69	3.83E+02	30.04			3.83E+02	3.00E+01
m	45	1384.22	8.57E+01	19.79			8.57E+01	1.98E+01
m	46	1401.01	1.22E+02	20.95			1.22E+02	2.10E+01
m	47	1407.29	1.41E+02	21.92			1.41E+02	2.19E+01
F	48	1459.86	4.14E+04	204.57	3.19E+02	2.58E+01	4.11E+04	2.06E+02
M	49	1494.79	1.13E+02	17.73			1.13E+02	1.77E+01
m	50	1500.86	7.76E+01	16.00			7.76E+01	1.60E+01
m	51	1508.69	1.99E+02	20.04			1.99E+02	2.00E+01
F	52	1587.53	2.90E+02	23.62			2.90E+02	2.36E+01
M	53	1620.09	1.44E+02	17.23			1.44E+02	1.72E+01
m	54	1629.68	1.28E+02	16.44			1.28E+02	1.64E+01
F	55	1728.53	2.59E+02	19.42			2.59E+02	1.94E+01
F	56	1763.47	1.13E+03	35.99	5.03E+01	1.15E+01	1.08E+03	3.78E+01
F	57	1788.44	2.53E+01	7.81			2.53E+01	7.81E+00
F	58	1846.46	1.54E+02	16.45			1.54E+02	1.65E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Diaryland\_NPP\Library\ENVLIB.NLB

### IDENTIFIED NUCLIDES



## Analysis Report for CDR-NRC-9

## SOIL

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (pCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.86	1460.81	*	10.67	1.03E+01	2.91E-01
CO-60	0.89	1173.22	*	100.00	7.16E-02	2.37E-03
		1332.49	*	100.00	7.44E-02	2.49E-03
CS-137	0.94	661.65	*	85.12	1.57E+00	4.29E-02
BI-212	0.97	727.17	*	11.80	1.19E-01	6.83E-03
		785.42	*	2.00	3.49E-01	4.46E-02
		1620.56	*	2.75	1.49E-01	1.82E-02
PB-212	0.98	77.11	*	17.50	1.91E-01	1.32E-02
		87.20	*	6.30	3.38E-01	2.39E-02
		89.80	*	1.75	1.05E+00	9.33E-02
		238.63	*	44.60	2.17E-01	6.31E-03
		300.09	*	3.41	2.11E-01	1.85E-02
BI-214	0.66	609.31	*	46.30	1.58E-01	5.24E-03
		768.36	*	5.04	1.97E-01	1.42E-02
		806.17		1.23		
		934.06	*	3.21	1.91E-01	2.46E-02
		1120.29	*	15.10	2.04E-01	9.10E-03
		1155.19		1.69		
		1238.11	*	5.94	2.23E-01	1.85E-02
		1280.96		1.47		
		1377.67	*	4.11	2.41E-01	1.99E-02
		1401.50	*	1.39	2.29E-01	3.98E-02
		1407.98	*	2.48	1.49E-01	2.35E-02
		1509.19	*	2.19	2.48E-01	2.58E-02
		1661.28		1.15		
		1729.60		3.05		
		1764.49		15.80		
		1847.44	*	2.12	2.18E-01	2.47E-02
PB-214	0.97	74.81	*	6.33	5.75E-01	3.25E-02
		77.11	*	10.70	3.13E-01	2.16E-02
		87.20	*	3.70	5.76E-01	4.06E-02
		89.80	*	1.03	1.78E+00	1.59E-01
		241.98	*	7.49	2.51E-01	1.15E-02
		295.21	*	19.20	1.78E-01	6.31E-03
		351.92	*	37.20	1.80E-01	5.33E-03
		785.91	*	1.10	6.35E-01	8.10E-02
RA-226	0.94	186.21	*	3.28	4.21E-01	3.08E-02
AC-228	0.52	129.08	*	2.80	1.68E-01	2.66E-02
		209.28	*	4.40	1.65E-01	1.71E-02
		270.23	*	3.60	2.46E-01	2.17E-02
		327.64	*	3.20	1.43E-01	1.85E-02
		338.32	*	11.40	2.05E-01	9.10E-03
		409.51	*	2.13	1.85E-01	3.15E-02
		463.00	*	4.40	1.37E-01	1.82E-02
		794.70	*	4.60	2.48E-01	1.72E-02
		911.60		27.70		
		964.60	*	5.20	2.75E-01	1.61E-02
		969.11	*	16.60	2.41E-01	8.47E-03
		1587.90	*	3.71	2.20E-01	1.88E-02
PA-234M	0.48	766.36		0.29		
		1001.03	*	0.84	3.06E-01	9.13E-02

Analysis Report for CDR-NRC-9  
SOIL

\* = 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

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (pCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
✓ K-40	0.865	1.03E+01	2.91E-01	
✓ CO-60	0.894	7.29E-02	1.72E-03	
✓ CS-137	0.946	1.57E+00	4.29E-02	
BI-212	0.974	1.26E-01	6.33E-03	
PB-212	0.982	1.97E-01	5.32E-03	
BI-214	0.662	1.80E-01	3.89E-03	
PB-214	0.974	1.88E-01	3.75E-03	
RA-226	0.948	4.21E-01	3.08E-02	
AC-228	0.528	2.14E-01	4.48E-03	
PA-234M	0.488	3.06E-01	9.13E-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 CDR-NRC-9

SOIL

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/19/2017 10:06:38PM

Peak Locate From Channel : 100

Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m 3	84.09	1.57785E-02	17.89		
m 6	92.53	6.68743E-02	6.78		
m 7	99.31	1.30809E-02	27.36	Tol.	CM-243 <sup>Pu-223</sup> <sup>Th-234</sup> 9/20/17
m 14	277.00	2.40628E-02	13.19	Tol.	CM-243 <sup>Pu-223</sup> <sup>Ac-228</sup>
F 22	510.30	5.43399E-02	7.62	Sum	1/28/00 9/20/17
F 23	582.65	1.88106E-01	2.08	Bi-206	
F 25	641.73	1.24872E-02	18.96	Pu-239	
M 28	754.73	4.00611E-03	33.55	Bi-214	
m 30	771.79	5.55421E-03	17.87	Ac-228	
F 33	859.80	2.49514E-02	7.71	Sum	Tl-208
F 34	910.50	1.43784E-01	2.25	Ac-228	
M 36	949.22	1.10234E-02	13.63	S-Esc	Pu-239
m 45	1384.22	3.96803E-03	23.08	Bi-214	
M 49	1494.79	5.22390E-03	15.71	Sum	Pu-239
m 50	1500.86	3.59404E-03	20.61	Sum	Ac-228
m 54	1629.68	5.90977E-03	12.88	Sum	Ac-228
F 55	1728.53	1.19886E-02	7.50	Sum	Bi-214
F 56	1763.47	4.99652E-02	3.50	Sum	Bi-214
F 57	1788.44	1.17059E-03	30.91	Sum	

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\Diary\and\_NPP\Library\ENVLIB.NLB

## Analysis Report for CDR-NRC-9

## SOIL

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	K-40	1460.81	*	10.67	1.03E+01	5.22E-02	5.22E-02
+	MN-54	834.83		99.97	9.63E-03	5.58E-03	5.58E-03
+	✓ CO-60	1173.22	*	100.00	7.16E-02	6.91E-03	8.16E-03
		1332.49	*	100.00	7.44E-02		6.91E-03
+	ZN-65	1115.52		50.75	5.75E-02	1.65E-02	1.65E-02
+	KR-85	513.99		0.43	5.92E+00	1.61E+00	1.61E+00
+	CD-109	88.03		3.72	1.56E+00	3.04E-01	3.04E-01
+	CS-134	604.70		97.60	7.81E-02	6.48E-03	7.78E-03
		795.84		85.40	6.73E-04		6.48E-03
+	✓ CS-137	661.65	*	85.12	1.57E+00	6.92E-03	6.92E-03
+	✓ EU-154	123.07		40.40	-9.78E-04	1.84E-02	1.84E-02
		722.30		20.00	5.23E-02		2.77E-02
		873.20		12.09	-1.17E-03		4.69E-02
		996.30		10.34	6.70E-02		6.17E-02
		1004.76		17.90	3.63E-02		3.62E-02
		1274.51		34.40	2.32E-02		2.12E-02
+	EU-155	86.54		32.80	-1.03E-01	3.53E-02	3.53E-02
		105.31		21.80	7.68E-03		3.82E-02
+	@ TL-208	72.80		2.02	1.00E+26	1.00E+26	1.00E+26
	@	74.97		3.41	1.00E+26		1.00E+26
	@	84.90		1.51	1.00E+26		1.00E+26
	@	277.36		6.31	1.00E+26		1.00E+26
	@	583.19		84.50	1.00E+26		1.00E+26
	@	763.13		1.81	1.00E+26		1.00E+26
	@	860.56		12.42	1.00E+26		1.00E+26
	@	1093.90		0.40	1.00E+26		1.00E+26
+	BI-214	609.31	*	46.30	1.58E-01	1.01E-02	1.01E-02
		768.36	*	5.04	1.97E-01		5.78E-02
		806.17		1.23	8.57E-02		4.22E-01
		934.06	*	3.21	1.91E-01		1.37E-01
		1120.29	*	15.10	2.04E-01		4.65E-02
		1155.19		1.69	-1.47E-01		4.63E-01
		1238.11	*	5.94	2.23E-01		1.28E-01
		1280.96		1.47	3.83E-01		4.87E-01
		1377.67	*	4.11	2.41E-01		7.33E-02
		1401.50	*	1.39	2.29E-01		2.09E-01
		1407.98	*	2.48	1.49E-01		1.16E-01
		1509.19	*	2.19	2.48E-01		9.76E-02
		1661.28		1.15	2.09E-01		2.68E-01
		1729.60		3.05	1.38E-01		1.14E-01
		1764.49		15.80	2.18E-01		3.50E-02
		1847.44	*	2.12	2.18E-01		1.01E-01
+	PB-214	74.81	*	6.33	5.75E-01	1.58E-02	1.35E-01
		77.11	*	10.70	3.13E-01		7.22E-02
		87.20	*	3.70	5.76E-01		1.62E-01
		89.80	*	1.03	1.78E+00		5.81E-01
		241.98	*	7.49	2.51E-01		4.70E-02
		295.21	*	19.20	1.78E-01		1.79E-02
		351.92	*	37.20	1.80E-01		1.58E-02

## Analysis Report for CDR-NRC-9

## SOIL

	Nuclide Name	Energy (keV)		Yield(%)	Activity (pCi/grams)	Nuclide MDA (pCi/grams)	Line MDA (pCi/grams)
+	PB-214	785.91	*	1.10	6.35E-01	1.58E-02	2.61E-01
	RA-223	81.07		15.00	6.50E-02	5.86E-02	1.08E-01
		83.78		24.80	-4.78E-01		5.86E-02
		94.90		11.30	-2.97E-02		1.12E-01
		122.31		1.19	3.22E-01		8.08E-01
		144.20		3.26	2.76E-01		2.72E-01
		154.19		5.59	4.76E-02		1.53E-01
		269.41		13.60	5.31E-02		6.26E-02
		323.89		3.90	-6.44E-02		2.13E-01
		338.32		2.78	3.21E-02		3.14E-01
		444.94		1.27	-7.30E-03		7.02E-01
+	RA-226	186.21	*	3.28	4.21E-01	1.72E-01	1.72E-01
+	AC-228	129.08	*	2.80	1.68E-01	2.07E-02	2.46E-01
		209.28	*	4.40	1.65E-01		8.72E-02
		270.23	*	3.60	2.46E-01		1.02E-01
		327.64	*	3.20	1.43E-01		1.03E-01
		338.32	*	11.40	2.05E-01		3.15E-02
		409.51	*	2.13	1.85E-01		2.79E-01
		463.00	*	4.40	1.37E-01		9.95E-02
		794.70	*	4.60	2.48E-01		6.18E-02
		911.60		27.70	2.16E-01		2.84E-02
		964.60	*	5.20	2.75E-01		6.71E-02
		969.11	*	16.60	2.41E-01		2.07E-02
+	Th-230	1587.90	*	3.71	2.20E-01		9.23E-02
		12.30		8.43	0.00E+00	5.02E+00	1.39E+10
		67.60		0.37	-4.46E+00		5.02E+00
		168.10		0.07	5.38E+00		9.41E+00
+	PA-234M	766.36		0.29	3.35E+00	5.19E-01	1.90E+00
+		1001.03	*	0.84	3.06E-01		5.19E-01
	TH-234	63.29		4.50	-3.51E-01	4.45E-01	5.80E-01
		92.38		2.60	9.84E-01		4.48E-01
		92.80		2.60	1.22E+00		4.45E-01
+	✓ AM-241	59.54		36.30	-9.50E-02	8.14E-02	8.14E-02
+	CM-243	99.55		14.30	2.19E-02	3.66E-02	6.33E-02
		103.76		23.00	-2.47E-04		3.66E-02
		117.00		10.80	1.18E-02		7.04E-02
		228.18		10.60	6.55E-03		6.40E-02
		277.60		14.00	-1.89E-02		4.64E-02

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for CDR-NRC-9  
SOIL

Analysis Report for SUMP AREA # 1  
9-9-17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : SUMP AREA # 1  
Sample Description : 9-9-17  
Sample Type : 500 ml Marinelli ✓  
Unit :  
Sample Point :  
  
Sample Size : 9.449E+02 grams  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/9/2017 1:43:00PM  
Acquisition Started : 9/12/2017 6:59:32AM  
  
Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli ✓  
Live Time : 3600.0 seconds  
Real Time : 3623.4 seconds  
  
Dead Time : 0.65 %  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3344

SUB-CDR

*2.31E+03*  
*Joe O'Neil*  
*9/12/17*

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/12/2017 7:59:58AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

Analysis Report for SUMP AREA # 1

9-9-17

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
F	1	59.48	112 -	126	119.52	4.41E+03	129.67	1.25E+04	2.89
F	2	122.98	239 -	253	246.48	6.31E+02	116.68	1.56E+04	2.43
F	3	145.81	290 -	295	292.14	1.84E+02	72.08	5.89E+03	1.10
F	4	661.99	1314 -	1333	1324.30	1.47E+05	385.75	2.01E+03	2.75
F	5	1173.88	2337 -	2358	2347.92	7.21E+03	87.09	4.00E+02	3.09
F	6	1275.71	2543 -	2557	2551.57	6.24E+01	12.27	1.11E+02	2.22
F	7	1333.26	2655 -	2677	2666.65	6.17E+03	79.05	7.77E+01	3.16
F	8	1461.72	2913 -	2933	2923.55	6.87E+02	27.18	4.46E+01	3.15

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/12/2017 7:59:58AM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
F	1	59.48	4.41E+03	129.67			4.41E+03	1.30E+02
F	2	122.98	6.31E+02	116.68			6.31E+02	1.17E+02
F	3	145.81	1.84E+02	72.08			1.84E+02	7.21E+01
F	4	661.99	1.47E+05	385.75	6.61E+01	1.27E+01	1.47E+05	3.86E+02
F	5	1173.88	7.21E+03	87.09	4.55E+01	8.62E+00	7.16E+03	8.75E+01
F	6	1275.71	6.24E+01	12.27			6.24E+01	1.23E+01
F	7	1333.26	6.17E+03	79.05			6.17E+03	7.90E+01
F	8	1461.72	6.87E+02	27.18			6.87E+02	2.72E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma



Analysis Report for SUMP AREA # 1

9-9-17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Daistryland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (uCi/grams)	Activity Uncertainty
K-40	0.86	1460.75 *		10.67	7.93E-06	3.83E-07
CO-60	0.92	1173.22 *		100.00	7.30E-06	1.97E-07
		1332.49 *		100.00	7.03E-06	2.01E-07
CS-137	0.98	661.65 *		85.12	1.05E-04	2.85E-06
CE-141	0.97	145.44 *		48.40	7.42E-08	2.91E-08
AM-241	0.99	59.54 *		36.30	5.77E-06	2.57E-07

\* = 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 (uCi/grams)	Wt mean Activity Uncertainty	Comments
K-40	0.860	7.93E-06	3.83E-07	
CO-60	0.921	7.16E-06	1.41E-07	
CS-137	0.982	1.05E-04	2.85E-06	
CE-141	0.978	7.42E-08	2.91E-08	
AM-241	0.999	5.77E-06	2.57E-07	

Analysis Report for SUMP AREA # 1

9-9-17

- ? = 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

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Analysis Report for SUMP AREA # 1

9-9-17

## UNIDENTIFIED PEAKS

Peak Locate Performed on : 9/12/2017 7:59:58AM  
 Peak Locate From Channel : 100  
 Peak Locate To Channel : 4096

Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
F 2	122.98	1.75237E-01	18.50	Tol.	EU-154 <i>m Pu<sup>232</sup></i>
F 6	1275.71	1.73398E-02	19.65		<i>Pu<sup>234</sup></i>

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

*gog*  
*9/12/17*

## NUCLIDE MDA REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

Nuclide Name	Energy (keV)	Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	* 10.67	7.93E-06	5.14E-07
+	AR-41	1293.64	99.16	2.12E+03	5.69E+03
+	CO-60	1173.22	* 100.00	7.30E-06	6.81E-08
		1332.49	* 100.00	7.03E-06	6.81E-08
+	KR-85	513.99	0.43	3.49E-05	5.29E-05
+	Y-88	898.04	93.70	1.17E-07	5.29E-08
		1836.06	99.20	-2.23E-08	5.29E-08
+	NB-94	702.63	100.00	6.99E-08	1.11E-07
		871.10	100.00	-1.38E-07	1.45E-07
+	I-131	284.30	6.06	-1.66E-06	3.36E-07
		364.48	81.20	-1.68E-07	3.36E-07
		636.97	7.27	-1.14E-06	3.27E-06
+	CS-134	604.70	97.60	8.86E-08	1.47E-07
		795.84	85.40	-1.03E-08	1.47E-07
+	CS-137	661.65	* 85.12	1.05E-04	2.04E-07

## Analysis Report for SUMP AREA # 1

9-9-17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
+	CE-144	80.12	1.36	6.08E-07	1.24E-06	1.21E-05
		133.51	11.09	1.20E-07		1.24E-06
+	EU-152	121.78	28.40	6.02E-07	2.75E-07	4.88E-07
		244.69	7.49	-1.55E-07		2.26E-06
		964.00	14.44	-3.38E-07		1.19E-06
		1408.00	20.74	-1.45E-07		2.75E-07
+	EU-154	123.07	40.40	2.57E-07	2.67E-07	3.43E-07
		247.94	6.60	-4.37E-06		2.73E-06
		723.30	19.70	4.77E-08		5.77E-07
		873.20	11.50	-5.02E-07		1.27E-06
		1004.76	17.90	2.86E-07		8.96E-07
		1274.51	35.50	2.17E-07		2.67E-07
+	EU-155	86.54	32.80	-1.84E-07	4.56E-07	4.56E-07
		105.31	21.80	-1.40E-07		6.27E-07
+	BI-214	609.31	46.30	2.11E-07	3.88E-07	3.88E-07
		1120.29	15.10	-2.65E-07		1.04E-06
		1238.11	5.94	6.01E-07		1.70E-06
		1377.67	4.11	-4.88E-08		1.45E-06
		1407.98	2.48	-1.21E-06		2.30E-06
		1509.19	2.19	-7.17E-07		2.41E-06
		1764.49	15.80	3.72E-07		4.32E-07
+	PB-214	77.11	10.70	1.20E-06	5.64E-07	1.61E-06
		295.21	19.20	2.14E-07		9.76E-07
		351.92	37.20	5.68E-09		5.64E-07
+	PA-228	89.95	22.00	6.35E-06	3.19E-06	5.24E-06
		93.35	35.00	1.91E-06		3.19E-06
		105.00	16.30	-2.36E-06		6.66E-06
		129.22	2.97	9.96E-06		3.69E-05
		338.32	5.30	2.57E-05		3.05E-05
		463.00	13.80	1.15E-05		1.79E-05
		911.23	16.70	2.21E-06		7.64E-06
+	AM-241	59.54	* 36.30	5.77E-06	8.22E-07	8.22E-07
+	CM-243	103.76	23.00	1.53E-07	5.97E-07	5.97E-07
		228.18	10.60	2.19E-07		1.58E-06
		277.60	14.00	2.23E-08		1.32E-06

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

Analysis Report for SUMP AREA # 2

9-9-17

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## GAMMA SPECTRUM ANALYSIS

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Sample Identification : SUMP AREA # 2  
Sample Description : 9-9-17  
Sample Type : 500 ml Marinelli ✓  
Unit :  
Sample Point :  
  
Sample Size : 8.825E+02 grams ✓  
Facility : Dairyland\_NPP  
  
Sample Taken On : 9/9/2017 1:48:00PM  
Acquisition Started : 9/12/2017 8:01:36AM  
  
Procedure : 500ml Marinelli  
Operator : Administrator  
Detector Name : HOTLAB  
Geometry : 500ml Marinelli  
Live Time : 3600.0 seconds ✓  
Real Time : 3631.8 seconds  
  
Dead Time : 0.88 % ✓  
  
Peak Locate Threshold : 3.00  
Peak Locate Range (in channels) : 100 - 4096  
Peak Area Range (in channels) : 100 - 4096  
Identification Energy Tolerance : 1.000 keV  
  
Energy Calibration Used Done On : 7/8/2014  
Efficiency Calibration Used Done On : 7/8/2014  
Efficiency Calibration Description :  
  
Sample Number : 3345

REVIEWED  
JL [signature]  
9/12/17

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## PEAK ANALYSIS REPORT

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Peak Analysis Performed on : 9/12/2017 9:02:10AM

Peak Analysis From Channel : 100  
Peak Analysis To Channel : 4096

## Analysis Report for SUMP AREA # 2

9-9-17

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>ROI start</b>	<b>ROI end</b>	<b>Peak Centroid</b>	<b>Net Peak Area</b>	<b>Net Area Uncertainty</b>	<b>Continuum Counts</b>	<b>FWHM (keV)</b>
F	1	59.22	112 -	125	119.00	1.43E+03	135.85	1.83E+04	2.54
F	2	186.45	365 -	377	373.40	4.83E+02	109.72	2.29E+04	1.20
F	3	662.01	1315 -	1333	1324.34	2.62E+05	514.29	2.49E+03	2.75
F	4	1173.93	2339 -	2358	2348.02	2.61E+03	52.83	1.73E+02	3.10
F	5	1333.29	2657 -	2677	2666.71	2.41E+03	49.91	5.89E+01	3.09
F	6	1461.66	2912 -	2933	2923.43	5.35E+02	23.56	1.93E+01	3.17

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

## BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 9/12/2017 9:02:10AM

Env. Background File : C:\Canberra\Apex\Root\Dairyland\_NPP\Data\0000001364.CNF

	<b>Peak No.</b>	<b>Energy (keV)</b>	<b>Original Area</b>	<b>Orig. Area Uncertainty</b>	<b>Ambient Background</b>	<b>Backgr. Uncert.</b>	<b>Subtracted Area</b>	<b>Subtracted Uncert.</b>
F	1	59.22	1.43E+03	135.85			1.43E+03	1.36E+02
F	2	186.45	4.83E+02	109.72			4.83E+02	1.10E+02
F	3	662.01	2.62E+05	514.29	6.61E+01	1.27E+01	2.62E+05	5.14E+02
F	4	1173.93	2.61E+03	52.83	4.55E+01	8.62E+00	2.57E+03	5.35E+01
F	5	1333.29	2.41E+03	49.91			2.41E+03	4.99E+01
F	6	1461.66	5.35E+02	23.56			5.35E+02	2.36E+01

M = First peak in a multiplet region

m = Other peak in a multiplet region

F = Fitted singlet

Errors quoted at 1.000sigma

Analysis Report for SUMP AREA # 2

9-9-17

## NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

### IDENTIFIED NUCLIDES

<b>Nuclide Name</b>	<b>Id Confidence</b>	<b>Energy (keV)</b>		<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Activity Uncertainty</b>
K-40	0.87	1460.75	*	10.67	6.61E-06	3.44E-07
CO-60	0.91	1173.22	*	100.00	2.80E-06	8.91E-08
		1332.49	*	100.00	2.94E-06	9.68E-08
CS-137	0.97	661.65	*	85.12	2.00E-04	5.43E-06
RA-226	0.99	186.21	*	3.28	3.23E-06	7.40E-07
AM-241	0.98	59.54	*	36.30	2.03E-06	2.05E-07

\* = 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

<b>Nuclide Name</b>	<b>Nuclide Id Confidence</b>	<b>Wt mean Activity (uCi/grams)</b>	<b>Wt mean Activity Uncertainty</b>	<b>Comments</b>
K-40	0.876	6.61E-06	3.44E-07	
CO-60	0.912	2.86E-06	6.55E-08	
CS-137	0.979	2.00E-04	5.43E-06	
RA-226	0.991	3.23E-06	7.40E-07	
AM-241	0.984	2.03E-06	2.05E-07	

## Analysis Report for SUMP AREA # 2

9-9-17

- ? = 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

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Analysis Report for SUMP AREA # 2

9-9-17

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## UNIDENTIFIED PEAKS

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Peak Locate Performed on : 9/12/2017 9:02:10AM  
 Peak Locate From Channel : 100  
 Peak Locate To Channel : 4096

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

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## NUCLIDE MDA REPORT

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Nuclide Library Used : C:\Canberra\Apex\Root\Dairyland\_NPP\Library\HOTLAB.NLB

	Nuclide Name	Energy (keV)		Yield(%)	Activity (uCi/grams)	Nuclide MDA (uCi/grams)	Line MDA (uCi/grams)
+	K-40	1460.75	*	10.67	6.61E-06	3.80E-07	3.80E-07
+	AR-41	1293.64		99.16	-1.24E+03	6.34E+03	6.34E+03
+	CO-60	1173.22	*	100.00	2.80E-06	6.16E-08	9.91E-08
		1332.49	*	100.00	2.94E-06		6.16E-08
+	KR-85	513.99		0.43	6.67E-05	7.22E-05	7.22E-05
+	Y-88	898.04		93.70	1.03E-07	4.17E-08	1.18E-07
		1836.06		99.20	-1.99E-08		4.17E-08
+	NB-94	702.63		100.00	4.14E-08	8.68E-08	8.68E-08
		871.10		100.00	-7.62E-08		1.02E-07
+	I-131	284.30		6.06	4.21E-06	4.63E-07	5.28E-06
		364.48		81.20	-2.23E-07		4.63E-07
		636.97		7.27	-4.67E-06		4.08E-06
+	CS-134	604.70		97.60	6.38E-08	1.07E-07	2.32E-07
		795.84		85.40	6.99E-09		1.07E-07
+	CS-137	661.65	*	85.12	2.00E-04	2.35E-07	2.35E-07
+	CE-144	80.12		1.36	1.34E-05	1.67E-06	1.64E-05
		133.51		11.09	1.04E-06		1.67E-06
+	EU-152	121.78		28.40	5.85E-07	2.51E-07	6.50E-07

## Analysis Report for SUMP AREA # 2

9-9-17

	<b>Nuclide Name</b>	<b>Energy (keV)</b>	<b>Yield(%)</b>	<b>Activity (uCi/grams)</b>	<b>Nuclide MDA (uCi/grams)</b>	<b>Line MDA (uCi/grams)</b>
	EU-152	244.69	7.49	-4.67E-07	2.51E-07	3.06E-06
		964.00	14.44	-1.88E-07		8.17E-07
		1408.00	20.74	-4.46E-08		2.51E-07
+	EU-154	123.07	40.40	1.42E-07	2.17E-07	4.57E-07
		247.94	6.60	-2.00E-06		3.73E-06
		723.30	19.70	2.21E-07		4.62E-07
		873.20	11.50	5.70E-07		8.97E-07
		1004.76	17.90	-1.80E-07		6.33E-07
		1274.51	35.50	2.66E-07		2.17E-07
+	EU-155	86.54	32.80	3.55E-07	6.17E-07	6.17E-07
		105.31	21.80	4.07E-07		8.48E-07
+	BI-214	609.31	46.30	1.42E-08	3.67E-07	4.86E-07
		1120.29	15.10	-2.23E-07		7.61E-07
		1238.11	5.94	8.09E-07		1.36E-06
		1377.67	4.11	1.95E-07		1.28E-06
		1407.98	2.48	-3.72E-07		2.10E-06
		1509.19	2.19	7.91E-07		2.05E-06
		1764.49	15.80	4.42E-07		3.67E-07
+	PB-214	77.11	10.70	1.55E-07	7.73E-07	2.17E-06
		295.21	19.20	-1.48E-07		1.33E-06
		351.92	37.20	4.48E-07		7.73E-07
+	PA-228	89.95	22.00	2.49E-06	4.40E-06	7.24E-06
		93.35	35.00	-2.97E-07		4.40E-06
		105.00	16.30	-1.78E-06		9.26E-06
		129.22	2.97	9.18E-06		5.09E-05
		338.32	5.30	2.86E-05		4.30E-05
		463.00	13.80	2.92E-05		2.59E-05
		911.23	16.70	2.96E-06		5.75E-06
+	AM-241	59.54	* 36.30	2.03E-06	1.05E-06	1.05E-06
+	CM-243	103.76	23.00	-7.68E-07	8.03E-07	8.03E-07
		228.18	10.60	-3.78E-07		2.17E-06
		277.60	14.00	-8.85E-07		1.78E-06

+ = Nuclide identified during the nuclide identification

\* = Energy line found in the spectrum

&gt; = MDA value not calculated

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

? = CAUTION: MDA value is inconsistent with Currie MDA at 95% confidence level

# **ATTACHMENT 8**

## **GEL LABORATORIES ANALYTICAL REPORTS**



January 22, 2018

Mr. Jason Q. Spaide  
LaCrosseSolutions  
S4601 State Hwy 35  
Genoa, Wisconsin 54632

Re: LACBWR Site Restoration Project  
Work Order: 441560

Dear Mr. Spaide:

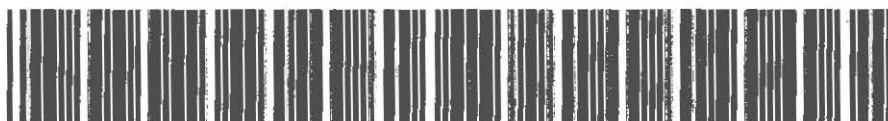
GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on October 30, 2017. This original data report has been prepared and reviewed in accordance with GEL's standard operating procedures.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4453.

Sincerely,

  
Kaitlyn Stone for  
Edith Kent  
Project Manager

Purchase Order: 672583  
Enclosures



## **GEL LABORATORIES LLC**

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

### **Certificate of Analysis Report for**

ENRG070 LaCrosseSolutions, LLC (672583)

Client SDG: 441560 GEL Work Order: 441560

**The Qualifiers in this report are defined as follows:**

- \* A quality control analyte recovery is outside of specified acceptance criteria
- \*\* Analyte is a Tracer compound
- \*\* Analyte is a surrogate compound
- U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Edith Kent.

Reviewed by



# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-008-SB  
Sample ID: 441560001  
Matrix: Soil  
Collect Date: 15-SEP-17 09:05  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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### Rad Alpha Spec Analysis

#### Alphaspec Np, Solid "Dry Weight Corrected"

Neptunium-237	U	-0.00162	+/-0.00252	0.00585	0.010	pCi/g			HAKB	01/17/18	0951	1731815	1
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#### The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

#### The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			97.7	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

#### Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Contact: Genoa, Wisconsin 54632  
Project: Mr. Jason Q. Spaide  
LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-009-SB  
Sample ID: 441560002  
Matrix: Soil  
Collect Date: 13-SEP-17 13:54  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	-0.00137	+/-0.00298	0.00659	0.010	pCi/g			HAKB	01/17/18	0951	1731815	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			100	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632

Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-011-SB

Project: ENRG07001

Sample ID: 441560003

Client ID: ENRG070

Matrix: Soil

Collect Date: 13-SEP-17 14:05

Receive Date: 30-OCT-17

Collector: Client

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	0.00181	+/-0.00451	0.008	0.010	pCi/g			HAKB	01/17/18	0950	1731815	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			94.4	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit



# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Contact: Genoa, Wisconsin 54632  
Project: Mr. Jason Q. Spaide  
LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-012-SB  
Sample ID: 441560004  
Matrix: Soil  
Collect Date: 13-SEP-17 14:08  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	0.00	+/-0.00357	0.00694	0.010	pCi/g			HAKB	01/17/18	0950	1731815	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			101	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Contact: Genoa, Wisconsin 54632  
Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-014-SB  
Sample ID: 441560005  
Matrix: Soil  
Collect Date: 13-SEP-17 14:18  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	-0.00203	+/-0.00347	0.00748	0.010	pCi/g			HAKB	01/17/18	0950	1731815	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			103	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632

Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: NRC #4  
Sample ID: 441560006  
Matrix: Soil  
Collect Date: 13-SEP-17 13:45  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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### Rad Alpha Spec Analysis

#### Alphaspec Np, Solid "Dry Weight Corrected"

Neptunium-237	U	0.000544	+/-0.00512	0.00964	0.010	pCi/g			HAKB	01/17/18	0950	1731815	1
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#### The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

#### The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			94.7	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

#### Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: January 22, 2018

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35  
Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: Sump Area #1  
Sample ID: 441560007  
Matrix: Soil  
Collect Date: 09-SEP-17 13:43  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	0.000475	+/-0.00384	0.00727	0.010	pCi/g			HAKB	01/17/18	0950	1731815	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1731648

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	ASTM C 1475-00 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			102	(15%-125%)

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

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## QC Summary

Report Date: January 22, 2018

Page 1 of 2

LaCrosseSolutions  
S4601 State Hwy 35  
Genoa, Wisconsin

Contact: Mr. Jason Q. Spaide

Workorder: 441560

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Alpha Spec</b>											
Batch	1731815										
QC1203952679	441559001	DUP									
Neptunium-237		U	-0.00303	U	0.00432	pCi/g	N/A		N/AHAKB	01/17/18	09:53
		Uncertainty	+/-0.00419		+/-0.00468						
QC1203952680	LCS										
Neptunium-237		1.45		1.54	pCi/g		106	(75%-125%)		01/17/18	09:51
		Uncertainty		+/-0.0514							
QC1203952678	MB										
Neptunium-237			U	-0.0024	pCi/g					01/17/18	09:53
		Uncertainty		+/-0.00332							

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

The Qualifiers in this report are defined as follows:

- \*\* Analyte is a Tracer compound
- < Result is less than value reported
- > Result is greater than value reported
- BD Results are either below the MDC or tracer recovery is low
- FA Failed analysis.
- H Analytical holding time was exceeded
- J Value is estimated
- K Analyte present. Reported value may be biased high. Actual value is expected to be lower.
- L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
- M M if above MDC and less than LLD
- M REMP Result > MDC/CL and < RDL
- N/A RPD or %Recovery limits do not apply.
- NI See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
- UI Gamma Spectroscopy--Uncertain identification
- UJ Gamma Spectroscopy--Uncertain identification

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### QC Summary

Workorder: 441560

Page 2 of 2

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
UL	Not considered detected. The associated number is the reported concentration, which may be inaccurate due to a low bias.										
X	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier										
Y	Other specific qualifiers were required to properly define the results. Consult case narrative.										
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.										
h	Preparation or preservation holding time was exceeded										

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.

^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.

\* Indicates that a Quality Control parameter was not within specifications.

For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

**Radiochemistry  
Technical Case Narrative  
LaCrosseSolutions, LLC (ENRG)  
SDG #: 441560**

**Product:** Alphaspec Np, Solid  
**Analytical Method:** ASTM C 1475-00 Modified  
**Analytical Procedure:** GL-RAD-A-032 REV# 21  
**Analytical Batch:** 1731815

**Preparation Method:** Dry Soil Prep  
**Preparation Procedure:** GL-RAD-A-021 REV# 22  
**Preparation Batch:** 1731648

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
441560001	LI-SUB-CDR-FSGS-008-SB
441560002	LI-SUB-CDR-FSGS-009-SB
441560003	LI-SUB-CDR-FSGS-011-SB
441560004	LI-SUB-CDR-FSGS-012-SB
441560005	LI-SUB-CDR-FSGS-014-SB
441560006	NRC #4
441560007	Sump Area #1
1203952678	Method Blank (MB)
1203952679	441559001(LI-010-101-FS-GS-C06-SB) Sample Duplicate (DUP)
1203952680	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** Dry Weight  
**Preparation Method:** Dry Soil Prep  
**Preparation Procedure:** GL-RAD-A-021 REV# 22  
**Preparation Batch:** 1731648

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
441560001	LI-SUB-CDR-FSGS-008-SB
441560002	LI-SUB-CDR-FSGS-009-SB
441560003	LI-SUB-CDR-FSGS-011-SB
441560004	LI-SUB-CDR-FSGS-012-SB

441560005	LI-SUB-CDR-FSGS-014-SB
441560006	NRC #4
441560007	Sump Area #1

The samples in this SDG were analyzed on an "as received" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Miscellaneous Information**

**Additional Comments**

These samples are re-logs. Data transferred from Batch# 1714238.

**Certification Statement**

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.



Page: \_\_\_\_\_ of \_\_\_\_\_  
 Project #: LACBWSITE  
 GEL Quote #: \_\_\_\_\_  
 COC Number <sup>(1)</sup>: \_\_\_\_\_  
 PO Number: 672583

**GEL Chain of Custody and Analytical Request**  
 \*\*See www.gel.com for GEL's Sample Acceptance SOP\*\*

GEL Laboratories, LLC  
 2040 Savage Road  
 Charleston, SC 29407  
 Phone: (843) 556-8171  
 Fax: (843) 766-1178

GEL Work Order Number: 43654 / 441560

Client Name: LaCrosse Solutions Phone #: 608 689 4259

Project/Site Name: LACBWR - Genoa, WI Fax #: \_\_\_\_\_

Address: 54601 State Rd 35

Collected by: \_\_\_\_\_ Send Results: Joe Jacobsen  
Jd.jacobsen@energysolutions.com

Sample Analysis Requested <sup>(5)</sup> (Fill in the number of containers for each test)

Sample ID <small>* For composites - indicate start and stop date/time</small>	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (6)	Field Filtered (6)	Sample Matrix (6)	Should this sample be considered: Radiative TSCA Regulated	Total number of containers	Preservative Type (6)												Comments Note: extra sample is required for sample specific QC					
								NI:59	Ca:60	Nb:94	Cr:52	Eu:152	Eu:154	Eu:155	H3:CH	Fe:55	U:63	Sr:90	Tc:99		Pu:241	Np:237	Pu:238	Pu:239	Pu:240
L1-SUB-CDR-FSGS-008-SB	09-15-17	0905	N	N	SO	Y	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	All samples are to be returned.
L1-SUB-CDR-FSGS-009-SB	09-13-17	1354	N	N	SO	Y	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
L1-SUB-CDR-FSGS-011-SB	09-13-17	1405	N	N	SO	Y	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
L1-SUB-CDR-FSGS-012-SB	09-13-17	1408	N	N	SO	Y	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
L1-SUB-CDR-FSGS-014-SB	09-13-17	1418	N	N	SO	Y	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

TAT Requested: Normal: X Rush: \_\_\_\_\_ Specify: \_\_\_\_\_ (Subject to Surcharge) Fax Results: Yes / No

Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: Are there any known hazards applicable to these samples? If so, please list the hazards  
None

Sample Collection Time Zone  
 Eastern Contra Pacific \_\_\_\_\_  
 Mountain Other \_\_\_\_\_

Chain of Custody Signatures				Sample Shipping and Delivery Details	
Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
<u>Joe Jacobsen</u>	<u>10/24/17</u>	<u>1300</u>	<u>Alvin...</u>	<u>10/30/17</u>	<u>8:50</u>

GEL PM: \_\_\_\_\_  
 Method of Shipment: \_\_\_\_\_ Date Shipped: \_\_\_\_\_  
 Airbill #: \_\_\_\_\_  
 Airbill #: \_\_\_\_\_

1.) Chain of Custody Number - Client Determined  
 2.) QC Codes: N = Nonsal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite  
 3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.  
 4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal  
 5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).  
 6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

WHITE = LABORATORY      YELLOW = FILE      PINK = CLIENT

For Lab Receiving Use Only	
Custody Seal Intact?	YES NO
Cooler Temp:	C

Project #: <u>LACBWR Site</u>		GEL Chain of Custody and Analytical Request										2040 Savage Road Charleston, SC 29407 Phone: (843) 556-8171 Fax: (843) 766-1178																											
GEL Quote #:		**See www.gel.com for GEL's Sample Acceptance SOP**																																					
COC Number (1):		GEL Work Order Number:																																					
PO Number: <u>672583</u>																																							
Client Name: <u>LaCrosse Solutions</u>		Phone #: <u>608-689-4259</u>		Sample Analysis Requested (5) (Fill in the number of containers for each test)																																			
Project/Site Name: <u>LACBWR - Genoa, WI.</u>		Fax #:		← Preservative Type (6)																																			
Address: <u>54601 STATE ROAD 35</u>		Should this sample be considered:		Comments Note: extra sample is required for sample specific QC																																			
Collected by: <u>JOE JACOBSEN</u>		Send Results: <u>JOE JACOBSEN</u>																																					
Sample ID * For composites - indicate start and stop date/time		*Date Collected (mm-dd-yy)		*Time Collected (Military) (hh:mm)		QC Code (3)		Field Filtered (3)		Sample Matrix (6)		Radioactive		TSCA Regulated		Total number of containers		N: 59, Co 60, Nb 94		Cs 137, Eu 152, Eu 154		Eu 155		H3, C14, Fe 55		Ni 63, Sr 90, Te 99		Pu 241		Pu 239, Pu 238		Pu 239, Pu 240		Am 241, Am 243		Cm 243, Cm 244			
<u>NRC # 4</u>		<u>09-13-17</u>		<u>1345</u>		<u>N</u>		<u>N</u>		<u>SO</u>		<u>Y</u>				1		1		1		1		1		1		1		1		1		1		1		1	
																																						All samples are to be returned please	



[illegible]

## SAMPLE RECEIPT &amp; REVIEW FORM

Client: <u>ENRG</u>		SDG/AR/COC/Work Order:	
Received By: <u>JA</u>		Date Received: <u>10/30/17</u>	
Carrier and Tracking Number		Circle Applicable: FedEx Express <u>FedEx Ground</u> UPS Field Services Courier Other	
		<u>7705 6606 1987</u>	
Suspected Hazard Information	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.	
Shipped as a DOT Hazardous?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Hazard Class Shipped: UN#:	
COC/Samples marked or classified as radioactive?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): <u>0</u> CPM / mR/Hr Classified as: <u>Rad 1</u> Rad 2 Rad 3	
Is package, COC, and/or Samples marked HAZ?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	If yes, select Hazards below, and contact the GEL Safety Group. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:	
Sample Receipt Criteria	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Comments/Qualifiers (Required for Non-Conforming Items)	
1 Shipping containers received intact and sealed?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe)	
2 Chain of custody documents included with shipment?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
3 Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Preservation Method: Wet Ice Ice Packs Dry Ice <u>None</u> Other: *all temperatures are recorded in Celsius TEMP: <u>17°</u>	
4 Daily check performed and passed on IR temperature gun?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Temperature Device Serial #: <u>TH2-17</u> Secondary Temperature Device Serial # (if Applicable):	
5 Sample containers intact and sealed?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Circle Applicable: Seals broken Damaged container Leaking container Other (describe)	
6 Samples requiring chemical preservation at proper pH?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Sample ID's and Containers Affected: <u>3rd Qtr. Composite arrived unpreserved</u> If Preservation added, Lot#: <u>171004</u>	
7 Do any samples require Volatile Analysis?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	If Yes, Are Encores or Soil Kits present? Yes <input type="checkbox"/> No <input type="checkbox"/> (If yes, take to VOA Freezer) Do VOA vials contain acid preservation? Yes <input type="checkbox"/> No <input type="checkbox"/> N/A (If unknown, select No) VOA vials free of headspace? Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Sample ID's and containers affected:	
8 Samples received within holding time?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	ID's and tests affected:	
9 Sample ID's on COC match ID's on bottles?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Sample ID's and containers affected:	
10 Date & time on COC match date & time on bottles?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Sample ID's affected:	
11 Number of containers received match number indicated on COC?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Sample ID's affected:	
12 Are sample containers identifiable as GEL provided?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
13 COC form is properly signed in relinquished/received sections?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
Comments (Use Continuation Form if needed):			

PM (or PMA) review: Initials EM Date 10/31/17 Page 1 of 1

**List of current GEL Certifications as of 22 January 2018**

State	Certification
Alaska	UST-0110
Arkansas	88-0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH-0169
Delaware	SC00012
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330-15-00283, P330-15-00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho Chemistry	SC00012
Idaho Radiochemistry	SC00012
Illinois NELAP	200029
Indiana	C-SC-01
Kansas NELAP	E-10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana NELAP	03046 (AI33904)
Louisiana SDWA	LA180011
Maryland	270
Massachusetts	M-SC012
Michigan	9976
Mississippi	SC00012
Nebraska	NE-OS-26-13
Nevada	SC000122018-1
New Hampshire NELAP	205415
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R-158
Oklahoma	9904
Pennsylvania NELAP	68-00485
Puerto Rico	SC00012
S.Carolina Radchem	10120002
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235-17-12
Utah NELAP	SC000122017-25
Vermont	VT87156
Virginia NELAP	460202
Washington	C780
West Virginia	997404

November 27, 2017

Mr. Jason Q. Spaide  
LaCrosseSolutions  
S4601 State Hwy 35  
Genoa, Wisconsin 54632

Re: LACBWR Site Restoration Project  
Work Order: 436541

Dear Mr. Spaide:

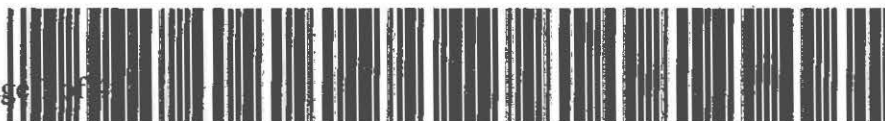
GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on October 30, 2017. This original data report has been prepared and reviewed in accordance with GEL's standard operating procedures.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4453.

Sincerely,

  
Kaitlyn Stone for  
Edith Kent  
Project Manager

Purchase Order: 672583  
Enclosures



## **GEL LABORATORIES LLC**

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

### **Certificate of Analysis Report for**

ENRG070 LaCrosseSolutions, LLC (672583)

Client SDG: 436541 GEL Work Order: 436541

**The Qualifiers in this report are defined as follows:**

- \* A quality control analyte recovery is outside of specified acceptance criteria
- \*\* Analyte is a Tracer compound
- \*\* Analyte is a surrogate compound
- U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
- UI Gamma Spectroscopy—Uncertain identification

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Edith Kent.

Reviewed by





# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35  
  
Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-008-SB  
Sample ID: 436541001  
Matrix: Soil  
Collect Date: 15-SEP-17 09:05  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
<b>Rad Alpha Spec Analysis</b>													
<b>Alphaspec Isotopic Am241, Cm243/244, Solid "Dry Weight Corrected"</b>													
Americium-241	U	0.0241	+/-0.0289	0.0444	0.400	pCi/g			BXA4	11/21/17	1420	1718468	1
Americium-243		0.0636	+/-0.0393	0.0173	0.400	pCi/g							
Curium-243/244	U	-0.00195	+/-0.0134	0.0327	0.400	pCi/g							
<b>Alphaspec Np, Solid "Dry Weight Corrected"</b>													
Neptunium-237	U	0.00876	+/-0.0993	0.211	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
<b>Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"</b>													
Plutonium-238		0.0137	+/-0.0181	0.0137	0.400	pCi/g			BXA4	11/21/17	0927	1718470	3
Plutonium-239/240	U	0.000183	+/-0.0135	0.0301	0.400	pCi/g							
<b>Liquid Scint Pu241, Solid "Dry Weight Corrected"</b>													
Plutonium-241	U	-1.46	+/-2.30	4.06	5.00	pCi/g			BXA4	11/24/17	0825	1718471	4
<b>Rad Gamma Spec Analysis</b>													
<b>Gamma Ni59, Solid "Dry Weight Corrected"</b>													
Nickel-59	U	-1.72	+/-1.60	2.53	5.00	pCi/g			TXJ1	11/17/17	0846	1715764	5
<b>Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"</b>													
Cesium-137		0.804	+/-0.115	0.0481	1.00	pCi/g			MXR1	11/16/17	1037	1714268	6
Cobalt-60	U	0.0245	+/-0.0399	0.088		pCi/g							
Europium-152	U	-0.055	+/-0.0747	0.138		pCi/g							
Europium-154	U	-0.0104	+/-0.0838	0.171		pCi/g							
Europium-155	U	0.0393	+/-0.0717	0.151		pCi/g							
Niobium-94	U	-0.00984	+/-0.024	0.0438		pCi/g							
<b>Rad Gas Flow Proportional Counting</b>													
<b>GFPC, Sr90, Solid "Dry Weight Corrected"</b>													
Strontium-90	U	0.248	+/-0.180	0.276	0.400	pCi/g			KSD1	11/16/17	1612	1717213	7
<b>Rad Liquid Scintillation Analysis</b>													
<b>LSC, Tritium Distillation, Solid "As Received"</b>													
Tritium	U	1.27	+/-5.11	8.88	10.0	pCi/g			BXM4	11/16/17	0717	1715582	8
<b>Liquid Scint C14, Solid "As Received"</b>													
Carbon-14	U	0.720	+/-2.36	4.01	5.00	pCi/g			BXM4	11/13/17	1325	1715576	9
<b>Liquid Scint Tc99, Solid "As Received"</b>													
Technetium-99	U	-0.208	+/-0.744	1.29	2.00	pCi/g			CXS7	11/14/17	0644	1715726	10
<b>Liquid Scint Fe55, Solid "Dry Weight Corrected"</b>													
Iron-55	U	-2.22	+/-4.73	6.51	10.0	pCi/g			TXJ1	11/18/17	0422	1715698	11
<b>Liquid Scint Ni63, Solid "Dry Weight Corrected"</b>													



# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-008-SB  
Sample ID: 436541001

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63	U	2.73	+/-1.99	3.27	5.00	pCi/g			TXJ1	11/17/17	2218	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			81.7	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			57.4	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			104	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			81.1	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			81.1	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			96.4	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			86.6	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			88.9	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			76.7	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			77.4	(25%-125%)

Notes:

## GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-008-SB  
Sample ID: 436541001

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
-----------	-----------	--------	-------------	-----	----	-------	----	----	---------	------	------	-------	--------

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35  
  
Contact: Genoa, Wisconsin 54632  
Project: Mr. Jason Q. Spaide  
LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-009-SB  
Sample ID: 436541002  
Matrix: Soil  
Collect Date: 13-SEP-17 13:54  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"													
Americium-241		0.556	+/-0.101	0.026	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243		0.0435	+/-0.0276	0.0194	0.400	pCi/g							
Curium-243/244	U	0.00931	+/-0.016	0.014	0.400	pCi/g							
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	-0.0376	+/-0.0484	0.168	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"													
Plutonium-238		0.107	+/-0.0432	0.0207	0.400	pCi/g			BXA4	11/21/17	0927	1718470	3
Plutonium-239/240		0.118	+/-0.0456	0.0238	0.400	pCi/g							
Liquid Scint Pu241, Solid "Dry Weight Corrected"													
Plutonium-241	U	2.53	+/-2.28	3.80	5.00	pCi/g			BXA4	11/24/17	0856	1718471	4
Rad Gamma Spec Analysis													
Gamma Ni59, Solid "Dry Weight Corrected"													
Nickel-59	U	-0.649	+/-1.18	2.02	5.00	pCi/g			TXJ1	11/17/17	0847	1715764	5
Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"													
Cesium-137		11.5	+/-0.274	0.0568	1.00	pCi/g			MXR1	11/16/17	1037	1714268	6
Cobalt-60		0.695	+/-0.0863	0.0429		pCi/g							
Europium-152	U	-0.00843	+/-0.109	0.196		pCi/g							
Europium-154	U	0.0273	+/-0.0674	0.139		pCi/g							
Europium-155	U	0.00639	+/-0.0949	0.177		pCi/g							
Niobium-94	U	0.00022	+/-0.0202	0.0382		pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, Solid "Dry Weight Corrected"													
Strontium-90	U	-0.178	+/-0.133	0.306	0.400	pCi/g			KSD1	11/16/17	1412	1717213	7
Rad Liquid Scintillation Analysis													
LSC, Tritium Distillation, Solid "As Received"													
Tritium	U	3.39	+/-5.26	8.95	10.0	pCi/g			BXM4	11/16/17	0804	1715582	8
Liquid Scint C14, Solid "As Received"													
Carbon-14	U	-0.851	+/-2.20	3.81	5.00	pCi/g			BXM4	11/13/17	1408	1715576	9
Liquid Scint Tc99, Solid "As Received"													
Technetium-99	U	-0.031	+/-0.809	1.40	2.00	pCi/g			CXS7	11/14/17	0716	1715726	10
Liquid Scint Fe55, Solid "Dry Weight Corrected"													
Iron-55	U	3.82	+/-5.00	6.72	10.0	pCi/g			TXJ1	11/18/17	0509	1715698	11
Liquid Scint Ni63, Solid "Dry Weight Corrected"													

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-009-SB  
Sample ID: 436541002

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63		9.70	+/-2.31	3.33	5.00	pCi/g			TXJ1	11/18/17	1230	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			64.8	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			93.8	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			105	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			86.8	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			86.8	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			106	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			91.7	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			86.7	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			72.5	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			76.6	(25%-125%)

Notes:

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### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-009-SB  
Sample ID: 436541002

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

**GEL LABORATORIES LLC**

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**Certificate of Analysis**

Report Date: November 27, 2017

Company : LaCrosseSolutions  
 Address : S4601 State Hwy 35  
  
 Contact: Genoa, Wisconsin 54632  
 Project: Mr. Jason Q. Spaide  
 LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-011-SB  
 Sample ID: 436541003  
 Matrix: Soil  
 Collect Date: 13-SEP-17 14:05  
 Receive Date: 30-OCT-17  
 Collector: Client

Project: ENRG07001  
 Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
<b>Rad Alpha Spec Analysis</b>													
<b>Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"</b>													
Americium-241		0.0771	+/-0.033	0.022	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243	U	0.0107	+/-0.017	0.0235	0.400	pCi/g							
Curium-243/244	U	0.00093	+/-0.00972	0.0203	0.400	pCi/g							
<b>Alphaspec Np, Solid "Dry Weight Corrected"</b>													
Neptunium-237	U	-0.0325	+/-0.0948	0.243	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
<b>Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"</b>													
Plutonium-238	U	0.0079	+/-0.0156	0.0264	0.400	pCi/g			BXA4	11/21/17	1838	1718470	3
Plutonium-239/240	U	0.0166	+/-0.0209	0.0322	0.400	pCi/g							
<b>Liquid Scint Pu241, Solid "Dry Weight Corrected"</b>													
Plutonium-241	U	-1.07	+/-1.97	3.48	5.00	pCi/g			BXA4	11/24/17	0928	1718471	4
<b>Rad Gamma Spec Analysis</b>													
<b>Gamma Ni59, Solid "Dry Weight Corrected"</b>													
Nickel-59	U	-0.254	+/-1.37	2.66	5.00	pCi/g			TXJ1	11/17/17	0847	1715764	5
<b>Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"</b>													
Cesium-137		3.77	+/-0.234	0.0693	1.00	pCi/g			MXR1	11/16/17	1038	1714268	6
Cobalt-60		0.229	+/-0.0834	0.0443		pCi/g							
Europium-152	U	0.0119	+/-0.0827	0.160		pCi/g							
Europium-154	U	0.0426	+/-0.0915	0.224		pCi/g							
Europium-155	U	0.012	+/-0.0464	0.102		pCi/g							
Niobium-94	U	0.0159	+/-0.0193	0.0489		pCi/g							
<b>Rad Gas Flow Proportional Counting</b>													
<b>GFPC, Sr90, Solid "Dry Weight Corrected"</b>													
Strontium-90	U	0.0787	+/-0.141	0.251	0.400	pCi/g			KSD1	11/16/17	1412	1717213	7
<b>Rad Liquid Scintillation Analysis</b>													
<b>LSC, Tritium Distillation, Solid "As Received"</b>													
Tritium	U	-0.287	+/-5.02	8.86	10.0	pCi/g			BXM4	11/16/17	0851	1715582	8
<b>Liquid Scint C14, Solid "As Received"</b>													
Carbon-14	U	0.352	+/-2.31	3.95	5.00	pCi/g			BXM4	11/13/17	1450	1715576	9
<b>Liquid Scint Tc99, Solid "As Received"</b>													
Technetium-99	U	-0.102	+/-0.816	1.41	2.00	pCi/g			CXS7	11/14/17	0748	1715726	10
<b>Liquid Scint Fe55, Solid "Dry Weight Corrected"</b>													
Iron-55	U	-0.95	+/-4.87	6.67	10.0	pCi/g			TXJ1	11/18/17	0556	1715698	11
<b>Liquid Scint Ni63, Solid "Dry Weight Corrected"</b>													

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-011-SB  
Sample ID: 436541003

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63	U	1.77	+/-2.04	3.44	5.00	pCi/g			TXJ1	11/18/17	1246	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			87.5	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			84.5	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			89.4	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			93.3	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			93.3	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			101	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			87.9	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			86.7	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			76.3	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			75	(25%-125%)

Notes:

## GEL LABORATORIES LLC

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### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-011-SB  
Sample ID: 436541003

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit



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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Contact: Genoa, Wisconsin 54632  
Project: Mr. Jason Q. Spaide  
LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-012-SB  
Sample ID: 436541004  
Matrix: Soil  
Collect Date: 13-SEP-17 14:08  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
<b>Rad Alpha Spec Analysis</b>													
<b>Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"</b>													
Americium-241		0.113	+/-0.0404	0.0109	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243	U	0.00295	+/-0.0164	0.0314	0.400	pCi/g							
Curium-243/244	U	-0.00159	+/-0.011	0.0267	0.400	pCi/g							
<b>Alphaspec Np, Solid "Dry Weight Corrected"</b>													
Neptunium-237	U	-0.0197	+/-0.0427	0.131	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
<b>Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"</b>													
Plutonium-238	U	0.0175	+/-0.020	0.025	0.400	pCi/g			BXA4	11/21/17	0927	1718470	3
Plutonium-239/240	U	0.0176	+/-0.0218	0.0316	0.400	pCi/g							
<b>Liquid Scint Pu241, Solid "Dry Weight Corrected"</b>													
Plutonium-241	U	-0.849	+/-2.14	3.75	5.00	pCi/g			BXA4	11/24/17	1000	1718471	4
<b>Rad Gamma Spec Analysis</b>													
<b>Gamma Ni59, Solid "Dry Weight Corrected"</b>													
Nickel-59	U	0.717	+/-0.723	0.770	5.00	pCi/g			TXJ1	11/17/17	0848	1715764	5
<b>Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"</b>													
Cesium-137		2.21	+/-0.168	0.0537	1.00	pCi/g			MXR1	11/16/17	1038	1714268	6
Cobalt-60	UI	0.00	+/-0.0734	0.0345		pCi/g							
Europium-152	U	0.0659	+/-0.0981	0.191		pCi/g							
Europium-154	U	-0.00813	+/-0.104	0.206		pCi/g							
Europium-155	U	-0.0145	+/-0.0681	0.137		pCi/g							
Niobium-94	U	-0.00759	+/-0.023	0.0428		pCi/g							
<b>Rad Gas Flow Proportional Counting</b>													
<b>GFPC, Sr90, Solid "Dry Weight Corrected"</b>													
Strontium-90	U	0.163	+/-0.193	0.325	0.400	pCi/g			KSD1	11/16/17	1412	1717213	7
<b>Rad Liquid Scintillation Analysis</b>													
<b>LSC, Tritium Distillation, Solid "As Received"</b>													
Tritium	U	1.54	+/-5.18	8.98	10.0	pCi/g			BXM4	11/16/17	0938	1715582	8
<b>Liquid Scint C14, Solid "As Received"</b>													
Carbon-14	U	0.118	+/-2.33	3.99	5.00	pCi/g			BXM4	11/13/17	1532	1715576	9
<b>Liquid Scint Tc99, Solid "As Received"</b>													
Technetium-99	U	0.308	+/-0.751	1.28	2.00	pCi/g			CXS7	11/14/17	0820	1715726	10
<b>Liquid Scint Fe55, Solid "Dry Weight Corrected"</b>													
Iron-55	U	-0.152	+/-4.83	6.55	10.0	pCi/g			TXJ1	11/18/17	0644	1715698	11
<b>Liquid Scint Ni63, Solid "Dry Weight Corrected"</b>													

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-012-SB  
Sample ID: 436541004

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63	U	1.58	+/-1.93	3.25	5.00	pCi/g			TXJ1	11/17/17	2307	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			80.4	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			64.3	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			101	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			89.6	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			89.6	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			106	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			79	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			89.1	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			80.4	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			77.4	(25%-125%)

Notes:

## GEL LABORATORIES LLC

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### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-012-SB  
Sample ID: 436541004

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-014-SB  
Sample ID: 436541005  
Matrix: Soil  
Collect Date: 13-SEP-17 14:18  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"													
Americium-241		0.0796	+/-0.0363	0.0193	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243	U	0.0138	+/-0.0219	0.0303	0.400	pCi/g							
Curium-243/244	U	-0.00192	+/-0.00848	0.0221	0.400	pCi/g							
Alphaspec Np, Solid "Dry Weight Corrected"													
Neptunium-237	U	0.0144	+/-0.0632	0.114	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"													
Plutonium-238	U	0.016	+/-0.0219	0.0298	0.400	pCi/g			BXA4	11/21/17	0927	1718470	3
Plutonium-239/240	U	0.0111	+/-0.0196	0.0298	0.400	pCi/g							
Liquid Scint Pu241, Solid "Dry Weight Corrected"													
Plutonium-241	U	-0.93	+/-2.61	4.58	5.00	pCi/g			BXA4	11/24/17	1031	1718471	4
Rad Gamma Spec Analysis													
Gamma Ni59, Solid "Dry Weight Corrected"													
Nickel-59	U	-1.92	+/-1.40	2.14	5.00	pCi/g			TXJ1	11/17/17	1044	1715764	5
Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"													
Cesium-137		2.77	+/-0.213	0.0799	1.00	pCi/g			MXR1	11/16/17	1039	1714268	6
Cobalt-60		0.192	+/-0.076	0.0714		pCi/g							
Europium-152	U	0.0472	+/-0.0913	0.193		pCi/g							
Europium-154	U	-0.0785	+/-0.103	0.174		pCi/g							
Europium-155	U	-0.0268	+/-0.0783	0.153		pCi/g							
Niobium-94	U	0.00726	+/-0.0324	0.0674		pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, Solid "Dry Weight Corrected"													
Strontium-90	U	0.0795	+/-0.159	0.286	0.400	pCi/g			KSD1	11/16/17	1412	1717213	7
Rad Liquid Scintillation Analysis													
LSC, Tritium Distillation, Solid "As Received"													
Tritium	U	2.67	+/-5.29	9.08	10.0	pCi/g			BXM4	11/16/17	1025	1715582	8
Liquid Scint C14, Solid "As Received"													
Carbon-14	U	1.46	+/-2.31	3.90	5.00	pCi/g			BXM4	11/13/17	1614	1715576	9
Liquid Scint Tc99, Solid "As Received"													
Technetium-99	U	-0.783	+/-0.902	1.60	2.00	pCi/g			CXS7	11/14/17	0853	1715726	10
Liquid Scint Fe55, Solid "Dry Weight Corrected"													
Iron-55	U	0.527	+/-4.81	6.53	10.0	pCi/g			TXJ1	11/18/17	0731	1715698	11
Liquid Scint Ni63, Solid "Dry Weight Corrected"													

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-014-SB  
Sample ID: 436541005

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63	U	1.95	+/-2.33	3.92	5.00	pCi/g			TXJ1	11/17/17	2323	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			70.1	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			65.2	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			92.1	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			72.7	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			72.7	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			111	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			89.2	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			84.4	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			77.4	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			65.5	(25%-125%)

Notes:

## GEL LABORATORIES LLC

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### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Contact: Genoa, Wisconsin 54632  
Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: LI-SUB-CDR-FSGS-014-SB  
Sample ID: 436541005

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35  
  
Contact: Genoa, Wisconsin 54632  
Project: Mr. Jason Q. Spaide  
LACBWR Site Restoration Project

Client Sample ID: NRC #4  
Sample ID: 436541006  
Matrix: Soil  
Collect Date: 13-SEP-17 13:45  
Receive Date: 30-OCT-17  
Collector: Client  
  
Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
<b>Rad Alpha Spec Analysis</b>													
<b>Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"</b>													
Americium-241		2.03	+/-0.169	0.0306	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243		0.137	+/-0.0539	0.0159	0.400	pCi/g							
Curium-243/244		0.0483	+/-0.0288	0.0281	0.400	pCi/g							
<b>Alphaspec Np, Solid "Dry Weight Corrected"</b>													
Neptunium-237	U	-0.0226	+/-0.0556	0.166	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
<b>Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"</b>													
Plutonium-238		0.622	+/-0.106	0.0283	0.400	pCi/g			BXA4	11/21/17	0927	1718470	3
Plutonium-239/240		0.615	+/-0.106	0.0325	0.400	pCi/g							
<b>Liquid Scint Pu241, Solid "Dry Weight Corrected"</b>													
Plutonium-241		6.57	+/-2.57	4.09	5.00	pCi/g			BXA4	11/24/17	1103	1718471	4
<b>Rad Gamma Spec Analysis</b>													
<b>Gamma Ni59, Solid "Dry Weight Corrected"</b>													
Nickel-59	U	-0.195	+/-1.37	2.46	5.00	pCi/g			TXJ1	11/17/17	1045	1715764	5
<b>Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"</b>													
Cesium-137		171	+/-0.867	0.135	1.00	pCi/g			MXR1	11/16/17	1121	1714268	6
Cobalt-60		18.8	+/-0.346	0.0593		pCi/g							
Europium-152	U	-0.0959	+/-0.283	0.512		pCi/g							
Europium-154	U	0.165	+/-0.176	0.218		pCi/g							
Europium-155	U	0.0694	+/-0.213	0.380		pCi/g							
Niobium-94	U	0.0541	+/-0.0447	0.0819		pCi/g							
<b>Rad Gas Flow Proportional Counting</b>													
<b>GFPC, Sr90, Solid "Dry Weight Corrected"</b>													
Strontium-90		3.55	+/-0.340	0.201	0.400	pCi/g			KSD1	11/21/17	0658	1717213	7
<b>Rad Liquid Scintillation Analysis</b>													
<b>LSC, Tritium Distillation, Solid "As Received"</b>													
Tritium	U	2.09	+/-5.32	9.17	10.0	pCi/g			BXM4	11/16/17	1112	1715582	8
<b>Liquid Scint C14, Solid "As Received"</b>													
Carbon-14	U	-0.44	+/-2.37	4.09	5.00	pCi/g			BXM4	11/13/17	1655	1715576	9
<b>Liquid Scint Tc99, Solid "As Received"</b>													
Technetium-99		7.92	+/-1.13	1.58	2.00	pCi/g			CXS7	11/15/17	0736	1715726	10
<b>Liquid Scint Fe55, Solid "Dry Weight Corrected"</b>													
Iron-55	U	2.45	+/-4.99	6.75	10.0	pCi/g			TXJ1	11/18/17	0818	1715698	11
<b>Liquid Scint Ni63, Solid "Dry Weight Corrected"</b>													

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: NRC #4

Project: ENRG07001

Sample ID: 436541006

Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63		50.4	+/-3.53	3.28	5.00	pCi/g			TXJ1	11/18/17	1302	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			91.4	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			68.1	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			82.5	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			81.9	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			81.9	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			95.9	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			77.7	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			93.5	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			72.9	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			79.8	(25%-125%)

Notes:



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### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: NRC #4

Sample ID: 436541006

Project: ENRG07001

Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor

DL: Detection Limit

MDA: Minimum Detectable Activity

MDC: Minimum Detectable Concentration

Lc/LC: Critical Level

PF: Prep Factor

RL: Reporting Limit

SQL: Sample Quantitation Limit

# GEL LABORATORIES LLC

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## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35  
  
Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: Sump Area #1  
Sample ID: 436541007  
Matrix: Soil  
Collect Date: 09-SEP-17 13:43  
Receive Date: 30-OCT-17  
Collector: Client

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
<b>Rad Alpha Spec Analysis</b>													
<b>Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"</b>													
Americium-241		10.4	+/-0.389	0.0181	0.400	pCi/g			BXA4	11/21/17	1423	1718468	1
Americium-243		0.436	+/-0.0907	0.0145	0.400	pCi/g							
Curium-243/244		0.110	+/-0.0411	0.0229	0.400	pCi/g							
<b>Alphaspec Np, Solid "Dry Weight Corrected"</b>													
Neptunium-237	U	-0.00443	+/-0.0638	0.151	0.400	pCi/g			BXA4	11/21/17	1036	1718469	2
<b>Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"</b>													
Plutonium-238		2.55	+/-0.198	0.0192	0.400	pCi/g			BXA4	11/21/17	1005	1718470	3
Plutonium-239/240		2.73	+/-0.205	0.0191	0.400	pCi/g							
<b>Liquid Scint Pu241, Solid "Dry Weight Corrected"</b>													
Plutonium-241		41.0	+/-2.86	3.09	5.00	pCi/g			BXA4	11/24/17	1135	1718471	4
<b>Rad Gamma Spec Analysis</b>													
<b>Gamma Ni59, Solid "Dry Weight Corrected"</b>													
Nickel-59	U	1.70	+/-1.41	3.09	5.00	pCi/g			TXJ1	11/17/17	1045	1715764	5
<b>Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155 "Dry Weight Corrected"</b>													
Cesium-137		193	+/-1.30	0.182	1.00	pCi/g			MXR1	11/16/17	1122	1714268	6
Cobalt-60		12.3	+/-0.406	0.0788		pCi/g							
Europium-152	U	-0.0371	+/-0.413	0.701		pCi/g							
Europium-154		0.557	+/-0.321	0.264		pCi/g							
Europium-155	U	0.0995	+/-0.252	0.482		pCi/g							
Niobium-94	U	0.00158	+/-0.0591	0.107		pCi/g							
<b>Rad Gas Flow Proportional Counting</b>													
<b>GFPC, Sr90, Solid "Dry Weight Corrected"</b>													
Strontium-90		4.24	+/-0.332	0.143	0.400	pCi/g			KSD1	11/21/17	0658	1717213	7
<b>Rad Liquid Scintillation Analysis</b>													
<b>LSC, Tritium Distillation, Solid "As Received"</b>													
Tritium	U	2.46	+/-5.19	8.92	10.0	pCi/g			BXM4	11/16/17	1159	1715582	8
<b>Liquid Scint C14, Solid "As Received"</b>													
Carbon-14	U	0.446	+/-2.34	4.01	5.00	pCi/g			BXM4	11/13/17	1737	1715576	9
<b>Liquid Scint Tc99, Solid "As Received"</b>													
Technetium-99		2.33	+/-0.974	1.56	2.00	pCi/g			CXS7	11/15/17	0808	1715726	10
<b>Liquid Scint Fe55, Solid "Dry Weight Corrected"</b>													
Iron-55	U	-0.263	+/-4.66	6.35	10.0	pCi/g			TXJ1	11/18/17	0905	1715698	11
<b>Liquid Scint Ni63, Solid "Dry Weight Corrected"</b>													

# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: Sump Area #1  
Sample ID: 436541007

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Liquid Scintillation Analysis													
Liquid Scint Ni63, Solid "Dry Weight Corrected"													
Nickel-63		183	+/-5.79	3.09	5.00	pCi/g			TXJ1	11/18/17	1319	1715705	12

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	LYT1	10/31/17	0808	1714238

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Am-05-RC Modified	
2	ASTM C 1475-00 Modified	
3	DOE EML HASL-300, Pu-11-RC Modified	
4	DOE EML HASL-300, Pu-11-RC Modified	
5	DOE RESL Ni-1	
6	DOE HASL 300, 4.5.2.3/Ga-01-R	
7	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
8	EPA 906.0 Modified	
9	EPA EERF C-01 Modified	
10	DOE EML HASL-300, Tc-02-RC Modified	
11	DOE RESL Fe-1, Modified	
12	DOE RESL Ni-1, Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Americium-243 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			114	(15%-125%)
Curium-243/244 Tracer	Alphaspec Isotopic Am241 Am243, Cm243/244, Solid "Dry Weight Corrected"			75.3	(15%-125%)
Americium-243 Tracer	Alphaspec Np, Solid "Dry Weight Corrected"			100	(15%-125%)
Plutonium-242 Tracer	Alphaspec Pu238, 239/240, Solid "Dry Weight Corrected"			108	(15%-125%)
Plutonium-242 Tracer	Liquid Scint Pu241, Solid "Dry Weight Corrected"			108	(15%-125%)
Nickel Carrier	Gamma Ni59, Solid "Dry Weight Corrected"			107	(25%-125%)
Strontium Carrier	GFPC, Sr90, Solid "Dry Weight Corrected"			86.6	(25%-125%)
Technetium-99m Tracer	Liquid Scint Tc99, Solid "As Received"			90.9	(15%-125%)
Iron-59 Tracer	Liquid Scint Fe55, Solid "Dry Weight Corrected"			78.3	(15%-125%)
Nickel Carrier	Liquid Scint Ni63, Solid "Dry Weight Corrected"			82.5	(25%-125%)

Notes:

## GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

### Certificate of Analysis

Report Date: November 27, 2017

Company : LaCrosseSolutions  
Address : S4601 State Hwy 35

Genoa, Wisconsin 54632  
Contact: Mr. Jason Q. Spaide  
Project: LACBWR Site Restoration Project

Client Sample ID: Sump Area #1  
Sample ID: 436541007

Project: ENRG07001  
Client ID: ENRG070

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
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Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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## QC Summary

Report Date: November 27, 2017

Page 1 of 7

LaCrosseSolutions  
S4601 State Hwy 35  
Genoa, Wisconsin  
Mr. Jason Q. Spaide

Contact:  
Workorder: 436541

Farmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Alpha Spec</b>											
Batch 1718468											
QC1203918724 436541001 DUP											
Americium-241	U	0.0241		0.0305	pCi/g	37.1		(0% - 100%)	BXA4	11/21/17	14:23
	Uncertainty	+/-0.0289		+/-0.021							
Americium-243		0.0636	U	0.00265	pCi/g	57.8		(0% - 100%)			
	Uncertainty	+/-0.0393		+/-0.0171							
Curium-243/244	U	-0.00195	U	-0.00152	pCi/g	N/A		N/A			
	Uncertainty	+/-0.0134		+/-0.00674							
QC1203918725 LCS											
Americium-241	0.980			0.900	pCi/g		91.8	(75%-125%)		11/21/17	14:23
	Uncertainty			+/-0.100							
Americium-243			U	0.00409	pCi/g			(75%-125%)			
	Uncertainty			+/-0.0115							
Curium-243/244	1.24			1.09	pCi/g		87.5	(75%-125%)			
	Uncertainty			+/-0.109							
QC1203918723 MB											
Americium-241			U	0.00156	pCi/g					11/21/17	14:23
	Uncertainty			+/-0.00866							
Americium-243			U	0.0125	pCi/g						
	Uncertainty			+/-0.0223							
Curium-243/244			U	-0.00213	pCi/g						
	Uncertainty			+/-0.00643							
Batch 1718469											
QC1203918727 436541001 DUP											
Neptunium-237	U	0.00876	U	-0.0104	pCi/g	N/A		N/A	BXA4	11/21/17	10:36
	Uncertainty	+/-0.0993		+/-0.0441							
QC1203918728 LCS											
Neptunium-237	8.79			9.12	pCi/g		104	(75%-125%)		11/21/17	10:36
	Uncertainty			+/-0.870							
QC1203918726 MB											
Neptunium-237			U	-0.0224	pCi/g					11/21/17	10:36
	Uncertainty			+/-0.0436							

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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Alpha Spec</b>											
Batch	1718470										
QC1203918730	436541001	DUP									
Plutonium-238		0.0137	U	0.00898	pCi/g	12.8			N/A BXA4	11/21/17	10:37
Uncertainty		+/-0.0181		+/-0.0129							
Plutonium-239/240		U	0.000183	U	0.00325	pCi/g	N/A		N/A		
Uncertainty		+/-0.0135		+/-0.00914							
QC1203918731	LCS										
Plutonium-238			U	0.0141	pCi/g					11/21/17	10:06
Uncertainty				+/-0.0166							
Plutonium-239/240		0.984		0.921	pCi/g		93.7	(75%-125%)			
Uncertainty				+/-0.116							
QC1203918729	MB										
Plutonium-238			U	-0.00125	pCi/g					11/21/17	10:06
Uncertainty				+/-0.0107							
Plutonium-239/240			U	0.00394	pCi/g						
Uncertainty				+/-0.0148							
Batch	1718471										
QC1203918733	436541001	DUP									
Plutonium-241		U	-1.46	U	-1.61	pCi/g	N/A		N/A BXA4	11/24/17	12:38
Uncertainty			+/-2.30		+/-2.25						
QC1203918734	LCS										
Plutonium-241		35.9		33.8	pCi/g		94.2	(75%-125%)		11/24/17	13:10
Uncertainty				+/-3.12							
QC1203918732	MB										
Plutonium-241			U	-0.755	pCi/g					11/24/17	12:06
Uncertainty				+/-2.64							
<b>Rad Gamma Spec</b>											
Batch	1714268										
QC1203908226	436541001	DUP									
Cesium-137		0.804		0.939	pCi/g	15.5		(0%-20%)	MXR1	11/16/17	12:28
Uncertainty		+/-0.115		+/-0.0985							
Cobalt-60		U	0.0245	U	0.0247	pCi/g	N/A		N/A		
Uncertainty			+/-0.0399		+/-0.0356						
Europium-152		U	-0.055	U	-0.0378	pCi/g	N/A		N/A		
Uncertainty			+/-0.0747		+/-0.0542						

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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Gamma Spec</b>											
Batch	1714268										
Europium-154	U	-0.0104	U	-0.00504	pCi/g	N/A			N/A MXR1	11/16/17	12:28
	Uncertainty	+/-0.0838		+/-0.0758							
Europium-155	U	0.0393	U	0.0182	pCi/g	N/A			N/A		
	Uncertainty	+/-0.0717		+/-0.0401							
Niobium-94	U	-0.00984	U	0.0183	pCi/g	N/A			N/A		
	Uncertainty	+/-0.024		+/-0.0209							
QC1203908227	LCS										
Americium-241	488			510	pCi/g		104	(75%-125%)		11/16/17	12:02
	Uncertainty			+/-11.2							
Cesium-137	175			177	pCi/g		101	(75%-125%)			
	Uncertainty			+/-3.38							
Cobalt-60	139			138	pCi/g		98.9	(75%-125%)			
	Uncertainty			+/-3.57							
Europium-152			U	0.586	pCi/g						
	Uncertainty			+/-1.49							
Europium-154			U	-0.552	pCi/g						
	Uncertainty			+/-1.06							
Europium-155			U	-0.821	pCi/g						
	Uncertainty			+/-1.36							
Niobium-94			U	0.246	pCi/g						
	Uncertainty			+/-0.491							
QC1203908225	MB										
Cesium-137			U	0.00657	pCi/g					11/16/17	11:23
	Uncertainty			+/-0.0157							
Cobalt-60			U	0.00816	pCi/g						
	Uncertainty			+/-0.0136							
Europium-152			U	-0.00798	pCi/g						
	Uncertainty			+/-0.0366							
Europium-154			U	-0.0148	pCi/g						
	Uncertainty			+/-0.0406							
Europium-155			U	-0.00742	pCi/g						
	Uncertainty			+/-0.0261							

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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Gamma Spec</b>											
Batch	1714268										
Niobium-94			U	-0.000682	pCi/g				MXR1	11/16/17	11:23
	Uncertainty			+/-0.0149							
<b>Rad Gas Flow</b>											
Batch	1715764										
QC1203911889	436541001	DUP									
Nickel-59		U	-1.72	U	-1.05	pCi/g	N/A		N/A	TXJ1	11/17/17 11:58
	Uncertainty		+/-1.60		+/-1.55						
QC1203911890	LCS										
Nickel-59			93.6		90.0	pCi/g	96.2	(75%-125%)			11/17/17 11:59
	Uncertainty				+/-6.15						
QC1203911888	MB										
Nickel-59				U	0.485	pCi/g					11/17/17 10:46
	Uncertainty				+/-0.578						
<b>Rad Liquid Scintillation</b>											
Batch	1717213										
QC1203915501	436541005	DUP									
Strontium-90		U	0.0795	U	0.169	pCi/g	N/A		N/A	KSD1	11/16/17 14:13
	Uncertainty		+/-0.159		+/-0.154						
QC1203915502	LCS										
Strontium-90			13.8		12.1	pCi/g	87.5	(75%-125%)			11/16/17 14:13
	Uncertainty				+/-0.695						
QC1203915500	MB										
Strontium-90				U	0.0523	pCi/g					11/16/17 14:13
	Uncertainty				+/-0.140						
<b>Rad Liquid Scintillation</b>											
Batch	1715576										
QC1203911442	436541001	DUP									
Carbon-14		U	0.720	U	-0.498	pCi/g	N/A		N/A	BXM4	11/13/17 19:02
	Uncertainty		+/-2.36		+/-2.19						
QC1203911444	LCS										
Carbon-14			140		139	pCi/g	99.3	(75%-125%)			11/13/17 20:26
	Uncertainty				+/-4.50						
QC1203911441	MB										
Carbon-14				U	1.49	pCi/g					11/13/17 18:19
	Uncertainty				+/-2.26						



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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Liquid Scintillation</b>											
Batch	1715576										
QC1203911443	436541001	MS									
Carbon-14	260	U	0.720	246	pCi/g		94.8	(75%-125%)	BXM4	11/13/17	19:44
	Uncertainty		+/-2.36	+/-8.17							
Batch	1715582										
QC1203911462	436541001	DUP									
Tritium		U	1.27	0.0497	pCi/g	N/A			N/ABXM4	11/16/17	13:33
	Uncertainty		+/-5.11	+/-5.14							
QC1203911464	LCS										
Tritium	53.7			50.4	pCi/g		93.9	(75%-125%)		11/16/17	15:07
	Uncertainty			+/-7.27							
QC1203911461	MB										
Tritium			U	1.06	pCi/g					11/16/17	12:46
	Uncertainty			+/-5.16							
QC1203911463	436541001	MS									
Tritium	108	U	1.27	95.0	pCi/g		87.7	(75%-125%)		11/16/17	14:20
	Uncertainty		+/-5.11	+/-14.1							
Batch	1715698										
QC1203911707	436541001	DUP									
Iron-55		U	-2.22	-0.891	pCi/g	N/A			N/A	TXJ1	11/18/17 10:40
	Uncertainty		+/-4.73	+/-4.89							
QC1203911708	LCS										
Iron-55	126			128	pCi/g		101	(75%-125%)		11/18/17	11:27
	Uncertainty			+/-6.70							
QC1203911706	MB										
Iron-55			U	3.13	pCi/g					11/18/17	09:52
	Uncertainty			+/-4.38							
Batch	1715705										
QC1203911729	436541001	DUP									
Nickel-63		U	2.73	0.745	pCi/g	N/A			N/A	TXJ1	11/18/17 00:28
	Uncertainty		+/-1.99	+/-1.80							
QC1203911730	LCS										
Nickel-63	85.9			94.1	pCi/g		110	(75%-125%)		11/18/17	00:45
	Uncertainty			+/-4.66							

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Parname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
<b>Rad Liquid Scintillation</b>											
Batch	1715705										
QC1203911728	MB										
Nickel-63			U	2.30	pCi/g				TXJ1	11/18/17	00:12
	Uncertainty			+/-1.95							
Batch	1715726										
QC1203911766	436541001	DUP									
Technetium-99			U	-0.208	U	0.425	pCi/g	N/A	N/A	CXS7	11/14/17 11:02
	Uncertainty			+/-0.744		+/-0.826					
QC1203911767	LCS										
Technetium-99				34.2		25.9	pCi/g	75.8	(75%-125%)		11/15/17 06:31
	Uncertainty					+/-1.19					
QC1203911765	MB										
Technetium-99			U	-0.368	pCi/g						11/14/17 10:30
	Uncertainty			+/-0.624							

### Notes:

Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

The Qualifiers in this report are defined as follows:

- \*\* Analyte is a Tracer compound
- < Result is less than value reported
- > Result is greater than value reported
- BD Results are either below the MDC or tracer recovery is low
- FA Failed analysis.
- H Analytical holding time was exceeded
- J Value is estimated
- K Analyte present. Reported value may be biased high. Actual value is expected to be lower.
- L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
- M M if above MDC and less than LLD
- M REMF Result > MDC/CL and < RDL
- N/A RPD or %Recovery limits do not apply.
- N1 See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
- UI Gamma Spectroscopy--Uncertain identification

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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
UJ	Gamma Spectroscopy--Uncertain identification										
UL	Not considered detected. The associated number is the reported concentration, which may be inaccurate due to a low bias.										
X	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier										
Y	Other specific qualifiers were required to properly define the results. Consult case narrative.										
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.										
h	Preparation or preservation holding time was exceeded										

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.

^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.

\* Indicates that a Quality Control parameter was not within specifications.

For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

**Radiochemistry  
Technical Case Narrative  
LaCrosseSolutions, LLC (ENRG)  
SDG #: 436541**

**Product:** Alphaspec Isotopic Am241 Am243, Cm243/244, Solid  
**Analytical Method:** DOE EML HASL-300, Am-05-RC Modified  
**Analytical Procedure:** GL-RAD-A-011 REV# 26  
**Analytical Batch:** 1718468

**Preparation Method:** Dry Soil Prep  
**Preparation Procedure:** GL-RAD-A-021 REV# 22  
**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203918723	Method Blank (MB)
1203918724	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203918725	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Technical Information**

**Recounts**

Sample 436541001 (LI-SUB-CDR-FSGS-008-SB) was given additional clean-up steps and recounted in order to remove suspected interferences. The recount is reported.

**Product:** Alphaspec Np, Solid  
**Analytical Method:** ASTM C 1475-00 Modified  
**Analytical Procedure:** GL-RAD-A-032 REV# 21  
**Analytical Batch:** 1718469

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203918726	Method Blank (MB)
1203918727	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203918728	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** Alphaspec Pu238, 239/240, Solid

**Analytical Method:** DOE EML HASL-300, Pu-11-RC Modified

**Analytical Procedure:** GL-RAD-A-011 REV# 26

**Analytical Batch:** 1718470

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203918729	Method Blank (MB)
1203918730	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203918731	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Technical Information**

**Recounts**

Sample 436541003 (LI-SUB-CDR-FSGS-011-SB) was recounted due to a peak shift. The recount is reported.

**Product:** Dry Weight

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1

The samples in this SDG were analyzed on an "as received" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** Gamma, Cs137, Co60, Nb94, Eu152, Eu154, Eu155

**Analytical Method:** DOE HASL 300, 4.5.2.3/Ga-01-R

**Analytical Procedure:** GL-RAD-A-013 REV# 27

**Analytical Batch:** 1714268

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<u>GEL Sample ID#</u>	<u>Client Sample Identification</u>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203908225	Method Blank (MB)
1203908226	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203908227	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Qualifier Information**

<b>Qualifier</b>	<b>Reason</b>	<b>Analyte</b>	<b>Sample</b>	<b>Client Sample</b>
UI	Results are considered a false positive due to high peak-width.	Cobalt-60	436541004	LI-SUB-CDR-FSGS-012-SB

**Product:** Gamma Ni59, Solid

**Analytical Method:** DOE RESL Ni-1

**Analytical Procedure:** GL-RAD-A-022 REV# 18

**Analytical Batch:** 1715764

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<u>GEL Sample ID#</u>	<u>Client Sample Identification</u>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203911888	Method Blank (MB)

1203911889                      436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)  
1203911890                      Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** GFPC, Sr90, Solid

**Analytical Method:** EPA 905.0 Modified/DOE RP501 Rev. 1 Modified

**Analytical Procedure:** GL-RAD-A-004 REV# 19

**Analytical Batch:** 1717213

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203915500	Method Blank (MB)
1203915501	436541005(LI-SUB-CDR-FSGS-014-SB) Sample Duplicate (DUP)
1203915502	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Technical Information**

**Recounts**

Sample 436541001 (LI-SUB-CDR-FSGS-008-SB) was recounted due to results more negative than the three sigma TPU. The second count is reported. Samples 436541006 (NRC #4) and 436541007 (Sump Area #1) were verified by recounting at least five days from the separation date. The recounts are reported.



**Product:** Liquid Scint Pu241, Solid  
**Analytical Method:** DOE EML HASL-300, Pu-11-RC Modified  
**Analytical Procedure:** GL-RAD-A-035 REV# 19  
**Analytical Batch:** 1718471

**Preparation Method:** Dry Soil Prep  
**Preparation Procedure:** GL-RAD-A-021 REV# 22  
**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203918732	Method Blank (MB)
1203918733	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203918734	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** Liquid Scint C14, Solid  
**Analytical Method:** EPA EERF C-01 Modified  
**Analytical Procedure:** GL-RAD-A-003 REV# 15  
**Analytical Batch:** 1715576

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1

1203911441	Method Blank (MB)
1203911442	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203911443	436541001(LI-SUB-CDR-FSGS-008-SB) Matrix Spike (MS)
1203911444	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Miscellaneous Information**

**Additional Comments**

The matrix spike, 1203911443 (LI-SUB-CDR-FSGS-008-SBMS), aliquot was reduced to conserve sample volume.

**Product:** LSC, Tritium Distillation, Solid

**Analytical Method:** EPA 906.0 Modified

**Analytical Procedure:** GL-RAD-A-002 REV# 22

**Analytical Batch:** 1715582

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203911461	Method Blank (MB)
1203911462	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203911463	436541001(LI-SUB-CDR-FSGS-008-SB) Matrix Spike (MS)
1203911464	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Miscellaneous Information**

**Additional Comments**

The matrix spike, 1203911463 (LI-SUB-CDR-FSGS-008-SBMS), aliquot was reduced to conserve sample

volume.

**Product:** Liquid Scint Fe55, Solid

**Analytical Method:** DOE RESL Fe-1, Modified

**Analytical Procedure:** GL-RAD-A-040 REV# 13

**Analytical Batch:** 1715698

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<b><u>GEL Sample ID#</u></b>	<b><u>Client Sample Identification</u></b>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203911706	Method Blank (MB)
1203911707	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203911708	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

There are no exceptions, anomalies or deviations from the specified methods. All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable.

**Product:** Liquid Scint Ni63, Solid

**Analytical Method:** DOE RESL Ni-1, Modified

**Analytical Procedure:** GL-RAD-A-022 REV# 18

**Analytical Batch:** 1715705

**Preparation Method:** Dry Soil Prep

**Preparation Procedure:** GL-RAD-A-021 REV# 22

**Preparation Batch:** 1714238

The following samples were analyzed using the above methods and analytical procedure(s).

<u>GEL Sample ID#</u>	<u>Client Sample Identification</u>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203911728	Method Blank (MB)
1203911729	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203911730	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on a "dry weight" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Technical Information**

**Recounts**

Samples 436541002 (LI-SUB-CDR-FSGS-009-SB), 436541003 (LI-SUB-CDR-FSGS-011-SB), 436541006 (NRC #4) and 436541007 (Sump Area #1) were recounted to verify sample results. Recounts are reported.

**Product: Liquid Scint Tc99, Solid**

**Analytical Method:** DOE EML HASL-300, Tc-02-RC Modified

**Analytical Procedure:** GL-RAD-A-059 REV# 5

**Analytical Batch:** 1715726

The following samples were analyzed using the above methods and analytical procedure(s).

<u>GEL Sample ID#</u>	<u>Client Sample Identification</u>
436541001	LI-SUB-CDR-FSGS-008-SB
436541002	LI-SUB-CDR-FSGS-009-SB
436541003	LI-SUB-CDR-FSGS-011-SB
436541004	LI-SUB-CDR-FSGS-012-SB
436541005	LI-SUB-CDR-FSGS-014-SB
436541006	NRC #4
436541007	Sump Area #1
1203911765	Method Blank (MB)
1203911766	436541001(LI-SUB-CDR-FSGS-008-SB) Sample Duplicate (DUP)
1203911767	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

**Data Summary:**

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

**Technical Information****Recounts**

Sample 1203911767 (LCS) was recounted due to low recovery. The recount is reported. Samples 436541006 (NRC #4) and 436541007 (Sump Area #1) were recounted to verify sample results. Recounts are reported.

**Certification Statement**

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.



<b>GEL Chain of Custody and Analytical Request</b> <b>**See <a href="http://www.gel.com">www.gel.com</a> for GEL's Sample Acceptance SOP**</b>		2040 Savage Road Charleston, SC 29407 Phone: (843) 556-8171 Fax: (843) 766-1178
<b>GEL Work Order Number:</b>		

[illegible]

- |                                   |           |
|-----------------------------------|-----------|
| <i>For Lab Receiving Use Only</i> |           |
| <i>Custody Seal Intact?</i>       |           |
| <i>YES</i>                        | <i>NO</i> |
| <i>Cooler Temp:</i>               |           |
| <i>C</i>                          |           |

**PINK = CLIENT**







**SAMPLE RECEIPT & REVIEW FORM**

Client: <u>ENRG</u>		SDG/AR/COC/Work Order:	
Received By: <u>AA</u>		Date Received: <u>10/30/17</u>	
Carrier and Tracking Number		Circle Applicable: FedEx Express <u>FedEx Ground</u> UPS   Field Services   Courier   Other	
		<u>7705 6606 1987</u>	
Suspected Hazard Information	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.	
Shipped as a DOT Hazardous?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Hazard Class Shipped: _____ UN#: _____	
COC/Samples marked or classified as radioactive?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): <u>9</u> CPM / mR/Hr Classified as: <u>Rad 1</u> Rad 2 Rad 3	
Is package, COC, and/or Samples marked HAZ?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	If yes, select Hazards below, and contact the GEL Safety Group. PCB's   Flammable   Foreign Soil   RCRA   Asbestos   Beryllium   Other: _____	

Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1 Shipping containers received intact and sealed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken   Damaged container   Leaking container   Other (describe)
2 Chain of custody documents included with shipment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3 Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Preservation Method: Wet Ice   Ice Packs   Dry Ice <u>None</u> Other: *all temperatures are recorded in Celsius <span style="float: right;">TEMP: <u>17°</u></span>
4 Daily check performed and passed on IR temperature gun?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Temperature Device Serial #: <u>TA2-17</u> Secondary Temperature Device Serial # (If Applicable): _____
5 Sample containers intact and sealed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Circle Applicable: Seals broken   Damaged container   Leaking container   Other (describe)
6 Samples requiring chemical preservation at proper pH?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Sample ID's and Containers Affected: <u>3rd Qtr. Composite arrived unpreserved</u> If Preservation added, Lot#: <u>171004</u> If Yes, Are Encores or Soil Kits present? Yes ___ No ___ (If yes, take to VOA Freezer) Do VOA vials contain acid preservation? Yes ___ No ___ N/A (If unknown, select No) VOA vials free of headspace? Yes ___ No ___ N/A
7 Do any samples require Volatile Analysis?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Sample ID's and containers affected: _____
8 Samples received within holding time?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ID's and tests affected:
9 Sample ID's on COC match ID's on bottles?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's and containers affected:
10 Date & time on COC match date & time on bottles?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected:
11 Number of containers received match number indicated on COC?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sample ID's affected:
12 Are sample containers identifiable as GEL provided?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
13 COC form is properly signed in relinquished/received sections?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Comments (Use Continuation Form If needed):

PM (or PMA) review: Initials EM Date 10/31/17 Page 1 of 1

**List of current GEL Certifications as of 27 November 2017**

State	Certification
Alaska	UST-0110
Arkansas	88-0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH-0169
Delaware	SC00012
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330-15-00283, P330-15-00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho Chemistry	SC00012
Idaho Radiochemistry	SC00012
Illinois NELAP	200029
Indiana	C-SC-01
Kansas NELAP	E-10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana NELAP	03046 (AI33904)
Louisiana SDWA	LA170010
Maryland	270
Massachusetts	M-SC012
Michigan	9976
Mississippi	SC00012
Nebraska	NE-OS-26-13
Nevada	SC000122018-1
New Hampshire NELAP	205415
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R-158
Oklahoma	9904
Pennsylvania NELAP	68-00485
Puerto Rico	SC00012
S.Carolina Radchem	10120002
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235-17-12
Utah NELAP	SC000122017-24
Vermont	VT87156
Virginia NELAP	460202
Washington	C780
West Virginia	997404