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PG&E Letter HBL-21-011

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

Docket No. 50-133, License No. DPR-7
Humboldt Bay Power Plant, Unit 3
Final Status Survey Report for the Humboldt Bay Power Plant

Dear Commissioners and Staff:

Pacific Gas and Electric Company (PG&E) hereby submits the enclosed Final Status Survey (FSS) Report for Humboldt Bay Power Plant (HBPP), Unit 3. Enclosure 1 provides an FSS Report for various survey units as described in the report. The FSS Report concludes that the survey areas surveyed and sampled during the FSS should be released from further radiological controls. Therefore, the FSS Report supports the regulatory decision to terminate the 10 CFR Part 50 license for these survey units. PG&E requests that the NRC review the enclosed information and concur that these areas meet the License Termination Plan release criteria.

PG&E is implementing a phased decommissioning approach to accomplish site release for unrestricted use and license termination. Upon completion of FSS reports, PG&E will request the site be released from the 10 CFR Part 50 license.

There are no new or revised regulatory commitments (as defined in NEI 99-04) in this letter.

If you have any questions or require additional supporting documentation for this submittal, please contact Mr. William Barley at (707) 267-0071.

Sincerely,

July 13, 2021

Maureen R. Zawalick Date

Enclosure
cc: HBPP Humboldt Distribution
cc/enc: Scott A. Morris, NRC Region IV Administrator
Amy M. Snyder, NRC Reactor Decommissioning Branch Project Manager

Humboldt Bay Power Plant

Final Status Survey Report

Final Status Survey Report for Survey Units:

HBPP-CHAR-OOL10-01, HBPP-FSSP-OOL10-01-FSR, HBPP-FSSP-OOL10-13, HBPP-FSSP-OOL10-17, HBPP-FSSP-OOL10-17-FSR, HBPP-FSSP-OOL10-20, HBPP-FSSP-OOL10-20-FSR, HBPP-FSSP-OOL10-22, HBPP-FSSP-OOL10-22-FSR, HBPP-FSSP-OOL10-24-FSR, HBPP-FSSP-OOL10-26-FSR

HUMBOLDT BAY POWER PLANT
FINAL STATUS SURVEY REPORT

Final Status Survey Report for Survey Units:

HBPP-CHAR-OOL10-01, HBPP-FSSP-OOL10-01-FSR, HBPP-FSSP-OOL10-13, HBPP-FSSP-OOL10-17, HBPP-FSSP-OOL10-17-FSR, HBPP-FSSP-OOL10-20, HBPP-FSSP-OOL10-20-FSR, HBPP-FSSP-OOL10-22, HBPP-FSSP-OOL10-22-FSR, HBPP-FSSP-OOL10-24-FSR, HBPP-FSSP-OOL10-26-FSR

Report Prepared by: _____ Date: 6/3/2021

Gordon Madison, CHP - FSS Engineering Supervisor

Technical Review: Marshall H Blake Date: 6/3/2021

Marshall Blake - FSS Engineer

Initial Report Approval: _____ Date: 6/3/2021

Kris Rowberry, MHP, AHP - Expert Site Closure Specialist

Final Report Approval: WHBarley Date: 6/3/2021

William Barley, CHP - Site Closure Manager

EXECUTIVE SUMMARY

In accordance with the provisions of the current revision of the Humboldt Bay License Termination Plan (LTP) at the time of the survey, (Ref. 1), Survey Units OOL10-13, OOL10-17, OOL10-20, and OOL10-22, were Final Status Surveyed (FSS) with additional Final Site Restoration (FSR) Survey Units OOL10-01-FSR, OOL10-17-FSR, OOL10-20-FSR, OOL10-22-FSR, OOL10-24-FSR and OOL10-26-FSR surveyed for phased release from the site's 10CFR50 license. For characterization Survey Unit OOL10-01, the FSS period of performance predated the approved LTP. Therefore, the characterization plan for the survey unit was performed to the rigors of FSS as discussed later in this report. This report was prepared to demonstrate that the designated survey units satisfy the radiological release criteria.

The areas under consideration consist of the remainder of open land area of the Fuel Oil Storage Tank Footprint, Coastal Trail, Bravo Road and Frog Pond, the Haul Road, Interim Spent Fuel Storage Installation (ISFSI) West, Waste Storage Facility Pad, and Charlie Road. There were five FSR survey units with backfilled re-use material presented in this report as several of the FSS areas described in this report were covered with reuse material. Charlie Road FSR survey unit contains Class 2 reuse material excavated from Haul Road Class 2 unit. The footprint of Charlie Road FSR survey unit (OOL10-26-FSR) sits on the boundary of Class 3 survey units Bravo Road and Frog Pond (OOL10-17), and Coastal Trail (OOL10-13).

The total footprint area of the five open land FSS units is approximately 110,564 square meters (m^2), and the total footprint area of the five open land and one concrete pad FSR units is approximately 73,200 m^2. All are located within the industrialized area, except for the coastal trail. See Executive Summary Tables for details of each survey unit. Survey Unit OOL10-24-FSR was also downgraded as part of the Waste Management Facility (WMF) downgrade letter to the NRC from a Class 1 to a Class 2 area as previously discussed in an earlier FSS Building report submittal.

The survey unit areas are designated as Class 2 and Class 3 land areas in the LTP. Class 2 impacted areas are not likely to have, concentrations of residual radioactivity in excess of the Derived Concentration Guideline Levels (DCGLs). Class 3 areas are impacted areas that have a low probability of containing areas with residual radioactivity.

The open land area surveys performed included a total of one-hundred ninety-two (192) soil samples, and one engineered material (EM) sample. The surveys performed for the WMF Pad Area survey unit included a total of fifteen (15) fixed alpha and beta direct (static) measurements to assess the total activity component and 15 smear measurements to assess the removable activity component at each location, with one composite media sample. Each of the statistical sample locations was selected based on a random start, systematic grid placement or random placement for Class 2 and Class 3 survey units respectively using the Visual Sample Plan (VSP) software program. Sample locations were confirmed by a high precision Global Positioning System (GPS) for all survey units. The sampling effort included one-hundred fifty-six (156) statistical soil samples, twenty-one (21) split-samples, thirty-seven (37) biased samples, twenty-two (22) HTD samples, and seven (7) statistical and six (6) biased samples collected concurrently and split for Oak Ridge Institute for Science and Education (ORISE). The ORISE survey activities for the former Fuel Oil Tank Area were completed on February 14th and 15th of 2012. One composite media sample was collected at two investigation locations identified as a result of beta-gamma scan surveys of the WMF Storage Pad. Fifteen (15) biased soil samples were taken during the re-use gamma walkover surveys performed of one-hundred and eighteen (118) six-inch lifts of the Class 2 material applied on backfilled final survey units OOL10-13, OOL10-17, and OOL10-20. Cross contamination controls were in place following completion of remediation in those areas while remediation work progressed in other areas of the site. See Executive Summary Tables for details of each area.

Additionally, seventeen (17) sample recounts were taken for quality assurance purposes. No Quality Assurance (QA) related discrepancies were noted that could impact the overall confidence in the results or conclusions of the FSS. Six (6) judgmental and seven (7) statistical soil samples (at the HBPP statistical locations) were collected and split with ORISE during confirmatory survey of the former Fuel Oil Tank Area (FOTA) within survey unit CHAR-OOL10-01 conducted during the period of February 14th and 15th, 2012. Two (2) archived statistical soil samples from Survey Units OOL10-01 and OOL10-20 were transferred to ORISE via Chain of Custody (COC) on August 29, 2019 during an U.S. Nuclear Regulatory Commission (NRC)/(ORISE) independent confirmatory survey of remaining land areas and select buildings inspection at HBPP.

Accessible land survey areas were also scanned with a gamma-sensitive Sodium-Iodide (NaI) detector system. There were two instances where beta-gamma scan investigation criteria were exceeded as noted in Survey Unit OOL10-24, each requiring an investigation measurement. No investigation samples were collected for any open land survey unit described in this report.

The maximum hypothetical dose, from all sources, including groundwater, to a future resident farmer was determined to be less than 1.1 millirem per year (mrem/yr) for all survey units described in this report. The maximum hypothetical dose, from all sources, including groundwater, to a future resident farmer was determined to be less than 0.9 millirem per year (mrem/yr) for all *open land* survey units described in this report. The maximum bounding dose for all open land survey units described in this report is 3.9 mrem/yr, which includes 3 mrem/yr Hard to Detect (HTD) bounding dose calculated from available data. The report concludes that the survey units have met the FSS data quality objectives, and each meet the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA (As Low As Reasonably Achievable).

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Table ES.1- Synopsis of OOL10-01

Feature	Design Criteria	Comment
Survey Unit Land Area	6,473 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on information provided in the HSA and Section 4.4 of MARSSIM(2)
Final Status Survey Plan (FSSP) No.	HBPP-CHAR-OOL10-01-03	HBPP Characterization Planning Worksheet
Scan Survey Area Coverage	100%	Table 5-9 of MARSSIM recommends Judgmental area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of 2.
Min. Value	-2.71E-02	pCi/g(3) Cs-137
Max. Value	3.53E-01	pCi/g Cs-137
Mean	1.85E-01	pCi/g Cs-137
Median	1.95E-01	pCi/g Cs-137
Std. Dev.	1.46E-01	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	HBPP Characterization Planning Worksheet
No. of Bias Measurements	10 Soil Samples and 1 Engineered Surface Material Sample	N/A
No. of Recount Measurements	1 Soil Sample	HBPP Characterization Planning Worksheet
Maximum Hypothetical Dose	8.50E-01 mrem/yr(4)	Meets FSS data quality objectives and regulatory release criteria of 25 mrem/yr TEDE(5)

Note (1): meters squared

Note (2): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)

Note (3): pico-curies per gram

Note (4): Based on DCGL of 5.5 pCi/g for Cs-137 which is 50% of the NRC screening values as the Characterization Survey Plan predated the approved LTP

Note (5): Total Effective Dose Equivalent

Table ES.2 - Synopsis of OOL10-01-FSR

Feature	Design Criteria	Comment
Survey Unit Land Area	3,020 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-01-FSR-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	5%	Table 5-4 of the HBPP LTP requires. Judgmental 1%-10% of area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-2.41E-02	pCi/g Cs-137
Max. Value	2.74E-01	pCi/g Cs-137
Mean	4.21E-02	pCi/g Cs-137
Median	3.38E-02	pCi/g Cs-137
Std. Dev.	7.16E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	7.10E-01 mrem/yr (1.42E-01 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.3 - Synopsis of OOL10-13

Feature	Design Criteria	Comment
Survey Unit Land Area	38,087 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-13-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	5%	Table 5-4 of the HBPP LTP requires Judgmental 1%-10% of area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-2.90E-02	pCi/g Cs-137
Max. Value	2.35E-01	pCi/g Cs-137
Mean	5.22E-02	pCi/g Cs-137
Median	3.70E-02	pCi/g Cs-137
Std. Dev.	7.12E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	1 Soil Sample	N/A
No. of Recount Measurements	2 Soil Samples	1 required per HBAP C-202
Maximum Hypothetical Dose	7.40E-01 mrem/yr (1.72E-01 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.4- Synopsis of OOL10-17

Feature	Design Criteria	Comment
Survey Unit Land Area	53,129 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-17-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	5%	Table 5-4 of the HBPP LTP requires Judgmental 1%-10% of area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-4.00E-02	pCi/g Cs-137
Max. Value	1.92E-01	pCi/g Cs-137
Mean	5.17E-02	pCi/g Cs-137
Median	4.09E-02	pCi/g Cs-137
Std. Dev.	6.56E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	20 Soil Samples	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	7.40E-01 mrem/yr (1.72E-01 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.5 - Synopsis of OOL10-17-FSR

Feature	Design Criteria	Comment
Survey Unit Land Area	53,129 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-17-FSR-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	5%	Table 5-4 of the HBPP LTP requires Judgmental 1%-10% of area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-5.02E-02	pCi/g Cs-137
Max. Value	1.83E-01	pCi/g Cs-137
Mean	5.40E-02	pCi/g Cs-137
Median	5.74E-02	pCi/g Cs-137
Std. Dev.	6.97E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	7.40E-01 mrem/yr (1.72E-01 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.6- Synopsis of OOL10-20

Feature	Design Criteria	Comment
Survey Unit Land Area	7,990 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 2	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-20-02	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Grid Spacing	21.0 m	HBPP Procedure RCP FSS-7 Attachment 8.1
Scan Survey Area Coverage	10%	Table 5-4 of the HBPP LTP requires 10%-100% area coverage for Class 2 survey units.
Number of Measurements	21 Soil Samples (non-parametric test)	15 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2, selected systematically with a random start point.
Min. Value	-2.29E-02	pCi/g Cs-137
Max. Value	5.53E-02	pCi/g Cs-137
Mean	1.04E-02	pCi/g Cs-137
Median	1.35E-02	pCi/g Cs-137
Std. Dev.	2.34E-02	pCi/g Cs-137
No. of Split Measurements	3 Soil Samples	2 required per HBAP(4) C-202
No. of Bias Measurements	5 Soil Samples	N/A
No. of Recount Measurements	3 Soil Samples	2 required per HBAP C-202
No. of ISOCS(9) Measurements	1	N/A
Maximum Hypothetical Dose	1.60E-01 mrem/yr (4.00E-02 mrem/yr(8) Survey unit dose plus 1.20E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g
Note (9): In-Situ Object Characterization System

Table ES.7 - Synopsis of OOL10-20-FSR

Feature	Design Criteria	Comment
Survey Unit Land Area	7,990 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 2	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-20-FSR-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Grid Spacing	24.8 m	HBPP Procedure RCP FSS-7 Attachment 8.1
Scan Survey Area Coverage	10%	Table 5-4 of the HBPP LTP requires 10%-100% area coverage for Class 2 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2, selected systematically with a random start point.
Min. Value	-2.35E-02	pCi/g Cs-137
Max. Value	7.93E-02	pCi/g Cs-137
Mean	2.08E-02	pCi/g Cs-137
Median	1.62E-02	pCi/g Cs-137
Std. Dev.	2.72E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	2 Soil Samples	1 required per HBAP C-202
Maximum Hypothetical Dose	1.90E-01 mrem/yr (7.00E-02 mrem/yr(8) Survey unit dose plus 1.20E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.8 - Synopsis of OOL10-22

Feature	Design Criteria	Comment
Survey Unit Land Area	4,885 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-22-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	10%	Table 5-4 of the HBPP LTP requires Judgmental 1%-10% area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-2.36E-02	pCi/g Cs-137
Max. Value	9.88E-02	pCi/g Cs-137
Mean	2.53E-02	pCi/g Cs-137
Median	2.46E-02	pCi/g Cs-137
Std. Dev.	3.41E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	2 Soil Samples	1 required per HBAP C-202
Maximum Hypothetical Dose	6.50E-01 mrem/yr (8.20E-02 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.9- Synopsis of OOL10-22-FSR

Feature	Design Criteria	Comment
Survey Unit Land Area	4,885 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 3	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-22-FSR-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Scan Survey Area Coverage	10%	Table 5-4 of the HBPP LTP requires Judgmental 1%-10% area coverage for Class 3 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-5.70E-03	pCi/g Cs-137
Max. Value	1.26E-01	pCi/g Cs-137
Mean	3.88E-02	pCi/g Cs-137
Median	2.90E-02	pCi/g Cs-137
Std. Dev.	3.60E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	2 Soil Samples	1 required per HBAP C-202
Maximum Hypothetical Dose	7.00E-01 mrem/yr (1.32E-01 mrem/yr(8) Survey unit dose plus 5.68E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.10 - Synopsis of OOL10-26-FSR

Feature	Design Criteria	Comment
Survey Unit Land Area	1,890 m^2 (1)	Footprint area based on AutoCAD
Classification	Class 2	Based on the HBPP LTP Rev. 2
Final Status Survey Plan No.	HBPP-FSSP-OOL10-26-FSR-00	HBPP Procedure RCP(2) FSS-2 Attachment 9.1
Grid Spacing	12.1 m	HBPP Procedure RCP FSS-7 Attachment 8.1
Scan Survey Area Coverage	100%	Table 5-4 of the HBPP LTP requires 10%-100% area coverage for Class 2 survey units.
Number of Measurements	15 Soil Samples (non-parametric test)	15 required selected randomly per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM(3) for relative shift of 2.
Min. Value	-1.08E-02	pCi/g Cs-137
Max. Value	8.17E-02	pCi/g Cs-137
Mean	2.85E-02	pCi/g Cs-137
Median	2.28E-02	pCi/g Cs-137
Std. Dev.	2.71E-02	pCi/g Cs-137
No. of Split Measurements	2 Soil Samples	1 required per HBAP(4) C-202
No. of Bias Measurements	None	N/A
No. of Recount Measurements	2 Soil Samples	1 required per HBAP C-202
Maximum Hypothetical Dose	2.20E-01 mrem/yr (1.00E-01 mrem/yr(8) Survey unit dose plus 1.20E-01 mrem/yr deselected HTD(5) radionuclide dose(6))	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(7)

Note (1): meters squared
Note (2): Radiation Control Procedure
Note (3): Multi-Agency Radiation Survey and Site Investigation Manual (Ref 2)
Note (4): Humboldt Bay Administrative Procedure
Note (5): Hard to Detect
Note (6): Calculation based on HBPP HTD Position Paper
Note (7): Total Effective Dose Equivalent
Note (8): Based on LTP Table 5-1 Soil DCGL for Cs-137 of 7.9 pCi/g

Table ES.11 – Synopsis of OOL10-24-FSR

Feature	Design Criteria	Comment
Survey Unit Building Area	2,286 m^2	Based on AutoCAD
Classification	Class 2 (Downgraded from Class 1)	Initial Classification was based on the HBPP LTP Rev. 2-Downgraded based on Characterization survey results and NRC reclassification notification letter
Final Status Survey Plan No.	HBPP-FSSP-OOL10-24-FSR-00	HBPP Procedure RCP FSS-2
Grid Spacing	13.3 m	HBPP Procedure RCP FSS-7 Attachment 8.1
Scan Survey Area Coverage	100% scans of the accessible concrete pad	Table 5-4 of the LTP requires 10%-100% of area coverage for Class 2 survey units
Number of Measurements	15 Direct Measurements for Beta/Gamma and Alpha (non-parametric test)	15 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of 2, selected systematically with a random start point
Min. Value	2.90E-02	Based on Unity
Max. Value	6.07E-02	Based on Unity
Mean	4.45E-02	Based on Unity
Median	4.40E-02	Based on Unity
Std. Dev.	8.52E-03	Based on Unity
No. of Bias Measurements	1 Composite Media Sample	Taken at the scan investigation locations after direct measurements
Number of Scan Investigation Measurements	2 Direct Measurements	Reproducible indication discernable above beta background using 43-68 with audible discrimination
Maximum Hypothetical Dose	1.11(1) mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr TEDE(2)
No. of ISOCS Measurements	1 ISOCS Measurement at Scan Investigation Location OOL10-24-002-F-I	Qualitative measurement at the highest scan investigation location.

Note (1): Dose estimate based on sum of fractions from Beta/Gamma-Gross Activity DCGL (based on Cs-137) and Alpha-Gross Activity DCGL (conservatively based on Am-241)

Note (2): Total Effective Dose Equivalent (TEDE)

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1.0 INTRODUCTION

This radiological FSS Report documents the radiological status of a small portion of the Humboldt Bay Power Plant (i.e., the Site) in Eureka, CA. Presently, the 1000 King Salmon Ave, Eureka, CA site is subject to U.S. Nuclear Regulatory Commission (NRC) Radioactive Materials License No. DPR-7 (Ref. 3). The long-term objective of the licensee, Pacific Gas and Electric Company (PG&E), is to decommission the Site such that it will meet the criteria for unrestricted use as specified in the License Termination Rule at 10 CFR Part 20, Subpart E and to terminate NRC Facility Operating License No. DRP-7. This FSS Report documents the final condition of the following Survey Units listed in Table 1.1 below in preparation for license termination.

Table 1.1 - FSS/FSR Survey Area Unit Descriptions

Survey Unit	Survey Unit Description
OOL10-01	Fuel Oil Storage Tank Footprint
OOL10-01-FSR	
OOL10-13	Coastal Trail
OOL10-17	Remainder of Land Area (Bravo Road and Frog Pond)
OOL10-17-FSR	
OOL10-20	Haul Road
OOL10-20-FSR	
OOL10-22	ISFSI West
OOL10-22-FSR	
OOL10-24-FSR	Waste Storage Facility Pad
OOL10-26-FSR	Charlie Road

This report documents the final radiological status of both the FSS and FSR Survey Units in the outlined areas in Figures 1.1 and 1.2 respectively, along with other report submittals, serves collectively to demonstrate that the criteria for unrestricted use have been met and serves to support the regulatory decision to terminate the license.

The FSS survey units cover an area of approximately 110,564 m^2 of land area. There was a total of one hundred ninety-four (194) samples collected during FSS of the survey units described in this report. Each of the statistical sample locations was selected based on a random start, systematic grid placement or random placement for Class 2 and Class 3 survey units respectively using the Visual Sample Plan (VSP) software program. Sample locations were confirmed by a high precision Global Positioning System (GPS) for all survey units. The sampling effort included one-hundred fifty-six (156) statistical samples, twenty-one (21) split-samples, thirty-seven (37) biased samples, and thirteen (13) Oak Ridge Institute for Science and Education (ORISE) split samples.

Additionally, twenty-two (22) samples were sent off-site for HTD analysis and seventeen (17) sample recounts were taken for quality assurance purposes. No Quality Assurance (QA) related discrepancies were noted that could impact the overall confidence in the results or conclusions of the FSS.

Accessible open land survey areas were also scanned with a gamma-sensitive Sodium-Iodide (NaI) detector system. There were no instances where scan investigation criteria were exceeded in the open land areas requiring an investigation sample. The surveys performed for the WMF Pad Area survey unit included a total of fifteen (15) fixed alpha and beta direct (static) measurements to assess the total activity component and 15 smear measurements to assess the removable activity component at each location. As mentioned earlier, there were two scan investigation direct static measurements performed as a result of the scan survey resulting in collection of a composite investigation media sample.

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Figure 1.1 - Overview of Final Status Surveyed Area Extents

Undated Aerial Photo taken from Google Earth

Figure 1.2 - Overview of Final Site Restoration Surveyed Area Extents

Undated Aerial Photo taken from Google Earth

1.1 PHASED RELEASE AREA DESCRIPTION

As described in the LTP, PG&E has performed a partial site release of the site south of King Salmon Avenue to the Humboldt Bay Harbor District. The remaining site land areas are to the north (site east) of King Salmon Avenue. Figure 1.3 depicts an aerial overview that indicates the current extents remaining to be released. The most recent version of the LTP stipulates that if an additional phased release is done the Phased Release Area map will be updated.

Figure 1.3 – Current Phase Release Area

Undated Aerial Photo taken from Google Earth

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1.2 SURVEY UNIT DESIGNATION

In accordance with Humboldt Bay Power Plant (HBPP) RCP FSS-1, Survey Units OOL10-01, OOL10-01-FSR, OOL10-17, OOL10-17-FSR, OOL10-22, and OOL10-22-FSR are designated as Class 3 Survey Units , and OOL10-20, OOL10-20-FSR, OOL10-24-FSR, and OOL10-26-FSR are designated as Class 2 Survey Units per the HBPP Historical Site Assessment (HSA) (Ref. 4) and were confirmed by subsequent reviews.

1.3 SURVEY UNIT DESCRIPTIONS

The Survey Units described in this report are part of Survey Area OOL10. A summary of each specific survey unit is provided below. The figures that follow show the individual survey unit boundary extents.

Survey Unit OOL10-01

Survey Unit OOL10-01 (Fuel Oil Storage Tank Footprint Area) is approximately 6,473 m^2 of surface area consisting primarily of soil. The survey unit is a sub-unit of survey area OOL10 and is bordered on all sides by OOL10-22 on the north and OOL10-17 on the south, east and west. The unit was surveyed prior to the construction of the Waste Management Facility (Approximately 1,161 m^2) and the waste storage pad (Approximately 2,286 m^2). Figure 1.4 shows the LFO area being backfilled with reuse material prior to construction of the WMF Structure and Storage Pad. The survey boundary is shown in Figure 1.5 below.

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Figure 1.4 –Photo of OOL10-01 LFO Area During Backfill Activities

Photo Dated September 27, 2012

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Figure 1.5 – Phase Release Area OOL10-01

Undated Aerial Photo taken from Google Earth

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Survey Unit OOL10-01-FSR

Survey Unit OOL10-01-FSR is a Class 3 open land area with approximately 3,020 m^2 of surface area. The survey unit is bounded on all external sides by OOL10-20-FSR on the north and OOL10-17-FSR on the south, east and west. The survey unit is bounded on the inside by the Waste Management Facility and OOL10-24-FSR on the north, east and west, with a small portion bordered by OOL-10-20-FSR on the northeast.

OOL10-01-FSR consists of the Class 3 open land area following FSR activities prior to covering with off-site soil or engineered materials. The surveys completed in this area depict the final radiological "surface" state of the survey unit. The survey boundary is shown in Figure 1.6 below.

Figure 1.6 – Phase Release Area OOL10-01-FSR

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-13

Survey Unit OOL10-13 (Coastal Trail) is approximately 38,087 m^2 of surface area consisting primarily of sand and gravel. The survey unit is the area of the northern portion of the site bordering Humboldt Bay and is bounded by OOL09, OOL07, OOL01, and OOL10 to the roughly one-fifth of the survey unit area on the west separated by OOL05. Figure 1.7 shows the Coastal Trail facing west overlooking Humboldt Bay. The survey boundary is shown in Figure 1.8 below.

Figure 1.7 – West Facing View of Coastal Trail

Photo Dated March 17, 2016

Figure 1.8 – Phase Release Area OOL10-13

Undated Aerial Photo taken from Google Earth

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Survey Unit OOL10-17

Survey Unit OOL10-17 (Remainder of Land Area, aka Bravo Road and Frog Pond) is approximately 53,129 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the Coastal Trail on the north, the LFO Area footprint and the intake canal on the south and west side, with Building 6 and OOL08 on the east side. Figure 1.9 shows a utility line trench excavation within Survey Unit OOL10-17 with the WMF Structure in the foreground. The survey boundary is shown in Figure 1.10 below.

Figure 1.9 – Utility Line Trenching Area OOL10-17

Photo Dated December 17, 2019

Figure 1.10 – Phase Release Area OOL10-17

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-17-FSR

Survey Unit OOL10-17-FSR (Remainder of Land Area, aka Bravo Road and Frog Pond) is approximately 53,129 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the Coastal Trail on the north, the Fuel Oil Tank Area footprint and the intake canal on the south and west side, with Building 6 and survey area OOL08 on the east side.

OOL10-17-FSR consists of the Class 3 open land area following FSR activities prior to covering with off-site soil or engineered materials. The surveys completed in this area depict the final radiological "surface" state of the survey unit. The survey boundary is shown in Figure 1.11 below.

Figure 1.11 – Phase Release Area OOL10-17-FSR

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-20

Survey Unit OOL10-20 (Haul Road) is approximately 7,990 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the ISFSI and ISFSI west survey units, Coastal Trail, and OOL07 on the west, north and east, and OOL08, OOL10-25, OOL10-01 and NOL01 to the south and west. The survey boundary is shown in Figure 1.12 below.

Figure 1.12 – Phase Release Area OOL10-20

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-20-FSR

Survey Unit OOL10-20-FSR (Haul Road) is approximately 7,990 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the ISFSI and ISFSI west survey units, Coastal Trail, and OOL07 on the west, north and east, and OOL08, OOL10-25, OOL10-01 and NOL01 to the south and west.

OOL10-20-FSR consists of the Class 2 open land area following FSR activities prior to covering with off-site soil or engineered materials. The surveys completed in this area depict the final radiological "surface" state of the survey unit. The survey boundary is shown in Figure 1.13 below.

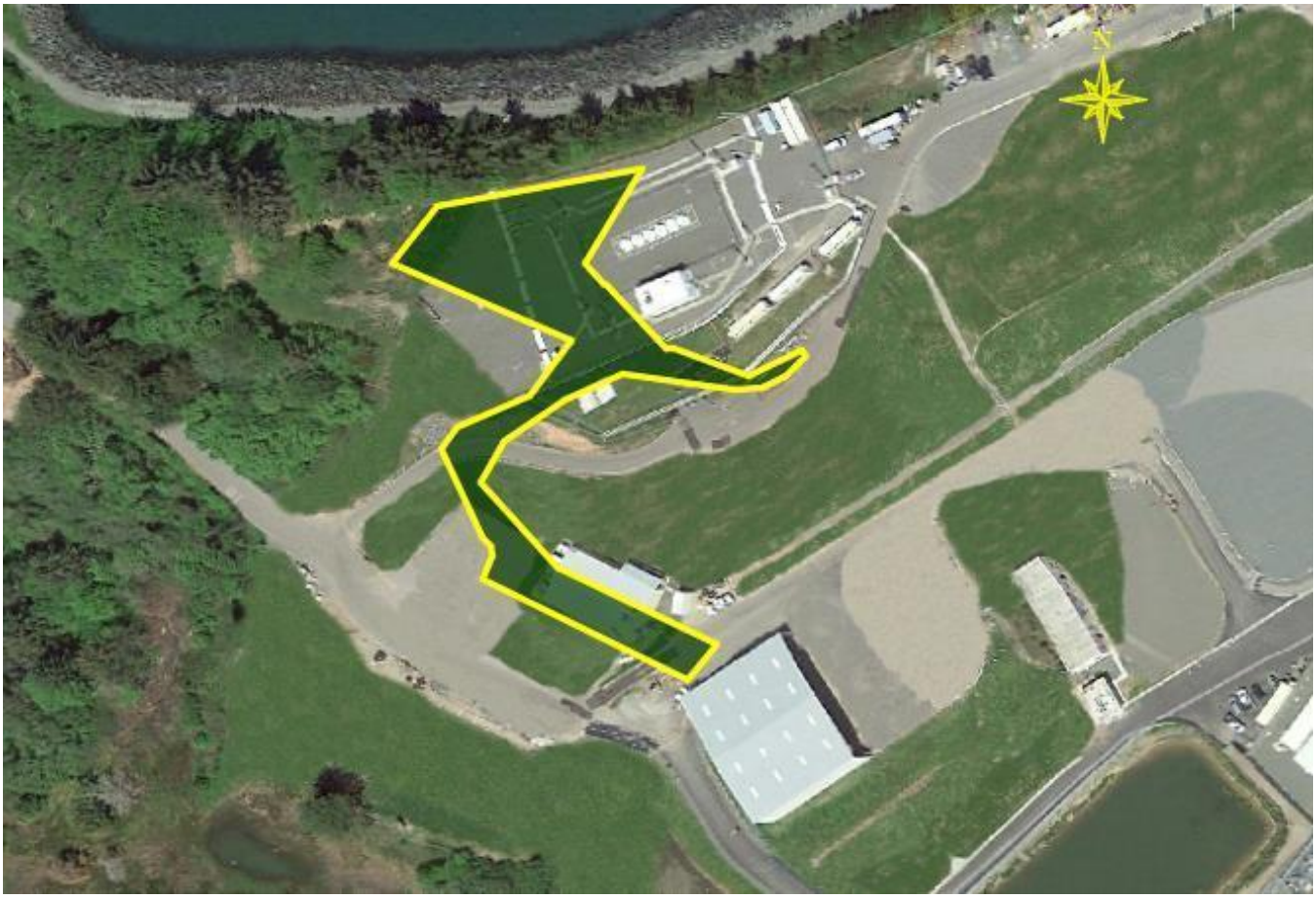
Figure 1.13– Phase Release Area OOL10-20-FSR

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-22

Survey Unit OOL10-22 (ISFSI West) is approximately 4,885 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the ISFSI and OOL10-20 (Haul Road) on the east, Coastal Trail (OOL10-13) on the north, and OOL10-17 on the south. The survey boundary is shown in Figure 1.14 below.

Figure 1.14 – Phase Release Area OOL10-22



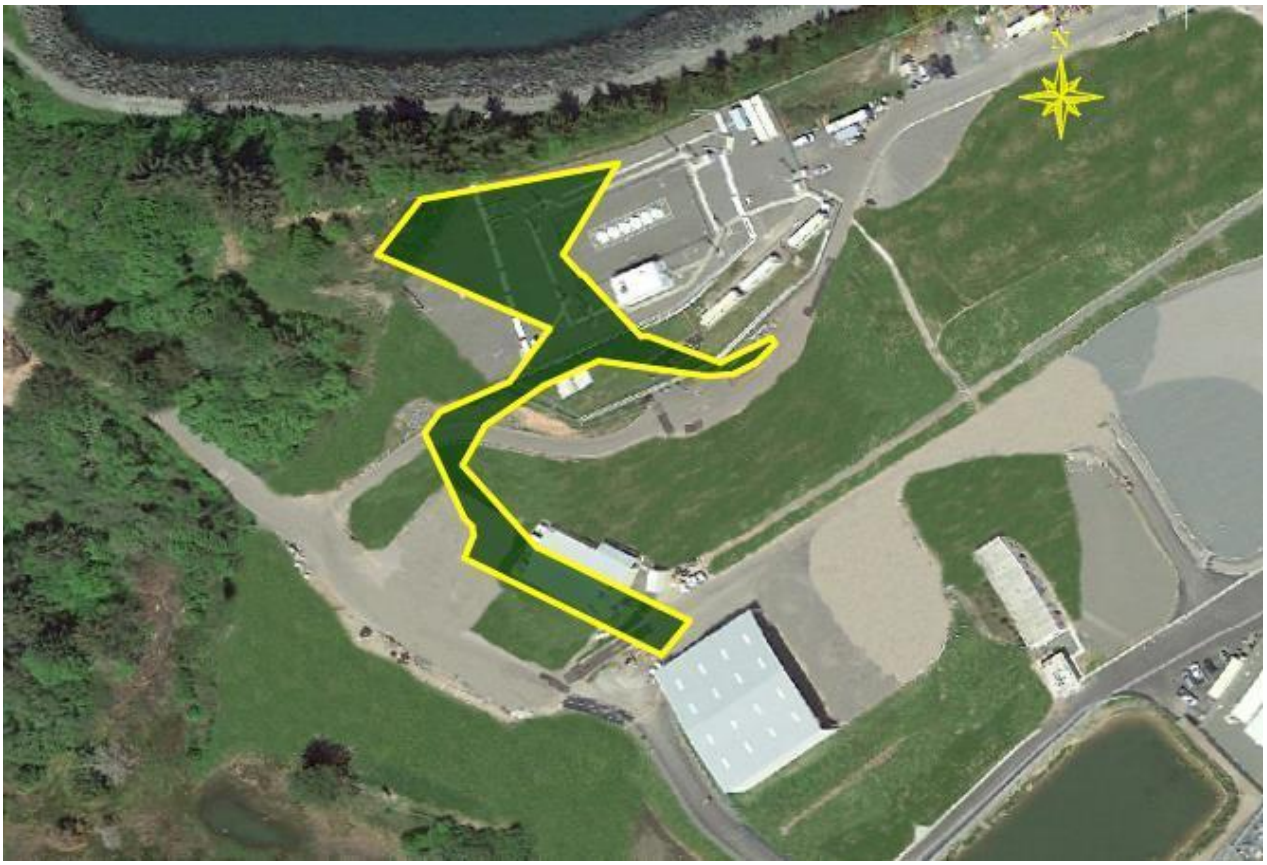
Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-22-FSR

Survey Unit OOL10-22-FSR (ISFSI West) is approximately 4,885 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the ISFSI and OOL10-20-FSR (Haul Road) on the east, Coastal Trail (OOL10-13) on the north, and OOL10-17-FSR on the south.

OOL10-22-FSR consists of the Class 3 open land area following FSR activities prior to covering with off-site soil or engineered materials. The surveys completed in this area depict the final radiological "surface" state of the survey unit. The survey boundary is shown in Figure 1.15 below.

Figure 1.15– Phase Release Area OOL10-22-FSR



Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-24-FSR

Survey Unit OOL10-24-FSR (WMF Pad) is approximately 2,286 m^2 of surface area consisting of the concrete pad exterior surfaces outside the WMF structure. The survey unit is a sub-unit of survey area OOL10 and is bordered by the WMF structure on the west, OOL10-01-FSR (Fuel Oil Storage Tank Footprint) on the east and south, and OOL10-20-FSR (Haul Road) on the north.

OOL10-24-FSR consists of the concrete pad surface as a result of FSR activities for a portion of surveyed unit OOL10-01 covered with an engineered material, and reduced in classification in an NRC Notification Letter (Ref. 5) as mentioned earlier in this report from Class 1 to Class 2. The surveys completed in this area depict the final radiological "surface" state of the survey unit. A photo of the WMF Pad with the WMF Structure in the foreground is shown in Figure 1.16. The survey boundary is shown in Figure 1.17 below.

Figure 1.16– Early Photo of WMF Pad Area OOL10-24-FSR

Photo Dated December 11, 2013

Figure 1.17– Phase Release Area OOL10-24-FSR

Undated Aerial Photo taken from Google Earth

Survey Unit OOL10-26-FSR

Survey Unit OOL10-26-FSR (Charlie Road) is approximately 1,890 m^2 of surface area consisting primarily of soil and vegetation. The survey unit is a sub-unit of survey area OOL10 and is bordered by the OOL10-17-FSR (Bravo Road and Frog Pond) on the south, Coastal Trail (OOL10-13) on the north, and OOL10-22-FSR on the east.

OOL10-26-FSR consists of the Class 2 reuse materials excavated from Survey Unit OOL10-20 (Haul Road) and placed on Charlie Road following FSR activities for Class 3 survey units OOL10-17 and OOL10-13 prior to covering with off-site soil or engineered materials. The surveys completed in this area depict the final radiological "surface" state of the survey unit. A photo of the eastern portion of the survey unit is shown in Figure 1.18. The survey boundary is shown in Figure 1.19 below.

Figure 1.18– Photo of Charlie Road Survey Area OOL10-26-FSR

Photo Dated August 1, 2019

Figure 1.19– Phase Release Area OOL10-26-FSR

Undated Aerial Photo taken from Google Earth

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1.3.1 HISTORICAL SITE ASSESSMENT (HSA)

Within the HSA (Ref. 4), the Fuel Oil Storage Tanks (FOST) indicated low levels of radiological contamination on the roof and sides of the tank from characterization surveys performed in early August of 2008. The tanks were demolished in the fall of 2008. Similarly, other small structures including the Assembly Building (Building 10), the Fitness for Duty Trailer (Building 9), the Security Building (Building 8), and the Fire Pump House (Building 27) showed low levels of radiological contamination for locations on the roof and interior floor and/or wall surfaces at just over instrument detection levels from characterization surveys performed in August and September of 2008. All the small structures originally located along Bravo Road, Bravo Parking lot, or within the footprint of the Class 3 Survey Unit OOL10-17 were removed prior to FSS. There is no mention of plant related activities occurring within the boundaries of the Area OOL10 Survey Units described in this report.

1.3.2 SCOPING SURVEYS

Scoping Surveys were not performed in the areas summarized in this report based on their assessment in the HSA.

1.3.3 CHARACTERIZATION

Based on a review of the general plant characterization data of the HBPP environs, Cs-137 was the only plant-related radionuclide that was identified consistently in the characterization samples analyzed. Seventy-one (71) samples from previous characterization data were used to provide the characterization data for survey area OOL10. The following data was sufficient to support the planning of Survey Units OOL10-01, OOL10-13, OOL10-17, OOL10-20, and OOL10-22.

- Cs-137 was present in 72 % (51 detects) of the characterization samples.
- There were no other easy to detect (ETD) nuclides identified >Minimum Detectable Activity (MDA).
- There were no hard to detect (HTD) nuclides identified in the four samples analyzed at the offsite laboratory.

According to the 2008 Characterization report (Ref. 6), radiological surveys, past and present, show that Unit 3 has impacted all areas of HBPP. Impacted areas, as defined in Section 1.3 and in the MARSSIM, are areas having some potential for residual contamination. These impacted areas are further divided into Class 1, Class 2, and Class 3 areas, based primarily on the relative potential for elevated activity.

A more recent (2019) characterization effort was performed on June 6, 2019 consisting of fifteen (15) direct static and fifteen (15) media samples of the Waste Management Facility (WMF) by PG&E to determine the radiological impact from past operations to the facility and to reclassify the structure and the pad to a less restrictive classification (Ref. 5). As mentioned earlier in this report, the WMF Pad was built during decommissioning and was classified as a Class 1 surface based on expected decommissioning support activities conducted. However, a subsequent decision to direct most of the radiological remediation waste to soil management structures reduced the anticipated radiological impact to the WMF Pad.

The following data sufficiently supported the planning of WMF Pad Survey Unit OOL10-24-FSR:

- Direct measurements collected of the limited accessible areas behind the south push wall including the structure metal wall and floor where residual spoils and debris were sampled indicated less than 1% of the building surface DCGL for Cs-137.
- Media samples of spoils, splatter, and debris material collected from the areas prior to direct measurement collection averaged less than 1% of the soil DCGL for Cs-137.

It should be noted that of all 15 media samples collected, only one indicated Cs-137, an HBPP plant-derived radionuclide, with a result of 0.32 pCi/g. This result is indicative of global fallout concentrations observed for the area. PG&E Letter HBL-19-012 (Ref. 5) was submitted to the NRC on July 11, 2019 to comply with the 14-day notification of intent to reclassify the WMF and the WMF Storage Pad from Class 1 to Class 2 and Class 3 areas. An independent confirmatory survey was conducted by ORAU/ORISE of the WMF Pad the week of the NRC Inspection Visit conducted August 26-29, 2019. No elevated areas were noted during the gamma and alpha plus beta walkover scan surveys of the WMF Pad, supporting the reduction in Survey Unit MARSSIM Classification from Class 1 to Class 2. The ORISE Confirmatory Survey Final Report is submitted for review in Attachment 1.

Alternative Survey Plan for Excavation Spoils Material

In December 2018 and June 2019, the Gamma Radiation Detection and In-Container Analysis (GARDIAN) I and III Trailers were demobilized respectively. Both GARDIAN Trailers were used to support decommissioning operations by certifying spoils materials transported in dump trucks during excavation of Class 1 and Class 2 areas for reuse during Final Site Restoration activities. Since decommissioning was not complete for a few remaining Class 1 and Class 2 areas of the site, in lieu of using the GARDIAN system, a six (6) inch walkover scan characterization survey process was implemented as required by LTP Section 5.4.2.5.3 *Alternative Survey Plan in Excavations* (Ref. 1). The reuse soil characterization plan specified to obtain a biased measurement at least every nine (9) lifts during the survey, which was expected to cover an excavated area of approximately one hundred thirty-nine (139) m^2, or approximately twenty-one (21) cubic meters (m^3). A total of fifteen (15) biased samples were collected and analyzed by the on-site gamma laboratory from July 16, 2019 to July 30, 2019. There were no plant-derived radionuclides identified in any of the biased samples analyzed at the on-site gamma laboratory. It should be noted that the last biased sample collected by the FSS technician, CHAR-REUSE-SOIL-144-016-F-B, was delivered to but not analyzed by the on-site laboratory. However, the survey plan data quality design objective of fifteen bias samples was achieved therefore, a Systems Application and Products Notification (SAPN) was not warranted. A total of one-hundred and six (106) six-inch lifts from Charlie Road were 100% walkover scanned surveyed using a Ludlum 2350-1 data logger in rate meter mode with a Model 44-10 2” by 2” NaI detector, scanning at a speed of 50 centimeter (cm) or less per second following a serpentine fashion covering a one square meter area in at least three passes. Table 1.2 summarizes the daily 6” lift scan results for the reuse soil approved for the two Class 2 FSR units listed in this report. It should be noted that three biased samples, CHAR-REUSE-SOIL-018-002-F-B, -045-005-F-B, and -063-007-F-B were not listed in the table as they were collected during walkover surveys of Class 1 reuse material on Bayview Road and will be discussed in a future FSS Report submittal. Figure 1.20 shows a photo of the process of staging excavation spoils material in a six-inch lift for walkover scan survey on top of Bayview Drive.

Figure 1.20–Spoils Materials Placement on Bayview Road for Walkover Survey

Photo Dated July 2, 2019

Table 1.2 – Six-inch Lift Walkover Scan Summary

Survey Date	Total Lifts Surveyed	Biased Sample Collected CHAR-REUSE-SOIL-	NaI Scan Range (kcpm)		Final FSR Disposition
7/16/19	10	009-001-F-B	4.1	5.3	OOL10-26 (Charlie Road)
7/17/19	21	027-003-F-B & 036-004-F-B	4.1	5.5	OOL10-26 (Charlie Road)
7/18/19	9	054-006-F-B	4.0	5.3	OOL10-26 (Charlie Road)
7/24/19	15	072-008-F-B & 081-009-F-B	4.2	5.7	OOL10-26 (Charlie Road)
7/25/19	7	090-010-F-B	4.5	5.5	OOL10-26 (Charlie Road)
7/26/19	18	099-011-F-B & 108-012-F-B	4.4	5.5	OOL10-26 (Charlie Road)
7/29/19	21	117-013-F-B & 126-014-F-B	4.2	5.6	OOL10-20-FSR (Haul Road) OOL10-26-FSR (Charlie Road)
7/30/19	11	135-015-F-B & 144-016-F-B	4.2	5.5	OOL10-20-FSR (Haul Road) OOL10-26-FSR (Charlie Road)
7/31/19	2	N/A	4.3	5.7	OOL10-20-FSR (Haul Road)
8/1/19	1	N/A	4.4	5.4	OOL10-20-FSR (Haul Road)
8/2/19	1	N/A	4.6	5.7	OOL10-20-FSR (Haul Road)
8/8/19	1	N/A	4.4	5.7	OOL10-20-FSR (Haul Road)

N/A-Not Applicable

1.3.4 REMEDIAL ACTION SURVEYS AND ACTIVITIES

OOL10-20 Remediation Turnover Surveys/Evaluations

Four (4) remediation turnover surveys were performed for Survey Unit OOL10-20 between a period of 12/8/2017 to 9/29/2018. For the four remediation turnover surveys performed, walk-over scanning using Ludlum Model 44-10 Sodium-Iodide (NaI) detectors of all accessible areas were completed with no audible indications of elevated readings above background ranging from 5.5 kilo-counts per minute (kcpm) to 8.0 kcpm. Of the three biased samples taken during three of the four remediation turnover surveys, none showed positive results for plant-derived radionuclides. From 10/12/2018 to 8/21/2019, the evaluation process was used resulting in thirty-three (33) remediation turnover evaluations performed for Survey Unit OOL10-20.

OOL10-20-FSR Remediation Turnover Surveys/Evaluations

Three (3) remediation turnover surveys were performed for Survey Unit OOL10-20-FSR between a period of 9/29/2018 to 10/6/2018. For the three remediation turnover surveys performed, walk-over scanning using NaI detectors of all accessible areas were completed with no audible indications of elevated readings above background ranging from 4.5 kcpm to 7.4 kcpm. No biased samples were taken during the three remediation turnover surveys. From 11/2/2018 to 10/24/2019, the evaluation process resulted in twenty-four (24) remediation turnover evaluations performed for Survey Unit OOL10-20-FSR.

1.3.5 AREA SURVEILLANCE SURVEY PLAN

As per HBPP Procedure RCP FSS-13 "Area Surveillance Following Final Status Survey," Rev 03, May 5th, 2017 (Ref. 7) there were six Area Surveillance Survey Plans (ASSPs) written to assure that the conditions verified by the FSS have not changed.

The primary functions of periodic surveillances are to determine the adequacy of isolation and control measures in areas where FSS activities are complete and to assure that the conditions verified by the FSS are unchanged and to detect the potential migration of contaminants from decommissioning activities taking place in adjacent areas. Due to decommissioning project work activities seven (7) ASSPs were written.

1) ASSP-17-03-003 for OOL10-01

An ASSP in the form of a periodic survey conducted on March 2, 2017 was warranted because the Waste Management Facility structure and pad was used to store loose soils/debris remediated from Class 1 Buildings and Open Land Area excavations which could result in the survey area or entire unit apron of Survey Unit OOL10-01 being compromised. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.0 kcpm to 5.3 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. The only plant-derived radionuclide present in any of the five samples collected during the survey were from Cs-137 in samples ASSP-17-03-003-002 and ASSP-17-03-003-005, at 1.54E-01 pCi/g and 1.10E-01 pCi/g respectively, indicative of fallout.

2) ASSP-17-06-005 for OOL10-01

An ASSP in the form of a periodic survey conducted on June 7, 2017 was warranted because the Waste Management Facility structure and pad was and continues to be used to store loose soils/debris remediated from Class 1 Buildings and Open Land Area excavations which could result in the survey area or entire unit apron of Survey Unit OOL10-01 being compromised. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.8 kcpm to 5.7 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

3) ASSP-17-09-012 for OOL10-01

A quarterly periodic ASSP survey was conducted on September 26, 2017 because of reasons stated previously in this section. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.8 kcpm to 6.2 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

4) ASSP-17-12-019 for OOL10-01

A quarterly periodic ASSP survey was conducted on December 20, 2017 because of reasons stated previously in this section. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 5.2 kcpm to 5.8 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

5) ASSP-18-03-008 for OOL10-01

A quarterly periodic ASSP survey was conducted on March 27, 2018 because of reasons stated previously in this section. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.0 kcpm to 4.5 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

6) ASSP-18-07-013 for OOL10-01

A quarterly periodic ASSP survey was conducted on July 2, 2018 because of reasons stated previously in this section. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.2 kcpm to 5.2 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

7) ASSP-18-09-016 for OOL10-01

A quarterly periodic ASSP survey was conducted on September 6, 2018 because of reasons stated previously in this section. The ASSP required five (5) biased samples within the affected area and walkover scans of the 1 m^2 area in the immediate vicinity of each sample collected. The walkover scan survey results indicated no area exceeding the investigation level of no audible indications discernable above the background range of 4.0 kcpm to 6.0 kcpm. The ASSP samples evaluation concluded that there was no impact to Survey Unit OOL10-01 and no investigation survey was warranted. There were no plant-derived radionuclides present in any of the five samples collected during the survey.

On November 17, 2017, the portion of OOL10-01 containing the LFO area with the WMF and the WMF pad was exempted for periodic surveys by the Site Closure Manager as the unit had an engineered surface or protective barrier in place. No other periodic surveys were performed as Survey Unit OOL10-01 was exempted from periodic surveillance surveys on December 15, 2018 by the Site Closure Manager as the unit had an engineered surface or protective barrier in place.

1.3.6 FINAL SITE RESTORATION FSS

A formal Final Site Restoration (FSR) survey was not conducted on Survey Unit OOL10-13 as there was no reuse soils applied for backfill for the unit. Off-site restoration materials used met Class 3 reuse requirements and did not contain HBPP-derived radionuclides above method detection levels. To determine the level of residual activity remaining after decommissioning activities were completed for the surveys that were conducted on Survey Units OOL10-01-FSR, OOL10-17-FSR, OOL10-20-FSR, OOL10-22-FSR, OOL10-24-FSR, and OOL10-26-FSR, survey packages were developed and implemented as described later in Section 2.0. It should be noted that WMF Pad Survey Unit OOL10-24-FSR was created after excavated portions of Survey Unit OOL10-01 were covered with an engineered surface (concrete created from offsite materials). As mentioned earlier in this report, the excavations were backfilled with soil approved for reuse after GARDIAN analysis or six-inch walkover scan surveys for Class 2 areas. Grab/composite soil sampling was the approved method of reuse material for Class 3 areas. The Survey Units met the clearance requirements as set forth for Class 2 and Class 3 open land areas as described later in this report.

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1.3.7 SAPNs and Corrective Actions

SAPN 1468051 WMF Pad FSS QC Replicate Non-Conformance Quality Problem

During FSS of the WMF Pad on October 31, 2019, it was noted that the Quality Control (QC) Replicate measurement of direct beta static location OOL10-24-009-FSR-B failed the replicate assessment at a comparison ratio of 0.71. The acceptable agreement range for the gross beta analysis of the replicate measurement was 0.75-1.33. Per Section 5.5.3 (b) of FSS-11, "Split Sample Assessment for Final Status Survey," an evaluation is required to determine the impact of the discrepancy to data quality before proceeding (Ref. 8). As part of the initial investigative actions, (and not required by the FSSP) the QC replicate instrument (Set 15 2350-1 Instrument #180733 Detector 43-68B #160699) was used to perform a QC Replicate measurement on November 1, 2019 of investigation location OOL10-24-002-FSR-F-I with a satisfactory comparison ratio of 0.91. Additionally, there was a duplicate QC Replicate measurement performed with the instrument at original QC Replicate location OOL10-24-009-FSR-B with a satisfactory comparison result ratio of 0.80 on November 1, 2019. Source response checks were reviewed for the last two years with no adverse trends noted and a majority of plotted data points greater than the established mean count rate for positions 1-3. It should be noted that if the reported gross beta values are adjusted for instrument background, the original measurement activity is approximately 18% of the calculated minimum detectable activity for the location measured October 30, 2019. The QC Replicate count result activity is approximately 43% *below* the calculated minimum detectable activity adjusted for instrument background for the location measured October 31, 2019, or indistinguishable from background. Therefore, it is likely that the reason for the first failure of the QC Replicate comparison was due to random background fluctuations as both the original and the replicate measurement were near the detection capabilities of both instruments. To illustrate, the original investigation measurement and the replicate count for location OOL10-24-002-FSR-F-I performed November 1, 2019 indicated good agreement in instrument adjusted background activity levels of approximately 249% and 230% respectively. This equates to a comparison ratio of 1.00 when the instrument background adjusted beta activity values of 886 disintegrations per minute per 100 centimeters squared (dpm/100cm^2) and 887 dpm/100cm^2 respectively for the original and replicate investigation location measurements. No FSS gross beta activity data has been reported with this instrument other than the QC Replicate

results described in this SAPN. Both instruments used were in calibration and satisfactorily passed pre- and post- operational use source checks. Since the investigation regarding the failure of the original and replicate measurement comparison is likely due to random background fluctuations, the FSS results are deemed to be of adequate data quality to be included in the statistical demonstration of dose compliance. The QC Replicate Comparison Calculation Sheets for locations OOL10-24-009-FSR-B and OOL10-24-002-FSR-F-I can be reviewed in Attachment 1.

SAPN 1454113 Sample Relocation for Fuel Oil Storage Tank Footprint Area

Sample location 14 of FOST HBPP-CHAR-OOL10-01-03 was relocated greater than the prescribed distance of 1 meter as follows due to obstructions or accessibility issues:

- Sample point # CHAR-OOL10-01-014-C relocated to an accessible location 3.5' Southeast (SE) to facilitate sampling as the original sample point was inaccessible underneath a concrete saddle that held a tank behind the Fire Pump House.

There is no impact to data quality as this issue was identified prior to generation of the FSS report for this area. Even though the alternate sample location was moved just over 1 meter, there is high confidence that relocated sample result used as a data point to show statistical compliance would show similar results (+/- total propagated error uncertainty) to the original sample location (had it been accessible) given its location in a MARSSIM Class 3 survey unit.

SAPN 1467080 Sample Relocations for ISFSI West and Coastal Trail

Sample location 12 of ISFSI West HBPP-FSSP-OOL10-22-00 and sample locations 3, 5, 8-10 and 15 of Coastal Trail HBPP-FSSP-OOL10-13-00 were all relocated greater than the prescribed distance of 1 meter as follows due to obstructions or accessibility issues:

- Sample point # OOL10-22-012-F relocated to an accessible location 21.29' Northeast (NE) to facilitate sampling as the original sample point landed in thick underbrush and could not be safely accessed.
- Sample point # OOL10-13-003-F relocated to an accessible location 28.89' Southeast (SE) to facilitate sampling as the original sample point landed in thick underbrush and could not be safely accessed.

- Sample point # OOL10-13-005-F relocated to an accessible location 17.45' Northwest (NW) to facilitate sampling as the original sample point landed in thick underbrush and could not be safely accessed.
- Sample point # OOL10-13-008-F relocated to an accessible location 40' North (N) to facilitate sampling as the original sample point landed in thick underbrush and could not be safely accessed.
- Sample point # OOL10-13-009-F relocated to an accessible location 30.18' SE to facilitate sampling as the original sample point landed in thick underbrush and could not be safely accessed.
- Sample point # OOL10-13-010-F relocated to an accessible location 24.80' Southwest (SW) to facilitate sampling as the original sample point landed on riprap.
- Sample point # OOL10-13-015-F relocated to an accessible location 5.71' N to facilitate sampling as the original sample point landed on top of an engineered surface (asphalt).

SUMMARY

The decision was made to move the above sample locations to facilitate sampling. The FSSP's for both survey units specify to document the new locations on the survey map. The survey map for both survey units reflect the new location parameters that have changed as indicated above. The revised sample location XY coordinates were documented on the survey map(s) and are noted respectively in the GPS Summary Tables for both survey units presented later in this report. There is no impact to data quality as this issue was identified prior to generation of the FSS report for this area. Even though each of the alternate sample locations were moved over 1 meter, there is high confidence that relocated sample results used as data points to show statistical compliance would show similar results (+/- total propagated error uncertainty) to the original sample locations (had they been accessible) given their locations in MARSSIM Class 3 survey units.

2.0 SURVEY UNIT DESIGN INFORMATION

The survey units were classified in accordance with Procedure RCP FSS-1, "Survey Unit Classification" (Ref. 9). OOL10-20, OOL10-20-FSR, OOL10-24-FSR, and OOL10-26-FSR were classified as Class 2 survey units based on the potential to contain residual radioactive material not likely to exceed the DCGLs. OOL10-01, OOL10-01-FSR, OOL10-13, OOL10-17,

OOL10-17-FSR, OOL10-22, and OOL10-22-FSR were classified as Class 3 survey units based on the low probability of containing residual radioactive material.

Guidance for preparing FSS plans is provided in Procedure RCP FSS-2, "Preparation of Final Status Survey Plans" (Ref. 10). The FSS plans developed used an integrated sample design that combines scanning surveys with a random start systematic grid sampling. A map of each respective area Survey Area is provided in Figure 1.5 thru Figure 1.19 above as applicable.

2.1 DATA QUALITY OBJECTIVES (DQOS)

FSS design and planning used the Data Quality Objective (DQO) process as described by the LTP, Procedure RCP FSS-2 (Ref. 10) and the NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Ref. 2).

The primary objective of the FSS plan was to demonstrate that the level of residual radioactivity in the Survey Units described in this report did not exceed the release criteria specified in the LTP and that the potential dose from residual radioactivity is ALARA.

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

The regulatory limit specified in the LTP is 25 mrem/yr Total Effective Dose Equivalent (TEDE) from all potentially present plant derived nuclides.

2.2 DQOS REGARDING NUCLIDE SELECTION AND DCGLS

The DQO process is used for designing and conducting all final status surveys at HBPP. Each survey package contains the appropriate information, statistical parameters, and contingencies to support the DQO process. The appropriate design for a given survey area is developed using the DQO process as outlined in MARSSIM, Appendix D.

The characterization data did not include a complete screening for all HTD radionuclides that were potentially present. However, the characterization data at HBPP has shown that Cs-137, an easy-

to-detect (ETD) radionuclide is by far the most prevalently detected radionuclide outside the Radiologically Controlled Area (RCA). To confirm the assumption that HTD nuclides are not present, a total of twenty-two (22) statistical soil samples were randomly selected to receive analyses for the full FSS suite of nuclides or HTD at an off-site laboratory. The samples included twenty-one (21) split samples.

Instrument DQOs included a verification of the ability of the survey instrument to detect the radiation(s) of interest relative to the DCGL. Survey instrument response checks were required prior to use 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. Therefore, results reported as less than Minimum Detectable Concentration (MDC) were not used for FSS. Sample report summaries included unique sample identification, analytical method, radionuclide, result, uncertainty, laboratory data qualifiers, units, and the Lower Limits of Detection (LLD) and MDC. Also, at least one recount sample and two split samples were taken to verify data quality for each survey unit. Additionally, for survey unit OOL10-01, there were seven (7) samples split with the NRC. Also, as previously mentioned, two archived statistical FSS samples from Survey Units OOL10-01 (CHAR-OOL10-01-005-C) and OOL10-20 (OOL10-20-005-F) were transferred to ORISE during the confirmatory survey site visit late August 2019 for gamma analysis at the ORAU laboratory.

Another important facet of the DQO process is to identify the radionuclides of concern and determine the concentration and variability. The surveys performed in the survey units described in this report spanned the time period of January 2011 thru October 2019. The media samples were analyzed for the HTD nuclides that are listed in bold in Table 2.1. The HTD nuclide results for all soil samples collected for the survey units described in this report were all less than their associated a-priori Minimum Detectable Concentrations (MDC) (Attachment 1).

For characterization Survey Unit OOL10-01, the FSS period of performance predated the approved LTP. Therefore, the characterization plan for the survey unit was performed to the rigors of FSS. Since the site-specific DCGLs had not yet been approved, conservative estimates of DCGLs were developed at the time consisting of the lesser of either an annual dose of 15 mrem/yr (the 25 mrem/yr DCGL provided in HBPP Procedure HBPP-PP-005 *Surface Soils DCGL Development*

(Ref. 11) adjusted to an assumed California Department of Toxic Control (DTSC) risk based release of 15 mrem/yr) or 50% of the NRC screening values (Ref. 12). The pre-LTP Soil DCGLs, along with the respective laboratory analytical lower limits of detection are provided in Table 2.1 below.

Table 2.1 - Soil DCGLs and Analysis Lower Limits of Detection (LLDs)

Radionuclide(1)	Soil DCGL (pCi/g)(2)	LLD (pCi/g)(3) 10% to 50%	
H-3	5.50E+01	5.50E+00	2.75E+01
C-14	6.00E+00	6.00E-01	3.00E+00
Co-60	2.75E+03	2.75E+02	1.38E+03
Ni-59	1.90E+00	1.90E-01	9.50E-01
Ni-63	1.05E+03	1.05E+02	5.25E+02
Sr-90	8.50E-01	8.50E-02	4.25E-01
Nb-94	2.90E+00	2.90E-01	1.45E+00
Tc-99	9.50E+00	9.50E-01	4.75E+00
I-129	2.50E-01	2.50E-02	1.25E-01
Cs-137	5.50E+00	5.50E-01	2.75E+00
Eu-152	4.35E+00	4.35E-01	2.18E+00
Eu-154	4.00E+00	4.00E-01	2.00E+00
Np-237	1.15E+02	1.15E+01	5.75E+01
Pu-238	1.25E+00	1.25E-01	6.25E-01
Pu-239	1.15E+00	1.15E-01	5.75E-01
Pu-240	1.24E+03	1.24E+02	6.20E+02
Pu-241	3.60E+01	3.60E+00	1.80E+01
Am-241(4)	1.05E+00	1.05E-01	5.25E-01
Cm-243	1.60E+00	1.60E-01	8.00E-01
Cm-244	2.20E+03	2.20E+02	1.10E+03
Cm-245	2.76E+02	2.76E+01	1.38E+02
Cm-246	1.19E+03	1.19E+02	5.95E+02

(1) Bold text indicates radionuclides that are considered Hard to Detect (HTD)

(2) The Soil DCGL(s) specified above are the lesser of either an annual dose of 15 mrem/yr (the 25 mrem/yr DCGL provided in HBPP Procedure HBPP-PP-005 (Ref. 11) adjusted to an assumed California Department of Toxic Control (DTSC) risk based release of 15 mrem/yr) or 50% of the NRC screening values (Ref. 12)

(3) The required LLD is between 10% to 50% of the Soil DCGL.

(4) Americium-241 can be analyzed by gamma and alpha spectroscopy and is considered Easy to Detect (ETD). The preferred result is the alpha spectroscopy's when both analyses are performed.

For the remainder of the survey units listed in this report, Table 2.2 and Table 2.3 present the Soil DCGLs and Building Surface DCGLs respectively per the HBPP LTP. Cs-137 and Co-60 were the only nuclides that could potentially be present based on characterization data.

While soil DCGLs do not apply to concrete surfaces, they were used as a metric for media characterization samples collected to close data gaps and verify assumptions used in the FSS design for the WMF Pad.

Table 2.2 - Soil DCGLs and Analysis Lower Limits of Detection (LLDs)

Radionuclide (1)	Soil DCGL (pCi/g) (2)	LLD (pCi/g) (3) 10% to 50%	
H-3	6.8E+02	6.8E+01	3.4E+02
C-14	6.3E+00	6.3E-01	3.1E+00
Co-60	3.8E+00	3.8E-01	1.9E+00
Ni-59	1.9E+03	1.9E+02	9.8E+02
Ni-63	7.2E+02	7.2E+01	3.6E+02
Sr-90	1.5E+00	1.5E-01	7.5E-01
Nb-94	7.1E+00	7.1E-01	3.5E+00
Tc-99	1.2E+01	1.2E+00	6.2E+00
Cs-137	7.9E+00	7.9E-01	3.9E+00
Eu-152	1.0E+01	1.0E+00	5.0E+00
Eu-154	9.4E+00	9.4E-01	4.7E+00
Np-237	1.1E+00	1.1E-01	5.5E-01
Pu-238	2.9E+01	2.9E+00	1.4E+01
Pu-239/240 (5)	2.6E+01	2.6E+00	1.3E+01
Am-241 (4)	2.5E+01	2.5E+00	1.2E+01
Pu-241	8.6E+02	8.6E+01	4.3E+02
Cm-243/244(5)	2.9E+01	2.9E+00	1.4E+01
Cm-245/246(5)	1.7E+01	1.7E+00	8.9E+00

(1) Bold text indicates radionuclides that are considered Hard to Detect (HTD)

(2) The Soil DCGL(s) are specified by the LTP in Chapter 6 and are equivalent to twenty-five (25) mrem/yr TEDE.

(3) The required LLD is between 10% to 50% of the Soil DCGL.

(4) Americium-241 can be analyzed by gamma and alpha spectroscopy and is considered Easy to Detect (ETD). The preferred result is the alpha spectroscopy's when both analyses are performed.

(5) For radiochemical analyses whose results cannot discern between two isotopes, i.e. Pu-239/240, Cm-243/244 and Cm-245/246, the lower of the two DCGLs was selected from the LTP.

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Table 2.3 – Building Surface DCGLs

Nuclide(1)	DCGL(2) (dpm/100 cm^2)	Nuclide(1)	DCGL(2) (dpm/100 cm^2)	Nuclide(1)	DCGL(2) (dpm/100 cm^2)
Am-241	3.0E+03	Eu-152	2.7E+04	Pu-239	3.1E+03
C-14	7.0E+06	Eu-154	2.5E+04	Pu-240	3.1E+03
Cm-243	4.3E+03	**H-3**	1.8E+08	**Pu-241**	1.4E+05
Cm-244	5.5E+03	Nb-94	1.9E+04	Sr-90	9.7E+04
Cm-245	2.2E+03	**Ni-59**	6.3E+07	Tc-99	9.6E+06
Cm-246	2.7E+03	**Ni-63**	2.4E+07		
Co-60	1.3E+04	Np-237	2.4E+03		
Cs-137	4.6E+04	Pu-238	3.4E+03		

(1) Bold text indicates radionuclides that are considered Hard to Detect (HTD) using specific gas proportional instrumentation listed in the next section.

(2) The Building Surface DCGL(s) listed in disintegrations per minute per 100 centimeters squared (dpm/100 cm^2) are specified by the LTP in Chapter 5 and are equivalent to twenty-five (25) mrem/yr TEDE.

2.2.1 SURVEY APPROACH/METHODS

Prior to mobilizing the radiological survey team to the survey site, the survey team was briefed on the FSS package requirements associated with each individual survey unit which referenced the appropriate field sampling equipment and procedures to be used. A set of maps created using Visual Sample Plan of Survey Units were created. These maps were then used in laying out the sampling and survey locations.

The prescribed survey approach for Class 2 open land and engineered surface areas consisted of soil or direct measurement collection of a statistically random start in a systematically gridded fashion with 10%-100% walk-over scanning of all accessible areas with a 2” x 2” Thallium-activated Sodium Iodide (NaI (Tl)) scintillation detector for open land areas, or beta scanning with a proportional floor monitor detector for the WMF Pad. For Class 3 areas, the prescribed survey approach consists of soil collection in a random-placement fashion and judgmental 1% - 10% walk-over scanning of accessible areas with a 2” x 2” NaI (Tl) detector. Additionally, all original direct non-parametric and biased soil sample locations were accessed, excepting statistical sample locations 14 for OOL10-01, 3, 5, 8-10, and 15 for OOL10-13 and 12 for OOL10-22, which as mentioned earlier were relocated as the original locations were deemed inaccessible or unsafe to access.

OOL10-24-FSR WMF Pad Survey Instrumentation

For the WMF Pad survey, three types of radiation detection instruments were selected for the survey application. The first type of instrument employed an instrument and detector connected by cable. The radiation detector was a gas flow proportional detector designed to measure both the beta and alpha radiation emitted from a surface (direct measurement). The detector was coupled to a scaler/ratemeter to form a complete instrument/detector probe package. Direct readings were performed utilizing a Model 2350-1 scaler/ratemeter with a Ludlum Model 43-68 detector.

The second type of instrument used was a large area floor monitor manufactured by Ludlum as Model 239-1F. The 239-1F floor monitor is comprised of a large area gas proportional detector (Model 43-37) coupled to a Model 2350-1 scaler/ratemeter and used to perform gross beta scanning of the accessible portions of the concrete pad.

In addition to these field measurements, removable radioactivity samples (smears) were made in the survey unit. The third instrument used was a low-background gas proportional system for counting smear samples in the on-site counting laboratory. The Protean WPC-9550 low-background proportional Alpha/Beta smear counter was utilized for counting smear samples from the concrete pad.

The field instruments used in the survey were calibrated and frequently response checked and verified to be in working order and within established tolerance limits prior to and post use.

2.2.2 Number of Samples and Measurements

The DQO process determined that Cs-137 is the radionuclide of concern in the survey units. Other radionuclides (if present) that were positively identified during the performance of this FSS would be evaluated to ensure adequate survey designs. Various amounts of Cs-137 was found in nine (9) of the one-hundred fifty-six (156) statistical soil samples collected and analyzed onsite, and ten (10) of the twenty-two (22) samples analyzed offsite. Four (4) of the thirty-seven (37) biased samples collected showed low levels of Cs-137. Four (4) of the thirty (30) statistical direct measurements (two gross alpha and two gross beta measurements) and gross two beta investigation measurements were greater than the method detection levels calculated for the analysis.

All seven (7) statistical samples provided to the NRC in the form of split samples from Fuel Oil Storage Tank Area (FOST) survey unit OOL10-01 detected small amounts of Cs-137 greater than method detection levels as described in the ORISE Confirmatory Survey Report. The report also mentions that two (2) of six (6) judgmental soil samples showed small amounts of Cs-137 greater than method detection levels. In summary, the confirmatory results indicated that the ORISE FOST Area survey unit Cs-137 mean concentration results compared favorably with the PG&E Laboratory FOTA survey unit Cs-137 mean concentration results (Ref. 13). The ORISE Survey Report is provided for review in Attachment 1.

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 for the open land FSS/FSR units. For the WMF Pad survey unit, the approach was conservative since instrument background or background attributable to naturally occurring radioactive materials (NORM) from building surfaces was not excluded from the sample set.

The minimum number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, "Determination of the Number and Location of FSS Samples" (Ref. 14). The Lower Bound of the Gray Region (LBGR) was set in accordance with Procedure RCP FSS-7 to achieve a relative shift (Δ/σ) in the range of 1 and 3. The resulting relative shift for each survey unit is specified in their respective survey plans.

A Prospective Power Curve was generated with these settings using MARSSIM Power 2000 (Ref. 15) and is provided in the Data Quality Assessment (Attachment 1). MARSSIM Power 2000 is a software package developed under the sponsorship of the United States Department of Energy (DOE) Environmental Measurement Laboratory. The results of the A Posteriori (retrospective) software run showed adequate power for the survey design. This indicates that the survey area had a high probability of rejecting the null hypothesis, assuming the characterization data are representative of the FSS results. The retrospective power curve for each survey unit is provided in Attachment 1.

The grid pattern and locations of the soil samples were determined using Visual Sample Plan (VSP) in accordance with Procedure RCP FSS-18, "Computer Determination of Number and Locations of FSS Samples" (Ref. 16) Visual Sample Plan was created by Pacific Northwest

National Laboratory (PNNL) for the DOE (Ref. 17). A systematic triangular grid sampling pattern with a random starting point was selected for sample design for OOL10-20, OOL10-20-FSR, OOL10-24-FSR. and OOL10-26-FSR, which is appropriate for Class 2 survey areas. For the remaining survey units (OOL10-01, OOL10-01-FSR, OOL10-13, OOL10-17, OOL10-17-FSR, OOL10-22, and OOL10-22-FSR), a random sampling pattern with a random starting point was selected for sample design, which is appropriate for Class 3 areas.

Sample locations were identified using AutoCAD, a commercially available plotting software package with coordinates consistent with the California State Plane System. These coordinates were integrated with a GPS to locate sample locations in the field. Sample Measurement Locations for the design are listed with the GPS coordinates in Tables 2.4 thru 2.14 as displayed in the Survey Plans for the survey units described in this report.

Table 2.4 – OOL10-01 Soil Sample GPS Coordinates

Sample	Easting	Northing
CHAR-OOL10-01-001-C	5949070.95	2160776.90
CHAR-OOL10-01-002-C	5948982.35	2160893.69
CHAR-OOL10-01-003-C	5948990.65	2160932.62
CHAR-OOL10-01-004-C	5948902.04	2160737.97
CHAR-OOL10-01-005-C	5949079.26	2160854.76
CHAR-OOL10-01-006-C	5948946.35	2160789.87
CHAR-OOL10-01-007-C	5949123.57	2160906.67
CHAR-OOL10-01-008-C	5949012.80	2160828.80
CHAR-OOL10-01-009-C	5948879.89	2160867.74
CHAR-OOL10-01-010-C	5948968.50	2160686.06
CHAR-OOL10-01-011-C	5949145.72	2160802.85
CHAR-OOL10-01-012-C	5949001.73	2160724.99
CHAR-OOL10-01-013-C	5948913.12	2160841.78
CHAR-OOL10-01-014-C(1)	5949090.34	2160958.57
CHAR-OOL10-01-015-C	5948868.82	2160763.92

Note 1: Location relocated ~3.5' SW as original location inaccessible underneath a concrete saddle that had previously held a tank. See SAPN 1454113 for additional details summarized earlier in Section 1.3.7 of this report.

Table 2.5 – OOL10-01-FSR Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-01-001-FSR	5949067.58	2160761.92
OOL10-01-002-FSR	5949128.50	2160857.09
OOL10-01-003-FSR	5949106.35	2160908.99
OOL10-01-004-FSR	5948884.83	2160714.34
OOL10-01-005-FSR	5948918.06	2160688.38
OOL10-01-006-FSR	5949095.27	2160805.18
OOL10-01-007-FSR	5948851.60	2160766.25
OOL10-01-008-FSR(1)	5948984.51	2160705.69
OOL10-01-009-FSR	5948986.59	2160744.62
OOL10-01-010-FSR	5949075.20	2160978.20
OOL10-01-011-FSR	5949097.35	2160874.39
OOL10-01-012-FSR	5949086.27	2160770.57
OOL10-01-013-FSR	5949108.42	2160932.06
OOL10-01-014-FSR	5948886.90	2160737.41
OOL10-01-015-FSR	5948814.91	2160789.32

Note 1: Location relocated ~3' N as original location fell on top of a filtration system. The as sampled GPS coordinates were Easting 5948982.82 Northing 23160707.77

Table 2.6– OOL10-13 Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-13-001-F	5948355.24	2161107.73
OOL10-13-002-F	5947712.24	2161518.31
OOL10-13-003-F(1)	5948487.30	2161067.37
OOL10-13-004-F	5950482.10	2161757.82
OOL10-13-005-F(1)	5948294.17	2161303.24
OOL10-13-006-F	5948009.01	2161427.07
OOL10-13-007-F	5950259.52	2161712.20
OOL10-13-008-F(1)	5948278.84	2161238.92
OOL10-13-009-F(1)	5948549.40	2161247.45
OOL10-13-010-F(1)	5947927.53	2161450.67
OOL10-13-011-F	5948231.59	2161337.52
OOL10-13-012-F	5947647.32	2161383.14
OOL10-13-013-F	5948834.40	2161314.71
OOL10-13-014-F	5948141.94	2161246.28
OOL10-13-015-F(1)	5947943.32	2161297.55

Note 1: Samples listed relocated to the coordinates listed in the table as original locations specified in the plan were either inaccessible or not easily accessed. Refer to detailed discussion in Section 1.3.7.

Table 2.7 – OOL10-17 Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-17-001-F	5948357.44	2160611.69
OOL10-17-002-F	5948420.59	2160884.80
OOL10-17-003-F	5948167.99	2160748.24
OOL10-17-004-F	5948631.08	2160543.41
OOL10-17-005-F	5948799.48	2160634.44
OOL10-17-006-F	5948041.69	2160839.28
OOL10-17-007-F	5948546.88	2160702.72
OOL10-17-008-F	5948915.25	2160497.89
OOL10-17-009-F	5948073.26	2161112.39
OOL10-17-010-F	5948662.66	2160361.33
OOL10-17-011-F	5948325.86	2160975.83
OOL10-17-012-F	5948788.96	2160452.37
OOL10-17-013-F	5948704.76	2160725.48
OOL10-17-014-F	5948199.56	2160930.31
OOL10-17-015-F	5948536.36	2160520.65

Table 2.8 – OOL10-17-FSR Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-17-001-FSR	5948671.48	2160308.60
OOL10-17-002-FSR	5948334.68	2160923.10
OOL10-17-003-FSR	5947955.79	2160786.55
OOL10-17-004-FSR	5948797.78	2160581.71
OOL10-17-005-FSR	5948713.58	2160612.06
OOL10-17-006-FSR	5948208.39	2160816.89
OOL10-17-007-FSR	5948545.18	2160407.23
OOL10-17-008-FSR	5948271.53	2160680.34
OOL10-17-009-FSR	5948018.94	2161090.00
OOL10-17-010-FSR	5948145.24	2160634.82
OOL10-17-011-FSR	5948734.63	2160429.99
OOL10-17-012-FSR	5948398.33	2160771.37
OOL10-17-013-FSR	5948987.72	2160566.54
OOL10-17-014-FSR	5948608.82	2160247.91
OOL10-17-015-FSR	5948272.03	2160862.41

Table 2.9 – OOL10-20 Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-20-001-F	5948741.56	2160790.06
OOL10-20-002-F	5948685.23	2160829.51
OOL10-20-003-F	5948996.86	2160974.82
OOL10-20-004-F	5949059.18	2161003.89
OOL10-20-005-F	5948628.90	2160868.95
OOL10-20-006-F	5948572.57	2160908.40
OOL10-20-007-F	5948821.87	2161024.65
OOL10-20-008-F	5948884.19	2161053.71
OOL10-20-009-F	5948946.52	2161082.78
OOL10-20-010-F	5949445.13	2161315.28
OOL10-20-011-F	5948516.23	2160947.84
OOL10-20-012-F	5948578.56	2160976.90
OOL10-20-013-F	5948952.51	2161151.28
OOL10-20-014-F	5949020.83	2161248.85
OOL10-20-015-F	5949394.79	2161423.23
OOL10-20-016-F	5948964.50	2161288.30
OOL10-20-017-F	5949026.83	2161317.36
OOL10-20-018-F	5949089.15	2161346.42
OOL10-20-019-F	5949151.48	2161375.49
OOL10-20-020-F	5949213.80	2161404.55
OOL10-20-021-F	5948970.49	2161356.80

Table 2.10 – OOL10-20-FSR Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-20-001-FSR	5948957.94	2160934.62
OOL10-20-002-FSR	5949418.20	2161394.87
OOL10-20-003-FSR	5948706.76	2160783.08
OOL10-20-004-FSR	5948685.70	2160861.67
OOL10-20-005-FSR	5948858.30	2161034.27
OOL10-20-006-FSR	5948915.83	2161091.80
OOL10-20-007-FSR	5948973.36	2161149.33
OOL10-20-008-FSR	5949203.49	2161379.46
OOL10-20-009-FSR	5948607.11	2160882.73
OOL10-20-010-FSR	5949009.83	2161285.45
OOL10-20-011-FSR	5949067.37	2161342.98
OOL10-20-012-FSR	5949124.90	2161400.52
OOL10-20-013-FSR	5948528.52	2160903.79
OOL10-20-014-FSR	5948643.58	2161018.85
OOL10-20-015-FSR	5948988.78	2161364.04

Table 2.11 – OOL10-22 Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-22-001-F	5948604.52	2161085.88
OOL10-22-002-F	5948538.33	2160852.90
OOL10-22-003-F	5948750.15	2161027.63
OOL10-22-004-F	5948485.37	2161202.36
OOL10-22-005-F	5948697.19	2160755.83
OOL10-22-006-F	5948564.81	2161163.53
OOL10-22-007-F	5948617.76	2160775.25
OOL10-22-008-F	5948673.20	2161066.46
OOL10-22-009-F	5948646.72	2161092.35
OOL10-22-010-F	5948487.86	2161150.59
OOL10-22-011-F	5948593.77	2161034.10
OOL10-22-012-F(1)	5948537.86	2161130.40
OOL10-22-013-F	5948659.96	2160781.72
OOL10-22-014-F	5948607.00	2161189.42
OOL10-22-015-F	5948679.82	2160784.60

Note 1: Sample listed relocated to the coordinates listed in the table as original locations specified in the plan were either inaccessible or not easily accessed. Refer to detailed discussion in Section 1.3.7.

Table 2.12 – OOL10-22-FSR Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-22-001-FSR	5948529.88	2161200.98
OOL10-22-002-FSR	5948476.93	2160929.18
OOL10-22-003-FSR	5948582.84	2160812.70
OOL10-22-004-FSR	5948450.45	2161162.15
OOL10-22-005-FSR	5948609.32	2161123.32
OOL10-22-006-FSR	5948523.27	2160890.35
OOL10-22-007-FSR	5948682.13	2160741.51
OOL10-22-008-FSR	5948549.74	2161149.21
OOL10-22-009-FSR	5948536.50	2160993.90
OOL10-22-010-FSR	5948695.37	2161052.14
OOL10-22-011-FSR	5948589.46	2161226.87
OOL10-22-012-FSR	5948562.98	2160838.58
OOL10-22-013-FSR	5948510.03	2161188.04
OOL10-22-014-FSR	5948615.94	2161071.55
OOL10-22-015-FSR	5948462.04	2160963.70

Table 2.13 – OOL10-24-FSR Direct Measurement GPS Coordinates

Sample	Easting	Northing
OOL10-24-001-FSR	5949015.12	2160782.15
OOL10-24-002-FSR	5949045.90	2160812.93
OOL10-24-003-FSR	5949076.68	2160843.70
OOL10-24-004-FSR	5949003.86	2160824.19
OOL10-24-005-FSR	5949034.64	2160854.97
OOL10-24-006-FSR	5949065.41	2160885.75
OOL10-24-007-FSR	5948992.59	2160866.24
OOL10-24-008-FSR	5949023.37	2160897.01
OOL10-24-009-FSR	5949054.15	2160927.79
OOL10-24-010-FSR	5948950.55	2160877.50
OOL10-24-011-FSR	5948981.33	2160908.28
OOL10-24-012-FSR	5949012.11	2160939.06
OOL10-24-013-FSR	5948846.95	2160827.21
OOL10-24-014-FSR	5948877.73	2160857.99
OOL10-24-015-FSR	5948908.51	2160888.77

Table 2.14 – OOL10-26-FSR Soil Sample GPS Coordinates

Sample	Easting	Northing
OOL10-26-001-FSR	5948411.59	2161007.35
OOL10-26-002-FSR	5948451.16	2161007.35
OOL10-26-003-FSR	5948391.80	2161041.61
OOL10-26-004-FSR	5948332.45	2161075.88
OOL10-26-005-FSR	5948273.10	2161110.15
OOL10-26-006-FSR	5948312.67	2161110.15
OOL10-26-007-FSR	5948213.75	2161144.41
OOL10-26-008-FSR	5948253.32	2161144.41
OOL10-26-009-FSR	5948114.83	2161178.68
OOL10-26-010-FSR	5948154.40	2161178.68
OOL10-26-011-FSR	5948193.97	2161178.68
OOL10-26-012-FSR	5948095.05	2161212.95
OOL10-26-013-FSR	5948134.62	2161212.95
OOL10-26-014-FSR	5948174.18	2161212.95
OOL10-26-015-FSR	5948114.83	2161247.21

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Procedure RCP FSS-2 specifies that 5% of the samples are required to be selected for HTD radionuclide analysis. The number and location of samples and measurements may be determined using RCP FSS-7 or RCP FSS-18. For all survey units except OOL10-24-FSR, at least two (2) soil samples or greater than 5% of the number of samples that would be used for non-parametric statistical testing were randomly selected for HTD radionuclide analyses using the Microsoft Excel "RAND" function. Each of the selected samples were sent off-site for a full suite analysis of the HTD radionuclides as specified.

The LTP requires a minimum of 5% of the samples taken for non-parametric statistical testing be selected for split sample analyses with the off-site laboratory. The implementation of quality control measures as referenced by Procedure RCP FSS-11, "Split Sample Assessment for Final Status Survey," (Ref. 8) included the collection of two (2) soil samples for "split sample" analysis by the off-site laboratory for all survey units except OOL10-24-FSR. These locations were selected randomly using the Microsoft Excel "RAND" function. It should be noted that a composite media sample was collected from two investigation locations within Survey Unit OOL10-24-FSR. However, there was no HTD analysis performed for the composite sample as it was determined that there was insufficient material available for the full suite of HTD analysis as described later in this report.

2.2.3 Synopsis of Survey Unit Design & Deselection

The design of each survey unit incorporates the MARSSIM approach to FSS. The DQO process as described in Procedure, *Final Status Survey Quality Assurance Project Plan (QAPP*) (Ref. 18) was used to develop each survey plan. It should also be noted that the area covered by scan measurement is based on the survey unit classification as described in MARSSIM. Table 5-4 of the LTP specifies accessible area scanning percentage of Class 2 survey units is 10%-100%, and Class 3 survey units is judgmental 1%-10%.

There were no reported deviations from this requirement. It should be noted that the scaled or operational DCGLs presented in the tables below are excerpted from each respective FSSP based on a conservative estimate of deselection HTD dose and only used in the survey unit design. The deselection HTD dose applied in the determination of survey unit compliance dose for this report is presented in Table 2.24 thru Table 2.25 respectively for Class 2 and Class 3 survey units. A summary of the synopsis of each survey design is displayed below in Tables 2.13 through 2.23.

Table 2.15 - Synopsis of the Survey Design OOL10-01

Feature	Design Criteria	Basis
Survey Unit Land Area	6,473 m^2	Based on AutoCAD
Number of Measurements	15 required[1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.18 (of unity), the adjusted LBGR was set at 0.64 (of unity) to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for class 3 areas.
Design DCGL[2]	1.90 pCi/g Co-60 5.50 pCi/g Cs-137	DCGLs presented are the lesser of an adjusted annual dose of 15 mrem/yr from DCGL in Report HBPP-PP-005 or 50% of the NRC screening values
Soil Investigation Level	<10% DCGL for Cs-137, or Sum of DCGL fractions >1.0	Survey Design Criteria Sheet HBPP-CHAR-OOL10-01-00
Scan Survey Area Coverage	50% of Survey Unit	Survey Design Criteria Sheet HBPP-CHAR-OOL10-01-00
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Survey Design Criteria Sheet HBPP-CHAR-OOL10-01-00

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] Since the Characterization Plan predated the NRC approval of the LTP, the above DCGLs specified correspond to the lesser of an annual dose of 15 mrem/yr (the 25 mrem/yr DCGL adjusted to an assumed California Department of Toxic Substance Control (DTSC) risk-based release level of 15 mrem/yr) or 50% of the NRC screening values. DCGLs presented were not scaled for deselected HTD radionuclides.

Table 2.16 - Synopsis of the Survey Design OOL10-01-FSR

Feature	Design Criteria	Basis
Survey Unit Land Area	3,020 m^2	Based on AutoCAD
Number of Measurements	15 required[1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.06 pCi/g, the LBGR was set at 7.1 pCi/g to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for class 3 areas.
Design $DCGL_{OP}$[2]	7.22 pCi/g Cs-137	Per Table of Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 22.85 mrem/yr TEDE
Soil Investigation Level	>50% of Cs-137 DCGL=3.6 pCi/g	Table 5-5 of the LTP for a Class 3 survey unit.
Scan Survey Area Coverage	Approximately 5%	Table 5-4 of the LTP requires judgmental 1%-10% coverage of accessible areas for Class 3 survey units
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 22.85 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose).

Table 2.17 - Synopsis of the Survey Design OOL10-13

Feature	Design Criteria	Basis
Survey Unit Land Area	38,087 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.50 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for Class 3 areas.
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per Table 2 of the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Soil Investigation Level	>50% of DCGL	Table 5-5 of the LTP for a Class 3 survey unit states >0.5 *DCGL is the direct investigation level.
Scan Survey Area Coverage	5%	Table 5-4 of the LTP requires Judgmental 1%-10% coverage of accessible areas for Class 3 survey units
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose).

Table 2.18 - Synopsis of the Survey Design OOL10-17

Feature	Design Criteria	Basis
Survey Unit Land Area	53,129 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.06 pCi/g, the LBGR was set at 7.1 pCi/g to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for Class 3 areas.
Design $DCGL_{OP}$[2]	7.22 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 22.85 mrem/yr TEDE
Sample Investigation Level	>50% of DCGL	Table 5-5 of the LTP for a Class 3 survey unit states >0.5 *DCGL is the direct investigation level.
Scan Survey Area Coverage	Approximately 5%	Table 5-4 of the LTP requires Judgmental 1%-10% coverage for accessible Class 3 areas
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 22.85 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Table 2.19 - Synopsis of the Survey Design OOL10-17-FSR

Feature	Design Criteria	Basis
Survey Unit Land Area	53,129 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.06 pCi/g, the LBGR was set at 7.1 pCi/g to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for Class 3 areas.
Design $DCGL_{OP}$[2]	7.22 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 22.85 mrem/yr TEDE
Sample Investigation Level	>50% of DCGL	Table 5-5 of the LTP for a Class 3 survey unit states >0.5 *DCGL is the direct investigation level.
Scan Survey Area Coverage	Approximately 5%	Table 5-4 of the LTP requires Judgmental 1%-10% coverage for accessible Class 3 areas
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 22.85 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Table 2.20 - Synopsis of the Survey Design OOL10-20

Feature	Design Criteria	Basis
Survey Unit Land Area	7,990 m^2	Based on AutoCAD
Number of Measurements	15 required [1] 6 additional samples added for total of 21 for additional power (Random start, systematic triangular grid)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.5 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	20.96 m	LTP Equation 5-5 for triangular grid pattern
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Sample Investigation Level	>DCGL for Cs- 137	Table 5-5 of the LTP for a Class 2 survey area.
Scan Survey Area Coverage	10%	Table 5-4 of the LTP requires 10%-100% coverage for Class 2 areas
Scan Investigation Level	>DCGL, or >MDC_{SCAN} if MDC_{SCAN} is greater than DCGL	Table 5-5 of the LTP for Class 2 Survey Units
Investigation Level for 1m ISOCS Scans	(a) 1.76E-01 pCi/g Cs-137[3] (b) Positive identification of any other plant-derived radionuclide	Attachment H of the FSSP

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

[3] Cs-137 Investigation level shown is near the upper end of the required MDA for the ISOCS system for a 900 second acquisition. The upper end of the required MDA for the specified radionuclide is set at 100% of the investigation level to satisfy the LTP Table 5-5 Scan Investigation Levels for a Class 2 area (>$DCGL_W$ or >MDC_{SCAN} when MDC_{SCAN} is >$DCGL_W$)

Table 2.21 - Synopsis of the Survey Design OOL10-20-FSR

Feature	Design Criteria	Basis
Survey Unit Land Area	7,990 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, systematic triangular grid)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.5 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	24.8 m	LTP Equation 5-5 for triangular grid pattern
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Sample Investigation Level	>DCGL for Cs-137	Table 5-5 of the LTP for a Class 2 survey area.
Scan Survey Area Coverage	10%	Table 5-4 of the LTP requires 10%-100% coverage for Class 2 areas
Scan Investigation Level	>DCGL, or >MDC_{SCAN} if MDC_{SCAN} is greater than DCGL	Table 5-5 of the LTP for Class 2 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Table 2.22 - Synopsis of the Survey Design OOL10-22

Feature	Design Criteria	Basis
Survey Unit Land Area	4,885 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.50 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for Class 3 areas.
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Sample Investigation Level	>50% of DCGL	Table 5-5 of the LTP for a Class 3 survey unit states >0.5 *DCGL is the direct investigation level.
Scan Survey Area Coverage	Approximately 10%	Table 5-4 of the LTP requires Judgmental 1%-10% coverage for accessible Class 3 areas
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Table 2.23 - Synopsis of the Survey Design OOL10-22-FSR

Feature	Design Criteria	Basis
Survey Unit Land Area	4,885 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, Random sampling pattern)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.50 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	N/A	N/A for Class 3 areas.
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Sample Investigation Level	>50% of DCGL	Table 5-5 of the LTP for a Class 3 survey unit states >0.5 *DCGL is the direct investigation level.
Scan Survey Area Coverage	Approximately 10%	Table 5-4 of the LTP requires Judgmental 1%-10% coverage for accessible Class 3 areas
Scan Investigation Level	Reproducible indication above background using 44-10 and audible discrimination.	Table 5-5 of the LTP for Class 3 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Table 2.24 – Synopsis of the Survey Design OOL10-24-FSR

Feature	Design Criteria	Basis
Survey Unit Surface Area	2,286 m^2	Based on AutoCAD
Number of Measurements	15 required[3] (random start, systematic triangular grid)	Type 1 and Type 2 errors were 0.05, sigma was 143 dpm/100 cm^2 and the adjusted LBGR was set at 45,714 dpm/100 cm^2 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	13.27 m	LTP Equation 5-5 for triangular grid pattern
$DCGL_{GA}$[1] Beta/Gamma (β/γ) $DCGL_{GA}$[2] Alpha (α)	46,000 dpm/100 cm^2 β/γ 3,000 dpm/100 cm^2 α	Per Table 5-1 of the LTP for Building Surfaces to achieve 25 mrem/yr TEDE
Direct Measurement Investigation Level	>46,000 dpm/100 cm^2 β/γ >3,000 dpm/100 cm^2 α	> $DCGL_W$ from investigation criteria provided from Table 5-5 of the LTP for a Class 2 survey unit.
Beta Scan Survey Area Coverage	Approximately 100% scans of accessible concrete pad	Table 5-4 of the LTP requires 10%-100% coverage area for Class 2 survey units
Scan Investigation Level	>$DCGL_W$ or >MDC_{SCAN} if MDC_{SCAN} is greater than $DCGL_W$	Per Table 5-5 of the LTP for Class 2 Survey Units

(1) $DCGL_{GA}$ Beta/Gamma-Gross Activity DCGL based on Cs-137

(2) $DCGL_{GA}$ Alpha-Gross Activity DCGL conservatively based on Am-241

(3) The number of fixed measurement locations for FSS was determined in accordance with Procedure RCP FSS-7, "Determination of Number and Location of FSS Samples" (Ref. 14).

Table 2.25 - Synopsis of the Survey Design OOL10-26-FSR

Feature	Design Criteria	Basis
Survey Unit Land Area	1,890 m^2	Based on AutoCAD
Number of Measurements	15 required [1] (Random start, systematic triangular grid)	Type 1 and Type 2 errors were 0.05, sigma was 0.25 (of unity), the LBGR was set at 0.5 to achieve a Relative Shift in the range of 1 and 3 (Δ/σ=2.0)
Grid Spacing	12.06 m	LTP Equation 5-5 for triangular grid pattern
Design $DCGL_{OP}$[2]	7.65 pCi/g Cs-137	Per the Scaled DCGLs from FSSP based on deselected HTD nuclides to achieve 24.21 mrem/yr TEDE
Sample Investigation Level	>DCGL for Cs-137	Table 5-5 of the LTP for a Class 2 survey area.
Scan Survey Area Coverage	10%	Table 5-4 of the LTP requires 10%-100% coverage for Class 2 areas
Scan Investigation Level	>DCGL, or >MDC_{SCAN} if MDC_{SCAN} is greater than DCGL	Table 5-5 of the LTP for Class 2 Survey Units

[1] The number of soil samples for FSS was determined in accordance with Procedure RCP FSS-7, *"Determination of Number and Location of FSS Samples"* (Ref. 14).

[2] $DCGL_{OP}$ - Operational DCGL is the LTP Table 5-1 DCGL scaled to a dose of 24.21 mrem/yr based on deselected HTD nuclide dose from nuclides determined to have a minimal dose contribution (i.e., contribute less than 10% collectively to the dose limit).

Surrogate/Deselection Discussion for FSS and FSR Open Land Survey Units

It should be noted that for all Survey Units described in this report, surrogate ratios were not used. However, there were deselected HTD radionuclides which were determined to be insignificant (i.e., contribute less than 10% collectively to the dose) for all survey units except OOL10-01 (predated the LTP) and OOL10-24 (concrete pad surface). The deselected dose was considered in the final dose estimate of all other survey unit TEDE for comparison to the release criteria.

Survey Unit Applied DCGLs

Previous characterization has shown that not all the site-specific radionuclides would be present in this survey unit. The following nuclides were deselected from the analysis, excepting the QC off-site samples and other additional samples analyzed off-site for full suite HTD analysis. Carbon-14 (C-14) was left off as there was no potential for it to be present in this area due to lack of production mechanism (neutron activated concrete).

- Cm-243/244
- Cm-245/246
- Ni-59
- Ni-63
- Pu-238
- Pu-239/240
- Pu-241
- Tc-99
- H-3
- Sr-90

The dose contribution from the deselected HTD nuclides is determined by calculation of radionuclide mean values from a comprehensive FSS and Characterization survey data set compiled from HTD analysis of on-site and off-site laboratory *a-posteriori* reported values from analysis during the six-year time span ranging from 2014 through 2019. The resultant dose from HTD nuclides was 0.120 mrem/yr and 0.568 mrem/yr for Class 2 and Class 3 survey units respectively which is conservative compared with the aggregate dose since various individual radionuclide doses (e.g., Cm-243/244, Sr-90, and Tc-99) were negative and were negated by assigning their individual dose contributions to zero (Ref. 19). Table 2.24 and Table 2.25 depict the total dose calculated for deselected nuclides for Class 2 and Class 3 survey units respectively.

The presence of all radionuclides listed in the plan (gamma emitters, HTD beta-emitters, and Transuranics (TRUs) in the soil) was evaluated. The HBPP Site Closure Department analyzed each soil sample for gamma-emitting nuclides.

Table 2.26 - Dose for Deselected Nuclides for Class 2 Survey Units

***a-posteriori* results compiled from Table 3 and Table 6 of HBPP Revised Position Paper**					
Nuclide	**Soil DCGL (pCi/g)**	***a-posteriori* Activity Results (pCi/g)**	**Results/DCGL Unity Fraction**	**Results/DCGL Unity Fraction *(assigning zeros for negative fractions)***	***a-posteriori* Deselection Dose Assignment (mrem/y)**
Cm-243/244	2.90E+01	-3.41E-02	-1.18E-03	0.00E+00	0.00E+00
Cm-245/246	1.70E+01	7.64E-02	4.49E-03	4.49E-03	1.12E-01
Ni-59	1.90E+03	-8.54E+00	-4.49E-03	0.00E+00	0.00E+00
Ni-63	7.20E+02	-1.80E+00	-2.51E-03	0.00E+00	0.00E+00
Pu-238	2.90E+01	-3.87E-03	-1.33E-04	0.00E+00	0.00E+00
Pu-239/240	2.60E+01	7.75E-03	2.98E-04	2.98E-04	7E-03
Pu-241	8.60E+02	-1.13E+00	-1.31E-03	0.00E+00	0.00E+00
Sr-90	1.50E+00	-7.05E-03	-4.70E-03	0.00E+00	0.00E+00
Tc-99	1.20E+01	-2.83E-02	-2.35E-03	0.00E+00	0.00E+00
H-3	6.80E+02	1.70E-02	2.50E-05	2.50E-05	1E-03
Total SOF assigning zeros for negative nuclide fractions				4.81E-03	
Total Deselection Nuclide Dose conservatively assigned using zeros for negative nuclide fractions (SOF*25 mrem/yr)					**1.20E-01**

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Table 2.27 - Dose for Deselected Nuclides for Class 3 Survey Units

***a-posteriori* results compiled from Table 4 and Table 7 of HBPP Revised Position Paper**					
Nuclide	**Soil DCGL (pCi/g)**	***a-posteriori* Activity Results (pCi/g)**	**Results/DCGL Unity Fraction**	**Results/DCGL Unity Fraction *(assigning zeros for negative fractions)***	***a-posteriori* Deselection Dose Assignment (mrem/y)**
Cm-243/244	2.90E+01	-2.57E-03	-8.85E-05	0.00E+00	0.00E+00
Cm-245/246	1.70E+01	1.56E-01	9.19E-03	9.19E-03	2.30E-01
Ni-59	1.90E+03	5.98E+00	3.15E-03	3.15E-03	7.9E-02
Ni-63	7.20E+02	3.40E+00	4.72E-03	4.72E-03	1.18E-01
Pu-238	2.90E+01	3.92E-02	1.35E-03	1.35E-03	3.4E-02
Pu-239/240	2.60E+01	-3.47E-03	-1.33E-04	0.00E+00	0.00E+00
Pu-241	8.60E+02	2.50E+00	2.91E-03	2.91E-03	7.3E-02
Sr-90	1.50E+00	-7.35E-03	-4.90E-03	0.00E+00	0.00E+00
Tc-99	1.20E+01	-1.05E-01	-8.77E-03	0.00E+00	0.00E+00
H-3	6.80E+02	9.40E-01	1.38E-03	1.38E-03	3.5E-02
Total SOF assigning zeros for negative nuclide fractions				2.27E-02	
Total Deselection Nuclide Dose conservatively assigned using zeros for negative nuclide fractions (SOF*25 mrem/yr)					**5.68E-01**

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Off-site Laboratory Analysis

OOL10-01:

Two (2) QC splits were also analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of all HTD radionuclides that were *not deselected* by the survey plan.

OOL10-01-FSR:

Two (2) QC splits were also analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory with the exception of Sr-90 and Tritium, which were analyzed for every statistical sample by the on-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-13:

Two (2) QC splits were also analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory with the exception of Sr-90 and Tritium, which were analyzed by the on-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-17:

Two (2) QC splits and one (1) additional sample were analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory to be analyzed to verify the absence of the HTD radionuclides deselected by the survey plan with the exception of Sr-90 and Tritium, which were analyzed for every statistical sample by the on-site laboratory.

OOL10-17-FSR:

Two (2) QC splits were also analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory with the exception of Sr-90 and Tritium, which were analyzed for every statistical sample by the on-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-20:

Three (3) QC splits were also analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-20-FSR:

Two (2) QC splits were analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-22:

Two (2) QC splits were analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-22-FSR:

Two (2) QC splits were analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

OOL10-26-FSR:

Two (2) QC splits were analyzed for the HBPP full suite of plant-derived radionuclides by the off-site laboratory. The QC splits analyzed by the independent laboratory were assessed to verify the absence of the HTD radionuclides deselected by the survey plan.

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3.0 SURVEY RESULTS

Final Status Survey field activities were conducted under approved FSS Plans for the areas as listed in this report. The preparations for work included a detailed review of each FSS Plan, job safety analysis, job planning checklist, and related procedures for reference. Daily briefings were conducted to discuss the expectations for job performance and the safety aspects of the survey. The Daily Survey Journal was used to document field activities and other information pertaining to the FSS. All field survey activities were performed on various dates within the guidelines as set forth in the governing procedures. Sample measurement locations using GPS coordinates were identified in the 1983 North American Datum (NAD) coordinate system.

3.1 SAMPLE MEASUREMENT RESULTS

Each of the one hundred fifty-six (156) statistical samples collected were analyzed by gamma spectroscopy at the HBPP laboratory. All soil and media samples obtained during the FSS of the survey units listed in this report were collected using Procedure FSS-8, "Collection of Site Characterization and Final Status Survey Samples" (Ref. 20). In addition, twenty-two (22) of the samples were sent to an off-site laboratory and analyzed for each of the nuclides in the FSS nuclide suite. The off-site laboratory employed for the radiological analyses of samples was General Engineering Laboratories (GEL), located in Charleston, South Carolina. The corresponding split sample comparison results between the GEL and HBPP laboratories can be reviewed in each associated Attachment 1 Survey Unit Data Assessment.

Oak Ridge Institute for Science and Education (ORISE) and NRC performed independent confirmatory surveys for the Fuel Oil Storage Tank Area (OOL10-01) at the Humboldt Bay Power Plant in Eureka, California during the period of February 14th and 15th, 2012. During that time frame PG&E site closure personnel collected splits of seven (7) statistical samples with ORISE personnel that were collected during performance of FSS. Six of the seven statistical sample splits showed good agreement for Cs-137 results between the PG&E HBPP Laboratory and the ORISE Laboratory with a Relative Error Ratio (RER) averaging 0.3. Additionally, ORISE requested side-by-side sample splits collected at six (6) judgmental locations. Two of the six judgmental sample splits showed good agreement for Cs-137 results between the PG&E HBPP Laboratory and the ORISE Laboratory with a Relative Error Ratio (RER) averaging 1.03. There was no comparison for one of the statistical samples split and four of the judgmental samples split as the PG&E

Laboratory results and the ORISE laboratory result were below the method detection level and/or showed high error. A copy of the results report is shown in Attachment 1.

ORISE and NRC performed independent confirmatory surveys for the remaining land areas and select buildings (including the WMF Pad) at the Humboldt Bay Power Plant in Eureka, California during the period of August 26-29, 2019. During that time frame ORISE personnel requested 10 archived statistical samples that were collected previously from different FSS areas onsite. A total of two (2) archived samples were requested from Survey Units OOL10-01 and OOL10-20. The ORISE Report is provided for review in Attachment 1.

Statistical sample results did not exceed the Investigation Level for soil samples. Therefore, gamma spectroscopy sample results did not require further investigation.

A summary of the statistical soil sample for each specific area is provided in Tables 3.1, and Table 3.3 though Table 3.11 for the open land survey units described in this report. A summary of the statistical gross alpha and gross beta direct measurement results for Survey Unit OOL10-24-FSR is provided in Table 3.13. Additionally, while not considered in the non-parametric statistical evaluation of compliance with the release criteria, a total of thirty-seven (37) biased soil or engineered material samples and one composite media sample collected in the survey units as listed in this submittal and analyzed using gamma spectroscopy at the on-site laboratory. Additionally, there were two (2) investigation direct gross beta measurements that were collected in Survey Unit OOL10-24-FSR using the Ludlum Model 43-68 proportional detector with the Ludlum Model 2350-1 Data Logger. A summary of the positive biased samples, the two investigation measurements, and the composite media sample collected for the two investigation locations is provided in Table 3.2, Table 3.14, and Table 3.15 respectively.

While not considered in the non-parametric statistical evaluation of compliance with the release criteria, there were a total of and thirteen (13) investigation samples collected in the survey units as listed in this submittal and analyzed using gamma spectroscopy at the on-site laboratory. A summary of those samples is provided in the respective survey unit later in this report.

3.1.1 Survey Unit OOL10-01 Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-01 were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. The analytical results show that the maximum fraction is less than 7% of Unity.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was considered, because it was the only gamma emitter listed in the characterization plan as radionuclide of concern and is confirmed by the presence of results greater than method detection levels in eight (8) of the statistical samples collected. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-1.77) mrem, there were no positive results for these radionuclides reported greater than *a posteriori* method detection levels, and over fifty-one percent (51%) of all reported values were less than zero. No investigation surveys were warranted as all statistical sample results were less than ten percent (10%) of the Cs-137 DCGL specified in the survey plan (5.5 pCi/g). Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.1 presents the FSS results for the fifteen (15) nonparametric samples collected for Survey unit OOL10-01.

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Table 3.1 - Summary of Nonparametric Soil Sample Results for OOL10-01

FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-01-001-C	2.59E-01	-8.12E-02	7.53E-02	1.17E-01	-8.47E-02	-8.12E-02	1.38E-01	1.4%
OOL10-01-002-C	-7.35E-03	-3.01E-02	**3.22E-01**	-1.90E-02	1.45E-02	-3.08E-02	7.15E-02	5.9%
OOL10-01-003-C	-1.21E-01	3.38E-02	**3.53E-01**	1.06E-01	-5.28E-02	1.16E-02	2.76E-02	6.4%
OOL10-01-004-C	-5.02E-02	-2.09E-02	**1.93E-01**	-1.27E-02	-7.08E-03	7.47E-03	8.25E-03	3.5%
OOL10-01-005-C	-4.11E-02	3.86E-03	1.43E-02	-4.90E-01	-2.02E-01	2.70E-03	4.06E-02	0.3%
OOL10-01-006-C	7.70E-02	-6.77E-02	-2.71E-02	-5.99E-02	-9.91E-03	1.30E-02	-9.82E-03	-0.5%
OOL10-01-007-C	1.68E-01	6.43E-03	**3.13E-01**	7.75E-02	-8.33E-02	3.20E-02	2.83E-02	5.7%
OOL10-01-008-C	-5.54E-02	-2.16E-02	4.94E-02	-7.86E-03	-1.12E-01	-3.89E-02	-8.02E-02	0.9%
OOL10-01-009-C	-1.56E-02	-1.40E-03	**1.95E-01**	-2.76E-03	-1.64E-02	-9.69E-03	-1.04E-01	3.5%
OOL10-01-010-C	-2.09E-01	2.48E-02	2.45E-01	-3.98E-02	-8.81E-02	-4.43E-02	1.07E-02	4.5%
OOL10-01-011-C	-2.87E-01	2.45E-02	**3.17E-01**	8.93E-03	-4.01E-02	9.94E-03	-2.09E-03	5.8%
OOL10-01-012-C	1.33E-01	-5.88E-02	**3.50E-01**	1.02E-02	-4.58E-02	8.62E-03	-5.45E-02	6.4%
OOL10-01-013-C	-3.46E-01	3.62E-03	-3.61E-03	7.62E-02	3.50E-03	-1.53E-02	5.84E-02	-0.1%
OOL10-01-014-C	-7.10E-02	2.25E-03	4.03E-02	-2.15E-01	-1.59E-02	-4.59E-03	9.91E-02	0.7%
OOL10-01-015-C	-1.01E-01	5.35E-03	**3.45E-01**	-5.01E-02	4.90E-02	1.17E-02	-6.69E-02	6.3%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [(1)] The calculated sum of fractions (SOF) presented above are the Cs-137 activity values relative to the Cs-137 DCGL specified in the plan (5.5 pCi/g)

3.1.2 Survey Unit OOL10-01 Biased Soil Sample Activity Results

As mentioned earlier in this report, there were eleven (11) biased samples (including one engineered material (EM) sample) that were collected in Survey Unit OOL10-01 and analyzed using gamma spectroscopy at the on-site laboratory. Also, as mentioned earlier in this report, six (6) of the ten (10) biased soil samples were collected and split as ORISE selected the locations using a judgmental fashion. Gamma results from the on-site laboratory indicated plant-derived activity (Cs-137) in four (4) biased samples collected. Since two of the biased soil samples collected indicated greater than the direct investigation levels specified for Class 3 areas as listed in the design section of the survey plan of 10% of the Cs-137 DCGL, an investigation survey was performed for locations 18-C-B and 25-C-B consisting of a walkover gamma scan of the 1 meter radius area surrounding each sample location on March 6, 2012. The investigation scan survey of the two locations showed no elevated readings with no areas exceeding the background range of 4.9 kilo-counts per minute (kcpm) to 5.8 kcpm and 5.5 kcpm to 6.3 kcpm respectively for locations 18-C-B and 25-C-B. The HBPP Laboratory gamma analytical results show that the maximum Cs-137 nuclide fraction for the biased samples collected is less than 13%. Table 3.2 presents the gamma analysis results for the biased samples collected for Survey Unit OOL10-01. Figure 3.1 displays the location of the biased samples in the survey unit.

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Table 3.2 - Summary of Biased Soil Sample Results for OOL10-01

Biased FSS Soil Samples Analyzed by the HBPP Laboratory				
Sample Number	**Sample Date**	**Cs-137 pCi/g**	**Nuclide Fraction**	**Comments**
OOL10-01-016-C-B	2/15/12	**1.76E-01**	3.2%	
OOL10-01-017-C-B	2/15/12	9.70E-02	1.8%	
OOL10-01-018-C-B	2/15/12	**7.00E-01**	12.7%	>10% of the DCGL
OOL10-01-019-C-B	2/15/12	1.76E-02	0.3%	
OOL10-01-020-C-B	2/15/12	2.04E-02	0.4%	ORISE ID S016
OOL10-01-021-C-B	2/15/12	-1.02E-01	-1.8%	ORISE ID S017
OOL10-01-022-C-B	2/15/12	2.36E-02	0.4%	ORISE ID S018
OOL10-01-023-C-B	2/15/12	**3.18E-01**	5.8%	ORISE ID S019
OOL10-01-024-C-B	2/15/12	2.05E-02	0.4%	ORISE ID S020
OOL10-01-024-C-EM(2)	2/15/12	8.47E-02	1.5%	
OOL10-01-025-C-B	2/15/12	**6.21E-01**	11.3%	ORISE ID S021, >10% of the DCGL

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note (1) The calculated nuclide fractions presented above are the Cs-137 activity values relative to the Cs-137 DCGL specified in the plan (5.5 pCi/g)
Note (2) Engineered Material (Asphalt)

Figure 3.1 – Biased Sample Locations for Survey Unit OOL10-01

3.1.3 Survey Unit OOL10-01-FSR Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-01-FSR were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. All reuse material deposited within the FSR unit met Class 3 reuse requirements, with approximately one hundred twenty (120) grab or composite samples being collected of spoils materials excavated from areas all over the site. Only two samples indicated plant-derived activity, a composite sample from a spoils pile excavated west of Trailer #25 and a grab sample from a sediment basin, with Cs-137 activity levels of 1.24E-01 pCi/g and 7.19E-02 pCi/g respectively, indicative of background attributed to fallout. The gamma analytical results show that the maximum fraction of the reuse material used for backfill is less than 4% of Unity based on the DCGL specified in the characterization plan of 5.5 pCi/g for Cs-137. Sample records indicate that the reuse spoils material was placed in the area from January 2011 to October 2012, long before the LTP was approved for use by the NRC.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, H-3, Sr-90, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-2.47) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and forty-seven percent (47%) of all reported values were less than zero. There were no biased or investigation samples collected for survey unit OOL10-01-FSR. No investigation surveys were warranted as all statistical sample results were less than ten percent (50%) of the scaled Cs-137 DCGL specified in the survey plan (7.22 pCi/g). Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. The HBPP Laboratory gamma analytical results show that the maximum Cs-137 nuclide fraction for the statistical samples collected is less than 4%. Table 3.3 presents the FSS results for the fifteen (15) nonparametric samples collected for Survey Unit OOL10-01-FSR.

Table 3.3 - Summary of Nonparametric Soil Sample Data for OOL10-01-FSR

FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[(1)]**
OOL10-01-001-FSR	-1.27E-01	-3.51E-02	-1.19E-02	-7.55E-02	2.40E-02	3.67E-02	-1.45E-01	-1.00E-02	-1.75E-01	-0.2%
OOL10-01-002-FSR	-7.71E-02	-2.20E-02	5.30E-02	6.38E-02	-5.51E-02	3.68E-02	-2.99E-02	3.00E-02	1.24E-01	0.7%
OOL10-01-003-FSR	-1.74E-01	2.92E-02	**2.74E-01**	8.61E-02	-3.07E-03	-3.10E-02	7.92E-03	0.00E+00	-1.94E-01	3.5%
OOL10-01-004-FSR	-2.14E-01	-6.58E-02	-2.41E-02	2.12E-02	-2.94E-02	2.14E-02	-4.35E-02	0.00E+00	-2.43E-01	-0.3%
OOL10-01-005-FSR	-1.75E-02	-2.86E-02	2.48E-02	1.11E-02	4.97E-02	-2.49E-02	1.16E-02	0.00E+00	-2.25E-01	0.3%
OOL10-01-006-FSR	-3.85E-01	1.29E-02	-5.23E-03	2.44E-02	-3.79E-02	9.73E-03	6.60E-03	4.00E-02	2.80E-02	-0.1%
OOL10-01-007-FSR	1.36E-01	4.68E-03	5.62E-02	7.38E-03	-1.26E-01	6.63E-03	-3.53E-02	1.00E-02	-4.70E-02	0.7%
OOL10-01-008-FSR	9.30E-03	2.84E-02	4.32E-02	-1.18E-01	-1.95E-02	3.39E-02	-9.00E-03	1.00E-02	-2.98E-01	0.5%
OOL10-01-009-FSR	-4.16E-02	3.68E-02	3.13E-02	6.83E-02	-4.85E-02	1.23E-02	-1.78E-02	-1.10E+00	-1.55E-01	0.4%
OOL10-01-010-FSR	-3.28E-01	-7.41E-03	5.09E-02	-2.51E-02	-1.30E-01	-7.83E-03	3.61E-02	-1.00E-02	-8.60E-02	0.6%
OOL10-01-011-FSR	-1.42E-02	4.00E-03	3.23E-03	-3.24E-02	7.94E-03	3.38E-02	1.69E-02	0.00E+00	-6.90E-02	0.0%
OOL10-01-012-FSR	1.77E-01	-3.66E-02	-1.41E-02	-3.71E-01	-6.26E-02	6.92E-03	3.10E-02	9.00E-02	2.20E-02	-0.2%
OOL10-01-013-FSR	1.33E-01	3.26E-02	4.58E-02	-1.87E-01	-1.53E-01	2.21E-02	-1.56E-01	2.00E-02	-2.25E-01	0.6%
OOL10-01-014-FSR	-4.17E-02	2.11E-02	1.47E-02	-3.22E-03	4.65E-03	9.05E-03	-5.49E-04	1.00E-02	-1.83E-01	0.2%
OOL10-01-015-FSR	-9.45E-02	-2.34E-02	3.63E-02	2.24E-02	-7.33E-03	1.45E-03	2.32E-02	2.00E-02	1.32E-01	0.5%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.4 Survey Unit OOL10-13 Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-13 were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. The analytical results show that the maximum fraction is about 3% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-.05) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-two percent (42%) of reported values were less than zero. There were no biased or investigation samples collected for survey unit OOL10-13. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.4 presents the FSS results for the fifteen (15) nonparametric samples collected for Survey Unit OOL10-13.

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Table 3.4 - Summary of Nonparametric Soil Sample Data for OOL10-13

FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-13-001-F	6.86E-02	1.15E-02	**7.21E-02**	2.04E-03	-1.44E-03	-8.43E-03	-2.37E-02	0.9%
OOL10-13-002-F	1.03E-01	6.53E-03	4.08E-03	-2.44E-02	-3.31E-02	1.51E-02	3.51E-02	0.1%
OOL10-13-003-F	3.50E-02	1.69E-02	-2.85E-02	-8.95E-02	2.96E-03	1.71E-02	-5.48E-02	-0.4%
OOL10-13-004-F	-7.24E-02	1.66E-04	-1.34E-02	2.13E-02	9.51E-03	7.37E-03	1.62E-02	-0.2%
OOL10-13-005-F	-6.96E-02	2.46E-02	**2.35E-01**	-1.03E-01	-2.11E-02	1.56E-03	-3.40E-02	3.0%
OOL10-13-006-F	-1.42E-02	-4.45E-03	3.57E-02	-6.45E-03	6.25E-03	-3.09E-02	-3.10E-02	0.5%
OOL10-13-007-F	9.25E-02	-6.48E-03	7.48E-03	-1.35E-02	-1.42E-02	1.55E-02	-4.26E-02	0.1%
OOL10-13-008-F	-5.90E-02	2.09E-03	2.38E-02	1.47E-02	2.97E-03	7.50E-03	1.61E-02	0.3%
OOL10-13-009-F	1.27E-01	-3.44E-02	7.30E-02	-6.87E-02	1.01E-02	-1.09E-03	8.40E-02	0.9%
OOL10-13-010-F	2.55E-02	-2.64E-04	5.73E-02	4.90E-02	-7.21E-02	-2.67E-02	3.34E-03	0.7%
OOL10-13-011-F	7.63E-02	1.73E-02	**1.60E-01**	3.36E-02	3.24E-02	2.09E-02	1.41E-02	2.0%
OOL10-13-012-F	4.91E-02	-4.01E-03	5.05E-02	-1.85E-02	6.14E-02	-7.53E-03	3.39E-03	0.6%
OOL10-13-013-F	6.63E-02	-4.59E-02	9.83E-02	3.50E-02	-5.23E-02	-4.59E-02	2.47E-02	1.2%
OOL10-13-014-F	-3.88E-02	1.60E-02	-2.90E-02	-7.42E-02	-6.76E-02	2.60E-02	-1.40E-02	-0.4%
OOL10-13-015-F	7.76E-02	2.99E-02	3.70E-02	-2.41E-02	-2.60E-02	3.41E-02	-1.26E-02	0.5%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)
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3.1.5 Survey Unit OOL10-17 Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-17 were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. The analytical results show that the maximum fraction is less than 3% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, H-3, Sr-90, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-0.3) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-seven percent (47%) of reported values were less than zero. There were twenty (20) biased samples collected for survey unit OOL10-17. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.5 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-17.

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Table 3.5 - Summary of Nonparametric Soil Sample Data for OOL10-17

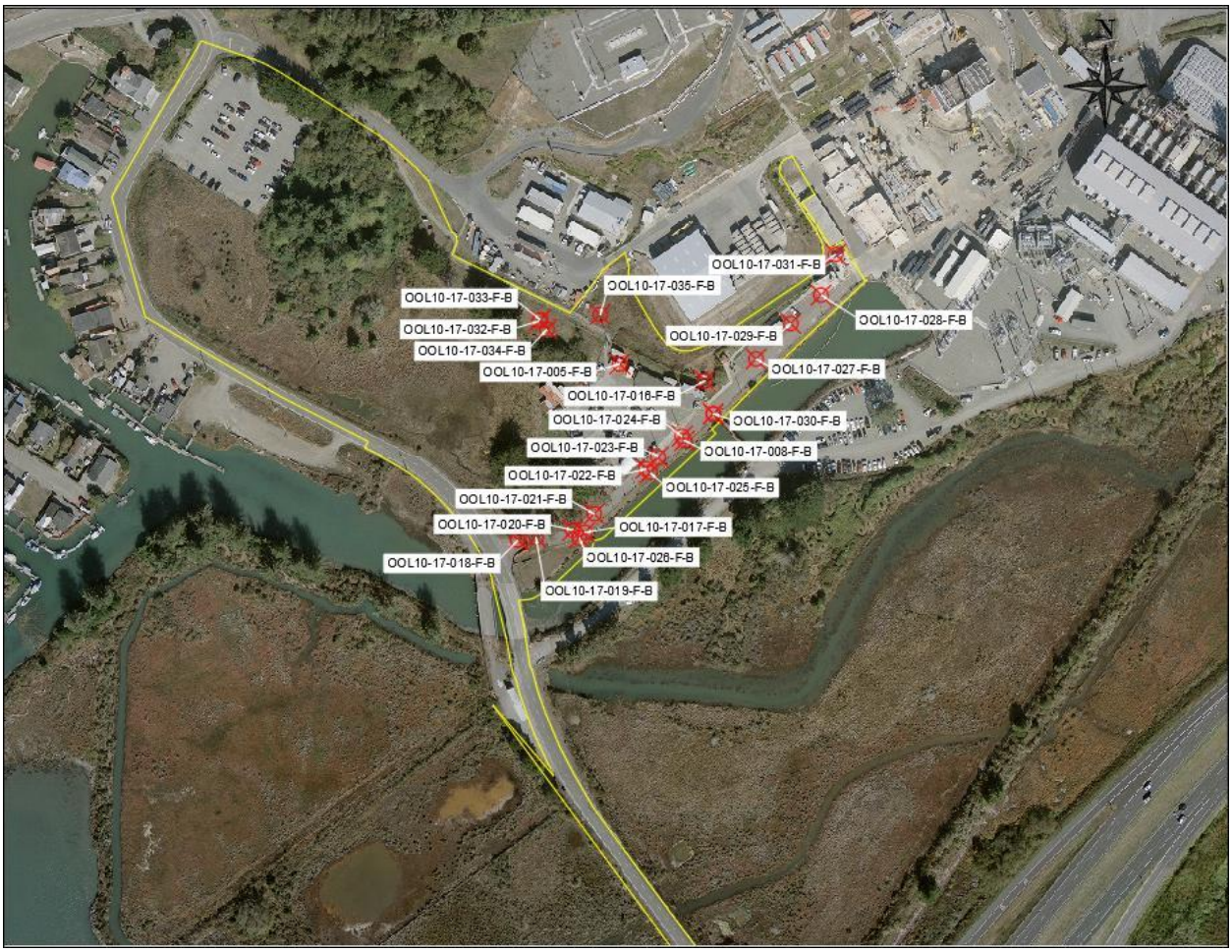
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[(1)]**
OOL10-17-001-F	1.19E-01	-5.90E-02	**8.19E-02**	-1.09E-01	3.89E-02	-2.35E-02	-4.43E-02	4.40E-01	-1.80E-02	1.0%
OOL10-17-002-F	-9.05E-02	-4.01E-02	**1.60E-01**	-5.31E-02	-4.52E-02	-2.20E-03	1.98E-02	6.00E-02	1.17E-01	2.0%
OOL10-17-003-F	-1.57E-01	-7.51E-03	4.09E-02	-1.20E-01	5.00E-02	-3.53E-02	3.47E-02	6.00E-02	-8.60E-02	0.5%
OOL10-17-004-F	-1.26E-01	-8.23E-03	1.78E-02	-4.14E-02	-2.98E-02	1.29E-02	1.44E-03	2.80E-01	-8.20E-02	0.2%
OOL10-17-005-F	-1.44E-02	3.14E-02	-4.00E-02	1.99E-02	-1.49E-02	-3.91E-02	-1.62E-02	-1.00E-02	-2.87E-01	-0.5%
OOL10-17-006-F	-1.29E-01	-3.15E-02	1.03E-02	3.52E-02	-1.96E-02	-8.24E-03	-3.07E-02	8.00E-02	9.30E-02	0.1%
OOL10-17-007-F	3.15E-02	-2.48E-03	1.08E-01	-3.25E-03	2.28E-02	2.48E-02	9.41E-04	5.00E-02	7.50E-02	1.4%
OOL10-17-008-F	8.06E-02	-4.05E-02	-1.11E-02	-3.40E-02	-2.01E-02	-1.80E-02	-1.32E-02	8.00E-02	8.40E-02	-0.1%
OOL10-17-009-F	5.72E-02	-1.78E-02	4.64E-02	-9.88E-02	-2.48E-03	-2.50E-02	-2.81E-02	0.00E+00	1.14E-01	0.6%
OOL10-17-010-F	5.07E-02	-2.82E-02	8.87E-02	6.21E-02	1.66E-03	1.52E-02	2.40E-02	7.00E-02	-3.40E-02	1.1%
OOL10-17-011-F	-9.59E-02	-6.20E-03	**1.92E-01**	5.88E-02	6.35E-02	9.84E-03	2.06E-02	5.40E-01	-9.30E-02	2.4%
OOL10-17-012-F	2.44E-02	1.57E-02	-1.89E-02	-7.28E-02	-1.35E-02	-1.83E-02	-3.22E-02	-2.00E-02	1.27E-01	-0.2%
OOL10-17-013-F	2.31E-03	3.23E-02	1.02E-02	-2.32E-01	2.15E-02	-2.08E-02	-3.32E-02	1.80E-01	1.37E-01	0.1%
OOL10-17-014-F	-4.71E-02	7.36E-03	1.90E-02	-2.56E-02	-3.34E-02	4.03E-03	3.97E-02	2.00E-01	-1.13E-01	0.2%
OOL10-17-015-F	4.68E-02	4.32E-03	**6.98E-02**	3.45E-02	2.11E-02	1.83E-02	-2.16E-02	7.20E-01	-4.50E-02	0.9%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.6 Survey Unit OOL10-17 Biased Soil Sample Activity Results

As mentioned earlier in this report, there were twenty (20) biased samples that were collected in Survey Unit OOL10-17 and analyzed using gamma spectroscopy at the on-site laboratory. Review of all the biased sample gamma results from the on-site laboratory indicated no plant-derived activity in any of the samples collected. Figure 3.2 displays the location of the biased samples collected in the survey unit.

Figure 3.2 – Biased Sample Locations for Survey Unit OOL10-17



3.1.7 Survey Unit OOL10-17-FSR Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-17-FSR were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. All reuse material deposited within the FSR unit met Class 3 reuse requirements. The analytical results show that the maximum fraction is less than 3% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, H-3, Sr-90, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.6 mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-three percent (43%) of reported values were less than zero. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.6 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-17-FSR.

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Table 3.6 - Summary of Nonparametric Soil Sample Data for OOL10-17-FSR

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[(1)]**
OOL10-17-001-FSR	-6.68E-03	-2.46E-03	-5.02E-02	3.40E-02	1.06E-02	6.44E-02	2.48E-02	0.00E+00	8.50E-02	-0.6%
OOL10-17-002-FSR	-3.71E-02	-4.52E-02	**1.76E-01**	-3.51E-02	6.61E-02	-2.65E-02	1.26E-01	2.40E-01	1.22E-01	2.2%
OOL10-17-003-FSR	-7.00E-03	-3.16E-03	3.26E-02	1.94E-02	1.50E-02	1.25E-02	-1.81E-02	5.00E-02	8.10E-02	0.4%
OOL10-17-004-FSR	-6.56E-02	-3.19E-02	2.28E-02	-1.65E-02	2.25E-02	1.84E-02	5.95E-03	3.00E-02	3.80E-02	0.3%
OOL10-17-005-FSR	2.38E-02	1.34E-02	1.02E-01	-5.71E-03	-4.81E-02	1.91E-02	-5.80E-02	7.00E-02	2.45E-01	1.3%
OOL10-17-006-FSR	2.66E-02	1.17E-02	6.70E-02	-3.85E-03	1.53E-02	-1.65E-02	3.11E-03	7.00E-02	-1.85E-01	0.8%
OOL10-17-007-FSR	-6.55E-02	4.04E-02	1.83E-01	8.54E-02	6.58E-02	-9.31E-03	5.06E-02	1.40E-01	-6.30E-02	2.3%
OOL10-17-008-FSR	-4.36E-02	1.15E-02	8.16E-03	-2.51E-02	-1.05E-02	5.41E-03	2.87E-02	1.70E-01	6.00E-03	0.1%
OOL10-17-009-FSR	-3.07E-02	-1.80E-02	-6.05E-03	-1.69E-02	-1.05E-01	4.96E-03	-1.60E-02	2.00E-02	1.60E-02	-0.1%
OOL10-17-010-FSR	-1.13E-01	5.65E-02	9.97E-02	-1.19E-02	-2.07E-02	-4.57E-04	-5.95E-03	3.60E-01	-5.00E-03	1.3%
OOL10-17-011-FSR	-1.74E-01	-1.42E-02	8.44E-02	2.45E-02	-4.46E-03	6.73E-03	4.29E-02	1.10E-01	1.71E-01	1.1%
OOL10-17-012-FSR	1.38E-01	-2.12E-03	**7.73E-02**	-3.81E-02	1.57E-03	-6.45E-03	-6.57E-02	1.00E-02	-1.25E-01	1.0%
OOL10-17-013-FSR	1.27E-01	7.07E-03	-4.36E-02	-1.18E-01	1.64E-03	-1.72E-02	-1.72E-02	2.00E-02	1.13E-01	-0.6%
OOL10-17-014-FSR	1.93E-02	6.08E-03	5.74E-02	6.87E-02	2.24E-03	-2.51E-02	-4.41E-03	0.00E+00	1.09E-01	0.7%
OOL10-17-015-FSR	-2.13E-01	8.67E-03	-1.94E-04	-3.33E-03	-1.92E-02	1.55E-02	-2.92E-02	1.80E-01	-1.79E-01	0.0%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.8 Survey Unit OOL10-20 Nonparametric Soil Sample Activity Results

Each of the twenty-one (21) random-start, systematically placed soil samples obtained during FSS in Survey Unit OOL10-20 were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. The analytical results show that the maximum fraction is less than 1% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-0.03) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately fifty-three percent (53%) of reported values were less than zero. There were five (5) biased samples collected for survey unit OOL10-20. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.7 presents the FSS results for the twenty-one (21) non-parametric samples collected for Survey Unit OOL10-20.

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Table 3.7 - Summary of Nonparametric Soil Sample Data for OOL10-20

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-20-001-F	-1.12E-01	-2.31E-03	5.53E-02	2.25E-04	6.09E-02	-4.08E-03	-5.30E-02	0.7%
OOL10-20-002-F	-1.38E-01	3.63E-04	3.63E-02	3.76E-02	4.36E-02	-1.39E-02	-5.43E-02	0.5%
OOL10-20-003-F	-4.83E-02	-5.14E-02	2.14E-02	-1.45E-02	4.85E-02	-1.38E-02	-6.06E-02	0.3%
OOL10-20-004-F	-1.06E-01	-2.63E-02	-2.29E-02	-1.41E-01	1.99E-02	1.49E-02	-1.17E-02	-0.3%
OOL10-20-005-F	-5.34E-03	1.74E-02	-2.16E-02	8.85E-02	-3.07E-02	-1.35E-02	-1.45E-02	-0.3%
OOL10-20-006-F	9.12E-02	3.53E-02	1.08E-02	-1.48E-02	-1.67E-03	-1.94E-03	-9.31E-03	0.1%
OOL10-20-007-F	-1.26E-01	-1.95E-02	-5.03E-03	6.88E-03	4.96E-02	5.17E-03	-1.96E-02	-0.1%
OOL10-20-008-F	-8.77E-03	5.62E-03	1.73E-02	1.32E-02	-4.27E-02	-6.86E-03	2.54E-02	0.2%
OOL10-20-009-F	-8.12E-03	4.30E-02	3.84E-02	7.07E-03	-3.47E-02	9.52E-04	-3.86E-02	0.5%
OOL10-20-010-F	5.89E-02	2.82E-02	1.35E-02	1.28E-02	-3.63E-02	-2.05E-02	-2.22E-02	0.2%
OOL10-20-011-F	-1.19E-01	1.25E-02	1.43E-02	-2.44E-02	7.33E-02	4.67E-03	-6.38E-03	0.2%
OOL10-20-012-F	4.18E-03	-2.74E-02	-3.84E-03	-5.18E-02	-4.96E-03	2.06E-02	6.09E-03	0.0%
OOL10-20-013-F	1.57E-01	-6.77E-03	1.63E-02	-7.06E-02	1.59E-02	-2.84E-02	2.91E-03	0.2%
OOL10-20-014-F	-1.45E-01	1.34E-02	3.14E-02	-9.24E-02	-1.04E-01	-8.29E-03	3.77E-02	0.4%
OOL10-20-015-F	-7.33E-02	-6.90E-03	-1.41E-02	-7.96E-02	-1.02E-02	6.74E-03	2.59E-02	-0.2%
OOL10-20-016-F	-5.53E-02	-3.95E-02	-3.97E-03	1.02E-01	2.03E-02	2.16E-02	2.03E-02	-0.1%
OOL10-20-017-F	-3.09E-02	2.34E-02	-1.71E-02	-2.04E-03	5.00E-03	-1.63E-02	3.89E-02	-0.2%
OOL10-20-018-F	4.96E-02	-4.42E-02	-1.38E-02	1.25E-02	1.01E-01	-2.02E-02	-8.33E-02	-0.2%
OOL10-20-019-F	3.05E-02	5.10E-02	5.37E-02	-1.12E-01	1.81E-02	2.87E-02	1.17E-01	0.7%
OOL10-20-020-F	4.03E-02	-5.79E-03	1.43E-02	-2.23E-02	8.08E-02	-1.71E-02	7.60E-02	0.2%
OOL10-20-021-F	-9.31E-03	-6.73E-02	-2.80E-03	-2.75E-02	3.16E-02	-6.52E-02	6.86E-02	0.0%

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.9 Survey Unit OOL10-20 Biased Soil Sample Activity Results

As mentioned earlier in this report, there were five (5) biased samples that were collected in Survey Unit OOL10-20 and analyzed using gamma spectroscopy at the on-site laboratory. Review of the biased sample gamma results from the on-site laboratory indicated no plant-derived activity in any of the biased samples collected.

3.1.10 Survey Unit OOL10-20-FSR Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, systematically placed soil samples obtained during FSS in Survey Unit OOL10-20-FSR were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. All reuse material deposited within the FSR unit met Class 2 reuse requirements as verified via either six-inch lift walkover characterization surveys or GARDIAN analysis of spoils of truckload material excavated from Survey Unit OOL10-20. The analytical results show that the maximum fraction is approximately 1% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.2 mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-five percent (45%) of reported values were less than zero. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.8 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-20-FSR.

Table 3.8 - Summary of Nonparametric Soil Sample Data for OOL10-20-FSR

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-20-001-FSR	2.26E-01	-7.84E-03	1.62E-02	-6.06E-03	3.59E-03	-3.09E-02	5.64E-02	0.2%
OOL10-20-002-FSR	2.91E-02	-3.69E-03	1.09E-02	1.14E-02	-3.73E-03	-3.75E-02	2.73E-02	0.1%
OOL10-20-003-FSR	9.63E-03	-1.38E-02	1.12E-02	-8.93E-02	8.90E-03	8.73E-03	-4.30E-03	0.1%
OOL10-20-004-FSR	-7.35E-02	-7.38E-03	2.68E-02	-5.85E-02	-3.48E-03	-1.22E-02	-2.79E-02	0.3%
OOL10-20-005-FSR	5.32E-02	4.27E-02	6.86E-02	-4.87E-02	-5.50E-02	4.48E-02	5.25E-02	0.9%
OOL10-20-006-FSR	3.59E-02	-1.32E-02	1.65E-02	-4.60E-02	3.22E-02	1.16E-02	2.41E-03	0.2%
OOL10-20-007-FSR	-1.17E-02	1.11E-02	-2.35E-02	-3.93E-02	-2.53E-02	-2.21E-02	2.90E-03	-0.3%
OOL10-20-008-FSR	-8.67E-03	-1.06E-03	2.55E-03	-6.96E-03	2.55E-02	-4.82E-03	3.84E-02	0.0%
OOL10-20-009-FSR	-3.67E-02	-1.93E-02	-1.26E-02	3.74E-02	-2.76E-02	2.78E-04	7.85E-02	-0.2%
OOL10-20-010-FSR	-1.73E-01	3.67E-02	1.09E-02	-2.60E-02	5.75E-02	7.16E-03	8.10E-03	0.1%
OOL10-20-011-FSR	9.25E-02	1.18E-02	8.03E-03	-4.51E-02	-9.88E-03	1.02E-02	-6.90E-04	0.1%
OOL10-20-012-FSR	1.23E-02	-2.26E-02	7.93E-02	2.52E-02	5.25E-02	1.72E-02	3.49E-02	1.0%
OOL10-20-013-FSR	-4.17E-02	1.22E-02	4.42E-02	2.91E-02	5.86E-02	-2.50E-02	-7.09E-02	0.6%
OOL10-20-014-FSR	1.02E-02	-5.65E-03	1.95E-02	-6.19E-02	6.27E-02	8.13E-03	-5.16E-02	0.2%
OOL10-20-015-FSR	-2.03E-01	2.84E-02	3.38E-02	5.10E-02	-1.58E-02	-2.71E-02	8.23E-03	0.4%

Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.11 Survey Unit OOL10-22 Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-22 were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. The analytical results show that the maximum fraction is less than 2% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-0.1) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-one percent (41%) of reported values were less than zero. There were no biased samples collected for survey unit OOL10-22. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.9 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-22.

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Table 3.9 - Summary of Nonparametric Soil Sample Data for OOL10-22

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-22-001-F	-5.13E-03	-6.56E-03	-1.44E-02	-5.49E-02	-2.59E-03	-4.19E-03	1.57E-02	-0.2%
OOL10-22-002-F	-8.42E-02	2.93E-02	4.78E-02	-1.25E-02	5.03E-02	4.04E-03	-7.84E-03	0.6%
OOL10-22-003-F	-8.70E-02	5.90E-03	2.61E-02	-9.03E-02	-5.42E-02	-4.47E-02	-4.82E-03	0.3%
OOL10-22-004-F	4.09E-02	-1.72E-02	2.46E-02	8.17E-03	2.74E-02	1.68E-03	-3.12E-02	0.3%
OOL10-22-005-F	-7.91E-02	-4.54E-02	2.65E-02	1.90E-02	3.65E-02	4.72E-02	-2.66E-02	0.3%
OOL10-22-006-F	7.66E-02	1.74E-02	3.37E-02	3.49E-02	1.43E-02	-5.47E-03	-1.19E-02	0.4%
OOL10-22-007-F	-7.65E-02	1.86E-02	-2.36E-02	2.04E-02	-3.59E-02	-3.03E-03	-3.87E-03	-0.3%
OOL10-22-008-F	-1.75E-01	-8.58E-03	7.11E-02	4.54E-02	3.17E-02	1.30E-02	1.41E-02	0.9%
OOL10-22-009-F	1.49E-01	1.13E-02	2.32E-03	5.37E-02	1.44E-02	4.71E-03	-4.73E-03	0.0%
OOL10-22-010-F	1.38E-03	2.79E-02	2.32E-02	9.86E-02	-6.62E-02	4.98E-04	-9.29E-02	0.3%
OOL10-22-011-F	1.24E-01	1.84E-02	5.68E-02	1.22E-01	-1.68E-01	-2.82E-02	4.41E-02	0.7%
OOL10-22-012-F	-1.20E-01	-3.53E-02	9.88E-02	5.70E-02	1.45E-03	-1.67E-02	1.11E-02	1.3%
OOL10-22-013-F	-2.01E-02	-8.78E-03	-2.32E-02	3.57E-02	6.73E-03	4.03E-04	4.13E-02	-0.3%
OOL10-22-014-F	-2.10E-01	1.11E-03	2.26E-02	5.94E-02	7.10E-03	1.82E-03	-4.29E-02	0.3%
OOL10-22-015-F	9.30E-03	-8.97E-03	7.61E-03	-6.99E-02	5.06E-02	6.53E-03	6.11E-03	0.1%

Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.12 Survey Unit OOL10-22-FSR Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, randomly placed soil samples obtained during FSS in Survey Unit OOL10-22-FSR were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. All reuse material deposited within the FSR survey unit met Class 3 reuse requirements. The analytical results show that the maximum fraction is less than 2% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-0.4) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately forty-five percent (45%) of reported values were less than zero. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.10 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-22-FSR.

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Table 3.10 - Summary of Nonparametric Soil Sample Data for OOL10-22-FSR

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-22-001-FSR	-5.66E-02	1.10E-02	7.94E-02	3.43E-03	1.01E-02	9.00E-03	-3.93E-02	1.0%
OOL10-22-002-FSR	4.49E-02	-4.84E-03	2.12E-02	3.07E-02	-3.06E-02	8.82E-03	-4.34E-02	0.3%
OOL10-22-003-FSR	-1.27E-01	-1.85E-02	2.40E-02	6.77E-02	-4.43E-06	1.57E-02	1.02E-02	0.3%
OOL10-22-004-FSR	2.32E-02	-4.88E-03	1.26E-01	8.96E-02	0.00E+00	-6.90E-03	-2.16E-02	1.6%
OOL10-22-005-FSR	-1.59E-01	9.27E-03	-5.65E-03	-2.44E-01	-4.47E-02	2.13E-02	1.24E-02	-0.1%
OOL10-22-006-FSR	-9.28E-02	4.18E-02	1.84E-03	-1.32E-01	-4.93E-02	-3.10E-03	-6.76E-02	0.0%
OOL10-22-007-FSR	1.38E-02	-8.80E-03	2.90E-02	-3.30E-02	1.67E-02	-2.22E-02	-2.95E-02	0.4%
OOL10-22-008-FSR	1.08E-01	-1.51E-02	4.39E-02	-4.42E-02	-2.87E-02	-1.51E-02	3.15E-02	0.6%
OOL10-22-009-FSR	5.12E-03	1.47E-03	**5.67E-02**	6.41E-02	-2.78E-02	-3.04E-02	-6.37E-02	0.7%
OOL10-22-010-FSR	-3.92E-01	-2.17E-02	5.27E-02	-1.34E-01	-2.05E-02	2.18E-02	4.26E-02	0.7%
OOL10-22-011-FSR	9.43E-02	1.39E-02	8.31E-02	2.22E-02	-3.05E-02	1.54E-02	-4.91E-02	1.1%
OOL10-22-012-FSR	2.24E-02	3.25E-02	2.32E-02	1.57E-02	1.08E-02	-6.86E-02	5.17E-02	0.3%
OOL10-22-013-FSR	-1.11E-02	1.69E-03	3.41E-02	-8.73E-02	8.40E-03	-6.87E-02	7.41E-02	0.4%
OOL10-22-014-FSR	-2.02E-01	-1.71E-02	1.29E-03	-4.10E-01	-8.12E-02	1.15E-02	1.25E-02	0.0%
OOL10-22-015-FSR	-2.23E-02	5.83E-03	1.11E-02	5.82E-02	6.37E-03	3.53E-03	-2.23E-02	0.1%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.1.13 Survey Unit OOL10-26-FSR Nonparametric Soil Sample Activity Results

Each of the fifteen (15) random-start, systematically placed soil samples obtained during FSS in Survey Unit OOL10-26-FSR were analyzed by gamma spectroscopy at the HBPP on-site laboratory. The FSS Plan stated that the presence of all radionuclides which include all plant-related nuclides (gamma-emitters, HTD beta-emitters, and TRUs) will be evaluated, with emphasis on Cs-137. All reuse material deposited within the FSR unit met Class 2 reuse requirements as verified via six-inch lift walkover characterization surveys. The analytical results show that the maximum fraction is approximately 1% of the Cs-137 DCGL.

Additionally, for calculation of the survey unit sum of fractions (SOF), only Cs-137 was used, because it was listed in the FSS plan as the radionuclide of concern and there were no other radionuclides that were present greater than method detection levels. This practice is reasonable since the total dose contribution from Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 was insignificant at 0.0 (-0.2) mrem, there were no positive analysis results for these radionuclides reported greater than *a posteriori* method detection levels, and approximately fifty-seven percent (57%) of reported values were less than zero. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.11 presents the FSS results for the fifteen (15) non-parametric samples collected for Survey Unit OOL10-26-FSR.

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Table 3.11 - Summary of Nonparametric Soil Sample Data for OOL10-26-FSR

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-26-001-FSR	5.78E-03	3.09E-02	5.29E-02	-1.83E-02	-6.02E-02	-2.64E-02	3.13E-02	0.7%
OOL10-26-002-FSR	-1.47E-01	-2.50E-02	5.97E-02	3.77E-02	-1.53E-02	-2.19E-03	1.02E-02	0.8%
OOL10-26-003-FSR	2.48E-02	-5.52E-04	2.96E-02	-1.24E-01	-1.51E-02	1.56E-03	6.32E-02	0.4%
OOL10-26-004-FSR	-8.10E-02	-2.03E-03	-1.08E-02	9.70E-03	-6.85E-02	7.60E-03	2.53E-02	-0.1%
OOL10-26-005-FSR	1.87E-01	-1.48E-02	-1.02E-02	1.61E-02	-1.26E-02	-5.23E-02	-2.12E-02	-0.1%
OOL10-26-006-FSR	1.90E-01	9.26E-03	2.00E-02	-5.93E-03	2.81E-02	1.15E-02	1.10E-02	0.3%
OOL10-26-007-FSR	-1.07E-01	-3.53E-02	5.40E-02	-2.62E-02	3.53E-02	-3.31E-02	-1.40E-02	0.7%
OOL10-26-008-FSR	-1.50E-01	-7.21E-04	**2.28E-02**	4.99E-02	-8.05E-02	-2.10E-02	2.52E-02	0.3%
OOL10-26-009-FSR	-1.58E-01	9.29E-03	1.12E-02	-6.31E-02	-1.35E-01	2.60E-02	2.00E-02	0.1%
OOL10-26-010-FSR	-1.20E-01	-4.92E-03	9.00E-03	-1.05E-01	2.76E-02	3.20E-03	4.44E-02	0.1%
OOL10-26-011-FSR	-8.93E-03	5.50E-03	2.74E-03	4.88E-02	1.53E-02	-1.60E-02	2.83E-02	0.0%
OOL10-26-012-FSR	-3.62E-02	-1.54E-01	5.36E-02	-1.02E-01	-2.67E-02	-1.98E-02	-3.37E-02	0.7%
OOL10-26-013-FSR	2.27E-01	-1.92E-03	1.82E-02	-1.01E-02	-8.93E-02	-3.90E-02	-1.66E-02	0.2%
OOL10-26-014-FSR	-2.22E-02	-1.20E-02	8.17E-02	-1.31E-01	-3.65E-03	-8.61E-03	-3.42E-02	1.0%
OOL10-26-015-FSR	-3.14E-02	-1.31E-02	3.35E-02	-2.86E-02	-6.89E-03	-5.53E-03	-6.88E-02	0.4%

*Result in **bold** indicates a positive identification of the associated radionuclide result *less* than reported *a posteriori* method detection levels (MDA=3.15E-02 pCi/g)

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

3.2 DIRECT MEASUREMENTS AND SCAN SURVEYS

Direct measurements of the radiation emission from surfaces were made using static, 60-second (for Beta) or 120-second (for Alpha) counting intervals, over which the total counts were integrated and recorded on a data logger. The measurements recorded were gross values. In the context of this sampling evolution, a "gross measurement" means a measurement made with a radiation detection instrument to which no background correction has been applied. Raw or gross data is important when measurements will be used to make statistical inferences, since not all data will necessarily have the same correction factors applied to properly reduce them to numbers that are meaningful in the context of the analysis. Reporting gross or raw data also permits one to analyze the functionality of the instrument with which the measurement was made, and to verify the appropriateness of the data reduction process. The data reduction process for the field measurement data collected in this surface measurement sampling program involves corrections for the efficiency of the radiation detector to the subject radiation and for the instrument response to background sources of radiation (excluding surface media contribution to background).

A 100% systematic scan survey of concrete pad surface was performed given the area history of use for waste packaging and storage operations.

3.2.1 PORTABLE INSTRUMENT CALIBRATION

MARSSIM guidance was considered in establishing efficiency factors (calibration constants) used to reduce the instrument count rate data to units comparable to those used in the surface standards along with guidance from other sources including NUREG-1507 (Ref. 21), ISO 7503-1 (Ref. 22), ISO 8769 (Ref. 23), and the Radiological Health Handbook (Ref. 24).

As defined in MARSSIM and NUREG-1507, instrument efficiency is that derived by measuring the surface emission rate of a clean, calibrated and certified National Institute of Standards and Technology (NIST) traceable, reference source. The observed emission rate (counts per unit time) is compared to the certified emission rate (betas or alphas per unit time) to arrive at the instrument efficiency. The source efficiency relates the amount of activity truly present on the surface being measured to the observable particle emission rate. As such, the source efficiency captures the effects of backscatter, and self-absorption inherent in the surface being measured.

In addressing the issues associated with the derivation of the appropriate total efficiency for the measurement, MARSSIM states (page 6-24) that the use of a total efficiency derived from measurements made on certified 4π activity traceable sources "…is not a problem, provided that the calibration source exhibits characteristics similar to the surface contamination (i.e., radiation energy, backscatter effects, source geometry, self-absorption)."

For the WMP Pad, each of these four parameters was addressed as discussed in the LTP:

Radiation Energy. Radiation energy was addressed by selecting a calibration source that was manufactured using a pure beta emitter with an energy that approximates the beta energy of Cesium-137 (Cs-137), the beta emitter of predominant concern in byproduct materials. For the WMF Pad, a NIST traceable, Cs-137 source was selected and used to establish the beta total efficiency as the average beta energy of this radionuclide is the predominant radionuclide found on surfaces at HBPP. The alpha calibration source used was an NIST traceable Americium-241 (Am-241) source that has an appropriate alpha energy for plant-specific alpha emitting radionuclides.

Source Geometry. The source geometry of interest is the infinite plane source geometry. This is true for two reasons: (1) the average surface activity guideline values (DCGLs of 3,000 dpm/100 cm^2 Alpha and 46,000 dpm/100 cm^2 Beta) are established over the entire survey units, and (2) a lack of perfect uniformity in response to radiation over the surface of the active face of the detector leading to what is generally termed "edge effects." Thus, a detector is typically slightly less efficient when measuring distributed activity than it is when measuring a discrete point source of radioactivity on a surface. A wide area calibration source, with an active area of 150 cm^2 was used to establish a calibration geometry that is essentially infinite with respect to the detector. The large area geometry of the source also accounts for any variability in efficiency across the face of the detector especially near the edges, introducing another small, but conservative bias. A second aspect of source geometry is that associated with the source to detector distance. Variability in the detector distance in the field introduces an uncertainty in the measurement made. The Source to Detector Effects on Instrument Efficiencies for α/β Emitters listed in Table 5-11 of the LTP for a detector distance of 0.5 cm from the surface were applied. The source to detector geometry is thus controlled through the calibration and field measurement process.

Backscatter and Self-Absorption. Backscatter and self-absorption are more difficult to control in the measurement process since they are impacted by field variables, beyond the control of the surveyor. The desire is to represent the total surface activity on a given surface as accurately as possible. To do this, consideration for the surface(s) to be measured and their effect on backscatter and self-absorption must be taken into account. For the building surveys at the Site, this was recognized very early in the process and controlled. It was known that concrete surfaces would likely pose the most challenging of surfaces that would require measurements associated with release decisions. It was also recognized that the errors that can arise because of the characteristics of surface (often non-conservative errors) are due to distinct and measurable differences between the backscatter and self-absorption characteristics of the calibration source as compared to the surface of interest. As described in Section 5.4.4.4.3 of the LTP, HBPP chose to specify efficiency calibration sources specifically designed to closely approximate the backscatter and self-absorption characteristics of concrete.

By adopting this efficiency calibration source, it can be said with reasonable confidence that the total efficiency (as measured by exposing the detector to the check source and comparing its response to the stated total 4π activity) is appropriate for making measurements on concrete surfaces, having taken into account both source efficiency and instrument efficiency.

The Source Efficiencies as Listed in ISO 7503-1 for α/β Emitters are provided in Table 5-12 of the LTP. Source efficiency of 0.5 and 0.25 were used respectively in the cited table for Cs-137 and Am-241. The source to detector geometry is thus controlled through the calibration and field measurement process. As part of the data reduction process, raw data was adjusted by the total efficiency (i.e., Instrument calibration efficiency*source to detector distance factor*source efficiency) to convert the measurement data into units directly comparable to the DGCLs.

Background and response checks were normally performed at least twice a day when in use, as a preoperational check, and post use to ensure the instrument was operating properly during the survey period.

3.2.2 MEASUREMENT DETECTION LIMITATIONS

In order to calculate the statistically significant surface radioactivity, which could be distinguished from background (*a posteriori* minimum detectable concentration [MDC]), it was necessary to convert the background measurement units from dpm/100 cm^2 to units of cpm. The mean for the instrument backgrounds collected during the all survey periods each instrument was the data set chosen to calculate the detection sensitivity achieved which includes local area backgrounds and pre- and post-source check data. The converted mean background count rates for the sampling period (cpm) along with other actual field measurement parameters are presented in Table 3.12. Using the actual instrument field measurement parameters, a calculation of the actual field measurement MDC achieved can be determined by solving the following equation listed in Section 5.4.4.4.1 of the LTP (Ref. 1):

$$MDCstatic = \frac{3 + 4.65\sqrt{B}}{(K)(t)}$$

where:

B = number of background counts during the count interval t

t = count interval (for paired observations of sample and blank, usually 1 minute for beta, 2 minutes for alpha)

K = calibration constant (counts/min per dpm/100 cm^2). The value of K includes correction factors for instrument and surface efficiency (e_i and e_s)

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Table 3.12 – Static Surface Contamination Measurement MDC Parameters

Parameter		Ludlum 2350-1 with 43-68		
		Set 1 2350-1/43-68 #193715/#148460		Set 15 2350-1/43-68 #180733/#160699
		Alpha	Beta	Beta
B	Background Count rate	1	260	236
t	Sample Count Time (minutes)	2	1	1
K	Calibration Constant (counts per disintegration)	0.072	0.298	0.296
MDC	dpm/100 cm^2	53	262	251

Therefore, the "gross" beta field instrument reading that can be distinguished as different from background (the maximum adjusted gross MDC from the two instruments used), is 1,135 dpm/100 cm^2 (262 + 873). Having identified the *a posteriori* MDC for the field sampling measurements and the adjusted gross MDC, a simple sort of the gross field measurement data points can be performed to identify those measurements from a survey unit that are greater than 1,135 dpm/100 cm^2. Those locations with gross residual surface radioactivity greater than the adjusted gross MDC are credited as having statistically distinguishable amounts of added radioactivity, while those less than the adjusted gross MDC are statistically indistinguishable from background values.

It is further important to note that the maximum net MDC distinguishable above background (262 dpm/100 cm^2) is significantly lower than the most limiting DCGL (46,000 dpm/100 cm^2).

Since the contribution from naturally occurring radionuclides present in the structural survey units described in this report was anticipated to be relatively small compared with the DCGLs (i.e., notably less than 3,000 dpm/100 cm^2 alpha or 46,000 dpm/100cm^2 beta), it was conservatively decided to accept their contribution to background as attributable to Site activities. Consequently, in this report, total and removable surface activity data sets are presented without background corrections.

3.2.3 DIRECT RADIOACTIVITY MEASUREMENTS

Each of the fifteen (15) random start, systematically placed fixed-point alpha and beta measurements performed for non-parametric statistical testing were collected the WMF Pad unit. Direct measurements of radiation emissions from surfaces were collected using static, 60-second counting intervals for gross beta-gamma activity, and 120-second counting intervals for gross alpha activity. In the context of the sampling evolution, "a gross measurement" means a measurement made with a radiation detection instrument to which no reference background correction has been applied. Raw or gross data is important when measurements will be used to make statistical inferences, since not all data will necessarily have the same correction factors to properly reduce them to numbers that are meaningful in the context of the analysis. Reporting raw or gross data also permits one to analyze the functionality of the instrument with which the measurement was made, and to verify the appropriateness of the data reduction process. The data reduction process for the field measurement data collected in this surface measurement sampling program involves corrections for the source efficiency of the radiation detector relative to the subject radiation, and the instrument efficiency that best reflects the predetermined geometry. However, there was no attempt to adjust the data relative to the background sources of radiation or natural radiation emanating from the surface.

3.2.4 SURVEY UNIT OOL10-24-FSR TOTAL SURFACE ACTIVITY RESULTS

Fifteen (15) random start, systematically placed direct static surface activity measurements were obtained for WMF Pad Survey Unit OOL10-24-FSR with the Ludlum Model 2350-1 Portable Radiation Survey Instrument coupled with the 43-68 Alpha/Beta detector probe. The results show the maximum sum of fractions is approximately 6%. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.13 presents the FSS results for both alpha and beta total surface activity (TSA) levels for Survey Unit OOL10-24-FSR.

Table 3.13 – Survey Unit OOL10-24-FSR TSA Direct Measurement Results					
Sample Number	**Alpha TSA (dpm/100 cm^2)**	**Beta TSA (dpm/100 cm^2)**	**Fraction of DCGL**		**Sum of Fractions**
			α	**β**	
OOL10-24-001-FSR	**83**	1,040	0.03	0.02	5.0%
OOL10-24-002-FSR	**111**	**1,084**	0.04	0.02	6.1%
OOL10-24-003-FSR	49	1,071	0.02	0.02	4.0%
OOL10-24-004-FSR	49	1,061	0.02	0.02	3.9%
OOL10-24-005-FSR	**111**	1,077	0.04	0.02	6.1%
OOL10-24-006-FSR	63	953	0.02	0.02	4.2%
OOL10-24-007-FSR	70	983	0.02	0.02	4.5%
OOL10-24-008-FSR	63	953	0.02	0.02	4.2%
OOL10-24-009-FSR	70	**1,205**	0.02	0.03	4.9%
OOL10-24-009-FSR-QC(1)	N/C	860		0.02	1.9%
OOL10-24-009-FSR-B-QC-2(1)	N/C	968		0.02	2.1%
OOL10-24-010-FSR	28	1,104	0.01	0.02	3.3%
OOL10-24-011-FSR	63	1,064	0.02	0.02	4.4%
OOL10-24-012-FSR	70	1,040	0.02	0.02	4.6%
OOL10-24-013-FSR	56	1,195	0.02	0.03	4.5%
OOL10-24-014-FSR	56	1,145	0.02	0.02	4.3%
OOL10-24-015-FSR	21	1,014	0.01	0.02	2.9%

Note: Activity values in bold indicate statistically significant surface radioactivity which could be distinguished from background (*a priori* minimum detectable concentration [MDC])

N/C Not Collected

Note (1): 1st replicate count failed low for acceptable comparison ratio on 10/31/19. As part of initial investigation, additional replicate count collected with same instrument by same technician on 11/1/19 with acceptable results. SAPN 1468051 was generated to document the non-conformance.

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3.3 REMOVABLE RADIOACTIVITY MEASUREMENTS

Technical smears were used to collect a sample of the removable radioactivity on concrete pad surfaces in the survey unit. The smear samples were collected by wiping the cloth filter over a 100 cm^2 area of the surface to be sampled using moderate pressure applied with two fingers. The smears were packaged to prevent sample contamination, labeled with a unique identification number linked to the location from which the smear sample was collected, and then measured for radioactivity using a low background Alpha/Beta proportional counter.

Because the historical radiological surveys performed on the pad consistently showed the absence of measurable removable surface radioactivity, and because the total (fixed + removable) residual surface radioactivity was expected to be low relative to the 3,000 dpm/100 cm^2 alpha DCGL and 46,000 dpm/100 cm^2 beta DGCL in the survey unit identified above, removable surface activity (RSA) measurements were not necessary to demonstrate compliance with the building DCGLs. However, to demonstrate compliance with the unrestricted release criterion for removable residual radioactivity, and to validate the assumptions used in the derivation of the DCGLs for the dose model, RSA measurements were taken after the direct static total surface activity (TSA) measurements were collected. The RSA measurements demonstrate compliance with HBPP's radioactive materials license, even though all of the measurement locations indicated that there was zero likelihood for the existence of removable radioactivity in excess of 1,000 dpm/100cm^2 above background given that all TSA direct alpha and beta instrument background corrected measurements were less than the removable radioactivity unrestricted release criterion. No attempt was made to adjust the RSA measurement data to account for smear collection efficiency or instrument background.

3.3.1 INSTRUMENT

Smear samples were counted on a Protean WPC-9550 Automatic Low Background Alpha/Beta Gas Proportional counting system. Background and response checks were performed at least once a day when in use.

3.3.2 INSTRUMENT CALIBRATION

The Protean WPC-9550 was calibrated for both alpha and beta. The alpha channel was calibrated with an Am-241 NIST traceable source. The beta channel was calibrated with a Cs-137 NIST

traceable source. Efficiency was determined utilizing calibration sources created on a glass fiber filter inside an aluminum planchet, which is the same material and geometry for analysis of the smears.

3.3.3 MEASUREMENT DETECTION LIMITATIONS

To calculate the statistically significant surface radioactivity, which could be distinguished from background (a priori MDC), the following equation was used. The mean background count rates derived during calibration with other parameters are presented in Table 3.14.

$$MDC = \frac{3 + 3.29\sqrt{R_b \times t_S\left(1 + \frac{t_s}{t_b}\right)}}{t_S \times \in_T}$$

where: MDC = the minimum detectable concentration of surface radioactivity above background radioactivity (in dpm/100 cm^2) that can be detected with 95% confidence

R_b = the background count rate

t_s = the sample count time, (1 or 3 minutes)

t_b = the background count time, (10 or 20 minutes)

$\in_T$ = system efficiency established at calibration (counts per disintegration)

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Table 3.14 – Removable Contamination Measurement MDC Parameters

Parameter		Protean WPC 9550	
		#7108-A	
		Alpha	Beta
R_b	Background Count rate	0.115	3.028
t_s	Sample Count Time (minutes)	3	1
t_b	Background count time	20	10
ϵ_T	System efficiency % (counts per disintegration)	27.2	44.8
MDC	dpm/100 cm^2	6	20

3.3.4 Survey Unit OOL10-24-FSR Removable Surface Activity Results

Fifteen (15) random start, systematically placed removable surface activity measurements (at the direct static locations) were obtained during FSS in WMF Pad Survey Unit OOL10-24-FSR and analyzed on-site with the automatic low background alpha/beta proportional smear counter. The analytical results show that the mean/median removable surface radioactivity is appreciably below the DCGLs. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.15 presents the FSS results for both alpha and beta removable surface activity levels for Survey Unit OOL10-24-FSR.

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Table 3.15 – Survey Unit OOL10-24-FSR Smear Results		
Sample Number	**Alpha RSA (dpm/100 cm^2)**	**Beta RSA (dpm/100 cm^2)**
OOL10-24-001-FSR	4	9
OOL10-24-002-FSR	0	2
OOL10-24-003-FSR	1	2
OOL10-24-004-FSR	1	7
OOL10-24-005-FSR	0	0
OOL10-24-006-FSR	2	7
OOL10-24-007-FSR	0	0
OOL10-24-008-FSR	0	11
OOL10-24-009-FSR	0	2
OOL10-24-010-FSR	4	0
OOL10-24-011-FSR	1	11
OOL10-24-012-FSR	2	2
OOL10-24-013-FSR	0	2
OOL10-24-014-FSR	1	7
OOL10-24-015-FSR	0	4

Note: There were no reported activity values that indicated statistically significant surface radioactivity which could be distinguished from the smear counting system background (*a priori* MDC) established at initial calibration

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3.4 SCAN SUMMARY

The scan summary discussion for each survey unit is described later in this section. Tables 3.16 and 3.17 show a summary of the scan percentages for FSS and FSR respectively.

Table 3.16 – Summary of Scan Percentages for FSS

FSS Stats					
Survey Unit	**Total Area (m^2)**	**Scanned Area (m^2)**	**Percentage Required**	**Percentage Completed**	**Variance**
OOL10-01	6,473	6,473	100%	100%	0%
OOL10-13	38,087	3,318	5%	9%	74%
OOL10-17	53,129	7.773	5%	15%	193%
OOL10-20	7,990	4,583	10%	57%	474%
OOL10-22	4,885	2,862	10%	59%	486%

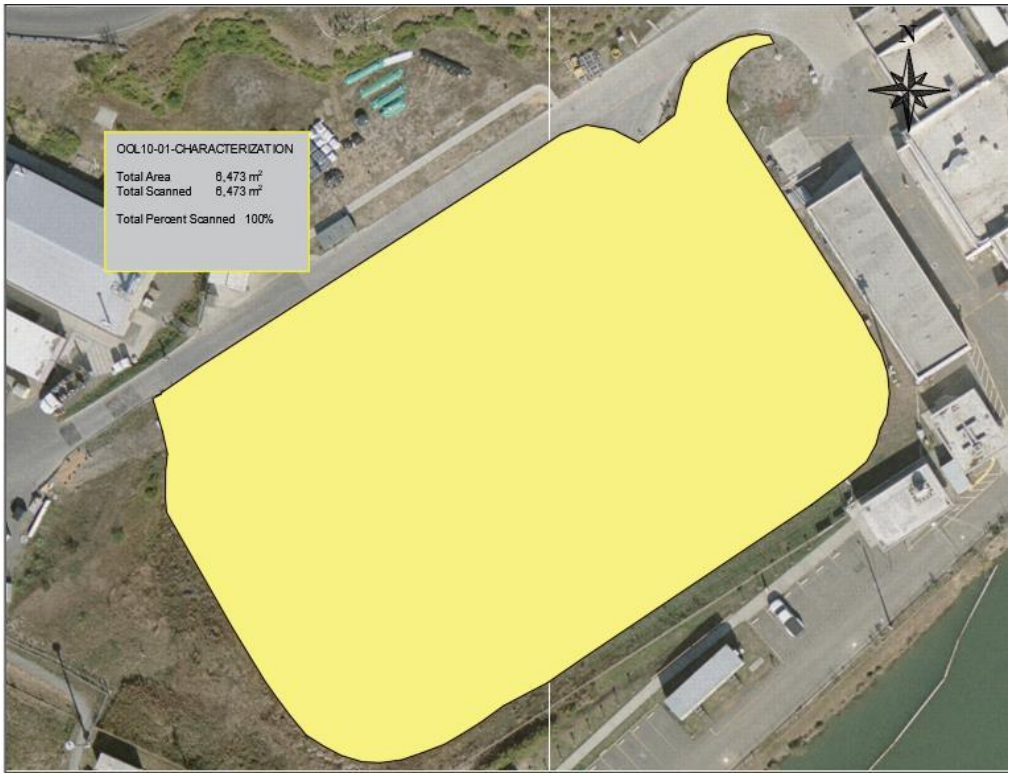
Table 3.17 – Summary of Scan Percentages for FSR

FSR Stats					
Survey Unit	**Total Area (m^2)**	**Scanned Area (m^2)**	**Percentage Required**	**Percentage Completed**	**Variance**
OOL10-01-FSR	3,020	3,020	5%	100%	1900%
OOL10-17-FSR	53,129	6,882	5%	13%	159%
OOL10-20-FSR	7,990	4,503	10%	56%	464%
OOL10-22-FSR	4,885	2,226	10%	46%	356%
OOL10-26-FSR	1,890	1,890	100%	100%	0%
OOL10-24-FSR	2,286	2,286	100%	100%	0%

Survey Unit OOL10-01

Approximately 100% of the accessible surface area (6,473 m^2) of Survey Unit OOL10-01 was surveyed from January 26, 2011 through October 25, 2012 by walking transects across the upper bank areas of the survey unit, moving the detector in a serpentine fashion for excavated portions of entryways, hillsides, berms, holes, utility trenches, drains, gratings, and truck roadways/pathways. Instrument readings ranging from 4.4 kcpm to 8.8 kcpm were recorded during the walkover scanning surveys for the 2" by 2" NaI (Tl) detector systems. As previously mentioned earlier in Section 3.1.2 this report, there was one investigation scan survey of two biased locations with gamma analysis results exceeding the investigation levels of 10% of the DCGL for Cs-137 specified in the characterization plan of 5.5 pCi/g. The investigation survey showed no elevated readings with no areas noted within a one-meter scanning radius of each location indicating reproducible indication above background using 44-10 detectors with audible discrimination. The 100% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 100%. Figure 3.3 below shows the NaI Walkover Scanning area coverage results for OOL10-01.

Figure 3.3 –Scan Plot for Survey Unit OOL10-01



Survey Unit OOL10-01-FSR

Approximately 100% of the accessible surface area (~3,020 m^2) of Survey Unit OOL10-01-FSR was surveyed from September 13, 2018 through December 17, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 4.1 kcpm to 9.0 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples collected for the survey unit. The 100% scanned area percentage of the survey unit exceeds the scan requirement stipulated in the survey plan of approximately 5%. Figure 3.4 below shows the NaI Walkover Scanning area coverage results for OOL10-01-FSR.

Figure 3.4 – Scan Plot for Survey Unit OOL10-01-FSR

Survey Unit OOL10-13

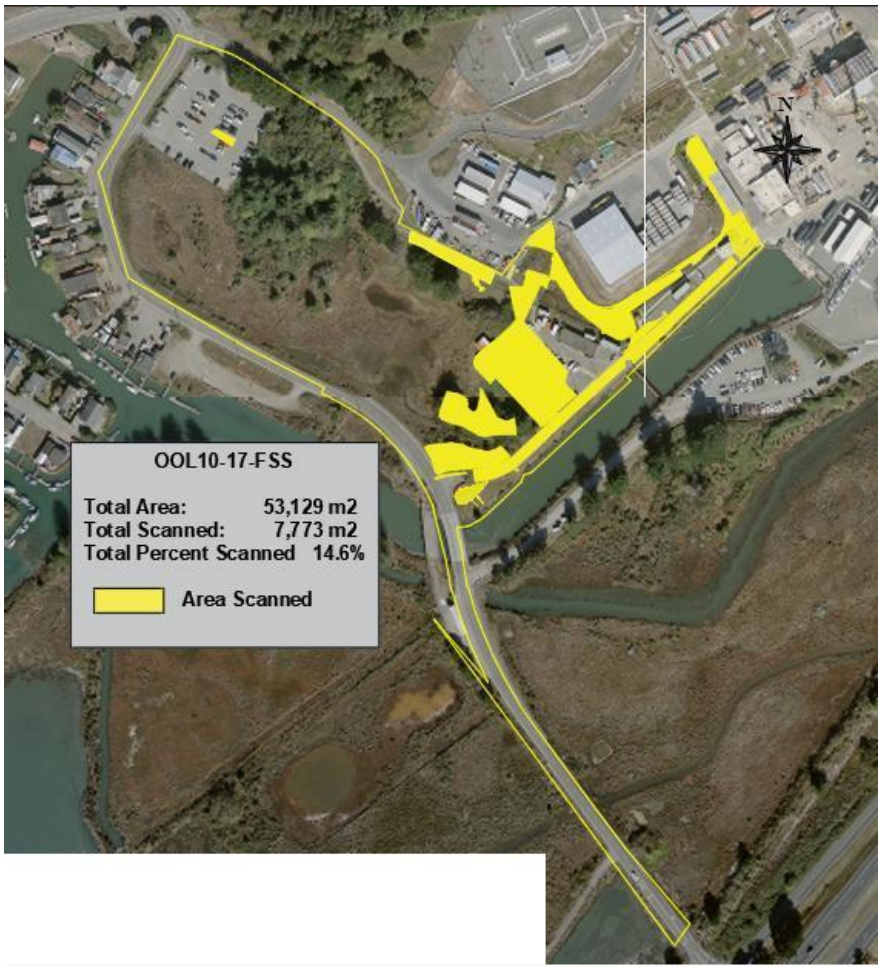
Approximately 9% of the accessible surface area (~3,318 m^2) of Survey Unit OOL10-13 was surveyed from May 16, 2019 through October 3, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.1 kcpm to 7.2 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples collected for the survey unit. The 9% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 5%. Figure 3.5 below shows the NaI Walkover Scanning area coverage results for OOL10-13.

Figure 3.5 – Scan Plot for Survey Unit OOL10-13

Survey Unit OOL10-17

Approximately 15% of the accessible surface area (~7,773 m^2) of Survey Unit OOL10-17 was surveyed from July 28, 2017 through December 17, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.7 kcpm to 11 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples collected for the survey unit. The 15% scanned area percentage of the survey unit exceeds the scan requirement stipulated in the survey plan of 5%. Figure 3.6 below shows the NaI Walkover Scanning area coverage results for OOL10-17.

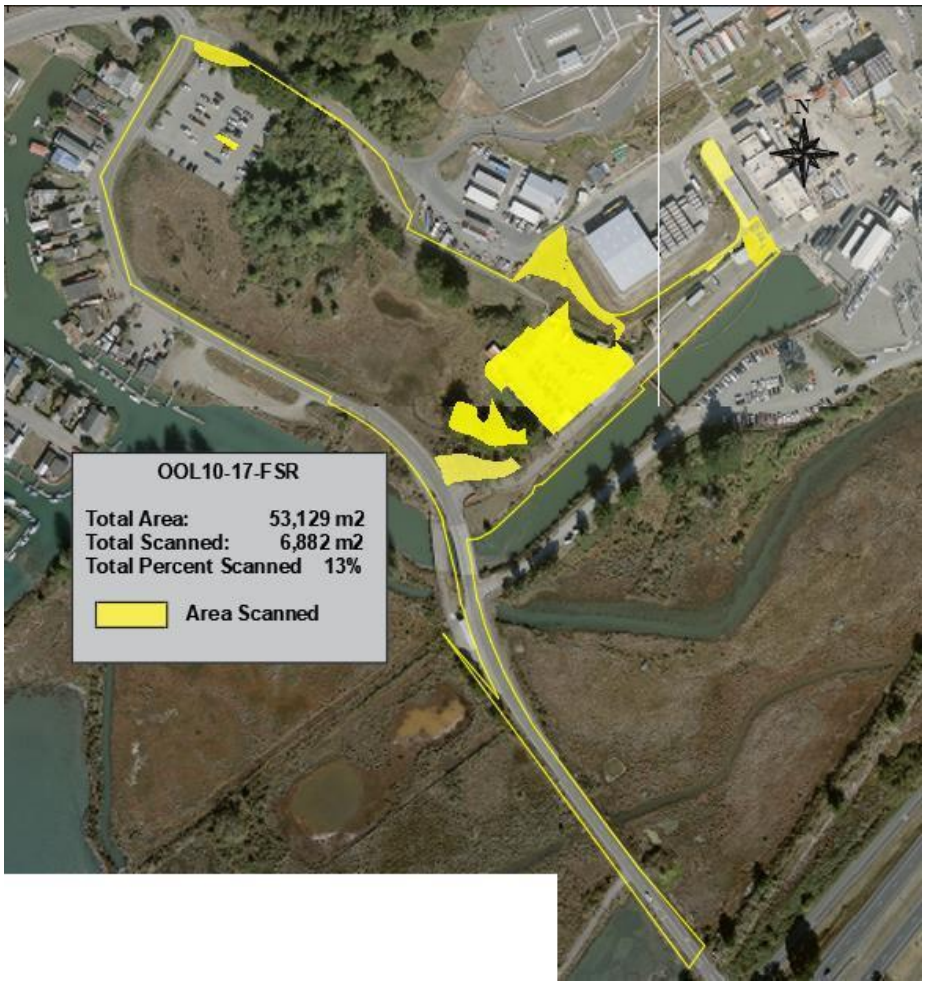
Figure 3.6 – Scan Plot for Survey Unit OOL10-17



Survey Unit OOL10-17-FSR

Approximately 13% of the accessible surface area (~6,882 m^2) of Survey Unit OOL10-17-FSR was surveyed from August 23, 2018 through August 28, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.8 kcpm to 8.7 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples collected for the survey unit. The 13% scanned area percentage of the survey unit exceeds the scan requirement stipulated in the survey plan of 5%. Figure 3.7 below shows the NaI Walkover Scanning area coverage results for OOL10-17-FSR.

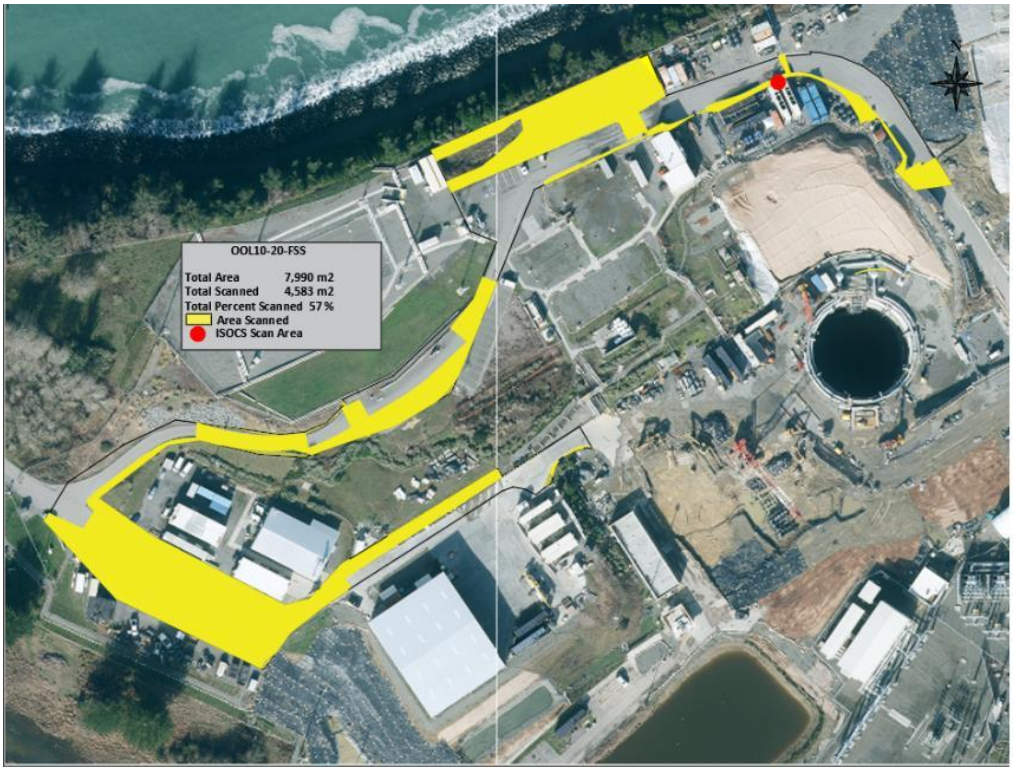
Figure 3.7 – Scan Plot for Survey Unit OOL10-17-FSR



Survey Unit OOL10-20

Approximately 57% of the accessible surface area (~4,583 m^2) of Survey Unit OOL10-20 was surveyed from December 19, 2017 through September 24, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.5 kcpm to 8.0 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. Additionally, on June 6, 2019, there was a single ISOCS measurement collected in a small excavation that was deemed unsafe for entry, with no plant derived radionuclides detected. The ISOCS MDA for Cs-137 easily met the derived Class 2 investigation level of 1.76E-01 pCi/g. As mentioned earlier in this report, there were five biased samples collected for the survey unit, however, there were no investigations performed for the survey unit. The 57% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 10%. Figure 3.8 below shows the NaI Walkover and ISOCS Scanning area coverage results for OOL10-20.

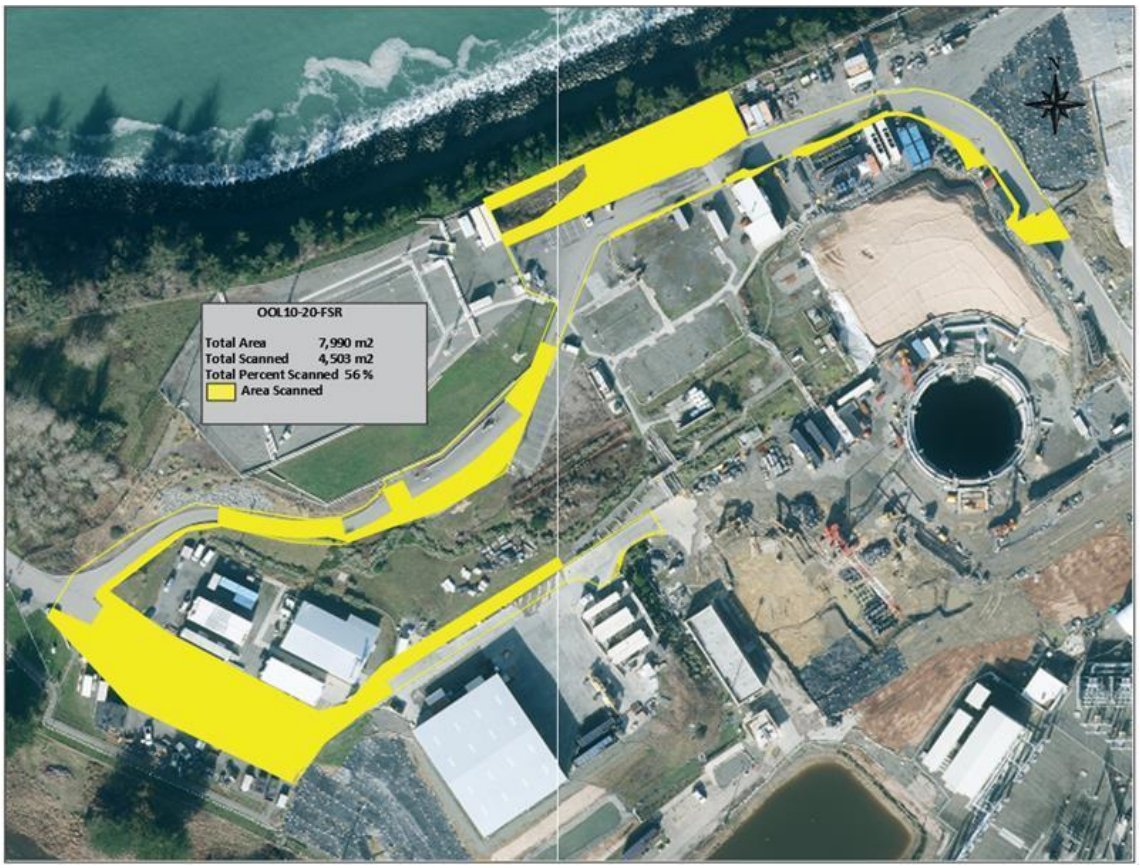
Figure 3.8 – Scan Plot for Survey Unit OOL10-20



Survey Unit OOL10-20-FSR

Approximately 56% of the accessible surface area (~4,503 m^2) of Survey Unit OOL10-20-FSR was surveyed from September 29, 2018 through September 24, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.5 kcpm to 9.0 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples collected for the survey unit. The 56% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 10%. Figure 3.9 below shows the NaI Walkover Scanning area coverage results for OOL10-20-FSR.

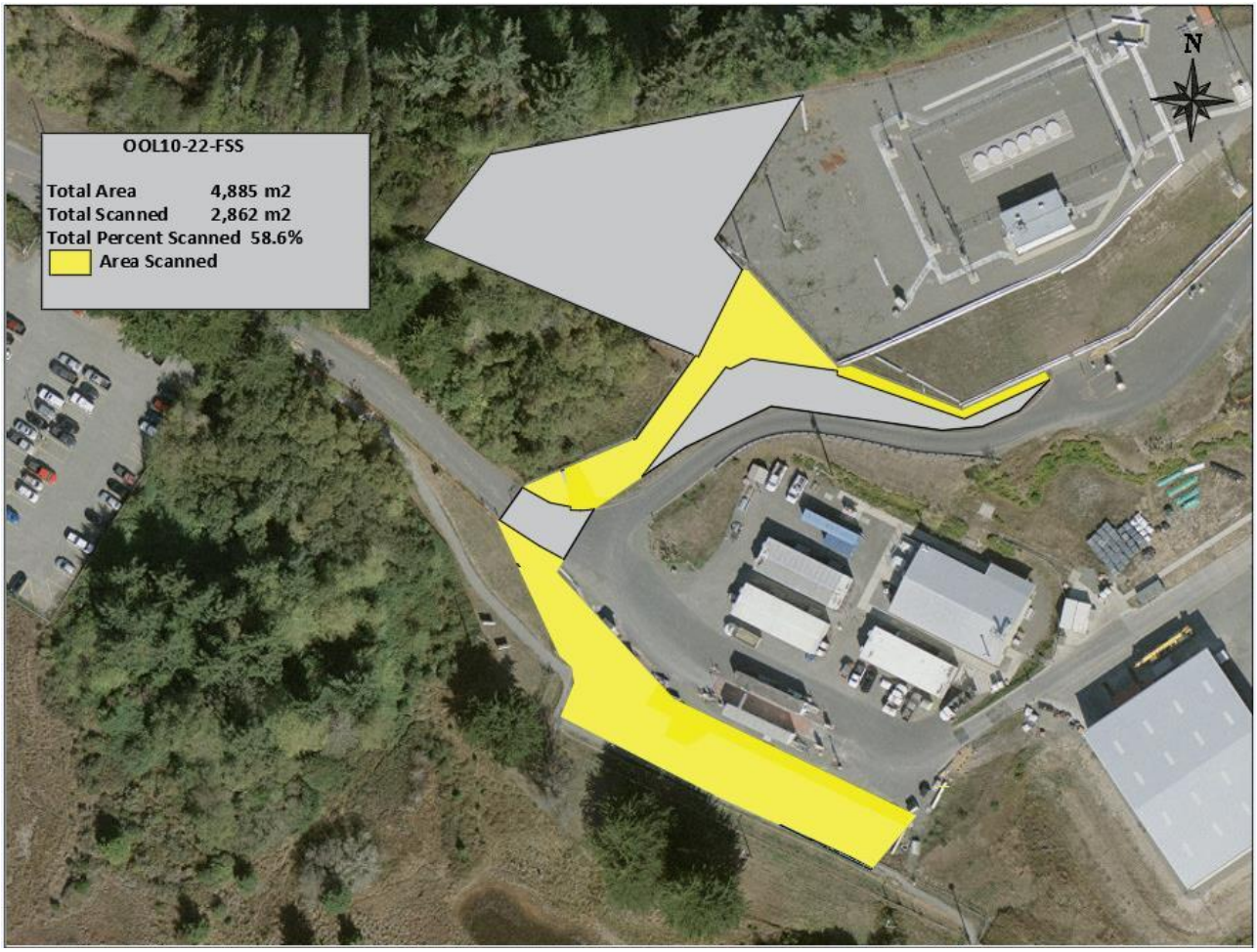
Figure 3.9 – Scan Plot for Survey Unit OOL10-20-FSR



Survey Unit OOL10-22

Approximately 59% of the accessible surface area (~2,862 m^2) of Survey Unit OOL10-22 was surveyed from September 29, 2018 through September 25, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.8 kcpm to 7.6 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples performed for the survey unit. The 59% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 10%. Figure 3.10 below shows the NaI Walkover Scanning area coverage results for OOL10-22.

Figure 3.10 – Scan Plot for Survey Unit OOL10-22



Survey Unit OOL10-22-FSR

Approximately 46% of the accessible surface area (~2,226 m^2) of Survey Unit OOL10-22-FSR was surveyed from September 29, 2018 through September 25, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 3.8 kcpm to 7.6 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples performed for the survey unit. The 46% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 10%. Figure 3.11 below shows the NaI Walkover Scanning area coverage results for OOL10-22-FSR.

Figure 3.11 – Scan Plot for Survey Unit OOL10-22-FSR

Survey Unit OOL10-26-FSR

Approximately 100% of the accessible surface area (~1,890 m^2) of Survey Unit OOL10-26-FSR was surveyed on August 7, 2019 by walking transects across the area, moving the detector in a serpentine fashion. Instrument readings ranging from 4.5 kcpm to 5.7 kcpm were recorded during the walkover survey for the 2" by 2" NaI (Tl) detector systems. There were no areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. There were no biased or investigation samples performed for the survey unit. The 100% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 100%. Figure 3.12 below shows the NaI Walkover Scanning area coverage results for OOL10-26-FSR.

Figure 3.12 – Scan Plot for Survey Unit OOL10-26-FSR

Survey Unit OOL10-24-FSR

Approximately 100% of the accessible surface area (~2,286 m^2) of Survey Unit OOL10-24-FSR was surveyed from October 24, 2019 through October 31, 2019 by walking the floor monitor (Ludlum 239-1F) in a systematic manner. Instrument readings ranging from 1.1 kilo-cpm (kcpm) to 1.4 kcpm (gross) beta were recorded during the concrete pad scan survey. There were two areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background. Therefore, two static investigation measurements were collected at the areas with elevated floor monitor gross beta readings, located on the north side of the WMF Structure near the discharge of the roof gutter downspouts. One minute static counts were collected with a Ludlum 2350-1/43-68 system at each investigation location with gross beta results ranging from factors of two and over three times greater than the method detection levels calculated for locations 001-F-I and 002-F-I respectively. Since both static investigation results were greater than detection levels, two additional measures were used to perform radionuclide identification to determine if the positive beta results were due to plant-derived radionuclide(s) with a gamma signature. First, a collimated In-Situ Object Characterization System (ISOCS) measurement was collected for 1200 seconds directly over the highest static investigation location, with gamma results detecting only naturally occurring radioactive materials (NORM) with a surface activity method detection level of 3.63E+02 dpm/100 cm^2 for Cs-137. Additionally, an investigation composite media sample was collected for the two locations, as there was not enough residual material at each location available. The media sample was analyzed at the HBPP gamma laboratory with Cs-137, a plant-derived radionuclide, present at 4.76E-02 pCi/g, which is indicative of fallout. There were no additional direct static measurements necessary to investigate elevated areas. The 100% scanned area percentage of the survey unit meets the scan requirement stipulated in the survey plan of 100%. Figure 3.13 below shows the Floor Monitor Scanning area coverage results for OOL10-24-FSR.

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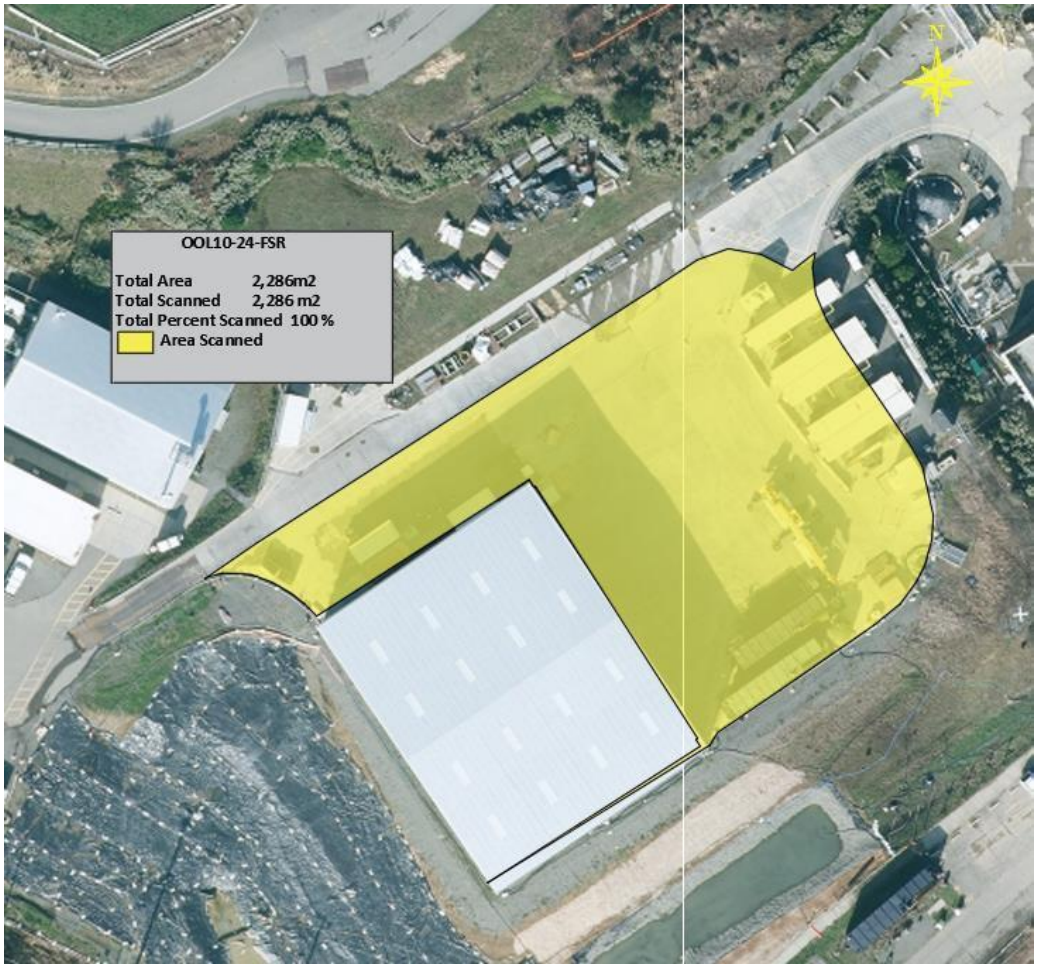
Figure 3.13 – Scan Plot for Survey Unit OOL10-24-FSR



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4.0 SURVEY UNIT DATA ASSESSMENT

4.1 STATISTICAL EVALUATIONS

The DQO sample design and data were reviewed in accordance with Procedure RCP FSS-14, "Data Quality Assessment" (Ref. 25) for completeness and consistency. The sampling design had adequate power for the survey units described in this report as indicated by their Retrospective Power Curves.

The Sign Test was performed by inspection on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign Test results demonstrates that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

Survey documentation was complete and legible. Surveys and sample collection were consistent with the DQOs and were adequate to ensure that each survey unit was properly designated as Class 2 and Class 3.

The final data review consisted of calculating basic statistical quantities (e.g., mean, median, standard deviation). The mean and median values are well below the DCGLs. Also, the retrospective power curves demonstrate that an adequate number of samples were collected to achieve the desired power.

Therefore, each survey unit meets the unrestricted release criteria with adequate power as required by the DQOs. The basic statistical quantities for the statistical sample population for Survey Units listed in this report are provided below in Table 4.1 through Table 4.11.

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Table 4.1 - Statistical Soil Sample Results Summary for OOL10-01

Statistic	Cs-137 (pCi/g	Sum of Fractions		
Minimum Value:	-2.71E-02	-4.93E-03	6.58%	Difference between mean and median
Maximum Value:	3.53E-01	6.42E-02	-0.21	Skew
Mean:	1.85E-01	3.37E-02	2.60	Range of Data
Median:	1.95E-01	3.55E-02	1.61	Max Dose contribution (mrem/yr)
Standard Deviation:	1.46E-01	2.65E-02	0.85	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-01 is approximately 3 standard deviations. The difference between the mean and median was about 6.6% of the standard deviation which indicates a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a negative skewness as confirmed by the calculated skew of -0.21, indicating slight skewness in the data. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 10% of the DCGL (5.5 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.85 mrem/yr (from all sources, including groundwater) to a future resident farmer is approximately 4% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-01 (0.85 mrem/yr). There was no assignment of deselected radionuclide dose as there were no HTD radionuclides present in any characterization samples collected within the survey area during HSA development, and evaluation confirmed the absence of HTD radionuclides in the two samples sent for full suite analysis at the off-site laboratory.

The results included in this report conclude that Survey Unit OOL10-01 has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.2 - Statistical Soil Sample Results Summary for OOL10-01-FSR

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-2.41E-02	-3.05E-03	-10.23%	Difference between mean and median
Maximum Value:	2.74E-01	3.47E-02	2.93	Skew
Mean:	3.85E-02	4.87E-03	4.23	Range of Data
Median:	3.13E-02	3.96E-03	1.44	Max Dose contribution (mrem/yr)
Standard Deviation:	7.04E-02	8.91E-03	0.69	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-01-FSR is approximately 4 standard deviations. The difference between the mean and the median is approximately -10% indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive high skewness as confirmed by the calculated skew of 2.93, indicating a non-normal distribution with no multimodal distribution noted and one outlier. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.22 pCi/g Cs-137), as provided in the FSSP for the associated area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.69 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be approximately 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-01-FSR (0.122 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-01-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.3 - Statistical Soil Sample Results Summary for OOL10-13

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-2.90E-02	-3.67E-03	-21.35%	Difference between mean and median
Maximum Value:	2.35E-01	2.97E-02	1.34	Skew
Mean:	5.22E-02	6.61E-03	3.71	Range of Data
Median:	3.70E-02	4.68E-03	1.32	Max Dose contribution (mrem/yr)
Standard Deviation:	7.12E-02	9.01E-03	0.74	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-13 is approximately 4 standard deviations. The difference between the mean and the median is approximately -21% indicating the distribution is skewed to the right. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 1.34, indicating high skewness and a normal distribution with no multimodal distribution noted with one outlier. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.74 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be approximately 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-13 (0.172 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-13 has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.4 - Statistical Soil Sample Results Summary for OOL10-17

Statistic	pCi/g	Fractions of the DCGL		
Minimum Value:	-4.00E-02	-5.06E-03	-16.46%	Difference between Mean and Median
Maximum Value:	1.92E-01	2.43E-02	0.79	Skew
Mean:	5.17E-02	6.54E-03	3.54	Range of Data
Median:	4.09E-02	5.18E-03	1.18	Max Dose Contribution
Standard Deviation:	6.56E-02	8.30E-03	0.74	Hypothetical Dose Contribution

The range of the data for survey unit OOL10-17 is approximately 4 standard deviations. The difference between the mean and the median is approximately -27% indicating the distribution is slightly skewed to the right. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.98, indicating moderate skewness and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.22 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.75 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-17 (0.182 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-17 has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.5 - Statistical Soil Sample Results Summary for OOL10-17-FSR

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-5.02E-02	-6.35E-03	4.88%	Difference between mean and median
Maximum Value:	1.83E-01	2.32E-02	0.40	Skew
Mean:	5.40E-02	6.84E-03	3.35	Range of Data
Median:	5.74E-02	7.27E-03	1.15	Max Dose contribution (mrem/yr)
Standard Deviation:	6.97E-02	8.82E-03	0.74	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-17-FSR is approximately 3 standard deviations. The mean is approximately equal to the median indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.40, indicating fair symmetry and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.22 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.74 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be approximately 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-17-FSR (0.172 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-17-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.6 - Statistical Soil Sample Results Summary for OOL10-20

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-2.29E-02	-2.90E-03	13.25%	Difference between mean and median
Maximum Value:	5.53E-02	7.00E-03	0.40	Skew
Mean:	1.04E-02	1.32E-03	3.34	Range of Data
Median:	1.35E-02	1.71E-03	0.3	Max Dose contribution (mrem/yr)
Standard Deviation:	2.34E-02	2.96E-03	0.16	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-20 is approximately 3 standard deviations. The difference between the mean and the median is approximately 13% indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.40, indicating fair symmetry and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 100% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.16 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 1% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-20 (0.040 mrem/yr) and the deselected radionuclide dose (0.120 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-20 has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.7 - Statistical Soil Sample Results Summary for OOL10-20-FSR

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-2.35E-02	-2.97E-03	-16.91%	Difference between mean and median
Maximum Value:	7.93E-02	1.00E-02	0.77	Skew
Mean:	2.08E-02	2.63E-03	3.78	Range of Data
Median:	1.62E-02	2.05E-03	0.38	Max Dose contribution (mrem/yr)
Standard Deviation:	2.72E-02	3.44E-03	0.19	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-20-FSR is approximately 4 standard deviations. The mean is approximately equal to the median indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.77, indicating moderate skewness and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 100% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.19 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 1% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-20-FSR (0.070 mrem/yr) and the deselected radionuclide dose (0.120 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-20-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.8 - Statistical Soil Sample Results Summary for OOL10-22

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-2.36E-02	-2.99E-03	-2.05%	Difference between mean and median
Maximum Value:	9.88E-02	1.25E-02	0.47	Skew
Mean:	2.53E-02	3.20E-03	3.59	Range of Data
Median:	2.46E-02	3.11E-03	0.89	Max Dose contribution (mrem/yr)
Standard Deviation:	3.41E-02	4.32E-03	0.65	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-22 is approximately 4 standard deviations. The mean is approximately equal to the median indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.47, indicating fair symmetry and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.65 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-22 (0.082 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-22 has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.9 - Statistical Soil Sample Results Summary for OOL10-22-FSR

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-5.70E-03	-7.22E-04	-27.22%	Difference between mean and median
Maximum Value:	1.26E-01	1.59E-02	1.06	Skew
Mean:	3.88E-02	4.91E-03	3.66	Range of Data
Median:	2.90E-02	3.67E-03	0.97	Max Dose contribution (mrem/yr)
Standard Deviation:	3.60E-02	4.56E-03	0.70	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-22-FSR is approximately 4 standard deviations. The difference between the mean and the median is approximately -27% indicating than the data is skewed to the right. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 1.06, indicating high skewness and a normal distribution with no multimodal distribution and one outlier noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 50% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.70 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 3% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-22-FSR (0.132 mrem/yr) and the deselected radionuclide dose (0.568 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-22-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.10 - Statistical Direct Results Summary for OOL10-24-FSR

Statistic	Sum of Fractions		
Minimum Value:	2.90E-02	-5.9%	Difference between mean and median
Maximum Value:	6.07E-02	0.43	Skew
Mean:	4.45E-02	3.73	Range of Data
Median:	4.40E-02	1.52	Max Dose contribution (mrem/yr)
Standard Deviation:	8.50E-03	1.12	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-24-FSR is approximately 4 standard deviations. The difference between the mean and the median is approximately -6% indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a slight positive skewness as confirmed by the calculated skew of 0.43, indicating fair symmetry and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the direct Investigation Levels of greater than 100% of the gross alpha DCGL based on Am-241 (3,000 dpm/100 cm^2) and the gross beta activity DCGL based on Cs-137 (46,000 dpm/100 cm^2), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 1.12 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 5% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-24-FSR gross alpha dose (0.533 mrem/yr) and the gross beta dose (0.579 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-24-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

Table 4.11 - Statistical Soil Sample Results Summary for OOL10-26-FSR

Statistic	Cs-137 (pCi/g	Fraction of the DCGL		
Minimum Value:	-1.08E-02	-1.37E-03	-21.03%	Difference between mean and median
Maximum Value:	8.17E-02	1.03E-02	0.32	Skew
Mean:	2.85E-02	3.61E-03	3.41	Range of Data
Median:	2.28E-02	2.89E-03	0.38	Max Dose contribution (mrem/yr)
Standard Deviation:	2.71E-02	3.43E-03	0.22	Hypothetical dose contribution (mrem/yr)

The range of the data for survey unit OOL10-26-FSR is approximately 4 standard deviations. The difference between the mean and the median is approximately -21% indicating a common central tendency. The data was represented graphically through posting plots, a frequency plot, and a quantile plot. The frequency plot indicates a positive skewness as confirmed by the calculated skew of 0.32, indicating fair symmetry and a normal distribution with no multimodal distribution noted. The data contained no abnormalities and supported all the key assumptions of the statistical test.

All soil samples were below the Investigation Levels of greater than 100% of the scaled DCGL (7.65 pCi/g Cs-137), as provided in the FSSP for the survey area. Since the Sign Test is passed if none of the data values exceed the DCGL, performing the test is unnecessary as it is passed by inspection.

The maximum hypothetical dose of 0.22 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be less than 1% of the release criteria. This dose is compiled from the statistical data evaluated from Survey Unit OOL10-26-FSR (0.100 mrem/yr) and the deselected radionuclide dose (0.120 mrem/yr).

The results included in this report conclude that Survey Unit OOL10-26-FSR has met the FSS data quality objectives and the regulatory release criteria of less than 25 mrem/yr to the average member of the critical group plus ALARA.

4.2 GRAPHICAL EVALUATIONS

The data assessments and graphical representations for all survey units are provided in Attachment 1, Data Quality Assessment (DQA).

4.3 SURVEY UNIT INVESTIGATIONS AND RESULTS

As discussed previously in Section 3.1.2 of this report, two of the four biased soil samples collected during FSS of Class 3 Characterization Survey Unit OOL10-01 indicated greater than the direct investigation levels specified of 10% of the Cs-137 DCGL specified in the plan of 5.5 pCi/g. Therefore, an investigation survey was performed for locations 18-C-B and 25-C-B. The first level investigation survey consisted of a walkover gamma scan of the 1 meter radius area surrounding each sample location on March 6, 2012. The investigation scan survey of the two locations showed no elevated readings with no areas exceeding the background range of 4.9 kilo-counts per minute (kcpm) to 5.8 kcpm and 5.5 kcpm to 6.3 kcpm respectively for locations 18-C-B and 25-C-B. Since all scan measurements proximal to the two areas surveyed showed no elevated readings, no investigation samples were warranted.

As discussed previously in Section 3.6 of this report, there were two areas that exceeded the scan investigation criteria specified in Table 5-5 of the LTP of detectable over background for Class 2 Survey Unit OOL10-24-FSR. Therefore, two static investigation measurements were collected at the areas with elevated floor monitor gross beta readings, located on the north side of the WMF Structure near the discharge of the roof gutter downspouts. One minute gross beta static counts were collected with a Ludlum 2350-1/43-68 system at each investigation location with results ranging from factors of two and over three times greater than the minimum detectable activity (MDA) levels calculated for locations 001-F-I and 002-F-I respectively. Since both static investigation results were greater than the calculated MDAs, two additional measures were used perform radionuclide identification to determine if the positive beta results were due to plant-derived radionuclide(s) with a gamma signature. First, a collimated ISOCS measurement was collected for 1200 seconds directly over the highest static investigation location, with gamma results detecting only NORM with a surface activity method detection level of 3.63E+02 dpm/100 cm^2 for Cs-137. Additionally, an investigation composite media sample was collected for the two locations, as there was not enough residual material at each location available. The media sample was analyzed at the HBPP gamma laboratory with Cs-137, a plant-derived radionuclide, present at 4.76E-02 pCi/g, which is indicative of fallout. There were no additional direct static measurements necessary to investigate elevated areas.

There were no investigations performed for the remainder of survey units presented in this report.

4.4 CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS

None of the initial assumptions were changed or challenged from information gained in the performance of the FSS survey or in reviewing its results.

5.0 DATA QUALITY ASSURANCE

An important aspect of any survey or sampling evolution is the effort made to assure the quality of data collected. It is critical to assure the quality of the data through quality checks and controls, calibrations, and training. The purpose of the DQA is to evaluate the data collected from the field considering its intended use in decision making. Decision makers should obtain an understanding of the verity of the data used in the FSS from reading this section.

Quality checks and controls were designed into the FSS to ensure adequate data quality. QC measurements were designed to provide a means of assessing the quality of the data set and demonstrate that measurement results had the required precision and were sufficiently free of errors to accurately represent the residual radiological conditions in the soils of the various survey units within the potentially impacted areas. The DQA uses guidance from MARSSIM and professional judgment.

Direct soil and surface measurement results are subjected to a focused DQA prior to using the data in FSS activities. The results are evaluated for apparent precision, accuracy, representativeness, completeness, and comparability; and appropriate data qualifiers are applied to the data set.

Since several naturally occurring radioactive material (NORM) nuclides are routinely identified during analysis of the FSS volumetric soil samples, a good test of accuracy and precision for a particular analytical program is to compare the detected radionuclide results for the samples homogenized and split from a single sample location, laboratory recounts of the same sample, and third-party analysis of split samples.

This comparison method provides a more realistic view of the detection capability of the analytical method. Since there is much less uncertainty with a detected result that may be more than several times its detection threshold than a result near or less than its detection level, it is reasonable and appropriate to evaluate the accuracy and precision data quality indicators using quantifiable radionuclide concentrations.

5.1 LABORATORY INSTRUMENTS AND QUALITY CONTROL

The prescribed QC for laboratory instruments consists of instrument source response checks, energy calibration checks, efficiency calibration checks, background checks, and replicate volumetric measurements performed on a percentage of the samples collected using an off-site system.

The on-site high purity germanium (HPGe) detector system used in the gamma analysis of volumetric soil media during FSS was controlled by Canberra's Genie System software. The software was used to perform the energy and efficiency calibration checks. A QA check of the on-site gamma spectroscopy systems for both energy and efficiency parameters was performed daily, prior to counting operations. This was achieved by using a National Institute of Standards and Technology (NIST) traceable multi-line standard calibration source in a comparable geometry (with a volumetric equivalent density) as the samples to be counted. The QA checks performed on the gamma spectroscopy system verify that the system parameters have not changed such that the energy and efficiency calibrations are still valid. This was accomplished by tracking peak location from a low-energy peak (59 kilo-electron volts [keV]) and a high-energy peak (1,332 keV) from a calibration source (to indicate a problem relative to the energy calibration), peak energy resolution (full width at half maximum [FWHM]) (indicate a problem relative to the energy shape calibration), and decay corrected activity (indicate a problem relative to the efficiency calibration).

Examination of data concludes that the gamma spectroscopy system was functioning correctly during FSS. A check of the gamma spectroscopy system QA Background measurements (in units of counts per second (cps)) covering the significant time periods when FSS sample analysis occurred showed no issues related to instrument background prior to FSS sample analysis. Coupled with the gamma spectroscopy system's source check QA measurements, the measured background data presents additional evidence of the gamma spectroscopy system's stability.

5.2 LABORATORY INSTRUMENT DATA QUALITY INDICATORS

To provide an assessment of precision, a measurement of the repeatability of a measurement or measurement technique was performed by the on-site analytical laboratory by performing a recount gamma analysis on samples and performing a comparison to the original count using the split sample assessment method described in HBPP Procedure RCP FSS-11, "Split Sample Assessment for Final

Status Survey" (Ref. 8). The Recount sample numbers for the survey units described in this report are listed in Table 5.1 and Table 5.2 below.

Table 5.1 - List of FSS Recount Samples

Survey Unit	Survey Plan Sample Number
OOL10-01	OOL10-01-006-C
OOL10-13	OOL10-13-009-F
	OOL10-13-011-F
OOL10-17	OOL10-17-001-F
OOL10-20	OOL10-20-006-F
	OOL10-20-009-F
	OOL10-20-021-F
OOL10-22	OOL10-22-006-F
	OOL10-22-008-F

Table 5.2 - List of FSR Recount Samples

Survey Unit	Survey Plan Sample Number
OOL10-01-FSR	OOL10-01-006-FSR
	OOL10-01-008-FSR
OOL10-17-FSR	OOL10-17-001-FSR
OOL10-20-FSR	OOL10-20-004-FSR
	OOL10-20-015-FSR
OOL10-22-FSR	OOL10-22-006-FSR
	OOL10-22-008-FSR
OOL10-26-FSR	OOL10-26-004-FSR
	OOL10-26-012-FSR

No DQA issues were noted during the comparison evaluation. The recount sample results were within the expected tolerance for the analysis, providing additional evidence that the sample preparation and measurement processes were precise (Attachment 1).

To provide an assessment of accuracy, the degree to which a measurement technique or method can reflect a known value or be compared to a known value or standard, a QC metric for split samples collected by the FSS Field Team were generated for all survey units except OOL10-24-FSR as shown in Table 5.3 and Table 5.4 below. The samples were analyzed by the on-site gamma laboratory and the corresponding split samples were analyzed by the off-site analytical laboratory. Therefore, those sample results were also evaluated via inter-laboratory comparison. The inter-laboratory comparison was evaluated using the split sample assessment method previously described. As mentioned earlier in this report, the ORISE requested that PG&E provide seven split samples from the FSS of Survey Unit OOL10-01. Additionally, ORISE collected six biased/judgmental samples which were split with PG&E. However, there was no split sample comparison performed by PG&E for the seven statistical and six biased samples split with the ORISE laboratory, and there was no requirement or commitment to do so. However, results of the side by side comparisons of the statistical and biased split sample comparisons are provided in Attachment 1 with satisfactory relative error ratios (RER) ranging from 0.05 to 0.86 and 0.35 to 1.03 for the statistical and biased samples respectively between the ORISE Laboratory and the PG&E Gamma Laboratory. It should be noted that two archived split samples were provided to ORAU for analysis during the August 2019 Confirmatory Survey for analysis by the ORISE Laboratory. The Cs-137 activity results for the PG&E Gamma Laboratory and the ORISE Laboratory as well as the results from the two archived samples, are provided for review in Table 5.5. No DQA issues were noted during the split sample comparison evaluations. The split sample results were within the expected tolerance for the analysis, providing additional evidence that the sample preparation and measurement processes were accurate (Attachment 1).

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Table 5.3 - List of FSS Split Samples

Survey Unit	Survey Plan Sample Number	Off-Site GEL Sample Number
OOL10-01	OOL10-01-012-C	302858001*
	OOL10-01-014-C	302858002*
OOL10-13	OOL10-13-004-F	492990008
	OOL10-13-008-F	492990010
OOL10-17	OOL10-17-009-F	465320001
	OOL10-17-013-F	467216009
OOL10-20	OOL10-20-004-F	492990002
	OOL10-20-005-F	487593002*
	OOL10-20-013-F	487593004
OOL10-22	OOL10-22-001-F	471586001
	OOL10-22-013-F	470413008

* These samples were also analyzed by the Oak Ridge Associated Universities (ORAU) Laboratory under the ORISE contract.

Table 5.4 - List of FSR Split Samples

Survey Unit	Survey Plan Sample Number	Off-Site GEL Sample Number
OOL10-01-FSR	OOL10-01-001-FSR	461718009
	OOL10-01-003-FSR	482372002
OOL10-17-FSR	OOL10-17-005-FSR	465182005
	OOL10-17-015-FSR	465320007
OOL10-20-FSR	OOL10-20-007-FSR	487593010
	OOL10-20-012-FSR	486651006
OOL10-22-FSR	OOL10-22-004-FSR	492990004
	OOL10-22-011-FSR	492990006
OOL10-26-FSR	OOL10-26-003-FSR	487593006
	OOL10-26-005-FSR	487593008

Table 5.5 – PG&E ORAU Split Sample Cs-137 Results

PG&E FSS Sample ID	Collection Date	HBPP Lab Cs-137 Results (pCi/g)	ORAU Split Sample ID	ORISE Lab Cs-137 Results (pCi/g)
OOL10-01-001-C	2/15/2012	7.53E-02	S001	3E-02
OOL10-01-002-C	2/15/2012	**3.22E-01**	S002	**3.0E-01**
OOL10-01-004-C	2/15/2012	**1.93E-01**	S004	**2.5E-01**
OOL10-01-005-C	2/15/2012	1.43E-02	N/A	**5.8E-02**(1)
OOL10-01-007-C	2/15/2012	**3.13E-01**	S007	**3.7E-01**
OOL10-01-009-C	2/15/2012	**1.95E-01**	S009	**2.0E-01**
OOL10-01-011-C	2/15/2012	**3.17E-01**	S011	**3.4E-01**
OOL10-01-015-C	1/26/2012	**3.45E-01**	S015	**3.5E-01**
OOL10-20-005-F	8/1/2019	-2.16E-02	N/A	-1.3E-02(1)
OOL10-01-020-C-B	2/15/2012	2.04E-02	S016	2E-02
OOL10-01-021-C-B	2/15/2012	-1.02E-01	S017	0E-02
OOL10-01-022-C-B	2/15/2012	2.36E-02	S018	-1E-02
OOL10-01-023-C-B	2/15/2012	**3.18E-01**	S019	**2.9E-01**
OOL10-01-024-C-B	2/15/2012	2.05E-02	S021	1E-02
OOL10-01-025-C-B	2/15/2012	**6.21E-01**	S021	**5.1E-01**

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note (1) Sample results shown from ORISE Laboratory from PG&E FSS Split Sample Archive requested by ORAU
N/A Not Applicable

To provide an assessment of representativeness, the degree to which a data set is actually a sample of a population (e.g., information presented by the data set can be extrapolated to describe the overall site or system), the survey was designed to produce a random start systematic triangular grid sample allocation distribution that ensured DQOs were met. The sample locations identified using VSP meet the survey design DQOs and are considered representative of the conditions for Site soils in the survey area. No DQA issues regarding analytical or measurement effects (e.g., holding times or compositing effects) were noted during the data evaluation process that suggest that representativeness was affected.

To provide an assessment of completeness, the ability of the data set to encompass the entirety of the target system, a minimum of fifteen (15) volumetric soil samples from each survey unit were calculated, as classified according to area contamination potential.

To provide an assessment of comparability, the degree to which a data set, or single datum, can be compared to another measurement for purposes of assessing change over time, or other dynamic

conditions, sampling procedures and protocols were used throughout the FSS process for the impacted Site area described in this report. There were no DQA issues regarding comparability as no critical deviation from procedures and protocols was encountered.

5.3 FIELD INSTRUMENT RESPONSE CHECKS

During the survey of the WMF Pad, to verify the quality of direct static surface measurements, the response of the instruments (Ludlum 2350-1 with the 43-68 αβ probe) to a surface deposited activity source with a known amount of radioactivity was performed. The source used was an anodized surface source containing Tc-99 or Am-241 radioactivity for the beta or alpha operating voltage respectively. The sources used were manufactured and certified to be NIST traceable.

Prior to initiating a survey each day, and at the end of a survey each day, the survey instrument in use was used to make a measurement on the known concentration source. Instrument response check data for each probe used during the final status survey is presented for individual probes. Review of the response check data sheets for the days the instruments were used indicate that the instruments were within acceptable limits. No degradation of the instruments' response was observed over the survey period of October 30, 2019 thru November 1, 2019.

MARSSIM states that "Determining precision by replicating measurements with results at or near the detection limit of the measurement system is not recommended because the measurement uncertainty is usually greater than the desired level of precision." Since several NORM nuclides are routinely identified during acquisition of direct total surface activity measurements, a good test of accuracy and precision for a particular survey program is to compare the detected results for the surface locations greater than MDC. This comparison method provides a more realistic view of the detection capability of the analytical method. Since there is much less uncertainty with a detected result that may be more than several times its detection threshold than a result near or less than its detection level, it is reasonable and appropriate to evaluate the accuracy and precision data quality indicators using quantifiable gross activity measurements

To provide an assessment of precision, a measurement of the repeatability of a measurement or measurement technique was performed by performing a replicate beta total surface activity static count using a different FSS technician and a similar but separate detector system and comparing to the original count using the split sample assessment method described in HBPP Procedure RCP FSS-

11, "Split Sample Assessment for Final Status Survey" (Ref. 8). While not required by the LTP, a total of three (3) replicate counts were performed in Survey Unit prior to the collection of the removable surface activity (smear) measurement to ensure there was no additional bias incorporated into the comparison. Each replicate count was performed at the location with the highest activity level(s) greater than the method detection level of the concrete pad. Except as noted in Section 1.3.7 regarding the 1st replicate count of direct beta static location OOL10-24-009-FSR-B failed the replicate assessment at a comparison ratio of 0.71, no DQA issues were noted during the comparison evaluation. As mentioned in the summary for SAPN 1468051, the cause of the 1st QC Replicate count failure was likely due to random background fluctuations as both the original and the replicate measurement were near the detection capabilities of both instruments. The 2nd QC Replicate measurement results compared with the original direct count were within the expected tolerance for the method, providing additional evidence that the technician training, survey plan, and instrument calibration and operating implementing procedures and measurement processes were precise. Additionally, a QC replicate measurement comparison was performed on November 1, 2019 for investigation location OOL10-24-002-FSR-F-I using the same instrument used for the previous QC Replicate measurements, with a satisfactory comparison ratio of 0.91. Since the investigation regarding the failure of the original and replicate measurement comparison is likely due to random background fluctuations, the FSS results were deemed to be of adequate data quality to be included in the statistical demonstration of dose compliance. The QC Replicate Comparisons performed on beta direct total surface activity statistical and investigation locations is provided in Attachment 1.

To provide an assessment of representativeness, the degree to which a data set is actually a sample of a population the survey was designed to produce a random or systematic sample allocation distribution that ensured DQOs were met. The sample locations identified using VSP meet the survey design DQOs and are considered to be representative of the conditions in the survey area. No DQA issues regarding analytical or measurement effects (e.g., holding times or compositing effects) were noted during the data evaluation process that suggest that representativeness was affected.

To provide an assessment of comparability, the degree to which a data set, or single datum, can be compared to another measurement for purposes of assessing change over time, or other dynamic conditions, sampling procedures and protocols were used throughout the FSS process for the

impacted Site areas described in this report. There were no DQA issues regarding comparability as no critical deviation from procedures and protocols was encountered.

5.4 CORRECTIVE ACTIONS

As mentioned earlier in this report, besides the issue with the QC Replicate non-conformance in Survey Unit OOL10-24-FSR, there was one SAPN and a memorandum regarding the relocation of samples greater than one meter due to accessibility issues to facilitate sampling. Both summaries of the evaluation concluded that even though each sample location was moved greater than one meter, there is high confidence that the activity results of the alternate sample locations presented in this report used as data points to show statistical compliance show similar results to the original designed samples (had they been accessible for collection) given their locations in MARSSIM Class 3 survey units. No other corrective actions were warranted during the performance and subsequent evaluation of FSS Survey Units as referenced in this report.

5.5 QUALITY VERIFICATION

There were four Quality Verification (QV) Assessments performed that were performed on Characterization Survey Unit OOL10-01 from January 26, 2010 to February 9, 2012. A Characterization versus a Final Status Survey of the Fuel Oil Storage Tank footprint was performed since there was no NRC-approved LTP in place at the time. The scope of each assessment was the MARSSIM Characterization Survey Planning and Execution with the premise that the survey was executed to the rigors of an FSS unit so the data collected could be of sufficient quality to be used to show compliance with the regulatory release criteria, as the initial version of the LTP (submitted in May of 2013) had not been approved by the NRC. As a result of the four assessments, a total of six SAPNs were generated shown in Table 5.6 below with corrective actions discussed further in this section. To ensure the corrective actions performed to address the findings of all four assessments were effective, the Site Closure Manager requested QV perform an effectiveness review for the domestic water line characterization excavation on September 20, 2012.

Table 5.6 – Quality Verification Assessments Summary

QV Number	Date Performed	Issues or Observations/Results Identified	SAPN(s) Generated
110380042	1/26/10	Inadequate survey area preparation (standing water and excessive brush) rendered portions of the unit inaccessible for scan survey. Isolation and Control measures were not implemented following the survey. One survey technician was not trained in the use of instrumentation. Inspection of the hole left from sample collection showed a depth of 3-4 inches compared with a specified depth of 15 cm.	1268875
110550005	2/22/11	All four issues identified in SAPN 1268875 as identified in previous assessment were adequately addressed. Various typographical and editorial issues were identified during review of the survey plan which were addressed in Rev. 02.	N/A
120450009	2/9/12	Various additional typographical and editorial errors were identified during review of the survey plan which were addressed. The seven steps of the DQO process used to plan the characterization survey were compared to the elements provided in MARSSIM Appendix D. The revision control and review process was evaluated and as a result of deficiencies identified, a "review guidance" desk guide was implemented for preparation and review of final status survey plans.	1282218
121100001	4/17/12	The assessment focused on the preparation and analysis of soil samples by the HBPP Laboratory, including review of sample analysis results and other data collected during the survey of OOL10-01. Minor issues identified: Two of the samples collected exceeded the investigation level of 10% of the DCGL specified in the survey plan for Cs-137 Split sample results from the independent offsite lab did not contain gamma spectroscopy results. An improvement item was noted on the survey form of reporting the sample location elevation in the survey documentation as an aid to follow backfill operations. While no issues were identified during the assessment affecting data quality, issues were identified mostly due to ineffective communication practices and lack of attention to detail.	1284293 1284226 1282556 1284294

SAPN 1268875 Summary of Corrective Actions

Four corrective actions/responses performed as a result of deficiencies observed in QV Assessment 110380042 include:

1. To eliminate brush and standing water presenting an obstacle to survey performance in the Class 3 area, the Decommissioning Contractor was coached and removed the excess brush and standing water. The scan survey was re-performed including the newly exposed areas.
2. To ensure Isolation and Controls measures were implemented to ensure radioactive materials were not introduced after FSS, an isolation and postings control program was implemented.
3. To ensure all personnel participating in the survey are trained in instrument operation, the Radiation Protection (RP) Supervisor responsible for the oversight was coached and was provided access to the training database as an pre-briefing verification check to ensure all technicians involved in the survey have completed the required instrumentation training.
4. One sample that was identified as having an insufficient volume for a satisfactory analysis upon investigation did have sufficient volume to perform a satisfactory analysis. However, the sample was lighter than the other samples when dried, which is compensated for in the efficiency calibration based on the medium instead of higher density soil. Regarding the issue of sample collection depth being contrary to the 15 cm depth specified in the plan, the dose model is more conservative for undisturbed areas such as the FOST area. The survey package was revised to specify the range of soil sampling depth not to exceed 15 cm.

SAPN 1282218 Summary of Corrective Actions

The corrective action performed as a result of deficiencies observed in QV Assessment 120450009 included:

1. The revision control and review process was evaluated and as a result of deficiencies identified, a "review guidance" desk guide was implemented for expectations regarding the preparation and review of final status survey plans for FSS Engineer Preparer (FSSEP) and the FSS Engineer Reviewer (FSSER).

SAPN 1284293 Summary of Corrective Actions

The corrective action performed as a result of confusion regarding the investigation level for samples determined that the error occurred because the NRC screening value of 11 pCi/g was conservatively pushed to 5.5 pCi/g, and the investigation level was assumed to be 10% of the full screening value. Investigation scan surveys were performed near the original two sample locations that were >10% of the DCGL with no indications of elevated activity discernable from background, therefore, no investigation samples were warranted.

SAPN 1284226 Summary of Corrective Actions

The corrective action performed as a result of the two split sample missed gamma analysis included communicating better with the off-site laboratory, analyzing the two split samples for gamma activity, and changing the protocol for sample Chain-of Custody (COC) analysis request of "Analyze for attached list of nuclides or letter from PG&E" to specify the actual requested analyses on the COC to prevent confusion.

SAPN 1282556 Summary of Corrective Actions

The corrective action performed as a result of the improvement item of reporting the sample location elevation in the survey documentation as an aid to follow backfill operations was implemented for the characterization plan final package prior to the Records Management System (RMS).

SAPN 1284294 Summary of Corrective Actions

Overall, QV concluded that there were no issues identified that impact data quality or disqualify the survey. However, a trend SAPN was initiated from QV regarding ineffective communication practices and less than attention to detail within the site closure group, the count room, and environmental. Personal review and observation by the Site Closure Manager (SCM) in the areas of plan development, execution, and close out for the Unit 3 Circulating Pipe Removal task indicated that corrective actions have been effective. The SCM also requested a future QA effectiveness review to verify that corrective actions involved in the process have been effective. On September 20, 2012, Quality Verification assessment 12376470 was completed for the characterization survey of the Domestic Water Line Excavation (HBPP-CHAR-OOL10-07) to evaluate the performance from survey planning through the final DQA. The assessor noted that the FSS team had made notable improvements since the initial QV assessment, however also noted that attention to detail continues to present opportunities for improvement, examples of which were easily corrected and none of which challenged the validity of the survey.

6.0 ALARA STATEMENT

The cost benefit analysis indicates that residual radioactivity in soils at the Site has been reduced to concentrations that are ALARA. Generic ALARA Statements have been prepared to demonstrate that it is not ALARA to further remediate soil and concrete surfaces at levels below the DCGL. The analysis shows that shipping affected soil from the open land survey areas described in this report and concrete from the WMF Pad to a low-level waste disposal facility is not cost effective for unrestricted release.

Therefore, by demonstrating that the rest of the decision criteria have been met, also demonstrates that the level of residual radioactivity is ALARA without taking additional remedial action. The decision rules, having been derived from the dose-based radiological criteria for unrestricted release, ensure that residual radioactivity in soils or concrete surfaces on the site will not pose an unacceptable radiological risk to humans under any reasonable and foreseeable future use or occupancy (Ref. 18). The Generic ALARA Review for Final Status Survey of Soil or Structures at HBPP, along with each Survey Unit ALARA Evaluation Comparison is provided in Attachment 2.

7.0 SUMMARY AND CONCLUSIONS

This report demonstrates that FSS and FSR Survey Units as shown below have met the release requirements associated with the DCGLs listed in the HBPP LTP.

OOL10-01-FSR	OOL10-17	OOL10-20	OOL10-22	OOL10-24-FSR
OOL10-13	OOL10-17-FSR	OOL10-20-FSR	OOL10-22-FSR	OOL10-26-FSR

Additionally, it was shown that Characterization Survey Unit OOL10-01, which was performed prior to NRC-approval of the HBPP LTP, was surveyed to the rigors of FSS using DCGLs that corresponded to the lesser of an annual dose of 15 mrem/yr DCGL adjusted California Department of Toxic Substance Control (DTSC) risk or 50% of the NRC screening values.

All identified radionuclides of concern were used for statistical testing to determine the adequacy of the survey unit for FSS. Although it is not required to demonstrate compliance with the release criteria, the sample data passed the Sign Test and the null hypothesis was rejected. All survey units were properly designated as Class 2 or Class 3 as appropriate.

Additionally, the data shows that the ALARA criteria for soils as specified in Chapter 4 of the HBPP LTP were achieved. This value is the TEDE based on the average concentration of the samples used for non-parametric statistical sampling. To uphold the commitments in License Amendment No. 40 to DPR-7, periodic surveillance surveys are performed for survey units that have undergone FSS to ensure adequate isolation controls are being maintained to preclude recontamination from Unit 3 decommissioning activities in accordance with HBPP Procedure RCP C-220, "Cross Contamination Prevention Plan" (Ref. 26). As discussed in Section 1.3.5 of this report, Survey Unit OOL10-01 was exempted from the periodic surveillance surveys by the Site Closure Manager in 2018 as this area had an engineered surface or barrier in place. The other survey units described in this report were never subject to periodic surveillance surveys as they were either always covered by a protective barrier or surrounded by Class 2 or Class 3 survey units never subjected to remediation activities.

Based on the analysis presented in this report, FSS data demonstrates that the subject area associated with potentially impacted areas has met the decision criteria, specifically:

- No unexpected results or trends are evident in the data.
- The sampling and survey results demonstrate that soil residual radioactivity in the potentially impacted areas is very minimal, and essentially indistinguishable from background.

- The data quality is judged to be adequate for its intended purpose.
- The amount of data collected from each survey unit is adequate to provide the required statistical confidence needed to decide that the DCGLs were met.
- The retrospective power of the Sign Test, used to judge compliance, was almost 100%.

All survey units described in this report have met the final DQOs of the FSS process based on the following criteria:

- The ALARA criteria for soils as specified in Chapter 4 of the LTP were achieved.
- The sample data passed the Sign Test.
- The null hypothesis was rejected.
- Graphical representation of data indicates some limited skewness.
- The Retrospective Power Curves generated show adequate power was achieved.
- The survey units were properly designated as Class 2 and Class 3.

The maximum hypothetical dose (from all sources, including groundwater) to a future resident farmer was determined to be a fraction of the DCGL. The maximum hypothetical dose for each Survey Unit is provided in Table 7.1 and 7.2 for FSS and FSR respectively below. A maximum hypothetical bounding dose can be calculated for each survey unit, with the exception of Survey Unit OOL10-24-FSR, by adding a Hard to Detect (HTD) bounding dose of 3 mrem/yr to the maximum hypothetical doses per area in Table 7.1 and Table 7.2 below.

Table 7.1 - Maximum Hypothetical Dose for FSS Per Area

Survey Unit	Max Hypothetical Dose (mrem/yr)
OOL10-01	0.85
OOL10-13	0.74
OOL10-17	0.74
OOL10-20	0.16
OOL10-22	0.65

Table 7.2 - Maximum Hypothetical Dose for FSR Per Area

Survey Unit	Max Hypothetical Dose (mrem/yr)
OOL10-01-FSR	0.69
OOL10-17-FSR	0.74
OOL10-20-FSR	0.19
OOL10-22-FSR	0.70
OOL10-24-FSR	1.12
OOL10-26-FSR	0.22

Thus, the null hypothesis, that residual radioactivity in the survey units exists in concentrations above the applicable DCGLs, should be rejected for each of the survey units in the potentially impacted area. The area surveyed and sampled during FSS (the survey unit identified in this report) should be released from further radiological controls. Therefore, this FSS Report submittal supports the regulatory decision to terminate the license following completion of all FSS report submittals for the site.

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8.0 REFERENCES

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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
Am-241	Americium-241
ASSP	Area Surveillance Survey Plan
C-14	Carbon-14
COC	Chain of Custody
Cm	Curium
Co-60	Cobalt-60
Cs-137	Cesium-137
DCGL	Derived concentration guideline level, the radionuclide specific activity concentration that corresponds to the release criterion (25 mrem/y) within a survey unit
$DCGL_{op}$	Operational DCGL
DOE	United States Department of Energy
DQA	Data Quality Assurance
DQO	Data Quality Objectives
EM	Engineered Material
ETD	easy to detect
Eu-152	Europium-152
Eu-154	Europium-154
FOST	Fuel Oil Storage Tanks
FOTA	Fuel Oil Tank Area
FSS	Final Status Survey
FSSEP	Final Status Survey Engineer Preparer
FSSER	Final Status Survey Engineer Reviewer
FSSP	Final Status Survey Plan
FSR	Final Site Restoration
FWHM	Full Width at Half Maximum
GARDIAN	Gamma Radiation Detection and In-Container Analysis system
GEL	General Engineering Laboratories, LLC
GPS	global positioning system
H-3	Tritium
HBPP	Humboldt Bay Power Plant
HBAP	Humboldt Bay Administrative Procedure
HPGe	High Purity Germanium Detector System
HSA	Historical Site Assessment

HTD	hard to detect (for this purpose, nuclides that are not detectable by gamma analysis)
ISFSI	Interim Spent Fuel Storage Installation
kcpm	kilo-counts per minute
keV	kilo-electron volts
LBGR	lower bound of the gray region
LLD	lower limit of detection
LTP	License Termination Plan
m^2	meter(s) squared
m^3	cubic meters
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	minimum detectable activity
MDC	minimum detectable concentration
mrem/yr	Millirem per year
NAD	North American Datum
NaI	Sodium-Iodide Detector
NaI (Tl)	Thallium-activated sodium iodide gamma scintillation detector
Nb-94	Niobium-94
NIST	National Institute of Standards and Technology
NORM	naturally occurring radioactive material
Np-237	Neptunium-237
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
PG&E	Pacific Gas and Electric Company
PNNL	Pacific Northwest National Laboratory
Pu	Plutonium
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCA	Radiologically Controlled Area
RCP	Radiation Control Procedure
RP	Radiation Protection
SAPN	Systems Application and Products Notification
SOF	Sum of Fractions

Sr-90	Strontium-90
Tc-99	Technetium-99
TEDE	total effective dose equivalent
TRU	transuranic
VSP	Visual Sample Plan computer program
WMF	Waste Management Facility

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Attachment 1

Data Assessment

ORISE
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Managed by ORAU for the U.S. Department of Energy

April 9, 2012

Mr. John Hickman
Mail Stop: T-E18
Division of Waste Management
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

SUBJECT: FINAL REPORT—CONFIRMATORY SURVEY OF THE FUEL OIL TANK AREA, HUMBOLDT BAY POWER PLANT, EUREKA, CALIFORNIA DCN: 5167-SR-01-0

Dear Mr. Hickman:

The Oak Ridge Institute for Science and Education (ORISE) performed confirmatory radiological survey activities on the former Fuel Oil Tank Area and other portions of the Humboldt Bay Power Plant as requested by the U.S. Nuclear Regulatory Commission (NRC) site representative. These survey activities were conducted during the period of February 14 and 15, 2012. Enclosed is the final report that summarizes ORISE's survey procedures and provides the results of the ORISE radiological survey activities. The surveys included gamma walkover scans, gamma direct measurements, and soil sampling.

My contact information is listed below, or you may contact Erika Bailey at 865.576.6659 or Tim Vitkus at 865.576.5073, should you require any additional information.

Sincerely,

Wade C. Adams

Wade C. Adams
Project Manager/Health Physicist
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WCA:fr

Enclosure

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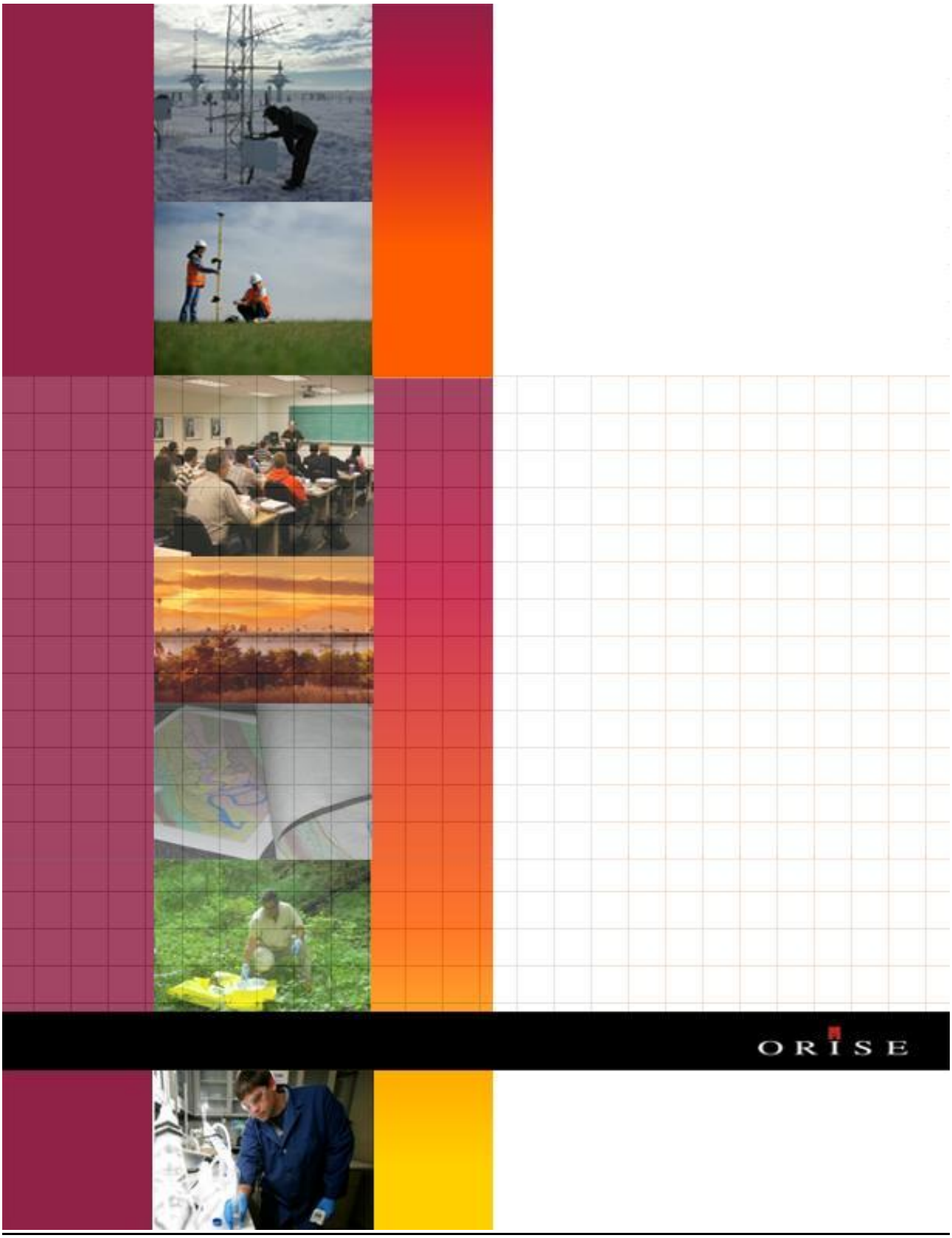
ORISE

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CONFIRMATORY SURVEY OF THE FUEL OIL TANK AREA
HUMBOLDT BAY POWER PLANT
EUREKA, CALIFORNIA

Prepared by

W. C. Adams

ORISE

Independent Environmental Assessment and Verification Program
Oak Ridge Institute for Science and Education
Oak Ridge, Tennessee 37831-0017

Prepared for the
U.S. Nuclear Regulatory Commission

FINAL REPORT

APRIL 2012

This report is based on work performed by the Oak Ridge Institute for Science and Education under contract number DE-AC05-06OR23100 with the Department of Energy.

Prepared by the Oak Ridge Institute for Science and Education, under interagency agreement (NRC FIN No. F1008) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

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CONFIRMATORY SURVEY OF THE FUEL OIL TANK AREA
HUMBOLDT BAY POWER PLANT
EUREKA, CALIFORNIA

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ACRONYMS

CFR	Code of Federal Regulations
cpm	counts per minute
CSPW	Characterization Survey Planning Worksheet
DCGL	derived concentration guideline level
DQO	data quality objectives
ESI	Enercon Services, Incorporated
FOTA	Fuel Oil Tank Area
FSS	final status survey
GPS	global positioning system
GWS	gamma walkover scans
HBPP	Humboldt Bay Power Plant
HBRP	Humboldt Bay Repowering Project
IEAV	Independent Environmental Assessment and Verification
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MeV	million electron volts
MWe	megawatt electric
NORM	naturally occurring radioactive material
NRC	U.S. Nuclear Regulatory Commission
OOL	Open Outside (of RCA) Land Area
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
PG&E	Pacific Gas & Electric Company
RCA	radiological control area
RER	Replicate Error Ratio
ROC	radionuclide of concern
SAFSTOR	cold shutdown and safe storage
SOR	Sum-of-Ratios
SPCS	State Plane Coordinate System
SU	survey unit

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CONFIRMATORY SURVEY OF THE FUEL OIL TANK AREA
HUMBOLDT BAY POWER PLANT
EUREKA, CALIFORNIA

1. INTRODUCTION AND SITE HISTORY

The Pacific Gas & Electric Company (PG&E) operated the Humboldt Bay Power Plant (HBPP) Unit 3 nuclear reactor near Eureka, California under U.S. Atomic Energy Commission provisional license number Demonstration Power Reactor license DPR-7. HBPP Unit 3 achieved initial criticality in February 1963 and began commercial operations in August 1963. Unit 3 was a natural circulation boiling water reactor with a direct-cycle design. This design eliminated the need for heat transfer loops and large containment structures. Also, the pressure suppression containment design permitted below-ground construction. Stainless steel fuel claddings were used from startup until cladding failures resulted in plant system contamination—zircaloy-clad fuel was used exclusively starting in 1965 eliminating cladding-related contamination. A number of spills and gaseous releases were reported during operations resulting in a range of mitigative activities (see ESI 2008 for details).

In July 1973, Unit 3 was shut down for annual refueling and seismic modifications. However, by December 1980 it was concluded that completing the required upgrades and restarting Unit 3 would be cost prohibitive. PG&E decided in June 1983 to decommission Unit 3, received a possession-only license amendment, and placed the unit into cold shutdown and safety storage (SAFSTOR). Unit 3 is currently undergoing decommissioning. Decommissioning activities have also been completed on the adjacent fossil fuel Units 1 and 2, with all materials being removed to ground level. As part of the Humboldt Bay Repowering Project (HBRP), PG&E has built ten new fossil fuel units (16.3 MWe [megawatt electric] each) on the site in the vicinity of Unit 3.

Currently, PG&E has demolished the Fuel Oil Tank and has performed final status surveys (FSS) on the former Fuel Oil Tank Area (FOTA) soils. Hence, the U.S. Nuclear Regulatory Commission's (NRC's) Headquarters and Region IV Offices have requested that the Independent Environmental Assessment and Verification (IEAV) Program of the Oak Ridge Institute for Science and Education (ORISE) perform confirmatory surveys of the former FOTA excavation. Due to the small footprint of the site, the licensee has found it necessary to conduct surveys of the decontaminated survey areas and then backfill and/or pave those areas to allow for further decommissioning work. Therefore, the NRC requested that ORISE perform confirmatory surveys coincident with the

licensee's surveys and soil sampling prior to backfilling. During the ORISE survey activities, the NRC also requested additional radiological survey activities consisting of gamma walkover scans (GWS) of the newly paved road along the north and east side of the site, the Unit 1 and Unit 2 concrete pads and the Northeast Laydown Area.

2. SITE DESCRIPTION

The HBPP site, owned by PG&E, consists of 143 acres on the southern edge of Humboldt Bay four miles southwest of the town of Eureka, in Humboldt County, in the State of California (Fig. A-1). PG&E maintains ten new operating electric generating units at the HBPP site (in the New Generation Footprint Area) that run on fossil fuels, two non-operating fossil fuel units (Units 1 and 2) and one non-operational nuclear unit (Unit 3). Units 1 and 2, which were recently decommissioned to ground level, were interconnected with and west of Unit 3 (ESI 2008). The remaining property includes mostly open areas and protected wetlands.

2.1 FUEL OIL TANK AREA (FOTA)

The FOTA, pictured in Figs. A-2 and A-3, covers approximately 6,500 square meters (m^2) and is located in the northwest section of the HBPP to the west of Units 1 and 2, north of the Intake Canal and south of the Independent Spent Fuel Storage Installation. Within the FOTA is a bermed soil area that contains some asphalt roadway on portions of the berm and concrete pads, which are positioned between an access ramp and metal stairs. With the exception of the areas that were remediated from under the tank and immediately adjacent to the tank due to hydrocarbon contamination, the soil remains at the level that existed when the fuel oil tank was present. FSS activities were performed on a section of the FOTA so that a portion of the FOTA could be used for a soil pile. ORISE did not perform any confirmatory activities of that portion of the FOTA. The FOTA is identified as an Open Outside (of the Radiological Control Area) Land Area (OOL) by PG&E. The survey unit (SU) designation is OOL10.

2.2 UNIT 1 AND UNIT 2 CONCRETE PADS

The Unit 1 and Unit 2 concrete pads are located east of the FOTA and west of the Unit 3 (the Reactor Building). These were where the fossil fuel units once stood (Fig. A-2). Portions of these pad areas were in use for radiological waste container storage and as material laydown areas and these portions were therefore inaccessible.

2.3 NORTHEAST LAYDOWN AREA

The Northeast Laydown Area is located northeast of Unit 3 and the curve of the New Asphalt Roadway and west of the Discharge Canal (Fig. A-2). The area has been repaved with asphalt and at the time of the GWS, a portion of the area was inaccessible due to radiological waste containers and other radiological waste storage bins.

2.4 NEW ASPHALT ROADWAY

The New Asphalt Roadway stretches from an east/west direction at the northern portion of the site and curves to a north/south direction along the eastern portion of the site just east of Unit 3 and west of the Discharge Canal (Fig. A-2).

3. OBJECTIVES

The objective of the confirmatory side-by-side survey was to generate independent radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological soil sampling results from the FOTA. Data collected by ORISE and the licensee were reviewed to assess whether classifications based on the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000) were appropriate; whether radionuclides of concern (ROCs) were detected above historically low levels in the HBRP footprint (i.e., averaged 0.38 picocuries per gram [pCi/g] for cesium-137 [Cs-137] and non-detected for all other ROCs); and, whether data quality were sufficient for comparison to generic NRC screening values and FOTA-specific derived concentration guideline levels (DCGLs).

During the ORISE confirmatory survey activities for the FOTA, the NRC site representative also tasked ORISE with performing GWS of three additional areas as stated in Section 1.

4. DOCUMENT REVIEW

ORISE has reviewed PG&E's *Characterization Survey Planning Worksheet* (CSPW) (PG&E 2012). Since the FOTA was classified as Class 3 SU as described in Section 5, it was PG&E's intention to use the data as FSS data in the event that the characterization survey findings met the classification criteria for a Class 3 SU. The characterization plan worksheet was specifically reviewed for historical information and to identify the ROCs and the applicable DCGLs for the FOTA. ORISE also reviewed preliminary FSS data for the soil pile area within the FOTA. The purpose of these reviews was to ensure that regulatory requirements were being met by PG&E and to develop the

confirmatory survey plan. ORISE also ensured that the current FSS activities within the area were adequate and appropriate, taking into account any supporting documentation and MARSSIM guidance (NRC 2000).

5. DATA QUALITY OBJECTIVES

The ORISE independent confirmatory survey planning relies on the Data Quality Objectives (DQO) process to design and implement the confirmatory activities planned for the HBPP site. The DQO process includes the following seven steps:

- Step 1: State the problem
- Step 2: Identify the decisions
- Step 3: Identify inputs to the decisions
- Step 4: Define the study boundaries
- Step 5: Develop a decision rule
- Step 6: Specify the decision errors
- Step 7: Optimize the survey design

The confirmatory DQO steps for the HBPP site were as follows:

- Step 1, problem: The confirmatory survey must assess the reliability and adequacy of the HBPP FSS results.

- Step 2, decisions: Are HBPP procedures sufficiently robust to identify residual material with concentrations that exceed the DCGLs for the ROCs, and are the residual concentrations of the primary ROC, Cs-137, sufficiently low (at background levels)?

- Step 3, decisions inputs: The decision inputs included: 1) gamma walkover scan results, and 2) soil sample results and comparison of ORISE and PG&E soil sample concentrations.

- Step 4, study boundaries: The former FOTA is the study boundary.

- Step 5, decision rules: There were two decision rules. The first was based on the comparison of the confirmatory soil sample results to the HBPP FSS results and to the site cleanup goals. The second rule was based on surface scan and judgmental sample results to

determine whether any residual "hot spots" were present and if the FOTA had been classified appropriately as Class 3.

- Step 6, decision errors: The gamma walkover scans and side-by-side split soil sample results should be in good agreement and soil sample results for the MARSSIM Class 3 Survey Unit should be at or near background levels and all ROCs below the CSPW survey design release criteria.

- Step 7, survey design optimization: The survey design was optimized to collect the appropriate data based on the procedures detailed below.

6. CONFIRMATORY RADIOLOGICAL SURVEY PROCEDURES

To expedite the survey process, ORISE coordinated and worked with the NRC site representative as the licensee planned their survey activities. This assured that ORISE would complete side-by-side confirmatory surveys at such a time as the licensee determined the probability of satisfying the FSS DQOs was high.

ORISE personnel visited the HBPP site from February 14 to 15, 2012 to perform visual inspections and independent measurements and sampling. The radiological survey activities were conducted in accordance with a project-specific plan submitted to and approved by the NRC, the ORISE *Survey Procedures Manual* and the Oak Ridge Associated Universities (ORAU) *Quality Program Manual* (ORISE 2012, 2008 and ORAU 2011).

6.1 SURVEY UNIT CLASSIFICATION

PG&E classifies SUs in accordance with MARSSIM guidance (NRC 2000) with three classifications for impacted areas, based on contamination potential—as either Class 1, 2, or 3. The FOTA has been classified by PG&E as a Class 3 SU and the historical documentation supports this classification. Class 3 area are designated as any impacted areas that are not expected to contain residual contamination, or are expected to contain levels of residual contamination at a small fraction of the DCGL.

Although the FOTA is a Class 3 SU, ORISE confirmatory survey activities coverage within the FOTA SU were conservative and on the same order of rigor as the PG&E CSPW (PG&E 2012). The PG&E CSPW called for 100% gamma scan coverage of the FOTA. Also, a portion of the

FOTA had already been surveyed and soil samples had been collected by the licensee. This was done so that a dirt pile could be placed in this portion of the FOTA SU.

6.2 Reference System

Global positioning system (GPS) coordinates were used for referencing measurement and sampling locations. The specific reference system used by the licensee was the California State Plane Coordinate System (SPCS FIPS 0401 US Survey feet; North American Datum 83).

6.3 Surface Scans

High-density gamma radiation surface scans were conducted over the soil, concrete, and asphalt surfaces within the FOTA, the area of interest for this survey report (Fig. A-3). Surface scans were performed using sodium iodide thallium-activated (NaI[Tl]) scintillation detectors coupled to ratemeter-scalers with audible indicators. Detectors were also coupled to global positioning systems (GPSs) that enabled real-time gamma count rate and position data capture. Field personnel relied on the audio output to identify and mark any locations of elevated direct gamma radiation for further investigations that might suggest the presence of residual contamination.

6.4 Gamma Direct Measurements

A one-minute static gamma count rate measurement was performed at each of the twelve remaining characterization soil sample locations determined per PG&E for the FOTA (Fig. A-4). After each soil sample was collected, a post-sample one-minute static gamma count rate was performed. Pre- and post-sample gamma direct measurements were also performed at judgmentally-selected locations exhibiting elevated gamma radiation level as determined by surface scans (Fig. A-5).

6.5 Soil Sampling

6.5.1 Systematic Sample Locations

Twelve duplicate systematic surface samples, 0 to 15 cm each, were collected from the FOTA at locations predetermined in the PG&E CSPW (Fig. A-4). Although ORISE collected one of the duplicate samples in conjunction with PG&E personnel, the final number of soil samples retained for confirmatory analysis depended upon the ORISE gamma direct measurement results and/or the PG&E preliminary gamma spectroscopy analyses of the ORISE samples. Based on the ORISE review of the aforementioned data, four of the twelve systematic soil sample duplicates were

retained for radiological analyses (PG&E samples OOL10-1, 2, 7, and 11 which corresponded to ORISE samples S001, 2, 7, and 11, respectively). Refer to Figs. A-4 and A-5, and Table B-1.

6.5.2 Judgmentally-Selected Sample Locations

Judgmental surface soil samples were collected at six locations of suspected elevated gamma radiation detected during the ORISE GWS of the FOTA surfaces (Fig. A-5). Since these were judgmental samples, ORISE requested each of these samples for independent analyses. These were ORISE samples S016 to S021 (Refer to Fig. A-5 and Table B-1).

6.6 INTERLABORATORY COMPARISON ANALYSES

Since some areas within the FOTA were covered with clean fill prior to ORISE gaining access, thus precluding direct confirmatory surveys for the soil pile area, ORISE requested that the three samples previously collected by PG&E (PG&E samples OOL10-4, 9, and 15, which were ORISE samples S004, 9, and 15, respectively) be provided to ORISE for interlaboratory comparison analysis.

7. ADDITIONAL RADIOLOGICAL SURVEY PROCEDURES

At the request of the NRC site representative, ORISE also performed limited, low-density radiological GWS of three other areas: the Unit 1 and Unit 2 remaining concrete pads (Fig. A-6), the Northeast Laydown Area (Fig. A-7), and the newly paved asphalt haul road (Fig. A-8). The additional surveys were to provide radiological scan data to ensure that radiological contamination was not being spread by continuing decommissioning activities of the Unit 3 reactor on previously released site surfaces as per the *Cross Contamination Prevention and Monitoring Plan* (CCPMP) (PG&E 2008).

8. RADIONUCLIDES OF CONCERN

The major ROC identified in the FOTA was Cs-137. A complete listing of ROCs and associated generic NRC Screening Values and FOTA-specific DCGLs are provided in Table 1. The soil DCGLs are reported in units of picocuries per gram (pCi/g).

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Table 1. Derived Concentration Guideline Levels for Surface Soil Radionuclides of Concern Humboldt Bay Power Plant Eureka, California

Nuclide	NRC Screening Value DCGLs (pCi/g)[a]	FOTA-Specific DCGLs (pCi/g)[b]
Easy to Detect – Gamma Spectroscopy[c]		
Co-60	3.8	1.9
Nb-94	5.8	2.9
I-129	0.5	0.25
Cs-137	11	5.5
Eu-152	8.7	4.35
Eu-154	8	4
Np-237	—[d]	115
Hard to Detect – Wet Chemistry[e]		
H-3	110	55
C-14	12	6
Ni-59	5,500	2,750
Ni-63	2,100	1,050
Sr-90	1.7	0.85
Tc-99	19	9.5
Pu-238	2.5	1.25
Pu-239	2.3	1.15
Pu-240	—	1,240
Pu-241	72	36
Am-241	2.1	1.05
Cm-243	3.2	1.6
Cm-244	—	2,200
Cm-245	—	276
Cm-246	—	1,190

[a]Derived concentration guideline levels from NUREG-1757, Volume 1, Revision 1 Table B-2 (NRC 2003)
[b]DCGLs applied under the *Characterization Survey Planning Worksheet* for the HBPP FOTA correspond to the lesser of either an annual dose of 15 mrem/y (the 25 mrem/y DCGL adjusted to an assumed California Department of Toxic Substance Control risk-based release of 15 mrem/y) or 50% of the NRC Screening Values (PG&E 2012)
[c]Easy-to-detect radionuclide concentrations determined via gamma spectroscopy
[d]NRC Screening Value not provided
[e]Hard-to-detect radionuclide concentrations may be determined with wet chemistry analytical procedures based on the gamma spectroscopy results and with guidance from the NRC site representative

9. SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to the ORISE laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2011). Soil samples were analyzed by gamma spectroscopy with the primary ROC being Cs-137; however, spectra were also reviewed for other gamma-emitting radionuclides (i.e., fission and activation products) associated with the HBPP. After reviewing the gamma spectroscopy results, wet chemistry analyses for additional radionuclides such as Ni-63, Sr-90, and transuranics were deemed not necessary.

Soil sample results were reported in units of pCi/g. Gamma count rate measurement results were reported in units of counts per minute (cpm). The data generated were compared with the PG&E analytical results (specifically for Cs-137) and then with the CSPW survey design release criteria established for the primary site-specific ROC for the FOTA. All sample results were compared with the FOTA-specific applicable DCGL and MARSSIM guidance to determine if the FOTA Class 3 designation was appropriate. Additional information regarding instrumentation and procedures may be found in Appendices C and D.

10. FINDINGS AND RESULTS

The results for each radiological survey procedure component are discussed in the following sections.

10.1 DOCUMENT REVIEW

The ORISE reviews of PG&E's CSPW and preliminary radiological data indicated that the procedures and methods implemented were appropriate for the FOTA (PG&E 2012).

10.2 SURFACE SCANS

Gamma radiation surface scans identified six areas of elevated gamma radiation, primarily along the excavation trenches used to drain standing water from the site, along other surface water runoff areas, and at the asphalt entrance at the northeast corner of the berm. The gamma scan paths and the normalized count rate in cpm are provided in Fig. A-3. The gamma scans ranged from less than 3,800 to 11,390 cpm. Figure A-9 is the frequency histogram of the normalized walkover gamma count rate data population for the FOTA; the histogram indicates a normal distribution typical of the background concentrations associated with those areas. ORISE did observe slightly elevated

gamma radiation levels over the ground surface where the standing water excavation trench dirt was piled. Further investigation indicated a natural soil strata layer deposit. The dark lines in the trench pictures (Fig. A-10) indicate the locations where the elevated gamma radiations were in the southern portion of the FOTA near where the former fuel tank used to be located.

The ORISE GWS data indicates that the low gamma radiation levels associated with the Class 3 SU is typical of background levels that ranged from 3,200 to 5,400 cpm over the various surfaces (soil, asphalt and concrete) within the FOTA.

10.3 Gamma Direct Measurements

Gamma direct measurements were performed at each soil sample location. The results indicated that gamma radiation levels were at or near background levels (3,500 cpm). ORISE selected soil samples from locations that exhibited the highest gamma radiation levels even though those locations were slightly above background levels.

10.4 Radionuclide Concentrations in Confirmatory Soil Samples

The summary data for the FOTA systematic and judgmental soil samples are presented in Table 2. The data for the radionuclide concentrations in individual samples are provided in Table B-1. All soil results for Cs-137 were less than the respective FOTA CSPW designed release criteria for each individual soil sample. Total uranium concentrations, as a naturally occurring radioactive material (NORM), are provided to account for the elevated gamma radiation levels determined by the GWS in the FOTA.

Table 2. Radionuclide Concentrations in FOTA Soil Samples Summary Results

Soil Sample Summary	Radionuclide Concentrations (pCi/g)				
	Cs-137	Co-60	U-235	U-238	Total U[a]
Systematic	0.03 to 0.37	-0.02 to 0.01	0.04 to 0.16	0.15 to 0.69	0.34 to 1.48
Mean Concentration	*0.26*	*0.00*[b]	*0.07*	*0.45*	*0.97*
Judgmental	-0.01 to 0.51	-0.01 to 0.01	-0.02 to 0.08	0.28 to 1.84	0.60 to 3.75
Mean Concentration	*0.14*	*0.00*	*0.04*	*0.82*	*1.69*

[a]Total U = U-238 * 2 + U-235
[b]Zero values due to rounding

ORISE also performed a comparison of the ORISE and PG&E soil samples results (Table B-2). PG&E's Cs-137 results, for those sample locations where both ORISE and PG&E provide analytical data, are in good agreement and indicate that the FOTA Cs-137 concentrations are at background levels.

10.5 Radionuclide Concentrations in Interlaboratory Comparison Analyses Soil Samples

The results of the interlaboratory comparison soil samples indicate that the ORISE and PG&E radiological soil sample results are in good agreement. The comparison soil sample results are presented in Table B-3.

11. COMPARISON OF RESULTS WITH RELEASE CRITERIA

The applicable site-specific soil DCGLs for the ROCs are provided in Table 1 and have been approved by the NRC (ESI 2007). The primary ROC for the FOTA, as designated by the CSPW, was Cs-137. To demonstrate compliance with the Table 1 FOTA-specific criteria, each radionuclide concentration should be less than its respective DCGL—with consideration for small areas of elevated activity—as well as application of the unity rule (Sum-of-Ratios [SOR]). The unity rule requires that the sum of the concentration of each contaminant divided by the respective guideline be less than one.

$$SOR = \frac{Conc_1}{DCGL_1} + \frac{Conc_2}{DCGL_2} + \cdots + \frac{Conc_n}{DCGL_n} \leq 1$$

Cs-137 and Co-60 were the only identified ROCs in the ORISE-analyzed soil samples. ORISE also reported the uranium concentrations to determine the natural concentrations associated with the NORM soil strata determined in the FOTA. Radionuclide concentrations in soil samples were directly compared with the Cs-137 DCGLs provided in Table 1. ORISE did not apply the unity rule/SOR in the activity calculations for each of the soil samples since the primary ROC, Cs-137, was well below the release criteria and a review of the gamma spectroscopy data did not indicate any other easy-to-detect ROC other than Co-60. Each of the 13 soil samples analyzed by ORISE was below the individual Cs-137 FOTA-specific release criteria.

12. ADDITIONAL RADIOLOGICAL SURVEY ACTIVITIES

12.1 UNIT 1 AND UNIT 2 - GAMMA WALKOVER SCANS

GWS over the Unit 1 and Unit 2 concrete pads indicated a gamma count rate range from less than 3,300 to approximately 13,000 cpm. The elevated gamma radiation levels were determined to be from shine when the surveyor was in the proximity of radiological waste containers and the radwater waste treatment facility. Elevated gamma radiation levels were not found on the portion of the concrete pads that were scanned. The GWS results are presented in Fig. A-6 and the GWS frequency histogram is provided in Fig. A-11.

12.2 NORTHEAST LAYDOWN AREA - GAMMA WALKOVER SCANS

GWS over the Northeast Laydown Area asphalt pad indicated a gamma count rate range from less than 3,000 to approximately 21,000 cpm. The elevated gamma radiation levels were determined to be from shine when the surveyor was in the proximity of radiological waste containers and other wrapped radiological waste. The highest count rate was on a piece of equipment that had been determined to an X-bar equipment lift; this piece of equipment was determined to not be tagged with a radiological identification tag). Elevated gamma radiation levels were not found on the portion of the Northeast Laydown Area asphalt pad that was scanned. The GWS results and a picture of the X-bar are presented in Fig. A-7 and the GWS frequency histogram is provided in Fig. A-12.

12.3 NEW ASPHALT ROADWAY - GAMMA WALKOVER SCANS

GWS over the new asphalt roadway indicated a gamma count rate range from less than 3,400 to approximately 11,000 cpm. The elevated gamma radiation levels were determined to be from shine when the surveyor was in the proximity of radiological waste containers and the radiological cleanup work associated with the reactor decommissioning. Elevated gamma radiation levels were not found on the portion of the asphalt roadway that was scanned. The GWS results are presented in Fig. A-8 and the GWS frequency histogram is provided in Fig. A-13.

13. SUMMARY

During the period of February 14 to 15, 2012, ORISE performed radiological confirmatory survey activities for the former FOTA and additional radiological surveys of portions of the HBPP site in Eureka, California. The radiological survey results demonstrate that residual surface soil

contamination was not present significantly above background levels within the FOTA. Therefore, it is ORISE's opinion that the radiological conditions for the FOTA surveyed by ORISE (refer to Tables 2 and B-1) are commensurate with the site release criteria for final status surveys as specified in PG&E's *Characterization Survey Planning Worksheet* (PG&E 2012). In addition, the confirmatory results indicated that the ORISE FOTA SU Cs-137 mean concentrations results compared favorably with the PG&E FOTA Cs-137 mean concentration results, as determined by ORISE from the PG&E characterization data (refer to Table B-2). The interlaboratory comparison analyses of the three soil samples analyzed by PG&E's onsite laboratory and the ORISE laboratory indicated good agreement for the sample results and provided confidence in the PG&E analytical procedures and FSS soil sample data reporting (Table B-3).

10. REFERENCES

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NRC 2003. *Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees. NUREG-1757; Volume 1, Revision 1.* Washington, DC. September.

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APPENDIX A
FIGURES

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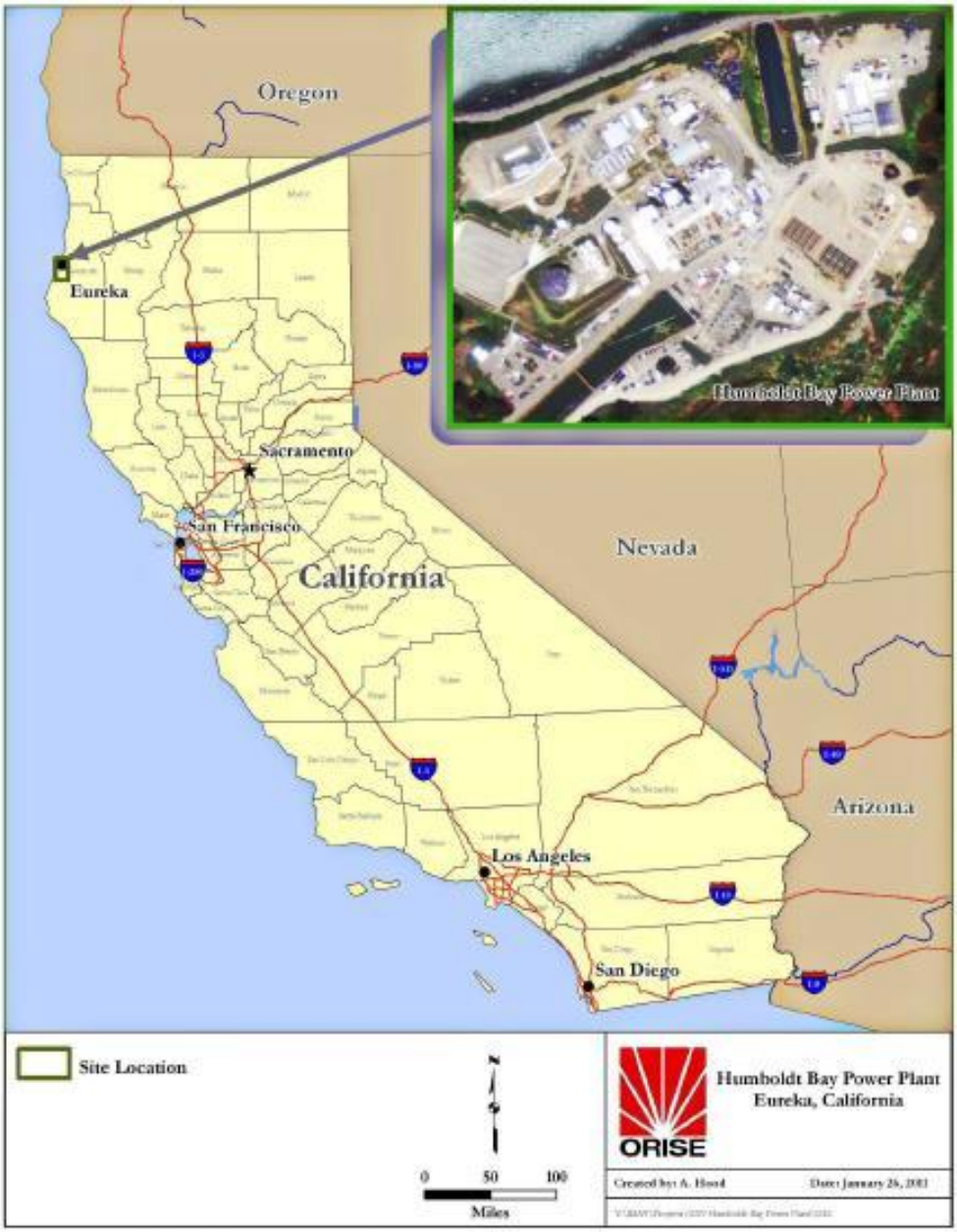

Fig. A-1. Site Location Map – Humboldt Bay Power Plant, Eureka, California

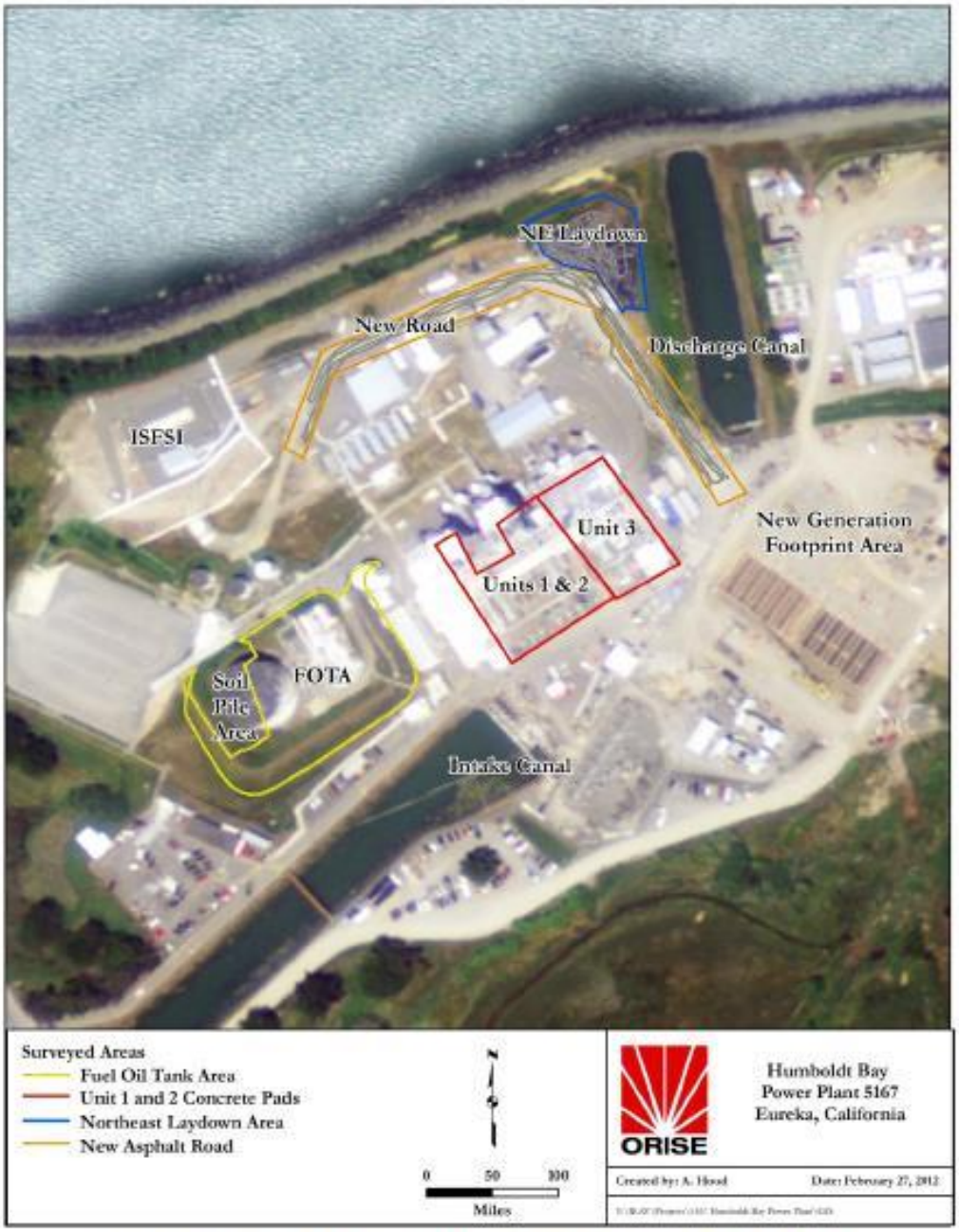

Fig. A-2. Humboldt Bay Power Plant – Site Overview of Surveyed Areas

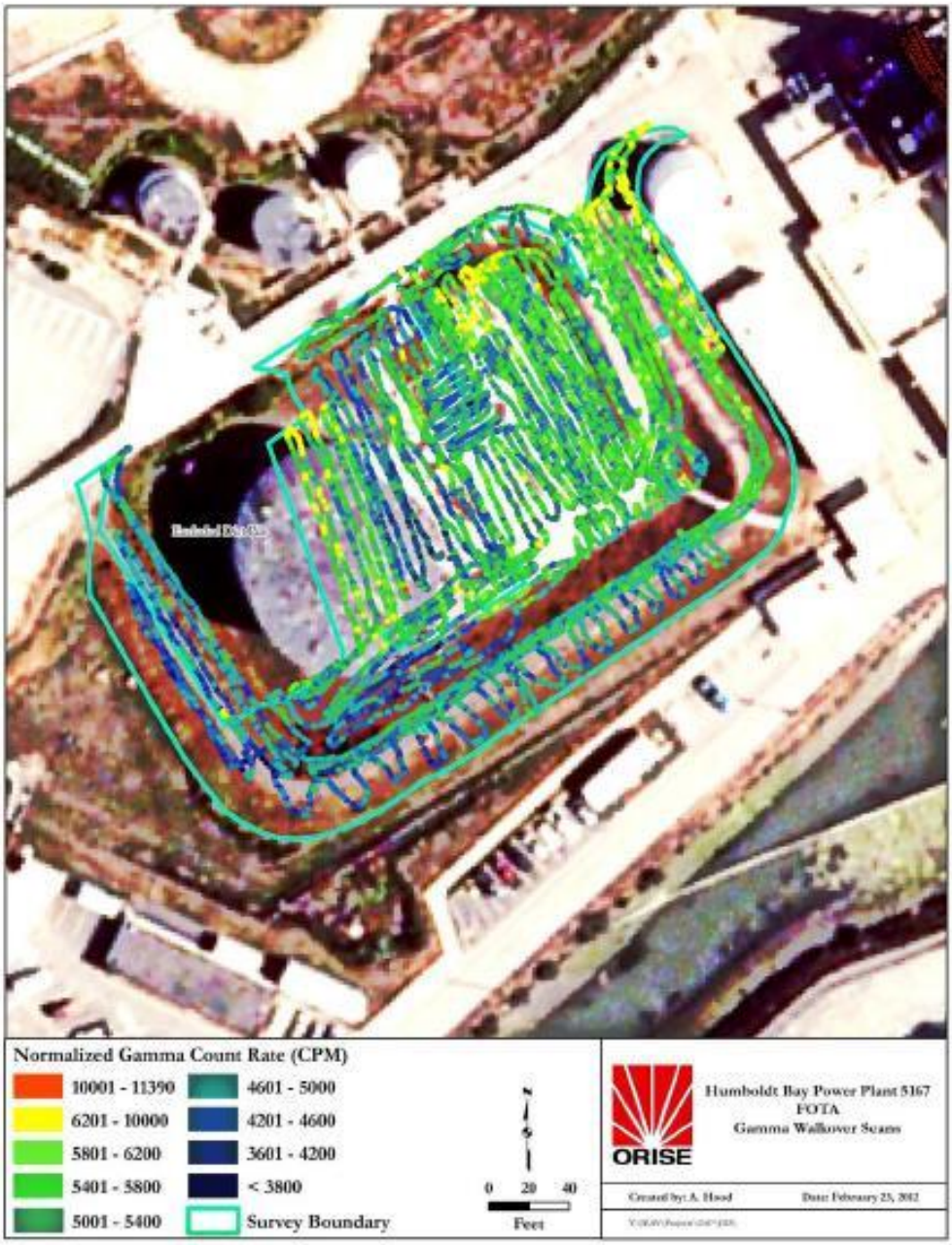

Fig. A-3. HBPP Fuel Oil Tank Area – Gamma Walkover Scans

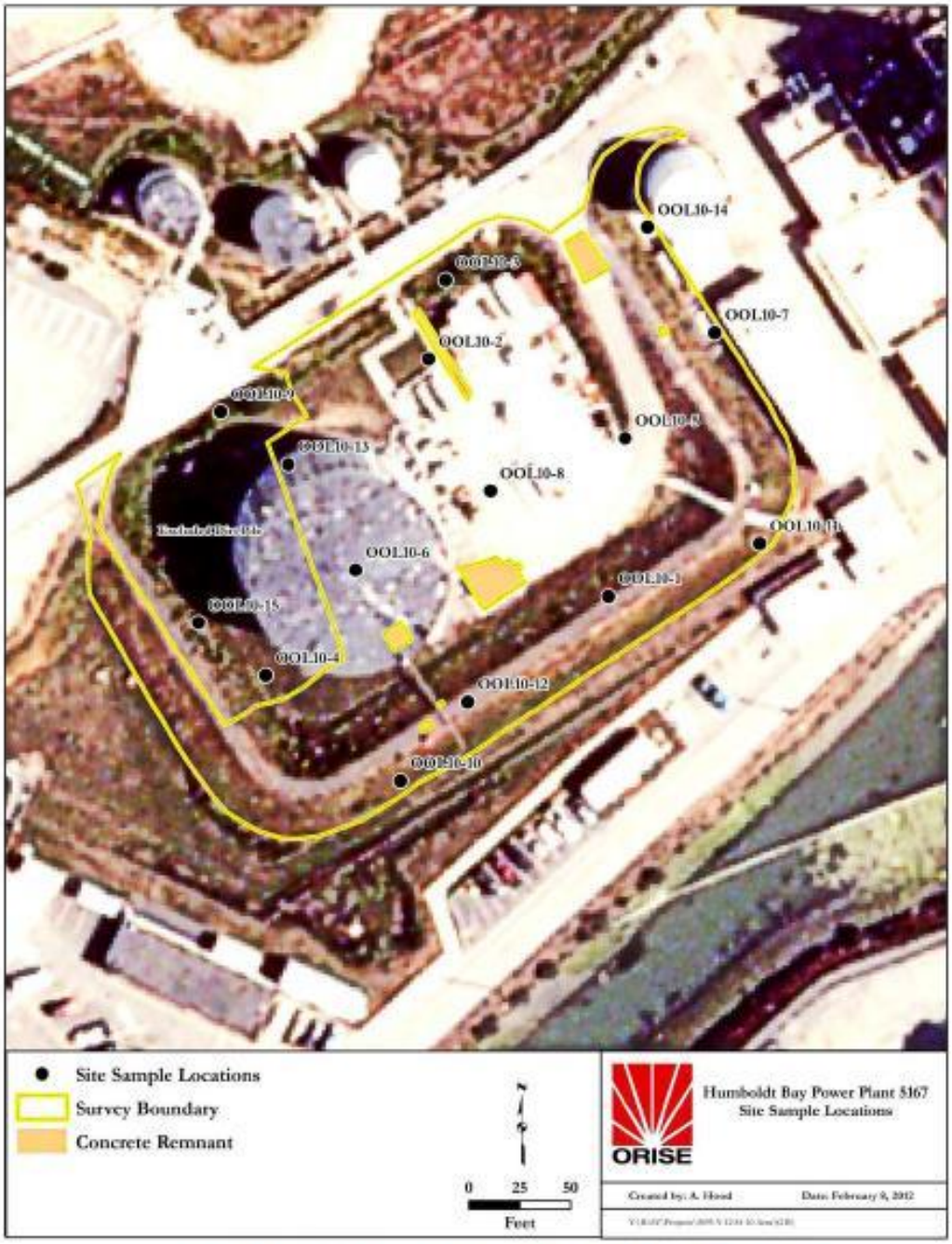

Fig. A-4. HBPP FOTA - PG&E Systematic Soil Sample Locations

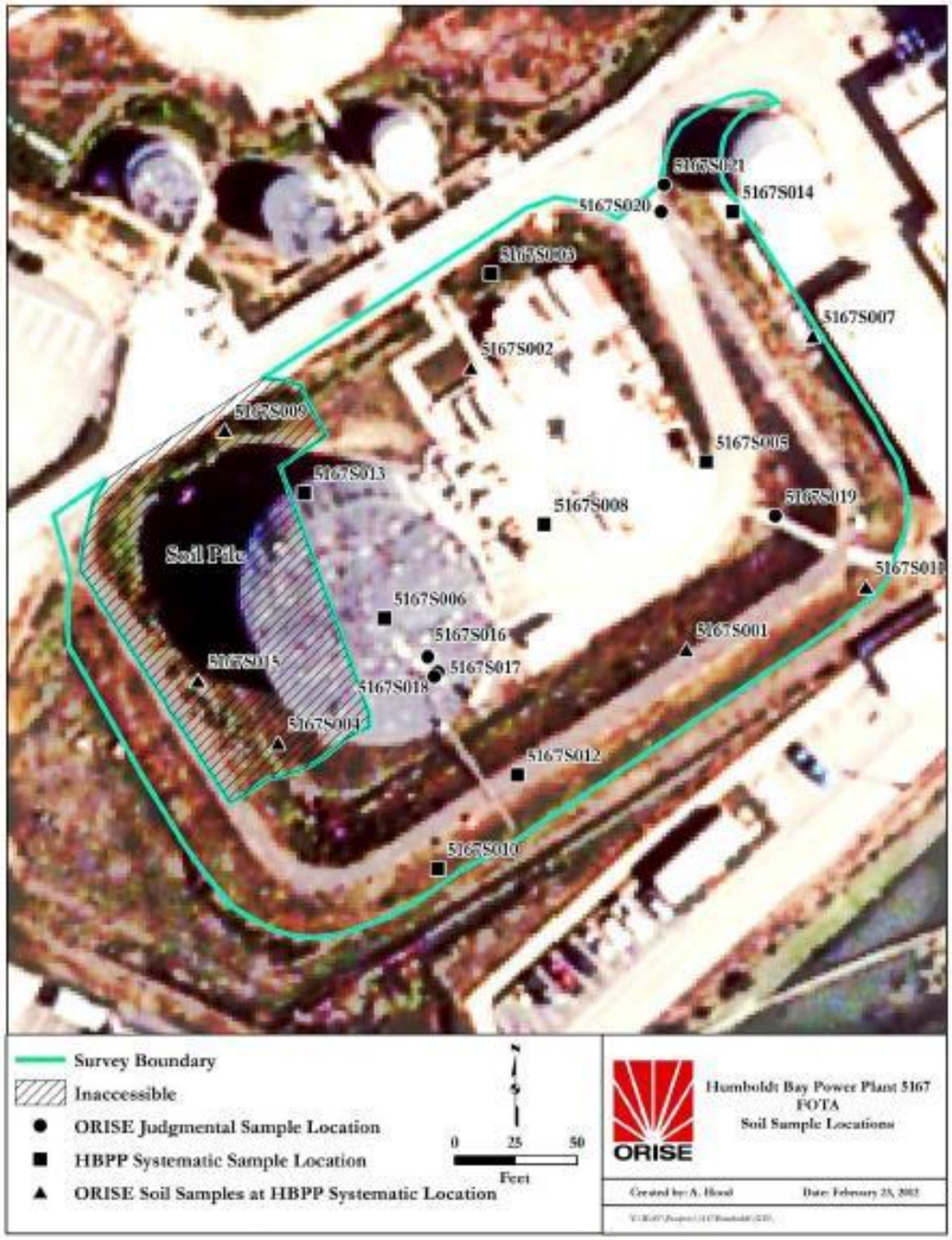

Fig. A-5. HBPP FOTA - Confirmatory Soil Sample Locations

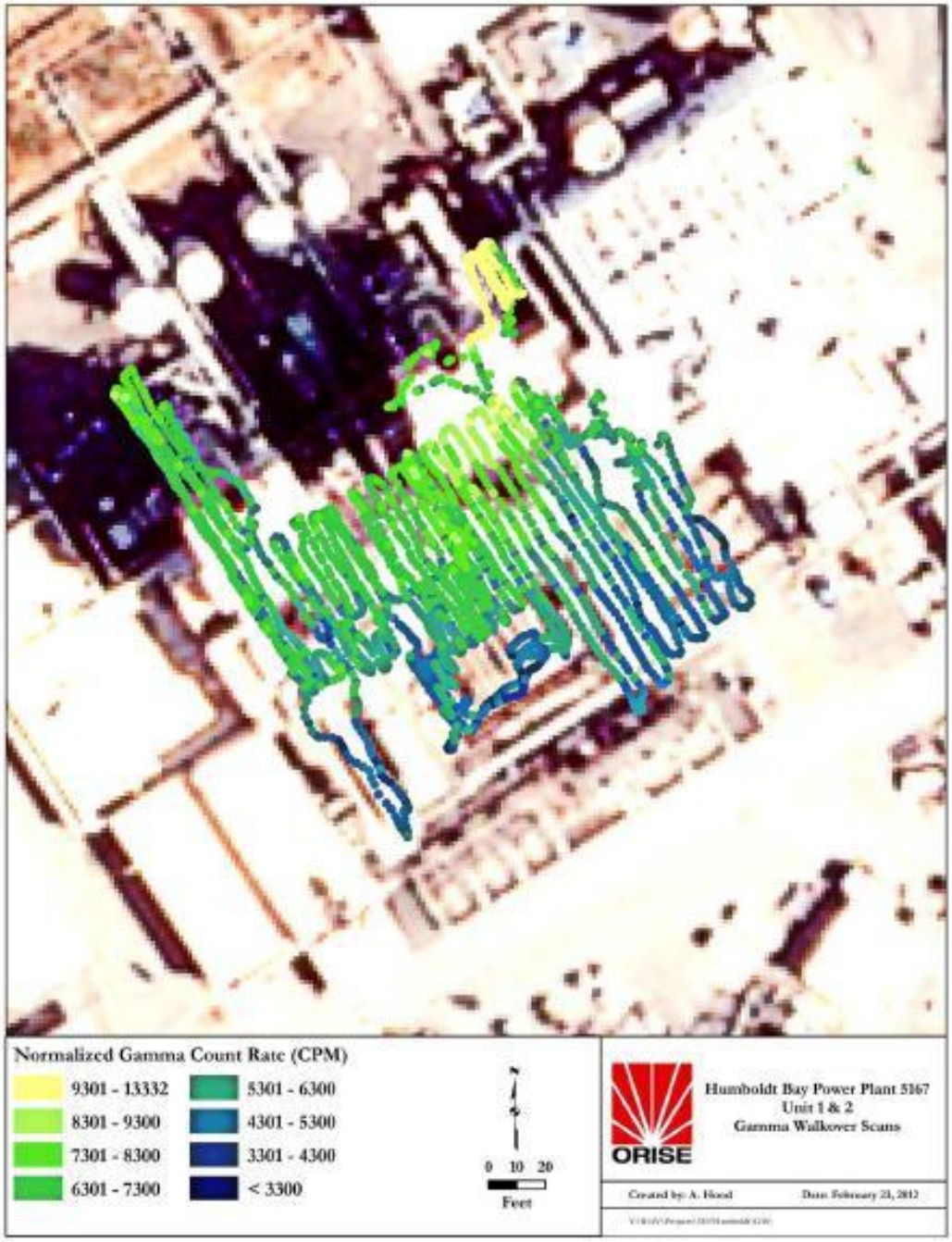

Fig. A-6. HBPP Unit 1 and Unit 2 Concrete Pads – Gamma Walkover Scans

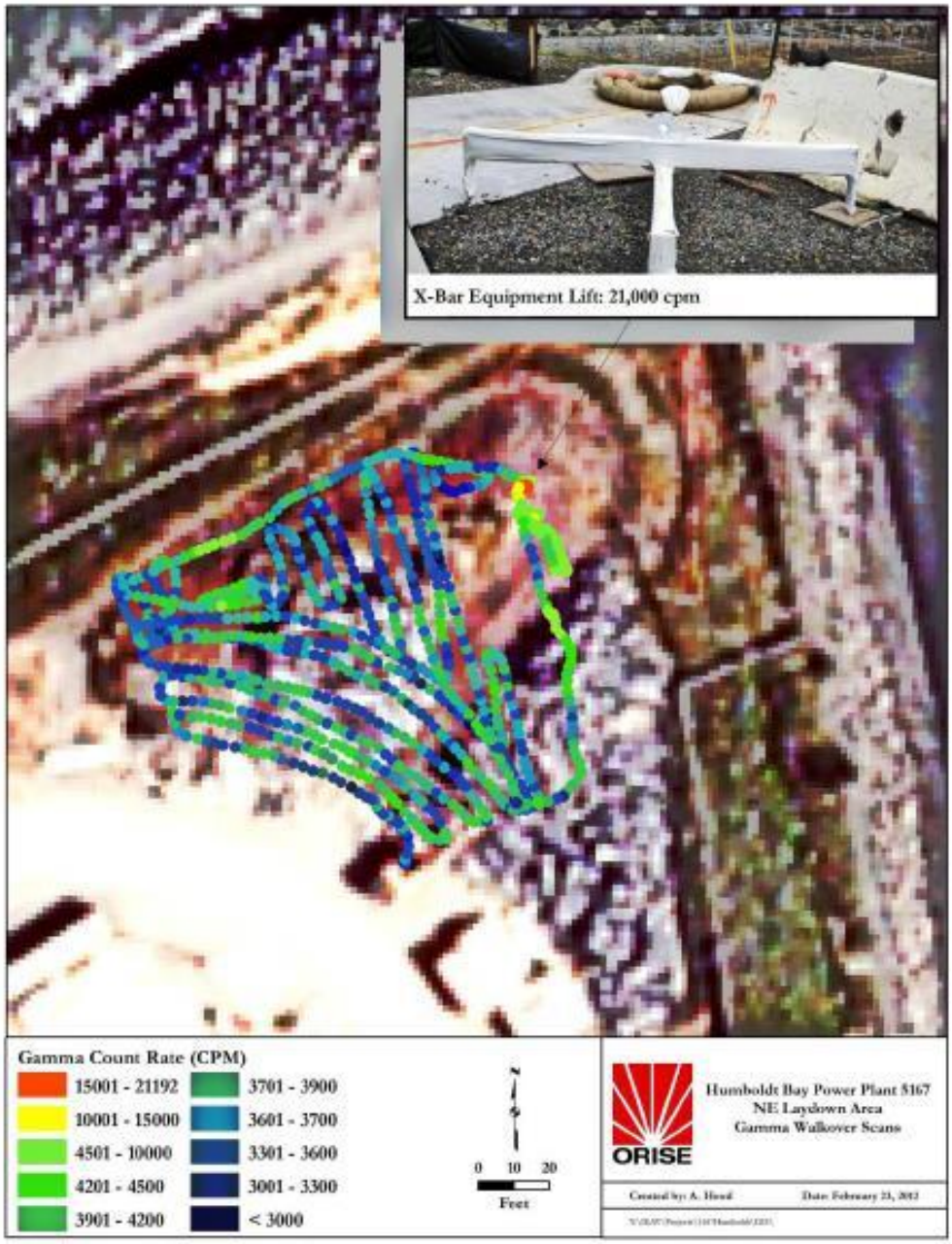

Fig. A-7. HBPP Northeast Laydown Area – Gamma Walkover Scans

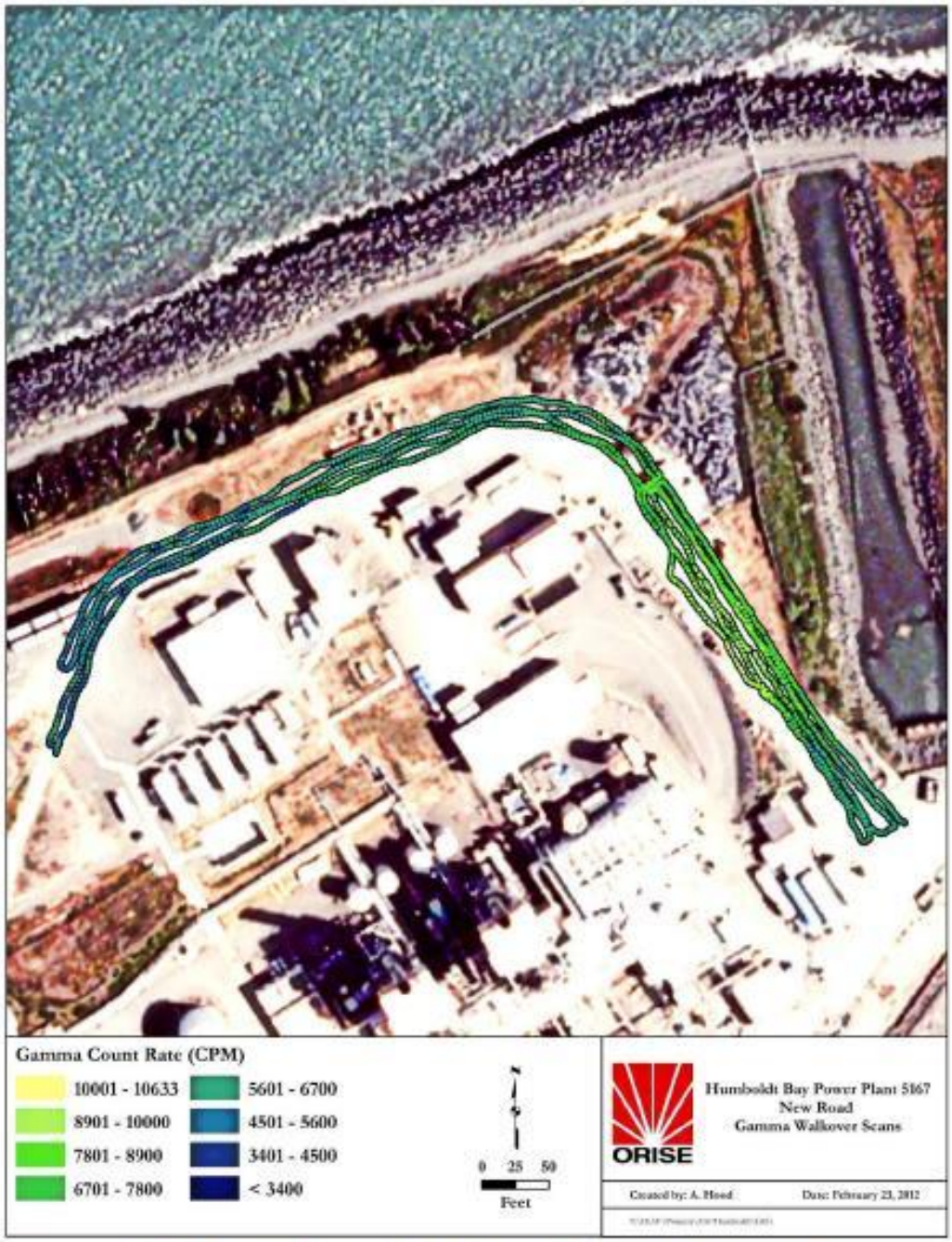

Fig. A-8. HBPP New Asphalt Roadway – Gamma Walkover Scans

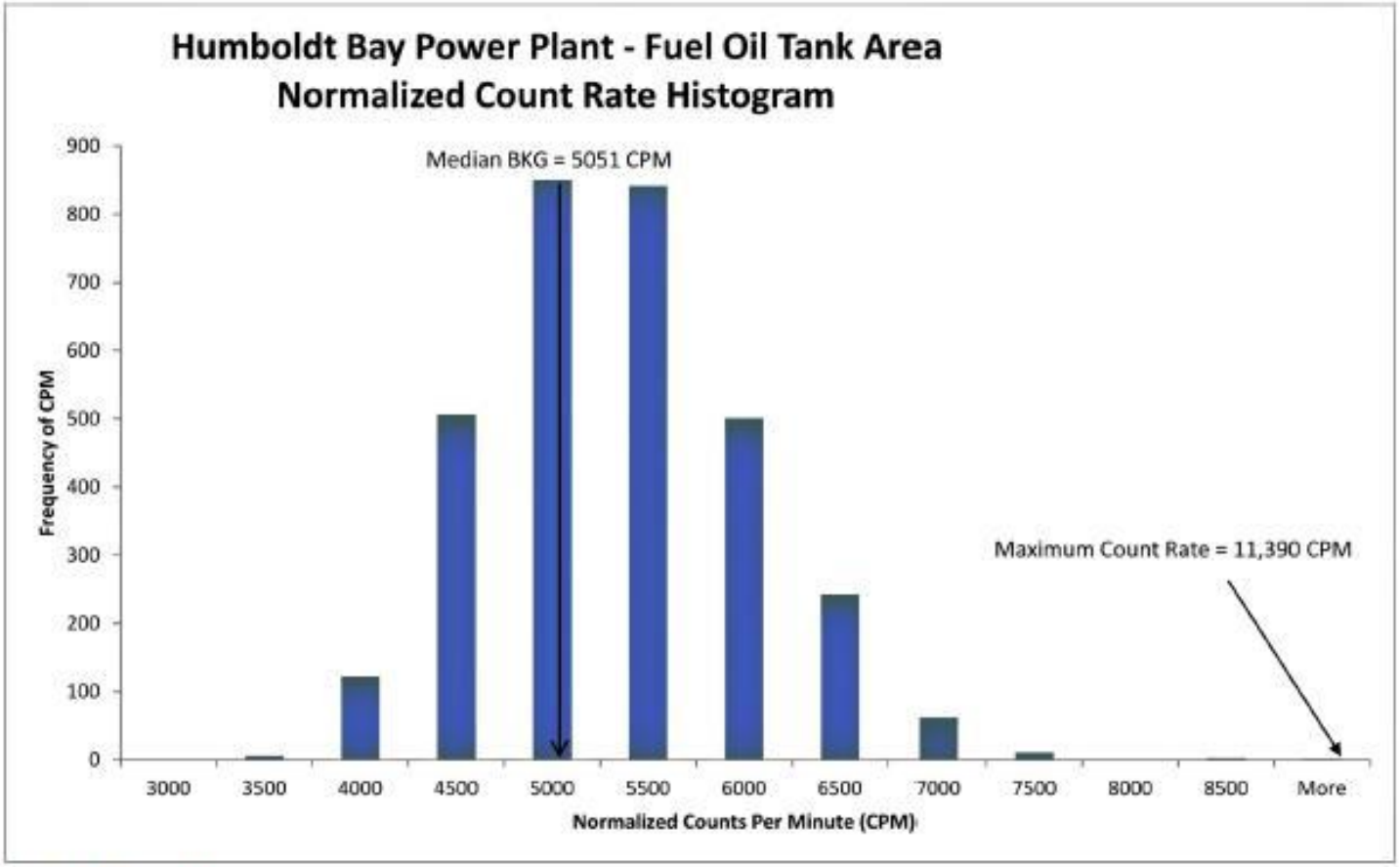

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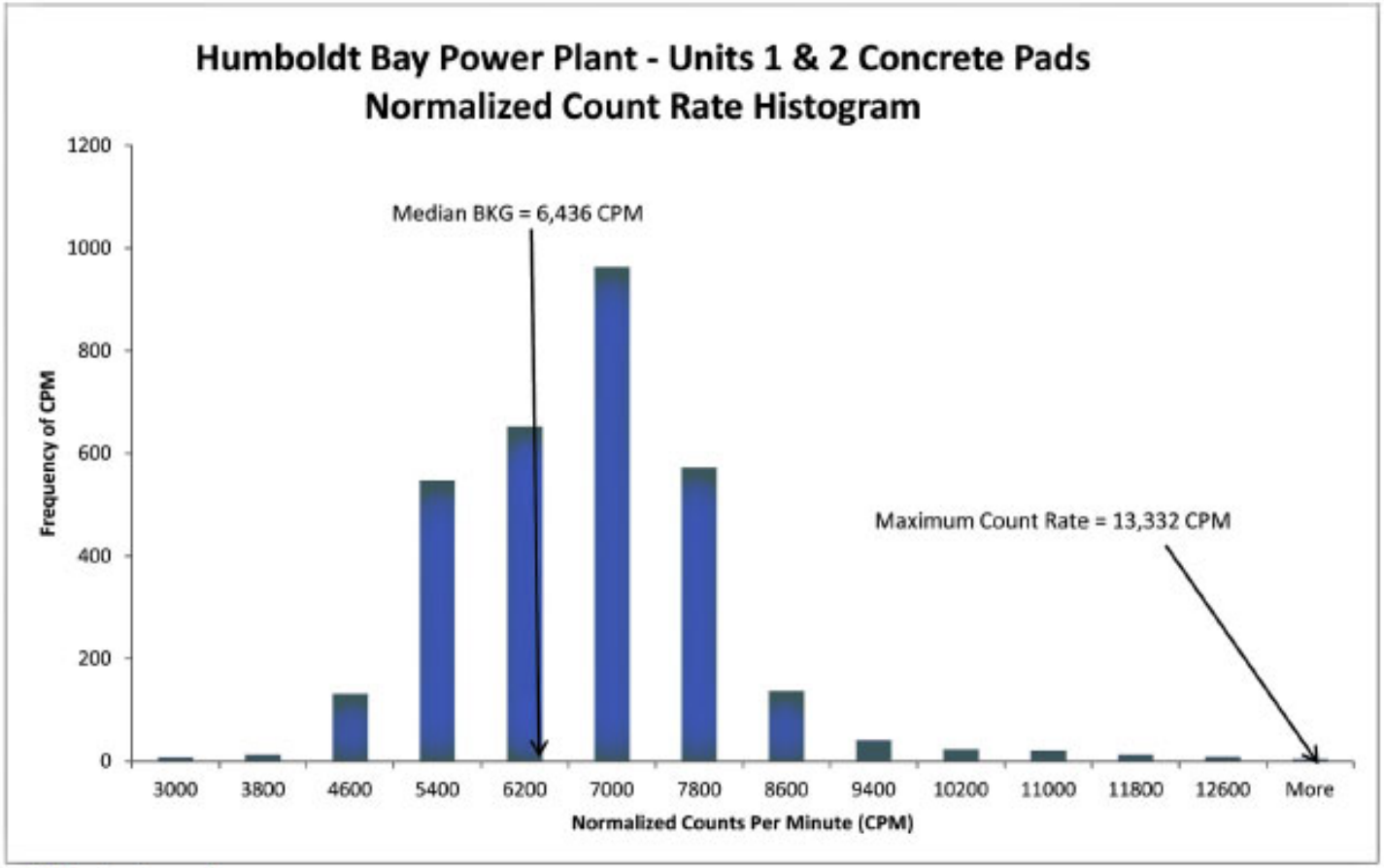
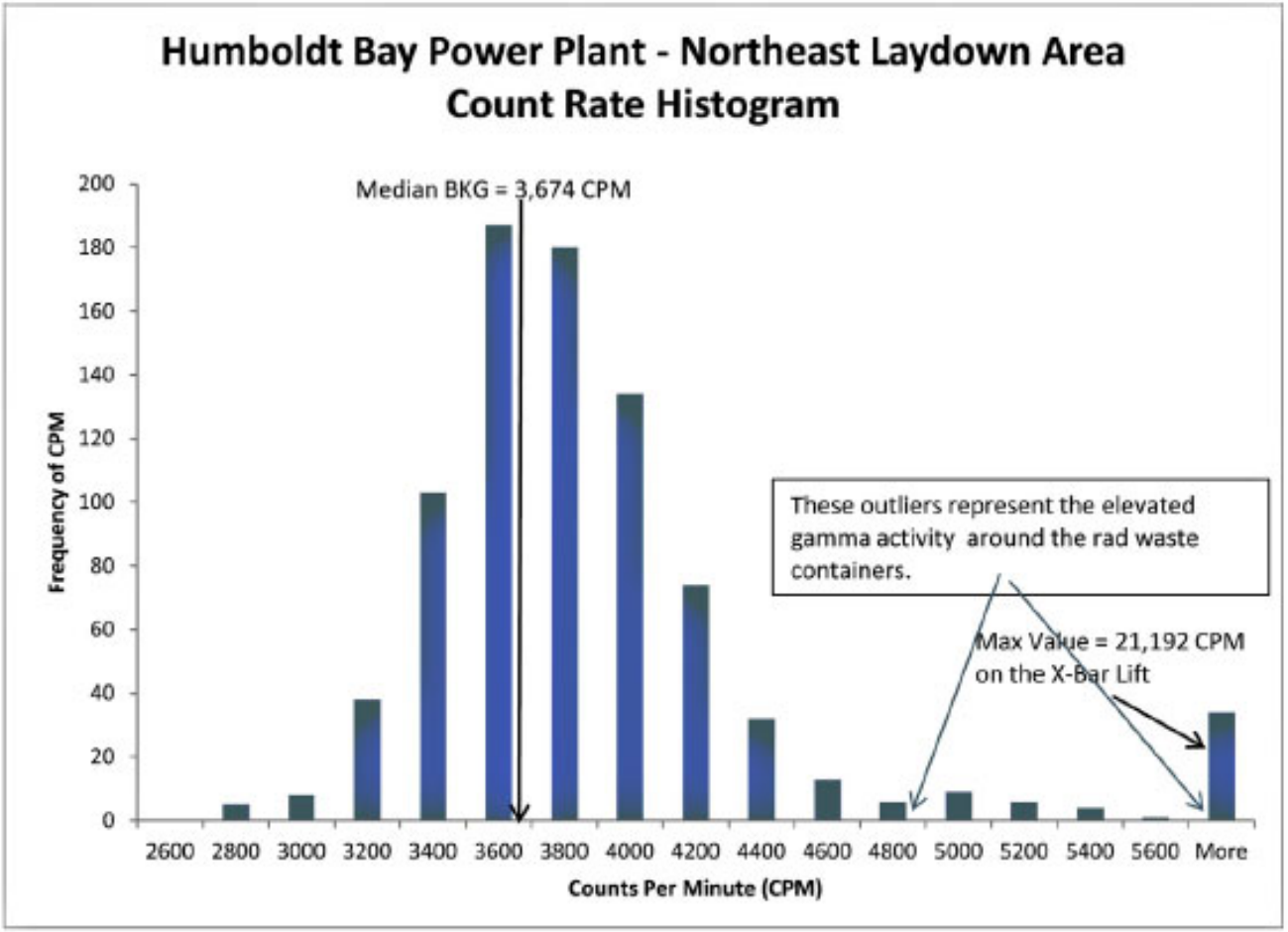
Fig. A-9. HBPP Fuel Oil Tank Area – Gamma Scan Count Rate Distribution

Fig. A-10. Fuel Oil Tank Area – Pictures of the Natural Strata Layer that Exhibited Elevated Gamma Radiation Levels



BKG = background

Fig. A-11. HBPP Units 1 & 2 Concrete Pads – Gamma Scan Count Rate Distribution



BKG = background

Fig. A-12. HBPP Northeast Laydown Area Asphalt Pad – Gamma Scan Count Rate Distribution

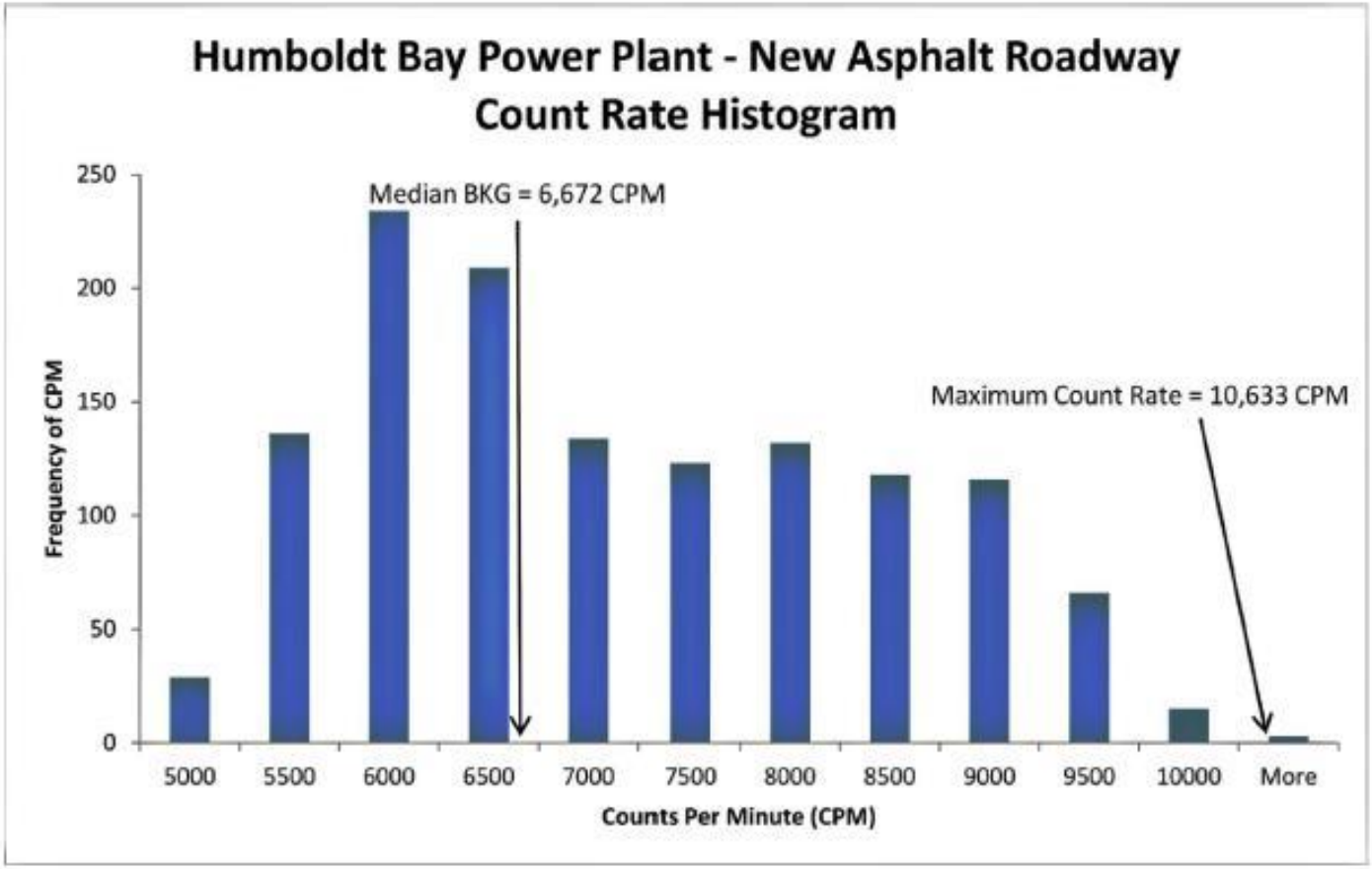


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Fig. A-13. HBPP New Asphalt Roadway – Gamma Scan Count Rate Distribution

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APPENDIX B
TABLES

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Table B-1. Radionuclide Concentrations in ORISE Soil Samples
Confirmatory Survey Activities for the Fuel Oil Tank Area
Humboldt Bay Power Plant
Eureka, California

Sample ID[a]	East (ft)	North (ft)	Cs-137	Co-60	U-235	U-238	Total U[b]
Humboldt Bay Systematically-Selected Soil Sample Locations							
S001	5949071	2160777	0.03 ± 0.02[c]	-0.01 ± 0.04	0.07 ± 0.06	0.26 ± 0.28	0.59 ± 0.56
S002	5948982	2160894	0.30 ± 0.04	0.01 ± 0.04	0.05 ± 0.14	0.52 ± 0.32	1.09 ± 0.66
S004	5948902	2160738	0.25 ± 0.04	0.00[d] ± 0.04	0.04 ± 0.08	0.24 ± 0.33	0.52 ± 0.66
S007	5949124	2160907	0.37 ± 0.04	0.00 ± 0.03	0.06 ± 0.11	0.67 ± 0.33	1.40 ± 0.67
S009	5948880	2160868	0.20 ± 0.02	0.01 ± 0.03	0.16 ± 0.11	0.59 ± 0.21	1.34 ± 0.43
S011	5949146	2160803	0.34 ± 0.04	0.00 ± 0.04	0.10 ± 0.08	0.69 ± 0.32	1.48 ± 0.64
S015	5948869	2160764	0.35 ± 0.04	-0.02 ± 0.04	0.04 ± 0.11	0.15 ± 0.36	0.34 ± 0.73
FOTA Average			*0.26*	*0.00*	*0.07*	*0.45*	*0.97*
FOTA Standard Deviation			*0.12*	*0.01*	*0.04*	*0.22*	*0.47*
ORISE Judgmental Soil Sample Locations							
S016	5948965	2160774	0.02 ± 0.01	0.00 ± 0.03	0.08 ± 0.06	0.72 ± 0.30	1.52 ± 0.60
S017	5948969	2160768	0.00 ± 0.03	0.00 ± 0.04	0.08 ± 0.06	1.11 ± 0.34	2.30 ± 0.68
S018	5948967	2160766	-0.01 ± 0.03	0.01 ± 0.05	0.07 ± 0.09	1.84 ± 0.42	3.75 ± 0.84
S019	5949108	2160832	0.29 ± 0.03	-0.01 ± 0.03	-0.02 ± 0.13	0.58 ± 0.24	1.14 ± 0.50
S020	5949061	2160958	0.01 ± 0.02	0.00 ± 0.03	0.04 ± 0.09	0.28 ± 0.23	0.60 ± 0.47
S021	5949062	2160970	0.51 ± 0.05	0.00 ± 0.04	-0.01 ± 0.12	0.41 ± 0.27	0.81 ± 0.55
Judgmental Average			*0.27*	*0.00*	*0.04*	*0.82*	*1.69*

[a]Refer to Figs. A-4 and A-5
[b]Total Uranium calculations for natural uranium were 2*U-238 + U-235
[c]Uncertainties represent the 95% confidence level, based on total propagated uncertainties
[d]Zero values are due to rounding

Table B-2. Fuel Oil Tank Area Comparison Data
Confirmatory Survey Activities for the Fuel Oil Tank Area
Humboldt Bay Power Plant
Eureka, California

ORISE Sample ID[a]	PG&E Sample ID[b]	East (ft)	North (ft)	Cs-137 Concentrations (pCi/g) ORISE			Cs-137 Concentrations (pCi/g) PG&E[c]			Relative Error Ratio (RER)[d]
Humboldt Bay Systematically-Selected Soil Sample Locations										
S001	OOL10-1	5949071	2160777	0.03	±	0.02[e]		<0.120		—[f]
S002	OOL10-2	5948982	2160894	0.30	±	0.04	0.322	±	0.080	0.25
S003	OOL10-3	5948991	2160933	—	±	—	0.353	±	0.096	—
S004	OOL10-4	5948902	2160738	0.25	±	0.04	0.193	±	0.053	0.86
S005	OOL10-5	5949079	2160855	—	±	—		<0.099		—
S006	OOL10-6	5948946	2160790	—	±	—		<0.094		—
S007	OOL10-7	5949124	2160907	0.37	±	0.04	0.313	±	0.082	0.62
S008	OOL10-8	5949013	2160829	—	±	—		<0.106		—
S009	OOL10-9	5948880	2160868	0.20	±	0.02	0.195	±	0.057	0.08
S010	OOL10-10	5948969	2160686	—	±	—		<0.179		—
S011	OOL10-11	5949146	2160803	0.34	±	0.04	0.317	±	0.088	0.24
S012	OOL10-12	5949002	2160725	—	±	—	0.350	±	0.076	—
S013	OOL10-13	5948913	2160842	—	±	—		<0.088		—
S014	OOL10-14	5949087	2160957	—	±	—		<0.129		—
S015	OOL10-15	5948869	2160764	0.35	±	0.04	0.345	±	0.083	0.05
FOTA Average				*0.26*			*0.30*			*0.30*
FOTA Standard Deviation				*0.12*			*0.07*			*0.32*

Table B-2. Fuel Oil Tank Area Comparison Data
Confirmatory Survey Activities for the Fuel Oil Tank Area
Humboldt Bay Power Plant
Eureka, California

ORISE Sample ID[a]	PG&E Sample ID[b]	East (ft)	North (ft)	Cs-137 Concentrations (pCi/g)						Relative Error Ratio (RER)[d]
				ORISE			PG&E[c]			
ORISE Judgmental Soil Sample Locations										
S016	OOL10-20	5948965	2160774	0.02	±	0.01	<0.084			—
S017	OOL10-21	5948969	2160768	0.00[g]	±	0.03	<0.082			—
S018	OOL10-22	5948967	2160766	-0.01	±	0.03	<0.108			—
S019	OOL10-23	5949108	2160832	0.29	±	0.03	0.318	±	0.074	0.35
S020	OOL10-24	5949061	2160958	0.01	±	0.02	<0.077			—
S021	OOL10-25	5949062	2160970	0.51	±	0.05	0.621	±	0.096	1.03
Judgmental Average[h]				*0.40*			*0.47*			*0.69*

[a]Refer to Figs. A-4 and A-5
[b]PG&E Sample ID provided by PG&E
[c]PG&E Cs-137 concentrations from PG&E-provided gamma spectroscopy reports
[d]Relative Error Ratio (RER) was calculated based on the formula in the DOE's Quality Systems for Analytical Services and provides a way to determine if analytical results of duplicates (in this case, split samples) are in agreement. A RER < 3 means the samples are in agreement at the 99% confidence level.
[e]Uncertainties represent the 95% confidence level, based on total propagated uncertainties
[f]Measurement or analysis not performed
[g]Zero values are due to rounding
[h]Calculated using concentrations that were greater than the minimum detectable concentration (MDC); ORISE samples used were S019 and S021

Table B-3. Radionuclide Concentrations in Interlaboratory Comparison Soil Samples
Confirmatory Survey Activities for the Fuel Oil Tank Area
Humboldt Bay Power Plant
Eureka, California

ORISE Sample ID[a]	PG&E Sample ID[b]	Cs-137 Concentrations (pCi/g)		Relative Error Ratio (RER)[c]
		ORISE	PG&E[c]	
S004	OOL10-4	0.25 ± 0.04[c]	0.19 ± 0.05	0.9
S009	OOL10-9	0.20 ± 0.02	0.20 ± 0.06	0.1
S015	OOL10-15	0.35 ± 0.04	0.35 ± 0.08	0.1

[a]Refer to Figs. A-4 and A-5
[b]PG&E sample identification and sample Cs-137 concentrations provided by PG&E
[c]Relative Error Ratio (RER) was calculated based on the formula in the DOE's Quality Systems for Analytical Services and provides a way to determine if analytical results of duplicates (in this case, split samples) are in agreement. A RER < 3 means the samples are in agreement at the 99% confidence level.
[d]ORISE uncertainties represent the 95% confidence level, based on total propagated uncertainties

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APPENDIX C
MAJOR INSTRUMENTATION

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The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or his employer.

C.1 Scanning and Measurement Instrument/Detector Combinations

C.1.1 Gamma

Ludlum NaI Scintillation Detector Model 44-10, Crystal:2 in x 2 in
coupled to:
Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to:
Trimble GeoXH Receiver and Data Logger
(Trimble Navigation Limited, Sunnyvale, CA)

C.1.2 Laboratory Analytical Instrumentation

High Purity Extended Range Intrinsic Detector
CANBERRA/Tennelec Model No: ERVDS30-25195
(Canberra, Meriden, CT)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
Canberra's Apex Gamma Software
Dell Workstation
(Canberra, Meriden, CT)

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(AMETEK/ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data)
Multichannel Analyzer
Canberra's Apex Gamma Software
Dell Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-30-P4, 30% Eff.
(AMETEK/ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
Canberra's Apex Gamma Software
Dell Workstation
(Canberra, Meriden, CT)

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APPENDIX D
SURVEY AND ANALYTICAL PROCEDURES

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D.1 PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current Job Hazard Analyses (JHA). All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures (ORISE 2008 and 2010).

Pre-survey activities included the evaluation and identification of potential health and safety issues. Survey work was performed per the ORISE generic health and safety plans and a site-specific Integrated Safety Management (ISM) pre-job hazard checklist. PG&E personnel also provided site-specific safety awareness training. An ORISE safety walkdown of the site indicated that the land clearing activities and restoration activities by PG&E personnel left uneven terrain in some areas typical for outdoor survey activities, steep inclines on the berms, and standing water and thick mud in a portion of the FOTA.

D.2 CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on sources/standards, traceable to the National Institute of Standards and Technology (NIST).

Analytical and field survey activities were conducted in accordance with procedures from the following ORAU and ORISE documents:

- Survey Procedures Manual (May 2008)
- Laboratory Procedures Manual (December 2011)
- Quality Program Manual (December 2011)

The procedures contained in these manuals were developed to meet the requirements of 10 Code of Federal Regulations (CFR) 830 Subpart A, *Quality Assurance Requirements*, Department of Energy Order 414.1C *Quality Assurance*, and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment Operation is within acceptable statistical fluctuations.
- Participation in Mixed-Analyte Performance Evaluation Program (MAPEP), NIST Radiochemistry Intercomparison Testing Program (NRIP), and Intercomparison Testing Program (ITP) Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

D.3 SURVEY PROCEDURES

D.3.1 SURFACE SCANS

A NaI(Tl) scintillation detector was used to scan for elevated gamma radiation. Identification of elevated radiation levels was based on increases in the audible signal from the recording and/or indicating instrument. Additionally, the detectors were coupled to GPS units with data loggers enabling real-time recording in one-second intervals of both geographic position and the gamma count rate. Positioning data files were downloaded from field data loggers for plotting using commercially available software (http://trl.trimble.com/docushare/dsweb/Get/Document-261826/GeoExpl2005_100A_GSG_ENG.pdf). Position and gamma count rate data files were transferred to a computer system, positions were differentially corrected, and the results were plotted on geo-referenced aerial photographs. Positional accuracy was within 0.5 meters at the 95th percentile.

ORISE Survey Procedures (ORISE 2008) require a minimum scan speed of 0.5 to 1 meter per second (m/s) based on the site contaminant and the DCGL for the primary contaminant of concern. A review of the gamma walkover scan data points relative to the scan area coverage indicate that the scan speed was less than 0.5 m/s. The scan minimum detectable concentrations for the NaI scintillation detectors was 6.6 pCi/g for Cs-137, the primary radionuclide of concern as provided in NUREG-1507 (Table 6.4). Any audible increase in radiation levels were investigated by

ORISE. It is standard procedure for the ORISE staff to pause and investigate any locations where gamma radiation is distinguishable from background levels.

D.3.2 Soil Sampling

Approximately 0.5 to 1 kg of soil was collected at each sample location. Collected samples were placed in a Marinelli jar, sealed, and labeled in accordance with ORISE survey procedures. The systematic soil samples were collected as split soil samples with PG&E personnel from the systematically-selected soil sample locations as determined by PG&E. The judgmental samples were collected as split samples with PG&E personnel from locations of elevated gamma radiation levels as determined by the ORISE gamma walkover scans.

D.4 RADIOLOGICAL ANALYSIS

D.4.1 Gamma Spectroscopy

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in a 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights and volumes were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All total absorption peaks (TAP) associated with the radionuclides of concern (ROCs) were reviewed for consistency of activity. TAPs used for determining the activities of ROCs and the typical associated minimum detectable concentration (MDCs) for a one-hour count time were:

Radionuclide	TAP[a] (MeV)	MDC (pCi/g)
Co-60	1.173	0.06
Cs-137	0.661	0.05
U-235	0.143	0.24
U-238 by Th-234	0.063	0.75

[a]Spectra were also reviewed for other identifiable easy-to-detect TAPs that would not be expected at this site.

D.4.2 Uncertainties

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels.

D.4.3 Detection Limits

Detection limits, referred to as minimum detectable concentrations, were based on 3 plus 4.65 times the standard deviation of the background count [$3 + (4.65\ (BKG)^{1/2})$]. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

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January 17, 2020

Mr. John Hickman
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Decommissioning, Uranium Recovery, and Waste Programs
Materials Decommissioning Branch
TWFN Mail Stop: T-8F5
Rockville, MD 20852

SUBJECT: DOE Contract No. DE-SC0014664
INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS AT THE HUMBOLDT BAY POWER PLANT, EUREKA, CALIFORNIA
DOCKET NO.05000133; RFTA NO. 18-005;
DCN 5272-SR-04-0

Dear Mr. Hickman:

The Oak Ridge Institute for Science and Education (ORISE) is pleased to provide the enclosed report, which describes the procedures and results of the independent confirmatory survey for remaining land areas and select buildings at the Humboldt Bay Power Plant in Eureka, California that ORISE performed during the period of August 26-29, 2019. NRC's comments on the draft report have been addressed in this final version.

You may contact me at 865.576.6659 or Kaitlin Engel at 865.574.7008 if you have any questions or require additional information.

Sincerely,

Erika N. Bailey

Erika N. Bailey
Survey and Technical Projects Group Manager
ORISE

KME:tb

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INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

K. M. Engel
ORISE

FINAL REPORT

Prepared for the
U.S. Nuclear Regulatory Commission

January 2020

Further dissemination authorized to NRC only; other requests shall be approved by the originating facility or higher NRC programmatic authority.

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INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

FINAL REPORT

OAK RIDGE INSTITUTE
FOR SCIENCE AND EDUCATION

Prepared by
K. M. Engel
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January 2020

Prepared for the
U.S. Nuclear Regulatory Commission

This document was prepared for U.S. Nuclear Regulatory Commission by the Oak Ridge Institute for Science and Education (ORISE) through interagency agreement number 31310018N0014 with the U.S. Department of Energy (DOE). ORISE is managed by Oak Ridge Associated Universities under DOE contract number DE-SC0014664.

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INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS FOR THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

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FINAL REPORT

January 2020

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ACRONYMS

AA	alternative action
AEC	Atomic Energy Commission
cm	centimeter
cpm	counts per minute
$DCGL_w$	derived concentration guideline levels
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DQO	data quality objective
FSS	final status survey
GPS	global positioning system
HBPP	Humboldt Bay Power Plant
HTD	hard-to-detect
MDC	minimum detectable concentration
mg/cm^2	milligram per square centimeter
mrem/yr	millirem per year
NaI[Tl]	thallium-doped sodium iodide
NORM	naturally occurring radioactive material
NRC	U.S. Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocurie per gram
PG&E	Pacific Gas & Electric
PSQ	principal study question
Q-Q	quantile-quantile
ROC	radionuclide of concern
SAFSTOR	safe storage
SOF	sum-of-fractions
SU	survey unit
VSP	Visual Sample Plan
WMF	waste management facility

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INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) requested that the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the remaining land areas and select buildings at the Humboldt Bay Power Plant in Eureka, California. ORISE performed independent assessment activities during the period of August 26-29, 2019. Confirmatory survey activities included gamma surface scans, gamma direct measurements, alpha-plus-beta scans, alpha-only and beta-only direct measurements, smear sampling, and soil sampling within the land areas and select buildings, as applicable.

No elevated direct gamma radiation levels distinguishable from background were identified in any of the land areas surveyed. In total, 20 surface soil samples were collected for analysis: eight random and two judgmental samples from areas believed to be mostly native soil and ten of the licensee's archived final status survey (FSS) surface soil samples from areas where the site's staff had confirmed backfill material had been applied. The radionuclide concentrations in the soil samples were compared to the NRC-approved derived concentration guidelines ($DCGL_{W}$s) established for the site. All radionuclide concentrations were below the $DCGL_{W}$s and all sum-of-fractions were less than 1. Additionally, all radionuclide concentrations were less than 50% of the respective gamma-emitting $DCGL_{W}$s, thus confirming the licensee's FSS classification.

Limited confirmatory survey activities were conducted in three buildings during this survey: the security building (Building 7), the Waste Management Facility (WMF), and the soil lab (Building 13). Gamma and alpha-plus-beta scans were performed in interior portions of all three buildings. Additionally, the roof of the security building and the asphalt/concrete pad north and east of the WMF were scanned for gamma radiation. Elevated gamma radiation was identified within the soil lab, where the site's radiological sources were stored. Judgmental direct measurements and smear samples were collected behind the "push walls" in the WMF. Total activities measured in the WMF did not exceed the $DCGL_{W}$s and the removable activity was less than ten percent of the total activity. Therefore, confirmatory direct measurements support the licensee's Class 2 FSS SU designation.

The confirmatory results indicate that the residual radioactivity concentrations in the remaining land areas and structural surfaces were below the applicable release criteria, and the confirmatory results support the licensee's classification of the FSS SUs. The confirmatory survey results indicate that the areas surveyed meet the NRC-approved criteria for release for unrestricted use. Such conclusions cannot be drawn about the soil lab at this time as radioactive materials (i.e., sources) were still present during the confirmatory survey.

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INDEPENDENT CONFIRMATORY SURVEY SUMMARY AND RESULTS FOR REMAINING LAND AREAS AND SELECT BUILDINGS AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

1. INTRODUCTION

The Pacific Gas & Electric Company (PG&E) operated the Humboldt Bay Power Plant (HBPP) Unit 3 nuclear reactor near Eureka, California under the Atomic Energy Commission (AEC) provisional license number DPR-7. HBPP Unit 3 achieved initial criticality in February 1963 and began commercial operations in August 1963. Unit 3 was a natural circulation boiling water reactor with a direct-cycle design. Stainless steel fuel claddings were used from reactor startup until cladding failures resulted in plant system contamination – zircaloy-clad fuel was used exclusively starting in 1965, eliminating cladding-related contamination. A number of spill and gaseous releases were reported during operations, resulting in a range of mitigation activities (ESI 2008).

In July 1973, Unit 3 was shut down for annual refueling and seismic modification. However, by December 1980, it was concluded that completing the required upgrades and restarting Unit 3 would be cost prohibitive. PG&E decided in June of 1983 to decommission Unit 3, received a possession-only license amendment, and placed the unit into cold shutdown and safe storage (SAFSTOR). The impacted areas associated with Unit 3 have gone through decommissioning. As part of the Humboldt Bay Repowering Project, PG&E has built ten new fossil fuel units, 16.3 megawatt electric each, on the site in the vicinity of Unit 3. Decommissioning activities have also been completed on the adjacent fossil fuel Units 1 and 2, with all structures removed to ground level (Bartlett 2011).

The U.S. Nuclear Regulatory Commission (NRC) requested that the Oak Ridge Institute for Science and Education (ORISE) perform confirmatory survey activities of the HBPP. The focus of this survey effort—as determined by NRC staff—was on the remaining land areas and three buildings: the security building (Building 7), soil lab (Building 13), and the Waste Management Facility (WMF).

2. SITE DESCRIPTION

The HBPP site, owned by PG&E consists of 58 hectares on the southern edge of Humboldt Bay, 6 kilometers southwest of the town of Eureka in Humboldt County, California. Figure 2.1 provides a recent aerial view of the HBPP.

Figure 2.1. HBPP Aerial View

Most buildings have been demolished and many roadways and parking lots have been removed. The survey units (SUs) were backfilled anywhere from 1 to 100% with onsite recycled soil from all three final status survey (FSS) classifications of material (MARSSIM class 1, 2, or 3). After backfilling with onsite soils was complete, the SUs were then covered with off-site material or engineered materials to various depths (ORAU 2019c). Figure 2.2 indicates the SUs that received some amount of backfill materials—either from onsite or offsite borrow—and Figure 2.3 shows the final status survey (FSS) classification of the SUs.

The three buildings selected for confirmatory surveys were the WMF, security building (Building 7), and soil lab (Building 13). The WMF was undergoing FSS during the onsite confirmatory survey activities while the security building and soil lab had not yet received FSS.

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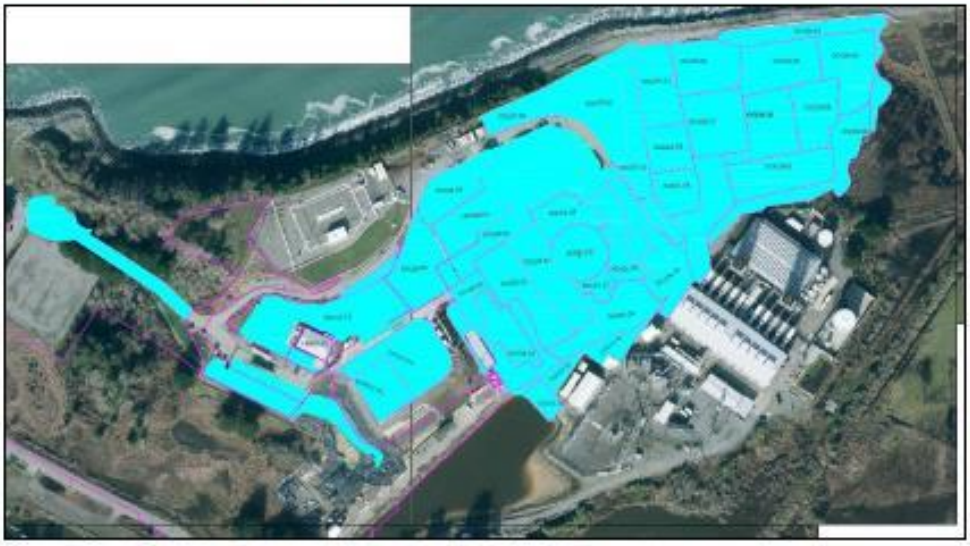

Figure 2.2. Backfilled Survey Units

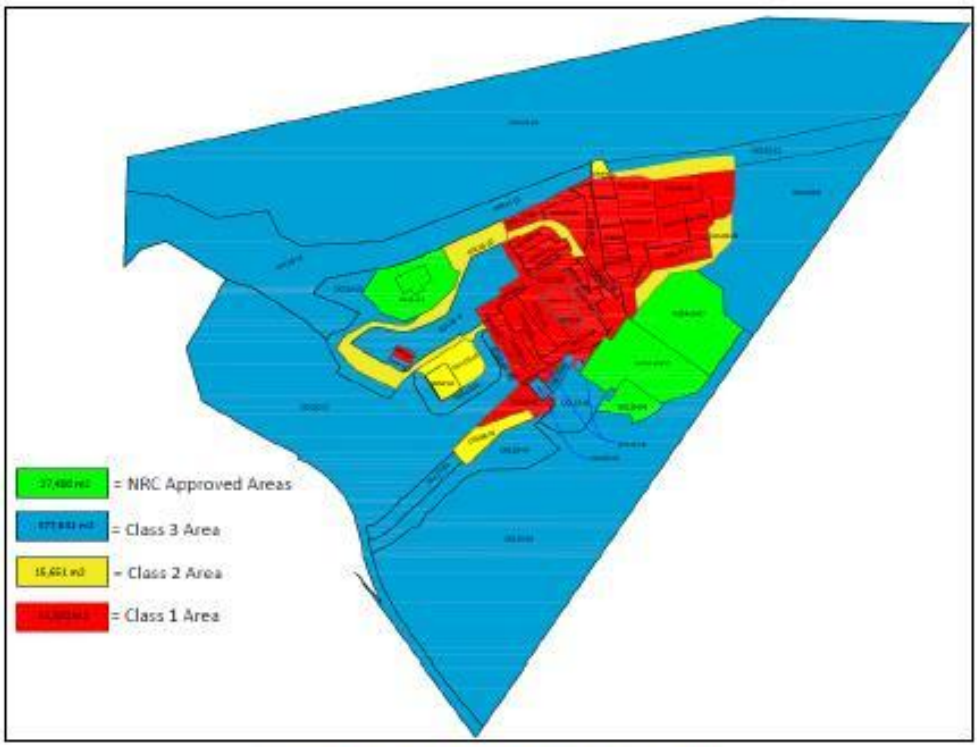

Figure 2.3. Survey Units FSS Classification

3. DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) described herein are consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006) and provide a formalized method for planning radiation surveys, improving survey efficiency and effectiveness, and ensuring that the type, quality, and quantity of data collected are adequate for the intended decision applications. The seven steps in the DQO process are as follows:

1. State the problem
2. Identify the decision
3. Identify inputs to the decision
4. Define the study boundaries
5. Develop a decision rule
6. Specify limits on decision errors
7. Optimize the design for obtaining data

3.1 STATE THE PROBLEM

The first step in the DQO process defined the problem that necessitated the study, identified the planning team, and examined the project budget and schedule. The planning team, project budget, and schedule are presented in the project-specific plan and are not repeated here (ORISE 2016). NRC staff requested that ORISE perform confirmatory survey activities at the HBPP. The objective of the confirmatory activities was to generate independent radiological data to assist NRC staff in evaluating the licensee's FSS results. The problem statement was as follows:

> Confirmatory surveys are necessary to generate independent radiological data to assist the NRC staff with their assessment and determination of the adequacy of the FSS design, implementation, and results for demonstrating compliance with the release criteria.

3.2 IDENTIFY THE DECISION

The second step in the DQO process identified the principal study questions (PSQs) and alternative actions (AAs), developed decision statements (DSs), and organized multiple decisions, as

appropriate. This was done by specifying AAs that could result from a "yes" response to the PSQs and combining the PSQs and AAs into DSs. Table 3.1 presents the PSQs, AAs, and DSs.

Table 3.1. HBPP Confirmatory Survey Decision Process

Principal Study Questions	Alternative Actions
PSQ1: Are residual radioactivity concentrations in the remaining land areas or structural surfaces below applicable release criteria?	**Yes:** Compile confirmatory data and report results to NRC staff for their decision making. Provide independent interpretation that confirmatory field surveys did not identify anomalous areas of residual radioactivity and that quantative field and laboratory data satisfied the NRC-approved decommissioning criteria. **No:** Compile confirmatory data and report results to NRC staff for their decision making. Provide independent interpretation of confirmatory survey results identifying any anomalous field or laboratory data for NRC staff's determination of the adequacy and accuracy of the FSS data.
PSQ2: Do the confirmatory results support the MARSSIM classification of the FSS SUs?	**Yes:** Confirmatory results support the classification of the FSS SUs. Compile confirmatory survey data and present results to NRC staff for their decision making. **No:** Confirmatory results do not support the classification of the FSS SUs. Summarize the discrepancies and provide technical comments to NRC staff for their decision making.
Decision Statements	
Determine if anomalous confirmatory survey results (i.e., volumetric concentrations and/or surface activity levels) exceed the NRC-approved decommissioning criteria. Determine if confirmatory survey results support the FSS SU classification as outlined in MARSSIM guidance classification.	

3.3 IDENTIFY INPUTS TO THE DECISION

The third step in the DQO process identified both the information needed and the sources of this information, determined the basis for action levels, and identified sampling and analytical methods to meet data requirements. For this effort, information inputs included the following:

- HBPP characterization data
- HBPP Geographic Information System and Visual Sample Plan (VSP) files, for SU boundaries
- HBPP's FSS data and supporting documentation (Note that, at the time of the confirmatory survey, the FSS was still in progress for the WMF and FSS had not started for the security building or soil lab)
- ORISE gamma walkover surveys
- ORISE volumetric sample analytical results for soil
- ORISE static direct measurements and removable activity results
- Radionuclides of concern (ROCs) and their associated limits (discussed in Section 3.3.1)

3.3.1 Radionuclides of Concern and Release Criteria

The primary ROCs identified for the HBPP are beta-gamma emitters—fission and activation products resulting from reactor operation. The HBPP derived concentration guideline levels ($DCGL_W$s) for soils and structural surfaces are presented in Table 3.2 and Table 3.3, respectively (PG&E 2014).

Table 3.2. HBPP Soil $DCGL_W$s

ROC	$DCGL_W$ (pCi/g)[a]	ROC	$DCGL_W$ (pCi/g)	ROC	$DCGL_W$ (pCi/g)
Am-241	25	Cs-137	7.9	Np-237	1.1
C-14	6.3	Eu-152	10	Pu-238	29
Cm-243	29	Eu-154	9.4	Pu-239	26
Cm-244	48	H-3	680	Pu-240	26
Cm-245	17	Nb-94	7.1	Pu-241	860
Cm-246	25	Ni-59	1,900	Sr-90	1.5
Co-60	3.8	Ni-63	720	Tc-99	12

[a] pCi/g = picocurie per gram

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Table 3.3. HBPP Surface Activity $DCGL_{WE}$					
ROC	$DCGL_W$ (dpm/100 cm²)*	ROC	$DCGL_W$ (dpm/100 cm²)	ROC	$DCGL_W$ (dpm/100 cm²)
Am-241	3.00E+03	Cs-137	4.60E+04	Np-237	2.40E+03
C-14	7.00E+06	Eu-152	2.70E+04	Pu-238	3.40E+03
Cm-243	4.30E+03	Eu-154	2.50E+04	Pu-239	3.10E+03
Cm-244	5.50E+03	H-3	1.80E+08	Pu-240	3.10E+03
Cm-245	2.20E+03	Nb-94	1.90E+04	Pu-241	1.40E+05
Cm-246	2.70E+03	Ni-59	6.30E+07	Sr-90	9.70E+04
Co-60	1.30E+04	Ni-63	2.40E+07	Tc-99	9.60E+06

* dpm/100 cm² = disintegrations per minute per 100 square centimeters

Each radionuclide-specific $DCGL_W$ value in Tables 3.2 and 3.3 represents the surficial concentration of individual radionuclides that would be deemed in compliance with the 25 millirem per year (mrem/yr) unrestricted release dose limit to the average member of the critical group. Therefore, for sites with multiple radionuclides present, radionuclide-specific results (i.e., volumetric samples) must be evaluated using the sum-of-fractions (SOF) approach to assess the total dose and demonstrate compliance with the dose limit. SOF calculations are performed as follows:

$$SOF_{TOTAL} = \sum_{j=0}^{n} SOF_j = \sum_{j=0}^{n} \frac{C_j}{DCGL_{W,j}}$$

Where C_j is the concentration of the ROC "j" and $DCGL_{W,j}$ is the $DCGL_W$ for ROC "j." Note that gross concentrations are considered for conservatism. A SU, where the average ROC concentration does not exceed 1 (unity), ensures compliance with the 25 mrem/yr unrestricted release dose limit. Elevated measurement comparisons were not necessary, and thus, not considered as part of this study.

3.4 Define the Study Boundaries

The fourth step in the DQO process defined target populations and spatial boundaries, determined the timeframe for collecting data and making decisions, addressed practical constraints, and determined the smallest subpopulations, area, volume, and time for which separate decisions must be made.

The areas of focus for this survey were the safely accessible Class 1, 2, and 3 land areas depicted in Figure 2.3 as well as three buildings: WMF, security building (Building 7), and soil lab (Building 13). Temporal boundaries to complete this survey were limited to four 10-hour days on-site during the week of August 26-29, 2019.

3.5 DEVELOP A DECISION RULE

The fifth step in the DQO process specified appropriate parameters (e.g., mean, median), confirmed action levels were above detection limits, and developed an "if…then…" decision rule statement. Decision rules for this survey focused on independent surface scanning surveys and sample results to identify locations that could exceed the applicable $DCGL_{W}$s and/or analytical minimum detectable concentrations (MDCs).

The confirmatory survey design for the land areas focused on generating an unbiased estimate of the site mean ROC concentration for direct comparison against the $DCGL_{W}$s and scanning to identify potential hot spots. For this survey effort, the parameter of interest was the mean SOF for the land area along with the ROC concentrations of individual samples. Individual sample results were compared directly to the $DCGL_{W}$s. The decision rules can be stated as:

> If the mean SOF, as determined by ORISE, and individual sample results are less than the $DCGL_{W}$s then recommend acceptance. If results are above the $DCGL_{W}$s, then perform further evaluations and provide technical comments/recommendations.

SU classifications were also assessed as part of the confirmatory process based on the requirements outlined in the LTP. Confirmatory investigations were focused on Class 2 and 3 SUs, as well as non-impacted areas, because a Class 1 SU will not receive higher classification. FSS investigation levels that trigger additional evaluations were established and are presented in Section 5.3.6.2 of the LTP. These investigation levels are reproduced in Table 3.4. During the confirmatory surveys, ORISE focused on identifying locations that could potentially exceed the soil sample investigation levels. These locations were used to confirm whether the SU should have been reclassified as part of the FSS process. The decision rule related to SU classification was stated as follows:

If soil concentrations or surface activity results indicate that a Class 2 or Class 3 area should be reclassified to a higher classification, then summarize confirmatory data for NRC staff's evaluation and decision making.

Table 3.4. HBPP Investigation Levels [a]

SU Classification	Scan Investigation Levels	Direct Investigation Levels
Class 1	> $DCGL_{EMC}$ [b]	> $DCGL_{EMC}$ or > $DCGL_W$ and > a statistical parameter-based value
Class 2	> $DCGL_W$ or > MDC_{Scan} if MDC_{Scan} is greater than $DCGL_W$ [c]	> $DCGL_W$
Class 3	Detectable over background	> 0.5 * $DCGL_W$

[a] Recreated from PG&E 2014
[b] $DCGL_{EMC}$ = derived concentration guideline level elevated measurement comparison
[c] MDC_{Scan} = scan minimum detectable concentration

3.6 SPECIFY LIMITS ON DECISION ERRORS

The sixth step in the DQO process established bounds of decision errors. Decision errors were controlled by optimizing the confirmatory field measurement and laboratory analytical MDCs.

One order of control was the allowable uncertainty in the estimated mean. The soil sample size was sufficient to estimate the mean SOF within 0.2 of the true mean at the 95% confidence level. The assumed standard deviation was 0.4, which is conservative, to reduce the probability of underestimating the site ROC variability. Any anomalies identified while performing surveys or following data assessment were fully investigated and discussed with NRC staff.

A second order of control was to optimize the MDCs of analyses performed by ORISE, both for field and laboratory measurements. Nominal scan and analytical MDCs for select ROCs are presented in Appendix D.

3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

The seventh step in the DQO process was used to review the DQO outputs; develop data collection design alternatives, formulate mathematical expressions for each design, select the sample size to satisfy DQOs, decide on the most resource-effective design of agreed alternatives, and document

requisite details. Survey design and laboratory analyses were optimized by implementing the procedures presented in Sections 4 and 5, respectively.

4. PROCEDURES

The confirmatory survey activities, conducted during the period of August 26-29, 2019, were in accordance with the project-specific confirmatory survey plan, the *ORAU Radiological and Environmental Survey Procedure Manual,* and the *ORAU Environmental Services and Radiation Training Quality Program Manual* (ORISE 2016, ORAU 2016a, 2019a). Appendices C and D provide additional information regarding survey instrumentation and related processes discussed within this section.

4.1 REFERENCE SYSTEM

ORISE referenced confirmatory measurement/sampling locations to global positioning system (GPS) coordinates, specifically NAD 1983 (CORS96) State Plane California Zone 1. Other prominent site features also were referenced. Measurement and sampling locations were documented on detailed survey maps.

4.2 SURFACE SCANS

Surface scans of land areas were performed with Ludlum model 44-10 5.48-centimeter (cm) by 5.48-cm thallium-doped sodium iodide (NaI[Tl]) scintillation detectors coupled to Ludlum Model 2221 ratemeter-scalers with audible indicators. Detectors were also coupled to GPS data logging systems that enabled real-time gamma count rate and spatial data capture. Low- to medium-density surface scans were performed within select SUs, as time and access permitted. Total scan coverage was dependent on accessibility as many areas were impassable due to thick grass or standing water. Many areas of the site had been backfilled and covered with offsite top soil as mentioned previously in Section 2.

Surface scans of structures were performed with NaI(Tl)s and either Ludlum model 43-68 gas-flow proportional hand-held detectors or Ludlum model 43-37 gas-flow proportional floor monitors with 0.8 milligram per square centimeter (mg/cm^2) thick Mylar windows operated in alpha-plus-beta mode. Both detector types were coupled to Ludlum model 2221 ratemeter-scalers with audible indicators. Detectors were also coupled to data loggers to electronically record all scanning data

points. Scans with the floor monitor were qualitative (scan MDCs not calculated), but ORISE experience is that floor monitors are efficient at identifying low levels of surface contamination that can be quantitatively investigated using other hand-held instruments.

As noted in Section 6.3 of the NRC-approved 2016 Confirmatory Survey Plan (ORISE 2016), direct measurements for total beta and alpha activity would, at a minimum, be collected from judgmentally selected locations based on surface scans. The total number of direct measurements was dependent on findings as the survey progressed. No areas were marked for further investigation based on scanning results.

4.3 Surface Activity Measurements

Total surface activity measurements were performed with Ludlum model 43-68 gas-flow proportional hand-held detectors coupled to Ludlum model 2221 ratemeter-scalers with audible output. The Mylar thickness was 0.8 mg/cm^2 for alpha-only measurements, and 3.8 mg/cm^2 thickness for beta-only measurements.

Although scans of the floors and walls in the WMF behind the north and south push walls did not indicate elevated radiation levels of concern, nine direct measurements for total alpha and beta activity were collected from judgmentally selected areas based on the concern for accumulation potential behind the walls. No direct measurements were collected in the main area of the WMF, security building, or the soil lab based on scanning results.

Smear samples, to determine removable alpha and beta activity levels, were collected from all direct measurement locations. Smears for hard-to-detects (HTDs), H-3, C-14, and Ni-63, were judgmentally collected at two locations within the WMF, co-located with the alpha and beta smear sample.

4.4 Soil Sampling

Eighteen random soil samples and two judgmental soil samples were collected from the land area SUs. Visual Sample Plan (VSP) version 7.10 was used to determine the number of samples required to estimate the mean ROC concentration within the study area. For this effort, based on the allowable uncertainty in the mean, presented in Section 3.6, 18 random samples were required.

A total of 20 confirmatory soil samples were collected—18 from randomly selected locations and 2 from judgmentally selected locations. Of the eighteen random samples, eight were from areas that had not been backfilled on the eastern and western sides of the property. The other ten random samples were from the site's archived samples that were collected from native soil before backfill, as requested by the NRC. The site's sample that was closest to the ORISE randomly generated location was selected for analysis. Two judgmental samples were selected from non-backfilled areas, per the request of NRC staff.

Surface soil samples were collected from a depth of 0–15 cm using hand trowels. Gamma measurements were performed prior to and after sample collection to assess the potential for subsurface contamination. No subsurface samples were collected. Sampling equipment was rinsed and wiped after each sample to minimize the potential for cross-contamination.

5. SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data collected on site were transferred to the ORISE facility for analysis and interpretation. Sample custody was transferred to the Radiological and Environmental Analytical Laboratory in Oak Ridge, Tennessee. Sample analyses were performed in accordance with the *ORAU Radiological and Environmental Analytical Laboratory Procedures Manual* (ORAU 2019b).

A wet aliquot of each soil sample was first set aside for further analyses of HTDs, if needed. The remaining portions of the soil samples were dried and homogenized before being analyzed via gamma spectrometry for gamma-emitting fission and activation products. The spectra also were reviewed for other identifiable photopeaks. Based on the results of the gamma spectroscopy and as directed by NRC staff, further analyses were not performed. Analytical results are reported in units of picocuries per gram (pCi/g).

Smear samples were analyzed for alpha and beta activity using a low-background proportional counter. Smears for HTDs, H-3 and C-14, were analyzed via liquid scintillation counting. Smear samples and direct measurement results are reported in units of disintegrations per minute per one hundred square centimeters (dpm/100 cm^2).

Direct measurements are gross and background contributions were not subtracted, which is consistent with the site's reporting and is conservative. Gamma radiation scan and static measurements are presented as gross counts per minute (cpm).

Scan data sets were graphed in a quantile-quantile (Q-Q) plot for assessment. The Q-Q plot is a graphical tool for assessing the distribution of a data set. For the scan data, the Y-axis represents gross gamma surface activity in units of cpm. The X-axis represents the data quantiles about the median value. Values less than the median are represented in the negative quantiles, and values greater than the median are represented in the positive quantiles. A normal distribution that is not skewed by outliers will appear as a straight line, with the slope of the line subject to the degree of variability among the data population. More than one distribution, such as background plus contamination or other outliers, will appear as a step function. Q-Q plots for the data are presented in Section 6.

6. FINDINGS AND RESULTS

The results of the confirmatory survey are discussed in the following subsections.

Appendix A provides the figures generated from the survey data, Appendix B provides data tables, and Appendices C and D provide additional details regarding field and laboratory instrumentation as well as additional information on calibration, quality assurance, survey and analytical procedures, and detection sensitivities.

6.1 SURFACE SCANS

Table 6.1 provides a summary of the scanning survey data collected at HBPP during the August 2019 survey activities.

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Table 6.1. Summary of Scan Results

Area	Scan Ranges (cpm)		
	Gamma Lower Walls and Floors	Alpha-plus-Beta Lower Walls	Alpha-plus-Beta Floors
Land Areas	3,200 to 8,800	--*	--
WMF	2,900 to 6,500	6 to 590	320 to 1,200
WMF Pad	3,300 to 6,000	--	700 to 1,800
Security Building	5,700 to 7,700	76 to 620	480 to 1,200
Security Building Roof	2,400 to 6,700	--	--
Soil Lab	3,100 to 13,000	44 to 530	340 to 1,100

* data not collected

A gamma walkover map of all of the land areas surveyed, the security building roof, and the WMF pad are provided in Appendix A. No elevated areas were identified in the land areas, security building roof, or WMF pad surveys. Q-Q plots for the scan data from inside the three buildings are shown in Figures 6.1 through 6.3. For most of the scan data, the Q-Q plots show a straight line indicating a normal distribution which is expected for background conditions. Gamma scans in the soil lab, however, do not indicate background conditions as there is a sharp increase in the right tail. This was due to the presence of sealed sources stored within the soil lab during the time of the survey.

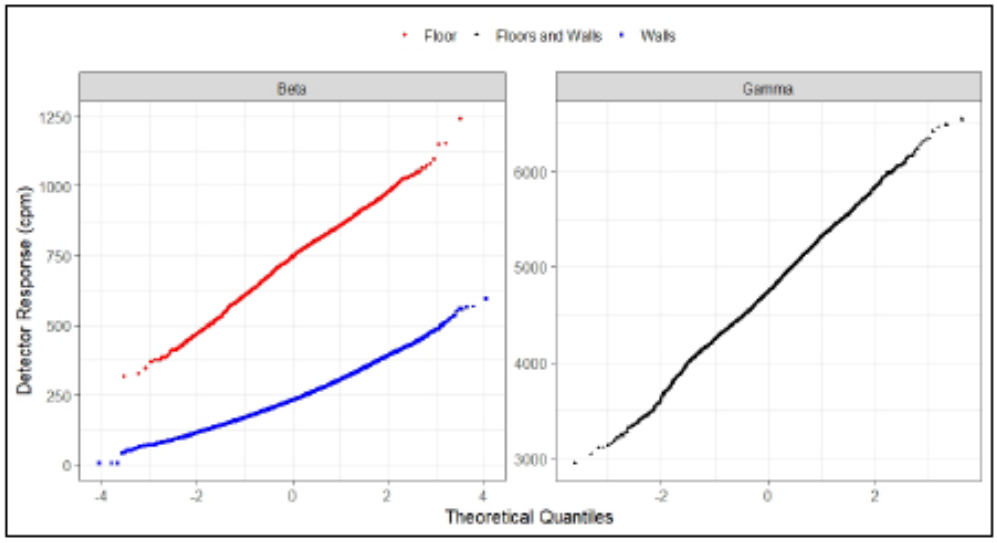

Figure 6.1. Q-Q Plots of WMF Scan Data

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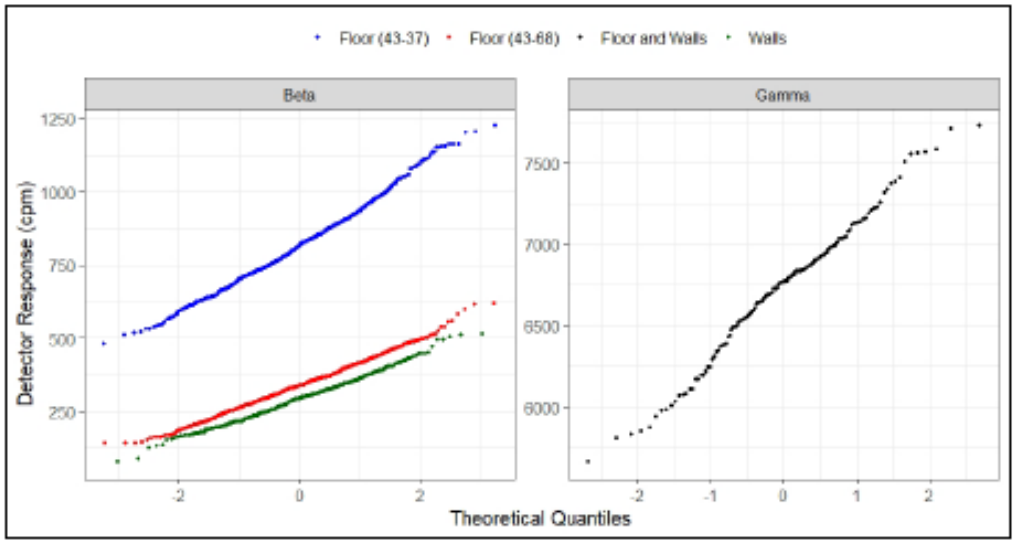

Figure 6.2. Q-Q Plots of Security Building Scan Data

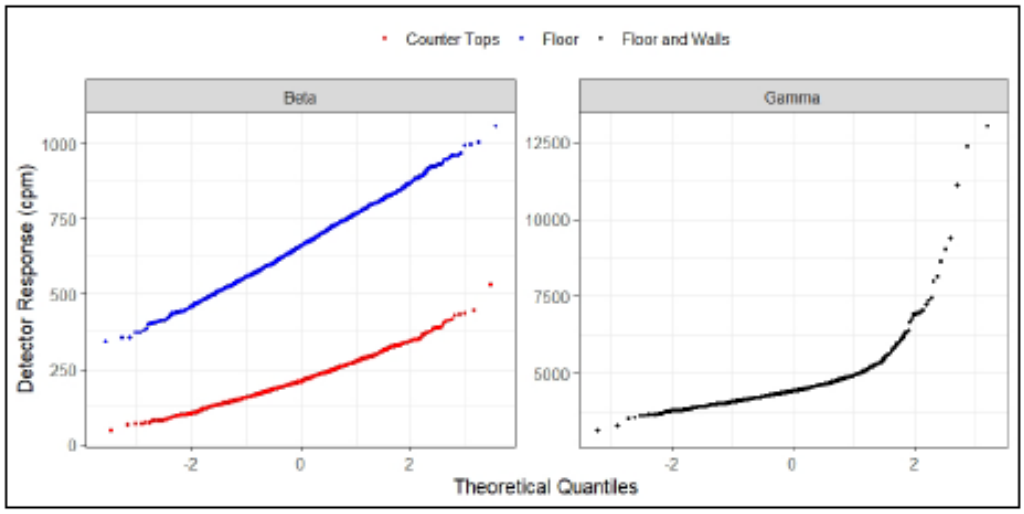

Figure 6.3. Q-Q Plots of Soil Lab Scan Data

6.2 SURFACE ACTIVITY MEASUREMENTS

Table 6.2 provides a summary of the surface activity measurements collected within the WMF. Full data tables can be found in Appendix B. In total nine locations were selected for direct measurements and smear sampling. The confirmatory data were compared against the investigation levels presented in Table 3.4. All total activity measurements were below the $DCGL_{W/S}$, thus confirming the Class 2 FSS SU classification. All removable activity was less than 10% of the total activity.

Table 6.2. Summary of Surface Activity Results[a]

Area	Total Activity		Removable Activity			
	Alpha	Beta	Alpha	Beta	H-3	C-14
	dpm/100 cm²		dpm/100 cm²			
WMF	10 to 50	1,200 to 1,800	0[b]	0 to 3	-7 to -2	-4 to 1

[a] Zeros due to rounding.
[b] All nine values were 0 dpm/100 cm²

6.3 GAMMA RADIATION MEASUREMENTS AND SOIL SAMPLING

Soil sampling locations are displayed in Appendix A. Table 6.3 provides a summary of the NaI(Tl) direct measurements collected pre- and post-sample. Table 6.4 provides a summary of the radionuclide concentrations. Appendix B provides individual sample results.

Table 6.3. Summary of Soil Sampling Direct Measurements

Sample Type	No. of Samples	Gamma Measurement (cpm)					
		Pre-Sample			Post-Sample		
ORISE Random	8	3,500	to	5,000	3,500	to	5,700
ORISE Judgmental	2	3,700	to	5,400	5,100	to	5,600
Archived FSS Random	10	-- [a]	to	--	--	to	--

[a] Pre- and post-sample gamma measurements not provided.

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Table 6.4. Summary of Soil Sample Concentrations[a]						
ROC[b]	ORISE Random		ORISE Judgmental		FSS Samples	
	Min	Max	Min	Max	Min	Max
	pCi/g					
Am-241	-0.10	-0.004	-0.023	0.050	-0.083	0.021
Cm-245	-0.06	0.7	0.00	0.06	-0.082	0.11
Co-60	-0.09	0.040	-0.027	0.016	-0.022	0.012
Cs-137	0.010	0.429	0.077	0.132	-0.013	0.058
Eu-152	-0.12	0.14	-0.010	0.035	-0.050	0.029
Eu-154	-0.38	0.2	-0.146	0.001	-0.36	-0.048
Nb-94	-0.06	0.005	0.009	0.013	-0.005	0.015
Np-237 by Pa-233	-0.23	0.012	0.036	0.042	-0.008	0.013
SOF	0.003	0.104	0.056	0.058	0.002	0.015

[a] Zeros due to rounding.
[b] Only these gamma emitting ROCs were used in the ORISE SOF calculations.

None of the individual ROC concentrations exceeded the $DCGL_{WS}$ and all SOF results were less than 1. The confirmatory data were compared against the investigation levels presented in Table 3.4. None of the ROC concentrations exceeded 50% of the respective gamma-emitting $DCGL_{WS}$, thus confirming the licensee's FSS SU classifications.

7. SUMMARY

At the NRC's request, ORISE conducted confirmatory survey activities at the HBPP during the period of August 26-29, 2019. Confirmatory survey activities included gamma walkover scans, gamma direct measurements, and soil sampling in the accessible land areas and alpha-plus-beta scans, alpha only and beta only direct measurements, and smear sampling in select buildings.

No elevated direct gamma radiation levels above localized background were identified in any of the land areas surveyed. In total, 20 soil samples were collected for laboratory analysis: eight random and two judgmental samples from areas thought to be native soil and ten archived samples from areas before backfill. The radionuclide concentrations in the soil samples were compared to the NRC approved $DCGL_{WS}$ established for the site. All concentrations were below the $DCGL_{WS}$ and all

sum-of-fractions results were less than 1. For all samples, the ROC concentrations were less than 50% of the respective gamma-emitting $DCGL_{w}$s, thus confirming the licensee's FSS classification.

Three buildings were also limitedly investigated during this survey: the security building (Building 7), the WMF, and the soil lab (Building 13). A portion of the interior of all the buildings and additionally, the roof of the security building and the asphalt/concrete pad north and east of the WMF were scanned. Only the area where the site's sources were stored within the soil lab was identified with elevated gamma radiation levels. Judgmental direct measurements and smear samples were collected behind the push walls in the WMF. Total activities measured in the WMF did not exceed the $DCGL_{w}$s and the removable activity was less than ten percent of the total activity, thus confirming the licensee's Class 2 FSS SU classification.

The confirmatory results indicate that the residual radioactivity concentrations in the remaining land areas and structural surfaces were below the applicable release criteria, and the confirmatory results support the licensee's classification of the FSS SUs. The confirmatory results indicate that the areas surveyed meet the NRC-approved criteria for release for unrestricted use. Such conclusions cannot be drawn about the soil lab at this time as radioactive materials (i.e., sources) were still present during the confirmatory survey.

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APPENDIX A: FIGURES

Figure A.1. Western Side of Site Gamma Walkover Data

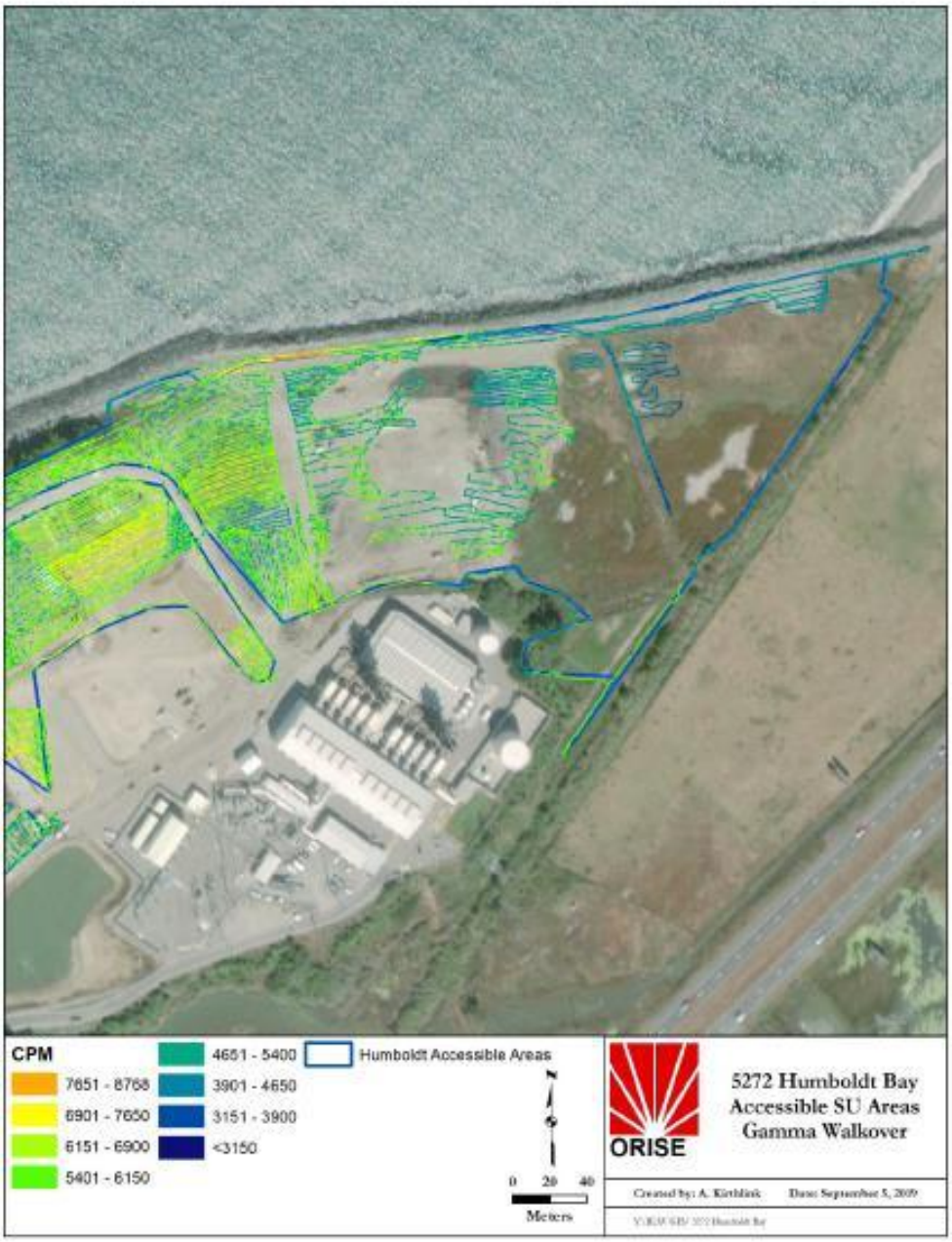


Figure A.2. Eastern Side of Site Gamma Walkover Data

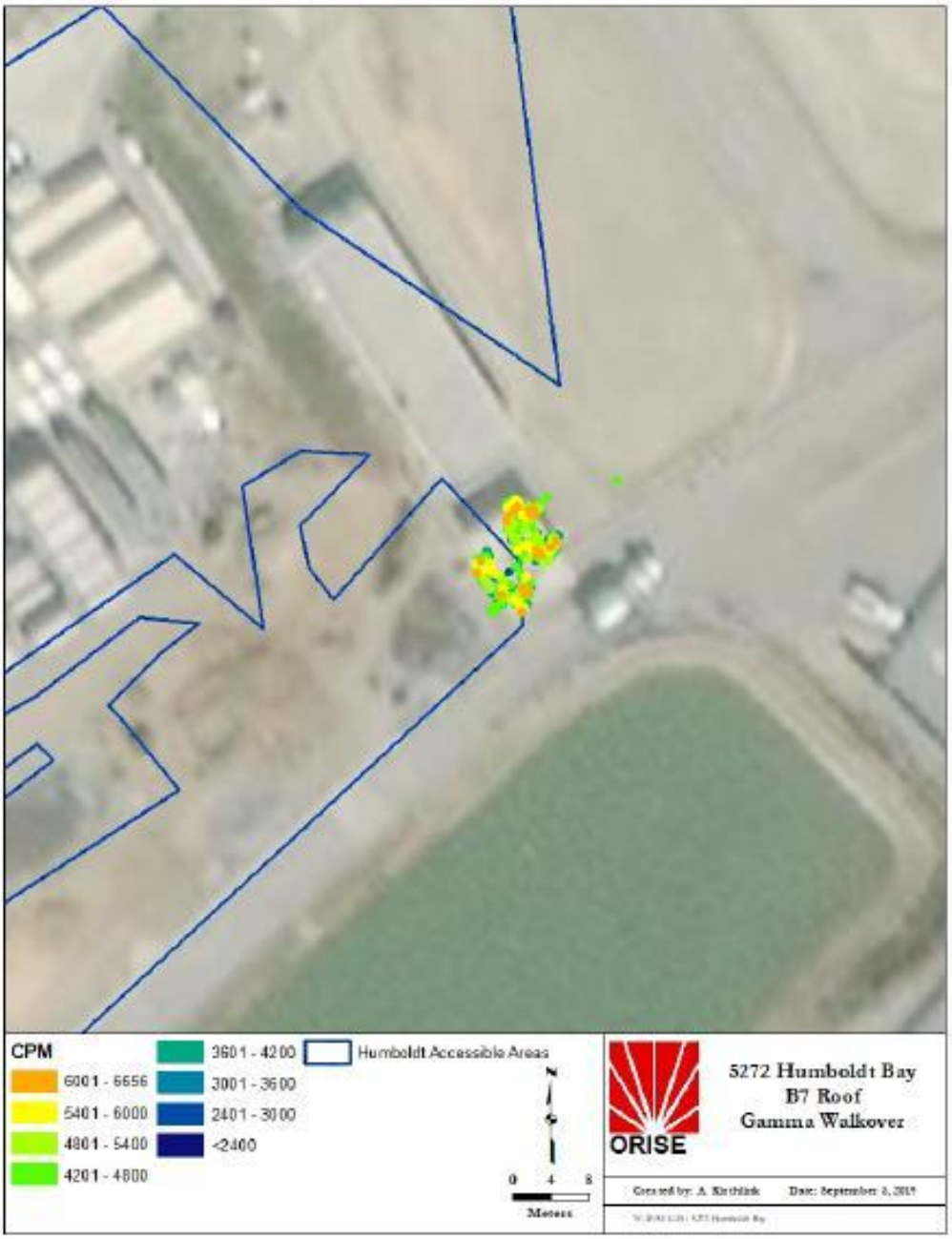


Figure A.3. Security Building Roof Gamma Walkover Data

Figure A.4. WMF Pad Gamma Walkover Data

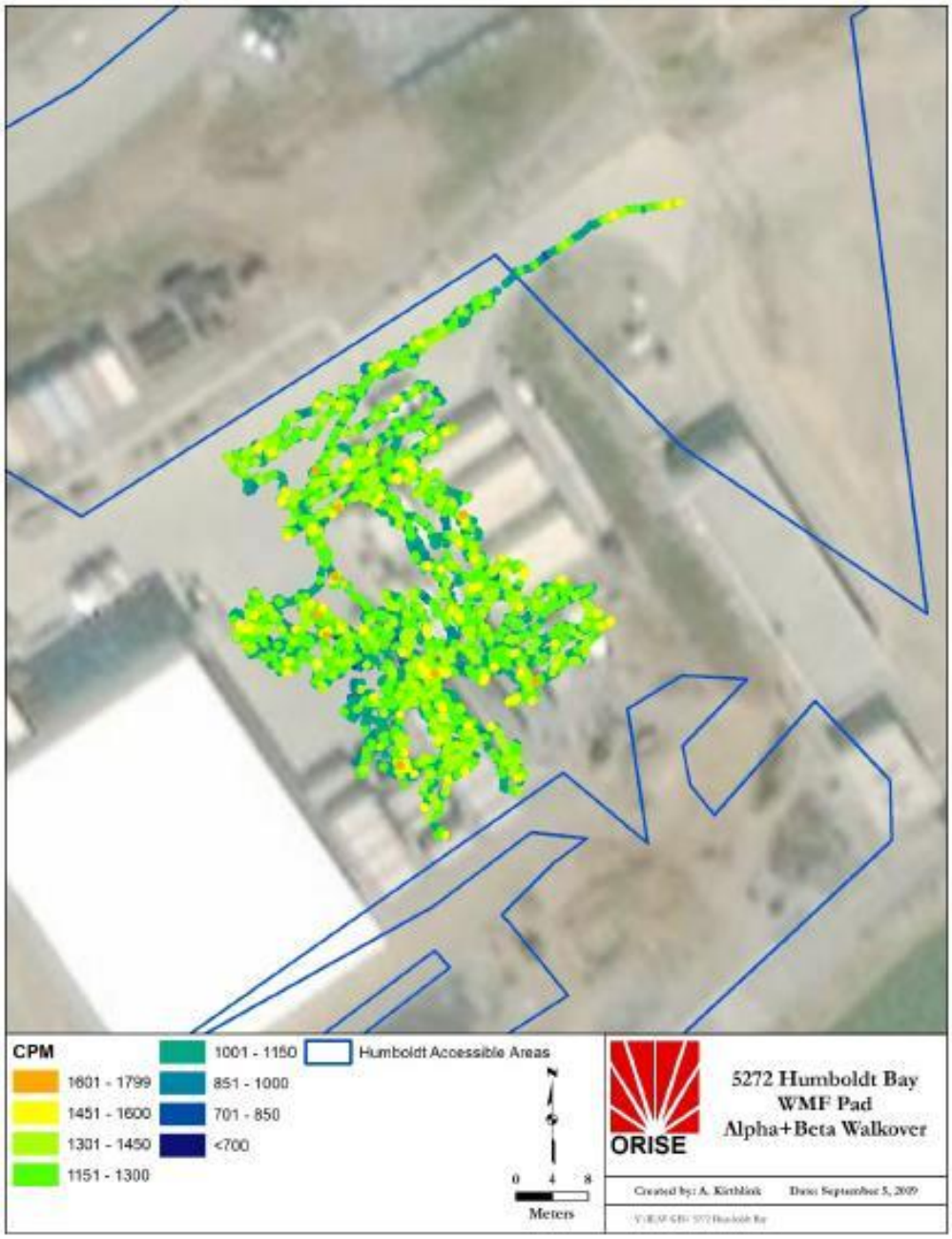


Figure A.5. WMF Pad Alpha-plus-Beta Walkover Data

Figure A.6. Soil Sample Locations

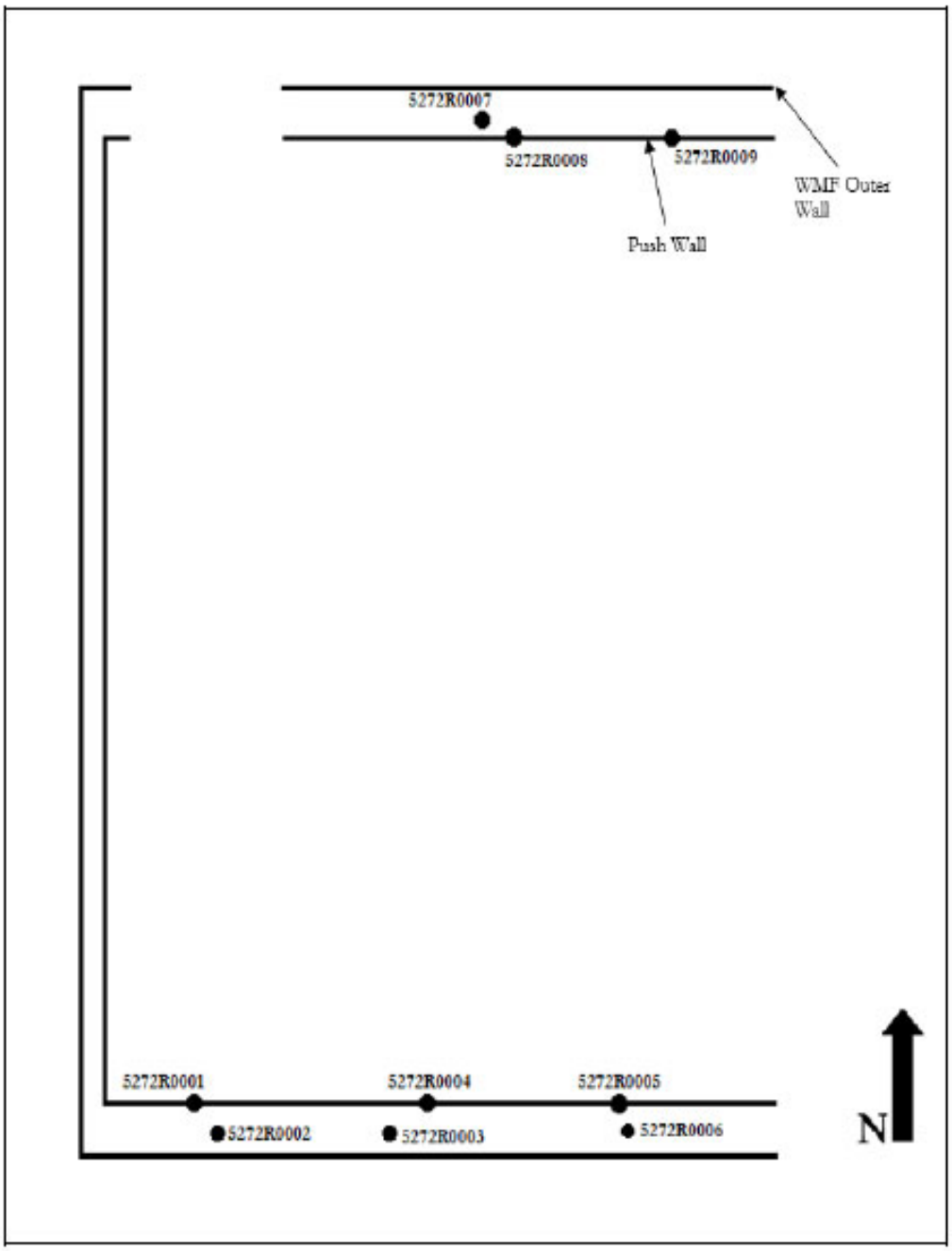


Figure A.7. WMF Direct Measurement and Smear Sampling Locations

APPENDIX B: DATA TABLES

Table B.1. Soil Sample Locations and Gamma Measurements					
Sample ID		Coordinates (ft)		Gamma (cpm)	
		Easting	Northing	Pre-	Post-
Random Locations					
ORISE	5272S0024	5948288	2161054	5,000	5,500
ORISE	5272S0025	5947703	2161509	3,600	4,100
ORISE	5272S0026	5947897	2161303	4,400	4,800
ORISE	5272S0028	5950292	2161514	3,500	3,500
ORISE	5272S0029	5950679	2161710	3,700	4,200
ORISE	5272S0030	5950407	2161732	4,400	4,900
ORISE	5272S0031	5950482	2161758	4,900	5,700
ORISE	5272S0032	5950140	2161278	4,800	5,300
Archived FSS	FSS-2377: OOL10-20-005-F	5948629	2160869	--	--
Archived FSS	2012-003: HBPP-CHAR-OOL10-05-C*	5949079	2160855	--	--
Archived FSS	FSS-2154: OOL10-25-003-F-RC	5949019	5121046	--	--
Archived FSS	FSS-1857: OOL10-25-007-F	5949120	2161264	--	--
Archived FSS	FSS-0694: NOL01-03-01-106-F-RC	5949366	2161272	--	--
Archived FSS	FSS-0519: OOL01-03-011-F-RC	5949628	2161279	--	--
Archived FSS	FSS-1707: OOL09-02-004-F	5949885	2161269	--	--
Archived FSS	FSS-2190: OOL07-03-120-F	5949504	2161518	--	--
Archived FSS	FSS-2057: OOL09-07-020-F	5949752	2161494	--	--
Archived FSS	FSS-1589: OOL09-06-003-F-RC	5950018	2161501	--	--
Judgmental Locations					
ORISE	5272S0027	5948353	2161310	3,700	5,100
ORISE	5272S0033	5949710	2160611	5,400	5,600

* This sample is likely a characterization sample based on the naming convention.

Table B.2. ORISE Random Soil Sample Results (pCi/g)

ROC	5272S0024				5272S0025				5272S0026				5272S0028			
	Conc.		TPU[a]	MDC[b]	Conc.		TPU	MDC	Conc.		TPU	MDC	Conc.		TPU	MDC
Am-241	-0.020	±	0.029	0.088	-0.004	±	0.054	0.132	-0.031	±	0.022	0.069	-0.10	±	0.44	1.08
Cm-245	-0.039	±	0.095	0.221	-0.011	±	0.086	0.200	-0.047	±	0.079	0.179	0.7	±	1.6	3.8
Co-60	0.009	±	0.020	0.048	-0.014	±	0.015	0.027	0.013	±	0.020	0.048	-0.09	±	0.21	0.54
Cs-137	**0.033**[c]	±	0.015	0.029	**0.019**	±	0.009	0.017	0.010	±	0.012	0.028	0.33	±	0.17	0.36
Eu-152	0.011	±	0.047	0.109	0.005	±	0.029	0.069	-0.005	±	0.040	0.089	-0.12	±	0.61	1.43
Eu-154	-0.142	±	0.092	0.196	-0.130	±	0.064	0.106	-0.012	±	0.059	0.174	0.2	±	1.0	2.3
Nb-94	0.005	±	0.018	0.041	0.001	±	0.008	0.026	0.003	±	0.015	0.033	-0.06	±	0.23	0.49
Np-237 by Pa-233	0.012	±	0.029	0.067	-0.003	±	0.020	0.047	0.001	±	0.026	0.058	-0.23	±	0.42	0.95
SOF	0.019				0.003				0.006				0.104			

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.

Table B.3. ORISE Random Soil Sample Results (pCi/g)

ROC	5272S0029				5272S0030				5272S0031				5272S0032			
	Conc.		TPU[a]	MDC[b]	Conc.		TPU	MDC	Conc.		TPU	MDC	Conc.		TPU	MDC
Am-241	-0.024	±	0.027	0.063	-0.046	±	0.061	0.144	-0.026	±	0.029	0.069	-0.084	±	0.068	0.156
Cm-245	0.017	±	0.079	0.189	-0.035	±	0.092	0.213	0.024	±	0.079	0.189	-0.06	±	0.27	0.63
Co-60	0.003	±	0.016	0.037	0.001	±	0.016	0.033	0.022	±	0.016	0.043	0.040	±	0.069	0.165
Cs-137	0.011	±	0.015	0.034	0.016	±	0.010	0.022	0.016	±	0.009	0.027	**0.429**[c]	±	0.077	0.096
Eu-152	0.009	±	0.038	0.089	-0.013	±	0.032	0.074	-0.013	±	0.036	0.079	0.14	±	0.15	0.36
Eu-154	-0.029	±	0.070	0.179	-0.049	±	0.058	0.134	-0.079	±	0.077	0.155	-0.38	±	0.34	0.65
Nb-94	-0.002	±	0.015	0.032	-0.002	±	0.013	0.028	-0.005	±	0.013	0.028	0.001	±	0.066	0.146
Np-237 by Pa-233	-0.014	±	0.016	0.059	0.002	±	0.023	0.054	-0.004	±	0.024	0.054	-0.02	±	0.10	0.23
SOF	0.004				0.004				0.009				0.079			

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.

Table B.4. Archived FSS Soil Sample Results (pCi/g)

ROC	FSS-2377: OOL10-20-005-F				2012-003: HBPP-CHAR-OOL10-05-C				FSS-2154: OOL10-25-003-F-RC				FSS-1857: OOL10-25-007-F			
	Conc.		TPU[a]	MDC[b]	Conc.		TPU	MDC	Conc.		TPU	MDC	Conc.		TPU	MDC
Am-241	-0.045	±	0.063	0.153	-0.016	±	0.032	0.077	-0.083	±	0.037	0.083	0.021	±	0.019	0.075
Cm-245	0.008	±	0.095	0.222	0.032	±	0.087	0.209	-0.020	±	0.098	0.227	-0.082	±	0.095	0.215
Co-60	-0.004	±	0.016	0.032	-0.006	±	0.049	0.102	-0.022	±	0.028	0.050	0.006	±	0.019	0.045
Cs-137	-0.013	±	0.013	0.027	**0.058**[c]	±	0.020	0.035	0.015	±	0.020	0.046	0.004	±	0.018	0.047
Eu-152	-0.034	±	0.036	0.079	0.029	±	0.059	0.140	-0.037	±	0.048	0.102	-0.001	±	0.048	0.109
Eu-154	-0.104	±	0.065	0.141	-0.29	±	0.18	0.31	-0.085	±	0.090	0.202	-0.113	±	0.069	0.181
Nb-94	0.015	±	0.013	0.031	0.006	±	0.017	0.040	-0.001	±	0.017	0.040	-0.005	±	0.016	0.035
Np-237 by Pa-233	0.013	±	0.022	0.054	-0.006	±	0.028	0.062	-0.003	±	0.032	0.072	0.004	±	0.030	0.068
SOF	0.014				0.013				0.002				0.007			

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.

Table B.5. Archived FSS Soil Sample Results (pCi/g)

ROC	FSS-0694: NOL01-03-01-106-F-RC				FSS-0519: OOL01-03-011-F-RC				FSS-1707: OOL09-02-004-F				FSS-2190: OOL07-03-120-F			
	Conc.		TPU[a]	MDC[b]	Conc.		TPU	MDC	Conc.		TPU	MDC	Conc.		TPU	MDC
Am-241	-0.035	±	0.034	0.081	-0.024	±	0.063	0.155	-0.029	±	0.026	0.082	-0.063	±	0.029	0.085
Cm-245	0.015	±	0.090	0.215	0.042	±	0.098	0.233	-0.007	±	0.070	0.219	0.054	±	0.095	0.228
Co-60	0.004	±	0.028	0.061	0.010	±	0.026	0.057	0.012	±	0.014	0.059	-0.003	±	0.015	0.044
Cs-137	0.018	±	0.015	0.033	**0.026**[c]	±	0.012	0.024	0.025	±	0.014	0.027	-0.009	±	0.023	0.046
Eu-152	-0.021	±	0.053	0.116	-0.010	±	0.040	0.094	-0.050	±	0.046	0.096	-0.022	±	0.050	0.109
Eu-154	-0.048	±	0.095	0.226	-0.195	±	0.097	0.160	-0.14	±	0.11	0.22	-0.19	±	0.11	0.20
Nb-94	0.002	±	0.018	0.040	-0.003	±	0.014	0.030	-0.003	±	0.015	0.033	0.008	±	0.017	0.040
Np-237 by Pa-233	-0.007	±	0.030	0.066	0.007	±	0.023	0.055	0.005	±	0.029	0.066	-0.000[d]	±	0.030	0.068
SOF	0.004				0.015				0.011				0.004			

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.
[d] Zero due to rounding

Table B.6. Archived FSS Soil Sample Results (pCi/g)

ROC	FSS-2057: OOL09-07-020-F			FSS-1589: OOL09-06-003-F-RC		
	Conc.	TPU[a]	MDC[b]	Conc.	TPU	MDC
Am-241	0.013	0.052	0.126	-0.08	0.12	0.28
Cm-245	0.06	0.11	0.26	0.11	0.15	0.36
Co-60	-0.013	0.018	0.034	0.004	0.027	0.058
Cs-137	0.001	0.009	0.040	-0.002	0.021	0.048
Eu-152	-0.030	0.037	0.084	0.014	0.055	0.132
Eu-154	-0.078	0.079	0.174	-0.36	0.14	0.23
Nb-94	0.007	0.015	0.034	0.007	0.022	0.049
Np-237 by Pa-233	-0.008	0.025	0.059	-0.005	0.036	0.085
SOF	0.005			0.010		

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.

Table B.7. ORISE Judgmental Soil Sample Results (pCi/g)						
ROC	5272S0027			5272S0033		
	Conc.	TPU[a]	MDC[b]	Conc.	TPU	MDC
Am-241	-0.023	0.097	0.239	0.050	0.094	0.236
Cm-245	-0.00[d]	0.14	0.32	0.06	0.13	0.30
Co-60	0.016	0.021	0.052	-0.027	0.023	0.037
Cs-137	**0.077**[c]	0.019	0.028	**0.132**	0.023	0.028
Eu-152	0.035	0.047	0.119	-0.010	0.045	0.107
Eu-154	0.001	0.081	0.202	-0.146	0.094	0.172
Nb-94	0.013	0.018	0.044	0.009	0.018	0.041
Np-237 by Pa-233	0.042	0.025	0.053	0.036	0.031	0.078
SOF	0.058			0.056		

[a] Uncertainties are based on total propagated uncertainties at the 95% confidence level.
[b] MDC = minimum detectable concentration.
[c] Results greater than the analytical MDC are bolded.
[d] Zero due to rounding.

Table B.8. WMF Sample Locations and Direct Measurements							
Sample ID	Location	Total Activity		Removable Activity			
		Alpha	Beta	Alpha	Beta	H-3	C-14
		dpm/100 cm²	dpm/100 cm²	dpm/100 cm²			
5272R0001	Behind South Push Wall, Western Wall	30	1,300	0	2	--	--
5272R0002	Behind South Push Wall, Western Floor	50	1,600	0	0	-2	-4
5272R0003	Behind South Push Wall, Middle Floor	10	1,800	0	2	--	--
5272R0004	Behind South Push Wall, Middle Wall	10	1,200	0	2	--	--
5272R0005	Behind South Push Wall, Eastern Wall	20	1,300	0	2	--	--
5272R0006	Behind South Push Wall, Eastern Floor	20	1,600	0	3	--	--
5272R0007	Behind North Push Wall, Middle Floor	40	1,600	0	0	-7	1
5272R0008	Behind North Push Wall, Middle Wall	20	1,200	0	0	--	--
5272R0009	Behind North Push Wall, Eastern Wall	20	1,400	0	0	--	--
Minimum		10	1,200	0	0	-7	-4
Maximum		50	1,800	0	3	-2	1

APPENDIX C: MAJOR INSTRUMENTATION

C.1. SCANNING AND MEASUREMENT INSTRUMENT / DETECTOR COMBINATIONS

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or his employer.

C.1.1 GAMMA

Ludlum NaI Scintillation Detector Model 44-10, Crystal: 5.1 cm × 5.1 cm
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Trimble Geo 7X
(Trimble Navigation Limited, Sunnyvale, CA)

C.1.2 ALPHA-PLUS-BETA

Ludlum Gas-flow Proportional Detector Model 43-68, 126 cm^2 physical area, 0.8 mg/cm^2 Mylar window
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, Texas)

Ludlum Gas-flow Proportional Detector Model 43-37, 584 cm^2 physical area, 0.8 mg/cm^2 Mylar window
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, Texas)

C.1.3 ALPHA

Ludlum Gas-flow Proportional Detector Model 43-68, 126 cm^2 physical area, 0.8 mg/cm^2 Mylar window
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, Texas)

C.1.4 BETA

Ludlum Gas-flow Proportional Detector Model 43-68, 126 cm^2 physical area, 3.8 mg/cm^2 Mylar window
(Ludlum Measurements, Inc., Sweetwater, Texas)
coupled to: Ludlum Ratemeter-scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, Texas)

C.2. LABORATORY ANALYTICAL INSTRUMENTATION

Low-Background Gas Proportional Counter
Series 5 XLB
(Canberra, Meriden, Connecticut)
Used in conjunction with:
Eclipse Software
Dell Workstation
(Canberra, Meriden, Connecticut)

High-Purity, Extended Range Intrinsic Detector
CANBERRA/Tennelec Model No: ERVDS30-25195
Canberra Lynx ® Multichannel Analyzer
Canberra Gamma-Apex Software
(Canberra, Meriden, Connecticut)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, Tennessee) and
Dell Workstation
(Canberra, Meriden, Connecticut)

High-Purity, Intrinsic Detector
EG&G ORTEC Model No. GMX-45200-5
Canberra Lynx ® Multichannel Analyzer
Canberra Gamma-Apex Software
(Canberra, Meriden, Connecticut)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, Tennessee) and
Dell Workstation
(Canberra, Meriden, Connecticut)

High-Purity, Intrinsic Detector
EG&G ORTEC Model No. GMX-30P4
Canberra Lynx ® Multichannel Analyzer
Canberra Gamma-Apex Software
(Canberra, Meriden, Connecticut)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, Tennessee) and
Dell Workstation
(Canberra, Meriden, Connecticut)

High-Purity, Intrinsic Detector
EG&G ORTEC Model No. CDG-SV-76/GEM-MX5970-S
Canberra Lynx ® Multichannel Analyzer
Canberra Gamma-Apex Software
(Canberra, Meriden, Connecticut)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, Tennessee) and
Dell Workstation
(Canberra, Meriden, Connecticut)

Liquid Scintillation Counter
Perkin Elmer Tricarb 5110TR
(Perkin Elmer, Waltham, Massachusetts)

APPENDIX D: SURVEY AND ANALYTICAL PROCEDURES

D.1. PROJECT HEALTH AND SAFETY

ORISE performed all survey activities in accordance with the *ORAU Radiation Protection Manual*, the *ORAU Radiological and Environmental Survey Procedures Manual*, and the *ORAU Health and Safety Manual*, (ORAU 2014, ORAU 2016a, and ORAU 2016b). Prior to on-site activities, a Work-Specific Hazard Checklist was completed for the project and discussed with field personnel. The planned activities were thoroughly discussed with site personnel prior to implementation to identify hazards present. Additionally, prior to performing work, a pre-job briefing and walk down of the survey areas were completed with field personnel to identify hazards present and discuss safety concerns. Should ORISE have identified a hazard not covered in the *ORAU Radiological and Environmental Survey Procedures Manual* (ORAU 2016a) or the project's Work-Specific Hazard Checklist for the planned survey and sampling procedures, work would not have been initiated or continued until the hazard was addressed by an appropriate job hazard analysis and hazard controls.

D.2. CALIBRATION AND QUALITY ASSURANCE

Calibration of all field instrumentation was based on standards/sources, traceable to National Institute of Standards and Technology (NIST).

Field survey activities were conducted in accordance with procedures from the following documents:

- ORAU *Radiological and Environmental Survey Procedures Manual* (ORAU 2016a)
- ORAU *Environmental Services and Radiation Training Quality Program Manual* (ORAU 2019a)
- ORAU *Radiological and Environmental Analytical Laboratory Procedures Manual* (ORAU 2019b)

The procedures contained in these manuals were developed to meet the requirements of U.S. Department of Energy (DOE) Order 414.1D and the U.S. Nuclear Regulatory Commission (NRC) *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards*, and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations
- Participation in Mixed-Analyte Performance Evaluation Program and Intercomparison Testing Program laboratory quality assurance programs
- Training and certification of all individuals performing procedures
- Periodic internal and external audits

D.3. SURVEY PROCEDURES

D.3.1 SURFACE SCANS

Gamma scans were performed using a hand-held thallium-doped sodium iodide (NaI[Tl]) scintillation detector with a 5 cm by 5 cm crystal. Alpha-plus-beta scans were performed using either the large-area (floor monitor) or hand-held gas proportional detector with a 0.8 (milligram per square centimeter (mg/cm^2) window with a physical detector area of 584 cm^2 or 126 cm^2, respectively. Scans for elevated radiation were performed by passing the detector slowly over the surface. The distance between the detector and surface was maintained at a minimum. The NaI[Tl] and floor monitor detectors were used solely as a qualitative means to identify elevated radiation levels in excess of background. Identifications of elevated radiation levels that could exceed the site criteria were determined based on an increase in the audible signal from the indicating instrument and quantitatively investigated using other hand-held instruments.

Surface scan minimum detectable concentrations (MDCs) for the hand-held gas proportional detectors were estimated using the approach described in NUREG-1507 (NRC 1998). The scan MDC is a function of many variables, including a two-second observation interval, a specific level of performance at the first scanning state of 95% true positive and 25% false positive rate, which yields a d' value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. The total efficiency for beta was 0.14 based on Cs-137. Per the PG&E Final Status Survey Planning Worksheet for the survey units in the Waste Management Facility building, Cs-137 was the only positive result for

plant-derived radionuclides identified during the characterization survey (PG&E 2019). The scan MDC was calculated using the following equation:

$$Scan\ MDC = \frac{d' \times \sqrt{C_b \times \left(\frac{i}{60}\right)} \times (60/i)}{\sqrt{p} \times \varepsilon_t \times \frac{Probe\ Area}{100\ cm^2}}$$

Where:

d' = index of sensitivity

C_b = background (cpm)

i = observation interval (sec)

p = surveyor efficiency

ε_t = total efficiency

The scan MDC for a nominal instrument background of 200 cpm was 1,500 dpm/100 cm^2 for the hand-held gas proportional detectors.

D.3.2 Surface Activity Measurements

Measurements of gross alpha and beta surface activity levels were performed using hand-held gas proportional detectors coupled to portable ratemeter-scalers. Count rates, which were a one-minute count with the detector held in a static position, were converted to activity levels by dividing the count rate by the total static efficiency and correcting for the physical area of the detector. For conservatism the licensee elected not to subtract out background. The MDC for static survey activity measurements was calculated using the following equation:

$$MDC = \frac{3 + (4.65\sqrt{B})}{T \times G \times \varepsilon_t}$$

Where:

B = background in time interval, T (1 min)

T = count time (min) used for field instruments

ε_{tot} = total efficiency = $\varepsilon_i \times \varepsilon_s$ (instrument efficiency × source efficiency)

G = geometry correction factor (1.26)

The static MDC was 390 dpm/100 cm^2 for beta, based on a nominal instrument background of 200 cpm and 90 dpm/100 cm^2 alpha, with a nominal instrument background of 2 cpm (using an efficiency of 0.08 for Th-230).

D.3.3. Removable Activity Sampling

Smear sampling for removable gross alpha and gross beta contamination as well as for hard-to-detect (HTD) radionuclides were obtained from independent confirmatory measurement locations. Removable activity samples were collected using numbered filter paper disks. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears for gross alpha and beta analysis were placed in labeled envelopes. Smears for HTD analysis were first wetted with deionized water before the surface was wiped. Wet smears were placed in glass vials with deionized water. Locations and other pertinent data were recorded and all samples were transferred under chain-of-custody.

D. 3.4. Soil Sampling

Soil samples (approximately 0.5 kilogram each) were collected by ORISE personnel using a clean garden trowel to transfer soil into a new sample container. The container was then labeled and security sealed in accordance with ORISE procedures. ORISE shipped samples under chain-of-custody to the ORISE laboratory for analysis.

D.4. RADIOLOGICAL ANALYSIS

D.4.1 Gross Alpha/Beta

Dry smears were counted on a low-background proportional counter for gross alpha and beta activity. The minimum detectable activity of the procedures is approximately 11 dpm/100 cm^2 for alpha and 14 dpm/100 cm^2 for beta.

D. 4.2. Gamma Spectroscopy

Samples were analyzed as received, and homogenized as necessary, and a portion sealed into an appropriate sized - Marinelli beaker. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic, high purity, germanium detectors coupled to a pulse height analyzer system. Background

and Compton stripping, peak search, peak identification, and concentration calculations were performed using computer capabilities inherent in the analyzer system. All total absorption peaks (TAPs) associated with the ROCs were reviewed for consistency of activity. Spectra were also reviewed for other identifiable TAPs.

Table D.1. Typical MDCs Total Absorption Peak

Radionuclide	TAP (MeV)[a]	MDC (pCi/g)
Co-60	1.332	0.06
Cs-137	0.662	0.05
Eu-152	0.344	0.10
Eu-154	0.723	0.15

D.4.3 H-3 AND C-14 ANALYSIS

Smear samples were placed into a scintillation cocktail without sample preparation and counted in a liquid scintillation analyzer. Tritium (H-3) and carbon-14 (C-14) values were calculated using the known efficiency in the appropriate energy region.

D.4.4 DETECTION LIMITS

Detection limits, referred to as MDCs, were based on 95% confidence level. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

OOL10-01

Data Assessment

Data Quality Assessment of OOL10-01;

1. *The HBPP Historical Site Assessment and MARSSIM were reviewed and compared to the DQOs of HBPP-CHAR-OOL10-01-03. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the Characterization Plan.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-2.71E-02
Maximum Value	3.53E-01
Mean	1.85E-01
Median	1.95E-01
a-posteriori σ	1.46E-01

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits relative normal symmetry.*
8. *The Frequency Plot demonstrates a non-normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

Summary:

The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

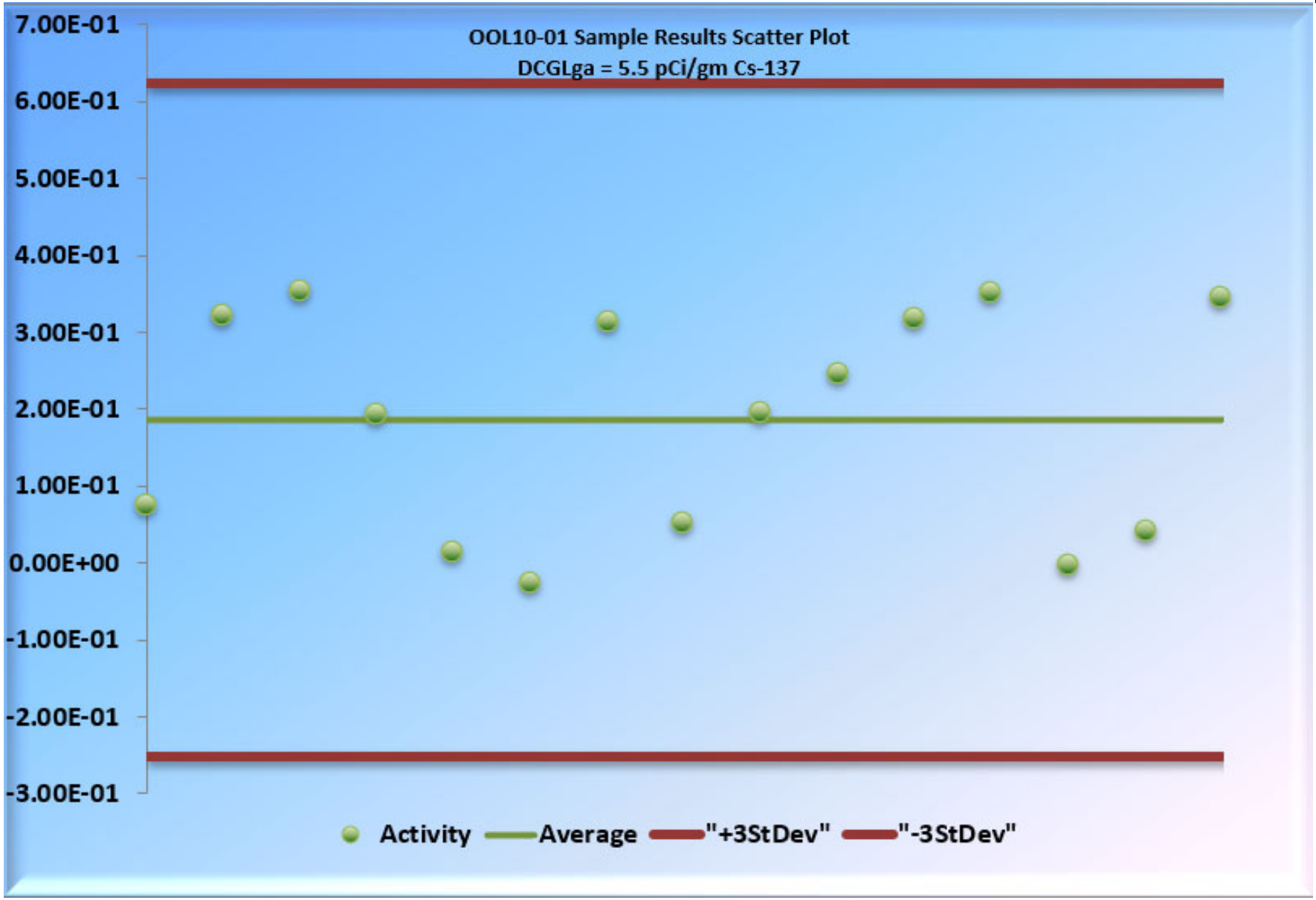
Survey Unit OOL10-01 meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-01.

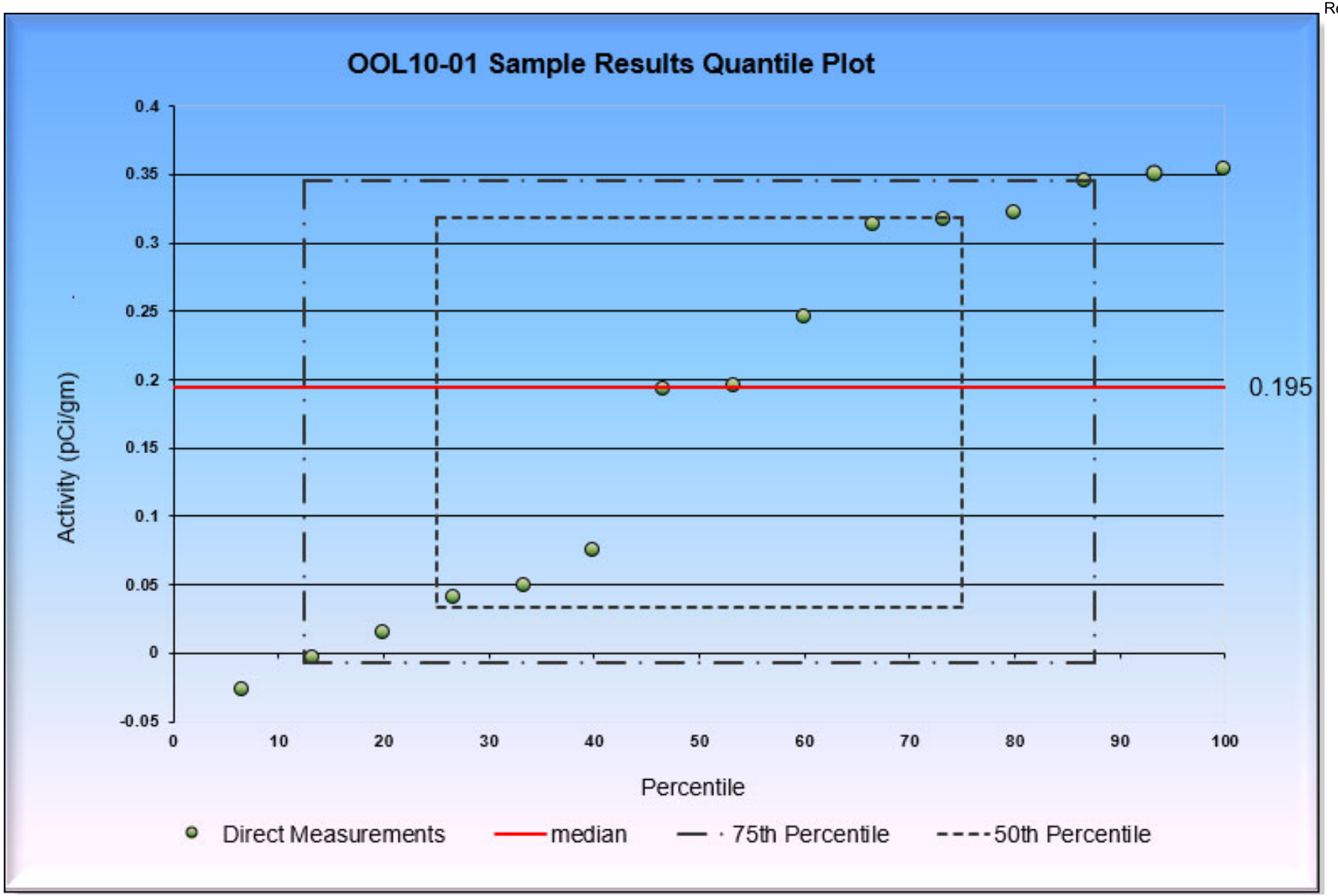
FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)

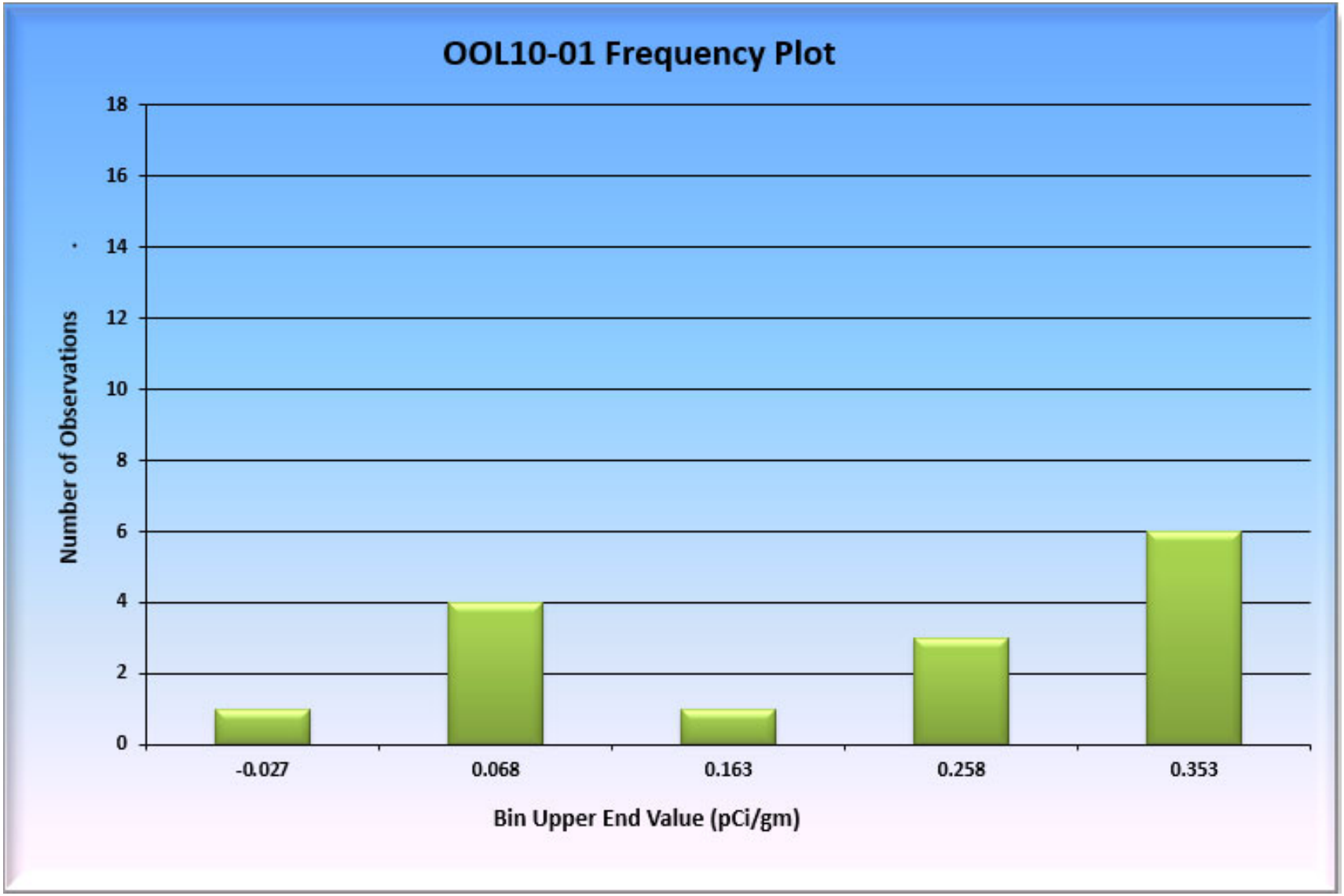
Sample Number	Am-241	Co-60	Cs-137	Eu-152	Eu-154	Nb-94	Np-237	SOF[1]
OOL10-01-001-C	2.59E-01	-8.12E-02	7.53E-02	1.17E-01	-8.47E-02	-8.12E-02	1.38E-01	1.4%
OOL10-01-002-C	-7.35E-03	-3.01E-02	**3.22E-01**	-1.90E-02	1.45E-02	-3.08E-02	7.15E-02	5.9%
OOL10-01-003-C	-1.21E-01	3.38E-02	**3.53E-01**	1.06E-01	-5.28E-02	1.16E-02	2.76E-02	6.4%
OOL10-01-004-C	-5.02E-02	-2.09E-02	**1.93E-01**	-1.27E-02	-7.08E-03	7.47E-03	8.25E-03	3.5%
OOL10-01-005-C	-4.11E-02	3.86E-03	1.43E-02	-4.90E-01	-2.02E-01	2.70E-03	4.06E-02	0.3%
OOL10-01-006-C	7.70E-02	-6.77E-02	-2.71E-02	-5.99E-02	-9.91E-03	1.30E-02	-9.82E-03	-0.5%
OOL10-01-007-C	1.68E-01	6.43E-03	**3.13E-01**	7.75E-02	-8.33E-02	3.20E-02	2.83E-02	5.7%
OOL10-01-008-C	-5.54E-02	-2.16E-02	4.94E-02	-7.86E-03	-1.12E-01	-3.89E-02	-8.02E-02	0.9%
OOL10-01-009-C	-1.56E-02	-1.40E-03	**1.95E-01**	-2.76E-03	-1.64E-02	-9.69E-03	-1.04E-01	3.5%
OOL10-01-010-C	-2.09E-01	2.48E-02	2.45E-01	-3.98E-02	-8.81E-02	-4.43E-02	1.07E-02	4.5%
OOL10-01-011-C	-2.87E-01	2.45E-02	**3.17E-01**	8.93E-03	-4.01E-02	9.94E-03	-2.09E-03	5.8%
OOL10-01-012-C	1.33E-01	-5.88E-02	**3.50E-01**	1.02E-02	-4.58E-02	8.62E-03	-5.45E-02	6.4%
OOL10-01-013-C	-3.46E-01	3.62E-03	-3.61E-03	7.62E-02	3.50E-03	-1.53E-02	5.84E-02	-0.1%
OOL10-01-014-C	-7.10E-02	2.25E-03	4.03E-02	-2.15E-01	-1.59E-02	-4.59E-03	9.91E-02	0.7%
OOL10-01-015-C	-1.01E-01	5.35E-03	**3.45E-01**	-5.01E-02	4.90E-02	1.17E-02	-6.69E-02	6.3%

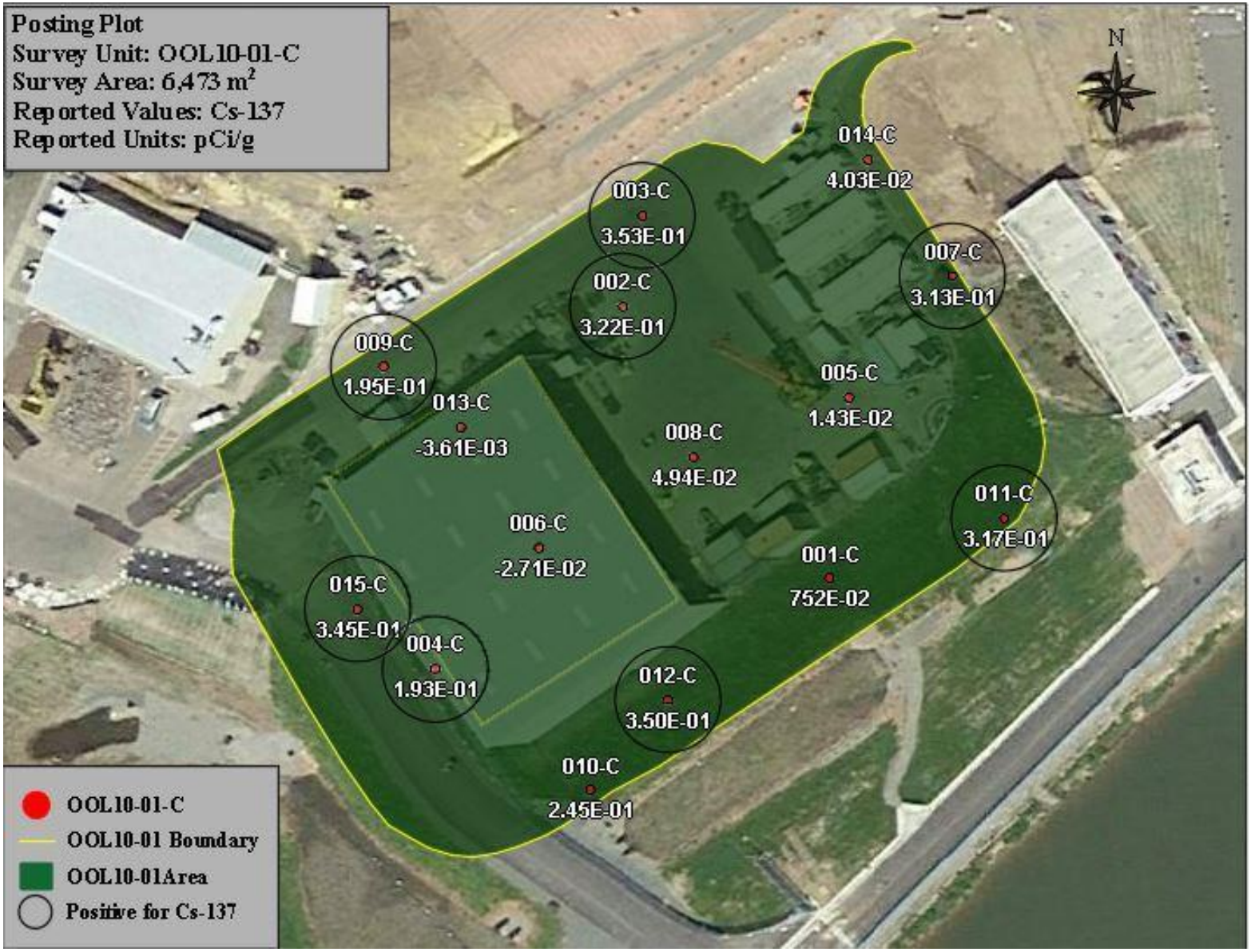
*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels

Note [1] The calculated sum of fractions (SOF) presented above are the Cs-137 activity values relative to the Cs-137 DCGL specified in the plan (5.5 pCi/g)

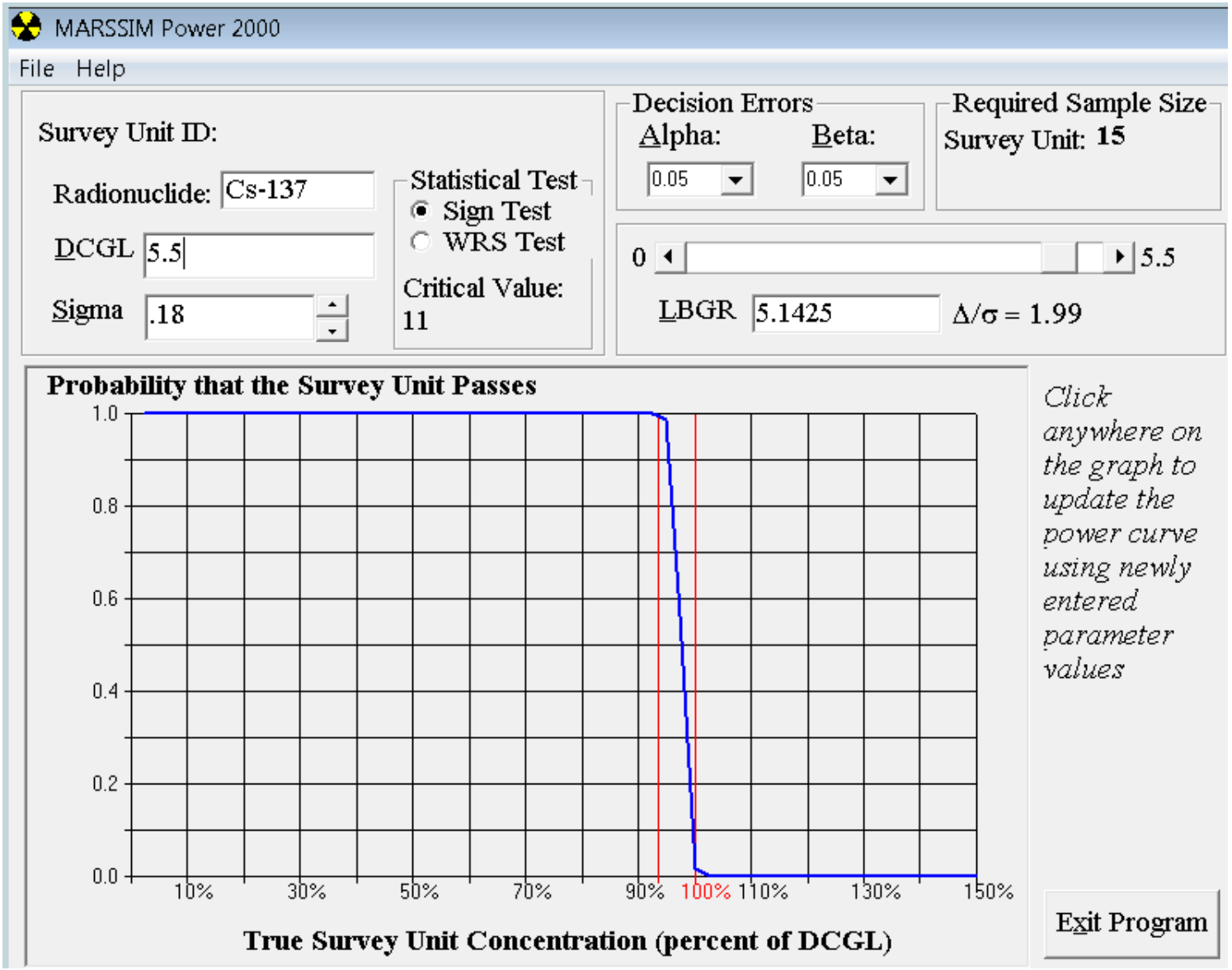

OOL10-01 Sample Results Scatter Plot
DCGLga = 5.5 pCi/gm Cs-137
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
-1.00E-01
-2.00E-01
-3.00E-01
Activity
Average
"+3StDev"
"-3StDev"


OOL10-01 Sample Results Quantile Plot
Activity (pCi/gm)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
10
20
30
40
50
60
70
80
90
100
Percentile
0.195
Direct Measurements
median
75th Percentile
50th Percentile

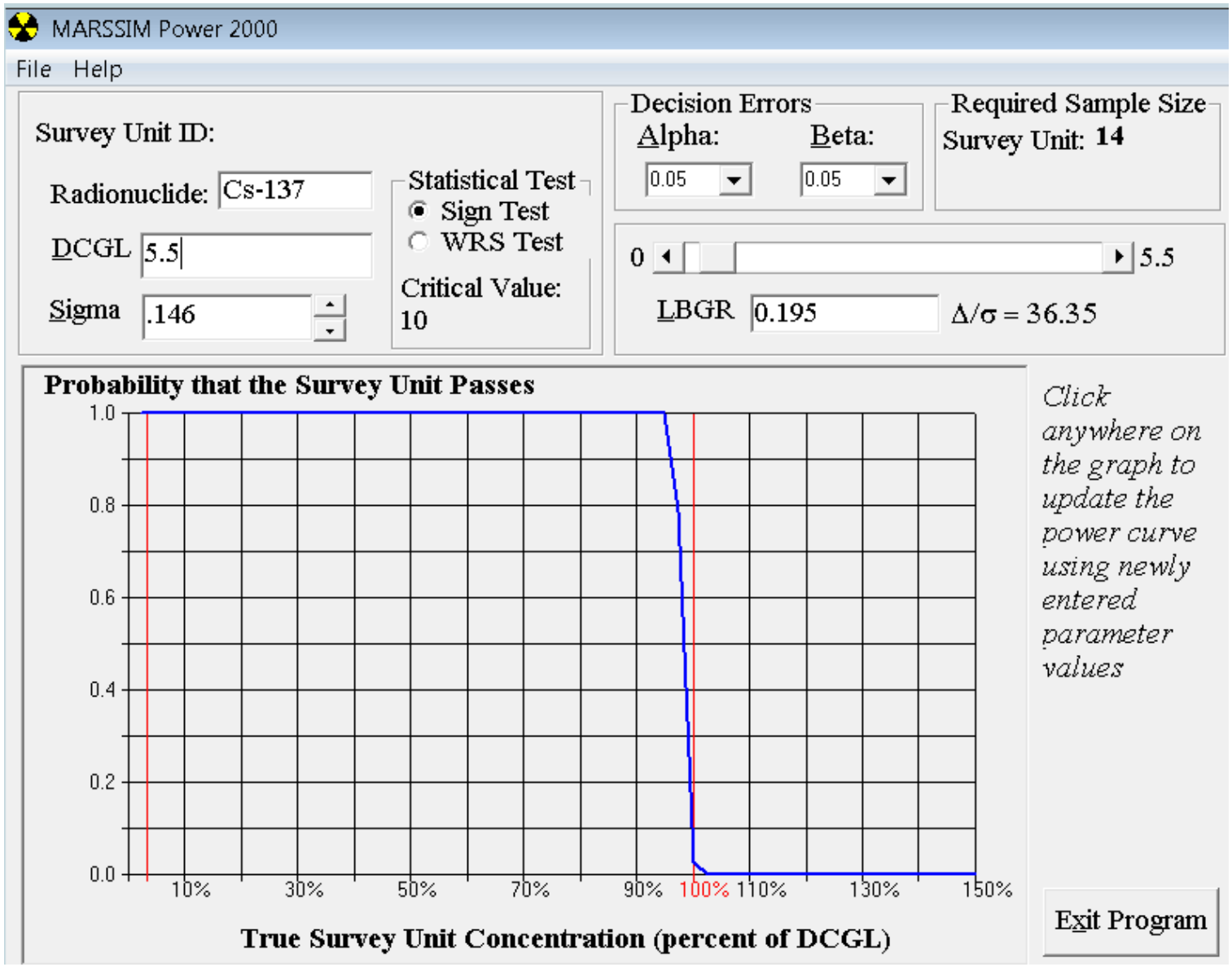

OOL10-01 Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.027
0.068
0.163
0.258
0.353
Bin Upper End Value (pCi/gm)



Prospective Power Curve



Retrospective Power Curve



Split Sample #012

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-CHAR-OOL10-01-03			Sample Measurement Location:	012

Sample Description:

Comparison of split samples collected from sample measurement location #012 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	5.97	0.62	10	0.6	1.66	6.15	0.48	1.03	Y
Pb-212	0.42	0.04	10	0.6	1.66	0.41	0.05	0.97	Y
Cs-137	0.35	0.04	9	0.6	1.66	0.30	0.03	0.86	Y
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	05/26/21	Concurrence by:	M. Blake	Date: 05/26/21
Signature:			Signature:	Marshall H Blake	

Split Sample #014

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-CHAR-OOL10-01-03			Sample Measurement Location:	014

Sample Description:

Comparison of split samples collected from sample measurement location #014 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	10.05	0.83	12	0.6	1.66	10.60	0.81	1.05	Y
Pb-212	0.39	0.04	9	0.6	1.66	0.53	0.06	1.36	Y
Cs-137[1]	0.04	N/A				0.08	0.03	1.92	N
		0.00					0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and under the MDA of 0.07 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/12/2021	Concurrence by:	M. Blake	Date:	1/12/2021
Signature:				Signature:			

Recount Sample #006

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-CHAR-OOL10-01-03			Sample Measurement Location:	006

Sample Description:

Duplicate count comparison from sample measurement location #006 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	8.22	0.70	12	0.6	1.66	7.06	0.64	0.86	Y
Pb-**212**	0.36	0.04	9	0.6	1.66	0.57	0.05	1.58	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Gordon Madison	Date:	1/25/2021	Concurrence by:	Marshall Blake	Date:	1/25/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID:	302858002	Client:	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-023	Collect Date:	February 15, 2012
Client Matrix:	Soil	Receive Date:	March 12, 2012
Amount of Sample Received:		Report Date:	April 25, 2012
Sample Description:	HBPP-CHAR-OOL10-01		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	04/21/12	U	3.75E-01	8.30E-01	1.43E+00		8.47E-01	pCi/g
Na-22	04/21/12	U	2.51E-02	4.69E-02	8.53E-02		4.83E-02	pCi/g
K-40	04/21/12		1.06E+01	1.62E+00	5.32E-01		1.62E+00	pCi/g
Cr-51	04/21/12	U	1.46E-01	1.39E+00	2.40E+00		1.39E+00	pCi/g
Mn-54	04/21/12	U	-3.46E-04	4.95E-02	8.23E-02		4.95E-02	pCi/g
Fe-59	04/21/12	U	-4.14E-02	2.24E-01	3.70E-01		2.25E-01	pCi/g
Co-56	04/21/12	U	1.04E-01	7.83E-02	1.50E-01		9.13E-02	pCi/g
Co-57	04/21/12	U	4.49E-03	2.66E-02	4.61E-02		2.67E-02	pCi/g
Co-58	04/21/12	U	3.79E-02	7.42E-02	1.32E-01		7.61E-02	pCi/g
Co-60	04/21/12	U	3.14E-02	4.60E-02	8.53E-02	9.50E-01	4.81E-02	pCi/g
Zn-65	04/21/12	U	-2.50E-01	1.36E-01	1.69E-01		1.77E-01	pCi/g
Y-88	04/21/12	U	3.39E-02	6.59E-02	1.23E-01		6.76E-02	pCi/g
Zr-95	04/21/12	U	2.37E-02	1.45E-01	2.48E-01		1.45E-01	pCi/g
Nb-94	04/21/12	U	-9.70E-03	3.80E-02	6.22E-02	1.45E+00	3.82E-02	pCi/g
Nb-95	04/21/12	U	3.45E-02	8.66E-02	1.52E-01		8.80E-02	pCi/g
Ru-106	04/21/12	U	-9.79E-02	3.94E-01	6.54E-01		3.97E-01	pCi/g
Ag-110m	04/21/12	U	-1.70E-02	5.74E-02	8.06E-02		5.79E-02	pCi/g
Sn-113	04/21/12	U	-4.90E-02	6.50E-02	1.00E-01		6.87E-02	pCi/g
Sb-124	04/21/12	U	8.20E-02	1.83E-01	3.39E-01		1.87E-01	pCi/g
Sb-125	04/21/12	U	-1.85E-03	1.16E-01	1.94E-01		1.16E-01	pCi/g
Cs-134	04/21/12	U	3.79E-02	6.18E-02	1.10E-01		6.41E-02	pCi/g
Cs-136	04/21/12	U	-7.63E-01	1.81E+00	2.90E+00		1.84E+00	pCi/g
Cs-137	04/21/12	M	7.75E-02	6.51E-02	7.27E-02	2.75E+00	6.51E-02	pCi/g
Ba-133	04/21/12	U	5.69E-03	4.82E-02	7.30E-02		4.83E-02	pCi/g
Ba-140	04/21/12	U	-1.48E+00	1.57E+00	2.06E+00		1.71E+00	pCi/g
Ce-139	04/21/12	U	-1.65E-02	3.88E-02	6.30E-02		3.95E-02	pCi/g
Ce-141	04/21/12	U	-1.32E-01	1.86E-01	2.93E-01		1.96E-01	pCi/g
Ce-144	04/21/12	U	-5.25E-03	2.07E-01	3.52E-01		2.07E-01	pCi/g
Nd-147	04/21/12	U	-6.74E+00	1.40E+01	2.28E+01		1.43E+01	pCi/g
Pm-144	04/21/12	U	4.18E-02	4.41E-02	8.23E-02		4.79E-02	pCi/g
Pm-146	04/21/12	U	3.76E-03	4.92E-02	8.25E-02		4.92E-02	pCi/g
Eu-152	04/21/12	U	1.29E-01	1.07E-01	1.84E-01	2.18E+00	1.22E-01	pCi/g
Eu-154	04/21/12	U	6.94E-02	1.30E-01	2.36E-01	2.00E+00	1.33E-01	pCi/g
Eu-155	04/21/12	U	3.15E-03	8.70E-02	1.51E-01		8.70E-02	pCi/g
Ir-192	04/21/12	U	1.28E-02	5.89E-02	1.03E-01		5.92E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID:	302858002	**Client:**	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-023	**Collect Date:**	February 15, 2012
Client Matrix:	Soil	**Receive Date:**	March 12, 2012
Amount of Sample Received:		**Report Date:**	April 25, 2012
Sample Description:	HBPP-CHAR-OOL10-01		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	04/21/12	U	-3.75E-02	8.05E-02	1.34E-01		8.22E-02	pCi/g
Tl-208	04/21/12		1.89E-01	8.74E-02	6.99E-02		8.74E-02	pCi/g
Pb-210	04/21/12		1.21E+00	1.04E+00	1.18E+00		1.04E+00	pCi/g
Pb-212	04/21/12		5.28E-01	1.20E-01	1.01E-01		1.20E-01	pCi/g
Pb-214	04/21/12		6.45E-01	1.88E-01	1.35E-01		1.88E-01	pCi/g
Bi-212	04/21/12	U	1.35E+00	7.41E-01	1.43E+00		9.58E-01	pCi/g
Bi-214	04/21/12		4.07E-01	1.68E-01	1.55E-01		1.68E-01	pCi/g
Ra-228	04/21/12		4.17E-01	2.46E-01	3.03E-01		2.46E-01	pCi/g
Ac-228	04/21/12		4.17E-01	2.46E-01	3.03E-01		2.46E-01	pCi/g
Th-234	04/21/12	UI	1.19E+00	1.72E+00	1.19E+00		1.72E+00	pCi/g
U-235	04/21/12	U	-5.47E-02	1.97E-01	3.20E-01		1.98E-01	pCi/g
U-238	04/21/12	UI	1.19E+00	1.72E+00	1.19E+00		1.72E+00	pCi/g
Np-237	04/21/12	U	-6.56E-03	6.52E-02	1.11E-01	1.15E+01	6.53E-02	pCi/g
Np-239	04/21/12	U	-1.02E-01	3.24E-01	5.44E-01		3.28E-01	pCi/g
Am-241	04/21/12	U	3.99E-02	8.17E-02	1.34E-01		8.36E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID:	297440002	**Client:**	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-023	**Collect Date:**	February 15, 2012
Client Matrix:	Soil	**Receive Date:**	March 12, 2012
Amount of Sample Received:		**Report Date:**	April 02, 2012
Sample Description:	HBPP-CHAR-OOL10-01		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	03/22/12	U	5.04E-01	1.69E+00	2.71E+00	5.50E+00	1.69E+00	pCi/g
C-14	03/18/12	U	2.23E-01	3.68E-01	6.13E-01	6.00E-01	3.68E-01	pCi/g
Ni-63	03/30/12	U	-1.10E+01	2.52E+01	4.32E+01	1.05E+02	2.52E+01	pCi/g
Sr-90	03/18/12	U	3.54E-02	4.91E-02	7.80E-02	8.50E-02	4.95E-02	pCi/g
Tc-99	03/20/12	U	-1.95E-01	4.35E-01	7.37E-01	9.50E-01	4.35E-01	pCi/g
Pu-241	03/19/12	U	1.34E+00	3.53E+00	5.82E+00	1.00E+01	3.54E+00	pCi/g
Alpha Spec								
Pu-238	03/14/12	U	-1.44E-03	1.21E-02	2.88E-02	1.25E-01	1.21E-02	pCi/g
Pu-239/240	03/14/12	U	9.13E-03	1.71E-02	3.32E-02	1.15E-01	1.72E-02	pCi/g
Am-241	03/15/12	U	1.83E-03	1.39E-02	3.99E-02	1.05E-01	1.39E-02	pCi/g
Cm-243/244	03/15/12	U	-1.73E-02	1.64E-02	5.86E-02	1.60E-01	1.64E-02	pCi/g
Cm-245/246	03/15/12	U	0.00E+00	1.49E-02	2.28E-02	2.76E+01	1.49E-02	pCi/g
Gamma Spec								
Ni-59	03/27/12	U	-8.81E+00	5.59E+01	9.17E+01	2.75E+02	5.60E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID:	302858001	Client:	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-006	Collect Date:	February 15, 2012
Client Matrix:	Soil	Receive Date:	March 12, 2012
Amount of Sample Received:		Report Date:	April 25, 2012
Sample Description:	HBPP-CHAR-OOL10-01-012S		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	04/21/12	U	-2.64E-01	4.37E-01	6.94E-01		4.53E-01	pCi/g
Na-22	04/21/12	U	-1.12E-02	2.75E-02	4.44E-02		2.80E-02	pCi/g
K-40	04/21/12		6.15E+00	9.57E-01	3.70E-01		9.57E-01	pCi/g
Cr-51	04/21/12	U	3.94E-01	7.83E-01	1.42E+00		8.03E-01	pCi/g
Mn-54	04/21/12	U	2.90E-02	3.03E-02	5.64E-02		3.30E-02	pCi/g
Fe-59	04/21/12	U	-2.70E-02	1.31E-01	2.11E-01		1.31E-01	pCi/g
Co-56	04/21/12	U	4.27E-03	3.75E-02	6.50E-02		3.76E-02	pCi/g
Co-57	04/21/12	U	-3.50E-03	1.58E-02	2.70E-02		1.59E-02	pCi/g
Co-58	04/21/12	U	3.38E-02	4.08E-02	7.64E-02		4.35E-02	pCi/g
Co-60	04/21/12	U	7.40E-04	2.17E-02	3.74E-02	9.50E-01	2.17E-02	pCi/g
Zn-65	04/21/12	U	-1.12E-01	7.02E-02	8.39E-02		8.64E-02	pCi/g
Y-88	04/21/12	U	1.43E-02	3.45E-02	6.28E-02		3.51E-02	pCi/g
Zr-95	04/21/12	U	-3.89E-03	8.46E-02	1.45E-01		8.47E-02	pCi/g
Nb-94	04/21/12	U	-7.91E-03	2.30E-02	3.84E-02	1.45E+00	2.32E-02	pCi/g
Nb-95	04/21/12	U	6.27E-03	4.83E-02	8.41E-02		4.83E-02	pCi/g
Ru-106	04/21/12	U	-3.74E-02	2.10E-01	3.40E-01		2.11E-01	pCi/g
Ag-110m	04/21/12	U	-8.47E-03	2.93E-02	4.25E-02		2.96E-02	pCi/g
Sn-113	04/21/12	U	-6.43E-03	3.93E-02	6.66E-02		3.94E-02	pCi/g
Sb-124	04/21/12	U	3.26E-02	1.03E-01	1.84E-01		1.04E-01	pCi/g
Sb-125	04/21/12	U	2.10E-02	6.84E-02	1.20E-01		6.90E-02	pCi/g
Cs-134	04/21/12	U	2.48E-02	2.94E-02	5.52E-02		3.14E-02	pCi/g
Cs-136	04/21/12	U	5.42E-01	9.24E-01	1.68E+00		9.55E-01	pCi/g
Cs-137	04/21/12	M	3.00E-01	6.19E-02	4.54E-02	2.75E+00	6.19E-02	pCi/g
Ba-133	04/21/12	U	-1.38E-02	2.95E-02	4.22E-02		3.02E-02	pCi/g
Ba-140	04/21/12	U	6.85E-02	8.21E-01	1.41E+00		8.22E-01	pCi/g
Ce-139	04/21/12	U	-1.60E-02	2.47E-02	4.01E-02		2.57E-02	pCi/g
Ce-141	04/21/12	U	8.38E-03	1.15E-01	1.99E-01		1.16E-01	pCi/g
Ce-144	04/21/12	U	6.53E-02	1.37E-01	2.42E-01		1.40E-01	pCi/g
Nd-147	04/21/12	U	-1.28E+00	9.08E+00	1.50E+01		9.10E+00	pCi/g
Pm-144	04/21/12	U	-1.06E-04	2.52E-02	4.36E-02		2.52E-02	pCi/g
Pm-146	04/21/12	U	4.90E-03	2.67E-02	4.62E-02		2.68E-02	pCi/g
Eu-152	04/21/12	U	1.63E-02	6.34E-02	1.09E-01	2.18E+00	6.38E-02	pCi/g
Eu-154	04/21/12	U	-3.08E-02	7.61E-02	1.23E-01	2.00E+00	7.73E-02	pCi/g
Eu-155	04/21/12	U	3.46E-02	6.14E-02	1.11E-01		6.34E-02	pCi/g
Ir-192	04/21/12	U	-1.65E-03	3.56E-02	6.20E-02		3.56E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID:	302858001	**Client:**	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-006	**Collect Date:**	February 15, 2012
Client Matrix:	Soil	**Receive Date:**	March 12, 2012
Amount of Sample Received:		**Report Date:**	April 25, 2012
Sample Description:	HBPP-CHAR-OOL10-01-012S		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	04/21/12	U	3.58E-02	5.15E-02	9.48E-02		5.39E-02	pCi/g
Tl-208	04/21/12		1.67E-01	5.31E-02	3.40E-02		5.31E-02	pCi/g
Pb-210	04/21/12	U	6.37E-01	2.98E+00	2.70E+00		2.98E+00	pCi/g
Pb-212	04/21/12		4.10E-01	9.08E-02	6.92E-02		9.08E-02	pCi/g
Pb-214	04/21/12		6.20E-01	1.32E-01	7.60E-02		1.32E-01	pCi/g
Bi-212	04/21/12	U	5.49E-01	7.07E-01	7.13E-01		7.49E-01	pCi/g
Bi-214	04/21/12		4.76E-01	1.10E-01	8.58E-02		1.10E-01	pCi/g
Ra-228	04/21/12		5.26E-01	2.02E-01	1.48E-01		2.02E-01	pCi/g
Ac-228	04/21/12		5.26E-01	2.02E-01	1.48E-01		2.02E-01	pCi/g
Th-234	04/21/12	U	1.16E+00	1.37E+00	1.22E+00		1.37E+00	pCi/g
U-235	04/21/12	U	1.41E-01	1.34E-01	2.35E-01		1.49E-01	pCi/g
U-238	04/21/12	U	1.16E+00	1.37E+00	1.22E+00		1.37E+00	pCi/g
Np-237	04/21/12	U	1.54E-02	4.46E-02	7.98E-02	1.15E+01	4.51E-02	pCi/g
Np-239	04/21/12	U	1.06E-01	2.43E-01	4.33E-01		2.47E-01	pCi/g
Am-241	04/21/12	U	-5.39E-02	8.93E-02	1.38E-01		9.25E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID:	297440001	**Client:**	Pacific Gas and Electric Company
Client Sample ID:	FSS-2012-006	**Collect Date:**	February 15, 2012
Client Matrix:	Soil	**Receive Date:**	March 12, 2012
Amount of Sample Received:		**Report Date:**	April 02, 2012
Sample Description:	HBPP-CHAR-OOL10-01-012S		

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	03/22/12	U	1.18E+00	1.81E+00	2.76E+00	5.50E+00	1.83E+00	pCi/g
C-14	03/18/12	U	2.28E-02	3.75E-01	6.28E-01	6.00E-01	3.75E-01	pCi/g
Ni-63	03/30/12	U	-7.00E-01	1.46E+01	2.45E+01	1.05E+02	1.46E+01	pCi/g
Sr-90	03/18/12	U	-4.19E-02	4.12E-02	7.58E-02	8.50E-02	4.12E-02	pCi/g
Tc-99	03/20/12	U	1.07E-01	4.16E-01	6.95E-01	9.50E-01	4.16E-01	pCi/g
Pu-241	03/19/12	U	-4.94E-01	3.61E+00	6.10E+00	1.00E+01	3.61E+00	pCi/g
Alpha Spec								
Pu-238	03/14/12	U	4.57E-03	1.21E-02	2.88E-02	1.25E-01	1.21E-02	pCi/g
Pu-239/240	03/14/12	U	-5.77E-03	1.31E-02	3.96E-02	1.15E-01	1.31E-02	pCi/g
Am-241	03/14/12	U	8.50E-03	1.59E-02	3.10E-02	1.05E-01	1.60E-02	pCi/g
Cm-243/244	03/14/12	U	4.48E-04	1.72E-02	4.53E-02	1.60E-01	1.72E-02	pCi/g
Cm-245/246	03/14/12	U	6.49E-03	1.27E-02	1.95E-02	2.76E+01	1.27E-02	pCi/g
Gamma Spec								
Ni-59	03/27/12	U	-1.29E+01	5.17E+01	8.61E+01	2.75E+02	5.20E+01	pCi/g

Notes: 1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers: U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-01-FSR

Data Assessment

Data Quality Assessment of OOL10-01-FSR;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-01-FSR-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-2.41E-02
Maximum Value	2.74E-01
Mean	4.21E-02
Median	3.38E-02
a-posteriori σ	7.16E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~4 standard deviations with one outlier.*
7. *The Quantile Plot exhibits relatively normal symmetry.*
8. *The Frequency Plot demonstrates a normal distribution with a high positive skewness distribution.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

Summary:

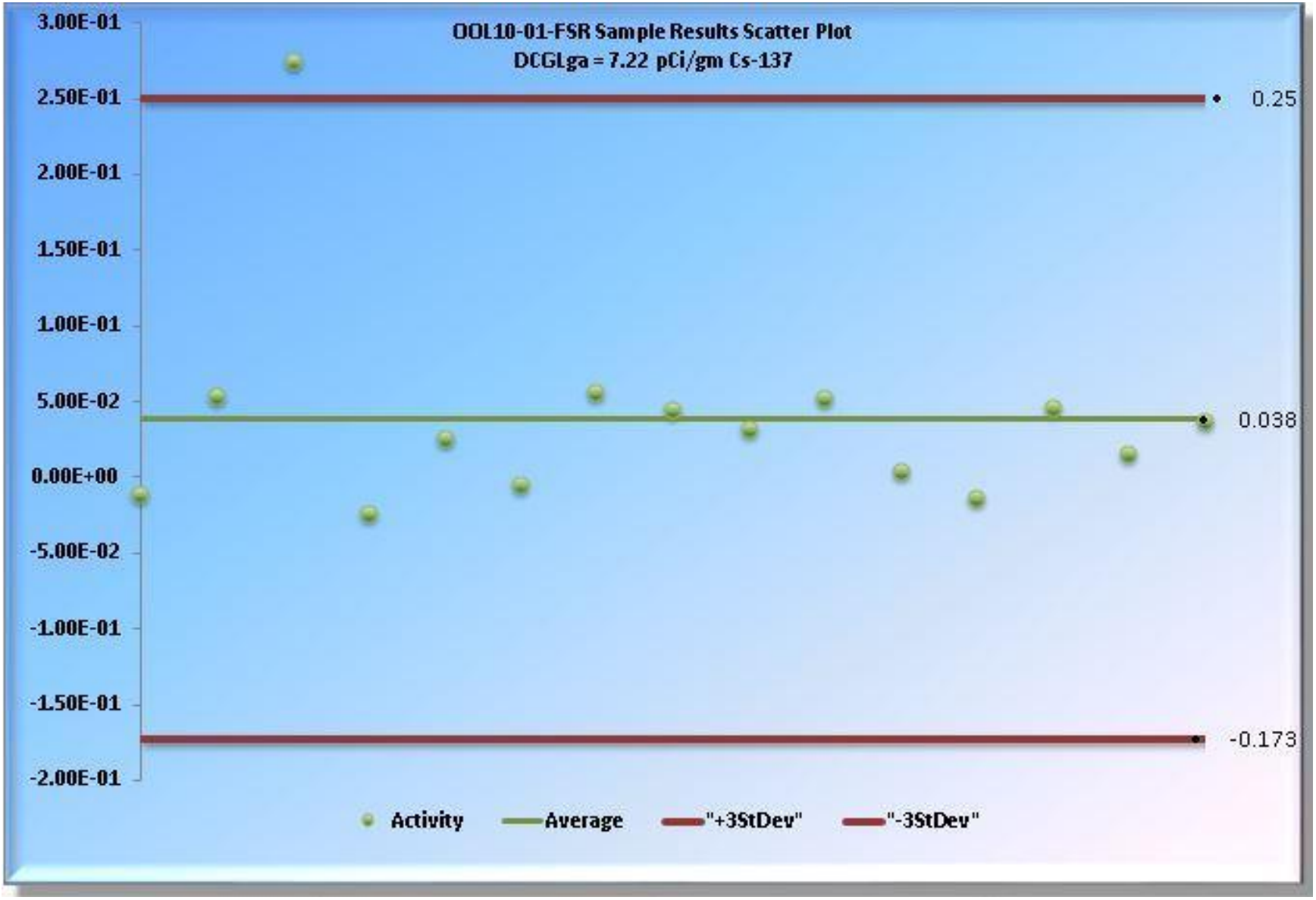
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

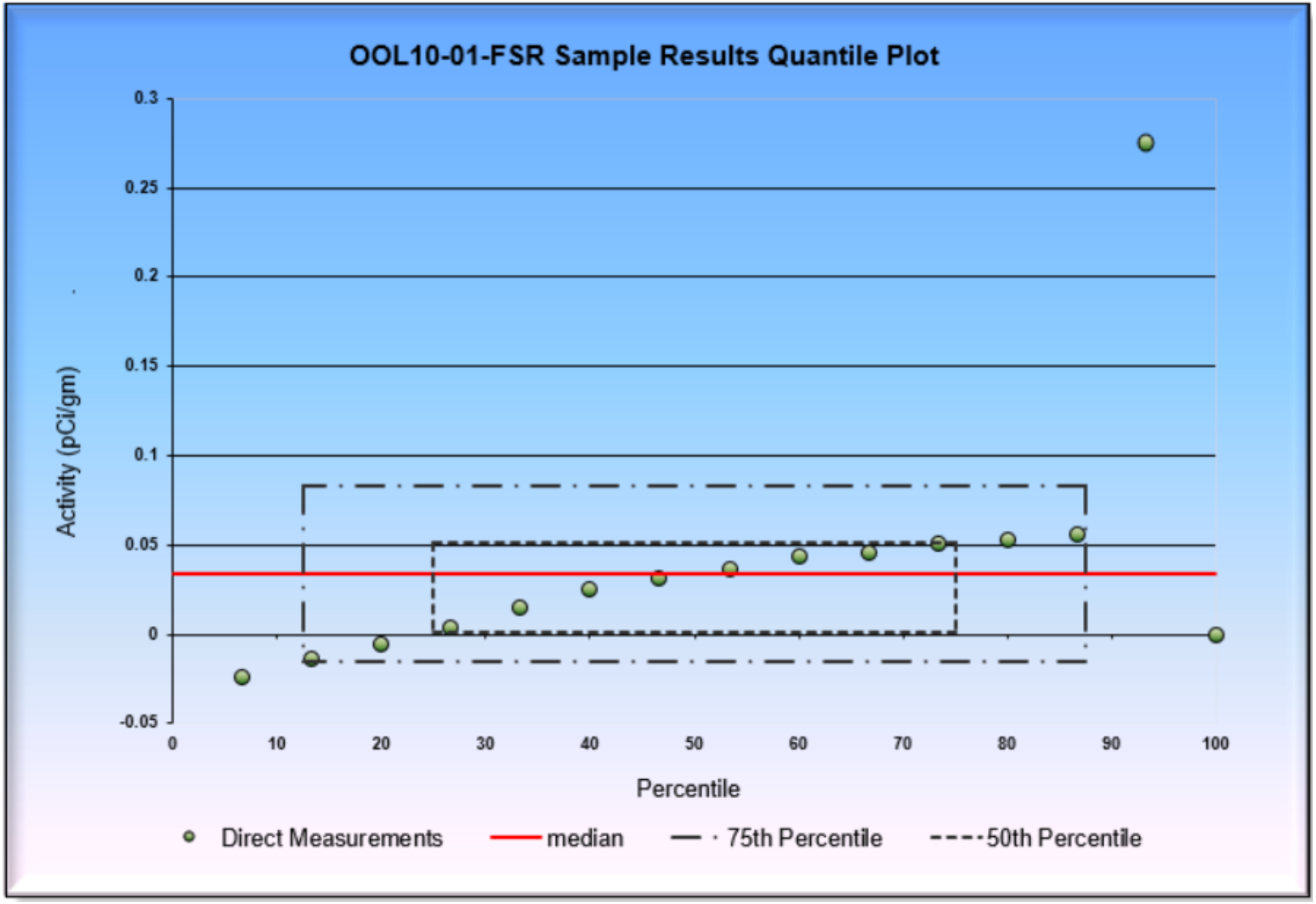
Survey Unit OOL10-01-FSR *meets the HBPP release criteria thus the null hypothesis is rejected for* OOL10-01-FSR.

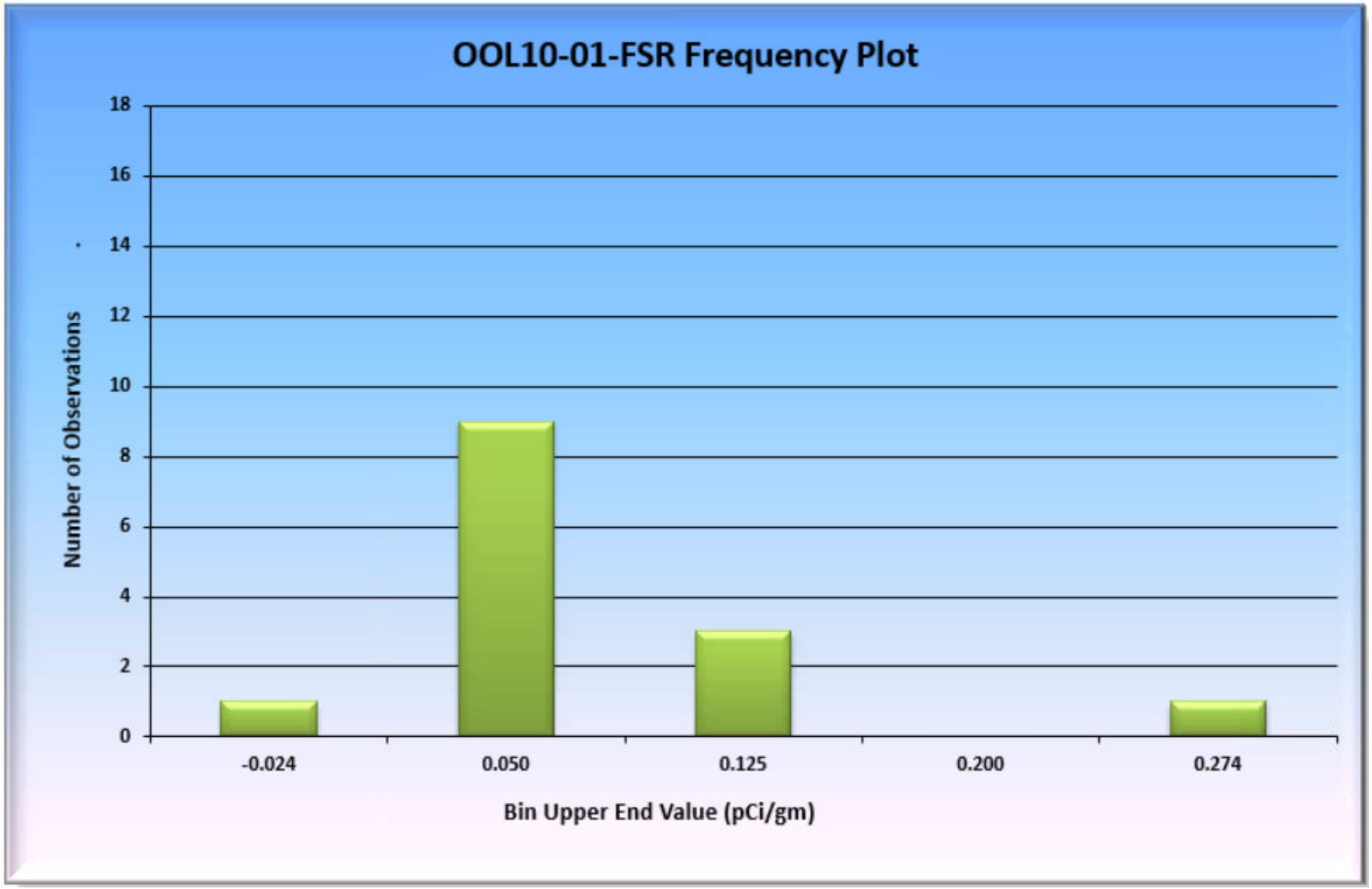
FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[(1)]**
OOL10-01-001-FSR	-1.27E-01	-3.51E-02	-1.19E-02	-7.55E-02	2.40E-02	3.67E-02	-1.45E-01	-1.00E-02	-1.75E-01	-0.2%
OOL10-01-002-FSR	-7.71E-02	-2.20E-02	5.30E-02	6.38E-02	-5.51E-02	3.68E-02	-2.99E-02	3.00E-02	1.24E-01	0.7%
OOL10-01-003-FSR	-1.74E-01	2.92E-02	**2.74E-01**	8.61E-02	-3.07E-03	-3.10E-02	7.92E-03	0.00E+00	-1.94E-01	3.5%
OOL10-01-004-FSR	-2.14E-01	-6.58E-02	-2.41E-02	2.12E-02	-2.94E-02	2.14E-02	-4.35E-02	0.00E+00	-2.43E-01	-0.3%
OOL10-01-005-FSR	-1.75E-02	-2.86E-02	2.48E-02	1.11E-02	4.97E-02	-2.49E-02	1.16E-02	0.00E+00	-2.25E-01	0.3%
OOL10-01-006-FSR	-3.85E-01	1.29E-02	-5.23E-03	2.44E-02	-3.79E-02	9.73E-03	6.60E-03	4.00E-02	2.80E-02	-0.1%
OOL10-01-007-FSR	1.36E-01	4.68E-03	5.62E-02	7.38E-03	-1.26E-01	6.63E-03	-3.53E-02	1.00E-02	-4.70E-02	0.7%
OOL10-01-008-FSR	9.30E-03	2.84E-02	4.32E-02	-1.18E-01	-1.95E-02	3.39E-02	-9.00E-03	1.00E-02	-2.98E-01	0.5%
OOL10-01-009-FSR	-4.16E-02	3.68E-02	3.13E-02	6.83E-02	-4.85E-02	1.23E-02	-1.78E-02	-1.10E+00	-1.55E-01	0.4%
OOL10-01-010-FSR	-3.28E-01	-7.41E-03	5.09E-02	-2.51E-02	-1.30E-01	-7.83E-03	3.61E-02	-1.00E-02	-8.60E-02	0.6%
OOL10-01-011-FSR	-1.42E-02	4.00E-03	3.23E-03	-3.24E-02	7.94E-03	3.38E-02	1.69E-02	0.00E+00	-6.90E-02	0.0%
OOL10-01-012-FSR	1.77E-01	-3.66E-02	-1.41E-02	-3.71E-01	-6.26E-02	6.92E-03	3.10E-02	9.00E-02	2.20E-02	-0.2%
OOL10-01-013-FSR	1.33E-01	3.26E-02	4.58E-02	-1.87E-01	-1.53E-01	2.21E-02	-1.56E-01	2.00E-02	-2.25E-01	0.6%
OOL10-01-014-FSR	-4.17E-02	2.11E-02	1.47E-02	-3.22E-03	4.65E-03	9.05E-03	-5.49E-04	1.00E-02	-1.83E-01	0.2%
OOL10-01-015-FSR	-9.45E-02	-2.34E-02	3.63E-02	2.24E-02	-7.33E-03	1.45E-03	2.32E-02	2.00E-02	1.32E-01	0.5%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

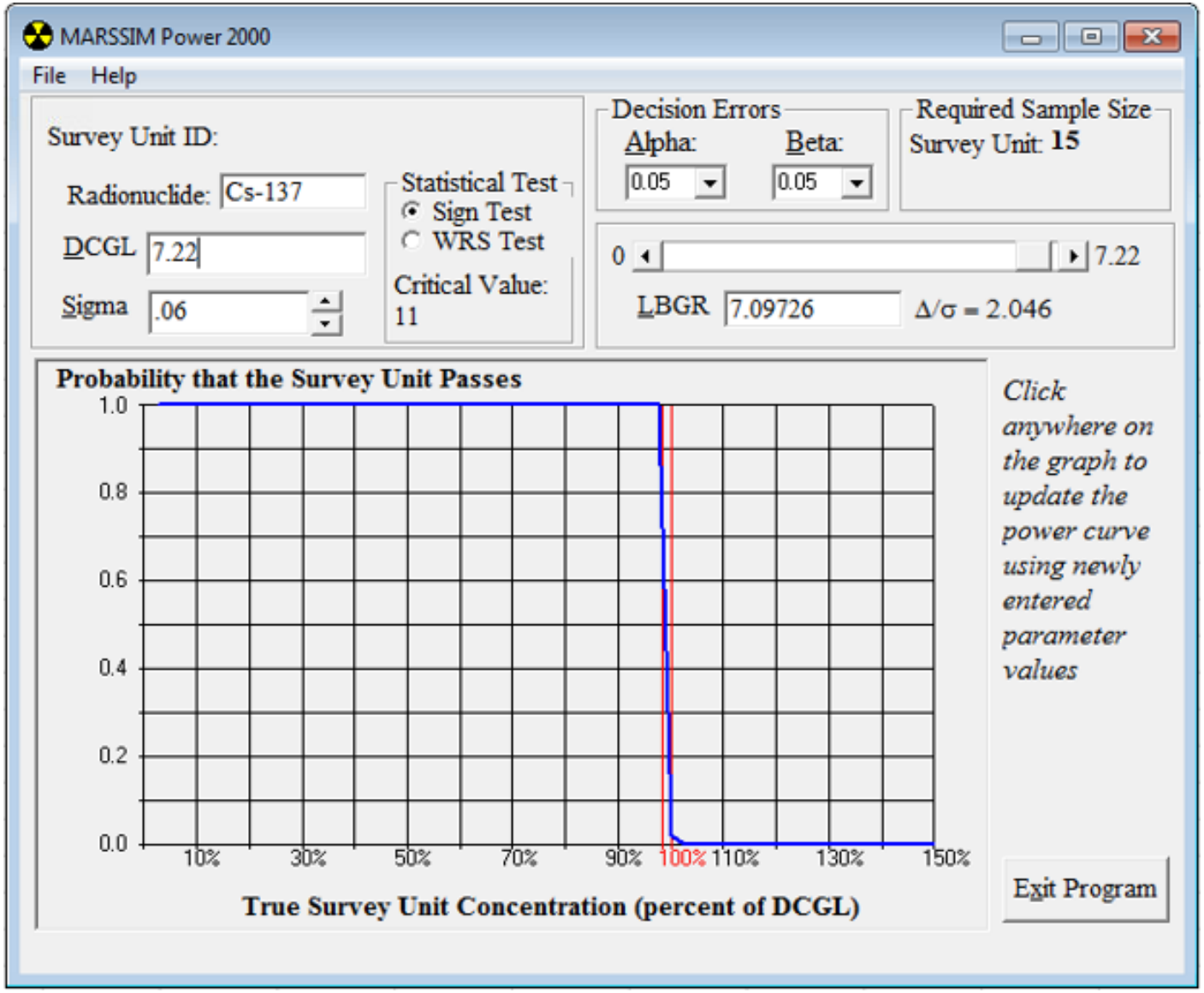

OOL10-01-FSR Sample Results Scatter Plot
DCGLga = 7.22 pCi/gm Cs-137
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
0.25
0.038
-0.173
Activity
Average
"+3StDev"
"-3StDev"


OOL10-01-FSR Sample Results Quantile Plot
Activity (pCi/gm)
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

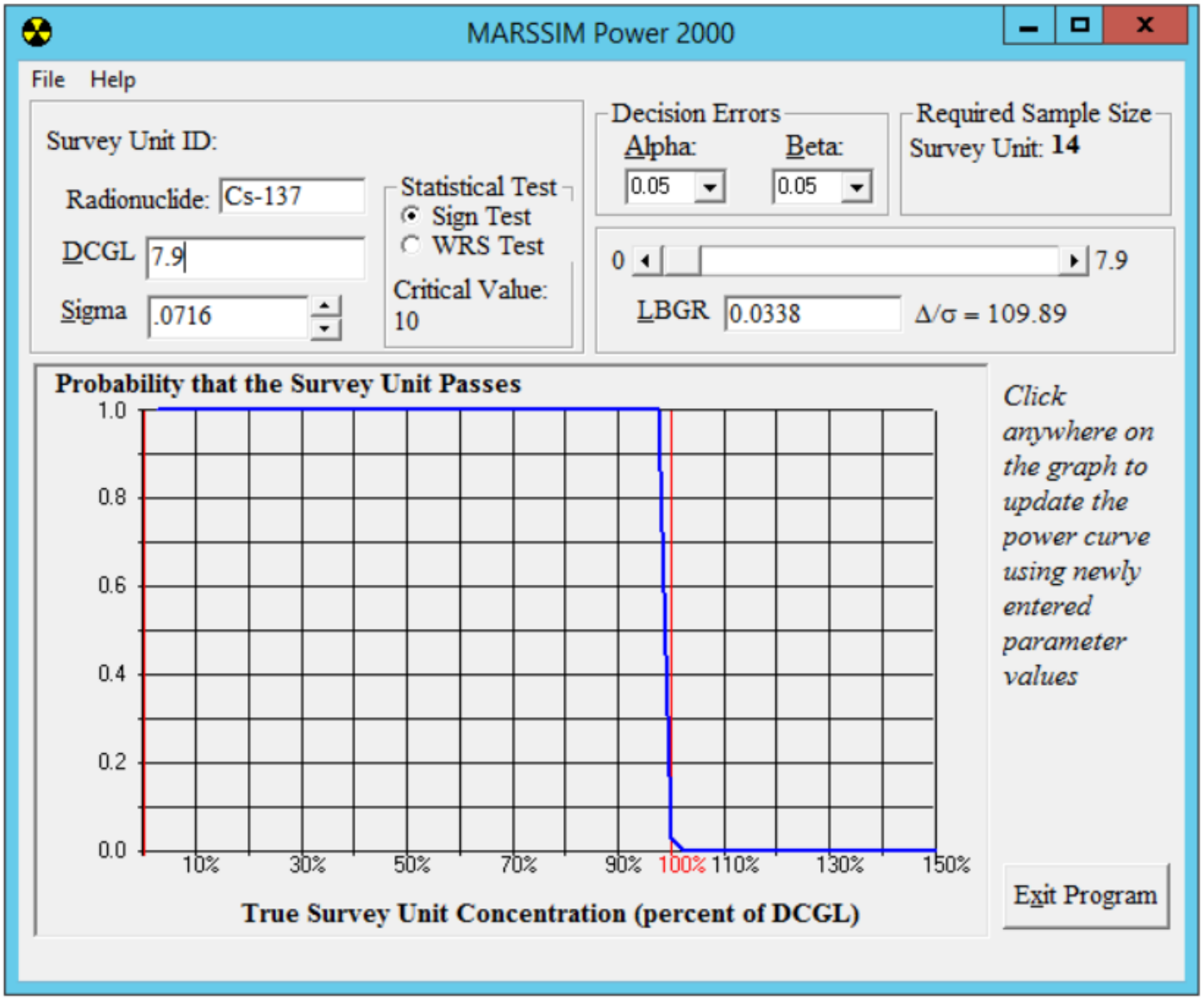

OOL10-01-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.024
0.050
0.125
0.200
0.274
Bin Upper End Value (pCi/gm)

Posting Plot
Survey Unit: OOL10-01-FSR
Survey Area: 3,020 m²
Reported Values: Cs-137
Reported Units: pCi/g
N
010
5.09E-02
013
4.58E-02
003
2.74E-01
011
3.23E-03
002
5.30E-02
006
-5.23E-03
012
-1.41E-02
001
-1.19E-02
009
3.13E-02
008
4.32E-02
015
3.63E-02
007
5.62E-02
014
1.47E-02
004
-2.41E-02
005
2.48E-02
OOL10-01-xxx-FSR
OOL10-01 Boundary
OOL10-01 Area
Positive for Cs-137

Prospective Power Curve



Retrospective Power Curve



Split Sample #003

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-FSSP-OOL10-01-FSR-00			Sample Measurement Location:	003

Sample Description:

Comparison of split samples collected from sample measurement location #003 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
Cs-137	0.27	0.04	7	0.5	2	0.37	0.02	1.34	Y
Pb-212	0.31	0.04	8	0.5	2	0.50	0.03	1.62	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/23/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Split Sample #001

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-FSSP-OOL10-01-FSR-00			Sample Measurement Location:	001

Sample Description:

Comparison of split samples collected from sample measurement location #001 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.30	1.37	5	0.5	2	6.36	0.15	1.01	Y
Pb-212	0.36	0.04	9	0.6	1.66	0.43	0.01	1.21	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	06/05/19	Concurrence by:	G. Madison	Date: 01/26/21
Signature:			Signature:		

Recount Sample #006

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	01	Survey Unit Name:	Fuel Oil Storage Tank Footprint
Sample Plan No.:	HBPP-FSSP-OOL10-01-FSR-00			Sample Measurement Location:	006

Sample Description:

Duplicate count comparison from sample measurement location #006 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.40	0.58	11	0.6	1.66	5.59	1.08	0.87	Y
Pb-214	0.43	0.04	10	0.6	1.66	0.26	0.05	0.61	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M Blake	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 461718009
Client Sample ID: FSS-1701: OOL10-01-001-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: October 06, 2018
Receive Date: October 15, 2018
Report Date: November 01, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/17/18	U	2.51E-02	4.73E-02	8.29E-02		4.86E-02	pCi/g
Na-22	10/17/18	U	4.15E-03	6.45E-03	1.16E-02		6.73E-03	pCi/g
K-40	10/17/18		6.36E+00	3.06E-01	7.88E-02		7.36E-01	pCi/g
Cr-51	10/17/18	U	1.25E-03	5.05E-02	8.81E-02		5.05E-02	pCi/g
Mn-54	10/17/18	U	6.38E-03	5.75E-03	1.02E-02		6.45E-03	pCi/g
Fe-59	10/17/18	U	1.09E-02	1.25E-02	2.28E-02		1.35E-02	pCi/g
Co-56	10/17/18	U	-2.68E-03	5.38E-03	8.33E-03		5.52E-03	pCi/g
Co-57	10/17/18	U	-1.88E-03	5.15E-03	8.43E-03		5.22E-03	pCi/g
Co-58	10/17/18	U	-4.84E-04	5.39E-03	8.74E-03		5.40E-03	pCi/g
Co-60	10/17/18	U	5.92E-04	5.62E-03	9.60E-03	3.42E-01	5.63E-03	pCi/g
Zn-65	10/17/18	U	6.84E-03	1.17E-02	1.91E-02		1.22E-02	pCi/g
Y-88	10/17/18	U	-5.16E-04	4.53E-03	7.28E-03		4.54E-03	pCi/g
Zr-95	10/17/18	U	5.19E-03	1.08E-02	1.84E-02		1.11E-02	pCi/g
Nb-94	10/17/18	U	1.42E-03	4.97E-03	8.33E-03	6.39E-01	5.01E-03	pCi/g
Nb-95	10/17/18	U	3.59E-03	6.66E-03	1.03E-02		6.86E-03	pCi/g
Ru-106	10/17/18	U	2.25E-03	4.25E-02	7.11E-02		4.25E-02	pCi/g
Ag-110m	10/17/18	U	3.19E-03	6.88E-03	1.17E-02		7.03E-03	pCi/g
Sn-113	10/17/18	U	2.02E-03	6.63E-03	1.16E-02		6.70E-03	pCi/g
Sb-124	10/17/18	U	3.98E-03	9.62E-03	1.71E-02		9.80E-03	pCi/g
Sb-125	10/17/18	U	-5.20E-03	1.35E-02	2.25E-02		1.37E-02	pCi/g
Cs-134	10/17/18	UI	1.23E-02	9.47E-03	1.23E-02		1.40E-02	pCi/g
Cs-136	10/17/18	U	-1.41E-04	1.27E-02	1.92E-02		1.27E-02	pCi/g
Cs-137	10/17/18	U	-1.10E-03	6.08E-03	8.85E-03	7.11E-01	6.11E-03	pCi/g
Ba-133	10/17/18	U	-1.90E-03	6.63E-03	1.01E-02		6.69E-03	pCi/g
Ba-140	10/17/18	U	-6.20E-03	3.18E-02	5.28E-02		3.19E-02	pCi/g
Ce-139	10/17/18	UI	8.22E-03	8.68E-03	8.22E-03		9.05E-03	pCi/g
Ce-141	10/17/18	U	-3.23E-03	1.30E-02	1.96E-02		1.31E-02	pCi/g
Ce-144	10/17/18	U	-1.37E-02	4.15E-02	6.78E-02		4.19E-02	pCi/g
Nd-147	10/17/18	U	-8.00E-02	5.60E-02	8.32E-02		6.70E-02	pCi/g
Pm-144	10/17/18	U	-2.44E-04	5.43E-03	7.97E-03		5.43E-03	pCi/g
Pm-146	10/17/18	U	5.81E-03	6.30E-03	1.13E-02		6.85E-03	pCi/g
Eu-152	10/17/18	U	8.07E-04	1.41E-02	2.45E-02	9.00E-01	1.41E-02	pCi/g
Eu-154	10/17/18	U	1.21E-02	1.84E-02	3.29E-02	8.46E-01	1.92E-02	pCi/g
Eu-155	10/17/18	U	1.71E-02	3.73E-02	3.78E-02		3.73E-02	pCi/g
Ir-192	10/17/18	U	-5.09E-04	4.99E-03	8.65E-03		4.99E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 461718009
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-1701: OOL10-01-001-FSR-S
Collect Date: October 06, 2018
Client Matrix: Soil
Receive Date: October 15, 2018
Amount of Sample Received:
Report Date: November 01, 2018
Sample Description: gamma

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/17/18	U	2.19E-03	6.28E-03	1.02E-02		6.36E-03	pCi/g
Tl-208	10/17/18		1.37E-01	1.50E-02	7.63E-03		1.88E-02	pCi/g
Pb-210	10/17/18	U	5.06E-01	2.23E+00	2.25E+00		2.23E+00	pCi/g
Pb-212	10/17/18		4.34E-01	2.31E-02	1.69E-02		4.40E-02	pCi/g
Pb-214	10/17/18		4.98E-01	3.51E-02	1.94E-02		5.42E-02	pCi/g
Bi-212	10/17/18		5.11E-01	1.32E-01	1.17E-01		1.40E-01	pCi/g
Bi-214	10/17/18		4.62E-01	3.22E-02	1.59E-02		4.99E-02	pCi/g
Ra-228	10/17/18		5.27E-01	6.04E-02	3.08E-02		7.99E-02	pCi/g
Ac-228	10/17/18		5.27E-01	6.04E-02	3.08E-02		7.99E-02	pCi/g
Th-234	10/17/18		8.55E-01	6.98E-01	5.74E-01		7.26E-01	pCi/g
U-235	10/17/18	U	-3.38E-03	4.29E-02	7.02E-02		4.29E-02	pCi/g
U-238	10/17/18		8.55E-01	6.98E-01	5.74E-01		7.26E-01	pCi/g
Np-237	10/17/18	U	-2.45E-04	9.77E-03	1.70E-02	9.90E-01	9.77E-03	pCi/g
Np-239	10/17/18	U	-3.55E-02	5.67E-02	9.23E-02		5.90E-02	pCi/g
Am-241	10/17/18	U	1.28E-03	4.69E-02	7.46E-02	2.27E+00	4.69E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 461718010
Client Sample ID: FSS-1701: OOL10-01-001-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: October 06, 2018
Receive Date: October 15, 2018
Report Date: November 01, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/18/18	U	-1.21E+01	1.46E+01	2.63E+01	6.16E+01	1.46E+01	pCi/g
C-14	10/31/18	U	-1.88E-01	2.13E-01	3.63E-01	5.00E-01	2.13E-01	pCi/g
Ni-63	10/25/18	U	7.41E+00	1.12E+01	1.81E+01	6.94E+01	1.12E+01	pCi/g
Sr-90	10/20/18	U	-5.64E-02	4.50E-02	9.33E-02	1.36E-01	4.50E-02	pCi/g
Tc-99	10/31/18	U	-4.46E-01	4.37E-01	7.82E-01	1.16E+00	4.37E-01	pCi/g
Pu-241	10/21/18	U	-2.51E+00	2.08E+01	3.51E+01	8.29E+01	2.08E+01	pCi/g
Alpha Spec								
Pu-238	10/18/18	U	-1.79E-02	7.91E-02	2.06E-01	2.80E+00	7.92E-02	pCi/g
Pu-239/240	10/18/18	U	-8.79E-02	1.24E-01	3.62E-01	2.51E+00	1.24E-01	pCi/g
Am-241	10/20/18	U	-1.78E-02	1.48E-01	3.48E-01	2.41E+00	1.49E-01	pCi/g
Cm-243/244	10/20/18	U	4.68E-02	2.05E-01	3.72E-01	2.80E+00	2.06E-01	pCi/g
Cm-245/246	10/20/18	U	3.29E-01	3.72E-01	3.56E-01	1.64E+00	3.76E-01	pCi/g
Gamma Spec								
Ni-59	10/26/18	U	-1.69E+00	1.17E+01	1.92E+01	1.83E+02	1.17E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 482372002
Client Sample ID: FSS-2321: OOL10-01-003-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: June 05, 2019
Receive Date: June 19, 2019
Report Date: July 09, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	06/21/19	U	8.94E-02	1.15E-01	2.02E-01		1.22E-01	pCi/g
Na-22	06/21/19	U	-3.12E-04	1.23E-02	2.01E-02		1.23E-02	pCi/g
K-40	06/21/19		6.35E+00	5.13E-01	1.17E-01		8.05E-01	pCi/g
Cr-51	06/21/19	U	-3.66E-02	1.29E-01	2.14E-01		1.31E-01	pCi/g
Mn-54	06/21/19	U	6.82E-03	1.11E-02	2.02E-02		1.15E-02	pCi/g
Fe-59	06/21/19	U	-3.07E-03	2.59E-02	4.22E-02		2.59E-02	pCi/g
Co-56	06/21/19	U	-6.90E-04	1.19E-02	2.00E-02		1.19E-02	pCi/g
Co-57	06/21/19	U	-1.15E-03	1.07E-02	1.71E-02		1.07E-02	pCi/g
Co-58	06/21/19	UI	2.01E-02	2.20E-02	2.01E-02		2.21E-02	pCi/g
Co-60	06/21/19	U	-6.00E-03	1.05E-02	1.49E-02	3.42E-01	1.09E-02	pCi/g
Zn-65	06/21/19	U	2.77E-03	3.10E-02	4.57E-02		3.10E-02	pCi/g
Y-88	06/21/19	U	1.43E-03	4.89E-03	9.48E-03		4.93E-03	pCi/g
Zr-95	06/21/19	U	2.04E-03	2.42E-02	4.18E-02		2.43E-02	pCi/g
Nb-94	06/21/19	U	2.88E-03	9.10E-03	1.62E-02	6.39E-01	9.19E-03	pCi/g
Nb-95	06/21/19	U	9.66E-03	1.39E-02	2.31E-02		1.46E-02	pCi/g
Ru-106	06/21/19	U	1.31E-03	9.05E-02	1.57E-01		9.05E-02	pCi/g
Ag-110m	06/21/19	U	7.19E-04	1.65E-02	2.81E-02		1.65E-02	pCi/g
Sn-113	06/21/19	U	3.23E-03	1.60E-02	2.71E-02		1.61E-02	pCi/g
Sb-124	06/21/19	U	-2.67E-03	1.82E-02	2.93E-02		1.82E-02	pCi/g
Sb-125	06/21/19	U	-4.93E-02	3.08E-02	4.23E-02		3.82E-02	pCi/g
Cs-134	06/21/19	UI	2.77E-02	1.67E-02	2.77E-02		2.26E-02	pCi/g
Cs-136	06/21/19	U	-3.53E-02	3.26E-02	4.46E-02		3.65E-02	pCi/g
Cs-137	06/21/19	M	3.68E-01	4.08E-02	2.07E-02	7.11E-01	5.05E-02	pCi/g
Ba-133	06/21/19	U	5.80E-03	1.65E-02	2.57E-02		1.67E-02	pCi/g
Ba-140	06/21/19	U	-1.48E-02	8.91E-02	1.43E-01		8.94E-02	pCi/g
Ce-139	06/21/19	U	-2.21E-03	1.15E-02	2.00E-02		1.16E-02	pCi/g
Ce-141	06/21/19	U	1.24E-02	4.48E-02	4.29E-02		4.52E-02	pCi/g
Ce-144	06/21/19	U	7.74E-03	8.57E-02	1.38E-01		8.58E-02	pCi/g
Nd-147	06/21/19	U	-9.46E-03	1.96E-01	3.18E-01		1.96E-01	pCi/g
Pm-144	06/21/19	U	-2.66E-04	1.03E-02	1.77E-02		1.03E-02	pCi/g
Pm-146	06/21/19	U	1.08E-02	1.45E-02	2.57E-02		1.54E-02	pCi/g
Eu-152	06/21/19	U	2.96E-02	3.34E-02	6.02E-02	9.00E-01	3.61E-02	pCi/g
Eu-154	06/21/19	U	3.91E-03	3.46E-02	5.79E-02	8.46E-01	3.47E-02	pCi/g
Eu-155	06/21/19	U	2.60E-02	4.78E-02	8.01E-02		4.93E-02	pCi/g
Ir-192	06/21/19	U	8.82E-03	1.18E-02	2.12E-02		1.25E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 482372002
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-2321: OOL10-01-003-FSR-S
Collect Date: June 05, 2019
Client Matrix: Soil
Receive Date: June 19, 2019
Amount of Sample Received:
Report Date: July 09, 2019
Sample Description: Gamma

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	06/21/19	U	4.91E-03	1.36E-02	2.39E-02		1.38E-02	pCi/g
Tl-208	06/21/19		1.38E-01	3.79E-02	1.89E-02		3.95E-02	pCi/g
Pb-210	06/21/19	U	5.12E+00	4.64E+00	8.33E+00		5.22E+00	pCi/g
Pb-212	06/21/19		4.98E-01	5.09E-02	3.53E-02		6.49E-02	pCi/g
Pb-214	06/21/19		4.93E-01	7.71E-02	4.74E-02		8.64E-02	pCi/g
Bi-212	06/21/19		8.03E-01	4.25E-01	2.36E-01		4.31E-01	pCi/g
Bi-214	06/21/19		4.80E-01	6.78E-02	3.39E-02		7.83E-02	pCi/g
Ra-228	06/21/19		4.62E-01	9.59E-02	6.79E-02		1.05E-01	pCi/g
Ac-228	06/21/19		4.62E-01	9.59E-02	6.79E-02		1.05E-01	pCi/g
Th-234	06/21/19	U	1.28E+00	1.67E+00	1.54E+00		1.70E+00	pCi/g
U-235	06/21/19	U	3.91E-02	1.41E-01	1.34E-01		1.41E-01	pCi/g
U-238	06/21/19	U	1.28E+00	1.67E+00	1.54E+00		1.70E+00	pCi/g
Np-237	06/21/19	U	1.49E-02	2.11E-02	3.78E-02	9.90E-01	2.22E-02	pCi/g
Np-239	06/21/19	U	-5.39E-02	1.19E-01	1.86E-01		1.21E-01	pCi/g
Am-241	06/21/19	U	-5.34E-02	1.25E-01	2.02E-01	2.27E+00	1.27E-01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 482372001
Client Sample ID: FSS-2321: OOL10-01-003-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: June 05, 2019
Receive Date: June 19, 2019
Report Date: July 09, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	06/28/19	U	-1.82E+01	2.30E+01	4.06E+01	6.16E+01	2.30E+01	pCi/g
C-14	06/29/19	U	-9.00E-02	2.17E-01	3.67E-01	5.00E-01	2.17E-01	pCi/g
Ni-63	07/01/19	U	3.45E+00	1.13E+01	1.87E+01	6.94E+01	1.13E+01	pCi/g
Sr-90	06/25/19	U	4.32E-02	7.02E-02	1.09E-01	1.36E-01	7.06E-02	pCi/g
Tc-99	06/30/19	U	1.61E-01	3.84E-01	6.28E-01	1.16E+00	3.84E-01	pCi/g
Pu-241	06/26/19	U	5.33E+00	2.54E+01	4.22E+01	8.29E+01	2.55E+01	pCi/g
Alpha Spec								
Pu-238	06/24/19	U	1.34E-01	2.60E-01	3.58E-01	2.80E+00	2.61E-01	pCi/g
Pu-239/240	06/24/19	U	2.04E-01	3.39E-01	5.32E-01	2.51E+00	3.41E-01	pCi/g
Am-241	06/24/19	U	-3.36E-02	3.85E-01	8.77E-01	2.41E+00	3.85E-01	pCi/g
Cm-243/244	06/24/19	U	-2.21E-02	1.85E-01	4.34E-01	2.80E+00	1.85E-01	pCi/g
Cm-245/246	06/24/19	U	3.89E-01	4.71E-01	5.44E-01	1.64E+00	4.77E-01	pCi/g
Gamma Spec								
Ni-59	07/01/19	U	7.34E+01	3.97E+01	7.64E+01	1.83E+02	5.22E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-13

Data Assessment

Data Quality Assessment of OOL10-13;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-13-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-2.90E-02
Maximum Value	2.35E-01
Mean	5.22E-02
Median	3.70E-02
a-posteriori σ	7.12E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~4 standard deviations with one outlier.*
7. *The Quantile Plot exhibits a moderate skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

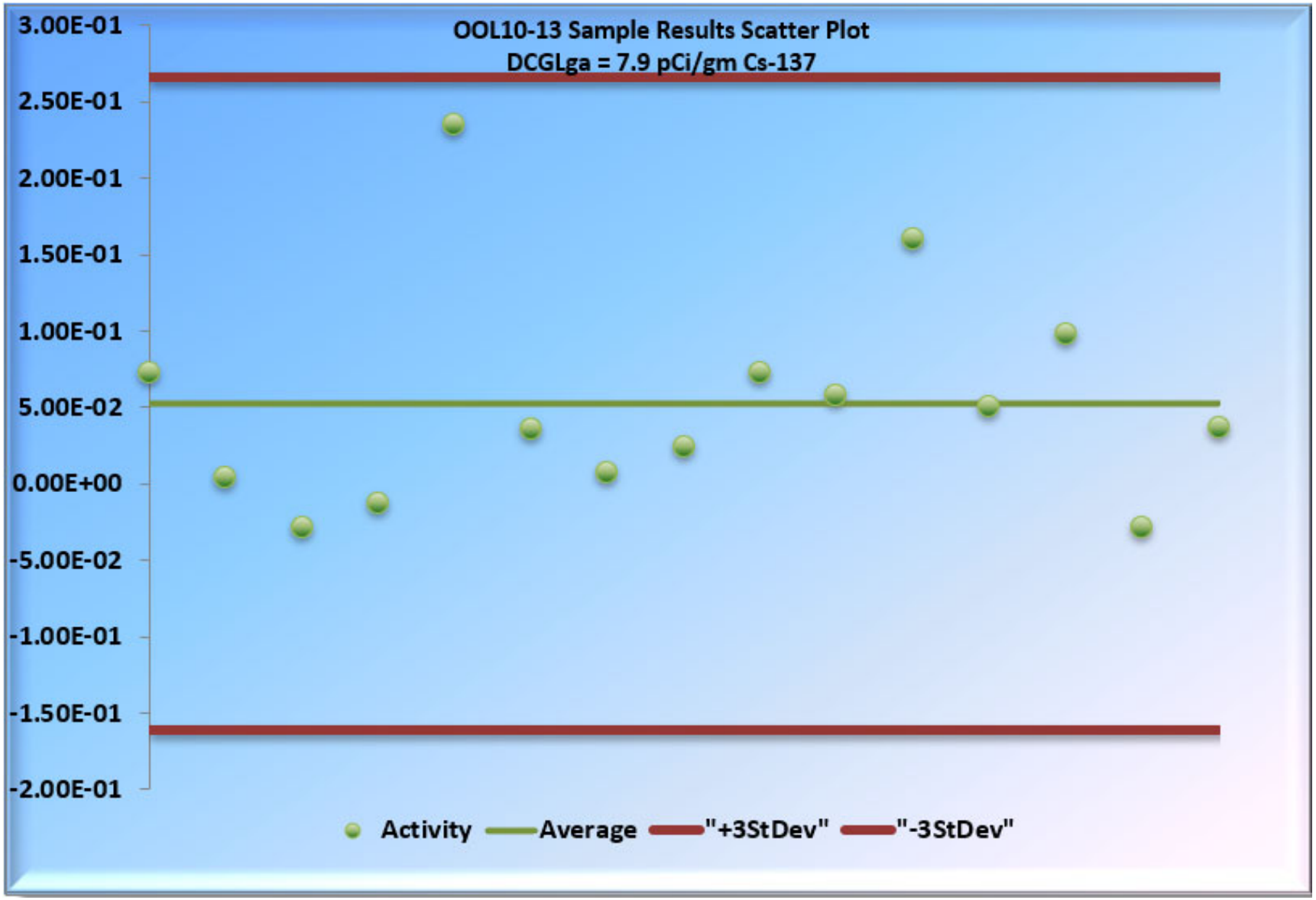
Summary:

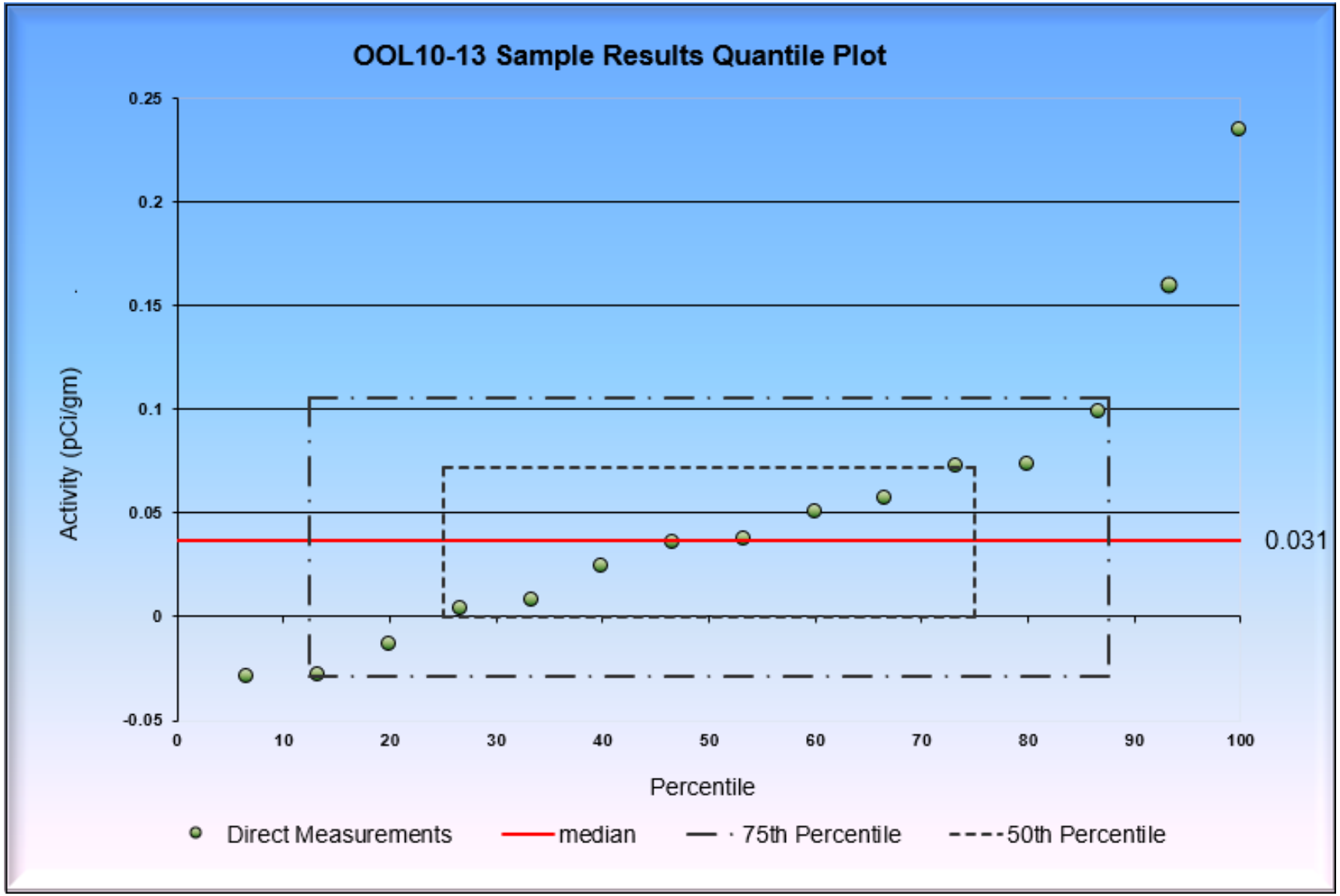
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

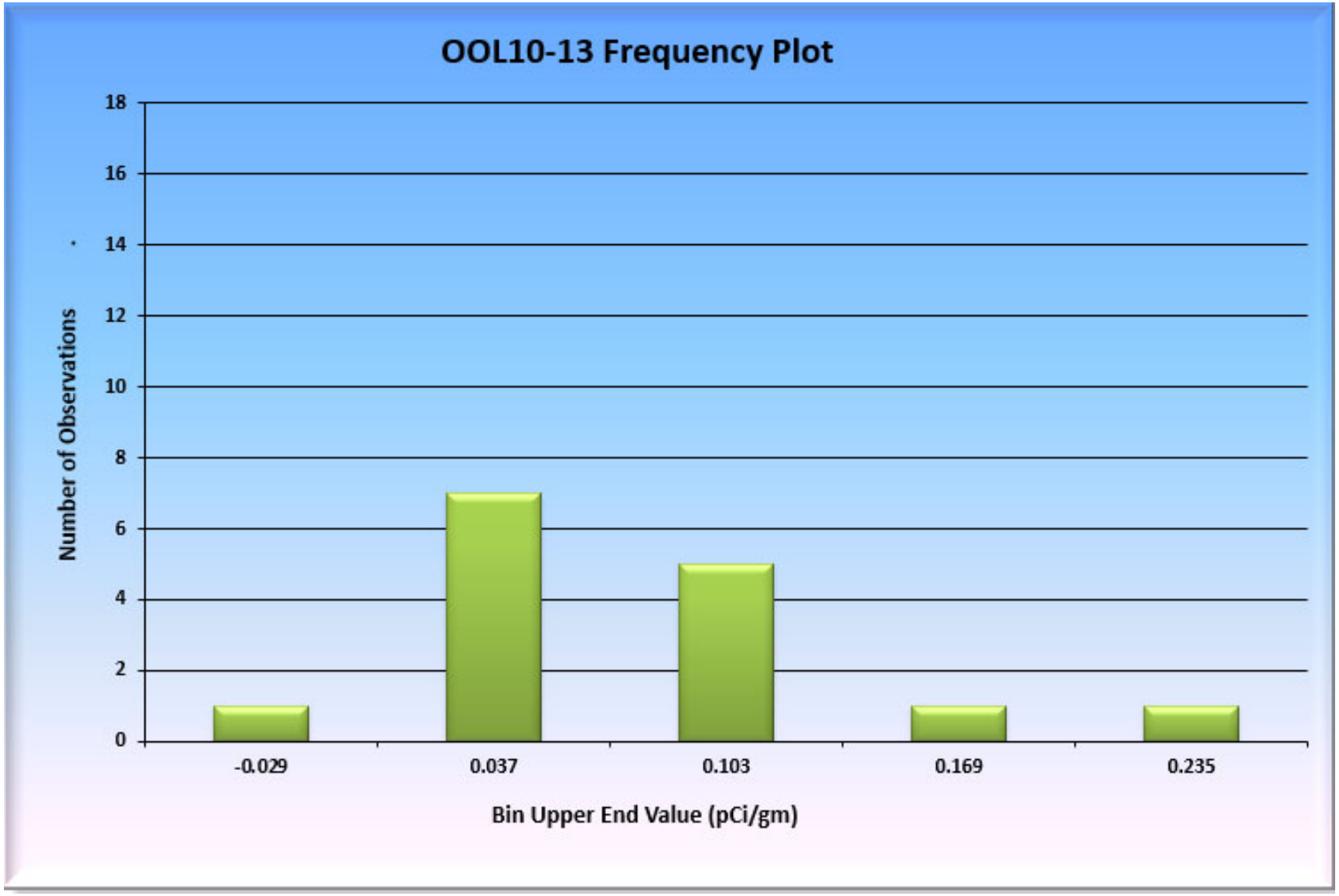
Survey Unit OOL10-13 *meets the HBPP release criteria thus the null hypothesis is rejected for* OOL10-13.

FSS Direct Soil Samples Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-13-001-F	6.86E-02	1.15E-02	**7.21E-02**	2.04E-03	-1.44E-03	-8.43E-03	-2.37E-02	0.9%
OOL10-13-002-F	1.03E-01	6.53E-03	4.08E-03	-2.44E-02	-3.31E-02	1.51E-02	3.51E-02	0.1%
OOL10-13-003-F	3.50E-02	1.69E-02	-2.85E-02	-8.95E-02	2.96E-03	1.71E-02	-5.48E-02	-0.4%
OOL10-13-004-F	-7.24E-02	1.66E-04	-1.34E-02	2.13E-02	9.51E-03	7.37E-03	1.62E-02	-0.2%
OOL10-13-005-F	-6.96E-02	2.46E-02	**2.35E-01**	-1.03E-01	-2.11E-02	1.56E-03	-3.40E-02	3.0%
OOL10-13-006-F	-1.42E-02	-4.45E-03	3.57E-02	-6.45E-03	6.25E-03	-3.09E-02	-3.10E-02	0.5%
OOL10-13-007-F	9.25E-02	-6.48E-03	7.48E-03	-1.35E-02	-1.42E-02	1.55E-02	-4.26E-02	0.1%
OOL10-13-008-F	-5.90E-02	2.09E-03	2.38E-02	1.47E-02	2.97E-03	7.50E-03	1.61E-02	0.3%
OOL10-13-009-F	1.27E-01	-3.44E-02	7.30E-02	-6.87E-02	1.01E-02	-1.09E-03	8.40E-02	0.9%
OOL10-13-010-F	2.55E-02	-2.64E-04	5.73E-02	4.90E-02	-7.21E-02	-2.67E-02	3.34E-03	0.7%
OOL10-13-011-F	7.63E-02	1.73E-02	**1.60E-01**	3.36E-02	3.24E-02	2.09E-02	1.41E-02	2.0%
OOL10-13-012-F	4.91E-02	-4.01E-03	5.05E-02	-1.85E-02	6.14E-02	-7.53E-03	3.39E-03	0.6%
OOL10-13-013-F	6.63E-02	-4.59E-02	9.83E-02	3.50E-02	-5.23E-02	-4.59E-02	2.47E-02	1.2%
OOL10-13-014-F	-3.88E-02	1.60E-02	-2.90E-02	-7.42E-02	-6.76E-02	2.60E-02	-1.40E-02	-0.4%
OOL10-13-015-F	7.76E-02	2.99E-02	3.70E-02	-2.41E-02	-2.60E-02	3.41E-02	-1.26E-02	0.5%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)


OOL10-13 Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Activity
Average
"+3StDev"
"-3StDev"

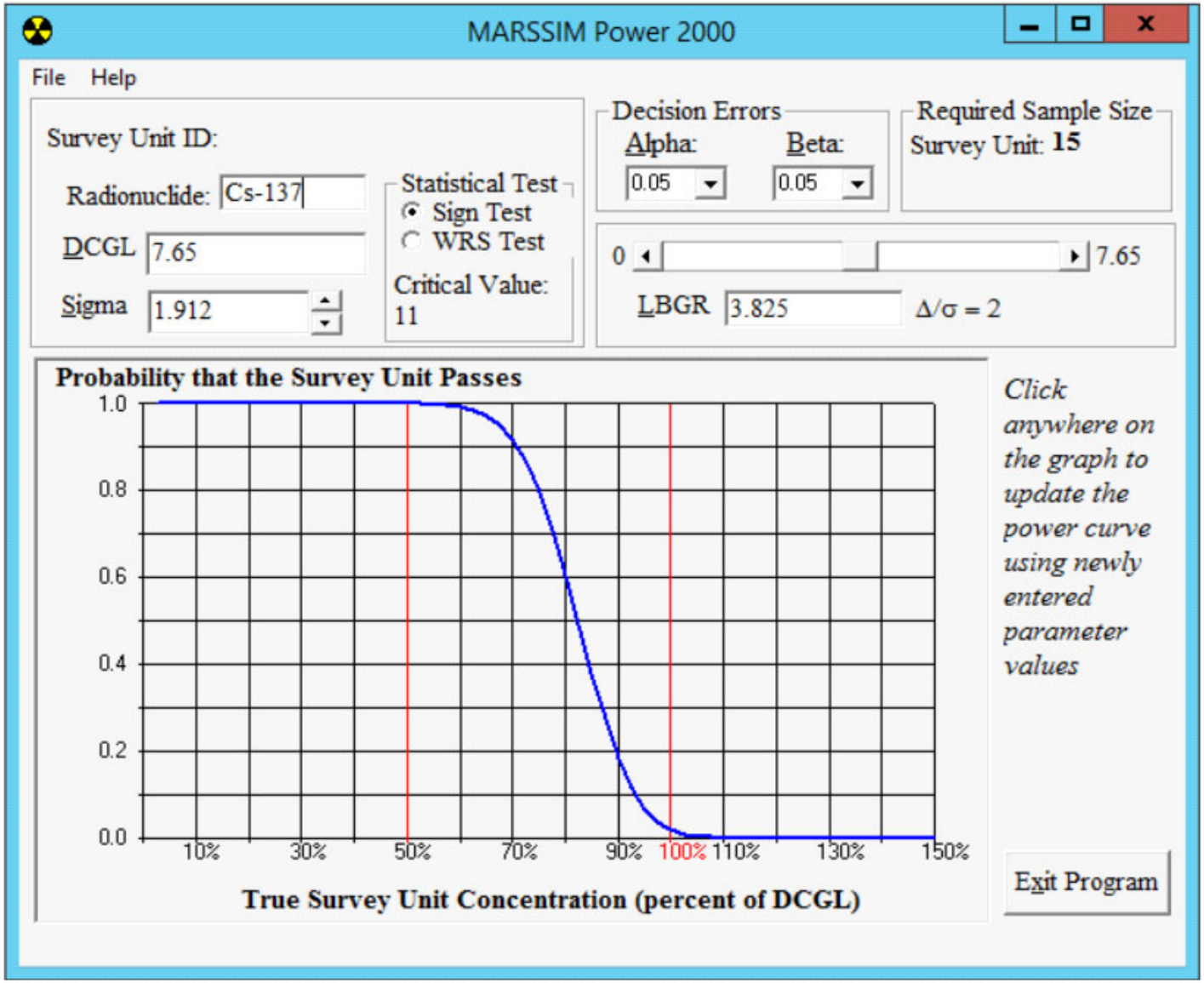

OOL10-13 Sample Results Quantile Plot
Activity (pCi/gm)
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
10
20
30
40
50
60
70
80
90
100
Percentile
0.031
Direct Measurements
median
75th Percentile
50th Percentile


OOL10-13 Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.029
0.037
0.103
0.169
0.235
Bin Upper End Value (pCi/gm)

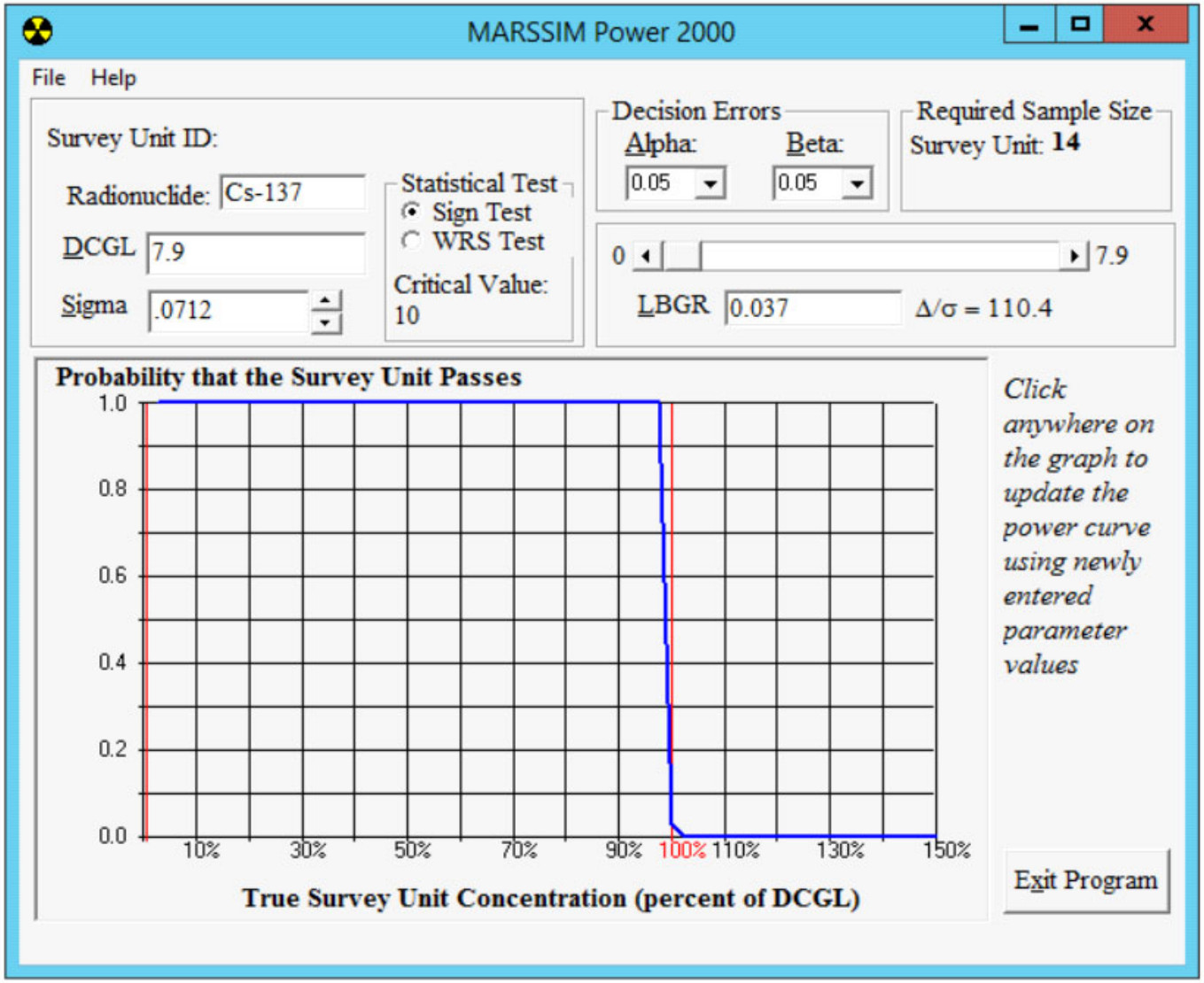
Posting Plot
Survey Unit: OOL10-13-SEC.A
Survey Area: 38,087 m²(Sec-A&B)
Reported Values: Cs-137
Reported Units: pCi/g
N
002
4.08E-03
010
5.73E-02
006
3.57E-02
012
5.05E-02
011
1.60E-01
005
2.35E-01
015
3.70E-02
014
-2.90E-02
008
2.38E-02
009
7.30E-02
013
9.83E-02
001
7.41E-02
003
-2.85E-02
OOL10-13-xxx-F
OOL10-13 Boundary
OOL10-13 Area
Positive for Cs-137

Posting Plot
Survey Unit: OOL10-13-SEC.B
Survey Area: 38,087m2 (Sec-A&B)
Reported Values: Cs-137
Reported Units: pCi/g
N
004
-1.34E-02
007
7.48E-03
OOL10-13-xxx-F
OOL10-13 Boundary
OOL10-13 Area
Positive for Cs-137

Prospective Power Curve



Retrospective Power Curve



Split Sample #004

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	13	Survey Unit Name:	Coastal Trail
Sample Plan No.:	HBPP-FSSP-OOL10-13-00			Sample Measurement Location:	004

Sample Description:

Comparison of split samples collected from sample measurement location #004 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	5.83	0.44	13	0.6	1.66	7.17	0.02	1.23	Y
Pb-212	0.22	0.02	10	0.6	1.66	0.33	0.01	1.49	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

Split Sample #008

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	13	Survey Unit Name:	Coastal Trail
Sample Plan No.:	HBPP-FSSP-OOL10-13-00			Sample Measurement Location:	008

Sample Description:

Comparison of split samples collected from sample measurement location #008 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.39	0.53	14	0.6	1.66	8.50	0.25	1.15	Y
Pb-212	0.34	0.04	8	0.6	1.66	0.45	0.02	1.35	Y
Cs-137[1]	0.02	N/A				0.04	0.01	1.81	N
							0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and under the MDA of 0.06 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	01/26/21	Concurrence by:	M. Blake	Date: 01/26/21
Signature:			Signature:		

Recount Sample #011

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	13	Survey Unit Name:	Coastal Trail
Sample Plan No.:	HBPP-FSSP-OOL10-13-00			Sample Measurement Location:	011

Sample Description:

Duplicate count comparison from sample measurement location #011 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.29	0.57	13	0.6	1.66	7.44	0.52	1.02	Y
Pb-212	0.34	0.03	11	0.6	1.66	0.32	0.03	0.96	Y
Cs-137	0.16	0.02	7	0.5	2	0.16	0.02	0.98	Y
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/21/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #009

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	13	Survey Unit Name:	Coastal Trail
Sample Plan No.:	HBPP-FSSP-OOL10-13-00			Sample Measurement Location:	009

Sample Description:

Duplicate count comparison from sample measurement location #009 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.06	0.54	11	0.6	1.66	5.34	0.50	0.88	Y
Pb-212	0.29	0.04	7	0.5	2	0.34	0.04	1.17	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990007
Client Sample ID: FSS-2476 OOL10-13-004-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: September 26, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/23/19	U	-4.71E+00	2.33E+01	3.98E+01	6.16E+01	2.33E+01	pCi/g
C-14	11/01/19	U	6.13E-02	2.87E-01	4.80E-01	5.00E-01	2.87E-01	pCi/g
Ni-63	10/23/19	U	2.95E+00	1.01E+01	1.67E+01	6.94E+01	1.01E+01	pCi/g
Sr-90	10/23/19	U	6.45E-02	7.90E-02	1.21E-01	1.36E-01	7.99E-02	pCi/g
Tc-99	10/28/19	U	-6.31E-01	5.03E-01	8.62E-01	1.16E+00	5.03E-01	pCi/g
Pu-241	10/29/19	U	-7.07E+00	2.81E+01	4.77E+01	8.29E+01	2.81E+01	pCi/g
Alpha Spec								
Pu-238	10/25/19	U	-1.91E-03	1.19E-01	2.71E-01	2.80E+00	1.19E-01	pCi/g
Pu-239/240	10/25/19	U	-4.65E-02	1.51E-01	3.80E-01	2.51E+00	1.51E-01	pCi/g
Am-241	10/24/19	U	1.27E-02	1.49E-01	3.15E-01	2.41E+00	1.49E-01	pCi/g
Cm-243/244	10/24/19	U	-2.50E-02	7.55E-02	2.12E-01	2.80E+00	7.57E-02	pCi/g
Cm-245/246	10/24/19	U	2.09E-02	1.16E-01	2.23E-01	1.64E+00	1.16E-01	pCi/g
Gamma Spec								
Ni-59	10/22/19	U	-4.73E+00	1.63E+01	2.56E+01	1.83E+02	1.65E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 492990008
Client Sample ID: FSS-2476 OOL10-13-004-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 26, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/24/19	U	-1.30E-02	6.05E-02	1.01E-01		6.08E-02	pCi/g
Na-22	10/24/19	U	7.39E-04	8.15E-03	1.23E-02		8.15E-03	pCi/g
K-40	10/24/19		7.17E+00	3.70E-01	7.24E-02		9.05E-01	pCi/g
Cr-51	10/24/19	U	2.45E-02	9.11E-02	1.47E-01		9.18E-02	pCi/g
Mn-54	10/24/19	U	2.44E-03	5.98E-03	1.02E-02		6.09E-03	pCi/g
Fe-59	10/24/19	U	-7.15E-05	1.73E-02	2.97E-02		1.73E-02	pCi/g
Co-56	10/24/19	UI	1.05E-02	1.07E-02	1.05E-02		1.08E-02	pCi/g
Co-57	10/24/19	U	-3.54E-03	5.96E-03	9.65E-03		6.18E-03	pCi/g
Co-58	10/24/19	U	4.05E-03	6.46E-03	1.14E-02		6.72E-03	pCi/g
Co-60	10/24/19	U	7.45E-03	5.97E-03	1.18E-02	3.42E-01	6.90E-03	pCi/g
Zn-65	10/24/19	U	5.85E-03	1.41E-02	2.28E-02		1.44E-02	pCi/g
Y-88	10/24/19	UI	1.08E-02	5.31E-03	1.08E-02		7.26E-03	pCi/g
Zr-95	10/24/19	U	-6.76E-04	1.42E-02	2.32E-02		1.42E-02	pCi/g
Nb-94	10/24/19	U	-5.07E-03	5.17E-03	7.60E-03	6.39E-01	5.67E-03	pCi/g
Nb-95	10/24/19	U	1.21E-05	7.56E-03	1.11E-02		7.56E-03	pCi/g
Ru-106	10/24/19	U	-4.95E-03	4.47E-02	7.38E-02		4.48E-02	pCi/g
Ag-110m	10/24/19	U	1.25E-03	7.96E-03	1.32E-02		7.99E-03	pCi/g
Sn-113	10/24/19	U	-2.90E-03	7.92E-03	1.33E-02		8.03E-03	pCi/g
Sb-124	10/24/19	U	-4.82E-03	1.09E-02	1.55E-02		1.11E-02	pCi/g
Sb-125	10/24/19	U	-7.92E-03	1.33E-02	2.15E-02		1.38E-02	pCi/g
Cs-134	10/24/19	U	1.28E-02	9.85E-03	1.43E-02		1.15E-02	pCi/g
Cs-136	10/24/19	U	-1.11E-02	3.47E-02	5.79E-02		3.51E-02	pCi/g
Cs-137	10/24/19	UI	9.46E-03	9.81E-03	9.46E-03	7.11E-01	9.85E-03	pCi/g
Ba-133	10/24/19	U	-1.95E-04	7.39E-03	1.15E-02		7.40E-03	pCi/g
Ba-140	10/24/19	U	4.01E-02	8.83E-02	1.41E-01		9.02E-02	pCi/g
Ce-139	10/24/19	U	-2.77E-03	7.17E-03	1.15E-02		7.30E-03	pCi/g
Ce-141	10/24/19	U	-5.03E-03	1.80E-02	2.95E-02		1.82E-02	pCi/g
Ce-144	10/24/19	U	-1.24E-02	4.63E-02	7.59E-02		4.67E-02	pCi/g
Nd-147	10/24/19	U	-7.48E-02	2.09E-01	3.43E-01		2.12E-01	pCi/g
Pm-144	10/24/19	U	4.77E-03	5.97E-03	1.06E-02		6.36E-03	pCi/g
Pm-146	10/24/19	U	2.09E-04	6.32E-03	1.08E-02		6.32E-03	pCi/g
Eu-152	10/24/19	U	1.22E-03	1.66E-02	2.90E-02	9.00E-01	1.66E-02	pCi/g
Eu-154	10/24/19	U	1.82E-03	2.29E-02	3.46E-02	8.46E-01	2.29E-02	pCi/g
Eu-155	10/24/19	U	9.64E-03	2.54E-02	4.34E-02		2.58E-02	pCi/g
Ir-192	10/24/19	U	2.84E-04	6.26E-03	1.10E-02		6.26E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990008
Client Sample ID: FSS-2476 OOL10-13-004-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 26, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/24/19	U	6.13E-03	9.51E-03	1.47E-02		9.93E-03	pCi/g
Tl-208	10/24/19		9.84E-02	1.39E-02	9.42E-03		1.63E-02	pCi/g
Pb-210	10/24/19	U	-5.27E-02	1.62E+00	2.82E+00		1.62E+00	pCi/g
Pb-212	10/24/19		3.33E-01	2.61E-02	1.94E-02		4.14E-02	pCi/g
Pb-214	10/24/19		3.29E-01	3.51E-02	2.21E-02		4.52E-02	pCi/g
Bi-212	10/24/19		2.97E-01	1.88E-01	1.30E-01		1.90E-01	pCi/g
Bi-214	10/24/19		3.00E-01	3.22E-02	1.64E-02		4.16E-02	pCi/g
Ra-228	10/24/19		3.67E-01	6.09E-02	3.66E-02		7.16E-02	pCi/g
Ac-228	10/24/19		3.67E-01	6.09E-02	3.66E-02		7.16E-02	pCi/g
Th-234	10/24/19	U	2.26E-02	3.88E-01	6.76E-01		3.88E-01	pCi/g
U-235	10/24/19	U	-1.87E-02	4.51E-02	7.33E-02		4.59E-02	pCi/g
U-238	10/24/19	U	2.26E-02	3.88E-01	6.76E-01		3.88E-01	pCi/g
Np-237	10/24/19	U	3.66E-03	1.08E-02	1.93E-02	9.90E-01	1.09E-02	pCi/g
Np-239	10/24/19	U	-1.94E-02	6.15E-02	1.01E-01		6.22E-02	pCi/g
Am-241	10/24/19	U	-1.80E-02	4.66E-02	7.86E-02	2.27E+00	4.74E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990009
Client Sample ID: FSS-2483 OOL10-13-008-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: October 02, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/23/19	U	2.55E+01	2.64E+01	4.11E+01	6.16E+01	2.71E+01	pCi/g
C-14	11/01/19	U	-1.60E-01	2.75E-01	4.65E-01	5.00E-01	2.75E-01	pCi/g
Ni-63	10/24/19	U	9.29E+00	1.18E+01	1.89E+01	6.94E+01	1.19E+01	pCi/g
Sr-90	10/23/19	U	-4.94E-02	6.54E-02	1.18E-01	1.36E-01	6.54E-02	pCi/g
Tc-99	10/28/19	U	-3.77E-01	6.23E-01	1.06E+00	1.16E+00	6.22E-01	pCi/g
Pu-241	10/29/19	U	-9.53E-01	2.56E+01	4.30E+01	8.29E+01	2.56E+01	pCi/g
Alpha Spec								
Pu-238	10/25/19	U	-5.78E-02	1.23E-01	3.43E-01	2.80E+00	1.23E-01	pCi/g
Pu-239/240	10/25/19	U	-8.25E-02	1.74E-01	4.41E-01	2.51E+00	1.74E-01	pCi/g
Am-241	10/26/19	U	-2.53E-02	1.41E-01	3.57E-01	2.41E+00	1.42E-01	pCi/g
Cm-243/244	10/26/19	U	-2.49E-02	1.40E-01	3.53E-01	2.80E+00	1.40E-01	pCi/g
Cm-245/246	10/26/19	U	-9.63E-03	1.60E-01	3.38E-01	1.64E+00	1.60E-01	pCi/g
Gamma Spec								
Ni-59	10/22/19	U	2.99E+00	1.31E+01	2.19E+01	1.83E+02	1.32E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990010
Client Sample ID: FSS-2483 OOL10-13-008-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: October 02, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/24/19	U	-3.38E-02	7.65E-02	1.26E-01		7.80E-02	pCi/g
Na-22	10/24/19	U	1.10E-03	9.51E-03	1.56E-02		9.52E-03	pCi/g
K-40	10/24/19		8.50E+00	4.91E-01	1.18E-01		9.35E-01	pCi/g
Cr-51	10/24/19	U	5.76E-02	1.02E-01	1.84E-01		1.05E-01	pCi/g
Mn-54	10/24/19	U	-3.05E-03	8.13E-03	1.29E-02		8.25E-03	pCi/g
Fe-59	10/24/19	U	3.45E-02	2.89E-02	4.48E-02		3.30E-02	pCi/g
Co-56	10/24/19	U	-1.92E-03	9.47E-03	1.53E-02		9.51E-03	pCi/g
Co-57	10/24/19	U	-4.96E-03	8.34E-03	1.33E-02		8.64E-03	pCi/g
Co-58	10/24/19	U	-3.99E-03	8.26E-03	1.28E-02		8.46E-03	pCi/g
Co-60	10/24/19	U	1.86E-03	8.66E-03	1.54E-02	3.42E-01	8.70E-03	pCi/g
Zn-65	10/24/19	U	-1.51E-02	2.11E-02	2.61E-02		2.22E-02	pCi/g
Y-88	10/24/19	U	3.94E-03	7.48E-03	1.42E-02		7.70E-03	pCi/g
Zr-95	10/24/19	U	7.72E-03	1.86E-02	3.25E-02		1.90E-02	pCi/g
Nb-94	10/24/19	U	9.52E-03	7.18E-03	1.37E-02	6.39E-01	8.40E-03	pCi/g
Nb-95	10/24/19	U	1.34E-03	1.13E-02	1.72E-02		1.13E-02	pCi/g
Ru-106	10/24/19	U	1.39E-02	6.21E-02	1.08E-01		6.24E-02	pCi/g
Ag-110m	10/24/19	U	-3.13E-03	1.08E-02	1.72E-02		1.09E-02	pCi/g
Sn-113	10/24/19	U	3.48E-03	1.06E-02	1.88E-02		1.07E-02	pCi/g
Sb-124	10/24/19	U	7.44E-04	1.03E-02	1.80E-02		1.03E-02	pCi/g
Sb-125	10/24/19	U	8.69E-03	2.12E-02	3.78E-02		2.16E-02	pCi/g
Cs-134	10/24/19	UI	2.06E-02	2.00E-02	2.06E-02		2.53E-02	pCi/g
Cs-136	10/24/19	U	5.61E-03	2.93E-02	4.95E-02		2.94E-02	pCi/g
Cs-137	10/24/19	M	4.30E-02	2.20E-02	1.37E-02	7.11E-01	2.23E-02	pCi/g
Ba-133	10/24/19	U	8.34E-03	9.69E-03	1.65E-02		1.04E-02	pCi/g
Ba-140	10/24/19	U	-2.74E-02	8.93E-02	1.48E-01		9.02E-02	pCi/g
Ce-139	10/24/19	U	-6.75E-03	9.38E-03	1.46E-02		9.96E-03	pCi/g
Ce-141	10/24/19	U	-1.01E-02	2.30E-02	3.68E-02		2.35E-02	pCi/g
Ce-144	10/24/19	U	-9.75E-03	6.85E-02	1.03E-01		6.87E-02	pCi/g
Nd-147	10/24/19	U	8.19E-02	1.78E-01	3.17E-01		1.82E-01	pCi/g
Pm-144	10/24/19	U	-4.27E-03	7.39E-03	1.16E-02		7.65E-03	pCi/g
Pm-146	10/24/19	U	6.58E-03	9.54E-03	1.74E-02		1.00E-02	pCi/g
Eu-152	10/24/19	U	-1.42E-02	2.19E-02	3.64E-02	9.00E-01	2.29E-02	pCi/g
Eu-154	10/24/19	U	-6.31E-04	2.70E-02	4.35E-02	8.46E-01	2.70E-02	pCi/g
Eu-155	10/24/19	U	3.10E-02	3.46E-02	5.98E-02		3.74E-02	pCi/g
Ir-192	10/24/19	U	-4.20E-03	8.68E-03	1.47E-02		8.89E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990010
Client Sample ID: FSS-2483 OOL10-13-008-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: October 02, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/24/19	U	7.68E-03	1.16E-02	1.80E-02		1.21E-02	pCi/g
Tl-208	10/24/19		1.37E-01	2.24E-02	1.27E-02		2.51E-02	pCi/g
Pb-210	10/24/19	U	3.40E-01	1.76E+00	3.02E+00		1.77E+00	pCi/g
Pb-212	10/24/19		4.53E-01	3.46E-02	2.35E-02		5.09E-02	pCi/g
Pb-214	10/24/19		4.73E-01	4.47E-02	8.94E-02		5.89E-02	pCi/g
Bi-212	10/24/19		4.15E-01	2.24E-01	1.82E-01		2.27E-01	pCi/g
Bi-214	10/24/19		4.18E-01	4.86E-02	2.35E-02		5.98E-02	pCi/g
Ra-228	10/24/19		4.25E-01	8.18E-02	5.32E-02		9.01E-02	pCi/g
Ac-228	10/24/19		4.25E-01	8.18E-02	5.32E-02		9.01E-02	pCi/g
Th-234	10/24/19	U	4.55E-01	8.33E-01	9.09E-01		8.40E-01	pCi/g
U-235	10/24/19	U	1.20E-02	6.32E-02	1.05E-01		6.33E-02	pCi/g
U-238	10/24/19	U	4.55E-01	8.33E-01	9.09E-01		8.40E-01	pCi/g
Np-237	10/24/19	U	-3.67E-03	1.45E-02	2.49E-02	9.90E-01	1.46E-02	pCi/g
Np-239	10/24/19	U	-7.62E-02	8.72E-02	1.37E-01		9.40E-02	pCi/g
Am-241	10/24/19	U	1.44E-02	6.45E-02	1.10E-01	2.27E+00	6.48E-02	pCi/g

Notes:
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3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
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UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-17

Data Assessment

Data Quality Assessment of OOL10-17;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-17-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-4.00E-02
Maximum Value	1.92E-01
Mean	5.17E-02
Median	4.09E-02
a-posteriori σ	6.56E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits a moderate skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

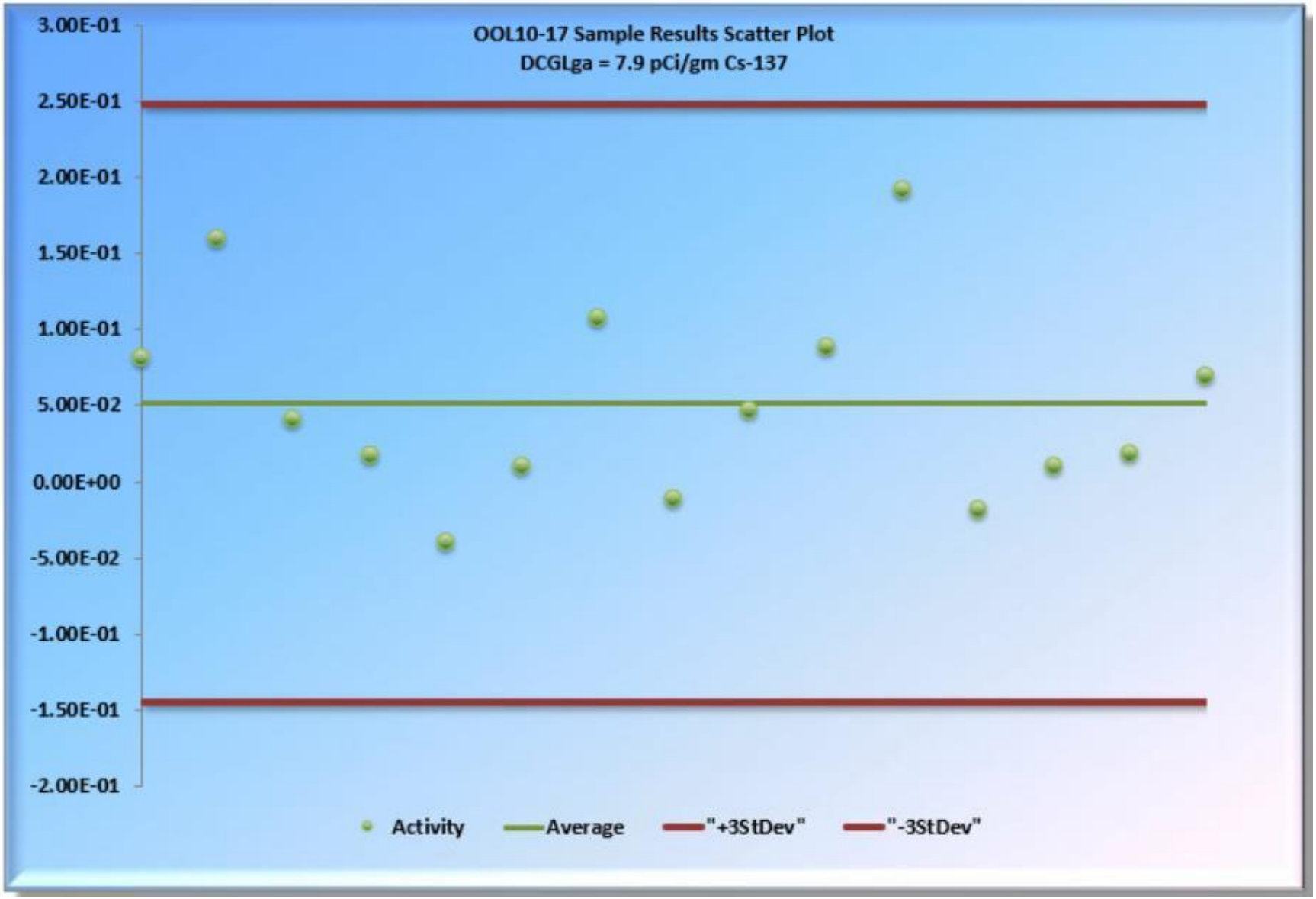
Summary:

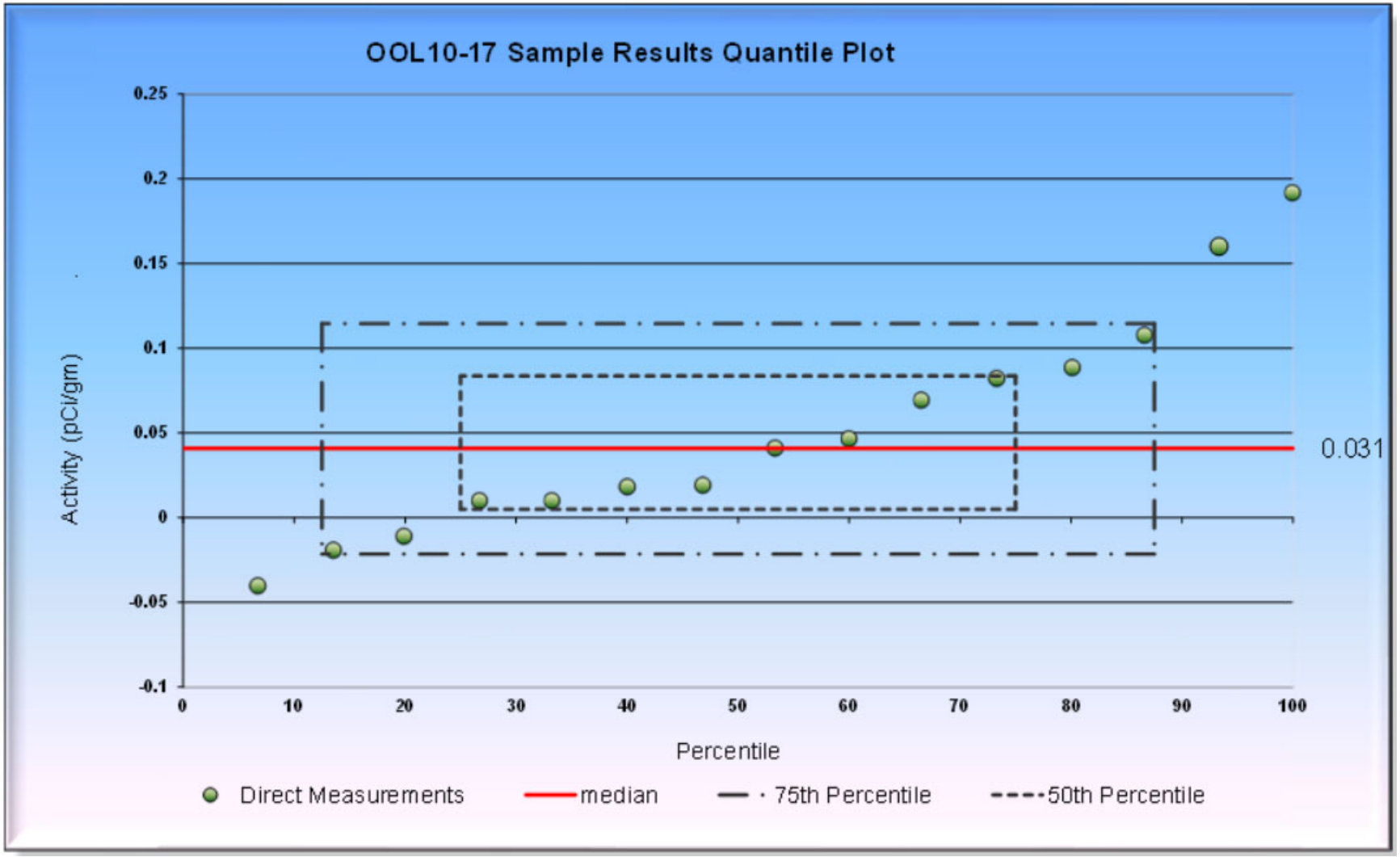
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

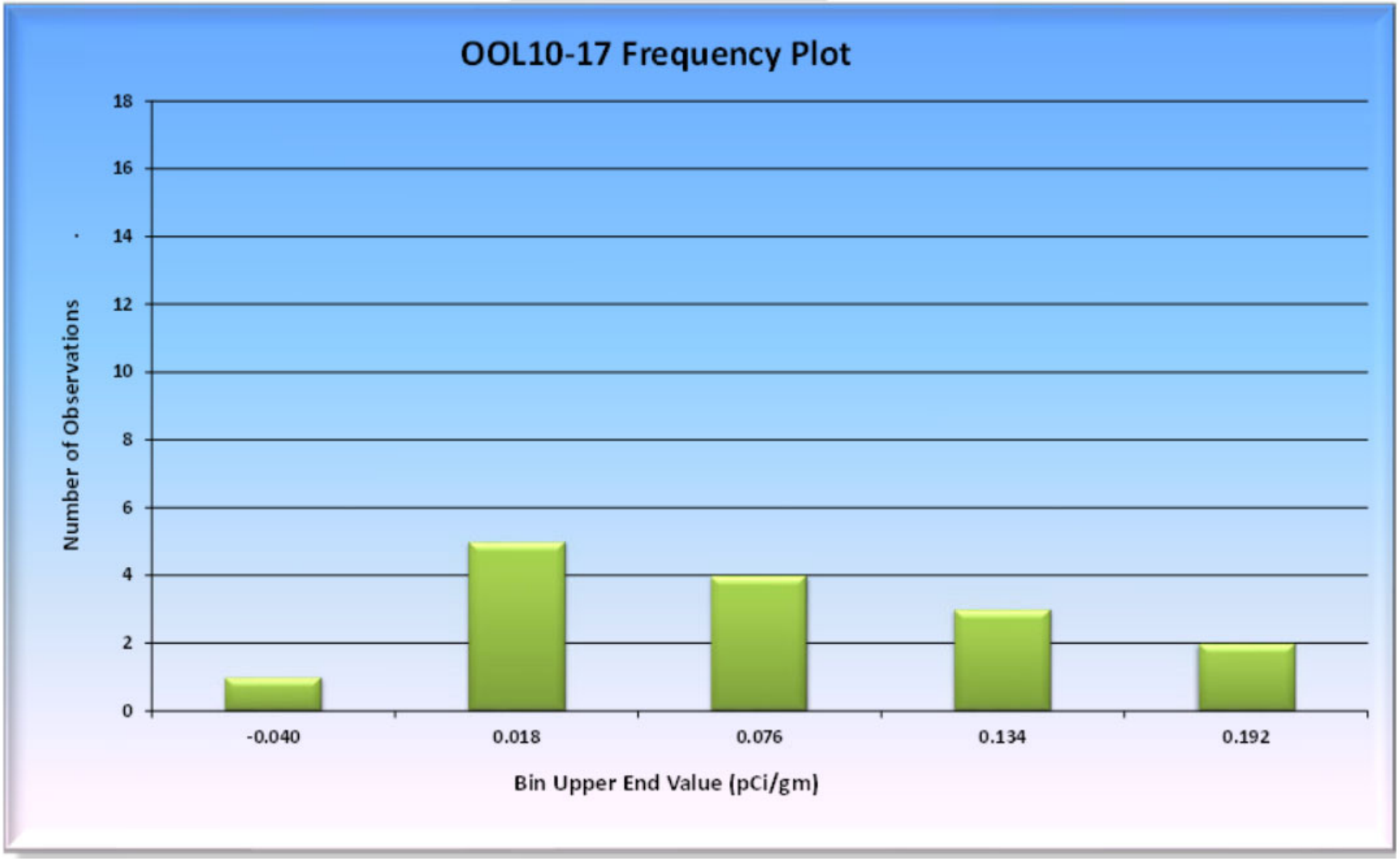
Survey Unit OOL10-17 *meets the HBPP release criteria thus the null hypothesis is rejected for* OOL10-17.

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[1]**
OOL10-17-001-F	1.19E-01	-5.90E-02	**8.19E-02**	1.19E-01	-1.09E-01	3.89E-02	-2.35E-02	-4.43E-02	4.40E-01	1.0%
OOL10-17-002-F	-9.05E-02	-4.01E-02	**1.60E-01**	-9.05E-02	-5.31E-02	-4.52E-02	-2.20E-03	1.98E-02	6.00E-02	2.0%
OOL10-17-003-F	-1.57E-01	-7.51E-03	4.09E-02	-1.57E-01	-1.20E-01	5.00E-02	-3.53E-02	3.47E-02	6.00E-02	0.5%
OOL10-17-004-F	-1.26E-01	-8.23E-03	1.78E-02	-1.26E-01	-4.14E-02	-2.98E-02	1.29E-02	1.44E-03	2.80E-01	0.2%
OOL10-17-005-F	-1.44E-02	3.14E-02	-4.00E-02	-1.44E-02	1.99E-02	-1.49E-02	-3.91E-02	-1.62E-02	-1.00E-02	0.5%
OOL10-17-006-F	-1.29E-01	-3.15E-02	1.03E-02	-1.29E-01	3.52E-02	-1.96E-02	-8.24E-03	-3.07E-02	8.00E-02	0.1%
OOL10-17-007-F	3.15E-02	-2.48E-03	1.08E-01	3.15E-02	-3.25E-03	2.28E-02	2.48E-02	9.41E-04	5.00E-02	1.4%
OOL10-17-008-F	8.06E-02	-4.05E-02	-1.11E-02	8.06E-02	-3.40E-02	-2.01E-02	-1.80E-02	-1.32E-02	8.00E-02	-0.1%
OOL10-17-009-F	5.72E-02	-1.78E-02	4.64E-02	5.72E-02	-9.88E-02	-2.48E-03	-2.50E-02	-2.81E-02	0.00E+00	0.6%
OOL10-17-010-F	5.07E-02	-2.82E-02	8.87E-02	5.07E-02	6.21E-02	1.66E-03	1.52E-02	2.40E-02	7.00E-02	1.1%
OOL10-17-011-F	-9.59E-02	-6.20E-03	**1.92E-01**	-9.59E-02	5.88E-02	6.35E-02	9.84E-03	2.06E-02	5.40E-01	2.4%
OOL10-17-012-F	2.44E-02	1.57E-02	-1.89E-02	2.44E-02	-7.28E-02	-1.35E-02	-1.83E-02	-3.22E-02	-2.00E-02	-0.2%
OOL10-17-013-F	2.31E-03	3.23E-02	1.02E-02	2.31E-03	-2.32E-01	2.15E-02	-2.08E-02	-3.32E-02	1.80E-01	0.1%
OOL10-17-014-F	-4.71E-02	7.36E-03	1.90E-02	-4.71E-02	-2.56E-02	-3.34E-02	4.03E-03	3.97E-02	2.00E-01	0.2%
OOL10-17-015-F	4.68E-02	4.32E-03	**6.98E-02**	4.68E-02	3.45E-02	2.11E-02	1.83E-02	-2.16E-02	7.20E-01	0.9%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

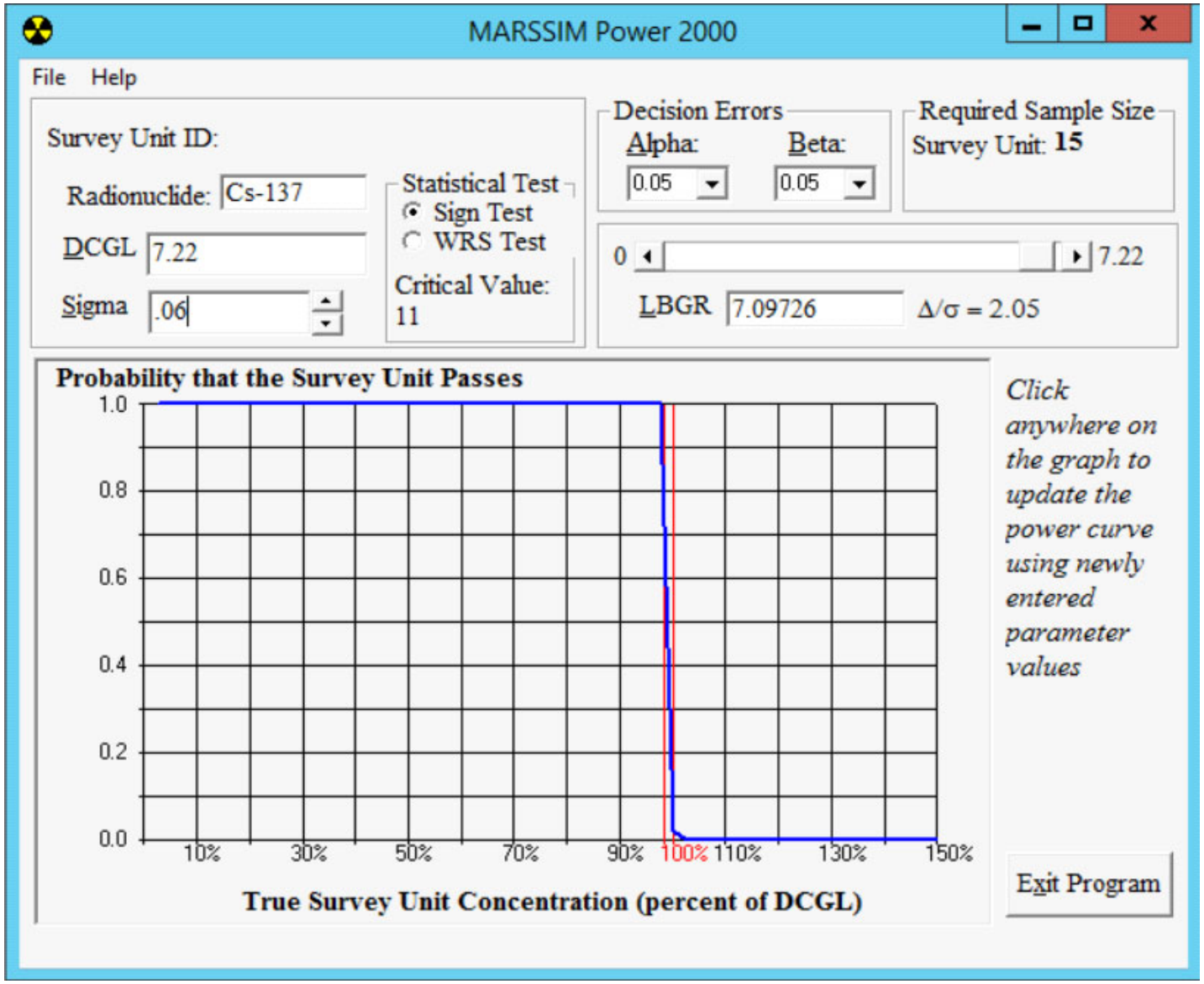

OOL10-17 Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Activity
Average
"+3StDev"
"-3StDev"


OOL10-17 Sample Results Quantile Plot
Activity (pCi/gm)
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
10
20
30
40
50
60
70
80
90
100
Percentile
0.031
Direct Measurements
median
75th Percentile
50th Percentile

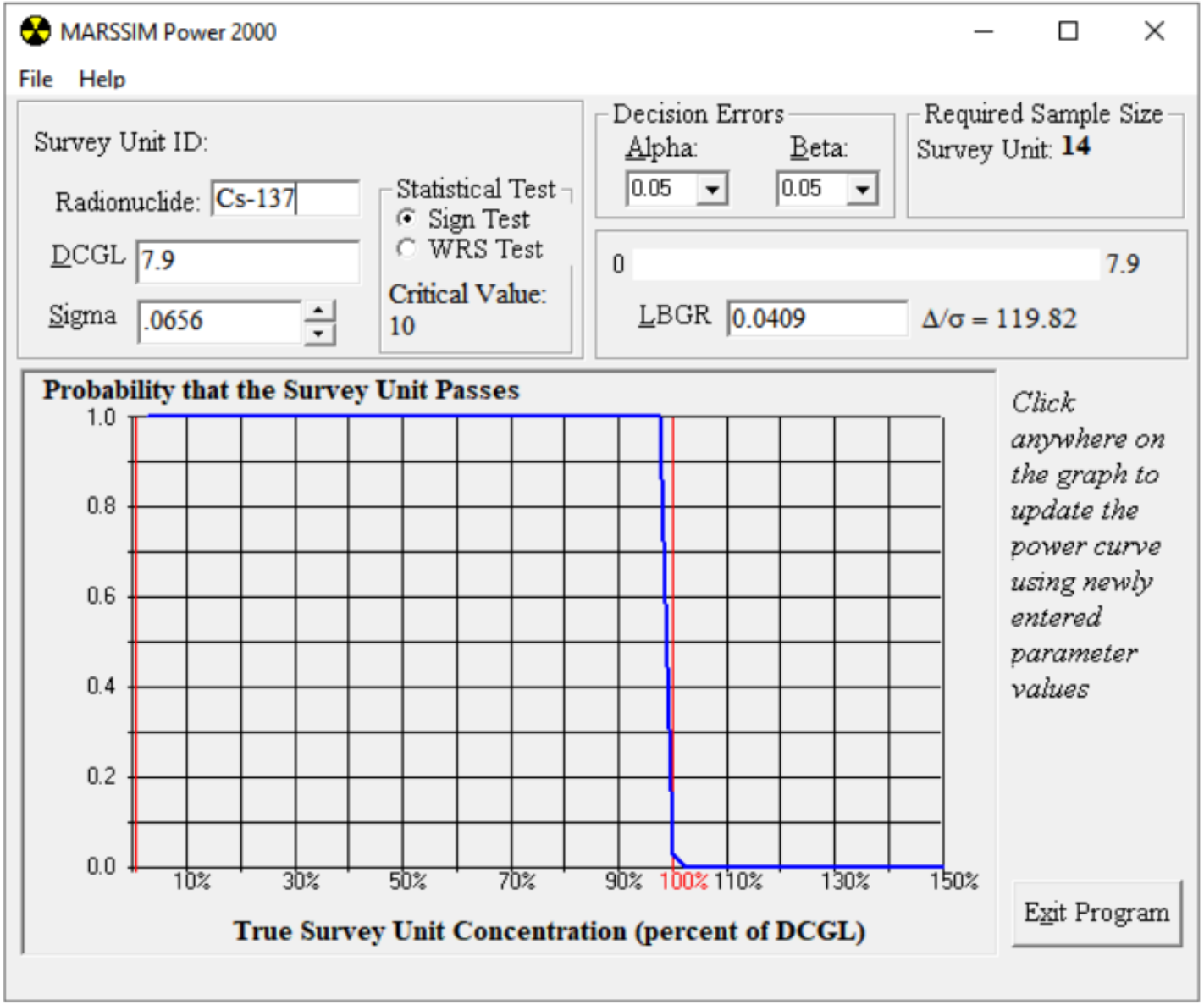

OOL10-17 Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.040
0.018
0.076
0.134
0.192
Bin Upper End Value (pCi/gm)

009
4.64E-02
011
1.92E-01
014
1.90E-02
002
1.60E-01
006
1.03E-02
003
4.09E-02
007
1.08E-01
013
1.02E-02
005
-4.00E-02
001
8.19E-02
004
1.78E-02
015
6.98E-02
008
-1.11E-02
012
-1.89E-02
010
8.87E-02
N
Posting Plot
Survey Unit: OOL10-17
Survey Area: 53,129 m²
Reported Values: Cs-137
Reported Units: pCi/g
OOL10-17-xxx-F
OOL10-17 Boundary
OOL10-17 Area
Positive for Cs-137

Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File
Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0656
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0
7.9
LBGR 0.0409
Δ/σ = 119.82
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10%
30%
50%
70%
90%
100%
110%
130%
150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #009

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-00			Sample Measurement Location:	009

Sample Description:

Comparison of split samples collected from sample measurement location #009 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.28	0.52	14	0.6	1.66	8.11	0.23	1.11	Y
Pb-212	0.40	0.03	12	0.6	1.66	0.46	0.02	1.15	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	01/26/21	Concurrence by:	M. Blake	Date: 01/26/21
Signature:			Signature:		

Split Sample #013

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-00			Sample Measurement Location:	013

Sample Description:

Comparison of split samples collected from sample measurement location #013 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	9.55	1.69	6	0.5	2	9.86	0.31	1.03	Y
Pb-212	0.48	0.05	10	0.6	1.66	0.59	0.02	1.21	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #001

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-00			Sample Measurement Location:	001

Sample Description:

Duplicate count comparison from sample measurement location #001 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	15.15	0.96	16	0.6	1.66	13.50	0.89	0.89	Y
Pb-212	0.57	0.07	9	0.6	1.66	0.66	0.07	1.17	Y
Cs-137[1]	0.08	0.03	3	No Comparison	No Comparison	0.11	0.02	1.29	N
		0.00					0.00		

Comments/Corrective Actions:

Note (1) There is no comparision between the two lab results for Cs-137, as the original HBPP value is at the minimum detection level reported of 8.18E-02 pCi/g. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 465195002
Client Sample ID: FSS-1990 OOL10-17-002-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: November 16, 2018
Receive Date: November 21, 2018
Report Date: December 10, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
C-14	12/03/18	U	1.21E-01	2.14E-01	3.55E-01	5.00E-01	2.14E-01	pCi/g
Ni-63	12/07/18	U	1.31E+00	3.09E+01	5.18E+01	6.88E+01	3.09E+01	pCi/g
Tc-99	12/09/18	U	4.89E-02	4.25E-01	7.09E-01	1.15E+00	4.25E-01	pCi/g
Pu-241	12/05/18	U	-5.68E+00	2.40E+01	4.07E+01	7.94E+01	2.40E+01	pCi/g
Alpha Spec								
Pu-238	11/30/18	U	-2.94E-02	8.89E-02	2.50E-01	2.80E+00	8.91E-02	pCi/g
Pu-239/240	11/30/18	U	-8.18E-03	1.23E-01	2.87E-01	2.51E+00	1.23E-01	pCi/g
Am-241	12/05/18	U	2.59E-02	9.72E-02	1.63E-01	2.28E+00	9.73E-02	pCi/g
Cm-243/244	12/05/18	U	-4.85E-02	7.81E-02	2.49E-01	2.80E+00	7.82E-02	pCi/g
Cm-245/246	12/05/18	U	7.96E-02	1.58E-01	2.57E-01	1.64E+00	1.59E-01	pCi/g
Gamma Spec								
Ni-59	12/07/18	U	2.96E+01	3.84E+01	6.33E+01	1.83E+02	4.08E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465195003
Client Sample ID: FSS-1990 OOL10-17-002-F-HTD
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 16, 2018
Receive Date: November 21, 2018
Report Date: December 10, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	12/01/18	U	4.12E-02	8.15E-02	1.46E-01		8.37E-02	pCi/g
Na-22	12/01/18	U	-4.26E-04	1.11E-02	1.78E-02		1.11E-02	pCi/g
K-40	12/01/18		9.17E+00	5.85E-01	1.59E-01		1.11E+00	pCi/g
Cr-51	12/01/18	U	3.81E-02	9.86E-02	1.77E-01		1.00E-01	pCi/g
Mn-54	12/01/18	U	-1.51E-03	8.61E-03	1.40E-02		8.64E-03	pCi/g
Fe-59	12/01/18	U	-2.27E-03	2.18E-02	3.51E-02		2.18E-02	pCi/g
Co-56	12/01/18	U	-9.30E-03	1.02E-02	1.50E-02		1.11E-02	pCi/g
Co-57	12/01/18	U	4.26E-04	9.06E-03	1.49E-02		9.07E-03	pCi/g
Co-58	12/01/18	U	5.14E-03	1.01E-02	1.79E-02		1.04E-02	pCi/g
Co-60	12/01/18	U	1.09E-02	1.03E-02	1.68E-02	3.42E-01	1.15E-02	pCi/g
Zn-65	12/01/18	U	7.55E-03	1.90E-02	3.01E-02		1.93E-02	pCi/g
Y-88	12/01/18	U	0.00E+00	8.24E-03	1.40E-02		0.00E+00	pCi/g
Zr-95	12/01/18	U	7.78E-03	1.71E-02	3.02E-02		1.75E-02	pCi/g
Nb-94	12/01/18	U	7.08E-05	7.21E-03	1.22E-02	6.39E-01	7.21E-03	pCi/g
Nb-95	12/01/18	U	-2.33E-03	1.28E-02	1.87E-02		1.29E-02	pCi/g
Ru-106	12/01/18	U	2.36E-02	8.11E-02	1.42E-01		8.18E-02	pCi/g
Ag-110m	12/01/18	U	-7.05E-03	1.16E-02	1.75E-02		1.20E-02	pCi/g
Sn-113	12/01/18	U	-6.58E-03	1.13E-02	1.87E-02		1.17E-02	pCi/g
Sb-124	12/01/18	U	2.98E-03	1.34E-02	2.45E-02		1.35E-02	pCi/g
Sb-125	12/01/18	U	-1.97E-03	2.29E-02	3.93E-02		2.29E-02	pCi/g
Cs-134	12/01/18	UI	2.34E-02	1.56E-02	2.34E-02		2.47E-02	pCi/g
Cs-136	12/01/18	U	1.13E-02	2.62E-02	4.57E-02		2.68E-02	pCi/g
Cs-137	12/01/18	M	1.87E-01	2.78E-02	1.58E-02	7.11E-01	3.17E-02	pCi/g
Ba-133	12/01/18	U	7.43E-03	1.14E-02	1.91E-02		1.19E-02	pCi/g
Ba-140	12/01/18	U	1.87E-02	6.30E-02	1.11E-01		6.35E-02	pCi/g
Ce-139	12/01/18	U	-5.17E-03	1.00E-02	1.58E-02		1.03E-02	pCi/g
Ce-141	12/01/18	U	8.18E-03	2.19E-02	3.66E-02		2.23E-02	pCi/g
Ce-144	12/01/18	U	-3.26E-03	7.40E-02	1.21E-01		7.41E-02	pCi/g
Nd-147	12/01/18	U	-6.63E-03	1.29E-01	2.19E-01		1.29E-01	pCi/g
Pm-144	12/01/18	U	-5.30E-03	7.55E-03	1.16E-02		7.93E-03	pCi/g
Pm-146	12/01/18	U	4.48E-03	1.11E-02	1.98E-02		1.13E-02	pCi/g
Eu-152	12/01/18	U	4.79E-03	2.82E-02	4.16E-02	9.00E-01	2.83E-02	pCi/g
Eu-154	12/01/18	U	-8.71E-03	3.25E-02	5.05E-02	8.46E-01	3.28E-02	pCi/g
Eu-155	12/01/18	U	9.31E-04	3.81E-02	6.30E-02		3.81E-02	pCi/g
Ir-192	12/01/18	U	-1.57E-03	9.25E-03	1.60E-02		9.28E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465195003
Client Sample ID: FSS-1990 OOL10-17-002-F-HTD
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 16, 2018
Receive Date: November 21, 2018
Report Date: December 10, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	12/01/18	U	-5.14E-03	1.26E-02	1.95E-02		1.28E-02	pCi/g
Tl-208	12/01/18		1.63E-01	2.13E-02	1.38E-02		2.52E-02	pCi/g
Pb-210	12/01/18	U	8.54E-01	1.81E+00	3.16E+00		1.85E+00	pCi/g
Pb-212	12/01/18		4.76E-01	3.89E-02	2.62E-02		5.46E-02	pCi/g
Pb-214	12/01/18		6.03E-01	5.37E-02	1.07E-01		7.19E-02	pCi/g
Bi-212	12/01/18		4.12E-01	2.16E-01	1.96E-01		2.19E-01	pCi/g
Bi-214	12/01/18		4.63E-01	5.78E-02	3.24E-02		6.93E-02	pCi/g
Ra-228	12/01/18		5.00E-01	8.60E-02	5.67E-02		9.86E-02	pCi/g
Ac-228	12/01/18		5.00E-01	8.60E-02	5.67E-02		9.86E-02	pCi/g
Th-234	12/01/18	U	3.60E-01	9.09E-01	1.00E+00		9.13E-01	pCi/g
U-235	12/01/18	U	3.42E-02	7.16E-02	1.21E-01		7.16E-02	pCi/g
U-238	12/01/18	U	3.60E-01	9.09E-01	1.00E+00		9.13E-01	pCi/g
Np-237	12/01/18	U	4.78E-03	1.79E-02	3.20E-02	9.90E-01	1.81E-02	pCi/g
Np-239	12/01/18	U	-2.79E-02	9.16E-02	1.48E-01		9.25E-02	pCi/g
Am-241	12/01/18	U	-3.08E-02	7.45E-02	1.13E-01	2.27E+00	7.59E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465320001
Client Sample ID: FSS-2008: OOL10-17-009-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 17, 2018
Receive Date: November 26, 2018
Report Date: December 14, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	12/02/18	U	-1.44E-03	7.22E-02	1.23E-01		7.22E-02	pCi/g
Na-22	12/02/18	U	8.43E-03	1.09E-02	1.98E-02		1.15E-02	pCi/g
K-40	12/02/18		8.11E+00	4.69E-01	1.06E-01		9.10E-01	pCi/g
Cr-51	12/02/18	U	1.57E-02	8.52E-02	1.51E-01		8.55E-02	pCi/g
Mn-54	12/02/18	UI	1.12E-02	9.47E-03	1.12E-02		9.57E-03	pCi/g
Fe-59	12/02/18	U	-1.23E-02	2.17E-02	3.47E-02		2.25E-02	pCi/g
Co-56	12/02/18	U	6.44E-03	8.56E-03	1.52E-02		9.06E-03	pCi/g
Co-57	12/02/18	U	-1.13E-03	7.55E-03	1.26E-02		7.57E-03	pCi/g
Co-58	12/02/18	U	6.11E-03	8.46E-03	1.45E-02		8.91E-03	pCi/g
Co-60	12/02/18	U	-1.71E-03	8.34E-03	1.35E-02	3.42E-01	8.38E-03	pCi/g
Zn-65	12/02/18	U	-8.03E-03	2.28E-02	3.22E-02		2.31E-02	pCi/g
Y-88	12/02/18	U	1.93E-03	4.82E-03	9.30E-03		4.90E-03	pCi/g
Zr-95	12/02/18	U	-7.55E-03	1.83E-02	2.48E-02		1.86E-02	pCi/g
Nb-94	12/02/18	U	5.86E-03	7.90E-03	1.40E-02	6.39E-01	8.34E-03	pCi/g
Nb-95	12/02/18	U	-1.12E-02	1.19E-02	1.50E-02		1.30E-02	pCi/g
Ru-106	12/02/18	U	-3.34E-02	6.87E-02	1.08E-01		7.04E-02	pCi/g
Ag-110m	12/02/18	U	-2.43E-03	9.79E-03	1.65E-02		9.86E-03	pCi/g
Sn-113	12/02/18	U	2.30E-03	1.01E-02	1.76E-02		1.01E-02	pCi/g
Sb-124	12/02/18	U	-7.08E-03	1.60E-02	2.30E-02		1.64E-02	pCi/g
Sb-125	12/02/18	U	-4.68E-03	2.09E-02	3.52E-02		2.10E-02	pCi/g
Cs-134	12/02/18	U	1.36E-02	1.11E-02	2.01E-02		1.27E-02	pCi/g
Cs-136	12/02/18	U	3.18E-03	2.12E-02	3.70E-02		2.13E-02	pCi/g
Cs-137	12/02/18	U	4.74E-03	9.24E-03	1.60E-02	7.11E-01	9.50E-03	pCi/g
Ba-133	12/02/18	U	5.95E-04	1.01E-02	1.58E-02		1.01E-02	pCi/g
Ba-140	12/02/18	U	-2.29E-02	5.76E-02	9.31E-02		5.85E-02	pCi/g
Ce-139	12/02/18	U	-6.67E-04	8.50E-03	1.40E-02		8.51E-03	pCi/g
Ce-141	12/02/18	U	1.29E-02	1.78E-02	3.07E-02		1.88E-02	pCi/g
Ce-144	12/02/18	U	6.24E-03	6.54E-02	1.02E-01		6.55E-02	pCi/g
Nd-147	12/02/18	U	7.33E-02	1.19E-01	2.13E-01		1.24E-01	pCi/g
Pm-144	12/02/18	U	-2.51E-03	8.52E-03	1.36E-02		8.59E-03	pCi/g
Pm-146	12/02/18	U	2.09E-03	9.67E-03	1.68E-02		9.72E-03	pCi/g
Eu-152	12/02/18	U	-3.11E-03	2.17E-02	3.75E-02	9.00E-01	2.18E-02	pCi/g
Eu-154	12/02/18	U	2.54E-02	3.10E-02	5.67E-02	8.46E-01	3.31E-02	pCi/g
Eu-155	12/02/18	U	3.14E-02	5.07E-02	5.28E-02		5.08E-02	pCi/g
Ir-192	12/02/18	U	-8.08E-04	8.17E-03	1.42E-02		8.17E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 465320001
Client Sample ID: FSS-2008: OOL10-17-009-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 17, 2018
Receive Date: November 26, 2018
Report Date: December 14, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	12/02/18	U	4.99E-03	1.06E-02	1.53E-02		1.06E-02	pCi/g
Tl-208	12/02/18		1.48E-01	2.19E-02	1.21E-02		2.51E-02	pCi/g
Pb-210	12/02/18	U	1.74E+00	3.90E+00	3.79E+00		3.90E+00	pCi/g
Pb-212	12/02/18		4.58E-01	3.36E-02	2.37E-02		4.95E-02	pCi/g
Pb-214	12/02/18		4.65E-01	5.54E-02	8.61E-02		6.62E-02	pCi/g
Bi-212	12/02/18		5.86E-01	1.99E-01	1.55E-01		2.05E-01	pCi/g
Bi-214	12/02/18		4.16E-01	4.53E-02	2.71E-02		5.68E-02	pCi/g
Ra-228	12/02/18		4.52E-01	8.26E-02	4.68E-02		9.23E-02	pCi/g
Ac-228	12/02/18		4.52E-01	8.26E-02	4.68E-02		9.23E-02	pCi/g
Th-234	12/02/18	U	4.14E-01	8.75E-01	8.79E-01		8.80E-01	pCi/g
U-235	12/02/18	U	7.14E-03	5.69E-02	9.52E-02		5.69E-02	pCi/g
U-238	12/02/18	U	4.14E-01	8.75E-01	8.79E-01		8.80E-01	pCi/g
Np-237	12/02/18	U	4.58E-03	1.42E-02	2.54E-02	9.90E-01	1.44E-02	pCi/g
Np-239	12/02/18	U	3.33E-03	8.85E-02	1.39E-01		8.85E-02	pCi/g
Am-241	12/02/18	U	-2.77E-03	6.48E-02	1.13E-01	2.27E+00	6.48E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 465320002
Client Sample ID: FSS-2008: OOL10-17-009-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: November 17, 2018
Receive Date: November 26, 2018
Report Date: December 14, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
C-14	12/04/18	U	1.07E-01	2.21E-01	3.68E-01	5.00E-01	2.21E-01	pCi/g
Ni-63	12/07/18	U	5.13E+00	2.17E+01	3.59E+01	6.88E+01	2.17E+01	pCi/g
Tc-99	12/11/18	U	-2.26E-01	2.71E-01	4.78E-01	1.15E+00	2.71E-01	pCi/g
Pu-241	12/12/18	U	-1.44E+01	2.84E+01	4.87E+01	7.94E+01	2.84E+01	pCi/g
Alpha Spec								
Pu-238	11/30/18	U	1.39E-02	7.73E-02	1.48E-01	2.80E+00	7.74E-02	pCi/g
Pu-239/240	11/30/18	U	2.78E-02	9.50E-02	1.76E-01	2.51E+00	9.51E-02	pCi/g
Am-241	12/04/18	U	-5.31E-02	1.31E-01	3.91E-01	2.28E+00	1.31E-01	pCi/g
Cm-243/244	12/04/18	U	-3.74E-02	1.27E-01	3.55E-01	2.80E+00	1.28E-01	pCi/g
Cm-245/246	12/04/18	U	4.63E-02	2.03E-01	3.68E-01	1.64E+00	2.04E-01	pCi/g
Gamma Spec								
Ni-59	12/07/18	U	7.48E-01	7.66E+00	1.43E+01	1.83E+02	7.67E+00	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
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Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 467216009
Client Sample ID: FSS-2120: OOL10-17-013-F-S
Client Matrix: Soil
Amount of Sample Received:

Client: Pacific Gas and Electric Company
Collect Date: December 07, 2018
Receive Date: December 19, 2018
Report Date: January 07, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	12/22/18	U	-1.04E-02	9.53E-02	1.59E-01		9.54E-02	pCi/g
Na-22	12/22/18	U	2.67E-03	1.23E-02	2.13E-02		1.24E-02	pCi/g
K-40	12/22/18		9.86E+00	6.25E-01	1.53E-01		1.22E+00	pCi/g
Cr-51	12/22/18	U	-9.40E-02	1.15E-01	1.88E-01		1.23E-01	pCi/g
Mn-54	12/22/18	U	7.04E-03	1.16E-02	2.13E-02		1.20E-02	pCi/g
Fe-59	12/22/18	U	9.04E-03	3.04E-02	5.32E-02		3.06E-02	pCi/g
Co-56	12/22/18	U	3.25E-03	1.13E-02	2.03E-02		1.14E-02	pCi/g
Co-57	12/22/18	U	-3.22E-03	1.06E-02	1.73E-02		1.07E-02	pCi/g
Co-58	12/22/18	U	-5.62E-03	1.25E-02	1.91E-02		1.28E-02	pCi/g
Co-60	12/22/18	U	-1.03E-02	1.41E-02	2.11E-02	3.42E-01	1.49E-02	pCi/g
Zn-65	12/22/18	U	-1.40E-02	2.94E-02	4.01E-02		3.01E-02	pCi/g
Y-88	12/22/18	U	-7.45E-04	9.42E-03	1.58E-02		9.43E-03	pCi/g
Zr-95	12/22/18	U	6.23E-03	2.49E-02	4.17E-02		2.51E-02	pCi/g
Nb-94	12/22/18	U	3.41E-03	1.04E-02	1.76E-02	6.39E-01	1.05E-02	pCi/g
Nb-95	12/22/18	U	8.58E-03	1.47E-02	2.31E-02		1.52E-02	pCi/g
Ru-106	12/22/18	U	-2.84E-02	1.03E-01	1.65E-01		1.03E-01	pCi/g
Ag-110m	12/22/18	U	-6.15E-03	1.42E-02	2.32E-02		1.45E-02	pCi/g
Sn-113	12/22/18	U	-1.89E-03	1.46E-02	2.48E-02		1.46E-02	pCi/g
Sb-124	12/22/18	U	-1.07E-02	2.60E-02	3.82E-02		2.65E-02	pCi/g
Sb-125	12/22/18	U	4.35E-03	2.67E-02	4.62E-02		2.68E-02	pCi/g
Cs-134	12/22/18	U	1.57E-02	2.14E-02	2.68E-02		2.26E-02	pCi/g
Cs-136	12/22/18	U	1.96E-03	3.76E-02	6.44E-02		3.76E-02	pCi/g
Cs-137	12/22/18	U	2.19E-03	1.28E-02	1.93E-02	7.11E-01	1.29E-02	pCi/g
Ba-133	12/22/18	U	6.66E-03	1.33E-02	2.17E-02		1.36E-02	pCi/g
Ba-140	12/22/18	U	-5.04E-02	9.38E-02	1.30E-01		9.66E-02	pCi/g
Ce-139	12/22/18	U	4.75E-03	1.20E-02	2.01E-02		1.23E-02	pCi/g
Ce-141	12/22/18	U	1.96E-02	2.62E-02	4.19E-02		2.77E-02	pCi/g
Ce-144	12/22/18	U	-5.16E-02	9.02E-02	1.33E-01		9.32E-02	pCi/g
Nd-147	12/22/18	U	9.62E-02	1.91E-01	3.05E-01		1.96E-01	pCi/g
Pm-144	12/22/18	U	3.94E-03	1.17E-02	1.98E-02		1.18E-02	pCi/g
Pm-146	12/22/18	U	2.36E-03	1.31E-02	2.26E-02		1.31E-02	pCi/g
Eu-152	12/22/18	U	-3.89E-03	3.18E-02	5.45E-02	9.00E-01	3.18E-02	pCi/g
Eu-154	12/22/18	U	6.50E-03	3.48E-02	5.98E-02	8.46E-01	3.49E-02	pCi/g
Eu-155	12/22/18	U	-1.11E-02	4.54E-02	7.53E-02		4.57E-02	pCi/g
Ir-192	12/22/18	U	-2.08E-03	1.10E-02	1.89E-02		1.11E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 467216009
Client Sample ID: FSS-2120: OOL10-17-013-F-S
Client Matrix: Soil
Amount of Sample Received:

Client: Pacific Gas and Electric Company
Collect Date: December 07, 2018
Receive Date: December 19, 2018
Report Date: January 07, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	12/22/18	U	7.02E-03	1.30E-02	2.14E-02		1.34E-02	pCi/g
Tl-208	12/22/18		1.73E-01	2.79E-02	2.12E-02		3.13E-02	pCi/g
Pb-210	12/22/18	U	-6.25E-01	3.94E+00	6.76E+00		3.95E+00	pCi/g
Pb-212	12/22/18		5.85E-01	4.60E-02	3.59E-02		6.68E-02	pCi/g
Pb-214	12/22/18		6.78E-01	6.87E-02	1.23E-01		8.69E-02	pCi/g
Bi-212	12/22/18		6.49E-01	4.11E-01	2.57E-01		4.15E-01	pCi/g
Bi-214	12/22/18		6.07E-01	6.63E-02	3.55E-02		8.29E-02	pCi/g
Ra-228	12/22/18		6.82E-01	1.46E-01	6.80E-02		1.61E-01	pCi/g
Ac-228	12/22/18		6.82E-01	1.46E-01	6.80E-02		1.61E-01	pCi/g
Th-234	12/22/18	U	5.26E-01	8.58E-01	1.52E+00		8.98E-01	pCi/g
U-235	12/22/18	U	6.59E-02	1.20E-01	1.34E-01		1.20E-01	pCi/g
U-238	12/22/18	U	5.26E-01	8.58E-01	1.52E+00		8.98E-01	pCi/g
Np-237	12/22/18	U	-3.10E-03	2.02E-02	3.47E-02	9.90E-01	2.02E-02	pCi/g
Np-239	12/22/18	U	-9.04E-02	1.24E-01	1.83E-01		1.31E-01	pCi/g
Am-241	12/22/18	U	6.99E-03	1.03E-01	1.78E-01	2.27E+00	1.03E-01	pCi/g

Notes:
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2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 467216010
Client Sample ID: FSS-2120: OOL10-17-013-F
Client Matrix: Soil
Amount of Sample Received:

Client: Pacific Gas and Electric Company
Collect Date: December 07, 2018
Receive Date: December 19, 2018
Report Date: January 07, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
C-14	01/02/19	U	-1.80E-01	2.47E-01	4.20E-01	5.00E-01	2.47E-01	pCi/g
Ni-63	01/03/19	U	5.10E+00	1.31E+01	2.15E+01	6.94E+01	1.31E+01	pCi/g
Tc-99	01/02/19	U	-1.69E-01	3.88E-01	6.69E-01	1.16E+00	3.88E-01	pCi/g
Pu-241	12/27/18	U	6.19E+00	2.51E+01	4.16E+01	8.29E+01	2.52E+01	pCi/g
Alpha Spec								
Pu-238	12/26/18	U	3.45E-02	1.08E-01	2.02E-01	2.80E+00	1.08E-01	pCi/g
Pu-239/240	12/26/18	U	1.46E-02	9.43E-02	1.93E-01	2.51E+00	9.44E-02	pCi/g
Am-241	12/26/18	U	-9.70E-02	1.11E-01	3.76E-01	2.28E+00	1.11E-01	pCi/g
Cm-243/244	12/26/18	U	1.01E-01	1.79E-01	2.71E-01	2.80E+00	1.79E-01	pCi/g
Cm-245/246	12/26/18	U	0.00E+00	1.04E-01	1.54E-01	1.64E+00	1.04E-01	pCi/g
Gamma Spec								
Ni-59	01/03/19	U	4.34E+01	3.69E+01	7.66E+01	1.83E+02	4.20E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-17-FSR

Data Assessment

Data Quality Assessment of OOL10-17-FSR;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-17-FSR-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-5.02E-02
Maximum Value	1.83E-01
Mean	5.40E-02
Median	5.74E-02
a-posteriori σ	6.97E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits a limited skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

Summary:

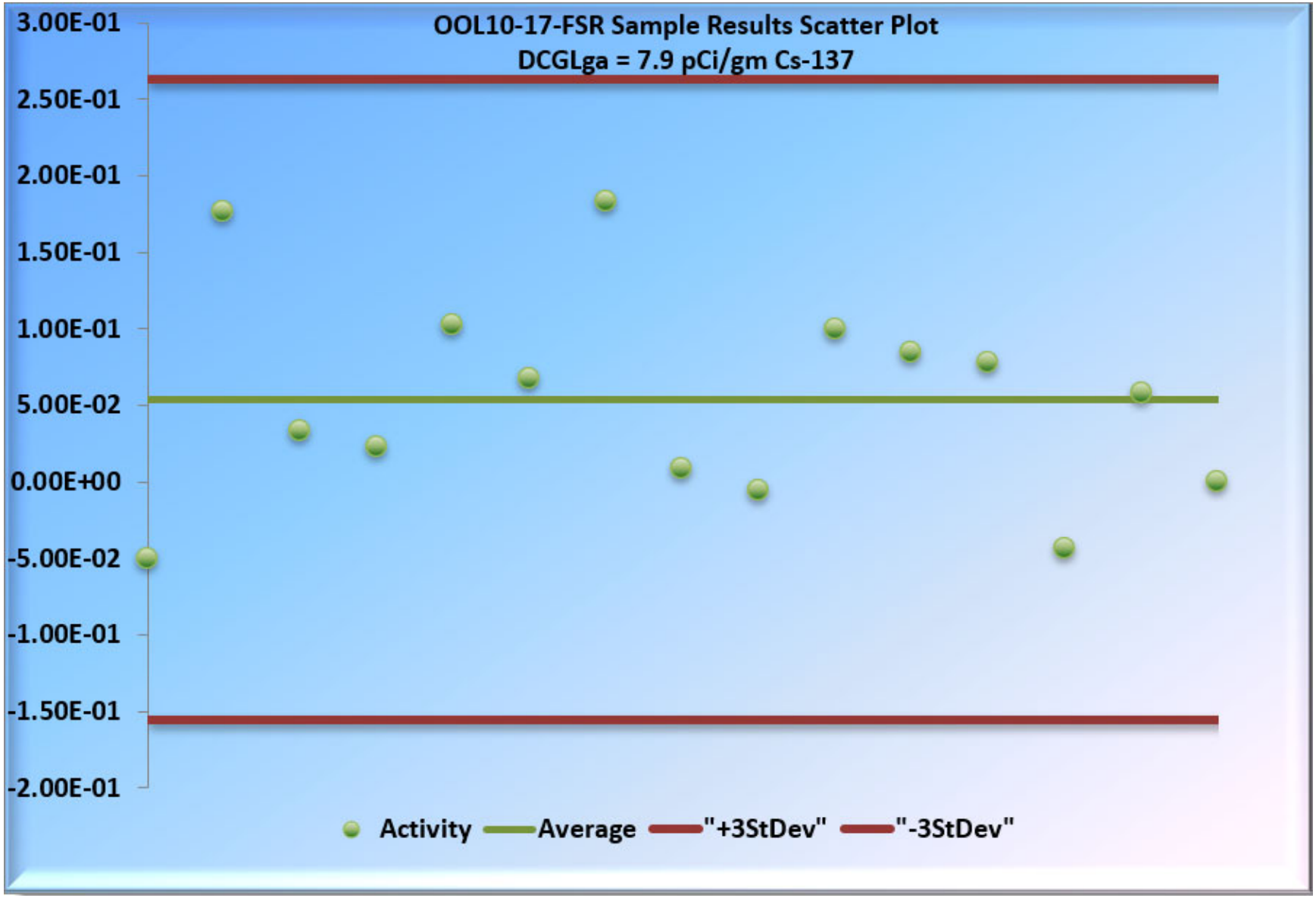
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

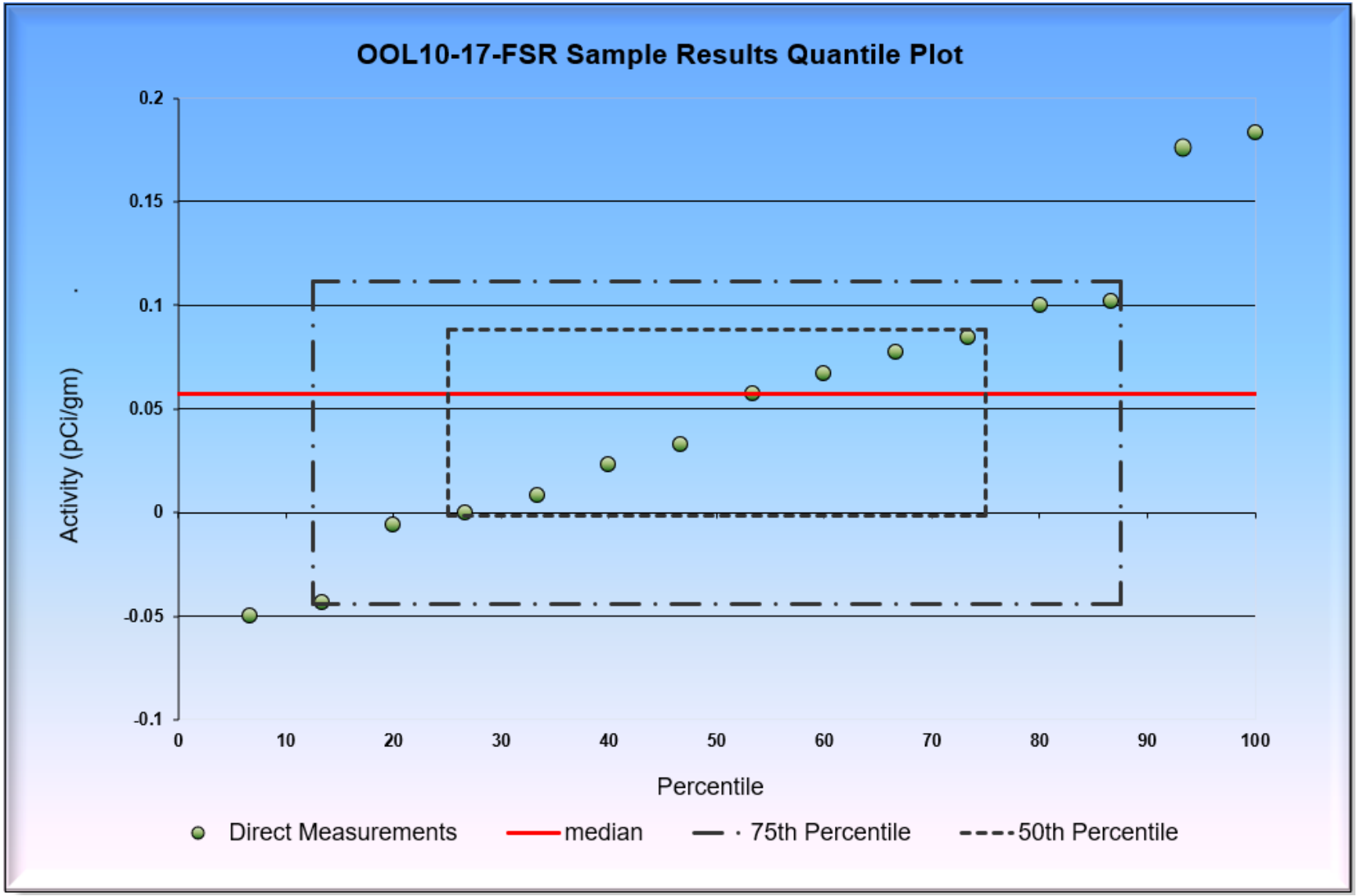
Survey Unit OOL10-17-FSR meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-17-FSR.

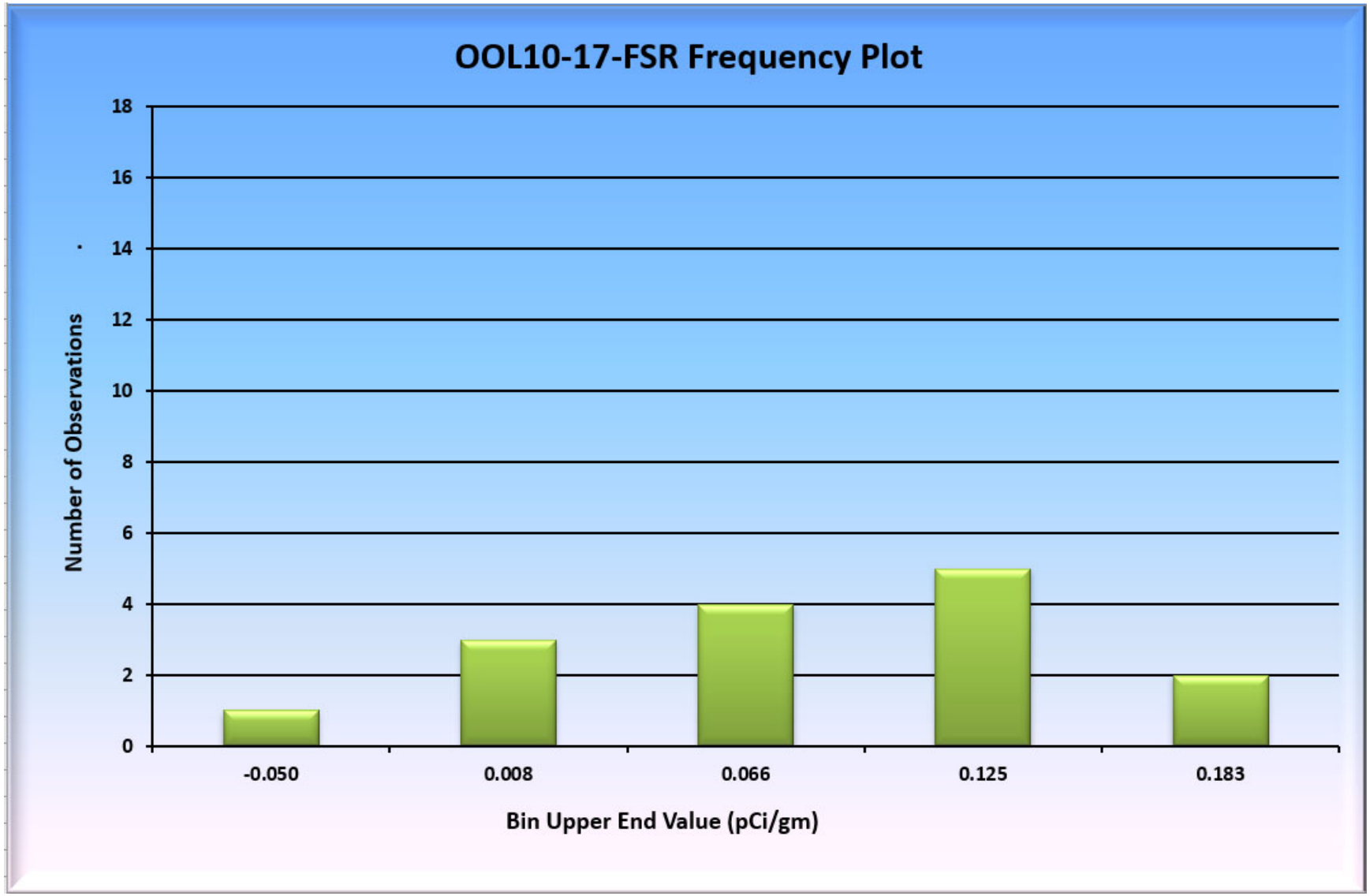
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)										
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**H-3**	**Sr-90**	**SOF[(1)]**
OOL10-17-001-FSR	-6.68E-03	-2.46E-03	-5.02E-02	3.40E-02	1.06E-02	6.44E-02	2.48E-02	0.00E+00	8.50E-02	-0.6%
OOL10-17-002-FSR	-3.71E-02	-4.52E-02	**1.76E-01**	-3.51E-02	6.61E-02	-2.65E-02	1.26E-01	2.40E-01	1.22E-01	2.2%
OOL10-17-003-FSR	-7.00E-03	-3.16E-03	3.26E-02	1.94E-02	1.50E-02	1.25E-02	-1.81E-02	5.00E-02	8.10E-02	0.4%
OOL10-17-004-FSR	-6.56E-02	-3.19E-02	2.28E-02	-1.65E-02	2.25E-02	1.84E-02	5.95E-03	3.00E-02	3.80E-02	0.3%
OOL10-17-005-FSR	2.38E-02	1.34E-02	1.02E-01	-5.71E-03	-4.81E-02	1.91E-02	-5.80E-02	7.00E-02	2.45E-01	1.3%
OOL10-17-006-FSR	2.66E-02	1.17E-02	6.70E-02	-3.85E-03	1.53E-02	-1.65E-02	3.11E-03	7.00E-02	-1.85E-01	0.8%
OOL10-17-007-FSR	-6.55E-02	4.04E-02	1.83E-01	8.54E-02	6.58E-02	-9.31E-03	5.06E-02	1.40E-01	-6.30E-02	2.3%
OOL10-17-008-FSR	-4.36E-02	1.15E-02	8.16E-03	-2.51E-02	-1.05E-02	5.41E-03	2.87E-02	1.70E-01	6.00E-03	0.1%
OOL10-17-009-FSR	-3.07E-02	-1.80E-02	-6.05E-03	-1.69E-02	-1.05E-01	4.96E-03	-1.60E-02	2.00E-02	1.60E-02	-0.1%
OOL10-17-010-FSR	-1.13E-01	5.65E-02	9.97E-02	-1.19E-02	-2.07E-02	-4.57E-04	-5.95E-03	3.60E-01	-5.00E-03	1.3%
OOL10-17-011-FSR	-1.74E-01	-1.42E-02	8.44E-02	2.45E-02	-4.46E-03	6.73E-03	4.29E-02	1.10E-01	1.71E-01	1.1%
OOL10-17-012-FSR	1.38E-01	-2.12E-03	**7.73E-02**	-3.81E-02	1.57E-03	-6.45E-03	-6.57E-02	1.00E-02	-1.25E-01	1.0%
OOL10-17-013-FSR	1.27E-01	7.07E-03	-4.36E-02	-1.18E-01	1.64E-03	-1.72E-02	-1.72E-02	2.00E-02	1.13E-01	-0.6%
OOL10-17-014-FSR	1.93E-02	6.08E-03	5.74E-02	6.87E-02	2.24E-03	-2.51E-02	-4.41E-03	0.00E+00	1.09E-01	0.7%
OOL10-17-015-FSR	-2.13E-01	8.67E-03	-1.94E-04	-3.33E-03	-1.92E-02	1.55E-02	-2.92E-02	1.80E-01	-1.79E-01	0.0%

*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels

Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

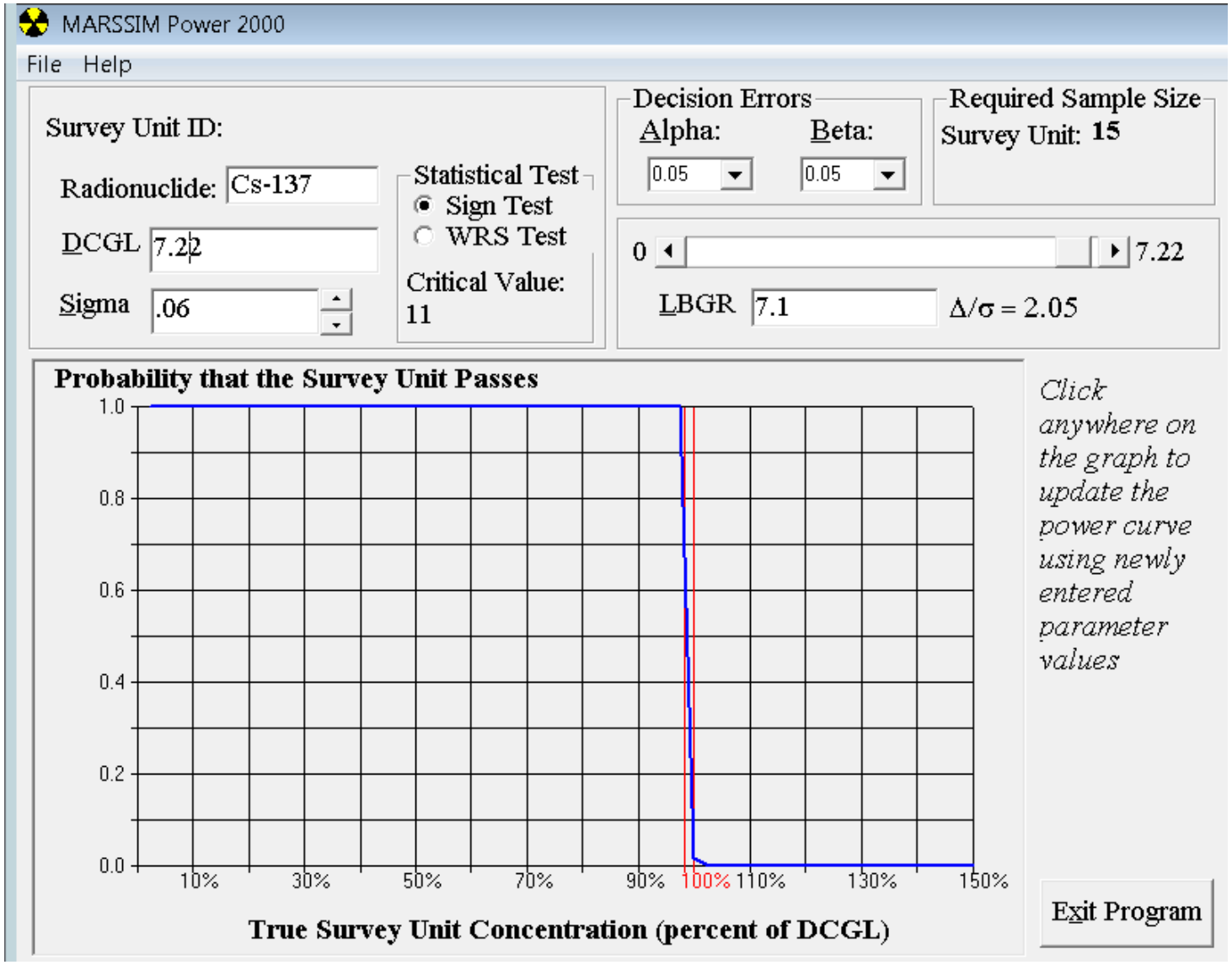

OOL10-17-FSR Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
-1.50E-01
-2.00E-01
Activity
Average
"+3StDev"
"-3StDev"


OOL10-17-FSR Sample Results Quantile Plot
0.2
0.15
0.1
0.05
0
-0.05
-0.1
Activity (pCi/gm)
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

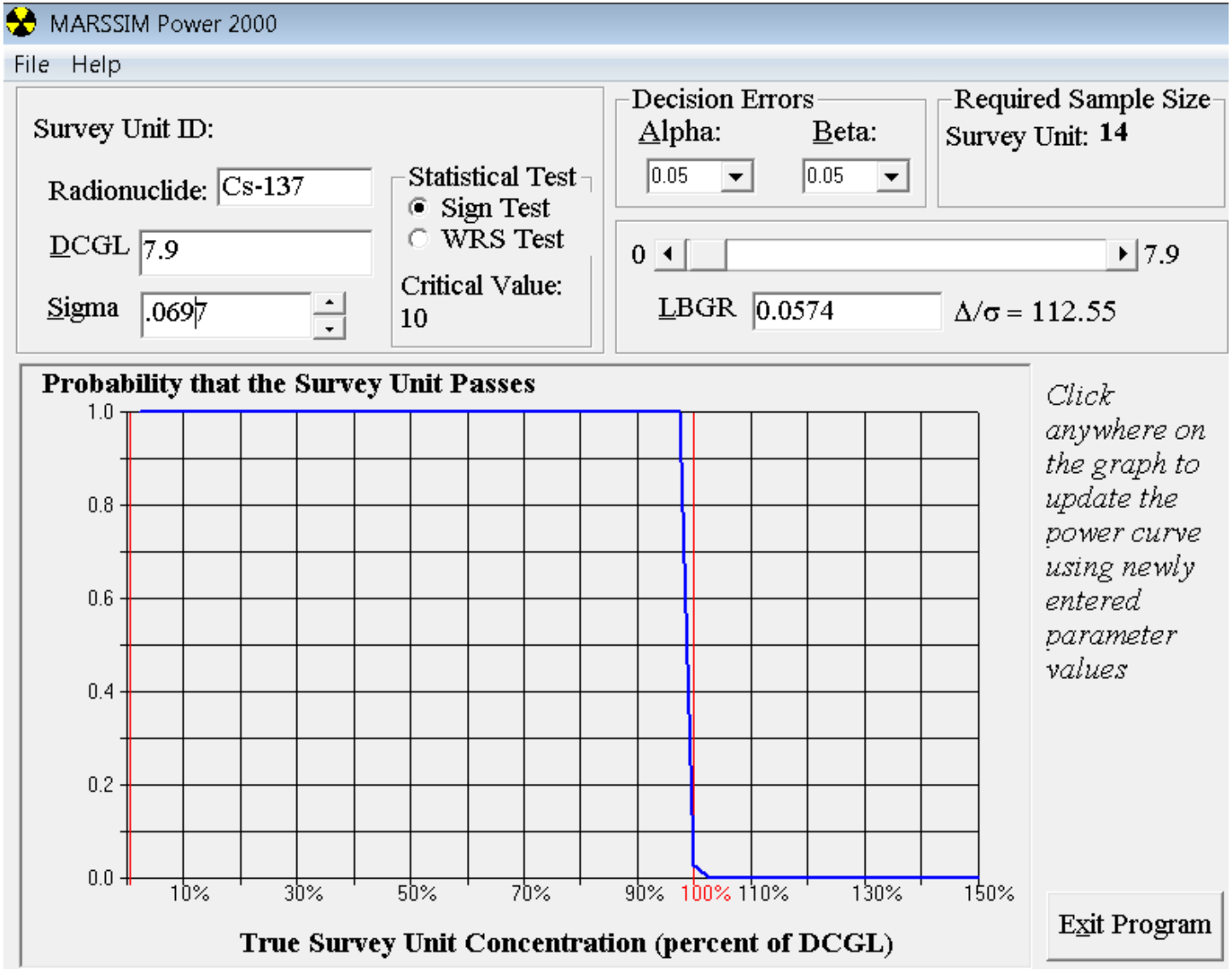

OOL10-17-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.050
0.008
0.066
0.125
0.183
Bin Upper End Value (pCi/gm)

Posting Plot
Survey Unit: OOL10-17-FSR
Survey Area: 53,129 m2
Reported Values: Cs-137
Reported Units: pCi/g
N
002
1.76E-01
015
006 -1.54E-04
6.70E-02
003
3.26E-02
012
3.76E-02
008
3.16E-03
010
3.97E-02
005
1.02E-01
004
2.23E-02
013
-4.39E-02
011
3.44E-02
007
1.83E-01
001
-5.02E-02
014
3.74E-02
OOL10-17-xxx-FSR
OOL10-17 Boundary
OOL10-17 Area
Positive for Cs-137

Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0697
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0 7.9
LBGR 0.0574
Δ/σ = 112.55
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10% 30% 50% 70% 90% 100% 110% 130% 150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #005

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-FSR-00			Sample Measurement Location:	005

Sample Description:

Comparison of split samples collected from sample measurement location #005 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	8.02	1.56	5	0.5	2	9.80	0.35	1.22	Y
Pb-212	0.39	0.10	4	No Comparison	No Comparison	0.52	0.02	1.34	N
Cs-137	0.10	N/A				0.07	0.02	0.70	N
		0.00					0.00		

Comments/Corrective Actions:

Note (1) There is no comparision between the two lab results for Cs-137, as the HBPP value is not detected and below the minimum detect on level reported of 1.44E-01 pCi/g. There is no comparison for the Pb-212 results as the error is high for the HBPP Laboratory result. However, the K-40 comparison show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	01/26/21	Concurrence by:	M. Blake	Date: 01/26/21
Signature:			Signature:		

Split Sample #015

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-FSR-00			Sample Measurement Location:	015

Sample Description:

Comparison of split samples collected from sample measurement location #015 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	10.20	0.77	13	0.6	1.66	12.50	0.34	1.23	Y
Pb-212	0.46	0.04	11	0.6	1.66	0.62	0.02	1.33	Y
Cs-137	0.00	0.00				0.04	0.01		Y
		0.00					0.00		

Comments/Corrective Actions:

Note (1) There is no comparision between the two lab results for Cs-137, as the HBPP value is not detected and below the minimum detection level reported of 9.37E-02 pCi/g. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #001

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	17	Survey Unit Name:	Remainder of Land Area (Bravo Road and Frog Pond)
Sample Plan No.:	HBPP-FSSP-OOL10-17-FSR-00			Sample Measurement Location:	001

Sample Description:

Duplicate count comparison from sample measurement location #001 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	5.91	0.50	12	0.6	1.66	6.55	0.52	1.11	Y
Pb-212	0.37	0.03	13	0.6	1.66	0.35	0.03	0.96	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465182005
Client Sample ID: FSS-1969 OOL10-17-005-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 08, 2018
Receive Date: November 21, 2018
Report Date: December 12, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	12/01/18	U	-1.15E-02	1.37E-01	2.25E-01		1.37E-01	pCi/g
Na-22	12/01/18	U	1.51E-03	1.78E-02	2.98E-02		1.78E-02	pCi/g
K-40	12/01/18		9.80E+00	6.94E-01	1.77E-01		1.08E+00	pCi/g
Cr-51	12/01/18	U	0.00E+00	1.34E-01	2.30E-01		0.00E+00	pCi/g
Mn-54	12/01/18	U	2.73E-03	1.31E-02	2.29E-02		1.31E-02	pCi/g
Fe-59	12/01/18	U	-1.49E-02	3.77E-02	5.98E-02		3.83E-02	pCi/g
Co-56	12/01/18	U	1.60E-02	1.62E-02	3.06E-02		1.77E-02	pCi/g
Co-57	12/01/18	U	-1.87E-03	9.39E-03	1.51E-02		9.42E-03	pCi/g
Co-58	12/01/18	U	8.04E-03	1.44E-02	2.64E-02		1.49E-02	pCi/g
Co-60	12/01/18	U	5.67E-03	1.46E-02	2.55E-02	3.42E-01	1.48E-02	pCi/g
Zn-65	12/01/18	U	2.69E-03	3.45E-02	5.13E-02		3.45E-02	pCi/g
Y-88	12/01/18	U	2.81E-04	1.10E-02	1.87E-02		1.10E-02	pCi/g
Zr-95	12/01/18	U	3.33E-02	4.41E-02	4.95E-02		4.67E-02	pCi/g
Nb-94	12/01/18	U	1.49E-02	1.19E-02	2.31E-02	6.39E-01	1.38E-02	pCi/g
Nb-95	12/01/18	U	-6.29E-03	2.42E-02	2.48E-02		2.44E-02	pCi/g
Ru-106	12/01/18	U	8.93E-02	1.11E-01	1.99E-01		1.18E-01	pCi/g
Ag-110m	12/01/18	U	-1.09E-02	1.74E-02	2.71E-02		1.81E-02	pCi/g
Sn-113	12/01/18	U	-4.17E-03	1.49E-02	2.44E-02		1.50E-02	pCi/g
Sb-124	12/01/18	U	1.60E-02	1.87E-02	4.10E-02		2.01E-02	pCi/g
Sb-125	12/01/18	U	5.71E-03	3.09E-02	5.28E-02		3.10E-02	pCi/g
Cs-134	12/01/18	U	1.38E-02	1.46E-02	2.77E-02		1.59E-02	pCi/g
Cs-136	12/01/18	U	-3.46E-02	6.16E-02	9.59E-02		6.37E-02	pCi/g
Cs-137	12/01/18	M	7.15E-02	3.50E-02	2.13E-02	7.11E-01	3.56E-02	pCi/g
Ba-133	12/01/18	U	-7.49E-03	1.51E-02	2.16E-02		1.55E-02	pCi/g
Ba-140	12/01/18	U	-8.00E-03	1.51E-01	2.47E-01		1.51E-01	pCi/g
Ce-139	12/01/18	U	-1.02E-02	1.15E-02	1.73E-02		1.26E-02	pCi/g
Ce-141	12/01/18	U	1.40E-02	2.78E-02	4.62E-02		2.85E-02	pCi/g
Ce-144	12/01/18	U	-3.22E-02	8.13E-02	1.18E-01		8.26E-02	pCi/g
Nd-147	12/01/18	U	-9.99E-02	3.35E-01	5.33E-01		3.38E-01	pCi/g
Pm-144	12/01/18	U	1.84E-03	1.14E-02	2.01E-02		1.15E-02	pCi/g
Pm-146	12/01/18	U	3.45E-03	1.59E-02	2.59E-02		1.60E-02	pCi/g
Eu-152	12/01/18	U	6.22E-03	3.63E-02	5.64E-02	9.00E-01	3.64E-02	pCi/g
Eu-154	12/01/18	U	9.45E-03	4.90E-02	8.32E-02	8.46E-01	4.92E-02	pCi/g
Eu-155	12/01/18	U	2.64E-02	3.67E-02	6.26E-02		3.87E-02	pCi/g
Ir-192	12/01/18	U	-6.44E-03	1.22E-02	1.88E-02		1.25E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465182005
Client Sample ID: FSS-1969 OOL10-17-005-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 08, 2018
Receive Date: November 21, 2018
Report Date: December 12, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	12/01/18	U	1.41E-02	2.95E-02	2.47E-02		3.02E-02	pCi/g
Tl-208	12/01/18		1.76E-01	3.20E-02	2.03E-02		3.54E-02	pCi/g
Pb-210	12/01/18		7.09E-01	4.67E-01	4.34E-01		4.71E-01	pCi/g
Pb-212	12/01/18		5.18E-01	4.32E-02	3.16E-02		5.84E-02	pCi/g
Pb-214	12/01/18		5.52E-01	7.12E-02	1.23E-01		8.27E-02	pCi/g
Bi-212	12/01/18		8.65E-01	3.32E-01	2.66E-01		3.41E-01	pCi/g
Bi-214	12/01/18		5.09E-01	8.01E-02	4.35E-02		9.13E-02	pCi/g
Ra-228	12/01/18		4.88E-01	1.23E-01	8.16E-02		1.29E-01	pCi/g
Ac-228	12/01/18		4.88E-01	1.23E-01	8.16E-02		1.29E-01	pCi/g
Th-234	12/01/18		8.81E-01	5.34E-01	4.87E-01		5.70E-01	pCi/g
U-235	12/01/18	U	-4.78E-02	7.73E-02	1.21E-01		7.73E-02	pCi/g
U-238	12/01/18		8.81E-01	5.34E-01	4.87E-01		5.70E-01	pCi/g
Np-237	12/01/18	U	3.42E-02	3.40E-02	3.74E-02	9.90E-01	3.75E-02	pCi/g
Np-239	12/01/18	U	-3.04E-02	9.51E-02	1.52E-01		9.61E-02	pCi/g
Am-241	12/01/18	U	-1.83E-02	3.10E-02	4.68E-02	2.27E+00	3.21E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 465182006
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-1969 OOL10-17-005-FSR
Collect Date: November 08, 2018
Client Matrix: Soil
Receive Date: November 21, 2018
Amount of Sample Received:
Report Date: December 12, 2018
Sample Description: HTDs

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
C-14	12/03/18	U	1.17E-01	2.21E-01	3.67E-01	5.00E-01	2.21E-01	pCi/g
Ni-63	12/07/18	U	1.22E+01	2.63E+01	4.32E+01	6.88E+01	2.64E+01	pCi/g
Tc-99	12/09/18	U	-1.31E-01	6.40E-01	1.09E+00	1.15E+00	6.40E-01	pCi/g
Pu-241	12/12/18	U	1.77E+01	3.60E+01	5.90E+01	7.94E+01	3.61E+01	pCi/g
Alpha Spec								
Pu-238	11/30/18	U	7.06E-02	1.21E-01	1.06E-01	2.80E+00	1.21E-01	pCi/g
Pu-239/240	11/30/18	U	1.24E-01	1.57E-01	1.95E-01	2.51E+00	1.58E-01	pCi/g
Am-241	11/30/18	U	-8.48E-03	1.27E-01	2.97E-01	2.28E+00	1.27E-01	pCi/g
Cm-243/244	11/30/18	U	-1.84E-02	1.27E-01	3.10E-01	2.80E+00	1.27E-01	pCi/g
Cm-245/246	11/30/18	U	4.85E-02	1.37E-01	1.46E-01	1.64E+00	1.37E-01	pCi/g
Gamma Spec								
Ni-59	12/07/18	U	2.70E+01	4.12E+01	8.01E+01	1.83E+02	4.30E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 465320007
Client Sample ID: FSS-1999: OOL10-17-015-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 16, 2018
Receive Date: November 26, 2018
Report Date: December 14, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	12/02/18	U	5.84E-02	9.85E-02	1.74E-01		1.02E-01	pCi/g
Na-22	12/02/18	U	-3.15E-03	1.32E-02	2.13E-02		1.33E-02	pCi/g
K-40	12/02/18		1.25E+01	6.87E-01	1.75E-01		1.39E+00	pCi/g
Cr-51	12/02/18	U	2.74E-02	1.16E-01	2.03E-01		1.17E-01	pCi/g
Mn-54	12/02/18	U	1.39E-02	1.78E-02	1.74E-02		1.78E-02	pCi/g
Fe-59	12/02/18	U	8.80E-03	3.71E-02	4.88E-02		3.73E-02	pCi/g
Co-56	12/02/18	U	-2.51E-03	1.12E-02	1.89E-02		1.13E-02	pCi/g
Co-57	12/02/18	U	3.29E-03	1.05E-02	1.75E-02		1.06E-02	pCi/g
Co-58	12/02/18	U	-9.10E-03	1.05E-02	1.63E-02		1.13E-02	pCi/g
Co-60	12/02/18	U	5.62E-04	1.25E-02	2.09E-02	3.42E-01	1.25E-02	pCi/g
Zn-65	12/02/18	U	-1.11E-02	3.32E-02	4.65E-02		3.36E-02	pCi/g
Y-88	12/02/18	U	5.98E-03	8.40E-03	1.68E-02		8.83E-03	pCi/g
Zr-95	12/02/18	U	-1.28E-02	2.11E-02	3.30E-02		2.19E-02	pCi/g
Nb-94	12/02/18	U	7.89E-03	1.60E-02	1.69E-02	6.39E-01	1.64E-02	pCi/g
Nb-95	12/02/18	U	1.17E-02	1.27E-02	2.38E-02		1.38E-02	pCi/g
Ru-106	12/02/18	U	-1.19E-02	9.63E-02	1.56E-01		9.64E-02	pCi/g
Ag-110m	12/02/18	U	-5.90E-03	1.50E-02	2.45E-02		1.52E-02	pCi/g
Sn-113	12/02/18	U	-5.59E-03	1.46E-02	2.41E-02		1.49E-02	pCi/g
Sb-124	12/02/18	U	6.43E-03	1.74E-02	3.28E-02		1.77E-02	pCi/g
Sb-125	12/02/18	U	-2.65E-02	2.98E-02	4.65E-02		3.22E-02	pCi/g
Cs-134	12/02/18	UI	2.61E-02	2.19E-02	2.61E-02		2.79E-02	pCi/g
Cs-136	12/02/18	U	1.60E-02	3.59E-02	5.74E-02		3.66E-02	pCi/g
Cs-137	12/02/18	M	3.95E-02	2.13E-02	2.09E-02	7.11E-01	2.15E-02	pCi/g
Ba-133	12/02/18	U	6.33E-03	1.36E-02	2.18E-02		1.39E-02	pCi/g
Ba-140	12/02/18	U	-1.21E-02	8.59E-02	1.41E-01		8.61E-02	pCi/g
Ce-139	12/02/18	U	6.16E-03	1.27E-02	1.73E-02		1.30E-02	pCi/g
Ce-141	12/02/18	U	1.61E-03	2.61E-02	4.26E-02		2.61E-02	pCi/g
Ce-144	12/02/18	U	1.80E-02	7.84E-02	1.30E-01		7.88E-02	pCi/g
Nd-147	12/02/18	U	-8.84E-02	1.92E-01	3.05E-01		1.96E-01	pCi/g
Pm-144	12/02/18	U	-1.19E-02	1.35E-02	1.72E-02		1.46E-02	pCi/g
Pm-146	12/02/18	U	6.87E-03	1.21E-02	2.14E-02		1.25E-02	pCi/g
Eu-152	12/02/18	U	-1.02E-02	2.94E-02	4.34E-02	9.00E-01	2.98E-02	pCi/g
Eu-154	12/02/18	U	-8.76E-03	3.68E-02	5.94E-02	8.46E-01	3.70E-02	pCi/g
Eu-155	12/02/18	U	2.59E-02	7.08E-02	7.05E-02		7.09E-02	pCi/g
Ir-192	12/02/18	U	-4.48E-03	1.08E-02	1.80E-02		1.10E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 465320007
Client Sample ID: FSS-1999: OOL10-17-015-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: November 16, 2018
Receive Date: November 26, 2018
Report Date: December 14, 2018

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	12/02/18	U	1.17E-03	1.35E-02	2.13E-02		1.36E-02	pCi/g
Tl-208	12/02/18		2.04E-01	3.12E-02	1.63E-02		3.56E-02	pCi/g
Pb-210	12/02/18	U	9.44E-01	2.32E+00	4.03E+00		2.36E+00	pCi/g
Pb-212	12/02/18		6.17E-01	4.59E-02	3.20E-02		6.65E-02	pCi/g
Pb-214	12/02/18		5.65E-01	6.13E-02	4.06E-02		7.49E-02	pCi/g
Bi-212	12/02/18		4.55E-01	3.68E-01	2.51E-01		3.70E-01	pCi/g
Bi-214	12/02/18		5.26E-01	6.35E-02	3.25E-02		7.74E-02	pCi/g
Ra-228	12/02/18		6.61E-01	1.25E-01	6.72E-02		1.40E-01	pCi/g
Ac-228	12/02/18		6.61E-01	1.25E-01	6.72E-02		1.40E-01	pCi/g
Th-234	12/02/18	UI	1.04E+00	1.57E+00	1.04E+00		1.64E+00	pCi/g
U-235	12/02/18	U	2.75E-02	8.25E-02	1.37E-01		8.25E-02	pCi/g
U-238	12/02/18	UI	1.04E+00	1.57E+00	1.04E+00		1.64E+00	pCi/g
Np-237	12/02/18	U	-4.66E-03	2.03E-02	3.43E-02	9.90E-01	2.04E-02	pCi/g
Np-239	12/02/18	U	-3.86E-02	1.14E-01	1.69E-01		1.16E-01	pCi/g
Am-241	12/02/18	U	7.83E-02	8.75E-02	1.45E-01	2.27E+00	9.46E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 465320008
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-1999: OOL10-17-015-FSR
Collect Date: November 16, 2018
Client Matrix: Soil
Receive Date: November 26, 2018
Amount of Sample Received:
Report Date: December 14, 2018
Sample Description: HTDs

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
C-14	12/04/18	U	8.10E-02	2.19E-01	3.65E-01	5.00E-01	2.19E-01	pCi/g
Ni-63	12/07/18	U	7.50E-01	2.41E+01	4.04E+01	6.88E+01	2.41E+01	pCi/g
Tc-99	12/11/18	U	-1.90E-01	4.20E-01	7.24E-01	1.15E+00	4.20E-01	pCi/g
Pu-241	12/12/18	U	1.83E+01	3.93E+01	6.45E+01	7.94E+01	3.95E+01	pCi/g
Alpha Spec								
Pu-238	11/30/18	U	4.17E-02	1.17E-01	1.25E-01	2.80E+00	1.17E-01	pCi/g
Pu-239/240	11/30/18	U	6.33E-02	1.45E-01	2.31E-01	2.51E+00	1.46E-01	pCi/g
Am-241	12/04/18	U	-7.83E-02	2.82E-01	7.07E-01	2.28E+00	2.82E-01	pCi/g
Cm-243/244	12/04/18	U	0.00E+00	1.53E-01	2.32E-01	2.80E+00	1.53E-01	pCi/g
Cm-245/246	12/04/18	U	4.16E-01	4.32E-01	4.56E-01	1.64E+00	4.38E-01	pCi/g
Gamma Spec								
Ni-59	12/07/18	U	1.81E+01	2.53E+01	5.38E+01	1.83E+02	2.66E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-20

Data Assessment

Data Quality Assessment of OOL10-20;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-20-02. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 21 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	21
Minimum value	-2.29E-02
Maximum Value	5.53E-02
Mean	1.04E-02
Median	1.35E-02
a-posteriori σ	2.34E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits a limited skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

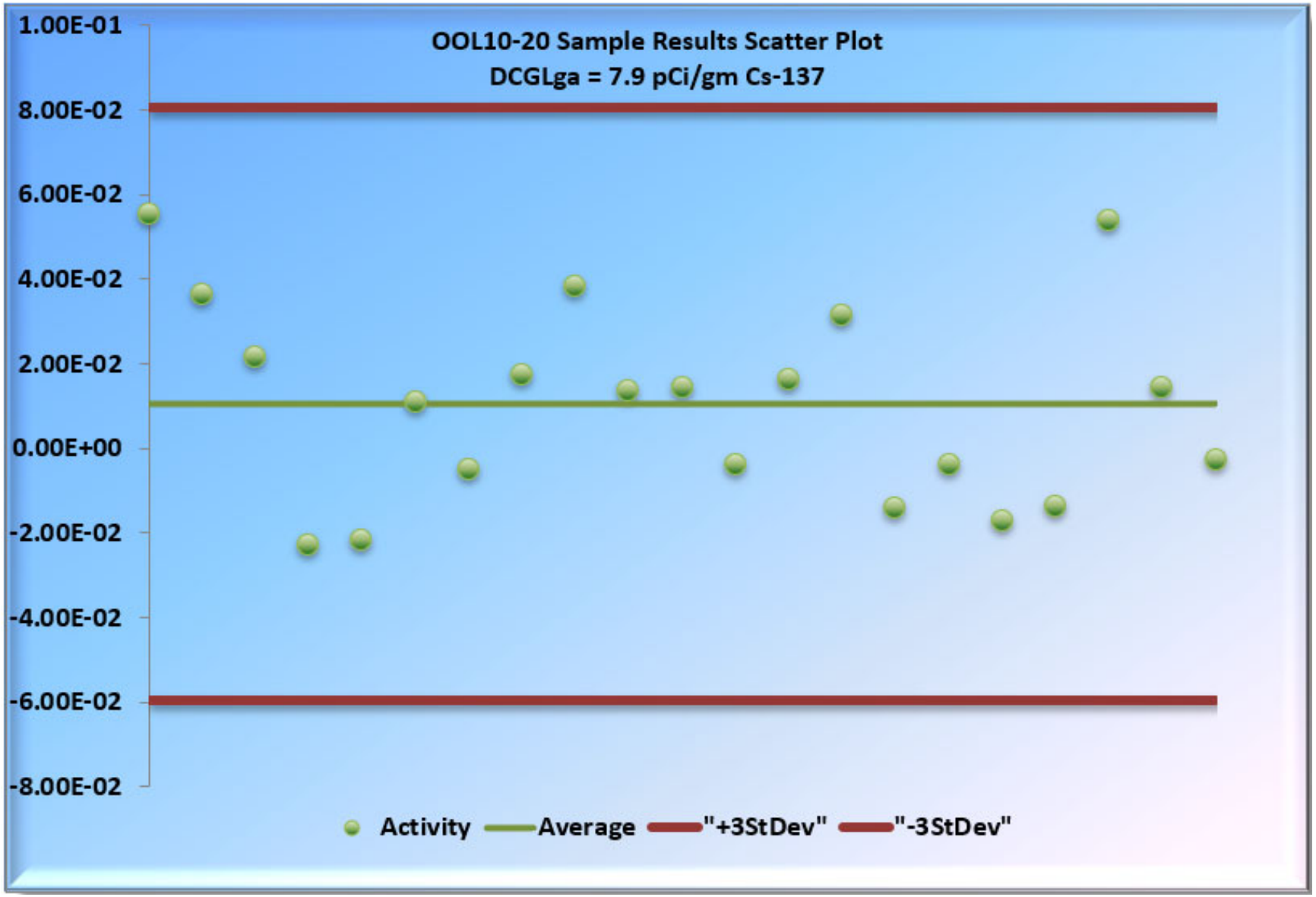
Summary:

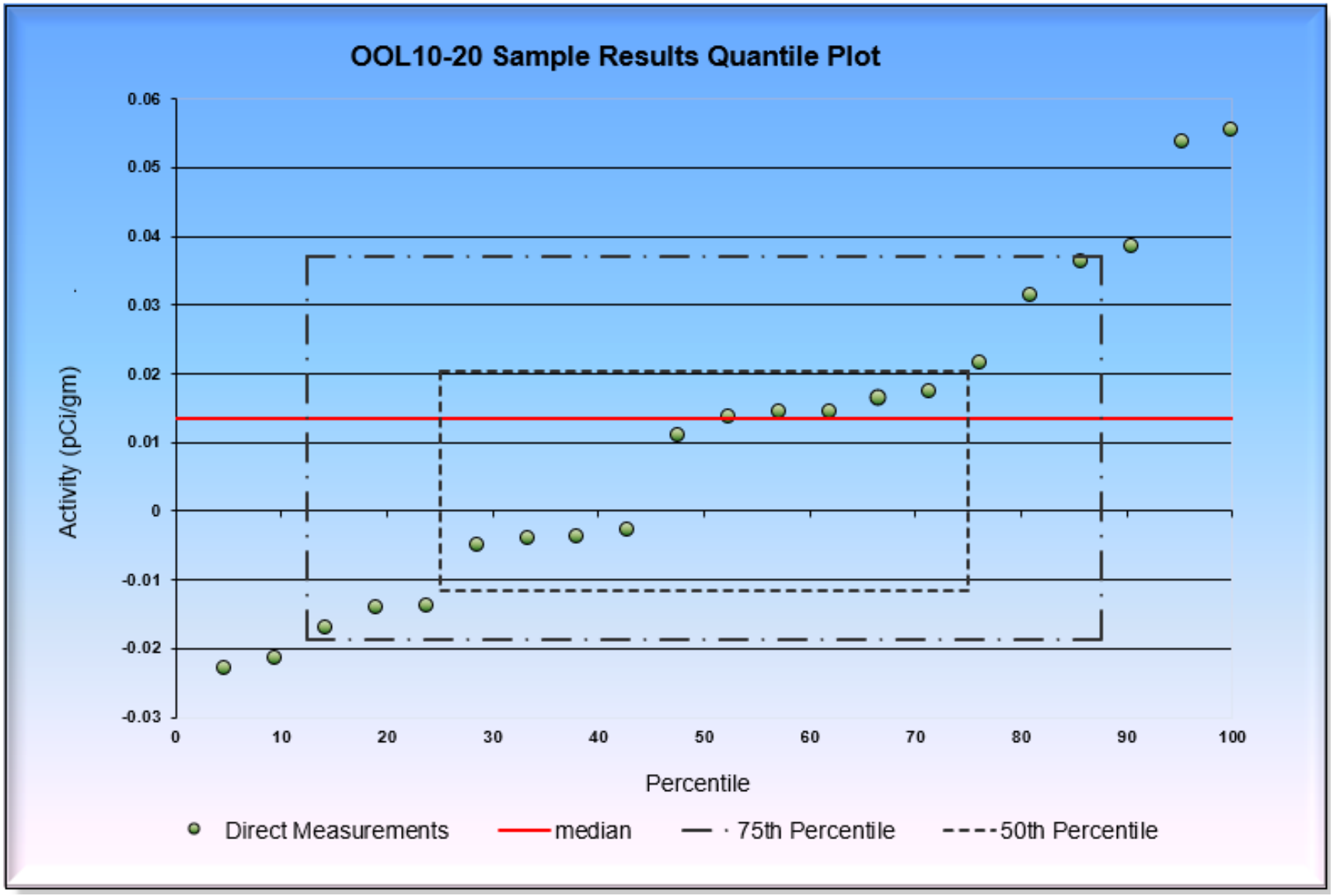
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

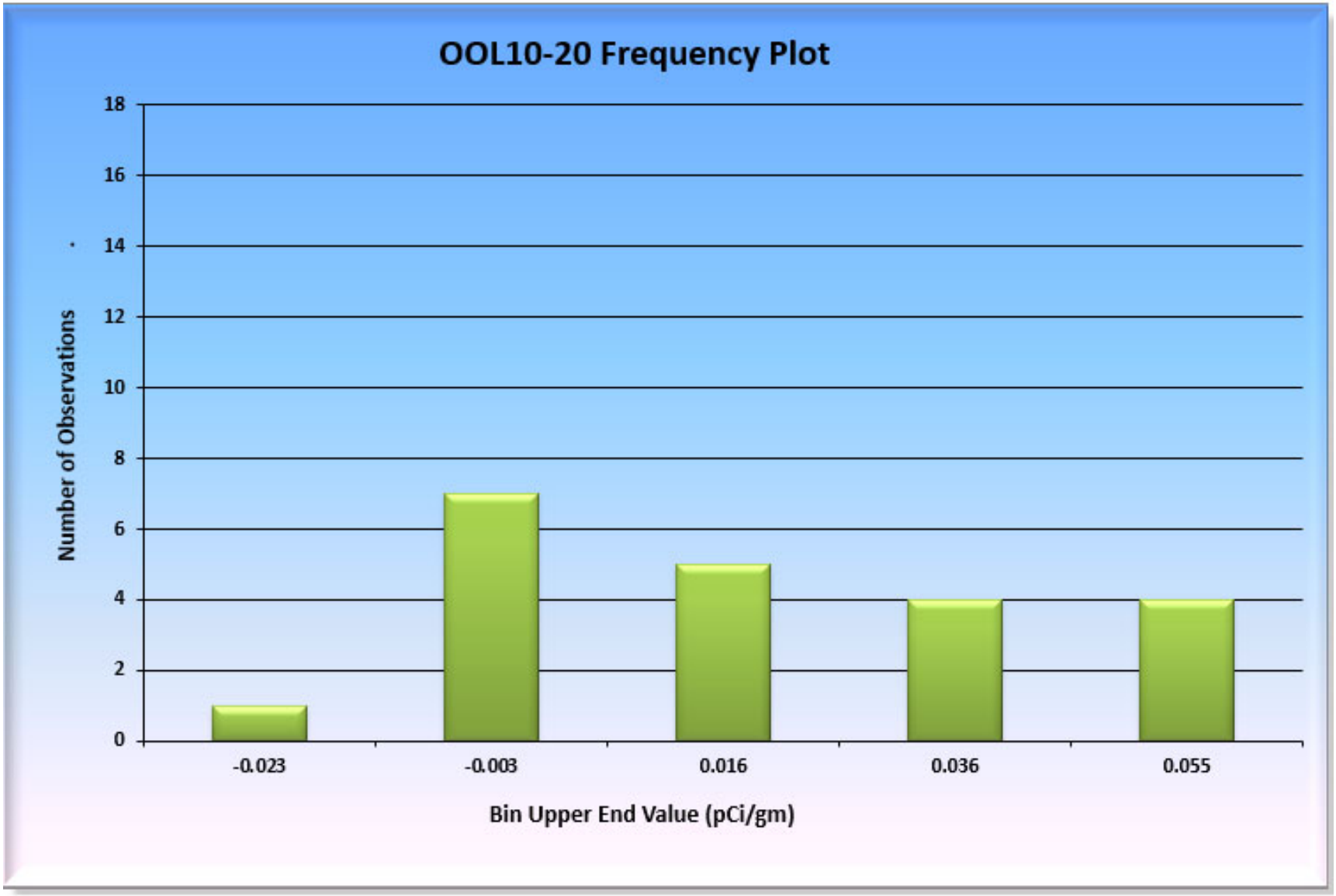
Survey Unit OOL10-20 meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-20.

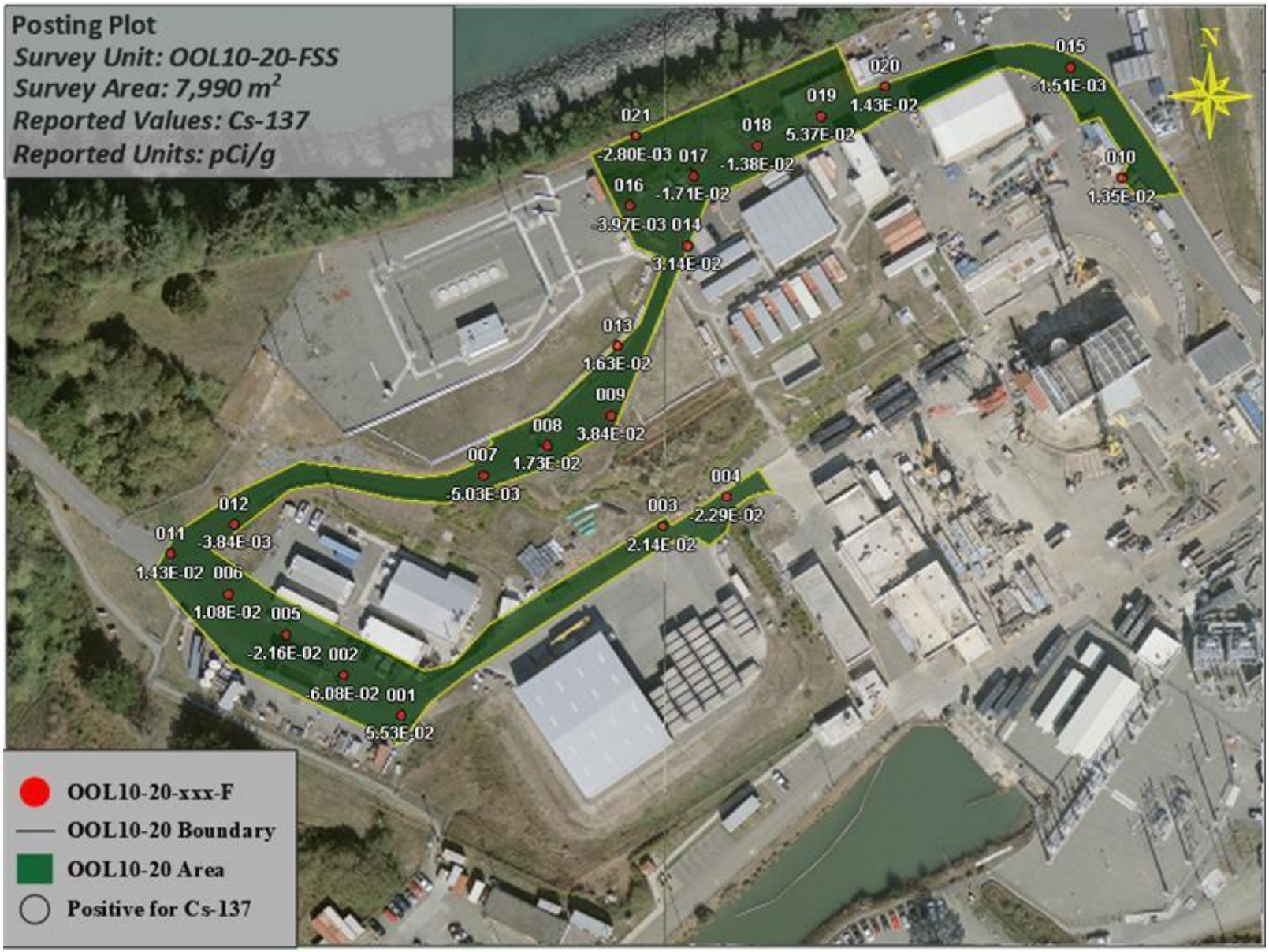
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-20-001-F	-1.12E-01	-2.31E-03	5.53E-02	2.25E-04	6.09E-02	-4.08E-03	-5.30E-02	0.7%
OOL10-20-002-F	-1.38E-01	3.63E-04	3.63E-02	3.76E-02	4.36E-02	-1.39E-02	-5.43E-02	0.5%
OOL10-20-003-F	-4.83E-02	-5.14E-02	2.14E-02	-1.45E-02	4.85E-02	-1.38E-02	-6.06E-02	0.3%
OOL10-20-004-F	-1.06E-01	-2.63E-02	-2.29E-02	-1.41E-01	1.99E-02	1.49E-02	-1.17E-02	-0.3%
OOL10-20-005-F	-5.34E-03	1.74E-02	-2.16E-02	8.85E-02	-3.07E-02	-1.35E-02	-1.45E-02	-0.3%
OOL10-20-006-F	9.12E-02	3.53E-02	1.08E-02	-1.48E-02	-1.67E-03	-1.94E-03	-9.31E-03	0.1%
OOL10-20-007-F	-1.26E-01	-1.95E-02	-5.03E-03	6.88E-03	4.96E-02	5.17E-03	-1.96E-02	-0.1%
OOL10-20-008-F	-8.77E-03	5.62E-03	1.73E-02	1.32E-02	-4.27E-02	-6.86E-03	2.54E-02	0.2%
OOL10-20-009-F	-8.12E-03	4.30E-02	3.84E-02	7.07E-03	-3.47E-02	9.52E-04	-3.86E-02	0.5%
OOL10-20-010-F	5.89E-02	2.82E-02	1.35E-02	1.28E-02	-3.63E-02	-2.05E-02	-2.22E-02	0.2%
OOL10-20-011-F	-1.19E-01	1.25E-02	1.43E-02	-2.44E-02	7.33E-02	4.67E-03	-6.38E-03	0.2%
OOL10-20-012-F	4.18E-03	-2.74E-02	-3.84E-03	-5.18E-02	-4.96E-03	2.06E-02	6.09E-03	0.0%
OOL10-20-013-F	1.57E-01	-6.77E-03	1.63E-02	-7.06E-02	1.59E-02	-2.84E-02	2.91E-03	0.2%
OOL10-20-014-F	-1.45E-01	1.34E-02	3.14E-02	-9.24E-02	-1.04E-01	-8.29E-03	3.77E-02	0.4%
OOL10-20-015-F	-7.33E-02	-6.90E-03	-1.41E-02	-7.96E-02	-1.02E-02	6.74E-03	2.59E-02	-0.2%
OOL10-20-016-F	-5.53E-02	-3.95E-02	-3.97E-03	1.02E-01	2.03E-02	2.16E-02	2.03E-02	-0.1%
OOL10-20-017-F	-3.09E-02	2.34E-02	-1.71E-02	-2.04E-03	5.00E-03	-1.63E-02	3.89E-02	-0.2%
OOL10-20-018-F	4.96E-02	-4.42E-02	-1.38E-02	1.25E-02	1.01E-01	-2.02E-02	-8.33E-02	-0.2%
OOL10-20-019-F	3.05E-02	5.10E-02	5.37E-02	-1.12E-01	1.81E-02	2.87E-02	1.17E-01	0.7%
OOL10-20-020-F	4.03E-02	-5.79E-03	1.43E-02	-2.23E-02	8.08E-02	-1.71E-02	7.60E-02	0.2%
OOL10-20-021-F	-9.31E-03	-6.73E-02	-2.80E-03	-2.75E-02	3.16E-02	-6.52E-02	6.86E-02	0.0%

Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

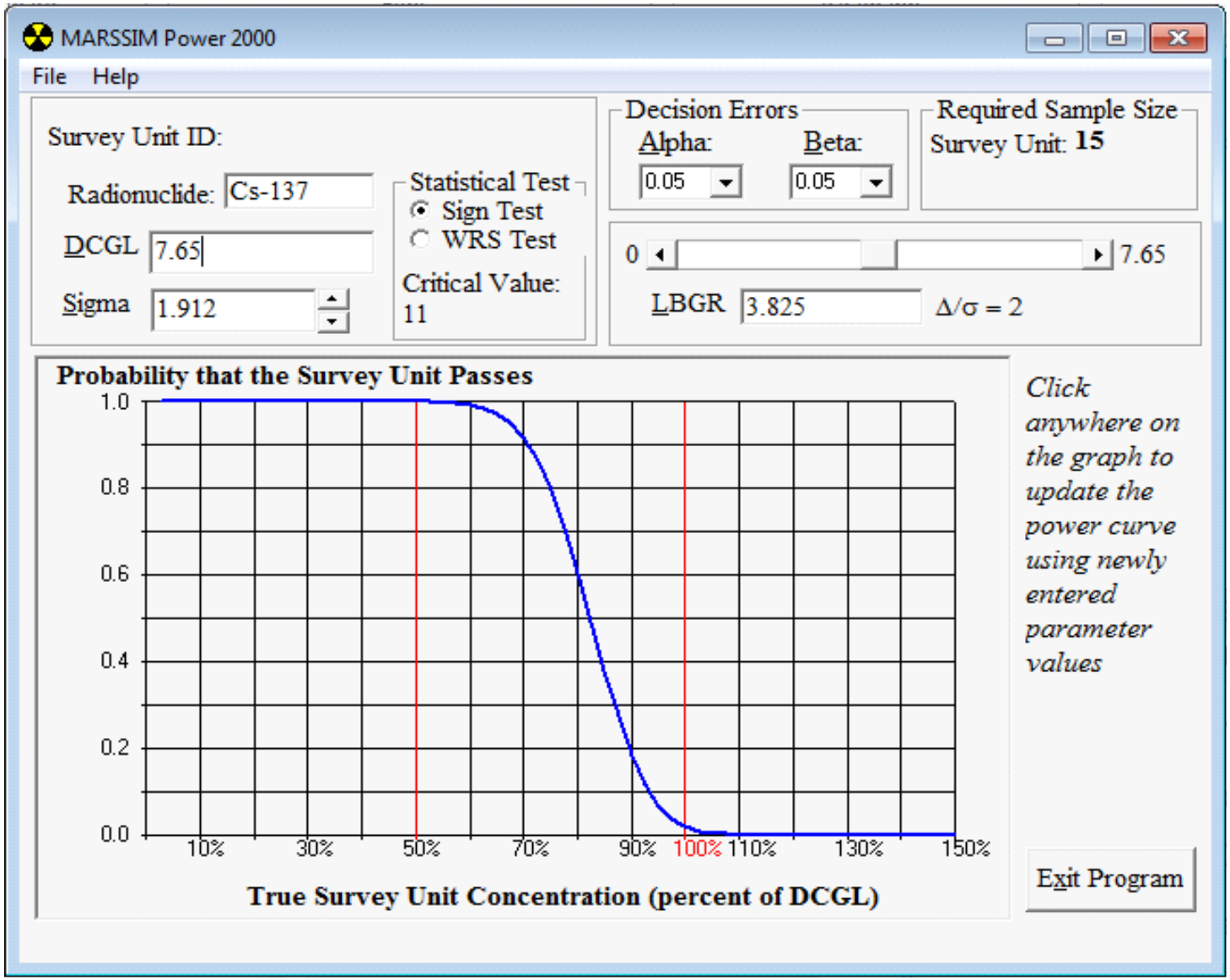

OOL10-20 Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Activity
Average
"+3StDev"
"-3StDev"


OOL10-20 Sample Results Quantile Plot
Activity (pCi/gm)
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

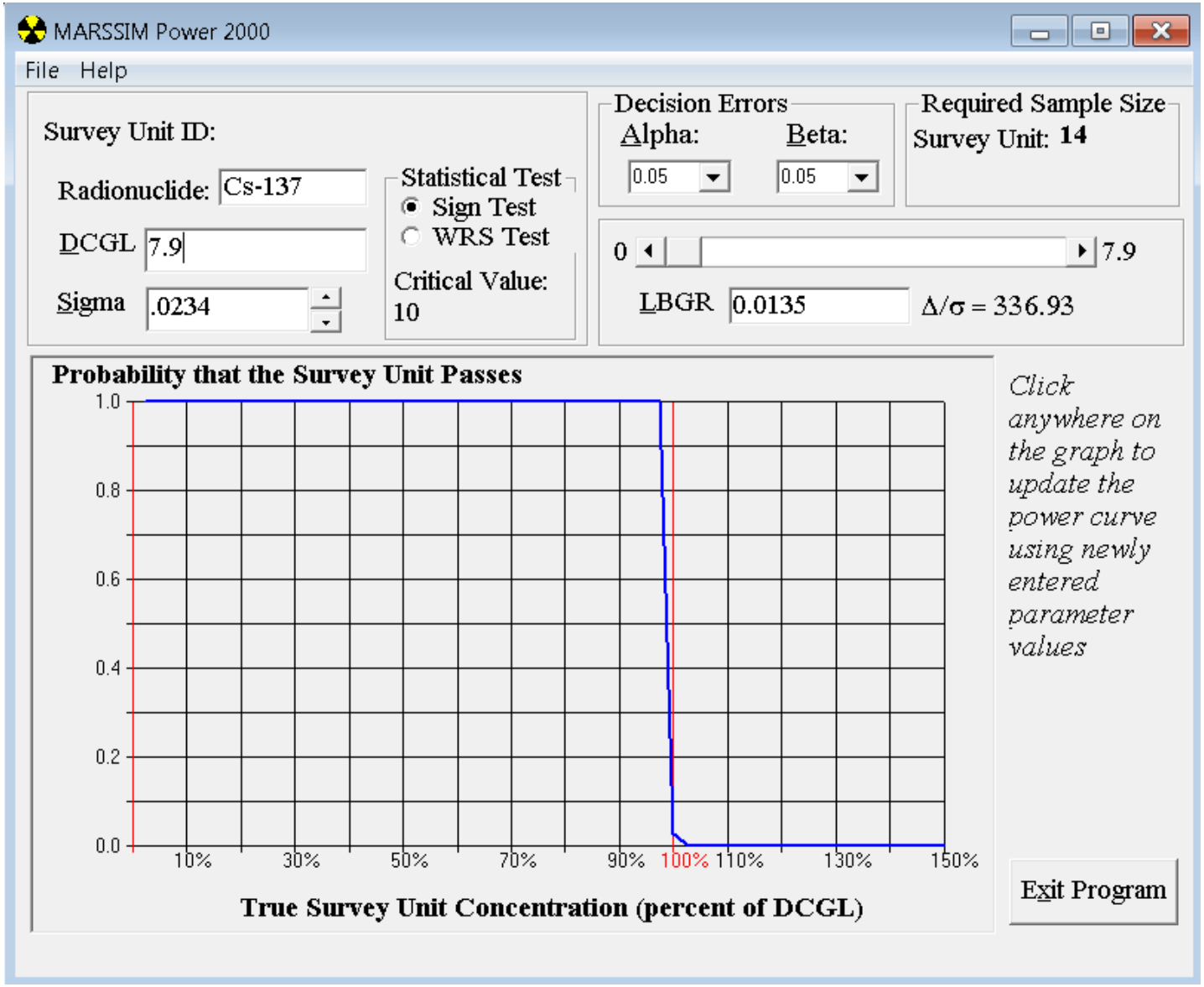

OOL10-20 Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.023
-0.003
0.016
0.036
0.055
Bin Upper End Value (pCi/gm)



Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0234
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0 7.9
LBGR 0.0135
Δ/σ = 336.93
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10% 30% 50% 70% 90% 100% 110% 130% 150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #013

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-02			Sample Measurement Location:	013

Sample Description:

Comparison of split samples collected from sample measurement location #013 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	5.33	0.43	13	0.6	1.66	6.88	0.18	1.29	Y
Pb-212	0.30	0.04	8	0.6	1.66	0.47	0.01	1.58	Y
Cs-137(1)	0.02	N/A				0.02	0.01	1.25	N
							0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and under the MDA of 0.07 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/26/2021
Signature:				Signature:			

Split Sample #004

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSPOOL10-20-FSS-02			Sample Measurement Location:	004

Sample Description:

Comparison of split samples collected from sample measurement location #004 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	8.37	0.52	16	0.75	1.33	9.38	0.28	1.12	Y
Pb-212	0.39	0.04	9	0.6	1.66	0.52	0.02	1.35	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Gordon Madison	05/26/21	Concurrence by:	Marshall Blake	Date: 05/26/21
Signature:			Signature:	Marshall H Blake	

Split Sample #005

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-02			Sample Measurement Location:	005

Sample Description:

Comparison of split samples collected from sample measurement location #005 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.94	0.57	14	0.6	1.66	8.12	0.18	1.02	Y
Pb-212	0.41	0.03	15	0.6	1.66	0.45	0.01	1.11	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	1/21/2021
Signature:				Signature:			

Recount Sample #021

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSPOOL10-20-FSS-02			Sample Measurement Location:	021

Sample Description:

Duplicate count comparison from sample measurement location #021 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	5.45	0.52	11	0.6	1.66	4.53	0.47	0.83	Y
Pb-212	0.43	0.03	13	0.6	1.66	0.39	0.32	0.90	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Gordon Madison	Date:	5/26/2021	Concurrence by:	Marshall Blake	Date:	5/26/2021
Signature:				Signature:	Marshall H Blake		

Recount Sample #006

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-02			Sample Measurement Location:	006

Sample Description:

Duplicate count comparison from sample measurement location #006 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.99	0.59	14	0.6	1.66	7.61	0.56	0.95	Y
Pb-212	0.29	0.03	10	0.6	1.66	0.30	0.03	1.04	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sircis	Date:	11/19/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #009

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-02			Sample Measurement Location:	009

Sample Description:

Duplicate count comparison from sample measurement location #009 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.14	0.57	13	0.6	1.66	8.14	0.61	1.14	Y
Pb-212	0.32	0.03	11	0.6	1.66	0.32	0.03	0.99	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/23/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 492990001
Client Sample ID: FSS-2448 OOL10-20-004-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: September 23, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/23/19	U	-1.15E+01	2.17E+01	3.80E+01	6.16E+01	2.17E+01	pCi/g
C-14	10/31/19	U	-2.19E-01	2.82E-01	4.78E-01	5.00E-01	2.82E-01	pCi/g
Ni-63	10/23/19	U	8.45E+00	1.02E+01	1.64E+01	6.94E+01	1.03E+01	pCi/g
Sr-90	10/23/19	U	1.54E-02	6.52E-02	1.05E-01	1.36E-01	6.52E-02	pCi/g
Tc-99	10/28/19	U	-3.85E-02	4.72E-01	7.93E-01	1.16E+00	4.72E-01	pCi/g
Pu-241	10/29/19	U	-8.39E+00	2.45E+01	4.18E+01	8.29E+01	2.45E+01	pCi/g
Alpha Spec								
Pu-238	10/24/19	U	-4.50E-03	1.04E-01	2.36E-01	2.80E+00	1.04E-01	pCi/g
Pu-239/240	10/24/19	U	1.43E-01	1.61E-01	2.27E-01	2.51E+00	1.62E-01	pCi/g
Am-241	10/26/19	U	4.09E-01	4.01E-01	5.26E-01	2.41E+00	4.07E-01	pCi/g
Cm-243/244	10/26/19	U	-5.59E-02	1.38E-01	4.12E-01	2.80E+00	1.38E-01	pCi/g
Cm-245/246	10/26/19	U	1.17E-01	2.64E-01	4.17E-01	1.64E+00	2.65E-01	pCi/g
Gamma Spec								
Ni-59	10/22/19	U	2.55E+00	1.68E+01	2.83E+01	1.83E+02	1.69E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990002
Client Sample ID: FSS-2448 OOL10-20-004-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 23, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/24/19	U	-5.59E-02	1.02E-01	1.64E-01		1.06E-01	pCi/g
Na-22	10/24/19	U	-3.34E-04	1.17E-02	1.94E-02		1.17E-02	pCi/g
K-40	10/24/19		9.38E+00	5.56E-01	1.16E-01		1.08E+00	pCi/g
Cr-51	10/24/19	U	7.73E-02	1.52E-01	2.71E-01		1.57E-01	pCi/g
Mn-54	10/24/19	U	1.99E-03	9.50E-03	1.67E-02		9.54E-03	pCi/g
Fe-59	10/24/19	U	3.49E-02	3.00E-02	5.68E-02		3.40E-02	pCi/g
Co-56	10/24/19	U	-3.69E-03	1.13E-02	1.89E-02		1.15E-02	pCi/g
Co-57	10/24/19	U	5.31E-03	9.11E-03	1.54E-02		9.43E-03	pCi/g
Co-58	10/24/19	U	-6.32E-03	1.07E-02	1.74E-02		1.11E-02	pCi/g
Co-60	10/24/19	U	5.66E-03	1.03E-02	1.85E-02	3.42E-01	1.06E-02	pCi/g
Zn-65	10/24/19	U	8.32E-03	2.67E-02	4.14E-02		2.70E-02	pCi/g
Y-88	10/24/19	U	3.85E-03	9.30E-03	1.72E-02		9.47E-03	pCi/g
Zr-95	10/24/19	U	-4.20E-03	2.34E-02	3.72E-02		2.35E-02	pCi/g
Nb-94	10/24/19	U	1.18E-02	8.77E-03	1.62E-02	6.39E-01	1.03E-02	pCi/g
Nb-95	10/24/19	U	3.94E-03	1.61E-02	2.38E-02		1.62E-02	pCi/g
Ru-106	10/24/19	U	-1.07E-02	8.36E-02	1.36E-01		8.38E-02	pCi/g
Ag-110m	10/24/19	U	-4.13E-04	1.41E-02	2.13E-02		1.41E-02	pCi/g
Sn-113	10/24/19	U	-4.14E-03	1.30E-02	2.15E-02		1.31E-02	pCi/g
Sb-124	10/24/19	U	-1.68E-02	1.95E-02	2.63E-02		2.10E-02	pCi/g
Sb-125	10/24/19	U	1.31E-02	2.44E-02	4.29E-02		2.51E-02	pCi/g
Cs-134	10/24/19	UI	2.37E-02	2.00E-02	2.37E-02		2.79E-02	pCi/g
Cs-136	10/24/19	U	6.07E-02	5.57E-02	9.64E-02		6.24E-02	pCi/g
Cs-137	10/24/19	U	2.86E-03	1.04E-02	1.58E-02	7.11E-01	1.05E-02	pCi/g
Ba-133	10/24/19	U	-7.19E-03	1.31E-02	1.92E-02		1.35E-02	pCi/g
Ba-140	10/24/19	U	-9.59E-02	1.60E-01	2.51E-01		1.66E-01	pCi/g
Ce-139	10/24/19	U	7.33E-03	1.11E-02	1.85E-02		1.17E-02	pCi/g
Ce-141	10/24/19	U	-2.77E-02	3.06E-02	4.77E-02		3.31E-02	pCi/g
Ce-144	10/24/19	U	-2.32E-03	7.44E-02	1.22E-01		7.44E-02	pCi/g
Nd-147	10/24/19	U	-2.87E-01	3.91E-01	6.06E-01		4.13E-01	pCi/g
Pm-144	10/24/19	U	-2.63E-03	9.34E-03	1.48E-02		9.41E-03	pCi/g
Pm-146	10/24/19	U	3.83E-03	1.08E-02	1.88E-02		1.10E-02	pCi/g
Eu-152	10/24/19	U	-1.98E-02	2.60E-02	4.00E-02	9.00E-01	2.76E-02	pCi/g
Eu-154	10/24/19	U	-2.14E-03	3.27E-02	5.41E-02	8.46E-01	3.27E-02	pCi/g
Eu-155	10/24/19	U	3.00E-02	7.63E-02	6.16E-02		7.64E-02	pCi/g
Ir-192	10/24/19	U	6.71E-03	1.04E-02	1.87E-02		1.09E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990002
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-2448 OOL10-20-004-F-S
Collect Date: September 23, 2019
Client Matrix: Soil
Receive Date: October 15, 2019
Amount of Sample Received:
Report Date: November 13, 2019
Sample Description: Gamma

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/24/19	U	1.03E-02	2.29E-02	2.23E-02		2.31E-02	pCi/g
Tl-208	10/24/19		1.62E-01	2.15E-02	1.56E-02		2.53E-02	pCi/g
Pb-210	10/24/19	U	-2.19E-01	2.10E+00	3.56E+00		2.10E+00	pCi/g
Pb-212	10/24/19		5.21E-01	3.91E-02	2.96E-02		5.98E-02	pCi/g
Pb-214	10/24/19		6.06E-01	5.99E-02	9.99E-02		7.84E-02	pCi/g
Bi-212	10/24/19		5.29E-01	2.21E-01	2.27E-01		2.26E-01	pCi/g
Bi-214	10/24/19		4.75E-01	4.74E-02	2.58E-02		6.15E-02	pCi/g
Ra-228	10/24/19		4.87E-01	1.02E-01	6.41E-02		1.12E-01	pCi/g
Ac-228	10/24/19		4.87E-01	1.02E-01	6.41E-02		1.12E-01	pCi/g
Th-234	10/24/19	UI	9.74E-01	1.21E+00	9.74E-01		1.23E+00	pCi/g
U-235	10/24/19	U	2.15E-02	7.18E-02	1.19E-01		7.18E-02	pCi/g
U-238	10/24/19	UI	9.74E-01	1.21E+00	9.74E-01		1.23E+00	pCi/g
Np-237	10/24/19	U	2.59E-03	1.72E-02	2.99E-02	9.90E-01	1.72E-02	pCi/g
Np-239	10/24/19	U	4.57E-02	9.81E-02	1.65E-01		1.00E-01	pCi/g
Am-241	10/24/19	U	1.88E-02	7.32E-02	1.17E-01	2.27E+00	7.37E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593001
Client Sample ID: FSS-2377: OOL10-20-005-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: August 01, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/24/19	U	-1.82E+00	2.32E+01	3.92E+01	6.16E+01	2.32E+01	pCi/g
C-14	08/31/19	U	-2.79E-01	2.14E-01	3.68E-01	5.00E-01	2.14E-01	pCi/g
Ni-63	08/30/19	U	-7.10E+00	1.12E+01	1.94E+01	6.94E+01	1.12E+01	pCi/g
Sr-90	08/28/19	U	1.39E-04	7.39E-02	1.24E-01	1.36E-01	7.39E-02	pCi/g
Tc-99	08/27/19	U	-6.66E-01	6.43E-01	1.09E+00	1.16E+00	6.43E-01	pCi/g
Pu-241	08/28/19	U	-1.78E+01	3.46E+01	5.95E+01	8.29E+01	3.46E+01	pCi/g
Alpha Spec								
Pu-238	08/24/19	U	-6.13E-02	1.51E-01	4.52E-01	2.80E+00	1.52E-01	pCi/g
Pu-239/240	08/24/19	U	-3.21E-02	2.12E-01	5.24E-01	2.51E+00	2.12E-01	pCi/g
Am-241	08/24/19	U	-4.56E-02	1.55E-01	4.33E-01	2.41E+00	1.56E-01	pCi/g
Cm-243/244	08/24/19	U	-3.60E-02	1.52E-01	4.06E-01	2.80E+00	1.53E-01	pCi/g
Cm-245/246	08/24/19	U	7.66E-02	2.43E-01	3.66E-01	1.64E+00	2.43E-01	pCi/g
Gamma Spec								
Ni-59	08/29/19	U	-2.08E+00	3.32E+01	5.47E+01	1.83E+02	3.32E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593002
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-2377: OOL10-20-005-F-S
Collect Date: August 01, 2019
Client Matrix: Soil
Receive Date: August 14, 2019
Amount of Sample Received:
Report Date: September 03, 2019
Sample Description: Gamma

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/15/19	U	-1.38E-03	5.25E-02	8.62E-02		5.25E-02	pCi/g
Na-22	08/15/19	U	3.64E-04	8.40E-03	1.28E-02		8.40E-03	pCi/g
K-40	08/15/19		8.12E+00	3.50E-01	6.65E-02		8.67E-01	pCi/g
Cr-51	08/15/19	U	-1.57E-02	7.01E-02	1.17E-01		7.05E-02	pCi/g
Mn-54	08/15/19	UI	9.52E-03	1.29E-02	9.52E-03		1.29E-02	pCi/g
Fe-59	08/15/19	U	-4.14E-03	1.54E-02	2.49E-02		1.55E-02	pCi/g
Co-56	08/15/19	U	4.60E-03	6.48E-03	1.13E-02		6.82E-03	pCi/g
Co-57	08/15/19	U	3.49E-03	6.56E-03	1.07E-02		6.75E-03	pCi/g
Co-58	08/15/19	U	1.61E-03	6.08E-03	1.06E-02		6.12E-03	pCi/g
Co-60	08/15/19	U	-7.34E-03	7.33E-03	1.07E-02	3.42E-01	8.07E-03	pCi/g
Zn-65	08/15/19	U	1.07E-02	1.59E-02	2.48E-02		1.66E-02	pCi/g
Y-88	08/15/19	U	1.78E-04	4.02E-03	6.83E-03		4.02E-03	pCi/g
Zr-95	08/15/19	U	7.08E-03	1.25E-02	2.21E-02		1.29E-02	pCi/g
Nb-94	08/15/19	U	1.89E-03	5.64E-03	9.89E-03	6.39E-01	5.70E-03	pCi/g
Nb-95	08/15/19	U	2.85E-03	7.58E-03	1.18E-02		7.69E-03	pCi/g
Ru-106	08/15/19	U	2.73E-02	5.98E-02	9.51E-02		6.11E-02	pCi/g
Ag-110m	08/15/19	U	-9.92E-04	8.60E-03	1.44E-02		8.62E-03	pCi/g
Sn-113	08/15/19	U	-1.96E-03	7.96E-03	1.31E-02		8.01E-03	pCi/g
Sb-124	08/15/19	U	3.68E-03	1.06E-02	1.90E-02		1.07E-02	pCi/g
Sb-125	08/15/19	U	1.55E-02	1.61E-02	2.71E-02		1.76E-02	pCi/g
Cs-134	08/15/19	UI	1.55E-02	1.39E-02	1.55E-02		1.76E-02	pCi/g
Cs-136	08/15/19	U	-7.34E-03	1.77E-02	2.85E-02		1.80E-02	pCi/g
Cs-137	08/15/19	U	2.39E-03	6.36E-03	1.12E-02	7.11E-01	6.45E-03	pCi/g
Ba-133	08/15/19	U	2.62E-03	7.90E-03	1.21E-02		7.99E-03	pCi/g
Ba-140	08/15/19	U	-9.94E-03	4.48E-02	7.19E-02		4.50E-02	pCi/g
Ce-139	08/15/19	U	-3.16E-05	6.27E-03	1.10E-02		6.27E-03	pCi/g
Ce-141	08/15/19	U	-1.56E-02	1.53E-02	2.35E-02		1.69E-02	pCi/g
Ce-144	08/15/19	U	-3.21E-02	5.08E-02	7.95E-02		5.29E-02	pCi/g
Nd-147	08/15/19	U	1.58E-02	9.14E-02	1.51E-01		9.17E-02	pCi/g
Pm-144	08/15/19	U	3.32E-04	5.62E-03	9.71E-03		5.62E-03	pCi/g
Pm-146	08/15/19	U	-2.36E-03	7.50E-03	1.22E-02		7.58E-03	pCi/g
Eu-152	08/15/19	U	1.10E-02	1.82E-02	3.02E-02	9.00E-01	1.89E-02	pCi/g
Eu-154	08/15/19	U	6.42E-03	2.32E-02	3.62E-02	8.46E-01	2.34E-02	pCi/g
Eu-155	08/15/19	U	3.54E-02	3.29E-02	4.33E-02		3.31E-02	pCi/g
Ir-192	08/15/19	U	6.13E-03	6.58E-03	1.16E-02		7.16E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593002
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-2377: OOL10-20-005-F-S
Collect Date: August 01, 2019
Client Matrix: Soil
Receive Date: August 14, 2019
Amount of Sample Received:
Report Date: September 03, 2019
Sample Description: Gamma

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/15/19	U	-5.55E-03	8.30E-03	1.22E-02		8.68E-03	pCi/g
Tl-208	08/15/19		1.38E-01	1.72E-02	8.92E-03		2.06E-02	pCi/g
Pb-210	08/15/19	U	-1.56E-01	2.64E+00	4.41E+00		2.64E+00	pCi/g
Pb-212	08/15/19		4.50E-01	2.56E-02	1.84E-02		4.46E-02	pCi/g
Pb-214	08/15/19		4.58E-01	3.89E-02	2.10E-02		5.31E-02	pCi/g
Bi-212	08/15/19		4.36E-01	1.36E-01	1.41E-01		1.41E-01	pCi/g
Bi-214	08/15/19		3.97E-01	3.40E-02	1.96E-02		4.70E-02	pCi/g
Ra-228	08/15/19		4.72E-01	6.44E-02	3.42E-02		7.76E-02	pCi/g
Ac-228	08/15/19		4.72E-01	6.44E-02	3.42E-02		7.76E-02	pCi/g
Th-234	08/15/19	U	6.75E-01	9.77E-01	8.65E-01		9.89E-01	pCi/g
U-235	08/15/19	U	-5.50E-03	5.04E-02	7.97E-02		5.04E-02	pCi/g
U-238	08/15/19	U	6.75E-01	9.77E-01	8.65E-01		9.89E-01	pCi/g
Np-237	08/15/19	U	5.87E-04	1.29E-02	1.96E-02	9.90E-01	1.29E-02	pCi/g
Np-239	08/15/19	U	9.91E-03	6.85E-02	1.11E-01		6.86E-02	pCi/g
Am-241	08/15/19	U	-5.56E-02	7.24E-02	1.08E-01	2.27E+00	7.68E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593003
Client Sample ID: FSS-2379: OOL10-20-013-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: August 01, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/24/19	U	6.62E+00	2.34E+01	3.84E+01	6.16E+01	2.34E+01	pCi/g
C-14	08/31/19	U	-1.29E-01	2.17E-01	3.68E-01	5.00E-01	2.17E-01	pCi/g
Ni-63	08/30/19	U	-4.24E+00	1.16E+01	1.98E+01	6.94E+01	1.16E+01	pCi/g
Sr-90	08/28/19	U	2.04E-02	7.49E-02	1.22E-01	1.36E-01	7.50E-02	pCi/g
Tc-99	09/01/19	U	-4.01E-01	5.48E-01	9.29E-01	1.16E+00	5.48E-01	pCi/g
Pu-241	08/28/19	U	-1.37E+01	3.18E+01	5.45E+01	8.29E+01	3.18E+01	pCi/g
Alpha Spec								
Pu-238	08/24/19	U	-5.14E-02	2.20E-01	5.67E-01	2.80E+00	2.21E-01	pCi/g
Pu-239/240	08/24/19	U	-1.45E-01	1.65E-01	5.91E-01	2.51E+00	1.66E-01	pCi/g
Am-241	08/26/19	U	2.91E-03	2.08E-01	4.67E-01	2.41E+00	2.09E-01	pCi/g
Cm-243/244	08/26/19	U	0.00E+00	1.42E-01	2.16E-01	2.80E+00	1.43E-01	pCi/g
Cm-245/246	08/26/19	U	0.00E+00	1.65E-01	2.50E-01	1.64E+00	1.65E-01	pCi/g
Gamma Spec								
Ni-59	08/29/19	U	4.88E+01	5.34E+01	9.80E+01	1.83E+02	5.80E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593004
Client Sample ID: FSS-2379: OOL10-20-013-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 01, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/15/19	U	5.04E-02	6.38E-02	1.11E-01		6.78E-02	pCi/g
Na-22	08/15/19	U	1.10E-03	8.69E-03	1.45E-02		8.70E-03	pCi/g
K-40	08/15/19		6.88E+00	3.69E-01	9.09E-02		7.73E-01	pCi/g
Cr-51	08/15/19	U	1.59E-02	7.20E-02	1.24E-01		7.24E-02	pCi/g
Mn-54	08/15/19	U	8.97E-03	8.70E-03	1.18E-02		8.74E-03	pCi/g
Fe-59	08/15/19	U	-2.78E-03	1.62E-02	2.66E-02		1.63E-02	pCi/g
Co-56	08/15/19	U	-2.20E-03	7.40E-03	1.23E-02		7.47E-03	pCi/g
Co-57	08/15/19	U	-3.71E-03	7.01E-03	1.11E-02		7.22E-03	pCi/g
Co-58	08/15/19	U	-6.86E-03	6.73E-03	1.04E-02		7.44E-03	pCi/g
Co-60	08/15/19	U	3.47E-03	7.10E-03	1.24E-02	3.42E-01	7.28E-03	pCi/g
Zn-65	08/15/19	U	2.42E-03	1.68E-02	2.49E-02		1.68E-02	pCi/g
Y-88	08/15/19	U	2.94E-03	6.38E-03	1.16E-02		6.52E-03	pCi/g
Zr-95	08/15/19	U	7.36E-03	1.31E-02	2.33E-02		1.35E-02	pCi/g
Nb-94	08/15/19	U	-3.07E-04	6.28E-03	1.08E-02	6.39E-01	6.29E-03	pCi/g
Nb-95	08/15/19	U	7.45E-03	9.17E-03	1.49E-02		9.79E-03	pCi/g
Ru-106	08/15/19	U	-4.71E-02	6.29E-02	9.50E-02		6.65E-02	pCi/g
Ag-110m	08/15/19	U	-1.09E-04	8.90E-03	1.51E-02		8.90E-03	pCi/g
Sn-113	08/15/19	U	1.21E-03	9.45E-03	1.43E-02		9.47E-03	pCi/g
Sb-124	08/15/19	U	1.07E-02	1.31E-02	2.52E-02		1.39E-02	pCi/g
Sb-125	08/15/19	U	8.39E-03	1.75E-02	3.01E-02		1.79E-02	pCi/g
Cs-134	08/15/19	UI	1.56E-02	1.33E-02	1.56E-02		1.67E-02	pCi/g
Cs-136	08/15/19	U	1.67E-02	2.00E-02	3.59E-02		2.15E-02	pCi/g
Cs-137	08/15/19	M	2.04E-02	1.56E-02	1.26E-02	7.11E-01	1.57E-02	pCi/g
Ba-133	08/15/19	U	8.46E-04	8.91E-03	1.35E-02		8.92E-03	pCi/g
Ba-140	08/15/19	U	2.45E-02	4.56E-02	7.80E-02		4.70E-02	pCi/g
Ce-139	08/15/19	U	-5.16E-03	8.42E-03	1.19E-02		8.81E-03	pCi/g
Ce-141	08/15/19	U	-1.22E-02	1.67E-02	2.61E-02		1.76E-02	pCi/g
Ce-144	08/15/19	U	-3.48E-02	5.52E-02	8.69E-02		5.75E-02	pCi/g
Nd-147	08/15/19	U	2.97E-03	9.99E-02	1.64E-01		9.99E-02	pCi/g
Pm-144	08/15/19	U	-8.61E-04	6.19E-03	1.06E-02		6.21E-03	pCi/g
Pm-146	08/15/19	U	2.93E-03	9.51E-03	1.45E-02		9.60E-03	pCi/g
Eu-152	08/15/19	U	-4.36E-03	1.95E-02	3.26E-02	9.00E-01	1.96E-02	pCi/g
Eu-154	08/15/19	U	5.20E-03	2.46E-02	4.12E-02	8.46E-01	2.47E-02	pCi/g
Eu-155	08/15/19	U	3.35E-02	4.62E-02	4.59E-02		4.63E-02	pCi/g
Ir-192	08/15/19	U	2.55E-03	7.10E-03	1.23E-02		7.19E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593004
Client Sample ID: FSS-2379: OOL10-20-013-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 01, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/15/19	U	6.36E-03	1.25E-02	1.46E-02		1.28E-02	pCi/g
Tl-208	08/15/19		1.49E-01	1.94E-02	1.19E-02		2.31E-02	pCi/g
Pb-210	08/15/19	U	7.41E-01	3.33E+00	3.83E+00		3.33E+00	pCi/g
Pb-212	08/15/19		4.69E-01	2.93E-02	2.26E-02		5.01E-02	pCi/g
Pb-214	08/15/19		5.37E-01	4.52E-02	2.44E-02		6.33E-02	pCi/g
Bi-212	08/15/19		5.19E-01	2.07E-01	1.61E-01		2.13E-01	pCi/g
Bi-214	08/15/19		4.23E-01	3.98E-02	2.09E-02		5.35E-02	pCi/g
Ra-228	08/15/19		4.70E-01	7.49E-02	4.41E-02		8.78E-02	pCi/g
Ac-228	08/15/19		4.70E-01	7.49E-02	4.41E-02		8.78E-02	pCi/g
Th-234	08/15/19		1.12E+00	9.11E-01	8.11E-01		9.46E-01	pCi/g
U-235	08/15/19	U	2.37E-02	5.40E-02	8.77E-02		5.41E-02	pCi/g
U-238	08/15/19		1.12E+00	9.11E-01	8.11E-01		9.46E-01	pCi/g
Np-237	08/15/19	U	4.30E-03	1.32E-02	2.29E-02	9.90E-01	1.34E-02	pCi/g
Np-239	08/15/19	U	-3.54E-03	7.18E-02	1.16E-01		7.18E-02	pCi/g
Am-241	08/15/19	U	2.07E-02	6.57E-02	1.03E-01	2.27E+00	6.63E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
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UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-20-FSR

Data Assessment

Data Quality Assessment of OOL10-20-FSR;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-20-FSR-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-2.35E-02
Maximum Value	7.93E-02
Mean	2.08E-02
Median	1.62E-02
a-posteriori σ	2.72E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits a limited skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

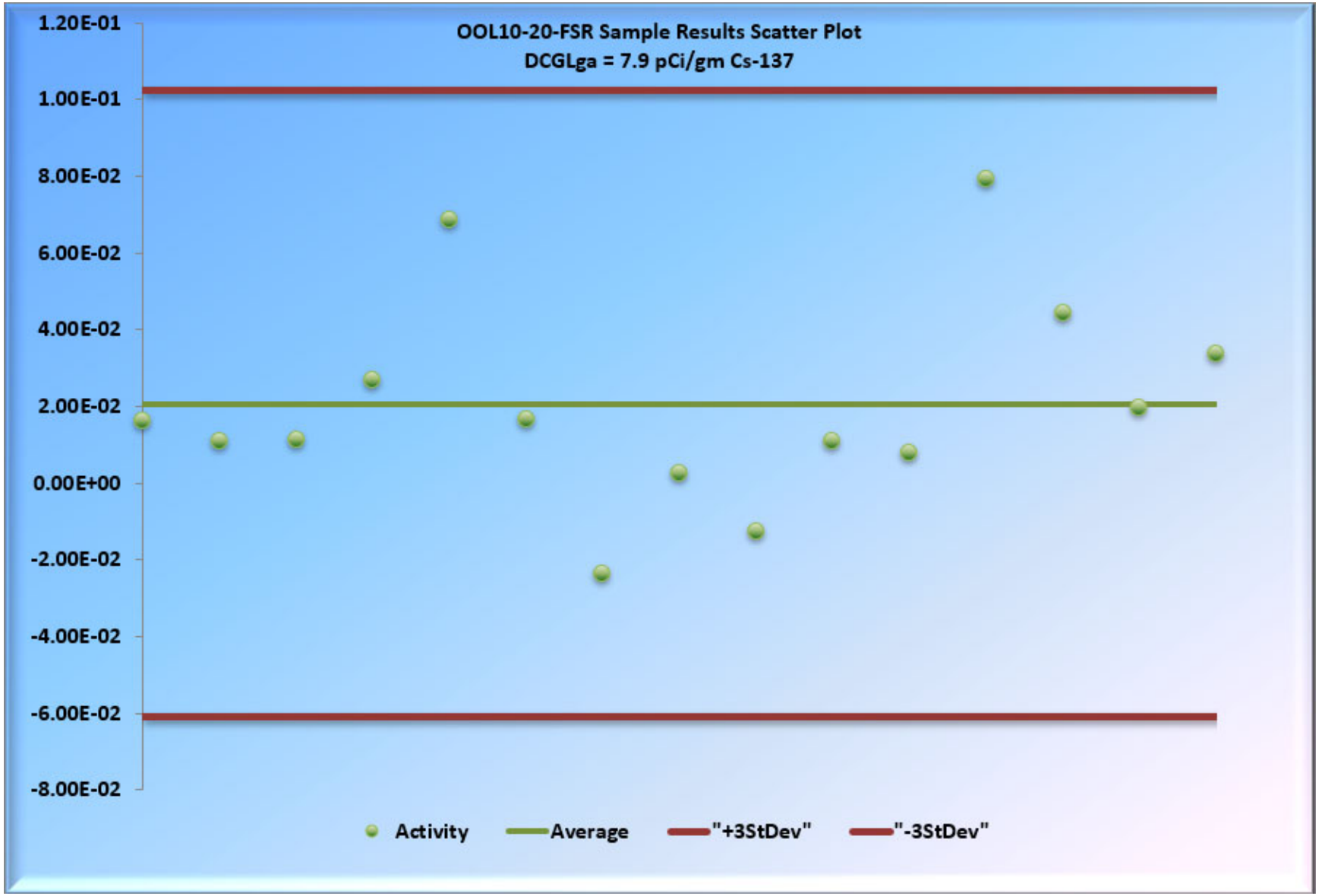
Summary:

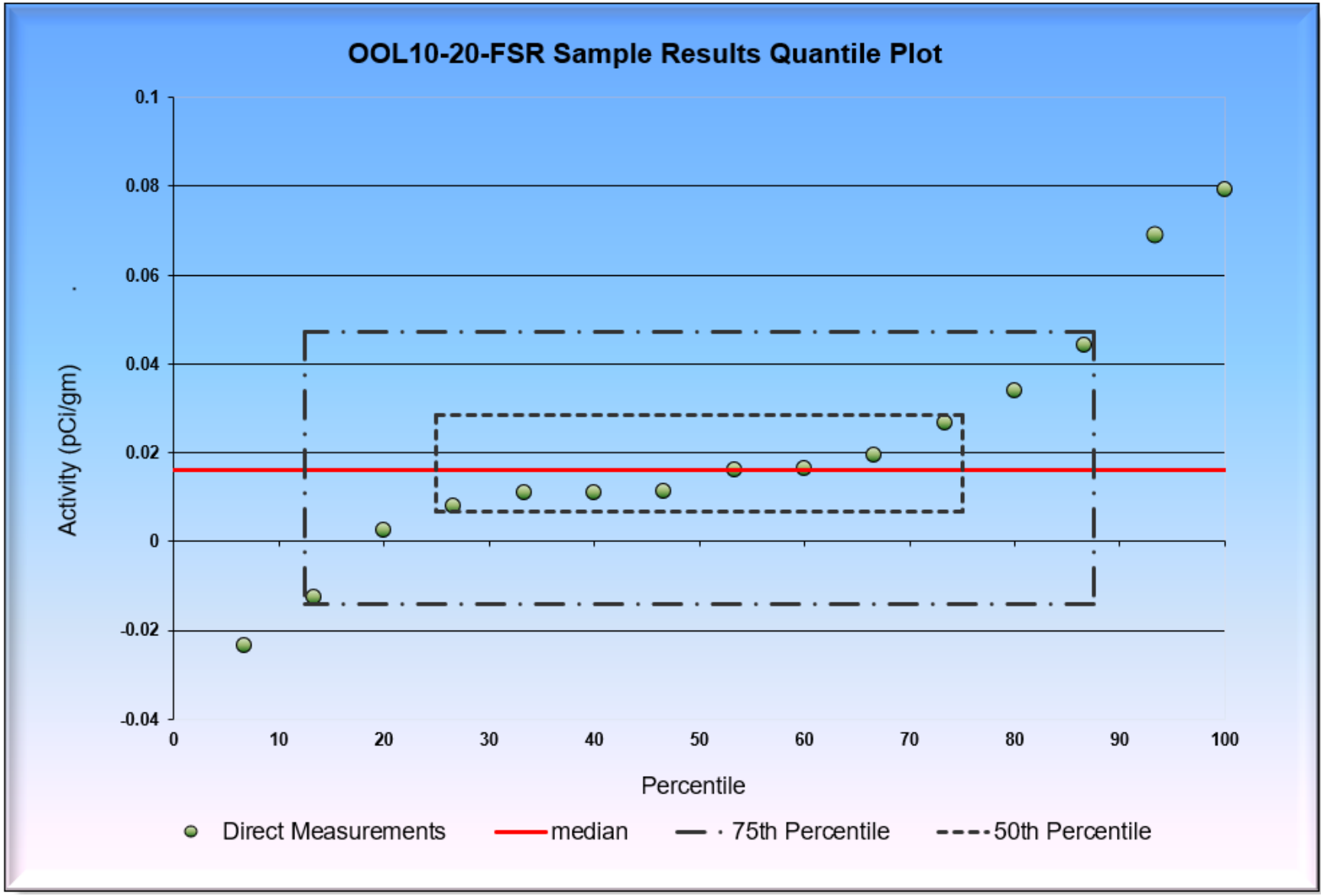
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

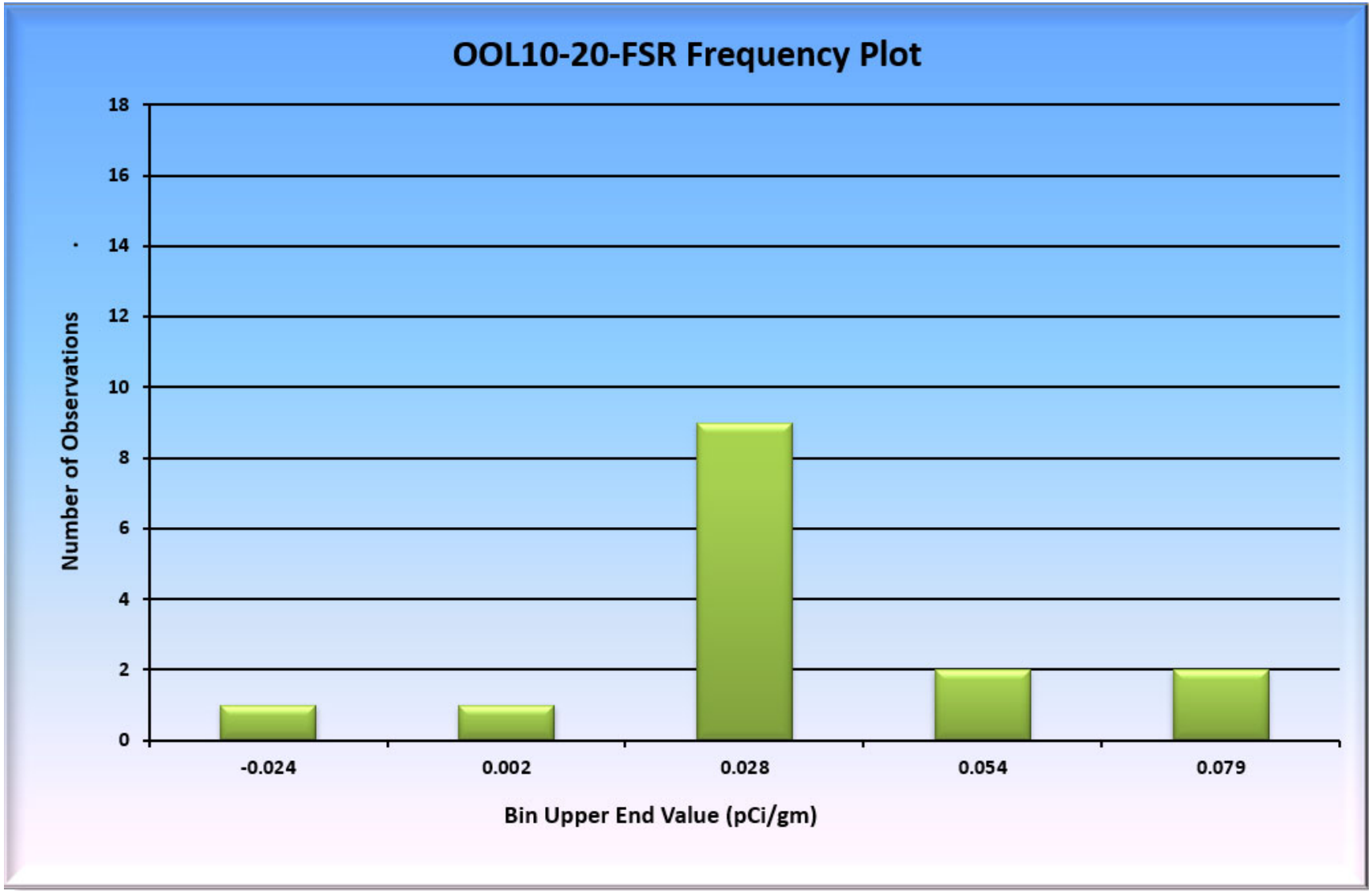
Survey Unit OOL10-20-FSR meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-20-FSR.

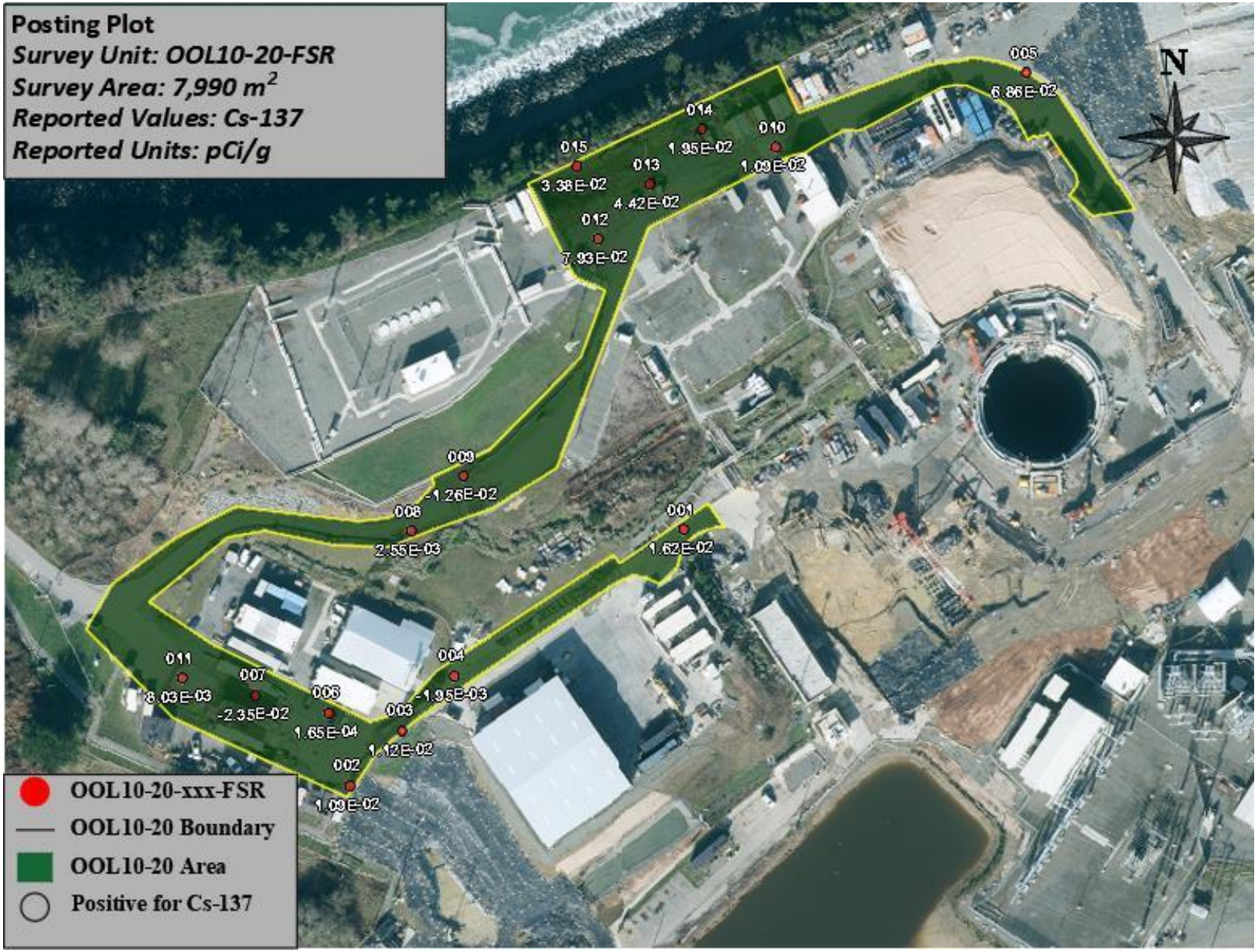
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-20-001-FSR	2.26E-01	-7.84E-03	1.62E-02	-6.06E-03	3.59E-03	-3.09E-02	5.64E-02	0.2%
OOL10-20-002-FSR	2.91E-02	-3.69E-03	1.09E-02	1.14E-02	-3.73E-03	-3.75E-02	2.73E-02	0.1%
OOL10-20-003-FSR	9.63E-03	-1.38E-02	1.12E-02	-8.93E-02	8.90E-03	8.73E-03	-4.30E-03	0.1%
OOL10-20-004-FSR	-7.35E-02	-7.38E-03	2.68E-02	-5.85E-02	-3.48E-03	-1.22E-02	-2.79E-02	0.3%
OOL10-20-005-FSR	5.32E-02	4.27E-02	6.86E-02	-4.87E-02	-5.50E-02	4.48E-02	5.25E-02	0.9%
OOL10-20-006-FSR	3.59E-02	-1.32E-02	1.65E-02	-4.60E-02	3.22E-02	1.16E-02	2.41E-03	0.2%
OOL10-20-007-FSR	-1.17E-02	1.11E-02	-2.35E-02	-3.93E-02	-2.53E-02	-2.21E-02	2.90E-03	-0.3%
OOL10-20-008-FSR	-8.67E-03	-1.06E-03	2.55E-03	-6.96E-03	2.55E-02	-4.82E-03	3.84E-02	0.0%
OOL10-20-009-FSR	-3.67E-02	-1.93E-02	-1.26E-02	3.74E-02	-2.76E-02	2.78E-04	7.85E-02	-0.2%
OOL10-20-010-FSR	-1.73E-01	3.67E-02	1.09E-02	-2.60E-02	5.75E-02	7.16E-03	8.10E-03	0.1%
OOL10-20-011-FSR	9.25E-02	1.18E-02	8.03E-03	-4.51E-02	-9.88E-03	1.02E-02	-6.90E-04	0.1%
OOL10-20-012-FSR	1.23E-02	-2.26E-02	7.93E-02	2.52E-02	5.25E-02	1.72E-02	3.49E-02	1.0%
OOL10-20-013-FSR	-4.17E-02	1.22E-02	4.42E-02	2.91E-02	5.86E-02	-2.50E-02	-7.09E-02	0.6%
OOL10-20-014-FSR	1.02E-02	-5.65E-03	1.95E-02	-6.19E-02	6.27E-02	8.13E-03	-5.16E-02	0.2%
OOL10-20-015-FSR	-2.03E-01	2.84E-02	3.38E-02	5.10E-02	-1.58E-02	-2.71E-02	8.23E-03	0.4%

Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

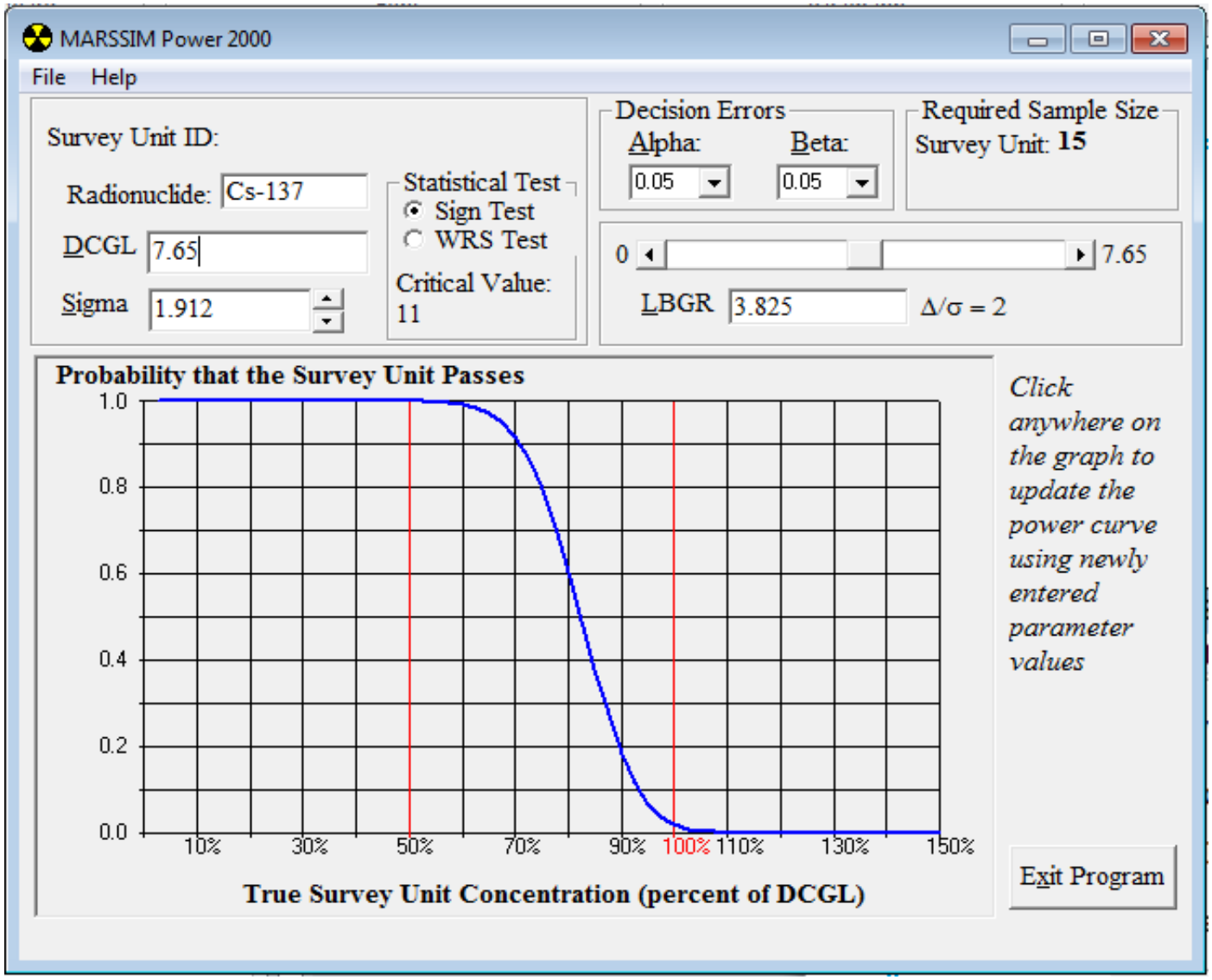

OOL10-20-FSR Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Activity
Average
"+3StDev"
"-3StDev"


OOL10-20-FSR Sample Results Quantile Plot
Activity (pCi/gm)
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

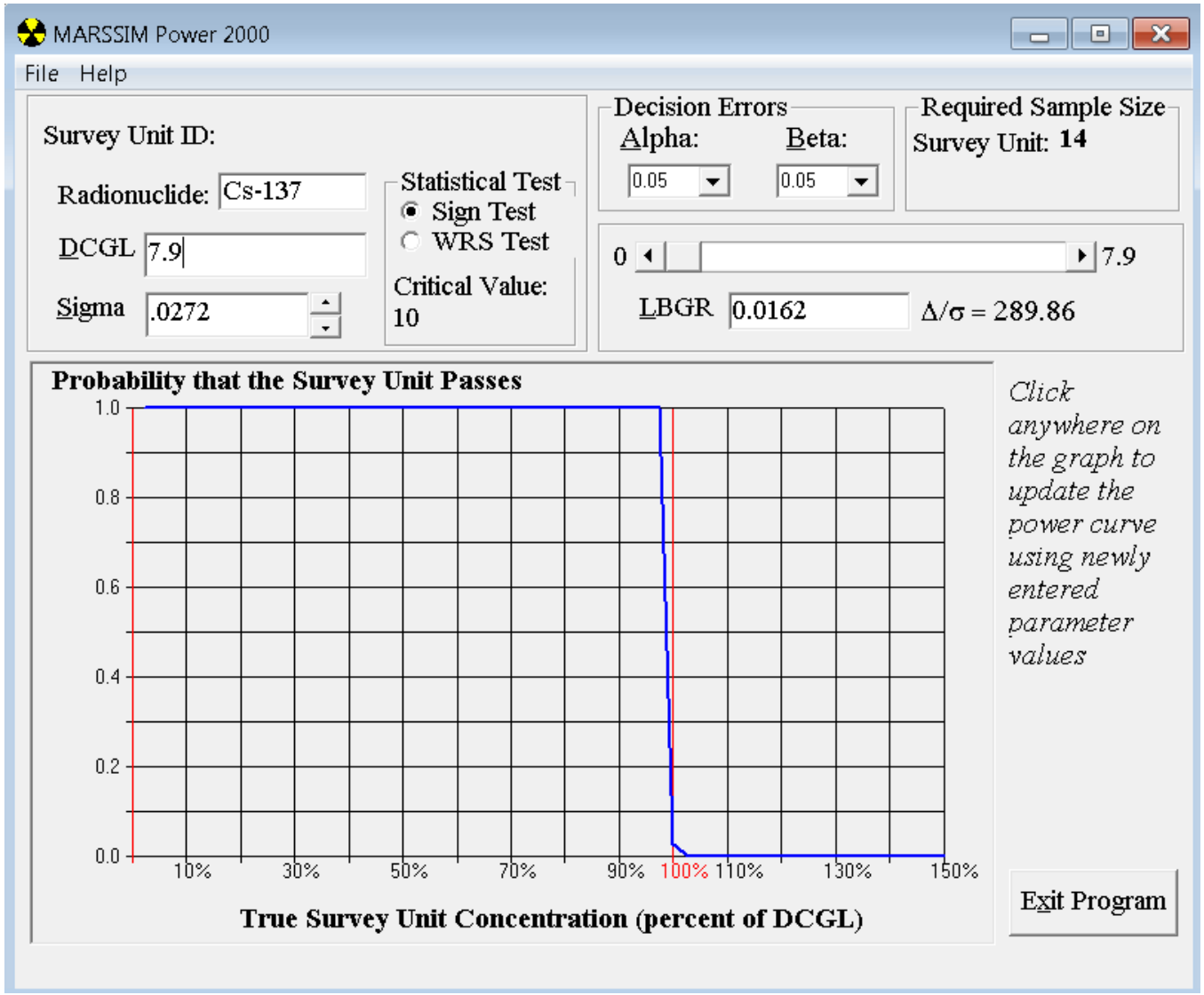

OOL10-20-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.024
0.002
0.028
0.054
0.079
Bin Upper End Value (pCi/gm)


Posting Plot
Survey Unit: OOL10-20-FSR
Survey Area: 7,990 m2
Reported Values: Cs-137
Reported Units: pCi/g
N
005
6.86E-02
014
1.95E-02
010
1.09E-02
015
3.38E-02
013
4.42E-02
012
7.93E-02
009
-1.26E-02
008
2.55E-03
001
1.62E-02
011
8.03E-03
007
-2.35E-02
006
1.65E-04
004
-1.95E-03
003
1.12E-02
002
1.09E-02
OOL10-20-xxx-FSR
OOL10-20 Boundary
OOL10-20 Area
Positive for Cs-137

Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0272
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0 7.9
LBGR 0.0162
Δ/σ = 289.86
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10% 30% 50% 70% 90% 100% 110% 130% 150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #007

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-FSR-00			Sample Measurement Location:	007

Sample Description:

Comparison of split samples collected from sample measurement location #007 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.19	0.53	14	0.6	1.66	8.54	0.20	1.19	Y
Pb-212	0.35	0.03	13	0.6	1.66	0.45	0.01	1.30	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	10/24/19	Concurrence by:	G. Madison	Date: 01/26/21
Signature:			Signature:		

Split Sample #012

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-FSR-00			Sample Measurement Location:	012

Sample Description:

Comparison of split samples collected from sample measurement location #012 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	4.85	0.39	12	0.6	1.66	4.79	0.15	0.99	Y
Pb-212	0.35	0.04	9	0.6	1.66	0.45	0.01	1.28	Y
Cs-137[1]	0.08	N/A				0.05	0.01	0.64	N
							0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and just over the MDA of 0.08 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/26/2021	Concurrence by:	M. Blake	Date:	
Signature:				Signature:			

Recount Sample #004

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-FSR-00			Sample Measurement Location:	004

Sample Description:

Duplicate count comparison from sample measurement location #004 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.13	0.56	13	0.6	1.66	6.72	0.54	0.94	Y
		0.00					0.00		Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

NOTE: Only K-40 can be compared as the initial and re-count only have K-40 in common.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/24/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #015

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	20	Survey Unit Name:	Haul Road
Sample Plan No.:	HBPP-FSSP-OOL10-20-FSR-00			Sample Measurement Location:	015

Sample Description:

Duplicate count comparison from sample measurement location #015 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
Bi-214	0.44	0.05	9	0.6	1.66	0.43	0.05	0.98	Y
Pb-212	0.40	0.04	11	0.6	1.66	0.52	0.04	1.28	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/24/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593009
Client Sample ID: FSS-2401: OOL10-20-007-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/24/19	U	1.22E+01	2.35E+01	3.79E+01	6.16E+01	2.37E+01	pCi/g
C-14	08/31/19	U	-9.89E-02	2.17E-01	3.68E-01	5.00E-01	2.17E-01	pCi/g
Ni-63	08/30/19	U	-4.96E+00	1.31E+01	2.24E+01	6.94E+01	1.31E+01	pCi/g
Sr-90	08/28/19	U	4.21E-02	7.65E-02	1.22E-01	1.36E-01	7.68E-02	pCi/g
Tc-99	08/28/19	U	-3.23E-01	6.59E-01	1.11E+00	1.16E+00	6.59E-01	pCi/g
Pu-241	08/28/19	U	-2.46E+00	3.17E+01	5.35E+01	8.29E+01	3.17E+01	pCi/g
Alpha Spec								
Pu-238	08/26/19	U	-6.22E-02	1.99E-01	5.29E-01	2.80E+00	1.99E-01	pCi/g
Pu-239/240	08/26/19	U	7.30E-02	2.73E-01	5.29E-01	2.51E+00	2.73E-01	pCi/g
Am-241	08/24/19	U	-4.26E-02	1.80E-01	4.80E-01	2.41E+00	1.81E-01	pCi/g
Cm-243/244	08/24/19	U	-2.10E-02	1.75E-01	4.12E-01	2.80E+00	1.76E-01	pCi/g
Cm-245/246	08/24/19	U	8.94E-02	2.84E-01	4.27E-01	1.64E+00	2.84E-01	pCi/g
Gamma Spec								
Ni-59	08/29/19	U	-2.73E+00	3.55E+01	5.83E+01	1.83E+02	3.56E+01	pCi/g

Notes: 1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers: U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593010
Client Sample ID: FSS-2401: OOL10-20-007-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/15/19	U	-3.09E-02	5.39E-02	8.54E-02		5.57E-02	pCi/g
Na-22	08/15/19	U	-3.68E-03	8.57E-03	1.37E-02		8.73E-03	pCi/g
K-40	08/15/19		8.54E+00	3.92E-01	1.10E-01		8.18E-01	pCi/g
Cr-51	08/15/19	U	-4.13E-03	5.77E-02	9.68E-02		5.77E-02	pCi/g
Mn-54	08/15/19	U	5.49E-03	6.91E-03	1.25E-02		7.35E-03	pCi/g
Fe-59	08/15/19	U	-1.18E-02	1.57E-02	2.47E-02		1.66E-02	pCi/g
Co-56	08/15/19	U	1.39E-03	7.17E-03	1.25E-02		7.20E-03	pCi/g
Co-57	08/15/19	U	-4.19E-03	5.14E-03	8.82E-03		5.49E-03	pCi/g
Co-58	08/15/19	U	-6.74E-03	6.76E-03	1.07E-02		7.43E-03	pCi/g
Co-60	08/15/19	UI	1.21E-02	6.92E-03	1.21E-02	3.42E-01	9.23E-03	pCi/g
Zn-65	08/15/19	U	3.37E-03	2.04E-02	3.07E-02		2.05E-02	pCi/g
Y-88	08/15/19	U	-1.40E-04	4.27E-03	7.28E-03		4.27E-03	pCi/g
Zr-95	08/15/19	U	5.89E-03	1.42E-02	2.24E-02		1.44E-02	pCi/g
Nb-94	08/15/19	U	2.30E-03	6.82E-03	1.20E-02	6.39E-01	6.90E-03	pCi/g
Nb-95	08/15/19	U	1.60E-03	7.90E-03	1.23E-02		7.94E-03	pCi/g
Ru-106	08/15/19	U	3.70E-02	6.15E-02	1.04E-01		6.38E-02	pCi/g
Ag-110m	08/15/19	U	-4.61E-03	9.42E-03	1.55E-02		9.66E-03	pCi/g
Sn-113	08/15/19	U	-3.53E-03	8.79E-03	1.42E-02		8.94E-03	pCi/g
Sb-124	08/15/19	U	-4.86E-03	1.08E-02	1.58E-02		1.10E-02	pCi/g
Sb-125	08/15/19	U	3.38E-03	1.70E-02	2.85E-02		1.70E-02	pCi/g
Cs-134	08/15/19	UI	1.77E-02	1.69E-02	1.77E-02		2.14E-02	pCi/g
Cs-136	08/15/19	U	1.15E-03	1.42E-02	2.41E-02		1.42E-02	pCi/g
Cs-137	08/15/19	U	2.93E-03	7.36E-03	1.23E-02	7.11E-01	7.48E-03	pCi/g
Ba-133	08/15/19	U	8.35E-04	8.52E-03	1.29E-02		8.53E-03	pCi/g
Ba-140	08/15/19	U	-3.70E-02	3.45E-02	5.21E-02		3.85E-02	pCi/g
Ce-139	08/15/19	U	-3.11E-05	5.83E-03	1.01E-02		5.83E-03	pCi/g
Ce-141	08/15/19	U	1.68E-02	1.53E-02	1.95E-02		1.72E-02	pCi/g
Ce-144	08/15/19	U	4.29E-02	4.51E-02	7.32E-02		4.92E-02	pCi/g
Nd-147	08/15/19	U	-1.12E-02	6.95E-02	1.13E-01		6.97E-02	pCi/g
Pm-144	08/15/19	U	-1.29E-03	6.47E-03	1.11E-02		6.50E-03	pCi/g
Pm-146	08/15/19	U	1.66E-03	7.98E-03	1.34E-02		8.02E-03	pCi/g
Eu-152	08/15/19	U	-3.88E-03	1.91E-02	2.82E-02	9.00E-01	1.92E-02	pCi/g
Eu-154	08/15/19	U	-1.00E-02	2.44E-02	3.92E-02	8.46E-01	2.48E-02	pCi/g
Eu-155	08/15/19	U	1.51E-02	2.29E-02	3.71E-02		2.39E-02	pCi/g
Ir-192	08/15/19	U	-1.17E-03	6.09E-03	1.02E-02		6.12E-03	pCi/g

Notes: 1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers: U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593010
Client Sample ID: FSS-2401: OOL10-20-007-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/15/19	U	4.66E-03	7.00E-03	1.10E-02		7.32E-03	pCi/g
Tl-208	08/15/19		1.36E-01	1.85E-02	1.13E-02		2.24E-02	pCi/g
Pb-210	08/15/19		5.37E-01	2.86E-01	2.65E-01		2.90E-01	pCi/g
Pb-212	08/15/19		4.52E-01	2.46E-02	1.82E-02		4.42E-02	pCi/g
Pb-214	08/15/19		4.50E-01	4.07E-02	6.26E-02		5.66E-02	pCi/g
Bi-212	08/15/19		5.88E-01	1.54E-01	1.54E-01		1.63E-01	pCi/g
Bi-214	08/15/19		4.43E-01	3.79E-02	2.07E-02		5.56E-02	pCi/g
Ra-228	08/15/19		4.21E-01	6.19E-02	4.46E-02		7.04E-02	pCi/g
Ac-228	08/15/19		4.21E-01	6.19E-02	4.46E-02		7.04E-02	pCi/g
Th-234	08/15/19	U	1.73E-01	3.69E-01	2.89E-01		3.71E-01	pCi/g
U-235	08/15/19	U	6.26E-02	5.72E-02	7.46E-02		5.74E-02	pCi/g
U-238	08/15/19	U	1.73E-01	3.69E-01	2.89E-01		3.71E-01	pCi/g
Np-237	08/15/19	U	-4.00E-03	1.17E-02	1.94E-02	9.90E-01	1.18E-02	pCi/g
Np-239	08/15/19	U	3.62E-02	5.55E-02	9.48E-02		5.79E-02	pCi/g
Am-241	08/15/19	U	1.85E-02	2.01E-02	3.08E-02	2.27E+00	2.18E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 486651005
Client Sample ID: FSS-2362: OOL10-20-012-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: July 27, 2019
Receive Date: August 05, 2019
Report Date: August 25, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/12/19	U	3.08E+00	3.13E+01	5.23E+01	6.16E+01	3.13E+01	pCi/g
C-14	08/18/19	U	3.43E-01	2.29E-01	3.76E-01	5.00E-01	2.31E-01	pCi/g
Ni-63	08/17/19	U	-6.45E+00	1.17E+01	2.01E+01	6.94E+01	1.17E+01	pCi/g
Sr-90	08/20/19	U	5.78E-02	7.81E-02	1.17E-01	1.36E-01	7.87E-02	pCi/g
Tc-99	08/18/19	U	-5.57E-01	5.38E-01	9.46E-01	1.16E+00	5.38E-01	pCi/g
Pu-241	08/17/19	U	3.39E+01	3.44E+01	5.46E+01	8.29E+01	3.52E+01	pCi/g
Alpha Spec								
Pu-238	08/14/19	U	-1.10E-01	1.55E-01	4.54E-01	2.80E+00	1.55E-01	pCi/g
Pu-239/240	08/14/19	U	-3.18E-02	1.44E-01	3.62E-01	2.51E+00	1.44E-01	pCi/g
Am-241	08/15/19	U	-2.76E-02	1.25E-01	3.14E-01	2.41E+00	1.25E-01	pCi/g
Cm-243/244	08/15/19	U	-5.77E-02	9.30E-02	2.96E-01	2.80E+00	9.31E-02	pCi/g
Cm-245/246	08/15/19	U	4.64E-02	1.31E-01	1.39E-01	1.64E+00	1.31E-01	pCi/g
Gamma Spec								
Ni-59	08/17/19	UI	1.56E+01	2.01E+01	1.56E+01	1.83E+02	2.02E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 486651006
Client Sample ID: FSS-2362: OOL10-20-012-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: GAMMA

Client: Pacific Gas and Electric Company
Collect Date: July 27, 2019
Receive Date: August 05, 2019
Report Date: August 25, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/07/19	U	1.83E-02	5.71E-02	9.60E-02		5.77E-02	pCi/g
Na-22	08/07/19	U	2.01E-03	6.21E-03	1.08E-02		6.27E-03	pCi/g
K-40	08/07/19		4.79E+00	3.00E-01	8.27E-02		5.07E-01	pCi/g
Cr-51	08/07/19	U	-2.44E-02	6.54E-02	1.08E-01		6.64E-02	pCi/g
Mn-54	08/07/19	UI	8.76E-03	8.57E-03	8.76E-03		8.91E-03	pCi/g
Fe-59	08/07/19	U	-8.10E-03	1.28E-02	2.03E-02		1.33E-02	pCi/g
Co-56	08/07/19	U	4.69E-03	5.94E-03	1.09E-02		6.32E-03	pCi/g
Co-57	08/07/19	U	3.03E-03	6.77E-03	1.18E-02		6.91E-03	pCi/g
Co-58	08/07/19	U	1.83E-03	6.53E-03	1.03E-02		6.59E-03	pCi/g
Co-60	08/07/19	U	-3.74E-04	5.92E-03	9.87E-03	3.42E-01	5.92E-03	pCi/g
Zn-65	08/07/19	U	-1.57E-03	1.51E-02	2.22E-02		1.51E-02	pCi/g
Y-88	08/07/19	U	2.55E-04	5.02E-03	8.34E-03		5.02E-03	pCi/g
Zr-95	08/07/19	U	1.35E-02	1.17E-02	2.19E-02		1.33E-02	pCi/g
Nb-94	08/07/19	U	3.13E-03	6.11E-03	1.09E-02	6.39E-01	6.27E-03	pCi/g
Nb-95	08/07/19	U	2.53E-03	7.87E-03	1.23E-02		7.96E-03	pCi/g
Ru-106	08/07/19	U	3.01E-02	5.72E-02	9.68E-02		5.89E-02	pCi/g
Ag-110m	08/07/19	U	4.59E-03	7.92E-03	1.40E-02		8.19E-03	pCi/g
Sn-113	08/07/19	U	-2.88E-03	8.66E-03	1.34E-02		8.76E-03	pCi/g
Sb-124	08/07/19	U	1.11E-02	1.02E-02	2.02E-02		1.14E-02	pCi/g
Sb-125	08/07/19	U	7.22E-03	1.65E-02	2.80E-02		1.68E-02	pCi/g
Cs-134	08/07/19	UI	1.52E-02	1.27E-02	1.52E-02		1.91E-02	pCi/g
Cs-136	08/07/19	U	-8.39E-03	1.32E-02	2.12E-02		1.38E-02	pCi/g
Cs-137	08/07/19	M	5.10E-02	1.21E-02	1.01E-02	7.11E-01	1.30E-02	pCi/g
Ba-133	08/07/19	U	7.65E-03	8.19E-03	1.31E-02		8.91E-03	pCi/g
Ba-140	08/07/19	U	5.53E-03	4.04E-02	6.69E-02		4.05E-02	pCi/g
Ce-139	08/07/19	U	-8.75E-03	6.76E-03	1.11E-02		8.03E-03	pCi/g
Ce-141	08/07/19	U	1.57E-03	1.40E-02	2.42E-02		1.41E-02	pCi/g
Ce-144	08/07/19	U	2.17E-03	5.68E-02	8.79E-02		5.68E-02	pCi/g
Nd-147	08/07/19	U	2.95E-02	8.00E-02	1.35E-01		8.11E-02	pCi/g
Pm-144	08/07/19	U	-2.52E-03	6.44E-03	8.81E-03		6.55E-03	pCi/g
Pm-146	08/07/19	U	5.45E-03	7.67E-03	1.32E-02		8.07E-03	pCi/g
Eu-152	08/07/19	U	1.23E-02	1.97E-02	3.25E-02	9.00E-01	2.05E-02	pCi/g
Eu-154	08/07/19	U	6.30E-03	1.77E-02	3.09E-02	8.46E-01	1.79E-02	pCi/g
Eu-155	08/07/19	U	2.51E-02	4.67E-02	5.22E-02		4.68E-02	pCi/g
Ir-192	08/07/19	U	2.04E-04	6.61E-03	1.11E-02		6.61E-03	pCi/g

Notes: 1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers: U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 486651006
Client Sample ID: FSS-2362: OOL10-20-012-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: GAMMA

Client: Pacific Gas and Electric Company
Collect Date: July 27, 2019
Receive Date: August 05, 2019
Report Date: August 25, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/07/19	U	4.49E-03	8.07E-03	1.25E-02		8.33E-03	pCi/g
Tl-208	08/07/19		1.55E-01	1.82E-02	1.06E-02		2.31E-02	pCi/g
Pb-210	08/07/19	UI	2.66E+00	3.31E+00	2.66E+00		3.37E+00	pCi/g
Pb-212	08/07/19		4.50E-01	2.71E-02	1.94E-02		4.30E-02	pCi/g
Pb-214	08/07/19		5.86E-01	3.97E-02	6.98E-02		5.95E-02	pCi/g
Bi-212	08/07/19		6.31E-01	1.59E-01	1.36E-01		1.70E-01	pCi/g
Bi-214	08/07/19		5.09E-01	4.20E-02	1.97E-02		6.32E-02	pCi/g
Ra-228	08/07/19		4.98E-01	6.28E-02	4.05E-02		7.58E-02	pCi/g
Ac-228	08/07/19		4.98E-01	6.28E-02	4.05E-02		7.58E-02	pCi/g
Th-234	08/07/19	U	7.02E-01	1.10E+00	9.97E-01		1.11E+00	pCi/g
U-235	08/07/19	U	-1.31E-02	5.03E-02	8.52E-02		5.03E-02	pCi/g
U-238	08/07/19	U	7.02E-01	1.10E+00	9.97E-01		1.11E+00	pCi/g
Np-237	08/07/19	U	-3.11E-03	1.25E-02	2.07E-02	9.90E-01	1.26E-02	pCi/g
Np-239	08/07/19	U	-8.06E-04	7.19E-02	1.24E-01		7.19E-02	pCi/g
Am-241	08/07/19	U	-4.82E-02	7.92E-02	1.22E-01	2.27E+00	8.22E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-22

Data Assessment

Data Quality Assessment of OOL10-22;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-22-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-2.36E-02
Maximum Value	9.88E-02
Mean	2.53E-02
Median	2.46E-02
a-posteriori σ	3.41E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the arithmetic mean.*
7. *The Quantile Plot exhibits a slight skew to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

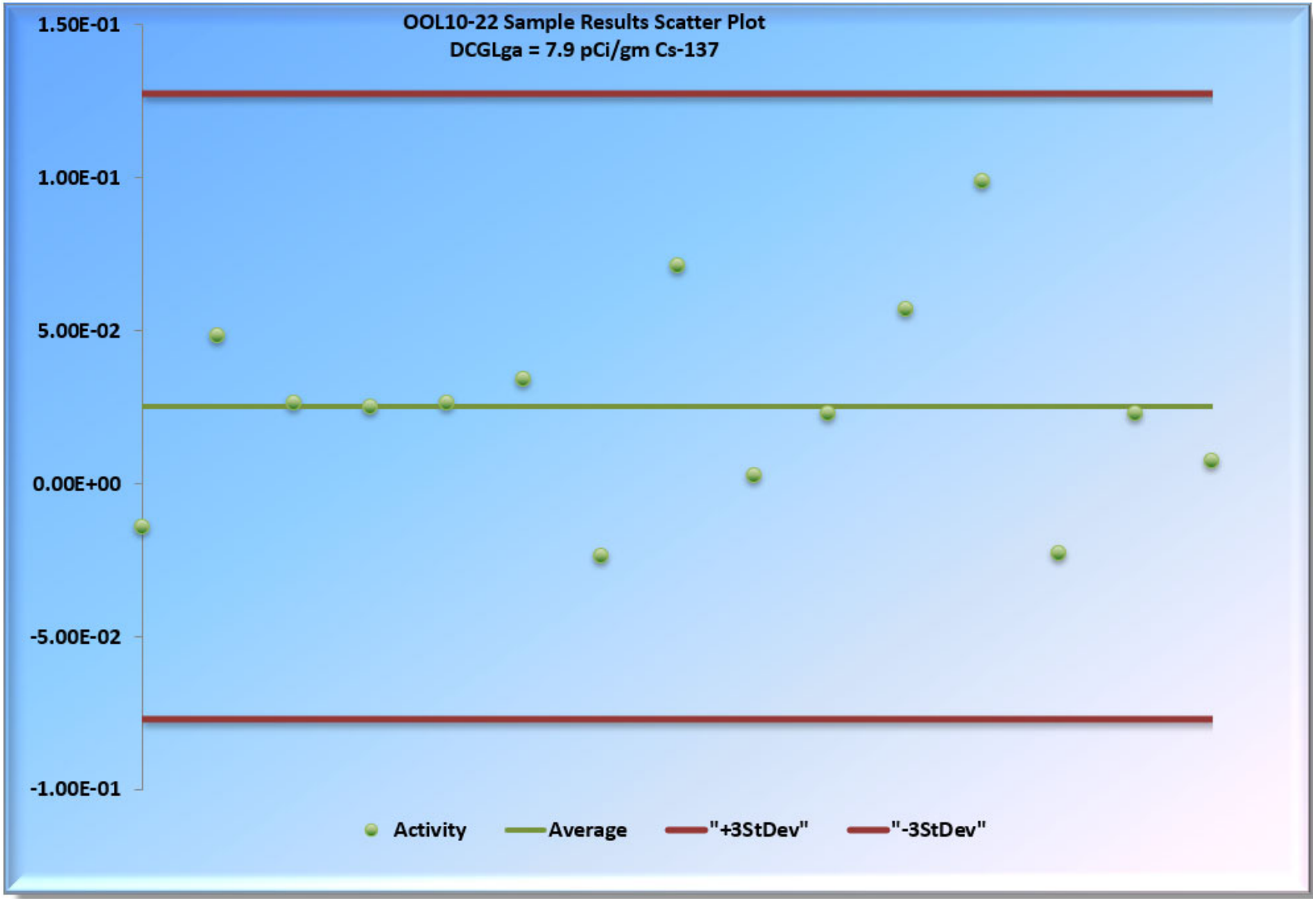
Summary:

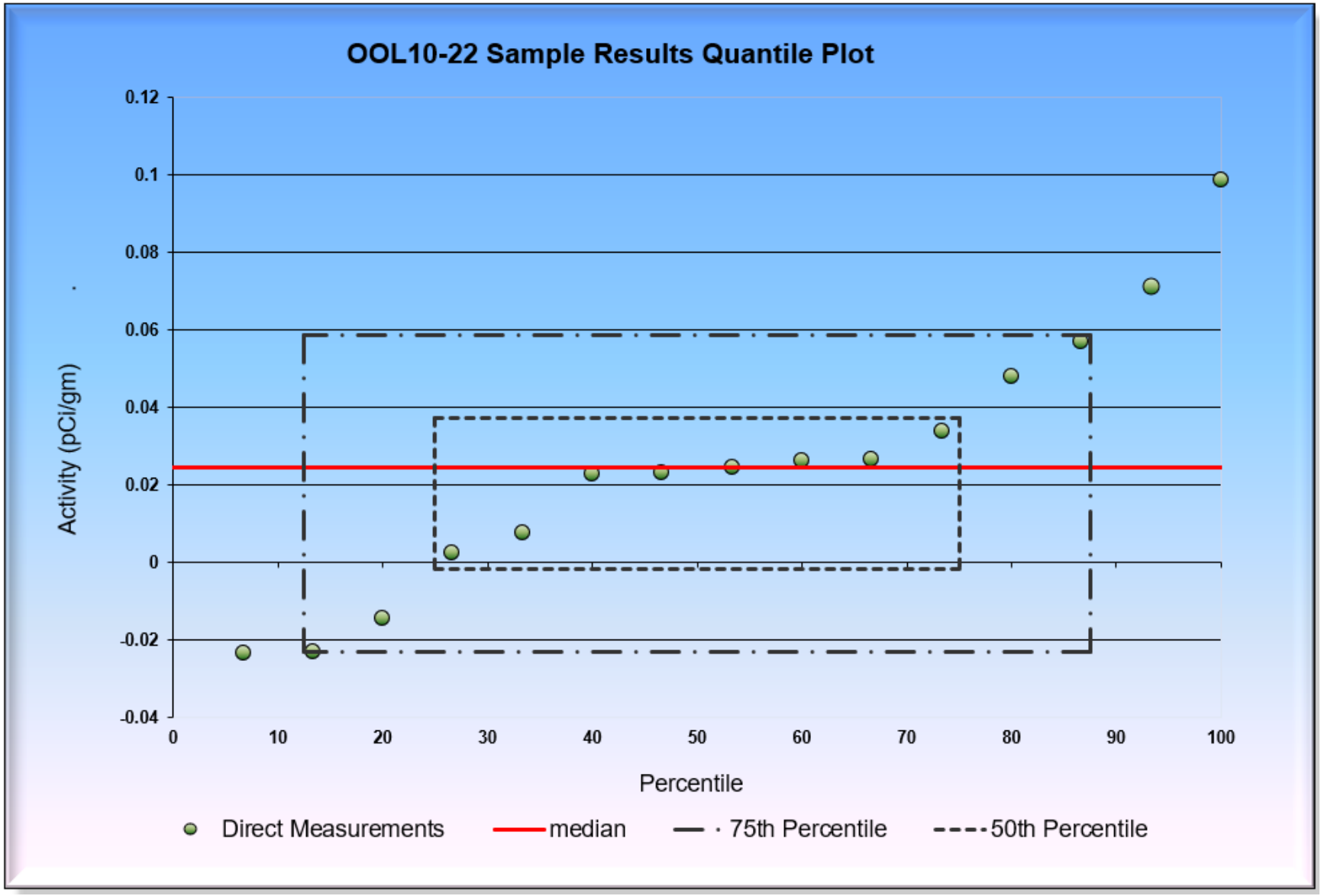
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

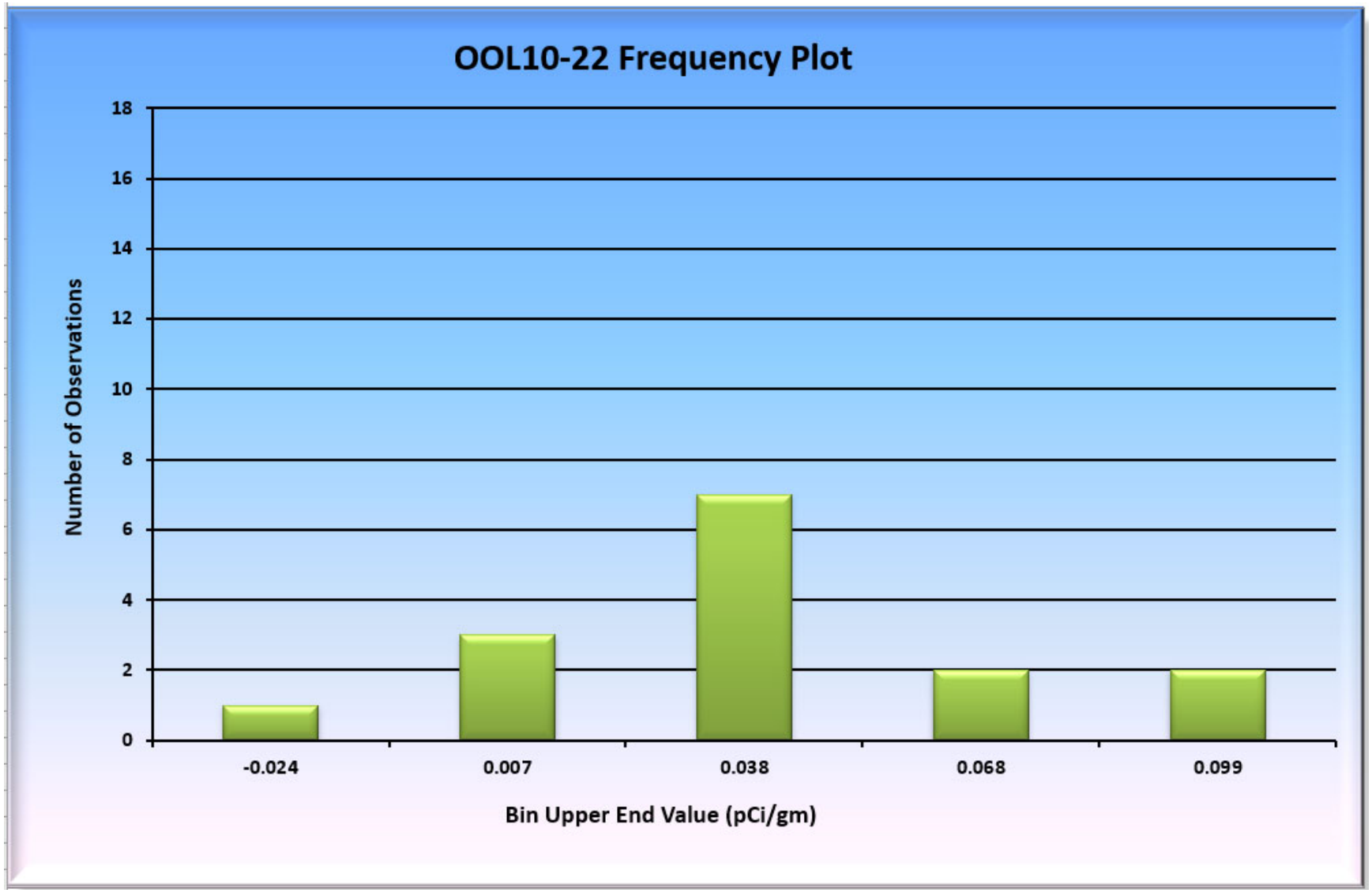
Survey Unit OOL10-22 meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-22.

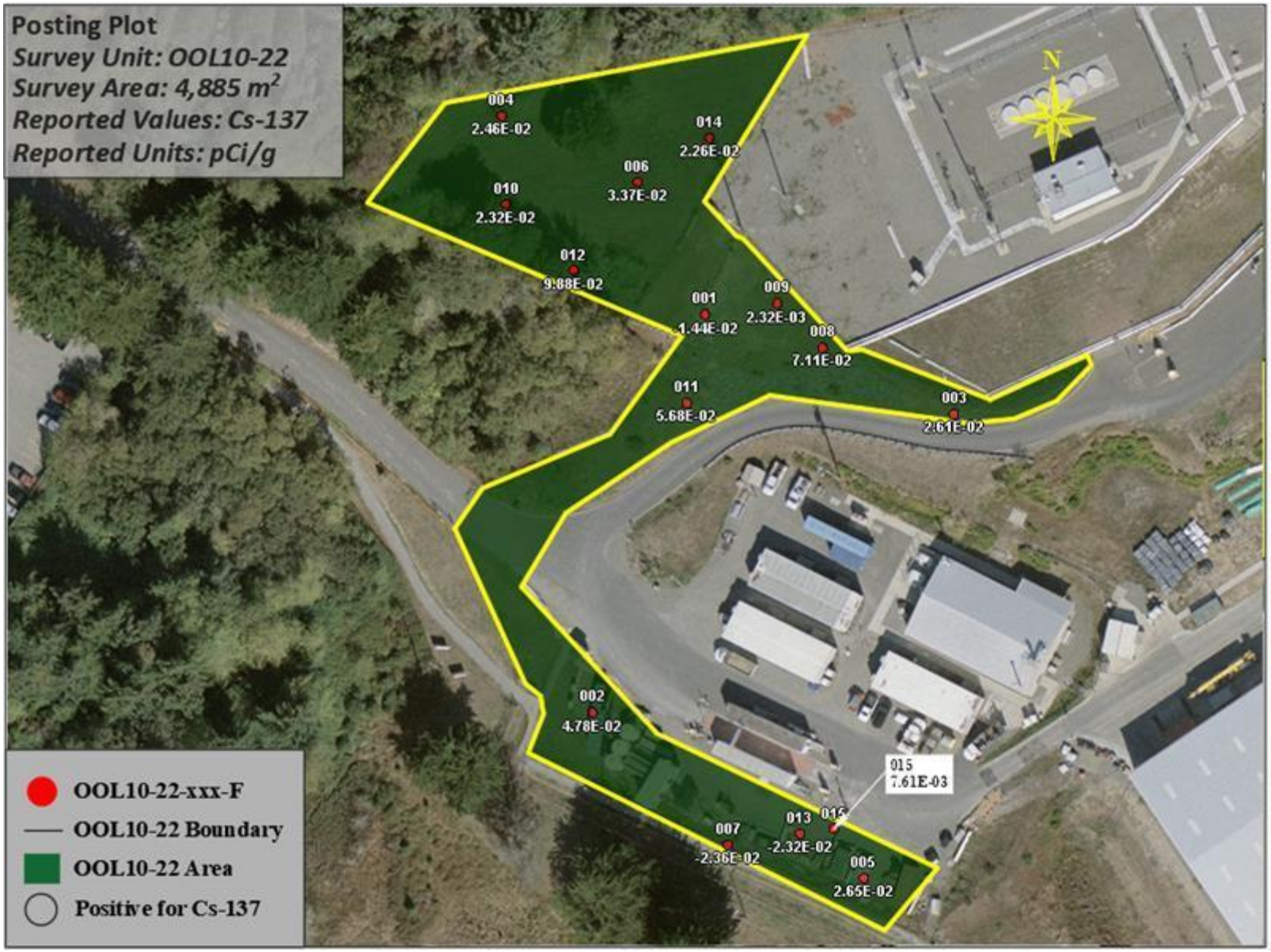
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-22-001-F	-5.13E-03	-6.56E-03	-1.44E-02	-5.49E-02	-2.59E-03	-4.19E-03	1.57E-02	-0.2%
OOL10-22-002-F	-8.42E-02	2.93E-02	4.78E-02	-1.25E-02	5.03E-02	4.04E-03	-7.84E-03	0.6%
OOL10-22-003-F	-8.70E-02	5.90E-03	2.61E-02	-9.03E-02	-5.42E-02	-4.47E-02	-4.82E-03	0.3%
OOL10-22-004-F	4.09E-02	-1.72E-02	2.46E-02	8.17E-03	2.74E-02	1.68E-03	-3.12E-02	0.3%
OOL10-22-005-F	-7.91E-02	-4.54E-02	2.65E-02	1.90E-02	3.65E-02	4.72E-02	-2.66E-02	0.3%
OOL10-22-006-F	7.66E-02	1.74E-02	3.37E-02	3.49E-02	1.43E-02	-5.47E-03	-1.19E-02	0.4%
OOL10-22-007-F	-7.65E-02	1.86E-02	-2.36E-02	2.04E-02	-3.59E-02	-3.03E-03	-3.87E-03	-0.3%
OOL10-22-008-F	-1.75E-01	-8.58E-03	7.11E-02	4.54E-02	3.17E-02	1.30E-02	1.41E-02	0.9%
OOL10-22-009-F	1.49E-01	1.13E-02	2.32E-03	5.37E-02	1.44E-02	4.71E-03	-4.73E-03	0.0%
OOL10-22-010-F	1.38E-03	2.79E-02	2.32E-02	9.86E-02	-6.62E-02	4.98E-04	-9.29E-02	0.3%
OOL10-22-011-F	1.24E-01	1.84E-02	5.68E-02	1.22E-01	-1.68E-01	-2.82E-02	4.41E-02	0.7%
OOL10-22-012-F	-1.20E-01	-3.53E-02	9.88E-02	5.70E-02	1.45E-03	-1.67E-02	1.11E-02	1.3%
OOL10-22-013-F	-2.01E-02	-8.78E-03	-2.32E-02	3.57E-02	6.73E-03	4.03E-04	4.13E-02	-0.3%
OOL10-22-014-F	-2.10E-01	1.11E-03	2.26E-02	5.94E-02	7.10E-03	1.82E-03	-4.29E-02	0.3%
OOL10-22-015-F	9.30E-03	-8.97E-03	7.61E-03	-6.99E-02	5.06E-02	6.53E-03	6.11E-03	0.1%

Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

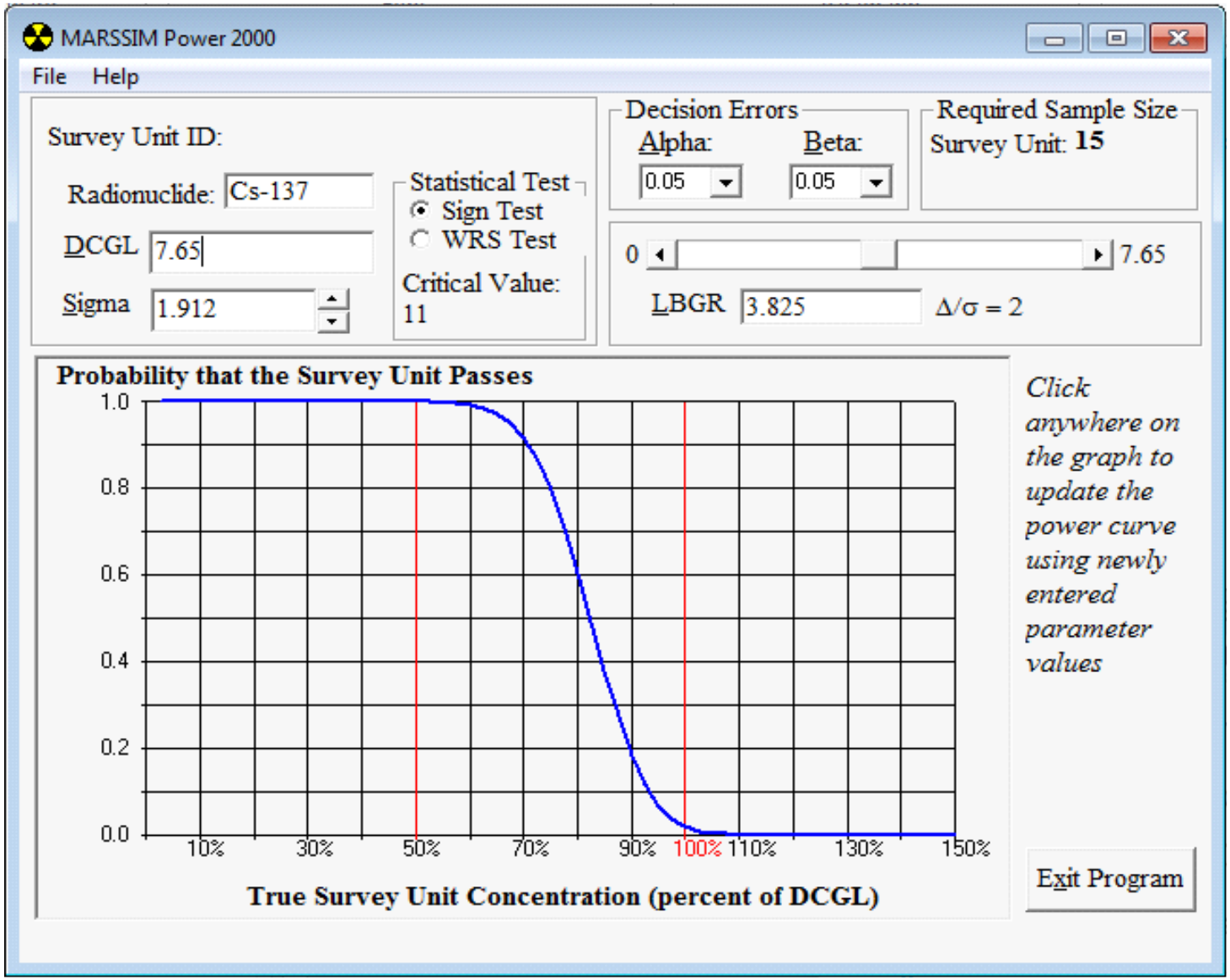

OOL10-22 Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Activity
Average
"+3StDev"
"-3StDev"


OOL10-22 Sample Results Quantile Plot
Activity (pCi/gm)
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

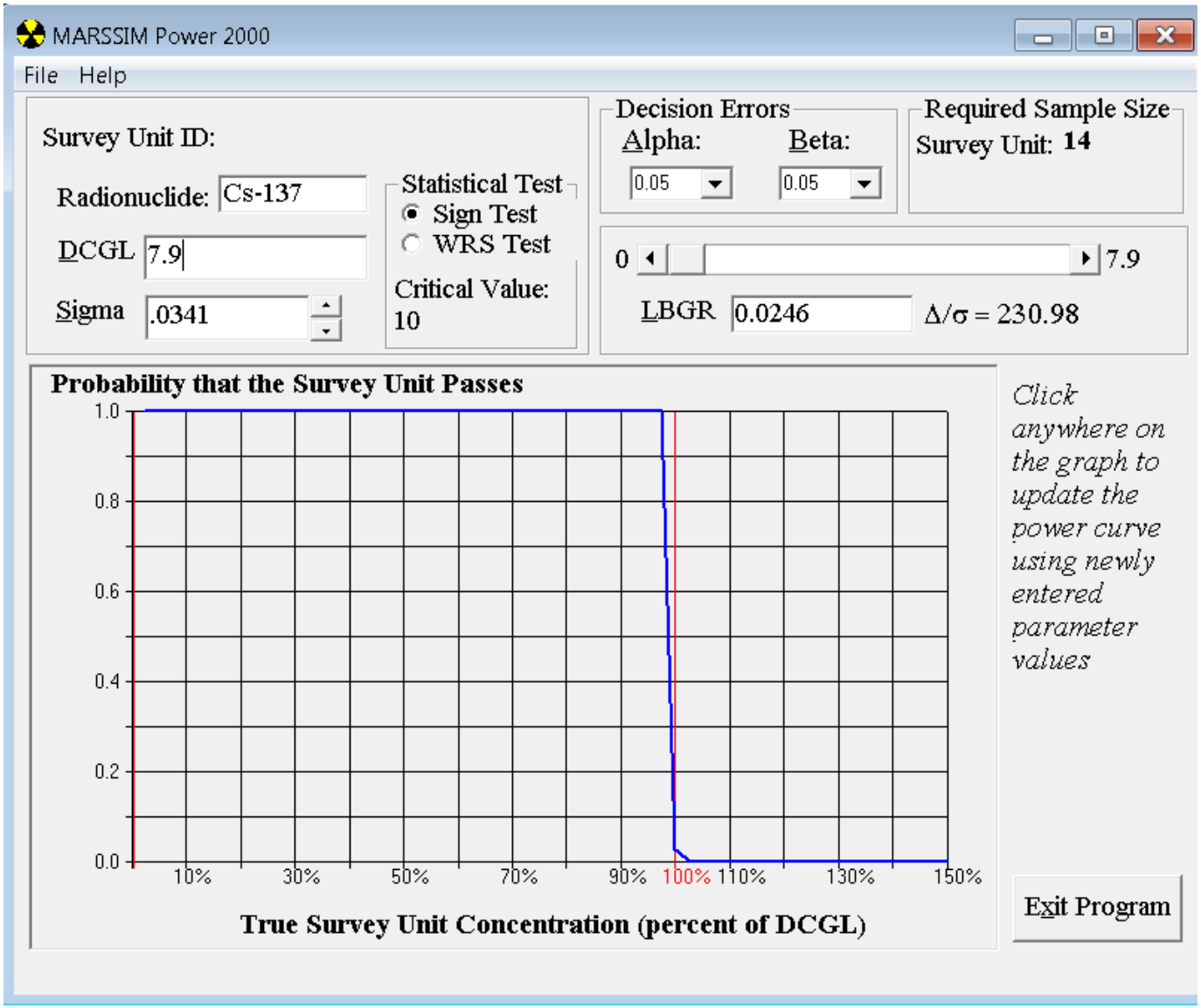

OOL10-22 Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.024
0.007
0.038
0.068
0.099
Bin Upper End Value (pCi/gm)



Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0341
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0 7.9
LBGR 0.0246
Δ/σ = 230.98
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10% 30% 50% 70% 90% 100% 110% 130% 150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #001

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-00			Sample Measurement Location:	001

Sample Description:

Comparison of split samples collected from sample measurement location #001 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.04	0.53	12	0.6	1.66	6.72	0.18	1.11	Y
Pb-212	0.42	0.03	13	0.6	1.66	0.54	0.01	1.29	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/24/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Split Sample #013

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-00			Sample Measurement Location:	013

Sample Description:

Comparison of split samples collected from sample measurement location #013 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.32	0.53	12	0.6	1.66	7.30	0.25	1.15	Y
Pb-212	0.35	0.03	10	0.6	1.66	0.57	0.02	1.65	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/24/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #006

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-00			Sample Measurement Location:	006

Sample Description:

Duplicate count comparison from sample measurement location #006 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	4.42	0.47	9	0.6	1.66	6.11	0.55	1.38	Y
Pb-212	0.33	0.03	10	0.6	1.66	0.29	0.03	0.89	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/24/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #008

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI WEST
Sample Plan No.:	HBPP-FSSP-OOL10-22-00			Sample Measurement Location:	008

Sample Description:

Duplicate count comparison from sample measurement location #008 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.60	0.58	11	0.6	1.66	5.95	0.52	0.90	Y
Pb-212	0.37	0.04	10	0.6	1.66	0.30	0.03	0.80	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Gordon Madison	Date:	5/26/2021	Concurrence by:	Marshall Blake	Date:	5/26/2021
Signature:				Signature:	Marshall H Blake		

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 471586001
Client Sample ID: FSS-2183 OOL10-22-001-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: February 05, 2019
Receive Date: February 19, 2019
Report Date: March 11, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	02/22/19	U	-1.02E-01	6.85E-02	1.01E-01		8.29E-02	pCi/g
Na-22	02/22/19	U	-1.97E-03	9.50E-03	1.32E-02		9.54E-03	pCi/g
K-40	02/22/19		6.72E+00	3.52E-01	8.46E-02		7.60E-01	pCi/g
Cr-51	02/22/19	U	-4.34E-02	8.17E-02	1.34E-01		8.41E-02	pCi/g
Mn-54	02/22/19	UI	1.13E-02	9.58E-03	1.13E-02		9.63E-03	pCi/g
Fe-59	02/22/19	U	-1.01E-03	1.77E-02	2.92E-02		1.77E-02	pCi/g
Co-56	02/22/19	U	-3.12E-03	7.64E-03	1.25E-02		7.78E-03	pCi/g
Co-57	02/22/19	U	5.53E-03	7.18E-03	1.19E-02		7.62E-03	pCi/g
Co-58	02/22/19	U	-2.50E-03	7.57E-03	1.26E-02		7.66E-03	pCi/g
Co-60	02/22/19	U	5.67E-03	4.97E-03	1.20E-02	3.42E-01	5.61E-03	pCi/g
Zn-65	02/22/19	U	-2.66E-03	2.01E-02	2.87E-02		2.02E-02	pCi/g
Y-88	02/22/19	U	2.28E-03	5.16E-03	9.44E-03		5.26E-03	pCi/g
Zr-95	02/22/19	U	-2.41E-03	1.35E-02	2.28E-02		1.36E-02	pCi/g
Nb-94	02/22/19	U	1.21E-03	6.51E-03	1.13E-02	6.39E-01	6.53E-03	pCi/g
Nb-95	02/22/19	U	8.74E-03	9.11E-03	1.49E-02		9.96E-03	pCi/g
Ru-106	02/22/19	U	6.84E-03	5.79E-02	1.01E-01		5.80E-02	pCi/g
Ag-110m	02/22/19	U	-4.41E-03	9.07E-03	1.47E-02		9.29E-03	pCi/g
Sn-113	02/22/19	U	-7.76E-03	9.59E-03	1.53E-02		1.02E-02	pCi/g
Sb-124	02/22/19	U	-1.34E-03	1.35E-02	2.25E-02		1.35E-02	pCi/g
Sb-125	02/22/19	U	4.02E-03	1.86E-02	3.13E-02		1.87E-02	pCi/g
Cs-134	02/22/19	UI	1.64E-02	1.49E-02	1.64E-02		2.08E-02	pCi/g
Cs-136	02/22/19	U	4.93E-03	2.13E-02	3.63E-02		2.14E-02	pCi/g
Cs-137	02/22/19	UI	1.22E-02	1.42E-02	1.22E-02	7.11E-01	1.42E-02	pCi/g
Ba-133	02/22/19	U	6.47E-03	8.72E-03	1.39E-02		9.21E-03	pCi/g
Ba-140	02/22/19	U	-1.30E-02	6.15E-02	9.88E-02		6.18E-02	pCi/g
Ce-139	02/22/19	U	-3.15E-04	8.03E-03	1.27E-02		8.03E-03	pCi/g
Ce-141	02/22/19	U	-1.32E-03	1.97E-02	2.87E-02		1.97E-02	pCi/g
Ce-144	02/22/19	U	-7.49E-03	5.59E-02	8.91E-02		5.60E-02	pCi/g
Nd-147	02/22/19	U	-1.01E-01	1.31E-01	2.01E-01		1.39E-01	pCi/g
Pm-144	02/22/19	U	8.20E-04	6.37E-03	1.11E-02		6.38E-03	pCi/g
Pm-146	02/22/19	U	1.46E-03	8.52E-03	1.42E-02		8.55E-03	pCi/g
Eu-152	02/22/19	U	-1.03E-02	2.04E-02	3.35E-02	9.00E-01	2.10E-02	pCi/g
Eu-154	02/22/19	U	-5.11E-03	2.69E-02	3.75E-02	8.46E-01	2.70E-02	pCi/g
Eu-155	02/22/19	U	4.72E-02	3.15E-02	5.36E-02		3.82E-02	pCi/g
Ir-192	02/22/19	U	2.28E-03	7.65E-03	1.31E-02		7.72E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 471586001
Client Sample ID: FSS-2183 OOL10-22-001-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: February 05, 2019
Receive Date: February 19, 2019
Report Date: March 11, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	02/22/19	U	1.31E-02	1.94E-02	1.44E-02		1.96E-02	pCi/g
Tl-208	02/22/19		1.81E-01	1.99E-02	1.05E-02		2.48E-02	pCi/g
Pb-210	02/22/19	U	2.26E+00	3.18E+00	5.48E+00		3.35E+00	pCi/g
Pb-212	02/22/19		5.41E-01	2.98E-02	2.14E-02		5.34E-02	pCi/g
Pb-214	02/22/19		5.74E-01	4.58E-02	2.39E-02		6.44E-02	pCi/g
Bi-212	02/22/19		6.76E-01	2.15E-01	1.54E-01		2.23E-01	pCi/g
Bi-214	02/22/19		4.86E-01	3.90E-02	2.10E-02		5.58E-02	pCi/g
Ra-228	02/22/19		6.17E-01	7.38E-02	3.88E-02		9.39E-02	pCi/g
Ac-228	02/22/19		6.17E-01	7.38E-02	3.88E-02		9.39E-02	pCi/g
Th-234	02/22/19	U	3.70E-01	9.98E-01	9.79E-01		1.00E+00	pCi/g
U-235	02/22/19	U	4.77E-02	7.29E-02	8.70E-02		7.31E-02	pCi/g
U-238	02/22/19	U	3.70E-01	9.98E-01	9.79E-01		1.00E+00	pCi/g
Np-237	02/22/19	U	4.99E-03	1.37E-02	2.35E-02	9.90E-01	1.38E-02	pCi/g
Np-239	02/22/19	U	-3.13E-02	7.49E-02	1.19E-01		7.63E-02	pCi/g
Am-241	02/22/19	U	7.91E-02	8.18E-02	1.31E-01	2.27E+00	8.95E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 471586002
Client Sample ID: FSS-2183 OOL10-22-001-F
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: February 05, 2019
Receive Date: February 19, 2019
Report Date: March 11, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	02/27/19	U	-1.65E+00	1.16E+01	1.97E+01	6.56E+01	1.16E+01	pCi/g
C-14	03/01/19	U	-3.11E-01	2.46E-01	4.22E-01	6.07E-01	2.46E-01	pCi/g
Ni-63	03/02/19	U	5.55E+00	1.21E+01	2.00E+01	6.94E+01	1.22E+01	pCi/g
Sr-90	02/26/19	U	2.13E-02	5.98E-02	9.41E-02	1.45E-01	5.99E-02	pCi/g
Tc-99	03/10/19	U	-4.91E-01	5.79E-01	9.88E-01	1.16E+00	5.78E-01	pCi/g
Pu-241	02/25/19	U	1.18E+01	3.07E+01	5.05E+01	8.29E+01	3.08E+01	pCi/g
Alpha Spec								
Pu-238	02/25/19	U	9.72E-02	1.57E-01	2.43E-01	2.80E+00	1.58E-01	pCi/g
Pu-239/240	02/25/19	U	3.61E-02	1.23E-01	2.29E-01	2.51E+00	1.23E-01	pCi/g
Am-241	02/21/19	U	1.24E-03	1.90E-01	3.94E-01	2.41E+00	1.90E-01	pCi/g
Cm-243/244	02/21/19	U	-7.37E-03	6.35E-02	1.47E-01	2.80E+00	6.36E-02	pCi/g
Cm-245/246	02/21/19	U	3.70E-02	1.27E-01	2.34E-01	1.64E+00	1.27E-01	pCi/g
Gamma Spec								
Ni-59	03/01/19	U	-1.58E+01	3.36E+01	4.99E+01	1.83E+02	3.44E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 470413007
Client: Pacific Gas and Electric Company
Client Sample ID: FSS-2163: OOL10-22-013-F
Collect Date: January 28, 2019
Client Matrix: Soil
Receive Date: February 04, 2019
Amount of Sample Received:
Report Date: February 20, 2019
Sample Description: HTDs

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	02/06/19	U	-3.97E+00	1.21E+01	2.10E+01	6.16E+01	1.21E+01	pCi/g
C-14	02/13/19	U	6.43E-02	1.88E-01	3.13E-01	5.00E-01	1.88E-01	pCi/g
Ni-63	02/14/19	U	-5.37E+00	1.41E+01	2.41E+01	6.94E+01	1.41E+01	pCi/g
Sr-90	02/11/19	U	-1.20E-02	7.00E-02	1.19E-01	1.36E-01	7.00E-02	pCi/g
Tc-99	02/19/19	U	-1.75E-01	4.91E-01	8.30E-01	1.16E+00	4.91E-01	pCi/g
Pu-241	02/08/19	U	1.25E+01	2.77E+01	4.55E+01	8.29E+01	2.79E+01	pCi/g
Alpha Spec								
Pu-238	02/06/19	U	-1.39E-02	1.67E-01	3.74E-01	2.80E+00	1.67E-01	pCi/g
Pu-239/240	02/06/19	U	-1.26E-01	2.59E-01	5.89E-01	2.51E+00	2.59E-01	pCi/g
Am-241	02/06/19	U	8.28E-02	1.65E-01	2.67E-01	2.28E+00	1.65E-01	pCi/g
Cm-243/244	02/06/19	U	7.20E-02	1.64E-01	2.81E-01	2.80E+00	1.64E-01	pCi/g
Cm-245/246	02/06/19	U	1.28E-01	1.85E-01	2.23E-01	1.64E+00	1.85E-01	pCi/g
Gamma Spec								
Ni-59	02/14/19	U	-8.31E+00	4.48E+01	7.42E+01	1.83E+02	4.49E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 470413008
Client Sample ID: FSS-2163: OOL10-22-013-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: January 28, 2019
Receive Date: February 04, 2019
Report Date: February 20, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	02/07/19	U	-3.74E-03	7.82E-02	1.32E-01		7.82E-02	pCi/g
Na-22	02/07/19	U	-4.91E-03	1.12E-02	1.76E-02		1.14E-02	pCi/g
K-40	02/07/19		7.30E+00	5.03E-01	1.15E-01		9.27E-01	pCi/g
Cr-51	02/07/19	U	3.64E-02	1.05E-01	1.69E-01		1.07E-01	pCi/g
Mn-54	02/07/19	U	7.23E-03	9.70E-03	1.80E-02		1.03E-02	pCi/g
Fe-59	02/07/19	U	8.11E-04	2.49E-02	3.73E-02		2.49E-02	pCi/g
Co-56	02/07/19	U	-4.84E-03	8.69E-03	1.41E-02		8.97E-03	pCi/g
Co-57	02/07/19	U	-9.47E-04	9.46E-03	1.57E-02		9.47E-03	pCi/g
Co-58	02/07/19	U	2.35E-03	1.04E-02	1.72E-02		1.04E-02	pCi/g
Co-60	02/07/19	U	4.62E-03	1.05E-02	1.87E-02	3.42E-01	1.07E-02	pCi/g
Zn-65	02/07/19	U	1.13E-04	2.42E-02	3.61E-02		2.42E-02	pCi/g
Y-88	02/07/19	U	4.93E-03	8.06E-03	1.56E-02		8.37E-03	pCi/g
Zr-95	02/07/19	U	1.75E-02	2.10E-02	3.42E-02		2.25E-02	pCi/g
Nb-94	02/07/19	U	-2.30E-03	9.18E-03	1.46E-02	6.39E-01	9.24E-03	pCi/g
Nb-95	02/07/19	U	6.27E-03	9.81E-03	1.72E-02		1.02E-02	pCi/g
Ru-106	02/07/19	U	-4.51E-02	8.33E-02	1.30E-01		8.59E-02	pCi/g
Ag-110m	02/07/19	U	1.78E-02	2.61E-02	2.38E-02		2.74E-02	pCi/g
Sn-113	02/07/19	U	5.41E-03	1.21E-02	2.13E-02		1.23E-02	pCi/g
Sb-124	02/07/19	U	9.09E-03	1.86E-02	3.39E-02		1.90E-02	pCi/g
Sb-125	02/07/19	U	-1.51E-02	2.44E-02	3.95E-02		2.54E-02	pCi/g
Cs-134	02/07/19	UI	2.24E-02	1.50E-02	2.24E-02		2.16E-02	pCi/g
Cs-136	02/07/19	U	1.54E-02	2.28E-02	3.80E-02		2.39E-02	pCi/g
Cs-137	02/07/19	U	2.02E-03	1.01E-02	1.70E-02	7.11E-01	1.02E-02	pCi/g
Ba-133	02/07/19	U	8.76E-03	1.21E-02	2.00E-02		1.27E-02	pCi/g
Ba-140	02/07/19	U	-5.51E-02	4.88E-02	7.12E-02		5.49E-02	pCi/g
Ce-139	02/07/19	U	3.01E-03	9.85E-03	1.64E-02		9.96E-03	pCi/g
Ce-141	02/07/19	U	-2.51E-02	1.97E-02	3.04E-02		2.28E-02	pCi/g
Ce-144	02/07/19	U	5.05E-02	7.40E-02	1.18E-01		7.75E-02	pCi/g
Nd-147	02/07/19	U	1.18E-02	9.70E-02	1.65E-01		9.72E-02	pCi/g
Pm-144	02/07/19	U	2.06E-03	8.76E-03	1.48E-02		8.81E-03	pCi/g
Pm-146	02/07/19	U	1.37E-03	1.13E-02	1.93E-02		1.13E-02	pCi/g
Eu-152	02/07/19	U	-3.37E-03	2.59E-02	4.44E-02	9.00E-01	2.59E-02	pCi/g
Eu-154	02/07/19	U	-1.22E-02	3.20E-02	5.09E-02	8.46E-01	3.25E-02	pCi/g
Eu-155	02/07/19	U	1.71E-02	4.17E-02	7.14E-02		4.25E-02	pCi/g
Ir-192	02/07/19	U	-3.73E-03	9.25E-03	1.49E-02		9.40E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 470413008
Client Sample ID: FSS-2163: OOL10-22-013-F-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: gamma

Client: Pacific Gas and Electric Company
Collect Date: January 28, 2019
Receive Date: February 04, 2019
Report Date: February 20, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	02/07/19	U	1.91E-03	1.09E-02	1.74E-02		1.09E-02	pCi/g
Tl-208	02/07/19		1.96E-01	2.42E-02	1.55E-02		2.91E-02	pCi/g
Pb-210	02/07/19	U	1.63E+00	3.33E+00	5.94E+00		3.42E+00	pCi/g
Pb-212	02/07/19		5.70E-01	4.19E-02	3.15E-02		6.31E-02	pCi/g
Pb-214	02/07/19		6.23E-01	5.67E-02	1.05E-01		7.49E-02	pCi/g
Bi-212	02/07/19		9.76E-01	3.00E-01	1.61E-01		3.12E-01	pCi/g
Bi-214	02/07/19		4.96E-01	5.50E-02	3.21E-02		6.84E-02	pCi/g
Ra-228	02/07/19		5.44E-01	9.87E-02	6.24E-02		1.12E-01	pCi/g
Ac-228	02/07/19		5.44E-01	9.87E-02	6.24E-02		1.12E-01	pCi/g
Th-234	02/07/19	U	-2.44E-01	7.46E-01	1.27E+00		7.57E-01	pCi/g
U-235	02/07/19	U	-1.05E-02	7.20E-02	1.18E-01		7.20E-02	pCi/g
U-238	02/07/19	U	-2.44E-01	7.46E-01	1.27E+00		7.57E-01	pCi/g
Np-237	02/07/19	U	-8.47E-03	1.57E-02	2.63E-02	9.90E-01	1.62E-02	pCi/g
Np-239	02/07/19	U	1.54E-01	1.66E-01	1.60E-01		1.80E-01	pCi/g
Am-241	02/07/19	U	-2.37E-02	9.80E-02	1.67E-01	2.27E+00	9.86E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-22-FSR

Data Assessment

Data Quality Assessment of OOL10-22-FSR;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-22-FSR-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-5.70E-03
Maximum Value	1.26E-01
Mean	3.88E-02
Median	2.90E-02
a-posteriori σ	3.60E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~4 standard deviations with one outlier.*
7. *The Quantile Plot exhibits a high skewness to the right, however a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

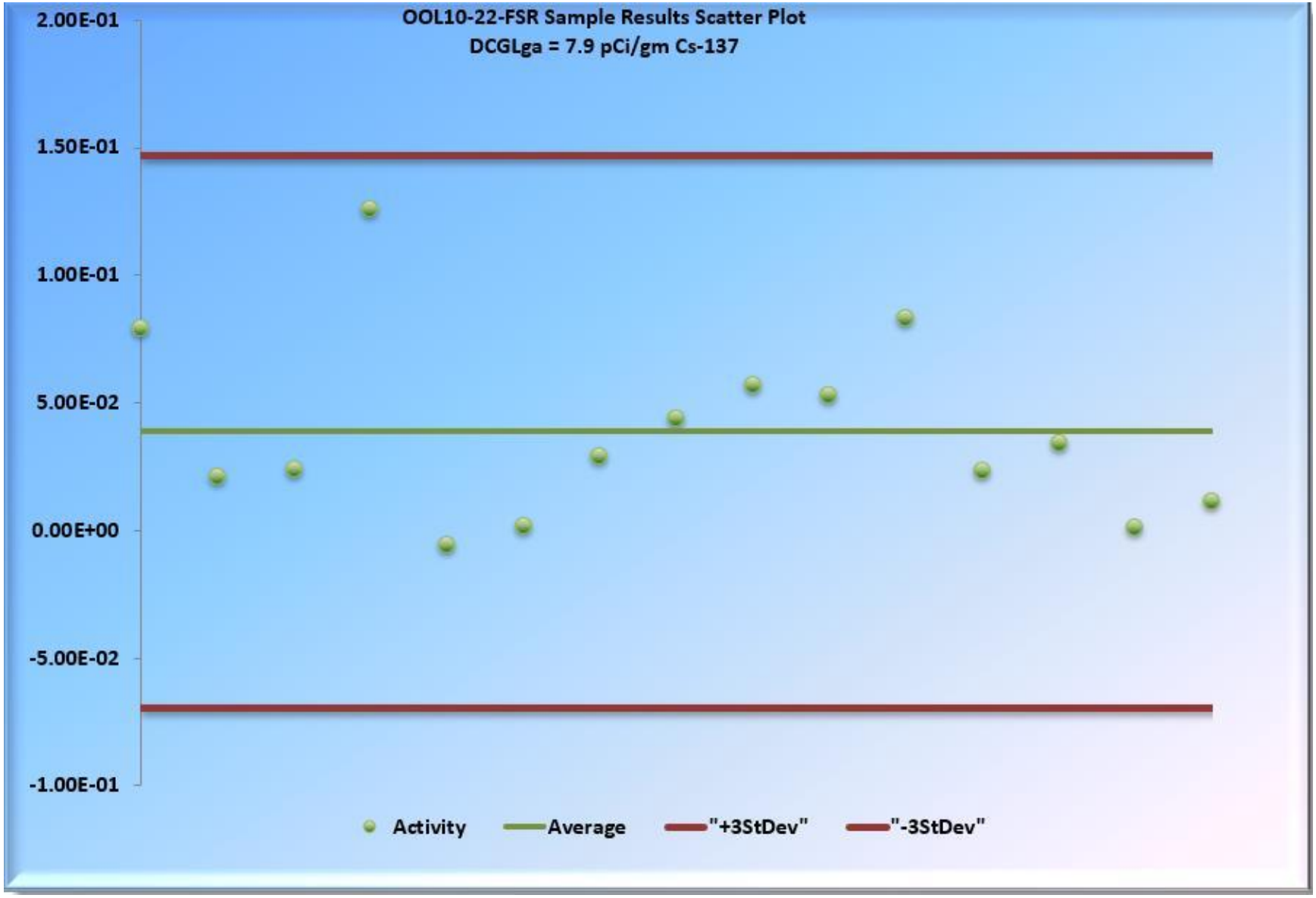
Summary:

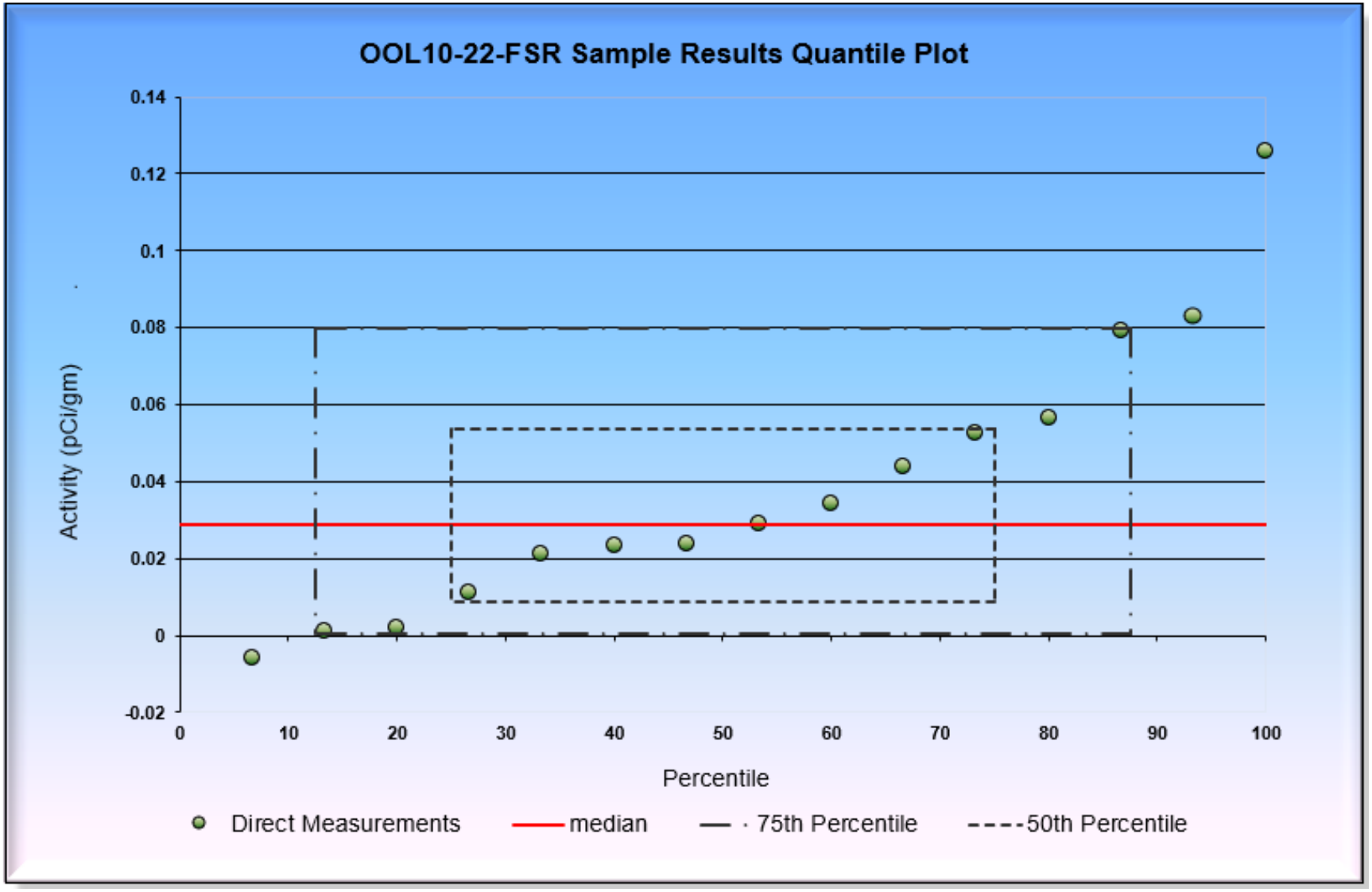
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

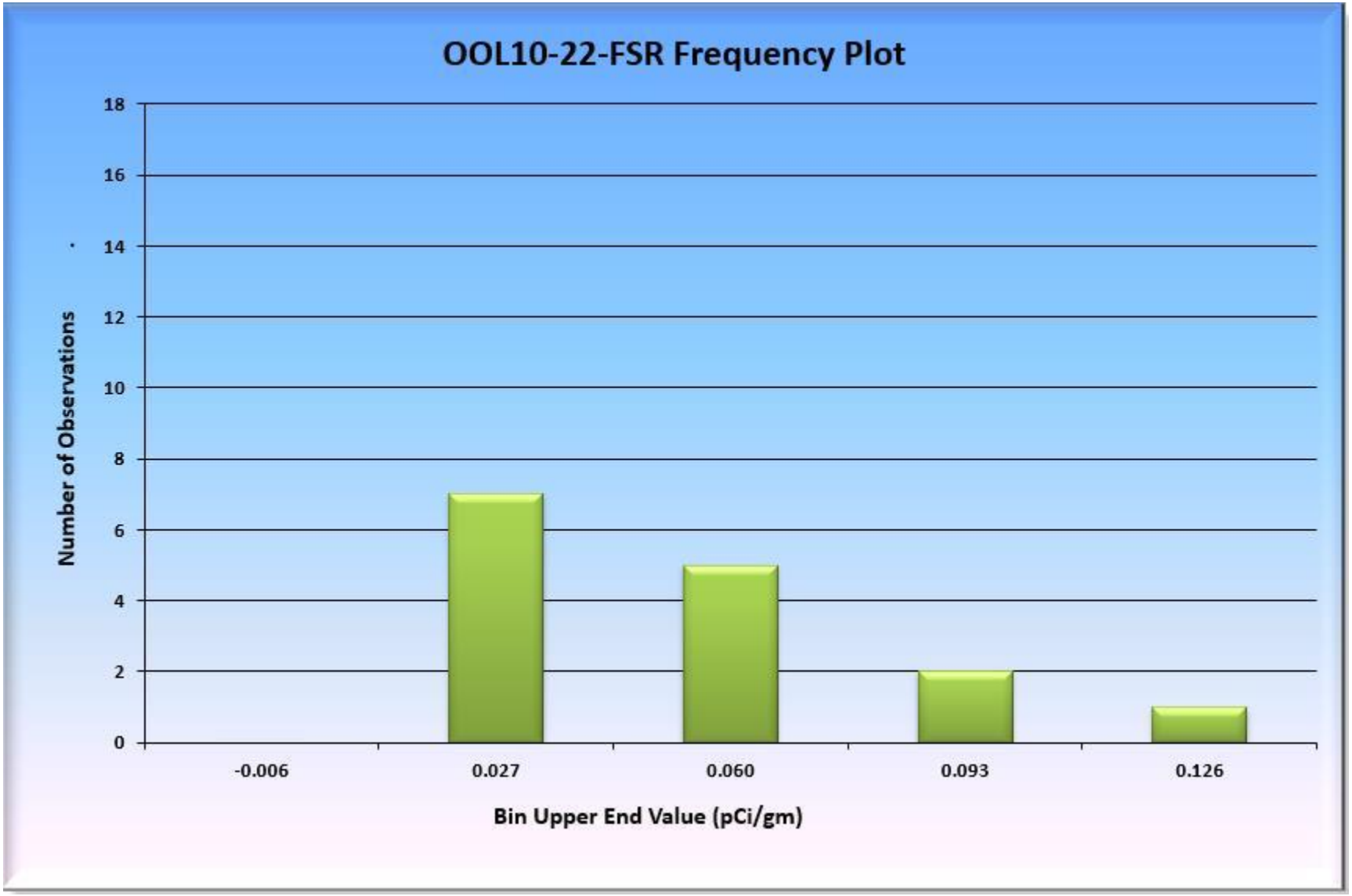
Survey Unit OOL10-22-FSR meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-22-FSR.

FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[1]**
OOL10-22-001-FSR	-5.66E-02	1.10E-02	7.94E-02	3.43E-03	1.01E-02	9.00E-03	-3.93E-02	1.0%
OOL10-22-002-FSR	4.49E-02	-4.84E-03	2.12E-02	3.07E-02	-3.06E-02	8.82E-03	-4.34E-02	0.3%
OOL10-22-003-FSR	-1.27E-01	-1.85E-02	2.40E-02	6.77E-02	-4.43E-06	1.57E-02	1.02E-02	0.3%
OOL10-22-004-FSR	2.32E-02	-4.88E-03	1.26E-01	8.96E-02	0.00E+00	-6.90E-03	-2.16E-02	1.6%
OOL10-22-005-FSR	-1.59E-01	9.27E-03	-5.65E-03	-2.44E-01	-4.47E-02	2.13E-02	1.24E-02	-0.1%
OOL10-22-006-FSR	-9.28E-02	4.18E-02	1.84E-03	-1.32E-01	-4.93E-02	-3.10E-03	-6.76E-02	0.0%
OOL10-22-007-FSR	1.38E-02	-8.80E-03	2.90E-02	-3.30E-02	1.67E-02	-2.22E-02	-2.95E-02	0.4%
OOL10-22-008-FSR	1.08E-01	-1.51E-02	4.39E-02	-4.42E-02	-2.87E-02	-1.51E-02	3.15E-02	0.6%
OOL10-22-009-FSR	5.12E-03	1.47E-03	**5.67E-02**	6.41E-02	-2.78E-02	-3.04E-02	-6.37E-02	0.7%
OOL10-22-010-FSR	-3.92E-01	-2.17E-02	5.27E-02	-1.34E-01	-2.05E-02	2.18E-02	4.26E-02	0.7%
OOL10-22-011-FSR	9.43E-02	1.39E-02	8.31E-02	2.22E-02	-3.05E-02	1.54E-02	-4.91E-02	1.1%
OOL10-22-012-FSR	2.24E-02	3.25E-02	2.32E-02	1.57E-02	1.08E-02	-6.86E-02	5.17E-02	0.3%
OOL10-22-013-FSR	-1.11E-02	1.69E-03	3.41E-02	-8.73E-02	8.40E-03	-6.87E-02	7.41E-02	0.4%
OOL10-22-014-FSR	-2.02E-01	-1.71E-02	1.29E-03	-4.10E-01	-8.12E-02	1.15E-02	1.25E-02	0.0%
OOL10-22-015-FSR	-2.23E-02	5.83E-03	1.11E-02	5.82E-02	6.37E-03	3.53E-03	-2.23E-02	0.1%

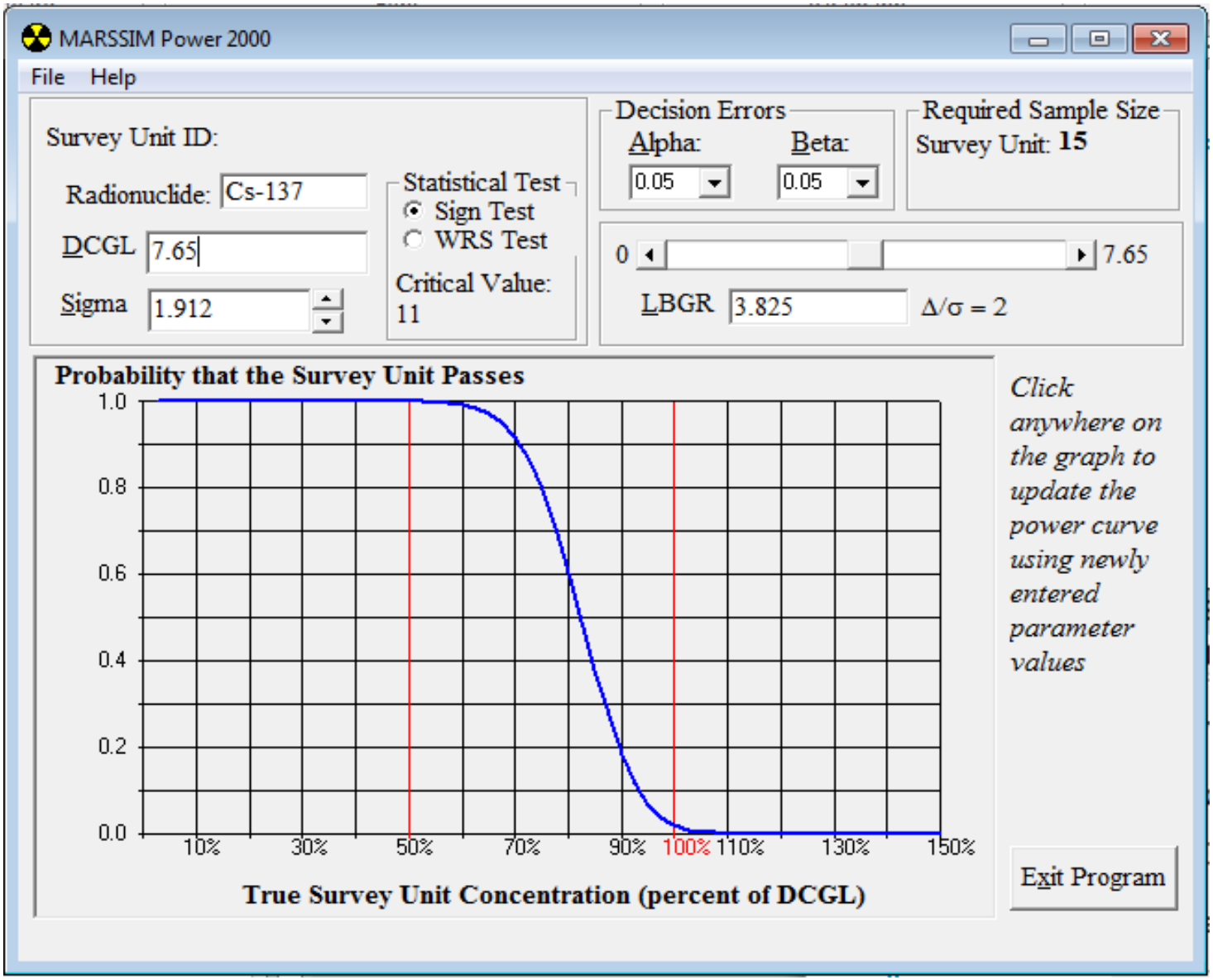
*Results in **bold** indicate positive radionuclide results greater than *a posteriori* method detection levels
Note [1] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)


OOL10-22-FSR Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
Activity
Average
"+3StDev"
"-3StDev"

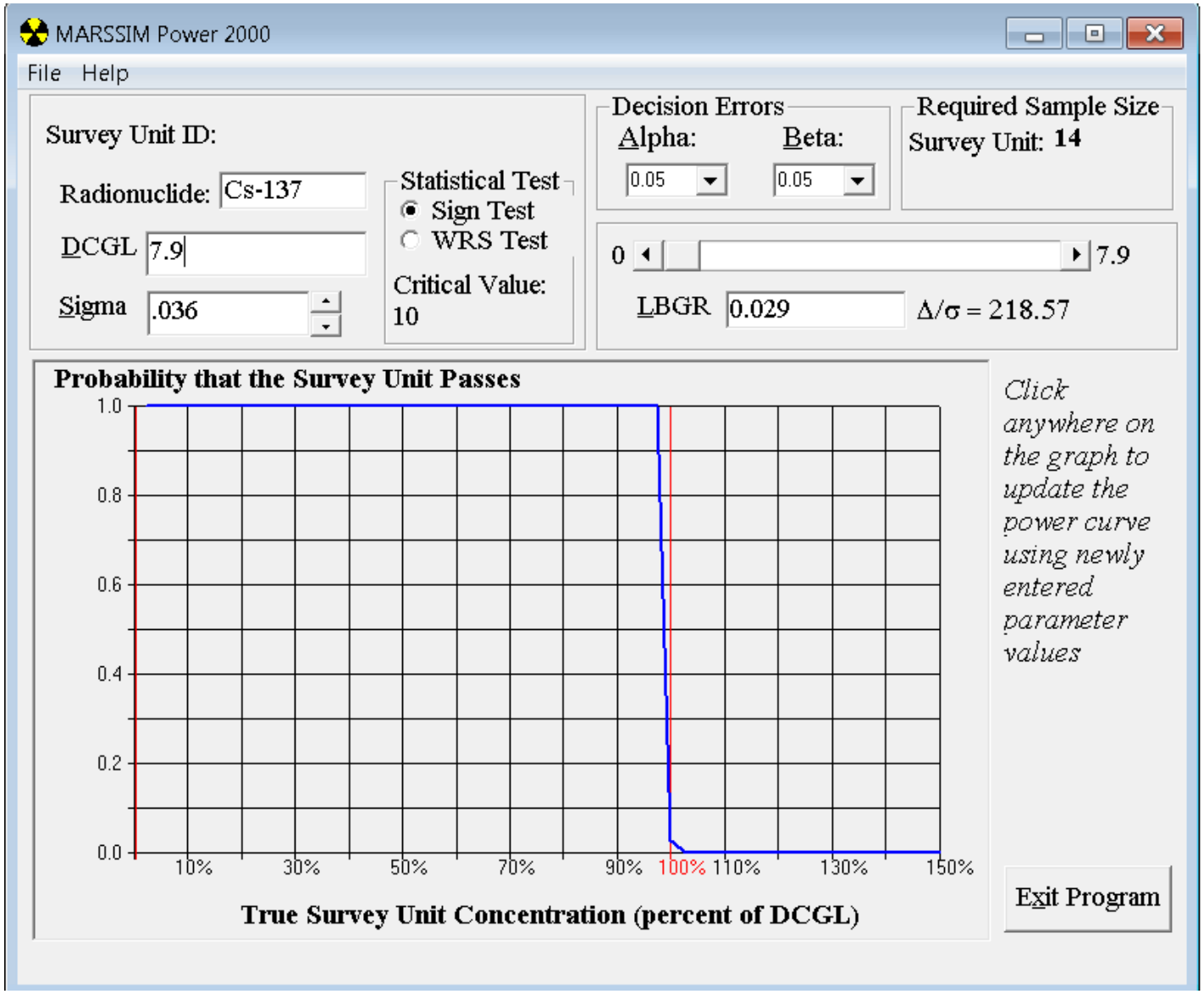

OOL10-22-FSR Sample Results Quantile Plot
Activity (pCi/gm)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile


OOL10-22-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.006
0.027
0.060
0.093
0.126
Bin Upper End Value (pCi/gm)

Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .036
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0 7.9
LBGR 0.029
Δ/σ = 218.57
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10% 30% 50% 70% 90% 100% 110% 130% 150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #004

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-FSR-00			Sample Measurement Location:	004

Sample Description:

Comparison of split samples collected from sample measurement location #004 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.78	0.65	11	0.6	1.66	8.71	0.35	1.29	Y
Pb-212	0.44	0.04	11	0.6	1.66	0.56	0.03	1.29	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	11/19/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Split Sample #011

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-FSR-00			Sample Measurement Location:	11

Sample Description:

Comparison of split samples collected from sample measurement location #011 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	9.96	0.68	15	0.6	1.66	10.80	0.34	1.08	Y
Pb-212	0.36	0.05	8	0.6	1.66	0.55	0.03	1.50	Y
Cs-137[1]	0.08	N/A				0.06	0.02	0.70	N
		0.00					0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and under the MDA of 0.09 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	11/19/19	Concurrence by:	G. Madison	Date: 01/26/21
Signature:			Signature:		

Recount Sample #006

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-FSR-00			Sample Measurement Location:	006

Sample Description:

Duplicate count comparison from sa nple measurement location #006 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.93	0.64	13	0.6	1.66	8.27	0.63	1.04	Y
Pb-212	0.45	0.03	14	0.6	1.66	0.44	0.03	0.96	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	11/19/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

Recount Sample #008

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	22	Survey Unit Name:	ISFSI West
Sample Plan No.:	HBPP-FSSP-OOL10-22-FSR-00			Sample Measurement Location:	008

Sample Description:

Duplicate count comparison from sample measurement location #008 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	6.89	0.64	11	0.6	1.66	7.69	0.57	1.12	Y
Pb-212	0.43	0.04	11	0.6	1.66	0.43	0.03	0.99	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Paul Sirois	Date:	10/29/2019	Concurrence by:	G. Madison	Date:	1/26/2021
Signature:				Signature:			

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 492990003
Client Sample ID: FSS-2470 OOL10-22-004-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/23/19	U	9.75E+00	2.96E+01	4.85E+01	6.16E+01	2.97E+01	pCi/g
C-14	10/31/19	U	-2.44E-01	2.79E-01	4.74E-01	5.00E-01	2.79E-01	pCi/g
Ni-63	10/23/19	U	3.58E+00	1.09E+01	1.80E+01	6.94E+01	1.09E+01	pCi/g
Sr-90	10/24/19	U	-5.25E-02	6.53E-02	1.20E-01	1.36E-01	6.53E-02	pCi/g
Tc-99	10/28/19	U	8.17E-02	6.52E-01	1.09E+00	1.16E+00	6.52E-01	pCi/g
Pu-241	10/29/19	U	-3.98E+00	2.40E+01	4.07E+01	8.29E+01	2.40E+01	pCi/g
Alpha Spec								
Pu-238	10/25/19	U	3.68E-02	1.39E-01	2.70E-01	2.80E+00	1.39E-01	pCi/g
Pu-239/240	10/25/19	U	-9.07E-03	1.23E-01	2.85E-01	2.51E+00	1.23E-01	pCi/g
Am-241	10/24/19	U	-1.22E-02	1.14E-01	2.65E-01	2.41E+00	1.14E-01	pCi/g
Cm-243/244	10/24/19	U	-3.50E-02	9.48E-02	2.53E-01	2.80E+00	9.49E-02	pCi/g
Cm-245/246	10/24/19	U	6.14E-02	1.21E-01	1.67E-01	1.64E+00	1.21E-01	pCi/g
Gamma Spec								
Ni-59	10/22/19	UI	9.08E+00	2.22E+01	9.08E+00	1.83E+02	2.24E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990004
Client Sample ID: FSS-2470 OOL10-22-004-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/24/19	U	-5.56E-03	1.45E-01	2.38E-01		1.45E-01	pCi/g
Na-22	10/24/19	U	-5.54E-04	1.53E-02	2.50E-02		1.53E-02	pCi/g
K-40	10/24/19		8.71E+00	6.93E-01	1.88E-01		1.10E+00	pCi/g
Cr-51	10/24/19	U	-1.04E-01	1.89E-01	3.07E-01		1.95E-01	pCi/g
Mn-54	10/24/19	U	-3.59E-03	1.42E-02	2.36E-02		1.43E-02	pCi/g
Fe-59	10/24/19	U	-1.51E-02	4.17E-02	6.61E-02		4.22E-02	pCi/g
Co-56	10/24/19	U	1.06E-02	1.55E-02	2.84E-02		1.63E-02	pCi/g
Co-57	10/24/19	U	-8.97E-03	1.20E-02	1.85E-02		1.27E-02	pCi/g
Co-58	10/24/19	U	2.32E-03	1.40E-02	2.44E-02		1.40E-02	pCi/g
Co-60	10/24/19	U	-1.07E-02	1.36E-02	1.89E-02	3.42E-01	1.45E-02	pCi/g
Zn-65	10/24/19	U	-2.10E-02	3.62E-02	4.67E-02		3.74E-02	pCi/g
Y-88	10/24/19	U	-5.19E-03	1.19E-02	1.59E-02		1.21E-02	pCi/g
Zr-95	10/24/19	U	3.22E-02	2.84E-02	5.44E-02		3.20E-02	pCi/g
Nb-94	10/24/19	U	8.54E-03	1.12E-02	2.07E-02	6.39E-01	1.18E-02	pCi/g
Nb-95	10/24/19	U	1.29E-02	1.92E-02	3.16E-02		2.01E-02	pCi/g
Ru-106	10/24/19	U	4.29E-02	1.01E-01	1.72E-01		1.02E-01	pCi/g
Ag-110m	10/24/19	U	5.14E-03	1.47E-02	2.61E-02		1.49E-02	pCi/g
Sn-113	10/24/19	U	-6.52E-03	1.96E-02	2.82E-02		1.98E-02	pCi/g
Sb-124	10/24/19	U	-7.24E-03	1.47E-02	1.80E-02		1.51E-02	pCi/g
Sb-125	10/24/19	U	-1.54E-02	3.19E-02	5.05E-02		3.26E-02	pCi/g
Cs-134	10/24/19	UI	2.93E-02	2.96E-02	2.93E-02		3.52E-02	pCi/g
Cs-136	10/24/19	U	1.30E-02	8.27E-02	1.41E-01		8.29E-02	pCi/g
Cs-137	10/24/19	U	1.84E-02	1.67E-02	1.86E-02	7.11E-01	1.67E-02	pCi/g
Ba-133	10/24/19	U	-3.08E-03	1.58E-02	2.32E-02		1.58E-02	pCi/g
Ba-140	10/24/19	U	-1.39E-01	1.67E-01	2.42E-01		1.79E-01	pCi/g
Ce-139	10/24/19	U	-2.02E-03	1.37E-02	2.16E-02		1.37E-02	pCi/g
Ce-141	10/24/19	U	-2.57E-02	4.09E-02	6.32E-02		4.25E-02	pCi/g
Ce-144	10/24/19	U	-2.32E-02	9.26E-02	1.47E-01		9.32E-02	pCi/g
Nd-147	10/24/19	U	-1.53E-02	4.40E-01	7.18E-01		4.40E-01	pCi/g
Pm-144	10/24/19	U	5.24E-03	1.13E-02	2.04E-02		1.15E-02	pCi/g
Pm-146	10/24/19	U	3.84E-03	1.45E-02	2.47E-02		1.46E-02	pCi/g
Eu-152	10/24/19	U	1.41E-02	3.44E-02	6.01E-02	9.00E-01	3.50E-02	pCi/g
Eu-154	10/24/19	U	4.28E-03	4.19E-02	6.99E-02	8.46E-01	4.20E-02	pCi/g
Eu-155	10/24/19	U	8.28E-02	8.11E-02	8.52E-02		8.96E-02	pCi/g
Ir-192	10/24/19	U	2.61E-03	1.39E-02	2.40E-02		1.40E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990004
Client Sample ID: FSS-2470 OOL10-22-004-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/24/19	U	1.32E-02	1.70E-02	3.07E-02		1.81E-02	pCi/g
Tl-208	10/24/19		1.59E-01	2.95E-02	2.03E-02		3.24E-02	pCi/g
Pb-210	10/24/19	U	8.75E-02	4.08E+00	6.89E+00		4.08E+00	pCi/g
Pb-212	10/24/19		5.61E-01	5.00E-02	3.86E-02		6.97E-02	pCi/g
Pb-214	10/24/19		6.88E-01	8.20E-02	4.15E-02		9.98E-02	pCi/g
Bi-212	10/24/19		4.57E-01	3.29E-01	2.95E-01		3.31E-01	pCi/g
Bi-214	10/24/19		5.99E-01	7.56E-02	4.38E-02		9.10E-02	pCi/g
Ra-228	10/24/19		5.70E-01	1.07E-01	6.92E-02		1.20E-01	pCi/g
Ac-228	10/24/19		5.70E-01	1.07E-01	6.92E-02		1.20E-01	pCi/g
Th-234	10/24/19	U	3.64E-01	1.43E+00	1.29E+00		1.43E+00	pCi/g
U-235	10/24/19	U	1.72E-02	9.45E-02	1.54E-01		9.48E-02	pCi/g
U-238	10/24/19	U	3.64E-01	1.43E+00	1.29E+00		1.43E+00	pCi/g
Np-237	10/24/19	U	3.15E-03	2.22E-02	3.81E-02	9.90E-01	2.22E-02	pCi/g
Np-239	10/24/19	U	-4.02E-02	1.27E-01	2.02E-01		1.28E-01	pCi/g
Am-241	10/24/19	U	4.19E-02	1.07E-01	1.71E-01	2.27E+00	1.09E-01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990005
Client Sample ID: FSS-2472 OOL10-22-011-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	10/23/19	U	6.85E+00	2.25E+01	3.69E+01	6.16E+01	2.26E+01	pCi/g
C-14	11/01/19	U	-1.29E-01	2.69E-01	4.54E-01	5.00E-01	2.69E-01	pCi/g
Ni-63	10/23/19	U	1.97E+00	1.01E+01	1.69E+01	6.94E+01	1.02E+01	pCi/g
Sr-90	10/23/19	U	-6.26E-02	6.36E-02	1.18E-01	1.36E-01	6.36E-02	pCi/g
Tc-99	10/28/19	U	-1.75E-02	5.77E-01	9.69E-01	1.16E+00	5.77E-01	pCi/g
Pu-241	10/29/19	U	-2.83E+01	2.92E+01	5.13E+01	8.29E+01	2.91E+01	pCi/g
Alpha Spec								
Pu-238	10/26/19	U	-8.27E-02	1.41E-01	3.78E-01	2.80E+00	1.41E-01	pCi/g
Pu-239/240	10/26/19	U	-9.12E-02	1.42E-01	3.86E-01	2.51E+00	1.42E-01	pCi/g
Am-241	10/24/19	U	-9.77E-02	9.43E-02	3.31E-01	2.41E+00	9.45E-02	pCi/g
Cm-243/244	10/24/19	U	-4.24E-02	1.15E-01	3.07E-01	2.80E+00	1.15E-01	pCi/g
Cm-245/246	10/24/19	U	7.45E-02	1.47E-01	2.03E-01	1.64E+00	1.47E-01	pCi/g
Gamma Spec								
Ni-59	10/22/19	U	2.00E+01	2.03E+01	3.75E+01	1.83E+02	2.23E+01	pCi/g

Notes:
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2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 492990006
Client Sample ID: FSS-2472 OOL10-22-011-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	10/24/19	U	-7.44E-02	1.46E-01	2.28E-01		1.50E-01	pCi/g
Na-22	10/24/19	U	-3.41E-03	1.49E-02	2.44E-02		1.50E-02	pCi/g
K-40	10/24/19		1.08E+01	6.75E-01	1.52E-01		1.14E+00	pCi/g
Cr-51	10/24/19	U	5.13E-03	1.91E-01	3.20E-01		1.91E-01	pCi/g
Mn-54	10/24/19	U	-6.08E-04	1.31E-02	2.24E-02		1.31E-02	pCi/g
Fe-59	10/24/19	U	6.21E-03	3.72E-02	6.45E-02		3.74E-02	pCi/g
Co-56	10/24/19	U	1.11E-03	1.59E-02	2.76E-02		1.59E-02	pCi/g
Co-57	10/24/19	U	-3.64E-03	1.30E-02	2.21E-02		1.31E-02	pCi/g
Co-58	10/24/19	U	-4.13E-03	1.52E-02	2.20E-02		1.53E-02	pCi/g
Co-60	10/24/19	U	-4.89E-03	1.06E-02	1.64E-02	3.42E-01	1.09E-02	pCi/g
Zn-65	10/24/19	U	-7.70E-03	3.46E-02	4.96E-02		3.48E-02	pCi/g
Y-88	10/24/19	U	-5.32E-04	8.98E-03	1.45E-02		8.98E-03	pCi/g
Zr-95	10/24/19	U	2.49E-03	2.73E-02	4.77E-02		2.74E-02	pCi/g
Nb-94	10/24/19	U	1.90E-03	1.14E-02	2.02E-02	6.39E-01	1.15E-02	pCi/g
Nb-95	10/24/19	U	2.75E-02	2.07E-02	3.64E-02		2.43E-02	pCi/g
Ru-106	10/24/19	U	5.59E-02	1.14E-01	1.96E-01		1.17E-01	pCi/g
Ag-110m	10/24/19	U	2.79E-03	1.54E-02	2.70E-02		1.54E-02	pCi/g
Sn-113	10/24/19	U	-7.67E-03	1.77E-02	2.84E-02		1.81E-02	pCi/g
Sb-124	10/24/19	U	1.32E-02	2.23E-02	4.34E-02		2.31E-02	pCi/g
Sb-125	10/24/19	U	1.77E-03	3.35E-02	5.56E-02		3.35E-02	pCi/g
Cs-134	10/24/19	UI	2.94E-02	2.09E-02	2.94E-02		2.75E-02	pCi/g
Cs-136	10/24/19	U	-4.72E-02	7.29E-02	1.14E-01		7.61E-02	pCi/g
Cs-137	10/24/19	M	5.85E-02	3.91E-02	2.42E-02	7.11E-01	3.95E-02	pCi/g
Ba-133	10/24/19	U	-4.13E-03	1.64E-02	2.37E-02		1.65E-02	pCi/g
Ba-140	10/24/19	U	1.88E-01	1.96E-01	3.54E-01		2.15E-01	pCi/g
Ce-139	10/24/19	U	2.53E-03	1.38E-02	2.38E-02		1.38E-02	pCi/g
Ce-141	10/24/19	U	-9.12E-03	3.93E-02	6.67E-02		3.95E-02	pCi/g
Ce-144	10/24/19	U	-5.69E-02	9.72E-02	1.63E-01		1.01E-01	pCi/g
Nd-147	10/24/19	U	2.48E-01	4.52E-01	7.85E-01		4.66E-01	pCi/g
Pm-144	10/24/19	U	-2.22E-03	1.24E-02	1.97E-02		1.25E-02	pCi/g
Pm-146	10/24/19	U	9.77E-03	1.66E-02	2.81E-02		1.72E-02	pCi/g
Eu-152	10/24/19	U	-7.16E-03	3.68E-02	6.06E-02	9.00E-01	3.70E-02	pCi/g
Eu-154	10/24/19	U	-7.35E-03	4.23E-02	6.97E-02	8.46E-01	4.24E-02	pCi/g
Eu-155	10/24/19	U	-2.01E-02	5.74E-02	9.79E-02		5.82E-02	pCi/g
Ir-192	10/24/19	U	-3.20E-03	1.49E-02	2.46E-02		1.50E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 492990006
Client Sample ID: FSS-2472 OOL10-22-011-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: September 25, 2019
Receive Date: October 15, 2019
Report Date: November 13, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	10/24/19	U	-1.06E-02	1.82E-02	2.95E-02		1.89E-02	pCi/g
Tl-208	10/24/19		1.56E-01	3.58E-02	2.19E-02		3.85E-02	pCi/g
Pb-210	10/24/19	UI	7.65E+00	4.00E+00	7.65E+00		7.03E+00	pCi/g
Pb-212	10/24/19		5.47E-01	5.20E-02	3.85E-02		6.59E-02	pCi/g
Pb-214	10/24/19		7.92E-01	8.33E-02	1.35E-01		1.03E-01	pCi/g
Bi-212	10/24/19		5.47E-01	3.38E-01	3.09E-01		3.42E-01	pCi/g
Bi-214	10/24/19		7.00E-01	7.56E-02	3.58E-02		9.97E-02	pCi/g
Ra-228	10/24/19		5.92E-01	1.41E-01	8.65E-02		1.50E-01	pCi/g
Ac-228	10/24/19		5.92E-01	1.41E-01	8.65E-02		1.50E-01	pCi/g
Th-234	10/24/19	U	3.93E-01	1.16E+00	1.99E+00		1.18E+00	pCi/g
U-235	10/24/19	U	1.41E-02	9.33E-02	1.61E-01		9.33E-02	pCi/g
U-238	10/24/19	U	3.93E-01	1.16E+00	1.99E+00		1.18E+00	pCi/g
Np-237	10/24/19	U	3.14E-03	2.56E-02	4.32E-02	9.90E-01	2.56E-02	pCi/g
Np-239	10/24/19	U	3.90E-02	1.35E-01	2.37E-01		1.37E-01	pCi/g
Am-241	10/24/19	U	1.90E-01	1.78E-01	2.37E-01	2.27E+00	1.79E-01	pCi/g

Notes:
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2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-26-FSR

Data Assessment

Data Quality Assessment of OOL10-26-FSR;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-26-FSR-00. The classification history satisfies the DQOs in the survey plan.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical samples gathered. The survey had more than sufficient power.*

Statistical quantities (Cs-137 reported in pCi/g):

Number of statistical samples	15
Minimum value	-1.08E-02
Maximum Value	8.17E-02
Mean	2.85E-02
Median	2.28E-02
a-posteriori σ	2.71E-02

5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the mean.*
7. *The Quantile Plot exhibits fair symmetry, and a review of the posting plot did not reveal any abnormalities.*
8. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution noted.*
9. *The data posting plot does not clearly reveal any systematic spatial trends.*
10. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
11. *The data verified all the key assumptions of the statistical test.*
12. *The survey possessed sufficient power to pass the survey unit.*

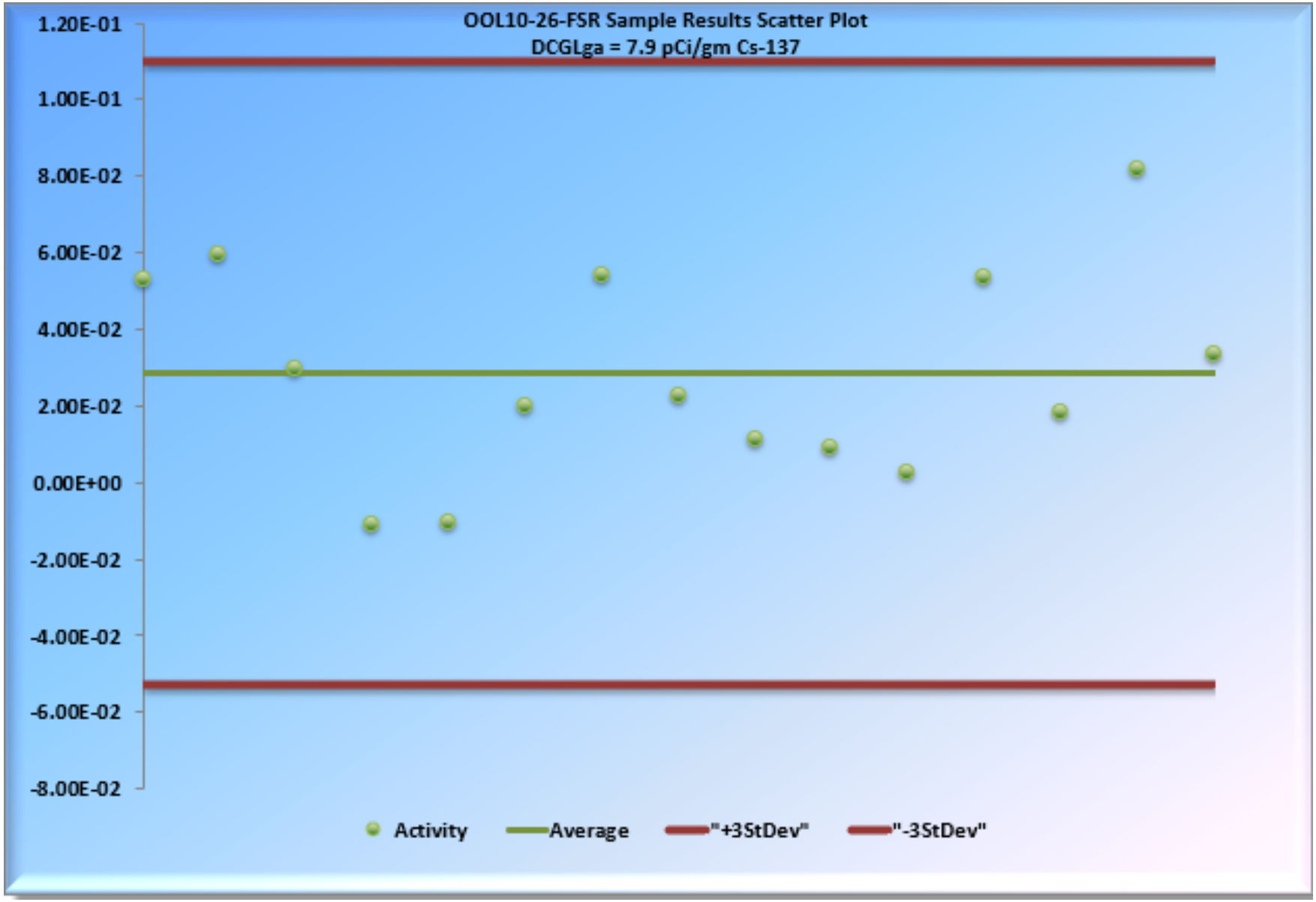
Summary:

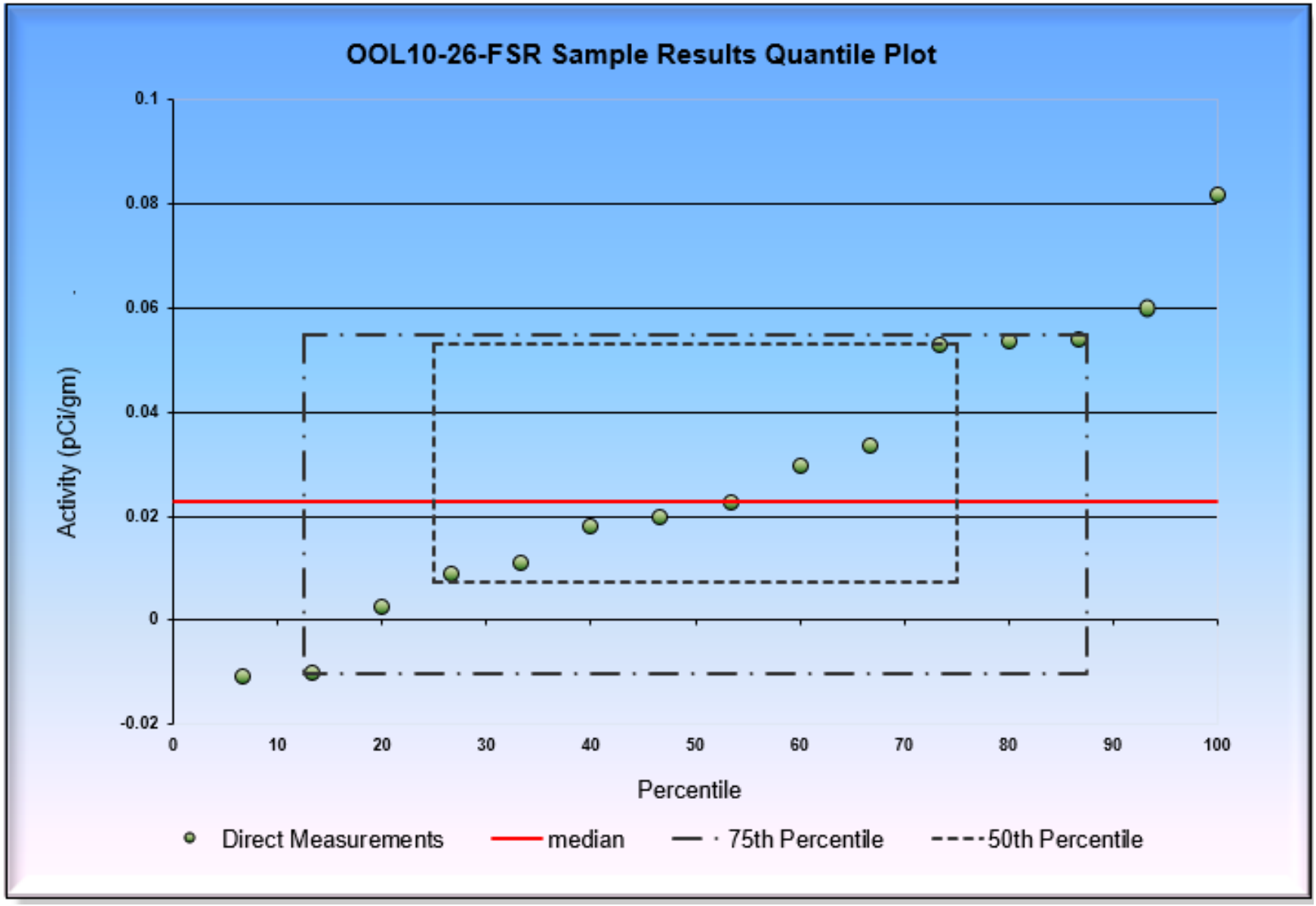
The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

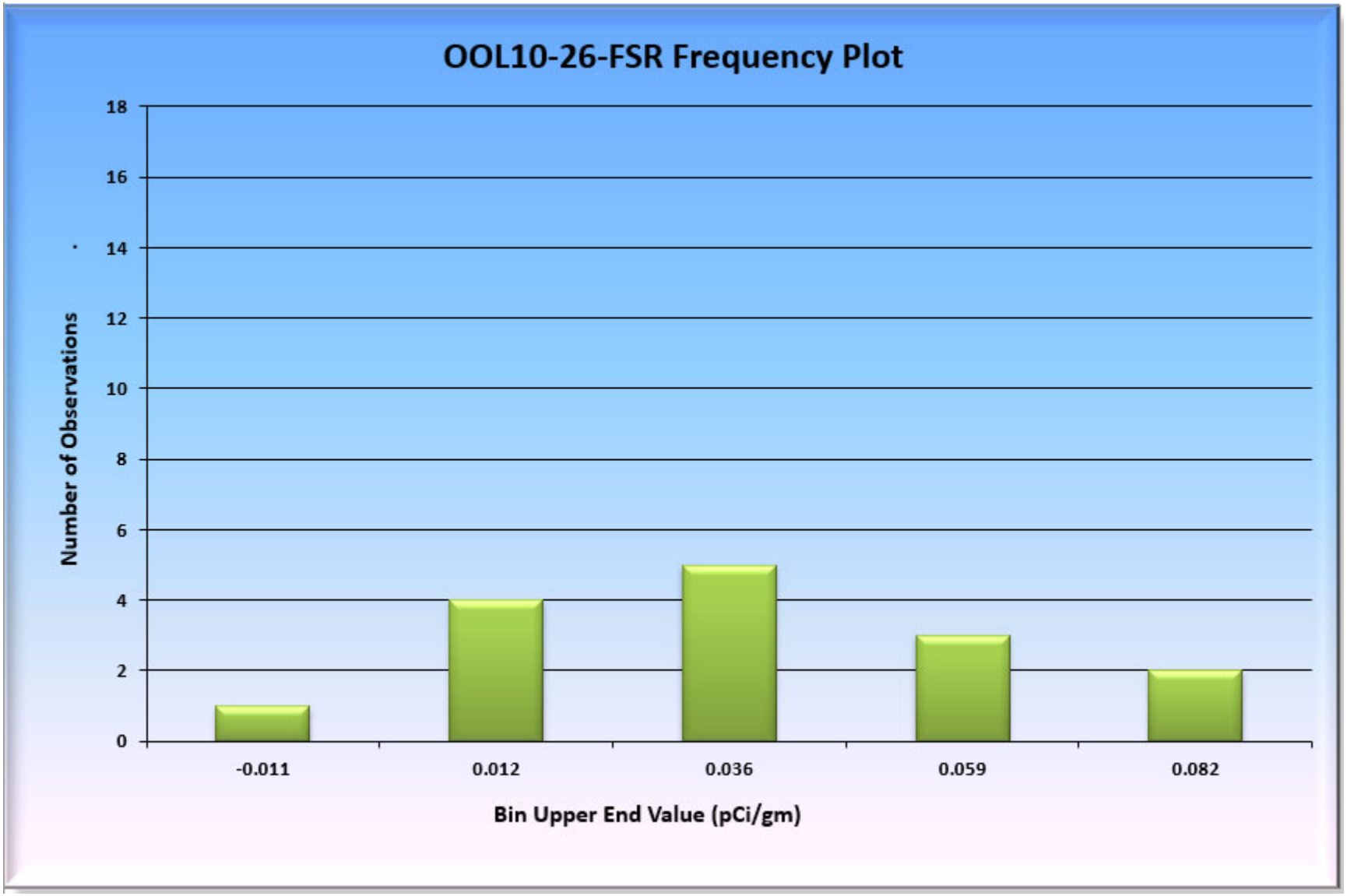
Survey Unit OOL10-26-FSR meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-26-FSR.

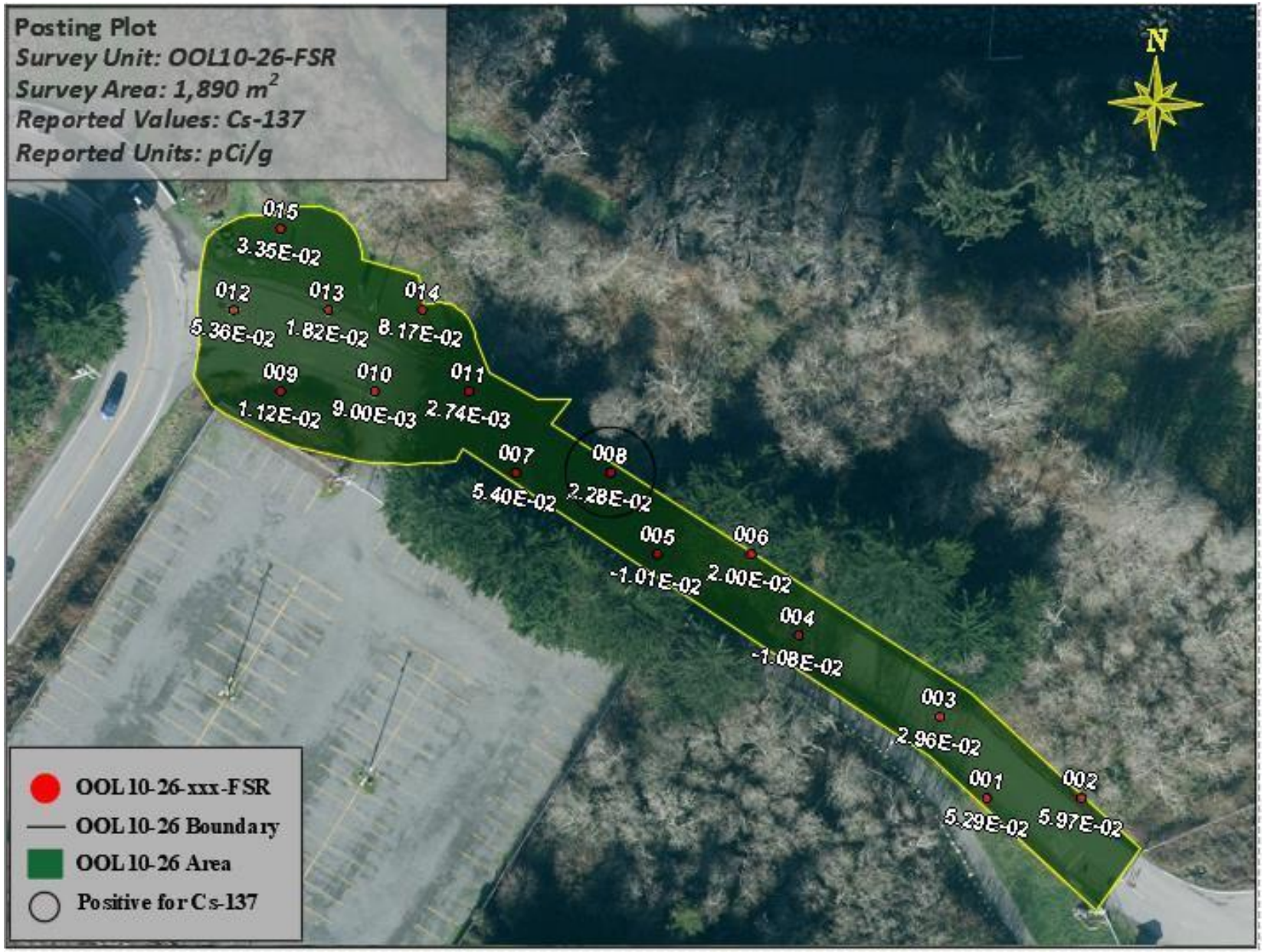
FSS Direct Soil Sample Radionuclides of Concern Results (pCi/g)								
Sample Number	**Am-241**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Nb-94**	**Np-237**	**SOF[(1)]**
OOL10-26-001-FSR	5.78E-03	3.09E-02	5.29E-02	-1.83E-02	-6.02E-02	-2.64E-02	3.13E-02	0.7%
OOL10-26-002-FSR	-1.47E-01	-2.50E-02	5.97E-02	3.77E-02	-1.53E-02	-2.19E-03	1.02E-02	0.8%
OOL10-26-003-FSR	2.48E-02	-5.52E-04	2.96E-02	-1.24E-01	-1.51E-02	1.56E-03	6.32E-02	0.4%
OOL10-26-004-FSR	-8.10E-02	-2.03E-03	-1.08E-02	9.70E-03	-6.85E-02	7.60E-03	2.53E-02	-0.1%
OOL10-26-005-FSR	1.87E-01	-1.48E-02	-1.02E-02	1.61E-02	-1.26E-02	-5.23E-02	-2.12E-02	-0.1%
OOL10-26-006-FSR	1.90E-01	9.26E-03	2.00E-02	-5.93E-03	2.81E-02	1.15E-02	1.10E-02	0.3%
OOL10-26-007-FSR	-1.07E-01	-3.53E-02	5.40E-02	-2.62E-02	3.53E-02	-3.31E-02	-1.40E-02	0.7%
OOL10-26-008-FSR	-1.50E-01	-7.21E-04	**2.28E-02**	4.99E-02	-8.05E-02	-2.10E-02	2.52E-02	0.3%
OOL10-26-009-FSR	-1.58E-01	9.29E-03	1.12E-02	-6.31E-02	-1.35E-01	2.60E-02	2.00E-02	0.1%
OOL10-26-010-FSR	-1.20E-01	-4.92E-03	9.00E-03	-1.05E-01	2.76E-02	3.20E-03	4.44E-02	0.1%
OOL10-26-011-FSR	-8.93E-03	5.50E-03	2.74E-03	4.88E-02	1.53E-02	-1.60E-02	2.83E-02	0.0%
OOL10-26-012-FSR	-3.62E-02	-1.54E-01	5.36E-02	-1.02E-01	-2.67E-02	-1.98E-02	-3.37E-02	0.7%
OOL10-26-013-FSR	2.27E-01	-1.92E-03	1.82E-02	-1.01E-02	-8.93E-02	-3.90E-02	-1.66E-02	0.2%
OOL10-26-014-FSR	-2.22E-02	-1.20E-02	8.17E-02	-1.31E-01	-3.65E-03	-8.61E-03	-3.42E-02	1.0%
OOL10-26-015-FSR	-3.14E-02	-1.31E-02	3.35E-02	-2.86E-02	-6.89E-03	-5.53E-03	-6.88E-02	0.4%

*Result in **bold** indicates a positive radionuclide result less than reported *a posteriori* method detection level (MDA=3.15E-02 pCi/g)
Note [(1)] The SOF (sum of fractions) presented in the table is calculated relative to the DCGL for Cs-137 as presented in LTP Table 5-1 (7.9 pCi/g)

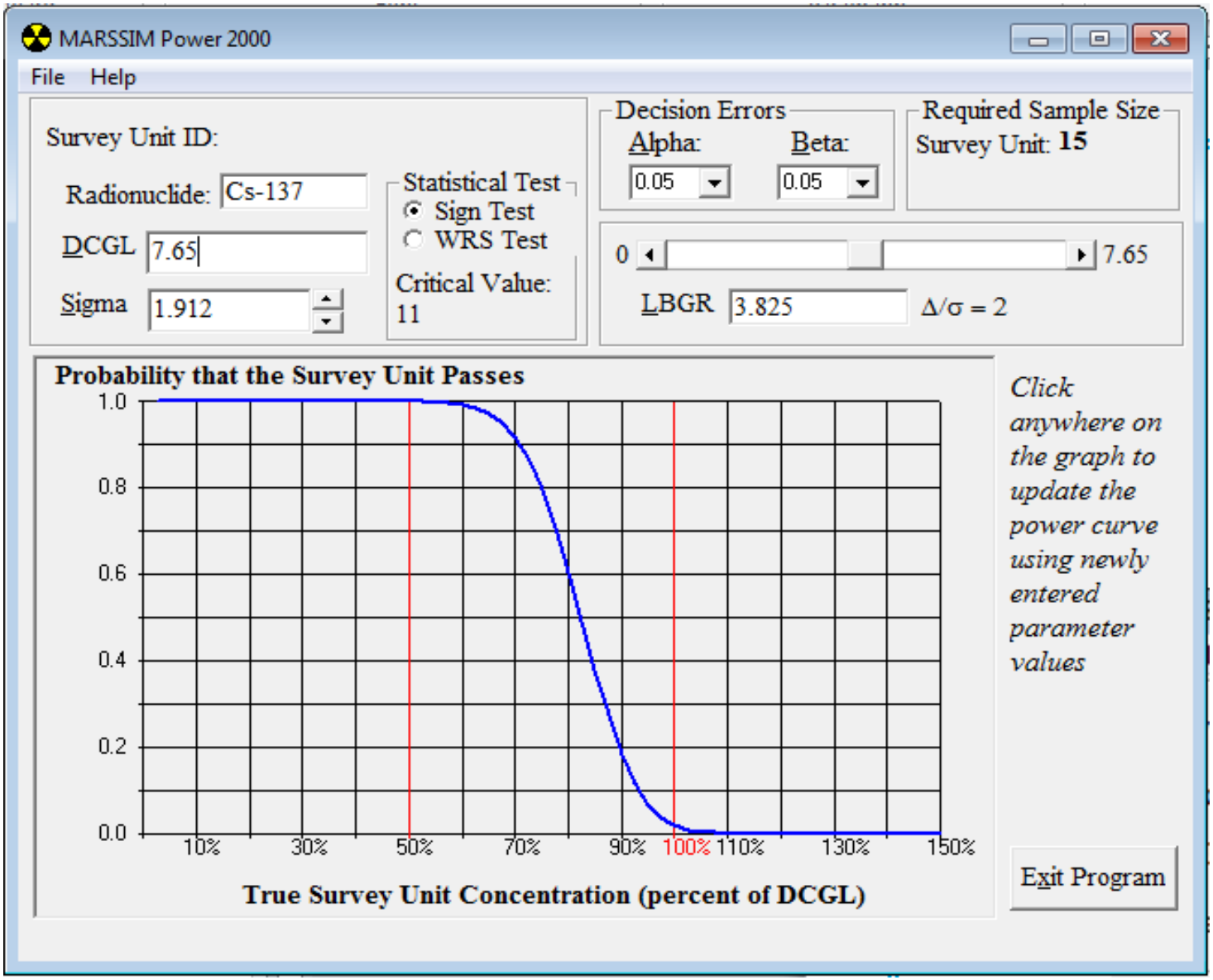

OOL10-26-FSR Sample Results Scatter Plot
DCGLga = 7.9 pCi/gm Cs-137
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
Activity
Average
"+3StDev"
"-3StDev"


OOL10-26-FSR Sample Results Quantile Plot
Activity (pCi/gm)
0.1
0.08
0.06
0.04
0.02
0
-0.02
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

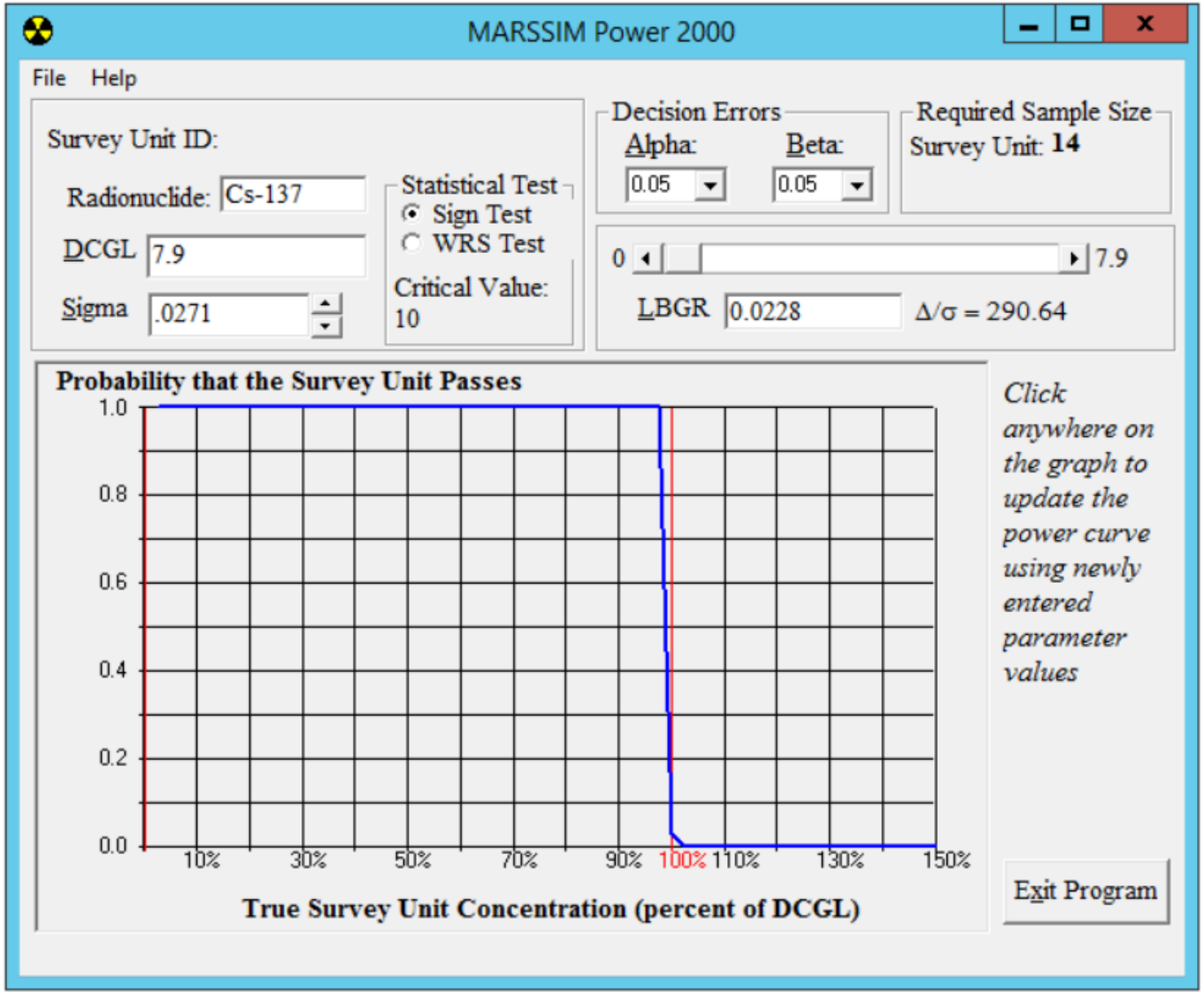

OOL10-26-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
-0.011
0.012
0.036
0.059
0.082
Bin Upper End Value (pCi/gm)



Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File
Help
Survey Unit ID:
Radionuclide: Cs-137
DCGL 7.9
Sigma .0271
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0
7.9
LBGR 0.0228
Δ/σ = 290.64
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10%
30%
50%
70%
90%
100%
110%
130%
150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

Split Sample #003

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	26	Survey Unit Name:	Charlie Road
Sample Plan No.:	HBPP-FSSP-OOL10-26-FSR-00.			Sample Measurement Location:	003

Sample Description:

Comparison of split samples collected from sample measurement location #003 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	8.51	0.54	16	0.6	1.66	8.72	0.17	1.03	Y
Pb-212	0.43	0.05	9	0.6	1.66	0.44	0.01	1.03	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	01/27/21	Concurrence by:	M. Blake	Date: 01/27/21
Signature:			Signature:		

Split Sample #005

Split Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	26	Survey Unit Name:	Charlie Road
Sample Plan No.:	HBPP-FSSP-OOL10-26-FSR-00.			Sample Measurement Location:	005

Sample Description:

Comparison of split samples collected from sample measurement location #005 and analyzed using gamma spectroscopy by an off-site vendor laboratory. The on-site result is the standard count and the off-site is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	8.31	0.60	14	0.6	1.66	10.60	0.20	1.28	Y
Pb-212	0.35	0.03	11	0.6	1.66	0.51	0.01	1.45	Y
Cs-137[1]	-0.01	N/A				0.02	0.01	-1.69	N
		0.00					0.00		

Comments/Corrective Actions:

Note (1) HBPP Lab reported result value listed for Cs-137 was not positively detected and under the MDA of 0.08 pCi/g. There is no comparision between the two lab results for Cs-137, as the HBPP value is a non-detect with no error reported. However, the K-40 and Pb-212 comparisons show good agreement between the two laboratory results.

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	1/27/2021	Concurrence by:	M. Blake	Date:	1/27/2021
Signature:				Signature:			

Recount Sample #004

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	26	Survey Unit Name:	Charlie Road
Sample Plan No.:	HBPP-FSSP-OOL10-26-FSR-00.			Sample Measurement Location:	004

Sample Description:

Duplicate count comparison from sa nple measurement location #004 and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	7.08	0.55	13	0.6	1.66	7.88	0.56	1.11	Y
Pb-212	0.44	0.03	14	0.6	1.66	0.35	0.03	0.80	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

N/A

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Mad son	Date:	1/27/2021	Concurrence by:	M. Blake	Date:	1/27/2021
Signature:				Signature:			

Recount Sample #012

Recount Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	26	Survey Unit Name:	Charlie Road
Sample Plan No.:	HBPP-FSSP-OOL10-26-FSR-00			Sample Measurement Location:	012

Sample Description:

Duplicate count comparison from sample measurement location #012and analyzed using gamma spectroscopy by the on-site laboratory. The original count result is the standard count and the recount is the comparison.

STANDARD						COMPARISON			
Radionuclide chosen	Standard Activity	1σ *Uncertainty*	Resolution	Agreement Range		Comparison Activity	Comparison Error	Comparison Ratio	Acceptable
(a)	(b)	(c)	(d)=(b)/(c)	(e)		(f)	(g)	(h)=(f)/(b)	(Y/N)
K-40	9.41	0.68	14	0.6	1.66	9.52	0.68	1.01	Y
Pb-212	0.43	0.03	13	0.6	1.66	0.46	0.03	1.08	Y
		0.00					0.00		
		0.00					0.00		

Comments/Corrective Actions:

Table 1 is provided to show acceptance criteria for sample recounts.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	Gordon Madison	Date:	5/26/2021	Concurrence by:	Marshall Blake	Date:	5/26/2021
Signature:				Signature:	Marshall H Blake		

GEL LABORATORIES LLC

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Certificate of Analysis

GEL Sample ID: 487593005
Client Sample ID: FSS-2386: OOL10-26-003-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/24/19	U	1.88E+01	2.42E+01	3.82E+01	6.16E+01	2.46E+01	pCi/g
C-14	08/31/19	U	-2.30E-01	2.15E-01	3.67E-01	5.00E-01	2.15E-01	pCi/g
Ni-63	08/30/19	U	-2.37E+00	1.19E+01	2.01E+01	6.94E+01	1.19E+01	pCi/g
Sr-90	08/28/19	U	3.31E-02	7.21E-02	1.11E-01	1.36E-01	7.24E-02	pCi/g
Tc-99	08/29/19	U	-9.48E-01	6.67E-01	1.14E+00	1.16E+00	6.67E-01	pCi/g
Pu-241	08/28/19	U	3.88E+00	3.53E+01	5.89E+01	8.29E+01	3.53E+01	pCi/g
Alpha Spec								
Pu-238	08/26/19	U	-4.34E-02	1.48E-01	4.12E-01	2.80E+00	1.48E-01	pCi/g
Pu-239/240	08/26/19	U	5.50E-02	2.03E-01	3.40E-01	2.51E+00	2.03E-01	pCi/g
Am-241	08/24/19	U	-3.41E-02	1.44E-01	3.85E-01	2.41E+00	1.45E-01	pCi/g
Cm-243/244	08/24/19	U	-4.21E-02	1.43E-01	4.00E-01	2.80E+00	1.44E-01	pCi/g
Cm-245/246	08/24/19	U	-2.93E-02	1.64E-01	4.14E-01	1.64E+00	1.65E-01	pCi/g
Gamma Spec								
Ni-59	08/29/19	U	9.68E-02	4.03E+01	6.82E+01	1.83E+02	4.03E+01	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593006
Client Sample ID: FSS-2386: OOL10-26-003-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/15/19	U	-2.78E-02	5.15E-02	8.19E-02		5.31E-02	pCi/g
Na-22	08/15/19	U	9.46E-05	6.88E-03	1.16E-02		6.88E-03	pCi/g
K-40	08/15/19		8.72E+00	3.48E-01	7.05E-02		8.22E-01	pCi/g
Cr-51	08/15/19	U	-1.99E-02	6.05E-02	9.98E-02		6.12E-02	pCi/g
Mn-54	08/15/19	U	1.28E-03	6.20E-03	1.08E-02		6.23E-03	pCi/g
Fe-59	08/15/19	U	-6.72E-03	1.31E-02	2.14E-02		1.35E-02	pCi/g
Co-56	08/15/19	U	1.11E-04	5.49E-03	9.41E-03		5.49E-03	pCi/g
Co-57	08/15/19	U	2.93E-03	6.83E-03	1.19E-02		6.96E-03	pCi/g
Co-58	08/15/19	U	2.31E-03	6.40E-03	1.01E-02		6.48E-03	pCi/g
Co-60	08/15/19	U	1.93E-03	6.19E-03	1.07E-02	3.42E-01	6.26E-03	pCi/g
Zn-65	08/15/19	U	9.22E-03	1.50E-02	2.38E-02		1.56E-02	pCi/g
Y-88	08/15/19	U	1.17E-03	4.55E-03	7.86E-03		4.58E-03	pCi/g
Zr-95	08/15/19	UI	2.18E-02	2.77E-02	2.18E-02		3.26E-02	pCi/g
Nb-94	08/15/19	U	2.53E-03	5.96E-03	1.06E-02	6.39E-01	6.07E-03	pCi/g
Nb-95	08/15/19	U	8.48E-03	7.29E-03	1.22E-02		8.27E-03	pCi/g
Ru-106	08/15/19	U	-7.96E-03	5.55E-02	8.92E-02		5.56E-02	pCi/g
Ag-110m	08/15/19	U	2.30E-03	8.04E-03	1.41E-02		8.10E-03	pCi/g
Sn-113	08/15/19	U	-3.05E-03	8.10E-03	1.32E-02		8.22E-03	pCi/g
Sb-124	08/15/19	U	-1.06E-02	1.03E-02	1.36E-02		1.13E-02	pCi/g
Sb-125	08/15/19	U	-5.57E-03	1.62E-02	2.62E-02		1.64E-02	pCi/g
Cs-134	08/15/19	UI	1.46E-02	1.15E-02	1.46E-02		1.71E-02	pCi/g
Cs-136	08/15/19	U	8.28E-03	1.17E-02	2.11E-02		1.24E-02	pCi/g
Cs-137	08/15/19	UI	1.19E-02	1.47E-02	1.19E-02	7.11E-01	1.48E-02	pCi/g
Ba-133	08/15/19	U	-6.92E-04	8.23E-03	1.22E-02		8.23E-03	pCi/g
Ba-140	08/15/19	U	9.47E-03	3.37E-02	5.61E-02		3.39E-02	pCi/g
Ce-139	08/15/19	U	-3.30E-03	6.78E-03	1.14E-02		6.97E-03	pCi/g
Ce-141	08/15/19	U	-1.55E-03	1.32E-02	2.26E-02		1.32E-02	pCi/g
Ce-144	08/15/19	U	9.88E-03	5.52E-02	8.58E-02		5.54E-02	pCi/g
Nd-147	08/15/19	U	-3.42E-02	6.28E-02	9.90E-02		6.47E-02	pCi/g
Pm-144	08/15/19	U	-3.83E-03	6.26E-03	9.67E-03		6.50E-03	pCi/g
Pm-146	08/15/19	U	5.62E-03	7.61E-03	1.31E-02		8.04E-03	pCi/g
Eu-152	08/15/19	U	-7.40E-03	1.92E-02	2.99E-02	9.00E-01	1.95E-02	pCi/g
Eu-154	08/15/19	U	9.31E-05	1.95E-02	3.29E-02	8.46E-01	1.95E-02	pCi/g
Eu-155	08/15/19	U	2.83E-02	3.11E-02	5.50E-02		3.37E-02	pCi/g
Ir-192	08/15/19	U	5.58E-03	6.03E-03	1.05E-02		6.55E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593006
Client Sample ID: FSS-2386: OOL10-26-003-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/15/19	U	5.00E-04	7.05E-03	1.19E-02		7.05E-03	pCi/g
Tl-208	08/15/19		1.51E-01	1.80E-02	1.08E-02		2.27E-02	pCi/g
Pb-210	08/15/19	U	1.31E+00	2.37E+00	3.57E+00		2.37E+00	pCi/g
Pb-212	08/15/19		4.43E-01	2.74E-02	2.02E-02		4.27E-02	pCi/g
Pb-214	08/15/19		4.96E-01	3.84E-02	2.33E-02		5.37E-02	pCi/g
Bi-212	08/15/19		4.67E-01	2.02E-01	1.31E-01		2.07E-01	pCi/g
Bi-214	08/15/19		4.42E-01	3.74E-02	1.97E-02		5.56E-02	pCi/g
Ra-228	08/15/19		6.16E-01	6.20E-02	3.31E-02		8.13E-02	pCi/g
Ac-228	08/15/19		6.16E-01	6.20E-02	3.31E-02		8.13E-02	pCi/g
Th-234	08/15/19	U	7.75E-01	9.16E-01	9.73E-01		9.34E-01	pCi/g
U-235	08/15/19	U	2.06E-02	5.11E-02	8.70E-02		5.20E-02	pCi/g
U-238	08/15/19	U	7.75E-01	9.16E-01	9.73E-01		9.34E-01	pCi/g
Np-237	08/15/19	U	1.54E-02	1.29E-02	2.07E-02	9.90E-01	1.47E-02	pCi/g
Np-239	08/15/19	U	-3.46E-02	7.54E-02	1.29E-01		7.71E-02	pCi/g
Am-241	08/15/19	U	3.87E-02	7.85E-02	1.26E-01	2.27E+00	8.05E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593007
Client Sample ID: FSS-2388: OOL10-26-005-FSR
Client Matrix: Soil
Amount of Sample Received:
Sample Description: HTDs

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
H-3	08/24/19	U	-1.38E+01	2.07E+01	3.66E+01	6.16E+01	2.07E+01	pCi/g
C-14	08/31/19	U	5.31E-02	2.20E-01	3.68E-01	5.00E-01	2.20E-01	pCi/g
Ni-63	08/30/19	U	-7.66E+00	1.15E+01	1.99E+01	6.94E+01	1.15E+01	pCi/g
Sr-90	08/28/19	U	-5.23E-02	6.44E-02	1.20E-01	1.36E-01	6.44E-02	pCi/g
Tc-99	09/01/19	U	-3.86E-01	5.32E-01	9.02E-01	1.16E+00	5.32E-01	pCi/g
Pu-241	08/28/19	U	-2.59E+00	3.55E+01	5.97E+01	8.29E+01	3.55E+01	pCi/g
Alpha Spec								
Pu-238	08/26/19	U	3.92E-02	2.12E-01	4.07E-01	2.80E+00	2.13E-01	pCi/g
Pu-239/240	08/26/19	U	2.11E-02	2.14E-01	4.48E-01	2.51E+00	2.14E-01	pCi/g
Am-241	08/26/19	U	1.20E-01	2.72E-01	4.28E-01	2.41E+00	2.73E-01	pCi/g
Cm-243/244	08/26/19	U	3.12E-02	2.21E-01	4.45E-01	2.80E+00	2.21E-01	pCi/g
Cm-245/246	08/26/19	U	-3.26E-02	1.82E-01	4.61E-01	1.64E+00	1.83E-01	pCi/g
Gamma Spec								
Ni-59	08/29/19	U	3.59E+00	7.32E+00	1.74E+01	1.83E+02	7.50E+00	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

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Certificate of Analysis

GEL Sample ID: 487593008
Client Sample ID: FSS-2388: OOL10-26-005-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Gamma Spec								
Be-7	08/15/19	U	-3.36E-03	5.00E-02	8.47E-02		5.01E-02	pCi/g
Na-22	08/15/19	U	-6.80E-04	7.92E-03	1.34E-02		7.93E-03	pCi/g
K-40	08/15/19		1.06E+01	4.00E-01	7.78E-02		1.11E+00	pCi/g
Cr-51	08/15/19	U	-1.79E-02	6.12E-02	9.42E-02		6.18E-02	pCi/g
Mn-54	08/15/19	U	9.80E-03	8.84E-03	1.05E-02		8.88E-03	pCi/g
Fe-59	08/15/19	U	8.89E-03	1.41E-02	2.55E-02		1.47E-02	pCi/g
Co-56	08/15/19	U	3.89E-04	6.33E-03	1.04E-02		6.33E-03	pCi/g
Co-57	08/15/19	U	1.67E-03	6.29E-03	1.04E-02		6.33E-03	pCi/g
Co-58	08/15/19	U	-5.11E-03	6.86E-03	9.12E-03		7.25E-03	pCi/g
Co-60	08/15/19	U	-1.12E-03	6.07E-03	1.01E-02	3.42E-01	6.09E-03	pCi/g
Zn-65	08/15/19	U	2.85E-03	1.65E-02	2.55E-02		1.65E-02	pCi/g
Y-88	08/15/19	U	2.21E-03	4.55E-03	7.86E-03		4.67E-03	pCi/g
Zr-95	08/15/19	U	2.75E-03	1.33E-02	1.99E-02		1.33E-02	pCi/g
Nb-94	08/15/19	U	1.84E-03	6.13E-03	1.04E-02	6.39E-01	6.18E-03	pCi/g
Nb-95	08/15/19	U	-1.13E-05	7.54E-03	1.11E-02		7.54E-03	pCi/g
Ru-106	08/15/19	U	-5.31E-03	5.72E-02	8.47E-02		5.73E-02	pCi/g
Ag-110m	08/15/19	U	-7.56E-03	8.96E-03	1.35E-02		9.61E-03	pCi/g
Sn-113	08/15/19	U	2.48E-03	7.90E-03	1.38E-02		7.98E-03	pCi/g
Sb-124	08/15/19	U	6.33E-03	1.03E-02	1.91E-02		1.07E-02	pCi/g
Sb-125	08/15/19	U	9.07E-03	1.53E-02	2.71E-02		1.59E-02	pCi/g
Cs-134	08/15/19	UI	1.50E-02	1.09E-02	1.50E-02		1.57E-02	pCi/g
Cs-136	08/15/19	U	9.61E-03	1.27E-02	2.32E-02		1.35E-02	pCi/g
Cs-137	08/15/19	M	1.71E-02	1.01E-02	9.91E-03	7.11E-01	1.02E-02	pCi/g
Ba-133	08/15/19	U	8.83E-03	8.17E-03	1.36E-02		9.12E-03	pCi/g
Ba-140	08/15/19	U	1.59E-02	3.23E-02	5.62E-02		3.31E-02	pCi/g
Ce-139	08/15/19	U	-6.88E-03	7.04E-03	1.10E-02		7.83E-03	pCi/g
Ce-141	08/15/19	U	-9.13E-03	1.33E-02	2.11E-02		1.40E-02	pCi/g
Ce-144	08/15/19	U	-1.23E-02	5.07E-02	8.25E-02		5.10E-02	pCi/g
Nd-147	08/15/19	U	-2.68E-02	6.15E-02	1.01E-01		6.27E-02	pCi/g
Pm-144	08/15/19	U	2.54E-03	5.72E-03	9.79E-03		5.83E-03	pCi/g
Pm-146	08/15/19	U	1.33E-03	7.26E-03	1.25E-02		7.29E-03	pCi/g
Eu-152	08/15/19	U	-3.42E-03	1.90E-02	3.12E-02	9.00E-01	1.91E-02	pCi/g
Eu-154	08/15/19	U	-2.13E-03	2.25E-02	3.82E-02	8.46E-01	2.25E-02	pCi/g
Eu-155	08/15/19	U	9.65E-03	2.74E-02	4.59E-02		2.78E-02	pCi/g
Ir-192	08/15/19	U	-3.98E-03	6.03E-03	1.02E-02		6.30E-03	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

GEL LABORATORIES LLC

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

Certificate of Analysis

GEL Sample ID: 487593008
Client Sample ID: FSS-2388: OOL10-26-005-FSR-S
Client Matrix: Soil
Amount of Sample Received:
Sample Description: Gamma

Client: Pacific Gas and Electric Company
Collect Date: August 07, 2019
Receive Date: August 14, 2019
Report Date: September 03, 2019

Isotope	Run Date	Qualifier	Activity	2 Sigma Uncertainty	MDC	LLD	2 Sigma TPU	Units
Hg-203	08/15/19	U	7.37E-03	8.53E-03	1.16E-02		9.18E-03	pCi/g
Tl-208	08/15/19		1.64E-01	1.89E-02	1.01E-02		2.33E-02	pCi/g
Pb-210	08/15/19	U	1.05E+00	1.98E+00	3.42E+00		2.04E+00	pCi/g
Pb-212	08/15/19		5.13E-01	2.62E-02	1.99E-02		5.30E-02	pCi/g
Pb-214	08/15/19		5.87E-01	4.11E-02	2.36E-02		6.52E-02	pCi/g
Bi-212	08/15/19		6.86E-01	1.79E-01	1.33E-01		1.89E-01	pCi/g
Bi-214	08/15/19		4.81E-01	4.03E-02	1.86E-02		5.67E-02	pCi/g
Ra-228	08/15/19		5.68E-01	6.88E-02	4.24E-02		8.65E-02	pCi/g
Ac-228	08/15/19		5.68E-01	6.88E-02	4.24E-02		8.65E-02	pCi/g
Th-234	08/15/19		1.31E+00	8.53E-01	7.50E-01		9.04E-01	pCi/g
U-235	08/15/19	U	4.59E-02	4.90E-02	8.19E-02		4.91E-02	pCi/g
U-238	08/15/19		1.31E+00	8.53E-01	7.50E-01		9.04E-01	pCi/g
Np-237	08/15/19	U	-2.91E-03	1.18E-02	2.04E-02	9.90E-01	1.19E-02	pCi/g
Np-239	08/15/19	U	-4.94E-02	6.81E-02	1.10E-01		7.18E-02	pCi/g
Am-241	08/15/19	U	7.67E-02	7.63E-02	8.83E-02	2.27E+00	7.66E-02	pCi/g

Notes:
1. LLDs are a-priori values.
2. MDCs are calculated a-posteriori values.
3. Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.
4. Air sample volumes are received in units of ft3. GEL converts the units and reports them as m3.

Qualifiers:
U Target isotope was analyzed for but not detected above the MDC and LLD.
UI Uncertain identification for gamma spectroscopy.
X Lab-specific qualifier-please see case narrative, data summary package or contact your project manager for details.
M Reported result is less than the LLD and greater than the MDC.

OOL10-24-FSR

Data Assessment

Pacific Gas and Electric Company®

James M. Welsch
Senior Vice President
Generation and
Chief Nuclear Officer

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

805.545.3242
E-Mail: James.Welsch@pge.com

July 11, 2019

PG&E Letter HBL-19-012

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

10 CFR 50.82 (a)(9)

Docket No. 50-133, OL-DPR-7
Humboldt Bay Power Plant, Unit 3
Reclassification of Building 47 Waste Management Facility and the Waste Management Facility Storage Pad at Humboldt Bay Power Plant

Dear Commissioners and Staff:

In accordance with Humboldt Bay Power Plant Unit 3 (HBPP) License Condition 2.C.(5), Pacific Gas and Electric Company (PG&E) is notifying the NRC at least 14 days prior to implementation of reclassification of a survey area to a less restrictive classification. PG&E intends to reclassify Building 47 (Waste Management Facility (WMF)) and the WMF Storage Pad as depicted in Figure 2-2 of the Defueled Safety Analysis Report and described in Section 2.1.8.17 of the License Termination Plan (LTP) from a Multi-Agency Radiation Survey and Site Investigation Manual Class 1 to lower classifications as described below.

The WMF was built during decommissioning and was classified as a Class 1 area based on the expected decommissioning support activities to be conducted in the area. However, a subsequent decision to direct most of the radiological remediation waste to new soil management structures reduced the anticipated radiological impact on the WMF. The current classification as indicated by LTP Section 2.1.8.17 is a Class 1 survey area.

Visual inspections performed of the areas behind the push walls, which are too small for a person to enter, indicate minimal amounts of spoils and decommissioning debris present. A characterization survey was performed June 6, 2019, to assess the radiological impact to the facility from past operations. The survey focused on the limited access areas behind the south push wall of the structure. Direct measurements collected from the structure wall, push wall, and floor where residual material was sampled indicate less than 1 percent of the building surface Derived Concentration Guideline Level (DCGL) for Cs-137. Media samples of spoils, splatter, and debris material collected from the areas prior to direct measurement collection averaged less than 1 percent of the soil DCGL for Cs-137. It should be noted that of all 15 media samples collected, only one indicated Cs-137, an HBPP plant-derived radionuclide, with a result of 3.24E-01 pCi/g. This result is indicative of global fallout concentrations observed for the area.

The WMF will be cleaned prior to final status survey (FSS) and then reconfigured as a warehouse facility for the Humboldt Bay Generating Station.

PG&E proposes to perform a survey to the rigors of a Class 2 survey area on accessible concrete surfaces of the floor and walls. The accessible and limited accessible areas within and behind the push wall respectively have the highest potential for contamination; therefore, activity levels should be similar to or greater than the inaccessible areas behind the push walls. However, static measurements of the inaccessible areas behind the push wall will be collected for statistical comparisons with data collected from the accessible areas behind the push wall as part of the Data Quality Objective process for FSS Survey Design.

PG&E also proposes a survey to the rigors of a Class 2 survey area on the remainder of the area surrounding the WMF, known as the WMF Storage Pad. The downgrading of the WMF Storage Pad from a Class 1 to a Class 2 survey unit is reasonable and appropriate given the above history and the absence of activity distinguishable from background from review of routine contamination surveys performed of this area.

PG&E proposes to perform a survey to the rigors of a Class 3 survey area on metal structures such as interior and exterior siding, side support beams, sheet metal roof, and overhead roof struts in the structure. The classification downgrade of the exterior and interior surfaces of the building structure are reasonable and appropriate given the characterization of the facility and the FSS data collected from the Class 2 and Class 3 survey areas surrounding the structure.

The above changes to classification for FSS of the WMF standing structure and WMF Storage Pad will be reflected in the biennial update to the LTP.

PG&E makes no new or revised regulatory commitments (as defined by NEI 99-04) in this letter.

If you have any questions, please contact William Barley, Site Closure Manager, at (707) 444-0856.

Sincerely,

Paula Gafen for James Welsch

James M. Welsch
Senior Vice President Generation, and Chief Nuclear Officer

cc: John B. Hickman, NRC Project Manager
Scott A. Morris, NRC Region IV Administrator
HBPP Humboldt Distribution NRC Document Control Desk

Data Quality Assessment of OOL10-24-FSR;

1. *The HBPP LTP Revision 1 Chapter 2 and Historical Site Assessment 2011 Update were reviewed and compared to the DQOs of HBPP-FSSP-OOL10-24-FSR-00. The classification of the WMF Pad was downgraded in accordance with Section 1.5 of the LTP. A characterization survey was completed before the FSS survey and it was deemed appropriate to downgrade the WMF Structure and Concrete Pad from Class 1 to Class 2 and Class 3 areas.*
2. *The survey unit description as well as the design, measurement locations, analytical methods and detection limits, variability (a-priori σ), QC requirements and survey and sampling accuracy were adequately discussed in the FSSP.*
3. *All field documents, instrument issue, measurement results and maps were complete and legible.*
4. *A preliminary data review was performed of the 15 statistical direct measurements for gross alpha and gross beta activity that were collected. The survey had more than sufficient power.*

Statistical quantities:

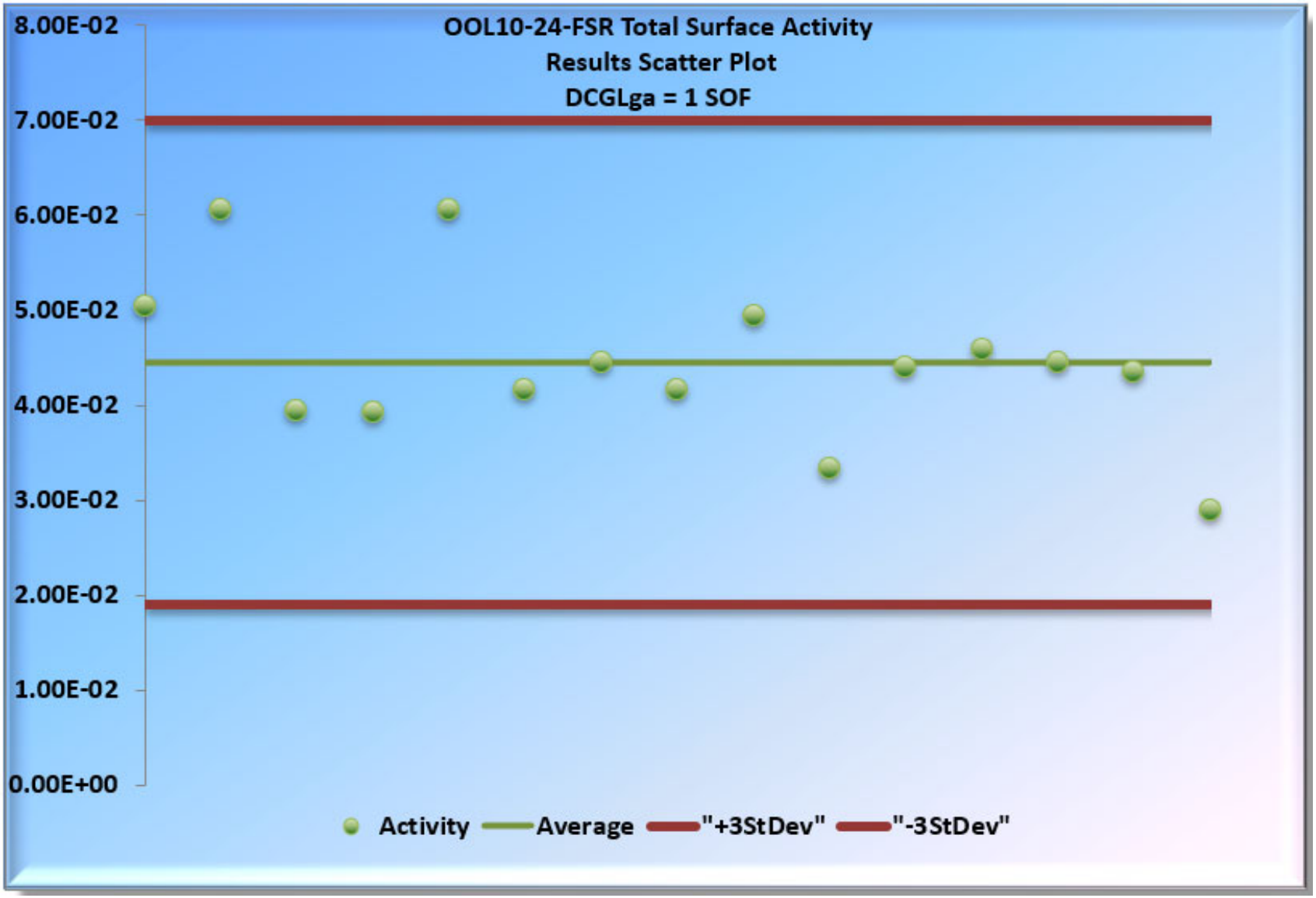
Number of statistical samples	15
Minimum value	2.90E-02
Maximum Value	6.07E-02
Mean	4.45E-02
Median	4.40E-02
a-posteriori σ	8.50E-03

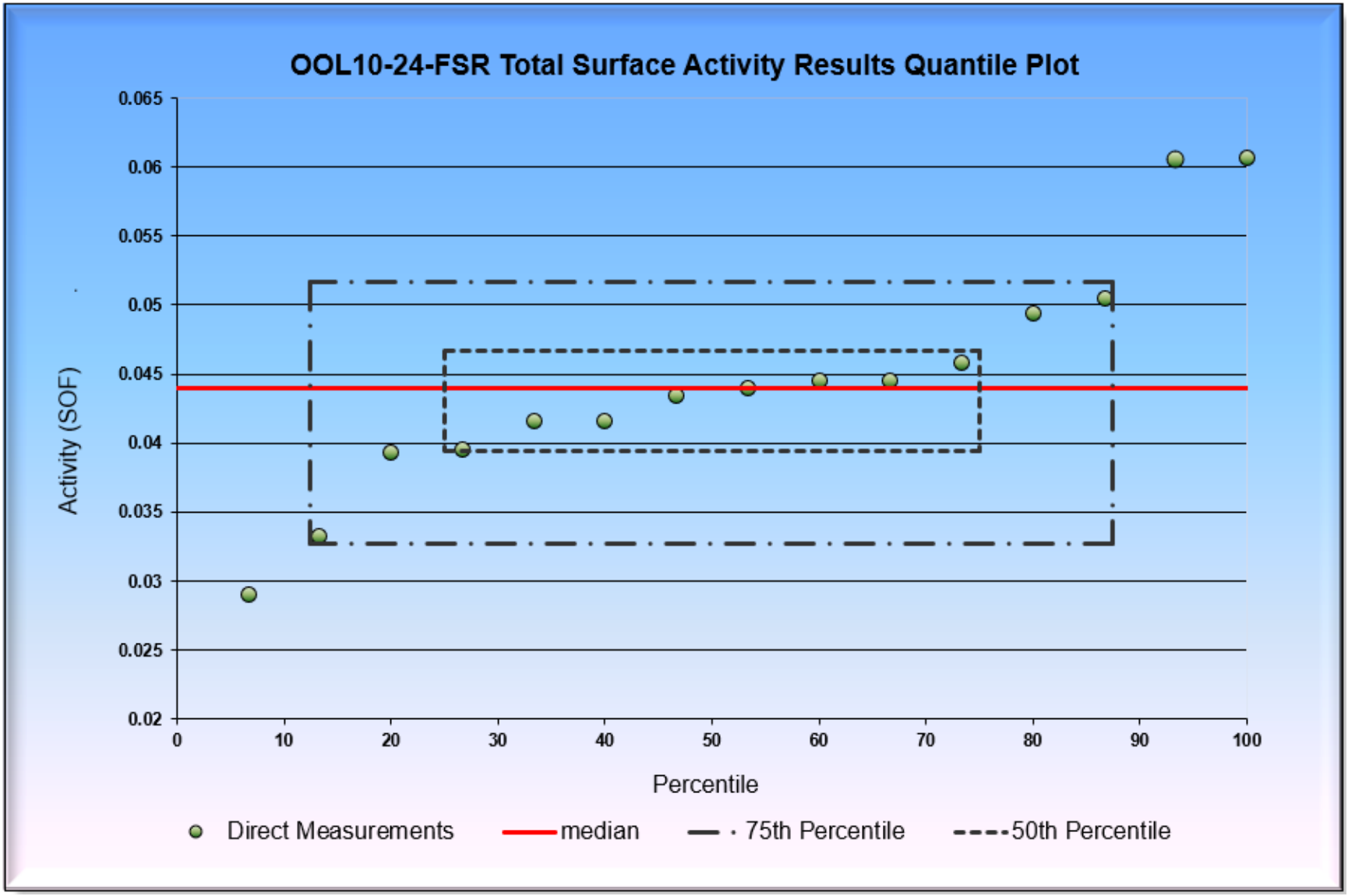
5. *The mean is approximately equal to the median indicating a common central tendency.*
6. *The range of the data varies within ~3 standard deviations about the mean.*
7. *The Scatter Plot shows there were no outlier measurements results.*
8. *The Quantile Plot exhibits normal symmetry.*
9. *The Frequency Plot demonstrates a slight positive skewed distribution.*
10. *The data posting plot does not clearly reveal any systematic spatial trends.*
11. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
12. *The data verified all the key assumptions of the statistical test.*
13. *The survey possessed sufficient power to pass the survey unit.*

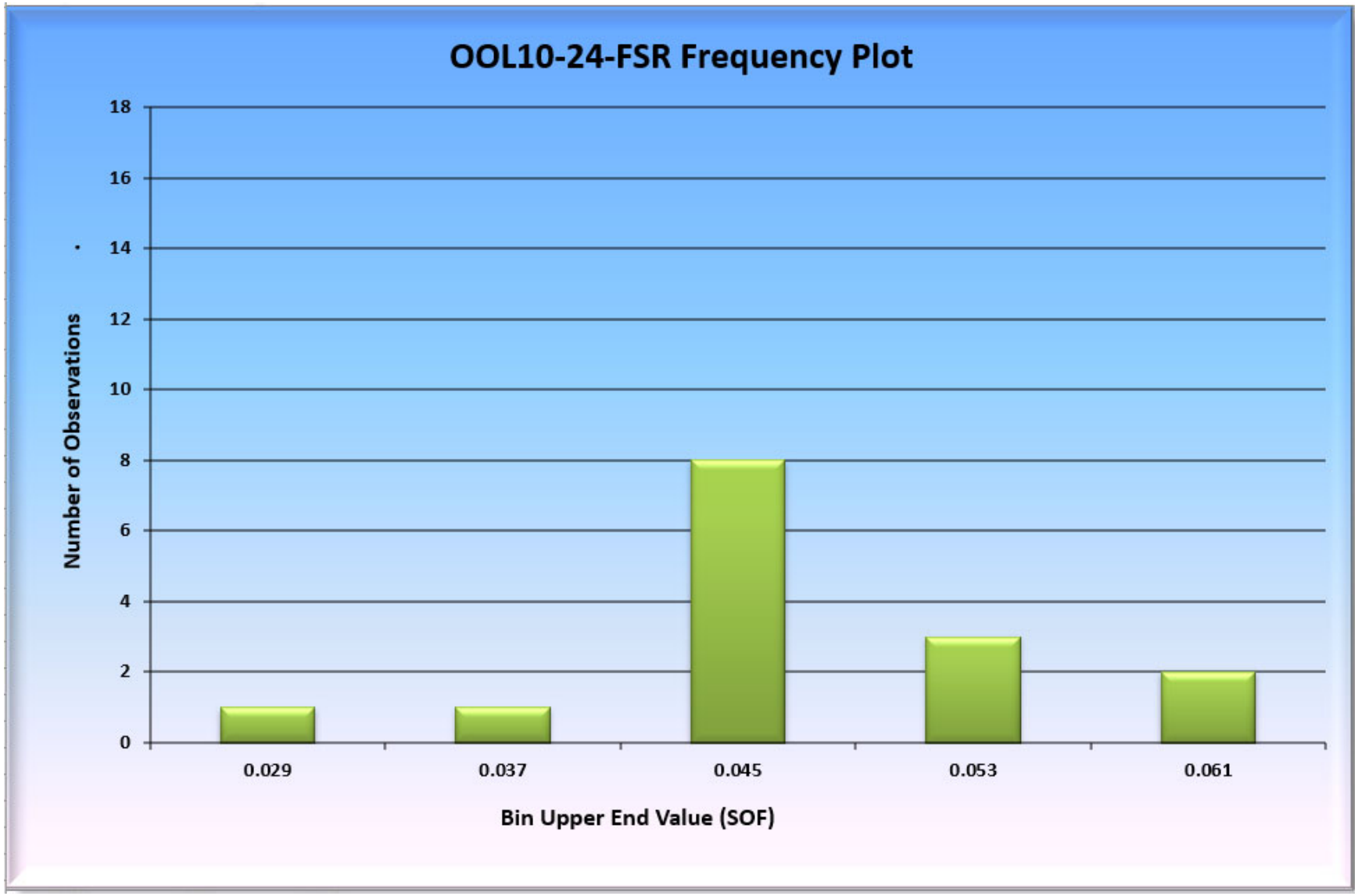
Summary:

The survey was performed as stated in the survey package, the data contained no abnormalities and supported all the key assumptions of the statistical test, and no sample exceeded the DCGL.

Survey Unit OOL10-24-FSR meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-24-FSR.


OOL10-24-FSR Total Surface Activity
Results Scatter Plot
DCGLga = 1 SOF
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Activity
Average
"+3StDev"
"-3StDev"


OOL10-24-FSR Total Surface Activity Results Quantile Plot
Activity (SOF)
0.065
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile


OOL10-24-FSR Frequency Plot
Number of Observations
18
16
14
12
10
8
6
4
2
0
0.029
0.037
0.045
0.053
0.061
Bin Upper End Value (SOF)

Sample Number	TSA (dpm/100 cm2) α	β
1	83	1,040
2	**111**	**1,084**
3	49	1,071
4	49	1,061
5	**111**	1,077
6	63	953
7	70	983
8	63	953
9	70	**1,205**
10	28	1,104
11	63	1,064
12	70	1,040
13	56	1,195
14	56	1,145
15	21	1,014

Survey Unit OOL10-24-FSR Total Surface Activity Results

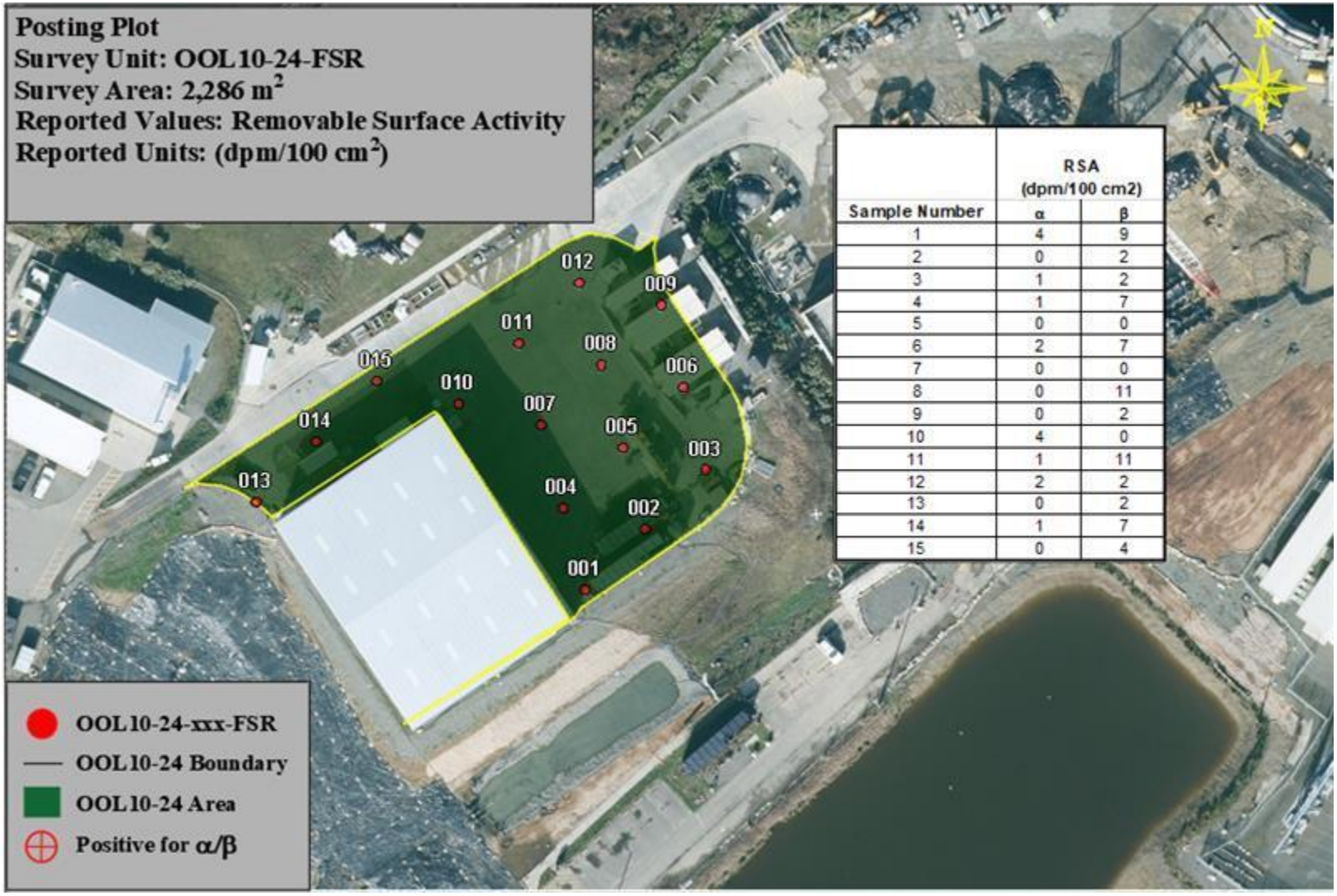
(unadjusted for instrument background)

Sample Number	Detector Model/Set	Date Collected	TSA (dpm/100 cm²)		Uncertainty 1.96 σ (dpm/100 cm²)		MDC (dpm/100 cm²)		Fraction of DCGL		Sum of Fractions
			α	β	α	β	α	β	α	β	
OOL10-24-001-FSR	43-68/1	10/30/2019	**83**	1,040	84	116	67	251	0.03	0.02	5.0%
OOL10-24-002-FSR	43-68/1	10/30/2019	**111**	**1,084**	97	118	67	254	0.04	0.02	6.1%
OOL10-24-003-FSR	43-68/1	10/30/2019	49	1,071	64	117	67	269	0.02	0.02	4.0%
OOL10-24-004-FSR	43-68/1	10/30/2019	49	1,061	64	117	67	267	0.02	0.02	3.9%
OOL10-24-005-FSR	43-68/1	10/30/2019	**111**	1,077	97	118	67	271	0.04	0.02	6.1%
OOL10-24-006-FSR	43-68/1	10/30/2019	63	953	73	111	67	259	0.02	0.02	4.2%
OOL10-24-007-FSR	43-68/1	10/30/2019	70	983	77	113	67	248	0.02	0.02	4.5%
OOL10-24-008-FSR	43-68/1	10/30/2019	63	953	73	111	67	259	0.02	0.02	4.2%
OOL10-24-009-FSR	43-68/1	10/30/2019	70	**1,205**	77	125	67	265	0.02	0.03	4.9%
OOL10-24-009-FSR-QC(1)	43-68/15	10/31/2019	N/C	860		106		213		0.02	1.9%
OOL10-24-009-FSR-B-QC-2(1)	43-68/15	11/1/2019	N/C	968		112		268		0.02	2.1%
OOL10-24-010-FSR	43-68/1	10/30/2019	28	1,104	49	119	67	263	0.01	0.02	3.3%
OOL10-24-011-FSR	43-68/1	10/30/2019	63	1,064	73	117	67	261	0.02	0.01	4.4%
OOL10-24-012-FSR	43-68/1	10/30/2019	70	1,040	77	116	67	256	0.02	0.01	4.6%
OOL10-24-013-FSR	43-68/1	10/30/2019	56	1,195	69	124	67	271	0.02	0.02	4.5%
OOL10-24-014-FSR	43-68/1	10/30/2019	56	1,145	69	121	67	275	0.02	0.01	4.3%
OOL10-24-015-FSR	43-68/1	10/30/2019	21	1,014	42	114	67	270	0.01	0.02	2.9%

Activity values in bold indicate statistically significant surface radioactivity which could be distinguished from background (a priori MDC)

N/C Not Collected

Note (1): 1st replicate count failed low for acceptable comparison ratio on 10/31/19. As part of initial investigation, additional replicate count collected with same instrument by same technician on 11/1/19 with acceptable results. SAPN 1468051 was generated to document the non-conformance.



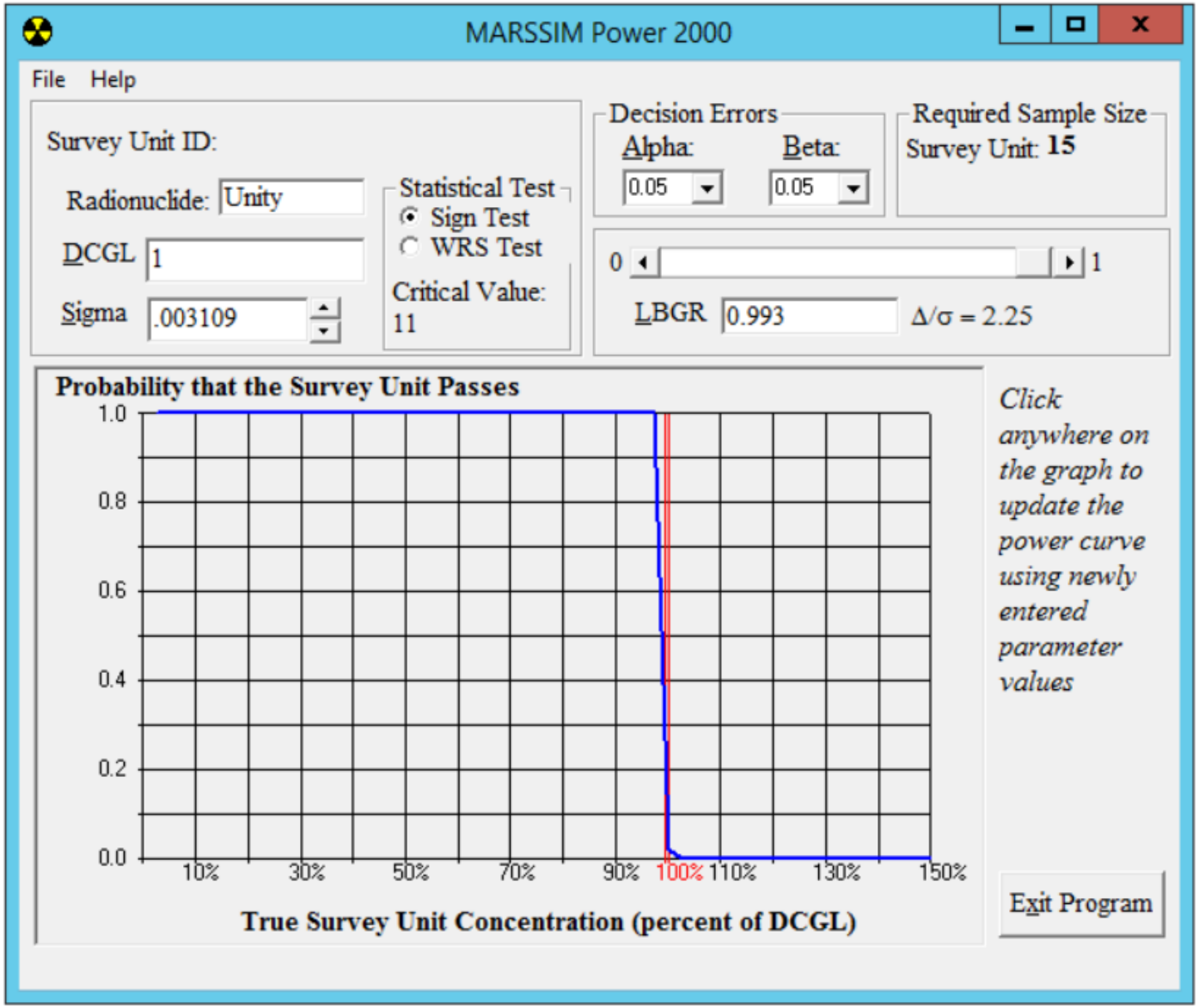
Sample Number	RSA (dpm/100 cm2) α	β
1	4	9
2	0	2
3	1	2
4	1	7
5	0	0
6	2	7
7	0	0
8	0	11
9	0	2
10	4	0
11	1	11
12	2	2
13	0	2
14	1	7
15	0	4

Survey Unit OOL10-24-FSR Removable Surface Activity Results

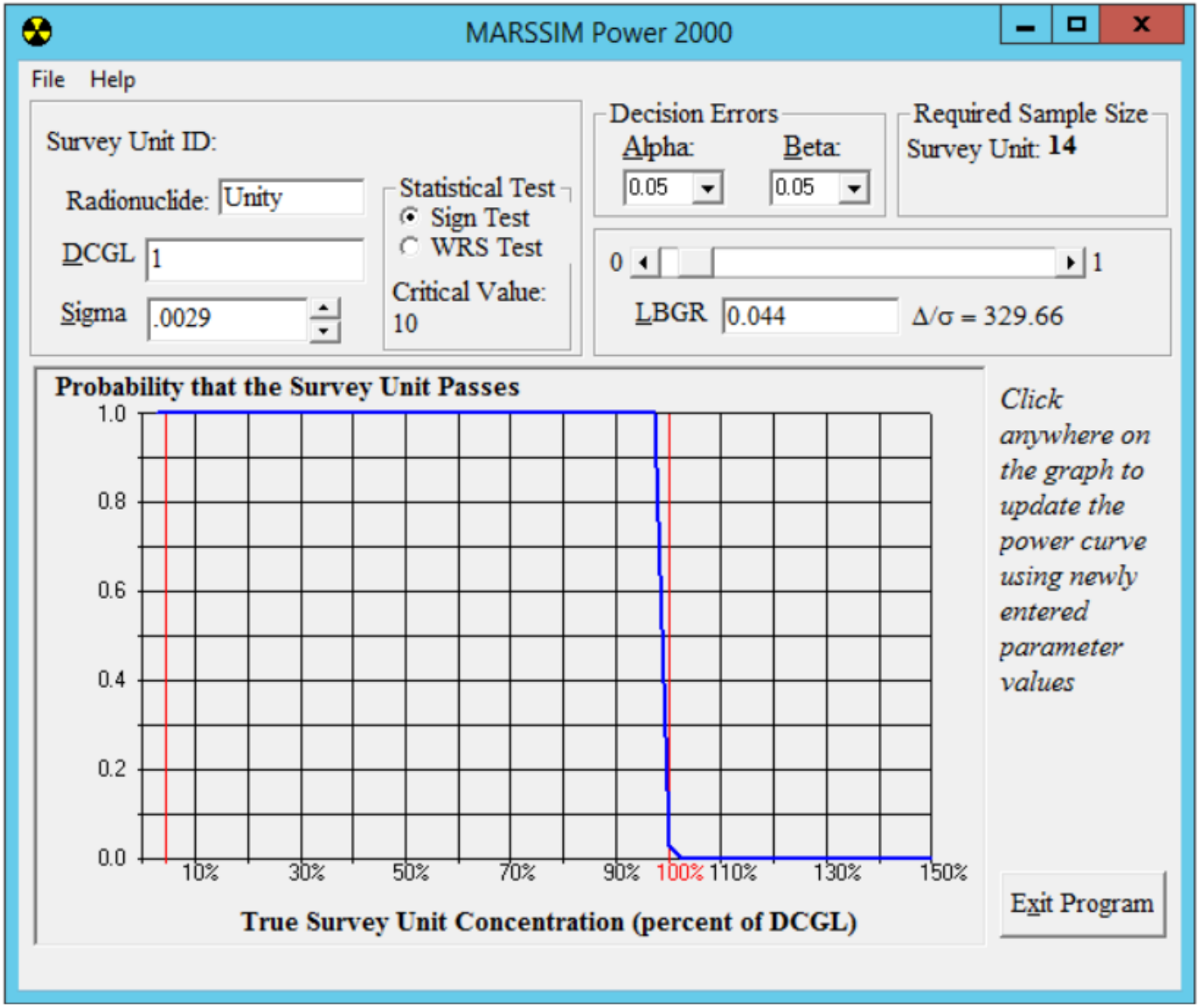
(unadjusted for instrument background)

Sample Number	Instrument Model	Analysis Date	RSA (dpm/100 cm^2)		Uncertainty 1.96 σ (dpm/100 cm^2)		MDC (dpm/100 cm^2)	
			α	β	α	β	α	β
OOL10-24-001-FSR	Protean#7108-A	10/31/2019	4	9	7	2	6	20
OOL10-24-002-FSR	Protean#7108-A	10/31/2019	0	2	0	1	6	20
OOL10-24-003-FSR	Protean#7108-A	10/31/2019	1	2	4	1	6	20
OOL10-24-004-FSR	Protean#7108-A	10/31/2019	1	7	4	2	6	20
OOL10-24-005-FSR	Protean#7108-A	10/31/2019	0	0	0	0	6	20
OOL10-24-006-FSR	Protean#7108-A	10/31/2019	2	7	6	2	6	20
OOL10-24-007-FSR	Protean#7108-A	10/31/2019	0	0	0	0	6	20
OOL10-24-008-FSR	Protean#7108-A	10/31/2019	0	11	0	3	6	20
OOL10-24-009-FSR	Protean#7108-A	10/31/2019	0	2	0	1	6	20
OOL10-24-010-FSR	Protean#7108-A	10/31/2019	4	0	7	0	6	20
OOL10-24-011-FSR	Protean#7108-A	10/31/2019	1	11	4	3	6	20
OOL10-24-012-FSR	Protean#7108-A	10/31/2019	2	2	6	1	6	20
OOL10-24-013-FSR	Protean#7108-A	10/31/2019	0	2	0	1	6	20
OOL10-24-014-FSR	Protean#7108-A	10/31/2019	1	7	4	2	6	20
OOL10-24-015-FSR	Protean#7108-A	10/31/2019	0	4	0	2	6	20

Prospective Power Curve



Retrospective Power Curve


MARSSIM Power 2000
File
Help
Survey Unit ID:
Radionuclide: Unity
DCGL 1
Sigma .0029
Statistical Test
Sign Test
WRS Test
Critical Value: 10
Decision Errors
Alpha: 0.05
Beta: 0.05
Required Sample Size
Survey Unit: 14
0
1
LBGR 0.044
Δ/σ = 329.66
Probability that the Survey Unit Passes
1.0
0.8
0.6
0.4
0.2
0.0
10%
30%
50%
70%
90%
100%
110%
130%
150%
True Survey Unit Concentration (percent of DCGL)
Click anywhere on the graph to update the power curve using newly entered parameter values
Exit Program

QC Replicate Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	24-FSR	Survey Unit Name:	WMF Pad
Sample Plan No.:	HBPP-FSSP-OOL10-24-FSR-00			Sample Measurement Location:	#009-B

Sample Description:

Comparison of gross beta duplicate measurement collected from direct measurement location #009-B and analyzed using a Ludlum 43-68 detector. The on-site result is the original count and the duplicate is the comparison measurement by a different FSS technician using a different 43-68 detector system. Results presented below are unadjusted for instrument background and are in units of dpm/100 cm^2.

STANDARD						COMPARISON			
Radionuclide chosen (a)	Standard Activity (b)	1σ *Uncertainty* (c)	Resolution (d)=(b)/(c)	Agreement Range (e)		Comparison Activity (f)	Comparison Error (g)	Comparison Ratio (h)=(f)/(b)	Acceptable (Y/N)
Gross Beta	1204.9	63.6	19	0.75	1.33	860.3	53.9	0.71	N
Gross Beta	1204.9	63.6	19	0.75	1.33	968.2	57.2	0.80	Y

Comments/Corrective Actions:

Note: 1st replicate count failed low for acceptable comparison ratio on 10/31/19. As part of initial investigation, additional replicate count collected with the same instrument by the same technician on 11/1/19 with acceptable results. SAPN 1468051 was generated to document the non-conformance.

Table 1 is provided to show acceptance criteria to assess split samples.

Resolution (d)		Agreement Range (e)	
Min	Max	Min	Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	11/6/2019	Concurrence by:	M. Blake	Date:	11/6/2019
Signature:				Signature:	

QC Replicate Sample Assessment Form

Survey Area No.:	OOL10	Survey Unit No.:	24-FSR	Survey Unit Name:	WMF Pad
Sample Plan No.:	HBPP-FSSP-OOL10-24-FSR-00			Sample Measurement Location:	#002-F-I

Sample Description:

Comparison of gross beta duplicate measurement collected from direct investigation measurement location #002-F-I and analyzed using a Ludlum 43-68 detector. The on-site result is the original count and the duplicate is the comparison measurement by a different FSS technician using a different 43-68 detector system. Results presented below are unadjusted for instrument background and are in units of dpm/100 cm^2.

STANDARD						COMPARISON			
Radionuclide chosen (a)	Standard Activity (b)	1σ *Uncertainty* (c)	Resolution (d)=(b)/(c)	Agreement Range (e)		Comparison Activity (f)	Comparison Error (g)	Comparison Ratio (h)=(f)/(b)	Acceptable (Y/N)
Gross Beta	1788.9	77.5	23	0.75	1.33	1632.8	74.2	0.91	Y

Comments/Corrective Actions:

N/A 0.75-1.33

Table 1 is provided to show acceptance criteria to assess split samples.

Resolution (d) Min	Resolution (d) Max	Agreement Range (e) Min	Agreement Range (e) Max
<4		No Comaprison	No Comaprison
4	7	0.5	2
8	15	0.6	1.66
16	50	0.75	1.33
51	200	0.8	1.25
>200		0.85	1.18

Performed By:	G. Madison	Date:	11/6/2019	Concurrence by:	M. Blake	Date:	11/6/2019
Signature:				Signature:			

Attachment 2

ALARA Statement

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 01

Reference Generic ALARA Evaluation No.: 88

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	1.85E-01	5.5	3.37E-02
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3/10/21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 01-FSR

Reference Generic ALARA Evaluation No.: 89

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	4.21E-02	7.9	5.33E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 5/25/21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Marshall H Blake Date: 5/25/21
FSS Engineer (Print/Sign)

Approved by: W H Barley WHBarley Date: 5/25/21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 13

Reference Generic ALARA Evaluation No.: 90

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	5.22E-02	7.9	6.61E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 Survey Unit: 17

Reference Generic ALARA Evaluation No.: 91

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	5.17E-02	7.9	6.54E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑ (fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 5/25/21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Marshall H Blake Date: 5/25/21
FSS Engineer (Print/Sign)

Approved by: W H Barley W H Barley Date: 5/25/21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 17-FSR

Reference Generic ALARA Evaluation No.: 92

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	5.40E-02	7.9	6.84E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 20

Reference Generic ALARA Evaluation No.: 93

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	1.04E-02	7.9	1.32E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the $\sum$(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 20-FSR

Reference Generic ALARA Evaluation No.: 94

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	2.08E-02	7.9	2.63E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the $\sum$(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 22

Reference Generic ALARA Evaluation No.: 95

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	2.53E-02	7.9	3.20E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 22-FSR

Reference Generic ALARA Evaluation No.: 96

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	3.88E-02	7.9	4.91E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 26-FSR

Reference Generic ALARA Evaluation No.: 97

Applicable Generic ALARA AL: 144

	Radionuclide	Average Concentration (pCi/g)	DCGL (pCi/g)	Fraction DCGL
1.	Cs-137	2.85E-02	7.9	3.61E-03
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)

Generic ALARA Evaluation Comparison Worksheet

Survey Area: OOL10 **Survey Unit:** 24-FSR

Reference Generic ALARA Evaluation No.: 98

Applicable Generic ALARA AL: 1.16E+04

	Radionuclide	(%)	DCGL (Unity)	Fraction DCGL
1.	Unity	4.45	1	4.45E-02
2.	N/A	N/A	N/A	N/A
3.	N/A	N/A	N/A	N/A
4.	N/A	N/A	N/A	N/A

If the ∑(fraction DCGL) <the generic ALARA AL, then the generic ALARA evaluation is applicable to the survey unit.

Check one:

X Generic ALARA AL IS satisfied

_____ Generic ALARA AL IS NOT satisfied

Prepared by: G S Madison Date: 3-8-21
FSS Engineer (Print/Sign)

Reviewed by: M H Blake Date: 3-10-21
FSS Engineer (Print/Sign)

Approved by: W H Barley Date: 3-10-21
Site Closure Manager or Designee (Print/Sign)