



October 17, 2019

PG&E Letter HBL-19-014

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 Six Survey Areas Within Survey Unit OOL10

- References:
1. PG&E Letter HBL-18-001, "Revision 12 to the Defueled Safety Analysis Report, Revision 2 of the License Termination Plan, and Revisions 34, 35, and 36 to the Humboldt Bay Quality Assurance Plan," dated February 23, 2018.
 2. PG&E Letter HBL-16-008, "Request for Partial Release of Humboldt Bay Power Plant Unit 3 Property from the Part 50 Site," dated November 9, 2016.
 3. NRC Letter to PG&E, "Humboldt Bay Power Plant Unit 3 – Request for Partial Site Release from Part 50 License (CAC No. L53153)," dated January 5, 2018.

Dear Commissioners and Staff:

On February 23, 2018, Pacific Gas & Electric Company (PG&E) submitted PG&E Letter HBL-18-001 (Reference 1), which included Revision 2 of the License Termination Plan (LTP). Section 1.2 of the LTP describes a phased decommissioning approach to accomplish site release for unrestricted use and license termination.

The first phase consisted of a partial site release of an area south of King Salmon Avenue. In Reference 2, PG&E submitted a request for the partial site release of this area. Reference 2 included a Final Status Survey (FSS) Report for the survey units within the area proposed to be released. The release was approved by the NRC in Reference 3.



In the subsequent phases, PG&E will submit FSS reports for the remaining survey units as they are completed. Upon completion of FSS reports, PG&E will request the site be released from the 10 CFR Part 50 license.

The Enclosure to this letter contains the FSS Report for the following six survey areas within Survey Unit OOL10:

- Circulating Water Intake Piping Excavation Area (OOL10-05)
- 60 kV Switchyard Excavation (OOL10-06)
- Remainder of Land Area (Parking Lot A) (OOL10-14)
- Buhne Slough (OOL10-15)
- Area East of Trailer City (OOL10-19)
- Humboldt Bay (OOL10-23)

The FSS Report demonstrates that the aggregate of the radiological data provides sufficient confidence to ensure that these areas meet the release criteria in accordance with the Humboldt Bay Power Plant Unit 3 LTP. This is based on a review of the design methodology, surveys, and sample results in reference to the site-specific derived concentration guideline level. 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 areas.

PG&E requests that the NRC review the enclosed information and concur that these areas meet the LTP release criteria.

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) 444-0856.

Sincerely,

James M. Welsch

Senior Vice President, Generation and Chief Nuclear Officer

Enclosure

cc: HBPP Humboldt Distribution
cc/enc: John B. Hickman, NRC Project Manager
Scott A. Morris, NRC Region IV Administrator

Humboldt Bay Power Plant

Final Status Survey Report

HBPP-FSS-OOL10-05

HBPP-FSS-OOL10-06

HBPP-FSS-OOL10-14

HBPP-FSS-OOL10-15

HBPP-FSS-OOL10-19

HBPP-FSS-OOL10-23



**HUMBOLDT BAY POWER PLANT
FINAL STATUS SURVEY REPORTS
HBPP-FSS-OOL10-05, HBPP-FSS-OOL10-06
HBPP-FSS-OOL10-14, HBPP-FSS-OOL10-15
HBPP-FSS-OOL10-19, HBPP-FSS-OOL10-23**



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Gordon Madison, CHP - FSS Engineering Supervisor

Initial Report Approval: Kris Rowberry Date: 10-7-19
Kris Rowberry, MHP, AHP - Site Closure Specialist, Expert

Final Report Approval: W B Barley Date: 10-7-19
William Barley, CHP - Site Closure Manager

EXECUTIVE SUMMARY

In accordance with the provisions of the Humboldt Bay License Termination Plan (LTP), Rev. 0, 1 and 2 (Ref. 1, 2 and 3), Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 were Final Status Surveyed (FSS) for release from the site's 10CFR50 license. This report was prepared as a stand-alone document to demonstrate that the designated survey unit satisfies the radiological release criteria.

The areas under consideration consists of the open land area northeast of King Salmon Avenue (southwest and southeast of the New Generation Footprint) and the Humboldt Bay itself to the north. Survey Unit OOL10 is made up of several survey areas. The open land areas under consideration consist of the following FSS Areas: OOL10-05 – CW Intake Piping Excavation Area, OOL10-06 – 60kV Switchyard Excavation, OOL10-14 – Remainder of Land Area (Parking Lot A), OOL10-15 – Buhne Slough, OOL10-19 – Area East of Trailer City and OOL10-23 – Humboldt Bay. The survey unit areas are approximately 239,172 m². See Executive Summary Tables for details of each area.

The survey unit areas are designated as Class 3 land areas in the LTP, indicating in those areas that there is a low likelihood of having residual radiological contaminants in excess of the derived concentration guideline levels (DCGLs). The survey areas are located on a footprint that is mainly made of marsh land and very hard to access or traverse and had a limited opportunity to receive radioactive contamination from on-site activities. No radiological remediation of these areas was required during decommissioning.

The surveys performed included a total of one hundred and fourteen (114) samples. Each of the sample locations was selected based on an approved randomized methodology and the locations were confirmed by a high precision Global Positioning System (GPS). The sampling included ninety-five (95) statistical samples, twelve (12) split-samples, two (2) bias sample locations in OOL10-05 and five (5) ORISE split samples in OOL10-05. Additionally, six (6) 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.

The land areas were also partially walkover scanned with a gamma sensitive instrument probe. Survey Unit OOL10-23 is the Humboldt Bay. Since there was no available means to perform a gamma scan of the submerged sediment media on the bottom of the bay, the survey unit was not scanned.

The maximum hypothetical dose (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. See the Executive Summary Table for each Survey Unit for details of each area. The reports concluded that the survey units have 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.

ES-1 - Executive Summary Table OOL10-05

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-05		
Survey Unit Land Area	453 m ²⁽¹⁾	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-CHAR-OOL10-05-00	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.93 pCi/g ⁽²⁾ Cs-137	Per Table 5-1 of the LTP for soils to achieve 25 mrem/yr Total Effective Dose Equivalent (TEDE)
Scan Survey Area Coverage	Approximately 100%	The LTP requires 1-10% of area coverage for Class 3 survey units
Number of Measurements	15 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	-4.62E-02	pCi/g Cs-137
Max. Value	4.71E-02	pCi/g Cs-137
Mean	1.72E-03	pCi/g Cs-137
Median	6.60E-04	pCi/g Cs-137
Std. Dev.	2.52E-02	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of ORISE Split Measurements	5 Soil Samples	NRC requested HBPP provide ORISE with five (5) samples
No. of Bias Measurements	2 Soil Samples	Judgmental locations selected by FSS Foreman
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	1.0E-02 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

ES-2 - Executive Summary Table OOL10-06

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-06		
Survey Unit Land Area	4,345 m ²⁽¹⁾	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-CHAR-OOL10-06-02	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.93 pCi/g ⁽²⁾ Cs-137	Per Table 5-1 of the LTP for soils to achieve 25 mrem/yr Total Effective Dose Equivalent (TEDE)
Scan Survey Area Coverage	Approximately 100%	The LTP requires 1-10% of area coverage for Class 3 survey units
Number of Measurements	20 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	-5.60E-02	pCi/g Cs-137
Max. Value	3.45E-01	pCi/g Cs-137
Mean	4.19E-02	pCi/g Cs-137
Median	2.01E-02	pCi/g Cs-137
Std. Dev.	9.39E-02	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of Bias Measurements	N/A	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	1.4E-01 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

ES-3 - Executive Summary Table OOL10-14

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-14		
Survey Unit Land Area	6,816 m ²⁽¹⁾	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-CHAR-OOL10-14-00	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.29 pCi/g ⁽²⁾ Cs-137	Scaled to reflect 23.07 mrem/yr due to resultant dose of 1.93 mrem/yr from deselected HTD radionuclides listed in HBPP-FSSP-OOL10-14-00.
Scan Survey Area Coverage	Approximately 25%	The LTP requires 1-10% of area coverage for Class 3 survey units
Number of Measurements	15 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	-6.53E-02	pCi/g Cs-137
Max. Value	5.41E-01	pCi/g Cs-137
Mean	9.04E-02	pCi/g Cs-137
Median	1.69E-02	pCi/g Cs-137
Std. Dev.	1.62E-01	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of Bias Measurements	N/A	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	2.2E+00 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

ES-4 - Executive Summary Table OOL10-15

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-15		
Survey Unit Land Area	70,367 m ² (1)	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-FSSP-OOL10-15-01	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.6 pCi/g ⁽²⁾ Cs-137	Scaled to reflect 23.9 mrem/yr due to resultant dose of 1.1 mrem/yr from deselected HTD radionuclides listed in HBPP-FSSP-OOL10-15-01.
Scan Survey Area Coverage	Approximately 5%	The LTP requires 1-10% of area coverage for Class 3 survey units
Number of Measurements	15 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	5.93E-02	pCi/g Cs-137
Max. Value	5.61E-01	pCi/g Cs-137
Mean	2.25E-01	pCi/g Cs-137
Median	2.24E-01	pCi/g Cs-137
Std. Dev.	1.40E-01	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of Bias Measurements	N/A	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	1.8E+00 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

ES-5 - Executive Summary Table OOL10-19

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-19		
Survey Unit Land Area	24,546 m ² (1)	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-FSSP-OOL10-19-00	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.16 pCi/g ⁽²⁾ Cs-137	Scaled to reflect 22.66 mrem/yr due to resultant dose of 2.34 mrem/yr from deselected HTD radionuclides listed in HBPP-FSSP-OOL10-19-00.
Scan Survey Area Coverage	Approximately 5%	The LTP requires 1-10% of area coverage for Class 3 survey units
Number of Measurements	15 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	2.51E-02	pCi/g Cs-137
Max. Value	4.07E-01	pCi/g Cs-137
Mean	1.49E-01	pCi/g Cs-137
Median	9.63E-02	pCi/g Cs-137
Std. Dev.	1.27E-01	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of Bias Measurements	N/A	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	2.8E+00 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

ES-6 - Executive Summary Table OOL10-23

Feature	Design Criteria	Comment
Synopsis of FSS of OOL10-23		
Survey Unit Land Area	132,587 m ² (1)	Based on AutoCAD GPS Coordinates
Classification	Class 3	Based on the HBPP LTP, Rev. 2.
Final Status Survey Plan No.	HBPP-FSSP-OOL10-23-00	HBPP Procedure RCP FSS-2
Grid Spacing	NA	NA for Class 3 areas
DCGL	7.22 pCi/g ⁽²⁾ Cs-137	Scaled to reflect 22.85 mrem/yr due to resultant dose of 2.15 mrem/yr from deselected HTD radionuclides listed in HBPP-FSSP-OOL10-23-00.
Scan Survey Area Coverage	0%	The LTP requires 1-10% of area coverage for Class 3 survey units. This survey unit is covered by the ocean and cannot be surveyed.
Number of Measurements	15 Soil Samples (non-parametric test)	14 required per LTP Section 5.3.3.3.1 using Table 5-5 of MARSSIM for relative shift of >3
Min. Value	-6.30E-03	pCi/g Cs-137
Max. Value	7.51E-02	pCi/g Cs-137
Mean	3.03E-02	pCi/g Cs-137
Median	2.50E-02	pCi/g Cs-137
Std. Dev.	2.43E-02	pCi/g Cs-137
No. of GEL Split Measurements	2 Soil Samples	1 required per HBAP C-202
No. of Bias Measurements	N/A	N/A
No. of Recount Measurements	1 Soil Sample	1 required per HBAP C-202
Maximum Hypothetical Dose	2.3E+00 mrem/yr	Meets FSS data quality objective and regulatory release criteria of 25 mrem/yr

Note (1)-meters squared

Note (2)-pico-curies per gram

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1.0 INTRODUCTION

This radiological FSS Report documents the radiological status of a 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. NRC Radioactive Materials License No. DPR-7 (Ref. 4) due to its historical use involving licensable quantities of radioactive materials. 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 FSS Areas: OOL10-05 - CW Intake Piping Excavation Area, OOL10-06 – 60kV Switchyard Excavation, OOL10-14 - Remainder of Land Area (Parking Lot A), OOL10-15 - Buhne Slough, OOL10-19 - Area East of Trailer City and OOL10-23 - Humboldt Bay in preparation for license termination. This report documents the final radiological status of the outlined area in Figure 1.1, 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.

Figure 1.1 - Overview of Surveyed Area Extents



Photo taken 1st Quarter 2018

1.1 PHASE 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 Phase consists of all remainder of site land areas that are to the north (site east) of King Salmon Avenue. Figure 1.2 depicts an aerial overview that indicates the current extents undergoing Phased release from the site.

Figure 1.2 - Current Phase Release Area

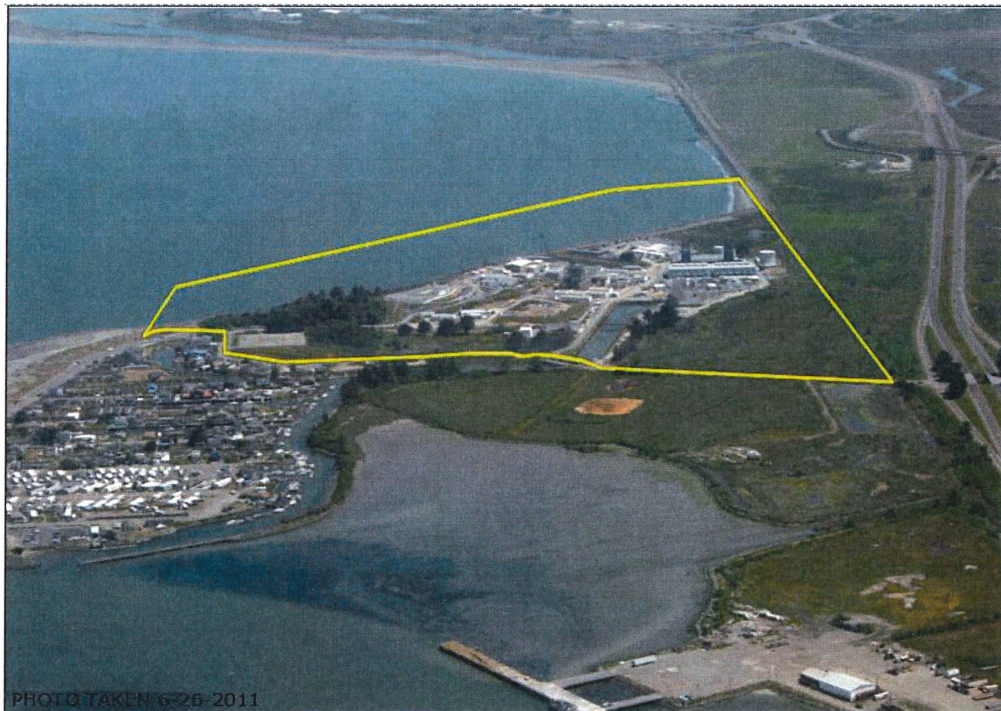


Photo taken 1st Quarter 2018

The following figures depict aerial overviews that indicate the extents of each specific area.

Figure 1.3 - Survey Unit OOL10-05 - CW Intake Piping Excavation Area,

Figure 1.4 - Survey Unit OOL10-06 - 60kV Switchyard Excavation,

Figure 1.5 - Survey Unit OOL10-14 - Remainder of Land Area (Parking Lot A),

Figure 1.6 - Survey Unit OOL10-15 - Buhne Slough,

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Figure 1.5 - Phase Release Area of OOL10-14



Figure 1.6 - Phase Release Area of OOL10-15



Figure 1.7 - Phase Release Area of OOL10-19



Figure 1.8 - Phase Release Area of OOL10-23



1.2 SURVEY UNIT DESIGNATIONS

In accordance with Humboldt Bay Power Plant (HBPP) Procedure RCP FSS-1, "Survey Unit Classification," Rev 1B, June 8, 2017 (Ref. 5) Survey Units HBPP-CHAR-OOL10-05-00, HBPP-CHAR-OOL10-06-02, HBPP-FSSP-OOL10-14-00, HBPP-FSSP-OOL10-15-01, HBPP-FSSP-OOL10-19-00 and HBPP-FSSP-OOL10-23-00 were designated as Class 3 Survey Units per the HBPP LTP and confirmed by subsequent reviews.

1.3 SURVEY UNIT DESCRIPTIONS

All of the following Survey Units are part of Survey Area OOL10. A summary of each specific Survey Unit is listed below.

Survey Unit OOL10-05:

Survey Unit OOL10-05 is approximately 453 m² of surface area. The survey unit boundary is an excavation to remove circulating water piping under Survey Units OOL10-06, OOL10-18 and NOL01-06. Once the portion of circulating water piping was removed from this Survey Unit and the FSS activities were completed the area was immediately backfilled with radiologically clean material from an off-site source. The survey boundary is shown in Figure 1.3.

Survey Unit OOL10-06:

Survey Unit OOL10-06 is approximately 4,345 m² of surface area. The survey unit boundary abuts Survey Units NGFA-West, MEPPS01-01/02, RLY01-01/02, OOL02-02, OOL10-04, OOL10-14, OOL10-15 and OOL10-18. This Survey Unit was an excavation that was made to upgrade the switchgear facility for the new HBGS power plant that was built. Once the FSS activities were completed the area was immediately backfilled with radiologically clean material from an off-site source. The survey boundary is shown in Figure 1.4.

Survey Unit OOL10-14:

Survey Unit OOL10-14 is approximately 6,816 m² of surface area. The survey unit boundary abuts Survey Units OOL02-01, OOL02-02, OOL06-01, OOL11-01, OOL10-06, OOL10-15 and OOL10-17. This Survey Unit was previously a plant site parking lot. This excavation was made to upgrade for the Final Site Restoration (FSR) activities to increase the intake canal to meet environmental requirements. The survey boundary is shown in Figure 1.5.

Survey Unit OOL10-15:

Survey Unit OOL10-15 is approximately 70,367 m² of surface area. The survey unit boundary abuts Survey Units NGFA-East, NGFA-West, OOL02-02, OOL10-04, OOL10-06, OOL10-14, OOL10-17, OOL10-19 and other non-PG&E properties. This Survey Unit is the Buhne Slough area and was not excavated for any decommissioning or FSR activities. The survey boundary is shown in Figure 1.6.

Survey Unit OOL10-19:

Survey Unit OOL10-19 is approximately 24,546 m² of surface area. The survey unit boundary abuts Survey Units NGFA-East, OOL10-13, OOL10-15, OOL09-06, OOL09-09, OOL09-10 and other non-PG&E properties. This survey unit is the area east of Trailer City, also known as the Duck Pond. It had some minor excavation work for asbestos remediation and removal purposes. The survey boundary is shown in Figure 1.7.

Survey Unit OOL10-23:

Survey Unit OOL10-23 is approximately 132,587 m² of ocean surface area. The survey unit boundary abuts Survey Units OOL05-01, OOL10-13, the remainder of the Bay and other non-PG&E properties. This Survey Unit is the Humboldt Bay Area. The survey boundary is shown in Figure 1.8.

1.3.1 HISTORICAL SITE ASSESSMENT (HSA) EVENTS

There is no mention within the HSA of plant-related activities occurring within the boundaries of the following Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19 and OOL10-23.

1.3.2 SCOPING SURVEYS

Scoping Surveys were not performed in these areas based on their assessment in the HSA. Survey Area OOL10-23 (Humboldt Bay) was assessed in the HSA as a non-impacted area.

1.3.3 CHARACTERIZATION

Three separate radiological characterizations occurred that are considered to be indicative of conditions in these areas. They were IT/Duratek Characterization (1997), ENERCON Characterization (2008), and TRC Characterization (2008). The highlights from the different sampling efforts specific to the area are as follows:

- IT/Duratek Characterization (1997) – Subsurface borings were advanced to a depth of 4 feet in 9 locations in the HBPP area. Samples were collected at 1-foot intervals beginning at 0.5 feet. One location in particular had 6 additional borings in the immediate area. This grouping of samples was to determine the extent of contamination located at the end of a drainage pipe that ran along the northern edge of the train tracks. The tracks and the drain line had been covered by fill and gravel. All samples in the HBGS area were less than the accepted site background of 0.5 pCi/g Cs-137, except the one location with close grouping of borings had three samples at a depth of 3.0 to 3.5 feet with concentrations ranging from 1.34 pCi/g to 1.84 pCi/g and three samples had detectable Co-60 with a maximum concentration of 0.9 pCi/g. The location with detectable Co-60 and elevated Cs-137 is on the northern edge of the HBRP boundary and is not near the foundation of the actual generating plants or ancillary equipment. Additional samples were not collected since the concentrations were less than the potential release criteria.

- ENERCON Characterization (2008) – The survey of the area indicated no significant detectable contamination from HBPP Unit 3 nuclear reactor operations. One surface soil sample result indicated a Cs-137 concentration of 0.653 pCi/g. All other samples Cs-137 results were less than the HBPP site established background of 0.5 pCi/g for Cs-137. All results for Co-60, Am-241, Pu-239/240, Cm-242/244, Sr-90, and Tritium were below the laboratory minimum detectable activity ranges. The result of the soil gamma radiation surveys indicated no levels of gamma radiation greater than twice background. Laboratory analysis reports from General Engineering Laboratories are attached as well as drawings of the surface soil sample locations and the gamma walkover measurement locations. Additional samples were not collected since the concentrations were less than potential release criteria.
- TRC Characterization (2008) – TRC Solutions Inc. advanced 44 borings with approximately 3 samples per boring in the HBGS area in support of their Environmental Remedial Investigations in July 2008. In addition to the remedial investigation analyses for non-radiological materials, all samples were submitted for gamma spectroscopy analysis to gain additional knowledge of the subsurface soils in the HBGS area. It was necessary to determine whether or not the soils could be released off site for disposal without restriction, i.e. no radionuclide concentrations derived from Unit 3 operations. All subsurface samples collected from the borings in HBGS were less than the site release criteria.

Scanning was performed on the bottoms of all excavations using Radiological survey instrumentation that was selected to ensure that sensitivities were sufficient to detect the expected radionuclides at the minimum detection requirements.

Classification Statement Concerning Soils in the HBGS and Surrounding Site Areas:

Based upon the current/best information concerning the radiological conditions and the conditions and events identified in the operating history, these survey areas area designated as a Class 3 area.

These areas were classified as a MARSSIM Class 3 areas due to the very low potential for radiological contamination to be present based off soil sample data from the IT/Duratek 1997 Characterization effort. The data as displayed above was sufficient to support the planning of Survey Units OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19 and OOL10-23.

1.3.4 REMEDIAL ACTION SURVEYS AND ACTIVITIES

The migration of surface and subsurface contamination appears to be limited to areas within proximity of Unit 3. The areas of concern for the HBGS facility and surrounding site area show little to no affect from operations at HBPP and the available data suggest that these areas do not require remediation.

No remedial action surveys have been performed in the following areas: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, OOL10-23. However, there were SAPNs and ASSPs written for corrective actions to be taken of these areas. The SAPNs are listed below.

Survey Unit OOL10-05 and OOL10-06 SAPNs:

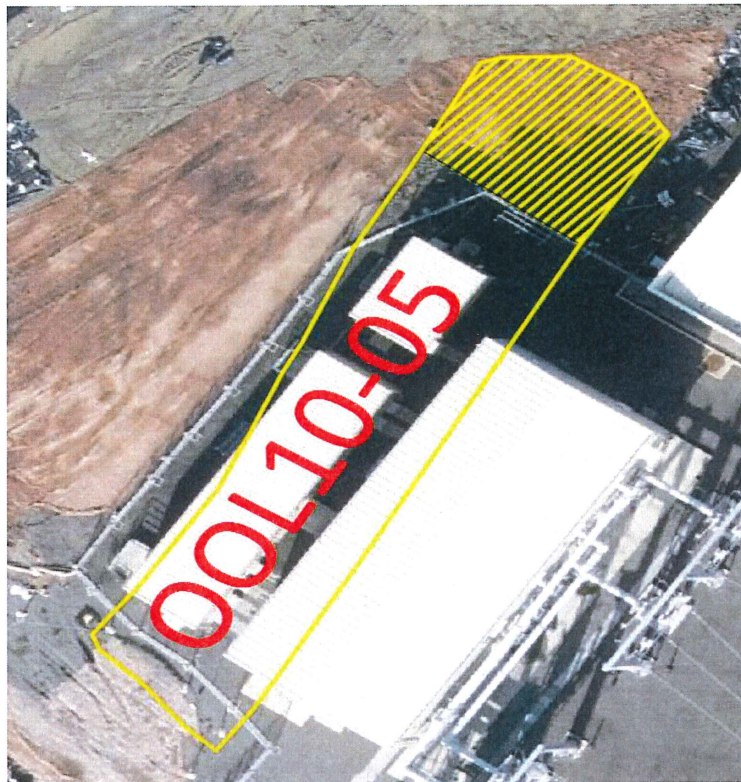
SAPN 1433151:

In July of 2017, the project placed Class 1 material originating from the Caisson and Discharge Canal excavations that had not been cleared through the GARDIAN to correct an unstable sloughing condition within the Work Package (WP-29) Circ Water Lines Removal Phase A area. The Class 1 material was placed near two Class 3 areas contained in this submittal (OOL10-05 and OOL10-06) and was later removed. The areas where the material had been placed were resurveyed with all results less than action levels.

SAPN 1440622:

After FSS activities had been completed for Survey Unit OOL10-05, the project identified additional decommissioning activities necessary within the northeastern portion of the survey unit which warranted boundary readjustment. Therefore, as shown in figure 1.9 below, approximately 108 m² of area formerly within the Survey Unit OOL10-05 FSS boundary was relocated to Survey Unit OOL10-18 Final Site Restoration (FSR) Survey plans.

Figure 1.9 – Boundary Adjustment



SAPN 1464620

The Final Status Survey Plans for OOL10-05 and OOL10-06 were written to have a 100% gamma scan coverage in each unit. While creating the report for both survey units it was determined that a small percentage, 0.4 & 1.6 respectively, was missed due to various reasons uncontrollable by the FSS group.

It is unlikely that these small unscanned areas contained any plant-derived radionuclides exceeding a small fraction of the DCGLs. The remainder of the scanned area showed no audible indications of elevated counts above background and the samples collected were well below a small fraction of the DCGLs.

The scan requirement stipulated for Class 3 areas as stated in Table 5-4, of the LTP is Judgmental (1-10%). Therefore, no other actions are required and this SAPN can be closed.

SAPN 1466330

During the generation and review of the FSS Report for OOL10-05 it was noticed that the Plot Plan sample numbers appeared to be in a systematic grid sampling pattern. After review of the VSP and AutoCAD files it was determined that in accordance with procedure RCP-FSS-7, step 2.5, the Sampling Goals for OOL10-05 were in fact generated as a Class 3 survey unit utilizing a random number generating method. However, the VSP table was then relabeled in numerical order as if it was a systematic grid pattern. Since the VSP table matches the FSS Plan there is no impact to data quality. Therefore, no additional corrective actions are required and this SAPN can be closed. This is a documentation SAPN.

Survey Unit OOL10-15 SAPN:

SAPN 1440720

During the split sample comparison evaluation (of a split between the HBPP Lab and the Offsite Lab) in accordance with Section 5.5 of RCP FSS-11 Split Sample Comparison for Final Status Survey for FSS sample location OOL10-15-006-F, the comparison ratio for nuclide Pb-212 fell outside the agreement range of 0.6-1.66. As a corrective action, the Bi-214 nuclide activity was evaluated and found to be within the agreement range. The good split sample comparison ratios for Bi-214 and K-40 indicate agreement and bracket the low and high energy range respectively of the nuclide gamma energies for two primary plant-derived radionuclides which were not detected, Cs-137, and Co-60. Therefore, no additional corrective actions are required and this SAPN can be closed. This is a documentation SAPN.

Survey Unit OOL10-19 SAPN:

SAPN 1441018

During an investigation of an elevated area near the Soil Management Facility-1 (SMF-1) pad footprint, interviews with a former RP Manager indicated that the source of the elevated area may have been Class 1 spoils material from the Recombiner Building. As the material placement may have extended into a large area extending into the southwestern portion of Class 3 Survey Unit OOL10-19 (approximately 666 m²), additional characterization measurements were collected prior to final site restoration contouring to ensure the area did not require segregation and upgrade in Classification to Class 1 status. Of ten borings ranging from 2' to 5' in depth, four composite samples collected indicated Cs-137 results ranging from 0.05 pCi/g to 0.13 pCi/g, indicative of global fallout background levels and giving high confidence that the identified area was classified correctly. No other plant derived radionuclides were identified.

Survey Unit OOL10-23 SAPNs:

SAPN: 1447780

On 11/05/19, the offsite analytical laboratory report for an FSS sample collected for Humboldt Bay (OOL10-23-011-F) indicated an activity value greater than 25% of the investigation level for a hard to detect (HTD) radionuclide, Carbon-14 (C-14). The C-14 DCGL provided in Table 5-1 of the HBPP LTP (Ref. 3) is 6.3 pCi/g. Table 1.1 below shows the original and reanalyzed reported results of the offsite laboratory.

TABLE 1.1 OFFSITE LABORATORY RESULTS FOR C-14 FOR FSS SAMPLE OOL10-23-011-F

Collection Date	Run Date	Reported Result	2 Sigma TPU	MDC	Comments
10/1/2018	11/1/2018	5.62E+00	8.53E-01	8.29E-01	Original Result
10/1/2018	11/11/2018	-4.62E-01	3.24E-01	5.57E-01	Reanalysis Result

Notes: All results above reported in units of pCi/g

Investigation Actions Initiated:

As part of the investigation regarding the elevated C-14 results, which were approximately 90% of the DCGL, two actions were initiated:

- On 11/7/18 the on-site laboratory sample was reanalyzed via the gamma spectroscopy method for 20,000 seconds to determine the presence of any neutron-activated gamma emitting radionuclides (i.e., Eu-152, Eu-154) indicative from HBPP decommissioning activities. No europium radioisotopes were identified on the reanalyzed sample.
- The sample was reanalyzed for C-14 by the off-site laboratory with results less than method detection levels, indicating that the original result was not reproducible.

Conclusion

The reanalyzed result was less than the investigation level of 25% of the DCGL. Therefore, an investigation survey was not performed and reclassification of the Class 3 MARSSIM designation for the survey unit was not warranted.

SAPN 1464630

The requirement stipulated for Class 3 areas as stated in Table 5-4 of the LTP is: Judgmental (1-10%). However, there is no readily available means to perform a gamma scan of the submerged sediment media as the survey unit is covered by the Pacific Ocean. Therefore, three compensatory variances from the FSS program will be applied:

- The investigation level is reduced to 25% (from the required 50%) of the DCGL.
- 15 random samples will be collected with contingency locations for initial locations that are inaccessible.
- The samples are collected with a 25 lb. SST sampling dredge designed for collecting sediment.

No other actions are required and this SAPN can be closed.

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 three (3) 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 three ASSP's were written.

OOL10-05 and OOL10-06 are Class 3 Areas that are located on the east end of the intake canal area and run along OOL10-18 toward the east near the Relay Building. There were three (3) ASSP's written for these two areas.

1) ASSP-16-08-011 for OOL10-06

An ASSP was warranted because the project dropped a large piece of concrete originating from the intake structure into the intake canal in an attempt to size reduce it for relocation. The concrete splashed mud onto a building located in the 60 kV Switchyard. The ASSP required direct readings of the splatter areas and a walkover scan of the area in the immediate vicinity. The results indicated no audible indications of elevated readings discernable above the background range.

2) ASSP-17-09-013 for OOL10-05

This ASSP was written after the environmental group directed the project to excavate additional material from the area because samples indicated elevated readings of PCBs and Lead. During performance of the ASSP survey, 100% of the area was scanned and one bias sample was collected (ASSP-17-09-013-001). The walkover scan results showed no audible indications of discernable from background and the sample results showed no plant derived radionuclides.

3) ASSP-17-09-014 for OOL10-06

This ASSP was written after the environmental group directed the project to excavate additional material from the area because samples indicated elevated readings of PCBs and Lead. During performance of the ASSP survey, 100% of the area was scanned and one bias sample was collected (ASSP-17-09-014-001). The walkover scan results showed no audible indications of discernable from background and the sample results showed no plant derived radionuclides.

Both biased samples collected during the performance of ASSP 17-09-013 and 17-09-014 were analyzed by gamma spectroscopy at the on-site laboratory. Samples obtained during the ASSPs were collected using Procedure FSS-8, "Collection of Site Characterization and Final Status Survey Samples" (Ref. 15).

1.3.6 FINAL SITE RESTORATION FSS

A formal FSR survey was not conducted over the backfilled survey units as they exist in the final site restoration condition based on the fact that all reuse or off-site restoration materials met Class 3 reuse requirements and did not contain HBPP-derived radionuclides above method detection levels. There were a couple of adjustments made to Survey Unit OOL10-05 as described below.

Adjustment 1:

Background:

While designing the FSR survey for the other survey units around Survey Unit OOL10-05 it was discovered that the original survey boundary of OOL10-05 was adjusted to the northwest by ~58 m² during excavation activities to allow for removal of the circulating water piping.

Assessment:

The movement of the survey boundary was required to address the unanticipated results of the extra excavation that was done on the northwest side of the circulating water pipe removal project. According to NUREG-1575, Rev 1 section 5.5.3.2 Land Area Surveys, a Class 3 area is not required to have 100% scan. It states, "Class 3 areas may be uniformly scanned for radiations from the radionuclides of interest, or the scanning may be performed in areas with the greatest potential for residual contamination based on professional judgment and the objectives of the survey. In some cases, a combination of these approaches may be the most appropriate. Locations exceeding the scanning survey investigation level are evaluated, and, if the presence of contamination not occurring in background is identified, reevaluation of the classification of contamination potential should be performed."

Summary:

The survey unit boundary was moved to accommodate the excavation size northwest onto the top slope of the bank. Surveys using GPS verified that the adjustment of the border added 58 m² to OOL10-05; still within the surface area limitations on Class 3 survey units. OOL10-05 is a sub-surface survey beneath Survey Unit OOL10-06

Adjustment 2:

Background:

The boundary was adjusted for Circulating Water pipe removal survey Unit OOL10-05 to perform additional surface grading activities. Most of the footprint of Survey Unit OOL10-05 is located underneath Survey Unit OOL10-06. Approximately 108 m² of the area will be relocated to Survey Unit OOL10-18 for FSR Survey Planning.

Assessment:

The movement of the northeast boundary portion of Survey Unit OOL10-05 is required in order to allow the decommissioning project contractor to regrade the surface which is a minimal adjustment to the elevation. Therefore, the movement is not an impact to the survey unit or previous surveys. Survey Unit OOL10-05 is covered by engineered surface or other protective barriers as per FSS procedures and guidelines.

Summary:

The boundary will be moved to accommodate the decommissioning project and allow FSS to proceed with the FSS Report of OOL10-05. Approximately 108 m² will be relocated to Survey Unit OOL10-18 FSR.

2.0 SURVEY UNIT DESIGN INFORMATION

These survey units were classified in accordance with Procedure RCP FSS-1, "Survey Unit Classification" (Ref. 5). Survey Units OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19 and OOL10-23 were classified as Class 3 survey units based on the low potential to contain residual radioactive material relative to the DCGLs.

Guidance for preparing FSS plans is provided in Procedure RCP FSS-2, "Preparation of Final Status Survey Plans" (Ref. 8). The FSS plan uses an integrated sample design that combines scanning surveys with either random or biased sampling. The exception to this is Survey Unit OOL10-23 which is covered by the Pacific Ocean. A map of each respective area Survey Area is provided in Figures 1.3-1.8 above.

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 and the NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Ref. 9). A summary of the main features of the DQO process are provided herein.

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

The primary objective of the FSS plan was to demonstrate that the level of residual radioactivity in all 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. Appendix I in Chapter 6 of the LTP describes in detail the modeling used to develop the DCGLs for soil.

The total dose under the LTP criteria is 25 mrem/yr Total Effective Dose Equivalent (TEDE) from all the 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 (ETD) is by far the most prevalently detected radionuclide outside the Radiologically Controlled Area (RCA). Additionally, the HBGS and surrounding areas were not involved in typical plant work activities during operation of the HBPP Unit 3 Nuclear Reactor. The northern portion of this area is downwind of the Unit 3 stack, for the typical winter south to southeast winds. A large portion of this area has been covered by fill material with about one third of the fill material placed prior to Unit 3 operation and about half of the fill material placed since the beginning of Unit 3 operation. To confirm the assumption that HTD nuclides are not present, twelve (12) split samples were randomly selected to receive analyses for the full FSS suite of nuclides at an off-site laboratory.

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 issue 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, one recount sample and two split samples were taken to verify data quality for each survey unit.

Another important facet of the DQO process is to identify the radionuclides of concern and determine the concentration and variability. The surveys performed in Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 spanned the time period of 2012-1018. Table 2.1 and Table 2.2 present the Soil DCGLs respectively per the HBPP LTP. Cs-137 and Co-60 were the only nuclides that could potentially be present based on characterization data. However, the primary contaminant of concern is Cs137 due to its longer half-life.

Table 2.1 Soil DCGLs and LLDs LTP Rev. 0 for OOL10-05 and OOL10-06

Radionuclide ⁽¹⁾	Soil DCGL (pCi/g) ⁽²⁾	LLD (pCi/g) ⁽³⁾	
		10% to 50%	
H-3	6.86E+02	6.86E+01	3.43E+02
C-14	6.30E+00	6.30E-01	3.15E+00
Co-60	3.82E+00	3.82E-01	1.91E+00
Ni-59	1.97E+03	1.97E+02	9.85E+02
Ni-63	7.24E+02	7.24E+01	3.62E+02
Sr-90	1.51E+00	1.51E-01	7.55E-01
Nb-94	7.13E+00	7.13E-01	3.57E+00
Tc-99	1.24E+01	1.24E+00	6.20E+00
I-129	4.83E+00	4.83E-01	2.42E+00
Cs-137	7.93E+00	7.93E-01	3.97E+00
Eu-152	1.01E+01	1.01E+00	5.05E+00
Eu-154	9.40E+00	9.40E-01	4.70E+00
Np-237	1.11E+00	1.11E-01	5.55E-01
Pu-238	2.97E+01	2.97E+00	1.49E+01
Pu-239/240 ⁽⁵⁾	2.67E+01	2.67E+00	1.34E+01
Am-241 ⁽⁴⁾	2.58E+01	2.58E+00	1.29E+01
Pu-241	8.61E+02	8.61E+01	4.31E+02
Cm-243/244 ⁽⁵⁾	2.90E+01	2.90E+00	1.45E+01
Cm-245/246 ⁽⁵⁾	1.78E+01	1.78E+00	8.90E+00

(1) Bold indicates those radionuclides 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 is considered an Easy to Detect (ETD) and can be analyzed by gamma and alpha spectroscopy. 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.

Table 2.2 Soil DCGLs and LLDs LTP Rev. 1 and Rev. 2 for OOL10-14, OOL10-15, OOL10-19 and OOL10-23

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	2.8E+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 indicates those radionuclides 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 is considered an Easy to Detect (ETD) and can be analyzed by gamma and alpha spectroscopy. 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.

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 each survey unit were created. These maps were then used in laying out the sampling and survey locations.

The prescribed survey approach for Class 3 land areas consisted of soil collection of statistically random locations and walk-over scanning of biased selected areas with a 2" x 2" Thallium-activated Sodium Iodide (NaI (Tl)) scintillation detector. Additionally, all direct non-parametric and biased soil sample locations were accessed with the exception of sample OOL10-14-009-F. This sample was inadvertently relocated outside of the survey unit boundary and was disregarded. Therefore, the data from this sample was expunged from the statistical data set used to document compliance with the survey unit dose release criteria.

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. Except for Cs-137 and small trace amounts of Co-60, no other plant-derived radionuclides were identified in the survey units direct soil samples analyzed in the onsite and offsite laboratories, indicating that the survey design was adequate.

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

The 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. 10). 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. 11) 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) computer run showed adequate power for the survey design. This indicates that the survey area had a high probability of rejecting the null hypothesis, assuming that the characterization data are representative of the FSS results. The retrospective power curve 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. 12) Visual Sample Plan was created by Pacific Northwest National Laboratory (PNNL) for the DOE (Ref. 6). A random sampling pattern with a random starting point was selected for sample design, which is appropriate for a Class 3 area.

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 2.3 thru 2.9 as displayed in the Survey Plans.

Table 2.3 Sample Measurement Locations with GPS Coordinates OOL10-05

Sample	Easting	Northing
OOL10-05-001-C	5949453.3	2160887.2
OOL10-05-002-C	5949434.2	2160884.6
OOL10-05-003-C	5949419.9	2160875.7
OOL10-05-004-C	5949439.0	2160864.3
OOL10-05-005-C	5949415.1	2160852.9
OOL10-05-006-C	5949421.5	2160850.4
OOL10-05-007-C	5949402.4	2160835.8
OOL10-05-008-C	5949412.0	2160827.6
OOL10-05-009-C	5949388.1	2160813.0
OOL10-05-010-C	5949392.9	2160810.5
OOL10-05-011-C	5949407.2	2160807.3
OOL10-05-012-C	5949370.6	2160799.1
OOL10-05-013-C	5949394.5	2160790.2
OOL10-05-014-C	5949361.1	2160776.3
OOL10-05-015-C	5949375.4	2160778.8
OOL10-05-016-C-B	5949424.8	2160889.0
OOL10-05-017-C-B	5949379.1	2160768.5

The NRC requested that PG&E provide Oak Ridge Institute for Science and Education (ORISE) with five (5) split samples during FSS of this survey unit. Samples 002, 005, 007, 009 and 015 were designated as splits and sent to ORISE. No plant derived radionuclides were identified in the five samples analyzed at both the on-site laboratory and the respective splits analyzed by the ORISE Laboratory (Ref. 19).

Table 2.4 Sample Measurement Locations with GPS Coordinates OOL10-06

Sample	Easting	Northing
OOL10-06-001-C	5949453.39	2160827.60
OOL10-06-002-C	5949402.08	2160783.69
OOL10-06-003-C	5949444.84	2160782.07
OOL10-06-004-C	5949473.70	2160772.72
OOL10-06-005-C	5949507.90	2160787.35
OOL10-06-006-C	5949396.74	2160754.42
OOL10-06-007-C	5949422.39	2160739.79
OOL10-06-008-C	5949521.80	2160728.81
OOL10-06-009-C	5949573.11	2160750.77
OOL10-06-010-C	5949419.19	2160695.89
OOL10-06-011-C	5949470.49	2160684.91
OOL10-06-012-C	5949513.25	2160683.29
OOL10-06-013-C	5949525.01	2160706.86
OOL10-06-014-C	5949436.29	2160651.98
OOL10-06-015-C	5949465.15	2160655.64
OOL10-06-016-C	5949490.80	2160641.01
OOL10-06-017-C	5949384.98	2160630.03
OOL10-06-018-C	5949388.19	2160608.08
OOL10-06-019-C	5949439.49	2160622.72
OOL10-06-020-C	5949487.59	2160597.11

Table 2.5 Sample Measurement Locations with GPS Coordinates OOL10-14

Sample	Easting	Northing
OOL10-14-001-F	5948850.654	2160287.705
OOL10-14-002-F	5949236.153	2160502.748
OOL10-14-003-F	5949332.528	2160534.606
OOL10-14-004-F*	5948706.092	2160176.202
OOL10-14-005-F	5949127.732	2160486.819
OOL10-14-006-F	5949368.669	2160725.755
OOL10-14-007-F*	5948910.889	2160351.421
OOL10-14-008-F	5949296.388	2160566.464
OOL10-14-009-F*	5948814.514	2160208.06
OOL10-14-010-F	5949169.896	2160529.296
OOL10-14-011-F	5949290.364	2160481.509
OOL10-14-012-F	5949037.380	2160433.722
OOL10-14-013-F	5949278.317	2160608.941
OOL10-14-014-F*	5948796.444	2160250.537
OOL10-14-015-F	5949181.943	2160465.580

*The above samples were relocated due to various reasons as stated below in Table 2.6 with the new GPS Coordinates.

Table 2.6 Relocated Samples with Associated GPS OOL10-14

Sample	Easting	Northing	Reason
OOL10-14-004-F	5948717.93	2160170.06	Environmental restricted area and wetland area
OOL10-14-007-F	5948908.89	2160353.42	Located in briar patch within intake canal
OOL10-14-009-F	5948820.33	2160200.34	Was located on top of gas line
OOL10-14-014-F	5948804.74	2160249.22	Environmental restricted area and wetland area

The decision was made to move the sample locations to facilitate sampling, eliminate underground utility line encroachment, and/or minimize intrusion into environmentally controlled/monitored areas. After sampling, sample location OOL10-14-009-F was plotted in AutoCAD and found to have been relocated outside of the original boundary of the survey plan. For this reason, sample OOL10-14-009-F is being disregarded and the data not used for this survey unit. There is still sufficient power in the remaining samples due to the 20% increase as stated in MARSSIM to account for unusable data.

Table 2.7 Sample Measurement Locations with GPS Coordinates OOL10-15

Sample	Easting	Northing
OOL10-15-001-F	5949482.63	2160102.24
OOL10-15-002-F	5948904.49	2160279.67
OOL10-15-003-F	5949289.91	2159924.81
OOL10-15-004-F	5949193.56	2159951.09
OOL10-15-005-F	5949000.84	2159596.23
OOL10-15-006-F	5949036.98	2159477.94
OOL10-15-007-F	5949229.69	2160187.67
OOL10-15-008-F	5949518.76	2160365.1
OOL10-15-009-F*	5948940.62	2160069.38
OOL10-15-010-F	5949711.47	2160601.67
OOL10-15-011-F	5949085.15	2160424.24
OOL10-15-012-F	5948796.08	2160148.24
OOL10-15-013-F	5949181.51	2159793.38
OOL10-15-014-F	5949374.22	2160029.95
OOL10-15-015-F	5949446.49	2160207.38
OOL10-15-016-F	5949157.42	2160266.53
OOL10-15-017-F	5948964.71	2159911.66
OOL10-15-018-F	5949735.56	2160443.96
OOL10-15-019-F	5948723.82	2159990.52
OOL10-15-020-F	5949494.67	2160522.82
OOL10-15-021-F	5949109.24	2159635.66

*Sample OOL10-15-009 was inaccessible due to the sample location being in the deep part of a water channel flowing through the area. It was replaced with sample number OOL10-15-016. Since this survey unit was a wetlands area (Buhne Slough), additional sample locations OOL10-15-016 thru OOL10-15-021 were added to the plan as a contingency should any original sample location be inaccessible. Locations OOL10-15-017-F thru OOL10-15-021-F were not sampled as the balance of the originally designed locations were accessible.

Table 2.8 Sample Measurement Locations with GPS Coordinates OOL10-19

Sample	Easting	Northing
OOL10-19-001-F	5950430.45	2161621.07
OOL10-19-002-F	5950233.65	2161174.93
OOL10-19-003-F	5950332.05	2161293.90
OOL10-19-004-F	5950368.95	2161383.13
OOL10-19-005-F	5950172.15	2161650.81
OOL10-19-006-F	5950221.35	2161412.87
OOL10-19-007-F	5950614.96	2161680.56
OOL10-19-008-F	5950122.95	2161234.42
OOL10-19-009-F	5950516.56	2161502.10
OOL10-19-010-F	5950393.55	2161541.76
OOL10-19-011-F	5950196.75	2161095.62
OOL10-19-012-F	5950295.15	2161452.53
OOL10-19-013-F	5950688.76	2161720.21
OOL10-19-014-F	5950245.95	2161571.50
OOL10-19-015-F	5950147.55	2161393.04

Table 2.9 Sample Measurement Locations with GPS Coordinates OOL10-23

Sample	Easting	Northing
OOL10-23-001	5949142.72	2161763.43
OOL10-23-002	5950845.17	2162070.12
OOL10-23-003	5947759.47	2161558.97
OOL10-23-004	5949461.93	2161865.66
OOL10-23-005	5948185.09	2161695.27
OOL10-23-006	5949887.54	2162001.96
OOL10-23-007	5948823.51	2161899.73
OOL10-23-008	5950525.96	2162206.42
OOL10-23-009	5948397.89	2161422.66
OOL10-23-010	5949249.12	2162036.04
OOL10-23-011	5948557.50	2161627.12
OOL10-23-012	5950259.96	2161933.81
OOL10-23-013	5948983.11	2161672.56
OOL10-23-014	5950685.57	2161979.25
OOL10-23-015	5949621.53	2161774.79
OOL10-23-016	5948682.24	2161640.48
OOL10-23-017	5950384.70	2161947.17
OOL10-23-018	5949107.85	2161655.63
OOL10-23-019	5950810.31	2161962.32
OOL10-23-020	5949746.27	2161757.86
OOL10-23-021	5948469.43	2161860.09
OOL10-23-022	5950171.89	2162166.78
OOL10-23-023	5948549.23	2161791.93
OOL10-23-024	5950251.69	2162098.62
OOL10-23-025	5948123.62	2161587.47
OOL10-23-026	5949826.08	2161894.16
OOL10-23-027	5947910.81	2161723.78
OOL10-23-028	5949613.27	2162030.47
OOL10-23-029	5948762.04	2161519.32
OOL10-23-030	5950464.50	2161826.01

Sample OOL10-23-003 was inaccessible due to the sample location having rip-rap covering the area which prevented it from being taken. Therefore, per the FSSP it was replaced with contingent sample number OOL10-23-027. Sample locations OOL10-23-016-F thru OOL10-23-030-F were designed as contingent locations for any of the original fifteen locations that were deemed inaccessible.

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 each of the survey units 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. 13) included the collection of two (2) soil samples for “split sample” analysis by the off-site laboratory. These locations were selected randomly using the Microsoft Excel “RAND” function. Additionally, Procedure HBAP C-202, “Final Status Survey Quality Assurance Project Plan” (Ref. 14) requires that 5% of the samples taken for non-parametric statistical testing be selected for QC Replicate analyses.

It should also be noted that the area covered by scan measurement is based on the survey unit classification as described in MARSSIM. As shown below, Table 5-4 of the LTP specifies scanning percentage of Class 3 survey units is judgmental from 1-10%. Scanning percentage of a Class 3 survey unit will be performed on likely areas of contamination based on the judgment of the FSS Engineer. An increase in the scan coverage beyond 10 percent, if desired, is conservative. There was one instance of a deviation from this requirement as stated in Table 2.15 for Survey Unit OOL10-23. A summary of the synopsis of the survey design is displayed below in Tables 2.10 thru 2.15.

Table 5-4 Scan Survey Coverage Requirements

	Class 1	Class 2	Class 3
Scan Coverage	100%	10-100%	Judgmental (1-10%)

Table 2.10 Synopsis of the Survey Design OOL10-05

Feature	Design Criteria	Basis
Survey Unit Land Area	453 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (15 Randomly selected)	Type 1 and Type 2 errors were 0.05, sigma was 0.02 pCi/g, the LBGR was set at 0.95 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=2.2$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.93 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	3.97 pCi/g Cs-137	>50% of the Cs-137 DCGL from investigation criteria provided from Table 5-5 of the LTP for a Class 3 survey unit.
Scan Survey Area Coverage	Approximately 100% ⁽²⁾	Table 5-4 of the LTP requires judgmental 1-10% coverage area for Class 3 survey units
Scan Investigation Level	Discernable and reproducible audible indication of activity above background	Detectable above background, Per 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. 10).

⁽²⁾ This survey unit was completely excavated; therefore, the unit was completely scanned as a conservative measure.

Table 2.11 Synopsis of the Survey Design OOL10-06

Feature	Design Criteria	Basis
Survey Unit Land Area	4,345 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (20 Randomly selected actually collected)	Type 1 and Type 2 errors were 0.05, sigma was 0.02 pCi/g, the LBGR was set at 0.95 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=2.2$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.93 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	3.97 pCi/g Cs-137	>50% of the Cs-137 DCGL from investigation criteria provided from Table 5-5 of the LTP for a Class 3 survey unit.
Scan Survey Area Coverage	Approximately 100% ⁽²⁾	Table 5-4 of the LTP requires judgmental 1-10% coverage area for Class 3 survey units
Scan Investigation Level	Discernable and reproducible audible indication of activity above background	Detectable above background, Per 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. 10).

⁽²⁾ This survey unit was planned to be completely excavated; therefore, the FSSP was written with 100% scan as a conservative measure.

Table 2.12 Synopsis of the Survey Design OOL10-14

Feature	Design Criteria	Basis
Survey Unit Land Area	6,816 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (15 Randomly selected)	Type 1 and Type 2 errors were 0.05, sigma was 0.18 pCi/g, the LBGR was set at 6.91 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=2.0$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.29 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	3.65 pCi/g Cs-137	>50% of the Cs-137 DCGL from investigation criteria provided from Table 5-5 of the LTP for a Class 3 survey unit.
Scan Survey Area Coverage	Approximately 25%	Table 5-4 of the LTP requires judgmental 1-10% coverage area for Class 3 survey units
Scan Investigation Level	Discernable and reproducible audible indication of activity above background	Detectable above background, Per 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. 10).

Table 2.13 Synopsis of the Survey Design OOL10-15

Feature	Design Criteria	Basis
Survey Unit Land Area	70,367 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (15 Randomly selected)	Type 1 and Type 2 errors were 0.05, sigma was 0.18 pCi/g, the LBGR was set at 7.24 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=1.98$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.6 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	3.8 pCi/g Cs-137	>50% of the Cs-137 DCGL from investigation criteria provided from 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 area for Class 3 survey units
Scan Investigation Level	Discernable and reproducible audible indication of activity above background	Detectable above background, Per 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. 10).

Table 2.14 Synopsis of the Survey Design OOL10-19

Feature	Design Criteria	Basis
Survey Unit Land Area	24,546 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (15 Randomly selected)	Type 1 and Type 2 errors were 0.05, sigma was 0.18 pCi/g, the LBGR was set at 6.8 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=1.99$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.16 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	3.8 pCi/g Cs-137	>50% of the Cs-137 DCGL from investigation criteria provided from Table 5-5 of the LTP for a Class 3 survey unit.
Scan Survey Area Coverage	Approximately 25%	Table 5-4 of the LTP requires judgmental 1-10% coverage area for Class 3 survey units
Scan Investigation Level	Discernable and reproducible audible indication of activity above background	Detectable above background, Per 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. 10).

Table 2.15 Synopsis of the Survey Design OOL10-23

Feature	Design Criteria	Basis
Survey Unit Land Area	132,587 m ²	Based on AutoCAD
Number of Measurements	15 required ⁽¹⁾ (15 Randomly selected)	Type 1 and Type 2 errors were 0.05, sigma was 0.01 pCi/g, the LBGR was set at 7.19 pCi/g to achieve a Relative Shift in the range of 1 and 3 ($\Delta/\sigma=2.17$)
Grid Spacing	NA	NA for Class 3 areas
Design DCGL	7.22 pCi/g Cs-137	To achieve 25 mrem/yr TEDE
Soil Investigation Level	1.80 pCi/g Cs-137	>25% of the Cs-137 DCGL ⁽²⁾
Scan Survey Area Coverage	N/A ⁽³⁾	N/A ⁽³⁾
Scan Investigation Level	N/A ⁽³⁾	N/A ⁽³⁾

⁽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. 10).

⁽²⁾ The investigation level was reduced to 25% (from the required 50%) of the DCGL since there was no available means to perform a gamma scan of the submerged sediment media on the bottom of the bay.

⁽³⁾ The scanning percentage for Class 3 areas are 1-10% as stated in Table 5-4 of the LTP. However, this survey unit is in the bay and covered by the Pacific Ocean. There were no means at the time to perform scanning of the sediment at the bottom of the bay.

3.0 SURVEY RESULTS

Final Status Survey field activities were conducted under Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23. The preparations for work included a detailed review of the FSS Plan, Job Safety Analysis (JSA), 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 MEASUREMENTS RESULTS

Each of the ninety-five (95) statistical samples collected were analyzed by gamma spectroscopy at the on-site laboratory. All samples obtained during the FSS of Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 were collected using Procedure FSS-8, "Collection of Site Characterization and Final Status Survey Samples" (Ref. 15). In addition, twelve (12) 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 NRC requested that PG&E provide ORISE with 5 split samples from the FSS of the Circulating Water Survey Unit. Five (5) samples from Survey Unit OOL10-05 were selected as splits for comparison with ORISE. Those samples are OOL10-05-002, OOL10-05-005, OOL10-05-007, OOL10-05-009 and OOL10-05-015. These samples were sent as collected (not dried).

On-site gamma spectroscopy analysis was performed to the required MDC. Gamma spectroscopy results positively identified some low-level Cs-137. Similarly, Cs-137 was found to be present in the samples analyzed by GEL and were >MDC but <LLD.

Sample results did not exceed the Investigation Level for soil samples (i.e., 50% of the DCGL). Therefore, gamma spectroscopy sample results did not require further investigation.

A summary of the statistical soil sample results for each specific area is provided in Tables 3.1-3.6. Additionally, while not considered in the non-parametric statistical evaluation of compliance with the release criteria, there were two (2) biased samples that were collected in Survey Unit OOL10-05 and analyzed using gamma spectroscopy. A summary of these two samples is provided in Table 3.1 along with the statistical sample results.

3.1.1 SURVEY UNIT OOL10-05 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Fifteen randomly-placed soil sample locations were obtained during FSS in Survey Unit OOL10-05 and analyzed on-site using the Apex-Gamma Analyst System. The analytical results show that the maximum fraction is less than 1% of the established Cs-137 DCGL. 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 all fifteen (15) samples plus the two (2) additional bias samples taken in Survey Unit OOL10-05.

Table 3.1 Summary of Systematic Soil Sample Results for OOL10-05

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g)*	Fraction of the DCGL
CHAR-OOL10-05-01-C	3.99E-02	5.03E-03
CHAR-OOL10-05-02-C	-1.50E-02	-1.89E-03
CHAR-OOL10-05-03-C	-3.38E-04	-4.26E-05
CHAR-OOL10-05-04-C	-3.47E-02	-4.38E-03
CHAR-OOL10-05-04-C-RC	1.28E-02	1.61E-03
CHAR-OOL10-05-05-C	0.00E+00	0.00E+00
CHAR-OOL10-05-06-C	8.34E-04	1.05E-04
CHAR-OOL10-05-07-C	6.60E-04	8.32E-05
CHAR-OOL10-05-08-C	5.02E-03	6.33E-04
CHAR-OOL10-05-09-C	1.50E-02	1.89E-03
CHAR-OOL10-05-10-C	7.32E-04	9.23E-05
CHAR-OOL10-05-11-C	3.20E-02	4.04E-03
CHAR-OOL10-05-12-C	-2.40E-03	-3.03E-04
CHAR-OOL10-05-13-C	-1.68E-02	-2.12E-03
CHAR-OOL10-05-14-C	-4.62E-02	-5.83E-03
CHAR-OOL10-05-15-C	4.71E-02	5.94E-03
CHAR-OOL10-05-16-C-B	4.90E-02	6.18E-03
CHAR-OOL10-05-17-C-B	-2.64E-02	-3.33E-03

*No sample was positive for plant derived radionuclides

3.1.2 SURVEY UNIT OOL10-06 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Twenty (20) randomly-placed soil sample locations were obtained during the FSS in Survey Unit OOL10-06 and analyzed on-site using the Apex-Gamma Analyst System. The analytical results show that the maximum fraction is less than 5% of the established Cs-137 DCGL. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.2 presents the FSS results for all twenty (20) samples taken in Survey Unit OOL10-06.

Table 3.2 Summary of Systematic Soil Sample Results for OOL10-06

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g) *	Fraction of the DCGL
CHAR-OOL10-06-001-C	4.67E-02	5.89E-03
CHAR-OOL10-06-002-C	-5.60E-02	-7.06E-03
CHAR-OOL10-06-003-C	-1.04E-02	-1.31E-03
CHAR-OOL10-06-004-C	9.28E-02	1.17E-02
CHAR-OOL10-06-005-C	3.45E-01	4.35E-02
CHAR-OOL10-06-006-C	1.56E-02	1.97E-03
CHAR-OOL10-06-007-C	7.62E-02	9.61E-03
CHAR-OOL10-06-008-C	1.27E-02	1.60E-03
CHAR-OOL10-06-009-C	-4.03E-02	-5.08E-03
CHAR-OOL10-06-010-C	5.35E-02	6.75E-03
CHAR-OOL10-06-011-C	-5.10E-02	-6.43E-03
CHAR-OOL10-06-012-C	2.13E-01	2.69E-02
CHAR-OOL10-06-013-C	2.31E-02	2.91E-03
CHAR-OOL10-06-014-C	5.27E-02	6.65E-03
CHAR-OOL10-06-015-C	-3.89E-02	-4.91E-03
CHAR-OOL10-06-016-C	-6.20E-03	-7.82E-04
CHAR-OOL10-06-017-C	-5.05E-03	-6.37E-04
CHAR-OOL10-06-018-C	1.71E-02	2.16E-03
CHAR-OOL10-06-019-C	7.27E-02	9.17E-03
CHAR-OOL10-06-020-C	2.56E-02	3.23E-03

*Results in bold indicates samples that showed a positive result for Cs-137

3.1.3 SURVEY UNIT OOL10-14 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Fifteen (15) randomly-placed soil sample locations were obtained during the FSS in Survey Unit OOL10-14 and analyzed on-site at the Count Room Laboratory. The analytical results show that the maximum fraction is less than 8% of the established Cs-137 DCGL. Data quality assessments indicated that the results meet the data quality requirements and are acceptable for use. Table 3.3 presents the FSS results for all fifteen (15) samples taken in Survey Unit OOL10-14.

Table 3.3 Summary of Systematic Soil Sample Results for OOL10-14

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g) *	Fraction of the DCGL
FSS-OOL10-14-001	1.55E-01	2.12E-02
FSS-OOL10-14-002	-1.53E-02	-2.10E-03
FSS-OOL10-14-003	9.47E-03	1.30E-03
FSS-OOL10-14-004	2.44E-01	3.35E-02
FSS-OOL10-14-005	1.56E-02	2.14E-03
FSS-OOL10-14-006	7.11E-02	9.75E-03
FSS-OOL10-14-007	5.41E-01	7.42E-02
FSS-OOL10-14-008	2.98E-03	4.09E-04
FSS-OOL10-14-009 ⁽¹⁾	N/A	N/A
FSS-OOL10-14-010	-1.65E-03	-2.26E-04
FSS-OOL10-14-011	7.15E-04	9.81E-05
FSS-OOL10-14-012	2.57E-02	3.53E-03
FSS-OOL10-14-012-RC	-3.13E-02	-4.29E-03
FSS-OOL10-14-013	-6.53E-02	-8.96E-03
FSS-OOL10-14-014	2.64E-01	3.62E-02
FSS-OOL10-14-015	1.82E-02	2.50E-03

⁽¹⁾Sample FSS-OOL10-14-009 had to be relocated in the field and using AutoCAD it was later determined that the relocated sample fell outside of the OOL10-14 Survey Unit boundary, therefore the sample is being expunged from the sample data population for statistical consideration used to support the survey unit release decision. There is still sufficient power in the remaining samples due to the 20% increase as stated in MARSSIM to account for unusable data.

***Results in bold indicates samples that showed a positive result for Cs-137**

3.1.4 SURVEY UNIT OOL10-15 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Fifteen (15) randomly-placed soil sample locations were obtained during the FSS in Survey Unit OOL10-15 and analyzed on-site at the Count Room Laboratory. The analytical results show that the maximum fraction is less than 8% of the established Cs-137 DCGL. 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 all fifteen (15) samples taken in Survey Unit OOL10-15.

Table 3.4 Summary of Systematic Soil Sample Results for OOL10-15

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g) *	Fraction of the DCGL
FSS-OOL10-15-001	1.69E-01	2.22E-02
FSS-OOL10-15-002	1.15E-01	1.51E-02
FSS-OOL10-15-003	3.16E-01	4.16E-02
FSS-OOL10-15-004	5.61E-01	7.38E-02
FSS-OOL10-15-005	5.93E-02	7.80E-03
FSS-OOL10-15-006	2.39E-01	3.14E-02
FSS-OOL10-15-007	4.09E-01	5.38E-02
FSS-OOL10-15-008	2.57E-01	3.38E-02
FSS-OOL10-15-009 ⁽¹⁾	N/A	N/A
FSS-OOL10-15-010	2.24E-01	2.95E-02
FSS-OOL10-15-011	1.50E-01	1.97E-02
FSS-OOL10-15-012	1.13E-01	1.49E-02
FSS-OOL10-15-013	2.37E-01	3.12E-02
FSS-OOL10-15-014	9.49E-02	1.25E-02
FSS-OOL10-15-015	3.58E-01	4.71E-02
FSS-OOL10-15-016	6.92E-02	9.11E-03

⁽¹⁾ Sample OOL10-15-009 was inaccessible due to the sample location being in the deep part of a water channel flowing through the area. As per the FSS Survey Plan it was replaced with sample number OOL10-15-016. This survey plan is the Buhne Slough which is a wetlands area so additional sample locations OOL10-15-016 thru OOL10-15-021 were added to the plan in case one of the original sample locations could not be accessed.

***Above results in bold indicates samples that identified Cs-137**

3.1.5 SURVEY UNIT OOL10-19 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Fifteen (15) randomly-placed soil sample locations were obtained during the FSS in Survey Unit OOL10-19 and analyzed on-site at the Count Room Laboratory. The analytical results show that the maximum fraction is less than 6% of the established Cs-137 DCGL. 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 all fifteen (15) samples taken in Survey Unit OOL10-19.

Table 3.5 Summary of Systematic Soil Sample Results for OOL10-19

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g) *	Fraction of the DCGL
FSS-OOL10-19-001	9.63E-02	1.34E-02
FSS-OOL10-19-002	2.15E-01	3.00E-02
FSS-OOL10-19-003	2.51E-02	3.51E-03
FSS-OOL10-19-004	4.07E-01	5.68E-02
FSS-OOL10-19-005	3.70E-02	5.17E-03
FSS-OOL10-19-006	2.64E-01	3.69E-02
FSS-OOL10-19-007	7.45E-02	1.04E-02
FSS-OOL10-19-008	3.46E-01	4.83E-02
FSS-OOL10-19-009	8.96E-02	1.25E-02
FSS-OOL10-19-010	9.26E-02	1.29E-02
FSS-OOL10-19-011	2.58E-02	3.60E-03
FSS-OOL10-19-012	4.09E-02	5.71E-03
FSS-OOL10-19-013	9.70E-02	1.35E-02
FSS-OOL10-19-014	1.00E-01	1.40E-02
FSS-OOL10-19-015	3.19E-01	4.46E-02

*Above results in bold indicates samples that identified Cs-137

3.1.6 SURVEY UNIT OOL10-23 STATISTICAL SOIL SAMPLE ACTIVITY RESULTS

Fifteen (15) randomly-placed soil sample locations were obtained during the FSS in Survey Unit OOL10-23 and analyzed on-site using the Apex-Gamma Analyst System. The analytical results show that the maximum fraction is approximately 1% of the established Cs-137 DCGL. 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 all fifteen (15) samples taken in Survey Unit OOL10-23.

Table 3.6 Summary of Systematic Soil Sample Results for OOL10-23

Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed using the On-Site Laboratory HPGe Gamma System		
Sample Number	Cs-137 (pCi/g) *	Fraction of the DCGL
OOL10-23-001	6.23E-02	8.63E-03
OOL10-23-002	1.96E-02	2.71E-03
OOL10-23-003	N/A ⁽¹⁾	N/A
OOL10-23-004	-3.55E-03	-4.92E-04
OOL10-23-005	8.50E-04	1.18E-04
OOL10-23-006	2.65E-02	3.67E-03
OOL10-23-007	1.78E-02	2.47E-03
OOL10-23-008	5.34E-02	7.40E-03
OOL10-23-009	2.50E-02	3.46E-03
OOL10-23-010	7.51E-02	1.04E-02
OOL10-23-011 ⁽²⁾	5.82E-02	8.06E-03
OOL10-23-012	3.80E-02	5.27E-03
OOL10-23-013	-6.29E-03	-8.71E-04
OOL10-23-014	2.14E-02	2.96E-03
OOL10-23-015	2.48E-02	3.43E-03
OOL10-23-027	4.13E-02	5.72E-03

⁽¹⁾ Location 3 was not accessible (covered by rip-rap). Per Specific Instructions Table 1 of HBPP-FSSP-OOL10-23-00, contingent alternate location 27 was used.

⁽²⁾ GEL sample results for OOL10-23-011-F showed 5.62E+00 pCi/g C-14. SAPN 1447780 was generated to document the elevated result and the subsequent investigation actions that were performed. The summary for SAPN 1447780 is presented in Section 1.3.4 of this report.

***Results in bold indicates samples that identified Cs-137**

3.2 SCAN SUMMARY

Due to the number of survey units in this report and the amount of surveys for scanning that was completed in each area, the total scan coverage area will be shown in this section on one map for each specific area. Total area, percent required, scanned and variance for all areas are shown in the table below. A map of Survey Units OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 are provided in figures 3.0 thru 3.5.

Survey Unit Scan Percentage Chart

Survey Unit	Total Area (m ²) ⁽⁴⁾	Scanned Area (m ²) ⁽⁴⁾	Survey Design	Percentage Completed	Variance
OOL10-05	511	509	100%	99.6%	-0.4% ^(1,3)
OOL10-06	4,345	4,274	100%	98.4%	-1.6% ^(1,3)
OOL10-14	6,816	4,042	25%	59.3%	34.3%
OOL10-15	70,367	3,717	5%	5.3%	0.3%
OOL10-19	24,546	1,261	5%	5.1%	0.1%
OOL10-23	132,587 ⁽²⁾	0	0%	0.0%	0.0% ^(2,3)

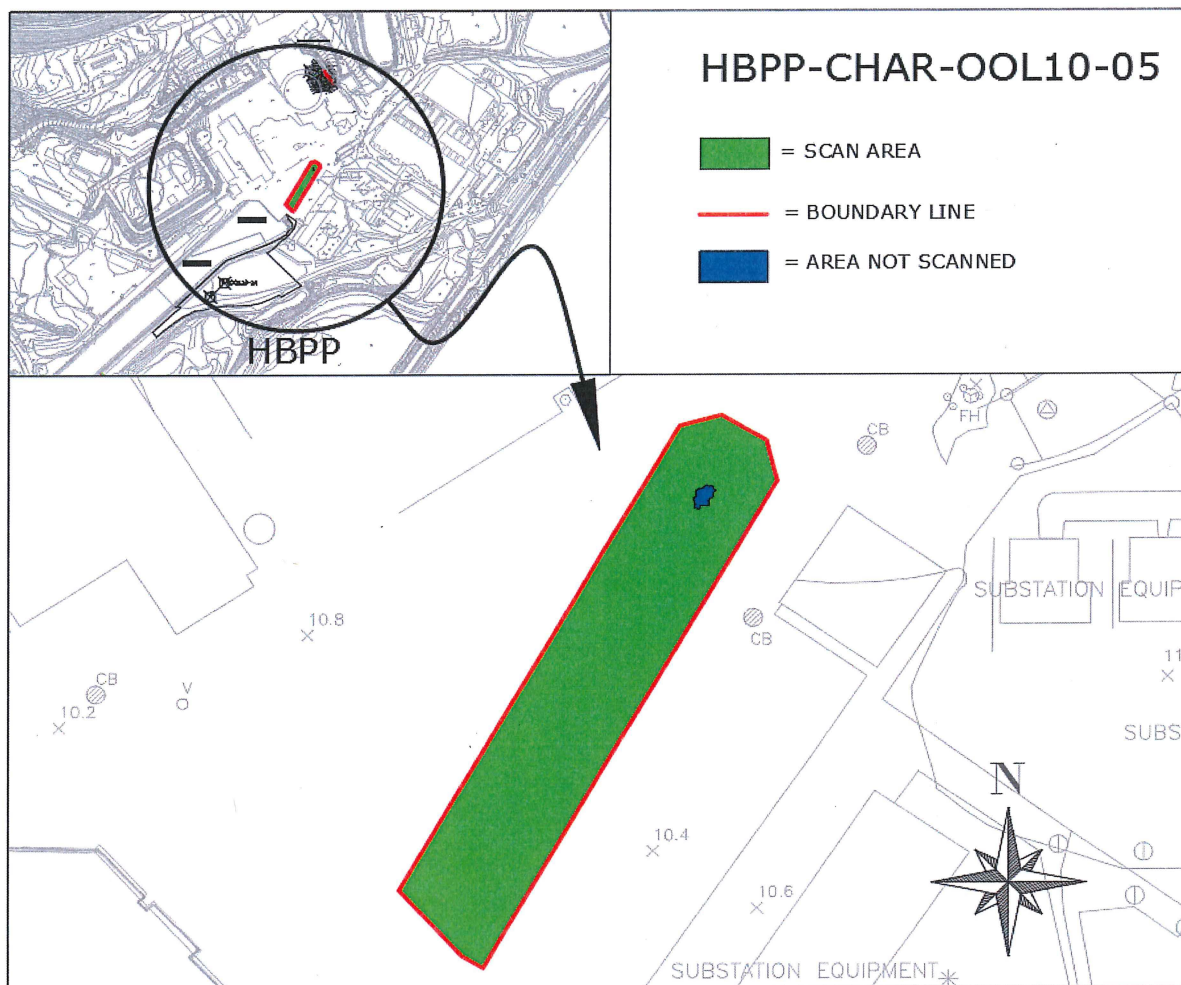
(1) SAPN 1464620 was written to address the variance from the Survey Plan Design.

(2) SAPN 1464630 was written to address the variance from the Survey Plan Design.

(3) All of these survey units are classified as Class 3 survey units per the LTP. The Scan Survey Coverage requirement as stated in 5.3.2, Table 5-4 is "Judgmental (1-10%)". Therefore, all of the survey units meet the requirements as stated in the LTP.

(4) Meters squared

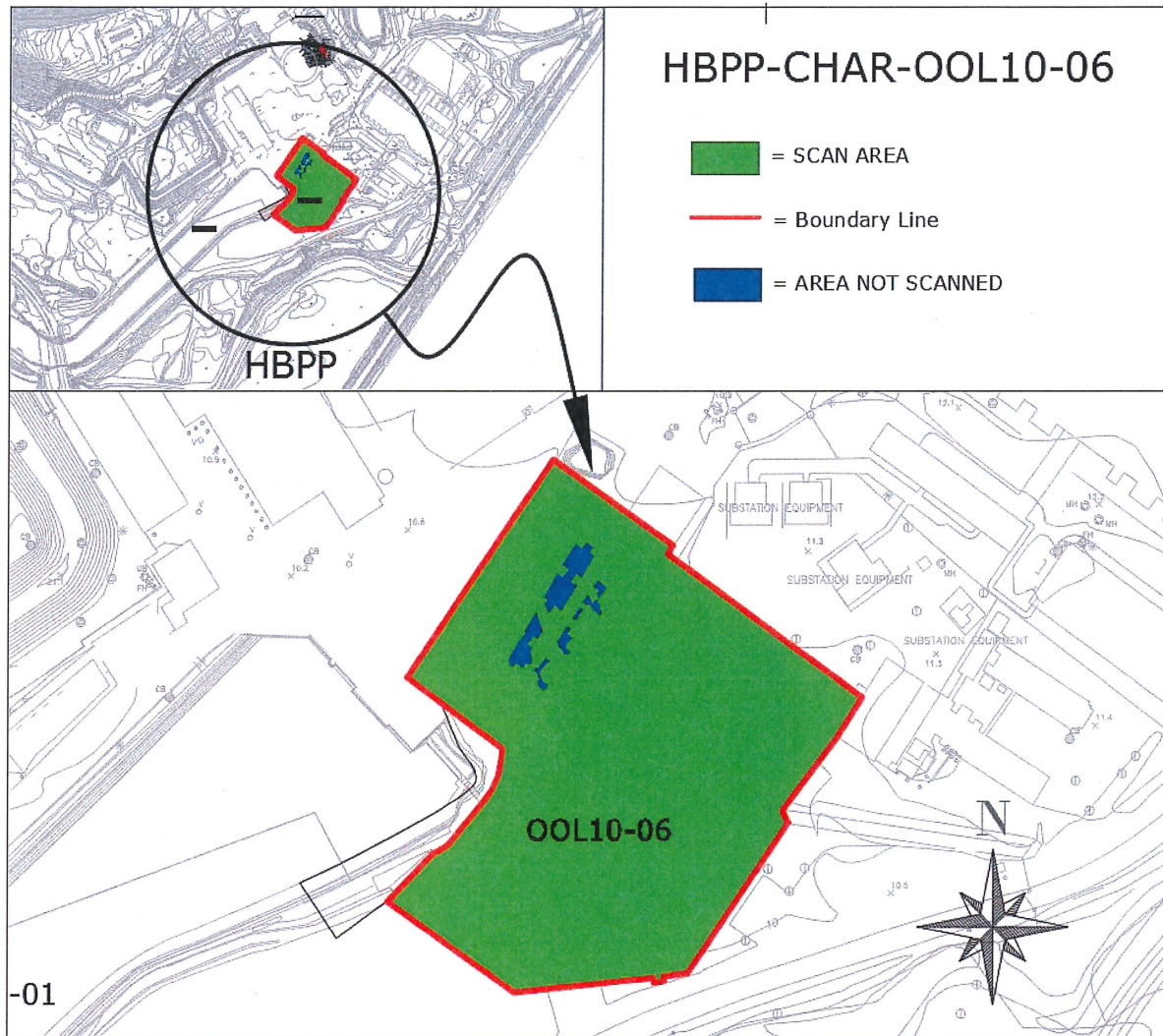
Figure 3.0 - Footprint of Survey Scanned Area for OOL10-05



The Survey Unit OOL10-05 survey plan called for a scan coverage of 100%. However, there was a small 2.6 m² area that was covered with water and not scanned. This represents a very small fraction of 0.4% unscanned of the total percentage with 99.6% scanned. It is very unlikely that this small unscanned area contains any plant-derived radionuclides exceeding a small fraction of the DCGLs. The remainder of the scanned showed no audible indications of elevated counts above background. The 99.6% scanned percentage meets the LTP requirements stipulated for Class 3 areas.

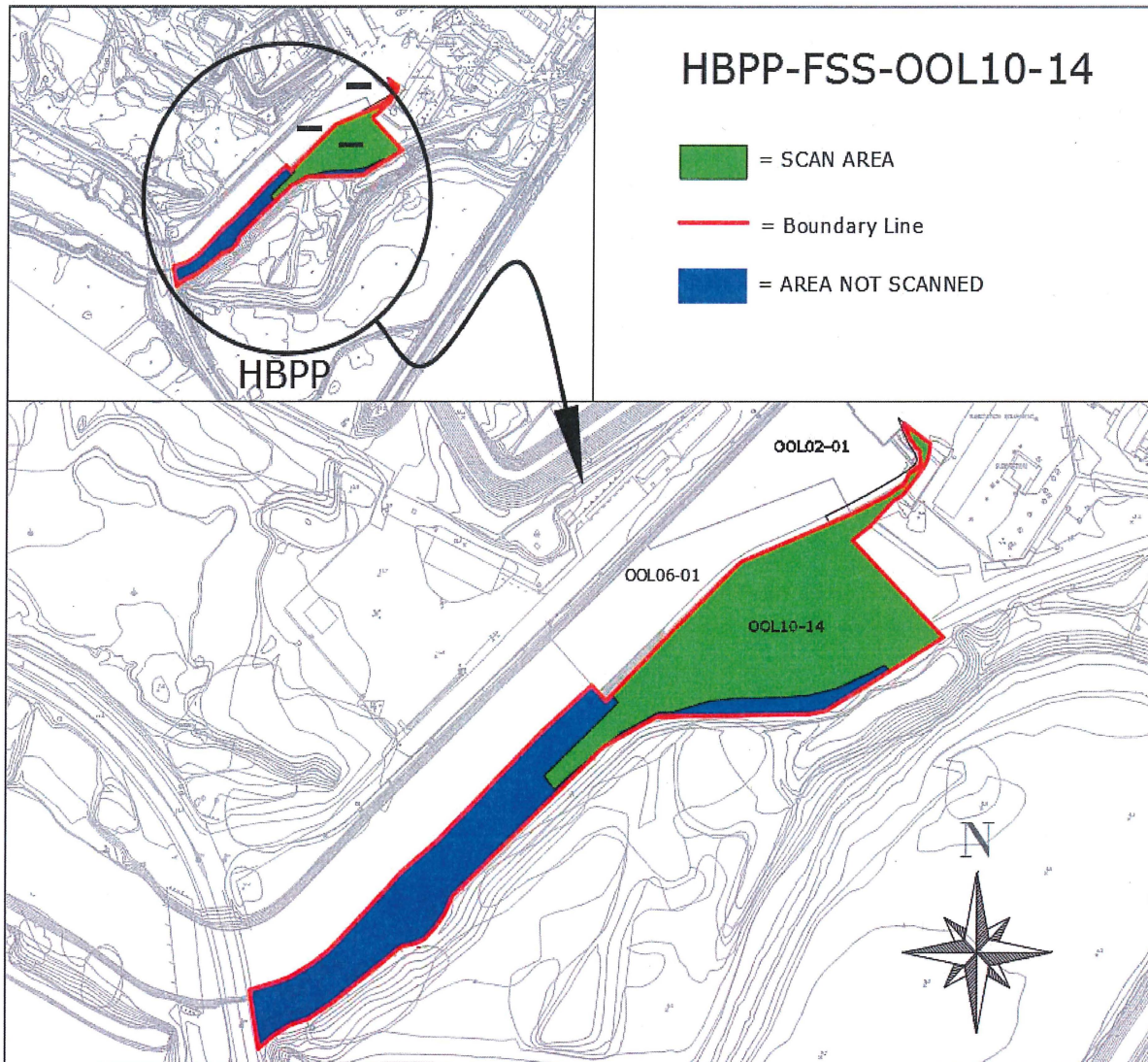
SAPN 1464620 summary is that the scan requirement stipulated for Class 3 areas as stated in Table 5-4, of the LTP is Judgmental (1-10%). Therefore, no other actions are required for this survey unit.

Figure 3.1 - Footprint of Survey Scanned Area for OOL10-06



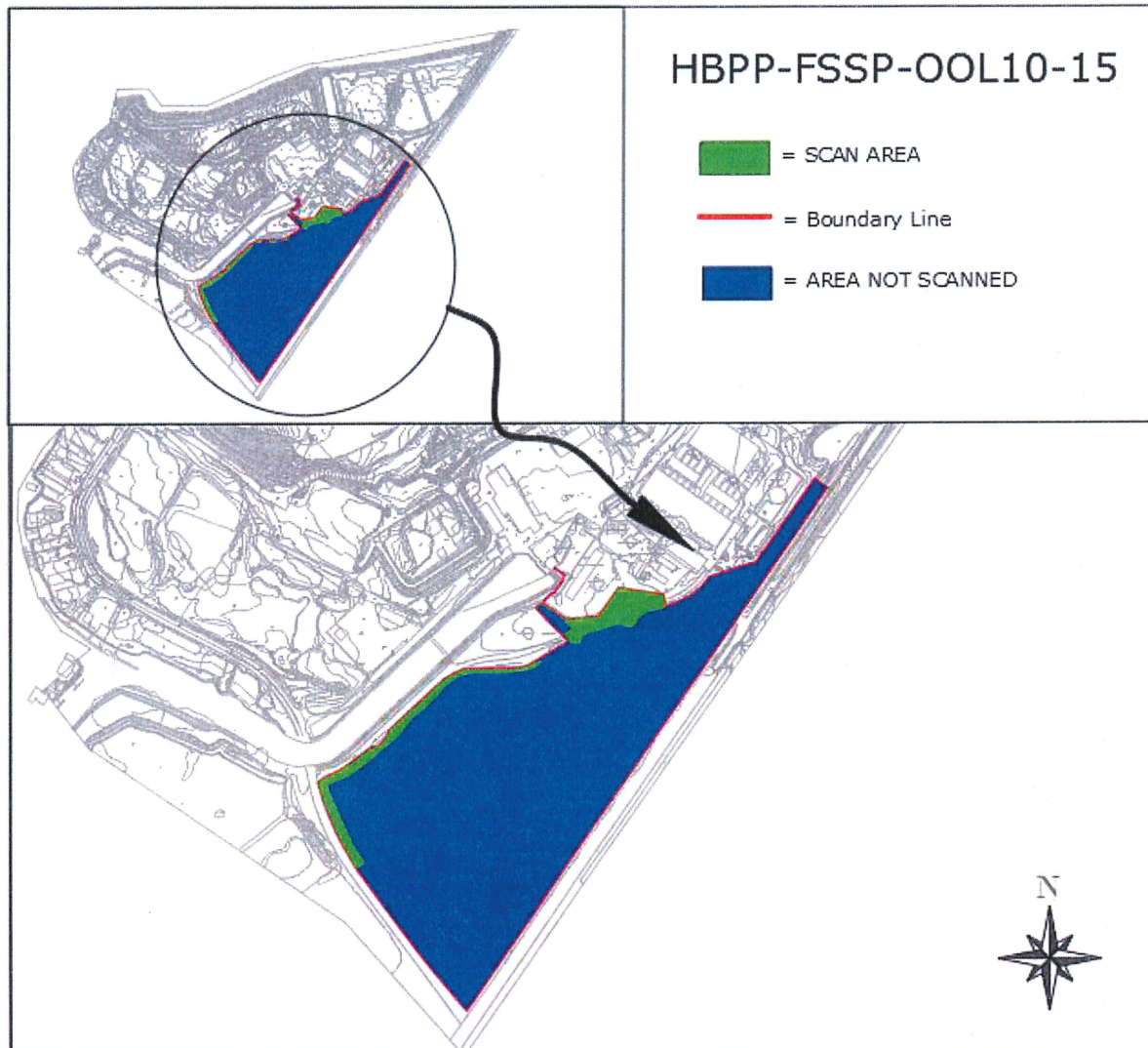
The Survey Unit OOL10-06 survey plan called for a scan coverage of 100%. However, when the scan maps were evaluated, a small percentage of the area (71 m²) was not scanned. This represents a small fraction (1.6%) of the total percentage with 98.4% being scanned. It is very unlikely that this small unscanned area contains any plant-derived radionuclides exceeding a small fraction of the DCGLs. The remainder of the scanned area showed no audible indications of elevated counts above background. The 98.4% scanned percentage meets the LTP requirements stipulated for Class 3 areas.

Figure 3.2 - Footprint of Survey Scanned Area for OOL10-14



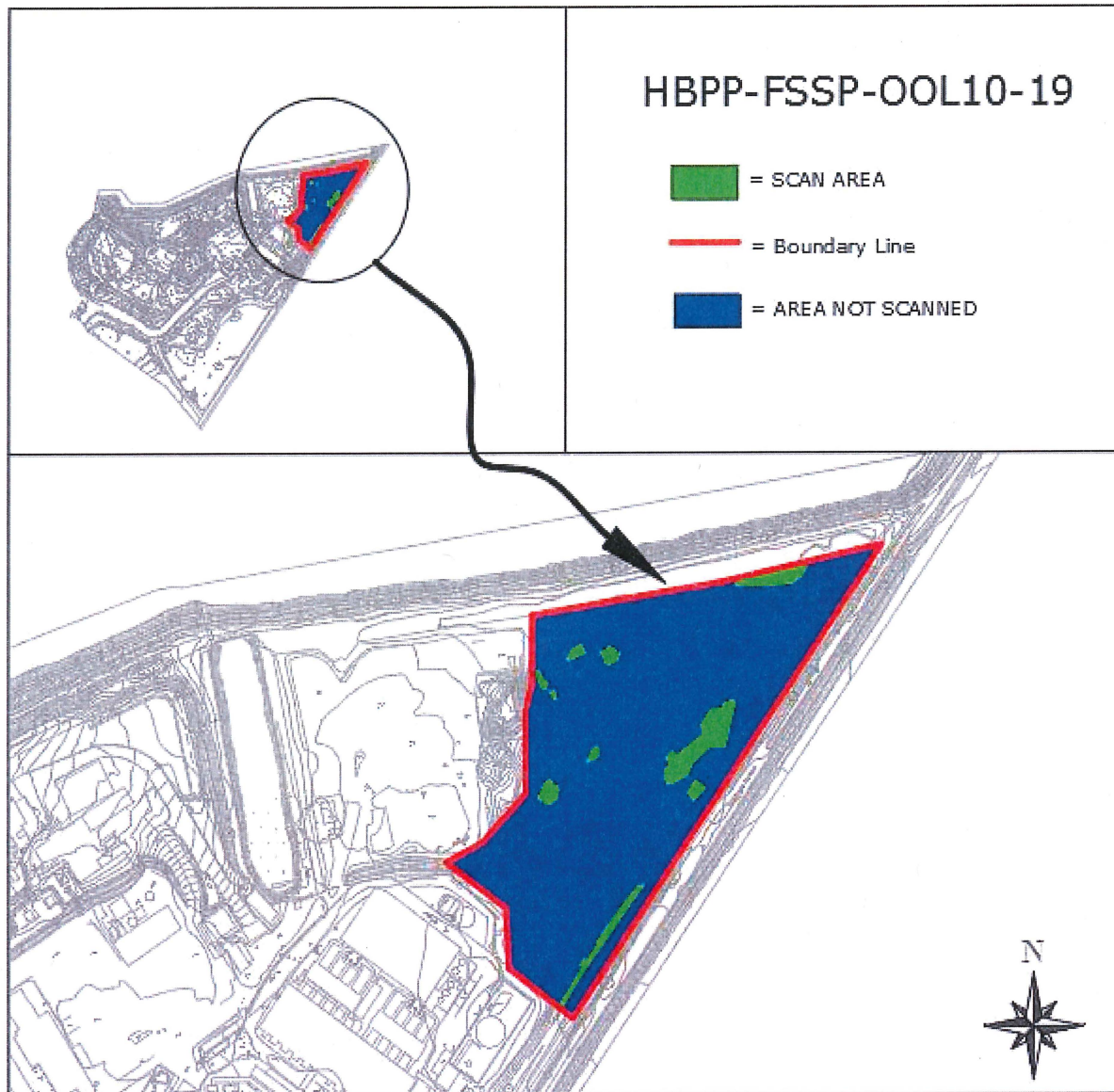
Survey Unit OOL10-14 survey plan called for a scan coverage of 25%. However, when the scan maps were put together it was discovered that 59.3% of the area was scanned. The scanned area showed no audible indications of elevated counts above background. The 59.3% scanned area percentage meets the LTP requirements stipulated for Class 3 areas.

Figure 3.3 - Footprint of Survey Scanned Area for OOL10-15



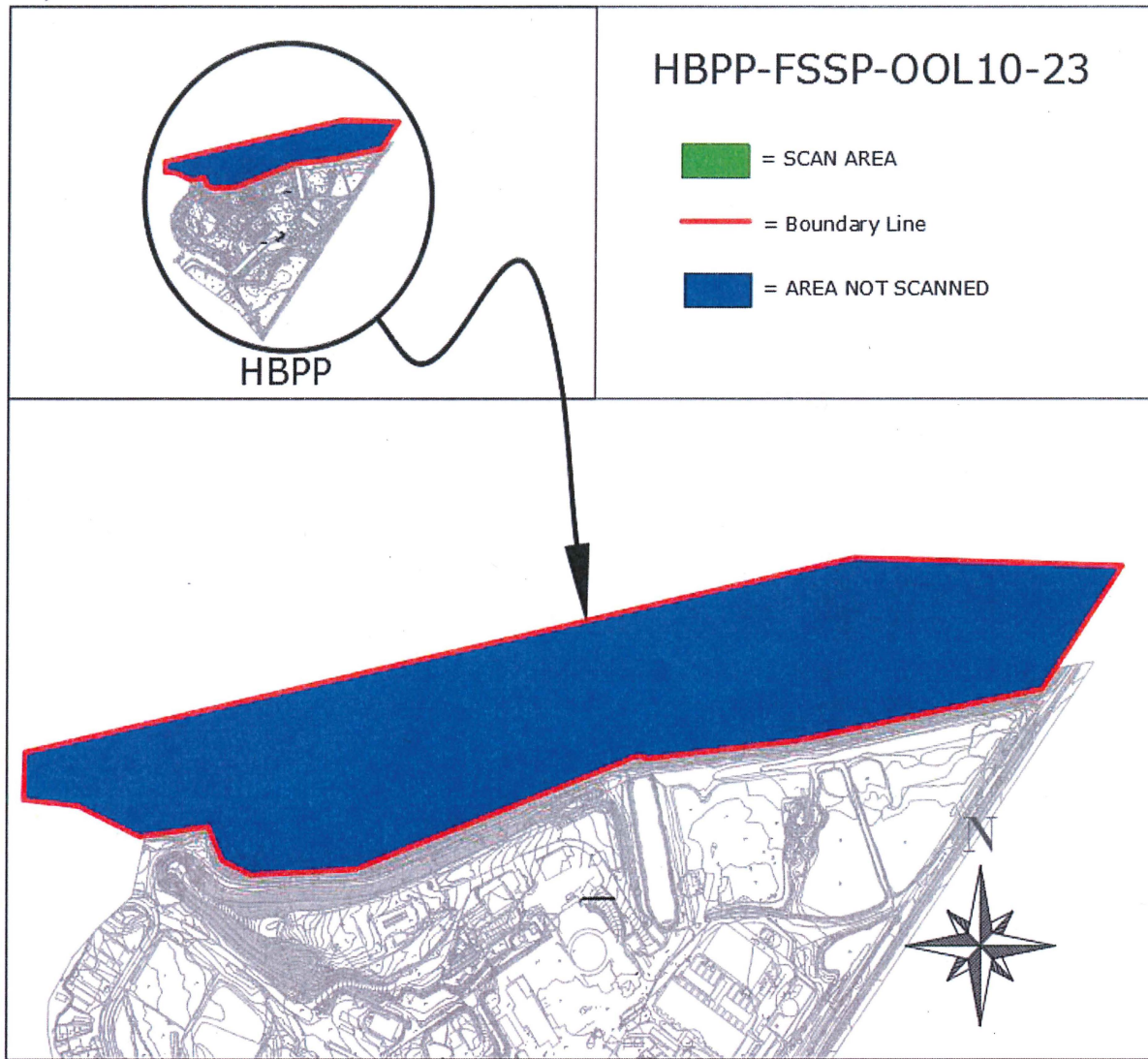
Survey Unit OOL10-15 survey plan called for a scan coverage of 5%. However, when the scan maps were put together it was discovered that 5.3% of the area was scanned. The scanned area showed no audible indications of elevated counts above background. The 5.3% scanned area percentage meets the LTP requirements stipulated for Class 3 areas.

Figure 3.4 - Footprint of Survey Scanned Area for OOL10-19



Survey Unit OOL10-19 survey plan called for a scan coverage of 5%. However, when the scan maps were put together it was discovered that 5.1% of the area was scanned. The scanned area showed no audible indications of elevated counts above background. The 5.1% scanned area percentage meets the LTP requirements stipulated for Class 3 areas.

Figure 3.5 - Footprint of Survey Scanned Area for OOL10-23



Survey Unit OOL10-23 survey plan called for a scan coverage of 0%. The entire unit is covered by the Pacific Ocean and at the time of the survey there was no readily available means to perform a gamma scan on the submerged sediment media on the ocean floor. Therefore, three compensatory measures variances from the FSS program were put into place:

- 1) The investigation level was reduced to 25% (from the required 50%) of the DCGL,
- 2) The 15 random samples collected had contingency sample locations in the event original location(s) were inaccessible,
- 3) The samples obtained were collected with a 25lb. SST sampling dredge designed for collecting sediment.

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. 16) for completeness and consistency. The sampling design of Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 had adequate power as indicated by the Retrospective Power Curves as shown in Attachment 1. 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 units pass 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 sufficient to ensure that the survey units were properly designated as Class 3.

The final data review consisted of calculating basic statistical quantities as depicted in the Data Assessment Attachment 1. The mean and median values are well below the Operational DCGL. Also, the retrospective power curves show that a sufficient number of samples were collected to achieve the desired power. Therefore, the survey units meet the unrestricted release criteria with adequate power as required by the DQOs. The basic statistical quantities for the statistical sample population for the survey units are provided below in Table 4.1 thru 4.6.

Table 4.1 Statistical Soil Sample Results Summary for OOL10-05

Statistic	pCi/g	Fraction of the DCGL		
Minimum Value:	-4.62E-02	-5.83E-03	-3.97%	Difference between mean and median
Maximum Value:	4.71E-02	5.94E-03	0.05	Skew
Mean:	1.72E-03	2.14E-04	3.70	Range of Data
Median:	6.60E-04	8.32E-05	0.15	Max Dose contribution (mrem/yr)
Standard Deviation:	2.52E-02	3.18E-03	0.01	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 3.70 standard deviations. The difference between the mean and median was about -3.97% of the standard deviation which indicates limited skewness in the data. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a symmetrical skewness as confirmed by the calculated skew of 0.05, indicating a nearly normal distribution.

All measurements for Cs-137 were non-detects. All biased soil samples were below the Investigation Level of 50% of the DCGL (3.97 pCi/g Cs-137), as provided in the associated FSSP. 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 0.01 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-05 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 OOL10-06

Statistic	pCi/g	Fraction of the DCGL		
Minimum Value:	-5.60E-02	-7.06E-03	-23.22%	Difference between mean and median
Maximum Value:	3.45E-01	4.35E-02	2.10	Skew
Mean:	4.19E-02	5.28E-03	4.27	Range of Data
Median:	2.01E-02	2.53E-03	1.09	Max Dose contribution (mrem/yr)
Standard Deviation:	9.39E-02	1.18E-02	0.14	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 4.27 standard deviations. The difference between the mean and median was about -23.22% of the standard deviation which indicates slight positive skewness to the left in the data. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a high positive skewness as confirmed by the calculated skew of 2.10, indicating a non-normal distribution with no multimodal distribution noted.

All soil samples were below the Investigation Level of 50% of the DCGL (3.97 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 0.14 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-06 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 OOL10-14

Statistic	pCi/g	Fraction of the DCGL		
Minimum Value:	-6.53E-02	-8.96E-03	-45.29%	Difference between mean and median
Maximum Value:	5.41E-01	7.42E-02	1.93	Skew
Mean:	9.04E-02	1.24E-02	3.7	Range of Data
Median:	1.69E-02	2.32E-03	3.65	Max Dose contribution (mrem/yr)
Standard Deviation:	1.62E-01	2.23E-02	2.22	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 3.7 standard deviations. The difference between the mean and median was about -45.29% of the standard deviation which indicates positive skewness to the left in the data. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a high positive skewness as confirmed by the calculated skew of 1.93, indicating a non-normal distribution with no multimodal distribution noted.

All soil samples were below the Investigation Level of 50% of the DCGL (3.65 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 2.22 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-14 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 OOL10-15

Statistic	pCi/g	Fraction of the DCGL		
Minimum Value:	5.93E-02	7.80E-03	-0.50%	Difference between mean and median
Maximum Value:	5.61E-01	7.38E-02	1.00	Skew
Mean:	2.25E-01	2.96E-02	3.6	Range of Data
Median:	2.24E-01	2.95E-02	2.87	Max Dose contribution (mrem/yr)
Standard Deviation:	1.40E-01	1.85E-02	1.81	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 3.6 standard deviations. The difference between the mean and median was about -0.50% of the standard deviation which indicates a nearly normal distribution in the data. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a moderately positive skewness as confirmed by the calculated skew of 1.00, indicating a near normal distribution.

All soil samples were below the Investigation Level of 50% of the DCGL (3.80 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 1.81 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-15 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 OOL10-19

Statistic	pCi/g	Fraction of the DCGL		
Minimum Value:	2.51E-02	3.51E-03	-41.16%	Difference between mean and median
Maximum Value:	4.07E-01	5.68E-02	0.97	Skew
Mean:	1.49E-01	2.08E-02	3.0	Range of Data
Median:	9.63E-02	1.34E-02	3.63	Max Dose contribution (mrem/yr)
Standard Deviation:	1.27E-01	1.78E-02	2.82	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 3 standard deviations. The difference between the mean and median was about -41.16% of the standard deviation which indicates a skewed distribution in the data to the left. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a moderately positive skewness as confirmed by the calculated skew of 0.97, indicating a non-normal distribution with no multimodal distribution noted.

All soil samples were below the Investigation Level of 50% of the DCGL (3.58 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 2.82 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-19 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 OOL10-23

Statistic	pCi/gm	Fraction of the DCGL		
Minimum Value:	-6.30E-03	-8.73E-04	-21.81%	Difference between mean and median
Maximum Value:	7.51E-02	1.04E-02	0.23	Skew
Mean:	3.03E-02	4.20E-03	3.35	Range of Data
Median:	2.50E-02	3.46E-03	2.39	Max Dose contribution (mrem/yr)
Standard Deviation:	2.43E-02	3.37E-03	2.25	Hypothetical dose contribution (mrem/yr)

The range of the data is approximately 3.35 standard deviations. The difference between the mean and median was about -21.81% of the standard deviation which indicates a skewed distribution in the data to the left. The data was represented graphically through posting plots, a frequency plot, and a quantile plot as shown in Attachment 1. The frequency plot indicates a moderate positive skewness as confirmed by the calculated skew of 0.23, indicating a normal distribution with no multimodal distribution noted.

All soil samples were below the Investigation Level of 50% of the DCGL (3.61 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 2.25 mrem/yr (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. The reports concluded that the Survey Unit OOL10-23 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

Graphical evaluations of the Survey Unit Data are included in Attachment 1, Data Quality Assessment (DQA).

4.3 SURVEY UNIT INVESTIGATIONS AND RESULTS

No elevated locations were detected as a result of Survey Unit scans and all sample results were below the investigation level for soil media, thus no investigations were performed.

4.4 CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS

There were no changes in the initial survey unit assumptions for the survey units in this report.

5.0 SURVEY UNIT INVESTIGATIONS AND RESULTS

No elevated locations were detected as a result of the Survey Unit scans and all sample results were below the investigation level for soil media, thus no investigations were performed.

6.0 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 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 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.

6.1 LABORATORY INSTRUMENTS

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 HPGe system used in the 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 system 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.

Examination of the data concluded that the gamma spectroscopy system was functioning correctly during FSS. A check of the gamma spectroscopy system QA Background measurements covering the time periods when FSS sample analysis occurred showed no issues related to instrument background prior to FSS sample analysis.

6.2 ISOCS RESPONSE CHECKS

A QA check of the ISOCS system for both energy and resolution parameters was performed daily, prior to counting operations. This was achieved by using a check source with gamma energies spanning the lower and upper end of the calibration range. The QA checks performed on the ISOCS system verify that the system parameters have not changed such that the energy and shape calibrations are still valid. This was accomplished by tracking peak location from a low-energy peak (86 keV) and a high-energy peak (1,274 keV) from a check source, and peak energy resolution (FWHM).

A decay-corrected peak activity was not tracked as a QC parameter for this system. As this was self-identified as an LTP non-conformance during the data quality assessment, SAPN 1450541 was initiated to address the requirement regarding performance of instrument response checks. Since only two parameters were being checked during the QC source check, peak centroid (location) and peak full-width half maximum (resolution), instrument response was not being captured in the form of decay-corrected peak activity to verify that the system's ability to quantify a known reference source. An evaluation was conducted which concluded that there was no adverse impact to the quality of the data collected with the ISOCS for the Circulating Water Intake Piping Excavation and 60 kV Switchyard survey units, OOL10-05 and OOL10-06 respectively.

A total of ten ISOCS measurements were performed within survey units OOL10-05 and OOL10-06. There was no plant-derived radionuclides identified in any of the ISOCS measurements collected. To qualify the ISOCS data collected, the ISOCS Potassium-40 (K-40) and Bismuth-214 (Bi-214) results were compared to the statistical sample results for the two survey units. Only these two naturally-occurring radioactive material (NORM) radionuclides were used in the comparison even though two samples from the OOL10-06 (sample locations #5 and #12) data set identified Cs-137. The Cs-137 results were considered present at background levels indicative of fallout (0.3 pCi/g and 0.2 pCi/g respectively) and were not obtained in the excavation. As shown in Table 6.1, there was good agreement between the ISOCS and statistical sample data sets for both K-40 and Bi-214 for both survey units. The table shows a relatively consistent bias of 16% to 18%, which is expected due to gamma activity seen by the detector originating outside/underneath the field of view of the calculated 95% infinite circular plane model used. In the absence of a QC response check peak activity parameter to provide confidence that the ISOCS system was detecting and reporting adequate radionuclide activity levels, it is reasonable to use the statistical sample data set that conducted QC source checks for lab instrumentation in accordance with an approved Quality Control Program as a metric for comparison to the ISOCS data set.

ISOCS Data Comparison to Statistical Samples

Survey Area	Data Set	Number of Samples/ Measurements	K-40 Mean (pCi/g)	K-40 Standard Deviation (pCi/g)	Bi-214 Mean (pCi/g)	Bi-214 Standard Deviation (pCi/g)
OOL10-05	ISOCS	9	7.81E+00	1.20E+00	3.77E-01	6.74E-02
OOL10-05	Statistical	15	6.75E+00	6.31E-01	3.22E-01	4.54E-02
Agreement Ratio			1.16		1.17	
OOL10-06	ISOCS	3	8.64E+00	1.93E-01	4.15E-01	1.94E-02
OOL10-06	Statistical	19	7.46E+00	1.08E+00	3.53E-01	5.70E-02
Agreement Ratio			1.16		1.18	

It should be noted that one ISOCS measurement (OOL10-05-005-F-G) was omitted from the results data set as it was an outlier because the shot was conservatively overestimated (modeled) using 2" water as an attenuator as it contained standing water.

The evaluation concluded that there was no impact to the ISOCS data quality for the following reasons:

- As summarized above, all ISOCS data indicated reasonable NORM radionuclide activity levels for K-40 and Bi-214 with a bias averaging 16% to 18%.
- Review of the pre-use monthly QC Source plots for peak centroid and FWHM performed during the period of use show good stability compared with other pre-use source checks collected during the month.
- During the period of use, the ISOCS provided consistent identification of NORM radionuclides and a reasonable range of FWHM values, with no FWHM value approaching the upper bound control limit of 2.5 keV.
- There was no positive identification of plant-derived materials during any of the ISOCS measurements that suggests that the two Class 3 survey units considered were misclassified or required further investigation.

To ensure that the initial characterization performed by the vendor was still valid, an annual calibration verification was performed on QC Source HBS-595 with satisfactory agreement ratio results within the listed agreement range for the calculated resolution for the Europium-155 (Eu-155) and Sodium-24 (Na-24) primary gamma peak activities used in the comparison. Examination of this data concludes that the gamma spectroscopy system was functioning correctly during FSS. A check of the ISOCS system QA Background measurements (in units of cps) covering the significant time periods when FSS sample analysis occurred showed no issues related to instrument background prior to FSS sample analysis.

As an internal QC check, every ISOCS field measurement reviewed indicated a K-40 1460 keV peak resolution FWHM values within established QC parameters for the 1274 keV peak, indicating the during each spectrum there were no gain shifts occurring during acquisition that could challenge the validity of each measurement result.

6.3 FIELD INSTRUMENT RESPONSE CHECKS

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 13). The Recount sample numbers for Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 are listed in Table 6.2 below.

Table 6.1 List of Recount Samples

Survey Unit	Sample Number
OOL10-05	OOL10-05-004-C-RC
OOL10-06	OOL10-06-010-C-RC
OOL10-14	OOL10-14-012-F-RC
OOL10-15	*OOL10-15-009-F-RC
OOL10-19	OOL10-19-007-F-RC
OOL10-23	OOL10-23-014-F-RC

* This sample was located in the deep part of a water channel flowing through the area was not able to be taken and per the FSSP was replaced with sample OOL10-15-016-F-RC

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 Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 as shown in Table 6.3 below. The samples were analyzed by the on-site gamma laboratory and the corresponding split samples were analyzed by the off-site analytical laboratory. As mentioned earlier in this report, the NRC requested that PG&E provide ORISE with 5 split samples from the FSS of Survey Unit OOL10-05. 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. No DQA issues were noted during the split sample comparison evaluation. 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).

Table 6.2 List of Split Samples

Survey Unit	Survey Plan Sample Number	Off-Site Split Sample Number
OOL10-05	OOL10-05-002-C	5201S0001*
	OOL10-05-005-C	5201S0002*
	OOL10-05-006-C	OOL10-05-006-C-S
	OOL10-05-007-C	5201S0003*
	OOL10-05-009-C	5201S0004*
	OOL10-05-010-C	OOL10-05-010-C-S
	OOL10-05-015-C	5201S0005*
OOL10-06	OOL10-06-017-C	OOL10-06-017-C-S
	OOL10-06-018-C	OOL10-06-018-C-S
OOL10-14	OOL10-14-003-F	OOL10-14-003-F-S
	OOL10-14-004-F	OOL10-14-004-F-S
OOL10-15	OOL10-15-006-F	OOL10-15-006-F-S
	OOL10-15-015-F	OOL10-15-015-F-S
OOL10-19	OOL10-19-001-F	OOL10-19-001-F-S
	OOL10-19-011-F	OOL10-19-011-F-S
OOL10-23	OOL10-23-021-F	OOL10-23-021-F-S
	OOL10-23-011-F	OOL10-23-011-F-S

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

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 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 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 the survey units were calculated, as classified according to area contamination potential. As a contingency for Survey Unit OOL10-23, fifteen (15) alternate sample locations were plotted using VSP in the case that a sample location fell within an area that was unobtainable.

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.

6.4 CORRECTIVE ACTIONS

No corrective actions were warranted during the performance and subsequent evaluation of FSS Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23.

6.5 QUALITY VERIFICATION

There were no quality verification assessments that were performed on Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23.

7.0 ALARA STATEMENT

The cost benefit analysis indicates that residual radioactivity in soils at the Site has been reduced to concentrations that are ALARA. A Generic ALARA Statement has been prepared to demonstrate that it is not ALARA to further remediate soil at levels below the DCGL. The analysis shows that shipping affected soil 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 on the site will not pose an unacceptable radiological risk to humans under any reasonable and foreseeable future use or occupancy (Ref. 17). The Generic ALARA Review for Final Status Survey of Soil at HBPP, along with each Survey Unit ALARA Evaluation Comparison is provided in Attachment 2.

8.0 SUMMARY AND CONCLUSIONS

This report demonstrates that FSS Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 have met the release requirements associated with the DCGLs listed in the HBPP LTP.

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. The survey units were properly designated as Class 3.

Additionally, the data show 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. 18). As discussed in Section 5.1 of this report, Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 were exempted from the periodic surveillance surveys by the Site Closure Manager as these areas had an engineered surface or barrier in place. However, in the event that isolation and control measures established for this area are compromised, a survey on the backfilled area may be warranted as a supplement of a documented evaluation to confirm that no HBPP plant-derived radioactive material has been introduced in the area that could jeopardize FSS results or change conclusions.

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%.

Survey Units: OOL10-05, OOL10-06, OOL10-14, OOL10-15, OOL10-19, and OOL10-23 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 3.

The maximum hypothetical dose (from all sources, including groundwater) to a future resident farmer was determined to be a small fraction of the DCGL. See the maximum hypothetical dose table 8.1 below.

Table 8.1 Maximum Hypothetical Dose Per Area

Survey Unit	Max Hypothetical Dose (mrem/yr)
OOL10-05	0.01
OOL10-06	0.14
OOL10-14	2.22
OOL10-15	1.81
OOL10-19	2.82
OOL10-23	2.25

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.

9.0 REFERENCES

- 1 Humboldt Bay Power Plant License Termination Plan, Rev 0, May 2013.
- 2 Humboldt Bay Power Plant License Termination Plan, Rev 1, July 2014.
- 3 Humboldt Bay Power Plant License Termination Plan, Rev 2, January 2018.
- 4 NRC Docket No. 50-133, Humboldt Bay Power Plant, Unit No. 3 Facility License DPR-7, As Amended.
- 5 HBPP Procedure RCP FSS-1, "Survey Unit Classification," Rev 0C, September 11, 2013.
- 6 VSP Development Team (2014). *Visual Sample Plan: A Tool for Design and Analysis of Environmental Sampling*, Version 6.2d, Pacific Northwest National Laboratory. Richland, WA. <http://vsp.pnnl.gov>.
- 7 HBPP Procedure RCP FSS-13 "Area Surveillance Following Final Status Survey," Rev 01, September 17th, 2015
- 8 HBPP Procedure RCP FSS-2, "Preparation of Final Status Survey Plan," Rev.0D, September 11, 2013.
- 9 NUREG 1575 *Multi Agency Radiation Site Survey and Investigation Manual*, (MARSSIM), USNRC, Rev. 1 August 2000.
- 10 HBPP Procedure RCP FSS-7, "Determination of the Number and Location of FSS Samples," Rev. 0C, September 11, 2013.
- 11 MARSSIM Power 2000 software, V. 1.0.0 Environmental Measurements Laboratory, US Department of Energy, December 2000.
- 12 HBPP Procedure RCP FSS-18, "Computer Determination of Number and Locations of FSS Samples," Rev. 0C, September 11, 2013.
- 13 HBPP Procedure RCP FSS-11, "Split Sample Assessment for Final Status Survey," Rev. 0C, September 11, 2013.
- 14 HBPP Procedure HBAP C-202, "Final Status Survey Quality Assurance Project Plan," Rev. 3, June 5, 2014.
- 15 HBPP Procedure FSS-8, "Collection of Site Characterization and Final Status Survey Samples," Rev 1D, September 11, 2013.
- 16 HBPP Procedure RCP FSS-14, "Data Quality Assessment," Rev. 0C, September 11, 2013.
- 17 Generic ALARA Review for Final Status Survey of Soil at HBPP, July 8, 2013.
- 18 HBPP Procedure C-220, "Cross Contamination Prevention and Monitoring Plan" Rev 1B, February 11, 2016.
- 19 ORAU Inspection Report No. 05000133/2012011, "Letter Report for Analytical Results for Five Soil Samples Associated with the Humboldt Bay Power Plant in Eureka, CA," September 5, 2012.

LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
DCGL	Derived Concentration Guideline Level, the radionuclide specific activity concentration that corresponds to the release criterion (25 mrem/y) within a survey unit
DOE	United States Department of Energy
DQA	Data Quality Assurance
DQO	Data Quality Objectives
ETD	Easy to Detect
FSS	Final Status Survey
FSSP	Final Status Survey Plan
FWHM	Full Width at Half Maximum
GEL	General Engineering Laboratories, LLC
GPS	Global Positioning System
HBGS	Humboldt Bay Generating Station
HBPP	Humboldt Bay Power Plant
HBRP	Humboldt Bay Repower Project
HSA	Historical Site Assessment
HTD	Hard to Detect (for this purpose, nuclides that are not detectable by gamma analysis)
ISOCS	In Situ Object Characterization System
JHA	Job Hazard Analysis
kcpm	kilo-counts per minute
LBGR	Lower Bound of the Gray Region
LTP	License Termination Plan

m ²	meter(s) squared
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MEPPS	Mobile Emergency Power Plant Station
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
NAD	North American Datum
NaI (TI)	Thallium-activated sodium iodide gamma scintillation detector
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NORM	Naturally Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
PSR	Partial Site Release
pCi/g	picocuries per gram
PG&E	Pacific Gas and Electric Company
QA	quality assurance
QC	quality control
Site	HBPP, 1000 King Salmon Ave, Eureka, CA
TEDE	Total Effective Dose Equivalent
TRU	Transuranic
VSP	Visual Sample Plan computer program

ATTACHMENT 1

DATA QUALITY ASSESSMENT

Data Quality Assessment of OOL10-05;

1. *The HBPP LTP and Historical Site Assessment were reviewed and compared to the DQOs of HBPP-CHAR-OOL10-05. 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 15 statistical samples were gathered. The survey had more than sufficient power.*
5. *A review of the characterization survey provided confidence that the survey contained a sufficient quantity and quality of samples and was performed to the rigors of a Final Status Survey.*

Statistical quantities:

Number of statistical samples	15
Minimum value	-4.62E-02
Maximum Value	4.71E-02
Mean	1.72E-03
Median	7.00E-04
a-posteriori σ	2.52E-02

6. *The mean is approximately equal to the median indicating a common central tendency.*
7. *The range of the data varies within ~3.7 standard deviations about the arithmetic mean.*
8. *The Scatter Plot exhibits that there were no outlier sample results.*
9. *The Quantile Plot exhibits normal symmetry.*
10. *The Frequency Plot demonstrates a normal distribution with no multimodal distribution.*
11. *The data posting plot does not clearly reveal any systematic spatial trends.*
12. *No sample data exceeded the DCGL, therefore a statistical test was not required.*
13. *The data was of sufficient quantity and quality to be used as FSS data.*
14. *The data verified all the key assumptions of the statistical test.*
15. *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 OOL10-05 meets the HBPP release criteria thus the null hypothesis is rejected for OOL10-05.

**Cs-137 Results for FSS Direct Soil /Sediment Samples Analyzed
using the On-Site Laboratory HPGe Gamma System**

Sample Number	Cs-137 (pCi/g)	Fraction of the DCGL
CHAR-OOL10-05-01-C	3.99E-02	5.03E-03
CHAR-OOL10-05-02-C	-1.50E-02	-1.89E-03
CHAR-OOL10-05-03-C	-3.38E-04	-4.26E-05
CHAR-OOL10-05-04-C	-3.47E-02	-4.38E-03
CHAR-OOL10-05-04-C-RC	1.28E-02	1.61E-03
CHAR-OOL10-05-05-C	0.00E+00	0.00E+00
CHAR-OOL10-05-06-C	8.34E-04	1.05E-04
CHAR-OOL10-05-07-C	6.60E-04	8.32E-05
CHAR-OOL10-05-08-C	5.02E-03	6.33E-04
CHAR-OOL10-05-09-C	1.50E-02	1.89E-03
CHAR-OOL10-05-10-C	7.32E-04	9.23E-05
CHAR-OOL10-05-11-C	3.20E-02	4.04E-03
CHAR-OOL10-05-12-C	-2.40E-03	-3.03E-04
CHAR-OOL10-05-13-C	-1.68E-02	-2.12E-03
CHAR-OOL10-05-14-C	-4.62E-02	-5.83E-03
CHAR-OOL10-05-15-C	4.71E-02	5.94E-03
CHAR-OOL10-05-16-C-B	4.90E-02	6.18E-03
CHAR-OOL10-05-17-C-B	-2.64E-02	-3.33E-03