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Manager
Regulatory Affairs

May 15, 2024

10 CFR 50, Appx. I

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

Subject: **Docket Nos. 50-206, 50-361, 50-362 and 72-41**
2023 Annual Radiological Environmental Operating Report
San Onofre Nuclear Generating Station (SONGS), Units 1, 2 and 3 and Independent Spent Fuel Storage Installation

In accordance with the San Onofre Nuclear Generating Station (SONGS) Licensee Controlled Specification 5.7.1.2, Southern California Edison (SCE) is submitting the 2023 Annual Radiological Environmental Operating Report (AREOR) for SONGS Units 1, 2 and 3. The AREOR covers the operation of SONGS during January 1, 2023 through December 31, 2023 and includes summaries, interpretations, and analyses of trends of the results of the Radiological Environmental Monitoring Program (REMP).

In addition, the AREOR includes the results for direct radiation monitoring near the Independent Spent Fuel Storage Installation.

There are no commitments in this letter or the enclosure.

If you have any questions, please contact me at (949) 368-6274.

Sincerely,

Enclosure: 2023 San Onofre Nuclear Generating Station Annual Radiological Environmental Operating Report

cc: J.D. Monninger, Regional Administrator, NRC Region IV
A.M. Snyder, NRC Project Manager, SONGS Units 1, 2, 3 and ISFSI
R. K. Lupo, California Department of Public Health

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ENCLOSURE

2023 San Onofre Nuclear Generating Station
Annual Radiological Environmental Operating Report

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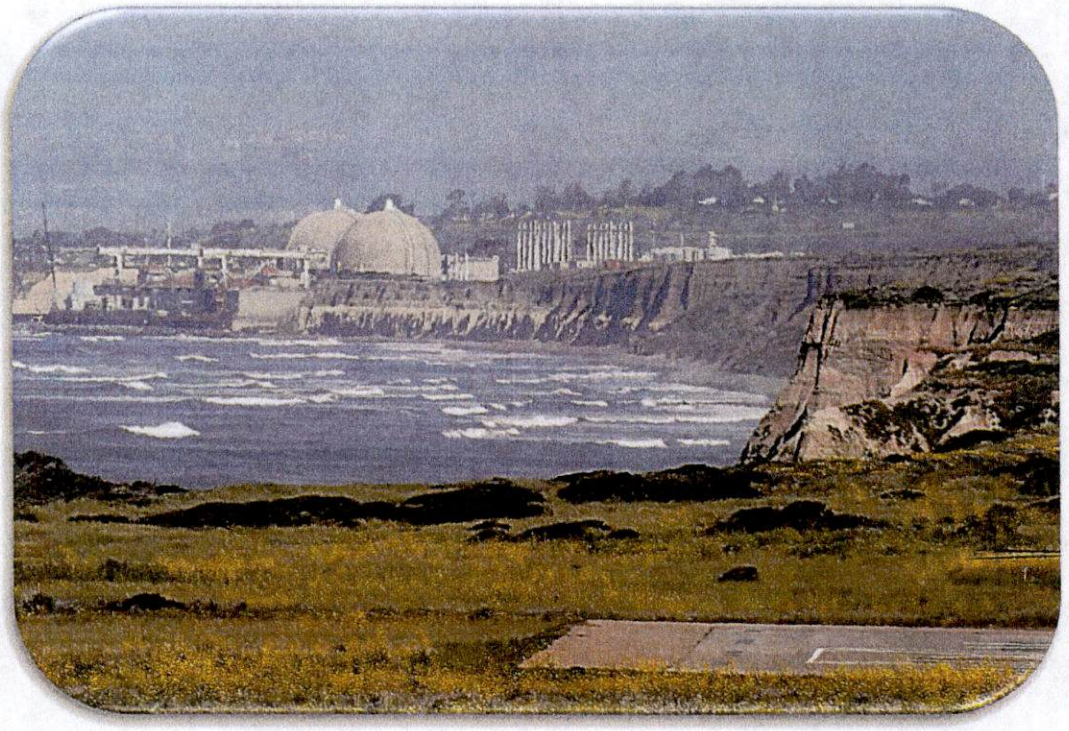
San Onofre Nuclear Generating Station



Annual Radiological Environmental Operating Report 2023

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1.0 LIST OF ACRONYMS AND DEFINITIONS

1. Airborne Activity Sampling: Continuous sampling of air through the collection of particulates and radionuclides on filter media.
2. ARERR: Annual Radioactive Effluent Release Report
3. AREOR: Annual Radiological Environmental Operating Report
4. BWR: Boiling Water Reactor
5. CDPH: California Department of Public Health
6. Composite Sample: A series of single collected portions (aliquots) analyzed as one sample. The aliquots making up the sample are collected at time intervals that are very short compared to the composite period.
7. Control: A sampling station in a location not likely to be affected by plant effluents due to its distance and/or direction from the station.
8. Curie (Ci): A measure of radioactivity; equal to 3.7×10^{10} disintegrations per second, or 2.22×10^{12} disintegrations per minute.
9. Direct Radiation Monitoring: The measurement of radiation dose at various distances from the plant is assessed using Thermoluminescent Dosimeters (TLD), Optically Stimulated Luminescence Dosimeters (OSLD) and pressurized ionization chambers.
10. DOE: Department of Energy
11. EDC: Environmental Dosimetry Company
12. EPA: Environmental Protection Agency
13. ERA: Environmental Resource Associates
14. GPI: Groundwater Protection Initiative
15. Grab Sample: A single discrete sample drawn at one point in time.
16. Indicator: A sampling location that is likely to be affected by plant effluents due to its proximity and/or direction from the plant.
17. Ingestion Pathway: The ingestion pathway includes milk, fish, drinking water and garden produce. Also sampled (under special circumstances) are other media such as vegetation or animal products when additional information about particular radionuclides is needed.
18. ISFSI: Independent Spent Fuel Storage Installation

19. LCS: Laboratory Control Spike

20. LCSD: Laboratory Control Spike Duplicate

21. Lower Limit of Detection (LLD): An *a priori* measure of the detection capability of a radiochemistry measurement based on instrument setup, calibration, background, decay time, and sample volume. An LLD is expressed as an activity concentration. The MDA is used for reporting results. LLD are specified by a regulator, such as the NRC and are typically listed in the ODCM.

22. MAPEP: Mixed Analyte Performance Evaluation Program

23. MDA: Minimum Detectable Activity. For radiochemistry instruments, the MDA is the *a posteriori* minimum concentration that a counting system detects. The smallest concentration or activity of radioactive material in a sample that will yield a net count above instrument background and that is detected with 95% probability, with only five % probability of falsely concluding that a blank observation represents a true signal.

24. MDC: Minimum Detectable Concentration. Essentially synonymous with MDA for the purposes of radiological monitoring.

25. Mean: The sum of all of the values in a distribution divided by the number of values in the distribution, synonymous with average.

26. N/A: Not Applicable

27. NEI: Nuclear Energy Institute

28. NIST: National Institute of Standards and Technology.

29. NRC: Nuclear Regulatory Commission

30. ODCM: Offsite Dose Calculation Manual

31. OSLD: Optically Stimulated Luminescence Dosimeter

32. Picocurie (pCi): 3.7×10^{-2} disintegrations per second, or 2.22 disintegrations per minute.

33. pCi/L: picocuries / Liter

34. PWR: Pressurized Water Reactor

35. REMP: Radiological Environmental Monitoring Program

36. TLD: Thermoluminescent Dosimeter

2.0 EXECUTIVE SUMMARY

San Onofre Nuclear Generating Station Radiological Environmental Monitoring Program (REMP) was established prior to the station becoming operational to provide information on background radiation present in the area. The goal of SONGS REMP is to evaluate the impact of the station on the environment. Environmental samples from different media are monitored as part of the program in accordance with specifications detailed in the Offsite Dose Calculation Manual (ODCM).The program compares data from Indicator locations near the plant, to Control locations farther away from the site to assess operation impacts.

The Annual Radiological Environmental Operating Report (AREOR) provides data obtained through analyses of environmental samples collected at SONGS for the reporting period of January 1st through December 31st, 2023. During that time period 615 analyses were performed on 543 samples. In assessing all the data gathered for this report and comparing these results with preoperational data and/or 10-year average values, it was concluded that the operation of SONGS did not result in detection of plant related radionuclides in the environment.

2.1 Summary of Conclusions:

No measurable activities above background levels were detected. All values were consistent with historical results which indicate no adverse radiological environmental impacts associated with the operation of SONGS. Naturally occurring radionuclides are present in the Earth's crust and atmosphere and exists in detectable quantities throughout the world. It is common to detect naturally occurring radionuclides in many of the samples collected for REMP. Some examples of naturally occurring radionuclides that are frequently seen in samples are potassium-40, beryllium-7, actinium-228 (present as a decay product of radium-228), and radium-226. Additionally, some relatively long-lived anthropogenic radioisotopes, such as strontium-90 and cesium-137, are also seen in some REMP samples; these radionuclides exist in measurable quantities throughout the world as a result of fallout from historic atmospheric nuclear weapons testing. Detailed information on the exposure of the U.S. population to ionizing radiation can be found in NCRP Report No. 160 [1].

3.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) provides data on measurable levels of radiation and radioactive materials in the environment. This program also evaluates the relationship between quantities of radioactive materials released from the plant and resultant doses to individuals from principal pathways of exposure. In this capacity, REMP provides a check on the effluent release program and dispersion modeling to ensure that concentrations in the environment due to radioactive effluents conform to the "As Low as Is Reasonably Achievable" (ALARA) design objectives of 10 CFR 50, Appendix I [2], and implements the requirements of Section IV.B.2 and IV.B.3 of Appendix I. REMP is designed to conform to the Nuclear Regulatory Commission (NRC) Regulatory Guide 4.1 [3], NUREG 1301/1302 [4] [5], and the 1979 NRC Branch Technical Position [6].

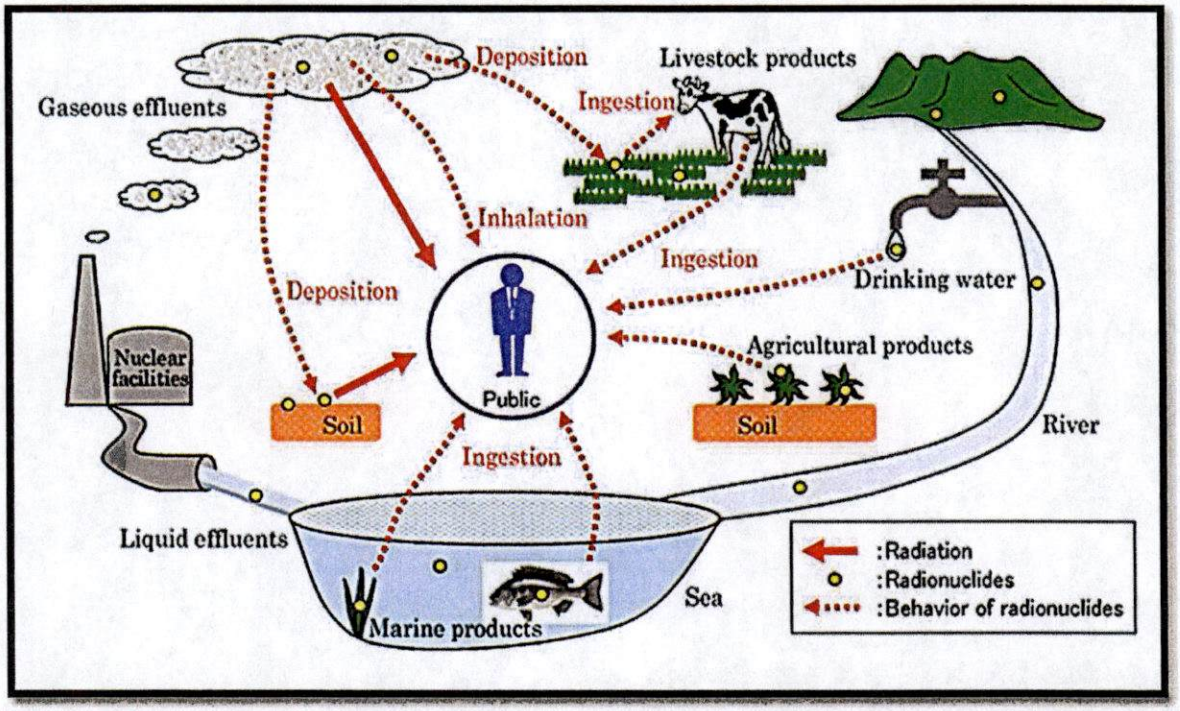

Figure 1: Potential exposure pathways to Members of the Public due to Plant Operations [7]

Quality assurance aspects of the sampling program and TLD/OSLD data collection are conducted in accordance with Regulatory Guides 4.15 [8] and 4.13 [9]. REMP also adheres to the requirements of SONGS Licensee Controlled Specifications, and Offsite Dose Calculation Manual (ODCM). These governing documents dictate the environmental sampling, sample analysis protocols, data reporting and quality assurance requirements for the environmental monitoring program.

The Annual Radiological Environmental Operating Report provides summaries of the environmental data from exposure pathways, interpretations of the data, and analyses of trends of the results. Routinely monitored pathways include ingestion, inhalation, and direct radiation. Routes of exposure are based on site specific information such as meteorology, receptor locations, and water usage around the plant.

4.0 SITE DESCRIPTION AND SAMPLE LOCATIONS

San Onofre Nuclear Generating Station is a commercial nuclear power plant that achieved initial criticality in 1967 for Unit 1. San Onofre Nuclear Generating Station is located next to San Onofre State Beach, adjoining Camp Pendleton Marine Corps Base, in San Diego County, 64 miles south of Los Angeles, California. At this time there are no operating reactors, but in the past, there were three operating pressurized water reactors with a total rated capacity of 2664 net megawatts electrical.

Unit 1 operated from 1968 to 1992 and has been partially decommissioned with all above-ground structures removed. The SONGS ISFSI is located in the area formerly occupied by Unit 1. Units 2 and 3 were operated from 1983 and 1984 until the units were permanently retired in 2013. Units 2 and 3 are under active decommissioning.

SONGS sampling media are selected based on site specific information such as meteorology, receptor locations, and water usage around the plant. Sampling and analysis frequencies are documented in the Offsite Dose Calculation Manual and site procedures. Required sampling, analysis frequencies and location of sample collected are captured in the following tables and figures:

- Table 1: Radiological Environmental Monitoring Program – Direct Radiation
- Table 2: Radiological Environmental Monitoring Program – Airborne
- Table 3: Radiological Environmental Monitoring Program – Waterborne
- Table 4: Radiological Environmental Monitoring Program – Ingestion
- Table 5: REMP Sampling Locations – Direct Radiation
- Figure 2: SONGS Nearby Terrestrial Locations, Aerial Image (SONGS ODCM Figure 5-1)
- Figure 3: SONGS Terrestrial Samples, 1-Mile (SONGS ODCM Figure 5-2)
- Figure 4: SONGS Terrestrial Samples, 5-Miles (SONGS ODCM Figure 5-3)
- Figure 5: SONGS Terrestrial Samples, Control (SONGS ODCM Figure 5-4)
- Figure 6: SONGS Marine Samples, Near (SONGS ODCM Figure 5-5)
- Figure 7: SONGS Marine Samples, Far (SONGS ODCM Figure 5-6)

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS

Table 1: Radiological Environmental Monitoring Program – Direct Radiation

Requirement	Sample Location Description, Distance, and Direction	Sampling Collection/ Frequency	Type and Frequency of Analyses
Direct Radiation At least 30 Routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations, one in each compass sector in the general area of the site boundary. An outer ring of stations, one in each compass sector at approximately five miles from the site; and Special interest areas, such as population centers, nearby recreation areas, and control stations	See Table 5	Quarterly	Gamma dose/Quarterly

Table 2: Radiological Environmental Monitoring Program – Airborne

Requirement	Sample Location Description, Distance, and Direction	Sampling Collection/ Frequency	Type and Frequency of Analyses
Airborne Particulates Samples from at least five locations: Three samples from offsite locations (in different sectors) of the highest calculated annual average ground level D/Q. One sample from the vicinity of a community having the highest calculated annual average D/Q. One sample from a control location, approximately 10 to 20 miles distant in the least prevalent wind direction.	**AS-1 (APA 01):** City of San Clemente (City Hall), 5.1 miles NW **AS-9 (APA 09):** State Beach Park, 0.6 miles ESE **AS-10[a] (APA 10):** Bluff, 0.7 miles WNW **AS-12 (APA 12):** Former SONGS Evaporation Pond, 0.6 miles NW **AS-13 (APA 13):** Marine Corp Base (Camp Pendleton East), 0.7 miles E **AS-16 (APA 16):** San Luis Rey Substation (Control), 16.7 miles SE	Continuous sampler operation with sample collection weekly	Analyze weekly for gross beta. Perform gamma isotopic analysis on composite sample (by location)/Quarterly.

[a] AS-10 is not required per REMP bases but has been maintained due to being collocated with a CDPH Air Sampler.

Table 3: Radiological Environmental Monitoring Program – Waterborne

Requirement	Sample Location Description, Distance, and Direction	Sampling Collection/ Frequency	Type and Frequency of Analyses
Ocean Water One sample taken at a distance beyond significant influence of the discharge (control) and three samples within the vicinity of the discharge (indicator)	**Ocean Water A (WSA 01):** Station Discharge Outfall – Unit 1, 0.6 miles SW **Ocean Water B (WSA 02):** Outfall – Unit 2, 1.5 miles SW **Ocean Water C (WSA 03):** Outfall – Unit 3, 1.2 miles SSW **Ocean Water D (WSA 04):** Newport Beach (Control), 30.0 miles NW	Samples are collected monthly.	Gamma isotopic and H-3 /Monthly
Shoreline Sediment One sample taken at a distance beyond significant influence of the discharge (control) and three samples within the vicinity of the discharge (indicator)	**Shoreline Sediment Sample 1 (SSA 01):** San Onofre State Beach (Southeast), 0.6 miles SE **Shoreline Sediment Sample 2 (SSA 02):** San Onofre Surfing Beach, 0.8 WNW **Shoreline Sediment Sample 3 (SSA 03):** San Onofre State Beach (Southeast), 3.5 miles SE **Shoreline Sediment Sample 4 (SSA 04):** Newport Beach (North End) (Control), 29.2 miles NW	Semiannual	Gamma isotopic /Semiannually
Ocean Bottom Sediment One sample taken at a distance beyond significant influence of the discharge (control) and four samples within the vicinity of the discharge (indicator)	**OBS Sample B (SEB 02):** Unit 1 Outfall, 0.8 miles SSW **OBS Sample C (SEB 03):** Unit 2 Outfall, 1.6 miles SW **OBS Sample D (SEB 04):** Unit 3 Outfall, 1.2 miles SSW **OBS Sample E (SEB 05):** Laguna Beach (Control), 15-20 miles NW **OBS Sample F (SEB 06):** SONGS Upcoast, 0.9 miles WSW	Semiannual	Gamma isotopic /Semiannually

Table 4: Radiological Environmental Monitoring Program – Ingestion

Requirement	Sample Location Description, Distance, and Direction	Sampling Collection/ Frequency	Type and Frequency of Analyses
Non-Migratory Marine Animal: Two recreationally important adult fish, one crustacean, and one mollusk from two locations in the vicinity of site discharge. One sample of same species in areas not influenced by plant discharge.	**NMMA Sample A (MOA 01):** Unit 1 Outfall, 0.9 miles WSW **NMMA Sample B (MOA 02):** Unit 2/3 Outfall, 1.5 miles SSW **NMMA Sample C (MOA 03):** Laguna Beach (Control), 15-20 miles WNW to NW	Semiannually if available	Gamma isotopic /Semiannually
Local Crops: One sample each of fleshy and leafy crops. One sample each of fleshy and leafy crops collected from the control location.	**Local Crops 2 (TFB 02):** Control (Vista/Oceanside), 15- 25 miles SE to ESE **Local Crops 6 (TFB 06):** SONGS Garden, 0.7 miles NNW	Semiannual	Gamma isotopic /Semiannually

Table 5: REMP Sampling Locations – Direct Radiation

Site #	Location Type	Sector	Distance	Description
1[a]	Special Interest	NW	5.7	City of San Clemente (Former SDG&E Offices)
2[a]	Outer Ring	N	3.6	Camp San Mateo – (MCB, Camp Pendleton)
3[a]	Special Interest	NE	2.8	Camp San Onofre – (MCB, Camp Pendleton)
4	Outer Ring	E	4.4	Camp Horno – (MCB, Camp Pendleton)
6[a]	Outer Ring	ESE	3.0	Old El Camino Real (AKA Old Highway 101)
8	Special Interest	NW	1.4	Noncommissioned Officers' Beach Club
10[a]	Inner Ring	WNW	0.7	Bluff (AS #10)
11	Inner Ring	NW	0.4	Former Visitors' Center
12	Special Interest	E	0.2*	South Edge of Switchyard
15	Special Interest	SSE	0.1*	Southeast Site Boundary
16[a]	Special Interest	ESE	0.4*	East Southeast Site Boundary
19	Outer Ring	NNW	4.9	San Clemente Highlands
22[a]	Outer Ring	WNW	2.7	Former US Coast Guard Station - San Mateo Point
34[a]	Special Interest	NW	1.9	San Onofre School – (MCB, Camp Pendleton)
35	Outer Ring	NNE	4.8	Range 312 – (MCB, Camp Pendleton)

[a] TLD is collocated with a CDPH TLD.
* TLD Location is within the SONGS Site Boundary.

Table 5: REMP Sampling Locations – Direct Radiation

Site #	Location Type	Sector	Distance	Description
36	Outer Ring	NE	4.1	Range 208C – (MCB, Camp Pendleton)
40	Inner Ring	NNW	0.7	Mesa SONGS Garden
41	Special Interest	E	0.3	Old Route 101 – East
46	Inner Ring	SE	1.0	San Onofre State Beach Park
50[a]	Special Interest	SE	15.6	Oceanside Fire Station (Control)
55	Special Interest	WNW	0.2*	San Onofre State Beach (U1 West)
56	Special Interest	W	0.2*	San Onofre State Beach (U1 West)
57	Special Interest	SW	0.1*	San Onofre State Beach (Unit 2)
58	Special Interest	S	0.1*	San Onofre State Beach (Unit 3)
61	Inner Ring	N	0.7	Mesa - East Boundary (Former PIC 4)
62	Inner Ring	NNE	0.7	MCB - Camp Pendleton (Former PIC 5)
63	Inner Ring	NE	0.6	MCB - Camp Pendleton (Former PIC 6)
64	Inner Ring	ENE	0.6	MCB - Camp Pendleton (Former PIC 7)
65	Inner Ring	E	0.7	MCB - Camp Pendleton (AS #13)
66	Inner Ring	ESE	0.6	San Onofre State Beach Park (AS #9)

[a] TLD is collocated with a CDPH TLD.
* TLD Location is within the SONGS Site Boundary.

Table 5: REMP Sampling Locations – Direct Radiation

Site #	Location Type	Sector	Distance	Description
68	Outer Ring	ENE	4.4	Range 210C – (MCB, Camp Pendleton)
73	Special Interest	ESE	0.4*	South Yard Facility
75	Outer Ring	SE	4.6	Gate 25 MCB
76	Outer Ring	NW	4.6	Former El Camino Real Mobil Station

[a] TLD is collocated with a CDPH TLD.
* TLD Location is within the SONGS Site Boundary.

6.0 MAPS OF COLLECTION SITES

Figure 2: SONGS Nearby Terrestrial Locations, Aerial Image (SONGS ODCM Figure 5-1)

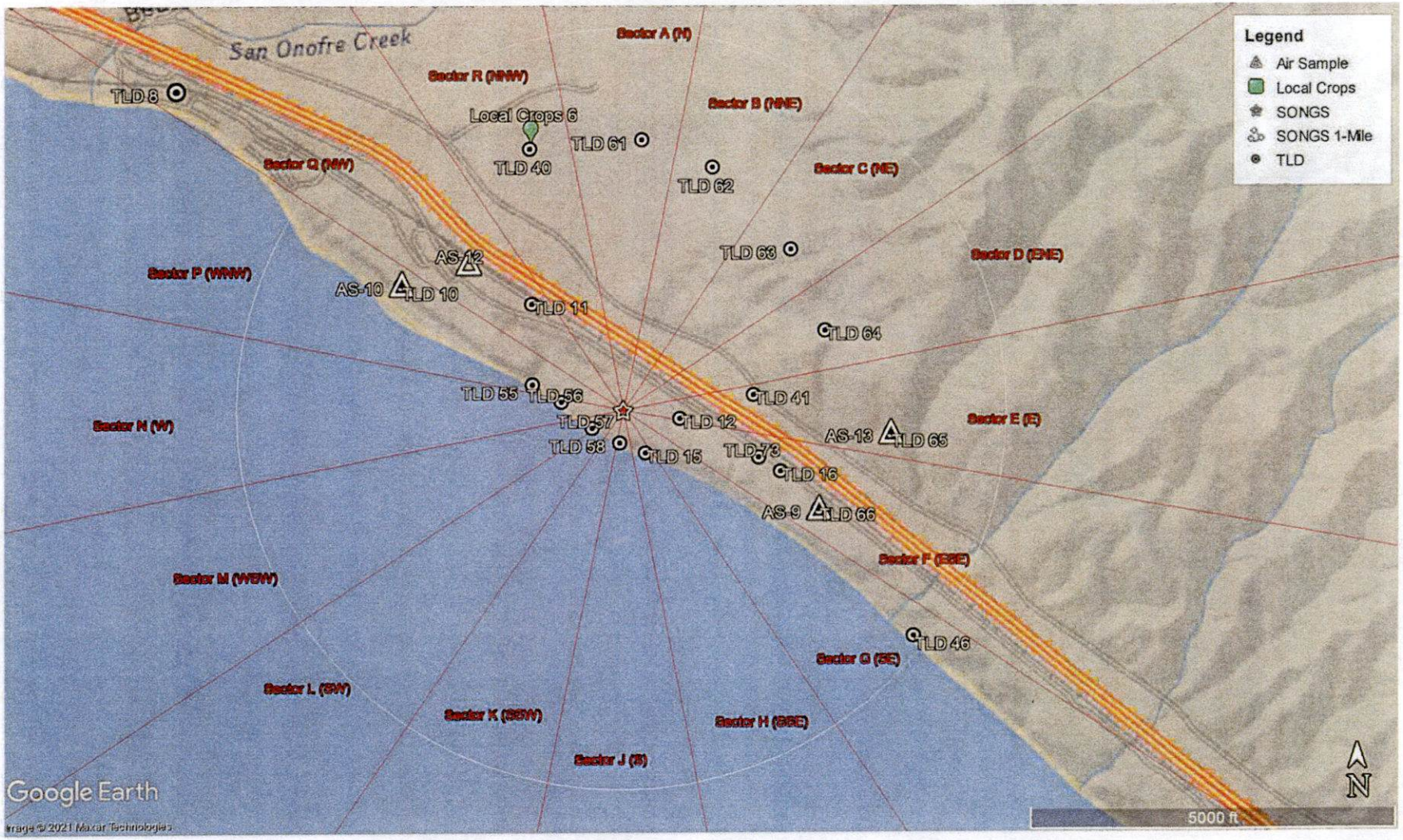

Figure 3: SONGS Terrestrial Samples, 1-Mile (SONGS ODCM Figure 5-2)

Figure 4: SONGS Terrestrial Samples, 5-Miles (SONGS ODCM Figure 5-3)

Figure 5: SONGS Terrestrial Samples, Control (SONGS ODCM Figure 5-4)

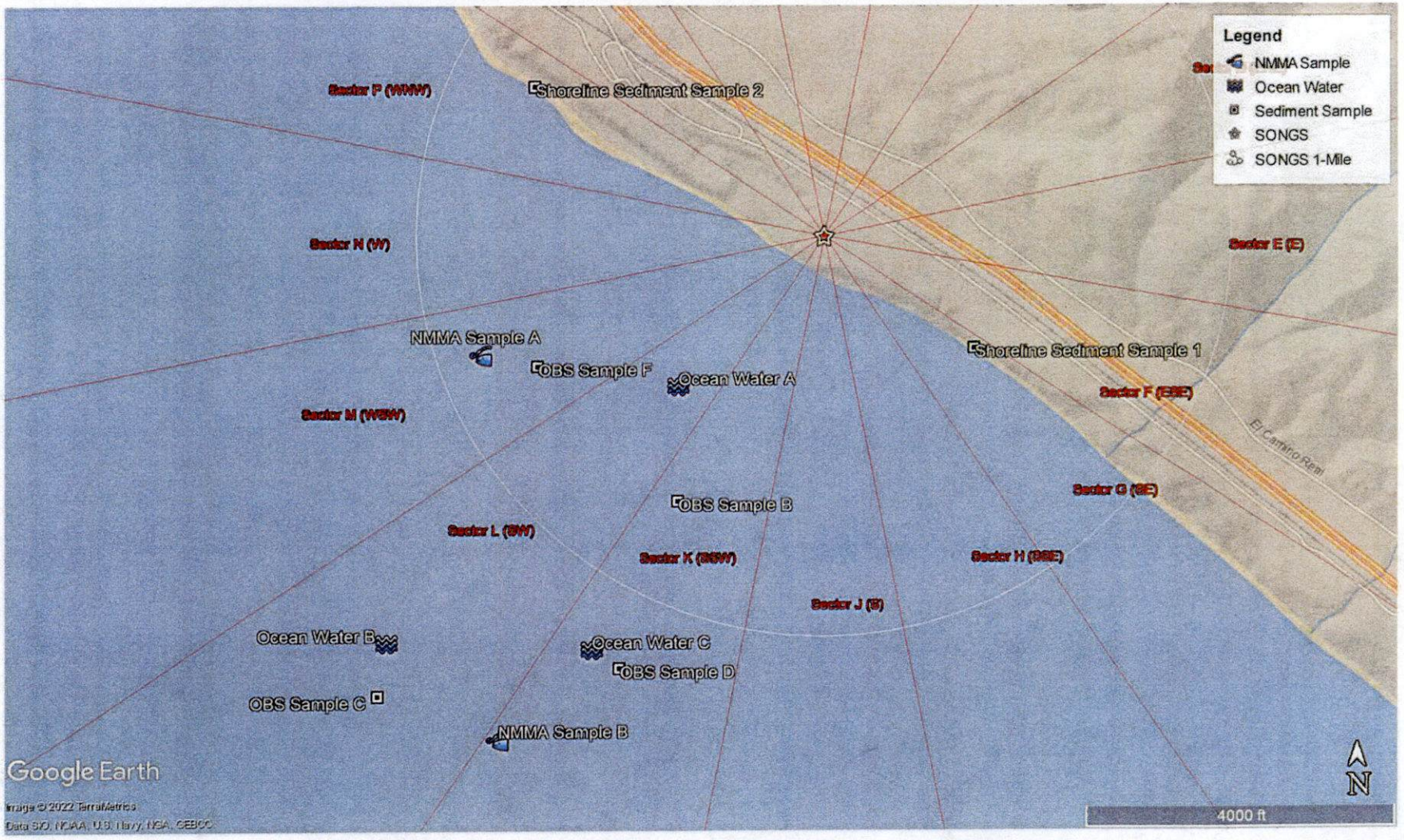

Figure 6: SONGS Marine Samples, Near (SONGS ODCM Figure 5-5)

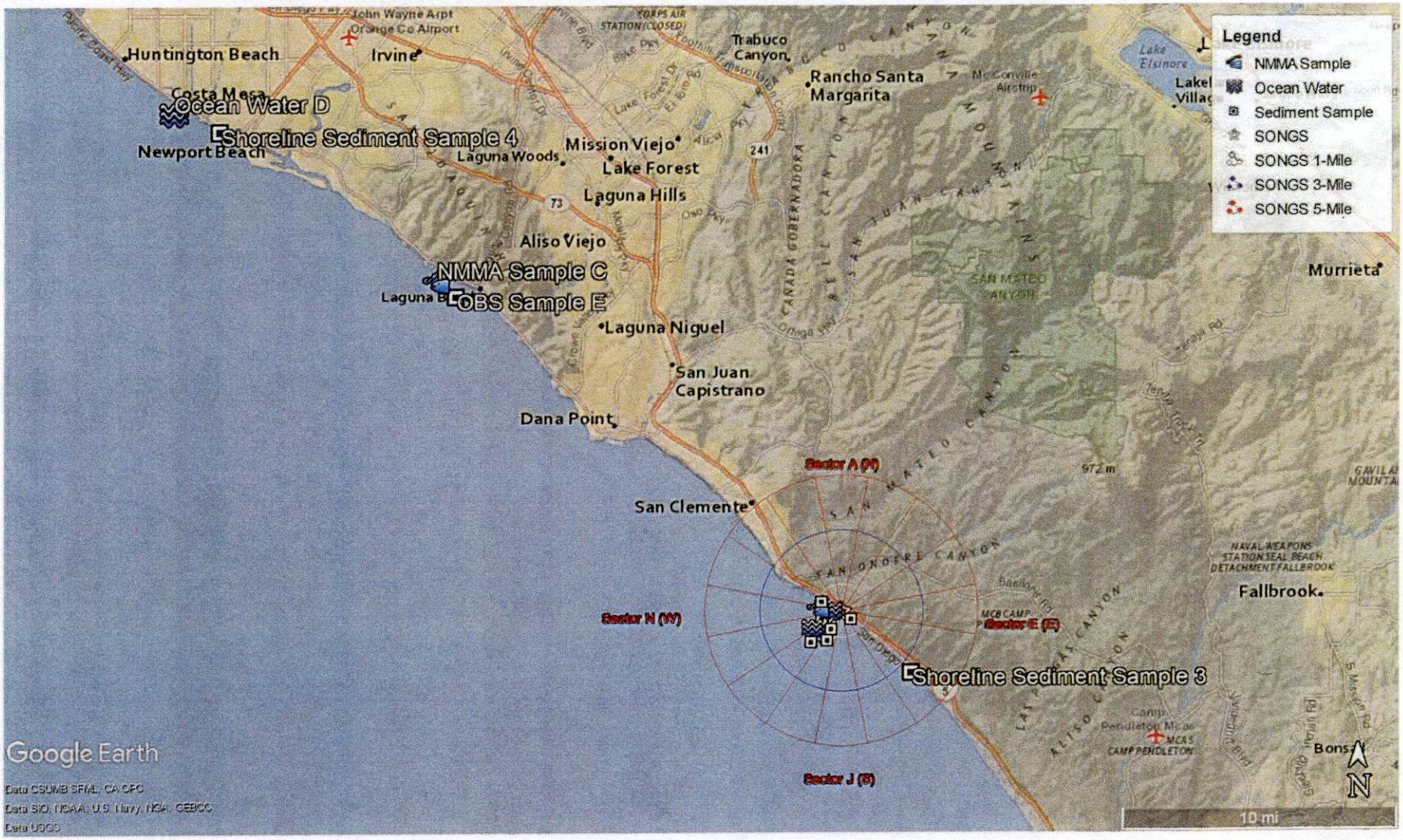

Figure 7: SONGS Marine Samples, Far (SONGS ODCM Figure 5-6)

7.0 REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Table 6: Reporting Levels for Radioactivity Concentrations in Environmental Samples

Radionuclide	Water (pCi/L)	Air Particulates or Gases (pCi/m^3)	Marine Animals (pCi/Kg-wet)	Local Crops (pCi/Kg-wet
H-3	30,000 (1)			
Mn-54	1,000		30,000	
Co-58	1,000		30,000	
Co-60	300		10,000	
Zn-65	300		20,000	
Cs-134	30	10	1,000	1,000
Cs-137	50	20	2,000	2,000

Table 7: Maximum Values for the Limit of Detection

Radionuclide	Water (pCi/L)	Air Particulates or Gases (pCi/m^3)	Marine Animals (pCi/Kg-wet)	Local Crops (pCi/Kg-wet)	Sediment (pCi/Kg-dry)
Gross Beta		0.01			
H-3	3,000 (2)				
Mn-54	15		130		
Co-58, Co-60	15		130		
Zn-65	30		260		
Cs-134	15	0.05	130	60	150
Cs-137	18	0.06	150	80	180

[1] For drinking water samples: If no drinking water pathway exists, a value of 30,000 pCi/L may be used.
[2] If no drinking water pathway exists, a value of 3,000 pCi/L may be used. Some states may require a lower LLD for drinking water sources- per the requirements of the Safe Drinking Water Act implemented by 10 CFR 141 National Primary Drinking Water Regulations [12].

8.0 SAMPLING PROGRAM, PROGRAM MODIFICATION AND INTEPRETATION OF RESULTS

At most nuclear stations, data was collected prior to plant operation to determine background radioactivity levels in the environment. Annual data is routinely compared to preoperational and/or 10-year average values to determine if changes in the environs are present. Strict comparison is difficult to make due to fallout from historical nuclear weapon testing. Cesium-137 can be routinely found in environmental samples as a results of above ground nuclear weapons testing. It is important to note, levels of Cs-137 in environment are observed to fluctuate, for example as silt distributions shift due to natural erosion and transport processes, Cs-137 may or may not be observed in sediment samples. Results from samples collected and analyzed during the year, 2023, are described below.

In the following sections, results from direct radiation, air, water, and food products analyzed as part of REMP in 2023 will be discussed. Sampling program descriptions and deviations will also be discussed.

8.1 Environmental Direct Radiation Dosimetry Results

Dose is measured as net exposure (field reading less transit reading) normalized to 91-day quarters. Data is treated and analyzed consistent with ANSI/HPS N13.37-2014 [10], which compares the measured dose for each location to the baseline background dose for that location. Environmental dose rates vary by location, depending on geological and land use considerations, and remain relatively constant for any given location (unless land use changes). Some facilities observe seasonal variation in environmental doses. Baseline Background Doses have been determined for both quarterly and annual measurements at each location using historical field measurements.

ANSI/HPS N13.37-2014 uses the concept of minimum differential dose (MDD), which is the minimum facility-related dose that can be detected above background. Due to natural background variations and measurement sensitivities and uncertainties, minimum differential dose is not zero. MDD is calculated based on statistical performance of the dosimetry system in the environment and is site specific.

Normalized doses that exceed the Minimum Differential Dose value above the Baseline Background Dose are considered to indicate Facility-Related Dose; a quality assurance review is performed to verify that any results indicating Facility-Related Dose are accurate.

During the calendar year 2023, a total of 34 locations were monitored and the data was analyzed in accordance with the requirements in Table 1: Radiological Environmental Monitoring Program – Direct Radiation. Attachment 4: Environmental Direct Radiation Dosimetry Results, provides the annual direct radiation dosimetry analysis.

There was no direct radiation dose to a Member of the Public detected from the facility. Facility Related Dose was indicated at TLD 55 and TLD 73 during 2023; however, the occupancy-adjusted dose to a Member of the Public was <1 mrem per year and is reported as Not Detected in accordance with ANSI/HPS N13.37-2014

8.2 Air Particulate Sample Results

Air particulate filters were collected from locations specified in Table 2: Radiological Environmental Monitoring Program – Airborne. During the calendar year 2023, a total of 309 samples were collected and analyzed for gross beta and gamma emitters. Particulate samplers are used to continuously collect airborne particulates on a filter. The samples are analyzed for gross beta activity following filter changeout which occurs weekly. Gamma isotopic analysis is also performed on the samples collected at each location and is analyzed quarterly. Naturally occurring beryllium-7 was detected on all control and indicator samples at concentrations consistent with previous years. Potassium-40, a naturally occurring radionuclide, was detected in both indicator and control samples periodically during 2023.

All gross beta analyses of air particulate filters detected gross beta activity at levels consistent with previous years. All air particulate quarterly gamma composite samples were below detection limit except for naturally occurring radionuclides.

Location APA 09 sample pump lost power as of 12/12/23 and was unable to be put back in operation during the remainder of 2023. Refer to Table 9: Sample Deviation Summary for more information.

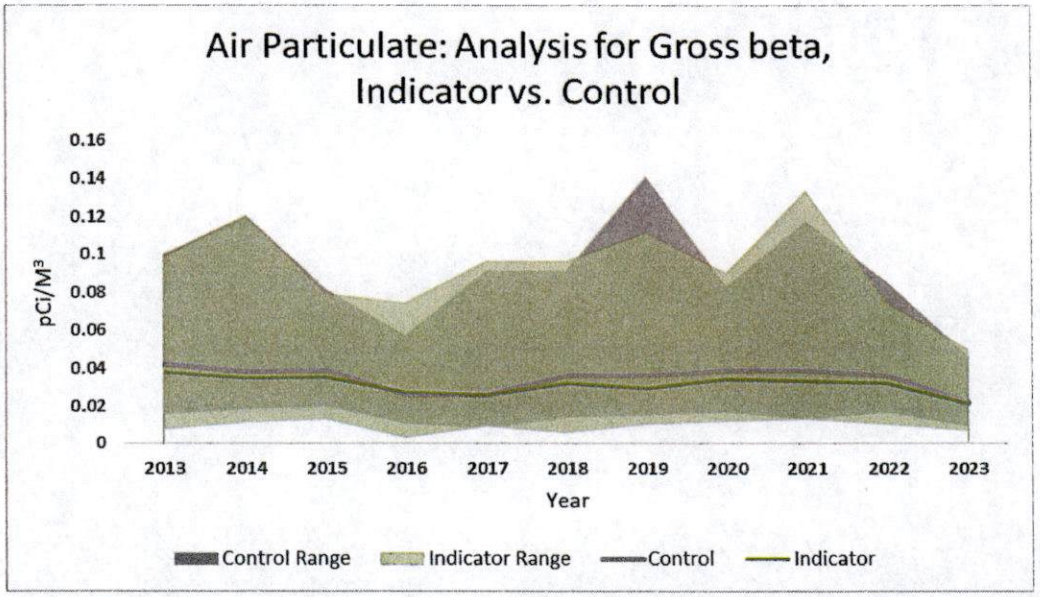

Figure 8: Air Particulate: Analysis for Gross Beta, Average for All Indicator vs. Control Location

Air particulate results from this monitoring period, 2023, were compared to 10-year average as shown in Figure 8, and there were no significant changes in the baseline.

8.3 Waterborne Sample Results

8.3.1 Ocean Water

Ocean water samples are collected monthly from a control location at a distance beyond significant influence of the discharge and at three indicator locations within the vicinity of the discharge. Monthly composite samples are analyzed for gamma emitters and tritium. During the calendar year 2023, a total of 48 ocean water samples were collected and analyzed in accordance with the requirements in the ODCM and shown in Table 3: Radiological Environmental Monitoring Program – Waterborne. Naturally occurring potassium-40 was identified in all ocean water samples from indicator and control locations with concentrations consistent in previous years. There has been no detectable tritium in any ocean water samples in 2023 or the previous 10 years. Therefore, no trend has been established above the detection limit to plot on a trending graph.

8.3.2 Shoreline Sediment

Shoreline sediment collections were made in March and September, 2023 and analyzed for gamma-emitting isotopes. Samples are collected at both indicator and control locations. A total of eight shoreline samples were analyzed in accordance with requirements in the ODCM and shown in Table 3: Radiological Environmental Monitoring Program – Waterborne.

Naturally occurring potassium-40 was identified in all shoreline sediment samples from indicator and control locations with concentrations consistent in previous years.

8.3.3 Ocean Bottom Sediment

Ocean Bottom sediment collections were made in April and October, 2023 and analyzed for gamma-emitting isotopes. Samples are collected at both indicator and control locations. A total of 10 ocean bottom sediment samples were analyzed in accordance with requirements in the ODCM and shown in Table 3: Radiological Environmental Monitoring Program – Waterborne.

Naturally occurring potassium-40 was identified in all ocean bottom sediment samples from indicator and control locations with concentrations consistent in previous years. Other naturally occurring radionuclides such as actinium-228, radium-226, thorium-228, and thorium 232 were also identified in indicator and control samples at concentrations consistent with previous years.

8.4 Ingestion Pathway Sample Results

8.4.1 Non-Migratory Marine Animal

A total of 24 non-migratory marine animal samples were collected in 2023. These samples were analyzed for gamma emitting radionuclides in edible portions, in accordance with requirements of the ODCM and summarized in Table 4: Radiological Environmental Monitoring Program – Ingestion. These samples are collected from the indicator and control areas as required by the ODCM.

Naturally occurring potassium-40 was identified in all non-migratory marine animal samples from indicator and control locations at concentrations consistent with previous years.

8.4.2 Local Crops

A total of eight local crop samples were analyzed in 2023, for gamma emitting radionuclides in accordance with requirements of the ODCM, as summarized in Table 4: Radiological Environmental Monitoring Program – Ingestion. The Control location for crop samples for 2023 was Bonsall Farms in Vista, CA, 21 mi ESE of SONGS.

Naturally occurring potassium-40 was identified in all local crop samples from indicator and control locations with concentrations consistent in previous years. Beryllium-7, also naturally occurring, was detected in one indicator sample in 2023.

9.0 LAND USE CENSUS

An annual land use census is required by the Offsite Dose Calculation Manual and is performed to ensure that changes in the use of areas at or beyond the site boundary are identified and modifications to REMP are made if required by changes in land use. The land use census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR 50 [2]. NUREG-1301/1302 Control 3.12.2 specifies that "a Land Use Census shall be conducted and shall identify within a distance of 8 km (5 mi.) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation. Note, per NUREG-1301/1302, Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census.

A Land Use Census was conducted during the calendar year, 2023, within the growing season to identify changes in land use, receptor locations, and new exposure pathways. The nearest receptor results for the 2023 Land Use Census are listed in Table 8: Land Use Census – Nearest Receptors within 5 miles. In summary, the highest D/Q locations for nearest garden, nearest residence and nearest milk animal did not change following the 2023 census.

The land use census included changes related to the former SONGS MESA facility. Control of the SONGS MESA transitioned from SCE to the USMC on June 1, 2023. Long term usage of the facility is not currently known, but the location has been utilized by USMC personnel during 2023.

Table 8: Land Use Census – Nearest Receptors within 5 miles				
Sector	**Direction**	**Nearest Residence (Miles)**	**Nearest Garden (Miles)**	**Other Specified Uses (Miles)**
A	N	3.6		0.5
B	NNE			2.1
C	NE	2.4		2.2
D	ENE	3.0		
E	E	4.1		4.0
F	ESE			0.8
G	SE	2.1		1.8
H	SSE	Sectors H through N are seaward sectors without significant land uses.		
J	S			
K	SSW			
L	SW			
M	WSW			
N	W			
P	WNW	1.0	2.8	0.5
Q	NW	1.1	4.0	0.6
R	NNW	1.3	4.9	0.7

10.0 SAMPLE DEVIATIONS, ANOMALIES AND UNAVAILABILITY

Sampling and analysis are performed for media types addressed in the Offsite Dose Calculation Manual. Sampling and analysis challenges may be experienced due to a multitude of reasons including environmental factors, loss of TLDs/OSLDs, contamination of samples, etc. To aid classification of sampling and analysis challenges experienced in 2023, the following three terms are used to describe the issues: Sample Anomalies, Sample Deviation, and Unavailable Samples.

Media that experienced downtime (i.e., air samplers or water samplers) during a surveillance period are classified as "Sample Deviation". "Sample Anomalies" are defined as errors that were introduced to a sample once it arrived in the laboratory, errors that prevents the sample from being analyzed as it normally would, or may have altered the outcome of the analysis (i.e., cross contamination, human error).

"Sample Unavailability" is defined as sample collection with no available sample (i.e., food crop, TLD).

All reported instances of not complying with SONGS REMP requirements in 2023 were classified as Sample Deviations (due to air sampler functionality) and input into SONGS corrective action program. AS-9 experienced significant issues with power availability during 2023. Initial work to resolve the issue involved changing outlets, switches, wiring connections, and breakers associated with the problem circuit. These actions were thought to have resolved the issue in August 2023. Periodic breaker trips were observed again starting in October and progressively worsened. Due to inaccessibility of the buried power cables, the line was not able to be directly repaired or replaced and work is in progress to implement a permanent alternative power solution. A compensatory sampler (AS-21) was established as close as feasible to the ESE site boundary (in the direction of AS-9) 0.4 miles from plant center (vs. 0.6 mi for AS-9). The location can be identified near TLD 16 on the maps and table in the AREOR.

All required samples were collected and analyzed as scheduled except for the following:

Table 9: Sample Deviation Summary

Sample Type and Analysis	Location	Collection Date or Period	Reason for not conducting REMP sampling as required by ODCM	Plans for preventing reoccurrence
Airborne Particulate	AS-12	1/3/23 – 1/10/23	Sample pump failed with ~130 hrs. runtime.	Replaced pump. (80% coverage)[3]
Airborne Particulate	AS-13	1/24/23 – 2/7/23	Location was not accessible due to road hazards/ safety restrictions following heavy rains with road washouts.	N/A Sample was collected over a two-week period. (100% coverage)[3]
Airborne Particulate	AS-13	3/21/23 – 4/4/23	Location was not accessible due to road hazards/ safety restrictions following heavy rains with road washouts.	N/A Sample was collected over a two-week period. (100% coverage)[3]
Airborne Particulate	AS-9	8/15/23 – 8/22/23	Power failure in local supply circuit. Troubleshooting and electrical repair work required to resolve resulted in partial sample coverage for second week.	(74% coverage)[3]
	AS-9	8/22/23 – 8/29/23		Repaired suspect wiring, outlets, and breakers. Daily function checks until apparent wiring issues resolved. (69% coverage)[3]
Airborne Particulate	AS-9	10/10/23 – 10/17/23	Power tripped at breaker with ~18 hrs. runtime.	Reset breaker and verified functional.
Airborne Particulate	AS-9	10/17/23 – 10/24/23	Unplanned off site power outage affected power availability at AS-9 and AS-12 for approximately 8.5 hours.	N/A Not preventable. (95% Coverage)[3]
	AS-12			

[3]Data was evaluated and found to be representative. Sample result was included in annual summary. Percent of sample period coverage included in parentheses, ().

Table 9: Sample Deviation Summary

Sample Type and Analysis	Location	Collection Date or Period	Reason for not conducting REMP sampling as required by ODCM	Plans for preventing reoccurrence
Airborne Particulate	AS-12	10/31/23 – 11/7/23	Sampler found running with no flow. Sample filter clogged due to wildfire smoke particulates.	Personnel coached to check sampler status during week when environmental particulates are visibly elevated due to local fires.
Airborne Particulate	AS-9	11/14/23 – 11/21/23	Power tripped at breaker with ~33 hrs. runtime.	Reset breaker. Evaluated additional options to resolve power issue for AS-9.
Airborne Particulate	AS-9	11/21/23 – 11/28/23	Power tripped at breaker with ~94 hours runtime.	Replaced pump for troubleshoot cause. Implemented daily function checks. Continued evaluation of long-term options. (55% coverage)[3]
Airborne Particulate	AS-9	12/5/23 – 12/12/23	Power tripped at breaker with ~164 hours runtime.	Breaker reset promptly after being discovered by electrician doing walk down for planning repair. (98% coverage)[3]
Airborne Particulate	AS-9	12/12/23 – 1/2/24	Power continued to trip after breaker was reset. Attempts to locate the fault were not successful.	Deployed temporary sampler near the East site boundary (AS-21) until power can be permanently restored. Pursuing alternative option to power AS-9.

11.0 OTHER SUPPLEMENTAL INFORMATION

11.1 NEI 07-07 Onsite Radiological Groundwater Monitoring Program

San Onofre Nuclear Generating Station has developed a Groundwater Protection Initiative (GPI) program in accordance with NEI 07-07, Industry Ground Water Protection Initiative – Final Guidance Document [11]. The purpose of the GPI is to ensure timely detection and an effective response to situations involving inadvertent radiological releases to groundwater in order to prevent migration of licensed radioactive material off-site and to quantify impacts on decommissioning. It is important to note, samples and results taken in support of NEI 07-07 on-site groundwater monitoring program are separate from the Radiological Environmental Monitoring Program (REMP). Results of the NEI 07-07 Radiological Groundwater Monitoring Program for onsite groundwater wells are provided in the ARERR.

11.2 Independent Spent Fuel Storage Installation (ISFSI) Monitoring Program

Per 10 CFR 72.126, SONGS implemented an area monitoring TLD program in the vicinity of the ISFSI.

An evaluation of historical REMP TLD data yielded an estimated background exposure rate of approximately 15.8 mrem/std. quarter (91 days).

Environmental exposure rates are variable and small changes in TLD location can measurably change the data. SONGS REMP TLD data show an environmental seasonal variability that is not related to any activities at SONGS. The ISFSI TLD data gathered to date follow a similar seasonal variability.

The measured exposure rates for the TLDs close to the ISFSI are consistent with the exposure rates expected from known radiological work activities and storage of spent fuel and radioactive material in the ISFSI.

The 2023 neutron TLDs identified low levels of neutron radiation from the ISFSI. Neutron TLDs were added to several locations around the ISFSI prior to the off load of spent fuel from Units 2 & 3 to obtain neutron dose information. Currently, neutron dosimeters are collocated with ISFSI TLDs 311, 326, 339-344, and REMP TLD 55.

A dose equivalent conversion factor for the TLD neutron signal based on a similar ISFSI facility at another site was adopted to estimate the neutron dose rate at SONGS. This conversion factor is being applied to the SONGS TLD results to provide an estimate of the neutron dose equivalent being measured. The neutron dose has been included in the quarterly results for these locations in Table 26: ISFSI TLD Data. The results from all locations at the fence around the ISFSI pad show that the dose to a member of the public, when adjusted for occupancy, would be less than one (1) mrem per year. The results for the ISFSI data are listed in Attachment 5: ISFSI TLD Data. The locations of the ISFISI TLDs are shown in Figure 9: SONGS ISFSI TLD Location Map.

11.3 Corrections to Previous Reports

There were no corrections to previous reports found in 2023.

11.4 ISFSI Location Map

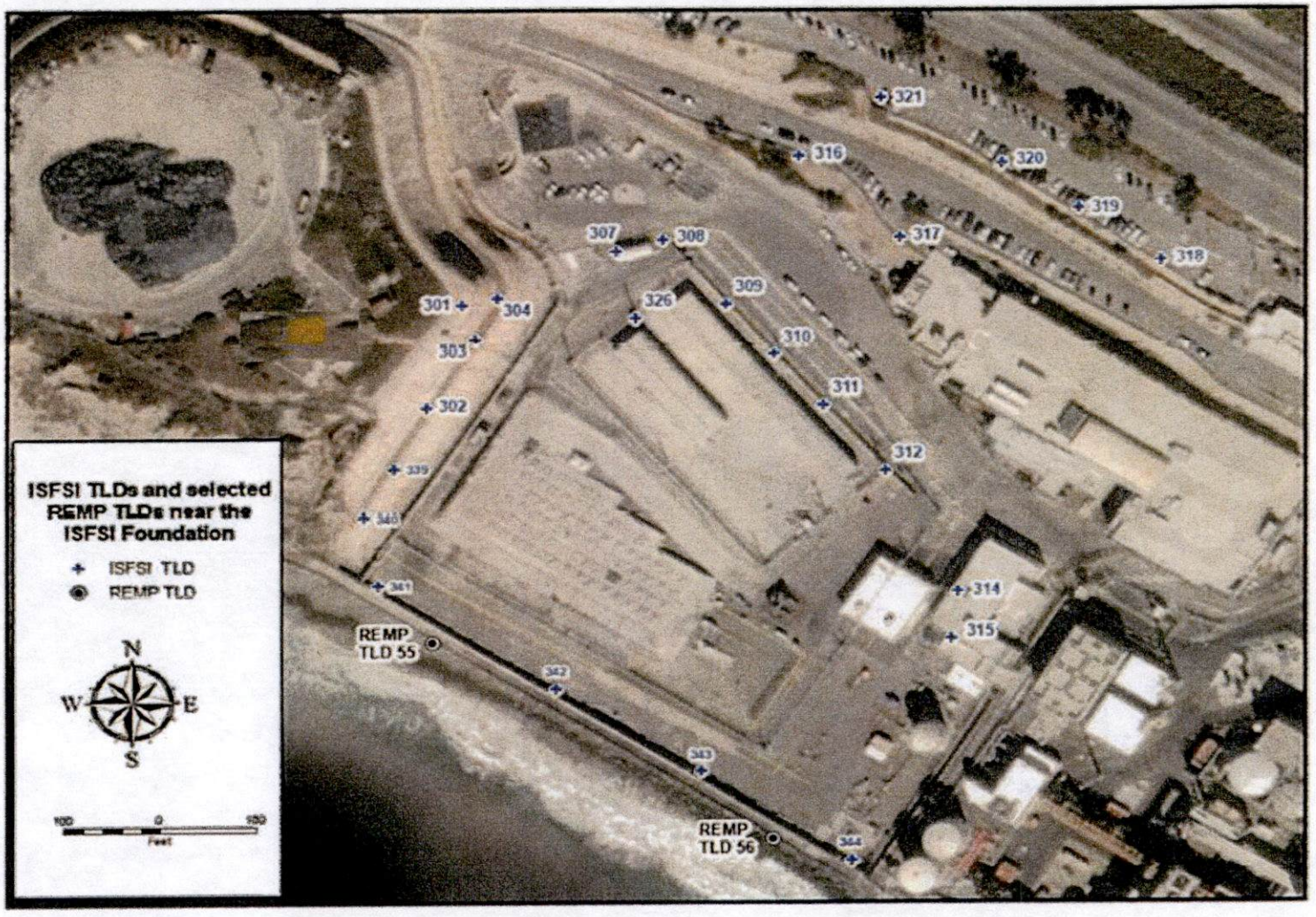

Figure 9: SONGS ISFSI TLD Location Map

12.0 BIBLIOGRAPHY

[1] NCRP, "Report No. 160 - Ionizing Radiation Exposure of the Population of the United States," National Council on Radiation Protection and Measurements, Bethesda, MD, 2009.

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[3] "Regulatory Guide 4.1 - Radiological Environmental Monitoring for Nuclear Power Plants, Revision 2," Nuclear Regulatory Commission, 2009.

[4] "NUREG-1301 - Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, .," Nuclear Regulatory Commission, April 1991.

[5] "NUREG-1302 - Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors,," Nuclear Regulatory Commission, April 1991.

[6] "Branch Technical Position, Revision 1," NRC000096, Submitted March 30, 2012, November 1979.

[7] "Japan Atomic Energy Agency," 06 November 2020. [Online]. Available: https://www.jaea.go.jp/english/04/ntokai/houkan/houkan_02.html.

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[10] "ANSI/HPS N13.37 - Environmental Dosimetry - Criteria for System Design and Implementation," American National Standards Institute, Inc., Herndon, VA, May, 2019.

[11] "NEI 07-07, - Industry Ground Water Protection Initiative—Final Guidance Document, Rev. 1," Nuclear Energy Institute, Washington, D.C., 2019.

[12] "40 CFR 141 - National Primary Drinking Water Regulations," US Environmental Protection Agency, Washington, DC..

Attachment 1: Data Table Summary

Table 10: SONGS Data Summary Table

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g., I-131, 400)		Lower Limit of Detection (LLD)	Indicator Mean[4] (f[5]) [Range[4]]	Location with Highest Annual Mean		Control Mean[4] (f[5]) [Range[4]]	Number of Nonroutine Reported Measurements
					Name Distance and Direction	Mean[4] (f[5]) [Range[4]]		
Direct Radiation (mrem/qtr.)	Gamma Dose, 136		N/A	16.3 (132/132) [9.3-21.7]	TLD 55 0.2 mi. WNW	20.8 (4/4) [19.0-21.7]	16.5 (4/4) [15.4-17.4]	0
Air Particulates (pCi/m^3)	Gross Beta, 309		0.01	0.021 (256/256) [0.007-0.050]	APA 16 16.7 mi. SE	0.022 (53/53) [0.009-0.046]	0.022 (53/53) [0.009-0.046]	0
	Gamma, 24	Cs-134	0.05	< LLD (0/20)	-	< LLD	< LLD (0/4)	0
		Cs-137	0.06	< LLD (0/20)	-	< LLD	< LLD (0/4)	0
Ocean Water (pCi/L)	Tritium, 48		500	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
	Gamma, 48	Mn-54	15	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
		Co-58	15	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
		Co-60	15	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
		Zn-65	30	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
		Cs-134	15	< LLD (0/36)	-	< LLD	< LLD (0/12)	0
		Cs-137	18	< LLD (0/36)	-	< LLD	< LLD (0/12)	0

[4] Mean and range are based on detectable measurements only.
[5] Fraction of detectable measurements at specified locations is indicated in parentheses.

Attachment 1: Data Table Summary Cont'd

Table 10: SONGS Data Summary Table

Medium or Pathway Sampled (Units)	Type, Total Number of Analyses performed (e.g., I-131, 400)		Lower Limit of Detection (LLD)	Indicator Mean[4] (f[5]) [Range[4]]	Location with Highest Annual Mean		Control Mean[4] (f[5]) [Range[4]]	Number of Nonroutine Reported Measurements
					Name Distance and Direction	Mean[4] (f[5]) [Range[4]]		
Shoreline Sediment (pCi/kg-dry)	Gamma, 8	Cs-134	150	< LLD (0/6)	-	< LLD	< LLD (0/2)	0
		Cs-137	180	< LLD (0/6)	-	< LLD	< LLD (0/2)	0
Ocean Bottom Sediment (pCi/kg-dry)	Gamma, 10	Cs-134	150	< LLD (0/8)	-	< LLD	< LLD (0/2)	0
		Cs-137	180	< LLD (0/8)	-	< LLD	< LLD (0/2)	0
Non-Migratory Marine Animal (pCi/kg-wet)	Gamma, 24	Mn-54	130	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
		Co-58	130	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
		Co-60	130	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
		Zn-65	260	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
		Cs-134	130	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
		Cs-137	150	< LLD (0/16)	-	< LLD	< LLD (0/8)	0
Local Crop (pCi/kg-wet)	Gamma, 8	Cs-134	60	< LLD (0/4)	-	< LLD	< LLD (0/4)	0
		Cs-137	80	< LLD (0/4)	-	< LLD	< LLD (0/4)	0

[4] Mean and range are based on detectable measurements only.
[5] Fraction of detectable measurements at specified locations is indicated in parentheses.

Attachment 2: Complete Data Table for All Analysis Results Obtained In 2023

Note: Throughout Attachment 2, bold data entries are for the reported concentration, either the measured value or the MDC.

Table 11: Weekly Air Particulate Gross Beta (pCi/m^3)

Date	APA 01 (Indicator)	APA 09 (Indicator)	APA 10 (Indicator)	APA 12 (Indicator)	APA 13 (Indicator)	APA 16 (Control)
01/03/2023	**1.62E-02** ± 2.81E-03	**1.18E-02** ± 2.60E-03	**1.20E-02** ± 2.64E-03	**1.47E-02** ± 2.65E-03	**1.34E-02** ± 2.48E-03	**1.64E-02** ± 2.89E-03
01/10/2023	**1.44E-02** ± 2.53E-03	**1.19E-02** ± 2.40E-03	**1.29E-02** ± 2.52E-03	**1.68E-02** ± 3.03E-03	**1.42E-02** ± 2.34E-03	**1.78E-02** ± 2.83E-03
01/17/2023	**1.30E-02** ± 2.35E-03	**1.28E-02** ± 2.44E-03	**1.44E-02** ± 2.62E-03	**1.41E-02** ± 2.59E-03	**1.18E-02** ± 2.11E-03	**1.49E-02** ± 2.54E-03
01/24/2023	**2.30E-02** ± 3.15E-03	**2.32E-02** ± 3.20E-03	**2.69E-02** ± 3.49E-03	**2.52E-02** ± 3.39E-03	**2.43E-02** ± 3.05E-03	**2.79E-02** ± 3.55E-03
01/31/2023	**2.52E-02** ± 3.23E-03	**2.74E-02** ± 3.54E-03	**2.89E-02** ± 3.58E-03	**2.44E-02** ± 3.37E-03	(a)	**2.67E-02** ± 3.40E-03
02/07/2023	**2.87E-02** ± 3.37E-03	**2.91E-02** ± 3.53E-03	**2.69E-02** ± 3.37E-03	**2.89E-02** ± 3.56E-03	**2.13E-02** ± 1.91E-03	**3.45E-02** ± 3.77E-03
02/14/2023	**2.57E-02** ± 3.30E-03	**2.55E-02** ± 3.45E-03	**2.46E-02** ± 3.44E-03	**2.94E-02** ± 3.70E-03	**2.78E-02** ± 3.40E-03	**2.10E-02** ± 3.13E-03
02/21/2023	**3.26E-02** ± 3.65E-03	**3.64E-02** ± 3.98E-03	**4.25E-02** ± 4.38E-03	**3.88E-02** ± 4.18E-03	**3.49E-02** ± 3.77E-03	**3.89E-02** ± 4.10E-03
02/28/2023	**1.36E-02** ± 2.48E-03	**1.46E-02** ± 2.64E-03	**1.36E-02** ± 2.51E-03	**1.43E-02** ± 2.68E-03	**1.20E-02** ± 2.39E-03	**1.20E-02** ± 2.49E-03
03/07/2023	**1.79E-02** ± 2.81E-03	**2.33E-02** ± 3.38E-03	**2.38E-02** ± 3.23E-03	**2.03E-02** ± 3.10E-03	**2.05E-02** ± 3.01E-03	**2.36E-02** ± 3.31E-03
03/14/2023	**1.51E-02** ± 2.66E-03	**1.51E-02** ± 2.79E-03	**1.39E-02** ± 2.52E-03	**1.42E-02** ± 2.70E-03	**1.35E-02** ± 2.52E-03	**1.63E-02** ± 2.86E-03
03/21/2023	**2.17E-02** ± 3.04E-03	**1.84E-02** ± 2.96E-03	**1.96E-02** ± 2.94E-03	**2.17E-02** ± 3.24E-03	**1.91E-02** ± 2.92E-03	**2.16E-02** ± 3.15E-03
03/28/2023	**2.74E-02** ± 3.41E-03	**2.25E-02** ± 3.29E-03	**1.98E-02** ± 2.92E-03	**2.42E-02** ± 3.39E-03	(a)	**2.85E-02** ± 3.65E-03
04/04/2023	**1.42E-02** ± 3.09E-03	**1.29E-02** ± 3.18E-03	**1.46E-02** ± 3.12E-03	**1.61E-02** ± 3.39E-03	**1.13E-02** ± 1.94E-03	**1.43E-02** ± 3.26E-03
04/11/2023	**1.40E-02** ± 3.04E-03	**1.74E-02** ± 3.50E-03	**1.54E-02** ± 3.12E-03	**1.72E-02** ± 3.39E-03	**1.23E-02** ± 2.90E-03	**1.57E-02** ± 3.29E-03
04/18/2023	**1.58E-02** ± 3.01E-03	**1.89E-02** ± 3.07E-03	**1.51E-02** ± 2.95E-03	**1.72E-02** ± 3.27E-03	**1.69E-02** ± 2.93E-03	**2.11E-02** ± 3.63E-03
04/25/2023	**2.13E-02** ± 3.42E-03	**2.06E-02** ± 3.17E-03	**2.16E-02** ± 3.49E-03	**2.45E-02** ± 3.80E-03	**1.99E-02** ± 3.44E-03	**2.14E-02** ± 3.63E-03
05/02/2023	**1.37E-02** ± 3.01E-03	**1.81E-02** ± 3.08E-03	**1.71E-02** ± 3.28E-03	**1.59E-02** ± 3.28E-03	**1.90E-02** ± 3.42E-03	**1.98E-02** ± 3.60E-03
05/09/2023	**7.27E-03** ± 2.55E-03	**8.91E-03** ± 2.49E-03	**9.06E-03** ± 2.73E-03	**1.01E-02** ± 2.95E-03	**8.96E-03** ± 2.80E-03	**8.96E-03** ± 2.89E-03
05/16/2023	**1.41E-02** ± 2.99E-03	**1.20E-02** ± 2.62E-03	**1.40E-02** ± 2.98E-03	**1.37E-02** ± 3.10E-03	**1.29E-02** ± 2.97E-03	**1.48E-02** ± 2.89E-03
05/23/2023	**1.30E-02** ± 2.88E-03	**1.31E-02** ± 2.62E-03	**1.29E-02** ± 2.83E-03	**1.32E-02** ± 3.01E-03	**1.66E-02** ± 3.22E-03	**1.52E-02** ± 2.94E-03

Table 11: Weekly Air Particulate Gross Beta (pCi/m^3)

Date	APA 01 (Indicator)	APA 09 (Indicator)	APA 10 (Indicator)	APA 12 (Indicator)	APA 13 (Indicator)	APA 16 (Control)
05/30/2023	**1.70E-02** ± 3.21E-03	**1.57E-02** ± 2.93E-03	**1.43E-02** ± 3.00E-03	**1.52E-02** ± 3.26E-03	**1.56E-02** ± 3.19E-03	**1.67E-02** ± 3.05E-03
06/06/2023	**1.56E-02** ± 3.13E-03	**1.73E-02** ± 3.02E-03	**1.83E-02** ± 3.33E-03	**1.81E-02** ± 3.47E-03	**1.43E-02** ± 3.13E-03	**1.58E-02** ± 3.00E-03
06/13/2023	**1.26E-02** ± 2.86E-03	**1.06E-02** ± 2.55E-03	**1.18E-02** ± 2.81E-03	**1.65E-02** ± 3.35E-03	**1.11E-02** ± 2.61E-03	**1.80E-02** ± 3.17E-03
06/20/2023	**1.61E-02** ± 3.12E-03	**1.29E-02** ± 2.68E-03	**1.97E-02** ± 3.35E-03	**1.65E-02** ± 3.24E-03	**1.55E-02** ± 3.06E-03	**1.39E-02** ± 2.74E-03
06/27/2023	**1.73E-02** ± 3.23E-03	**1.55E-02** ± 2.98E-03	**1.60E-02** ± 3.21E-03	**1.64E-02** ± 3.40E-03	**1.34E-02** ± 3.02E-03	**1.22E-02** ± 2.72E-03
07/05/2023	**1.48E-02** ± 2.84E-03	**1.33E-02** ± 2.53E-03	**1.52E-02** ± 2.81E-03	**1.51E-02** ± 2.95E-03	**1.69E-02** ± 2.95E-03	**1.40E-02** ± 2.50E-03
07/11/2023	**2.11E-02** ± 3.72E-03	**1.59E-02** ± 3.18E-03	**2.00E-02** ± 3.73E-03	**1.88E-02** ± 3.84E-03	**1.94E-02** ± 3.64E-03	**1.62E-02** ± 3.16E-03
07/18/2023	**1.46E-02** ± 3.17E-03	**1.08E-02** ± 2.63E-03	**1.28E-02** ± 2.96E-03	**1.26E-02** ± 3.07E-03	**1.41E-02** ± 3.07E-03	**1.44E-02** ± 2.84E-03
07/25/2023	**1.44E-02** ± 3.06E-03	**1.54E-02** ± 2.96E-03	**1.51E-02** ± 3.09E-03	**1.71E-02** ± 3.40E-03	**1.62E-02** ± 3.20E-03	**1.66E-02** ± 2.95E-03
08/01/2023	**1.79E-02** ± 3.36E-03	**1.68E-02** ± 3.06E-03	**1.76E-02** ± 3.28E-03	**1.60E-02** ± 3.43E-03	**1.75E-02** ± 3.31E-03	**1.64E-02** ± 3.03E-03
08/08/2023	**1.64E-02** ± 3.19E-03	**1.96E-02** ± 3.16E-03	**1.94E-02** ± 3.34E-03	**1.77E-02** ± 3.05E-03	**1.84E-02** ± 3.23E-03	**1.86E-02** ± 3.03E-03
08/15/2023	**1.98E-02** ± 3.61E-03	**2.10E-02** ± 3.34E-03	**1.60E-02** ± 3.15E-03	**2.16E-02** ± 3.38E-03	**1.68E-02** ± 3.24E-03	**1.70E-02** ± 3.03E-03
08/22/2023	**1.83E-02** ± 3.45E-03	**2.26E-02** ± 4.17E-03	**1.39E-02** ± 2.99E-03	**1.72E-02** ± 3.07E-03	**2.01E-02** ± 3.51E-03	**1.68E-02** ± 2.98E-03
08/29/2023	**2.13E-02** ± 3.53E-03	**2.25E-02** ± 4.19E-03	**1.94E-02** ± 3.32E-03	**2.10E-02** ± 3.19E-03	**2.48E-02** ± 3.66E-03	**2.52E-02** ± 3.45E-03
09/05/2023	**1.84E-02** ± 3.53E-03	**1.26E-02** ± 2.82E-03	**1.74E-02** ± 3.41E-03	**1.80E-02** ± 3.17E-03	**1.99E-02** ± 3.54E-03	**2.26E-02** ± 3.40E-03
09/12/2023	**2.21E-02** ± 3.59E-03	**1.68E-02** ± 2.94E-03	**2.01E-02** ± 3.24E-03	**1.86E-02** ± 3.06E-03	**2.19E-02** ± 3.54E-03	**2.14E-02** ± 3.21E-03
09/19/2023	**2.01E-02** ± 3.60E-03	**1.72E-02** ± 3.09E-03	**1.65E-02** ± 3.23E-03	**2.05E-02** ± 3.33E-03	**1.78E-02** ± 3.43E-03	**2.01E-02** ± 3.35E-03
09/26/2023	**2.54E-02** ± 3.83E-03	**2.45E-02** ± 3.43E-03	**2.52E-02** ± 3.65E-03	**3.03E-02** ± 3.77E-03	**2.63E-02** ± 3.82E-03	**2.54E-02** ± 3.39E-03
10/03/2023	**1.70E-02** ± 3.37E-03	**1.93E-02** ± 3.29E-03	**1.95E-02** ± 3.38E-03	**1.83E-02** ± 3.15E-03	**2.09E-02** ± 3.51E-03	**1.77E-02** ± 3.03E-03
10/10/2023	**2.84E-02** ± 3.67E-03	**2.93E-02** ± 3.88E-03	**2.35E-02** ± 3.69E-03	**2.60E-02** ± 3.53E-03	**3.06E-02** ± 4.23E-03	**2.92E-02** ± 3.79E-03
10/17/2023	**2.20E-02** ± 3.30E-03	(a)	**1.74E-02** ± 3.19E-03	**1.95E-02** ± 3.20E-03	**2.30E-02** ± 3.63E-03	**2.30E-02** ± 3.37E-03

(a) Refer to Sample Deviation Summary Table 9

Table 11: Weekly Air Particulate Gross Beta (pCi/m^3)

Date	APA 01 (Indicator)	APA 09 (Indicator)	APA 10 (Indicator)	APA 12 (Indicator)	APA 13 (Indicator)	APA 16 (Control)
10/24/2023	**2.66E-02** ± 3.59E-03	**2.15E-02** ± 3.45E-03	**2.84E-02** ± 3.88E-03	**2.56E-02** ± 3.72E-03	**2.49E-02** ± 3.77E-03	**2.48E-02** ± 3.45E-03
10/31/2023	**2.81E-02** ± 3.75E-03	**2.63E-02** ± 3.80E-03	**2.39E-02** ± 3.97E-03	**2.61E-02** ± 3.84E-03	**2.82E-02** ± 4.15E-03	**2.41E-02** ± 3.50E-03
11/07/2023	**4.57E-02** ± 4.53E-03	**4.08E-02** ± 4.29E-03	(b)	(a)	**4.48E-02** ± 4.80E-03	**4.63E-02** ± 4.51E-03
11/14/2023	**2.78E-02** ± 3.71E-03	**3.24E-02** ± 4.04E-03	**3.04E-02** ± 4.07E-03	**2.86E-02** ± 3.66E-03	**3.27E-02** ± 4.27E-03	**2.70E-02** ± 3.61E-03
11/21/2023	**1.96E-02** ± 3.31E-03	(a)	**2.00E-02** ± 3.66E-03	**2.10E-02** ± 3.29E-03	**1.88E-02** ± 3.57E-03	**2.11E-02** ± 3.36E-03
11/28/2023	**3.05E-02** ± 3.89E-03	**2.93E-02** ± 5.59E-03	**2.93E-02** ± 4.22E-03	**3.15E-02** ± 3.81E-03	**3.07E-02** ± 4.27E-03	**3.14E-02** ± 3.90E-03
12/05/2023	**2.51E-02** ± 3.69E-03	**2.55E-02** ± 3.72E-03	**2.54E-02** ± 4.06E-03	**2.91E-02** ± 3.82E-03	**2.83E-02** ± 4.21E-03	**2.65E-02** ± 3.72E-03
12/12/2023	**2.41E-02** ± 3.51E-03	**2.86E-02** ± 3.71E-03	**2.45E-02** ± 3.80E-03	**2.85E-02** ± 3.63E-03	**2.95E-02** ± 4.14E-03	**3.09E-02** ± 3.80E-03
12/19/2023	**5.01E-02** ± 4.86E-03	(a)	**4.52E-02** ± 5.07E-03	**4.45E-02** ± 4.47E-03	**5.02E-02** ± 4.65E-03	**4.22E-02** ± 4.46E-03
12/26/2023	**2.63E-02** ± 3.62E-03	(a)*	**1.84E-02** ± 2.90E-03	**2.56E-02** ± 3.44E-03	**2.47E-02** ± 3.33E-03	**2.74E-02** ± 3.66E-03
01/02/2024	**2.97E-02** ± 3.85E-03	(a)*	**2.54E-02** ± 3.42E-03	**3.07E-02** ± 3.80E-03	**3.30E-02** ± 3.84E-03	**3.12E-02** ± 3.81E-03

(a) Refer to Sample Deviation Summary Table 9
(b) AS-10 is not a required sample location. Sample was affected by the same smoke particulate loading condition as AS-12 for this week.

*Station APA 21 (located near TLD 16) was put into service as a replacement air station when APA 09 was removed from service. The weekly gross beta results for Station APA 21 are listed below.

Date	APA 21 (Indicator)
• 12/26/23	2.30E-02 ± 3.24E-03 pCi/m^3
• 01/02/24	2.86E-02 ± 3.62E-03 pCi/m^3

Table 12: Quarterly Air Particulate Gamma Isotopic (pCi/m^3)

Station	Nuclide	Q1			Q2			Q3			Q4		
		Activity	Error	MDC	Activity	Error	MDC	Activity	Error	MDC	Activity	Error	MDC
APA 01	Cs-134	-8.03E-05	± 1.77E-04	**2.91E-04**	-2.59E-04	± 9.10E-04	**1.42E-03**	-5.64E-04	± 7.47E-04	**9.68E-04**	-5.18E-04	± 1.15E-03	**1.75E-03**
	Cs-137	-4.74E-05	± 1.70E-04	**2.64E-04**	-7.41E-04	± 8.15E-04	**1.06E-03**	2.80E-04	± 7.67E-04	**1.36E-03**	6.55E-04	± 1.23E-03	**2.16E-03**
APA 09	Cs-134	-2.91E-05	± 2.27E-04	**3.57E-04**	2.22E-04	± 9.00E-04	**1.55E-03**	-6.73E-05	± 9.77E-04	**1.60E-03**	-5.21E-04	± 2.02E-03	**3.20E-03**
	Cs-137	8.49E-05	± 3.65E-04	**3.20E-04**	-1.29E-04	± 7.93E-04	**1.27E-03**	-1.36E-05	± 6.89E-04	**1.13E-03**	-2.59E-04	± 1.51E-03	**2.41E-03**
APA 10	Cs-134	-1.09E-05	± 2.85E-04	**4.27E-04**	7.03E-04	± 1.30E-03	**2.31E-03**	-2.18E-04	± 1.01E-03	**1.59E-03**	-4.69E-04	± 1.37E-03	**2.13E-03**
	Cs-137	-1.86E-04	± 2.29E-04	**3.13E-04**	-2.18E-04	± 1.08E-03	**1.71E-03**	-4.58E-04	± 7.50E-04	**1.06E-03**	6.62E-04	± 1.11E-03	**2.01E-03**
APA 12	Cs-134	6.55E-05	± 2.51E-04	**4.32E-04**	-2.24E-04	± 8.17E-04	**1.52E-03**	-1.33E-03	± 1.26E-03	**1.97E-03**	1.78E-04	± 9.13E-04	**1.56E-03**
	Cs-137	9.34E-05	± 2.04E-04	**3.66E-04**	-1.48E-04	± 6.91E-04	**1.28E-03**	1.37E-03	± 1.17E-03	**2.49E-03**	-8.42E-04	± 7.09E-04	**8.17E-04**
APA 13	Cs-134	-1.74E-04	± 1.74E-04	**2.05E-04**	-2.37E-04	± 9.78E-04	**1.56E-03**	7.14E-04	± 1.09E-03	**2.01E-03**	-4.23E-05	± 9.64E-04	**1.56E-03**
	Cs-137	-7.66E-06	± 1.55E-04	**2.56E-04**	5.05E-04	± 8.91E-04	**1.55E-03**	-2.30E-04	± 8.12E-04	**1.24E-03**	-2.09E-04	± 8.67E-04	**1.37E-03**
APA 16	Cs-134	-1.93E-05	± 2.73E-04	**4.33E-04**	-2.43E-05	± 9.08E-04	**1.47E-03**	2.34E-04	± 1.14E-03	**1.92E-03**	2.30E-04	± 1.24E-03	**2.09E-03**
	Cs-137	-7.25E-05	± 2.20E-04	**3.38E-04**	1.69E-04	± 6.94E-04	**1.22E-03**	-7.15E-04	± 1.00E-03	**1.50E-03**	7.39E-04	± 1.12E-03	**2.00E-03**

Table 13: Monthly Ocean Water Gamma Isotopic (pCi/L)

Station	Collection Date	H-3	Mn-54	Co-58	Co-60	Zn-65	Cs-134	Cs-137
WSA 01	January	56.4 ± 293 **< 488**	-0.18 ± 1.05 **< 1.78**	-1.15 ± 1.17 **< 1.86**	0.78 ± 1.23 **< 2.18**	0.34 ± 2.43 **< 4.14**	0.13 ± 1.22 **< 2.13**	-0.19 ± 1.08 **< 1.75**
	February	-67.2 ± 191 **< 329**	0.61 ± 1.17 **< 2.09**	-0.15 ± 1.11 **< 1.88**	-0.19 ± 1.31 **< 2.11**	-0.39 ± 2.63 **< 4.32**	-0.74 ± 1.64 **< 2.32**	-0.72 ± 1.24 **< 1.92**
	March	116 ± 260 **< 423**	0.22 ± 0.87 **< 1.46**	-0.46 ± 0.87 **< 1.36**	-0.04 ± 0.89 **< 1.51**	-1.18 ± 1.97 **< 3.25**	-0.60 ± 0.99 **< 1.54**	0.58 ± 0.91 **< 1.59**
	April	-172 ± 244 **< 432**	-2.62 ± 4.68 **< 6.74**	-0.65 ± 4.57 **< 7.33**	2.92 ± 5.02 **< 9.63**	-4.77 ± 9.81 **< 13.4**	-2.84 ± 4.06 **< 5.29**	-2.84 ± 4.06 **< 9.47**
	May	-79.1 ± 249 **< 425**	1.70 ± 6.53 **< 11.4**	0.54 ± 6.75 **< 11.4**	1.25 ± 6.61 **< 12.3**	12.4 ± 12.9 **< 26.1**	-7.96 ± 6.97 **< 8.29**	-7.96 ± 6.97 **< 12.7**
	June	-52.0 ± 108 **< 182**	-2.11 ± 5.19 **< 7.85**	-0.46 ± 5.67 **< 9.27**	0.25 ± 6.78 **< 11.4**	-4.80 ± 9.31 **< 12.4**	4.33 ± 6.40 **< 11.9**	4.33 ± 6.40 **< 9.60**
	July	55.2 ± 258 **< 415**	-6.15 ± 5.22 **< 7.35**	0.34 ± 5.57 **< 9.32**	1.13 ± 5.94 **< 10.6**	-2.06 ± 12.9 **< 20.5**	-1.23 ± 5.77 **< 9.34**	-1.23 ± 5.77 **< 9.92**
	August	53.1 ± 300 **< 487**	4.53 ± 6.44 **< 11.8**	4.43 ± 6.11 **< 11.0**	-1.95 ± 6.41 **< 10.1**	1.11 ± 15.9 **< 22.7**	3.01 ± 6.91 **< 11.9**	3.01 ± 6.91 **< 7.30**
	September	0.00 ± 260 **< 429**	-2.10 ± 5.50 **< 8.70**	3.74 ± 6.90 **< 12.0**	-0.47 ± 5.80 **< 10.0**	-29.7 ± 17.2 **< 20.6**	-2.27 ± 6.01 **< 9.01**	-2.27 ± 6.01 **< 11.4**
	October	46.7 ± 281 **< 456**	0.20 ± 5.33 **< 8.69**	-1.43 ± 5.44 **< 8.56**	1.78 ± 4.82 **< 8.49**	-29.1 ± 15.2 **< 20.3**	-1.24 ± 5.69 **< 8.99**	-2.11 ± 5.50 **< 8.63**
	November	4.06 ± 258 **< 424**	-2.74 ± 6.41 **< 9.63**	-2.78 ± 7.65 **< 11.9**	0.32 ± 7.28 **< 12.3**	-15.3 ± 13.7 **< 14.0**	4.05 ± 6.69 **< 12.6**	4.17 ± 6.77 **< 12.2**
	December	-21.5 ± 285 **< 473**	0.54 ± 3.46 **< 5.81**	-1.26 ± 3.62 **< 5.85**	0.21 ± 4.03 **< 6.78**	2.76 ± 7.96 **< 13.4**	-1.56 ± 4.32 **< 7.00**	-0.18 ± 3.77 **< 6.11**

Result entries are organized in the format below.

Activity ± Error *< MDA*

Table 13: Monthly Ocean Water Gamma Isotopic (pCi/L) Cont'd

Station	Collection Date	H-3	Mn-54	Co-58	Co-60	Zn-65	Cs-134	Cs-137
WSA 02	January	78.6 ± 281 **< 467**	-0.62 ± 0.86 **< 1.31**	-0.97 ± 1.23 **< 1.43**	-0.81 ± 0.81 **< 1.20**	-0.18 ± 2.13 **< 3.20**	-0.70 ± 1.21 **< 1.46**	0.25 ± 0.91 **< 1.55**
	February	62.3 ± 205 **< 337**	-0.24 ± 1.25 **< 2.02**	-1.28 ± 1.24 **< 1.85**	1.31 ± 1.09 **< 2.12**	-6.19 ± 3.46 **< 3.59**	-0.17 ± 1.32 **< 2.15**	1.02 ± 1.22 **< 2.18**
	March	83.2 ± 250 **< 410**	0.40 ± 1.04 **< 1.79**	-0.66 ± 1.02 **< 1.61**	0.42 ± 1.21 **< 2.13**	-0.33 ± 4.23 **< 4.23**	0.94 ± 1.14 **< 2.04**	0.38 ± 1.46 **< 1.78**
	April	-149 ± 252 **< 440**	1.65 ± 4.29 **< 7.47**	-0.22 ± 4.89 **< 7.88**	0.41 ± 5.00 **< 8.33**	2.87 ± 8.48 **< 15.1**	-0.07 ± 4.94 **< 8.02**	1.21 ± 3.90 **< 6.83**
	May	-167 ± 234 **< 416**	-1.20 ± 6.29 **< 10.0**	-2.55 ± 6.68 **< 10.3**	0.23 ± 6.74 **< 11.3**	5.25 ± 11.5 **< 20.9**	-3.92 ± 5.23 **< 6.89**	-5.61 ± 6.00 **< 8.30**
	June	-7.95 ± 110 **< 181**	1.99 ± 5.09 **< 8.86**	-2.63 ± 4.79 **< 7.33**	2.35 ± 6.75 **< 12.1**	-12.7 ± 11.7 **< 15.6**	1.51 ± 6.51 **< 11.1**	0.23 ± 5.87 **< 9.59**
	July	-8.21 ± 262 **< 433**	-1.08 ± 5.85 **< 9.52**	-2.20 ± 5.33 **< 8.30**	-0.46 ± 6.31 **< 10.3**	-20.4 ± 15.1 **< 18.2**	-1.15 ± 5.31 **< 8.10**	-3.95 ± 5.95 **< 8.63**
	August	-106 ± 284 **< 486**	0.88 ± 5.28 **< 9.15**	-2.95 ± 5.99 **< 9.10**	-1.28 ± 7.55 **< 12.1**	-2.64 ± 16.3 **< 25.7**	6.24 ± 6.77 **< 12.9**	3.73 ± 6.27 **< 11.4**
	September	10.5 ± 258 **< 424**	-1.03 ± 7.29 **< 12.0**	0.76 ± 7.03 **< 12.0**	-4.74 ± 7.42 **< 10.4**	-22.7 ± 20.5 **< 27.3**	2.37 ± 6.24 **< 10.9**	-0.89 ± 7.62 **< 12.3**
	October	-160 ± 264 **< 463**	1.51 ± 6.46 **< 10.8**	-0.63 ± 6.43 **< 10.3**	3.49 ± 6.57 **< 12.0**	10.5 ± 14.1 **< 26.1**	0.38 ± 6.98 **< 11.4**	9.18 ± 6.12 **< 11.9**
	November	104 ± 264 **< 417**	0.04 ± 5.92 **< 9.82**	0.77 ± 5.64 **< 9.55**	-4.68 ± 6.13 **< 8.72**	8.77 ± 15.4 **< 26.8**	-3.99 ± 6.69 **< 10.3**	-5.31 ± 6.47 **< 9.40**
	December	52.9 ± 276 **< 446**	2.98 ± 5.59 **< 9.91**	1.22 ± 5.84 **< 9.90**	2.78 ± 7.32 **< 12.7**	-16.6 ± 15.4 **< 20.8**	-4.73 ± 6.44 **< 9.39**	0.55 ± 5.97 **< 10.0**

Result entries are organized in the format below.

Activity ± *Error* < *MDA*

Table 13: Monthly Ocean Water Gamma Isotopic (pCi/L) Cont'd

Station	Collection Date	H-3	Mn-54	Co-58	Co-60	Zn-65	Cs-134	Cs-137
WSA 03	January	142 ± 289 **< 475**	-0.16 ± 0.87 **< 1.40**	-0.39 ± 0.89 **< 1.32**	0.36 ± 0.87 **< 1.55**	-0.26 ± 1.76 **< 2.98**	-0.35 ± 0.93 **< 1.47**	-0.13 ± 1.23 **< 1.54**
	February	148 ± 200 **< 317**	-0.44 ± 0.91 **< 1.51**	0.80 ± 1.03 **< 1.79**	-0.14 ± 1.14 **< 1.88**	-0.48 ± 2.32 **< 3.86**	-0.80 ± 1.35 **< 1.58**	-0.05 ± 1.63 **< 1.92**
	March	87.3 ± 257 **< 421**	1.18 ± 1.33 **< 2.45**	-0.08 ± 1.27 **< 2.20**	0.29 ± 1.37 **< 2.32**	-0.25 ± 3.47 **< 5.80**	0.07 ± 1.42 **< 2.31**	-1.64 ± 2.26 **< 2.42**
	April	-55.7 ± 255 **< 429**	-5.42 ± 6.29 **< 9.29**	-1.19 ± 5.81 **< 9.40**	5.96 ± 8.20 **< 14.7**	-1.33 ± 13.5 **< 22.0**	-2.25 ± 7.40 **< 11.9**	0.58 ± 6.34 **< 10.6**
	May	-100 ± 249 **< 428**	2.53 ± 5.55 **< 9.76**	-2.56 ± 5.54 **< 8.58**	0.76 ± 5.53 **< 9.96**	-4.7 ± 12.1 **< 18.4**	1.22 ± 7.14 **< 12.1**	3.69 ± 6.47 **< 11.2**
	June	18.7 ± 114 **< 186**	-0.19 ± 5.05 **< 8.29**	-2.00 ± 5.64 **< 8.74**	5.45 ± 5.01 **< 10.6**	-2.85 ± 11.1 **< 16.7**	2.11 ± 6.29 **< 11.1**	0.94 ± 6.47 **< 11.1**
	July	2.08 ± 267 **< 439**	-2.08 ± 6.04 **< 9.46**	-2.19 ± 5.86 **< 9.14**	0.48 ± 5.92 **< 9.96**	-9.99 ± 12.7 **< 16.8**	1.97 ± 5.68 **< 10.0**	-1.65 ± 5.79 **< 8.80**
	August	4.26 ± 297 **< 489**	2.73 ± 5.73 **< 10.1**	1.37 ± 6.10 **< 10.4**	-5.93 ± 5.81 **< 8.70**	0.74 ± 13.0 **< 21.4**	-3.00 ± 6.68 **< 10.5**	3.69 ± 6.07 **< 10.6**
	September	109 ± 269 **< 423**	-2.50 ± 5.56 **< 8.66**	-2.06 ± 5.53 **< 8.72**	0.93 ± 6.38 **< 11.4**	-14.8 ± 13.8 **< 18.9**	-0.08 ± 6.14 **< 10.2**	-3.06 ± 6.17 **< 9.38**
	October	-91.1 ± 266 **< 455**	-4.50 ± 5.18 **< 8.43**	2.30 ± 5.60 **< 11.0**	0.81 ± 5.34 **< 10.8**	2.8 ± 13.0 **< 24.7**	-0.92 ± 5.82 **< 10.7**	-1.81 ± 4.97 **< 8.97**
	November	-26.3 ± 254 **< 423**	1.66 ± 5.73 **< 10.1**	-4.05 ± 6.03 **< 8.74**	0.75 ± 7.66 **< 13.0**	-20.8 ± 21.7 **< 30.0**	1.39 ± 7.63 **< 12.7**	-3.22 ± 7.53 **< 11.5**
	December	-87.3 ± 282 **< 479**	-2.02 ± 5.99 **< 9.34**	2.70 ± 5.01 **< 8.99**	6.79 ± 5.47 **< 11.4**	-4.80 ± 13.6 **< 20.8**	5.05 ± 6.44 **< 11.8**	-3.60 ± 6.56 **< 10.1**

Result entries are organized in the format below.

Activity ± Error *< MDA*

Table 13: Monthly Ocean Water Gamma Isotopic (pCi/L) Cont'd

Station	Collection Date	H-3	Mn-54	Co-58	Co-60	Zn-65	Cs-134	Cs-137
WSA 04	January	155 ± 290 **< 477**	0.67 ± 0.97 **< 1.55**	0.13 ± 1.01 **< 1.69**	-0.58 ± 0.95 **< 1.51**	1.77 ± 1.99 **< 3.72**	-0.50 ± 1.04 **< 1.63**	-0.20 ± 0.97 **< 1.60**
	February	116 ± 208 **< 334**	-0.20 ± 1.17 **< 1.88**	-0.35 ± 1.07 **< 1.69**	-0.01 ± 1.24 **< 1.85**	-1.95 ± 2.22 **< 3.50**	-0.65 ± 1.20 **< 1.87**	0.16 ± 0.98 **< 1.65**
	March	108 ± 249 **< 405**	-0.89 ± 1.79 **< 1.98**	0.08 ± 1.23 **< 2.14**	-0.46 ± 1.25 **< 1.98**	0.75 ± 2.66 **< 4.57**	1.45 ± 1.27 **< 2.36**	1.72 ± 1.30 **< 2.16**
	April	-60.1 ± 256 **< 432**	-0.65 ± 5.11 **< 8.33**	0.28 ± 5.05 **< 8.45**	-0.08 ± 4.77 **< 8.50**	-16.2 ± 11.0 **< 13.4**	-4.27 ± 4.65 **< 6.56**	-0.36 ± 5.33 **< 8.59**
	May	-159 ± 239 **< 422**	-2.19 ± 5.33 **< 7.95**	0.19 ± 5.17 **< 8.46**	-2.67 ± 6.17 **< 9.71**	-0.03 ± 10.5 **< 17.5**	-2.39 ± 5.27 **< 7.72**	-0.64 ± 5.73 **< 9.28**
	June	40.3 ± 112 **< 181**	1.26 ± 5.03 **< 8.50**	-2.06 ± 4.59 **< 6.80**	-0.56 ± 5.40 **< 8.63**	-7.8 ± 10.7 **< 15.2**	2.94 ± 5.53 **< 9.80**	-1.10 ± 5.21 **< 8.32**
	July	-72.8 ± 244 **< 415**	-1.47 ± 4.74 **< 7.60**	0.53 ± 4.49 **< 7.40**	6.24 ± 5.02 **< 10.3**	-6.7 ± 10.4 **< 14.9**	3.21 ± 5.84 **< 10.2**	1.08 ± 5.49 **< 9.24**
	August	-206 ± 275 **< 486**	-1.09 ± 5.13 **< 8.1**	3.13 ± 5.75 **< 10.5**	-3.29 ± 4.73 **< 5.6**	-4.62 ± 16.3 **< 24.7**	3.56 ± 5.93 **< 11.1**	-0.02 ± 6.29 **< 10.1**
	September	-46.5 ± 253 **< 426**	0.19 ± 3.76 **< 7.35**	-2.96 ± 4.42 **< 7.51**	-2.80 ± 4.68 **< 8.86**	-17.2 ± 10.6 **< 13.2**	-1.80 ± 4.43 **< 7.97**	-2.77 ± 4.44 **< 7.73**
	October	29.9 ± 281 **< 458**	2.18 ± 6.01 **< 10.7**	-1.93 ± 5.73 **< 8.87**	3.58 ± 6.61 **< 12.4**	0.72 ± 15.3 **< 25.1**	0.61 ± 6.51 **< 11.1**	-4.34 ± 6.32 **< 8.80**
	November	-76.1 ± 246 **< 419**	6.08 ± 6.56 **< 12.1**	3.40 ± 6.57 **< 11.6**	3.59 ± 7.25 **< 12.9**	-17.5 ± 15.9 **< 21.2**	0.44 ± 6.95 **< 11.6**	-0.62 ± 5.96 **< 9.7**
	December	-14.9 ± 282 **< 468**	-2.01 ± 5.89 **< 9.09**	0.20 ± 4.59 **< 7.72**	-0.93 ± 7.28 **< 11.7**	-3.46 ± 15.3 **< 23.4**	2.97 ± 6.33 **< 11.5**	-0.55 ± 5.69 **< 8.91**

Result entries are organized in the format below.

Activity ± Error *< MDA*

Table 14: Semi-Annual Shoreline Sediment Gamma Isotopic (pCi/kg dry)

Station	Nuclide	March				September			
		Activity		Error	MDC	Activity		Error	MDC
SSA 01	Cs-134	3.97E+00	±	1.89E+01	**3.37E+01**	1.40E+01	±	4.40E+01	**7.67E+01**
	Cs-137	1.08E+01	±	1.98E+01	**3.44E+01**	2.80E+01	±	4.51E+01	**7.83E+01**
SSA 02	Cs-134	-2.14E+00	±	2.08E+01	**3.48E+01**	1.43E+01	±	3.24E+01	**5.63E+01**
	Cs-137	-4.91E+00	±	2.02E+01	**3.24E+01**	-4.94E-01	±	2.96E+01	**4.81E+01**
SSA 03	Cs-134	0.00E+00[a]	±	2.05E+01	**2.37E+01**	2.72E+01	±	3.84E+01	**6.64E+01**
	Cs-137	1.65E+01	±	1.16E+01	**2.18E+01**	2.67E+01	±	3.63E+01	**6.28E+01**
SSA 04	Cs-134	0.00E+00[a]	±	4.44E+01	**6.01E+01**	5.18E+01	±	5.03E+01	**9.10E+01**
	Cs-137	-5.42E+00	±	2.08E+01	**3.49E+01**	-2.70E+01	±	4.46E+01	**6.78E+01**

(a): GEL Laboratories identified Cs-134 as "UI Uncertain identification for gamma spectroscopy" for March samples from Station SSA 03 and SSA 04. Results were rejected due to false positives.

Table 15: Semi-Annual Ocean Bottom Sediment Gamma Isotopic (pCi/kg Dry)

Station	Nuclide	April				October			
		Activity		Error	MDC	Activity		Error	MDC
SEB 02	Cs-134	-1.82E+01	±	4.18E+01	**6.17E+01**	-1.61E+01	±	4.29E+01	**6.87E+01**
	Cs-137	-3.61E+00	±	3.26E+01	**5.21E+01**	1.23E+01	±	3.86E+01	**6.49E+01**
SEB 03	Cs-134	-2.97E+00	±	5.80E+01	**9.60E+01**	3.63E+01	±	5.56E+01	**9.66E+01**
	Cs-137	-1.71E+01	±	5.10E+01	**8.01E+01**	-8.26E+00	±	4.92E+01	**7.90E+01**
SEB 04	Cs-134	4.68E+00	±	5.45E+01	**8.81E+01**	3.50E+01	±	3.73E+01	**7.05E+01**
	Cs-137	-2.90E+01	±	5.35E+01	**8.04E+01**	-1.16E+01	±	3.85E+01	**5.89E+01**
SEB 05	Cs-134	3.01E+01	±	4.72E+01	**8.33E+01**	3.52E+01	±	3.75E+01	**7.10E+01**
	Cs-137	-1.96E+01	±	4.35E+01	**6.52E+01**	-4.58E+00	±	3.68E+01	**5.78E+01**
SEB 06	Cs-134	1.10E+01	±	4.52E+01	**7.45E+01**	7.38E+01	±	5.78E+01	**1.09E+02**
	Cs-137	-3.40E+01	±	4.36E+01	**6.42E+01**	4.76E+01	±	5.20E+01	**9.25E+01**

Table 16: Semi-Annual Marine Animal Gamma Isotopic (pCi/kg)

Station	Date	Species	Mn-65	Co-58	Co-60	Zn-65	Cs-134	Cs-137
MOA 01	April	California Mussel	-3.75 ± 39.8 **< 65.2**	-31.3 ± 41.7 **< 61.7**	-47.2 ± 39.2 **< 54.2**	-31.2 ± 100 **< 156**	-3.85 ± 45.2 **< 74.3**	42.5 ± 43.5 **< 79.7**
		Kelp Bass	-10.7 ± 35.5 **< 54.6**	1.79 ± 34.1 **< 56.0**	4.07 ± 44.6 **< 74.2**	-14.0 ± 66.6 **< 106**	41.3 ± 37.7 **< 72.4**	8.51 ± 36.0 **< 61.6**
		Sand Bass	19.0 ± 31.6 **< 59.2**	-9.66 ± 30.4 **< 46.7**	23.4 ± 43.0 **< 80.6**	-12.1 ± 103 **< 162**	-3.59 ± 36.2 **< 59.1**	10.4 ± 26.7 **< 47.3**
		Spiny Lobster	9.72 ± 39.6 **< 68.0**	-48.9 ± 48.3 **< 69.2**	-35.4 ± 45.5 **< 69.9**	18.4 ± 101 **< 170**	-18.1 ± 51.9 **< 82.4**	44.8 ± 45.8 **< 83.9**
	October	Black Perch	-17.1 ± 36.2 **< 61.7**	-32.7 ± 35.8 **< 55.4**	-15.3 ± 37.3 **< 72.3**	24.2 ± 79.7 **< 152**	-4.42 ± 42.8 **< 77.9**	4.23 ± 30.8 **< 60.6**
		Spiny Lobster	-4.74 ± 31.2 **< 50.4**	5.47 ± 32.9 **< 56.5**	-4.04 ± 35.1 **< 56.2**	-76.0 ± 80.4 **< 99.8**	7.95 ± 36.9 **< 64.0**	-2.69 ± 36.4 **< 58.4**
		California Mussel	-15.4 ± 50.8 **< 89.9**	-33.9 ± 42.6 **< 70.5**	2.90 ± 44.8 **< 89.1**	-119 ± 113 **< 171**	-34.0 ± 48.1 **< 81.0**	-49.2 ± 50.3 **< 82.6**
		Kelp Bass	4.07 ± 38.0 **< 64.8**	-4.12 ± 32.6 **< 53.3**	20.9 ± 45.2 **< 82.3**	-57.4 ± 99.6 **< 144**	40.3 ± 38.2 **< 74.5**	9.46 ± 40.8 **< 69.4**

Result entries are organized in the format below.

Activity ± Error
< MDA

Table 16: Semi-Annual Marine Animal Gamma Isotopic (pCi/kg) Cont'd

Station	Date	Species	Mn-65	Co-58	Co-60	Zn-65	Cs-134	Cs-137
MOA 02	April	Black Perch	-0.53 ± 30.1 **< 48.8**	-11.8 ± 30.5 **< 46.6**	-1.56 ± 28.8 **< 46.5**	-131 ± 75.3 **< 90.8**	-4.31 ± 27.4 **< 43.3**	12.4 ± 31.8 **< 55.0**
		California Mussel	2.43 ± 27.7 **< 45.8**	7.72 ± 26.7 **< 46.2**	-5.06 ± 32.1 **< 50.4**	-28.7 ± 84.7 **< 133**	3.15 ± 35.1 **< 58.0**	-3.50 ± 32.7 **< 53.0**
		Sheephead	-12.2 ± 30.5 **< 46.3**	2.59 ± 31.9 **< 52.5**	25.1 ± 32.7 **< 61.4**	-3.10 ± 66.7 **< 110**	24.6 ± 32.0 **< 58.3**	-8.45 ± 27.4 **< 42.9**
		Spiny Lobster	24.8 ± 39.1 **< 71.8**	10.1 ± 29.3 **< 52.6**	9.04 ± 38.2 **< 67.6**	-46.3 ± 80.4 **< 110**	31.9 ± 34.9 **< 68.7**	-7.35 ± 34.5 **< 52.7**
	October	Kelp Bass	8.93 ± 49.4 **< 83.8**	-27.5 ± 48.7 **< 74.8**	35.8 ± 53.8 **< 98.5**	-73.6 ± 128 **< 193**	-36.6 ± 64.5 **< 100**	68.4 ± 57.6 **< 106**
		Black Perch	-26.4 ± 37.1 **< 52.0**	7.98 ± 37.9 **< 65.5**	14.5 ± 45.8 **< 81.3**	-117.5 ± 116 **< 149**	-29.3 ± 45.4 **< 66.4**	-30.1 ± 45.1 **< 63.1**
		Spiny Lobster	19.1 ± 43.1 **< 74.9**	-4.57 ± 42.8 **< 68.3**	14.7 ± 41.9 **< 75.0**	-30.7 ± 98.7 **< 156**	26.1 ± 55.8 **< 96.6**	-7.93 ± 46.4 **< 74.1**
		California Mussel	20.7 ± 41.9 **< 72.6**	-23.3 ± 39.1 **< 57.3**	9.81 ± 39.0 **< 67.9**	-58.7 ± 100 **< 154**	5.56 ± 47.9 **< 79.2**	-22.3 ± 48.8 **< 75.5**

Result entries are organized in the format below.

Activity ± Error *< MDA*

Table 16: Semi-Annual Marine Animal Gamma Isotopic (pCi/kg) Cont'd

Station	Date	Species	Mn-65	Co-58	Co-60	Zn-65	Cs-134	Cs-137
MOA 03	April	California Mussel	-6.71 ± 28.8 **< 45.2**	6.99 ± 27.1 **< 47.5**	8.38 ± 17.8 **< 35.8**	-12.8 ± 59.9 **< 90.5**	-43.0 ± 32.5 **< 36.3**	-3.33 ± 30.5 **< 50.5**
		Kelp Bass	12.3 ± 36.2 **< 61.9**	-12.3 ± 27.9 **< 40.6**	23.1 ± 43.1 **< 77.7**	-68.7 ± 75.4 **< 102**	13.7 ± 35.2 **< 61.4**	22.3 ± 37.2 **< 66.6**
		Sheephead	16.3 ± 29.4 **< 54.5**	-23.4 ± 28.9 **< 39.5**	-2.73 ± 37.3 **< 61.3**	-109 ± 69.7 **< 55.9**	0.00 ± 31.2 **< 49.8**	12.7 ± 29.3 **< 52.0**
		Spiny Lobster	7.25 ± 35.5 **< 60.6**	26.4 ± 39.5 **< 71.4**	4.14 ± 40.4 **< 73.2**	-18.0 ± 90.7 **< 143**	-13.3 ± 39.6 **< 62.5**	9.30 ± 45.0 **< 75.0**
	October	Sheephead	-18.2 ± 43.0 **< 67.0**	8.36 ± 43.5 **< 74.2**	-4.47 ± 45.4 **< 73.9**	55.2 ± 106 **< 186**	-0.82 ± 48.0 **< 79.6**	16.4 ± 48.0 **< 81.4**
		Black Perch	-15.4 ± 44.7 **< 70.6**	-34.7 ± 35.5 **< 47.7**	8.77 ± 50.3 **< 86.3**	-207 ± 119 **< 129**	37.2 ± 46.7 **< 87.4**	-0.03 ± 46.2 **< 75.3**
		Spiny Lobster	24.9 ± 45.5 **< 79.9**	-13.0 ± 44.9 **< 70.0**	30.1 ± 50.6 **< 93.1**	-298 ± 141 **< 155**	28.1 ± 48.5 **< 85.8**	-84.3 ± 51.3 **< 65.4**
		California Mussel	7.16 ± 32.6 **< 56.7**	1.94 ± 31.5 **< 53.2**	12.8 ± 43.7 **< 77.8**	-19.9 ± 69.8 **< 103**	-21.3 ± 34.5 **< 48.7**	-27.6 ± 37.1 **< 49.2**

Result entries are organized in the format below.

Activity ± *Error* < *MDA*

Table 17: Semi-Annual Local Crops Gamma Isotopic (pCi/kg Wet)

Station	Date	Description	Cs-134			Cs-137		
			Activity	Error	MDC	Activity	Error	MDC
TFB 02	March	Lettuce	-9.43E+00	± 1.77E+01	**2.59E+01**	-9.66E-01	± 1.69E+01	**2.72E+01**
		Tomato	6.75E+00	± 1.47E+01	**2.59E+01**	-1.74E+00	± 1.17E+01	**1.87E+01**
	September	Kale	6.22E+00	± 1.91E+01	**3.41E+01**	-8.90E+00	± 1.99E+01	**2.87E+01**
		Tomato	-3.79E+00	± 1.64E+01	**2.62E+01**	-8.91E+00	± 1.50E+01	**2.09E+01**
TFB 06	March	Tomato	2.04E+00	± 1.09E+01	**1.85E+01**	-2.54E+00	± 1.02E+01	**1.61E+01**
		Sorrel	3.94E+00	± 1.23E+01	**2.18E+01**	3.11E+00	± 1.30E+01	**2.27E+01**
	September	Tomato	1.83E+00	± 1.26E+01	**2.08E+01**	-6.09E+00	± 1.16E+01	**1.78E+01**
		Sorrel	5.21E+00	± 1.37E+01	**2.34E+01**	1.23E+01	± 1.25E+01	**2.29E+01**

Attachment 3: Cross Check Intercomparison Program

Participation in cross check intercomparison studies is mandatory for laboratories performing analyses of REMP samples satisfying the requirements in the Offsite Site Dose Calculation Manual. Intercomparison studies provide a consistent and effective means to evaluate the accuracy and precision of analyses performed by a laboratory. Study results should fall within specified control limits and results that fall outside the control limits are investigated and corrected.

1.0 Teledyne Brown Engineering Inc. (TBE) participated in the following proficiency testing studies provided by Eckert Ziegler Analytics, DOE's Mixed Analyte Performance Evaluation Program (MAPEP), and/or Environmental Resource Associates (ERA), in 2023. The Laboratory's intercomparison program results for 2023 are summarized below.

For the TBE laboratory, 124 out of 131 analyses performed met the specified acceptance criteria. Seven analyses did not meet the specified acceptance criteria and were addressed through the TBE Corrective Action Program. A summary is found below:

I. The MAPEP February 2023 Soil Ni-63 result was evaluated as *Not Acceptable*. TBE's reported value was 294 Bq/kg and the known result was 1130 Bq/kg (range 791 - 1469). The sample was reprepped by a different (senior) lab technician with results of 1120 and 1250 Bq. It was determined that there was a difference between the two techs during the sample prep (technique) and the procedure was revised to reflect these differences including using a specific aliquot amount. SONGS does not analyze for Ni-63, therefore no SONGS samples were affected.

II. The MAPEP February 2023 vegetation Sr-90 result was evaluated as *Not Acceptable*. The reported value was 0.05 Bq (not detected) and the known result was a "false positive". This was considered to be a statistical failure because TBE's reported result with 3 times the uncertainty resulted in a slightly positive net result (0.03194 Bq/kg). The reported result was significantly below TBE's average detection limit for vegetation samples. SONGS does not analyze for Sr-90, therefore no SONGS samples were affected.

III. The ERA RAD April 2023 water Ba-133 result was evaluated as *Not Acceptable*. The reported value was 26.0 pCi/L and the known was 22.3 pCi/L (acceptance range 17.1 – 25.8 pCi/L) or 117% of the known (acceptable for TBE QC). The sample was used as the workgroup duplicate with a result of 25.4 pCi/L (114%). The sample had also been counted on a different detector with a result of 21.9 pCi/L (98%). This was TBE's first failure for Ba-133. There were no SONGS samples included in this workgroup for Gamma analysis, therefore no SONGS samples were affected.

IV. The MAPEP August 2023 soil Fe-55 result was evaluated as *Not Acceptable*. The reported value was 346 Bq/kg and the known result was 1280 Bq/kg (acceptance range of 896-1664 Bq/kg). This was TBE's initial evaluation for Fe-55 in soils. The result was received at the end of December and the root cause is under investigation. No client samples were associated with this cross-check. SONGS does not analyze for Fe-55, therefore no SONGS samples were affected.

V. The Analytics September 2023 milk Sr-90 result was evaluated as Not Acceptable. The reported result was 7.28 pCi/L and the known result was 12.8 (57% of known). This sample was used as the workgroup duplicate and the carrier yields for both samples were 107% and 75%. The LCS recovery for the workgroup was at 106%. The ERA drinking water Sr-90 cross check that was analyzed around the same time was acceptable at 108%. There was no explanation for the failure. This is the first low biased failure for Sr-90 milk. The last failure (high) was in 2016. SONGS does not sample milk, therefore no SONGS samples were affected.

VI. The ERA RAD October 2023 water Gross Alpha result was evaluated as *Not Acceptable*. The reported result was 53.2 pCi/L and the known result was 70.6 pCi/L (acceptable range of 54.0 – 87.2 pCi/L). The reported result was the workgroup duplicate and was within 75% of the known value (within TBE QC range). The original result was 63.3 pCi/L (90% of the known). Because the LCS result was biased slightly high, the decision was made to report the lower value. SONGS does not analyze for Gross Alpha, therefore no SONGS samples were affected.

VII. The ERA RAD October 2023 water I-131 result was evaluated as *Not Acceptable*. The reported value was 23.5 pCi/L and the known result was 29.7 pCi/L (acceptable range of 25.8 – 33.6) The reported result was 79% of the known, which is within the acceptable TBE QC range. The workgroup was reviewed with no anomalies found. The LCS/LCSD results were 109% and 86.1%. The sample was not processed in a timely manner as per the ERA instructions which stated to analyze shortly after receipt due to the short half-life. The laboratory and QA manager communicated expectation to analyze the samples in a timely manager. SONGS does not analyze for I-131, therefore no SONGS samples were affected.

The Interlaboratory Comparison Program provides evidence of "in control" counting systems and methods, and that the laboratories are producing accurate and reliable data.

Table 18: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value[a]	Ratio of TBE to Analytics Result	Evaluation [b]
March 2023	E13826	Milk	Sr-89	pCi/L	70.5	93.1	0.76	W
			Sr-90	pCi/L	12.3	14.7	0.84	A
	E13827	Milk	Ce-141	pCi/L	127	139	0.91	A
			Co-58	pCi/L	119	131	0.91	A
			Co-60	pCi/L	250	279	0.90	A
			Cr-51	pCi/L	246	302	0.82	A
			Cs-134	pCi/L	172	200	0.86	A
			Cs-137	pCi/L	125	140	0.89	A
			Fe-59	pCi/L	122	122	1.00	A
			I-131	pCi/L	70.2	82.0	0.86	A
			Mn-54	pCi/L	165	180	0.92	A
			Zn-65	pCi/L	306	306	1.00	A
	E13828	Charcoal	I-131	pCi	79.0	89.9	0.88	A
	E13829	AP	Ce-141	pCi	91.9	87.8	1.05	A
			Co-58	pCi	87.5	82.5	1.06	A
			Co-60	pCi	199	176	1.13	A
			Cr-51	pCi	218	191	1.14	A
			Cs-134	pCi	119	126	0.94	A
			Cs-137	pCi	92.4	88.7	1.04	A
			Fe-59	pCi	95.5	76.9	1.24	W
			Mn-54	pCi	120	113	1.06	A
			Zn-65	pCi	179	193	0.93	A
	E13830	Soil	Ce-141	pCi/g	0.224	0.220	1.02	A
			Co-58	pCi/g	0.193	0.207	0.93	A
			Co-60	pCi/g	0.406	0.441	0.92	A
			Cr-51	pCi/g	0.464	0.477	0.97	A
			Cs-134	pCi/g	0.334	0.316	1.06	A
			Cs-137	pCi/g	0.270	0.288	0.94	A
			Fe-59	pCi/g	0.183	0.193	0.95	A
			Mn-54	pCi/g	0.263	0.284	0.93	A
			Zn-65	pCi/g	0.475	0.484	0.98	A
	E13831	AP	Sr-89	pCi	99.4	90.8	1.09	A
			Sr-90	pCi	14.6	14.3	1.02	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table 18: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value[a]	Ratio of TBE to Analytics Result	Evaluation [b]
September 2023	E13832	Milk	Sr-89	pCi/L	49.8	71.4	0.70	W
			Sr-90	pCi/L	7.28	12.8	0.57	N(V)
	E13833	Milk	Ce-141	pCi/L	93.4	104	0.90	A
			Co-58	pCi/L	58.2	65.8	0.88	A
			Co-60	pCi/L	190	223	0.85	A
			Cr-51	pCi/L	207	205	1.01	A
			Cs-134	pCi/L	96.0	114	0.84	A
			Cs-137	pCi/L	121	141	0.86	A
			Fe-59	pCi/L	78.8	78.8	1.00	A
			I-131	pCi/L	27.9	37.4	0.75	W
			Mn-54	pCi/L	128	146	0.88	A
			Zn-65	pCi/L	185	203	0.91	A
	E13834	Charcoal	I-131	pCi	76.9	78.7	0.98	A
	E13835	AP	Ce-141	pCi	91.9	87.1	1.05	A
			Co-58	pCi	58.7	55.2	1.06	A
			Co-60	pCi	200	187	1.07	A
			Cr-51	pCi	192	172	1.12	A
			Cs-134	pCi	89.6	96	0.94	A
			Cs-137	pCi	109	119	0.92	A
			Fe-59	pCi	68.3	66.1	1.03	A
			Mn-54	pCi	129	123	1.05	A
			Zn-65	pCi	163	171	0.96	A
	E13836	Soil	Ce-141	pCi/g	0.228	0.184	1.24	W
			Co-58	pCi/g	0.103	0.116	0.89	A
			Co-60	pCi/g	0.364	0.394	0.92	A
			Cr-51	pCi/g	0.371	0.362	1.02	A
			Cs-134	pCi/g	0.176	0.202	0.87	A
			Cs-137	pCi/g	0.285	0.315	0.90	A
			Fe-59	pCi/g	0.140	0.139	1.00	A
			Mn-54	pCi/g	0.237	0.259	0.92	A
			Zn-65	pCi/g	0.349	0.359	0.97	A
	E13837	AP	Sr-89	pCi	74.6	80.2	0.93	A
			Sr-90	pCi	13.9	14.4	0.96	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(V) See item V. on page 48, above.

Table 19: DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value[a]	Ratio of TBE to Analytics Result	Evaluation [b]
February 2023	23-MaS48	Soil	Ni-63	Bq/kg	294	1130	791 - 1469	N(I)
	23-MaSU48	Urine	Cs-134	Bq/L	9.92	10	6.7 - 12.4	A
			Cs-137	Bq/L	0.0994		(1)	A
			Co-57	Bq/L	9.35	8.67	6.07 - 11.27	A
			Co-60	Bq/L	9.03	8.13	5.69 - 10.57	A
			Mn-54	Bq/L	11.80	10.0	7.0 - 13.0	A
			U-234	Bq/L	0.01		Not spiked	
			U-238	Bq/L	0.01		Not spiked	
			Zn-65	Bq/L	10.60	9.29	6.50 - 12.08	A
	23-MaW48	Water	Ni-63	Bq/L	23.1	27.3	19.1 - 35.5	A
	23-RdV48	Vegetation	Cs-134	Bq/sample	5.6	7.6	5.32 - 9.88	W
			Cs-137	Bq/sample	0.03		*(1)*	A
			Co-57	Bq/sample	5.9	6.9	4.85 - 9.01	A
			Co-60	Bq/sample	5.00	6.51	4.56 - 8.46	W
			Mn-54	Bq/sample	6.08	8.03	5.62 - 10.44	W
			Sr-90	Bq/sample	0.05		*(1)*	N(II)
			Zn-65	Bq/sample	5.49	7.43	*5.20 - 9.66*	W
August 2023	23-MaS49	Soil	Fe-55	Bq/kg	346	1280	896 - 1664	N(IV)
			Ni-63	Bq/kg	1260	1370	959 - 1781	A
	23-MaW49	Water	Ni-63	Bq/L	1.0	1	*(2)*	A
	23-RdV49	Vegetation	Cs-134	Bq/sample	3.860	4.98	3.49 - 6.47	W
			Cs-137	Bq/sample	0.027		*(1)*	A
			Co-57	Bq/sample	3.88	4.24	2.97 - 5.51	A
			Co-60	Bq/sample	2.37	2.79	1.95 - 3.63	A
			Mn-54	Bq/sample	2.04	2.56	1.79 - 3.33	W
			Sr-90	Bq/sample	0.96	1.17	0.82 - 1.52	A
			Zn-65	Bq/sample	-0.514		*(1)*	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements
made during standard preparation
(b) DOE/MAPEP evaluation:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30
(1) False positive test
(2) Sensitivity evaluation
(I) See item I. on page 47, above.
(II) See item II. on page 47, above.
(IV) See item IV. on page 48, above.

Table 20: ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value[a]	Ratio of TBE to Analytics Result	Evaluation [b]
March 2023	MRAD-38	Water	Am-241	pCi/L	28.1	32.1	22.0 - 41.0	A
			Fe-55	pCi/L	1180	1380	811 - 2010	A
			Pu-238	pCi/L	65.6	70.7	42.5 - 91.6	A
			Pu-239	pCi/L	82.9	92.4	57.2 - 114	A
		Soil	Sr-90	pCi/kg	2630	2580	803 - 4020	A
		AP	GR-A	pCi/filter	69.6	76.8	40.1 - 127	A
			GR-B	pCi/filter	36.8	32.8	19.9 - 49.6	A
	RAD-133	Water	Ba-133	pCi/L	26.0	22.3	17.1 - 25.8	N(III)
			Cs-134	pCi/L	72.1	77.6	63.4 - 85.4	A
			Cs-137	pCi/L	62.1	63.1	56.8 - 72.2	A
			Co-60	pCi/L	32.6	30.3	26.7 - 36.1	A
			Zn-65	pCi/L	253	242	218 - 283	A
			GR-A	pCi/L	34.2	29.2	14.9 - 38.2	A
			GR-B	pCi/L	64.3	60.7	41.8 - 67.4	A
			U-Nat	pCi/L	61.75	62.7	51.2 - 69.0	A
			H-3	pCi/L	13,300	12700	11,100 - 14,000	A
			Sr-89	pCi/L	67.0	61.1	49.2 - 69.0	A
			Sr-90	pCi/L	36.5	36.0	26.4 - 41.5	A
			I-131	pCi/L	24.3	28.7	23.9 - 33.6	A
	MRAD-39	Water	Am-241	pCi/L	54.0	71.0	48.7 - 90.8	A
			Fe-55	pCi/L	2430	2630	1550 - 3830	A
			Pu-238	pCi/L	172	177	106 - 229	A
			Pu-239	pCi/L	171	182	113 - 224	A
		Soil	Sr-90	pCi/kg	9580	6800	2120 - 10,600	A
		AP	GR-A	pCi/filter	82.2	79.8	41.7 - 131	A
			GR-B	pCi/filter	54.3	42.6	25.8 - 64.4	A
	RAD-135	Water	Ba-133	pCi/L	86.3	92.2	73.8 - 111	A
			Cs-134	pCi/L	38.4	41.2	27.9 - 54.5	A
			Cs-137	pCi/L	194	199	161 - 237	A
			Co-60	pCi/L	49.5	47.8	33.8 - 61.8	A
			Zn-65	pCi/L	59.7	57.0	23.7 - 90.3	A
			GR-A	pCi/L	53.2	70.6	54.0 - 87.2	N(VI)
			GR-B	pCi/L	46.9	42.2	30.5 - 53.9	A
			U-Nat	pCi/L	51.26	51.7	45.9- 57.5	A
			H-3	pCi/L	20,100	22,900	19,700 - 26,100	A
			Sr-89	pCi/L	51.1	38.2	25.2 - 51.2	A
			Sr-90	pCi/L	31.7	35.7	30.3 - 41.1	A
			I-131	pCi/L	23.5	29.7	25.8 - 33.6	N(VII)

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.
(b) ERA evaluation:
A = Acceptable - Reported value falls within the Acceptance Limits
N = Not Acceptable - Reported value falls outside of the Acceptance Limits
(III) See item III. on page 47, above.
(VI) See item VI. on page 48, above.
(VII) See item VII. on page 48, above.

2.0 In accordance with the U.S. Nuclear Regulatory Commission requirements, GEL Laboratories, LLC (GEL) participates in an Interlaboratory Comparison Program (ICP). This satisfies the requirements of both Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979 and Regulatory Guide 4.15, Revision 2, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) - Effluent Streams and the Environment", July, 2007. Both guides indicate the ICP is to be conducted with the U.S. Environmental Protection Agency (EPA) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and the ICP should include all sample medium/radionuclide combinations that are offered by the EPA and included in the REMP.

Throughout the year, GEL receives performance evaluation samples from the U.S. Department of Energy Mixed Analyte Performance Evaluation Program (MAPEP), ERA's Mixed Rad (MRAD) Proficiency Testing Program, ERA's RadChem Proficiency Testing Program (RAD), and ERA's Quik Response Proficiency Testing Program. Each provider has a documented Quality Assurance (QA) program and the capability to prepare Quality Control (QC) materials traceable to the National Institute of Standards and Technology. The ICP is a third-party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. The providers supply the crosscheck samples to GEL. Upon receipt, the laboratory performs the analyses in a normal manner. Laboratory results are given to each provider for evaluation.

GEL analyzed samples from SONGS during the First Quarter 2023. A summary of GEL's results received during First Quarter 2023 is provided in Table 21: GEL Quarterly Interlaboratory Comparison for the required sample matrix types and isotopic distribution. GEL's results met acceptance criteria for 20 of 21 reported analytes, investigations and/or corrective actions were necessary for one isotope.

RAD 132 Zn-65 was evaluated as *Not Acceptable*. Upon receipt of the PT report, an investigation was initiated by the Quality Department and a Corrective Action (CARR) team assembled. The team consisted of representatives from the affected laboratories. The sample preparation and analytical processes were reviewed. This included review of reagents and standards used in the sample preparation steps, calibration records, process control samples, and interviews with the analysts. Additionally, all internal procedures and policies were performed as required. These failures were tracked through GEL's internal non-conformance system.

Root Cause(s): Gamma: The laboratory reviewed the data of the original analysis, and no anomalies were noted. A review of the sample preparation processes, and data set did not reveal any errors or possible contributors to the high bias. All other analyses reported by this method were within the acceptance limits concluding that the unacceptable result is due to an unknown error. The laboratory will continue to investigate all steps of the analytical process including the standardization of the carrier reagent as a possible contributor to the low bias.

Table 21: GEL Quarterly Interlaboratory Comparison

PT Provider	Quarter / Year	Report Closing / Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Barium-133	32.8	30.5	24.2 - 34.6	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Barium-133	32.8	30.5	24.2 - 34.6	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Cesium-134	28.3	28.2	21.9 - 31.1	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Cesium-137	202	190	171 - 211	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Cobalt-60	120	110	99.0 - 123	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Zinc-65	126	105	94.5 - 125	Not Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Gross Alpha	27.7	30	15.3 - 39.2	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Gross Alpha	26.4	30	15.3 - 39.2	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Gross Alpha	26.4	30	15.3 - 39.2	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Gross Beta	13.6	16.5	9.25 - 24.8	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Gross Beta	13.6	16.5	9.25 - 24.8	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Radium-228	5.97	7.17	4.51 - 9.20	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Radium-228	5.4	7.17	4.51 - 9.20	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Uranium (Nat)	6.41	7.36	5.64 - 8.60	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	µg/L	Uranium (mass)	11.18	10.7	8.18 - 12.5	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Tritium	20600	21600	18900 - 23800	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Strontium-89	59.8	53.5	42.5 - 61.1	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Strontium-89	57.4	53.5	42.5 - 61.1	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Strontium-90	26.2	28.8	20.9 - 33.5	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Strontium-90	26.9	28.8	20.9 - 33.5	Acceptable
ERA	1st/2023	02/27/23	RAD 132	Water	pCi/L	Iodine-131	28.3	27	22.4 - 31.8	Acceptable

3.0 Stanford Dosimetry performs the environmental TLD analyses noted in this report. Stanford Dosimetry performs the requested analyses under its Quality Assurance Program which meets the requirement of 10 CFR 50, Appendix B, ASME NQA-1, Regulatory Guide 4.15 Revision 1 and Regulatory Guide 4.13 Revision 2 (Environmental Dosimetry – Performance Standards, Testing and Data Analysis).

Results of performance tests conducted are summarized and discussed in the following sections. Summaries of the performance tests for the reporting period are given below.

Table 22: Percentage of Individual Dosimeters that passed EDC Internal Criteria provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons only. During this period 100% (72/72) of the individual dosimeters, evaluated against these criteria, met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision.

Table 22: Percentage of Individual Dosimeters that passed EDC Internal Criteria January – December 2023[1], [2]

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

[1]This table summarizes results of tests conducted by EDC.
[2]Environmental dosimeter results are free in air.

Table 23: Mean Dosimeter Analyses (N=6) January – December 2023[1], [2] provides the bias and standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall,100% (12/12) of the dosimeter sets, evaluated against the internal tolerance performance criteria, met these criteria.

Table 23: Mean Dosimeter Analyses (N=6) January – December 2023[1], [2]

Process Date	Exposure Level	Mean Bias %	Standard Deviation %	Tolerance Limit +/-15%
04/25/2023	107	0.8	1.1	Pass
05/02/2023	33	5.4	1.6	Pass
05/15/2023	56	5.1	1.3	Pass
07/23/2023	52	0.0	0.7	Pass
07/26/2023	33	2.8	2.6	Pass
08/14/2023	76	-3.0	1.5	Pass
11/04/2023	44	1.7	0.8	Pass
11/13/2023	64	-1.9	2.4	Pass
12/08/2023	83	2.7	1.0	Pass
01/30/2024	28	-0.7	1.6	Pass
02/04/2024	123	-2.7	1.6	Pass
02/08/2024	97	-1.1	1.2	Pass

[1]This table summarizes results of tests conducted by EDC for TLDs issued in 2023.
[2]Environmental dosimeter results are free in air.

Table 24: Summary of Independent Dosimeter Testing January – December 2023[1],[2] presents the independent blind spike results for dosimeters processed during this annual period. All results passed the performance acceptance criterion.

Table 24: Summary of Independent Dosimeter Testing January – December 2023[1],[2]

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2023	Millstone	1.9	1.1	Pass
2nd Qtr. 2023	Seabrook	0.6	1.3	Pass
3rd Qtr. 2023	Millstone	-3.8	1.4	Pass
3rd Qtr. 2023	SONGS	-14.8	1.5	Pass
4th Qtr. 2023	Millstone	7.7	5.3	Pass
4th Qtr. 2023	PSEG(PNNL) 48mR	2.9	2.9	Pass
4th Qtr. 2023	PSEG(PNNL) 95mR	0.0	0.7	Pass
4th Qtr. 2023	PSEG(PNNL) 143mR	1.2	1.3	Pass
4th Qtr. 2023	PSEG(PNNL) 191mR	2.2	0.6	Pass
4th Qtr. 2023	Seabrook	2.6	1.6	Pass

[1]Performance criteria are +/- 15%.
[2]Blind spike irradiations using Cs-137

Attachment 4: Environmental Direct Radiation Dosimetry Results

Table 25: Environmental Direct Radiation Dosimetry Results

Monitoring Location	Quarterly Baseline, B_Q (mrem)	B_Q + MDD_Q (mrem)	Normalized Quarterly Monitoring Data, M_Q (mrem)				Quarterly Facility Dose, $F_Q=M_Q-B_Q$ (mrem, or "ND" if $F_Q \leq MDD_Q$)				Annual Baseline, B_A (mrem)	B_A + MDD_A (mrem)	Annual Monitoring Data, M_A (mrem)	Annual Facility Dose, $F_A=M_A-B_A$ (mrem, or "ND" if $F_A \leq MDD_A$)	Annual** Dose to Member of Public[e] (mrem)
			1	2	3	4	1	2	3	4					
1	18.4	23.4	16.3	17.8	18.8	19.1	ND	ND	ND	ND	73.6	83.6	71.9	ND	ND
2	19.6	24.6	16.3	19.5	19.6	18.1	ND	ND	ND	ND	78.2	88.2	73.5	ND	ND
3	17.2	22.2	14.0	17.2	17.6	17.6	ND	ND	ND	ND	69.0	79.0	66.4	ND	ND
4	19.0	24.0	15.2	18.7	19.2	19.3	ND	ND	ND	ND	76.1	86.1	72.4	ND	ND
6	12.0	17.0	9.3	11.6	11.9	11.1	ND	ND	ND	ND	47.9	57.9	44.0	ND	ND
8	16.2	21.2	13.9	14.8	16.4	15.4	ND	ND	ND	ND	64.8	74.8	60.5	ND	ND
10	17.2	22.2	14.7	16.1	16.6	17.8	ND	ND	ND	ND	69.0	79.0	65.2	ND	ND
11*	15.8	20.8	14.0	16.0	16.0	16.9	ND	ND	ND	ND	63.1	73.1	63.0	ND	ND
12*,a,b	15.8	20.8	15.3	17.4	18.5	18.8	ND	ND	ND	ND	63.1	73.1	70.1	ND	ND
15*,a	15.8	20.8	16.5	16.9	17.2	17.1	ND	ND	ND	ND	63.1	73.1	67.6	ND	ND
16*,a,b	15.8	20.8	15.3	15.8	17.8	17.2	ND	ND	ND	ND	63.1	73.1	66.1	ND	ND
19	18.7	23.7	16.1	18.1	18.4	19.4	ND	ND	ND	ND	74.8	84.8	72.1	ND	ND
22	18.8	23.8	15.2	19.6	19.1	19.3	ND	ND	ND	ND	75.3	85.3	73.2	ND	ND
34	17.0	22.0	15.6	17.3	18.2	17.6	ND	ND	ND	ND	68.1	78.1	68.7	ND	ND
35	17.8	22.8	13.5	15.6	15.6	15.2	ND	ND	ND	ND	71.1	81.1	59.9	ND	ND
36	20.5	25.5	16.7	20.4	19.9	19.9	ND	ND	ND	ND	82.0	92.0	77.0	ND	ND
40	18.0	23.0	15.7	17.5	18.0	17.5	ND	ND	ND	ND	71.9	81.9	68.8	ND	ND
41	15.8	20.8	13.4	16.6	16.6	16.3	ND	ND	ND	ND	63.1	73.1	62.9	ND	ND
46	12.8	17.8	12.0	13.9	13.3	12.9	ND	ND	ND	ND	51.3	61.3	52.2	ND	ND
50	17.4	22.4	15.4	16.3	17.4	16.9	ND	ND	ND	ND	69.8	79.8	66.1	ND	ND
55*,a,c	15.8	20.8	19.0	21.3	21.1	21.7	ND	5.6	5.3	5.9	63.1	73.1	83.1	20	ND
56*,a	15.8	20.8	16.9	18.5	17.6	17.8	ND	ND	ND	ND	63.1	73.1	70.7	ND	ND

Monitoring Location	Quarterly Baseline, B_Q (mrem)	B_Q + MDD_Q (mrem)	Normalized Quarterly Monitoring Data, M_Q (mrem)				Quarterly Facility Dose, $F_Q=M_Q-B_Q$ (mrem, or "ND" if $F_Q \leq MDD_Q$)				Annual Baseline, B_A (mrem)	B_A + MDD_A (mrem)	Annual Monitoring Data, M_A (mrem)	Annual Facility Dose, $F_A=M_A-B_A$ (mrem, or "ND" if $F_A \leq MDD_A$)	Annual** Dose to Member of Public[e] (mrem)
			1	2	3	4	1	2	3	4					
57*,[a]	15.8	20.8	**16.3**	**17.3**	**16.6**	**17.7**	ND	ND	ND	ND	63.1	73.1	**67.8**	ND	ND
58*,[a]	15.8	20.8	**16.8**	**17.5**	**17.3**	**17.4**	ND	ND	ND	ND	63.1	73.1	**68.9**	ND	ND
61	16.2	21.2	**13.7**	**14.7**	**15.2**	**16.4**	ND	ND	ND	ND	64.8	74.8	**60.0**	ND	ND
62	13.9	18.9	**10.6**	**13.3**	**13.4**	**13.2**	ND	ND	ND	ND	55.5	65.5	**50.5**	ND	ND
63	14.6	19.6	**11.7**	**14.2**	**14.6**	**14.3**	ND	ND	ND	ND	58.4	68.4	**54.8**	ND	ND
64	15.8	20.8	**13.1**	**16.1**	**15.8**	**15.8**	ND	ND	ND	ND	63.1	73.1	**60.9**	ND	ND
65	14.1	19.1	**11.3**	**14.1**	**13.9**	**13.8**	ND	ND	ND	ND	56.3	66.3	**53.0**	ND	ND
66	14.7	19.7	**12.6**	**14.1**	**14.4**	**14.9**	ND	ND	ND	ND	58.9	68.9	**56.1**	ND	ND
68	15.8	20.8	**15.2**	**17.5**	**17.0**	**17.0**	ND	ND	ND	ND	63.1	73.1	**66.7**	ND	ND
73*,[b,d]	15.8	20.8	**17.5**	**18.6**	**19.1**	**18.7**	ND	ND	ND	ND	63.1	73.1	**73.9**	**10.9**	ND
75	16.7	21.7	**13.5**	**16.1**	**15.6**	**16.0**	ND	ND	ND	ND	66.9	76.9	**61.2**	ND	ND
76	18.2	23.2	**16.4**	**18.0**	**19.6**	**17.8**	ND	ND	ND	ND	72.7	82.7	**71.8**	ND	ND

Highlighted results include any indicated neutron dose, estimated using a neutron signal (Rn) conversion factor of 10.5 Rn/rem.

* Indicates that the station is within the site boundary. The baseline has been estimated to be 15.8 mrem per standard 91-day quarter within the site boundary.

** Dose to members of the public is based on estimated annual occupancy times.

a The dose to members of the public is based on a beach annual occupancy time of 300 hours per year near the SONGS sea wall.

b This location is not accessible to members of the general public.

c A neutron dosimeter was collocated with REMP TLD 55 and selected ISFSI TLDs. The estimated neutron dose was added to the gamma dose.

d The dose to members of the public is based on an annual occupancy time of 8 hours per year for transit along road near TLD 73.

MDD_Q = Quarterly Minimum Differential Dose = 5 mrem

MDD_A = Annual Minimum Differential Dose = 10 mrem

ND = Not Detected, where $M_Q \leq (B_Q+MDD_Q)$ or $M_A \leq (B_A+MDD_A)$

Attachment 5: ISFSI TLD Data

The TLD data presented below is for ISFSI TLD locations. These locations are not accessible to the public and do not represent a dose pathway for Members of the Public that are outside of the Site Boundary. The data is presented for trending purposes, as discussed in 11.2 Independent Spent Fuel Storage Installation (ISFSI) Monitoring Program

Table 26: ISFSI TLD Data

Monitoring Location[a]	Quarterly Baseline, B^Q (mrem)	B_Q + MDD_Q (mrem)	Normalized Quarterly Monitoring Data, M_Q (mrem)				Quarterly Facility Dose, $F_Q=M_Q-B_Q$ (mrem, or "ND" if $F_Q \leq MDD_Q$)				Annual Baseline, B_A (mrem)	B_A + MDD_A (mrem)	Annual Monitoring Data, M_A (mrem)	Annual Facility Dose, $F_A=M_A-B_A$ (mrem, or "ND" if $F_A \leq MDD_A$)	Annual[a] Dose to Member of Public[b] (mrem)
			1	2	3	4	1	2	3	4					
301	15.8	20.8	17.7	18	18.6	18.8	ND	ND	ND	ND	63.1	73.1	73	ND	-
302	15.8	20.8	21.1	20.9	22.3	22.1	5.3	5.1	6.6	6.3	63.1	73.1	86.4	23.3	-
303	15.8	20.8	20.9	21.4	21.7	21.9	5.2	5.6	5.9	6.1	63.1	73.1	85.9	22.8	-
304	15.8	20.8	19.7	20.3	21.1	20.9	ND	ND	5.3	5.2	63.1	73.1	82	18.9	-
307	15.8	20.8	18.1	17.8	18.8	18.9	ND	ND	ND	ND	63.1	73.1	73.7	10.6	-
308	15.8	20.8	16.6	17.7	18.3	18.9	ND	ND	ND	ND	63.1	73.1	71.5	ND	-
309	15.8	20.8	18	18.8	19.8	19.7	ND	ND	ND	ND	63.1	73.1	76.2	13.2	-
310	15.8	20.8	19.1	19.9	20.6	20.9	ND	ND	ND	5.1	63.1	73.1	80.4	17.3	-
311[c]	15.8	20.8	19.5	18.5	21.3	20.2	ND	ND	5.5	ND	63.1	73.1	79.4	16.4	-
312	15.8	20.8	15.2	14.7	16.1	15.9	ND	ND	ND	ND	63.1	73.1	62	ND	-
314	15.8	20.8	19.7	19	19.4	19.9	ND	ND	ND	ND	63.1	73.1	78.1	15	-
315	15.8	20.8	18.2	18.7	19	18.6	ND	ND	ND	ND	63.1	73.1	74.6	11.5	-
316	15.8	20.8	16	17.9	16.1	16.5	ND	ND	ND	ND	63.1	73.1	66.6	ND	-
317	15.8	20.8	16.3	16.6	16.8	17.9	ND	ND	ND	ND	63.1	73.1	67.6	ND	-
318	15.8	20.8	18.5	18.7	19.9	20.3	ND	ND	ND	ND	63.1	73.1	77.3	14.2	-
319	15.8	20.8	18.1	18.9	19.9	20.1	ND	ND	ND	ND	63.1	73.1	77.1	14	-
320	15.8	20.8	18.1	18.3	19.7	20.6	ND	ND	ND	ND	63.1	73.1	76.7	13.6	-
321	15.8	20.8	17.9	18.6	19.4	19.8	ND	ND	ND	ND	63.1	73.1	75.7	12.6	-
326[c]	15.8	20.8	20.5	23.4	18.2	23.9	ND	7.7	ND	8.2	63.1	73.1	86.1	23	-

Monitoring Location[a]	Quarterly Baseline, B^Q (mrem)	B_Q + MDD_Q (mrem)	Normalized Quarterly Monitoring Data, M_Q (mrem)				Quarterly Facility Dose, $F_Q=M_Q-B_Q$ (mrem, or "ND" if $F_Q \leq MDD_Q$)				Annual Baseline, B_A (mrem)	B_A + MDD_A (mrem)	Annual Monitoring Data, M_A (mrem)	Annual Facility Dose, $F_A=M_A-B_A$ (mrem, or "ND" if $F_A \leq MDD_A$)	Annual[a] Dose to Member of Public[b] (mrem)
			1	2	3	4	1	2	3	4					
339[c]	15.8	20.8	22.1	23.6	24.2	25.4	6.3	7.9	8.4	9.7	63.1	73.1	95.4	32.3	-
340[c]	15.8	20.8	18.8	21.2	21.6	21.8	ND	5.4	5.8	6.1	63.1	73.1	83.4	20.3	-
341[c]	15.8	20.8	20.1	21.9	23.2	24.5	ND	6.2	7.4	8.7	63.1	73.1	89.7	26.6	-
342[c]	15.8	20.8	24.3	24.6	25.4	25.3	8.6	8.9	9.7	9.5	63.1	73.1	99.7	36.6	-
343[c]	15.8	20.8	20.8	21.1	22.3	21.4	ND	5.4	6.5	5.7	63.1	73.1	85.6	22.5	-
344[c]	15.8	20.8	19.6	19.1	20.4	19.9	ND	ND	ND	ND	63.1	73.1	79	15.9	-

Highlighted results include any indicated neutron dose, estimated using a neutron signal (Rn) conversion factor of 10.5 Rn/rem.

a ISFSI TLDs (SCE-301 through SCE-344) are placed around the ISFSI pad, and not in locations accessible to the general public.

b Public dose is not applicable for those TLDs that are not accessible to the general public.

c Station has a collocated neutron dosimeter package. The neutron dose is estimated using a neutron signal conversion factor measured at a similar ISFSI installation.

Attachment 6: CDPH Collocated samples

The CDPH participates in a comprehensive radiological environmental split sampling program in conjunction with SONGS. In 2023, the CDPH acquired split samples, collected by an independent third party, from the following SONGS media: non-migratory marine animals, kelp, ocean water gamma emitters, and ocean water tritium. The CDPH also conducts parallel air sampling and terrestrial direct radiation (TLD) measurement efforts at SONGS, (refer to Table 30: 2023 State of California Data from the CDPH TLD program (mR/Qtr.) for a discussion of the CDPH TLD data).

CDPH Air Sampling Gross Beta and quarterly gamma analysis results were similar to the SONGS results for the same media. As expected, both the CDPH Drinking Water and Radiation Laboratory (DWRL) and the SONGS contracted Teledyne and GEL found a gross beta signal above the detection limit. All labs detected naturally occurring Be-7 in the quarterly composite gamma particulate media samples. The labs did not detect anthropogenic radionuclides in the split samples with the exception of Cs-137 in non-migratory marine animals.

Since ocean water tritium and non-migratory marine animals have the potential for human consumption, their raw data are tabulated below. Sixteen split sample analyses for marine species were conducted. Analysis methodologies are different in that the SONGS contracted laboratory reported results based on sample wet weight, where the CDPH lab reported results based on sample dry weight. Low level Cs-137 was detected above MDC in some samples. The variability in the detection of positive results is due to the low activity of the samples, the differences in sample processing, the uncertainty of isotope detection and detection limits at low concentrations. (For a discussion on the presence of Cs-137 in fish, refer to Appendix B.) Note that CDPH sample results were not available for some fourth quarter samples at the time of publishing this report. Cells have been marked with a note where results were not available.

Radiological split sampling is performed by SONGS to demonstrate repeatability of the sample collection, preparation, and analysis process. Split sample analysis is performed for the evaluation of the precision and bias trends of the method of analysis without the added variables introduced by sampling. The 2023 CDPH data resulted in similar conclusions to the 2023 SONGS REMP data.

Table 27: CDPH and SONGS Split Sample Tritium in Ocean Water

SPLIT SAMPLE LOCATION		Sample Date	SONGS tritium data		CDPH tritium data	
			H-3 result ± 2 sigma (pCi/L)	MDC	H-3 result ± uncertainty (pCi/L)	MDC
A	Station Discharge Outfall - Unit 1	1/18/2023	56.4 ± 293	488	-94.7 ± 153	267
		2/16/2023	-67.2 ± 191	329	-92.6 ± 153	267
		3/20/2023	116 ± 260	423	-71.5 ± 136	238
		4/18/2023	-172 ± 244	432	-14.6 ± 142	244
		5/15/2023	-79.1 ± 249	425	-9.53 ± 129	223
		6/19/2023	-52 ± 108	182	112 ± 133	223
		7/17/2023	55.2 ± 258	415	57.4 ± 133	226
		8/16/2023	53.1 ± 300	487	-58.5 ± 159	276
		9/18/2023	0 ± 260	429	-65.3 ± 159	276
		10/17/2023	46.7 ± 281	456	17 ± 177	302
		11/15/2023	4.06 ± 258	424	-151 ± 150	263
		12/18/2023	-21.5 ± 285	473	-12.8 ± 151	260
B	Outfall - Unit 2	1/18/2023	78.6 ± 281	467	-23.7 ± 154	267
		2/16/2023	62.3 ± 205	337	-172 ± 150	267
		3/20/2023	83.2 ± 250	410	38.3 ± 139	238
		4/18/2023	-149 ± 252	440	-66.8 ± 140	244
		5/15/2023	-167 ± 234	416	120 ± 133	223
		6/19/2023	-7.95 ± 110	181	19.1 ± 130	223
		7/17/2023	-8.21 ± 262	433	85.1 ± 134	226
		8/16/2023	-106 ± 284	486	0 ± 160	276
		9/18/2023	10.5 ± 258	424	-67.5 ± 158	276
		10/17/2023	-160 ± 264	463	29.7 ± 177	302
		11/15/2023	104 ± 264	417	-93.5 ± 151	263
		12/18/2023	52.9 ± 276	446	-29.4 ± 151	260

Note that the EPA drinking water maximum permissible tritium activity is 20,000 pCi / liter. Both labs only detected naturally occurring radionuclides in ocean water. No plant-related radionuclides were reported above the MDC.

SPLIT SAMPLE LOCATION		Sample Date	SONGS tritium data		CDPH tritium data	
			H-3 result ± 2 sigma (pCi/L)	MDC	H-3 result ± uncertainty (pCi/L)	MDC
C	Outfall - Unit 3	1/18/2023	142 ± 289	475	-34.5 ± 154	267
		2/16/2023	148 ± 200	317	-62.4 ± 153	267
		3/20/2023	87.3 ± 257	421	-5.18 ± 138	238
		4/18/2023	-55.7 ± 255	429	-79.3 ± 140	244
		5/15/2023	-100 ± 249	428	-28.6 ± 129	223
		6/19/2023	18.7 ± 114	186	66.7 ± 132	223
		7/17/2023	2.08 ± 267	439	-17.8 ± 131	226
		8/16/2023	4.26 ± 297	489	-24.8 ± 160	276
		9/18/2023	109 ± 269	423	-151 ± 156	276
		10/17/2023	-91.1 ± 266	455	-27.6 ± 176	302
		11/15/2023	-26.3 ± 254	423	-57.9 ± 152	263
		12/18/2023	-87.3 ± 282	479	-172 ± 148	260
D	Newport Beach (Control)	1/18/2023	155 ± 290	477	-110 ± 152	267
		2/16/2023	116 ± 208	334	-8.61 ± 155	267
		3/20/2023	108 ± 249	405	52.8 ± 140	238
		4/18/2023	-60.1 ± 256	432	6.26 ± 142	244
		5/15/2023	-159 ± 239	422	41.9 ± 131	223
		6/19/2023	40.3 ± 112	181	26.7 ± 131	223
		7/17/2023	-72.8 ± 244	415	69.3 ± 133	226
		8/16/2023	-206 ± 275	486	-38.3 ± 159	276
		9/18/2023	-46.5 ± 253	426	-81 ± 158	276
		10/17/2023	29.9 ± 281	458	-2.12 ± 176	302
		11/15/2023	-76.1 ± 246	419	29.9 ± 154	263
		12/18/2023	-14.9 ± 282	468	-156 ± 148	260

Note that the EPA drinking water maximum permissible tritium activity is 20,000 pCi / liter. Both labs only detected naturally occurring radionuclides in ocean water. No plant-related radionuclides were reported above the MDC.

Table 28: Non-migratory Marine Animals analysis results – Potassium-40

SPLIT SAMPLE LOCATION		Sample Date	Sample Type	Dry/Wet Weight Ratio (g_{dry}/g_{wet})	Nuclide	SONGS data (wet weight)		CDPH data (dry weight)	
						Gamma result +/- 2 sigma (pCi/g)	MDC (pCi/g)	Gamma result +/- uncertainty (pCi/g)	MDC (pCi/g)
A	Outfall – Unit 1	4/11/2023	Fish	0.24	Potassium-40	4.11 ± 0.99	0.35	17.4 ± 0.9	0.3
		4/11/2023	Fish	0.239	Potassium-40	3.01 ± 0.92	0.47	16.2 ± 0.8	0.4
		10/3/2023	Mollusk	•	Potassium-40	1.84 ± 0.92	0.92	•	•
		10/24/2023	Fish	•	Potassium-40	3.44 ± 1.12	0.64	•	•
B	Outfall – Units 2 & 3	4/7/2023	Fish	0.238	Potassium-40	3.15 ± 0.80	0.45	17.0 ± 0.9	0.4
		4/7/2023	Crustacean	0.253	Potassium-40	2.69 ± 0.95	0.75	12.9 ± 0.8	0.5
		4/7/2023	Mollusk	0.192	Potassium-40	2.25 ± 0.73	0.41	11.2 ± 0.7	0.5
		10/3/2023	Fish	•	Potassium-40	2.93 ± 0.99	0.47	•	•
		10/3/2023	Crustacean	•	Potassium-40	3.16 ± 1.21	0.64	•	•
		10/3/2023	Mollusk	•	Potassium-40	2.81 ± 0.97	0.58	•	•
C	Laguna Beach – Control	4/17/2023	Crustacean	0.254	Potassium-40	2.38 ± 0.78	0.56	14.4 ± 0.7	0.4
		4/17/2023	Mollusk	0.199	Potassium-40	1.85 ± 0.73	0.53	12.5 ± 0.7	0.6
		4/17/2023	Fish	0.236	Potassium-40	4.21 ± 1.02	0.28	17.8 ± 0.9	0.4
		10/23/2023	Crustacean	•	Potassium-40	3.84 ± 1.20	0.60	•	•
		10/23/2023	Fish	•	Potassium-40	3.13 ± 1.02	0.27	•	•
		10/26/2023	Mollusk	•	Potassium-40	2.00 ± 0.81	0.34	•	•

Note: "•" indicates data was not available from CDPH at the time of publication.

Table 29: Non-migratory Marine Animals analysis results – Cesium-137

SPLIT SAMPLE LOCATION		Sample Date	Sample Type	Dry/Wet Weight Ratio (g_{dry}/g_{wet})	Nuclide	SONGS data (wet weight)		CDPH data (dry weight)	
						Gamma result +/- 2 sigma (pCi/g)	MDC (pCi/g)	Gamma result +/- uncertainty (pCi/g)	MDC (pCi/g)
A	Outfall – Unit 1	4/11/2023	Fish	0.24	Cesium-137	0.0085 ± 0.0360	0.0616	0.0277 ± 0.0122	0.0191
		4/11/2023	Fish	0.239	Cesium-137	0.0104 ± 0.0267	0.0473	0.0207 ± 0.0110	0.0173
		10/3/2023	Mollusk	•	Cesium-137	-0.0492 ± 0.0503	0.0826	•	•
		10/24/2023	Fish	•	Cesium-137	0.0095 ± 0.0408	0.0694	•	•
B	Outfall – Units 2 & 3	4/7/2023	Fish	0.238	Cesium-137	-0.0085 ± 0.0274	0.0429	0.0232 ± 0.0096	0.0146
		4/7/2023	Crustacean	0.253	Cesium-137	-0.0074 ± 0.0345	0.0527	0.0101 ± 0.0094	0.0163
		4/7/2023	Mollusk	0.192	Cesium-137	-0.0035 ± 0.0327	0.0530	0.0122 ± 0.0119	0.0206
		10/3/2023	Fish	•	Cesium-137	-0.0301 ± 0.0451	0.0631	•	•
		10/3/2023	Crustacean	•	Cesium-137	-0.0079 ± 0.0464	0.0741	•	•
		10/3/2023	Mollusk	•	Cesium-137	-0.0223 ± 0.0488	0.0755	•	•
C	Laguna Beach - Control	4/17/2023	Crustacean	0.254	Cesium-137	0.0093 ± 0.0450	0.0750	0.0179 ± 0.0083	0.0129
		4/17/2023	Mollusk	0.199	Cesium-137	-0.0033 ± 0.0305	0.0505	0.0027 ± 0.0064	0.0105
		4/17/2023	Fish	0.236	Cesium-137	0.0127 ± 0.0293	0.0520	0.0307 ± 0.0105	0.0161
		10/23/2023	Crustacean	•	Cesium-137	-0.0843 ± 0.0513	0.0654	•	•
		10/23/2023	Fish	•	Cesium-137	0.0164 ± 0.0480	0.0814	•	•
		10/26/2023	Mollusk	•	Cesium-137	-0.0276 ± 0.0371	0.0492	•	•

Note: "•" indicates data was not available from CDPH at the time of publication.

CDPH maintains a TLD program in the environs of SONGS. Per CDPH request, the 2023 exposure results from the CDPH dosimeters are reported in Table 30: 2023 State of California Data from the CDPH TLD program (mR/Qtr.), below. The Location Numbers refer to the current SONGS DecommissioningSolutions (SDS) alphanumeric location identifier and the current CDPH location number.

The CDPH TLD program does not conform to the same environmental dosimeter standard Reg. Guide 4.13 (ANSI N13.37-2014) used to generate direct radiation data for the SONGS REMP TLD program. The CDPH reports results in different units of measurement and is therefore not technically equivalent to the SONGS TLD data set. The different methodologies and the different units of measurement make it unsuitable to directly compare individual REMP data to the corresponding individual CDPH TLD data. However, the CDPH results are consistent with the conclusion that beyond the Site Boundary there is no detectable direct radiation that is attributable to SONGS.

Table 30: 2023 State of California Data from the CDPH TLD program (mR/Qtr.)

Location Numbers	Location Name	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
SDS-1, CDPH #2	City of San Clemente	32	20	27	32
SDS-22, CDPH #4	Former US Coast Guard Station – San Mateo Point	28	21	26	31
SDS-34, CDPH #5	San Onofre Elementary School	29	21	25	31
SDS-10, CDPH #6	Bluff (Adjacent to PIC #1) (San Onofre Surfing Beach)	26	20	25	29
SDS-16, CDPH #7	East Southeast Site Boundary	25	18	23	26
SDS-2, CDPH #8	Camp San Mateo	31	21	28	30
SDS-3, CDPH #9	Camp San Onofre	28	19	26	30
SDS-6, CDPH #10	Old El Camino Real (Old Highway 101) (ESE)	22	16	20	22
SDS-50, CDPH #13	Oceanside Fire Station	28	19	27	29