

2016 San Onofre Nuclear Generating Station Annual Radiological Environmental Operating Report



SOUTHERN CALIFORNIA
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This 2016 Annual Radiological Environmental Operating Report (AREOR) for the San Onofre Nuclear Generating Station (SONGS) fulfills the requirements of Technical Specifications (TS) Section §D6.9.1.3 of SONGS Unit 1 License DPR-13, Section §5.7.1.2 of the permanently defueled SONGS Units 2 and 3 Licenses NPF-10 and NPF-15, respectively, and the Independent Spent Fuel Storage Installation (ISFSI) facility. The 2016 AREOR covers the results of the environmental monitoring performed around SONGS during the time period January 1, 2016 through December 31, 2016.

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Acronyms

AREOR	Annual Radiological Environmental Operating Report
CAB	Controlled Area Boundary
CDPH	California Department of Public Health
CEAL	Contracted Environmental Analysis Laboratory
DOE	Department of Energy
EAB	Exclusion Area Boundary
EPA	U.S. Environmental Protection Agency
ISFSI	Independent Spent Fuel Storage Installation
LLD	Lower Limit of Detection
LUC	Land Use Census
MDC	Minimum Detectable Concentration
MDD	Minimum Differential Dose
ND	Not Detectable
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
QA	Quality Assurance
QC	Quality Control
SAB	Site Area Boundary
TLD	Thermoluminescent Dosimeter

Part 1 Executive Summary and Introduction

On June 12, 2013, Southern California Edison notified the Nuclear Regulatory Commission (NRC) that it had permanently ceased operation for both Units 2 and 3 on June 7, 2013. While all power operations have ceased, spent fuel remains stored on site. San Onofre Nuclear Generating Station (hereafter referred to as San Onofre or SONGS) continues to fulfill its regulatory commitment to monitor the environment and potential exposure pathways until termination of the license. The environmental monitoring data collected during the 2016 time frame demonstrates that San Onofre causes no adverse effect on the population or the environment. The hypothetical exposure for people living in the surrounding area remains at less than 1 mrem per year. The Radiological Environmental Monitoring Program (REMP) monitors known and predictable relationships between the current shutdown of the plant and the surrounding area. The REMP verifies that San Onofre has had no radiological impact to the surrounding environment or people and that it is within applicable state and federal regulations. An independent assessment of environmental impact is verified by the California Department of Public Health (CDPH) through the collection and analysis of samples, placement of dosimeters and collection of air samples. In addition, the site participates in onsite and offsite inspections. This report describes the REMP conducted at San Onofre and covers the period from January 1, 2016 through December 31, 2016. The REMP produces scientifically defensible data to ensure that the site meets the license commitments described in DPR-13, NPF-10, NPF-15, and the Offsite Dose Calculation Manual (ODCM).

The 2016 AREOR is divided into two parts. The first part addresses the executive summary, exposure pathways, site area description and purpose of the REMP. The second part addresses the regulatory requirements, methodology, type of samples obtained and associated locations, summary of sample results, quality control programs, comparison of operational and pre-operational data, deviations from the ODCM sampling requirements, land use census, and dosimeter results for the Independent Spent Fuel Storage Installation (ISFSI).

A. Exposure Pathways

Exposure pathways are the different routes by which people can potentially be exposed to radiation or radioactive materials. The pathways are divided into four general types, each described below:

- **AIRBORNE.** The airborne pathway represents the inhalation intake of airborne radioactive materials. This pathway is sampled in areas around SONGS by continuously drawing air through specialized filters and charcoal cartridges 24 hours a day, 7 days a week. Although both units at SONGS have been shut down since January 2012, these air samples continue to be collected on a weekly basis.
- **WATERBORNE.** The waterborne pathways include the exposure to radioactive materials accumulated in aquatic biota (fish, shellfish) and in shoreline sediments. These pathways are assessed through the collection of fish and shellfish samples in the environment around the plant. Sediment samples are also collected to evaluate any long term buildup in the environment.
- **INGESTION.** The ingestion pathway includes broadleaf vegetation, agricultural products, and food products. Atmospheric releases from the plant can deposit on these food products, representing an intake exposure pathway through the consumption of these food products. Samples of crops (e.g., tomato, lettuce, sorrel) are collected from the local area around the plant to evaluate any impact on this pathway.

- **DIRECT RADIATION.** The direct radiation pathway represents the external exposure from sources on the plant site and directly from any radioactive effluents released to the air or water. This direct environmental radiation dose is measured through the use of specialized dosimeters, referred to as thermoluminescent dosimeters (TLDs) that are placed around the plant site and in the local environment.

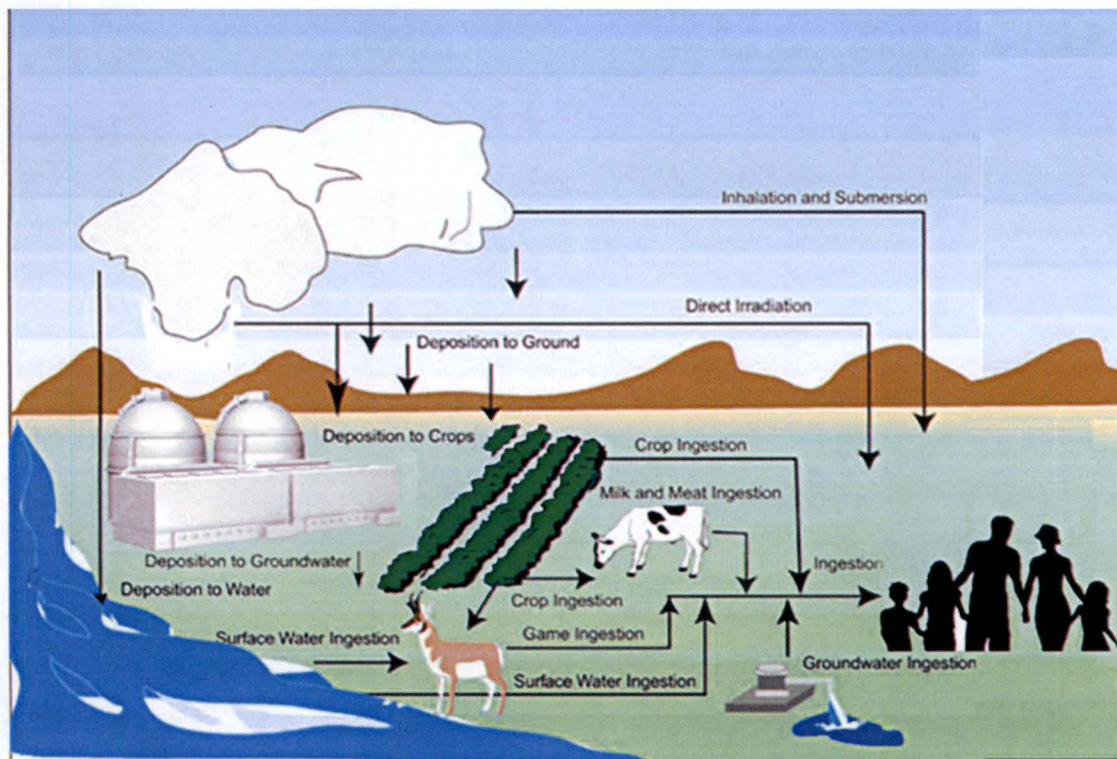


Figure 1 - Examples of Exposure Pathways

The environment within a 45 mile radius, as identified in the ODCM Section 5, is routinely monitored for radiation and radioactivity. Sampling locations have been selected based on meteorology, land use and water use data. Two types of sampling locations are used. The first type, representing control stations, is located in areas that are beyond the measurable influence of San Onofre, typically at distance of greater than 5 miles away. The sample results from these stations are considered representative of background levels with no potential for contribution from releases and sources at SONGS. The control stations also serve as indicators of radioactive sources other than SONGS, such as nuclear medicine applications. The second type, representing indicator stations, is used to measure any radiation contributed to the environment caused by San Onofre. Indicator stations are located close to San Onofre (less than 5 miles), reflecting the nearby areas to provide environmental measurements for releases from the plant. Indicator stations can be located either onsite or offsite.

The Radiological Environmental Monitoring Program (REMP) provides an assessment of the radiological impact of any releases of radioactive materials from SONGS to the nearby environment. The REMP includes the collection and analysis of samples for the primary exposure pathways. It includes a rigorous Quality Control and Quality Assurance Program and its performance is cross-checked through independent dosimeters placed by the State of California's Department of Public Health and well as on-site and off-site inspections.

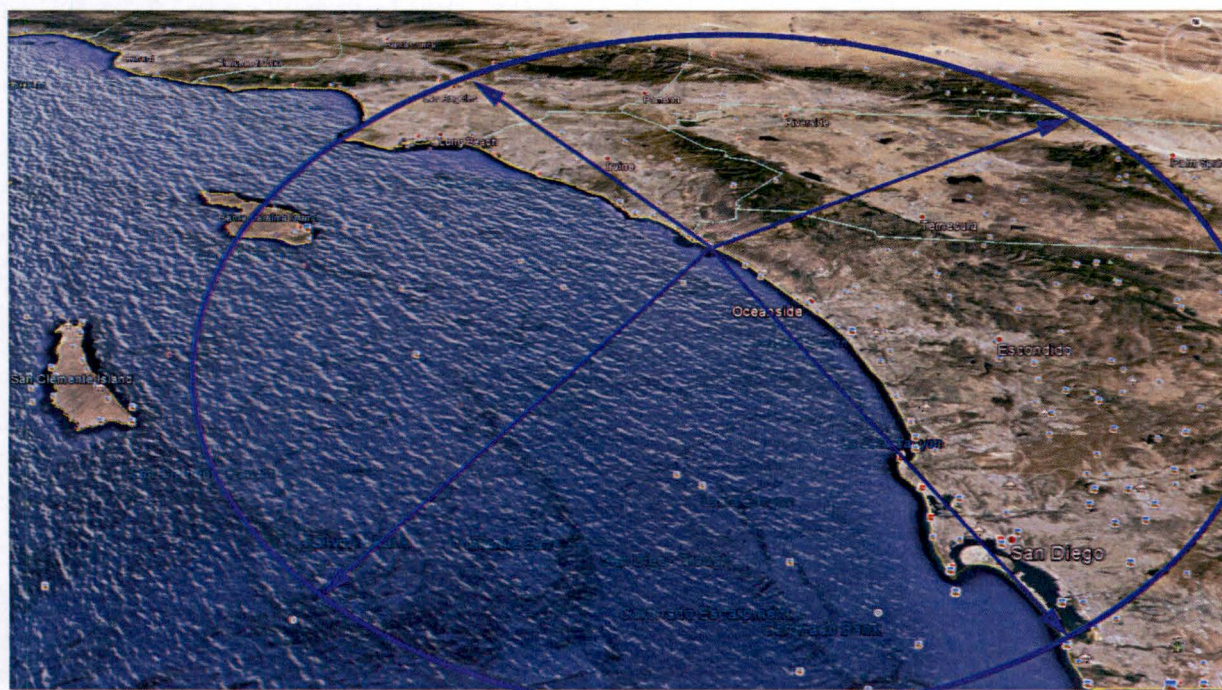


Figure 2 - SONGS 45 mile REMP Radius

There is a natural and manmade radiation background. This background is comprised of the natural terrestrial and cosmic radiation sources and the manmade component from past weapons testing fallout and routine medical applications. Prior to the construction of SONGS, environmental samples and measurements were collected and analyzed to determine the baseline natural radiation levels. The results from the indicator stations are compared to this pre-operational data as well as control samples to gauge if changes in any radiation levels can be attributed to SONGS or other causes such as natural variations in the environment or man made contributions.

The levels of radioactive materials in environmental samples collected around SONGS are for the most part undetectable, except for naturally occurring radionuclides such as K-40, natural uranium and natural thorium.

The NRC has established required reporting levels that represent thresholds above which an investigation is needed to evaluate and ensure compliance with radiation safety standards for the public. Licensed nuclear facilities must prepare a special report and increase their sampling if any measured level of radiation or radioactive material in an environmental sample is equal to or greater than the corresponding reporting level. No sample from SONGS has ever exceeded a small fraction of the reporting levels.

B. Site Area and Description



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. Over time there were three operating pressurized water reactors with a total rated capacity of 2664 net megawatts electrical.

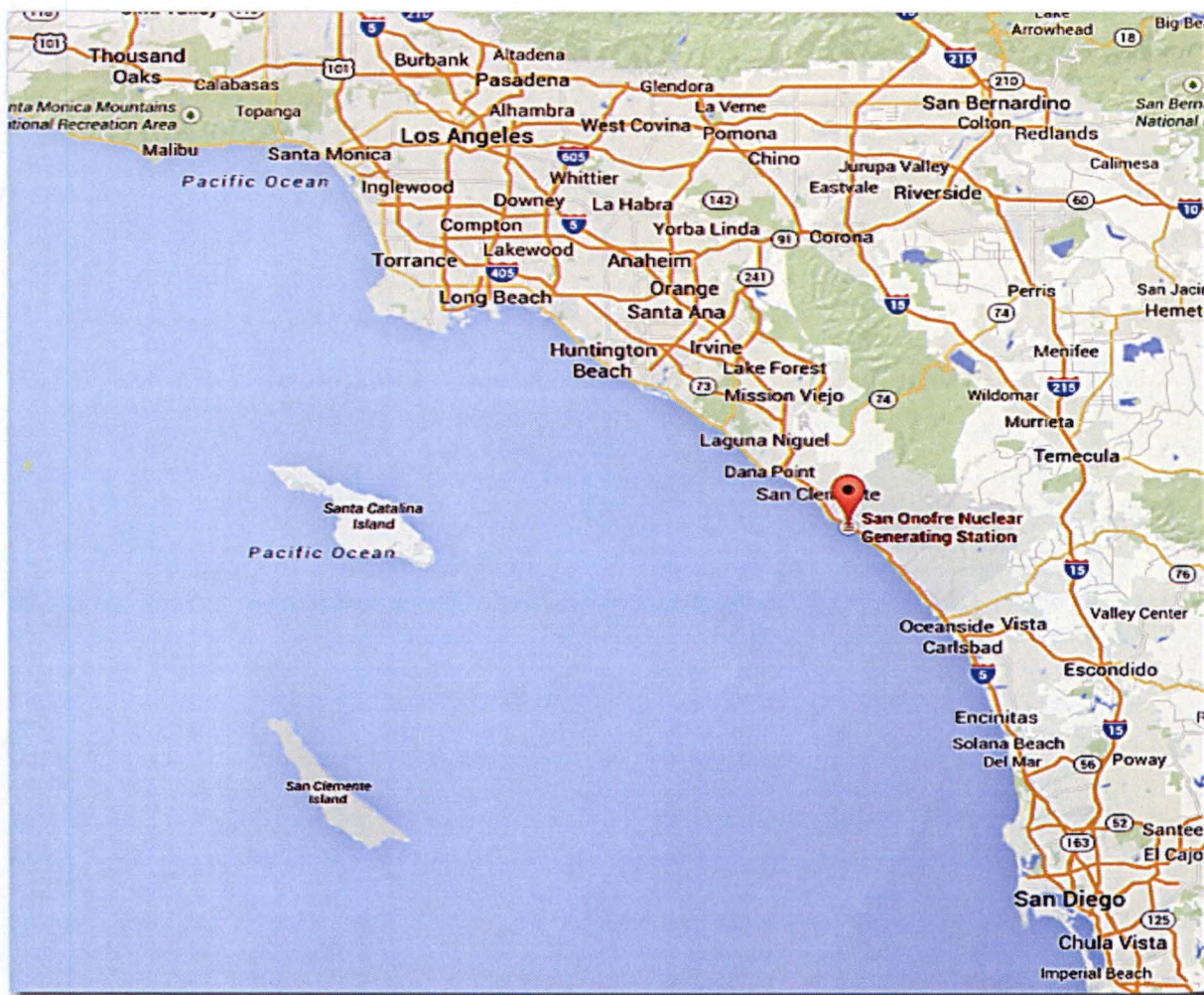


Figure 3 - SONGS Location

Unit 1, rated at 410 net megawatts electrical, was supplied by Westinghouse Electric Company. Unit 1 began commercial operation on January 1, 1968. The unit was permanently shut down on November 30, 1992 and has been decommissioned. By August 31, 2004, all fuel was transferred to the Independent Spent Fuel Storage Installation (ISFSI). By November 29, 2006, all remaining monitored effluent pathways were permanently removed from service or routed to Unit 2 discharge to the outfall. Unit 1 is owned by Southern California Edison (80%) and San Diego Gas and Electric (20%).

Unit 2 and Unit 3 were supplied by Combustion Engineering, Inc., with turbine generators supplied by G.E.C. Turbine Generators, Ltd., of England. The units began commercial operation on August 18, 1983, and April 1, 1984, respectively and were rated at 1127 net megawatts electrical each. The twin units are owned by Southern California Edison (78.21%), San Diego Gas and Electric (20%), and the City of Riverside (1.79%).

Effective December 29, 2006, the City of Anaheim had transferred its ownership interests in San Onofre Units 2 and 3 and the entitlement to the Units 2 and 3 output, to Southern California Edison Company, except that it retains its ownership interests in its spent nuclear fuel and Units 2 and 3's independent spent fuel storage installation located on the facility's site. In addition,

the City of Anaheim retains financial responsibility for its spent fuel and for a portion of the Units 2 and 3 decommissioning costs. The City of Anaheim remains a licensee for purposes of its retained interests and liabilities. Southern California Edison notified the Nuclear Regulatory Commission (NRC) on June 12, 2013, that it had permanently ceased operation of Units 2 and 3 on June 7, 2013. The NRC notification, called a Certification of Permanent Cessation of Power Operations, sets the stage for SCE to begin preparations for decommissioning.

SCE and the current or former San Onofre owners responsible for decommissioning have established core principles of safety, stewardship and engagement to guide the long and complex decommissioning process. These guiding principles support SCE's vision of making the decommissioning of the San Onofre nuclear plant a model for the nuclear industry:

Safety

- We commit to safely decommissioning San Onofre.
- We are determined to complete the safe decommissioning of San Onofre as expeditiously and cost efficiently as possible. Our immediate goal is to safely move the power plant's spent fuel, now cooling in pools, into dry cask storage as quickly and as carefully as we can until the government creates the long-term storage option that it has committed to implement. We will continue to urge the government and other stakeholders to find a solution to provide the timely removal of spent nuclear fuel from the San Onofre site.

Stewardship

- We are committed to leaving the community better off as a result of having been home to San Onofre for 40 years and we will be open to exploring opportunities for doing so with our landlord, the U.S. Navy, and the community.
- Substantial dollars have accumulated in Nuclear Decommissioning Trusts through customer contributions and judicious investing, and the owners recognize their legal responsibility to spend those funds wisely and return any unused monies to ratepayers.

Engagement

- We want the San Onofre decommissioning process to be managed in an inclusive, forward-thinking and responsible way. In particular, the current and previous owners of San Onofre are committed to creating an advisory Community Engagement Panel (CEP) to bring together diverse stakeholders and open a conduit of information and ideas between the owners and the public. The panel will foster direct public outreach and ensure that all key interests are included and heard: Elected representatives of the surrounding cities and counties, the military, emergency responders, local environmentalists, business, organized labor, customer interests and academia. (see <http://www.songscommunity.com/decommissioning.asp>)

While decommissioning, SONGS continues to fulfill its commitment to monitor the environment and exposure pathways.



C. Radiological Environmental Monitoring Introduction and Summary

The purpose of the radiological environmental monitoring program is to measure radiation levels in the environment surrounding SONGS, and to identify any levels of radioactivity or radiation associated with SONGS that have a potential exposure pathway to a member of the general public. This is accomplished through the measurement of direct radiation with the use of thermoluminescent dosimeters and by the sampling and analyses of various environmental media, including:

- soil
- shoreline sediment (beach sand)
- air (particulate & iodine)
- local crops
- non-migratory marine species
- kelp
- drinking water
- ocean water
- ocean bottom sediments

Samples are analyzed for both naturally occurring and SONGS-plant related radionuclides.

A detailed description of the 2016 sampling locations and location maps are included in Appendix A of this report.

1. Summary of Analysis of Results and Trends

The results of the 2016 monitoring program show no levels of direct radiation or radioactive materials from SONGS distinguishable from background in the offsite environment. Environmental samples from areas surrounding SONGS continue to indicate no radiological

impacts from plant operation. A detailed discussion of the 2016 analytical results and discussions is presented in Appendix B of this report. Analytical values from offsite indicator sample stations continue to trend with the control stations. Measurements from onsite indicator samples continue to fluctuate within normal historical ranges.

The 2016 SONGS REMP was conducted in accordance with 10 CFR 50, Appendix I, 10 CFR §50.36a, and Section 5.0 of the SONGS Offsite Dose Calculation Manual (ODCM). The data indicate that SONGS continues to have no measurable radiological impact on the environment or any member of the public during 2016. In addition, dose to members of the public attributable to SONGS related radiological activities remain well below regulatory limit of 100 mrem per year, as specified in 10 CFR 20, § 20.1301 and in keeping with the philosophy of “as low as is reasonably achievable” (ALARA), as specified in 10 CFR 20.1101(b).

The REMP data collected during 2016, as in previous years, continues to be in line with background levels. The data are summarized in the Statistical Summary of REMP Data found in Appendix B. Cesium-137 (Cs-137) is routinely identified in some soil samples and Iodine-131 (I-131) is routinely found in some kelp samples. Cs-137 and I-131 are radionuclides that could be associated with releases from nuclear power plants, including SONGS. However, the level of Cs-137 found in soil is consistent with historical and expected Cs-137 concentrations from nuclear weapons testing. The I-131 in kelp is consistent with medical administrations and releases of I-131, and not related to plant operations or releases. These isotopes have been detected at indicator locations, as well as at control locations, in past years. Naturally occurring radionuclides, including beryllium-7 (Be-7), potassium-40 (K-40), thorium-228 (Th-228) and thorium-230 (Th-230) were detected in both control and indicator locations at similar concentrations and are not related to the operation of SONGS. Refer to Appendix B for a more detailed discussion.

2. Land Use Census

In accordance with 10CFR Part 50, Appendix I, Section IV.B.3, each year a Land Use Census is performed to identify any changes in the use of areas at and beyond the site boundary. Modifications to the monitoring program are made if required by the results of this census to reflect new or changes in locations for pathways of exposure around the plant. Appendix F of the report identifies changes to the census in 2016; no changes in the sampling media or sample locations were required. However, the SONGS indicator garden was relocated to a location near Air Sampler #11.

3. Quality Assurance

To assure quality of sample analyses, a portion of REMP is devoted to quality assurance. All REMP activities, including support contractors, are assessed as defined in Regulatory Guide 4.15. The quality assurance program's main aspects include process quality control, instrument quality control, comprehensive data reviews, cross-check analyses, and audits. Routine REMP assessments ensure that the program, procedures and personnel are performing satisfactorily.

Quality audits and independent technical reviews help determine areas that need attention. These areas are addressed in accordance with the station's Corrective Action Program.

The measurement capabilities of the radiological laboratory are demonstrated by participating in an inter-laboratory measurement assurance program, and performing duplicate and split sample analyses. Approximately 10% of the analyses performed are quality control samples, consisting

of inter-laboratory measurement assurance program samples, duplicate samples, and split samples.

The inter-laboratory measurement assurance program provides samples that are similar in matrix and size to those sampled and measured by the REMP. This program assures that equipment calibrations and sample preparation methods accurately measure radioactive material in samples.

Duplicate sampling of the environment 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. SONGS participates in a sample splitting program with the California Department of Public Health Radiological Health Branch (CDPH-RHB) in accordance with the site's REMP procedures. The general public can access these CDPH-RHB split sampling results via the internet at: <http://cdph.ca.gov/programs/Pages/RHB-RadReport.aspx>.

SONGS utilizes the services of GEL Laboratories, LLC (GEL) for the radiochemistry analysis of samples noted within this report. GEL performs the requested analysis under its Quality Assurance Program which meets the requirements of Title 10 Code of Federal Regulations Appendix B Part 50, NQA-1 and Regulatory Guide 4.15 Revision 1.

SONGS utilizes the services of Stanford Dosimetry for the environmental TLD analyses noted in this report. Stanford Dosimetry performs the requested analyses under its quality assurance program which meets the requirement of Title 10 Code of Federal Regulations Appendix B Part 50, NQA-1 and Regulatory Guide 4.15 Revision 1.

4. Program Deviations

Any deviation in the conduct of the program as required, either in terms of sample collection or analysis, requires an investigation as to the cause and identification of measures to prevent recurrence. Deviations from the sampling program or sensitivity requirements are acknowledged and explained in Appendix E to this report.



Part 2 Radiological Environmental Monitoring Program Analysis Technical Summary

The 2016 SONGS REMP was conducted in accordance with 10 CFR 50, Appendix I, 10 CFR § 50.36a, and Section 5.0 of the SONGS Offsite Dose Calculation Manual (ODCM). The data indicate that SONGS continues to have no measurable radiological impact on the environment or any member of the public during 2016. In addition, dose to members of the public attributable to SONGS related radiological activities remain well below regulatory limit of 100 mrem per year, as specified in 10 CFR 20, § 20.1301 and in keeping with the philosophy of “as low as is reasonably achievable” (ALARA), as specified in 10 CFR 20.1101(b).

The REMP data collected during 2016, as in previous years, continues to be representative of background levels. The data is summarized in the Statistical Summary of REMP Data found in Appendix B. Potentially plant related radionuclides, including cesium-137 (Cs-137) in soil and iodine-131 (I-131) in kelp, detected above the minimum detectable concentration (MDC) are attributable to either fallout from nuclear weapons testing and the Fukushima Daiichi accident in Japan (in the case of Cs-137) or medical administrations of radionuclides (in the case of I-131). These isotopes have been detected at indicator locations, as well as at control locations, in past years. Naturally occurring radionuclides, including beryllium-7 (Be-7), potassium-40 (K-40), thorium-228 (Th-228) and thorium-230 (Th-230) were detected in both control and indicator locations at similar concentrations and are not related to the operation of SONGS. Refer to Appendix B for a more detailed discussion.

To conform with 10 CFR Part 50, Appendix I, Section IV B.2, data on measurable levels of radiation and radioactive materials in the environment are provided to allow for a comparison to the predicted (calculated) values in the environment from radioactive material released in effluents.

A. Objectives

1. Characterize the radiological footprint outside of the power block resulting from the licensed operations and during decommissioning phases of SONGS Units 2 and 3.
2. To detect any significant increase in the concentration of radionuclides in the pathways of exposure to the public.
3. To detect any significant change in ambient gamma radiation levels.
4. To fulfill the radiological environmental monitoring requirements of the ODCM

B. Sample Collection

Samples of environmental media were obtained to meet the stated objectives. The selection of sample types was based on established important pathways for the transfer of radionuclides through the environment to individuals, and based on the evaluation of data during the operational phase. Sampling locations were selected with consideration given to site meteorology, local demography, and land uses. Refer to Appendix A for a complete list of REMP sample locations as described in Table 5-4 of the ODCM.

Sampling locations are divided into two classes, indicator and control. Control stations are at locations considered to be unaffected by SONGS operations. All others are considered indicator locations and may be potentially affected by SONGS operations.

C. Regulations and Guidance

- 10 CFR 50, Appendix I

10 CFR 50, Appendix I establishes limits on releases of radioactivity to the environment and the resulting dose to the public. The limits are:

Source	NRC Limits for SONGS
Liquid Effluent	Less than or equal to 3 mrem/yr to whole body from all pathways of exposure Less than or equal to 10 mrem/yr to any organ from all pathways of exposure
Gaseous Effluents – Noble Gases	Less than or equal to 10 mrad/yr gamma air dose Less than 20 mrad/yr, beta air dose Less than 5 mrem/yr, maximum offsite exposed individual of the public
Iodine-131, tritium and particulates with half-life greater than 8 days	Less than or equal to 15 mrem to any organ, all pathways of exposure

- **40 CFR 190**

The Environmental Protection Agency (EPA) has established environmental radiation protection standards for nuclear power plants in 40CFR190. These limits are applicable to the sum of liquid effluent, gaseous effluents and direct radiation. .

The dose limits from all applicable pathways to any offsite individual are

- 25 mrem/year to the whole body
- 75 mrem/year to the thyroid
- 25 mrem to any other organ

As discussed in the 2016 SONGS Annual Radioactive Effluent Release Report, the calculated dose to a member of the public as a result of SONGS is a small fraction of the dose standard established by the EPA. This conclusion is supported by the results of the REMP, as reflected by the absence of measurable levels of radioactive materials in the environment attributable to SONGS.

The EPA established the following concentration limits for drinking water in 40 CFR141:

Source	NRC Limits for SONGS
Gross Alpha	15 pCi/L
Gross Beta	50 pCi/L
Ra-226 and Ra-228 combined	5 pCi/L
Sr-90	8 pCi/L
Uranium	30 µG/L
Tritium	30,000 pCi/L (limit for saltwater site; no downstream drinking water supplier)

These limits are selected to ensure that no member of the public receives more than 4 mrem total body or organ dose, based on 2 liters per day drinking water intake. The sampling of ocean water and groundwater in and around the plant confirms that SONGS has no impact on public water supplies for the surrounding communities.

The following regulatory and industry guidance has been identified as applicable to the SONGS REMP with application as may be required.

- US NRC Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants, 1975
- US NRC Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations, 1976
- US NRC Regulatory Guide 4.13, Performance, Testing, and Procedural Specification for Thermoluminescent Dosimetry: Environmental Applications, 1977

- NUREG-0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants
- US NRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, 1977
- NUREG-1301, Offsite Dose Calculations Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No. 1, 1991
- ANSI N545, American National Standard Institute, "American National Standard Performance, Testing, And Procedural Specifications for Thermoluminescence Dosimetry (Environmental Application), 1975
- ANSI/HPS N13.37, "Environmental Dosimetry – Criteria for System Design and Implementation", 2014
- US NRC Regulatory Guide 4.15, Rev. 1, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, 1979
- NUREG-1576, Multi-agency Radiological Laboratory Analytical Protocols
- NUREG/CR-4007, Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, 1984



D. Data Management

This annual report summarizes the environmental data in the format specified in NUREG-1301. Data have been evaluated to identify the levels of any plant-related environmental radioactivity above background levels (i.e., plant-related contributions that are distinguishable from background). For data distinguishable from background levels, a comparison has been made of current environmental monitoring results with preoperational data as appropriate and previous operational measurements for the purpose of trending environmental radioactivity resulting from licensed plant operation.

The tabulated means, ranges, and standard deviations are presented in Appendix B. Comparisons with background and pre-operational baseline data are presented in Appendix D.

The REMP data are reviewed for accuracy, compared against NRC reporting levels, and entered into the REMP database. Measurements exceeding the administrative levels (10% of the NRC reporting levels) are flagged by SCE. Analyses are performed using instrumentation and methods that provide analytical results with a level of detection as required by the ODCM. The *a posteriori* MDC is compared to the maximum value for the *a priori* Lower Limit of Detection (LLD) specified in the ODCM. This ensures that regulatory limits for the maximum LLD are met.

The impact of SONGS on the surrounding environment is assessed through a series of analyses. These analyses include: data reduction, comparisons of indicator to control locations (Appendix B); comparison of operational to preoperational environmental data (Appendix D); summary of deviations from sampling requirements and corrective actions taken (Appendix E); and the results of the 2016 Land Use Census (Appendix F).

The SONGS REMP is conducted in accordance with a Quality Assurance Program meeting the requirements of NRC Regulatory Guide 4.15. Samples are collected using approved methods; radiochemical analyses of these samples are performed using standardized analytical methods. The Contracted Environmental Analysis Laboratory (CEAL) participates in an inter-laboratory comparison program in partial fulfillment of the quality assurance requirements for environmental monitoring. The CEAL participated in cross check programs which meet the intent of Reg. Guide 4.15. See Appendix C for additional details.

E. Detection Limit Terminology

The United States Nuclear Regulatory Commission (NRC) requires that equipment and analytical methods used for radiological monitoring must be able to detect specified minimum limits for the type sample and the radionuclide of the analysis. The *a priori* detection capability for the analytical system used for the measurement is referred to as the Lower Limit of Detection (LLD). This LLD ensures that radiation measurements are sufficiently sensitive to detect any levels of concern and small changes in the environment. Samples with no detectable radiation levels are typically referred to as less than the minimum detectable concentration (MDC). The MDC is evaluated for each sample and is used to ensure that the specific analysis has sufficient sensitivity to detect levels consistent with the requirements for analysis by the system LLD. For a more thorough discussion, refer to NUREG/CR-4007.

Lower Limit of Detection (LLD) - The LLD is the *a priori* (before the fact) lower limit of detection for the method used for the analysis. It is a measure of the detection capability for the analytical method and not for any single sample analysis. This value is calculated for each isotope and every matrix based on typical or expected values of decay time, sample size, counter efficiency, etc. The LLD values are listed in the ODCM and represent the detection capability that the analytical methods must meet for the specified sample media.

Minimum Detectable Concentration (MDC) - The MDC is the *a posteriori* (after the fact) lower limit of detection based on actual decay time, measured sample size, and counting efficiency for an individual sample analysis. The MDC is compared to the LLD to verify that the measurement met the ODCM requirements for the maximum value of the LLD for the listed analytes. Values above the MDC are presumed to represent "detected" levels of radioactivity.

No Detectable (ND) – “No Detectable” is used for TLD data to designate when the exposure measured by the TLD is below the expected background exposure, plus a calculated uncertainty. The TLD will have measured radiation exposure, but the magnitude of the exposure is within the expected range, accounting for natural background and seasonal fluctuations. ND indicates that no additional exposure, potentially attributed to the operation of SONGS, was measured.

F. Conclusion

Radiological environmental data collected throughout 2016 have been evaluated to determine any impact that San Onofre operations has on the surrounding environment. To accomplish this, several methods of evaluation were employed, namely:

1. Compilation and verification of all data, as well as a determination of those data considered to be significantly greater than background levels.
2. Correlation of effluent concentrations to concentrations in the environment. Refer to Appendix B.
3. Examination of time dependent variations of pertinent radioisotopes in selected environmental media throughout the year at both indicator and control locations.
4. Comparison of radioactivity in various media in 2016 against the levels observed in preoperational years.
5. Historical trending of radionuclides in various media during operational years.

This evaluation did not identify SONGS-related radionuclides to be present above background in any sample measurement or media. It is concluded that the operation of SONGS through 2016 had no observable radiological environmental impact.

G. References

1. SONGS Offsite Dose Calculation Manual (ODCM) Revision 10, Section 5.0, 2016.
2. SONGS Radiological Monitoring (RM) Procedures
 - a. SO123-RM-1, Radiological Environmental Monitoring Program
 - b. SO123-IX-1.10, Review, Analysis and Reporting of Radiological Environmental Monitoring Program (REMP) Data
3. NUREG/CR-4007, “Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements”, August 1984.

APPENDIX A. SAMPLE TYPE AND SAMPLING LOCATIONS

Table 1 - Direct Radiation Measuring Locations

DIRECT RADIATION MEASURING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
1	City of San Clemente (Former SDG&E Offices) (Control)	5.7	NW
2	Camp San Mateo – (MCB, Camp Pendleton)	3.6	N
3	Camp San Onofre – (MCB, Camp Pendleton)	2.8	NE
4	Camp Horno – (MCB, Camp Pendleton)	4.4	E
6	Old El Camino Real (AKA Old Highway 101)	3.0	ESE
8	Noncommissioned Officers' Beach Club	1.4	NW
10	Bluff	0.7	WNW
11	Former Visitors' Center	0.4 ^b	NW
12	South Edge of Switchyard	0.2 ^b	E
13	Southeast Site Boundary (Bluff)	0.4 ^b	ESE
15	Southwest Site Boundary (Office Building)	0.1 ^b	SSE
16	East Southeast Site Boundary	0.4 ^b	ESE
19	San Clemente Highlands	4.9	NNW
22	Former US Coast Guard Station - San Mateo Point	2.7	WNW
23	SDG&E Service Center Yard (Control)	8.1	NW
31	Aurora Park - Mission Viejo (Control)	18.6	NNW
33	Camp Talega – (MCB, Camp Pendleton) (Control)	5.9	N
34	San Onofre School – (MCB, Camp Pendleton)	1.9	NW
35	Range 312 – (MCB, Camp Pendleton)	4.8	NNE
36	Range 208C – (MCB, Camp Pendleton)	4.1	NE
38	San Onofre State Beach Park	3.4	SE
40	SCE Training Center - Mesa	0.7	NNW
41	Old Route 101 – East	0.3 ^b	E
44	Fallbrook Fire Station (Control)	17.7	E
46	San Onofre State Beach Park	1.0	SE
47	Camp Las Flores – (MCB, Camp Pendleton) (Control)	8.6	SE
49	Camp Chappo – MCB (Control)	12.9	ESE
50	Oceanside Fire Station (Control)	15.6	SE
53	San Diego County Operations Center (Control)	44.2	SE
54	Escondido Fire Station (Control)	31.8	ESE
55	San Onofre State Beach (U1 West)	0.2 ^b	WNW

DIRECT RADIATION MEASURING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
56	San Onofre State Beach (U1 West)	0.2 ^b	W
57	San Onofre State Beach (Unit 2)	0.1 ^b	SW
58	San Onofre State Beach (Unit 3)	0.1 ^b	S
59	SONGS Meteorological Tower	0.3 ^b	WNW
61	Mesa - East Boundary	0.7	N
62	MCB - Camp Pendleton	0.7	NNE
63	MCB - Camp Pendleton	0.6	NE
64	MCB - Camp Pendleton	0.6	ENE
65	MCB - Camp Pendleton	0.7	E
66	San Onofre State Beach	0.6	ESE
67	Former SONGS Evaporation Pond	0.6	NW
68	Range 210C – (MCB, Camp Pendleton)	4.4	ENE
73	South Yard Facility	0.4 ^b	ESE
74	Oceanside City Hall (Backup Control)	15.6	SE
75	Gate 25 MCB	4.6	SE
76	El Camino Real Mobil Station	4.6	NW
77	Area 62 Heavy Lift Pad	4.2	N
78	Horno Canyon (AKA Sheep Valley)	4.4	ESE

Table 2 – Airborne Radioactivity Sampling Locations

AIRBORNE (AP and AC) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
1	City of San Clemente (City Hall)	5.1	NW
7	AWS Roof	0.18 ^b	NW
9	State Beach Park	0.6	ESE
10	Bluff	0.7	WNW
11	Mesa EOF	0.7	NNW
12	Former SONGS Evaporation Pond	0.6	NW
13	Marine Corp Base (Camp Pendleton East)	0.7	E
16	San Luis Rey Substation (Control)	16.7	SE

Table 3 – Soil Sampling Locations

SOIL (TSC SO) SAMPLING LOCATION ^c		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
1	Camp San Onofre	2.8	NE
2	Old Route 101 – (East Southeast)	3.0	ESE
3	Basilone Road / I-5 Freeway Off ramp	2.0	NW
5	Former Visitors Center	0.4 ^b	NW
7	Prince of Peace Abbey – Oceanside (Control)	15	SE

Table 4 – Ocean Water Radioactivity Sampling Locations

OCEAN WATER (SW) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
A	Station Discharge Outfall - Unit 1	0.6	SW
B	Outfall - Unit 2	1.5	SW
C	Outfall - Unit 3	1.2	SSW
D	Newport Beach (Control)	30.0	NW
51	Unit 2 Conduit (not listed in the ODCM)	0.1	SW
52	Unit 3 Conduit (not listed in the ODCM)	0.1	SSW

Table 5 – Drinking Water Radioactivity Sampling Locations

DRINKING WATER (WGC DW) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
4	Camp Pendleton Drinking Water Reservoir	2.0	NW
5	Oceanside City Hall (Control)	15.6	SE

Table 6 – Shoreline Sediment Radioactivity Sampling Locations

SHORELINE SEDIMENT (SSA SO) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
1	San Onofre State Beach (Southeast)	0.6	SE
2	San Onofre Surfing Beach	0.8	WNW
3	San Onofre State Beach (Southeast)	3.5	SE
4	Newport Beach North End (Control)	29.1	NW

Table 7 – Local Crops Sampling Locations

LOCAL CROPS SAMPLING (TFB VG) LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
2	Oceanside (Control)	21	SE to ESE
6	SONGS Garden Mesa EOF	0.7	NNW

Table 8 – Non-Migratory Marine Animal Sampling Locations

MARINE ANIMAL (MOA) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
A	Unit 1 Outfall	0.9	WSW
B	Units 2/3 Outfall	1.5	SSW
C	Laguna Beach (Control)	20 to 25	WNW to NW

Table 9 – Kelp Sampling Locations

KELP (VG) SAMPLING LOCATION ^d		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
A	San Onofre Kelp Bed	1.5	S
B	San Mateo Kelp Bed	3.8	WNW
C	Barn Kelp Bed	6.3	SSE
E	Salt Creek (Control)	11 to 13	WNW to NW

Table 10 – Backup Kelp Sampling Locations

Backup KELP (VG) SAMPLING LOCATION ^{d, e}		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
G	Capistrano Beach Reef (not listed in the ODCM)	8.9 to 9.1	NW
H	San Clemente Pier (not listed in the ODCM)	5.7 to 5.8	NW
I	Wheeler North Artificial Reef (not listed in the ODCM)	5.3	WNW

Table 11 – Ocean Bottom Sediment Sampling Locations

OCEAN BOTTOM (SEB SO) SAMPLING LOCATION		DISTANCE ^a (miles)	DIRECTION ^a (Sector)
B	Unit 1 Outfall	0.8	SSW
C	Unit 2 Outfall	1.6	SW
D	Unit 3 Outfall	1.2	SSW
E	Laguna Beach (Control)	20-25	NW
F	SONGS Up-coast	0.9	WSW
51	Unit 2 Conduit (not listed in the ODCM)	0.1	SW
52	Unit 3 Conduit (not listed in the ODCM)	0.1	SSW

NOTES

- a Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 8. Direction determined from degrees true north.
- b Distances are within the Units 2/3 SAB/EAB (Site Area Boundary/Exclusion Area Boundary)
- c Soil samples are not required by Technical Specifications.
- d Kelp samples are not required by Technical Specifications.
- e Backup kelp sampling locations are only used if needed. In 2016, no samples were obtained from backup kelp sampling locations.

MCB Marine Corps Base (Camp Pendleton)

Table 12 - Sector and Direction Designations

DEGREES TRUE NORTH FROM SONGS 2 AND 3 MIDPOINT			NOMENCLATURE	
Sector Limit	Center Line	Sector Limit	22.5° Sector	Direction
348.75	0 & 360	11.25	A	N
11.25	22.5	33.75	B	NNE
33.75	45.0	56.25	C	NE
56.25	67.5	78.75	D	ENE
78.75	90.0	101.25	E	E
101.25	112.0	123.75	F	ESE
123.75	135.0	146.25	G	SE
146.25	157.0	168.75	H	SSE
168.75	180.0	191.25	J	S
191.25	202.5	213.75	K	SSW
213.75	225.0	236.25	L	SW
236.25	247.5	258.75	M	WSW
258.75	270.0	281.25	N	W
281.25	292.5	303.75	P	WNW
303.75	315.0	326.25	Q	NW
326.25	337.5	348.75	R	NNW

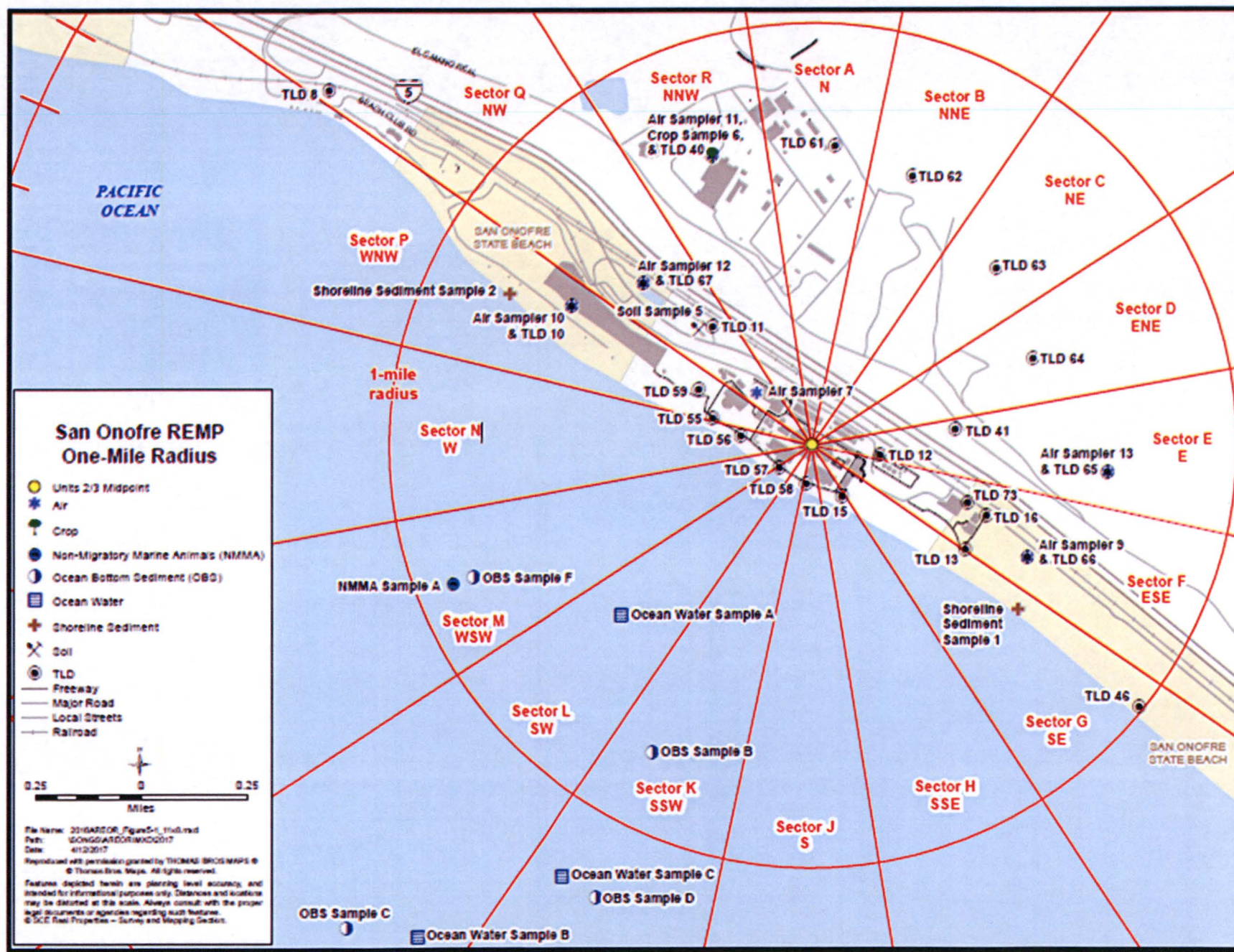


Figure 4 - SONGS REMP One Mile Radius

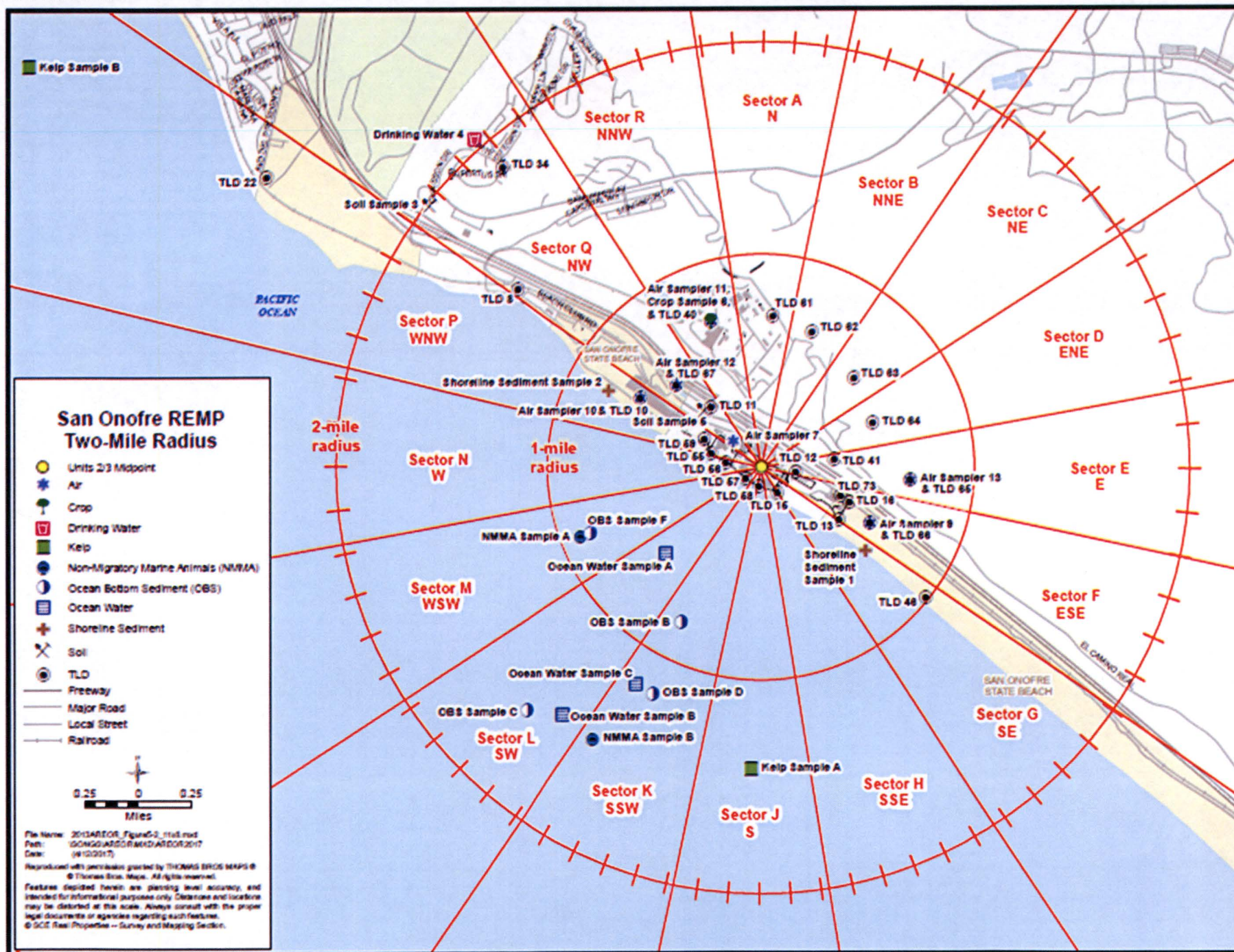


Figure 5 - SONGS REMP Two Mile Radius

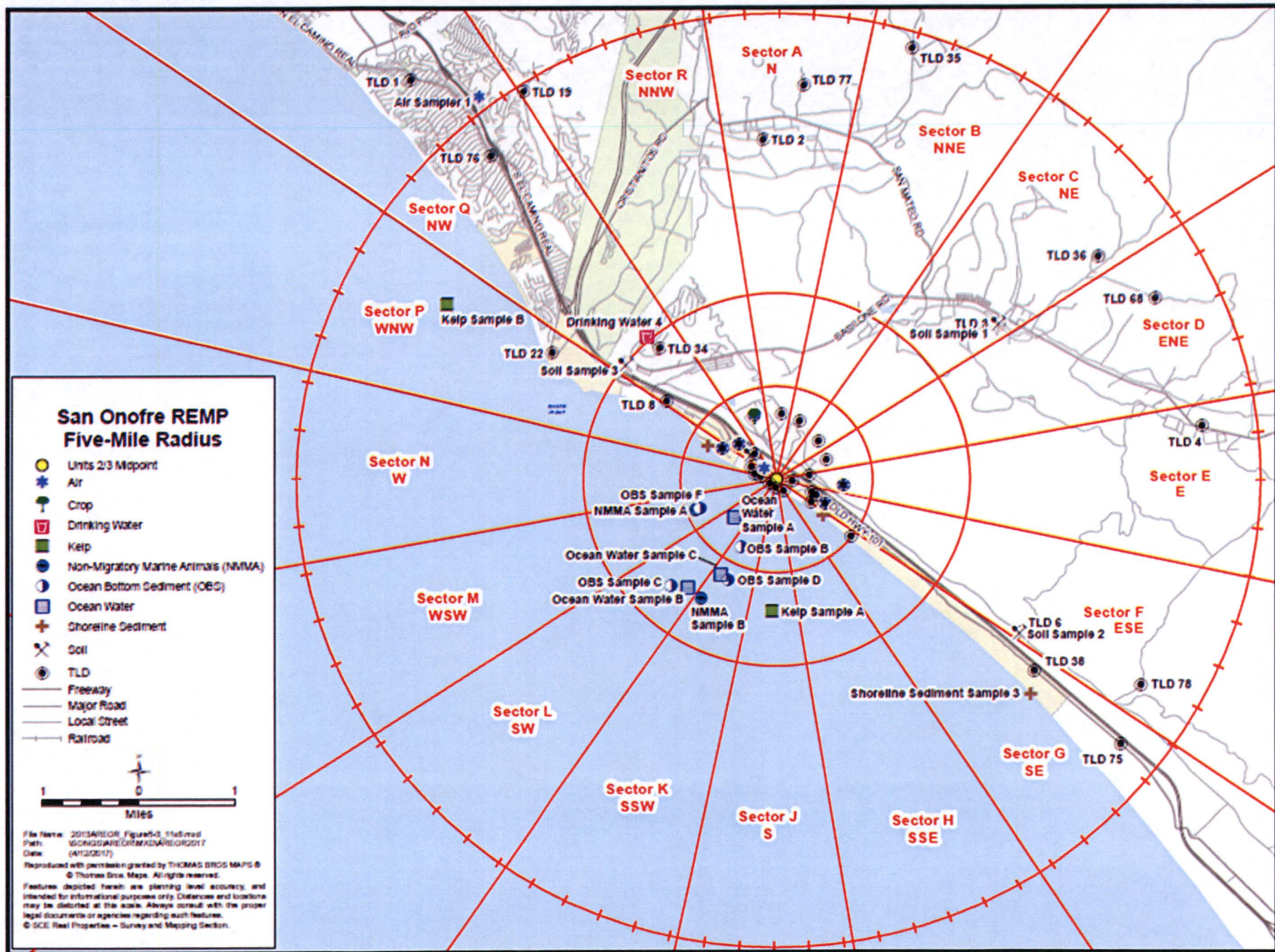


Figure 6 - SONGS REMP Five Mile Radius

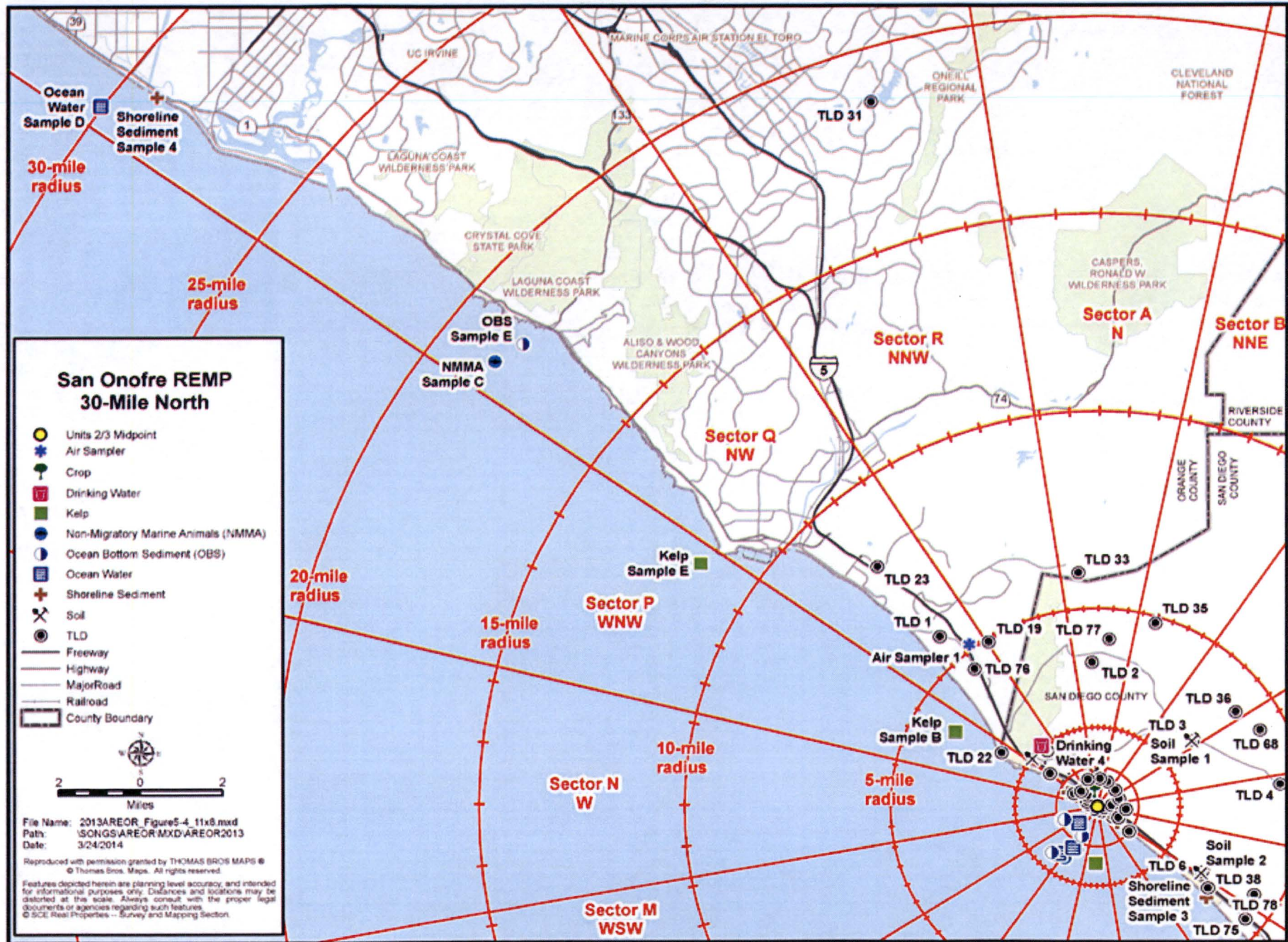


Figure 7 - SONGS REMP 30-mile Radius North

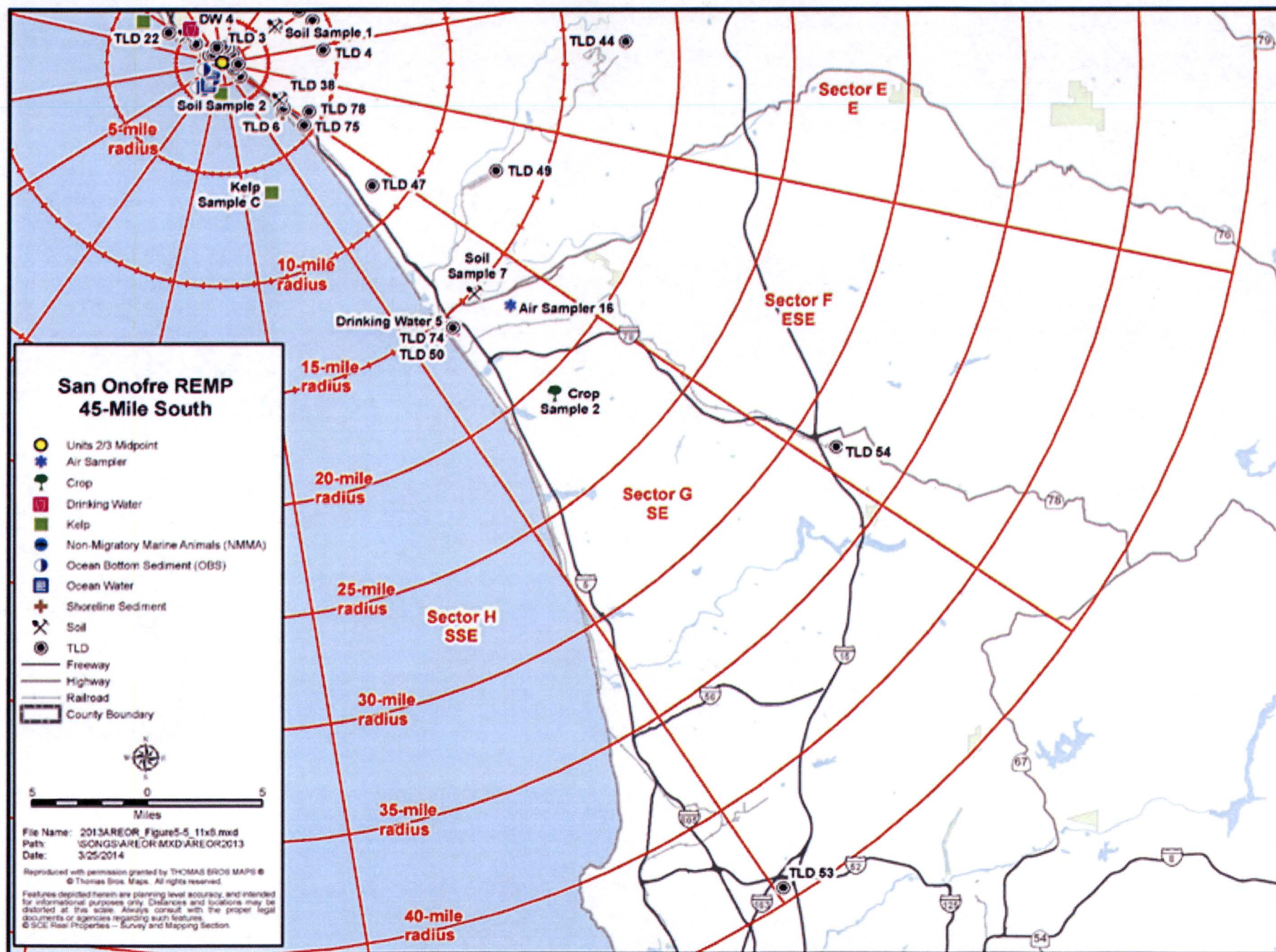


Figure 8 - SONGS REMP 45-mile Radius South

APPENDIX B. RESULTS AND DISCUSSIONS OF 2016 ENVIRONMENTAL DATA

To assess the changes or trends in the radioactivity level in the environment over the past year, the data from January 1st, 2016 through December 31st, 2016 were evaluated. A summary of the type and number of REMP samples obtained in 2016 appears in Table 13.

The analysis results, as presented below, support the conclusion that all measureable levels of radioactivity are attributable to sources external to SONGS (fallout from the nuclear accident at the Fukushima Daiichi Nuclear Power Station, or Chernobyl, residual fallout from legacy atmospheric nuclear weapons testing, and discharge of medically administered I-131 from the San Juan Sewage Plant outfall). Cs-137 has been intermittently detected in the indicator and in the control soil samples in past years and no correlation between Cs-137 level in soil and proximity to the plant has been observed.

Cs-137 levels in marine animal flesh found in indicator samples closely mirror those found in control samples. We conclude that SONGS had no statistically significant radiological environmental impact during 2016.

Table 13 - REMP Sample Analysis Summary for 2016

Medium	Analysis Type	Sampling Frequency	# of Locations	Total # of Analyses in 2016 ^a
Direct Radiation	Dosimetry	Quarterly	49	196
Airborne Particulates	Gross Beta	Weekly	8	416
	I-131	Weekly	8	416
	Gamma	Quarterly	8	32
Ocean Water	Gamma, H-3	Monthly	4	52
	H-3	Quarterly	4	16
Drinking Water, Unfiltered	Gamma,	Monthly	2	24
	H-3		2	24
	Gross Beta		2	24
Shoreline Sediment	Gamma	Semi-Annually	4	8
Ocean Bottom Sediment	Gamma	Semi-Annually	7	14
Marine Species, Flesh	Gamma	Semi-Annually	3	24
Local Crops	Gamma	Semi-Annually	2	8
Kelp	Gamma	Semi-Annually	4	8
Soil	Gamma	Annually	5	5

NOTES

- a The total number of analyses listed above includes samples not required by the ODCM, including additional ocean water samples and additional ocean bottom sediment samples.

A. Results and Discussions of 2016 Environmental Data**1. Direct Radiation**

Direct gamma radiation is monitored in the environment by calcium sulfate (CaSO_4) Thermoluminescent Dosimeters (TLDs) placed at 49 locations and analyzed quarterly per ANSI-N545 standards. The natural direct gamma radiation varies according to location because of differences in the natural radioactive materials in the soil, soil moisture content, and other factors. Figure 9 compares the direct gamma radiation measurements for indicator and control locations with those from the site EAB. The values plotted are the averages for all of the stations according to type. The trends of Figure 9 clearly show that any contribution from SONGS to the off-site environment direct dose component is negligible, being indistinguishable from the background variation.

Beginning in October 2016, SONGS implemented new ANSI/HPS N13.37-2014 for environmental dosimetry system design and implementation. In accordance with this standard, the raw TLD results are adjusted by the exposure to air kerma (8.76 mGy/R) and air kerma to ambient dose (1.2 rem/Gy) conversion factors described in ANSI/HPS N13.37-2014, Section 3.2.1. This change results in a slight increase in the value of the dose, by a factor of 1.05 mrem/mR. Previous results in the AREOR were expressed in mR, but in keeping with ANSI N13.37, 2016 results are expressed in mrem

For each TLD location outside the exclusion area boundary a baseline value was computed using ten years of TLD data (2001 through 2010). The baseline is used to determine if radiation levels above the detection level for this media were observed during 2016, in accordance with the minimum detectable dose calculations as contained in ANSI N13.37-2014. TLDs located greater than five miles from SONGS are generally considered control TLDs. The indicator locations are selected as inner and outer rings as required by the ODCM. Additional TLDs are placed at locations of interest such as schools and hospitals. All 2016 control location TLD readings were below the minimum detectable dose and all 2016 indicator location readings outside the Exclusion Area Boundary (EAB) were below the minimum detectable dose.

The Annual Public Dose, as referenced in Table 14, is based on the potential member of the public exposure at the listed location. For offsite locations, the occupancy factor is 1, for potential full time occupancy. For onsite locations, at or near the EAB/CAB, the occupancy factor is 0.057 based on 500 hours of exposure per year.

The data indicate detectable direct radiation measurements only in the immediate vicinity of SONGS, via those dosimeters placed either within or immediately adjacent to the EAB. Since SONGS has shut down, the direct radiation exposure in the EAB has fallen to very near the exposure measured at both the control and indicator locations. The hypothetical maximum associated exposure to a member of the general public, adjusted for occupancy, is less than 2 mrem per year as measured by this sample media. TLD station #13 had the highest measured REMP TLD annual baseline adjusted exposure in 2016 (24 mrem, Southeast Site Boundary (Bluff)). The occupancy adjusted exposure for TLD#13 is less than 2 mrem per year. Refer to Table 14 for a summary of all 2016 SONGS REMP TLD data.

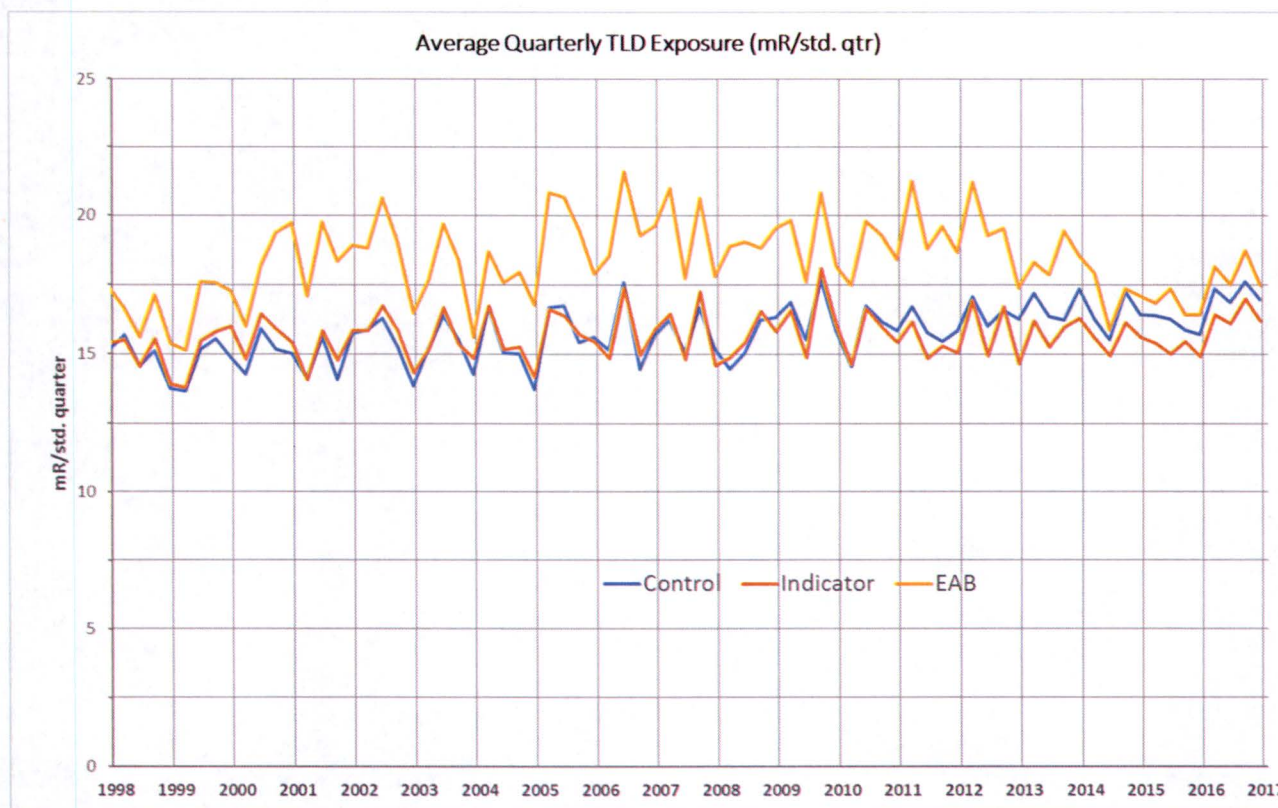


Figure 9 – SONGS REMP TLD data through 2016

Figure 9 compares environmental radiation levels of indicator and control locations for 2016 and previous years. These figures show the close correlation between the control and indicator location TLD exposure data. Beginning in 2016, the results have been increased by the conversion factors as described above. This increase, of roughly 1 mrem/quarter, can be seen in Figure 9 above.

Ten laboratory control TLDs were analyzed quarterly. TLD numbers 23, 31, 33, 44, 47, 49, 50, 53, 54 and 74 are used for background dose normalization. Separate TLDs are used to compensate for transit dose and a fade TLD is used to evaluate for the time and temperature dependent "fade" that may affect dosimeter data. After the samples were analyzed, the measured doses were corrected for pre and post field exposure times.

Neutron dosimeters were placed at REMP TLD station 55 and at selected locations around the Independent Spent Fuel Storage Installation (ISFSI). In 2016, neutron radiation (1.7 mrem) was detected in the 3rd quarter, but not for the rest of the year.

a. Direct Radiation baseline evaluation and estimation of natural background

An in-depth analysis of the environmental radiation results for the period of 2001 through 2010 was completed for all the monitoring locations. It can be inferred that if the standard deviation was low and no additional exposure above background was identified at a particular station, the average of that station's radiation exposure results should be equal to natural background (baseline) at that location. The baseline results for REMP TLDs have been summarized with the annual and

quarterly values in the 2016 TLD Data Table. Natural background radiation is variable and a minor shift in location can yield a measurable change in background radiation. Therefore if a TLD is moved the baseline (background) for that location may be affected.

The baseline environmental exposure analysis of 2001 through 2010 environmental TLD results included an assessment of the standard deviation of the quarterly results and annual totals at each control location. This is an appropriate methodology to determine the ability to detect radiation exposure above background, described in ANSI/HPS N13.37-2014, "Environmental Dosimetry – Criteria for System Design and Implementation". The minimum differential dose (MDD) is defined as the 90th percentile value of three standard deviations for the 2001 through 2010 data. The historical (2001 through 2010) data was adjusted by the conversion factors from ANSI/HPS N13.37-2014 so that they could be compared to the converted 2016 environmental TLD data. This results in 4.4 mrem for the quarterly measurements (MDD_Q or $3\sigma_Q$) and 9.5 mrem for the annual measurements (MDD_A or $3\sigma_A$). The quarterly and annual results expressed in Table 14 are positive exposure if they exceed three standard deviations above the historical background for either the quarterly or annual results. If not, the measurement is noted as "ND" for "Not Detectable".

An empirical determination of the background baseline for stations within the Exclusion Area Boundary (EAB) is not possible due to the known plant related radiological activities (e.g., storage and transport of radioactive materials) that occurred during the baseline calculation study period. The average of the non-EAB stations close to the beach was approximately 15.8 mrem per quarter. A value of 15.8 mrem per quarter was conservatively selected as the baseline for the REMP stations located within the EAB.

In 1980 the Department of Energy (DOE) conducted an Aerial Radiological Survey of SONGS and the surrounding area. The baseline/background value of 15.8 mrem per standard quarter within the SONGS EAB is consistent with the 1980 gamma exposure rates reported by the DOE for the areas immediately north and south of SONGS, taking into account the reduction in environmental radioactivity and background dose rates caused by the decay of atmospheric nuclear weapons testing fallout since 1980.

APPENDIX B

2016 AREOR

Table 14 - SONGS REMP TLD Data

TLD (SCE- ##)	Location	Distance (miles)	Qtr. Baseline (mrem)	2016 Quarterly Results (mrem)				Baseline Adjusted Quarterly Results (mrem)				Ann. Baseline (mrem)	Annual Total (mrem)	Annual Facility Dose (mrem)	Annual Public ^c Dose (mrem)
				1	2	3	4	1	2	3	4				
1	City of San Clemente	5.7	18.4	18.08	18.30	18.08	18.48	ND	ND	ND	ND	73.48	72.94	ND	ND
2	Camp San Mateo – MCB	3.6	19.6	19.25	19.79	19.82	18.89	ND	ND	ND	ND	78.21	77.75	ND	ND
3	Camp San Onofre – MCB	2.8	17.2	17.45	17.19	18.32	17.30	ND	ND	ND	ND	68.85	70.26	ND	ND
4	Camp Horno – MCB	4.4	19.0	17.99	18.48	18.77	18.84	ND	ND	ND	ND	76.00	74.08	ND	ND
6	Old Route 101 (ESE)	3	12.0	11.30	11.89	11.41	11.66	ND	ND	ND	ND	47.93	46.25	ND	ND
8	Noncommissioned Officers' Beach Club	1.4	16.2	16.46	16.80	16.76	16.27	ND	ND	ND	ND	64.96	66.29	ND	ND
10	Bluff	0.7	17.2	16.67	16.42	17.63	16.47	ND	ND	ND	ND	69.06	67.19	ND	ND
19	San Clemente Highlands	4.9	18.7	19.03	18.59	20.00	18.64	ND	ND	ND	ND	74.95	76.25	ND	ND
22	Former US Coast Guard Station	2.7	18.8	18.84	17.80	19.88	18.91	ND	ND	ND	ND	75.37	75.42	ND	ND
23	SDG&E Service Center Yard (Control)	8.1	16.6	16.61	16.19	16.31	15.64	ND	ND	ND	ND	66.33	64.75	ND	ND
31	Aurora Park - Mission Viejo (Control)	18.6	19.4	20.15	19.08	21.55	19.69	ND	ND	ND	ND	77.89	80.47	ND	ND
33	Camp Talega – MCB (Control)	5.9	19.9	19.39	19.95	20.34	18.97	ND	ND	ND	ND	79.26	78.66	ND	ND
34	San Onofre School – MCB	1.9	17.0	17.36	16.79	17.94	16.54	ND	ND	ND	ND	68.01	68.62	ND	ND
35	Range 312 – MCB	4.8	17.8	16.80	16.06	15.96	15.98	ND	ND	ND	ND	70.96	64.80	ND	ND
36	Range 208C – MCB	4.1	20.5	20.54	19.56	20.44	19.87	ND	ND	ND	ND	81.78	80.41	ND	ND
38	San Onofre State Beach Park	3.4	15.0	14.03	13.00	14.95	14.24	ND	ND	ND	ND	60.13	56.23	ND	ND
40	SCE Training Center - Mesa	0.7	18.0	17.95	17.10	18.04	17.98	ND	ND	ND	ND	71.90	71.07	ND	ND
44	Fallbrook Fire Station (Control)	17.7	14.7	15.38	15.18	15.25	14.64	ND	ND	ND	ND	58.87	60.45	ND	ND
46	San Onofre State Beach Park	1	12.8	14.52	13.57	15.90	11.89	ND	ND	ND	ND	51.19	55.88	ND	ND
47	Camp Las Flores – MCB (Control)	8.6	14.0	15.82	14.98	16.05	15.65	ND	ND	ND	ND	55.82	62.50	ND	ND
49	Camp Chappo – MCB (Control)	12.9	14.9	16.19	14.83	16.46	15.69	ND	ND	ND	ND	59.81	63.18	ND	ND
50	Oceanside Fire Station (Control)	15.6	17.4	17.29	16.91	17.24	17.16	ND	ND	ND	ND	69.69	68.60	ND	ND
53	San Diego County Operations Center (Control)	44.2	19.1	20.13	18.97	20.28	19.29	ND	ND	ND	ND	76.63	78.67	ND	ND
54	Escondido Fire Station (Control)	31.8	16.9	17.50	17.18	18.01	17.49	ND	ND	ND	ND	67.70	70.18	ND	ND
61	Mesa - East Boundary	0.7	16.2	15.62	15.19	16.59	15.77	ND	ND	ND	ND	64.86	63.17	ND	ND
62	Camp Pendleton	0.7	13.9	12.97	12.48	14.55	13.34	ND	ND	ND	ND	52.98	53.34	ND	ND
63	Camp Pendleton	0.6	14.6	14.50	14.04	14.62	14.41	ND	ND	ND	ND	58.34	57.57	ND	ND
64	Camp Pendleton	0.6	15.8	15.69	15.79	15.84	15.61	ND	ND	ND	ND	63.18	62.94	ND	ND

APPENDIX B

2016 AREOR

TLD (SCE- ##)	Location	Distance (miles)	Qtr. Baseline (mrem)	2016 Quarterly Results (mrem)				Baseline Adjusted Quarterly Results (mrem)				Ann. Baseline (mrem)	Annual Total (mrem)	Annual Facility Dose (mrem)	Annual Public ^c Dose (mrem)
				1	2	3	4	1	2	3	4				
65	Camp Pendleton	0.7	14.1	13.73	12.89	13.87	13.49	ND	ND	ND	ND	56.55	53.97	ND	ND
66	San Onofre State Beach	0.6	14.7	14.85	13.89	16.27	14.12	ND	ND	ND	ND	58.45	59.13	ND	ND
67	Former SONGS Evaporation Pond	0.6	17.8	17.19	17.81	19.16	17.47	ND	ND	ND	ND	71.17	71.63	ND	ND
68	Range 210C – MCB	4.4	15.8	16.92	16.56	16.69	16.65	ND	ND	ND	ND	63.28	66.82	ND	ND
74	Oceanside City Hall (Backup Control)	15.6	14.0	14.24	13.83	14.21	13.94	ND	ND	ND	ND	56.13	56.23	ND	ND
75	Gate 25 MCB	4.6	16.7	16.63	17.21	17.90	16.76	ND	ND	ND	ND	66.86	68.50	ND	ND
76	El Camino Real Mobil Station	4.6	18.2	17.92	17.63	18.82	18.00	ND	ND	ND	ND	72.95	72.36	ND	ND
77	Area 62 Heavy Lift Pad	4.2	20.2	20.35	19.35	19.84	19.64	ND	ND	ND	ND	80.84	79.18	ND	ND
78	Horno Canyon	4.4	11.7	12.17	12.36	12.13	11.95	ND	ND	ND	ND	46.88	48.62	ND	ND
11	Former Visitors' Center ^a	0.4	15.8	16.11	15.97	17.49	16.19	ND	ND	ND	ND	63.07	65.76	ND	ND
12	South Edge of Switchyard ^a	0.2	15.8	18.54	16.58	18.74	16.30	ND	ND	ND	ND	63.07	70.17	ND	ND
13	Southeast Site Boundary (Bluff) ^a	0.4	15.8	22.56	23.55	21.30	19.86	6.79	7.78	5.53	ND	63.07	87.26	24.19	1.38
15	Southeast Site Boundary (Office Bldg) ^a	0.1	15.8	18.08	16.88	21.53	20.40	ND	ND	5.76	4.64	63.07	76.90	13.82	0.79
16	East Southeast Site Boundary ^a	0.4	15.8	17.17	16.55	17.10	15.27	ND	ND	ND	ND	63.07	66.09	ND	ND
41	Old Route 101 – East ^a	0.3	15.8	16.14	15.75	15.70	15.85	ND	ND	ND	ND	63.07	63.44	ND	ND
55	San Onofre State Beach (U1 West) ^a	0.2	15.8	19.23	18.52	21.16	18.34	ND	ND	5.40	ND	63.07	77.26	14.18	0.81
56	San Onofre State Beach (U1 West) ^a	0.2	15.8	19.33	16.29	16.19	15.48	ND	ND	ND	ND	63.07	67.30	ND	ND
57	San Onofre State Beach (Unit 2) ^a	0.1	15.8	16.74	16.80	16.84	17.09	ND	ND	ND	ND	63.07	67.47	ND	ND
58	San Onofre State Beach (Unit 3) ^a	0.1	15.8	15.45	15.19	16.40	17.34	ND	ND	ND	ND	63.07	64.39	ND	ND
59	SONGS Meteorological Tower ^a	0.3	15.8	19.11	19.38	20.86	18.64	ND	ND	5.09	ND	63.07	77.99	14.92	0.85
73	South Yard Facility ^a	0.4	15.8	19.43	18.46	19.38	18.83	ND	ND	ND	ND	63.07	76.10	13.02	0.74

NOTES:

- Station is within the Exclusion Area Boundary (EAB). The quarterly baseline has been estimated to be 15.0 mR within the EAB.
- ND indicates that the TLD did not measure exposure greater than $3\sigma_Q$ or $3\sigma_A$ above the historical baseline, for that location. See ANSI/HPS N13.37-2014 for information on the determination of $3\sigma_Q$ or $3\sigma_A$.
- Public dose is calculated based on an occupancy factor of 1 (full time exposure) for locations offsite. Public dose is calculated with an assumed occupancy factor of 0.057 (500 hours annually) for locations in the EAB/CAB

b. Quality Control Duplicate Direct Radiation Samples

Duplicate Quality Control (QC) TLD was installed adjacent to TLD #66. The duplicate TLDs agreed closely with the indicator TLDs, see Appendix C for results. These TLDs were not required by the ODCM and are not included in the Statistical Summary of REMP Data.

c. ISFSI Direct Radiation Samples

Independent Spent Fuel Storage Installation (ISFSI) TLDs were placed in the vicinity of the ISFSI. Data from these TLDs have not been included in the statistical summary of REMP data since these TLDs are not required by the ODCM. The ISFSI data are listed and discussed in Appendix I.

2. Airborne Particulate, Iodine, and Composite Isotopic Analyses

Air particulate samples were collected on a weekly basis from seven indicator locations and from one control location. The samples were analyzed for gross beta activity, I-131, and composited quarterly for gamma isotopic analysis. Sample locations were selected according to the requirements of the ODCM.

Gross beta analysis is a measure of total radioactivity of beta-emitting radionuclides in a sample. Beta radiation is emitted by many radionuclides, but beta decay gives a continuous energy spectrum rather than the discrete energy lines or peaks associated with gamma radiation. Gross beta measurements can only be used as an indicator of potentially elevated levels; it does not identify specific radionuclides. Gross beta measurement data serves as a screening tool to determine if further analysis is required.

All gross beta activity analysis results were above the MDC. The concentration of gross beta activity in the samples collected from the indicator locations ranged from 0.003 pCi/m³ to 0.074 pCi/m³, averaging 0.027 pCi/m³ of air. The concentrations of gross beta activity in the samples from the control location ranged from 0.011 to 0.057 pCi/m³, averaging 0.026 pCi/m³ of air.

Per the requirements of the ODCM, Section 5, Table 5-1, an assessment was performed to determine whether the gross beta activity of the indicators exceeded 10 times the background (control location #16). The results showed that indicator locations maximum gross beta activity in air in 2016 was 0.0742 pCi/m³ which is less than 10 times the average background measured at the control location (0.0261 pCi/m³). No further action is required by the ODCM.

Indicator samples analyzed for I-131 were all identified below the MDC. No action was required by the ODCM.

In summary, average quarterly air particulate sample beta activity from the indicator stations and control station have been compared historically through 2016. The average of the indicators trends closely with the offsite control values. The comparison illustrates that SONGS has not contributed to detectable levels of radioactive material in the environment around the plant. There has been no detectable impact of the plant on air radioactivity. These stations are located near the site boundary downwind from the plant, based on the prevailing wind direction. The beta activity measured in the air particulate samples is from naturally occurring radioactive material. Gamma analyses are performed on quarterly composites of the air particulate samples to determine if any activity is from SONGS. The gamma analyses have revealed no radioactivity from SONGS.

3. Ocean Water

Monthly ocean water samples were collected from three indicator locations in the vicinity of each station discharge and from the control location at Newport Beach. The samples were analyzed for naturally-occurring and SONGS-related gamma-emitting radionuclides. Quarterly composite ocean water samples were analyzed for tritium according to ODCM requirements.

Throughout 2016, only naturally occurring radionuclides were detected in the monthly gamma spectral analyses of ocean water. Monthly ocean water samples were also analyzed for tritium, consistent with the State of California Department of Public Health (DPH) split sample program. During 2016 all REMP ocean water sample results for tritium were below the count specific MDC.

The data indicate that the operation of SONGS had no measureable impact on the environment as measured by ocean water.

4. Drinking Water

In 2016, drinking water samples were collected on a monthly basis from one indicator location and from the Oceanside control location. Samples were analyzed for tritium, gross beta, and naturally occurring and SONGS related gamma emitting radionuclides. There is no drinking water pathway for liquid effluent at SONGS.

No station related radionuclides were detected in drinking water during 2016. Gross beta activity was identified in some samples, but gamma spectroscopy identified only natural radionuclides. The operation of SONGS had no impact on the environment as measured by drinking water.

5. Shoreline Sediment (Beach Sand)

Beach sand was collected semiannually in 2016 from three indicator locations and from a control location situated in Newport Beach. After collection, the samples were analyzed for plant related and naturally occurring radionuclides. Only naturally occurring radionuclides were detected in all samples. No plant related radionuclides were reported above the MDC. The operation of SONGS had no impact on the environment as measured in beach sand.

6. Ocean Bottom Sediments

Ocean bottom sediments were collected in the vicinity of each of the four indicator locations and at the Laguna Beach control location. The samples were analyzed by gamma spectral analysis for naturally occurring and station related radionuclides. Only naturally occurring radionuclides were detected in ocean bottom sediment samples collected during 2016.

Four non-ODCM ocean bottom sediment samples were obtained from two locations, Unit 2 outfall conduit and Unit 3 outfall conduit. The conduit samples were collected to measure the radiological environmental effect potentially resulting from the minor conduit leakage. During 2016, all conduit sample analysis results were below the MDC for station related radionuclides. The operation of SONGS had no impact on the environment as measured by ocean bottom sediments.

7. Marine Species (Flesh)

Species of adult fish, crustacean and mollusks were collected on a semi-annual basis at the SONGS Unit 1 outfall, the SONGS Units 2/3 outfall and from Laguna Beach control location. The

flesh portion of each sample type was analyzed for gamma-emitting station-related and naturally occurring radionuclides. The results were subsequently reported to SONGS in terms of wet sample weights. Because results based on a wet sample weight are most useful for calculating doses, the results of sample analyses are summarized in terms of "as received" wet weights. No plant related radionuclides were detected above the MDC.

Naturally-occurring radionuclides were detected in marine species samples collected during 2016. The operation of SONGS had no impact on the environment as measured by this sample medium.

8. Local Crops

Fleshy and leafy crops were collected semiannually in 2016 from the SONGS garden and from the control location 21 miles SE from SONGS Units 2/3 midpoint. Tomato, cabbage and sorrel were sampled in 2016, and only naturally occurring radionuclides were identified. No plant related radioactivity was detected. It is concluded that in 2016 SONGS had no measurable impact on local crops.

9. Soil

To determine if there is evidence of a build-up of radionuclides in the land near SONGS, indicator soil samples were collected from Camp San Onofre, Old Route 101, Basilone Road and the East Site Boundary (Former Visitor's center). A control sample was obtained from Prince of Peace Abbey in Oceanside. Surface soil was collected from all indicator and control locations at the depth of 3 inches. The sampling protocol is consistent with the procedure described in HASL-300. Soil sampling is not required by the ODCM.

Soil samples were analyzed for naturally-occurring and SONGS-related gamma-emitting radionuclides using gamma spectral analysis. The 2016 soil samples showed measurable levels of naturally occurring radionuclides; and Cs-137 was detected in one (1) indicator sample and the control sample. Cs-137 in environmental sediment samples is attributable to residual nuclear weapons testing fallout or to the Fukushima accident.

Cs-137 and strontium-90 (Sr-90) were detected in soil profile analyses conducted in previous years. These radionuclides are mostly due to the nuclear weapons testing fallout depositing on soil and retention of these radionuclides due to their long half-lives. The presence of Cs-137 in the indicator and the control locations in previous years supports the conclusion that the major source of this radionuclide is fallout deposition. During 2016, the operation of SONGS did not have a measurable effect on the environment as measured by soil samples.

10. Kelp

Kelp was collected in April and October of 2016 from the San Onofre kelp beds, San Mateo kelp bed, Barn kelp bed, and from the Salt Creek control location. Upon collection, the samples were analyzed by gamma-spectral analysis for naturally-occurring and station-related radionuclides. Naturally occurring radionuclides (such as K-40, Th-228 and others) were detected in several samples in 2016, from both indicator and control locations. Iodine I-131 was identified in the San Onofre, San Mateo and control kelp beds. Iodine-131 is a relatively short-lived radionuclide with an 8 day half-life. It is produced and released from operating nuclear power plants. However, with SONGS being shutdown and nuclear fuel stored in spent fuel pools, I-131 is not being generated.

I-131 has been detected at indicator and control locations in previous years. I-131 data in ocean water samples near SONGS have been consistently indistinguishable radiologically from background. The northern control locations are too far away and in the predominantly upstream current direction for the I-131 activity to be attributable to SONGS. The Salt Creek control kelp sample station near the San Juan Sewage Plant outfall has consistently yielded the highest I-131 activity measured in kelp, and has consistently yielded I-131 above radiological background. Figure 10 shows a relatively close correlation between indicator and control locations over an extended period, further supporting the assessment that the likely source for this radionuclide is external to SONGS. (Note: Figure 10 includes all I-131 results, including those that are below the MDC.)

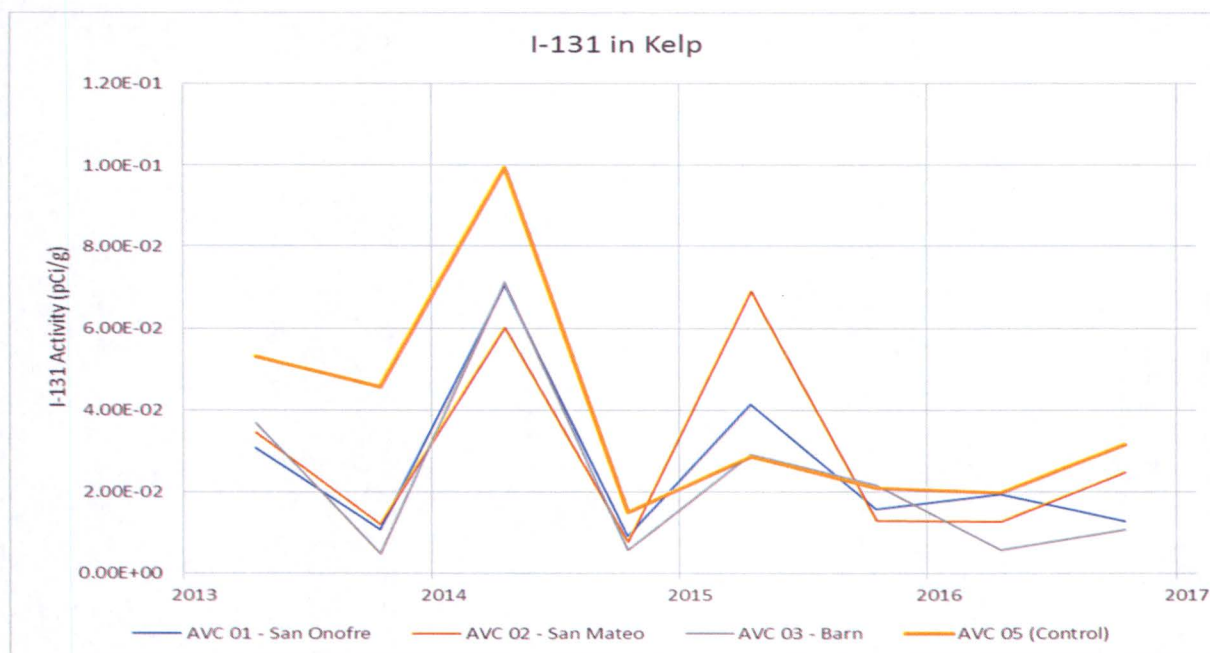


Figure 10 - I-131 in Aquatic Kelp

Refer to Figure 11 for the relative location of the kelp beds, the San Juan Sewage Plant outfall, and the SONGS outfalls. The data strongly support the conclusion that the I-131 detected in kelp is attributable to medically administered I-131 discharged through the San Juan Sewage Plant outfall and not to the operation of SONGS.

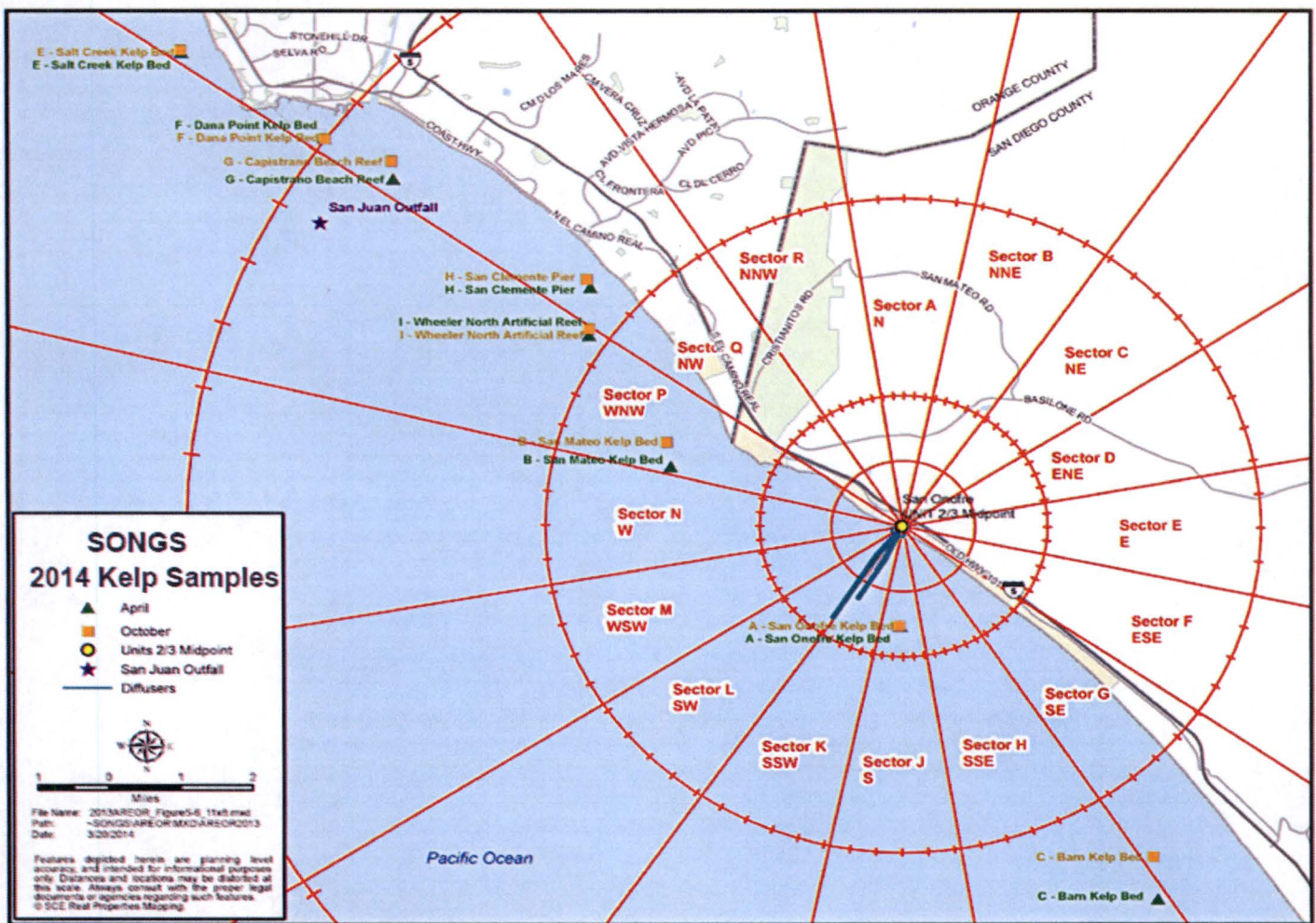


Figure 11 - Kelp Sampling Locations

11. Correlation of Effluent Concentration to Concentrations in the Environment

In accordance with 10 CFR 50 Appendix I, Section IV, B.2, data on measurable levels of radiation and radioactive materials in the environment have been evaluated to determine the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure.

REMP samples, both terrestrial and marine, indicated no accumulation of plant-related radioactivity in the environs. No samples exceeded investigation levels and, in fact, all samples with detectable activity were not statistically different from controls and were therefore attributed to non-plant-related sources—past nuclear weapons fallout, Chernobyl, Fukushima, and medical iodine releases in sewage. As such, the operations of SONGS did not have any measurable effect on the environment.

The regulatory requirement to evaluate the relationship between quantities of radioactive materials released in effluents and the resultant radiation doses to individuals may be summarized by the following conclusion:

Effluent program releases are evaluated annually to determine the receptor(s) with the highest hypothetical dose. The 2016 REMP sample data indicated no accumulation of plant-related radioactive materials in the offsite environment, thereby lending confirmation to the adequacy of the in-plant effluent controls program and dose assessments.



B. Statistical Summary of REMP Data For 2016

Table 15 - 2016 Quarterly Gamma Exposure (mR/std. qtr)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
TLD Direct Exposure (mrem)	Gamma 196	5	16.91 (152/152) (11 – 24)	Southeast Site Boundary (Bluff) 0.4 Mi. ESE	22 (4/4) (20 – 24)	17.16 (44/44) (14 – 22)	0

NOTES

- a Indicator location TLDs include all REMP TLDs 5.0 miles or closer to SONGS 2/3 midpoint
- b Control location TLDs include all REMP TLDs more than 5.0 miles from SONGS 2/3 midpoint
- c TLD data excludes QC TLDs, transit dose TLDs, and ISFSI TLDs

Table 16 – Weekly Airborne Particulates Gross Beta (pCi/m³)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Air Filter Inhalation (pCi/m³)	Gross Beta 416	0.01	0.027 (364/364) (0.003 – 0.074)	Mesa EOF 0.7 Mi. NNW	0.030 (52/52) (0.014 – 0.068)	0.026 (52/52) (0.011 – 0.057)	0

Table 17 – Weekly Radioiodine I-131 Activity (pCi/m³)

Pathway ^a (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD) ^b	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Activated Charcoal Inhalation (pCi/m ³)	I-131 416	0.07	< LLD ^c (0/364)	< LLD	< LLD	< LLD (0/52)	0

NOTES

- a This table summarizes the weekly air iodine 131 cartridge data above the MDC. Iodine 131 has an 8 day half-life. With reactor shutdown, it is no longer a radionuclide attributable to SONGS
- b LLD is the a priori limit as prescribed by the ODCM.
- c The Term <LLD as used means that results had no detectable activity above the minimum detectable.

Table 18 – Quarterly Composite Airborne Particulate Gamma Activity (pCi/m³)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Air Filter Inhalation (pCi/m ³)	Gamma Isotopic 32	Various	< LLD (0/28)	< LLD	< LLD	< LLD (0/4)	0

NOTES

- a Natural occurring radionuclides (Be-7, Th-232 and others) were observed in quarterly composite air samples in 2016.

Table 19 – Monthly Ocean Water Activity

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Ocean Water (pCi/L)	Gamma Isotopic 52	Various	< LLD (0/60)	< LLD	< LLD	< LLD (0/12)	0

NOTES

a Natural occurring radionuclides (K-40 and others) were observed in samples in 2016.

Table 20 – Quarterly Ocean Water Tritium (pCi/L)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Ocean Water (pCi/L)	Tritium 16	2000	< LLD (0/16)	< LLD	< LLD	< LLD	0

Table 21 – Monthly Drinking Water Activity

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Drinking Water (pCi/L)	Gamma Isotopic 24	Various	< LLD (0/12)	< LLD	< LLD	< LLD (0/12)	0
Drinking Water (pCi/L)	Gross Beta 24	4	< LLD (0/12)	< LLD	< LLD	4.74 (9/12) 1.98 – 7.35	0
Drinking Water (pCi/L)	H-3 24	2000	< LLD (0/12)	< LLD	< LLD	< LLD (0/12)	0

NOTES

a Natural occurring radionuclides (Pb-214, Th-228, Th-232 and others) were observed in samples in 2016.

Table 22 – Semi-annual Shoreline Sediment Gamma Activity (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Beach Sand Direct Exposure (pCi/g)	Gamma Isotopic 8	Various	< LLD (0/6)	< LLD	< LLD	< LLD (0/2)	0

NOTES

- a During 2016 naturally occurring radionuclides were detected above the MDC in most shoreline sediment samples.

Table 23 – Semi-annual Ocean Bottom Sediment Gamma Activity (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Waterborne Ocean Bottom Sediment (pCi/g)	Gamma Isotopic 14	Various	< LLD (0/12)	< LLD	< LLD	< LLD (0/2)	0

NOTES

- a During 2016 naturally occurring radionuclides were detected above the MDC in most ocean bottom sediment samples.

Table 24 – Semi-annual Marine Animal Gamma Activity (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
California Mussel Ingestion (pCi/g)	Gamma Isotopic 4	Various	< LLD (0/4)	< LLD	< LLD	N/A	0
Keyhole Limpet Ingestion (pCi/g)	Gamma Isotopic 2	Various	N/A	N/A	N/A	< LLD (0/2)	0

Spiny Lobster Ingestion (pCi/g)	Gamma Isotopic	6	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/2)	0
Sheephead Ingestion (pCi/g)	Gamma Isotopic	6	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/2)	0
Kelp Bass Ingestion (pCi/g)	Gamma Isotopic	3	Various	< LLD (0/2)	< LLD	< LLD	< LLD (0/1)	0

NOTES

a During 2016 naturally occurring K-40 and other radionuclides were detected above the MDC in samples.

Table 25 – Semi-annual Local Crops Gamma Activity (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Sorrell Ingestion (pCi/g)	Gamma Isotopic	2	Various	< LLD (0/2)	< LLD	N/A	0
Tomato Ingestion (pCi/g)	Gamma Isotopic	4	Various	< LLD (0/2)	< LLD	< LLD (0/2)	0
Cabbage Ingestion (pCi/g)	Gamma Isotopic	2	Various	N/A	N/A	< LLD (0/2)	0

NOTES

a During 2016 naturally occurring K-40 and other radionuclides were detected above the MDC in samples.

Table 26 –Annual Soil Gamma Activity, 3" Depth (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Soil Direct Radiation (pCi/g)	Gamma Isotopic 5	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/1)	0
	Cs-137 5	0.18	0.170 (1/4) (0.170 – 0.170)	Old Route 101 3.0 Mi. ESE	0.170 (0.170 – 0.170)	0.104 (1/1) (0.104 – 0.104)	0

NOTES

a During 2016 naturally occurring K-40 and other radionuclides were detected above the MDC in most samples.

Table 27 –Semi-Annual Kelp Gamma Activity (pCi/g)

Pathway (Measurement Unit)	Type and Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Range)	Location with Highest Annual Mean		Control Locations Mean (Range)	Non-routine Reported Measurements
				Name, Distance and Direction	Mean (Range)		
Kelp Ingestion (pCi/g)	Gamma Isotopic 8	Various	< LLD (0/6)	< LLD	< LLD	< LLD (0/2)	0
	I-131 8	0.06	0.016 (2/6) (0.013 – 0.019)	San Mateo Kelp Bed 3.8 Mi. WNW	0.013 (0.013 – 0.013)	0.026 (2/2) (0.020 – 0.032)	0

NOTES

- a I-131 was confirmed above the MDC in 4 of 8 kelp samples. I-131 is known to be a constituent of sewage plant discharges due to medically administered I-131. The activity of I-131 in the control sample (Salt Creek – about 11 miles up coast from SONGS) has historically been higher than the I-131 activity in kelp closer to SONGS.
- b During 2016 naturally occurring K-40 and other radionuclides were detected above the MDC in most samples

APPENDIX C. SUMMARY OF QUALITY CONTROL PROGRAMS

A. Summary

All REMP samples are collected, shipped, and analyzed in accordance with NRC Regulatory Guide 4.15. Marine radiological environmental samples are collected by a vendor, MBC Environmental, per the vendors Quality Assurance manual. REMP sample analysis is performed by the Contracted Environmental Analysis Laboratory (CEAL) in accordance with the Laboratory Quality Assurance Plan. During 2016 the CEAL was General Engineering Laboratory (GEL). The CEAL for REMP TLDs was Stanford Dosimetry.

B. Quarterly Duplicate TLDs

SONGS deployed a duplicate TLD package in the same location and canister as TLD 66. The quarterly dose measured by these separate TLD packages is statistically equivalent.

Table 28 - 2016 Quarterly Duplicate TLD Data Comparison

TLD #	1 ST QUARTER (mR)	2 ND QUARTER (mR)	3 RD QUARTER (mR)	4 TH QUARTER (mR)
TLD 66	14.13 ± 0.86	13.21 ± 0.86	15.48 ± 1.04	13.43 ± 0.96
TLD 200	14.12 ± 0.59	13.43 ± 0.77	14.29 ± 1.05	13.04 ± 1.06

NOTES:

- a. Data is reported as mR per standard quarter ± 1 sigma

C. Annual Duplicate TLDs

SONGS deployed a 12 month duplicate TLD package in the same location and canister as TLD 67. The 2016 TLD 67 exposure is not significantly different from the TLD 201 results for the 12 months from July 2015 through June 2016.

Table 29 - 2016 Annual Duplicate TLD Data

TLD 67 (mR) (July 2015 to June 2016)	TLD 201 (mR) (July 2015 to June 2016)
66.68	65.92

NOTES:

- a. Data is reported as mR per 12 months

D. Calibration of Air Sampler Volume Meters

Air samplers undergo annual calibration using standards referenced to NIST on all REMP air sampler gas meters. When the gas meters are removed from service, the meter is calibrated and the calibration reports are reviewed for bias. This is an *a posteriori* review of the gas meter performance to evaluate method bias and to identify possible outlier analysis results. No anomalies in post calibration occurred.

E. Interlaboratory Cross-Check Program:

The CEAL participates in a number of independent cross check programs, including the National Institute of Standards and Technology (NIST) and Analytics cross-check programs. A summary of the cross check data is included below.

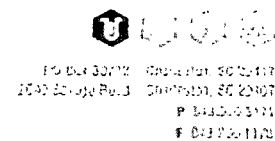
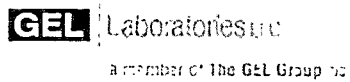
Per the 2016 Annual Environmental Quality Assurance (QA) Report, GEL was provided one hundred fifteen (115) individual environmental analyses. The accuracy of each result reported to Eckert& Ziegler

Analytics, Inc. is measured by the ratio of GEL's result to the known value. All results fell within GEL's acceptance criteria (100%)

In 2016, the environmental TLDs, routine quality control (QC) testing was performed for dosimeters issued by the Environmental Dosimetry Company (EDC). During 2016, 100% (72/72) of individual dosimeters evaluated against the EDC internal performance acceptance criteria (high-energy photons only) met the criterion for accuracy and 100% (72/72) met the criterion for precision.

The CEAL's performance meets the criteria described in Reg. Guide 4.15.

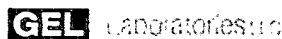
F. Analytical Laboratory Cross Check Program Summary



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GEL QUARTERLY INTERLABORATORY COMPARISON

January through March 2016



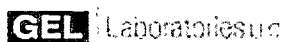
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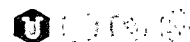
U.S. EPA/600/R-16/001
 2017-01-01 to 12-31-2016
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PT Provider	Quarter / Year	Report Closing / Received Date	Sample Number	Sample Media	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
EZA	4th/2015	2/18/2016	E11412	Cartridge	Iodine-131	pCi	7.73E+01	7.95E+01	0.97	Acceptable
EZA	4th/2015	2/18/2016	E11413	Milk	Strontium-89	pCi/L	9.41E+01	8.65E+01	1.08	Acceptable
EZA	4th/2015	2/18/2016	E11413	Milk	Strontium-90	pCi/L	9.74E+00	1.25E+01	0.78	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Iodine-131	pCi/L	1.01E+02	9.12E+01	1.11	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Cerium-141	pCi/L	1.36E+02	1.29E+02	1.06	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Chromium-51	pCi/L	2.79E+02	2.81E+02	0.99	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Cesium-134	pCi/L	1.45E+02	1.60E+02	0.91	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Cesium-137	pCi/L	1.15E+02	1.15E+02	1.00	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Cobalt-58	pCi/L	1.05E+02	1.10E+02	0.95	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Manganese-54	pCi/L	1.53E+02	1.45E+02	1.05	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Iron-59	pCi/L	1.19E+02	1.08E+02	1.10	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Zinc-65	pCi/L	2.65E+02	2.48E+02	1.08	Acceptable
EZA	4th/2015	2/18/2016	E11414	Milk	Cobalt-60	pCi/L	2.12E+02	2.13E+02	0.99	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Iodine-131	pCi/L	1.05E+02	9.26E+01	1.13	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Cerium-141	pCi/L	1.27E+02	1.12E+02	1.14	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Chromium-51	pCi/L	2.60E+02	2.44E+02	1.07	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Cesium-134	pCi/L	1.25E+02	1.35E+02	0.90	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Cesium-137	pCi/L	1.12E+02	9.95E+01	1.13	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Cobalt-58	pCi/L	9.73E+01	9.56E+01	1.02	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Manganese-54	pCi/L	1.41E+02	1.26E+02	1.12	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Iron-59	pCi/L	1.11E+02	9.34E+01	1.19	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Zinc-65	pCi/L	2.43E+02	2.15E+02	1.13	Acceptable
EZA	4th/2015	2/18/2016	E11415	Water	Cobalt-60	pCi/L	1.92E+02	1.85E+02	1.04	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Barium-133	pCi/L	94.1	90.5	76.2 - 99.6	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Cesium-134	pCi/L	24.0	23.2	17.7 - 25.9	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Cesium-137	pCi/L	72.6	59.1	53.2 - 67.8	Not Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Cobalt-60	pCi/L	65.3	63.4	75.1 - 94.1	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Zinc-65	pCi/L	118	102	91.8 - 122	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Gross Alpha	pCi/L	91.1	72.8	38.3 - 69.7	Not Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Gross Alpha	pCi/L	92.1	72.8	38.3 - 69.7	Not Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Gross Beta	pCi/L	20.0	17.8	10.2 - 25.0	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-226	pCi/L	11.0	10.0	7.49 - 11.7	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-226	pCi/L	11.6	10.0	7.49 - 11.7	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-226	pCi/L	10.7	10.0	7.49 - 11.7	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-226	pCi/L	1.99	2.21	1.02 - 3.52	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-228	pCi/L	2.20	2.21	1.02 - 3.52	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Radium-228	pCi/L	1.99	2.21	1.02 - 3.52	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Uranium (Nat)	pCi/L	66.9	67.1	54.6 - 74.4	Acceptable
ERA	1st /2016	2/25/2016	RAD-104	Water	Uranium (Nat)	pCi/L	65.5	67.1	54.6 - 74.4	Acceptable



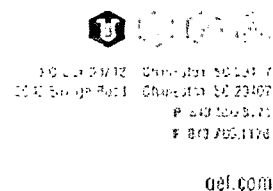
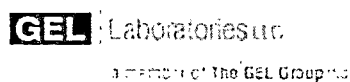
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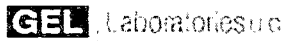
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ERA	1st / 2016	2/25/2016	RAD-104	Water	Uranium (Total mass)	µg/L	99.9	97.9	79.7 - 109	Acceptable
ERA	1st / 2016	2/25/2016	RAD-104	Water	Tritium	pCi/L	11700	12100	10500 - 13300	Acceptable
ERA	1st / 2016	2/25/2016	RAD-104	Water	Strontium-89	pCi/L	55.8	63.0	55.4 - 76.2	Acceptable
ERA	1st / 2016	2/25/2016	RAD-104	Water	Strontium-90	pCi/L	44.7	43.4	32.0 - 49.6	Acceptable
ERA	1st / 2016	2/25/2016	RAD-104	Water	Iodine-131	pCi/L	24.6	25.1	20.6 - 29.7	Acceptable
ERA	1st / 2016	2/25/2016	RAD-104	Water	Iodine-131	pCi/L	24.2	25.1	20.6 - 29.7	Acceptable
ERA	1st / 2016	3/14/2016	QR030716U	Water	Cesium-137	pCi/L	156	157	141-175	Acceptable

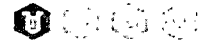


GEL QUARTERLY INTERLABORATORY COMPARISON

April through June, 2016



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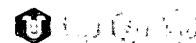
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F. 888-766-1117

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Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
1st/2016	05/16/15	E11445	Cartridge	pCi	Iodine-131	9.39E+01	8.66E+01	1.06	Acceptable
1st/2016	05/16/15	E11446	Milk	pCi/L	Strontium-89	8.16E+01	8.67E+01	0.94	Acceptable
1st/2016	05/16/15	E11446	Milk	pCi/L	Strontium-90	1.08E+01	1.14E+01	0.95	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Iodine-131	9.41E+01	8.22E+01	1.15	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Cerium-141	1.05E+02	9.84E+01	1.07	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Chromium-51	2.69E+02	2.43E+02	1.11	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Cesium-134	1.13E+02	1.30E+02	0.87	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Cesium-137	1.64E+02	1.61E+02	1.02	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Cobalt-58	1.16E+02	1.17E+02	0.99	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Manganese-54	1.24E+02	1.17E+02	1.05	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Iron-59	1.47E+02	1.31E+02	1.12	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Zinc-65	1.98E+02	1.79E+02	1.11	Acceptable
1st/2016	05/16/15	E11447	Milk	pCi/L	Cobalt-60	2.59E+02	2.44E+02	1.06	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Iodine-131	9.92E+01	9.67E+01	1.03	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Cerium-141	1.40E+02	1.39E+02	1.01	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Chromium-51	3.95E+02	3.66E+02	1.08	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Cesium-134	1.12E+02	1.26E+02	0.89	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Cesium-137	1.69E+02	1.67E+02	1.01	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Cobalt-58	1.78E+02	1.80E+02	0.99	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Manganese-54	1.66E+02	1.59E+02	1.05	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Iron-59	2.14E+02	1.95E+02	1.01	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Zinc-65	3.25E+02	2.99E+02	1.09	Acceptable
1st/2016	05/16/15	E11448	Water	pCi/L	Cobalt-60	3.23E+02	3.28E+02	0.98	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Niobium-95	4.01E+03	3.62E+03	1.11	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Zirconium-95	9.79E+03	9.48E+03	1.03	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Tc-99M	1.34E+03	1.32E+03	1.02	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Ruthenium-103	6.33E+03	6.23E+03	1.02	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Iodine-131	4.64E+03	4.83E+03	0.95	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Iodine-132	1.39E+03	1.62E+03	0.85	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Tellurium-132	1.81E+03	1.50E+03	1.21	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Cesium-137	7.79E+01	7.31E+01	1.07	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Barium-140	1.89E+04	1.85E+04	1.02	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Lanthanum-140	2.11E+04	2.06E+04	1.03	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Cerium-141	1.43E+04	1.39E+04	1.03	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Cerium-144	2.20E+03	2.08E+03	1.05	Acceptable
1st/2016	05/16/15	E11449	Water	pCi/L	Neodymium-147	6.40E+03	6.19E+03	1.03	Acceptable



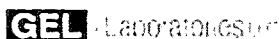
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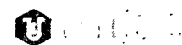
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2nd/2016	06/02/16	MAPEP-16-GF34	Filter	Bq/sample	Gross Alpha	1.41	1.20	0.36-2.04	Acceptable
2nd/2016	06/02/16	MAPEP-16-GF34	Filter	Bq/sample	Gross Beta	0.897	0.790	0.40-1.19	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Americium-241	111	103.0	72-134	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Cesium-134	953	1030	721-1339	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Cesium-137	2.57		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Cobalt-57	1030.000	992	694-1290	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Cobalt-60	1270	1190	833-1647	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Iron-55	197	428	300-556	Not Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Manganese-54	1230	1160	812-1508	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Nickel-63	1240	1250	875-1625	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Plutonium-238	60.1	63.6	44.5-82.7	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Plutonium-239/240	1.15	0.21	Sens. Eval.	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Potassium-40	680	607	425-789	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Strontium-90	-3.40		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Technetium-99	32		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	U-234/233	49.0	45.9	32.1-59.7	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Uranium-238	143	146	102-190	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3034	Soil	Bq/Kg	Zinc-65	785.0	692	484-900	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Americium-241	0.0113		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Cesium-134	15.0	16.1	11.3 - 20.9	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Cesium-137	21.8	21.2	14.8 - 27.6	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Cobalt-57	0.000		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Cobalt-60	12.2	11.8	8.3 - 15.3	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Hydrogen-3	0.878		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Iron-55	18.3	16.2	11.3 - 21.1	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Manganese-54	11.4	11.1	7.8 - 14.4	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Nickel-63	12.0	12.3	8.6 - 16.0	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Plutonium-238	1.14	1.244	0.871 - 1.617	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Plutonium-239/240	0.566	0.641	0.449 - 0.833	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Potassium-40	272	251	176 - 326	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Radium-226	1.45	0.718	0.503 - 0.933	Not Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Strontium-90	7.12	8.74	6.12 - 11.36	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Technetium-99	0.0453		False Pos Test	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Uranium-234/233	1.37	1.48	1.04 - 1.92	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Uranium-238	1.43	1.53	1.07 - 1.59	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Zinc-65	14.3	13.6	9.5 - 17.7	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Gross Alpha	0.957	0.67	0.202-1.144	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Gross Beta	2.390	2.150	1.69-3.23	Acceptable
2nd/2016	06/02/16	MAPEP-16-M3W34	Water	Bq/L	Iodine-129	4.00	3.85	2.70-5.01	Acceptable
2nd/2016	06/02/16	MAPEP-16-R6F34	Filter	ug/sample	Uranium-235	0.091	0.101	0.071 - 0.131	Acceptable



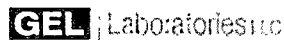
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2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	ug/sample	Uranium-238	13.9	13.8	9.7 - 17.9	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	ug/sample	Uranium-Total	14.0	13.9	9.7 - 18.1	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Americium-241	0.0751	0.0305	0.0564 - 0.1047	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Cesium-134	-0.0349		False Pos Test	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Cesium-137	2.37	2.30	1.61 - 2.99	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Cobalt-57	3	2.94	2.06 - 3.82	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Cobalt-60	4.17	4.02	2.81 - 5.23	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Manganese-54	4.60	4.53	3.17 - 5.89	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Plutonium-238	0.0593	0.0537	0.0446 - 0.0628	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Plutonium-239/240	0.0889	0.099	0.069 - 0.129	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Strontium-90	1.01	1.38	0.97 - 1.79	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Uranium-234/233	0.170	0.165	0.116 - 0.215	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Uranium-238	0.179	0.172	0.120 - 0.224	Acceptable
2nd/2016	06/02/16	MAFEP-16-RdF34	Filter	Bq/sample	Zinc-65	3.52	3.57	2.50 - 4.64	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Americium-241	0.101	0.059	0.052 - 0.116	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Cesium-134	9.49	10.62	7.43 - 13.81	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Cesium-137	5.50	5.62	3.93 - 7.31	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Cobalt-57	12.0	11.8	8.3 - 15.3	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Cobalt-60	-0.0339		False Pos Test	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Manganese-54	-0.00655		False Pos Test	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Plutonium-238	0.0929	0.105	0.074 - 0.137	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Plutonium-239/240	0.0801	0.092	0.054 - 0.120	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Strontium-90	-0.03648		False Pos Test	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Uranium-234/233	0.204	0.195	0.137 - 0.255	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Uranium-238	0.225	0.204	0.143 - 0.265	Acceptable
2nd/2016	06/02/16	MAFEP-16-Rv34	Vegetation	Bq/sample	Zinc-65	10.3	9.6	6.7 - 12.5	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Actinium-228	1320	1240	795 - 1720	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Americium-241	1410	1350	795 - 1770	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Bismuth-212	1220	1240	330 - 1820	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Bismuth-214	4130	3530	2130 - 5080	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Cesium-134	3500	3450	2260 - 4140	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Cesium-137	4510	4310	3300 - 5550	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Cobalt-60	5760	5490	3710 - 7560	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Lead-212	1350	1240	812 - 1730	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Lead-214	4590	3710	2170 - 5530	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Manganese-54	<54.7	<1000	<1000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Plutonium-238	585	658	356 - 908	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Plutonium-239	477	495	324 - 685	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Potassium-40	10900	10500	7740 - 14200	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Strontium-90	7120	6550	3250 - 13500	Acceptable



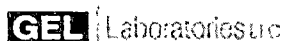
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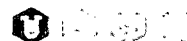
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2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Thorium-234	3590	3430	1050 - 6450	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-234	3940	3460	2110 - 4430	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-234	2334	3460	2110 - 4430	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-234	3460	3460	2110 - 4430	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-238	3540	3430	2120 - 4350	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-238	2757	3430	2120 - 4350	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-238	3340	3430	2120 - 4350	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-Total	7428	7050	3820 - 9300	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-Total	5091	7050	3820 - 9300	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Uranium-Total	7214	7050	3820 - 9300	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	µg/kg	Uranium-Total (mass)	10600	10300	5680 - 13000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	µg/kg	Uranium-Total (mass)	9790	10300	5680 - 13000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	µg/kg	Uranium-Total (mass)	8450	10300	5680 - 13000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	µg/kg	Uranium-Total (mass)	9370	10300	5680 - 13000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	µg/kg	Uranium-Total (mass)	9790	10300	5680 - 13000	Acceptable
2nd/2016	05/13/16	MRAD-24	Soil	pCi/kg	Zinc-65	2730	2450	1950 - 3260	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Americium-241	2240	2120	1300 - 2820	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Cesium-134	1070	1070	687 - 1350	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Cesium-137	941	838	608 - 1170	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Cobalt-60	1300	1160	759 - 1540	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Curium-244	1310	1560	764 - 2430	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Manganese-54	<34.1	<300	<300	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Plutonium-238	2620	2810	1680 - 3850	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Plutonium-239	3360	3640	2230 - 5010	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Potassium-40	38100	31000	22400 - 43500	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Strontium-90	8370	8710	4950 - 11500	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Uranium-234	4320	4160	2740 - 5340	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Uranium-238	4430	4120	2750 - 5230	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Uranium-Total	9040	8470	5740 - 10500	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	µg/kg	Uranium-Total (mass)	12500	12400	8310 - 15700	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	µg/kg	Uranium-Total (mass)	13300	12400	8310 - 15700	Acceptable
2nd/2016	05/13/16	MRAD-24	Vegetation	pCi/kg	Zinc-65	3700	2820	2030 - 3960	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Americium-241	44.2	45.9	28.3 - 62.1	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Cesium-134	254	304	193 - 377	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Cesium-137	1060	1150	654 - 1510	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Cobalt-60	576	623	482 - 776	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Iron-55	94.9	126	39.1 - 246	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Manganese-54	<3.61	<50.0	<50.0	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Plutonium-238	60.8	70.5	48.3 - 92.7	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Plutonium-239	46.9	54.8	39.7 - 71.6	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Strontium-90	141	150	73.3 - 225	Acceptable



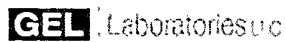
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2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-234	63.1	64.8	40.2 - 97.7	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-234	54.2	64.8	40.2 - 97.7	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-238	51.4	64.2	41.5 - 88.8	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-238	56.9	64.2	41.5 - 88.8	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-Total	117	132	73.1 - 201	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Uranium-Total	114	132	73.1 - 201	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	µg/Filter	Uranium-Total (mass)	156	192	123 - 270	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	µg/Filter	Uranium-Total (mass)	171	192	123 - 270	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	µg/Filter	Uranium-Total (mass)	154	192	123 - 270	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	µg/Filter	Uranium-Total (mass)	156	192	123 - 270	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Zinc-65	358	356	255 - 492	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Gross Alpha	79.5	70.1	23.5 - 109	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Gross Beta	63.5	54.4	34.4 - 79.3	Acceptable
2nd/2016	05/13/16	MRAD-24	Filter	pCi/Filter	Gross Beta	63.5	54.4	34.4 - 79.3	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Americium-241	134	121	81.5 - 162	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Cesium-134	813	842	618 - 956	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Cesium-137	1110	1100	934 - 1326	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Cobalt-60	1090	1050	912 - 1230	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Iron-55	1630	1650	984 - 2240	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Manganese-54	<6.38	<100	<100	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Plutonium-238	126	138	102 - 172	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Plutonium-239	88.2	98.7	76.6 - 124	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Strontium-90	472	434	283 - 574	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-234	59.3	52.7	39.6 - 68.0	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-234	49.9	52.7	39.6 - 68.0	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-234	49.8	52.7	39.6 - 68.0	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-238	54.1	52.3	39.9 - 64.2	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-238	53.7	52.3	39.9 - 64.2	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-238	49.1	52.3	39.9 - 64.2	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-Total	110.7	107	78.6 - 138	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-Total	158	107	78.6 - 138	Not Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-Total	106.4	107	78.6 - 138	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Uranium-Total	103.9	107	78.6 - 138	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	µg/L	Uranium-Total (mass)	160.9	157	125 - 190	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	µg/L	Uranium-Total (mass)	147	157	125 - 190	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	µg/L	Uranium-Total (mass)	161	157	125 - 190	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Zinc-65	1130	1010	842 - 1270	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Gross Alpha	160	117	41.5 - 181	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Gross Beta	79.3	75.5	43.2 - 112	Acceptable
2nd/2016	05/13/16	MRAD-24	Water	pCi/L	Tritium	8470	8650	5800 - 12300	Acceptable



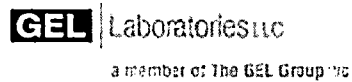
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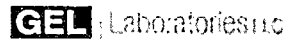
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2nd/2016	05/23/16	RAD-105	Water	pCi/L	Gross Alpha	72.6	62.7	32.9 - 77.8	Acceptable
2nd/2016	05/23/16	RAD-105	Water	pCi/L	Gross Alpha	74	62.7	32.9 - 77.8	Acceptable
2nd/2016	05/23/16	RAD-105	Water	pCi/L	Iodine-131	27.9	26.6	22.1 - 31.3	Acceptable



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GEL QUARTERLY INTERLABORATORY COMPARISON

July through September 2016



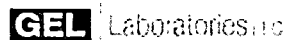
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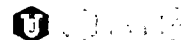
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PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	2nd/2016	07/27/16	E11573	Cartridge	pCi	Iodine-131	9.52E+01	8.94E+01	1.07	Acceptable
EZA	2nd/2016	07/27/16	E11574	Milk	pCi/L	Strontium-89	8.51E+01	9.44E+01	0.90	Acceptable
EZA	2nd/2016	07/27/16	E11574	Milk	pCi/L	Strontium-90	9.49E+01	1.54E+01	0.62	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Iodine-131	9.77E+01	9.45E+01	1.03	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Cesium-141	1.46E+02	1.39E+02	1.05	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Chromium-51	2.53E+02	2.76E+02	0.92	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Cesium-134	1.62E+02	1.74E+02	0.93	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Cesium-137	1.20E+02	1.20E+02	1.00	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Cobalt-59	1.39E+02	1.42E+02	0.98	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Manganese-54	1.26E+02	1.25E+02	1.00	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Iron-59	1.25E+02	1.22E+02	1.03	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Zinc-65	2.47E+02	2.35E+02	1.05	Acceptable
EZA	2nd/2016	07/27/16	E11575	Milk	pCi/L	Cobalt-60	1.72E+02	1.73E+02	1.00	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Iodine-131	1.02E+02	9.67E+01	1.05	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Cesium-141	1.56E+02	1.47E+02	1.06	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Chromium-51	3.33E+02	2.92E+02	1.14	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Cesium-134	1.65E+02	1.85E+02	0.89	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Cesium-137	1.34E+02	1.28E+02	1.05	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Cobalt-59	1.47E+02	1.51E+02	0.98	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Manganese-54	1.45E+02	1.33E+02	1.09	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Iron-59	1.54E+02	1.29E+02	1.19	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Zinc-65	2.72E+02	2.49E+02	1.09	Acceptable
EZA	2nd/2016	07/27/16	E11576	Water	pCi/L	Cobalt-60	1.99E+02	1.83E+02	1.09	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Barium-133	66.2	82.9	69.7 - 91.2	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Cesium-134	62.3	65.3	53.1 - 71.8	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Cesium-137	99.3	95.2	65.7 - 107	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Cobalt-60	123	117	105 - 131	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Zinc-65	116	113	102 - 134	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Gross Alpha	42.5	45.1	25.0 - 60.5	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Gross Alpha	48.7	48.1	25.0 - 60.5	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Gross Beta	27.3	28.6	18.2 - 35.4	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Radium-226	10.4	12.3	9.18 - 14.2	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Radium-226	10	12.3	9.18 - 14.2	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Radium-226	11.3	12.3	9.18 - 14.2	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Radium-228	5.89	5.75	3.51 - 7.57	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Radium-228	5.53	5.75	3.51 - 7.57	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Uranium (Nat)	35.4	35.2	28.4 - 39.3	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Uranium (Nat)	34.2	35.2	28.4 - 39.3	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	µCi/L	Uranium (Nat) in soil	51.1	51.3	41.4 - 57.3	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	µCi/L	Uranium (Nat) in soil	55.6	51.3	41.4 - 57.3	Acceptable



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ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Tritium	11600	12400	10500 - 13600	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Strontium-89	56.9	53.3	42.3 - 60.9	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Strontium-89	62.8	53.3	42.3 - 60.9	Not Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Strontium-90	39.1	39.2	26.8 - 45.1	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Strontium-90	35.1	39.2	26.8 - 45.1	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Iodine-131	27.3	24.9	20.7 - 29.5	Acceptable
ERA	3rd / 2016	08/30/16	RAD - 105	Water	pCi/L	Iodine-131	25.2	24.9	20.7 - 29.5	Acceptable



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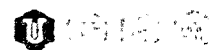
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GEL QUARTERLY INTERLABORATORY COMPARISON

October through December 2016



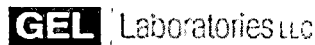
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PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	3rd/2016	11/28/16	E11605	Cartridge	pCi	Iodine-131	6.33E+01	6.01E+01	1.05	Acceptable
EZA	3rd/2016	11/28/16	E11606	Milk	pCi/L	Strontium-89	7.60E+01	9.02E+01	0.84	Acceptable
EZA	3rd/2016	11/28/16	E11606	Milk	pCi/L	Strontium-90	1.17E+01	1.37E+01	0.85	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Iodine-131	7.53E+01	7.19E+01	1.05	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Cerium-141	9.85E+01	9.32E+01	1.08	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Chromium-51	2.63E+02	2.36E+02	1.12	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Cesium-134	1.21E+02	1.36E+02	0.89	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Cesium-137	1.19E+02	1.19E+02	1.00	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Cobalt-58	9.56E+01	9.74E+01	0.98	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Manganese-54	1.61E+02	1.52E+02	1.06	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Iron-59	9.00E+01	9.06E+01	0.99	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Zinc-65	2.11E+02	1.79E+02	1.18	Acceptable
EZA	3rd/2016	11/28/16	E11607	Milk	pCi/L	Cobalt-60	1.44E+02	1.35E+02	1.07	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Iodine-131	5.53E+01	4.90E+01	1.13	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Cerium-141	9.49E+01	8.52E+01	1.11	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Chromium-51	2.03E+02	2.15E+02	0.95	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Cesium-134	1.20E+02	1.24E+02	0.97	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Cesium-137	1.15E+02	1.08E+02	1.06	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Cobalt-58	9.54E+01	8.90E+01	1.07	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Manganese-54	1.47E+02	1.39E+02	1.06	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Iron-59	8.73E+01	8.28E+01	1.05	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Zinc-65	1.79E+02	1.63E+02	1.10	Acceptable
EZA	3rd/2016	11/28/16	E11068	Water	pCi/L	Cobalt-60	1.26E+02	1.23E+02	1.02	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Americium-241	-0.563		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Cesium-134	3.74		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Cesium-137	1180	1067	747-1387	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Cobalt-57	1220	1190	833-1547	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Cobalt-60	889	851	586-1106	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Iron-55	-337		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Manganese-54	2.50		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Nickel-63	1020	990	693-1287	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Plutonium-239	69.0	70.4	49.3-91.5	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Plutonium-239/240	46.8	53.8	37.7-69.9	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Potassium-40	619	588	412-764	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Strontium-90	770	894	626-1162	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-	Soil	Bq/Kg	Technetium-99	548	556	389-723	Acceptable



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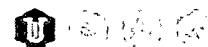
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			MaS35							
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	U-234/233	122	122	85-159	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Uranium-238	122	121	85-157	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaS35	Soil	Bq/Kg	Zinc-65	775.0	695	487-904	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Americium-241	0.725	0.814	0.570-1.058	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Cesium-134	22.20	23.9	18.7-31.1	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Cesium-137	-0.089		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Cobalt-57	27.6	27.3	19.1-35.5	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Cobalt-60	-0.001	0.0	False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Hydrogen-3	337	334	151-281	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Iron-55	22.3	21.5	15.1-28.0	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Manganese-54	14.7	14.8	10.4-19.2	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Nickel-63	17.0	17.2	12.0-22.4	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Plutonium-238	1.09	1.13	0.79-1.47	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Plutonium-239/240	0.024	0.013	Sens. Eval.	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Potassium-40	275	252	178-328	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Radium-226	1.02	1.33	0.93-1.73	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Strontium-90	-0.00289		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Technetium-99	10.90	11.60	8.1-15.1	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Uranium-234/233	1.85	1.98	1.30-2.42	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Uranium-238	1.890	1.920	1.34-2.50	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-MaW35	Water	Bq/L	Zinc-65	17.5	17.4	12.2-22.6	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-XaW35	Alk. Water	Bq/L	Iodine-129	0.425	0.429	0.129-0.729	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	ug/sample	Uranium-235	0.0915	0.0903	0.0632-0.1174	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	ug/sample	Uranium-238	13.0	12.5	8.8-16.3	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	ug/sample	Uranium-Total	13.60	12.6	8.8-16.4	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	ug/sample	Americium-241	0.000067		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Cesium-134	1.7500	2.04	1.43-2.65	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Cesium-137	1.89	1.78	1.25-2.31	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Cobalt-57	2.48	2.49	1.74-3.22	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Cobalt-60	3.30	3.26	2.28-4.24	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Manganese-54	2.87	2.75	1.93-3.59	Acceptable



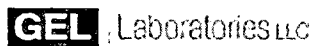
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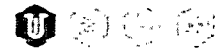
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			RdF35							
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Plutonium-238	0.0694	0.0693	0.0485-0.0901	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Plutonium-239/240	0.0508	0.0535	0.0375-0.0696	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Strontium-90	0.726	1.03	0.72-1.34	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Uranium-234/233	0.150	0.150	0.105-0.195	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Uranium-238	0.152	0.156	0.102-0.203	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdF35	Filter	Bq/sample	Zinc-65	0.0232		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Americium-241	0.052	0.062	0.076-0.140	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Cesium-134	0.0307		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Cesium-137	5.8100	5.51	3.88-7.20	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Cobalt-57	6.920	6.81	4.77-8.85	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Cobalt-60	4.950	4.88	3.40-6.32	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Manganese-54	7.800	7.27	5.09-9.45	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Plutonium-238	0.078300	0.0820	0.57-0.107	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Plutonium-239/240	0.00151		False Pos Test	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Strontium-90	0.575	0.80	0.58-1.04	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Uranium-234/233	0.114	0.117	0.082-0.152	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Uranium-238	0.125	0.122	0.085-0.159	Acceptable
MAPEP	4th/2016	12/02/16	MAPEP-16-RdV35	Vegetation	Bq/sample	Zinc-65	5.870	5.40	3.78-7.02	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Actinium-228	1140	1170	750 - 1620	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Americium-241	1040	878	514 - 1140	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Bismuth-212	1500	1280	341 - 1880	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Bismuth-214	1350	1230	741 - 1770	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Cesium-134	5450	5470	3580 - 6570	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Cesium-137	7230	6700	5130 - 8620	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Cobalt-60	8490	8020	5420 - 11000	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Lead-212	1230	1200	786 - 1670	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Lead-214	1480	1280	747 - 1810	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Manganese-54	<51.2	<1000	<1000	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Plutonium-238	587	647	389 - 893	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Plutonium-239	561	525	343 - 725	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Potassium-40	11000	10800	7740 - 14200	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Strontium-90	3740	4540	1730 - 7170	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Thorium-234	2120	1750	553 - 3290	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-234	1650	1760	1080 - 2260	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-234	1230	1760	1080 - 2260	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-234	2220	1760	1080 - 2260	Acceptable



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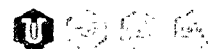
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ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-235	1630	1750	1080 - 2220	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-238	1290	1750	1080 - 2220	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-238	1550	1750	1080 - 2220	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-Total	3810	3580	1950 - 4740	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-Total	3310	3580	1950 - 4740	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-Total	2520	3580	1950 - 4740	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Uranium-Total	3930	3580	1950 - 4740	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	µg/kg	Uranium-Total (mass)	4890	5240	2890 - 6590	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	µg/kg	Uranium-Total (mass)	5840	5240	2890 - 6590	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	µg/kg	Uranium-Total (mass)	3780	5240	2890 - 6590	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	µg/kg	Uranium-Total (mass)	4670	5240	2890 - 6590	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Soil	pCi/kg	Zinc-65	3310	2920	2330 - 3880	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Americium-241	1520	1530	935 - 2030	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Cesium-134	1640	1690	1080 - 2200	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Cesium-137	1170	1030	747 - 1430	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Cobalt-60	1680	1560	1080 - 2180	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Curium-244	496	530	280 - 826	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Manganese-54	<29.6	<300	<300	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Plutonium-238	1440	1330	793 - 1820	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Plutonium-239	1230	1100	675 - 1510	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Potassium-40	31400	30900	22300 - 43400	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Strontium-90	4290	4670	2680 - 6190	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-234	3730	3110	2040 - 3990	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-234	3430	3110	2040 - 3990	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-238	3490	3090	2060 - 3930	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-239	3370	3090	2060 - 3930	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-Total	7248	6340	4300 - 7890	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-Total	6680	6340	4300 - 7890	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Uranium-Total	7190	6340	4300 - 7890	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	µg/kg	Uranium-Total (mass)	9980	9250	6200 - 11700	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	µg/kg	Uranium-Total (mass)	10500	9250	6200 - 11700	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	µg/kg	Uranium-Total (mass)	10100	9250	6200 - 11700	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Vegetation	pCi/kg	Zinc-65	2090	1690	1220 - 2370	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Americium-241	44	42.3	26.1 - 57.2	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Cesium-134	614	614	391 - 762	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Cesium-137	1280	1170	879 - 1540	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Cobalt-60	950	900	696 - 1120	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Iron-55	232	248	76.9 - 485	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Manganese-54	<4.55	<50.0	<50.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Plutonium-238	54.5	61.9	42.4 - 81.4	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Plutonium-239	54.8	59.7	43.2 - 78.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Strontium-90	97.4	101	49.4 - 151	Acceptable



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ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-234	30.3	29.2	18.1 - 44.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-234	30.9	29.2	19.1 - 44.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-238	27.9	28.9	18.7 - 40.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-238	29.4	28.9	18.7 - 40.0	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-Total	54.1	59.5	32.9 - 90.5	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-Total	61.5	59.5	32.9 - 90.5	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Uranium-Total	60	59.5	32.9 - 90.5	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	µg/Filter	Uranium-Total (mass)	83.7	86.7	55.5 - 122	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	µg/Filter	Uranium-Total (mass)	80.7	86.7	55.5 - 122	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	µg/Filter	Uranium-Total (mass)	88.3	86.7	55.5 - 122	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	µg/Filter	Uranium-Total (mass)	80.7	86.7	55.5 - 122	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Zinc-65	1330	1150	824 - 1590	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Gross Alpha	79.6	71.2	23.9 - 111	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Filter	pCi/Filter	Gross Beta	71.7	60.3	39.1 - 87.9	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Americium-241	58.8	56.2	37.9 - 75.4	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Cesium-134	1190	1260	925 - 1450	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Cesium-137	1030	987	838 - 1180	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Cobalt-60	1990	1960	1700 - 2290	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Iron-55	228	245	146 - 332	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Manganese-54	<5.09	<100	<100	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Plutonium-239	85.6	112	82.9 - 139	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Plutonium-239	125	157	122 - 198	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Strontium-90	658	751	489 - 993	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-234	106	105	78.9 - 135	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-234	109	105	78.9 - 135	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-234	103	105	78.9 - 135	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-238	98.4	104	79.3 - 128	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-Total	209	213	157 - 275	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-Total	225	213	157 - 275	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-Total	214	213	157 - 275	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Uranium-Total	211	213	157 - 275	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	µg/L	Uranium-Total (mass)	295	311	248 - 376	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	µg/L	Uranium-Total (mass)	317	311	248 - 376	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	µg/L	Uranium-Total (mass)	336	311	248 - 376	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	µg/L	Uranium-Total (mass)	312	311	248 - 376	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Zinc-65	807	724	604 - 913	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Gross Alpha	207	165	58.8 - 258	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Gross Beta	119	130	74.4 - 193	Acceptable
ERA	4th/2016	11/23/16	MRAD-25	Water	pCi/L	Tritium	9210	10100	6770 - 14400	Acceptable

APPENDIX D. COMPARISON OF OPERATIONAL TO PREOPERATIONAL DATA

Comparison of Operational to Preoperational Data and Analysis of Trends

Unit 1 achieved criticality on June 14, 1967 and was permanently retired from service on November 30, 1992. Unit 2 attained initial criticality on July 26, 1982 and Unit 3 on August 29, 1983.

A variety of environmental samples were analyzed and the analytical results (January 1, 1979 to July 31, 1982) were compared with the 2016 operational data obtained for SONGS Units 2/3.

The following media were evaluated and compared with the operational data of SONGS Units 1, 2 and 3:

- External Radiation
- Air Particulates
- Radioiodine
- Ocean Water
- Shoreline Sediment (Sand)
- Ocean Bottom Sediments
- Marine Species
- Local Crops
- Soil
- Kelp
- Drinking Water

All of the measurements obtained from the SONGS Unit 1 operational Radiological Environmental Monitoring Program (REMP) during the period from January 1979 to July 1982 are used as the preoperational baseline for SONGS Units 2/3. This is in accordance with San Onofre Units 2/3, Environmental Report, Operating License Stage, Appendix 6A, Pre-operational Radiological Environmental Monitoring, May 31, 1978. Comparisons of preoperational data to 2016 operational data are possible for each of the following exposure pathways: (1) direct radiation, (2) air particulates (inhalation), and (3) ocean water (marine pathway for ingestion). Comparisons can also be made between preoperational and operational data for ocean bottom sediment data to ascertain if there has been any significant increase in radioactivity in ocean bottom sediments in the vicinity of the SONGS Units 2/3 outfalls.

Currently the preoperational data are higher than the operational data. The decrease in radioactivity is due primarily to the cessation of nuclear weapons testing and to the decay of fallout radionuclides. There is a close correlation between indicator and control data over several decades. There are no indications of adverse effects from SONGS on the environment.

A. Direct Radiation

The direct radiation measurements for the SONGS REMP were made by TLDs on a quarterly collection cycle at 38 indicator locations and 11 control locations in 2016. (See Appendix I for ISFSI TLD data). The TLDs were located at a number of inner and outer ring locations as specified by the ODCM. During the preoperational period from January 1979 to July 31, 1982, the indicator stations ranged from 16.1 to 46.6 mR. The preoperational indicator average was 25.3 mR. The preoperational control range was 19.3 to 30.1 and the control mean was 23.1 mR. During the 2016 operational year for Units 2/3, the routine indicator TLD locations ranged from 11.3 to 23.6 mrem, averaging 16.91 mrem while the control

locations ranged from 13.8 to 21.6 mrem with an average of 17.2 mrem. Outside the EAB, all TLD results (control and indicator, for quarterly and annual measurements) are below each locations historical background plus the minimum differential dose (see ANSI/HPS N13.37-2014). Refer to Appendix B for a detailed discussion of the REMP TLD data.

Factors such as meteorology, local geology, the fallout from atmospheric nuclear weapons testing, and seasonal fluctuations account for the variability in the data as observed during the preoperational period for each location. The decrease in radiation levels at all TLD sample locations is attributable to the curtailment of the atmospheric nuclear weapons testing, and the continued decay of the manmade background from fallout from past nuclear weapons tests.

Figure 9 compares the environmental radiation levels of selected indicator and control locations. Simultaneous variation in the radiation levels at both the control and indicator locations shows that the variations are due to factors external to SONGS. Outside the EAB there were no measurable levels of increased direct radiation associated with SONGS as measured by TLD.

B. Airborne Particulates

From January 1979 through July 1982 (considered to be the preoperational period for SONGS Units 2/3), there was a noticeably higher gross beta activity in air at all sample locations. This period extends from the fourth quarter of 1980 through the fourth quarter of 1981. These higher activity levels were attributable to the Chinese atmospheric nuclear weapons test conducted on October 15, 1980.

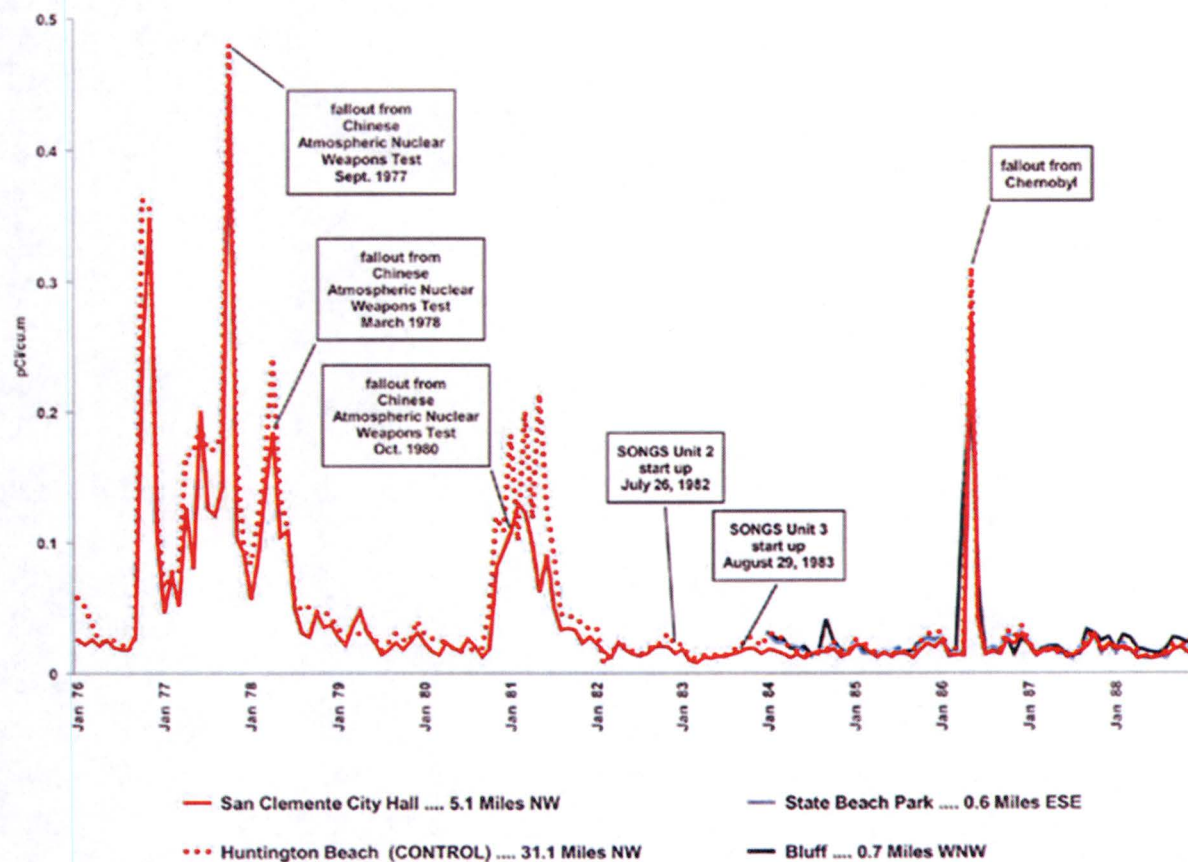


Figure 12 – Monthly Average Airborne Particulate Gross Beta Preoperational and Operational Data for Units 2 and 3, (1976 – 1988)

For 2016, the maximum monthly average airborne particulate gross beta result was approximately 0.027 pCi/m³. This result is in line with both recent history and SONGS preoperational data.

C. Radioiodine

Most of the preoperational data for I-131 level were below the detection limit. All of the 2016 operational I-131 data were below the detection limit. This is expected, as the shutdown and defueled SONGS is no longer producing I-131, and all previously produced I-131 has decayed away. SONGS had no effect on the environment as measured by the radioiodine cartridge data in 2016.

D. Ocean Water

Ocean water samples were collected on a monthly basis in the vicinity of each of the Station discharge outfalls, and from the Newport Beach control location. The ocean water samples are analyzed for naturally-occurring and station-related gamma-emitting radionuclides. Samples composited quarterly and analyzed for tritium.

During the preoperational period, naturally occurring potassium-40 was detected in each of the samples collected from both indicator and control locations. Other gamma-emitting radionuclides were detected in only one ocean water sample. In May 1980, Co-58, Co-60, Cs-134, and Cs-137 were detected in an ocean water sample collected from the SONGS Unit 1 outfall. Concentrations of the radionuclides in this sample were 11, 6, 380, and 430 pCi/l, respectively. Tritium was also detected in two of the ocean

water samples collected in May 1980 from the SONGS Unit 2 outfall and from the Newport Beach control location.

The data for all plant related radionuclides at all ocean water locations during the 2016 operational period were not detectable and below the MDC. We conclude that the operation of SONGS had a negligible impact on the environment as measured by this sample medium.

E. Drinking Water

Due to its location on the beach, there is no drinking water pathway for SONGS. Nonetheless, drinking water samples from Oceanside and Camp Pendleton were collected and analyzed. No plant related radionuclides were detected during the 2016 operational period. Gross beta activity (from natural radionuclides) was detected during both the operational and preoperational periods at both the indicator and the control locations. No plant related radionuclides (including tritium) have been identified in 2016, and no trends have been noted. The operation of SONGS had no impact on the environment as measured by this exposure pathway.

F. Shoreline Sediments (Sand)

Beach sand is collected semiannually from three indicator locations and from a control location situated at Newport Beach. The samples are analyzed for naturally occurring and plant-related radionuclides.

To assess the impact of SONGS operations on this environmental medium, preoperational data were compared to 2016 operational data. The radionuclide detected in shoreline sediment in the preoperational time frame was Cs-137 with a range of 0.012 to 0.022 pCi/g, averaging 0.019 in 5 sediment samples. One control sample with a Cs-137 activity of 0.032 pCi/g was observed in July 1979. The presence of Cs-137 in both control and indicator locations during the preoperational period leads to the conclusion that the root cause is external to SONGS and is most likely attributable to atmospheric nuclear weapons testing. No SONGS-related radionuclides were detected in shoreline sediment during the 2016 operational period. Thus the impact of SONGS on the environment as measured by the shoreline sediment is considered to be no different than that of natural background.

Table 30 - Shoreline Sediment Concentration

Radionuclide	Period ^a	INDICATOR		CONTROL	
		Range ^b (pCi/g, wet)	Average (pCi/g, wet)	Range (pCi/g, wet)	Average (pCi/g, wet)
Cs-137	PreOp Operational	0.012 - 0.022 < LLD	0.019 < LLD	< LLD - 0.032 < LLD	< LLD < LLD
All other SONGS radionuclides	PreOp Operational ^c	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD

NOTES:

- Preoperational period is January 1979 – July 1982. Operational period is January 2016 – December 2016
- LLD for operational data are listed in Appendix B
- During 2016, all station related radionuclides from all sample locations were < LLD

G. Ocean Bottom Sediments

During the preoperational and operational periods, representative samples of ocean bottom sediments were collected semiannually from each of the Station discharge outfalls and from a control station in Laguna Beach. The samples were analyzed for naturally occurring and SONGS related radionuclides.

During the preoperational period, Manganese-54 (Mn-54) was detected in 5 of the 28 samples. The concentrations of Mn-54 in these samples ranged from 0.015 to 0.49 pCi/g, averaging 0.13 pCi/g. Cobalt-58 (Co-58) was detected in nine samples. The concentration of Co-58 in the samples ranged from 0.013 to 1.16 pCi/g, averaging 0.20 pCi/g. Cobalt-60 (Co-60) was measured in 15 of the 28 samples. The concentration of Co-60 in the sample ranged from 0.014 to 8.1 pCi/g, averaging 0.79 pCi/g. Cs-137 was also detected in 16 of the 28 samples. The concentrations of Cs-137 in the samples ranged from 0.014 to 0.090 pCi/g, averaging 0.039 pCi/g. Cerium-144 (Ce-144) was found in two samples. The concentration of Ce-144 in the samples was 0.06 and 0.26 pCi/g, respectively.

Results of the 2016 data indicate that there has not been a build-up of radionuclides with time in ocean bottom sediments near SONGS. The results also indicate notable decrease in the concentrations of plant-related radionuclides in the ocean bottom sediment. Although Co-58, Co-60, and Cs-137 are normally associated with nuclear power operations, preoperational study reveals no accumulation trend for these radionuclides, and no increase in levels for these radionuclides was detected during the operational period.

The concentration of station-related radionuclides in all ocean bottom sediment samples analyzed in 2016 was below the MDC, supporting the conclusion of no detectable impact on ocean bottom sediments from SONGS.

Table 31 - Ocean Bottom Sediment Concentration

		INDICATOR		CONTROL	
Radionuclide	Period ^a	Range ^b (pCi/g, wet)	Average ^b (pCi/g, wet)	Range (pCi/g, wet)	Average (pCi/g, wet)
Mn-54	PreOp Operational	0.015 - 0.49 < LLD	0.129 < LLD	< LLD < LLD	< LLD < LLD
Co-58	PreOp Operational	0.013 - 1.160 < LLD	0.199 < LLD	< LLD < LLD	< LLD < LLD
Co-60	PreOp Operational	0.014 - 8.100 < LLD	0.788 < LLD	< LLD < LLD	< LLD < LLD
Ag-110m	PreOp Operational	< LLD - 0.020 < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.014 - 0.090 < LLD	0.039 < LLD	< LLD < LLD	< LLD < LLD
Ce-144	PreOp Operational	0.060 - 0.260 < LLD	0.160 < LLD	< LLD < LLD	< LLD < LLD
All other SONGS radionuclides	PreOp Operational ^c	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD

NOTES:

- a Preoperational period is January 1979 – July 1982. Operational period is January 2016 – December 2016
- b LLD for operational data are listed in Appendix B
- c During 2016, all station related radionuclides from all sample locations were < LLD

H. Marine Species (Flesh)

Non-migratory marine species are collected semi-annually near SONGS. As a norm, marine species caught by the SONGS outfalls and from Laguna Beach include various species of adult fish, crustacean and mollusks. Upon collection the flesh portion is analyzed for gamma-emitting radionuclides as specified in the ODCM. The results are subsequently reported as pCi/g, wet weight.

Results for several marine species for both the preoperational and 2016 operational periods for Units 2/3 are summarized in Table 32. The marine species used for purposes of comparison include: Sheephead (a fish), Blacksmith (a fish), Black Perch (a fish), Bay Mussel (a mollusk), and Spiny Lobster (a crustacean). Radionuclides analyzed but not included in Table 32 were below the lower limits of detection for both the preoperational and operational periods.

During the 2016 operational period, no SONGS related radionuclides were detected above the MDC. The data indicate no accumulation trends. The operation of SONGS Units 2/3 in 2016 had no impact on the environment as measured by this exposure pathway.

Table 32 - Marine Species Concentration

		INDICATOR		CONTROL	
Radionuclide	Period ^a	Range (pCi/g, wet)	Average (pCi/g, wet)	Range (pCi/g, wet)	Average (pCi/g, wet)
Sheephead Flesh ^d					
Co-58	PreOp Operational	0.016 - 0.030 < LLD	0.023 < LLD	< LLD < LLD	< LLD < LLD
Co-60	PreOp Operational	0.005 - 0.044 < LLD	0.017 < LLD	< LLD < LLD	< LLD < LLD
Ag-110m	PreOp Operational	< LLD - 0.004 < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.004 - 0.018 < LLD	0.007 < LLD	0.005 - 0.012 < LLD	0.007 < LLD
All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Black Perch Flesh ^e					
Co-58	PreOp Operational	0.009-0.011 N/A	0.010 N/A	< LLD N/A	< LLD N/A
Co-60	PreOp Operational	0.004-0.045 N/A	0.017 N/A	< LLD N/A	< LLD N/A
Ag-110m	PreOp Operational	0.002-0.009 N/A	0.006 N/A	< LLD N/A	< LLD N/A
Cs-137	PreOp Operational	0.003-0.015 N/A	0.008 N/A	0.004-0.014 N/A	0.009 N/A

All other SONGS radionuclides	PreOp Operational	< LLD N/A	< LLD N/A	< LLD N/A	< LLD N/A
Mussel Flesh (Bay or California) ^d					
Mn-54	PreOp Operational	0.009 - 0.025 < LLD	0.017 < LLD	< LLD < LLD	< LLD < LLD
Co-58	PreOp Operational	0.008 - 0.080 < LLD	0.028 < LLD	-- < LLD	-- < LLD
Co-60	PreOp Operational	0.005 - 0.400 < LLD	0.077 < LLD	< LLD < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.003 - 0.006 < LLD	0.004 < LLD	< LLD < LLD	< LLD < LLD
Ru-103	PreOp Operational	< LLD - 0.045 < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Spiny Lobster Flesh (Bay or California) ^d					
Co-58	PreOp Operational	0.007 - 0.270 < LLD	0.086 < LLD	< LLD < LLD	< LLD < LLD
Co-60	PreOp Operational	0.014 - 0.210 < LLD	0.060 < LLD	< LLD < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.005 - 0.011 < LLD	0.008 < LLD	0.040 - 0.015 < LLD	0.008 < LLD
All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD

NOTES:

- a Preoperational period is January 1979 – July 1982. Operational period is January 2016 – December 2016
- b LLD for operational data are listed in Appendix B
- c During 2016, all station related radionuclides from all sample locations were < LLD
- d Species collected in 2016 include California Mussel, Sheephead, Kelp Bass, Keyhole Limpet and Spiny Lobster
- e Black perch was not collected in 2016

I. Local Crops

In the preoperational period of January 1979 through July 1982, Sr-90 was detected in the control samples of kale, parsley, and squash. Naturally occurring K-40 was detected in cucumber, kale, and tomato samples from the indicator and control locations. Ce-144 and Zr-95 were detected in one sample of parsley at the control location at concentrations of 0.12 and 0.09 pCi/g, wet weight respectively.

During 2016, only natural radionuclides were identified in local crops, at both the indicator and control locations. The operation of SONGS had no impact on the environment as measured by this exposure pathway.

J. Soil

A comparison of operational and preoperational data does not reveal any accumulation pattern of SONGS related isotopes in soil. The intermittent detection of Cs-137 in both indicator and control locations is due to residual fallout from atmospheric nuclear weapons testing.

The operation of SONGS had no impact on the environment as measured by this exposure pathway.

Table 33 - Soil Concentration

Radionuclide	Period	Indicator		Control	
		Range (pCi/g)	Average (pCi/g)	Range (pCi/g)	Average (pCi/g)
Sr-90	PreOp Operational	0.02 - 0.08 < LLD	0.044 < LLD	< LLD - 0.03 < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.02 - 0.20 < LLD - 0.17	0.096 0.17	< LLD - 0.06 < LLD - 0.104	< 0.10 0.104
All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD

K. Kelp

Kelp is collected semiannually from three indicator locations and from a control location situated at Salt Creek. After collection, the samples are analyzed by gamma-spectral analysis for naturally-occurring and SONGS-related radionuclides.

To assess the impact of SONGS operations on kelp, preoperational data were compared to 2016 operational data in Table 34. Radionuclides detected during the preoperational period for SONGS Units 2/3 include Mn-54, Co-60, Zr-95, I-131, and Cs-137.

During the 2016 operational period, I-131 was detected in two indicator samples. No other station related isotopes were detected in kelp samples during the 2016 operational period. Figure 10 shows a close correlation between indicator and control sample locations over an extended period of time.

Although I-131 activity has been detected in kelp since 1977, there is no evidence that the concentration of I-131 or other station related radionuclides are a result of operations at SONGS. The presence of I-131 in kelp is apparently due to the sewer release of medical administrations of radioisotopes, since it has been detected consistently in control as well as indicator locations. Since 1988 the concentration of I-131, when detected, has typically been highest at the control locations.

Table 34 - Kelp Concentration

Radionuclide	Period	Indicator		Control	
		Range (pCi/g)	Average (pCi/g)	Range (pCi/g)	Average (pCi/g)
Mn-54	PreOp Operational	< LLD - 0.005 < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Co-60	PreOp Operational	0.006 - 0.009 < LLD	0.008 < LLD	< LLD < LLD	< LLD < LLD
Zr(Nb)-95	PreOp Operational	0.014 - 0.090 < LLD	0.046 < LLD	0.018 - 0.053 < LLD	0.036 < LLD

I-131	PreOp Operational	0.006 - 0.024 0.013 – 0.019	0.013 0.016	0.008 - 0.030 0.013 – 0.013	0.014 0.013
Cs-137	PreOp Operational	0.004 - 0.071 < LLD	0.027 < LLD	< LLD < LLD	< LLD < LLD
All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD

These data support the conclusion that during the Units 2/3 operational period, the detection of I-131 in kelp is due to factors external to SONGS. Moreover, with the permanent shutdown of both Units 2 and 3, the production of I-131 ceased. With a short 8 day half-life, SONGS can no longer contribute I-131 to the environment.

APPENDIX E. DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS IN 2016

DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS

Deviations from the ODCM sampling requirements are identified below in accordance with section 5.0 of the ODCM. The performance standard for environmental data collection of 95% was met for all sample types. During 2016, the ODCM specified a priori LLD was achieved for all REMP samples. Deviations from the ODCM were associated with external factors not within the control of REMP personnel such as limited availability of marine samples at the locations specified in the ODCM. The 2016 ODCM deviations had no meaningful impact on the REMP database and did not compromise the validity of the reported conclusions.

A. Direct Radiation

Thermoluminescent Dosimeters (TLDs)

1. During the 3rd quarter Environmental TLD change out, it was determined the TLD #46 (San Onofre State Beach) for 2016 2nd quarter was missing. Based on investigation, it was determined that there were several storm surges which washed the staked TLD away. Re-established the TLD's location per site procedures. (NN# 203365183)
2. During the 4th quarter Environmental TLD change out, TLD #46 was missing. Unknown person had cut the otter box off the pole and took the TLD with it. Replaced a less desirable container and placed the 4th quarter TLD inside it. (NN# 203388253)
3. The 2nd quarter Environmental TLDs were lost during shipment to the vendor that performs the analysis. A lost package trace was initiated and the Environmental TLDs were located on August 12, 2016. All the TLDs were accounted for and reshipped overnight back to vendor on August 16, 2016. The TLDs were analyzed and compared to historical data. There was very little deviation based on the historical data. (NN# 203369070)

B. Air Sampling

At SONGS, there are a total of 7 Indicator and 1 Control Air Samplers.

Downtime for each air sampler in 2016 was due to weekly sample collection, annual Preventative Maintenance (PM), and the change outs for the flow meters/pumps was approximately 46 minutes for each sampler.

Weekly Change Out:	0.5 minutes (approx.) x 52 = 26 minutes
Annual PM	15 minutes (approx.)
Annual Flow meter/Pump change out	5 minutes (approx.)

Downtimes in excess of 1 hour are addressed below for each ODCM required air sample.

- 1) During the week of March 13, 2016, air samplers (#1, #7, #9, #10, #11, #12, #13 and #16) had one (1) hour difference between operating and elapsed time. This was due to Day Light Savings Time Change. In addition, the week of November 06, 2016, air samplers (#1, #7, #9, #10, #11, #12, #13 and #16) had one (1) hour difference between operating and elapsed time. This was due to the end of Day Light Savings Time.

2) Air Sampler #1 (City of San Clemente)

- a. On February 24, 2016, air sampler's air flow meter was reading out of specification low. Troubleshooting was performed and it was determined that air sample pump was failing. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample. Monitored the sample flow until a new pump was shipped from vendor. The new pump was installed on March 15, 2016 and sample flow was within acceptable range of operation. (NN# 203331306)
- b. On March 22, 2016, the air sampler's air flow meter failed. A calculated volume and time in-service was performed based on sample pump's operation. Samples were collected and analyzed. There was no detectable plant licensed radioactive material detected on the samples. Therefore, no dose impact to the public or environment. (NN# 203333460)
- c. On May 17, 2016, air sampler's air flow meter was reading out of specification low. Troubleshooting was performed by changing out the hoses and sample pump. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample until a newly calibrated flow meter was shipped. On June 14, 2016, the environmental technician installed a newly calibrated flow meter on air sampler and sample flow was within acceptable range of operation. (NN# 203350431)
- d. On June 8, 2016, air sampler pump failed. The pump was replaced and sample flow was re-established. The samples were collected and analyzed. There was no detectable plant licensed radioactive material detected on the samples. Therefore, no dose impact to the public or environment. (NN# 203356235)
- e. On August 8, 2016, air sampler's air flow meter was reading out of specification low. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample until new flow meters were bought. New air flow meters were bought based on maintenance field observation that Trimax air samplers were obsolete. The new air flow meter was installed on September 7, 2016 and flow was within acceptable range of operation. (NN# 203373388)

3) Air Sampler #7 (AWS Roof)

- a. On May 17, 2016 air sampler's air flow meter was reading out of specification low. Troubleshooting was performed by changing out the hoses and sample pump. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample until a newly calibrated flow meter was shipped. On July 19, 2016, replaced the air flow meter with a newly calibrated flow meter and sample flow was within acceptable range of operation. (NN# 203350431)

- b. On August 25, 2016, air sampler's air flow meter was reading out of specification low. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample until a newly calibrated flow meter was shipped. New air flow meters were bought based on maintenance field observation that Trimax air samplers were obsolete. The new air flow meter was installed on September 7, 2016 and sample flow was within acceptable range of operation. (NN# 203377517)
- 4) Air Sampler #9 (South State Park Beach)
 - a. On August 30, 2016, air sampler's air flow meter was reading out of specification low. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air sampler was continuously collecting the required amount of sample until a newly calibrated flow meter was shipped. New air flow meters were bought based on maintenance field observation that Trimax air samplers were obsolete. The new air flow meter was installed on September 27, 2016 and sample flow was within acceptable range of operation. (NN# 203379041)
- 5) Air Sampler #11 (EOF)
 - a. On May 10, 2016, the air sampler's pump failed. Changed out the pump with a new pump and sampling was re-established. Samples were collected and analyzed. There was no detectable plant licensed radioactive material detected on the samples. Therefore, no dose impact to the public or environment. (NN# 203348260)
- 6) Air Sampler #13 (Camp Pendleton)
 - a. On February 22, 2016, air sampler lost power due to damage power line. Power was restored and air sampler was placed back in-service on March 17, 2017. (NN# 203323725)
 - b. On April 5, 2016, air sampler total volume and time in service was lower than expected. An investigation was performed and It was determined that there was an electrical grid interruption to the air sampler. Samples were collected and analyzed. There was no detectable plant licensed radioactive material detected on the samples. Therefore, no dose impact to the public or environment. (NN# 203337746)
 - c. On October 25, 2016, air sample pump failed and was replaced with a new pump. Samples were collected and analyzed. There was no detectable plant licensed radioactive material detected on the samples. Therefore, no dose impact to the public or environment. (NN# 203394060)
- 7) Air Sampler #16 (San Luis Rey)
 - a. On May 17, 2016, air sampler's air flow meter was reading out of specification low. Troubleshooting was conducted by changing out the hoses. Even though the flow was out of specification low, at no time were there challenges to the ODCM, because the air samplers was continuously collecting the required amount of samples until a newly calibrated flow meter

was shipped. On June 14, 2016, replaced the air sampler with a newly calibrated flow meter. Flow was within acceptable limits of operation. (NN# 203350431)

In all these events, the Radiological Effluent and Environmental Specialist reviewed previous and post event's data to verify no deviations were noted and that all ODCM LLDs were met. The Radiological Effluent and Environmental Specialist did initiate a trend corrective action (NN# 203376820) due to degraded performance in the air samplers' flow meters. Based on evaluation, new air flow meters were procured and replaced in September 2016. Since then the air flow meters have been operating satisfactory. Per ODCM Table 5-2, there were no challenges to the reporting levels for radioactivity concentrations. This is documented in the site's corrective action program for tracking events in the 2016 AREOR. (NN# 203341463)

C. Ocean Water Sampling

No deviations were observed

D. Drinking Water

No deviations were observed

E. Shoreline Sediments

No deviations were observed

F. Ocean Bottom Sediments

No deviations were observed

G. Marine Species (Flesh)

No deviations were observed

H. Local Crops

No deviations were observed

I. Soil

No deviations were observed

J. Kelp

No deviations were observed

APPENDIX F. LAND USE CENSUS

Introduction

The regulatory basis for conducting a Land Use Census (LUC) is identified in 10CFR50, Appendix I, Sec IV.B.3. The purpose of the LUC is to “identify changes in the use of unrestricted areas and to permit modifications in monitoring program for evaluating doses to individuals from principle pathways of exposure.”¹ In addition, Regulatory Guide 4.15, Rev. 1, section C3 address that “written procedures should be prepared, reviewed, and approved for activities involved in carrying out the monitoring program.” The 2016 LUC was conducted to comply with the surveillance requirement as defined in the Offsite Dose Calculation Manual (ODCM) Section 5.2. The current Radiological Environmental Monitoring Program Procedure SO123-IX-1.20, Land Use Census, establishes the method of documenting and verifying land use census results obtained in compliance to San Onofre’s Technical Specifications and ODCM.

Executive Summary

The land area around San Onofre Nuclear Generating Station (SONGS) is not subject to significant change due to the nature of the land uses. The area around SONGS is divided into sixteen (16) geographical sectors. The Pacific Ocean and United States Marine Corps (USMC) Base Camp Pendleton comprise 13 of the 16 sectors surrounding SONGS. The City of San Clemente (a mature municipal area) and coastline comprise the remaining three sectors. Therefore, the characteristics of the local land area substantially inhibit significant land use changes.

Definition of Uses

Residence is defined as any structure (single-family house, apartment, mobile home, barracks or similar unit) that is occupied by an individual(s) or resident(s) for three months or longer in a given year.

Other Specified Use is defined as a location occupied by members of the general population as other than their primary residence. The use is divided into two categories: employment and non-employment related.

Employment use is defined as a location occupied by members of the general population engaged in normal work activities regardless of the length of time spent at the location, and regardless of its permanence, including concession stands, restaurants, campground hosts, markets and guard shacks.

Non-employment-related use is defined as a location occupied by members of the general population who are not engaged in normal work activities, including campgrounds, temporary housing, time-share condominiums, motels, hotels, schools and beaches.

Milk animals are cows, goats, and sheep whose milk is used in dairy products for human consumption.

¹ 10CFR50 Appendix I, Section IV, B.3

Meat animals include, but are not limited to, deer, cattle, goats and sheep whose meat is used for human consumption.

Fresh, leafy vegetables include, but are not limited to, lettuce, cabbage and spinach.

Fleshy vegetables include, but are not limited to, tomatoes, cucumbers, cauliflower and sweet corn.

The Land Use Census Scope

The land area around SONGS includes both Orange and San Diego counties. The Orange County portion includes a portion of the city of San Clemente (official population as of May 2014 is 66,245 per the city's demographics and statistical information website) and the San Clemente State Park. The San Diego County portion includes much of the (USMC) Base Camp Pendleton, San Onofre State Beach and Park, and SONGS itself.

The LUC map is divided into 16 geographical sectors: A, B, C, D, E, F, G, H, J, K, L, M, N, P, Q and R. The ODCM surveillance requirement is performed by identifying the location of the nearest garden greater than 500 square feet, nearest milk animals, nearest residence, and other identified land uses in each of the sixteen (16) geographical sectors within a distance of five (5) miles from San Onofre Units 2 and 3. In addition, the land use census aids in detecting changes in the presence of hazardous manufacturing and handling facilities within the five (5) mile radius. The methodology consists of reviewing data from the previous LUC reports and verifying if any information has changed. The LUC is conducted and updated at least once per 12 months between the dates of June 1st and October 1st. Also, non-residential usage such as fire stations, surf camps and other potential pathways of exposure to an individual are identified due to the fact that these usages are closer to full time residence based on information provided by the appropriate point of contact or agency.

Sectors A, B, C, D, E, and F include land within the boundaries of (USMC) Base Camp Pendleton. The study area in sector G includes the area along the coast south of SONGS. Sectors H, J, K, L, M, and N are the Pacific Ocean, therefore no land use possible. Sectors P, Q, and R include a section of San Clemente and part of Camp Pendleton.

Research Methodology

Completion of the 2016 SONGS Land Use Census required conversations with agencies, organizations, individuals and field research. The Radiological Effluent and Environmental Specialist reviewed the previous 2015 LUC and associated documentation Spreadsheet. Then the data was verified. If changes occurred, then changes were reflected in this land use census. This was accomplished by contacting the point of contact for the appropriate agency, organization, or military base whom possessed knowledge on the land usage. The following agencies and organizations were contacted or additional information was researched through their respective websites:

- California Highway Patrol
- Orange County Agricultural
- State of California Department of Parks and Recreation, including San Onofre State Beach
- United States Border Patrol
- USMC Base, Camp Pendleton
- City of San Clemente

In cases where it was deemed appropriate, letters requesting information were sent to residents that in the past land use census have identified gardens 500 square feet or greater. The United States Border Patrol did not respond to our inquiries due to national security so an "estimated hours of occupancy" value of 2400 hours was utilized. It was determined that military personnel would have complete control over the land uses within their jurisdiction. Communication provided by the point of contacts from Camp Pendleton and State Parks was considered final. Agency contact and documentation were completed in compliance with the Land Use Census procedure.

Field Research

During and after the completion of the preliminary research, field research was undertaken to confirm initial findings and obtain further information necessary to complete the land use census. Field research was initiated in mid-August 2016.

Data and Methodology Summary

The appropriate individual or organization was identified for each existing and new LUC location. The individual or organization was contacted to determine the use and occupancy for that location. For each LUC location, the appropriate individual was asked to provide an estimate of annual occupancy based on personal knowledge of the location. The information gathered is summarized in Table 1. Additional information, not required by the ODCM, has been included in Table 2 for historical trending purposes.

Documentation Spreadsheet

Throughout the study, records of contacts and findings were maintained in accordance with the Land Use Census Procedure, SO123-IX-1.20. A documentation spreadsheet was prepared and retained in the Radiological Effluents and Environmental files. The spreadsheet may have telephone notes, agency contacts, Southern California Edison (SCE) memoranda, and any other types of correspondence.

2016 Land Use Census Observations and Changes

The follow observations were noted:

- No new garden was identified in 2016.
- The following addresses no longer have gardens:
 - Resident at 1315 South Ola Vista, San Clemente, CA stated that there is no longer a food crop garden on their property. This LUC point is G-6.
 - Letter from 432 Avenida Crespi was returned to sender. Radiological Effluent and Environmental Specialist drove to the address and performed a visual survey and determined that a garden would not be able to be grown on this property. This LUC point is G-16.
- The State Parks Ranger stated that a full time resident has been an addition. There are two (2) camp host volunteers over the age of 18 that live within San Onofre State Beach Campground at campsites #99 through #104. A visual inspection was conducted to verify the residence

Chemical and Toxic Waste

The presence of manufacturing facilities, chemical plants, and toxic waste sites was researched to provide information in detecting any hazardous chemicals, which could impede the operation of SONGS through fire, explosion, or chemical spills. Some manufacturing is located in the northeastern section of the city of San Clemente and is outside the study area. No such uses are allowed to exist in the commercial and residential areas of the city of San Clemente within the study area. In Camp Pendleton, there are no designated manufacturing or chemical use areas within the 5 mile radius of the plant based on conversation with Camp Pendleton's Director of Community Plans and Liaison Office.

Milk Animals

No dairies or other facilities producing milk for human consumption were identified in 2016.

Meat Animals

No agricultural meat animals were identified during the 2016 LUC. The only known meat animal pathway land uses is recreational hunting. Deer graze year round on Camp Pendleton.

Growing Season for fleshy and leafy vegetables

Leafy vegetable samples are available at the SONGS garden year round. Fleshy and leafy vegetables were available approximately eight months during 2016 at the SONGS garden.

Desalination Plant in Carlsbad, California

The Carlsbad desalination plant (officially known as the Claude "Bud" Lewis Carlsbad Desalination Plant) opened on December 14, 2015. The plant is 27 miles south of SONGS. It is located on the coast adjacent to the north end of the Encina Power Station. The plant produces approximately 50 million gallons of water per day. It is the largest and most technologically advanced desalination plant in the Western Hemisphere. The plant produces enough water to meet the daily needs of 300,000 San Diego residents

Summary of Changes

1. For the period of July 1, 2015 to June 30, 2016, the Camp Pendleton deer hunting take data was updated and reflected in Table 3. Per the USMC wildlife biologist, the exact location of a particular kill was not known. The reported take area should be interpreted as an estimate of approximate location. Thus a deer reported taken in hunting area Alpha 2 may actually have been taken in an adjacent hunting area (such as Romeo 3 or Bravo 3). There were no changes to the estimated distances from SONGS to the nearest vegetation potentially consumed by deer from July 1, 2015 through June 30, 2016.

Distances to nearest vegetation typically consumed by deer:

Units 2/3 Sector	Distance from Units 2/3 (miles)
P	0.3
Q	0.3
R	0.2
A	0.1
B	0.1
C	0.1
D	0.1
E	0.2
F	0.3
G	0.1

Table 1 – SONGS 2016 Land Use Census

Units 2/3 Sector	LUC #	Residence	Miles from U2/3	Estimated hours of Maximum Occupancy	LUC #	Gardens	Miles from U2/3	LUC #	Other Specified Uses	Miles from U2/3	Estimated hours of Maximum
A	R-A1	Camp San Mateo	3.6	FTR				O-8	Camp San Mateo Motor Pool	3.6	2,000
								22	SCE Land Uses	0.4	
B								O-9	USMC CP Sanitary Land Fill	2.1	816
C	R-C2	Camp San Onofre Fire Station #7 52 Area	2.4	FTR				O-10	Camp San Onofre (STP #11)	2.2	2,000
	R-C1	Camp san Onofre Barracks 524101	2.8	FTR							
	R-C3	Camp San Onofre Barracks	2.6	FTR							
D	R-D1	Camp San Onofre Barracks	3.0	FTR							
E	R-E1	Camp Horno Barracks	4.1	FTR				O-5	Camp Horno Motor Pool	4.0	2,500
F								O-1	San Onofre State Beach Guard Shack	0.8	1,500
								31A	Border Patrol Checkpoint (NB)	1.9	2,400*
								31B	Hwy Patrol Weigh Station (NB)	2.1	1,960
G	R-G1-	San Onofre State Park-campsite s#99-104 2 Camp Host Volunteers over 18 yrs.	3.0	FTR				O-2	San Onofre Beach Campground	1.8	720
								32	Hwy Patrol Weigh Station (SB)	2.1	1,960
								O-2A	Endless Summer Surf Camp (see notes) / Campground Host	2.8	4,380
								O-2B	YMCA Surf Camp (see notes)	2	576
Sectors H, J, K, L, M, and N have no identified land uses These sectors are primarily the Pacific Ocean and contain only a small portion of the plant site, and a beach walkway providing access for state beach park users north & south of SONGS.											
P	R-P3	San Onofre Rec Beach (SORB)	1	FTR	G-3	4130 Calle Isabella	2.8	O-6	Surf Beach (Lifeguard)	0.5	800
	R-P2	San Mateo Point housing	2.7	FTR	G-14	4090 Calle Isabella	2.9	3	Trestles Beach Lookout tower	1.8	500
	R-P1	Cotton point Estates	2.7	FTR				O-2D	Summer Soul Surf Camp	0.5	440
Q	R-Q5	SORB Resident Employee	1.1	FTR	G-8	2240 Ave Salvador	4.1	O-3	State Park Office Trailer	0.69	2,000
	R-Q2	San Onofre III housing	1.4	FTR	G-5	1706 S Ola Vista	4.4	5	Surf Beach Guard Shack	0.7	1,500
	R-Q3	San Mateo Point Housing	2.7	FTR	G-15	130 Calle del Pacifico	4	18	SORB Lifeguard Tower	1.2	2,000
					G-18	115 Ave San Pablo	4.1	1A	SORB Campground Check-in	1.3	2,000
R	R-R1	San Onofre III housing	1.3	FTR	G-10	SONGS Garden	0.4				
					G-17	788 Ave Salvador	4.9				

Bold Text indicates a change from the 2015 LUC Data as of 9-30-2016 FTR - Full Time Residence

Table 2

Units 2/3 Sector	LUC #	Residence	Miles from U2/3	Estimated hours of Maximum Occupancy	LUC #	Gardens	Miles from U2/3	LUC #	Other Specified Uses	Miles from U2/3	Estimated hours of Maximum Occupancy
A	R-A2	SONGS Camp Mesa	0.4	FTR				24	Cristianitos Fire Station	5	3,984
B											
C											
D											
E											
F											
G					G-6	1315 S Ola Vista	4.6	O-2C	SurfCamp.com State Beach Surf Camp did not occupy San Onofre Park in 2012	2.3	
<p>Sectors H, J, K, L, M, and N have no identified land uses. These sectors are primarily the Pacific Ocean and contain only a small portion of the plant site, and a beach walkway providing access for state beach park users north & south of SONGS.</p>											
P	R-P5	Contractor overnight parking in Lot 4	0.6	1040							
Q	11	State Parks Main Offices	3.5	FTR	14	3 W San Antonio	4.3	7	SORB Clubhouse (permanently closed per USMC)		
					16	147 W Junipero:	4.1	8	USMC Exchange & Commissary	1.7	2,000
					G-6	1315 S Ola Vista	4.6	9	Basilone Road USMC Entry Gate	2	520
					G-16	432 Ave Crespi	3.8	12	San Mateo Campground	2.9	4,380
								17	Beach Concession (Pier Shack and Grill)	4.5	2,600
								13	Beach Concession (Califia Beach Café)	3.9	1,200
R	20	Sea Ridge Estates	4.5	FTR				19	Camp San Mateo (STP#12)	3.7	2,000
	R-R3	SONGS Dry Camping PL12	0.7	2136				21	Cristianitos USMC Entry Gate	4.1	520
	R-R2	SONGS Camp Mesa (See notes for Table 1)	0.4	FTR				23	Cristianitos USMC Gas Station	4.1	2,000
<p>Bold Text indicates a change from the 2015 LUC Data as of 9-30-2016 FTR - Full Time Residence</p>											

NOTES FOR TABLES 1 AND 2**RESIDENCES**

LUC#	Description
R-A1	CAMP SAN MATEO (barracks)-This is an employment and an FTR land use location for persons 17 and older.
R-A2, R-R2	CAMP MESA-Former FTR and is permanently closed.
R-C2	CAMP SAN ONOFRE FIRE STATION-This is an employment and FTR land use location for persons 18 and older
R-C1, R-C3, R-D1	CAMP SAN ONOFRE (barracks)-This is an employment and FTR land use locations for persons 17 and older
R-E1	CAMP HORNO (barracks)-This is an employment and a FTR land use location for persons 17 and older
R-G1	San Onofre State Park- (2) Camp Host Volunteers live FTR at campsites #99-104.
R-P1	COTTON POINT ESTATES-This is a FTR for all age groups
R-P2, R-Q3	SAN MATEO POINT HOUSING-This is a FTR for all age groups
R-Q2, R-R1	SAN ONOFRE III housing-This permanent housing development is a FTR for all age groups
R-P3, R-Q5	SAN ONOFRE RECREATION BEACH (SORB)-This is a FTR for SORB employees and campground hosts (age 18 & over). This is also a non-employment land use location (camping) for all age groups. A person or family may camp at SORB for a maximum of 60 days per calendar year

VEGETABLE GARDENS

There were no new identified gardens for 2016. In November 2015, SONGS garden was relocated by Air Sampler #11 on the Mesa, because SCE Corporate Real Properties wanted to return a portion of the MESA back to Department of Navy. LUC G-6 is no longer an active garden per resident residing at 1315 South Ola Vista in San Clemente. LUC G-16 is no longer an active garden based on visual inspection conducted at 432 Avenida Crespi in San Clemente.

OTHER LUC LOCATIONS CLOSER THAN THE CLOSEST RESIDENCE

LUC#	Description
O-1	SAN ONOFRE STATE BEACH GUARD SHACK-this is an employment land use location for persons 18 and older.
O-2	SAN ONOFRE BEACH CAMPGROUND-This is a non-employment (recreational) and use location for all age groups.
O-2A	ENDLESS SUMMER SURF CAMP/CAMPGROUND HOST-The Endless summer Surf Camp and the State Parks Campground host are located in spaces 100 to 103. The maximum occupancy for persons age 18 and older is 4380 hours. The maximum occupancy for persons 17 and younger is 360 hours. This is both an employment and a non-employment land use location.

O-2B	YMCA Surf Camp
O-2C	Summer Soul Surf Camp- Summer Soul Surf Camp is a day camp that takes place at Dog Patch beach in San Onofre Beach. The maximum occupancy for persons age 18 and older is 440 hours. The maximum occupancy for 17 and younger is 40 hours.
O-3	STATE PARK OFFICE TRAILER-This is an employment land use location for persons 18 and older.
O-5	CAMP HORNO MOTOR POOL-This is an employment land use location for persons 17 and older.
O-6	SURF BEACH (LIFEGUARD)-This is an employment land use location for persons 18 and older.
O-8	CAMP SAN MATEO MOTOR POOL-This is an employment land use location for persons 17 and older.
O-9	USMC CP SANITARY LANDFILL-This is an employment land use location for persons 18 and older.
O-10	CAMP SAN ONOFRE WASTE WATER TREATMENT PLANT (STP #11)-This is an employment land use location for persons 18 and older.
R-C2	SAN ONOFRE FIRE STATION #7 52 AREA-This is an employment land use location for persons 18 and older.
1A	SORB CAMPGROUND CHECKIN-This is an employment land use location for persons 18 and older.
3	TRESTLES BEACH LOOKOUT TOWER-This is an employment land use location for persons 18 and older.
5	SURF BEACH GUARD SHACK-This is an employment land use location for persons 18 and older.
18	SORB LIFEGUARD TOWER-This is an employment land use location for persons 18 and older.
22	SCE Land Uses-Are occupied by unmonitored SCE workers
31A	BORDER PATROL CHECKPOINT-This is an employment land use location for persons 18 and older.
31B 32	HIGHWAY PATROL WEIGH STATIONS-These are employment land use locations for persons 18 and older

Table 2 Notes:

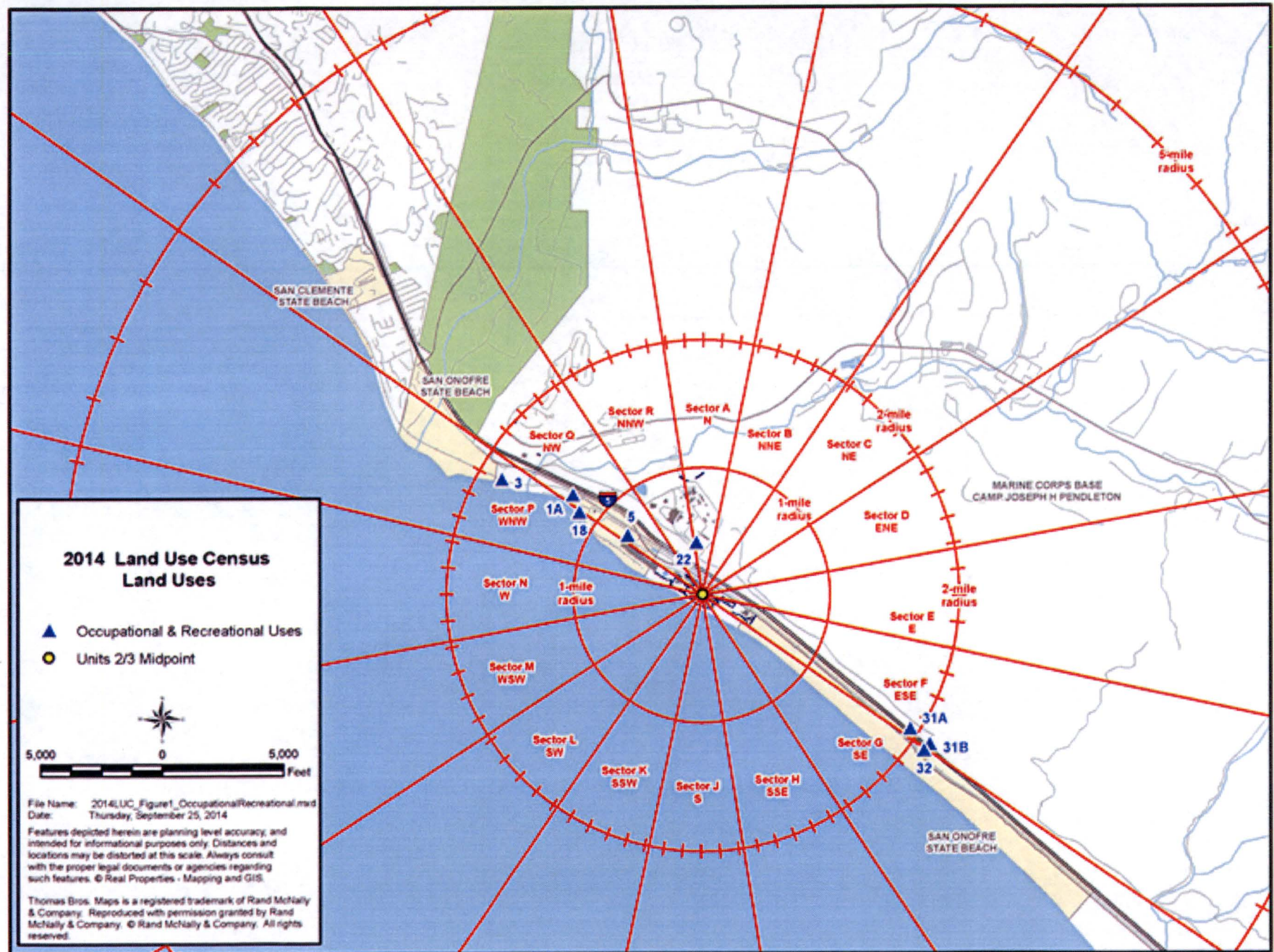
Table 2 locations are not mapped. The garden land uses listed in Table 2 do not exist (LUC #14 and LUC #16 gardens have been paved over and are no longer able to support vegetation growth). LUC G-6 and G-16 no longer have gardens on property. SONGS Camp Mesa is no longer a residence and is permanently closed. The "other specified uses" locations listed in Table 2 are further away from the midpoint of Units 2/3 that is closest to the full time residence (all age groups) in the corresponding sector. The residences listed in Table 2 are not the closest full time residence in the corresponding sector. The Table 2 locations have been retained for historical trending purposes and are not required by the ODCM. A review of the business need to continue including these locations was closed in March 2013 because these locations were used to track locations that in the past were input for R(i) tables' calculations and they need to remain in the LUC. Refer to NN (Nuclear Notification) 202232049. R-P5Contract

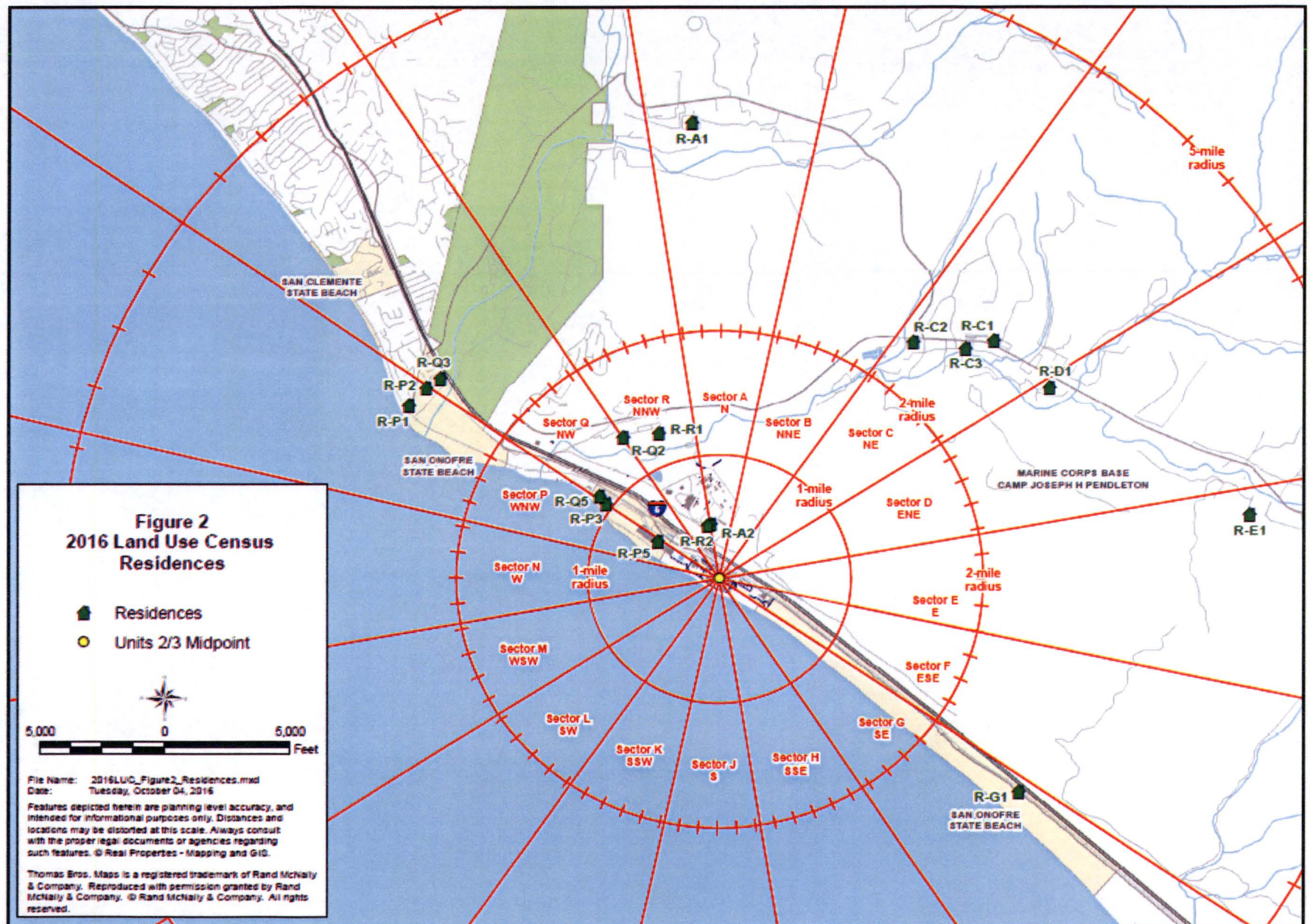
Worker in Parking Lot 4-This was a 6 month residence for a contract worker that slept in personal vehicle in between shifts until 4/1/2013 (NN 202649118). This is an inactive residence.

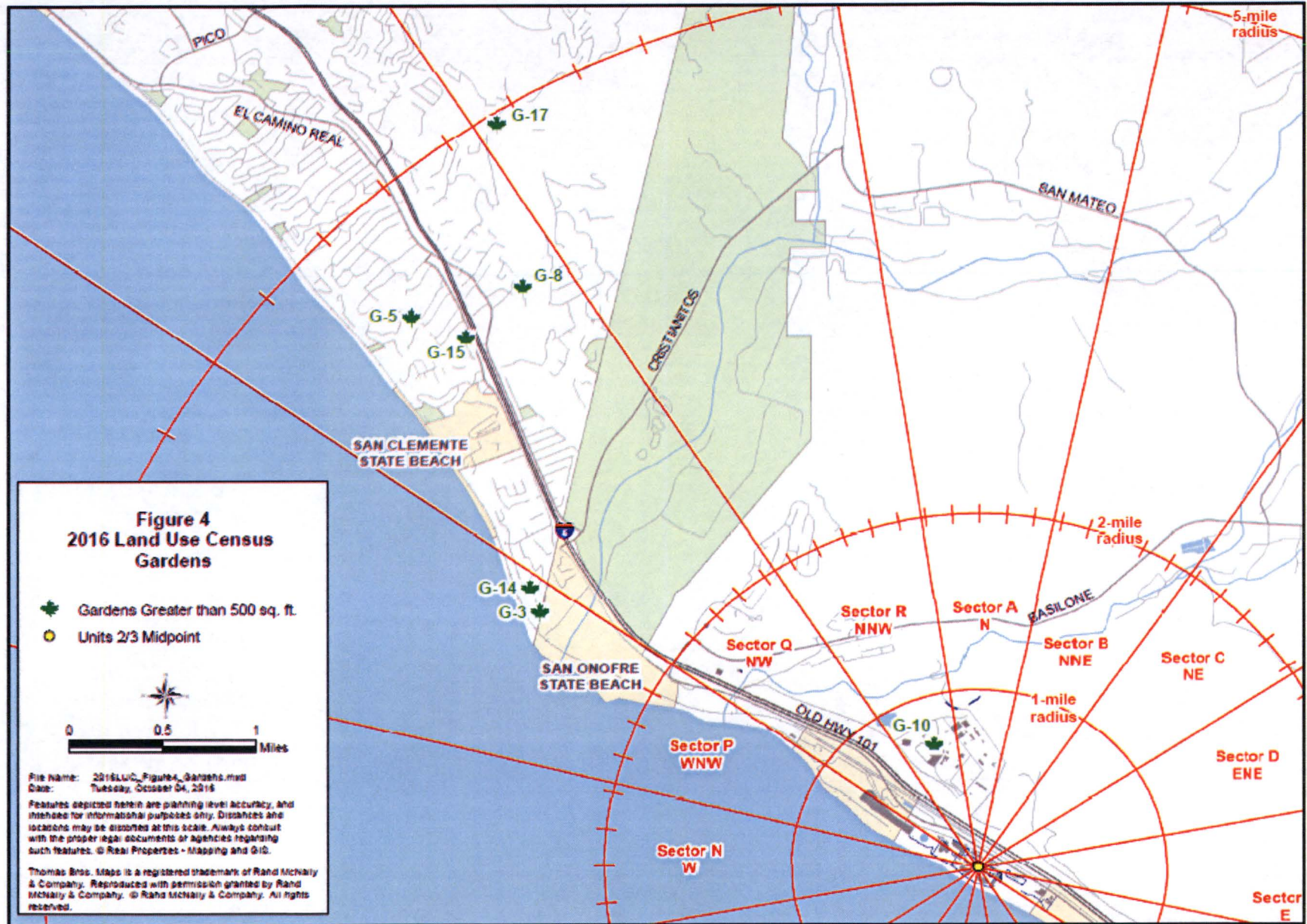
Table 3 – Camp Pendleton Hunting Take Data. July 1, 2015 – June 30, 2016

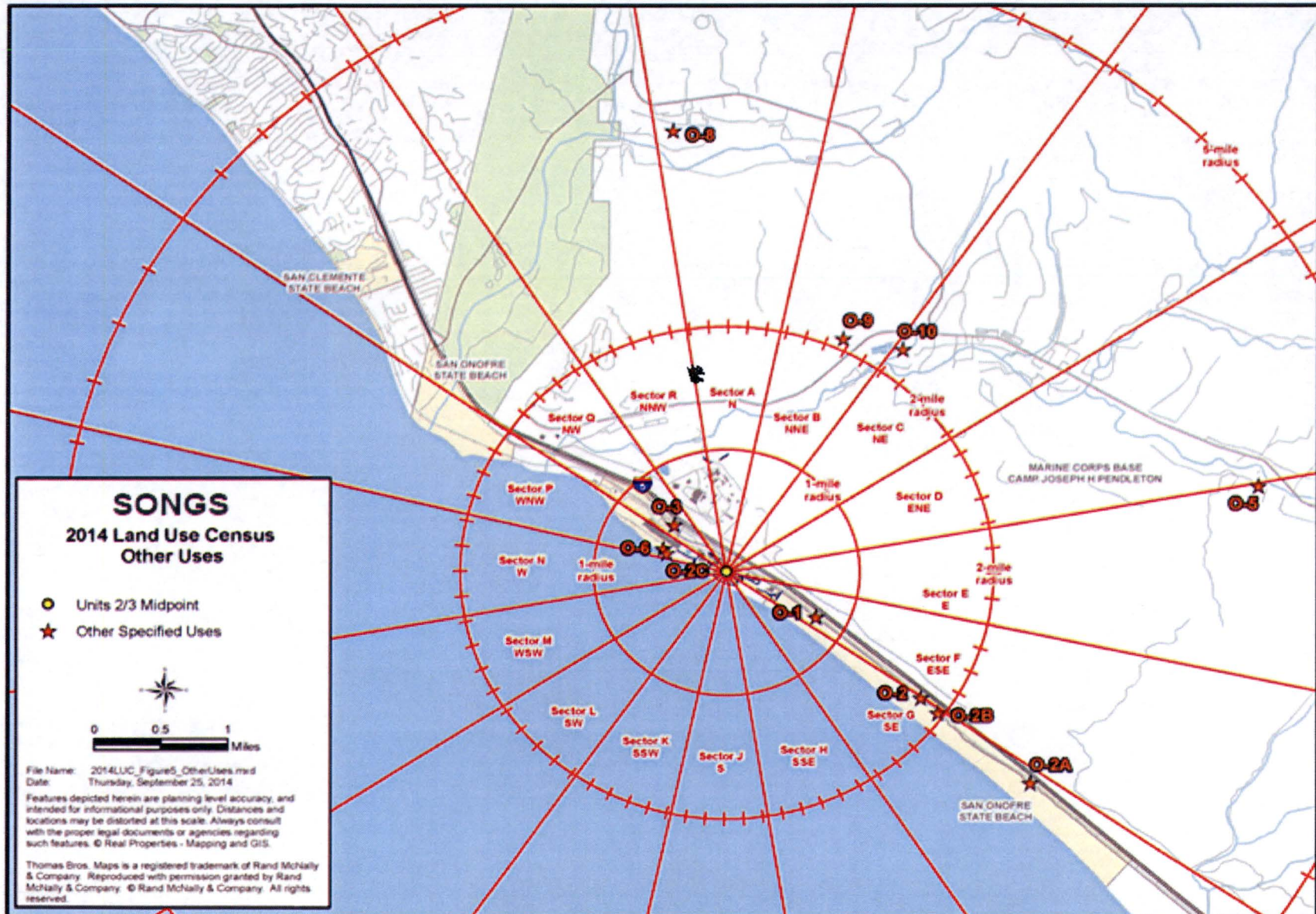
Area	Deer Hunter Effort	Sm Game Hunter Effort	Deer	Coyote	Dove	Quail	Rabbit	Squirrel	Pigeon
	Hours	Hours							
Alpha-1 B(3),C(3.2)	484	38	0	0	0	0	0	0	0
Alpha-2 E(0.8),D(0.8),C(3)	0	0	0	0	0	0	0	0	0
Alpha-3 D(2.2)	475	142	0	1	0	0	0	0	0
Bravo-2 B(3.8), A(4.2)	88	127	0	0	15	0	0	0	0
Bravo-3 B(1.6),A(1.8),R(1.8)	46	0	0	0	0	0	0	0	0
Romeo-1 E(1)	141	16	1	0	0	0	0	0	0
Romeo-2 E(2.6)	105	56	2	0	2	1	0	0	0
Romeo-3 E(1.4), F(1.5)	100	55	2	0	0	0	0	0	0
Papa-2 & Tango F(5)	259	144	5	0	14	1	0	5	0
Totals	1698	578	10	1	31	2	0	5	0

1. The total hunting hours includes time attributable to multiple individuals. This value bounds the maximally exposed individual.









APPENDIX G. ERRATA TO PREVIOUS AREORs

An ODCM audit was performed in August 2016. An auditor reviewed the 2014 Annual Radiological Environmental Operating Report (AREOR). Appendix B, Section F for Ocean Bottom Sediment samples, it was noted that the control sample was obtained from Newport Beach. The 2014 AREOR should have stated that the control location is Laguna Beach. Laboratory reports were reviewed and the control sample was collected at Laguna Beach. An extent of condition was performed on other AREORs and it was determined that the 2012 and 2013 reports identified Newport Beach as the control location. The 2012 and 2013 should have stated the correct control location as Laguna Beach. The data generated from 2012 and 2013 was from Laguna Beach control location. This was captured under the site's corrective action program. (NN# 203379097)

APPENDIX H. CDPH CO-LOCATED TLDs

CDPH TLDs CO-LOCATED WITH REMP TLDs DURING 2016

California Department of Public Health (CDPH) maintains a TLD program in the environs of SONGS. Per DPH (Department of Public Health) request, the results of CDPH dosimeters that are co-located with SONGS dosimeters are reported below.

Table 35. 2016 Data from SCE TLDs (mR/ standard quarter)

Location Number	Location Name	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
SCE-1 , NRC -7, DPH #2	City of San Clemente	8	10	14	14
SCE-2, NRC -23, DPH #8	Camp San Mateo	11	9	17	15
SCE-3, NRC -19, DPH #9	Camp San Onofre	9	9	10	11
SCE-6, DPH #10	Old El Camino Real (Old Highway 101) (ESE)	6	4	6	8
SCE-10, NRC -12, DPH #6	Bluff (Adjacent to PIC #1) (San Onofre Surfing Beach)	9	8	12	12
SCE-22, NRC 11, DPH #4	Former US Coast Guard Station – San Mateo Point	9	11	12	15
SCE-34, NRC -14, DPH #5	San Onofre Elementary School	6	8	13	13
SCE-50, NRC 32, DPH #13	Oceanside Fire Station	8	9	11	13

Note: Requirements in the standard Technical Specifications (TS) adopted under the TS Improvement Program include reporting results of TLDs that are co-located with NRC dosimeters. The NRC dosimeters were exchanged by the CDPH under contract with the NRC. This contract expired in December 1997 and the NRC TLDs were no longer being deployed around SONGS. See Appendix I of the "1997 Radiological Environmental Operating Report", April, 1998

The CDPH TLD results confirm that SONGS does not have a significant impact on direct radiation exposures in the environment.

APPENDIX I. ISFSI TLD DATA

Summary

Per 10 CFR 72.126, SONGS implemented an area monitoring TLD program in the vicinity of the ISFSI. In the fourth quarter of 2001, 21 pre-operational TLDs were deployed in the area around the ISFSI foundation then under construction. This pre-operational TLD data are compared to the data obtained after the commencement of used fuel storage in the ISFSI for the purposes of estimating the additional exposure attributable to the operation of the ISFSI.

An evaluation of the entire REMP TLD database yielded an estimated background exposure rate of approximately 15 mR/std. quarter (91 days). However, some local variability within the CAB / EAB is to be attributable to factors external to SONGS. Another variable for the measured exposure rate is transit exposure to and from the TLD lab. The transit exposure is variable and is corrected by the lab. Therefore, a comparison of pre-operational data and operational data needs to be considered in conjunction with a comparison of ISFSI TLD data and the estimated baseline background exposure rate within the EAB.

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 does not appear to be related to any activities at SONGS. The ISFSI TLD data gathered to date appears to follow a similar seasonal variability (Figure 14). In addition to environmental factors, some non-ISFSI work activities at Unit 1 have elevated the pre-operational measured ISFSI TLD exposure.

The storage and transport of radioactive materials and waste near the location of the ISFSI foundation area in 2001 and 2002 appears to have elevated the exposure rates of TLDs 306 to 315. In addition, the movement of the Unit 1 reactor vessel in October 2002 caused a noticeable increase in the measured exposure for TLDs 301 to 315. The measured exposure rate for the ISFSI TLDs close to the ISFSI is consistent with the exposure rate expected from known radiological work activities. The elevated exposure rate from TLDs 301, 302, 303, 304, 323, 324, 325, 326, 327 and 328 is primarily due to the movement and storage of used fuel at the ISFSI.

In the second quarter of 2011 additional TLDs 327 and 328 were placed along the fence on the southwest side of the ISFSI. These TLDs routinely have the highest measured doses, as they did in 2016. These locations, however, are not accessible to members of the public. Publicly accessible REMP TLDs include SCE-55, SCE-56 and SCE-57. Only SCE-55 (San Onofre State Beach) recorded measurable dose, at approximately 14 mrem/yr. In 2016, additional ISFSI TLD locations were added immediately along the fence and seawall south and west of the ISFSI: Locations SCE-339, 340, 341, 342, 343 and 344 (see Figure 13).

Starting in the fourth quarter 2010 neutron dosimeters were placed in ISFSI TLD canisters 311, 324, 325, and 326. In the second quarter 2011 neutron dosimeters were also placed adjacent to TLDs 327 and 328. Beginning in the 4th quarter of 2016, neutron TLDs were co-located with locations SCE-339 through SCE-343. The neutron TLDs were added to obtain neutron information prior to the off load of spent fuel from Units 2 and 3.

The 2016 neutron TLDs identified measurable levels of neutron radiation from spent fuel in storage. A dose equivalent conversion factor for the TLD neutron signal of 10.5 mrem/mR neutron has been applied, based on a similar ISFSI facility at another site. It is being applied to the SONGS TLD results only to provide an estimate of the neutron dose equivalent being

measured. The neutron dose is not significant, and has been included in the quarterly results for these locations in Table 36.

Neutron exposure during fuel transfer is measurable at the fence surrounding the storage facility at low levels, estimated to be less than 3 mrem per quarter. These measurements demonstrate that the neutron exposure is bounded by the projected neutron dose rates in calculation SCE-23-0508, is well within the limits specified in 10CFR72.104 (0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid and 0.25 mSv (25 mrem) to any other critical organ, and is consistent with known ISFSI radiological conditions. The measured ISFSI gamma TLD exposure rates were also determined to be consistent with the calculated ISFSI dose rates and known radiological conditions.

The results from all locations around the ISFSI pad show that a member of the public, even if present at those locations for 500 hours in a year, would receive less than 2 mrem, well below regulatory limits.

Table 36. 2016 ISFSI TLD Data

TLD (SCE- ##)	Location ^a	Qtr. Baseline (mrem)	Quarterly Results (mrem)				Baseline Adjusted Quarterly Results (mrem)				Annual Dose (mrem)	Annual Facility Dose (mrem)	Annual Public Dose ^b (mrem)
			1	2	3	4	1	2	3	4			
301		15.8	17.59	17.45	18.92	17.05	ND	ND	ND	ND	71.01	ND	ND
302		15.8	20.52	19.17	21.47	19.79	4.75	ND	5.70	ND	80.95	17.88	1.02
303		15.8	21.54	21.01	21.21	20.90	5.77	5.25	5.45	5.13	84.66	21.59	1.23
304		15.8	20.68	19.83	20.10	20.12	4.91	ND	ND	ND	80.72	17.65	1.01
306		15.8	20.45	19.63	21.78	20.34	4.68	ND	6.01	4.57	82.19	19.12	1.09
307		15.8	16.87	15.86	16.13	15.99	ND	ND	ND	ND	64.85	ND	ND
308		15.8	19.62	18.25	20.35	18.57	ND	ND	4.58	ND	76.79	13.72	0.78
309		15.8	19.66	18.64	21.35	19.42	ND	ND	5.58	ND	79.06	15.99	0.91
310		15.8	19.57	20.11	20.67	19.41	ND	ND	4.90	ND	79.75	16.68	0.95
311	ISFSI-01	15.8	19.67	18.57	18.35	19.70	ND	ND	ND	ND	76.30	13.22	0.75
312		15.8	15.08	15.44	15.22	14.65	ND	ND	ND	ND	60.40	ND	ND
314		15.8	17.51	18.07	18.42	18.60	ND	ND	ND	ND	72.60	9.52	0.54
315		15.8	18.27	17.75	18.72	18.68	ND	ND	ND	ND	73.43	10.35	0.59
316		15.8	14.86	14.44	16.21	15.41	ND	ND	ND	ND	60.93	ND	ND
317		15.8	16.16	16.28	16.47	16.10	ND	ND	ND	ND	65.02	ND	ND
318		15.8	18.20	18.03	18.88	18.76	ND	ND	ND	ND	73.87	10.80	0.62
319		15.8	18.14	17.90	19.83	19.15	ND	ND	ND	ND	75.02	11.95	0.68
320		15.8	18.75	17.09	19.08	19.28	ND	ND	ND	ND	74.20	11.13	0.63
321		15.8	18.91	18.57	19.51	18.88	ND	ND	ND	ND	75.88	12.80	0.73
322		15.8	16.06	18.06	19.34	15.34	ND	ND	ND	ND	68.80	ND	ND
323		15.8	20.65	20.06	19.63	20.21	4.88	ND	ND	4.45	80.54	17.47	1.00
324	ISFSI-04	15.8	23.35	22.80	24.73	22.47	7.58	7.03	8.96	6.71	93.36	30.28	1.73
325	ISFSI-03	15.8	22.47	24.87	22.98	23.96	6.71	9.10	7.21	8.20	94.29	31.22	1.78
326	ISFSI-02	15.8	21.17	22.05	20.56	24.44	5.40	6.29	4.79	8.67	88.22	25.15	1.43
327	ISFSI-05	15.8	43.38	47.54	55.86	46.45	27.61	31.77	40.09	30.69	193.23	130.16	7.42
328	ISFSI-06	15.8	34.55	35.59	40.63	38.45	18.78	19.83	24.86	22.69	149.22	86.15	4.91
339	ISFSI-08	15.8	21.32	18.95	20.68	19.70	5.55	ND	4.91	ND	80.65	17.58	1.00
340	ISFSI-09	15.8	19.95	18.28	19.65	18.92	ND	ND	ND	ND	76.80	13.73	0.78
341	ISFSI-10	15.8	21.67	20.31	20.69	20.09	5.90	4.54	4.92	ND	82.75	19.68	1.12
342	ISFSI-11	15.8	22.47	20.90	21.24	20.59	6.71	5.13	5.48	4.83	85.21	22.14	1.26
343	ISFSI-12	15.8	21.12	20.81	20.77	19.41	5.35	5.05	5.00	ND	82.11	19.04	1.09
344		15.8	20.53	19.78	20.08	19.50	4.76	ND	ND	ND	79.89	16.82	0.96

APPENDIX I

2016 AREOR

55	San Onofre State Beach (U1 West) ISFSI-07	15.8	19.23	18.52	21.16	18.34	ND	ND	5.40	ND	77.26	14.18	0.81
56	San Onofre State Beach (U1 West)	15.8	19.33	16.29	16.19	15.48	ND	ND	ND	ND	67.30	ND	ND
57	San Onofre State Beach (Unit 2)	15.8	16.74	16.80	16.84	17.09	ND	ND	ND	ND	67.47	ND	ND

Notes:

- a. ISFSI TLDs are placed around the ISFSI pad, and not in locations accessible to the general public.
- b. Public dose is based on the Administrative Dose Control occupancy of 500 hours, in accordance with SO123-VII-20.16

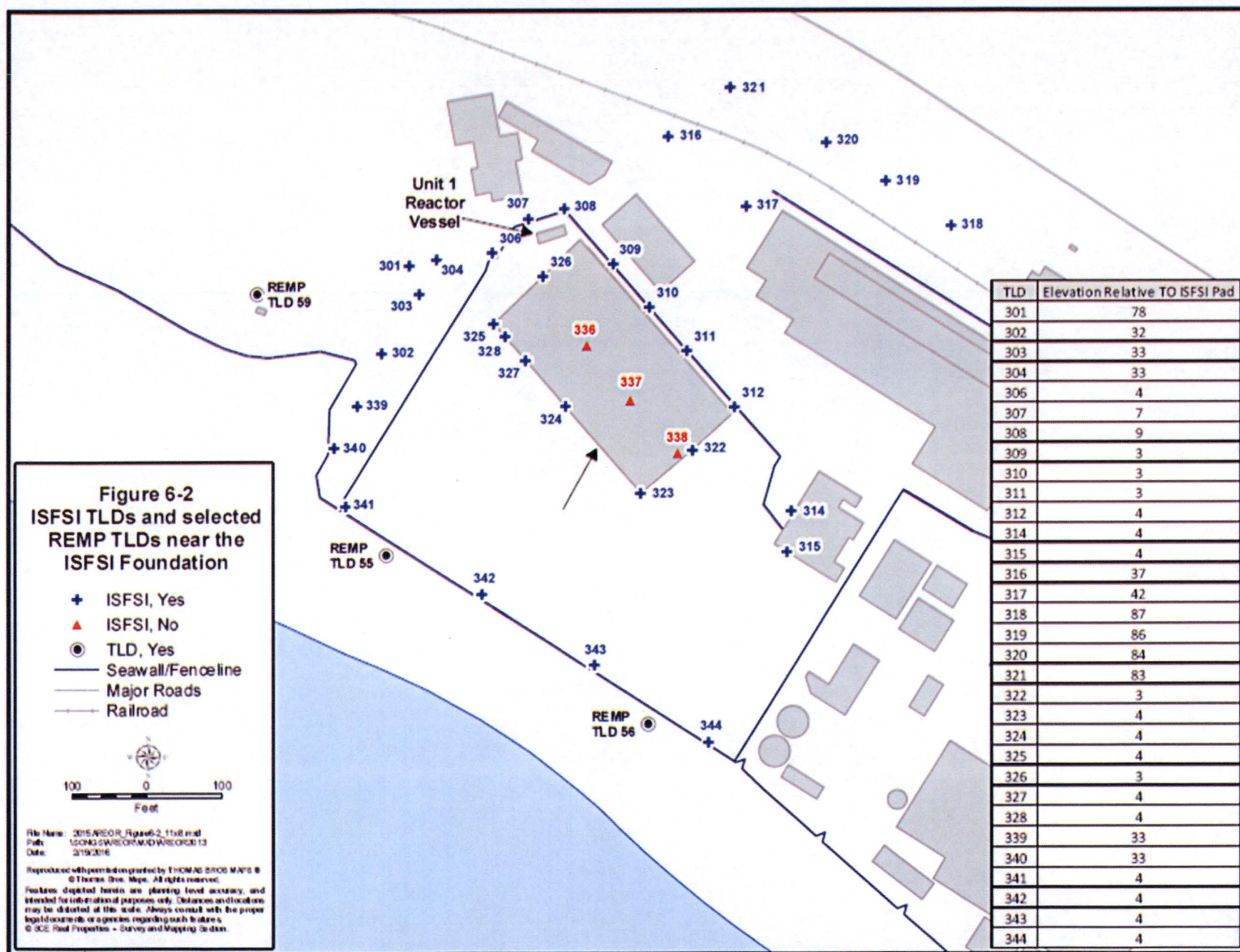


Figure 13 – SONGS ISFSI and Selected REMF TLD Locations

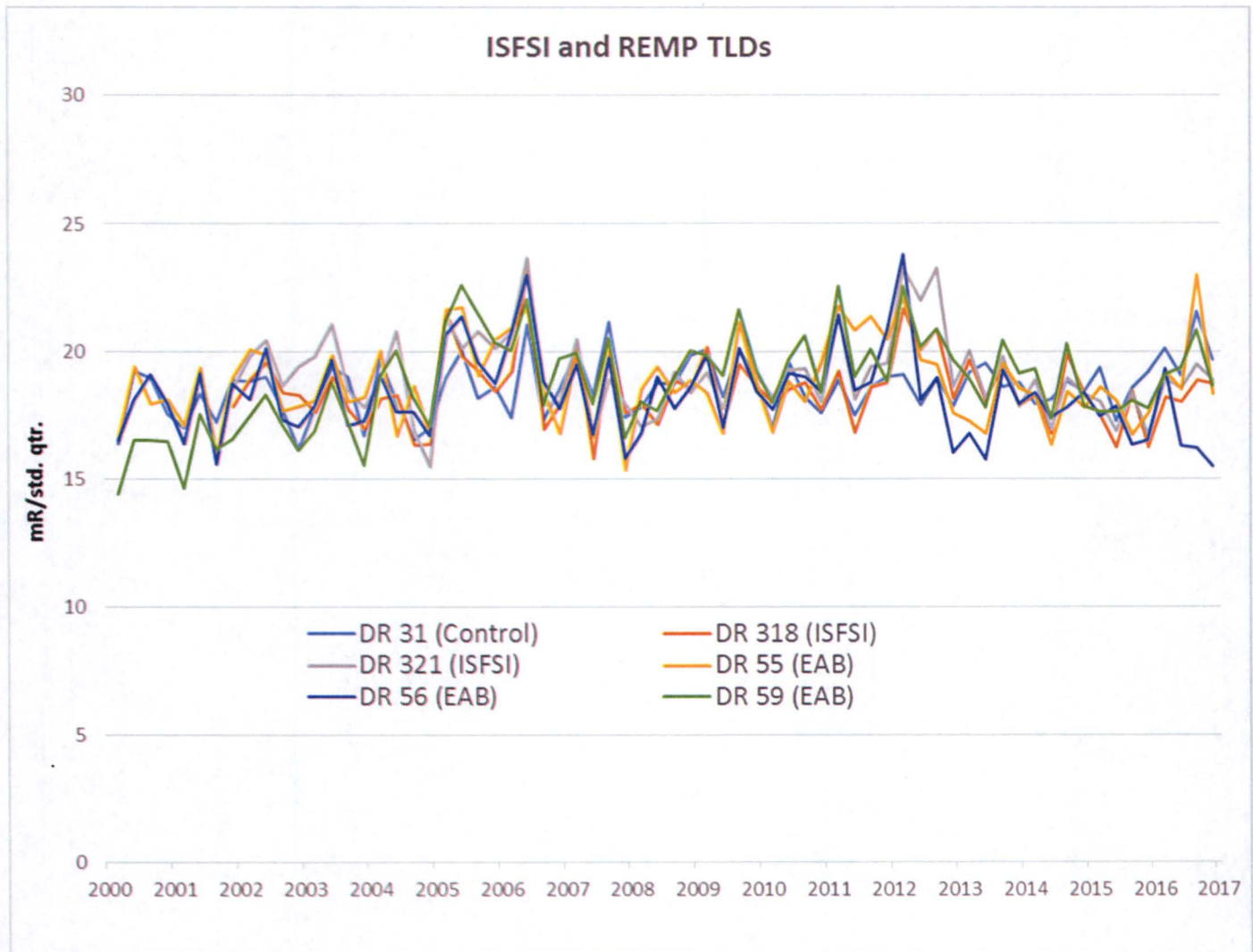


Figure 14 - ISFSI and REMP TLDs

APPENDIX J. OFFSITE GROUND WATER SAMPLING

Offsite Drinking Water Data

All investigations have shown that there are no drinking water pathways at SONGS. Figure 15 below illustrates groundwater well locations along with the flow of the groundwater. The operation of SONGS had no impact on drinking water wells in the vicinity of SONGS.

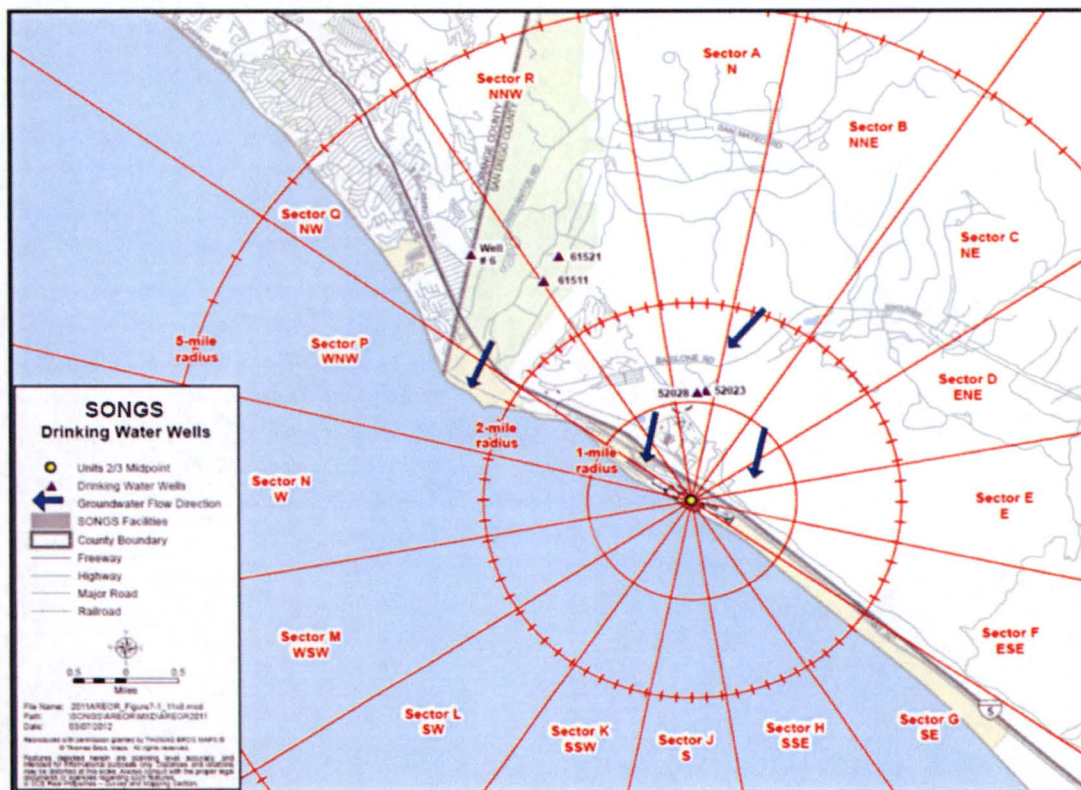


Figure 15 – Closest Drinking Water Wells

Glossary

a posteriori

After the fact

a priori

Before the fact

ALARA

As Low As is Reasonably Achievable means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Cosmogenic nuclides

Radionuclides (or isotopes) created when a high-energy cosmic ray interacts with the nucleus of an atom. These isotopes are produced within Earth materials such as rocks or soil, in Earth's atmosphere, and in extraterrestrial items such as meteorites. Radioactive isotopes beryllium-7 and beryllium-10 fall into this series of three light elements (lithium, beryllium, boron) formed mostly[citation needed] by cosmic ray spallation nucleosynthesis, both of these nuclides have half-lives too short for them to have been formed before the formation of the Solar System, and thus they cannot be primordial nuclides. Since the cosmic ray spallation route is the only possible source of beryllium-7 and beryllium-10 occurrence naturally in the environment, they are therefore cosmogenic.

Below is a list of radioisotopes formed by the action of cosmic rays in the atmosphere; the list also contains the production mode of the isotope.

Isotope	Mode of formation
^3H (tritium)	^{14}N (n, ^{12}C) ^3H
^7Be	Spallation (N and O)
^{10}Be	Spallation (N and O)
^{11}C	Spallation (N and O)
^{14}C	^{14}N (n, p) ^{14}C
^{18}F	^{18}O (p, n) ^{18}F and Spallation (Ar)
^{22}Na	Spallation (Ar)
^{24}Na	Spallation (Ar)
^{28}Mg	Spallation (Ar)
^{31}Si	Spallation (Ar)
^{32}Si	Spallation (Ar)
^{32}P	Spallation (Ar)
$^{34\text{m}}\text{Cl}$	Spallation (Ar)
^{35}S	Spallation (Ar)
^{36}Cl	^{35}Cl (n, γ) ^{36}Cl

^{37}Ar	$^{37}\text{Cl} (p, n)^{37}\text{Ar}$
^{38}Cl	Spallation (Ar)
^{39}Ar	$^{38}\text{Ar} (n, \gamma)^{39}\text{Ar}$
^{39}Cl	$^{40}\text{Ar} (n, np)^{39}\text{Cl}$ & spallation (Ar)
^{41}Ar	$^{40}\text{Ar} (n, \gamma)^{41}\text{Ar}$
^{81}Kr	$^{80}\text{Kr} (n, \gamma)^{81}\text{Kr}$

Decay Series

There are three naturally occurring decay series of heavy elements that transform into a series of various radioactive elements by releasing energy in the form of particles, (such as alpha or beta), and/or gamma rays to end in a stable form of non-radioactive Lead. All three decay series start with extremely long lived radioactive, heavy elements that can be measured in geologic time units. They are Uranium-238 with an approximate half-life of 4.5 billion years, Uranium-235 with a half-life of about 700 million years, and Thorium-232 with a half-life of 14 billion years. All three series contain some more well-known radioactive species, Radium and Radon.

Distinguishable from background

Detectable concentration of a radionuclide that is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Dose

The amount of radiation that is absorbed by a person's body. In the radiation field the term dose is sometimes used interchangeably with dose equivalent, which is defined as the rem and described below.

Half-life

A measure of how fast half the mass of a radioactive element will transform itself into another element. Each radioactive element has its own unique rate of transformation. Consequently, if a radioactive element, such as Iodine-131 has a half-life of 8 days, then in 8 days half of the original amount of Iodine-131 will be gone; in another 8 days half of that half will be left and so on.

Gamma Spectroscopy

A scientific method used to analyze gamma rays emanating from radioactive elements. The analytical system determines the gamma ray energy which acts as a "fingerprint" for specific radioactive materials. For example, Potassium-40 (K-40) has a very, distinctive gamma energy at 1460 keV. This uniqueness allows the instrument to positively identify the K-40 1460 energy as its own unique fingerprint. A keV is an abbreviation for kilo electron volt, which is a measure of energy at the atomic level. A kilo is a scientific prefix for the multiplier 1,000.

Gross Beta

A simple screening technique employed to measure the total number of beta particles emanating from a potentially radioactive sample, with higher values usually indicating that the sample contains natural and/or man-made radioactive elements. High values would prompt further analyses to identify the radioactive species. A beta is a negatively charged particle that is emitted from the nucleus of an atom with a mass equal to that of an orbiting electron.

Liquid Scintillation	An analytical technique by which Tritium and many other radioactive contaminants in water are measured. A sample is placed in a special glass vial that already contains a special scintillation cocktail. The vial is sealed and the container vigorously shaken to create a homogeneous mix. When the tritium transforms or decays it emits a very low energy beta particle. The beta interacts with the scintillating medium and produces a light pulse that is counted by the instrument. Although a different scintillation cocktail is used, this is basically how radon in well water is measured.
Members of the Public	Members of the Public shall include all individuals who by virtue of their occupational status have no formal association with the plant. This category complies with the requirements of 10 CFR 50 and shall include non-employees of the licensee who are permitted to use portions of the site for recreational, occupational, or purposes not associated with plant functions. This category shall not include non-employees such as vending machine servicemen or postmen who, as part of their formal job function, occasionally enter an area that is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials
Millirem (mrem)	one thousandth (1/1000) of a rem.
milliRoentgen (mR)	one thousandth (1/1000) of a rem
pCi/kg	an acronym for a pico-curie per kilogram, which is a concentration unit that defines how much radioactivity is present in a unit mass, such as a kilogram. A "pico" is a scientific prefix for an exponential term that is equivalent to one trillionth (1/1,000,000,000,000).
pCi/L	an acronym for a pico-curie per liter, which is a concentration unit that defines how much radioactivity is present in a unit volume, such as a liter.
Rem	an acronym for roentgen equivalent man. It is a conventional unit of dose equivalent that is based on how much of the radiation energy is absorbed by the body multiplied by a quality factor, which is a measure of the relative hazard of energy transfer by different particles, (alpha, beta, neutrons, protons, etc.), gamma rays or x-rays. In comparison the average natural background radiation dose equivalent to the United States population is estimated to be 292 millirems per year, or 0.8 millirem per day, with 68 % of that dose coming from radon. A millirem is one thousandth, (1/1000), of a rem.
Roentgen	a special unit of exposure named after the discoverer of X-Rays, Wilhelm Roentgen. It is a measure of how much ionization is produced in the air when it is bombarded with X-Rays or Gamma Rays. Ionization is described as the removal of an orbital electron from an atom.
Skyshine	is radiation from a radioactive source that bounces off air molecules in the sky, much like a cue ball does off the banking of a billiard table, and is scattered/redirected back down to the earth.

Site Area Boundary (SAB)	SONGS SAB is defined as that line beyond which the land is not owned, leased, or otherwise controlled by the licensee; from ODCM definition
Thermoluminescent Dosimeters (TLD)	very small plastic-like phosphors or crystals that are placed in a small plastic cage and mounted on trees, posts, etc. to absorb any radiation that impinges on the material. Special readers are then used to heat the plastic to release the energy that was stored when the radiation was absorbed by the plastic. The energy released is in the form of invisible light and that light is counted by the TLD reader. The intensity of the light emitted from the crystals is directly proportional to the amount of radiation that the TLD phosphor was exposed to.
Tritium (Hydrogen-3 or H-3)	a special name given to the radioactive form of Hydrogen usually found in nature. All radioactive elements are represented as a combination of their chemical symbol and their mass number. Therefore, Tritium, which is a heavy form of the Hydrogen molecule with one proton and two neutrons in the nucleus of its atom, is abbreviated and represented by its chemical symbol, H, for Hydrogen and 3 for the number of particles in its nucleus, or mass number. Similarly, other radioactive elements, such as Potassium-40, can be represented and abbreviated as K-40, and so on