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James A. Kay
Manager, Regulatory Affairs

May 10, 2016

10 CFR 50.36a

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

Subject: **Docket Nos. 50-206, 50-361, 50-362 and 72-41**
2015 Annual Radiological Environmental Operating Report
San Onofre Nuclear Generating Station (SONGS) Units 1, 2 and 3 and Independent Spent Fuel Storage Facility

Dear Sir or Madam:

As required by San Onofre Nuclear Generating Station (SONGS) Unit 1 Permanently Defueled Technical Specification (TS) Section D6.9.1.3 and SONGS Units 2 and 3 Permanently Defueled TS Section 5.7.1.2, Southern California Edison (SCE) is submitting the 2015 Annual Radiological Environmental Operating Report (AREOR) for SONGS Units 1, 2 and 3.

The AREOR covers the operation of SONGS during January 1, 2015 through December 31, 2015 and includes summaries, interpretations, and analyses of trends of the results of the Radiological Environmental Monitoring Program.

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

This letter does not contain any commitments.

If you have any questions or require additional information, please contact me at (949) 368-7418.

Sincerely,

J. A. Kay

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NRR
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Enclosure: 2015 San Onofre Nuclear Generating Station Annual Radiological Environmental Operating Report

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Enclosure

2015 San Onofre Nuclear Generating Station Annual Radiological Environmental Operating Report

P. O. Box 128
San Clemente, CA 92672

2015 San Onofre Nuclear Generating Station Annual Radiological Environmental Operating Report

License Numbers: DPR-13, NPF-10, NPF-15

May 2016

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This 2015 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 2015 AREOR covers the results of the environmental monitoring performed around SONGS during the time period January 1, 2015 through December 31, 2015.

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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
NN	Nuclear Notification used at site for the Corrective Action Program
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
QA	Quality Assurance
QC	Quality Control
SAB	Site Area Boundary

Part 1 Executive Summary/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 2015 time frame demonstrates that San Onofre continues to operate with no adverse effect on the population or the environment. The 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 operation 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, 2015 through December 31, 2015. 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 2015 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 TLD 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, and 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 to sources on the plant site and directly to any radioactive effluents released from the site 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.

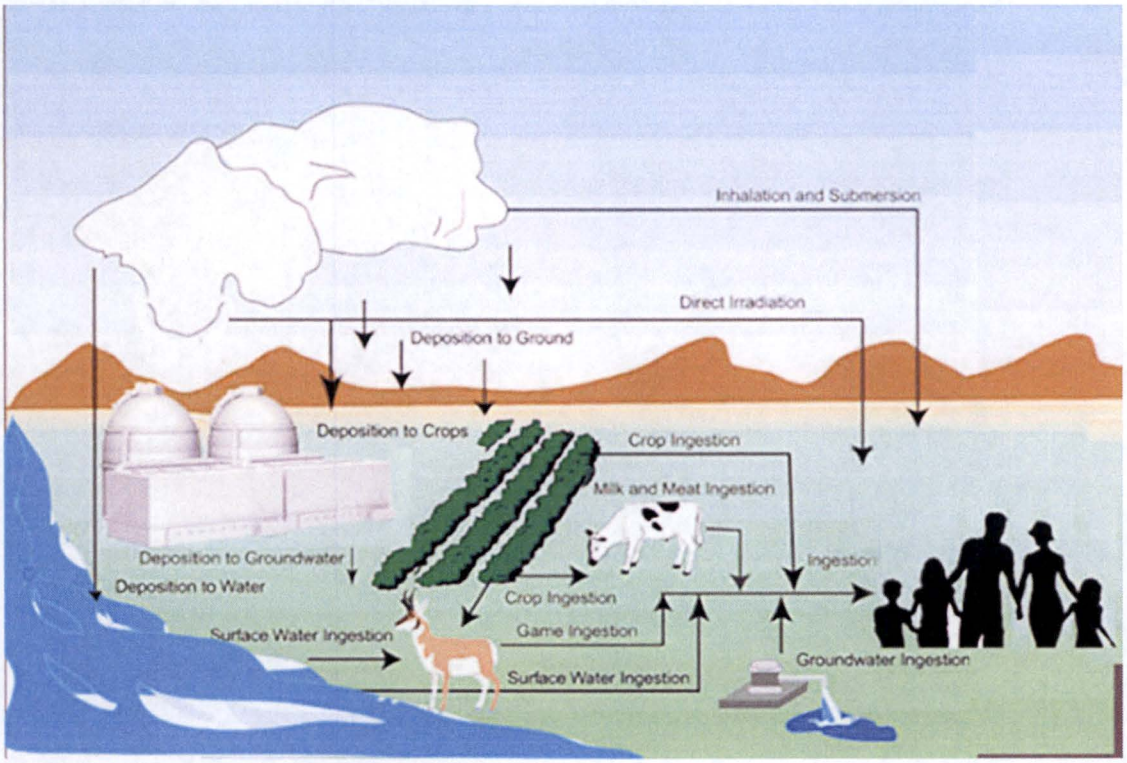


Figure 1 - Examples of Exposure Pathways

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, control stations, are 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 used to explain radiation from sources other than San Onofre. The second type, indicator stations, are used to measure any radiation contributed to the environment caused by San Onofre. Indicator stations are located in areas close to San Onofre, reflecting the nearby locations that could more likely show any measurable levels from releases from the plant. These indicators are located both onsite and offsite.

The assessment of the radiological impact of any releases of radioactive materials from SONGS to the nearby environment is verified through the conduct of the Radiological Environmental Monitoring Program (REMP), through its collection and analysis of samples, a rigorous Quality Control and Quality Assurance Program, the State of California's Department of Public Health monitoring dosimeters and other on-site and off-site inspections.

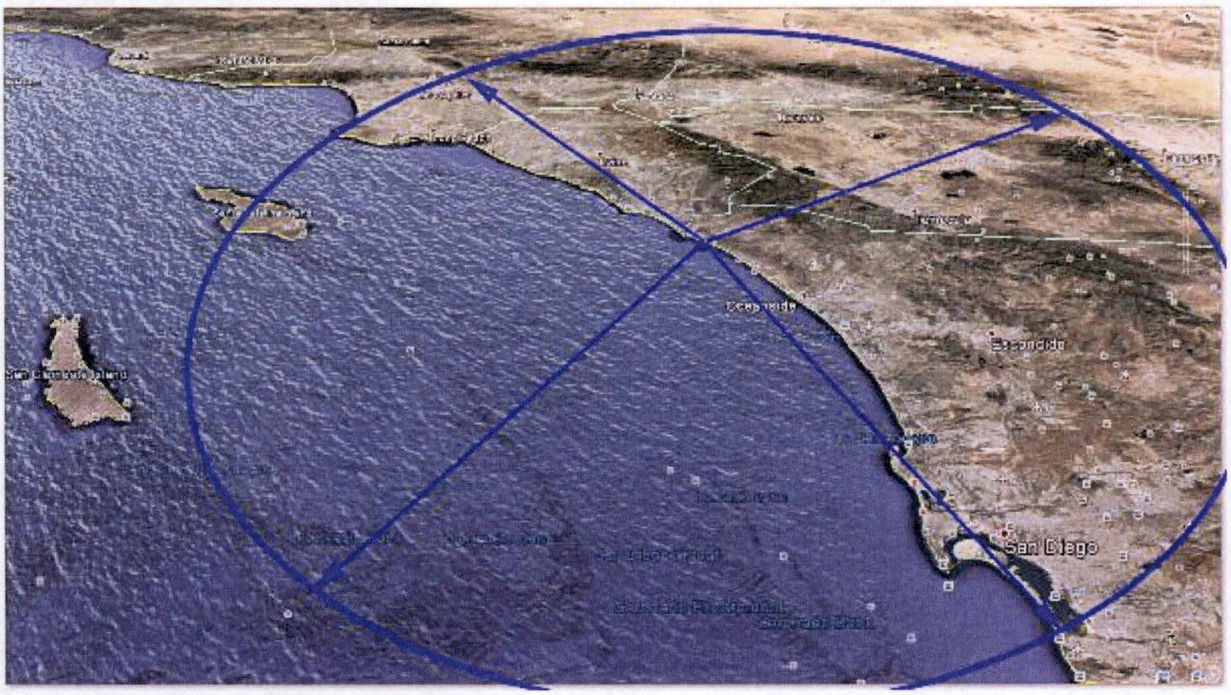


Figure 2 - SONGS 45 mile REMP Radius

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 measurable levels of radioactive materials in environmental samples collected around SONGS, as part of the REMP, are for the most part undetectable, except for the naturally occurring radionuclides in the environment, such as potassium 40 (K-40), natural uranium and natural thorium. It is recognized that there are limits to the detection levels for any type of environmental analysis.

The NRC also 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 radiation level is equal to or greater than this reporting level. None of SONGS's samples has ever reached a small fraction of these 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.

Figure 3 - SONGS Location

Unit 1 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, 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. Currently, the North Industrial Area Sump effluent pathway is routed to Units 2 or 3 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 1983, and April 1984, respectively. 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.

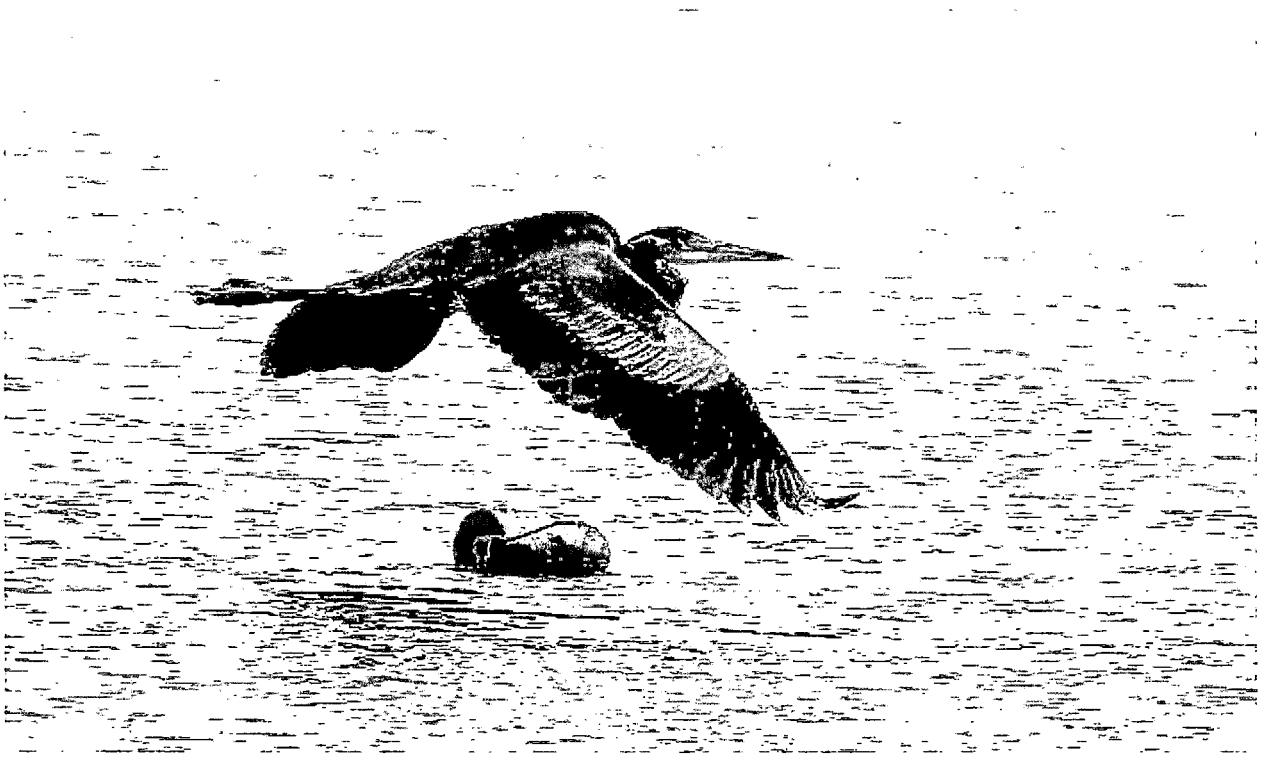
Stewardship

- 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 2015 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 2015 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 2015 analytical results and discussions are 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 2015 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 2015. 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 reasonably achievable" (ALARA), as specified in 10 CFR 20.1101(b).

The REMP data collected during 2015, 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.

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 2015; no changes in the sampling media or sample locations were required.

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 10 CFR 50 Appendix B, 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 is quality assurance program which meets the requirement of 10 CFR 50 Appendix B, 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 2015 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 indicates that SONGS continues to have no measurable radiological impact on the environment or any member of the public during 2015. 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 reasonably achievable" (ALARA), as specified in 10 CFR 20.1101(b).

The REMP data collected during 2015, 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. To fulfill the radiological environmental monitoring requirements of the ODCM
2. Characterize the radiological footprint outside of the plant resulting from the licensed operations and during decommissioning phases of SONGS Units 2 and 3.
3. To detect any significant increase in the concentration of radionuclides in the pathways of exposure to the public.
4. To detect any significant change in ambient gamma radiation levels.

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

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-1301/1302. 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 is 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 2015 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.

Not Detectable (ND) – "Not 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 2015 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 2015 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 in 2015 had no observable radiological environmental impact.

G. References

1. SONGS Offsite Dose Calculation Manual (ODCM) Revision 9, Section 5.0, 2015.

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)	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 (Adjacent to PIC #1)	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 (Adjacent to PIC #3)	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) (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 (Adjacent to PIC #4)	0.7	N
62	MCB - Camp Pendleton (Adjacent to PIC #5)	0.7	NNE
63	MCB - Camp Pendleton (Adjacent to PIC #6)	0.6	NE
64	MCB - Camp Pendleton (Adjacent to PIC #7)	0.6	ENE
65	MCB - Camp Pendleton (Adjacent to PIC #8)	0.7	E
66	San Onofre State Beach (Adjacent to PIC #9)	0.6	ESE
67	Former SONGS Evaporation Pond (Adjacent to PIC #2)	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)

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 SAMPLING (TFB VG) LOCATION		DISTANCE[a] (miles)	DIRECTION[a] (Sector)
2	Oceanside (Control)	21	SE to ESE
6	SONGS Garden	0.4	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)	15 to 150	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)	17-19	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 2015, no samples were obtained from backup kelp sampling locations.
MCB Marine Corps Base (Camp Pendleton)
PIC Pressurized Ion Chamber

Table 12 - Sector and Direction Designations

DEGREES TRUE NORTH FROM SONGS 2 AND 3 MIDPOINT			NOMENCLATURE	
Sector Limit	**Center Line**	**Sector Limit**	**22.5^0 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

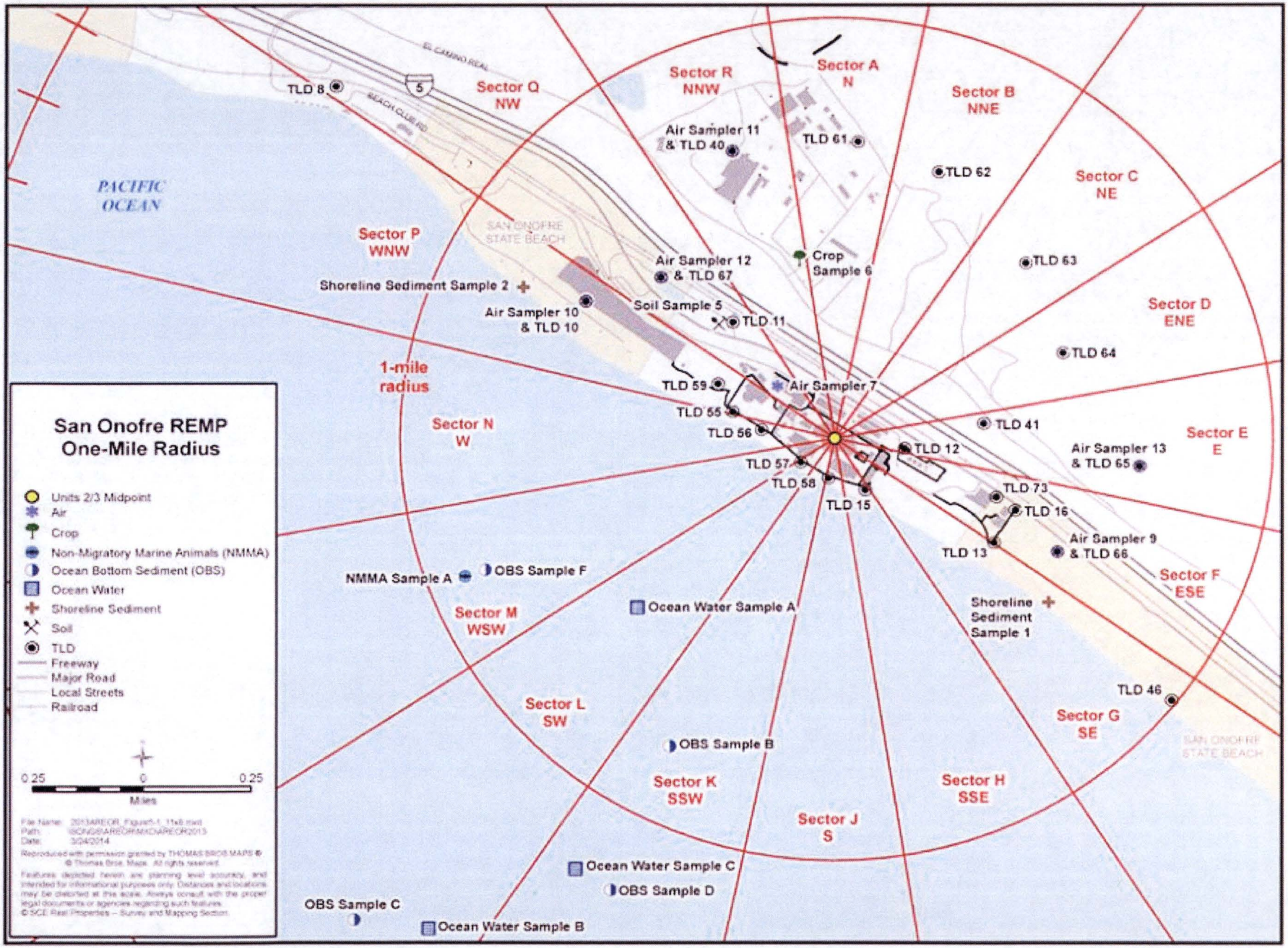


Figure 4 - SONGS REMP One Mile Radius

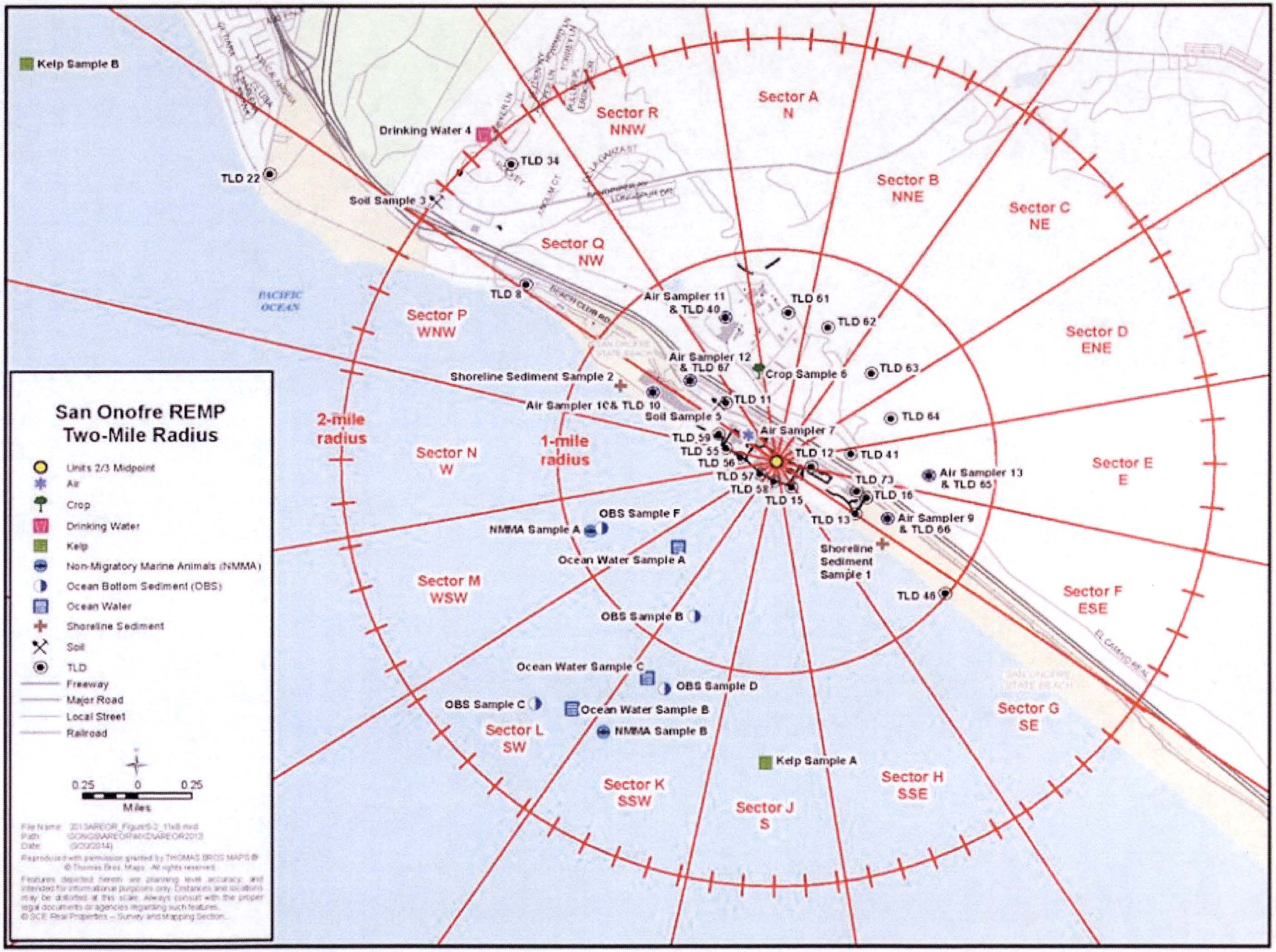


Figure 5 - SONGS REMP Two Mile Radius

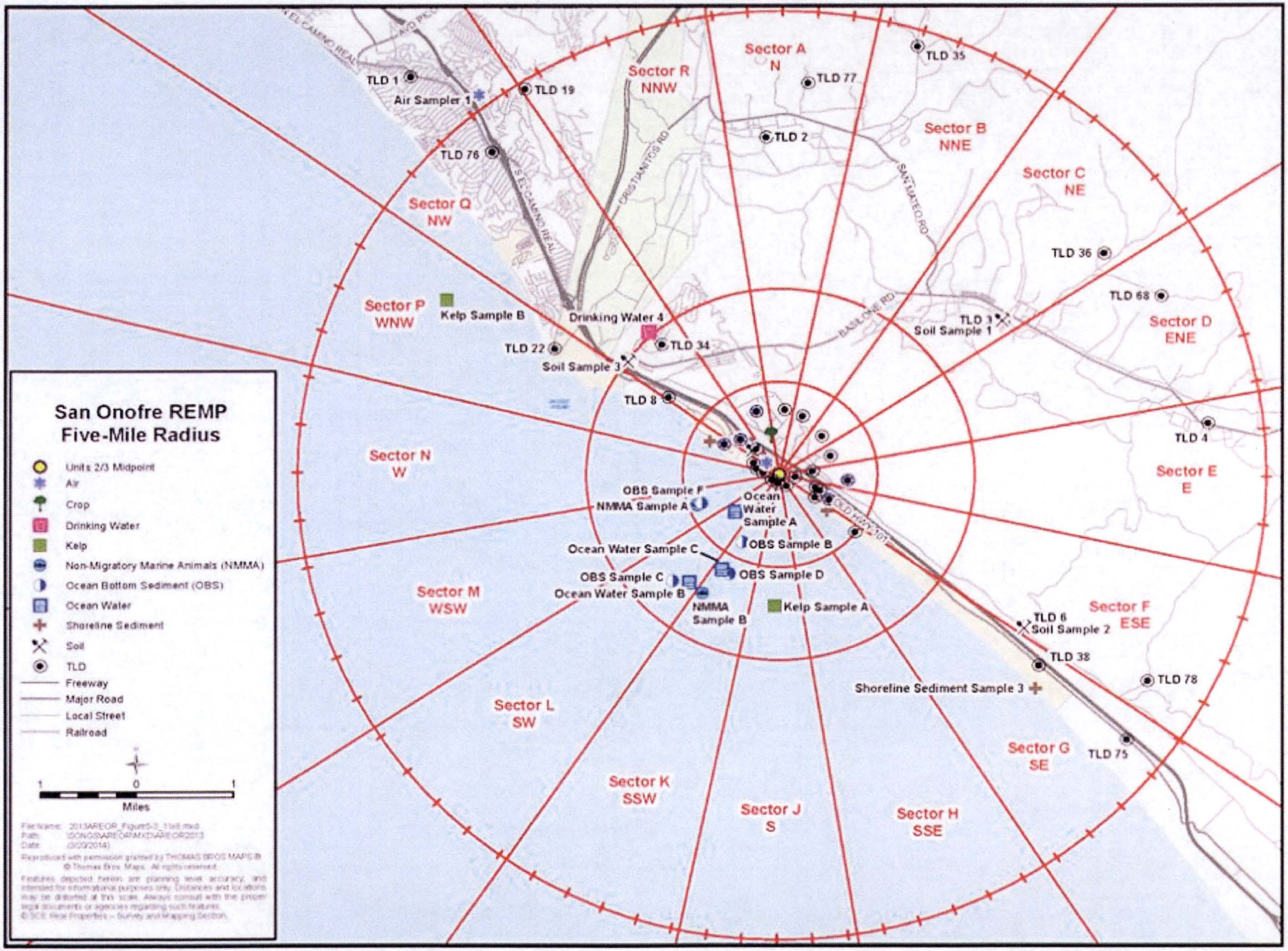


Figure 6 - SONGS REMP Five Mile Radius

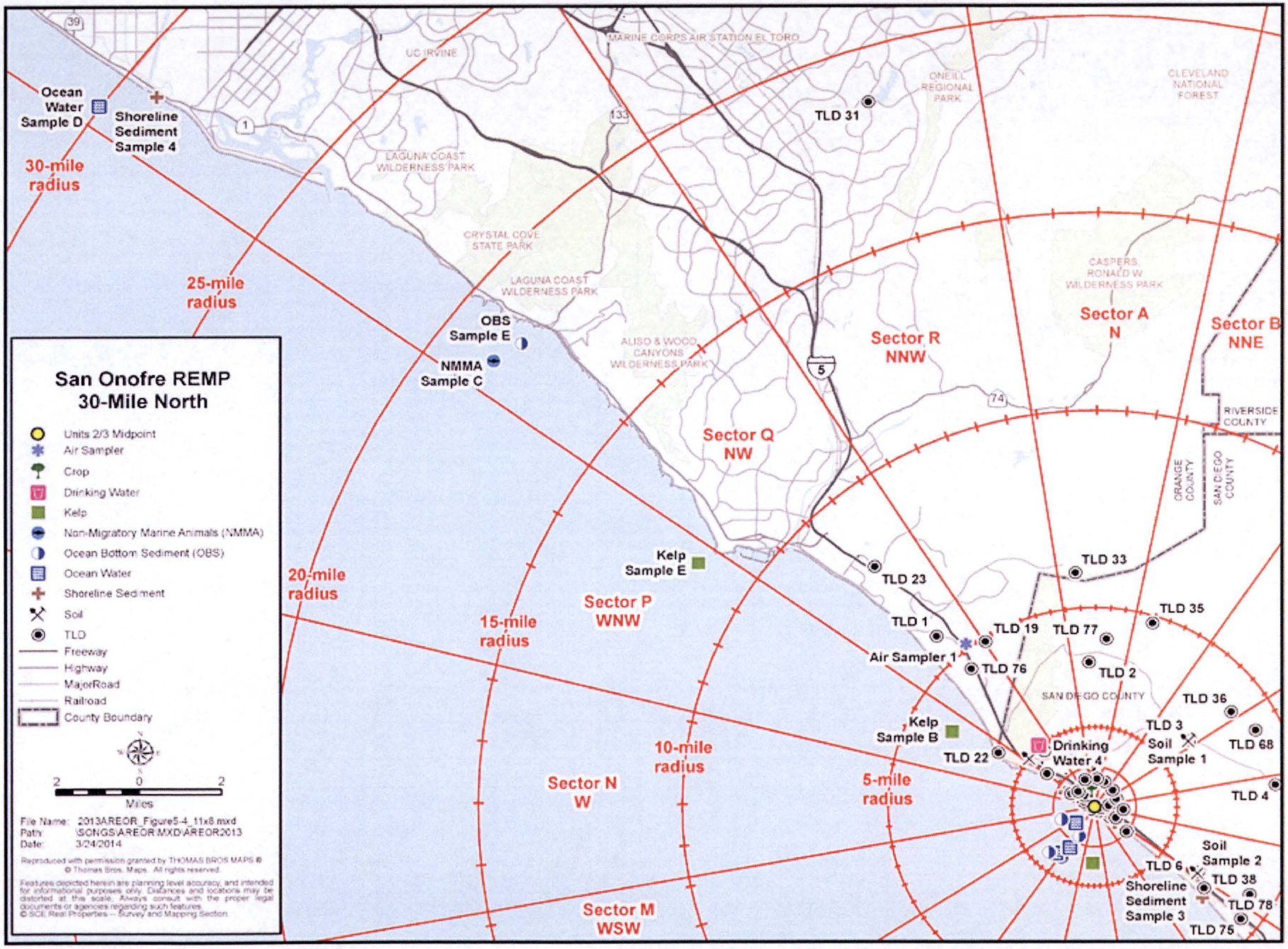


Figure 7 - SONGS REMP 30-mile Radius North

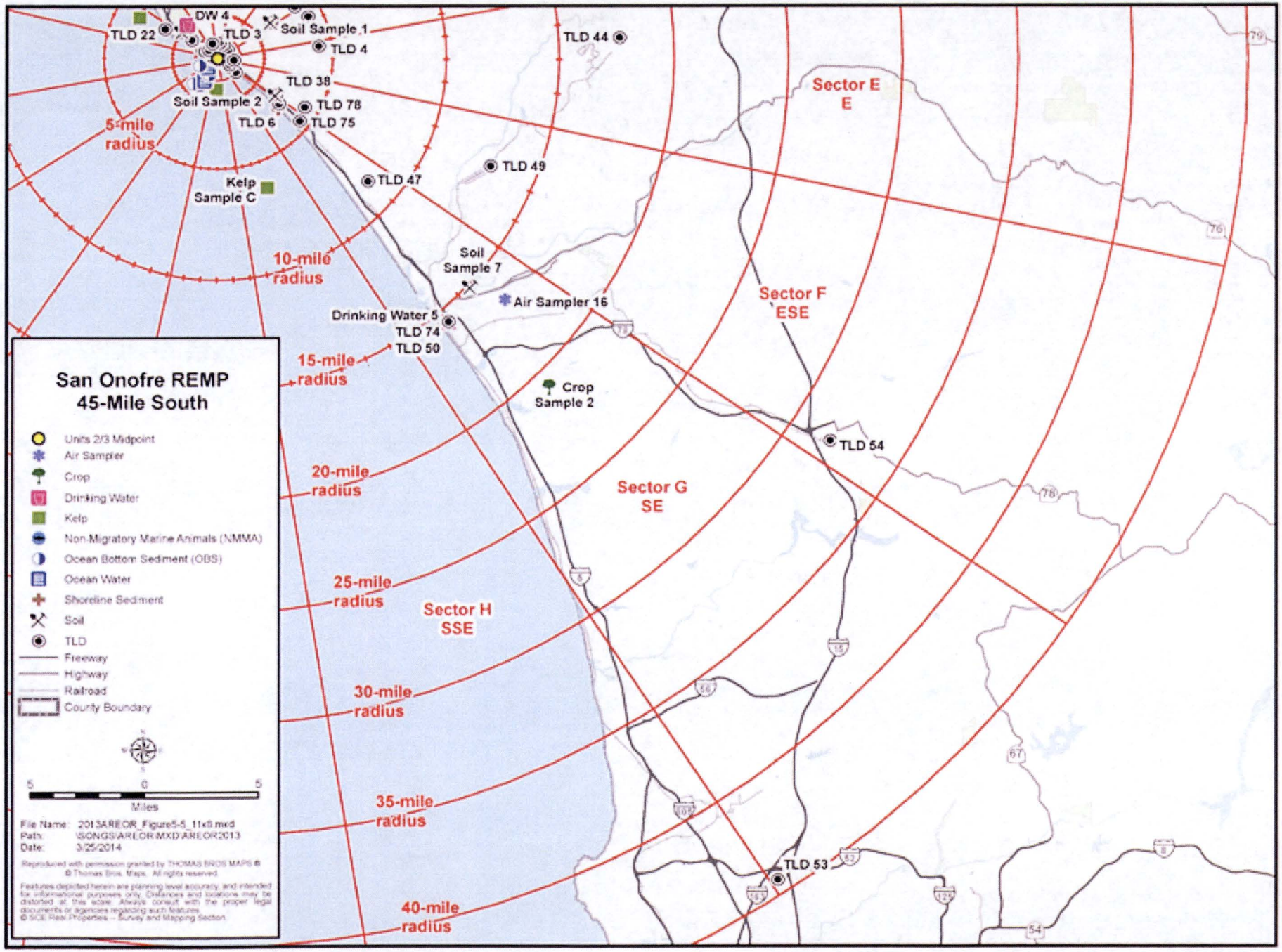


Figure 8 - SONGS REMP 45-mile Radius South

APPENDIX B. RESULTS AND DISCUSSIONS OF 2015 ENVIRONMENTAL DATA

To assess the changes or trends in the radioactivity level in the environment over the past year, the data from January 1st, 2015 through December 31st 2015 were evaluated. A summary of the type and number of REMP samples obtained in 2015 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 2015.

Table 13 - REMP Sample Analysis Summary for 2015

Medium	Analysis Type	Sampling Frequency	# of Locations	Total # of Analyses in 2015 [a]
Direct Radiation	Dosimetry	Quarterly	49	196
Airborne Particulates	Gross Beta	Weekly	8	416
Charcoal Cartridge	I-131	Weekly	8	416
Airborne Particulates	Gamma	Quarterly	8	32
Ocean Water	Gamma, H-3	Monthly	4	52
	H-3	Quarterly	4	16
Drinking Water, Unfiltered	Gamma, H-3 Gross Beta	Monthly	2 2 2	25 24 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, additional ocean bottom sediment samples and additional crop samples.

A. Results and Discussions of 2015 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.

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 2015 (i.e., greater than 5 mR per standard quarter or 10 mR per year).

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 2015 control location TLD readings were below the minimum detectable dose and all 2015 indicator location readings outside the Exclusion Area Boundary (EAB) were below the minimum detectable dose.

The data indicate detectable direct radiation measurements only in the immediate vicinity of SONGS, via those dosimeters placed within 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 1 mR per year as measured by this sample media. TLD station #13 had the highest measured REMP TLD annual baseline adjusted exposure in 2015 (27 mR, Southeast Site Boundary (Bluff)). The occupancy adjusted exposure for TLD#13 is less than 1 mR per year. Refer to Table 14 for a summary of all 2015 SONGS REMP TLD data.

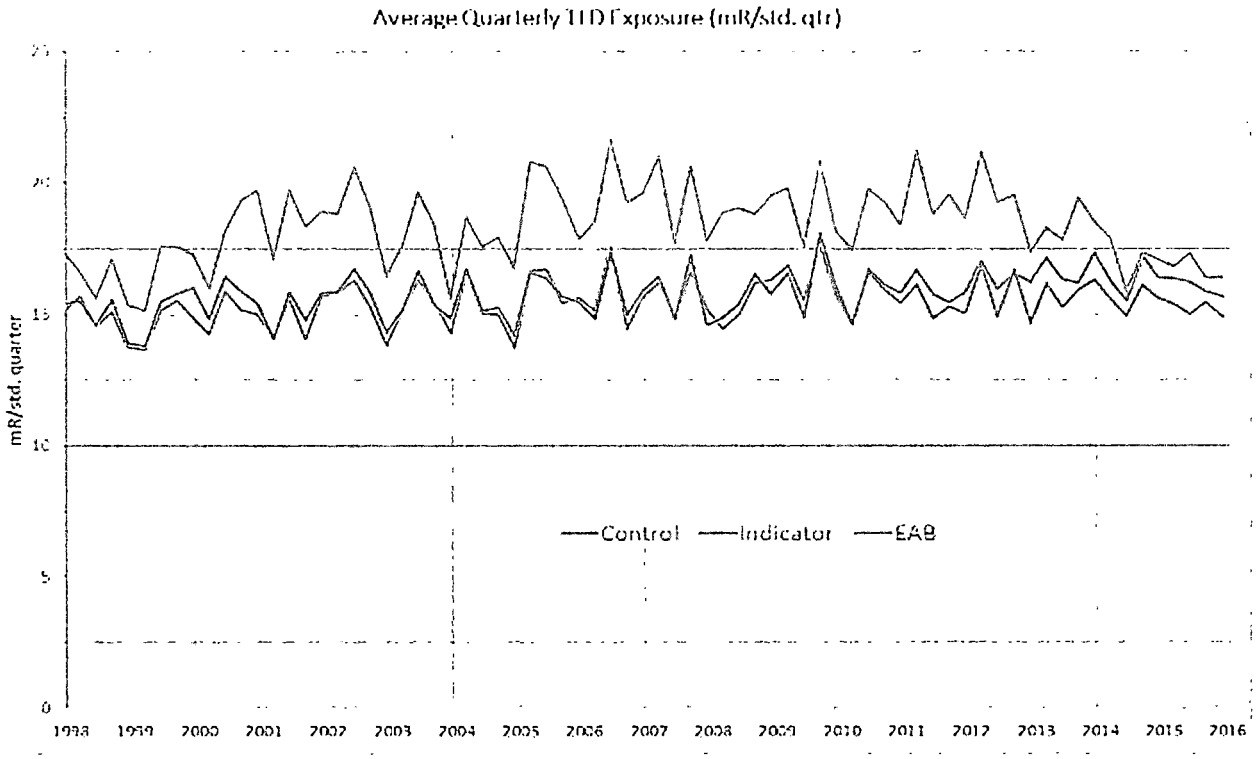


Figure 9 – SONGS REMP TLD data through 2015

Figure 9 compares environmental radiation levels of indicator and control locations for the operational year 2015 and for previous years. These figures show the close correlation between the control and indicator location TLD exposure data.

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 fader 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 2015, there was no detectable neutron exposure measured by TLDs.

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 2015 TLD Data Table 14. 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. This results in 4.1 mR for the quarterly measurements (MDD_Q or $3\sigma_Q$) and 9.0 mR 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 15.0 mR per quarter. A value of 15.0 mR 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 15.0 mR 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.

Table 14 - SONGS REMP TLD Data

TLD	Location	Dist. (miles)	Qtr. Baseline (mR)	Quarterly Results (mR)				Baseline Adjusted Quarterly Results (mR)				Ann. Baseline (mR)	2015 Annual Total (mR)	Baseline Adjusted Annual (mR)
				1	2	3	4	1	2	3	4			
1	City of San Clemente	5.7	17.5	17.08	16.50	16.86	17.01	ND	ND	ND	ND	69.9	67.45	ND
2	Camp San Mateo – MCB	3.6	18.6	18.21	16.98	19.00	18.57	ND	ND	ND	ND	74.4	72.76	ND
3	Camp San Onofre – MCB	2.8	16.4	16.43	15.37	16.42	16.12	ND	ND	ND	ND	65.5	64.34	ND
4	Camp Horno – MCB	4.4	18.1	18.27	17.55	18.01	17.25	ND	ND	ND	ND	72.3	71.08	ND
6	Old Route 101 (ESE)	3	11.4	10.58	10.82	10.77	10.76	ND	ND	ND	ND	45.6	42.93	ND
8	Noncommissioned Officers' Beach Club	1.4	15.4	15.30	14.57	15.58	16.08	ND	ND	ND	ND	61.8	61.53	ND
10	Bluff (Adjacent to PIC #1)	0.7	16.4	15.90	16.12	15.33	15.72	ND	ND	ND	ND	65.7	63.07	ND
19	San Clemente Highlands	4.9	17.8	17.94	17.65	17.86	17.66	ND	ND	ND	ND	71.3	71.11	ND
22	Former US Coast Guard Station	2.7	17.9	17.78	17.70	17.59	17.82	ND	ND	ND	ND	71.7	70.89	ND
23	SDG&E Service Center Yard (Control)	8.1	15.8	15.58	14.75	15.95	15.16	ND	ND	ND	ND	63.1	61.44	ND
31	Aurora Park - Mission Viejo (Control)	18.6	18.5	19.36	17.28	18.59	19.20	ND	ND	ND	ND	74.1	74.43	ND
33	Camp Talega – MCB (Control)	5.9	18.9	18.65	18.07	19.26	17.71	ND	ND	ND	ND	75.4	73.69	ND
34	San Onofre School – MCB	1.9	16.2	16.52	16.18	16.53	15.36	ND	ND	ND	ND	64.7	64.59	ND
35	Range 312 – MCB	4.8	16.9	14.30	14.06	15.53	14.36	ND	ND	ND	ND	67.5	58.25	ND
36	Range 208C – MCB	4.1	19.5	17.95	17.79	19.07	17.35	ND	ND	ND	ND	77.8	72.16	ND
38	San Onofre State Beach Park	3.4	14.3	13.44	12.90	13.50	12.71	ND	ND	ND	ND	57.2	52.55	ND
40	SCE Training Center - Mesa (Adjacent to PIC #3)	0.7	17.1	16.76	16.19	16.92	15.62	ND	ND	ND	ND	68.4	65.49	ND
44	Fallbrook Fire Station (Control)	17.7	14	14.03	14.74	13.51	14.03	ND	ND	ND	ND	56	56.31	ND
46	San Onofre State Beach Park	1	12.2	13.97	12.70	12.70	12.76	ND	ND	ND	ND	48.7	52.13	ND
47	Camp Las Flores – MCB (Control)	8.6	13.3	15.09	15.82	14.37	14.21	ND	ND	ND	ND	53.1	59.49	ND
49	Camp Chappo – MCB (Control)	12.9	14.2	15.25	14.60	14.25	13.69	ND	ND	ND	ND	56.9	57.79	ND
50	Oceanside Fire Station (Control)	15.6	16.6	16.42	16.19	15.16	15.62	ND	ND	ND	ND	66.3	63.39	ND
53	San Diego County Operations Center (Control)	44.2	18.2	19.13	19.58	18.39	17.63	ND	ND	ND	ND	72.9	74.73	ND
54	Escondido Fire Station (Control)	31.8	16.1	16.53	17.61	15.67	16.02	ND	ND	ND	ND	64.4	65.83	ND
61	Mesa - East Boundary (PIC #4)	0.7	15.4	14.44	14.56	14.62	14.35	ND	ND	ND	ND	61.7	57.97	ND
62	Camp Pendleton (PIC #5)	0.7	13.2	12.25	11.92	12.73	12.26	ND	ND	ND	ND	50.4	49.16	ND
63	Camp Pendleton (PIC #6)	0.6	13.9	13.75	13.14	13.80	12.76	ND	ND	ND	ND	55.5	53.45	ND
64	Camp Pendleton (PIC #7)	0.6	15	14.53	14.75	14.98	14.11	ND	ND	ND	ND	60.1	58.37	ND
65	Camp Pendleton (PIC #8)	0.7	13.4	12.94	12.88	12.79	12.88	ND	ND	ND	ND	53.8	51.49	ND
66	San Onofre State Beach (PIC #9)	0.6	14	13.78	13.47	13.50	12.90	ND	ND	ND	ND	55.6	53.65	ND
67	Former SONGS Evaporation Pond (PIC #2)	0.6	16.9	16.66	16.00	16.35	17.04	ND	ND	ND	ND	67.7	66.05	ND

TLD	Location	Dist. (miles)	Qtr. Baseline (mR)	Quarterly Results (mR)				Baseline Adjusted Quarterly Results (mR)				Ann. Baseline (mR)	2015 Annual Total	Baseline Adjusted Annual
68	Range 210C – MCB	4.4	15	15.83	15.21	15.60	13.91	ND	ND	ND	ND	60.2	60.55	ND
74	Oceanside City Hall (Backup Control)	15.6	13.3	13.23	13.72	12.60	12.46	ND	ND	ND	ND	53.4	52.01	ND
75	Gate 25 MCB	4.6	15.9	15.27	16.26	15.53	15.37	ND	ND	ND	ND	63.6	62.43	ND
76	El Camino Real Mobil Station	4.6	17.3	17.51	16.77	16.94	16.31	ND	ND	ND	ND	69.4	67.53	ND
77	Area 62 Heavy Lift Pad	4.2	19.2	18.39	17.79	18.91	17.26	ND	ND	ND	ND	76.9	72.35	ND
78	Horno Canyon	4.4	11.1	11.29	11.15	11.33	10.43	ND	ND	ND	ND	44.6	44.20	ND
11	Former Visitors' Center [a]	0.4	15	15.34	15.75	15.38	15.51	ND	ND	ND	ND	60	61.98	ND
12	South Edge of Switchyard [a]	0.2	15	16.72	16.20	16.92	16.54	ND	ND	ND	ND	60	66.38	ND
13	Southeast Site Boundary (Bluff) [a]	0.4	15	19.78	22.91	22.14	21.83	4.78	7.91	7.14	6.83	60	86.66	26.66
15	Southeast Site Boundary (Office Bldg.) [a]	0.1	15	17.28	17.69	16.52	17.76	ND	ND	ND	ND	60	69.25	9.25
16	East Southeast Site Boundary [a]	0.4	15	14.89	16.13	14.62	13.89	ND	ND	ND	ND	60	59.53	ND
41	Old Route 101 – East [a]	0.3	15	15.26	14.81	14.65	15.04	ND	ND	ND	ND	60	59.76	ND
55	San Onofre State Beach (U1 West) [a]	0.2	15	18.62	18.06	16.75	17.57	ND	ND	ND	ND	60	71.00	11
56	San Onofre State Beach (U1 West) [a]	0.2	15	17.44	17.84	16.32	16.51	ND	ND	ND	ND	60	68.11	ND
57	San Onofre State Beach (Unit 2) [a]	0.1	15	15.13	16.47	14.39	14.43	ND	ND	ND	ND	60	60.42	ND
58	San Onofre State Beach (Unit 3) [a]	0.1	15	15.59	16.82	13.53	13.25	ND	ND	ND	ND	60	59.19	ND
59	SONGS Meteorological Tower [a]	0.3	15	17.61	17.65	18.08	17.75	ND	ND	ND	ND	60	71.09	11.09
73	South Yard Facility [a]	0.4	15	18.40	17.64	17.73	16.90	ND	ND	ND	ND	60	70.67	10.67

NOTES:

a. Station is within the Exclusion Area Boundary (EAB). The quarterly baseline has been estimated to be 15.0 mR within the EAB.

b. 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 $3\sigma_A$.

b. Quality Control Duplicate Direct Radiation Samples

Duplicate Quality Control (QC) TLDs were installed adjacent to TLD #66 and TLD #67. 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. These stations are located near the site boundary downwind from the plant, based on the prevailing wind direction.

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 0.0135 pCi/m^3 to 0.0790 pCi/m^3, averaging 0.0346 pCi/m^3 of air. The concentrations of gross beta activity in the samples from the control location ranged from 0.0198 pCi/m^3 to 0.0809 pCi/m^3, averaging 0.0388 pCi/m^3 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 2015 was 0.0790 pCi/m^3 which is less than 10 times the average background measured at the control location (0.0388 pCi/m^3). 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 2015. 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. 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 2015, 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 2015 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 2015, 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 2015. 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 2015 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 2015.

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 2015, all conduit sample analysis results were below the MDC for station related radionuclides.

Therefore, 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 I 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 were detected in marine species samples collected during 2015. The operation of SONGS had no impact on the environment as measured by this sample medium. The potential dose to members of the public from consumption of marine species near SONGS is due only to naturally occurring radioisotopes.

8. Local Crops

Fleshy and leafy crops were collected semiannually in 2015 from the SONGS garden and from the control location 21 miles SE from SONGS Units 2/3 midpoint. Tomato, lettuce and sorrel were sampled in 2015, and only naturally occurring radionuclides were identified. No plant related radioactivity was detected. It is concluded that in 2015 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. 2015 soil samples yielded naturally occurring radionuclides and Cs-137 was detected in one (1) indicator 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 or Fukushima. During 2015, 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 2015 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 2015, from both indicator and control locations. One indicator location sample from the San Mateo Kelp bed identified I-131. Iodine-131 is a radionuclide that is produced and released from operating nuclear power plants. However, SONGS nuclear fuel is stored in spent fuel pools and not generating I-131.

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. The San Juan outfall 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.

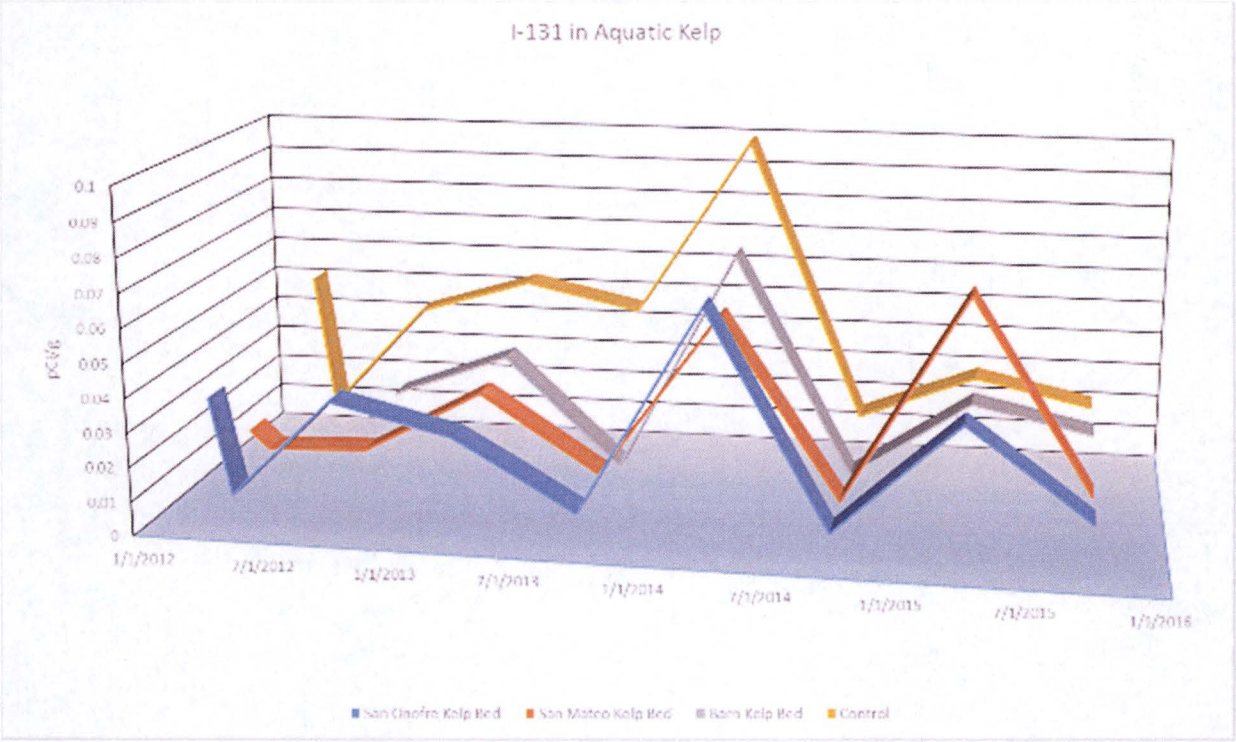


Figure 10 - I-131 in Aquatic Kelp

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.

11. Deer

Although deer meat is not part of the exposure pathway in the ODCM, beginning in 2008 and continuing through 2014 samples of deer meat and bone harvested from road kill were analyzed for Cs-137 to evaluate deer meat as a potential exposure pathway. Road kill deer are sampled in accordance with a California Fish and Game scientific permit issued to the Camp Pendleton Game Warden. In 2015, no deer samples were obtained by the game warden, so no results are reported.

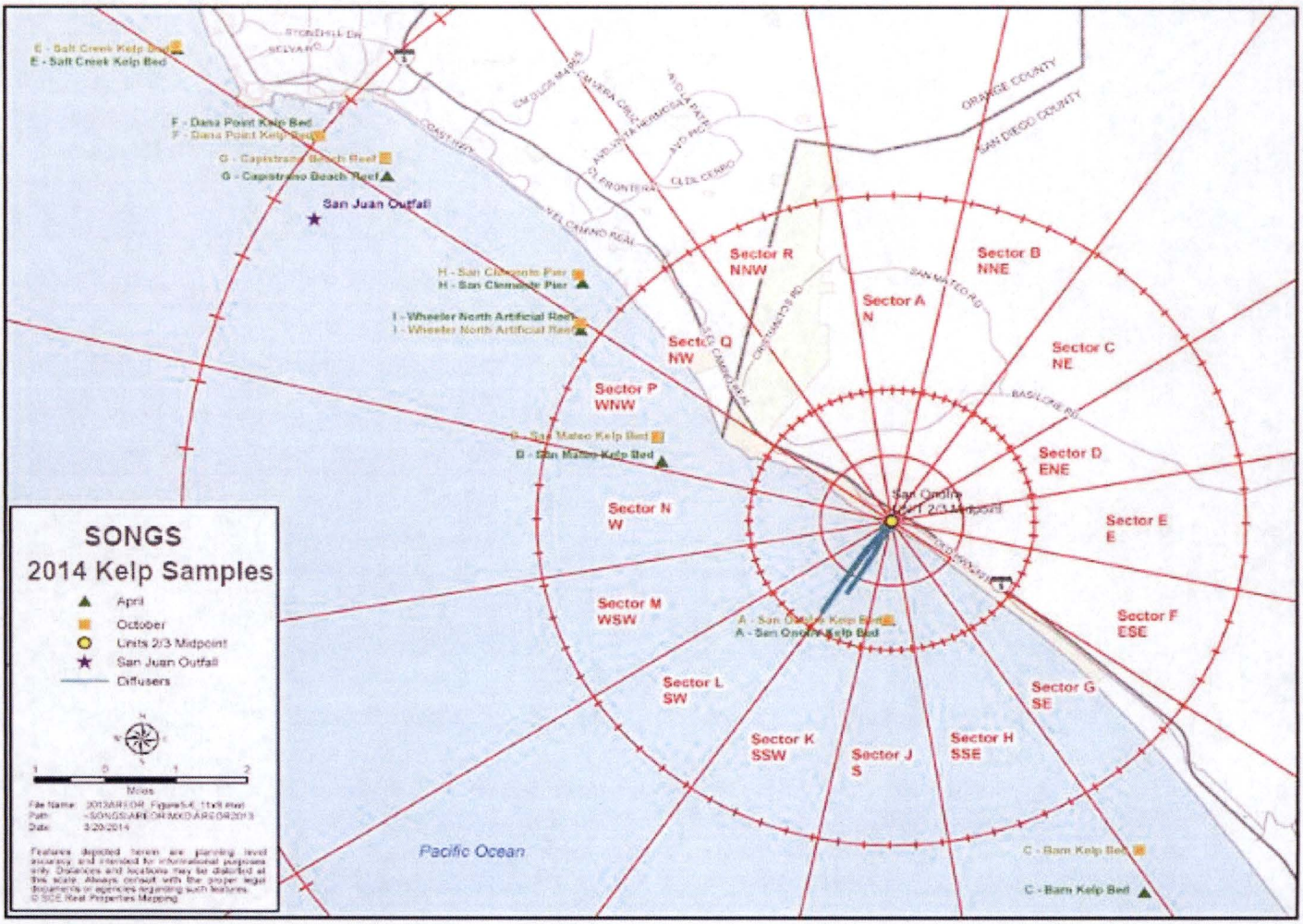


Figure 11 - Kelp Sampling Locations

12. 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:

SONGS' effluent program releases are evaluated annually to determine the receptor(s) with the highest hypothetical dose. The 2015 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. There is no off-site environmental radioactivity that can be compared to effluent releases.

B. Statistical Summary of REMP Data for 2015

Table 15 - 2015 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 (mR)	Gamma 218	5	15.69 (152/152) (10 – 23)	Southeast Site Boundary (Bluff) 0.4 Mi. ESE	22 (4/4) (20 – 23)	16.06 (66/66) (12 – 20)	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/m^3)

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)	Gross Beta 416	0.01	0.035 (364/364) (0.013 – 0.079)	Mesa EOF 0.7 Mi. NNW	0.039 (52/52) (0.018 – 0.075)	0.039 (52/52) (0.020 – 0.081)	0

Table 17 – Weekly Radioiodine I-131 Activity (pCi/m^3)

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-131 415	0.07	< LLD [c] (0/363)	< 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/m^3)

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 2015.

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	72	Various	< LLD (0/60)	< LLD	< LLD	< LLD (0/12)	0

NOTES

a Natural occurring radionuclides (K-40 and others) were observed in samples in 2015.

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	2.350 (2/12) 1.906 – 2.793	Camp Pendleton 2.0 Mi. NW	2.350 (2/12) 1.906 – 2.793	5.052 (5/12) 3.237 – 6.985	0
Drinking Water (pCi/L)	H-3	24	2000	< LLD (0/12)	Camp Pendleton 2.0 Mi. NW	< LLD (0/12)	< LLD (0/12)	0

NOTES

a Natural occurring radionuclides (Pb-214, Th-228, Th-232 and others) were observed in samples in 2015.

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 2015 naturally occurring Ac-228, Bi-214, Pb-212, Pb-214, Ra-226, Ra-228, Th-230, Th-232, Tl-208, U-234, and K-40 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 2015 naturally occurring Ac-228, Bi-214, Pb-212, Pb-214, Ra-226, Ra-228, Th-230, Th-232, Tl-208, U-234, and K-40 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	6	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/2)	0
Spiny Lobster	Gamma	6	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/2)	0

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

NOTES
a During 2015 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	3	Various	< LLD (0/2)	< LLD	< LLD	< LLD (0/1)	0
Tomato Ingestion (pCi/g)	Gamma Isotopic	4	Various	< LLD (0/2)	< LLD	< LLD	< LLD (0/2)	0
Lettuce Ingestion (pCi/g)	Gamma Isotopic	1	Various	N/A	< LLD	< LLD	< LLD (0/1)	0

NOTES
a During 2015 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 Ingestion (pCi/g)	Gamma Isotopic	5	Various	< LLD (0/4)	< LLD	< LLD	< LLD (0/1)	0
	Cs-137	5	0.18	0.333 (1/4) (0.333 – 0.333)	Old Route 101 3.0 Mi. ESE	0.333 (0.333 – 0.333)	< LLD (0/1)	0

NOTES

a During 2015 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	0.015	0.032 (6/6) (0.013 – 0.069)	San Mateo Kelp Bed 3.8 Mi. WNW	0.041 (0.013 – 0.069)	0.025 (1/2) (0.021 – 0.029)	0

NOTES

a I-131 was confirmed above the MDC in 7 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 2015 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 2015 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 equal.

Table 28 - 2015 Quarterly Duplicate TLD Data Comparison

TLD #	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
TLD 66	13.8 ± 0.80	13.5 ± 0.92	13.5 ± 0.64	12.9 ± 0.76
TLD 200	13.5 ± 0.96	13.9 ± 0.66	13.8 ± 0.60	12.5 ± 0.53

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

C. Annual Duplicate TLDs

Table 29 - 2015 Annual Duplicate TLD Data

TLD 67 (mR) (January 2015 to December 2015)	TLD 201 (annual duplicate) (July 2014 to June 2015)
66.1	64.3

Table 30 - PIC Data Compared to TLD Results

	Quarterly Exposure (mR)		Quarterly Exposure (mR)
PIC 2	18.7	TLD 67	16.7
PIC 3	19.0	TLD 40	16.8
PIC 4	17.3	TLD 61	14.4
PIC 5	16.2	TLD 62	12.3
PIC 9	15.5	TLD 66	13.8

NOTES:
a. PIC Data is converted from average hourly exposure from Q1 2015.
b. TLD Data is standard quarter Q1 2015 results.

The results from the installed PICs is generally higher than the results obtained from TLDs. However, the magnitude of the exposure is consistent with results seen in previous years, and within the expected variations to be seen between these measurements.

As of June 8, 2015, the Permanently Defueled Emergency Plan (PDEP) no longer requires the use of PIC measurements. The direct gamma measurements provided by TLDs will continue to be implemented in the site's REMP. The use of TLDs for measurement of the gamma direct

dose component is performed in accordance with NRC Regulatory Guide 4.13, Rev. 1, meeting specified performance criteria for TLDs. Data from PIC measurements will no longer be used for TLD comparisons in the future.

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 2015 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 2015, the environmental TLDs, routine quality control (QC) testing was performed for dosimeters issued by the Environmental Dosimetry Company (EDC). During 2015, 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 2015

GEL Laboratories LLC

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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	4th/2014	03/10/15	E11057	Cartridge	pCi	Iodine-131	8.70E+01	9.85E+01	0.88	Acceptable
EZA	4th/2014	03/10/15	E11058	Milk	pCi/L	Strontium-89	9.09E+01	9.57E+01	0.95	Acceptable
EZA	4th/2014	03/10/15	E11058	Milk	pCi/L	Strontium-90	1.39E+01	1.56E+01	0.89	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Iodine-131	9.34E+01	9.51E+01	0.98	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cerium-141	2.33E+02	2.19E+02	1.06	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cr-51	4.22E+02	4.06E+02	1.04	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cesium-134	1.50E+02	1.64E+02	0.91	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cesium-137	2.16E+02	1.98E+02	1.09	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cobalt-58	1.32E+02	1.30E+02	1.02	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Mn-54	2.39E+02	2.25E+02	1.06	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Iron-59	1.60E+02	1.75E+02	1.03	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Zinc-65	3.32E+02	2.97E+02	1.12	Acceptable
EZA	4th/2014	03/10/15	E11059	Milk	pCi/L	Cobalt-60	2.49E+02	2.35E+02	1.06	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Iodine-131	1.11E+02	9.53E+01	1.16	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cerium-141	3.02E+02	2.84E+02	1.06	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cr-51	5.43E+02	5.26E+02	1.03	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cesium-134	1.90E+02	2.13E+02	0.89	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cesium-137	2.58E+02	2.57E+02	1.01	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cobalt-58	1.73E+02	1.68E+02	1.03	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Mn-54	3.06E+02	2.92E+02	1.05	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Iron-59	2.51E+02	2.26E+02	1.11	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Zinc-65	4.20E+02	3.84E+02	1.09	Acceptable
EZA	4th/2014	03/10/15	E11060	Water	pCi/L	Cobalt-60	3.24E+02	3.04E+02	1.06	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Barium-133	73.2	67.6	56.4-74.4	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Cesium-134	51.9	51.3	41.3-55.4	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Cesium-137	142	124	112-139	Not Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Cobalt-60	62.7	62.4	56.2-71.2	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Zinc-65	107	95.7	88.8-118	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Gross Alpha	67.2	62.3	32.5-77.3	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Gross Beta	43.2	45.9	33.1-56.0	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Gross Alpha	66.7	62.3	32.5-77.3	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Radium-226	16.1	15.8	12.5-19.2	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Radium-226	16.9	15.8	12.5-19.2	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Radium-226	16.8	15.8	12.5-19.2	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Radium-228	4.50	5.12	3.07-6.85	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Radium-228	7.40	5.12	3.07-6.85	Not Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	pCi/L	Uranium (Nat)	11.0	10.6	8.27-12.2	Acceptable
ERA	1st / 2015	02/23/15	RAD-100	Water	ug/L	Uranium (Nat) mass	16.4	15.5	12.1-17.9	Acceptable

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ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Uranium (Nat)	11.3	10.6	5.27-12.2	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	ug/L	Uranium (Nat) Mass	17.1	15.5	12.1-17.9	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Tritium	10000	10500	9220-11700	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Strontium-89	47.3	52.1	41.2-59.6	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Strontium-90	26.7	32.4	23.7-37.5	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Strontium-89	54.6	52.1	41.2-59.6	Acceptable
ERA	1st/2015	02/23/15	RAD-100	Water	pCi/L	Strontium-90	24.6	32.4	23.7-37.5	Acceptable

GEL QUARTERLY INTERLABORATORY COMPARISON

April through June 2015

GEL Laboratories LLC

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	1st/2015	05/21/15	E11174	Cartridge	pCi	Iodine-131	8.01E+01	7.74E+01	1.03	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Strontium-89	9.75E+01	1.05E+01	1.00	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Strontium-90	1.10E+01	1.44E+01	0.93	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Iodine-131	9.60E+01	9.75E+01	0.98	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Cerium-141	2.13E+02	2.11E+02	1.01	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Chromium-51	5.88E+02	5.55E+02	1.06	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Cesium-134	1.71E+02	1.91E+02	0.9	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Cesium-137	2.59E+02	2.53E+02	1.02	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Cobalt-58	2.64E+02	2.72E+02	0.97	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Manganese-54	2.43E+02	2.40E+02	1.01	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Iron-59	3.14E+02	2.95E+02	1.06	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Zinc-65	4.67E+02	4.53E+02	1.03	Acceptable
EZA	1st/2015	05/21/15	E11175	Milk	pCi/L	Cobalt-60	4.81E+02	4.98E+02	0.97	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Iodine-131	9.92E+01	9.67E+01	1.03	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Cerium-141	1.40E+02	1.39E+02	1.01	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Chromium-51	3.95E+02	3.66E+02	1.08	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Cesium-134	1.12E+02	1.26E+02	0.89	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Cesium-137	1.59E+02	1.57E+02	1.01	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Cobalt-58	1.78E+02	1.80E+02	0.99	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Manganese-54	1.66E+02	1.59E+02	1.05	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Iron-59	2.14E+02	1.95E+02	1.01	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Zinc-65	3.25E+02	2.99E+02	1.09	Acceptable
EZA	1st/2015	05/21/15	E11175	Water	pCi/L	Cobalt-60	3.23E+02	3.28E+02	0.98	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Ms532	Filter	Bq/sample	Gross Alpha	1.520	1.770	0.53-3.01	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Ms532	Filter	Bq/sample	Gross Beta	0.644	0.750	0.38-1.13	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Americium-241	114.0	97.0	68-126	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Cesium-134	639	678	475-861	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Cesium-137	-0.279		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Cobalt-57	0.369		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Cobalt-60	852	817	572-1062	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Iron-55	330	205	Sens. Eval.	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Manganese-54	1280	1196	839-1557	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Nickel-63	481	448	314-582	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Plutonium-238	80.3	83.9	58.7-109.1	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Plutonium-239/240	69.1	70.8	49.6-92.0	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Potassium-40	684	622	435-809	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Strontium-90	601	653	457-849	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Technetium-99	694	867	607-1127	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	U-234/233	58	53	36.8-68.3	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Uranium-238	204	201	141-261	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Gr532	Soil	Bq/Kg	Zinc-65	1190.0	1064	745-1383	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Ms532	Water	Bq/L	Americium-241	0.657	0.654	0.458-0.850	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Ms532	Water	Bq/L	Cesium-134	20.80	23.5	16.5-30.6	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-Ms532	Water	Bq/L	Cesium-137	19.7	19.1	13.4-24.8	Acceptable

MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Cobalt-57	30	29.9	20.9-38.9	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Cobalt-60	0.0		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Hydrogen-3	633	553	394-732	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Iron-55	6.81	5.68	4.82-8.94	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Manganese-54	0.314		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Nickel-63	0.350		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Plutonium-238	0.0103	0.0089	Sens. Eval.	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Plutonium-239/240	0.770	0.832	0.582-1.082	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Potassium-40	0.159		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Strontium-90	8.49	9.48	6.64-12.32	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Technetium-99	2.90	3.18	2.23-4.13	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Uranium-234/233	0.145	0.148	0.104-0.192	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Uranium-238	0.918	0.970	0.68-1.26	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Zinc-65	19.500	18.30	12.8-23.8	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Gross Alpha	1.050	1.066	0.320-1.812	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-MaW22	Water	Bq/L	Gross Beta	3.220	2.79	1.40-4.19	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	ug/sample	Uranium-235	0.014	0.015	0.0103-0.0191	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	ug/sample	Uranium-238	7.55	7.96	5.57-10.35	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	ug/sample	Uranium-Total	7.96	8.0	5.58-10.36	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	ug/sample	Americium-241	0.0657	0.068	0.0477-0.0885	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Cesium-134	1.0600	1.15	0.81-1.50	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Cesium-137	0.0166		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Cobalt-57	1.590	1.51	1.06-1.96	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Cobalt-60	0.015		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Manganese-54	0.988	1.02	0.71-1.33	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Plutonium-238	0.00005		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Plutonium-239/240	0.0788	0.0847	0.0593-0.1101	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Strontium-90	-0.025		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Uranium-234/233	0.017	0.0155	0.0109-0.0202	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Uranium-238	0.0958	0.099	0.069-0.129	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdF22	Filter	Bq/sample	Zinc-65	0.667	0.63	0.58-1.08	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdV22	Vegetation	Bq/sample	Americium-241	0.115	0.11	0.076-0.140	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdV22	Vegetation	Bq/sample	Cesium-134	6.44	7.32	5.12-9.52	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdV22	Vegetation	Bq/sample	Cesium-137	9.30	9.18	6.43-11.93	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdV22	Vegetation	Bq/sample	Cobalt-57	0.037		False Pos Test	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-RdV22	Vegetation	Bq/sample	Cobalt-60	5.680	5.55	3.89-7.22	Acceptable
MAPEP	2nd/2015	06/15/15	MAPEP-15-	Vegetation	Bq/sample	Manganese-54	0.009		False Pos	Acceptable

			Ref/32						Test	
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Plutonium-238	0.094	0.065	0.050-0.111	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Plutonium-239/240	0.0898	0.094	0.066-0.122	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Strontium-90	0.852	1.08	0.76-1.40	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Uranium-234/233	0.023	0.022	0.0153-0.0283	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Uranium-238	0.129	0.128	0.090-0.166	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-Ref/32	Vegetation	Bq/sample	Zinc-65	-0.0058		False Pos Test	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-SrF-32	Filter	Bq/sample	Strontium-89	41.7	47.5	33.3-61.8	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-SrF-32	Filter	Bq/sample	Strontium-90	0.749	1.06	0.74-1.38	Acceptable
MAPEP	2nd2015	06/16/15	MAPEP-15-SrF-32	Water	Bq/L	Iodine-129	1.72	1.49	1.04-1.94	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Actinium-228	1090	1250	802-1730	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Americium-241	1410	1500	876-1950	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Bismuth-212	1090	1780	474-2620	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Bismuth-214	4340	4430	2570-6380	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Cesium-134	6020	6390	4180-7680	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Cesium-137	1540	1490	1140-1920	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Cobalt-60	2010	1880	1270-2590	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Lead-212	1200	1230	805-1710	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Lead-214	4890	4530	2540-6760	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Manganese-54	<49.9	<1000	0-1000	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Plutonium-238	978	998	600-1380	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Plutonium-239	1240	1210	791-1670	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Potassium-40	10900	10700	7810-14400	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Strontium-90	1230	1940	740-3060	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Thorium-234	3840	3890	1230-7320	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Zinc-65	8030	7130	5680-9470	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-234	3754	3920	2400-5050	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-238	3665	3890	2410-4930	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-Total	7319	7990	4330-10500	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	ug/kg	Uranium-Total(mass)	8030	7130	5680-9470	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-234	4040	3920	2400-5050	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-238	4230	3890	2410-4930	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-Total	8477	7990	4330-10500	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	ug/kg	Uranium-Total(mass)	8030	7130	5680-9470	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-234	4490	3920	2400-5050	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-238	4020	3890	2410-4930	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	pCi/kg	Uranium-Total	8653	7990	4330-10500	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	ug/kg	Uranium-Total(mass)	12000	7130	5680-9470	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Soil	ug/kg	Uranium-Total(mass)	12600	11600	6390-14500	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-234	3480	3150	2070-4050	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-238	3090	3130	2090-3960	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-Total	6715	6420	4350-7990	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Vegetation	ug/kg	Uranium-Total(mass)	9370	6280-	3540-6710	Acceptable

								11900		
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Am-241	5130	4340	2550-5770	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Cesium-134	2210	2550	1700-3440	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Cesium-137	1790	1810	1310-2520	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Cobalt-60	1570	1540	1060-2150	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Curium-244	1370	1360	666-2120	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Manganese-54	<31.1	<300	0-300	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Plutonium-238	4700	3680	2190-5040	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Plutonium-239	5120	4180	2570-5760	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Potassium-40	33100	30900	22300-43400	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Strontium-90	5920	6550	3750-8740	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-234	3230	3150	2070-4050	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-238	3340	3130	2090-3950	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-Total	6742	6420	4350-7990	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	ug/kg	Uranium-Total(mass)	10000	9370	3540-6710	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	ug/kg	Uranium-Total(mass)	8780	5280	3540-6710	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Uranium-Total	8780	6420	4350-7990	Not Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Vegetation	pCi/kg	Zinc-65	1250	1090	786-1530	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Americium-241	50.2	49.8	30.7-67.4	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Cesium-134	951	909	578-1130	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Cesium-137	1320	1170	879-1540	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Cobalt-60	87.6	79.1	61.2-98.8	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Iron-55	879	836.0	259-1530	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Manganese-54	<5.09	<50	0.00-50.0	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	ug/Filter	Plutonium-238	57.1	52.1	35.7-68.5	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Plutonium-239	46.0	40.3	29.2-52.7	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Strontium-90	84.6	96.6	47.2-145	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-234	34.7	34.3	21.3-51.7	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-238	34.5	34.0	17.8-38.2	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-Total	70.9	69.9	38.7-106	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	ug/Filter	Uranium-Total(mass)	103	102	65.3-144	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Zinc-65	1190	986	706-1360	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-234	39.2	34.3	21.3-51.7	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-238	34.9	34.0	17.8-38.2	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Uranium-Total	75.7	69.9	38.7-106	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	ug/Filter	Uranium-Total(mass)	105	102	65.3-144	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	ug/Filter	Uranium-Total(mass)	95.5	102	52.9-116	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Gross Alpha	77.2	62.2	20.8-95.6	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Filter	pCi/Filter	Gross Beta	62.7	56.4	36.9-85.1	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Americium-241	48.5	46.0	31.0-61.7	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Cesium-134	1180	1260	925-1450	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Cesium-137	1410	1360	1150-1630	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Cobalt-60	1280	1250	1090-1460	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Iron-55	1080	1070	538-1450	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Manganese-54	<5.41	<100	0.00-100	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Plutonium-238	81.0	72.4	53.6-90.1	Acceptable
ERA	2nd/2015	05/19/15	MRAD-22	Water	pCi/L	Plutonium-239	205	184	143-232	Acceptable

ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Strontium-90	865	912	594-1210	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-234	68.5	51.8	45.4-79.7	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-238	71.8	51.3	45.7-75.2	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-Total	140	126	92.6-163	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	ug/L	Uranium-Total(mass)	214	184	147-222	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Zinc-65	1310	1160	984-1450	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-234	60.7	51.8	45.4-79.7	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-238	58.0	51.3	45.7-75.2	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-Total	121	126	92.6-163	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	ug/L	Uranium-Total(mass)	174	184	147-222	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-234	64.1	51.8	45.4-79.7	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-238	60.4	51.3	45.7-75.2	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Uranium-Total	127	126	92.6-163	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	ug/L	Uranium-Total(mass)	181	184	147-222	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	ug/L	Uranium-Total(mass)	175	184	147-222	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Gross Alpha	138	119	42.2-184	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Gross Beta	155.0	158.0	90.5-234	Acceptable
ERA	2nd2015	05/19/15	MRAD-22	Water	pCi/L	Tritium	10500	10300	6900-14700	Acceptable

ERA	2nd2015	05/25/15	RAD-101	Water	pCi/L	Iodine-131	18.2	23.8	19.7-28.3	Not Acceptable
ERA	2nd2015	05/25/15	RAD-101	Water	pCi/L	Iodine-131	23.5	23.8	19.7-28.3	Acceptable

GEL QUARTERLY INTERLABORATORY COMPARISON

July through September 2015

GEL Laboratories LLC

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	2nd/2015	08/06/15	E11215	Cartridge	pCi	Iodine-131	8.92E+01	8.01E+01	1.11	Acceptable
EZA	2nd/2015	08/06/15	E11217	Milk	pCi/L	Strontium-89	9.13E+01	8.25E+01	0.99	Acceptable
EZA	2nd/2015	08/06/15	E11217	Milk	pCi/L	Strontium-90	1.16E+01	1.27E+01	0.91	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Iodine-131	1.05E+02	9.59E+01	1.10	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Cerium-141	2.70E+00	Not Pres.	-	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Chromium-51	2.70E+02	2.76E+02	0.98	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Cesium-134	1.46E+02	1.63E+02	0.90	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Cesium-137	1.31E+02	1.25E+02	1.05	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Cobalt-58	7.16E+01	6.84E+01	1.05	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Manganese-54	1.02E+02	1.01E+02	1.01	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Iron-59	1.51E+02	1.51E+02	1.00	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Zinc-65	2.63E+02	2.48E+02	1.06	Acceptable
EZA	2nd/2015	08/06/15	E11218	Milk	pCi/L	Cobalt-60	1.96E+02	1.93E+02	1.02	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Iodine-131	9.53E+01	9.34E+01	1.02	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Cerium-141	1.24E-01	Not Pres.	-	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Chromium-51	3.47E+02	2.93E+02	1.18	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Cesium-134	1.63E+02	1.73E+02	0.94	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Cesium-137	1.34E+02	1.33E+02	1.01	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Cobalt-58	7.21E+01	7.26E+01	0.99	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Manganese-54	1.17E+02	1.07E+02	1.10	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Iron-59	1.76E+02	1.61E+02	1.09	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Zinc-65	2.65E+02	2.54E+02	1.08	Acceptable
EZA	2nd/2015	08/06/15	E11219	Water	pCi/L	Cobalt-60	2.10E+02	2.05E+02	1.03	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Barium-133	63.9	64.7	53.9-71.2	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Cesium-134	45.2	50.1	40.3-55.1	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Cesium-137	90.5	89.9	80.8-101	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Cobalt-60	58.7	59.9	53.9-68.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Zinc-65	282	255	239-310	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Gross Alpha	37.1	34.5	17.7-44.5	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Gross Beta	26.2	25.1	15.6-33.1	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Gross Alpha	35.3	34.5	17.7-44.5	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Radium-226	15.9	15.2	11.3-17.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Radium-226	15.7	15.2	11.3-17.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Radium-226	15.1	15.2	11.3-17.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Radium-228	5.31	5.12	3.13-6.95	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Radium-228	5.14	5.12	3.13-6.95	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Uranium (Nat)	24.2	24	19.3-27.0	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	ug/L	Uranium (Nat) mass	37.9	35	28.1-39.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Uranium (Nat)	23.4	24	19.3-27.0	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	ug/L	Uranium (Nat) mass	34.9	35	28.1-39.4	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Tritium	14500	15600	13600-17200	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Strontium-89	24.1	42.1	32.3-49.2	Not Accpt
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Strontium-90	27.7	25.6	19.4-31.2	Acceptable
ERA	3rd / 2015	09/25/15	RAD - 102	Water	pCi/L	Iodine-131	24.7	25.7	21.3-30.3	Acceptable

GEL QUARTERLY INTERLABORATORY COMPARISON

October through December 2015

GEL Laboratories LLC

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
EZA	3rd2015	11/15/15	E11310	Cartridge	pCi	Iodine-131	8.21E+01	8.15E+01	1.01	Acceptable
EZA	3rd2015	11/15/15	E11311	Milk	pCi/L	Strontium-89	8.79E+01	8.91E+01	0.99	Acceptable
EZA	3rd2015	11/15/15	E11311	Milk	pCi/L	Strontium-90	1.07E+01	1.64E+01	0.65	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Iodine-131	9.61E+01	9.99E+01	0.96	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Cerium-141	2.15E+02	2.13E+02	1.01	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Chromium-51	5.82E+02	5.38E+02	1.08	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Cesium-134	1.89E+02	2.12E+02	0.89	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Cesium-137	2.43E+02	2.55E+02	0.95	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Cobalt-58	2.50E+02	2.63E+02	0.95	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Manganese-54	3.02E+02	2.90E+02	1.04	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Iron-59	2.30E+02	2.26E+02	1.02	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Zinc-65	3.62E+02	3.53E+02	1.02	Acceptable
EZA	3rd2015	11/15/15	E11312	Milk	pCi/L	Cobalt-60	3.42E+02	3.30E+02	1.04	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Iodine-131	1.00E+02	9.67E+01	1.03	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Cerium-141	2.05E+02	1.99E+02	1.03	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Chromium-51	5.42E+02	5.02E+02	1.08	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Cesium-134	1.75E+02	1.98E+02	0.89	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Cesium-137	2.40E+02	2.38E+02	1.01	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Cobalt-58	2.45E+02	2.46E+02	1.00	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Manganese-54	2.88E+02	2.71E+02	1.06	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Iron-59	2.31E+02	2.11E+02	1.10	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Zinc-65	3.75E+02	3.30E+02	1.14	Acceptable
EZA	3rd2015	11/15/15	E11313	Water	pCi/L	Cobalt-60	3.11E+02	3.06E+02	1.01	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-GrF32	Filter	Bq/sample	Gross Alpha	0.999	0.900	0.27-1.53	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-GrF33	Filter	Bq/sample	Gross Beta	1.570	1.560	0.78-2.34	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Americium-241	61.7	49.5	34.7-64.4	Warning
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Cesium-134	933	1010	707-1313	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Cesium-137	851.00	809	566-1052	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Cobalt-57	1240	1180	826-1534	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Cobalt-60	2.45	1.30	Sens. Eval.	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Iron-55	557	555	389-722	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Manganese-54	1450	1340	938-1742	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Nickel-63	625	682	477-887	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Plutonium-238	100.00	97.50	68.3-126.8	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Plutonium-239/240	76.7	80.4	56.3-104.5	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Potassium-40	667	599	419-779	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Strontium-90	403	425	298-553	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Technetium-99	639	631	442-820	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	U-234/233	59	56	39-73	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Uranium-238	208	220	154-286	Acceptable

MAPEP	4th/2015	12/03/15	MAPEP-15-MaS33	Soil	Bq/Kg	Zinc-65	751.0	662	463-861	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Americium-241	1.030	1.055	0.739-1.372	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Cesium-134	21.20	23.1	16.2-30.0	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Cesium-137	0.00355		False Pos Test	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Cobalt-57	21	20.9	14.6-27.0	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Cobalt-60	17.5	17.1	12.0-22.2	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Hydrogen-3	212	216	151-281	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Iron-55	12.7	13.1	9.2-17.0	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Manganese-54	15.9	15.6	10.5-20.3	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Nickel-63	8.7	8.6	5.99-11.12	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Plutonium-238	0.607	0.661	0.477-0.885	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Plutonium-239/240	0.843	0.900	0.630-1.170	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Potassium-40	210	214	150-273	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Strontium-90	4.06	4.80	3.36-6.24	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Technetium-99	7.27	7.19	5.03-9.35	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Uranium-234/233	1.130	1.140	0.80-1.46	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Uranium-238	1.150	1.150	0.83-1.53	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Zinc-65	14.7	13.9	9.7-19.1	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Gross Alpha	0.425	0.429	0.129-0.729	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-MaW33	Water	Bq/L	Gross Beta	3.59	3.52	1.76-5.28	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	ug/sample	Uranium-235	0.0769	0.086	0.060-0.112	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	ug/sample	Uranium-238	11.2	11.9	8.3-15.5	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	ug/sample	Uranium-Total	11.30	12.0	8.4-15.6	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	ug/sample	Americium-241	0.1550	0.147	0.103-0.191	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Cesium-134	2.2900	2.45	1.72-3.19	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Cesium-137	1.940	1.96	1.37-2.55	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Cobalt-57	2.870	2.74	1.92-3.56	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Cobalt-60	1.800	1.71	1.20-2.22	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Manganese-54	22.200	2.11	1.48-2.74	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Plutonium-238	0.099	0.104	0.073-0.135	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Plutonium-239/240	0.004	0.0025	Sens. Eval.	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Strontium-90	2.090	2.18	1.53-2.83	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Uranium-234/233	0.152	0.143	0.100-0.186	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Uranium-238	0.159	0.148	0.104-0.192	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Bq/sample	Zinc-65	1.560	1.32	0.92-1.72	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Bq/sample	Americium-241	0.128	0.11	0.076-0.140	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Bq/sample	Cesium-134	5.150	5.80	4.06-7.54	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Bq/sample	Cesium-137	0.0326		False Pos Test	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Bq/sample	Cobalt-57	6.930	6.62	4.63-8.61	Acceptable

MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Cobalt-60	4.810	4.56	3.19-5.93	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Manganese-54	7.640	7.68	5.38-9.86	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Plutonium-238	0.000495	0.0007	Sens. Eval.	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Plutonium-239/240	0.0654	0.077	0.054-0.100	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Strontium-90	1.090	1.30	0.91-1.69	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Uranium-234/233	0.192	0.162	0.113-0.211	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Uranium-238	0.192	0.168	0.119-0.219	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdV33	Vegetation	Batsample	Zinc-65	6.120	5.46	3.82-7.10	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Batsample	Gross Alpha	0.999	0.900	0.27-1.53	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-15-RdF33	Filter	Batsample	Gross Beta	1.57	1.56	0.78-2.34	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-14-SrF-31	Filter	Batsample	Strontium-89	3.313	3.88	2.79-5.17	Acceptable
MAPEP	4th/2015	12/03/15	MAPEP-14-SrF-31	Filter	Batsample	Strontium-90	0.962	1.05	0.74-1.37	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Actinium-228	1220	1040	735-1720	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Americium-241	667	539	315-700	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Bismuth-212	1240	1240	330-1820	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Bismuth-214	1690	2560	1600-3830	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Cesium-134	2250	2420	1580-2910	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Cesium-137	5400	5120	3920-6590	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Cobalt-60	4290	3900	2540-5370	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Lead-212	1290	1240	812-1730	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Lead-214	2090	2800	1530-4150	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Manganese-54	<29.7	<1000	0-1000	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Plutonium-238	934	864	515-1150	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Plutonium-239	952	969	533-1340	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Potassium-40	11700	10600	7740-14200	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Strontium-90	7490	8820	3360-13900	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Thorium-234	3760	3330	1950-6250	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Zinc-65	4610	3520	2980-4810	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-234	2559	3360	2050-4310	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-238	2931	3330	2050-4220	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-Total	5490	6850	3720-9040	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	ug/kg	Uranium-Total(mass)	8420	9990	5510-12500	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-234	2970	3360	2050-4310	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-238	3010	3330	2050-4220	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	pCi/kg	Uranium-Total	6091	6850	3720-9040	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	ug/kg	Uranium-Total(mass)	8990	9990	5510-12500	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Soil	ug/kg	Uranium-Total(mass)	8470	9990	5510-12500	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Am-241	1780	1590	972-2110	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Cesium-134	652	749	481-972	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Cesium-137	1140	1230	892-1710	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Cobalt-60	1870	1930	1330-2700	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Curium-244	2910	3230	1580-5030	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Manganese-54	<45.2	<300	0-300	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Plutonium-238	4720	3920	2340-5370	Acceptable
ERA	3rd/2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Plutonium-239	2530	2390	1470-3290	Acceptable

ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Potassium-40	31200	31000	22400-43500	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Strontium-90	7590	7160	4080-5490	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Uranium-234	4230	4010	2540-5150	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Uranium-238	4620	3970	2550-5040	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Uranium-Total	9155	8150	5530-10200	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	ug/kg	Uranium-Total(mass)	13900	11900	3540-6710	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	ug/kg	Uranium-Total(mass)	13100	11900	7970-15100	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Vegetation	pCi/kg	Zinc-65	1530	1540	1110-2160	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Americium-241	35.1	36.8	22.7-49.6	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Cesium-134	315	349.0	222-433	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Cesium-137	595	612	451-805	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Cobalt-60	509	521	403-651	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Iron-55	546	595.0	184-1160	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Manganese-54	<4.53	<50	0.00-50.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	ug/Filter	Plutonium-238	43.6	42.6	29.2-56.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Plutonium-239	63.6	63.8	45.2-83.4	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Strontium-90	37.1	45.7	22.3-68.5	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-234	38.4	43.0	26.7-64.8	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-238	39.3	42.7	27.6-59.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-Total	80.1	87.7	48.6-133	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	ug/Filter	Uranium-Total(mass)	116	128	81.9-180	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Zinc-65	727	685	491-946	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-234	45.7	43.0	26.7-64.8	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-238	43.4	42.7	27.6-59.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Uranium-Total	91.1	87.7	48.6-133	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	ug/Filter	Uranium-Total(mass)	130	128	81.9-180	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	ug/Filter	Uranium-Total(mass)	117	128	81.9-180	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Gross Alpha	95	77.3	25.9-120	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Filter	pCi/Filter	Gross Beta	52.2	41.3	26.1-60.2	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Americium-241	114	113	75.1-152	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Cesium-134	702	759	557-972	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Cesium-137	622	623	529-747	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Cobalt-60	927	896	776-1050	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Iron-55	196	212	109-288	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Manganese-54	<6.14	<100	0.00-100	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Plutonium-238	117	140	104-174	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Plutonium-239	88.5	114	88.6-144	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Strontium-90	505	544	354-719	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-234	49.2	49.5	36.4-62.6	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-238	49.7	48.1	36.7-59.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-Total	98.9	98.9	72.7-125	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	ug/L	Uranium-Total(mass)	145	144	115-174	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Zinc-65	755	712	554-938	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-234	45.8	49.5	36.4-62.6	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-238	44.4	48.1	36.7-59.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-Total	92.8	98.9	72.7-125	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	ug/L	Uranium-Total(mass)	135.0	144.0	115-174	Acceptable

ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-234	49.5	49.5	36.4-62.5	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-238	43.1	48.1	36.7-59.0	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Uranium-Total	95	98.9	72.7-123	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	ug/L	Uranium-Total(mass)	129	144	115-174	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	ug/L	Uranium-Total(mass)	135	144	115-174	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Gross Alpha	104.0	136	43.3-211	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Gross Beta	61.6	53.7	30.7-73.6	Acceptable
ERA	3rd / 2015	11/24/15	MRAD-23	Water	pCi/L	Tritium	20500	21500	14400-30700	Acceptable
ERA	3rd / 2015	11/23/15	RAD - 103	Water	pCi/L	Strontium-89	42	35.7	26.7-42.5	Acceptable
ERA	3rd / 2015	11/23/15	RAD - 103	Water	pCi/L	Strontium-90	25.9	31.1	22.7-36.1	Acceptable
ERA	3rd / 2015	11/23/15	RAD - 103	Water	pCi/L	Strontium-89	41.9	35.7	26.7-42.5	Acceptable
ERA	3rd / 2015	11/23/15	RAD - 103	Water	pCi/L	Strontium-90	22	31.1	22.7-36.1	Not 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 2015 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 2015 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 10 control locations in 2015. (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 2015 operational year for Units 2/3, the routine indicator TLD locations ranged from 10.4 to 22.9 mR, averaging 15.7 mR while the control locations ranged from 12.5 to 19.6 mR with an average of 16.0 mR. 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.

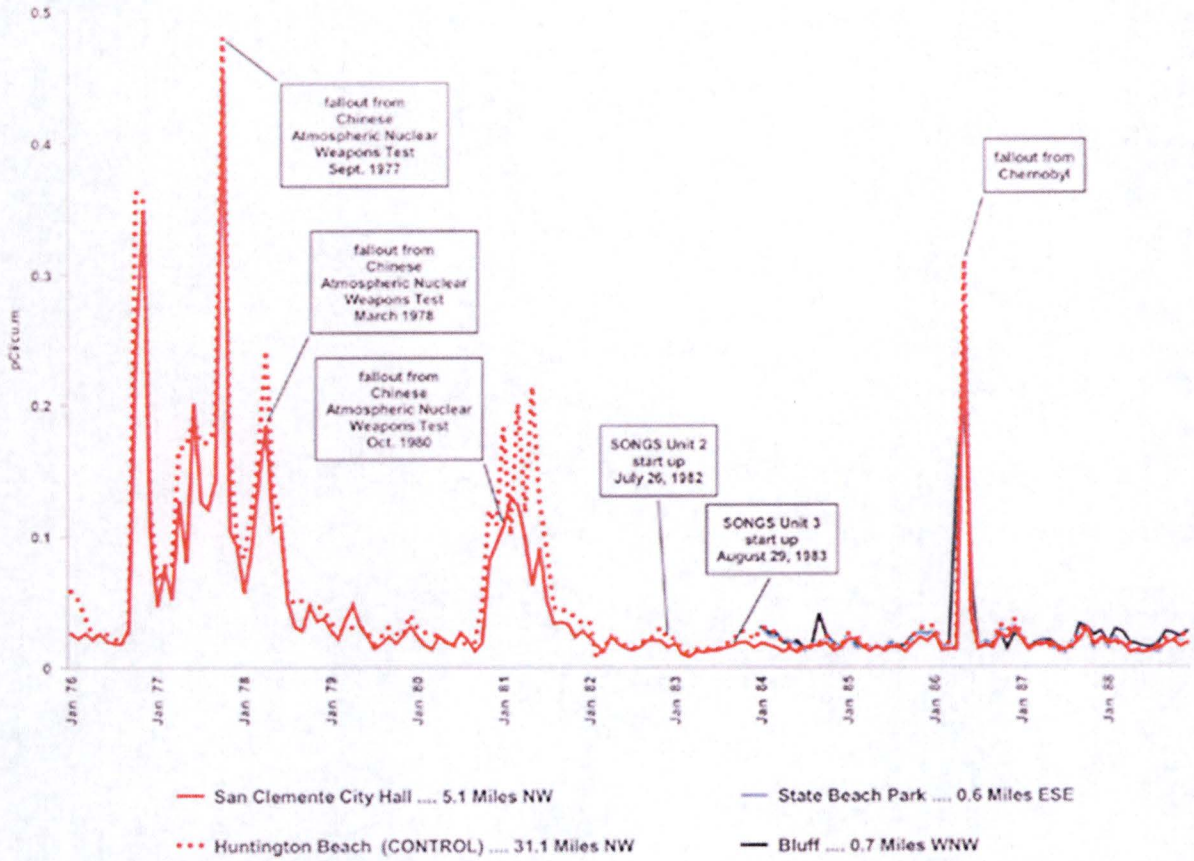


Figure 12 – Monthly Average Airborne Particulate Gross Beta Preoperational and Operational Data for Units 2 and 3, (1976 – 1988)

For 2015, the maximum monthly average airborne particulate gross beta result was approximately 0.054 pCi/m^3. 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 2015 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 2015.

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 2015 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 are no drinking water pathway for SONGS. Nonetheless, drinking water samples from Ocean Side and Camp Pendleton were collected and analyzed. No plant related radionuclides were detected during the 2015 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 2015, 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 2015 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 2015 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 31 - Shoreline Sediment Concentration

		INDICATOR		CONTROL	
Radionuclide	**Period [a]**	**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:

a. Preoperational period is January 1979 – July 1982. Operational period is January 2015 – December 2015

b LLD for operational data are listed in Appendix B

c During 2015, 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.l 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 2015 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 2015 was below the MDC, supporting the conclusion of no detectable impact on ocean bottom sediments from SONGS.

Table 32 - 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 2015 – December 2015

b LLD for operational data are listed in Appendix B

c During 2015, 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 2015 operational periods for Units 2/3 are summarized in Table 33. 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 33 were below the lower limits of detection for both the preoperational and operational periods.

During the 2015 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 2015 had no impact on the environment as measured by this exposure pathway.

Table 33 - 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[e]					
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 [d]					
Co-58	PreOp Operational	0.009-0.011 < LLD	0.010 < LLD	< LLD < LLD	< LLD < LLD
Co-60	PreOp Operational	0.004-0.045 < LLD	0.017 < LLD	< LLD < LLD	< LLD < LLD
Ag-110m	PreOp Operational	0.002-0.009 < LLD	0.006 < LLD	< LLD < LLD	< LLD < LLD
Cs-137	PreOp Operational	0.003-0.015 < LLD	0.008 < LLD	0.004-0.014 < LLD	0.009 < LLD

All other SONGS radionuclides	PreOp Operational	< LLD < LLD	< LLD < LLD	< LLD < LLD	< LLD < LLD
Mussel Flesh (Bay or California) [e]					
Mn-54	PreOp	0.009 - 0.025	0.017	< LLD	< LLD
Co-58	PreOp	0.008 - 0.080	0.028	--	--
Co-60	PreOp	0.005 - 0.400	0.077	< LLD	< LLD
Cs-137	PreOp	0.003 - 0.006	0.004	< LLD	< LLD
Ru-103	PreOp	< LLD - 0.045	< LLD	< LLD	< LLD
All other SONGS radionuclides	PreOp	< 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 2015 – December 2015

b LLD for operational data are listed in Appendix B

c During 2015, all station related radionuclides from all sample locations were < LLD

d Species collected in 2015 California Mussel, Blacksmith, Sheephead, Kelp Bass, Barred Sand Bass, and Spiny Lobster

e Mussel flesh and black perch were not collected in 2015

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 2015, 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 34 - 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 – 0.333	0.096 < LLD	< LLD - 0.06 < LLD	< 0.10 < LLD
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 2015 operational data in Table 35. 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 2015 operational period, I-131 was detected in one indicator sample. No other station related isotopes were detected in kelp samples during the 2015 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 35 - 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 – 0.069	0.013 0.032	0.008 - 0.030 0.021 – 0.029	0.014 0.025
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 2015

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 2015, the ODCM specified LLD was achieved for most 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 2015 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)

There was one (1) ODCM deviation noted. The Environmental Manager received a phone call from the State Parks stated that one of the TLD canisters may be affected by excessive high tide. Environmental Technician went out and discovered that it was buried under the sand and was recovered. The TLD is in a waterproof bag and was still locked to the pole. There were no consequence, as the canister and TLD package were not lost. The TLD remained in the same place and elevated the sample to an additional 4'. There were no deviations noted in the sample results. This is documented in the site's corrective action program. (NN# 203224979)

Pressurized Ion Chambers (PICs)

In the ODCM, under Section 5.0, it states that Pressurized Ion Chambers (PICs) are required to be functional. The Permanently Defueled Emergency Plant (PDEP) no longer requires the PICs. The plan was approved by the NRC on June 4, 2015 and the site implemented the PDEP on June 8, 2015. The PICs were originally installed as part of the Emergency Plan and were added to the ODCM at a later date to validate TLD and air particulate results in the event of an unplanned and off-normal occurrence. PICs are not required by NUREG 1301, and the merit of maintaining them for REMP no longer exists. In addition, per the site's qualified REMP TLD vendor, the TLD pack contains 2 TLDs with 3 phosphors apiece with a demonstrated performance meeting the requirements of Regulatory Guide 4.13 for TLD systems used for environmental monitoring. On November 9, 2015, the PICs were removed from ODCM Section 5.0 utilizing the effluent evaluation process.

B. Air Sampling

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

Downtime for each air sampler in 2015 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.)

Down Times in the excess of 1 hours are addressed below for each ODCM required air sample.

1) During the week of March 10, 2015, 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 03, 2015, 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 #9 (State Beach Park)
   a. On March 17, 2015, during the weekly air sample collection, the environmental technician observed REMP Air Sampler #9 to have no flow through the air sampling head. The no flow was due to the failure of the air sampler's motor which was promptly replaced with a new motor. The time at which the failure occurred is unknown, but based on rough calculation, the motor failed about 1- 3 days before the collection period. The sample media was collected and analyzed in accordance with the site's environmental procedure. The discrepancy was noted prior to sending samples to the offsite vendor for analysis. There was no plant related activity detected on the sample media. In addition, the air sample collected the week prior and week after did not show any plant related activity. After the motor was changed out, the air sampler continued to perform the required ODCM Section 5.0 surveillance. This event is documented in the site's corrective action program. (NN# 203232699-002)

   b. On October 2, 2015, Air Sampler #9 lost power due to a scheduled 12 kV power outage. Prior to the scheduled power outage, the switchyard project manager stated that the power would be off for about a day. The power outage commenced at 0930 and was returned to service at 1830. The air sampler had no power for 9 hours. Once power was restored, the air sampler continued to operate and perform the required ODCM Section 5.0 requirement. The sample media was collected and processed in accordance with Environmental procedure and the discrepancy was documented on the chain of custody prior to sending samples to the off-site vendor for analysis. This event is documented in the site's corrective action program. (NN# 203232699-004)

3) Air Sampler #10 (Bluff)
   a. On May 1, 2015, Air Sampler #10 lost power due to a scheduled power outage to perform transformer maintenance. The power outage commenced at 0955 and was returned to service at 1338. The air sampler had no power for 3 hours and 41 minutes. Once power was restored, the air sampler continued to operate and perform the required ODCM Section 5.0 requirement. The sample media was collected and processed in accordance to Environmental Procedure and the discrepancy was documented on the chain of custody prior to sending samples to off-site vendor for analysis. This event was documented in the site's corrective action program. In addition, the California Department Public Health Radiological Branch was notified on April 22, 2015 that their sampler would be off. (NN# 202969551)

   b. On November 6, 2015, Air Sampler #10 lost power due to a scheduled outage to work on 12 kV line. The sampler was off for a total of 2.5 hours. Once power was restored, the air sampler continued to operate and perform the required ODCM Section 5.0 requirement. The sample media was collected and processed in accordance to Environmental Procedure and the discrepancy was documented on the chain of custody prior to sending

samples to off-site vendor for analysis. This event was documented in the site's corrective action program. (NN# 203232699-005)

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. 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 2015 AREOR that need to be documented. (NN# 202794860)

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 prepared, reviewed, and approved for activities involved in carrying out the monitoring program." The 2015 LUC was conducted to comply with the surveillance requirement as defined in the Offsite Dose Calculation Manual (ODCM) Section 5.2. The Radiological Environmental Monitoring Program Procedure SO123-IX-1.20 Rev. 7, 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. After conducting the 2015 land use census, there were no changes noted when compared to 2014 Land Use Census.

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.

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.

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 (population estimated to be 65,326 as of July 1, 2014 based on census information) 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 1 and October 1. Also, non-residential usage such as fire stations, Camp Mesa, 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 2015 SONGS Land Use Census required conversations and meetings with agencies and individuals, field research, and Geographical Information System (GIS) work detailing the findings on study area land use maps. Environmental personnel conducted a review of the previous 2014 LUC and associated documentation notebook. Then the data was verified and if changes were noted, then the changes were reflected in the 2015 land use census.

This was accomplished by contacting the point of contact for the appropriate agency, organization, or military base which possesses knowledge on the land usage.

The following agencies and organizations were contacted:

- SCE Real Properties, for Aerial Photography
- California Highway Patrol
- Orange County Agricultural Commissioner
- 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 organizations. 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 contact from Camp Pendleton and other agencies (State Parks, California Highway Patrol, etc.) was considered final. Agency contact and documentation were completed in compliance with the Land Use Census procedure.

Aerial photography was not conducted for the 2014 to 2015 year. The Land Use Census data were collected by contacting Camp Pendleton Public Information Officer, the Local Agricultural Authority, Planning and Building Departments of the City of San Clemente, and San Clemente Community Development Center

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 June 2015.

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 Notebook

Throughout the study, records of contacts and findings were maintained in accordance with the Land Use Census Procedure. A documentation notebook has been prepared and is retained in the Radiological Effluents and Environmental files with the aerial photographs. The notebook provides telephone notes, agency contacts, Southern California Edison (SCE) memoranda, and any correspondence. The notebook can be found under the SONGS' MapInfo shared drive.

2015 Land Use Census Observations and Changes

The follow observations were noted:

- No new garden was identified in 2015.
- No land uses with the potential to affect SONGS were identified in 2015.

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, etc. 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 conversation with Camp Pendleton's Director of Community Plans and Liaison Office.

This type of survey is referenced in the Nuclear Regulatory Commission (NRC) Inspection Manual, temporary instruction 2515/112, dated 05/31/91, and is required by the Land Use Census Procedure SO123-IX-1.20, Section 1.1.2.

Milk Animals

No dairies or other facilities producing milk for human consumption were identified in 2015.

Meat Animals

No agricultural meat animals were identified during the 2015 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 vegetables were available approximately eight months during 2015 at the SONGS garden.

Desalination Plant in Carlsbad, California

The forecast for the Carlsbad desalination plant to producing 50 million gallons of drinking water per day is November 2015. The plant is located on the coast next to the Encina Power Station and will eventually reach nine stories below ground. This will be the largest and most technologically advanced desalination plant in the Western Hemisphere. The project's goal is to produce enough water to meet the daily needs of 300,000 San Diego residents. The desalination plant is located 27 miles south of San Onofre

Summary of Changes

1. For the period of July 1, 2014 to June 30, 2015, 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 is 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 are no changes to the estimated distances from SONGS to the nearest vegetation potentially consumed by deer from July 1, 2014 through June 30, 2015.

Distances to nearest vegetation typically consumed by deer:

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

Table 1 – SONGS 2015 Land Use Census

Units 2/3 Sector	LUC #	Residence	Miles from U2/3	Maximum Occupancy (Hours)	LUC #	Gardens	Miles from U2/3	LUC #	Other Specified Uses	Miles from U2/3	Maximum Occupancy (Hours)
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								O-2	San Onofre Beach Campground	1.8	720
								32	Hwy Patrol Weigh Sta (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
	R-P5	Contractor overnight parking in Lot 4	0.6	0							
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-6	1315 S Ola Vista	4.6	18	SORB Lifeguard Tower	1.2	2,000
					G-15	130 Calle del Pacifico	4	1A	SORB Campground Check-in	1.3	2,000
					G-16	432 Ave Crespi	3.8				
					G-18	115 Ave San Pablo	4.1				
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 9-30-2015 FTR – Full Time Residence There were no changes for 2015											

Table 2

Units 2/3 Sector	LUC #	**Residence**	Miles from U2/3	Maximum Occupancy (hours)	LUC #	**Gardens**	Miles from U2/3	LUC #	**Other Specified Uses**	Miles from U2/3	Maximum Occupancy (hours)
A	R-A2	SONGS Camp Mesa	0.4	FTR				24	Cristianitos Fire Station	5	3,984
B											
C											
D											
E											
F											
G								O-2C	SurfCamp.com State Beach Surf Camp	2.3	
									did not occupy San Onofre Park in 2012		
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-P5	Contractor overnight parking in Lot 4	0.6	1040							
Q	11	State Parks Main Offices	3.5	FTR	14	Inactive	4.3	7	SORB Clubhouse (permanently closed per USMC)		
						3 W San Antonio		8	USMC Exchange & Commissary	1.7	2,000
					16	Inactive	4.1	9	Basilone Road USMC Entry Gate	2	520
						147 W Junipero		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
Bold Text indicates a change from the 2015 LUC. Data as of 9-30-2015 FTR – Full Time Residence											

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-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
R-P4	Contract 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

VEGETABLE GARDENS

There were no new gardens identified for 2015.

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	HIGHWAY PATROL WEIGH STATIONS-These are employment land use
32	Locations for persons 18 and older.

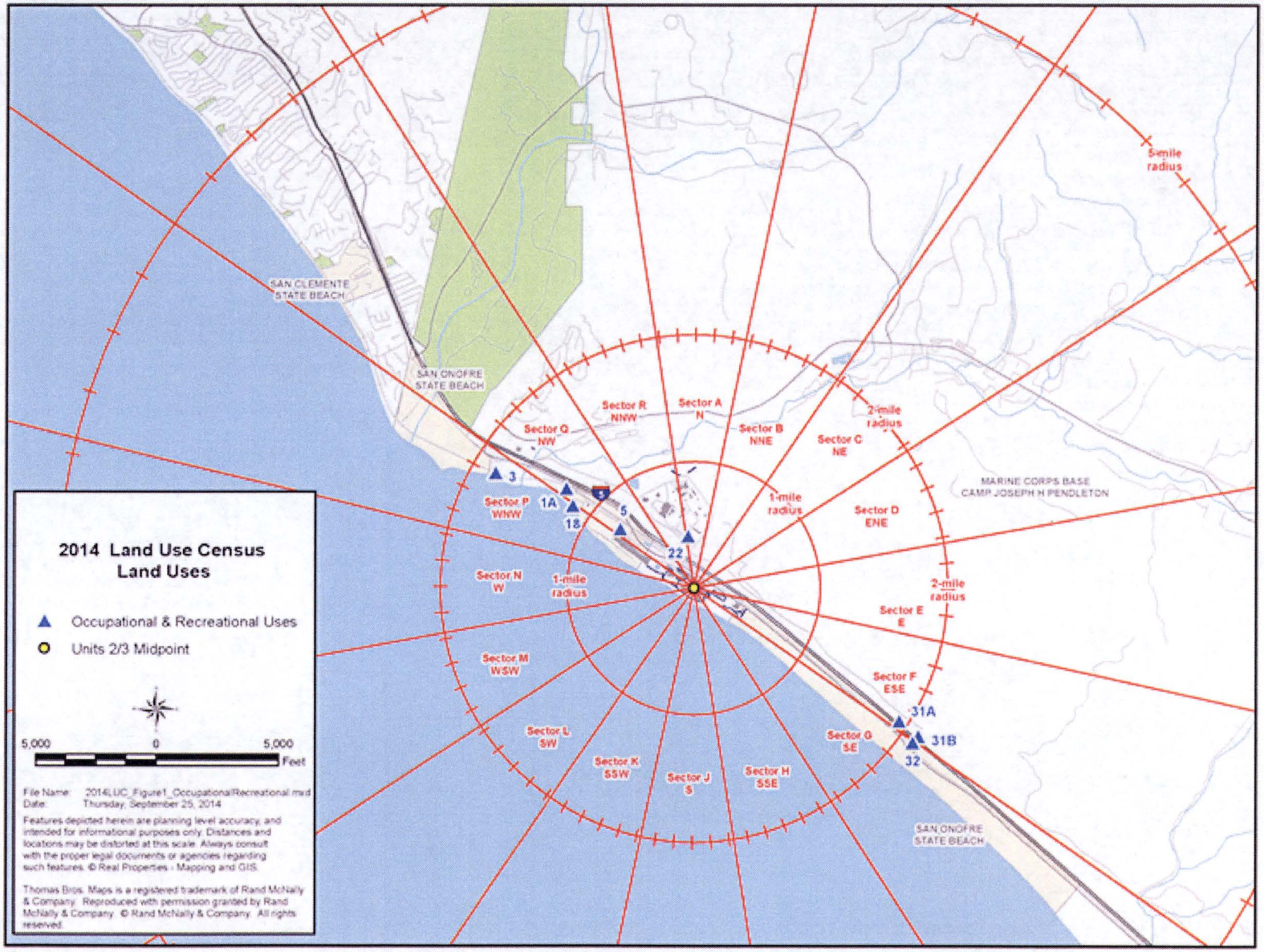
Table 2 Notes:

Table 2 locations are not mapped. Table 2 contains locations included per SO123-IX-1.20, step 6.3. 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). 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.

Table 3 – Camp Pendleton Hunting Take Data. July 1, 2014 – June 30, 2015

Area	Deer Hunter Effort	Sm Game Hunter Effort	Deer	Coyote	Dove	Quail	Rabbit	Squirrel	Pigeon
	Hours	Hours							
Alpha-1 B(3),C(3.2)	100	14	0	1	0	0	0	0	0
Alpha-2 E(0.8),D(0.8),C(3)	52.8	0	0	0	0	0	0	0	0
Alpha-3 D(2.2)	187.2	38	7	3	0	0	1	2	0
Bravo-2 B(3.8), A(4.2)	369.6	20	0	0	21	0	0	0	0
Bravo-3 B(1.6),A(1.8),R(1.8)	232.8	8	0	0	0	0	0	0	0
Romeo-1 E(1)	320	39	4	1	0	0	0	0	0
Romeo-2 E(2.6)	457.6	26	3	0	59	0	1	0	0
Romeo-3 E(1.4), F(1.5)	363.2	7	3	0	0	0	0	0	0
Papa-2 F(5)	224.8	9	4	0	0	0	3	0	0
Totals	**2308**	161	21	5	80	0	5	2	0

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


2014 Land Use Census
Land Uses
Occupational & Recreational Uses
Units 2/3 Midpoint
5,000
0
5,000
Feet
File Name: 2014LUC_Figure1_OccupationalRecreational.mxd
Date: Thursday, September 25, 2014
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SAN CLEMENTE STATE BEACH
SAN ONOFRE STATE BEACH
MARINE CORPS BASE CAMP JOSEPH H PENDLETON
5-mile radius
2-mile radius
1-mile radius
Sector A N
Sector B NNE
Sector C NE
Sector D ENE
Sector E E
Sector F ESE
Sector G SE
Sector H SSE
Sector J S
Sector K SSW
Sector L SW
Sector M WSW
Sector N W
Sector P WNW
Sector Q NW
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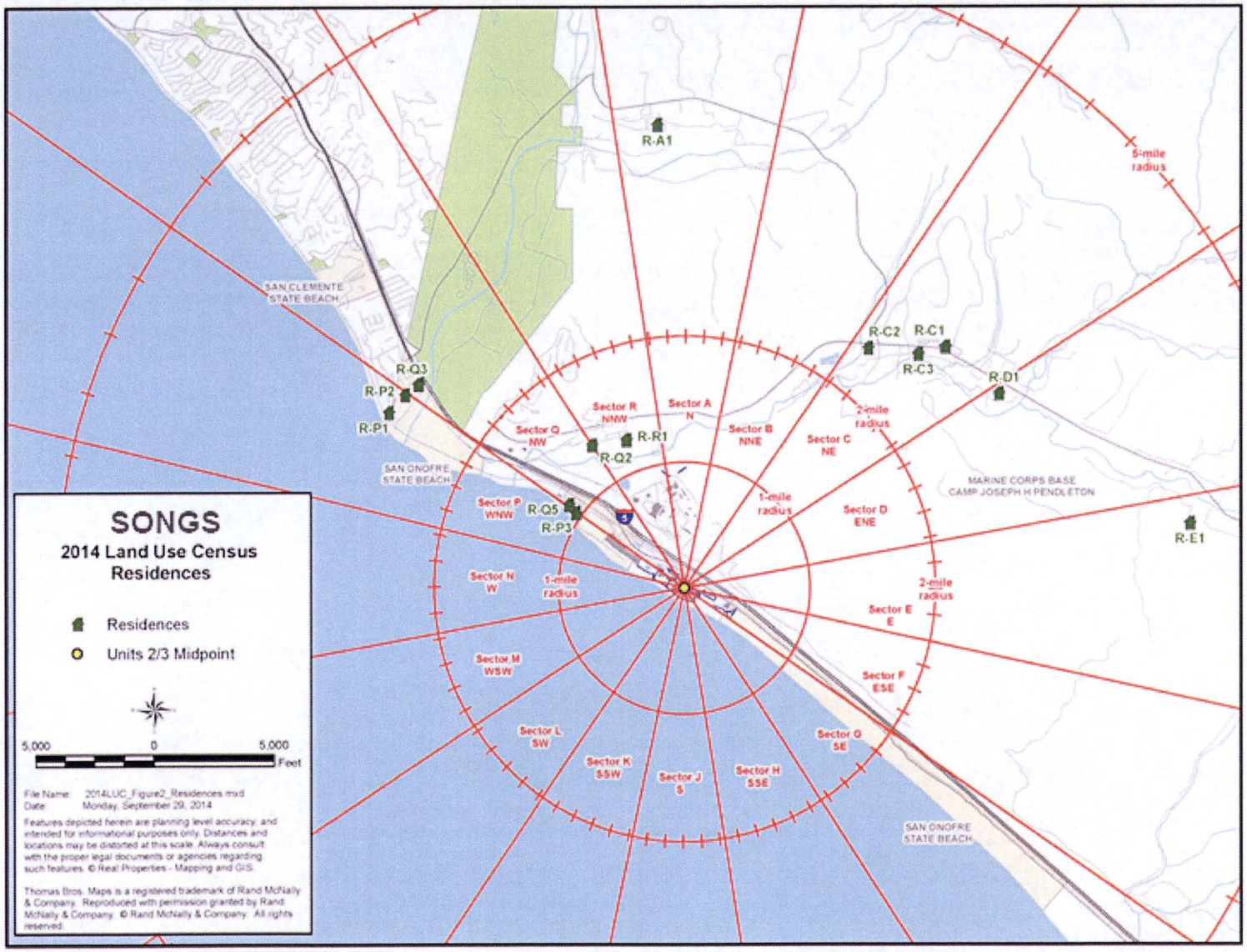
3
1A
18
5
22
31A
31B
32


SONGS
2014 Land Use Census
Residences
Residences
Units 2/3 Midpoint
5,000
0
5,000
Feet
File Name: 2014LUC_Figure2_Residences.mxd
Date: Monday, September 29, 2014
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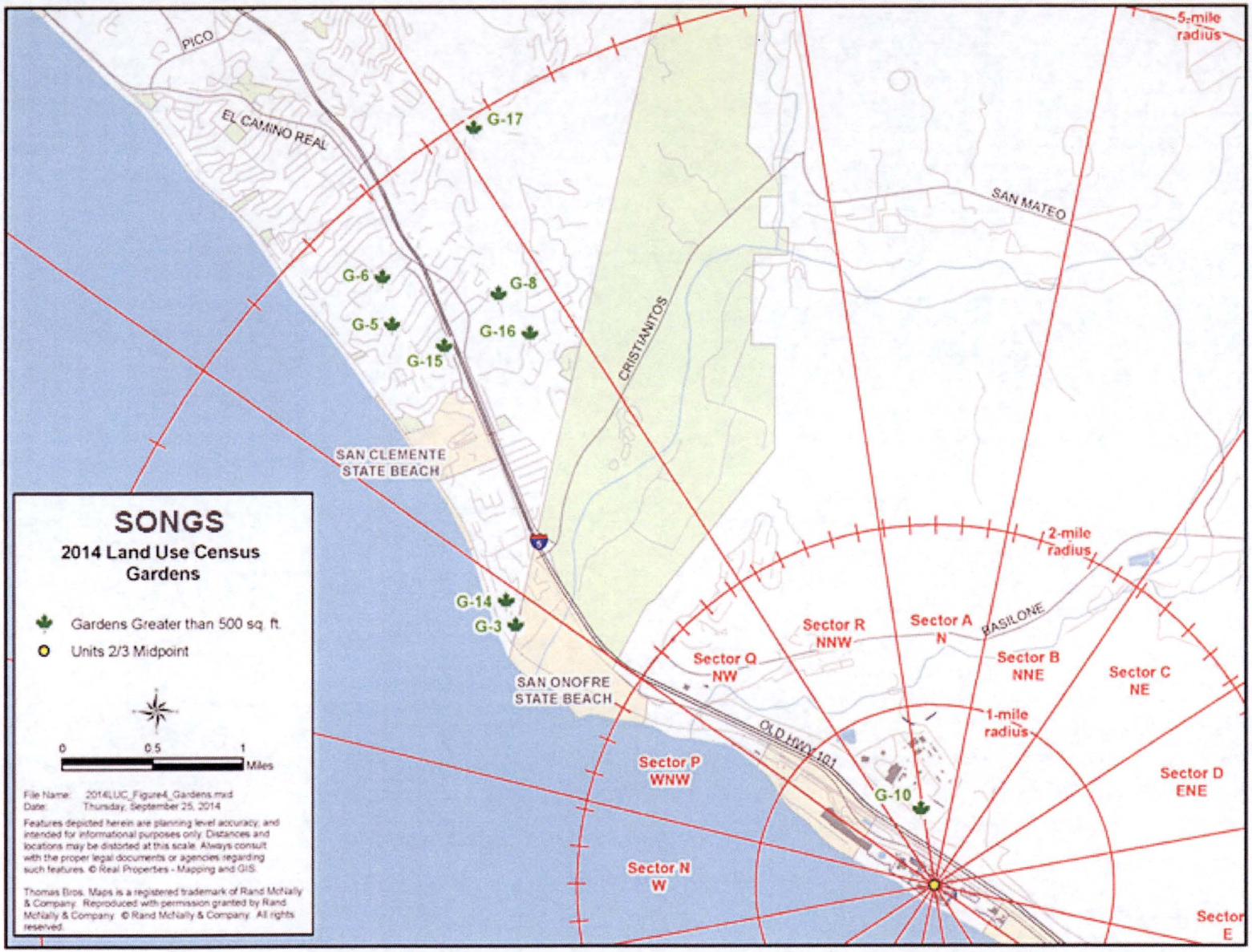
R-A1
R-C2
R-C1
R-C3
R-D1
R-E1
R-Q3
R-P2
R-P1
R-R1
R-Q2
R-Q5
R-P3
5-mile radius
2-mile radius
1-mile radius
Sector A N
Sector B NNE
Sector C NE
Sector D ENE
Sector E E
Sector F ESE
Sector G SE
Sector H SSE
Sector J S
Sector K SSW
Sector L SW
Sector M WSW
Sector N W
Sector P WNW
Sector Q NW
Sector R NNW
SAN CLEMENTE STATE BEACH
SAN ONOFRE STATE BEACH
MARINE CORPS BASE CAMP JOSEPH H PENDLETON


SONGS
2014 Land Use Census
Gardens
Gardens Greater than 500 sq. ft.
Units 2/3 Midpoint
0
0.5
1
Miles
File Name: 2014LUC_Figure4_Gardens.mxd
Date: Thursday, September 25, 2014
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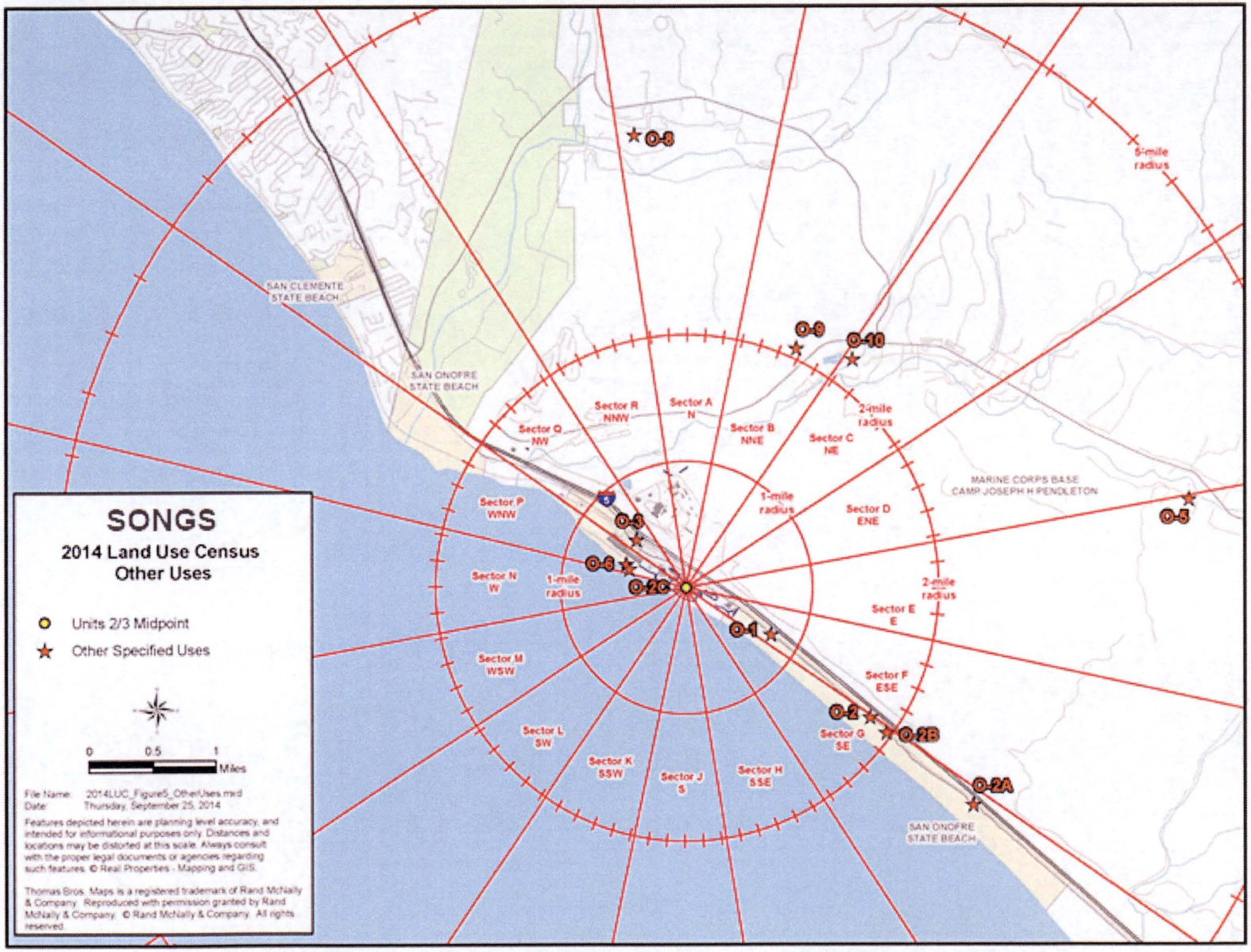
PICO
EL CAMINO REAL
G-17
G-6
G-8
G-5
G-16
G-15
CRISTIANITOS
SAN MATEO
SAN CLEMENTE STATE BEACH
5-mile radius
2-mile radius
1-mile radius
G-14
G-3
SAN ONOFRE STATE BEACH
Sector R NNW
Sector A N
BASILONE
Sector Q NW
Sector B NNE
Sector C NE
OLD HWY 101
G-10
Sector P WNW
Sector D ENE
Sector N W
Sector E


SONGS
2014 Land Use Census
Other Uses
Units 2/3 Midpoint
Other Specified Uses
0 0.5 1 Miles
File Name: 2014LUC_Figure5_OtherUses.mxd
Date: Thursday, September 25, 2014
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O-3
O-9
O-10
O-5
O-6
O-2C
O-1
O-2
O-2B
O-2A
Sector R NNW
Sector A N
Sector B NNE
Sector C NE
Sector D ENE
Sector E E
Sector F ESE
Sector G SE
Sector H SSE
Sector J S
Sector K SSW
Sector L SW
Sector M WSW
Sector N W
Sector P WNW
Sector Q NW
1-mile radius
2-mile radius
5-mile radius
SAN CLEMENTE STATE BEACH
SAN ONOFRE STATE BEACH
MARINE CORPS BASE CAMP JOSEPH H PENDLETON

APPENDIX G. ERRATA TO THE 2014 AREOR

No errors have been noted in the 2014 AREOR

APPENDIX H. REMP AND CDPH CO-LOCATED TLDs

REMP TLDs CO-LOCATED WITH CDPH TLDs DURING 2015

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 SONGS dosimeters that are co-located with CDPH dosimeters are reported below.

Table 36. 2015 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	13	12	15
SCE-2, NRC -23, DPH #8	Camp San Mateo	8	13	10	15
SCE-3, NRC -19, DPH #9	Camp San Onofre	9	13	9	15
SCE-6, DPH #10	Old El Camino Real (Old Highway 101) (ESE)	3	3	5	9
SCE-10, NRC -12, DPH #6	Bluff (Adjacent to PIC #1) (San Onofre Surfing Beach)	7	9	9	14
SCE-22, NRC 11, DPH #4	Former US Coast Guard Station – San Mateo Point	10	20	12	Damaged
SCE-34, NRC -14, DPH #5	San Onofre Elementary School	8	14	9	17
SCE-50, NRC 32, DPH #13	Oceanside Fire Station	9	10	9	15

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

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 potentially 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 but the issue of TLD shipment packaging geometry cannot be readily corrected. 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. Using this information, we conclude that the exposure rate outside the CAB (10 CFR 72 Controlled Area Boundary) is less than detectable. The detection limits are 5 mR/standard quarter and 10 mR/year. The exposure attributable to the operation of the ISFSI as indicated by this media is not measurable beyond the immediate area of the ISFSI.

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 had the highest readings in 2013 through 2015. The closest publicly accessible location is SW of the ISFSI along the San Onofre Beach access road, outside the plant's perimeter. The background corrected annual exposures for the access road TLDs 55 and 56 were 11 and 8 mR/yr., respectively in 2015. Assuming a maximum occupancy of 300 hours per year the dose to a member of the general public is < 1 mrem per year at this location as measured by the REMP TLDs.

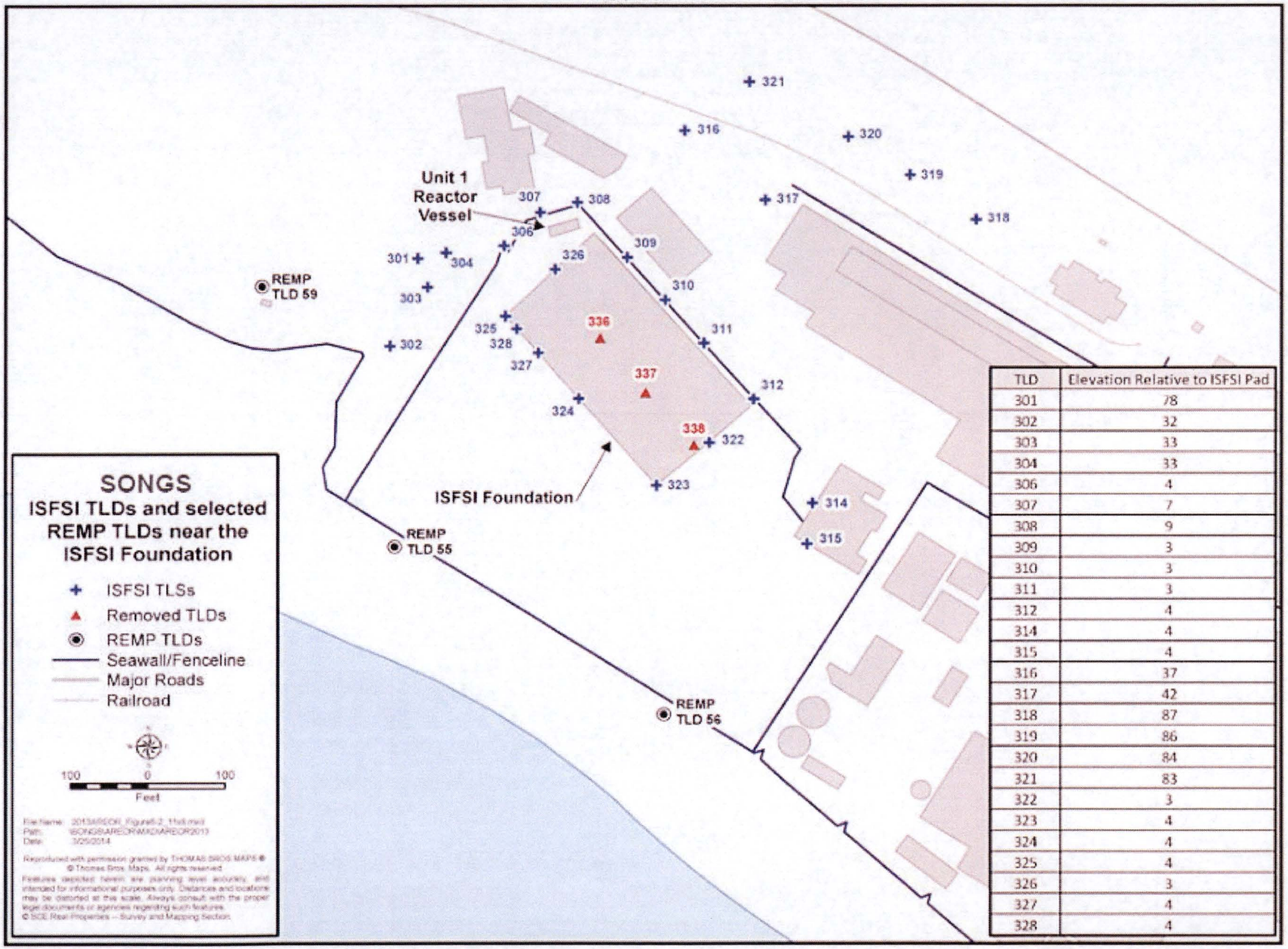
Starting in the fourth quarter 2010 neutron dosimeters were placed in ISFSI TLD canisters 311, 324, 325, and 326. In the second quarter 2011 neutron dosimeters were also placed adjacent to TLDs 327 and 328. The 2015 neutron TLDs identified measurable levels of neutron radiation for spent fuel in storage. Neutron exposure during fuel transfer is measurable at the fence surrounding the storage facility at low levels, typically a few mR 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.

We conclude that exposure attributable to the storage of used fuel in the ISFSI is not measurable beyond the immediate area of the ISFSI and is well below regulatory limits.

Table 37. 2015 ISFSI TLD Data

Location	Quarterly Background (mR)	2015 Quarterly Results (mR)				Background adjusted 2015 Quarterly Results (mR)				2015 Annual Total (mR)	2015 Net Total (mR)
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
ISFSI 301	15	16.49	15.83	17.29	16.44	ND	ND	ND	ND	66.05	ND
ISFSI 302	15	19.09	19.34	20.14	19.42	ND	4.34	5.14	4.42	77.99	17.99
ISFSI 303	15	19.62	19.50	20.85	19.37	4.62	4.50	5.85	4.37	79.34	19.34
ISFSI 304	15	18.27	18.83	19.55	18.35	ND	ND	4.55	ND	75.00	15.00
ISFSI 306	15	19.31	19.67	19.43	18.78	4.31	4.67	4.43	ND	77.19	17.19
ISFSI 307	15	15.15	15.76	16.36	14.82	ND	ND	ND	ND	62.09	ND
ISFSI 308	15	18.19	17.48	19.06	17.40	ND	ND	ND	ND	72.13	12.13
ISFSI 309	15	17.43	17.34	19.82	18.07	ND	ND	4.82	ND	72.66	12.66
ISFSI 310	15	19.33	17.88	19.76	17.95	4.33	ND	4.76	ND	74.92	14.92
ISFSI 311	15	17.48	17.81	18.54	16.64	ND	ND	ND	ND	70.47	10.47
ISFSI 312	15	14.22	13.56	14.67	13.23	ND	ND	ND	ND	55.68	ND
ISFSI 314	15	16.68	16.37	17.08	15.77	ND	ND	ND	ND	65.90	ND
ISFSI 315	15	17.45	17.02	17.73	16.79	ND	ND	ND	ND	68.99	ND
ISFSI 316	15	14.34	14.27	14.84	14.67	ND	ND	ND	ND	58.12	ND
ISFSI 317	15	15.79	15.38	15.03	14.90	ND	ND	ND	ND	61.10	ND
ISFSI 318	15	17.51	16.24	18.45	16.22	ND	ND	ND	ND	68.42	ND
ISFSI 319	15	17.83	17.62	17.99	16.98	ND	ND	ND	ND	70.42	10.42
ISFSI 320	15	17.34	16.74	18.29	17.01	ND	ND	ND	ND	69.38	9.38
ISFSI 321	15	18.02	16.85	18.40	16.71	ND	ND	ND	ND	69.98	9.98
ISFSI 322	15	15.73	14.66	16.22	15.49	ND	ND	ND	ND	62.10	ND
ISFSI 323	15	18.33	17.63	18.90	17.91	ND	ND	ND	ND	72.77	12.77
ISFSI 324	15	21.05	20.81	21.09	20.21	6.05	5.81	6.09	5.21	83.16	23.16
ISFSI 325	15	21.48	20.98	22.82	21.11	6.48	5.98	7.82	6.11	86.39	26.39
ISFSI 326	15	20.53	20.61	21.27	19.62	5.53	5.61	6.27	4.62	82.03	22.03
ISFSI 327	15	37.07	37.55	38.84	37.99	22.07	22.55	23.84	22.99	151.45	91.45
ISFSI 328	15	34.83	35.31	34.43	31.96	19.83	20.31	19.43	16.96	136.53	76.53
55 San Onofre State Beach (U1 West)	15	18.62	18.06	16.75	17.57	ND	ND	ND	ND	71.00	11.00
56 San Onofre State Beach (U1 West)	15	17.44	17.87	16.32	16.51	ND	ND	ND	ND	68.14	ND
57 San Onofre State Beach (Unit 2)	15	15.13	16.47	14.39	14.43	ND	ND	ND	ND	60.42	ND
59 SONGS Meteorological Tower	15	17.61	17.65	18.08	17.75	ND	ND	ND	ND	71.09	11.09



TLD	Elevation Relative to ISFSI Pad
301	78
302	32
303	33
304	33
306	4
307	7
308	9
309	3
310	3
311	3
312	4
314	4
315	4
316	37
317	42
318	87
319	86
320	84
321	83
322	3
323	4
324	4
325	4
326	3
327	4
328	4

Figure 13 – SONGS ISFSI and Selected REMP TLD Locations

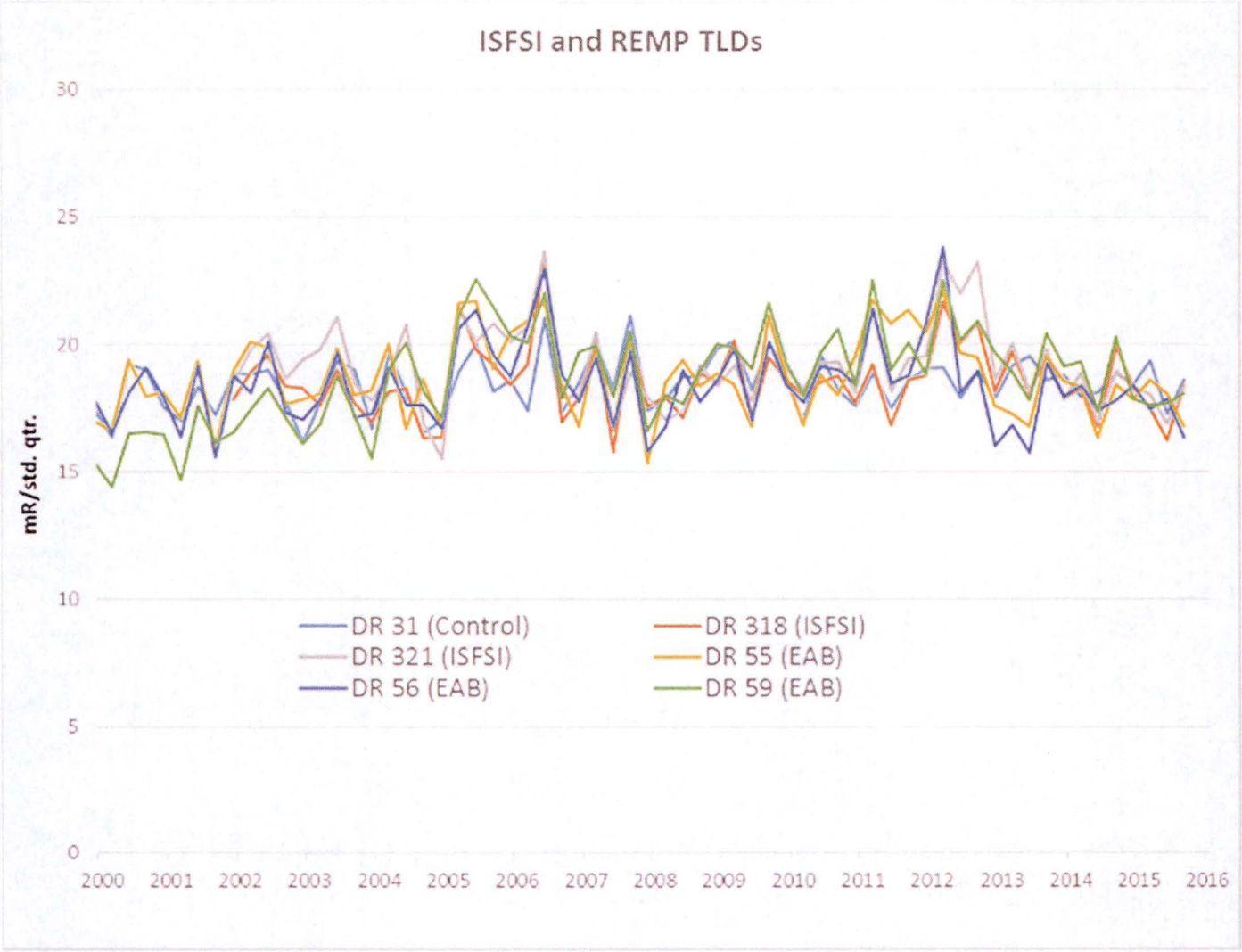


Figure 14 - ISFSI and REMP TLDs

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. As described in the Annual Radiological Effluent Release Report, we conclude that the operation of SONGS had no impact on drinking water wells in the vicinity of SONGS.

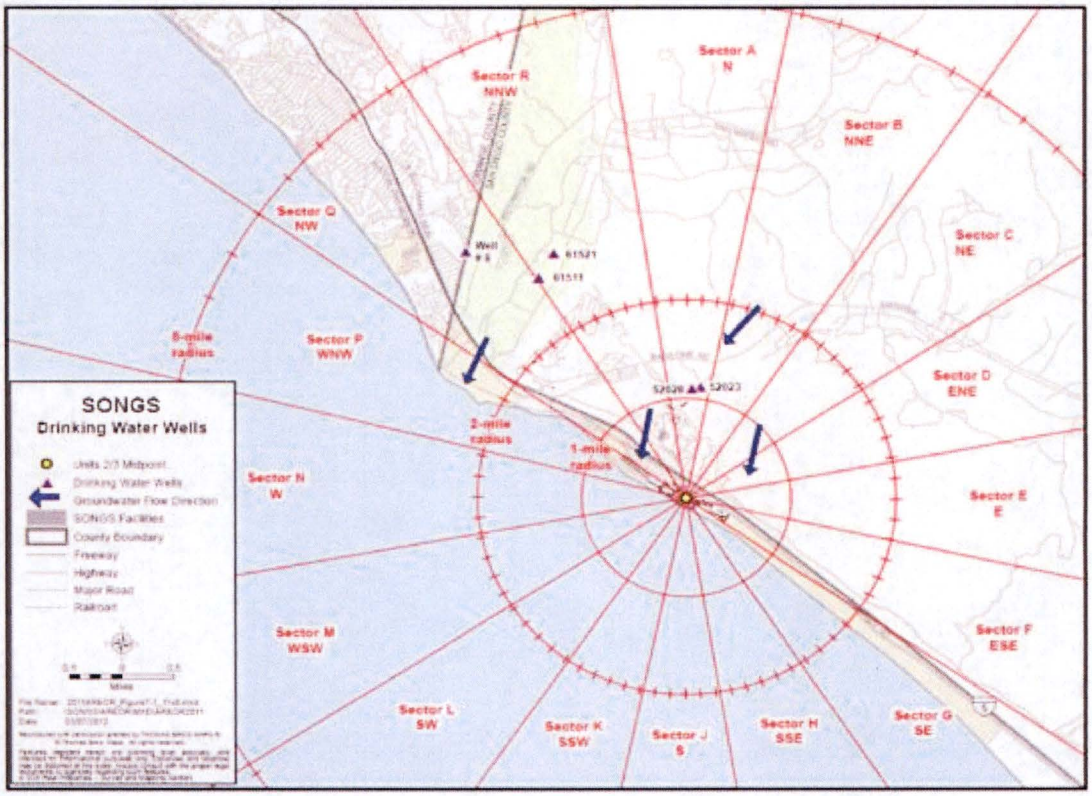


Figure 15 – Closest Drinking Water Wells

Glossary

a posteriori — After the fact

a priori — Before the fact

ALARA — As Low As as 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
^{3}H (tritium)	^{14}N (n, ^{12}C)^{3}H
^{7}Be	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)
^{34m}Cl	Spallation (Ar)
^{35}S	Spallation (Ar)

^{36}Cl	$^{35}Cl\ (n, \gamma)^{36}Cl$
^{37}Ar	$^{37}Cl\ (p, n)^{37}Ar$
^{38}Cl	Spallation (Ar)
^{39}Ar	$^{38}Ar\ (n, \gamma)^{39}Ar$
^{39}Cl	$^{40}Ar\ (n, np)^{39}Cl$ & spallation (Ar)
^{41}Ar	$^{40}Ar\ (n, \gamma)^{41}Ar$
^{81}Kr	$^{80}Kr\ (n, \gamma)\ ^{81}Kr$

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.

fCi/m^3

acronym for a femto-curie per cubic meter, which is a concentration unit that defines how much radioactivity is present in a particular air volume, such as a cubic meter. A curie, named after its discoverers Pierre and Marie Curie, is defined as the rate at which a radioactive element transforms itself into another element that is most often another radioactive element. It is mathematically equivalent to 37 billion disintegrations or transformations per second. A "femto" is a scientific prefix for an exponential term that is equivalent to one quadrillionth (1/1,000,000,000,000,000).

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.

Millirem (mrem) — One thousandth (1/1000) of a rem.

MilliRoentgen (mR) — One thousandth (1/1000) of a rem

pCi/g — An acronym for pico-curie per gram which is a concentration unit that defines how much radioactivity is present in a unit mass such as a gram. A 'pico" is a scientific prefix for an exponential term that is equivalent to the one trillionth. (1/1,000,000,000,000) 1 pCi =0.37 disintegrations/second or 1 xE-12 of a curie

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.

pCi/m^3 — An acronym for pico-curie per cubic meter, which is a concentration unit that defines how much radioactivity is present in a unit of volume or capacity equal to 1000 liters.

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	It 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.
Thermoluminescent Dosimeters (TLD)	It is a 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.
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
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