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**A. Edward Scherer**
Director
Nuclear Regulatory Affairs

May 11, 2009

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: **Docket Nos. 50-206, 50-361, 50-362 and 72-41**
**2008 Annual Radiological Environmental Operating Report**
**San Onofre Nuclear Generating Station Units 1, 2 and 3 and**
**Independent Spent Fuel Storage Facility**

Dear Sir or Madam:

As required by Technical Specification (TS) Section D6.9.1.3 of San Onofre Nuclear Generating Station (SONGS) Unit 1 Facility Operating License DPR-13, and TS Section 5.7.1.2 of Facility Operating Licenses NPF-10 and NPF-15 for SONGS Units 2 and 3, respectively, this letter transmits the 2008 Annual Radiological Environmental Operating Report (AREOR) for SONGS Units 1, 2 and 3.

The AREOR covers the operation of SONGS during the calendar year 2008 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.

If you require any additional information, please contact Mr. Geoffrey M. Cook at (949) 368-9008.

Sincerely,

Enclosure

P.O. Box 128
San Clemente, CA 92674

cc: E. E. Collins, Regional Administrator, NRC Region IV
J. E. Whitten, Region IV, San Onofre Unit 1
M. C. Hay, NRC Region IV, San Onofre Units 2 & 3
R. Hall, NRC Project Manager, San Onofre Units 2, and 3
J. C. Shepherd, NRC Project Manager, San Onofre Unit 1
G. G. Warnick, NRC Senior Resident Inspector, San Onofre Units 2 and 3
S. Y. Hsu, California Department of Public Health

# 2008
# Radiological Environmental Operating Report
## San Onofre Nuclear Generating Station

## Southern California Edison
***An Edison International Company***

Docket Nos. 50-206, 50-361, 50-362
License Nos. DPR-13, NPF-10, NPF-15

**April 2009**

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

# 2008 ANNUAL

# RADIOLOGICAL ENVIRONMENTAL

# OPERATING REPORT

## San Onofre Nuclear Generating Station

UNITS 1, 2, & 3


Southern California Edison

*An Edison International Company*


| | |
|---|---|
| Prepared by: N.A Hansen | 4-29-09 |
| Approved by: R.K. Heckler | 4-30/ 09 |
| Approved by: M.J. Johnson | 5-5/ 09 |
| Approved by: J.A. Madigan | 5-7/ 09 |
| Approved by: O. E. Flores | 5-7/ 09 |

APRIL 2009

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# Executive Summary

The data from the San Onofre Nuclear Generating Station (SONGS) Radiological Environmental Monitoring Program (REMP) indicate that SONGS had a negligible radiological environmental impact during 2008.

Preparation of the 2008 Annual Radiological Environmental Operating Report (AREOR) used the data reduction protocol described in NUREG/CR-4007. A meaningful analysis of data at, near, or below the detection limit must necessarily involve a consideration of the degrees of uncertainty associated with the data. The data have been summarized in the Statistical Summary of REMP Data found in Appendix B. The plant related radionuclides (Cs-137 in soil and sediment, as well as I-131 in kelp) detected above the *a posteriori* minimum detectable concentration (MDC) are attributable to fallout from nuclear weapons testing (Cs-137) and medical administrations of radionuclides (I-131). Plant related radionuclide detected in deer meat and bone (Sr-90 and Cs137) are at levels consistent with fallout from weapons testing. These isotopes have been detected at indicator as well as control locations in past years. The naturally occurring radionuclides (Be-7, K-40, and Th-228) detected were observed in both control and indicator locations at substantially similar concentrations and are not related to the operation of SONGS. Tritium was detected in three ocean water samples at levels below the *a priori* LLD. The detection of tritium in the ocean water is attributable to unique sampling conditions. Refer to Appendix B for a more detailed discussion. The balance of 2008 SONGS REMP database displays behavior statistically consistent with a null set database.

## INTRODUCTION

SONGS consists of two pressurized water nuclear reactors housed in separate containment buildings. Unit 1 attained initial criticality June 1967 and was permanently retired from service in November 1992. Units 2/3 attained initial criticality in July 1982 and August 1983, respectively, and have been in operation to date.

The purpose of the REMP is to quantify ambient radiation levels in the environs of SONGS, and to identify and quantify concentrations of radioactivity in various environmental media in the vicinity of SONGS which have a potential radiation exposure pathway to man. Thermoluminescent dosimeters (TLDs) were used to measure direct radiation levels. Sampled environmental media include soil, shoreline sediment (beach sand), air (particulate & iodine), local crops, non-migratory marine species, kelp, drinking water, ocean water, and ocean bottom sediments. Each of the samples was analyzed for both naturally-occurring and SONGS-related radionuclides.

The REMP is conducted in accordance with Section 5.0 of the SONGS Offsite Dose Calculation Manual (ODCM).

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 have been compared against predicted (calculated) values to evaluate the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure. Refer to Appendix B for a correlation of effluent to environmental concentrations.

A land use census was performed in 2008 to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census. Appendix F of the report identifies changes to the census and the resultant dose increase, if any, to individuals from principal pathways of exposures in conformance with 10CFR Part 50, Appendix I, Section IV. B.3.

## OBJECTIVES

1. To fulfill the radiological environmental monitoring requirements of the ODCM

2. To detect any significant increase in the concentration of radionuclides in critical pathways.

3. To detect any significant change in ambient gamma radiation levels.

4. To verify that the operation of SONGS Units 2 and 3 has a negligible effect on the health and safety of the public and the environment.

## SAMPLE COLLECTION

Samples of various environmental media were obtained to meet the stated objectives. The selection of sample types was based on established critical pathways for the transfer of radionuclides through the environment to individuals, and the evaluation of data during the operational phase. Sampling locations were determined 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 were divided into two classes, indicator and control. Control stations were at locations considered to be unaffected by SONGS operations. All others are considered indicator locations and may be potentially affected by SONGS operations.

## REGULATORY LIMITS, GUIDANCE, AND REQUIREMENTS

* 10CFR50

  The Code of Federal Regulations Title 10, Part 50, Appendix I.

* 40CFR190

  The Environmental Protection Agency (EPA) has established environmental radiation protection standards for nuclear power plants in 40CFR190. The standards for normal operation recommend that the dose from all discharges of radioactivity should not exceed 25 mrem/yr. These limits are applicable to the sum of both liquid and gaseous effluents and direct radiation. The environmental doses calculated at SONGS are a small fraction of the dose limits established by the EPA.

* 10CFR20

  10CFR20, Appendix B, Table II, “Effluent Concentrations” and Appendix C, “Concentration for Release to Sewerage”

**Guidance:**

* Regulatory Guide 4.1

  Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants, 1975

* Regulatory Guide 4.2

  Preparation of Environmental Reports for Nuclear Power Stations, 1976

* Regulatory Guide 4.8

  Environmental Technical Specifications for Nuclear Power Plants, 1975

* 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

* 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 (TLD's)

  American National Standard Performance, Testing, And Procedural Specifications for Thermoluminesence Dosimetry (Environmental Application), 1975

* Regulatory Guide 4.15

  Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, 1979

* NUREG 1576 MARLAP

  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

## DATA MANAGEMENT

The tabulated means, ranges and standard deviations presented in Appendix B were calculated following the standard format specified in Regulatory Guide 4.8, the Radiological Assessment Branch Technical Position, Revision 1, 1979, and in accordance with the protocol outlined in NUREG/CR-4007. A custom data management software package was used to perform the statistical analysis and tabulation of the data.

The REMP data are reviewed for accuracy and comparison against NRC reporting levels, and then entered into the REMP database. One of the REMP menus flags measurements exceeding the administrative levels (10% of the NRC reporting levels) established by Southern California Edison (SCE). 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 was assessed through a series of analyses. These analyses included: data reduction, comparisons of indicator to control locations, and summary (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 2008 Land Use Census (Appendix F).

All Radiological Environmental Monitoring activities for San Onofre are assessed in accordance with Quality Assurance requirements as defined in Regulatory Guide 4.15. The Contracted Environmental Analysis Laboratory (CEAL) participated in an interlaboratory 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. Refer to Appendix C.

## DETECTION LIMIT TERMINOLOGY

This report utilizes three distinct terms to describe the concept of "lower limit of detection" at various detection confidence levels. The terms are briefly defined below. For a more thorough discussion, the reader should refer to NUREG/CR-4007.

Critical level - Defined as 1.64 sigma. For a sufficiently large database of [isotopically analyzed] sample results, with the "true" activity being equal to zero, approximately 5% of the results should be above the critical level.

Lower Limit of Detection (LLD) - The LLD is the *a priori* (before the fact) lower limit of detection. This value is calculated for each isotope and every matrix based on typical or expected values of decay time, sample size, counter efficiency, etc. These values are listed in the ODCM and represent the maximum permissible value for the "lower limit of detection" for 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, counter efficiency as determined by recent calibration, etc. 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" activity at the 95% detection confidence level. Refer to NUREG 1576

The 2008 SONGS REMP data required by the ODCM have been summarized in the Statistical Summary of REMP Data found in Appendix B.

## CONCLUSION

Levels of radioactivity in environmental media are a function of several factors including: site release rates; meteorology; number, location, size and date of nuclear weapons tests; seasonal variability of fallout; soil conditions; local terrain and variability in the natural environment.

Radiological environmental data collected throughout 2008 have been evaluated to determine the impact, if any, of San Onofre operations 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 2008 against the levels observed in pre-operational years.

5. Historical trending of radionuclides in various media during operational years.

In comparing these findings to the conservatively-defined limits of the facility operating licenses, it is concluded that the radiological environmental impact of the operation of SONGS through 2008 has been negligible, and the resulting dose to man is negligible.

## REFERENCES


1. 10CFR50, Appendix I

2. Land Use Census for SONGS Units l, 2 and 3 Radiological Environmental Monitoring Program, October 2008.

3. SONGS Offsite Dose Calculation Manual (ODCM) Revision 1, Section 5.0, 2008.

4. SONGS Radiological Monitoring (RM) Procedures: SO123-RM-1 (SO123-IX-1.10).

5. L. Currie. 1968 "Limits for the Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Analytical Chemistry, vol. 40 pp. 586-593

# APPENDIX A

# SAMPLE TYPE AND SAMPLING LOCATION

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

| TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications) | | DISTANCE* (miles) | DIRECTION* (Sector) |
|---|---|---|---|
| ***Direct Radiation*** | | | |
| 1 | City of San Clemente (Former SDG&E Offices) | 5.7 | NW |
| 2 | Camp San Mateo – MCB | 3.5 | N |
| 3 | Camp San Onofre – MCB | 2.6 | NE |
| 4 | Camp Horno – MCB | 4.5 | E |
| 6 | Old Route 101 (East-Southeast) | 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 ** | NW |
| 12 | South Edge of Switchyard | 0.2 ** | E |
| 13 | Southeast Site Boundary (Bluff) | 0.4 ** | ESE |
| 15 | Southeast Site Boundary (Office Building) | 0.1 ** | SSE |
| 16 | East Southeast Site Boundary | 0.4 ** | ESE |
| 19 | San Clemente Highlands | 5.0 | NNW |
| 22 | Former US Coast Guard Station - San Mateo Point | 2.7 | WNW |
| 23 | SDG&E Service Center Yard | 8.1 | NW |
| 31 | Aurora Park - Mission Viejo (Control) | 18.6 | NNW |
| 33 | Camp Talega – MCB | 5.7 | N |
| 34 | San Onofre School – MCB | 1.9 | NW |
| 35 | Range 312 – MCB | 4.7 | NNE |
| 36 | Range 208C – MCB | 4.2 | NE |
| 38 | San Onofre State Beach Park | 3.3 | SE |
| 40 | SCE Training Center - Mesa (Adjacent to PIC #3) | 0.7 | NNW |
| 41 | Old Route 101 – East | 0.3 ** | E |
| 44 | Fallbrook Fire Station | 17.7 | E |

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 1. Direction determined from degrees true north.
** Distances are within the Units 2/3 CAB/EAB (Controlled Area Boundary/Exclusion Area Boundary)
*** Soil samples are not required by Technical Specifications.
**** Kelp samples are not required by Technical Specifications.
MCB Marine Corps Base Camp Pendleton
PIC Pressurized Ion Chamber

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

| TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications) | | DISTANCE* (miles) | DIRECTION* (Sector) |
|---|---|---|---|
| ***Direct Radiation*** (Continued) | | | |
| 46 | San Onofre State Beach Park | 0.9 | SE |
| 47 | Camp Las Flores – MCB | 8.6 | SE |
| 49 | Camp Chappo – MCB | 12.8 | ESE |
| 50 | Oceanside Fire Station (Control) | 15.6 | SE |
| 53 | San Diego County Operations Center | 44.3 | SE |
| 54 | Escondido Fire Station | 31.8 | ESE |
| 55 | San Onofre State Beach (U1 West) | 0.2 ** | W |
| 56 | San Onofre State Beach (U1 West) | 0.2 ** | W |
| 57 | San Onofre State Beach (Unit 2) | 0.1 ** | WSW |
| 58 | San Onofre State Beach (Unit 3) | 0.1 ** | S |
| 59 | SONGS Meteorological Tower | 0.3 ** | WNW |
| 61 | Mesa - East Boundary (Adjacent to PIC #4) | 0.7 | N |
| 62 | MCB - Camp Pendleton (Adjacent to PIC #5) | 0.6 | 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 | 4.3 | ENE |
| 73 | South Yard Facility | 0.4 ** | 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 | 4.3 | N |
| 78 | Sheep Valley | 4.4 | ESE |

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 1. Direction determined from degrees true north.
** Distances are within the Units 2/3 CAB/EAB (Controlled Area Boundary/Exclusion Area Boundary)
*** Soil samples are not required by Technical Specifications.
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TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

| TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications) | | DISTANCE* (miles) | DIRECTION* (Sector) |
|---|---|---|---|
| ***Airborne*** | | | |
| 1 | City of San Clemente (City Hall) | 5.1 | NW |
| 7 | AWS Roof | 0.18 ** | 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 |
| 14 | Mesa Medical Facility | 0.7 | NNW |
| 15 | Oceanside City Hall (Control) | 15.6 | SE |
| ***Soil Samples ****** | | | |
| 1 | Camp San Onofre | 2.6 | NE |
| 2 | Old Route 101 - East Southeast | 3.0 | ESE |
| 3 | Basilone Road / I-5 Freeway Off ramp | 2.0 | NW |
| 5 | Former Visitor's Center | 0.4 ** | NW |
| 6 | Oceanside (Control) | 16.0 | SE |

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 1. Direction determined from degrees true north.
** Distances are within the Units 2/3 CAB/EAB (Controlled Area Boundary/Exclusion Area Boundary)
*** Soil samples are not required by Technical Specifications.
**** Kelp samples are not required by Technical Specifications.
MCB Marine Corps Base Camp Pendleton
PIC Pressurized Ion Chamber

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

| TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications) | | DISTANCE* (miles) | DIRECTION* (Sector) |
|---|---|---|---|
| ***Ocean Water*** | | | |
| 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 |
| ***Drinking Water*** | | | |
| 4 | Camp Pendleton Drinking Water Reservoir | 2.2 | NNW |
| 5 | Oceanside City Hall (Control) | 15.6 | SE |
| ***Shoreline Sediment (Beach Sand)*** | | | |
| 1 | San Onofre State Beach (SE) | 0.6 | SE |
| 2 | San Onofre Surfing Beach | 0.8 | WNW |
| 3 | San Onofre State Beach (SE) | 3.5 | SE |
| 4 | Newport Beach North End (Control) | 29.2 | NW |
| ***Local Crops*** | | | |
| 1 | San Clemente Ranch (San Mateo Canyon) | 2.6 | NW |
| 2 | Oceanside (Control) | 15-25 | SE to ESE |
| 4 | San Clemente Residence (Ola Vista) with Garden | 4.4 | NW |
| 6 | SONGS Garden | 0.4 | NNW |
| ***Non-Migratory Marine Animals*** | | | |
| 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 |

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 1. Direction determined from degrees true north.

*** Soil samples are not required by Technical Specifications.

**** Kelp samples are not required by Technical Specifications.

MCB Marine Corps Base Camp Pendleton

PIC Pressurized Ion Chamber

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

| TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications) | | DISTANCE* (miles) | DIRECTION* (Sector) |
|---|---|---|---|
| ***Kelp*** **** | | | |
| 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 |
| ***Ocean Bottom Sediments*** | | | |
| B | Unit 1 Outfall (0.6 mile West) | 0.8 | SSW |
| C | Unit 2 Outfall | 1.6 | SW |
| D | Unit 3 Outfall | 1.2 | SSW |
| E | Laguna Beach (Control) | 18.2 | NW |
| F | SONGS Upcoast | 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 |

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 1. Direction determined from degrees true north.

*** Soil samples are not required by Technical Specifications.

**** Kelp samples are not required by Technical Specifications.

MCB Marine Corps Base Camp Pendleton

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TABLE A-2

SECTOR AND DIRECTION DESIGNATION FOR REMP SAMPLE LOCATION MAP

| 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 |

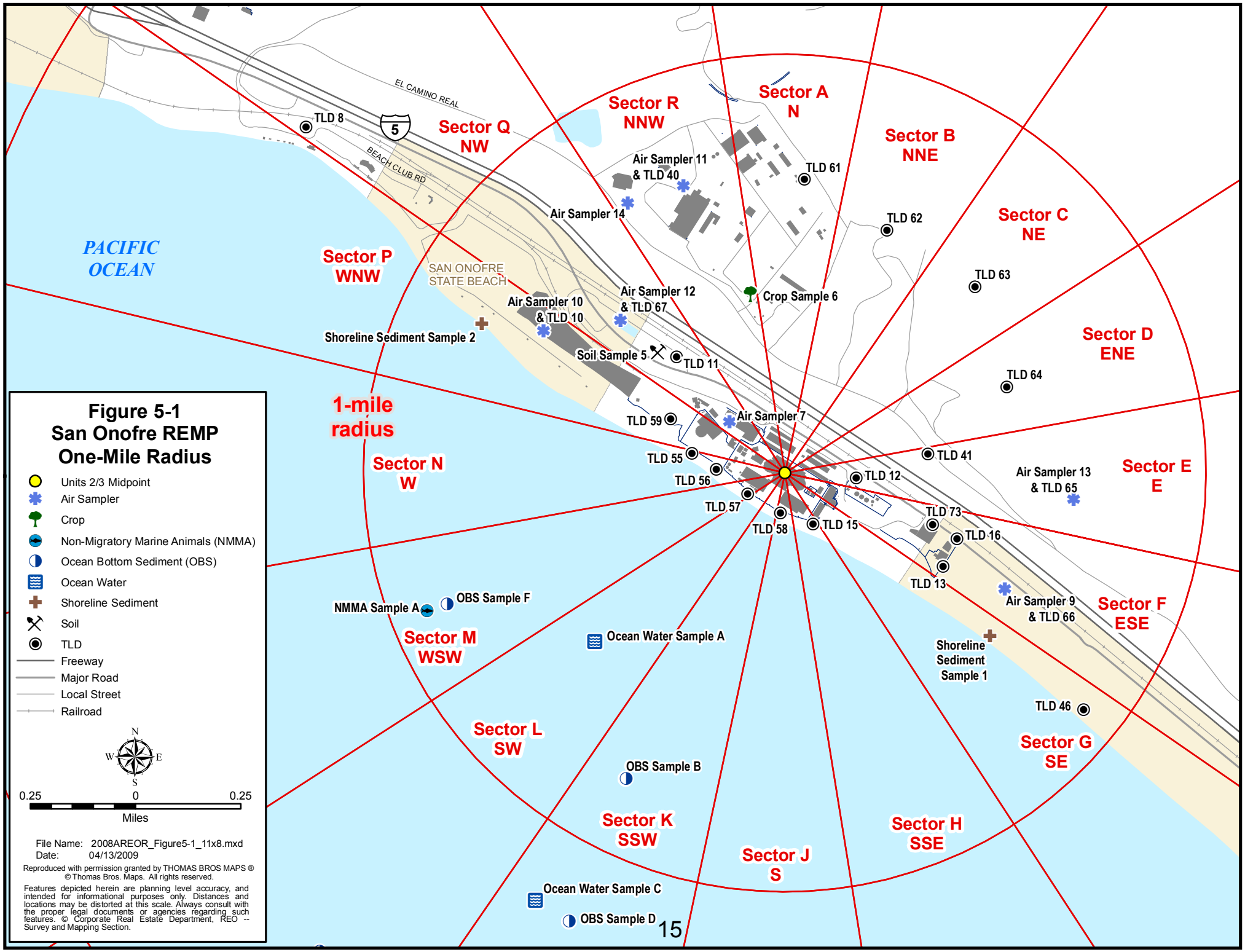
Figure 5-1
San Onofre REMP
One-Mile Radius
Units 2/3 Midpoint
Air Sampler
Crop
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Major Road
Local Street
Railroad
N
W
E
S
0.25
0
0.25
Miles
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Date: 04/13/2009
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PACIFIC OCEAN
EL CAMINO REAL
BEACH CLUB RD
5
SAN ONOFRE STATE BEACH
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
TLD 8
TLD 61
TLD 62
TLD 63
TLD 64
TLD 41
TLD 12
TLD 73
TLD 16
TLD 13
TLD 15
TLD 58
TLD 57
TLD 56
TLD 55
TLD 59
TLD 11
TLD 46
Air Sampler 11 & TLD 40
Air Sampler 14
Air Sampler 12 & TLD 67
Air Sampler 10 & TLD 10
Air Sampler 7
Air Sampler 13 & TLD 65
Air Sampler 9 & TLD 66
Crop Sample 6
Soil Sample 5
Shoreline Sediment Sample 2
Shoreline Sediment Sample 1
NMMA Sample A
OBS Sample F
Ocean Water Sample A
OBS Sample B
Ocean Water Sample C
OBS Sample D

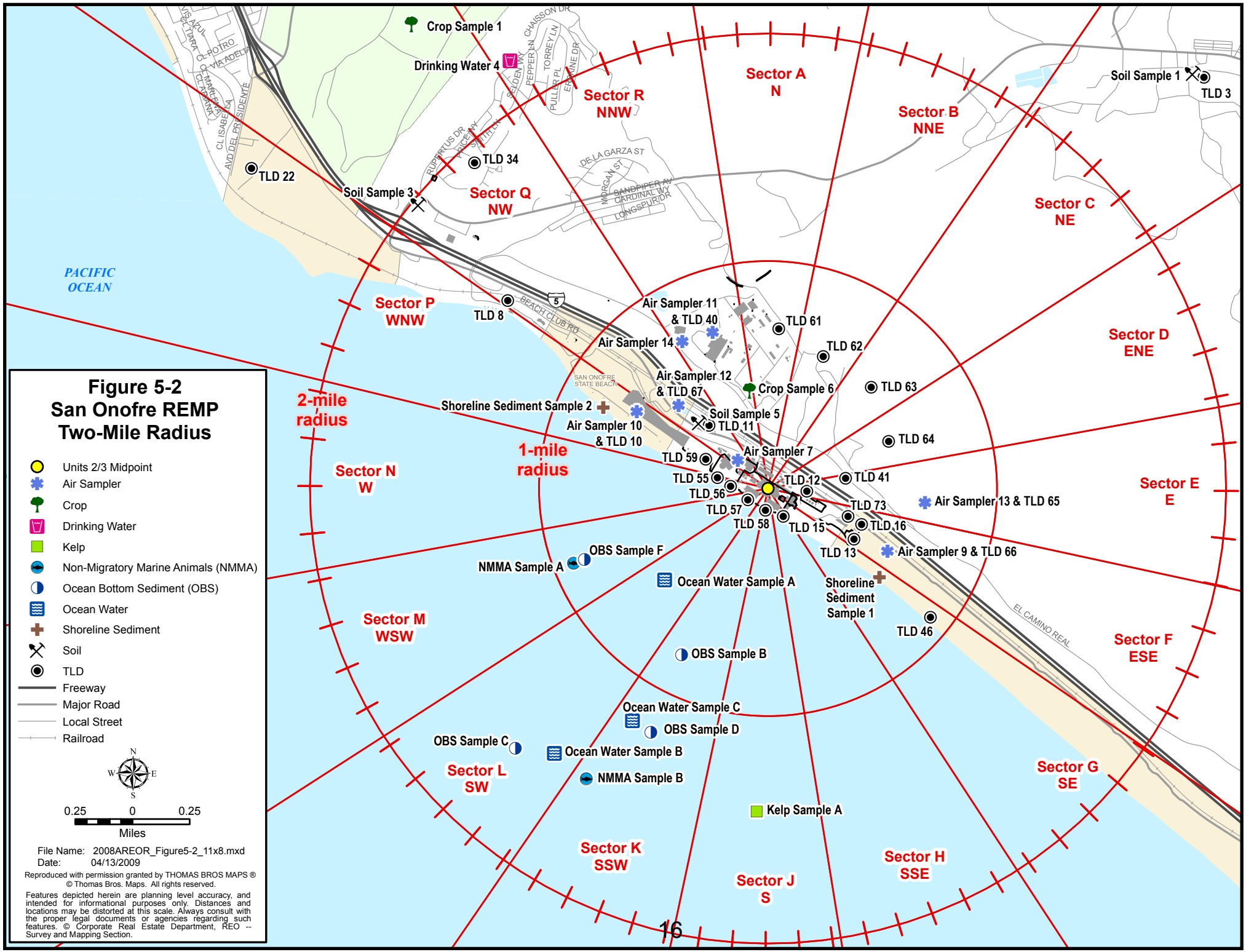


**Figure 5-2**
**San Onofre REMP**
**Two-Mile Radius**

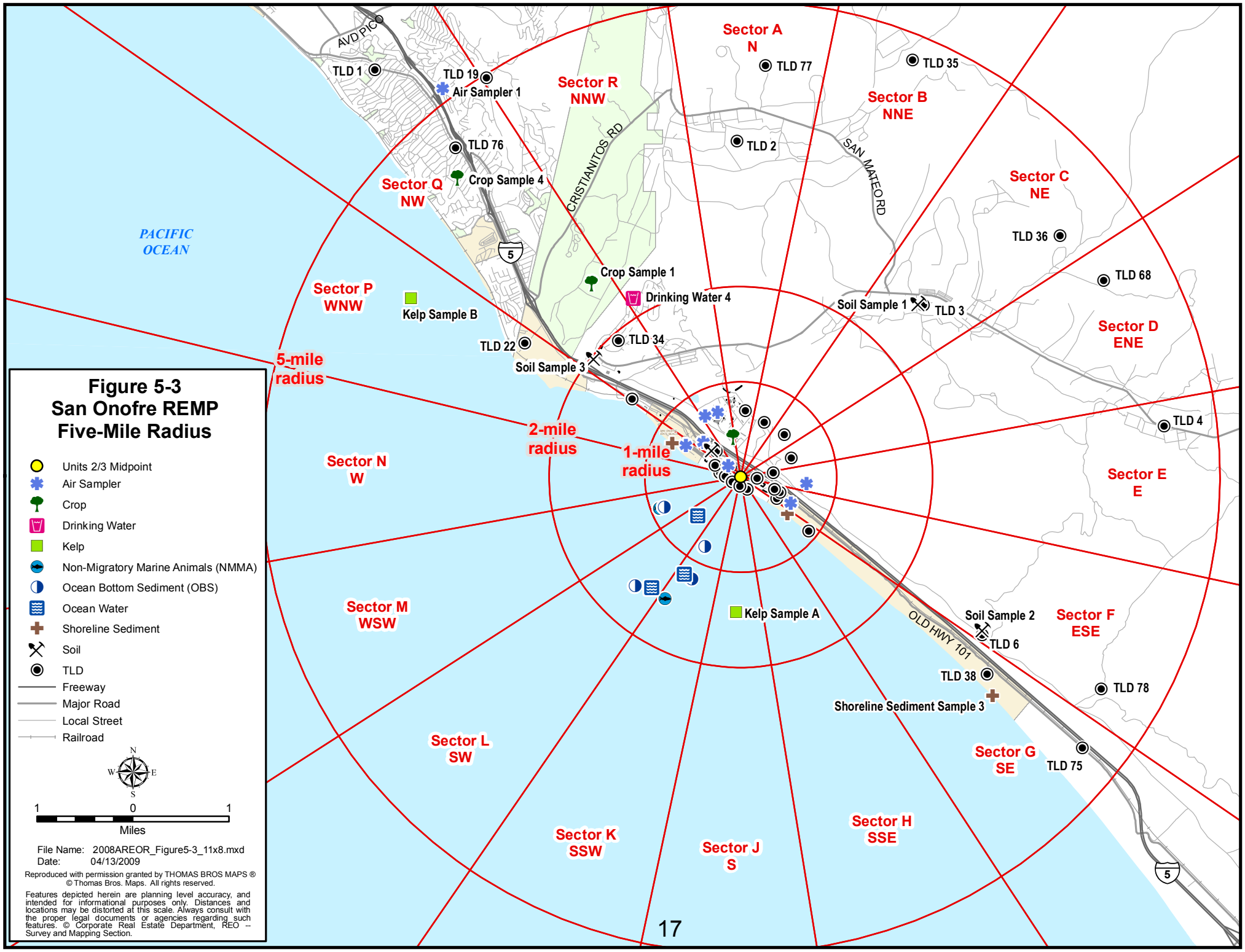
Figure 5-3
San Onofre REMP
Five-Mile Radius
Units 2/3 Midpoint
Air Sampler
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Major Road
Local Street
Railroad
N
W
E
S
1
0
1
Miles
File Name: 2008AREOR_Figure5-3_11x8.mxd
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PACIFIC OCEAN
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
5-mile radius
2-mile radius
1-mile radius
AVD PICO
CRISTIANITOS RD
SAN MATEO RD
OLD HWY 101
5
TLD 1
TLD 19
Air Sampler 1
TLD 76
Crop Sample 4
TLD 77
TLD 35
TLD 2
TLD 36
TLD 68
Crop Sample 1
Drinking Water 4
Soil Sample 1
TLD 3
Kelp Sample B
TLD 22
TLD 34
Soil Sample 3
TLD 4
Kelp Sample A
Soil Sample 2
TLD 6
TLD 38
TLD 78
Shoreline Sediment Sample 3
TLD 75

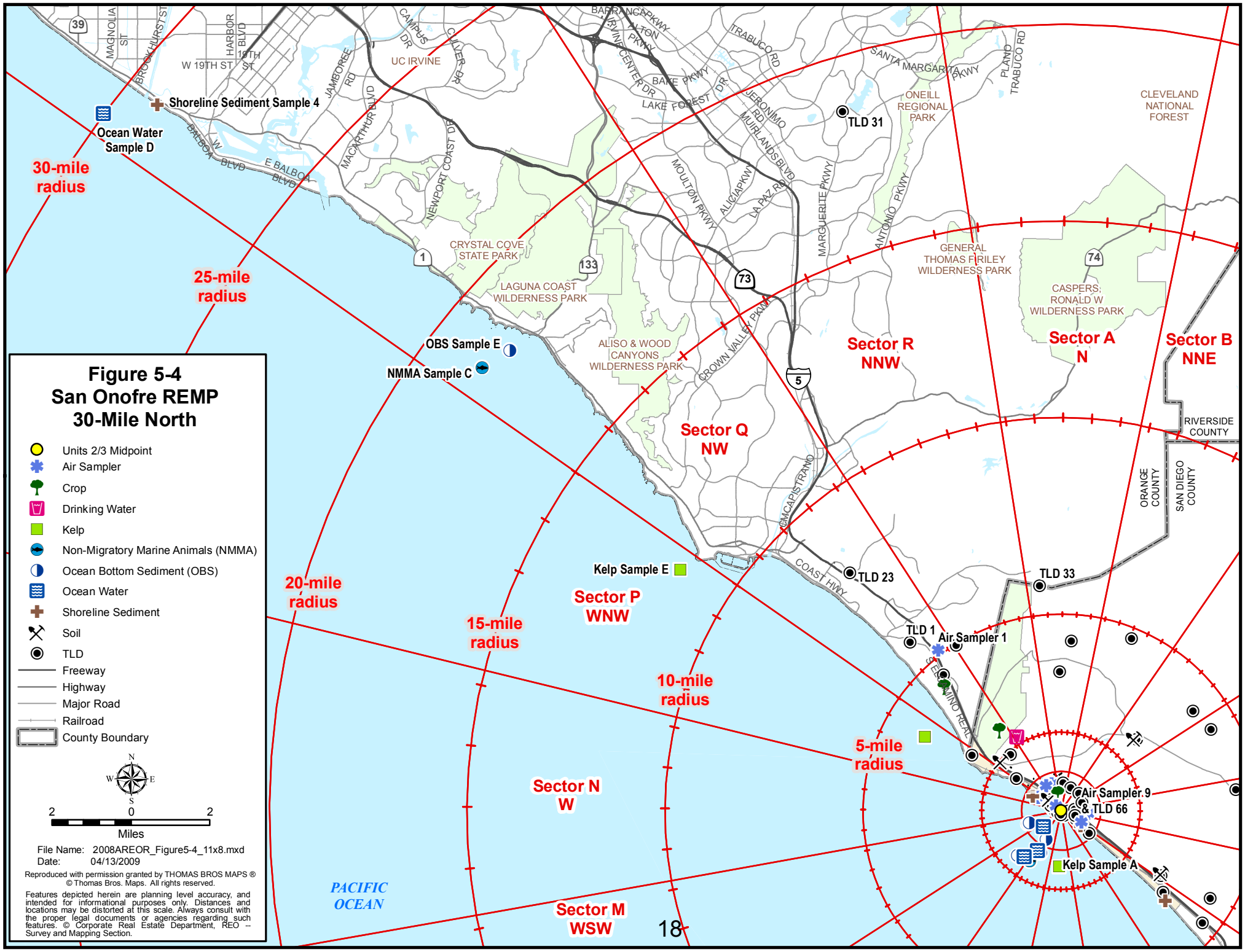
Figure 5-4
San Onofre REMP
30-Mile North
Units 2/3 Midpoint
Air Sampler
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Highway
Major Road
Railroad
County Boundary
N
W
E
S
2
0
2
Miles
File Name: 2008AREOR_Figure5-4_11x8.mxd
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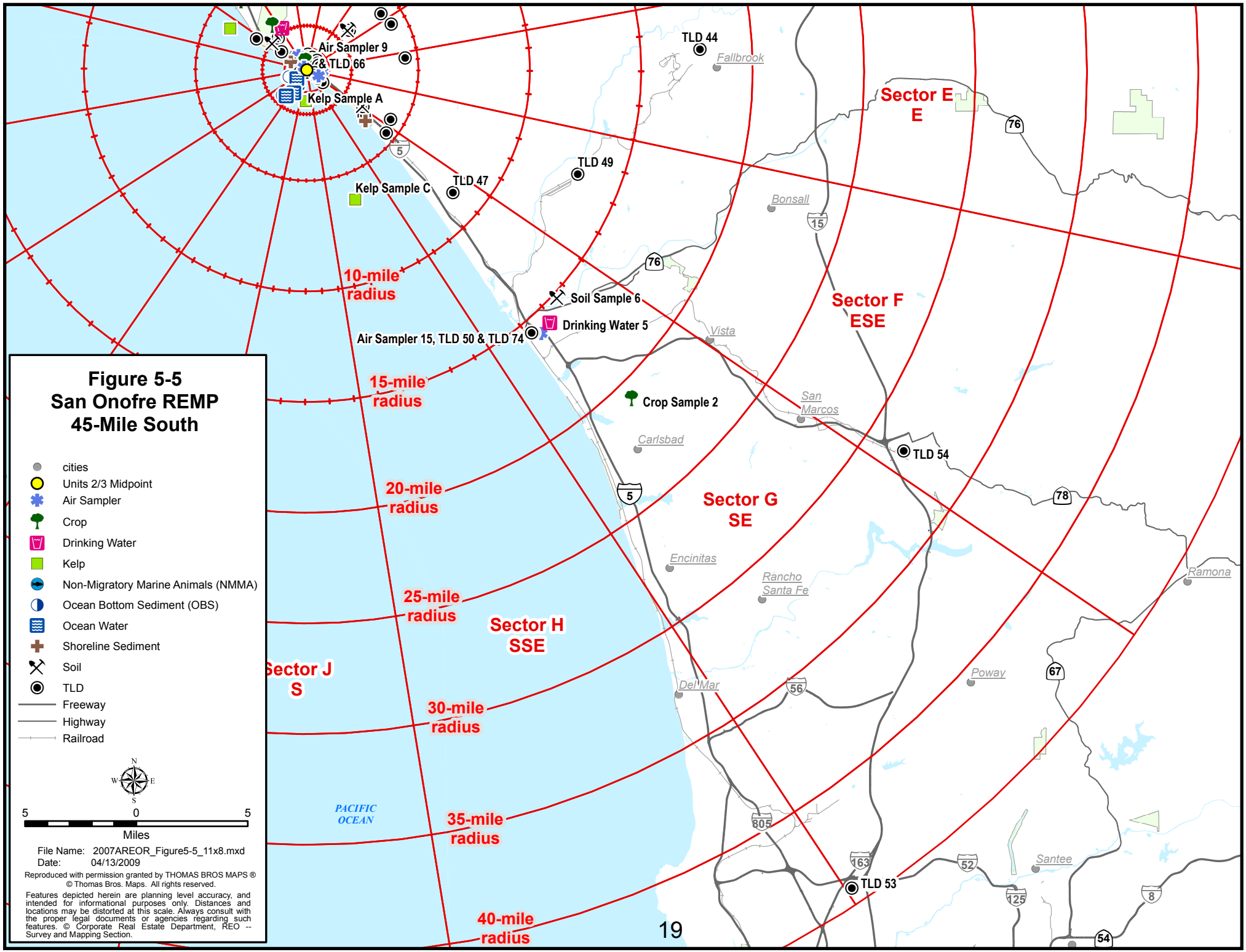
30-mile radius
25-mile radius
20-mile radius
15-mile radius
10-mile radius
5-mile radius
Sector R NNW
Sector A N
Sector B NNE
Sector Q NW
Sector P WNW
Sector N W
Sector M WSW
Shoreline Sediment Sample 4
Ocean Water Sample D
OBS Sample E
NMMA Sample C
Kelp Sample E
Kelp Sample A
TLD 31
TLD 23
TLD 33
TLD 1
Air Sampler 1
Air Sampler 9 & TLD 66
PACIFIC OCEAN
UC IRVINE
CRYSTAL COVE STATE PARK
LAGUNA COAST WILDERNESS PARK
ALISO & WOOD CANYONS WILDERNESS PARK
ONEILL REGIONAL PARK
GENERAL THOMAS FRILEY WILDERNESS PARK
CASPERS, RONALD W WILDERNESS PARK
CLEVELAND NATIONAL FOREST
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY
MAGNOLIA ST
BROOKHURST ST
HARBOR BLVD
W 19TH ST
19TH ST
JAMBOREE RD
CAMPUS DR
CULVER DR
BARRANCA PKWY
ALTON PKWY
IRVINE CENTER DR
BAKE PKWY
LAKE FOREST DR
TRABUCO RD
SANTA MARGARITA PKWY
PLANO TRABUCO RD
JERONIMO RD
MUIRLANDS BLVD
MACARTHUR BLVD
NEWPORT COAST DR
BALBOA BLVD
W BALBOA BLVD
E BALBOA BLVD
MOULTON PKWY
ALICIA PKWY
LA PAZ RD
MARGUERITE PKWY
ANTONIO PKWY
CROWN VALLEY PKWY
CAMINO CAPISTRANO
COAST HWY
EL CAMINO REAL
39
1
133
73
5
74


Air Sampler 9
& TLD 66
Kelp Sample A
Kelp Sample C
TLD 47
TLD 49
TLD 44
Fallbrook
Bonsall
Soil Sample 6
Drinking Water 5
Air Sampler 15, TLD 50 & TLD 74
Vista
Crop Sample 2
San Marcos
Carlsbad
TLD 54
Encinitas
Rancho Santa Fe
Ramona
Del Mar
Poway
Santee
TLD 53
PACIFIC OCEAN
10-mile radius
15-mile radius
20-mile radius
25-mile radius
30-mile radius
35-mile radius
40-mile radius
Sector E
E
Sector F
ESE
Sector G
SE
Sector H
SSE
Sector J
S
5
76
15
78
67
56
805
163
52
125
8
54
Figure 5-5
San Onofre REMP
45-Mile South
cities
Units 2/3 Midpoint
Air Sampler
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Highway
Railroad
N
W
E
S
5
0
5
Miles
File Name: 2007AREOR_Figure5-5_11x8.mxd
Date: 04/13/2009
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# APPENDIX B

# SUMMARY, RESULTS, AND DISCUSSIONS

# OF 2008 ENVIRONMENTAL DATA

## SUMMARY

To assess the changes or trends in the radioactivity level in the environment over the past year, the data from January 2008 to December 2008 were evaluated. The 2008 REMP data were evaluated according to the criteria described in NUREG/CR-4007 and with the methodology described by Currie (1968).* The REMP data above the critical level (1.64 times one sigma) for selected radionuclides, were reduced and tabulated in the Statistical Summary of REMP Data in accordance with the format specified in Reg. Guide 4.8. It should be noted that in an ideal database with the "true" value of each data point equal to zero, five (5)% of the values should be expected to be above the critical level. Thus the 2008 SONGS REMP database, when examined in accordance with the Currie data reduction protocol, leads to the conclusion that SONGS had no statistically significant radiological environmental impact. A summary of the type and number of REMP samples obtained in 2008 appears in Table B-2.

As noted above, the SONGS REMP data base behaves substantially similar to a data base with values statistically indistinguishable from zero for station related isotopes. The exceptions, summarized in Table B-1, include isotopically analyzed samples with station related activity reported above the *a posteriori* MDC. All sample values were significantly less than the NRC reporting levels. I-131 was detected in kelp, tritium was detected in ocean water, and Cs-137 was detected in soil, Sr-90 and Cs-137 were detected in deer samples. These radionuclides have been detected in control as well as indicator locations in previous years. Cs-137 is commonly detected in environmental sediment samples because of fallout from weapons testing. 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. The data strongly suggest that the low level Cs-137 in certain soil samples is due to fallout from nuclear weapons testing and from Chernobyl. We conclude that the low level Cs-137 in soil is not due to the operation of SONGS. The San Juan sewage outfall was sampled for gamma emitters. We conclude that the detectable I-131 in kelp is attributable to the San Juan sewage treatment discharge. I-131 is a medically administered radionuclide which is often detected in sewage plant outfalls. We conclude that SONGS had a negligible radiological environmental impact during 2008.

Historical trending of data near and below the detection limits is necessarily limited. The concentration of radionuclides in the environs of SONGS has trended downward since the early to mid 1980s. In the past decade only a few REMP analysis results have been above the detection limit. These isotopes are detected in control as well as indicator locations and there are known sources for these radionuclides external to SONGS. The overall trend of the REMP data at SONGS is *de minimis* levels of anthropogenic radioactivity with occasional samples showing radioactivity above the *a posteriori* MDC.

* L. Currie. 1968 "Limits for the Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Analytical Chemistry, vol. 40 pp. 586-593

## RESULTS AND DISCUSSIONS OF 2008 ENVIRONMENTAL DATA

### *A. Direct Radiation*

The purpose of this program element was to measure the quarterly environmental gamma radiation in the vicinity of SONGS. To accomplish this task, calcium sulfate ($CaSO_4$) thermoluminescent dosimeters (TLDs) were placed at 38 indicator and 11 control locations. They were collected and analyzed quarterly in accordance with ANSI-N545 standards. TLDs within five miles of SONGS were considered indicator locations. TLDs located greater than five miles from SONGS were considered control locations. 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.

Six laboratory control TLDs were analyzed quarterly. TLD numbers 17, 18, and 60 are used for background dose normalization. TLDs #A and #B are used to compensate for transit dose. 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. The average indicator location dose was 16.74 mR with a range of 10.38 to 28.45 mR. The average control location dose was 15.50 mR with a range of 11.72 to 19.86 mR. The routine 2008 REMP TLD data has been grouped into four categories based on distance from SONGS for the purposes of trending any correlation between distance from SONGS and total annual dose.

2008 REMP TLD data (Average Dose vs. Distance from SONGS)

| | Average Quarterly Dose in mR |
|---|---|
| TLDs ≤ 0.5 miles from SONGS | 19.07 |
| TLDs > 0.5 miles AND ≤ 1.0 mile from SONGS | 14.54 |
| TLDs > 1.0 mile AND ≤ 5.0 miles from SONGS | 16.36 |
| TLDs > 5 miles from SONGS (Control TLDs) | 15.50 |

These data indicate no correlation between total dose and distance from SONGS. The variations in the average dose is approximately equal to the median two sigma variation of measurement (2.1 mR per quarter). Statistically, the control and indicator doses are the same value. The routine indicator location at the South Yard Facility (0.4 miles ESE from the Units 2/3 midpoint) had the highest TLD average in 2008. The operation of SONGS had no impact on the environment as measured by this sample medium.

Figure 2A compares environmental radiation levels of indicator and control locations for the operational year 2008 and for previous years. This figure shows the close correlation between the control and indicator location TLD dose data.

**Quality Control Duplicate Direct Radiation Samples**
Duplicate QC TLDs were installed adjacent to TLD #66 and TLD #67. Refer to Appendix C for results. These TLDs were not required by the ODCM and are not included in the Statistical Summary of REMP Data.

**ISFSI Direct Radiation Samples**
ISFSI (Independent Spent Fuel Storage Installation) TLDs were deployed 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 J.

### *B. Airborne Particulate, Iodine, and Composite Isotopic Analyses*

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

Gross beta analysis is a measure of total radioactivity of beta-emitting radionuclides in a sample. Beta radiation is emitted by many radionuclides, but beta decay gives a continuous energy spectrum rather than the discrete lines or peaks associated with gamma radiation. Gross beta measurements only indicate whether the sample contains normal or abnormal concentrations of beta-emitting radionuclides and does not identify specific radionuclides. Gross beta measurement data serves as a screening tool to determine if further analysis is required.

Nearly all gross beta activity analysis results were above the *a posteriori* MDC. The concentration of gross beta activity in the samples collected from the indicator locations ranged from 0.0112 to 0.130 pCi/m$^3$, averaging 0.0415 pCi/m$^3$ of air. The concentrations of gross beta activity in the samples from the control location ranged from 0.0100 to 0.110 pCi/m$^3$, averaging 0.0416 pCi/m$^3$ of air. Figure 3D shows the variation in gross beta activity level in 2008 at different locations. This graph show a close correlation between the indicator and control location data.

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 #15). The results showed that indicator locations maximum gross beta activity in air in 2008 was 0.130 pCi/m$^3$ and the 2007 control location average was 0.0263 pCi/m$^3$. No action was taken since no indicator location value exceeded ten times the annual average gross beta activity of the control location data from the previous year.

All samples analyzed for I-131 were less than the *a posteriori* MDC and all I-131 samples were less than the *a priori* lower limit of detection (LLD). The airborne indicator and control I-131 REMP samples taken in 2008 at SONGS were statistically indistinguishable from zero.

No samples yielded station related isotopic results confirmed above the *a posteriori* MDC. Quarterly composite gamma spectral analysis analyses yielded naturally occurring beryllium-7 (Be-7) above the *a posteriori* MDC.

We conclude that the operation of SONGS had no impact on the environment as measured by this sample medium.

### *C. 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 2008, 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. In May 2008 the indicator ocean water samples were collected within 24 hours of a batch effluent release. Two of the May 2008 indicator ocean water tritium analysis results were below the *a priori* LLD, but above the *a posteriori* MDC. The samples, taken at locations A and C, represent surface water samples close to the area of the Units 3 diffuser discharge plume. The measured ocean water tritium activity, collected the day after the effluent batch release, is consistent with known effluent batch release and dilution conditions. The duplicate DPH sample results (818 and 1,199 pCi/l) compare well with the SONGS results (1,060 and 2,250 pCi/l), for Stations A and C, respectively. As a result the second quarter 2008 Station C quarterly composite (ODCM required) tritium value was greater than the *a posteriori* MDC. The tritium activity measured is approximately 1/10 the EPA (Environmental Protection agency) drinking water limit. Because no drinking water pathway exists at SONGS, the public dose consequence is negligible. The ocean water tritium activity is well below all regulatory limits. The remaining 2008 monthly DPH and SONGS ocean water tritium analysis results were less than the a posteriori MDC.

Naturally occurring potassium-40 (K-40) was detected in all ocean water samples obtained in 2008. Excluding naturally occurring radionuclides, the ocean water gamma isotopic database is statistically indistinguishable from a database with zero activity.

The data indicate that the operation of SONGS had a negligible impact on the environment as measured by this sample medium.

### *D. Drinking Water*

In 2008, 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 2008. The gross beta activity is due to naturally occurring radionuclides. The drinking water gamma isotopic database is statistically indistinguishable from a database with zero activity. The operation of SONGS had no impact on this sample medium.

### *E. Shoreline Sediment (Beach Sand)*

Beach sand was collected semiannually in 2008 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. Naturally occurring K-40 and thorium-228 (Th-228) were detected in all samples. No plant related radionuclides were reported above the *a posteriori* MDC. The operation of SONGS had no impact on the environment as measured by this sample medium.

### *F. Ocean Bottom Sediments*

Ocean bottom sediments were collected in the vicinity of each of the three SONGS discharge locations and at the Newport Beach control location. The samples were analyzed by gamma-spectral analysis for naturally-occurring and station-related radionuclides. K-40 and Th-228 were detected in ocean bottom sediment samples collected during 2008.

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 2008, all of the conduit sample analysis results were below the MDC for station related radionuclides.

We conclude that the operation of SONGS had no measurable impact on the environment as measured by this sample medium.

### *G. Non-Migratory Marine Species (Flesh)*

Species of adult fish, crustacea and mollusks, were collected on a semi annual basis at the SONGS Unit l 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 SCE 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 *a posteriori* MDC.

Naturally-occurring K-40 was detected in most marine species samples collected during 2008. No plant related isotopes were reported above the *a posteriori* MDC. 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 negligible.

### *H. Local Crops*

Fleshy and leafy crops were collected semiannually in 2008 from the SONGS garden and from the control location 21 miles from SONGS Units 2/3 midpoint in sector F. The crop samples were analyzed quantitatively for natural and plant related radionuclides. Only naturally

occurring radionuclides were detected. SONGS had no measurable impact on this sample medium.

### *I. Soil*

To determine if there is evidence of a build-up of radionuclides in the land near SONGS, indicator soil samples were collected from the East Site Boundary (Former Visitor's center), Old Route 101, Basilone Road, and Camp San Onofre. A control sample was obtained from 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. All 2008 soil samples yielded naturally occurring K-40 and Th-228. Cs-137 was detected in three indicator samples, as well as the control sample. Cs-137 is often detected in environmental sediment samples and the presence of Cs-137 is most likely related to nuclear weapons testing fallout.

Cs-137 and strontium-90 (Sr-90) were detected in soil profile analyses conducted in previous years. These radionuclides are mostly due to the nuclear weapons testing fallout depositing on soil and retention of these radionuclides due to their long half lives. The presence of Cs-137 in the indicator and the control locations in previous years supports the conclusion that the major source of this radionuclide is fallout deposition. During 2008, the operation of SONGS had a negligible impact on the environment as measured by this sample medium.

### *J. Kelp Sampling*

Kelp was collected during April and October 2008 from the San Onofre kelp beds, San Mateo kelp bed, Barn kelp bed, the Dana Point Kelp Bed, the Capistrano Beach Reef, the San Clemente Pier, the Wheeler North Artificial Reef, and from the Salt Creek control location. Upon collection, the samples were analyzed by gamma-spectral analysis for naturally-occurring and Station-related radionuclides. The radionuclides detected in 2008 included K-40 and I-131. K-40 is naturally occurring and not related to the operation of SONGS. I-131 was detected in ten control samples and two indicator samples.

I-131 has been detected at indicator and control locations in previous years. The northern control location is too far away and in the predominantly upstream current direction for the I-131 activity to be attributable to SONGS. The higher I-131 activity in the San Juan sewage outfall supports the conclusion that I-131 in kelp is due to sewage discharges. Note that the I-131 in kelp near the San Juan outfall is approximately one order of magnitude greater than the kelp near SONGS. The I-131 activity in kelp data, graphically presented in Figure 4, shows a relatively close correlation between indicator and control locations over a 25 year period - further supporting the assessment that the likely source for this radionuclide is external to SONGS. Refer to Figure 5-6 for the relative location of the kelp beds, the San Juan Outfall, and the SONGS outfalls.

### *K. Deer Sampling*

Deer meat, bone, and liver samples were collected in 2008 because locally harvested deer meat is a potential pathway to humans. Road kill deer were sampled in accordance with a California Fish and Game scientific take permit issued to the Camp Pendleton Game Warden. Two samples were confirmed above the *a posteriori* MDC, Sr-90 in bone and Cs-137 in meat. The data are consistent with the activity attributable to fallout. In 2008 the operation of SONGS had a negligible environmental impact as measured in this media.

### *L. Correlation of Effluent Concentrations to Concentrations in the Environment*

In accordance with 10 CFR 50 Appendix I, 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.

The REMP soil Cs-137 levels in the control and indicator samples are about equal which leads to the conclusion that Cs-137 in soil is attributable to residual fallout from external anthropogenic factors such as nuclear weapons testing and Chernobyl. The predicted concentration for Cs-137 in soil (based on effluent data reported in the 2007 SONGS Annual Radioactive Effluent Release Report) is about 2 to 3 orders of magnitude lower than the measured concentration of Cs-137 in soil. The effluent based correlation calculation indicates that even if there were no Cs-137 in soil from sources external to SONGS, the Cs-137 concentration in soil attributable to the operation of SONGS would be undetectable and the resultant doses to individuals would be negligible.

Data from 2008 continue to support the historical conclusion that the measured concentration of I-131 in kelp is not increasing near SONGS, and is not statistically higher around SONGS than it is at the control locations. I-131 in kelp is due to the release to the ocean from sewage treatment facilities of medical administrations. The data showing that environmental concentrations are not statistically higher around SONGS than at the control locations are consistent with the low levels of radio-iodine released during 2008. The effluent based correlation calculation indicates that I-131 activity in kelp attributable to the operation of SONGS would be undetectable and the resultant doses to individuals would be negligible.

Sr-90 and Cs-137 detected in two deer samples during 2008 is consistent with activity projected from fallout and is not related to the operation of SONGS. The control and indicator samples of deer meat and bone samples collected during 2008 are statistically equal. This data is consistent with the low levels of Sr-90 and Cs-137 released from SONGS. The evaluation indicates that Cs-137 activity in deer meat attributable to the operation of SONGS would be undetectable and the resultant doses to individuals would be negligible.

The collection of ocean water samples within 24 hours of a batch release caused the May 2008 ocean water tritium samples (Station A and C) and the second quarter 2008 Station C ocean water composite tritium analysis to be > *a posteriori* MDC. Unique sampling conditions (collection closely timed with a release) and the variability of the local current conditions may have led to detectable concentrations of tritium in these samples and would be expected. The remaining samples show no detectable concentration of tritium and demonstrate that environmental concentrations are consistent with the low levels of tritium released during 2008. The evaluation indicates that tritium activity in ocean water attributable to the operation of SONGS would result in negligible doses to individuals.

E Salt Creek Kelp Bed
E Salt Creek Kelp Bed
SELVA RD
COAST HWY
F Dana Point Kelp Bed
F Dana Point Kelp Bed
G Capistrano Beach Reef
G Capistrano Beach Reef
5
AVD PICO
CL DL CERRO
AVD PICO
ORANGE COUNTY
SAN DIEGO COUNTY
San Juan Outfall
SAN MATEO RD
H San Clemente Pier Reef
H San Clemente Pier Reef
CRISTIANITOS RD
I Wheeler North Artifical Reef
I Wheeler North Artifical Reef
5
BASILONE RD
BASILONE RD
B San Mateo Kelp Bed
B San Mateo Kelp Bed
OLD HWY 101
A San Onofre Kelp Bed
A San Onofre Kelp Bed
Unit 2 & 3 Diffusers
Pacific Ocean
C Barn Kelp Bed
C Barn Kelp Bed
Figure 5-6
2008 Kelp Samples
SanJuanOutfall
KelpSamples_2008
Kelp Samples - April 2008
Kelp Samples - October 2008
Units 2/3 Midpoint
Diffusers
Freeway
Major Road
Railroad
County Boundary
N
W
E
S
1
0
1
2
Miles
File Name: 2008AREOR_Figure5-6_11x8.mxd
Path: ~SONGS\AREOR\MXD\AREOR2008
Date: 03/19/2009
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## TABLE B-1

## Summary of SONGS related Gamma Isotopic Analyses confirmed above MDC

| Sample Media & location | Radionuclide | Sample Value | MDC (*a posteriori*) |
|---|---|---|---|
| Aquatic Kelp<br>San Onofre Kelp Bed<br>Station A 15APR08 | I-131 | (26 ± 24) E-3 pCi/g | 25 E-3 pCi/g |
| Aquatic Kelp<br>San Mateo Kelp Bed<br>Station C 15APR08 | I-131 | (35 ± 25) E-3 pCi/g | 24 E-3 pCi/g |
| Aquatic Kelp<br>Salt Creek<br>Station E 15APR08 | I-131 | (140 ± 28) E-3 pCi/g | 22 E-3 pCi/g |
| Aquatic Kelp<br>Salt Creek<br>Station E 15OCT08 | I-131 | (66 ± 43) E-3 pCi/g | 42 E-3 pCi/g |
| Aquatic Kelp<br>Dana Point Kelp Bed<br>Station F 15OCT08 | I-131 | (137 ± 34) E-3 pCi/g | 49 E-3 pCi/g |
| Aquatic Kelp<br>Dana Point Kelp Bed<br>Station F 15APR08 | I-131 | (56 ± 21) E-3 pCi/g | 24 E-3 pCi/g |
| Aquatic Kelp<br>Capistrano Beach Reef<br>Station G 15OCT08 | I-131 | (111 ± 45) E-3 pCi/g | 52 E-3 pCi/g |
| Aquatic Kelp<br>Capistrano Beach Reef<br>Station G 15APR08 | I-131 | (58 ± 25) E-3 pCi/g | 26 E-3 pCi/g |
| Aquatic Kelp<br>San Clemente Pier<br>Station H 15OCT08 | I-131 | (52 ± 34) E-3 pCi/g | 46 E-3 pCi/g |
| Aquatic Kelp<br>San Clemente Pier<br>Station H 15APR08 | I-131 | (92 ± 25) E-3 pCi/g | 27 E-3 pCi/g |
| Aquatic Kelp<br>Wheeler North Artificial Reef<br>Station I 15OCT08 | I-131 | (70 ± 30) E-3 pCi/g | 40 E-3 pCi/g |
| Aquatic Kelp<br>Wheeler North Artificial Reef<br>Station I 15APR08 | I-131 | (91 ± 22) E-3 pCi/g | 18 E-3 pCi/g |

| Sample Media & location | Radionuclide | Sample Value | MDC (*a posteriori*) |
|---|---|---|---|
| Municipal Sewage Discharge<br>San Juan Outfall<br>(sewage effluent) 06NOV08 | I-131 | (28100 ± 3980) E-3 pCi/l | 3370 E-3 pCi/l |
| Ocean Water<br>Station A<br>Unit 1 Outfall 19MAY08 | H-3 | (1060 ± 349) pCi/*l* | 421 pCi/*l* |
| Ocean Water<br>Station C<br>Unit 3 Outfall 19MAY08 | H-3 | (2250 ± 435) pCi/*l* | 423 pCi/*l* |
| Ocean Water<br>Station C<br>Unit 3 Outfall Second Quarter<br>2008 Composite | H-3 | (484 ± 304) pCi/*l* | 440 pCi/*l* |
| Soil<br>Camp San Onofre<br>Location # 1 12SEP08 | Cs-137 | (98 ± 49) E-3 pCi/g | 52 E-3 pCi/g |
| Soil<br>Old El Camino Real<br>Location #2 12SEP08 | Cs-137 | (114 ± 70) E-3 pCi/g | 58 E-3 pCi/g |
| Soil<br>Oceanside<br>Location #6 11SEP08 | Cs-137 | (197 ± 69) E-3 pCi/g | 68 E-3 pCi/g |
| Deer Meat<br>11OCT2008 | Cs-137 | (3.41 ± 2.12) E-3 pCi/g | 2.74 E-3 pCi/g |
| Deer Bone<br>14JUL08 | Sr-90 | (20.9 ± 7.52) E-2 pCi/g | 9.39 E-2 pCi/g |

**TABLE B-2**

**REMP SAMPLE ANALYSIS SUMMARY FOR 2008**

| Medium | Analysis Type | Sampling Frequency | # of Locations | Total # of Analyses in 2008 |
|---|---|---|---|---|
| Direct Radiation | Dosimetry | Quarterly | 49 | 196 |
| Airborne Particulates | Gross Beta | Weekly | 9 | 468 |
| Charcoal Cartridge | I-131 | Weekly | 9 | 468 |
| Airborne Particulates | Ge (Li) Scan | Quarterly | 9 | 36 |
| Ocean Water | Ge (Li) Scan, H-3 | Monthly | 4 | 48 |
| Ocean Water | H-3 | Quarterly | 4 | 16 |
| Ocean Water Conduit | Ge (Li) Scan | Semi-Annually | 2 | 4 |
| [1] Drinking Water, Unfiltered | Ge (Li) Scan,<br>H-3<br>Gross Beta | Monthly | 3<br>3<br>3 | 35<br>35<br>35 |
| Shoreline Sediment | Ge (Li) Scan | Semi-Annually | 4 | 8 |
| Ocean Bottom Sediment | Ge (Li) Scan | Semi-Annually | 7 | 14 |
| Marine Species, Flesh | Ge (Li) Scan | Semi-Annually | 3 | 24 |
| Crops | Ge (Li) Scan | Semi-Annually | 2 | 8 |
| Kelp | Ge (Li) Scan | Semi-Annually | 8 | 16 |
| Soil | Ge (Li) Scan | Annually | 5 | 5 |

1. The total number of analyses include data from drinking water well #6, San Clemente.

# STATISTICAL SUMMARY OF REMP DATA FOR 2008

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | Control Locations Mean (Range) | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|
| Quarterly Gamma Exposure – Table 1A (mR/std quarter) | | | | | | | |
| | Gamma 196 | 5 | 16.74 (152/152)<br>(10.38 – 28.45) | South Yard Facility, 0-4, ESE | 27.39 (4/4)<br>(24.57 – 28.45) | 15.50 (44/44)<br>(11.72 – 19.86) | 0 |

(1) Indicator location TLDs include all REMP TLDs 5.0 miles or closer to SONGS 2/3 midpoint.
(2) Control location TLDs include all REMP TLDs more than 5.0 miles from SONGS 2/3 midpoint.
(3) TLD data excludes QC TLDs, transit dose TLDs, and ISFSI TLDs.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

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| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | Control Locations Mean (Range) | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|
| Weekly Airborne Particulates Gross Beta Activity – Table 2 (pCi/cu.m) | | | | | | | |
| | Gross Beta 468 | 0.01 | 0.0415 (416/416) (0.0112 – 0.13) | Mesa Medical Facility 0.7 Mi. NNW | 0.0451 (52/52) (0.0118 – 0.12) | 0.0416 (52/52) (0.0100 – 0.11) | 0 |

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

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**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | Control Locations Mean (Range) | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|
| Weekly Radioiodine I-131 Activity – Table 3 (pCi/cu.m) | | | | | | | |
| | I-131 468 | 0.07 | 0.0074 (31/416)<br>(0.0038 – 0.0149) | State Beach Park<br>0.6 Mi. ESE | 0.0084 (3/52)<br>(0.0062 – 0.0103) | 0.0081 (2/52)<br>(0.0058 – 0.0104) | 0 |

This table summarizes the weekly air iodine 131 cartridge data above the critical level (1.64 x One Sigma). Note that in an ideal gamma isotopic database, consisting entirely of sample values with no detectable radioactivity, approximately 5% of the data will be greater than the critical level. Iodine 131 was not detected during 2008 in this media.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | Control Locations Mean (Range) | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|
| Quarterly Comp. Airborne Particulates Gamma – Table 4A (pCi/cu.m) | | | | | | | | |
| | Be-7 | 36 | - | 0.23 (32/32) (0.0822 – 0.32) | Former SONGS Evaporation Pond 0.6 Mi. NW | 0.26 (4/4) (0.20 – 0.30) | 0.24 (4/4) (0.17 – 0.26) | 0 |
| | Cs-134 | 36 | 0.05 | 7.55E-4 (1/32) (7.55E-4 – 7.55E-4) | Former SONGS Evaporation Pond 0.6 Mi. NW | 7.55E-4 (1/4) (7.55E-4 – 7.55E-4) | 7.49E-4 (1/4) (7.49E-4 – 7.49E-4) | 0 |
| | Cs-137 | 36 | 0.06 | 3.67E-4 (1/32) (3.67E-4 – 3.67E-4) | Marine Corp Base (Camp Pendleton East) 0.7 Mi. E | 3.67E-4 (1/4) (3.67E-4 – 3.67E-4) | <LLD (0/4) (-) | 0 |

Be-7 (Beryllium 7) is a naturally occurring radioactive isotope produced by cosmic radiation. Be-7 was confirmed above the detection limit in all the SONGS air particulate quarterly composite samples analyzed in 2008. The results for all plant related radionuclides were less than the aposteriori MDC.

The term "< LLD," as used above, means that all results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background. The numerical values for Cs-134 (Cesium-134) and Cs-137 (Cesium-137) listed in this table are those values above the critical level and do not indicate that these radionuclides were detected in any samples.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly Ocean Water Gamma Spectral Analysis – Table 5 (pCi/l) | | | | | | | | | | | |
| | Ba-140 | 52 | 15 | 4.68 (4.21 – 5.51) | (4/40) | (C) Outfall – Unit 3 1.2 Mi SSW | 5.51 (5.51 – 5.51) | (1/12) | 3.47 (3.47 – 3.47) | (1/12) | 0 |
| | Be-7 | 52 | - | 10.75 (8.90 – 11.70) | (4/40) | (A) Station discharge Outfall – Unit 1 0.6 Mi SW | 11.70 (11.70 – 11.70) | (1/12) | < LLD (-) | (0/12) | 0 |
| | Co-58 | 52 | 15 | 1.40 (1.40-1.40) | (1/40) | (C) Outfall -Unit 3 1.2 Mi. SSW | 1.40 (1.40 – 1.40) | (1/12) | 1.16 (1.16 – 1.16) | (1/12) | 0 |
| | Co-60 | 52 | 15 | 1.38 (0.83 – 1.99) | (8/40) | (A) Station discharge Outfall – Unit 1 0.6 Mi. SW | 1.99 (1.99 – 1.99) | (1/12) | 1.51 (1.51 – 1.51) | (1/12) | 0 |
| | Cs-134 | 52 | 15 | 1.76 (1.24 – 2.32) | (7/40) | (B) Outfall - Unit 2 1.5 Mi. SW | 2.09 (1.95 – 2.22) | (2/12) | 0.92 (0.92 – 0.92) | (1/12) | 0 |
| | Cs-137 | 52 | 18 | 1.47 (0.78 – 2.43) | (6/40) | (A) Station discharge Outfall – Unit 1 0.6 Mi. SW | 1.61 (0.78 – 2.43) | (2/12) | < LLD (-) | (0/12) | 0 |
| | Fe-59 | 52 | 30 | 2.47 (2.06-3.10) | (4/40) | (D) Newport Beach 30 Mi. NW | 5.45 (5.45-5.45) | (1/12) | 5.45 (5.45-5.45) | (1/12) | 0 |

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly Ocean Water Gamma Spectral Analysis – Table 5 (pCi/l) | | | | | | | | | | | |
| | H-3 | 52 | 3000 | 665.86<br>(164.00-2250.00) | (7/40) | (C) Outfall – Unit 3<br>1.2 Mi. SSW | 1245.00<br>(240.00-2250.00) | (2/12) | 216.00<br>(216.00-216.00) | (1/12) | 0 |
| | I-131 | 52 | 15 | 2.14<br>(2.14 – 2.14) | (1/40) | (A) Station Discharge Outfall – Unit 1<br>0.6 Mi. SW | 2.14<br>(2.14 – 2.14) | (1/12) | < LLD<br>(-) | (0/12) | 0 |
| | K-40 | 52 | - | 337.23<br>(289.00 – 403.00) | (40/40) | (C) Outfall – Unit 3<br>1.2 Mi. SSW | 350.33<br>(328.00 - 403.00) | (12/12) | 329.83<br>(312.00 – 354.00) | (12/12) | 0 |
| | La-140 | 52 | 15 | 1.90<br>(1.62 – 2.11) | (3/40) | (A) Station Discharge Outfall – Unit 1<br>0.6 Mi. SW | 1.96<br>(1.96 – 1.96) | (1/12) | < LLD<br>(-) | (0/12) | 0 |
| | Mn-54 | 52 | 15 | < LLD<br>(-) | (0/40) | (D) Newport Beach<br>30 Mi. NW | 1.22<br>(1.22 – 1.22) | (1/12) | 1.22<br>(1.22 – 1.22) | (1/12) | 0 |
| | Nb-95 | 52 | 15 | 1.47<br>(0.95 – 2.88) | (12/40) | Unit 2 Conduit<br>0.1 Mi. SW | 2.88<br>(2.88 – 2.88) | (1/2) | 1.68<br>(1.12 – 2.53) | (3/12) | 0 |
| | Zn-65 | 52 | 30 | 2.76<br>(2.07 – 3.11) | (3/40) | (C) Outfall - Unit 3<br>1.2 Mi. SSW | 3.11<br>(3.10 – 3.11) | (2/12) | < LLD<br>(-) | (0/12) | 0 |
| | Zr-95 | 52 | 15 | 3.02<br>(1.92 – 3.81) | (3/40) | (B) Outfall - Unit 2<br>1.5 Mi. SW | 3.33<br>(3.33 – 3.33) | (1/12) | 2.80<br>(2.80 – 2.80) | (1/12) | 0 |

The naturally occurring radioactive isotope K-40 (Potassium 40) was detected in all SONGS Ocean water samples analyzed in 2008. The analysis results for all other radionuclides were less than the detection limit.

The term "< LLD," as used above, means that all results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background. The numerical values listed in this table are those values above the critical level and do not indicate that these radionuclides were detected in any samples.

This table is a statistical summary of the radionuclides detected in 2008 (K-40) and the radionuclides listed in the ODCM

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| Quarterly Composite Ocean Water Tritium Activity – Table 7 (pCi/l) | | | | | | | | | | |
| | H-3 | 16 | 3000 | 291.20 (127.00 – 484.00) | (5/12) | (A) Station Discharge Outfall – Unit 1 0.6 mi. SW | 327.00 (327.00– 327.00) | (1/4) | < LLD (-) | (0/4) | 0 |

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly Drinking Water Analysis – Table 9A (pCi/l) | | | | | | | | | | | |
| | Ba-140 | 35 | 15 | 5.50<br>(4.37 – 6.62) | (2/23) | San Clemente Golf Course Well<br>3.3 Mi. NW | 5.50<br>(4.37 – 6.62) | (2/11) | 4.53<br>(4.53 – 4.53) | (1/12) | 0 |
| | Be-7 | 35 | - | < LLD<br>(-) | (0/23) | | ---<br>(-) | (0/12) | < LLD<br>(-) | (0/12) | 0 |
| | Co-58 | 35 | 15 | 14.50<br>(14.50 – 14.50) | (1/23) | Camp Pendleton<br>2.2 Mi. NNW | 14.50<br>(14.50 – 14.50) | (1/12) | 1.30<br>(0.92 – 1.92) | (3/12) | 0 |
| | Co-60 | 35 | 15 | 1.57<br>(1.04 – 1.97) | (4/23) | San Clemente Golf Course Well<br>3.3 Mi. NW | 1.97<br>(1.97 – 1.97) | (1/11) | 0.81<br>(0.81 – 0.81) | (1/12) | 0 |
| | Cs-134 | 35 | 15 | < LLD<br>(-) | (0/23) | | ----<br>( – ) | (0/12) | < LLD<br>(-) | (0/12) | 0 |
| | Cs-137 | 35 | 18 | 3.46<br>(2.97 – 3.94) | (2/23) | Camp Pendleton<br>2.2 Mi. NNW | 3.94<br>(3.94 – 3.94) | (1/12) | 2.46<br>(2.46 – 2.46) | (1/12) | 0 |
| | Fe-59 | 35 | 30 | 2.96<br>(2.56 – 3.36) | (2/23) | San Clemente Golf Course Well<br>3.3 Mi. NW | 3.36<br>(3.36 – 3.36) | (1/11) | < LLD<br>(-) | (0/12) | 0 |
| | Gross Beta | 35 | 4 | 3.97<br>(1.83 – 12.40) | (21/23) | Oceanside (Control)<br>15.6 Mi SE | 5.57<br>(1.83 – 8.89) | (12/12) | 5.57<br>(1.83 – 8.89) | (12/12) | 0 |

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly Drinking Water Analysis – Table 9A (pCi/l) | | | | | | | | | | | |
| | H-3 | 35 | 3000 | < LLD (-) | (0/23) | Oceanside (Control) 15.6 Mi SE | 143.00 (143.00 – 143.00) | (1/12) | 143.00 (143.00 – 143.00) | (1/12) | 0 |
| | I-131 | 35 | 15 | 1.32 (0.51 – 2.13) | (2/23) | Oceanside (Control) 15.6 Mi SE | 2.05 (2.05 – 2.05) | (1/12) | 2.05 (2.05 – 2.05) | (1/12) | 0 |
| | K-40 | 35 | - | 53.44 (32.10 – 107.00) | (5/23) | Camp Pendleton 2.2 Mi NNW | 107.00 (107.00 – 107.00) | (1/12) | < LLD ( – ) | (0/12) | 0 |
| | La-140 | 35 | 15 | 4.64 (4.64 – 4.64) | (1/23) | San Clemente Golf Course Well 3.3 Mi. NW | 4.64 (4.64 – 4.64) | (1/11) | < LLD (-) | (0/12) | 0 |
| | Mn-54 | 35 | 15 | 1.27 (1.10 – 1.43) | (2/23) | San Clemente Golf Course Well 3.3 Mi. NW | 1.43 (1.43 – 1.43) | (1/11) | < LLD (-) | (0/12) | 0 |
| | Nb-95 | 35 | 15 | 1.60 (0.98 – 3.37) | (7/23) | Camp Pendleton 2.2 Mi. NNW | 1.84 (1.14 – 3.37) | (5/12) | < LLD (-) | (0/12) | 0 |
| | Zn-65 | 35 | 30 | < LLD (-) | (0/23) | | ---- (-) | (0/12) | < LLD (-) | (0/12) | 0 |
| | Zr-95 | 35 | 15 | 1.74 (1.67 – 1.79) | (3/23) | Oceanside (Control) 15.6 Mi. SE | 1.88 (1.88 – 1.88) | (1/12) | 1.88 (1.88 – 1.88) | (1/12) | 0 |

During 2008 gross beta was confirmed above the *a posteriori* MDC in most drinking water samples. Gross beta is attributable to naturally occurring radionuclides. All the other analysis results were less than detectable.

The term "< LLD," as used above, means that all results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background. The numerical values listed in this table are those values above the critical level and do not indicate that these radionuclides were detected in any samples.

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2008 (Gross Beta) as well as those radionuclides listed in the ODCM

Starting in October 2006 San Clemente Well # 6 was sampled and analyzed as a courtesy to the City of San Clemente. This table includes the City of San Clemente drinking water analysis results.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | Control Locations Mean (Range) | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|
| Semi-annual Shoreline Sediment Gamma Spectral Analysis – Table 10 (pCi/g) | | | | | | | | |
| | Cs-134 | 8 | 0.15 | 0.0274 (3/6) (0.0128 - 0.0538) | Newport Beach North End 29.2 Mi. NW | 0.0608 (2/2) (0.0467 – 0.0749) | 0.0608 (2/2) (0.0467 – 0.0749) | 0 |
| | Cs-137 | 8 | 0.18 | 0.0140 (1/6) (0.0140 - 0.0140) | San Onofre State Beach 0.6 Mi. SE | 0.0140 (1/2) (0.0140 – 0.0140) | <LLD (0/2) (-) | 0 |
| | K-40 | 8 | - | 11.85 (6/6) (9.87 – 13.10) | Newport Beach North End 29.2 Mi. NW | 19.35 (2/2) (19.30 – 19.40) | 19.35 (2/2) (19.30 – 19.40) | 0 |

During 2008 naturally occurring Th-228 (thorium 228) and K-40 (potassium 40) were confirmed above the *a posteriori* MDC in most shoreline sediment samples.

The term "< LLD," used above, indicates that all analysis results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background. The numerical values listed in this table for Cs-137 are those values above the critical level and do not indicate that Cs-137 was detected in any samples.

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2008 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis – Table 11 (pCi/g) | | | | | | | | | | |
| | Cs-134 | 14 | 0.15 | 0.0292 (0.0139 – 0.0496) | (5/12) | (C) Unit 2 Outfall 1.6 Mi SW | 0.0454 (0.0454 – 0.0454) | (1/2) | 0.0078 (0.0078 – 0.0078) | (1/2) | 0 |
| | Cs-137 | 14 | 0.18 | 0.0203 (0.0068 – 0.0362) | (3/12) | (D) Unit 3 Outfall 1.2 Mi SSW | 0.0362 (0.0362 – 0.0362) | (1/2) | < LLD (-) | (0/2) | 0 |
| | K-40 | 14 | - | 15.93 (11.50 – 22.00) | (12/12) | (B) Unit 1 Outfall 0.8 Mi SSW | 19.00 (16.00 – 22.00) | (2/2) | 10.62 (8.23 – 13.00) | (2/2) | 0 |

During 2008, naturally occurring Th-228 (thorium 228) and K-40 (potassium 40) were confirmed above the *a posteriori* MDC in most ocean bottom sediment samples.

The term "< LLD," used above, indicates that all analysis results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background. The numerical values listed in this table for Cs-137 are those values above the critical level and do not indicate that Cs-137 was detected in any samples.

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2008 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Bay Mussel | Co-58 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Co-60 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Cs-134 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Cs-137 | 1 | 0.15 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Fe-59 | 1 | 0.26 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | K-40 | 1 | - | 1.61 (1.61 – 1.61) | (1/1) | (A) Unit 1 Outfall 0.9 Mi. WSW | 1.61 (1.61 – 1.61) | (1/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Mn-54 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Bay Mussel | Zn-65 | 1 | 0.26 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Black Perch | Co-58 | 2 | 0.13 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Co-60 | 2 | 0.13 | 0.0078 (0.0078 – 0.0078) | (1/2) | (A) Unit 1 Outfall 0.9 Mi. WSW | 0.0078 (0.0078 – 0.0078) | (1/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Cs-134 | 2 | 0.13 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Cs-137 | 2 | 0.15 | 0.0028 (0.0028 – 0.0028) | (1/2) | (A) Unit 1 Outfall 0.9 Mi. WSW | 0.0028 (0.0028 – 0.0028) | (1/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Fe-59 | 2 | 0.26 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | K-40 | 2 | - | 3.15 (3.11 – 3.19) | (2/2) | (A) Unit 1 Outfall 0.9 Mi. WSW | 3.15 (3.11 – 3.19) | (2/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Mn-54 | 2 | 0.13 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/0) | 0 |
| Black Perch | Zn-65 | 2 | 0.26 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/0) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Blacksmith | Co-58 | 4 | 0.13 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |
| Blacksmith | Co-60 | 4 | 0.13 | < LLD (-) | (0/2) | (C) Laguna Beachl 18.2 Mi NW | 0.0532 (0.0532 – 0.0532) | (1/2) | 0.0532 (0.0532 – 0.0532) | (1/2) | 0 |
| Blacksmith | Cs-134 | 4 | 0.13 | < LLD ( – ) | (0/2) | | ---- ( – ) | (0/2) | < LLD (-) | (0/2) | 0 |
| Blacksmith | Cs-137 | 4 | 0.15 | < LLD (-) | (0/2) | (C) Laguna Beach 18.2 Mi NW | 0.0043 (0.0043 – 0.0043) | (1/2) | 0.0043 (0.0043 – 0.0043) | (1/2) | 0 |
| Blacksmith | Fe-59 | 4 | 0.26 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |
| Blacksmith | K-40 | 4 | - | 4.05 (3.71 – 4.39) | (2/2) | (B) Units 2 and 3 Outfall 1.5 Mi. SSW | 4.05 (3.71 – 4.39) | (2/2) | 4.02 (3.80 – 4.24) | (2/2) | 0 |
| Blacksmith | Mn-54 | 4 | 0.13 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |
| Blacksmith | Zn-65 | 4 | 0.26 | < LLD (-) | (0/2) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| California Mussel | Co-58 | 5 | 0.13 | < LLD (-) | (0/3) | (C) Laguna Beach 18.2 Mi NW | 0.0053 (0.0053 – 0.0053) | (1/2) | 0.0053 (0.0053 – 0.0053) | (1/2) | 0 |
| California Mussel | Co-60 | 5 | 0.13 | 0.0331 (0.0331 – 0.0331) | (1/3) | (B) Units 2 & 3 Outfall 1.5 MI. SSW | 0.0331 (0.0331 – 0.0331) | (1/2) | < LLD (-) | (0/2) | 0 |
| California Mussel | Cs-134 | 5 | 0.13 | < LLD (-) | (0/3) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |
| California Mussel | Cs-137 | 5 | 0.15 | < LLD (-) | (0/3) | | ---- ( - ) | (0/2) | < LLD (-) | (0/2) | 0 |
| California Mussel | Fe-59 | 5 | 0.26 | < LLD (-) | (0/3) | | ---- (-) | (0/2) | < LLD (-) | (0/2) | 0 |
| California Mussel | K-40 | 5 | - | 2.31 (1.85 – 2.59) | (3/3) | (C) Laguna Beach 18.2 Mi NW | 2.85 (1.88 – 3.82) | (2/2) | 2.85 (1.88 – 3.82) | (2/2) | 0 |
| California Mussel | Mn-54 | 5 | 0.13 | 0.0398 (0.0398 – 0.0398) | (1/3) | (B) Units 2 & 3 Outfall 1.5 MI. SSW | 0.0398 (0.0398 – 0.0398) | (1/2) | < LLD (-) | (0/2) | 0 |
| California Mussel | Zn-65 | 5 | 0.26 | < LLD (-) | (0/3) | (C) Laguna Beach 18.2 Mi NW | 0.0491 (0.0491 – 0.0491) | (1/2) | 0.0491 (0.0491 – 0.0491) | (1/2) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Kelp Bass | Co-58 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- ( – ) | (0/1) | < LLD (-) | (0/0) | 0 |
| Kelp Bass | Co-60 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- ( - ) | (0/1) | < LLD (-) | (0/0) | 0 |
| Kelp Bass | Cs-134 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- ( – ) | (0/1) | < LLD ( – ) | (0/0) | 0 |
| Kelp Bass | Cs-137 | 1 | 0.15 | 0.0028 (0.0028 – 0.0028) | (1/1) | (A) Unit 1 Outfall 0.9 Mi. WSW | 0.0028 (0.0028 – 0.0028) | (1/1) | < LLD (-) | (0/0) | 0 |
| Kelp Bass | Fe-59 | 1 | 0.26 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Kelp Bass | K-40 | 1 | - | 3.16 (3.16 – 3.16) | (1/1) | (A) Unit 1 Outfall 0.9 Mi. WSW | 3.16 (3.16 – 3.16) | (1/1) | < LLD ( – ) | (0/0) | 0 |
| Kelp Bass | Mn-54 | 1 | 0.13 | < LLD (-) | (0/1) | | ---- ( – ) | (0/1) | < LLD ( – ) | (0/0) | 0 |
| Kelp Bass | Zn-65 | 1 | 0.26 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Sheephead | Co-58 | 5 | 0.13 | < LLD (– ) | (0/3) | | ---- ( – ) | (0/1) | < LLD (-) | (0/2) | 0 |
| Sheephead | Co-60 | 5 | 0.13 | < LLD ( – ) | (0/3) | | ---- (– ) | (0/2) | < LLD (-) | (0/2) | 0 |
| Sheephead | Cs-134 | 5 | 0.13 | < LLD ( – ) | (0/3) | | ---- ( – ) | (0/2) | < LLD ( – ) | (0/2) | 0 |
| Sheephead | Cs-137 | 5 | 0.15 | < LLD (-) | (0/3) | (C) Laguna Beach 18.2 Mi. NW | 0.0073 (0.0073 – 0.0073) | (1/2) | 0.0073 (0.0073 – 0.0073) | (1/2) | 0 |
| Sheephead | Fe-59 | 5 | 0.26 | < LLD (-) | (0/3) | (C) Laguna Beach 18.2 Mi. NW | 0.0148 (0.0148 – 0.0148) | (1/2) | 0.0148 (0.0148 – 0.0148) | (1/2) | 0 |
| Sheephead | K-40 | 5 | - | 3.67 (3.09 – 4.65) | (3/3) | (B) Units 2 & 3 Outfall 1.5 Mi SSW | 3.87 (3.09 – 4.65) | (2/2) | 3.77 (3.15 - 4.38) | (2/2) | 0 |
| Sheephead | Mn-54 | 5 | 0.13 | < LLD ( – ) | (0/3) | (C) Laguna Beach 18.2 Mi. NW | 0.0345 (0.0345 – 0.0345) | (1/2) | 0.0345 (0.0345 – 0.0345) | (1/2) | 0 |

<LLD results are less than the critical level 1.64 sigma.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g) | | | | | | | | | | | |
| Sheephead | Zn-65 | 5 | 0.26 | < LLD ( - ) | (0/3) | | --- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Co-58 | 6 | 0.13 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Co-60 | 6 | 0.13 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Cs-134 | 6 | 0.13 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Cs-137 | 6 | 0.15 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Fe-59 | 6 | 0.26 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | K-40 | 6 | - | 3.82 (3.37 – 4.61) | (4/4) | (A) Unit 1 Outfall 0.9 Mi. WSW | 4.16 (3.71 – 4.61) | (2/2) | 3.96 (3.69 – 4.23) | (2/2) | 0 |
| Spiny Lobster | Mn-54 | 6 | 0.13 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Spiny Lobster | Zn-65 | 6 | 0.26 | < LLD ( - ) | (0/4) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Local Crops Gamma Spectral Analysis – Table 13A (pCi/g) | | | | | | | | | | | |
| Artichoke | Be-7 | 1 | 0.3 | 0.14 (0.14 – 0.14) | (1/1) | SONGS Garden 0.4 Mi. NNW | 0.14 (0.14 – 0.14) | (1/1) | < LLD ( - ) | (0/0) | 0 |
| Artichoke | Cs-134 | 1 | 0.06 | 0.0110 (0.0110 – 0.0110) | (1/1) | SONGS Garden 0.4 Mi. NNW | 0.0110 (0.0110 – 0.0110) | (1/1) | < LLD (-) | (0/0) | 0 |
| Artichoke | Cs-137 | 1 | 0.08 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Artichoke | I-131 | 1 | 0.06 | < LLD (-) | (0/1) | | ---- (-) | (0/1) | < LLD (-) | (0/0) | 0 |
| Artichoke | K-40 | 1 | - | 4.83 (4.83 – 4.83) | (1/1) | SONGS Garden 0.4 Mi. NNW | 4.83 (4.83 – 4.83) | (1/1) | < LLD ( - ) | (0/0) | 0 |
| Lettuce | Be-7 | 2 | - | < LLD ( - ) | (0/0) | South East of Oceanside 22 Mi. SE | 0.0457 (0.0457 – 0.0457) | (1/2) | 0.0457 (0.0457-0.0457) | (1/2) | 0 |
| Lettuce | Cs-134 | 2 | 0.06 | < LLD ( - ) | (0/0) | | ---- ( – ) | (0/2) | < LLD ( - ) | (0/2) | 0 |
| Lettuce | Cs-137 | 2 | 0.08 | < LLD ( - ) | (0/0) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/2) | 0 |

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**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Local Crops Gamma Spectral Analysis – Table 13A (pCi/g) | | | | | | | | | | | |
| Lettuce | I-131 | 2 | 0.06 | < LLD<br>( - ) | (0/0) | | ----<br>( - ) | (0/2) | < LLD<br>( - ) | (0/2) | 0 |
| Lettuce | K-40 | 2 | - | < LLD<br>( – ) | (0/0) | South East of Oceanside 22 Mi. SE | 2.36<br>(1.33 – 3.38) | (2/2) | 2.36<br>(1.33 – 3.38) | (2/2) | 0 |
| Sorrel | Be-7 | 2 | - | 0.0649<br>(0.0607 – 0.0691) | (2/2) | SONGS Garden 0.4 Mi. NNW | 0.0649<br>(0.0607 – 0.0691) | (2/2) | < LLD<br>( - ) | (0/0) | 0 |
| Sorrel | Cs-134 | 2 | 0.06 | < LLD<br>( - ) | (0/2) | | ----<br>( - ) | (0/2) | < LLD<br>( - ) | (0/0) | 0 |
| Sorrel | Cs-137 | 2 | 0.08 | < LLD<br>( - ) | (0/2) | | ----<br>( - ) | (0/2) | < LLD<br>( - ) | (0/0) | 0 |
| Sorrel | I-131 | 2 | 0.06 | < LLD<br>( - ) | (0/2) | | ----<br>( - ) | (0/2) | < LLD<br>( - ) | (0/0) | 0 |
| Sorrel | K-40 | 2 | - | 3.75<br>(2.60 – 4.89) | (2/2) | SONGS Garden 0.4 Mi. NNW | 3.75<br>(2.60 – 4.89) | (2/2) | < LLD<br>(- ) | (0/0) | 0 |
| Squash | Be-7 | 1 | - | < LLD<br>( - ) | (0/0) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/3/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Local Crops Gamma Spectral Analysis – Table 13A (pCi/g) | | | | | | | | | | | |
| Squash | Cs-134 | 1 | 0.06 | < LLD<br>( - ) | (0/0) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |
| Squash | Cs-137 | 1 | 0.08 | < LLD<br>( - ) | (0/0) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |
| Squash | I-131 | 1 | 0.06 | < LLD<br>( – ) | (0/0) | | ----<br>( – ) | (0/1) | < LLD<br>( – ) | (0/1) | 0 |
| Squash | K-40 | 1 | - | < LLD<br>( - ) | (0/0) | South East of Oceanside<br>22 Mi. SE | 1.63<br>(1.63 – 1.63) | (1/1) | 1.63<br>(1.63 – 1.63) | (1/1) | 0 |
| Tomato | Be-7 | 2 | - | < LLD<br>( - ) | (0/1) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |
| Tomato | Cs-134 | 2 | 0.06 | < LLD<br>( - ) | (0/1) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |
| Tomato | Cs-137 | 2 | 0.08 | 0.0031<br>(0.0031 – 0.0031) | (1/1) | SONGS Garden<br>0.4 Mi. NNW | 0.0031<br>(0.0031 – 0.0031) | (1/1) | < LLD<br>( - ) | (0/1) | 0 |

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean | | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Name, Distance and Direction | Mean (Range) | | | | |
| Semi-Annual Local Crops Gamma Spectral Analysis – Table 13A (pCi/g) | | | | | | | | | | | |
| Tomato | I-131 | 2 | 0.06 | < LLD<br>( - ) | (0/1) | | ----<br>( - ) | (0/1) | < LLD<br>( - ) | (0/1) | 0 |
| Tomato | K-40 | 2 | - | 1.86<br>(1.86 – 1.86) | (1/1) | SONGS Garden<br>0.4 Mi. NNW | 1.86<br>(1.86 – 1.86) | (1/1) | 1.71<br>(1.71 – 1.71) | (1/1) | 0 |

During 2008, naturally occurring K-40 (potassium 40) and Be-7 (Beryllium 7) were confirmed above the *a posteriori* MDC in local crop samples.

The term "< LLD," used above, indicates that all analysis results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular analysis result should be considered as other than background. The numerical values listed in this table for Cs-137 are those values above the critical level and do not indicate that Cs-137 was detected in any samples.

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2008 (K-40) as well as those radionuclides listed in the ODCM

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/1/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| Annual Soil Analysis – Depth 3 ” – Table 14 (pCi/g) | | | | | | | | | | |
| | Cs-134 | 5 | 0.15 | 0.0534 (0.0425 – 0.0653) | (3/4) | Former Visitor’s Center (East Site Boundary) 0.4 Mi. NW | 0.0653 (0.0653 – 0.0653) | (1/1) | < LLD ( - ) | (0/1) | 0 |
| | Cs-137 | 5 | 0.18 | 0.0816 (0.0332 – 0.11) | (3/4) | Oceanside 16 Mi. SE | 0.20 (0.20 – 0.20) | (1/1) | 0.20 (0.20 – 0.20) | (1/1) | 0 |
| | K-40 | 5 | - | 17.83 (9.33 – 23.80) | (4/4) | Camp San Onofre 2.6 Mi NE | 23.80 (23.80 – 23.80) | (1/1) | 4.33 (4.33 – 4.33) | (1/1) | 0 |

During 2008, naturally occurring Th-228 (thorium 228) and K-40 (potassium 40) were confirmed above the *a posteriori* MDC in all soil samples. Cs-137 (Cesium 137) was detected in four samples and is attributable to fallout from nuclear weapons testing and from Chernobyl.

The term "< LLD," used above, indicates that all analysis results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background.

This table is a statistical summary of the analysis results for K-40 and those radionuclides listed in the ODCM for sediment samples.

**ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**DOCKET NOS. 50-206, 50-361, 50-362**
**SAN DIEGO COUNTY, CALIFORNIA**

**Reporting Period: 1/3/2008 to 12/31/2008**

| Medium or Pathway sampled (Unit of Measurement) | Type and Total Number of Analysis Performed | | Lower Limit of Detection (LLD) | All Indicator Locations Mean (Range) | | Location with Highest Annual Mean: Name, Distance and Direction | Location with Highest Annual Mean: Mean (Range) | | Control Locations Mean (Range) | | Number of Nonroutine Reported Measurements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi-Annual Kelp Analysis – Table 15 (pCi/g) | | | | | | | | | | | |
| | Cs-134 | 16 | 0.06 | <LLD (-) | (0/6) | | ---- ( - ) | (0/2) | < LLD ( - ) | (0/10) | 0 |
| | Cs-137 | 16 | 0.08 | 0.0122 (0.0122 – 0.0122) | (1/6) | (C) Barn Kelp Bed 6.3 Mi. SSE | 0.0122 (0.0122 – 0.0122) | (1/2) | 0.0077 (0.0077 – 0.0077) | (1/10) | 0 |
| | I-131 | 16 | 0.06 | 0.0352 (0.0258 – 0.0492) | (5/6) | (E) Salt Creek (CONTROL) 11 Mi. NNW | 0.10 (0.0660 – 0.14) | (2/2) | 0.0872 (0.0521 – 0.14) | (10/10) | 0 |
| | K-40 | 16 | - | 10.60 (8.81 – 12.30) | (6/6) | Dana Point Kelp Bed Mi. | 11.35 (10.20 – 12.50) | (2/2) | 10.20 (7.94 – 12.50) | (10/10) | 0 |

During 2008, naturally occurring K-40 (potassium 40) were confirmed above the *a posteriori* MDC in all kelp samples. I-131 (iodine 131) was also confirmed above the *a posteriori* MDC in twelve 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 is historically been higher than the I-131 activity in kelp closer to SONGS. I-131 in kelp is attributable to sewage plant effluents.

The term "< LLD," used above, indicates that all analysis results were less than the critical level (1.64 x One Sigma). The critical level is used to determine if a bias exists in the database and is not used to determine if a particular sample result should be considered other than background.

# APPENDIX C

# SUMMARY OF 2008 QUALITY CONTROL PROGRAMS

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 vendor's Quality Assurance manual. REMP sample analysis is performed by the Contracted Environmental Analysis Laboratory (CEAL) in accordance with the Laboratory Quality Assurance Plan. During 2008 the CEAL was GEL (General Engineering Laboratory). The CEAL for REMP TLDs was Areva.

**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 Analytics cross check data is included in Table C-1. The CEAL's performance meets the criteria described in Reg. Guide 4.15. Discrepancies and non-agreement results are resolved through a formal Condition Report evaluation process.

**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.

DUPLICATE TLD DATA COMPARISON

| | 1ST QUARTER | 2ND QUARTER | 3RD QUARTER | 4TH QUARTER |
|---|---|---|---|---|
| TLD 66 | 13.34 ± 0.70 | 13.68 ± 0.92 | 14.17 ± 0.77 | 14.05 ± 0.89 |
| TLD 200 | 13.81 ± 0.90 | 14.02 ± 0.68 | 14.70 ± 0.87 | 13.63 ± 1.38 |

* Data is reported as mR per standard quarter ± 1 sigma

**ANNUAL DUPLICATE TLDs**

An annual duplicate TLD package is collocated with TLD 67.

| **TLD 67**<br>**average dose in mR**<br>**per standard quarter**<br><br>**(July 2007 to July 2008)** | **TLD 201 (annual duplicate)**<br>**dose in mR**<br>**per standard quarter**<br><br>**(July 2007 to July 2008)** |
|---|---|
| **16.71** | **17.25** |

**COMPARISON OF TLD TO PIC DATA**,

| PIC 1<br>17.31 | PIC 3<br>18.07 | PIC 4<br>17.03 | PIC 8<br>15.43 |
|---|---|---|---|
| TLD 10<br>16.45 | TLD 40<br>16.94 | TLD 61<br>15.58 | TLD 65<br>13.89 |

PIC data converted to mR per standard quarter compared to the 4th Quarter co-located 2008 TLD data.

**CALIBRATION OF AIR SAMPLER VOLUME METERS**

The Shop Services and Instrumentation Division of SCE performs an annual calibration procedure 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. In 2008, one (1) gas meter failed to meet this criterion at all calibrated flow rates and one gas meter was inoperable. A review of the affected gross beta data has revealed no meaningful anomalies. Thus no discernable impact to the REMP database or conclusions resulted from use of the out of tolerance gas meter.

## TABLE C-1

## ANALYTICS CROSS-CHECK PROGRAM SUMMARY

| Sample Number | Quarter / Year | Sample Media | Analyte / Nuclide | Units | Reported Value | Known Value | Ratio E-LAB/ Analytics[1] | Evaluation |
|---|---|---|---|---|---|---|---|---|
| E5827-278 | 1st/2008 | Cartridge | I-131 | pCi | 63 | 60 | 1.05 | Acceptable |
| E5828-278 | 1st/2008 | Milk | Sr-89 | pCi/L | 96.70 | 95.8 | 1.01 | Acceptable |
| E5828-278 | 1st/2008 | Milk | Sr-90 | pCi/L | 9.32 | 12.9 | 0.72 | Not Acceptable |
| E5829-278 | 1st/2008 | Milk | I-131 | pCi/L | 61.8 | 60 | 1.03 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Ce-141 | pCi/L | 255 | 249 | 1.02 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Cr-51 | pCi/L | 331 | 359 | 0.92 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Cs-134 | pCi/L | 107 | 125 | 0.85 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Cs-137 | pCi/L | 151 | 146 | 1.03 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Co-58 | pCi/L | 72.9 | 70.8 | 1.03 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Mn-54 | pCi/L | 98.7 | 94.2 | 1.05 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Fe-59 | pCi/L | 106 | 102 | 1.04 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Zn-65 | pCi/L | 142 | 137 | 1.03 | Acceptable |
| E5829-278 | 1st/2008 | Milk | Co-60 | pCi/L | 240 | 236 | 1.01 | Acceptable |
| E5830-278 | 1st/2008 | Water | I-131 | pCi/L | 77.3 | 70.4 | 1.10 | Acceptable |
| E5830-278 | 1st/2008 | Water | Ce-141 | pCi/L | 191.3 | 198 | 0.97 | Acceptable |
| E5830-278 | 1st/2008 | Water | Cr-51 | pCi/L | 279.2 | 286 | 0.98 | Acceptable |
| E5830-278 | 1st/2008 | Water | Cs-134 | pCi/L | 96.1 | 99.7 | 0.96 | Acceptable |
| E5830-278 | 1st/2008 | Water | Cs-137 | pCi/L | 114.8 | 116 | 0.99 | Acceptable |
| E5830-278 | 1st/2008 | Water | Co-58 | pCi/L | 58.9 | 56.4 | 1.05 | Acceptable |
| E5830-278 | 1st/2008 | Water | Mn-54 | pCi/L | 80.4 | 75 | 1.07 | Acceptable |
| E5830-278 | 1st/2008 | Water | Fe-59 | pCi/L | 86.1 | 81.4 | 1.06 | Acceptable |
| E5830-278 | 1st/2008 | Water | Zn-65 | pCi/L | 110.7 | 109 | 1.02 | Acceptable |
| E5830-278 | 1st/2008 | Water | Co-60 | pCi/L | 194.8 | 188 | 1.04 | Acceptable |
| E5945-278 | 2nd/2008 | Cartridge | I-131 | pCi | 87.5 | 84.5 | 1.04 | Acceptable |
| E5946-278 | 2nd/2008 | Milk | Sr-89 | pCi/L | 61.14 | 85 | 0.72 | Not Acceptable |
| E5946-278 | 2nd/2008 | Milk | Sr-90 | pCi/L | 11.82 | 14.5 | 0.82 | Acceptable |

[1] The acceptable ratio is ± 25% of the known value.

## TABLE C-1

## ANALYTICS CROSS-CHECK PROGRAM SUMMARY

| Sample Number | Quarter / Year | Sample Media | Analyte / Nuclide | Units | Reported Value | Known Value | Ratio E-LAB/ Analytics[1] | Evaluation |
|---|---|---|---|---|---|---|---|---|
| E5947-278 | 2nd/2008 | Milk | I-131 | pCi/L | 72.9 | 71.4 | 1.02 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Ce-141 | pCi/L | 166 | 174 | 0.95 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Cr-51 | pCi/L | 151.5 | 138 | 1.1 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Cs-134 | pCi/L | 73.8 | 76.7 | 0.96 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Cs-137 | pCi/L | 122 | 116 | 1.05 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Co-58 | pCi/L | 64.4 | 61.9 | 1.04 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Mn-54 | pCi/L | 153.0 | 135 | 1.13 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Fe-59 | pCi/L | 92 | 91.7 | 1.00 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Zn-65 | pCi/L | 128 | 127 | 1.01 | Acceptable |
| E5947-278 | 2nd/2008 | Milk | Co-60 | pCi/L | 103 | 104 | 0.99 | Acceptable |
| E5948-278 | 2nd/2008 | Water | I-131 | pCi/L | 40.9 | 45.3 | 0.90 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Ce-141 | pCi/L | 222.0 | 237 | 0.94 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Cr-51 | pCi/L | 212.0 | 188 | 1.13 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Cs-134 | pCi/L | 100.0 | 104 | 0.96 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Cs-137 | pCi/L | 169.0 | 158 | 1.07 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Co-58 | pCi/L | 85.6 | 84.2 | 1.02 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Mn-54 | pCi/L | 193.0 | 184 | 1.05 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Fe-59 | pCi/L | 129.0 | 125 | 1.03 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Zn-65 | pCi/L | 194.0 | 172 | 1.13 | Acceptable |
| E5948-278 | 2nd/2008 | Water | Co-60 | pCi/L | 155.0 | 142 | 1.09 | Acceptable |
| E6254-278 | 3rd/2008 | Cartridge | I-131 | pCi | 93.80 | 89.1 | 1.05 | Acceptable |
| E6255-278 | 3rd/2008 | Milk | Sr-89 | pCi/L | 63.10 | 73.9 | 0.85 | Acceptable |
| E6255-278 | 3rd/2008 | Milk | Sr-90 | pCi/L | 9.25 | 11 | 0.84 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | I-131 | pCi/L | 69.1 | 67.9 | 1.02 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Ce-141 | pCi/L | 159 | 161 | 0.99 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Cr-51 | pCi/L | 392 | 421 | 0.93 | Acceptable |

[1] The acceptable ratio is ± 25% of the known value.

## TABLE C-1

## ANALYTICS CROSS-CHECK PROGRAM SUMMARY

| Sample Number | Quarter / Year | Sample Media | Analyte / Nuclide | Units | Reported Value | Known Value | Ratio E-LAB/ Analytics[1] | Evaluation |
|---|---|---|---|---|---|---|---|---|
| E6256-278 | 3rd/2008 | Milk | Cs-134 | pCi/L | 213 | 232 | 0.92 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Cs-137 | pCi/L | 154 | 162 | 0.95 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Co-58 | pCi/L | 167 | 179 | 0.93 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Mn-54 | pCi/L | 172.00 | 166 | 1.03 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Fe-59 | pCi/L | 157 | 144 | 1.09 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Zn-65 | pCi/L | 327 | 319 | 1.03 | Acceptable |
| E6256-278 | 3rd/2008 | Milk | Co-60 | pCi/L | 227 | 234 | 0.97 | Acceptable |
| E6257-278 | 3rd/2008 | Water | I-131 | pCi/L | 115 | 105 | 1.09 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Ce-141 | pCi/L | 114 | 107 | 1.07 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Cr-51 | pCi/L | 317 | 279 | 1.14 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Cs-134 | pCi/L | 147 | 154 | 0.96 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Cs-137 | pCi/L | 116 | 107 | 1.08 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Co-58 | pCi/L | 119 | 118 | 1.01 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Mn-54 | pCi/L | 126 | 110 | 1.15 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Fe-59 | pCi/L | 109 | 95.6 | 1.14 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Zn-65 | pCi/L | 228 | 211 | 1.08 | Acceptable |
| E6257-278 | 3rd/2008 | Water | Co-60 | pCi/L | 155 | 155 | 1.00 | Acceptable |

[1] The acceptable ratio is ± 25% of the known value.

# APPENDIX D

# COMPARISON OF OPERATIONAL TO PREOPERATIONAL DATA AND ANALYSIS OF TRENDS

## 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 2008 operational data obtained for SONGS Units 2/3, which is the subject post-operational period for SONGS Unit 1.

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

| | | | |
|---|---|---|---|
| A. | External Radiation | F. | Ocean Bottom Sediments |
| B. | Air Particulates | G. | Marine Species |
| C. | Radioiodine | H. | Local Crops |
| D. | Ocean Water | I. | Soil |
| E. | Shoreline Sediment (sand) | J. | Kelp |
| | | K. | 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 2008 operational data are possible for each of the exposure pathways to man, namely: (1) direct radiation, (2) air particulates (inhalation), and (3) ocean water (waterborne). 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.

Overall, the preoperational data are much 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. See Figures 2A, 2B, 3A, 3B, 3C and 4. There are no adverse trends.

### A. Direct Radiation

*SONGS Units 2/3:*

Direct radiation measurements for the SONGS REMP were made quarterly at 38 indicator locations and 11 control locations in 2008. (See Appendix I for ISFSI TLD data). Direct radiation samples (TLDs) were collected 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 millirem. 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 2008 operational year for Units 2/3, the routine indicator TLD locations ranged

from 10.38 to 28.45 millirem, averaging 16.94 millirem while the control locations ranged from 11.72 to 19.86 millirem with an average of 15.50 millirem.

Factors such as meteorology, geographic location, the fallout from atmospheric nuclear weapons testing, and seasonal fluctuations account for the variability in the data seen 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 fission products from previous nuclear weapons tests.

The average direct radiation doses were larger at both indicator and control locations during the preoperational period than during the 2008 operational period for SONGS Units 2/3. The larger average observed during the preoperational time span may be attributable to Chinese atmospheric nuclear weapons tests on March 14, 1978 and on October 15, 1980. The large average of the annual direct radiation levels seen at most TLD sample locations during 1986 and 1987 is attributable to the Chernobyl Nuclear Power Plant accident that occurred April 26, 1986.

Figure 2A and 2B compares the environmental radiation levels of selected indicator and control locations. Simultaneous variation in the radiation levels at both the control and indicator locations show that the variations are due to factors external to SONGS. The operation of SONGS had no impact on the environment as measured by this sample medium.

## B. Air Particulates

*SONGS Units 2/3:*

From January 1979 through July 1982 (considered to be the preoperational period for SONGS Units 2/3), there is a period of 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 are attributable to the Chinese atmospheric nuclear weapons test conducted on October 15, 1980.

Figures 3A, 3B, and 3C compare the monthly average gross beta particulate in air activity levels of selected indicator locations with the control location over a period of 32 years (January 1976 to December 2008). The data clearly show a close correlation between the indicator and control locations for the entire time period covered. The various spike increases in gross beta activity at all sample locations are closely grouped and timed to coincide with known events external to SONGS with worldwide radiological impact. These events include: Chinese atmospheric nuclear weapons testing on September 17, 1977; March 14, 1978; October 15, 1980; and the April 1986 Chernobyl accident. The graphs (Figures 3A, 3B and 3C) show that the environmental levels of gross beta remained substantially similar at both the indicator and the control locations over an extended period of time, with both control and indicator locations showing simultaneous variations of equal magnitude. The fluctuations in gross beta activity are not attributable to SONGS and are the result of other environmental phenomena and seasonal variations.

## C. Radioiodine

*SONGS Units 2/3:*

Most of the preoperational and all of the 2008 operational data for I-131 level were below the detection limit.

## D. Ocean Water

*SONGS Units 2/3:*

Ocean water samples were collected on a monthly basis in the vicinity of each of the Station discharge outfalls, which served as indicator locations, and from the Newport Beach control location. The ocean water samples are analyzed for naturally-occurring and station-related gamma-emitting radionuclides. They are 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-l34, and Cs-137 were detected in an ocean water sample collected from the SONGS Unit l 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.

Tritium was detected in three indicator ocean water samples during 2008. The data for all other SONGS related radionuclides at all other ocean water locations during the 2008 operational period were below both the *a priori* LLD and the lower *a posteriori* MDC. We conclude that the operation of SONGS had a negligible impact on the environment as measured by this sample medium.

## E. Shoreline Sediments (Sand)

*SONGS Units 2/3:*

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 2008 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 2008 operational period. Thus the

impact of SONGS on the environment as measured by the sample medium is considered to be negligible.

## F. Ocean Bottom Sediments

*SONGS Units 2/3*:

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. The results of the analyses are listed in Table D-1B.

SONGS-related radionuclides were also detected in samples collected during 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.

The results 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 2008 was below the *a posteriori* MDC. We conclude that operation of SONGS Units 2/3 has had a negligible impact upon this environmental medium.

## TABLE D-1A

## SHORELINE SEDIMENTS CONCENTRATION (pCi/g, wet weight)
## PREOPERATIONAL AND OPERATIONAL DATA*
## SONGS UNITS 2/3

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide**** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Cs-137 | PreOp | 0.012-0.022 | 0.019 | <LLD-0.032 | <LLD |
| All other measured SONGS related radionuclides | PreOp | < LLD | < LLD | < LLD | < LLD |
| | Operational | < LLD | < LLD | < LLD | < LLD |

## TABLE D-1B

## OCEAN BOTTOM SEDIMENTS CONCENTRATION (pCi/g, wet weight)
## PREOPERATIONAL AND OPERATIONAL DATA*
## SONGS UNITS 2/3

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Mn-54 | PreOp | 0.0150-0.49 | 0.129 | <LLD | <LLD |
| Co-58 | PreOp | 0.013-1.160 | 0.199 | <LLD | <LLD |
| Co-60 | PreOp | 0.014-8.100 | 0.788 | <LLD | <LLD |
| Ag-110m | PreOp | <LLD-0.020 | <LLD | <LLD | <LLD |
| Cs-137 | PreOp | 0.014-0.090 | 0.039 | <LLD-0.043 | <LLD |
| Cs-137 | Operational | <LLD | <LLD | <LLD | <LLD |
| Ce-144 | PreOp | 0.060-0.260 | 0.160 | <LLD | <LLD |
| All other measured SONGS related radionuclides | PreOp | < LLD | < LLD | < LLD | < LLD |
| | Operational | < LLD | < LLD | < LLD | < LLD |

***** **PreOp = January 1979 to July 1982; Operational - January to December 2008**
****** **During January to December 2008 all station related Radionuclides from all sample locations were < LLD**
**LLD** **Lower limits of detection for operational data are listed in Appendix B.**

## G. Marine Species (Flesh)

*SONGS Units 2/3:*

Non-migratory marine species were collected semi-annually near SONGS to determine the amount of radioactivity that could be consumed by man or that was present in the food chain to man. Marine species caught by the SONGS outfalls and from Laguna Beach include two species of adult fish, crustacea 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/gram wet weight.

Results for several marine species for both the preoperational and 2008 operational periods for Units 2/3 are summarized in Table D-2. The marine species used for purposes of comparison include: sheephead (a fish), Blacksmith, black perch (a fish), bay mussel (a mollusk), spiny lobster (a crustacea), and keyhole limpet (a mollusk). Radionuclides analyzed but not included in Table D-2 were below the lower limits of detection for both the preoperational and operational periods.

During the 2008 operational period, no SONGS related radionuclides were detected at either the *a priori* LLD or the lower *a posteriori* MDC. The data indicate no accumulation trends. The operation of SONGS Units 2/3 in 2008 had no impact on the environment as measured by this sample medium.

## TABLE D-2

## MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND 2008 OPERATIONAL DATA (SONGS UNITS 2/3)*

**Sheephead Flesh****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Co-58 | PreOp | 0.016-0.030 | 0.023 | <LLD | <LLD |
| Co-60 | PreOp | 0.005-0.044 | 0.017 | <LLD | <LLD |
| Ag-110m | PreOp | <LLD-0.004 | <LLD | <LLD | <LLD |
| Cs-137 | PreOp | 0.004-0.018 | 0.007 | 0.005-0.012 | 0.007 |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related radionuclides | Operational | < LLD | < LLD | < LLD | < LLD |

**Black Perch Flesh****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Co-58 | PreOp | 0.009-0.011 | 0.010 | <LLD | <LLD |
| Co-60 | PreOp | 0.004-0.045 | 0.017 | <LLD | <LLD |
| Ag-110m | PreOp | 0.002-0.009 | 0.006 | <LLD | <LLD |
| Cs-137 | PreOp | 0.003-0.015 | 0.008 | 0.004-0.014 | 0.009 |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related radionuclides | Operational | < LLD | < LLD | < LLD | < LLD |

* **PreOp = January 1979 to July 1982; Operational = January to December 2008. The species collected in 2008 were Bay Mussel, California Mussel, Black Perch, Blacksmith, Kelp Bass, Sheephead, and Spiny Lobster.**

** **During January to December 2008 all station related Radionuclides from all sample locations were < LLD**

**LLD** **Lower limits of detection for operational data are listed in Appendix B.**

## TABLE D-2

## MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND 2008 OPERATIONAL DATA (SONGS UNITS 2/3)*

**Bay Mussel Flesh****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Mn-54 | PreOp | 0.009-0.025 | 0.017 | <LLD | <LLD |
| Co-58 | PreOp | 0.008-0.080 | 0.028 | -- | -- |
| Co-60 | PreOp | 0.005-0.40 | 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 measured SONGS related radionuclides | PreOp | < LLD | < LLD | < LLD | < LLD |
| | Operational | --- | --- | --- | --- |

**Spiny Lobster Flesh****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Co-58 | PreOp | 0.007-0.270 | 0.086 | <LLD | <LLD |
| Co-60 | PreOp | 0.014-0.210 | 0.060 | <LLD | <LLD |
| Cs-137 | PreOp | 0.005-0.011 | 0.008 | 0.040-0.015 | 0.008 |
| All other measured SONGS related radionuclides | PreOp | < LLD | < LLD | < LLD | < LLD |
| | Operational | < LLD | < LLD | < LLD | < LLD |

* **PreOp = January 1979 to July 1982; Operational = January to December 2008. The species collected in 2008 were Bay Mussel, California Mussel, Black Perch, Blacksmith, Kelp Bass, Sheephead, and Spiny Lobster.**

** **During January to December 2008 all station related Radionuclides from all sample locations were < LLD**

**LLD** **Lower limits of detection for operational data are listed in Appendix B.**

## TABLE D-2

## MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND 2008 OPERATIONAL DATA (SONGS UNITS 2/3)*

**Sea Hare Flesh****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Co-57 | PreOp | 0.006-0.017 | 0.009 | <LLD | <LLD |
| Co-58 | PreOp | 0.006-12.4 | 1.233 | <LLD | <LLD |
| Co-60 | PreOp | 0.016-2.000 | 0.448 | 0.003-0.027 | 0.013 |
| Zn-65 | PreOp | <LLD-0.10 | <LLD | <LLD | <LLD |
| Ag-110m | PreOp | 0.018-0.50 | 0.138 | 0.020-0.039 | 0.030 |
| Cs-137 | PreOp | <LLD-0.004 | <LLD | <LLD-0.005 | <LLD |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related radionuclides | Operational | --- | --- | --- | --- |

**Keyhole Limpet (Flesh)****

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Co-58 | PreOp | 0.007-0.101 | 0.054 | <LLD-0.190 | <LLD |
| Co-60 | PreOp | 0.021-0.040 | 0.033 | <LLD-0.022 | 0.022 |
| Ag-110m | PreOp | 0.033-0.101 | 0.054 | 0.005-0.042 | 0.022 |
| Cs-137 | PreOp | <LLD | <LLD | <LLD-0.005 | <LLD |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related Radionuclides | Operational | --- | --- | --- | --- |

* **PreOp = January 1979 to July 1982; Operational = January to December 2008**
** **Sea Hare and Keyhole Limpet samples were not collected in 2008**
**LLD** **Lower limits of detection for operational data are listed in Appendix B.**

## H. Local Crops

*SONGS Units 2/3:*

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.

In the 2008 operational period, only naturally occurring radionuclides were detected in the crop samples. The data indicate that the concentration of SONGS related radionuclides have decreased over time in this sample medium. This decrease is attributable to the termination of atmospheric nuclear weapons testing. The operation of SONGS had no impact on the environment as measured by this sample medium.

## I. Soil

*SONGS Units 2/3:*

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.

## J. Kelp

*SONGS Units 2/3:*

Kelp is collected semiannually from three indicator locations and from a control location situated in Laguna Beach. After collection, the samples are analyzed by gamma-spectral analysis for naturally-occurring and SONGS-related radionuclides. During 2008 four additional control sample locations were analyzed.

To assess the impact of SONGS operations on kelp, preoperational data were compared to 2008 operational data in Table D-4. 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 2008 operational period, I-131 was detected in two (2) indicator samples and ten (10) control samples. No other station related isotopes were detected in kelp samples during the 2008 operational period. Figure 4 (I-131 in Kelp) shows a close correlation between indicator and control sample locations over an extended period of time.

Although I-131 activity has been randomly detected in kelp since 1977, there is no evidence that the concentration of I-131 or other station related radionuclides in kelp is increasing near SONGS. I-131 in kelp is due to the sewer release of medical administrations, 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 location. These data support the

conclusion that during the Units 2/3 operational period, the detection of I-131 in kelp is primarily due to factors external to SONGS.

## K. Drinking Water

No plant related radionuclides were detected during the 2008 operational period. Gross beta activity was detected during both the operational and preoperational periods at both the indicator and the control locations. No trends have been noted. There is no drinking water pathway for SONGS. The operation of SONGS had no impact on the environment as measured by this sample medium.

**TABLE D-3**
**SOIL PREOPERATIONAL AND OPERATIONAL DATA* (pCi/g, dry weight)**
**SONGS UNITS 2/3**

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Sr-90 | PreOp | 0.02-0.08 | 0.044 | <LLD-0.03 | <LLD |
| Cs-137 | PreOp | 0.02-0.20 | 0.096 | <LLD-0.06 | <LLD |
| Cs-137 | Operational | < LLD-0.329 | 0.23 | 0.245 | 0.245 |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related radionuclides | Operational | < LLD | < LLD | < LLD | < LLD |

**TABLE D-4**
**KELP PREOPERATIONAL AND OPERATIONAL DATA* (pCi/g, wet weight)**
**SONGS UNITS 2/3**

| | | INDICATOR | | CONTROL | |
|---|---|---|---|---|---|
| **Radionuclide** | **Period** | **Range** | **Average** | **Range** | **Average** |
| Mn-54 | PreOp | <LLD-0.005 | <LLD | <LLD | <LLD |
| Co-60 | PreOp | 0.006-0.009 | 0.008 | <LLD | <LLD |
| Zr(Nb)-95 | PreOp | 0.014-0.090 | 0.046 | 0.018-0.053 | 0.036 |
| I-131 | PreOp | 0.006-0.024 | 0.013 | 0.008-0.030 | 0.014 |
| I-131 | Operational | <LLD-0.0492 | 0.0352 | <0.0521-0.14 | 0.0872 |
| Cs-137 | PreOp | 0.004-0.009 | 0.006 | <LLD | <LLD |
| All other measured | PreOp | < LLD | < LLD | < LLD | < LLD |
| SONGS related radionuclides | Operational | < LLD | < LLD | < LLD | < LLD |

* **PreOp = January 1979 to July 1982; Operational = January to December 2008**
**LLD Lower Limit of Detection for operational data are listed in Appendix B.**

# APPENDIX E

# DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS

# IN 2008

## 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 2008, the ODCM specified *a priori* 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 2008 ODCM deviations had no meaningful impact on the REMP database and did not compromise the validity of the reported conclusions.

# PART I TERRESTRIAL SAMPLING

### *A. WEEKLY AIR SAMPLING*

Downtime for each air sampler in 2008 due to weekly sample collection, annual preventive maintenance (PM), and the annual gas meter change out was approximately 46 minutes for each sampler.

| | |
|---|---|
| Weekly Change out: | Approximately 0.5 minutes x 52 = 26 minutes |
| Annual PM: | Approximately 15 minutes |
| Annual Gas Meter change out: | Approximately 5 minutes |

Down times in excess of 1 hour are described below for each ODCM required air sample.

**Air Sampler 1 (City of San Clemente):** No deviations were observed.

**Air Sampler 9 (State Beach Park):** No deviations were observed

**Air Sampler 12 (Former SONGS Evaporation Pond):** No deviations were observed

**Air Sampler 13 (Camp Pendleton East):** One hour of down time during 2008 due to an external power outage.

**Air Sampler 15 (Oceanside Control):** Air sampler #15 had 3.3 hours of down time due to external power outages.

**Summary of Air Sampler Corrective Actions**

The useful life of the vacuum pump motor assemblies is estimated to be five years based on the recommendation of the manufacturer and upon experience. If the internal components (motor and control valve) are replaced the useful life may be extended. During 2008 the REMP air samplers experienced no down time attributable to motor or vacuum pump assembly failure. Thus there were no avoidable air sampler deviations from the ODCM during 2008.

### *B. DIRECT RADIATION*

No deviations were observed. TLD location deviations observed during 2007 were addressed in revision 2 of the ODCM.

### *C. LOCAL CROPS*

No deviations were observed.

### *D. SHORELINE SEDIMENTS*

No deviations were observed.

### *E. DRINKING WATER*

No deviations were observed. The location deviation observed during 2007 was addressed in revision 2 of the ODCM.

### *F. SOIL*

No deviations were observed. The location deviation observed during 2007 was addressed in revision 2 of the ODCM.

## PART II MARINE SAMPLING

### *A. NON-MIGRATORY MARINE ANIMALS*

Samples were collected from the specified ODCM sample location when samples were available at that location. When the specified sample type was not available at the ODCM listed location, alternate locations were selected based on sample availability and proximity to the specified sample location. All indicator samples were obtained within two miles of the associated outfall. In some cases the indicator species is not the same as the control species due to limited availability at the indicator location. Most non-migratory marine species samples were not available at the locations specified in the ODCM. All indicator marine animal samples were collected within 2 miles of the Units 2 & 3 discharge diffusers.

### *B. OCEAN WATER SAMPLING*

No deviations were observed.

### *C. OCEAN BOTTOM SEDIMENTS*

No deviations were observed.

# APPENDIX F

# LAND USE CENSUS

## INTRODUCTION

Southern California Edison conducted the annual 2008 Land Use Census (LUC) in accordance with section 5.2 of the ODCM. The purpose of the LUC is to identify important radiological exposure pathways to humans. The LUC identifies the nearest residences, milk animals, meat animals, gardens of at least 500 square feet that produce fleshy or leafy vegetables, and other specified uses (campgrounds, employment, etc.) in each of the meteorological landward sectors within five miles of SONGS. Results are summarized in Table F-1 and F-2 at the end of this appendix.

## THE STUDY AREA

The study area includes half of the city of San Clemente (population estimated at 67,892 as of January 1, 2008), the San Clemente State Park, U.S. Marine Corps Base Camp Pendleton (MCB), San Onofre State Beach and Park, the San Clemente Ranch (now known as Seaview Farm), the former U. S. Coast Guard Station at San Mateo Point, and SONGS.

## METHODOLOGY

A review of the 2007 LUC and documentation notebook was conducted. Verification and revision of the 2007 data was accomplished by inquiry to the cognizant agency, organization, or individual possessing direct knowledge of the item being verified.

The garden census was performed by examining aerial photographs taken. The photographic image areas which appeared to correspond to likely garden locations were converted to street addresses. The corresponding residences were observed from the nearest public road to determine if a garden was present. If the entire property was not visible from the street then a garden was assumed to be present.

The closest residence was established in each sector by correspondence with cognizant authorities (City of San Clemente Planning Department and USMC Camp Pendleton). The meat and milk animal survey was performed by contacting the natural resources office on Camp Pendleton, the Orange County Agricultural Commissioner, and the County of San Diego Department of Agriculture. Information on other uses was obtained by contacting the appropriate organizations.

## DEFINITIONS

Residence is defined as any structure (single-family house, apartment, mobile home, barracks or similar unit) occupied by individual(s) for three months (2,000 hours) or longer per 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, 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 include, but are not limited to cows, goats and sheep, whose milk is used in dairy products for human consumption.

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

Leafy vegetables include, but are not limited to lettuce, cabbage, collard greens, Bok choi, sorrel, and spinach.

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

## SUMMARY OF CHANGES

1. LUC #'s R-A2 & R-R2 - Camp Mesa - Camp Mesa was occupied for all 2008.

2. LUC # R-R3 – Camp Mesa Dry Camping was occupied for 2,208 hours.

3. LUC # O-8 – Camp San Mateo Motor Pool and LUC # O-5 (Camp Horno Motor Pool) – The estimated occupancy changed to 2500 hours in 2008.

4. LUC # 23 – Christianitos Gas Station and LUC # 8 – USMC Exchange – The estimated occupancy changed to 2000 in 2008.

5. LUC # O-9 Sanitary Land Fill – the occupancy was increased per Camp Pendleton.

6. LUC # 7 SORB Clubhouse – This facility has been closed.

7. LUC # 13 and LUC # 17 – Beach Concessions – The occupancy has changed per City of San Clemente.

8. The State of California Department of Fish and Game (CFDG) did not issue commercial Kelp harvesting permits during the 2008 for kelp within the study area.

## TABLE F-1
## 2008` SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

| Units 2/3 Sector | LUC # | Residence | Miles From Unit 1 | Unit 1 Sector | Miles From U2/3 | Estimated Hours of Maximum Occupancy |
|---|---|---|---|---|---|---|
| | | | | | | |
| A | R-A1 | Camp San Mateo | 3.5 | A | 3.6 | FTR |
| | R-A2 | SONGS Camp Mesa | 0.3 | B | 0.4 | **FTR** |
| | | | | | | |
| | | | | | | |
| B | | | | | | |
| | | | | | | |
| | | | | | | |
| C | R-C2 | Camp San Onofre Fire Station | 2.4 | C | 2.4 | 3,744 |
| | R-C1 | Camp San Onofre Barracks 524101 | 2.9 | C | 2.8 | FTR |
| | | | | | | |
| D | R-D1 | Camp San Onofre Barracks | 3.0 | D | 3.0 | FTR |
| | | | | | | |
| E | R-E1 | Camp Horno Barracks | 4.2 | E | 4.1 | FTR |
| | | | | | | |
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| M | | | | | | |
| N | | | | | | |
| | | | | | | |
| P | R-P3 | San Onofre Rec Beach (SORB) | 0.8 | Q | 1.0 | FTR |
| | R-P2 | San Mateo Point Housing | 2.5 | P | 2.7 | FTR |
| | R-P1 | Cotton Point Estates | 2.5 | P | 2.7 | FTR |
| | | | | | | |
| | | | | | | |
| Q | R-Q5 | SORB Resident Employee | 0.9 | Q | 1.1 | FTR |
| | **R-Q2** | **San Onofre Mobile Homes (Construction Site)** | **1.2** | **Q** | **1.4** | **0** |
| | R-Q3 | San Mateo Point Housing | 2.5 | Q | 2.7 | FTR |
| | 11 | State park Main Offices | 3.3 | Q | 3.5 | FTR |
| | | | | | | |
| R | R-R2 | SONGS Camp Mesa | 0.3 | A | 0.4 | **FTR** |
| | R-R3 | SONGS Dry Camping PL12 | 0.6 | Q/R | 0.7 | **2208** |
| | **R-R1** | **San Onofre Mobile Homes (Construction Site)** | **1.2** | **R** | **1.3** | **0** |
| | 20 | Sea Ridge Estates | 4.4 | R | 4.5 | FTR |
| | | | | | | |
| | | | | | | |

FTR – Full Time Residence **Bolt Text** indicates changes from 2007 LUC

## TABLE F-2
## 2008 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

| Units 2/3 Sector | LUC # | Gardens | Miles From Unit 1 | Unit 1 Sector | Miles From U2/3 |
|---|---|---|---|---|---|
| | | | | | |
| A | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| B | | | | | |
| | | | | | |
| | | | | | |
| C | | | | | |
| | | | | | |
| | | | | | |
| D | | | | | |
| | | | | | |
| E | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| F | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| G | | | | | |
| | | | | | |
| | | | | | |
| H | | | | | |
| J | | | | | |
| K | | | | | |
| L | | | | | |
| M | | | | | |
| N | | | | | |
| | | | | | |
| P | G-3 | Cotton Point Estate | 2.6 | P | 2.8 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Q | G-8 | 2240 Ave. Salvador | 3.9 | Q | 4.1 |
| | G-5 | 1706 S Ola Vista | 4.2 | Q | 4.4 |
| | G-6 | 1315 S Ola Vista | 4.4 | Q | 4.6 |
| | 14 | Inactive - | 4.1 | Q | 4.3 |
| | | 3 W Ave San Antonio | | | |
| | 16 | Inactive - | 3.9 | Q | 4.1 |
| | | 147 W Junipero | | | |
| | | | | | |
| R | G-10 | SONGS Garden | 0.3 | B | 0.4 |
| | | | | | |
| | | | | | |

FTR – Full Time Residence **Bolt Text** indicates changes from 2007 LUC

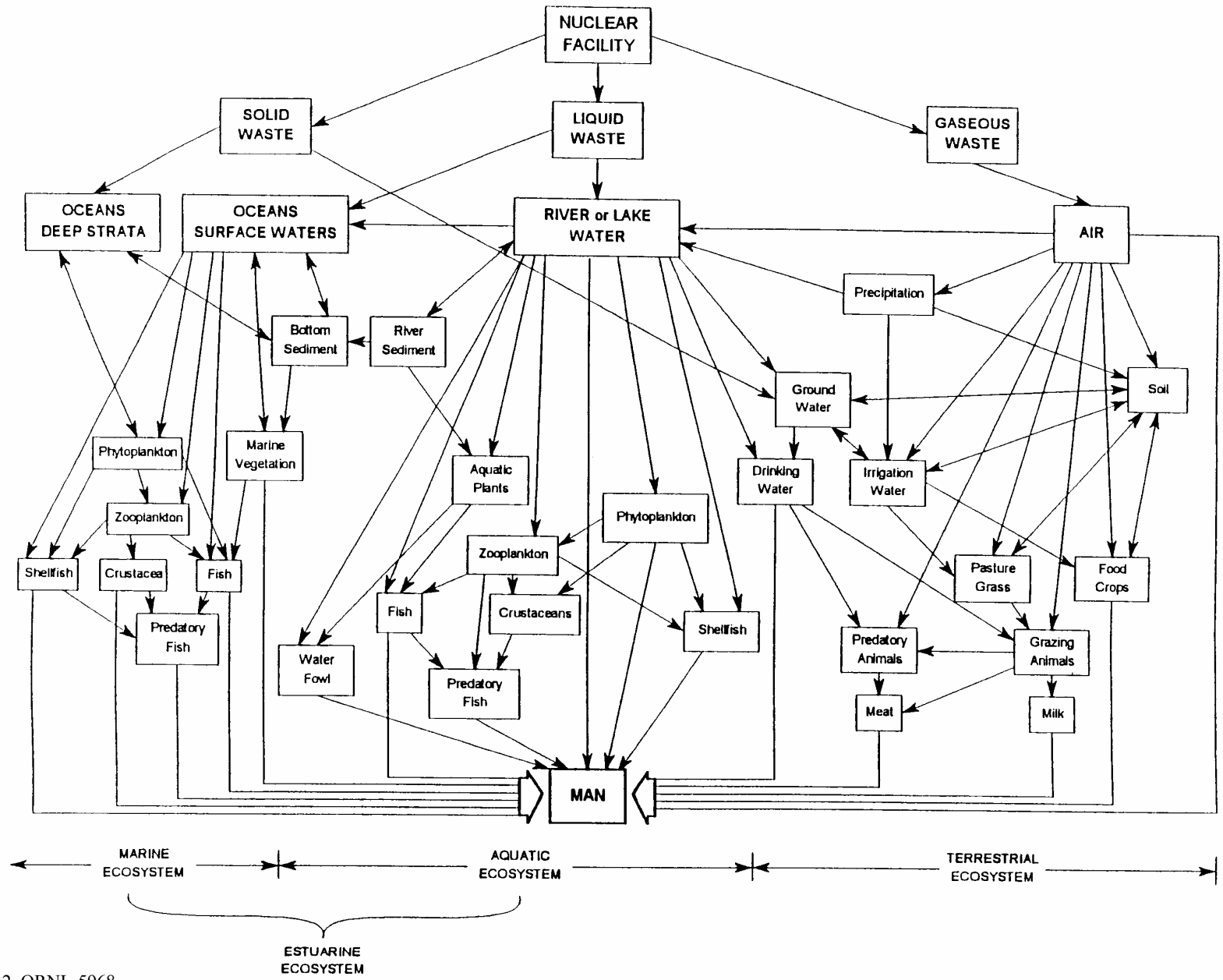
# TABLE F-3
# 2008 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

| Units 2/3 Sector | LUC # | **Other Specified Uses** | Miles From Unit 1 | Unit 1 Sector | Miles From U2/3 | Estimated Hours of Maximum Occupancy |
|---|---|---|---|---|---|---|
| | | | | | | |
| A | O-8 | Camp San Mateo Motor Pool | 3.5 | A | 3.6 | **2500** |
| | 24 | Cristianitos Fire Station | 4.8 | A | 5.0 | 3,744 |
| | 22 | SCE Land Uses | 0.3 | B | 0.4 | --- |
| | | | | | | |
| B | O-9 | USMC CP Sanitary Land Fill | 2.1 | B | 2.1 | **624** |
| | | | | | | |
| C | O-10 | Camp San Onofre (STP #11) | 2.3 | C | 2.2 | **2,000** |
| | | | | | | |
| | | | | | | |
| D | | | | | | |
| | | | | | | |
| E | O-5 | Camp Horno Motor Pool | 4.2 | E | 4.0 | **2500** |
| | | | | | | |
| | | | | | | |
| F | O-1 | San Onofre State Beach Guard Shack | 1.0 | F | 0.8 | 1,500 |
| | 31A | Border Patrol Checkpoint (NB) | 2.2 | F | 1.9 | 2,256 |
| | 31B | Hwy Patrol Weigh Sta (NB) | 2.3 | F | 2.1 | 1,960 |
| | | | | | | |
| G | O-2 | San Onofre Beach Campground | 2.0 | G | 1.8 | 720 |
| | 32 | Hwy Patrol Weigh Sta (SB) | 2.3 | G | 2.1 | 1,960 |
| | O-2A | Surf Camp (2448 hours) / Campground Host | 3.0 | G | 2.8 | 4,380 |
| | O-2B | YMCA Surf Camp | 2.1 | F | 1.9 | 288 |
| | O-2C | SurfCamp.com State Beach Surf Camp | 2.5 | G | 2.3 | 2,280 |
| | | | | | | |
| H | | | | | | |
| J | | | | | | |
| K | | | | | | |
| L | | | | | | |
| M | | | | | | |
| N | | | | | | |
| | | | | | | |
| P | O-6 | Surf Beach (Lifeguard) | 0.3 | P | 0.5 | 800 |
| | 3 | Trestles Beach Lookout Tower | 1.6 | P | 1.8 | 500 |
| | | | | | | |
| Q | O-3 | State Park Office Trailer | 0.4 | Q | 0.6 | 2,000 |
| | 5 | Surf Beach Guard Shack | 0.5 | Q | 0.7 | 1,500 |
| | **7** | **SORB Clubhouse (Closed)** | **1.0** | **Q** | **1.2** | **0** |
| | 18 | SORB Lifeguard Tower | 1.0 | Q | 1.2 | 2,000 |
| | 8 | USMC Exchange & Commissary | 1.5 | Q | 1.7 | **2,000** |
| | 9 | Basilone Road USMC Entry Gate | 1.8 | Q | 2.0 | **2,000** |
| | 12 | San Mateo Campground | 2.7 | Q | 2.9 | 4,380 |
| | 13 | Beach Concession | 3.7 | Q | 3.9 | **0** |
| | 17 | Beach Concession | 4.7 | Q | 4.5 | **575** |
| | 1A | SORB Campground Checkin | 1.1 | Q | 1.3 | 2000 |
| | | | | | | |
| R | 19 | Camp San Mateo (STP #12) | 3.5 | A | 3.7 | 2,000 |
| | 21 | Cristainitos USMC Entry Gate | 4.0 | A | 4.1 | 1,248 |
| | 23 | Cristianitos USMC Gas Station | 4.0 | A | 4.1 | **2,000** |
| | | | | | | |

FTR – Full Time Residence **Bolt Text** indicates changes from 2007 LUC

# APPENDIX G

# FIGURES FOR 2008




NuReg/CR-3332, ORNL-5968, "Radiological Assessment"

**Figure 1. Potential Radiation Exposure Pathways Leading to Man**

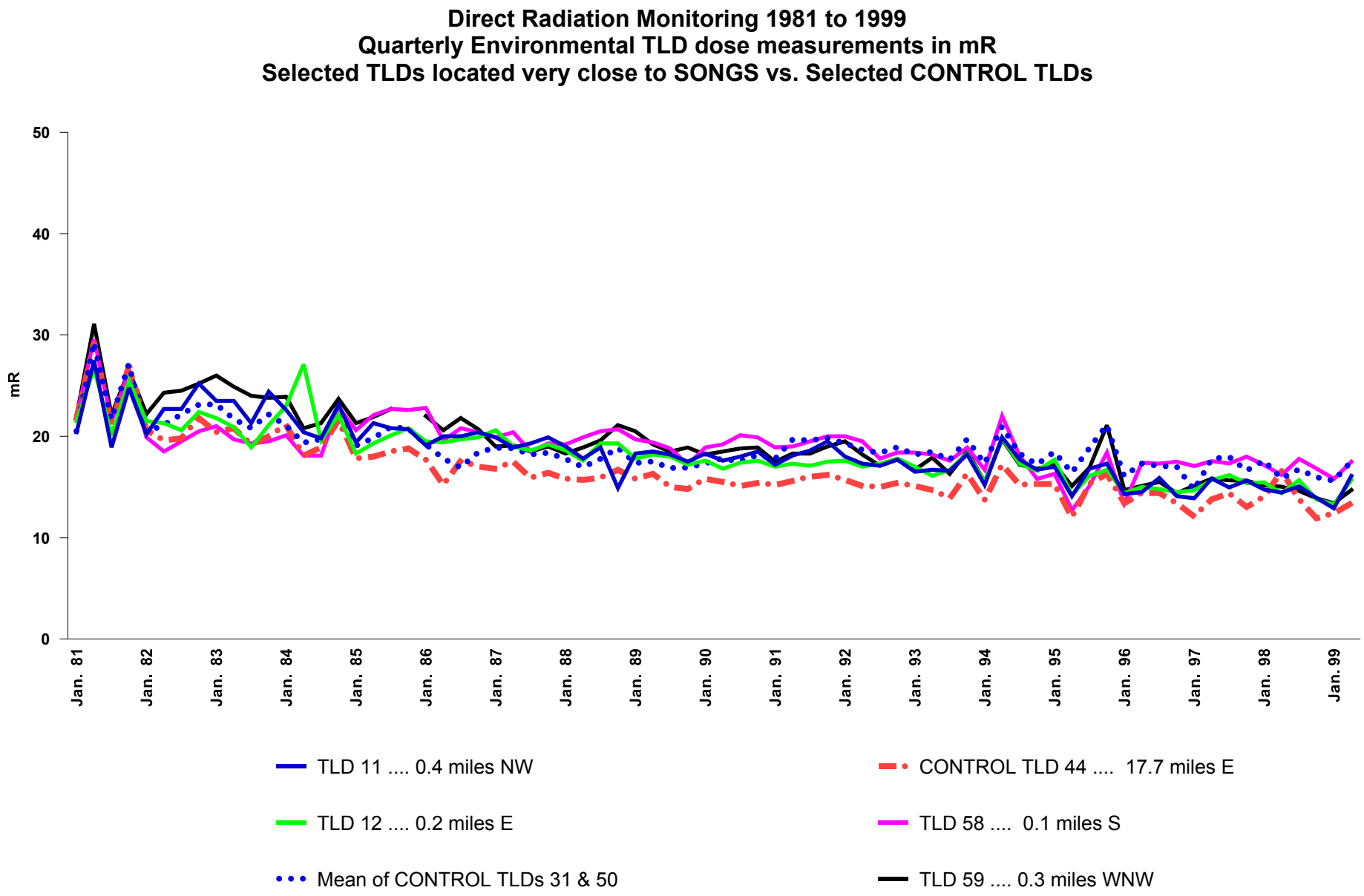

Direct Radiation Monitoring 1981 to 1999
Quarterly Environmental TLD dose measurements in mR
Selected TLDs located very close to SONGS vs. Selected CONTROL TLDs
mR
50
40
30
20
10
0
Jan. 81
Jan. 82
Jan. 83
Jan. 84
Jan. 85
Jan. 86
Jan. 87
Jan. 88
Jan. 89
Jan. 90
Jan. 91
Jan. 92
Jan. 93
Jan. 94
Jan. 95
Jan. 96
Jan. 97
Jan. 98
Jan. 99
TLD 11 .... 0.4 miles NW
CONTROL TLD 44 .... 17.7 miles E
TLD 12 .... 0.2 miles E
TLD 58 .... 0.1 miles S
Mean of CONTROL TLDs 31 & 50
TLD 59 .... 0.3 miles WNW

**Figure 2A**

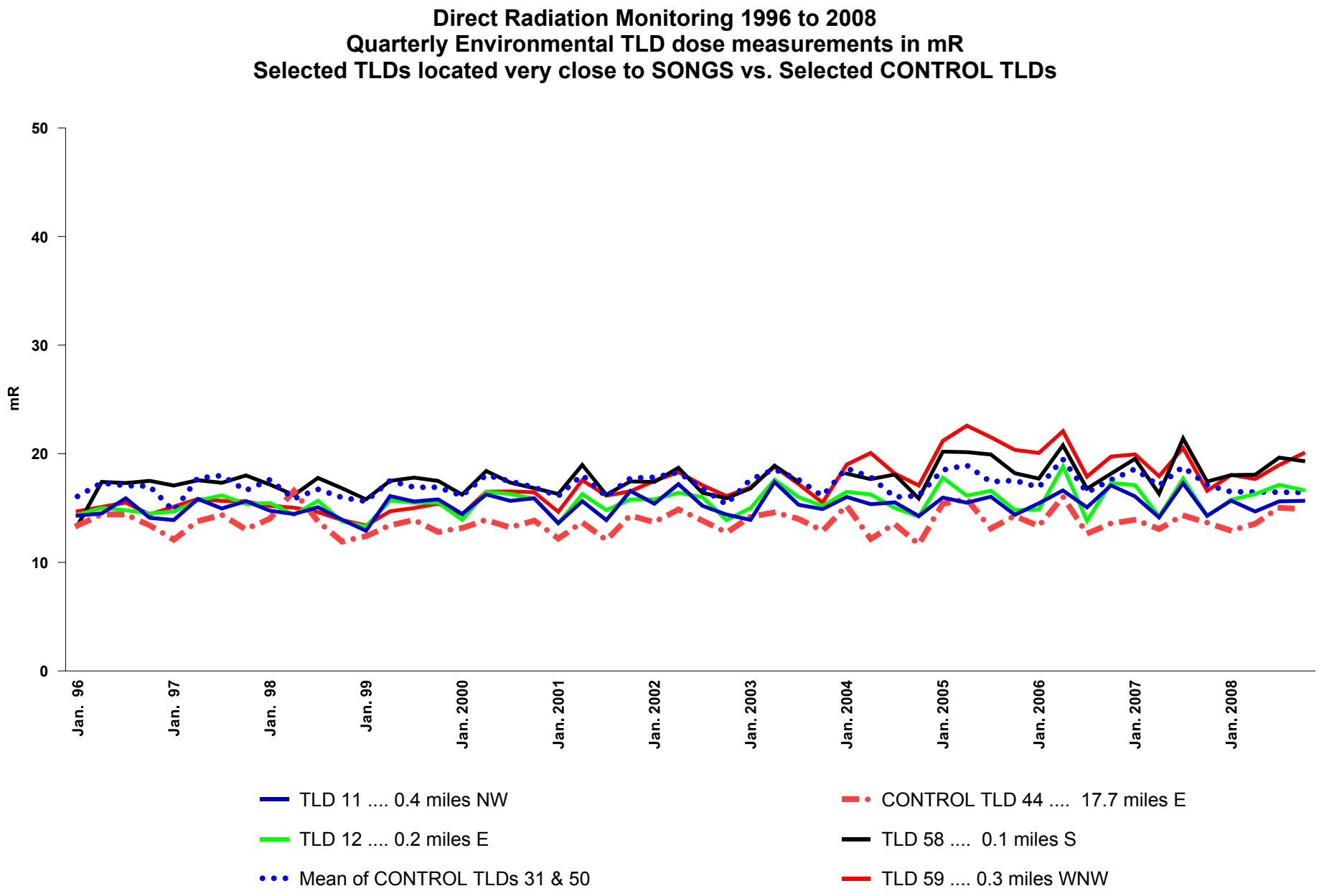

Direct Radiation Monitoring 1996 to 2008
Quarterly Environmental TLD dose measurements in mR
Selected TLDs located very close to SONGS vs. Selected CONTROL TLDs
mR
50
40
30
20
10
0
Jan. 96
Jan. 97
Jan. 98
Jan. 99
Jan. 2000
Jan. 2001
Jan. 2002
Jan. 2003
Jan. 2004
Jan. 2005
Jan. 2006
Jan. 2007
Jan. 2008
TLD 11 .... 0.4 miles NW
TLD 12 .... 0.2 miles E
Mean of CONTROL TLDs 31 & 50
CONTROL TLD 44 .... 17.7 miles E
TLD 58 .... 0.1 miles S
TLD 59 .... 0.3 miles WNW

**Figure 2B**

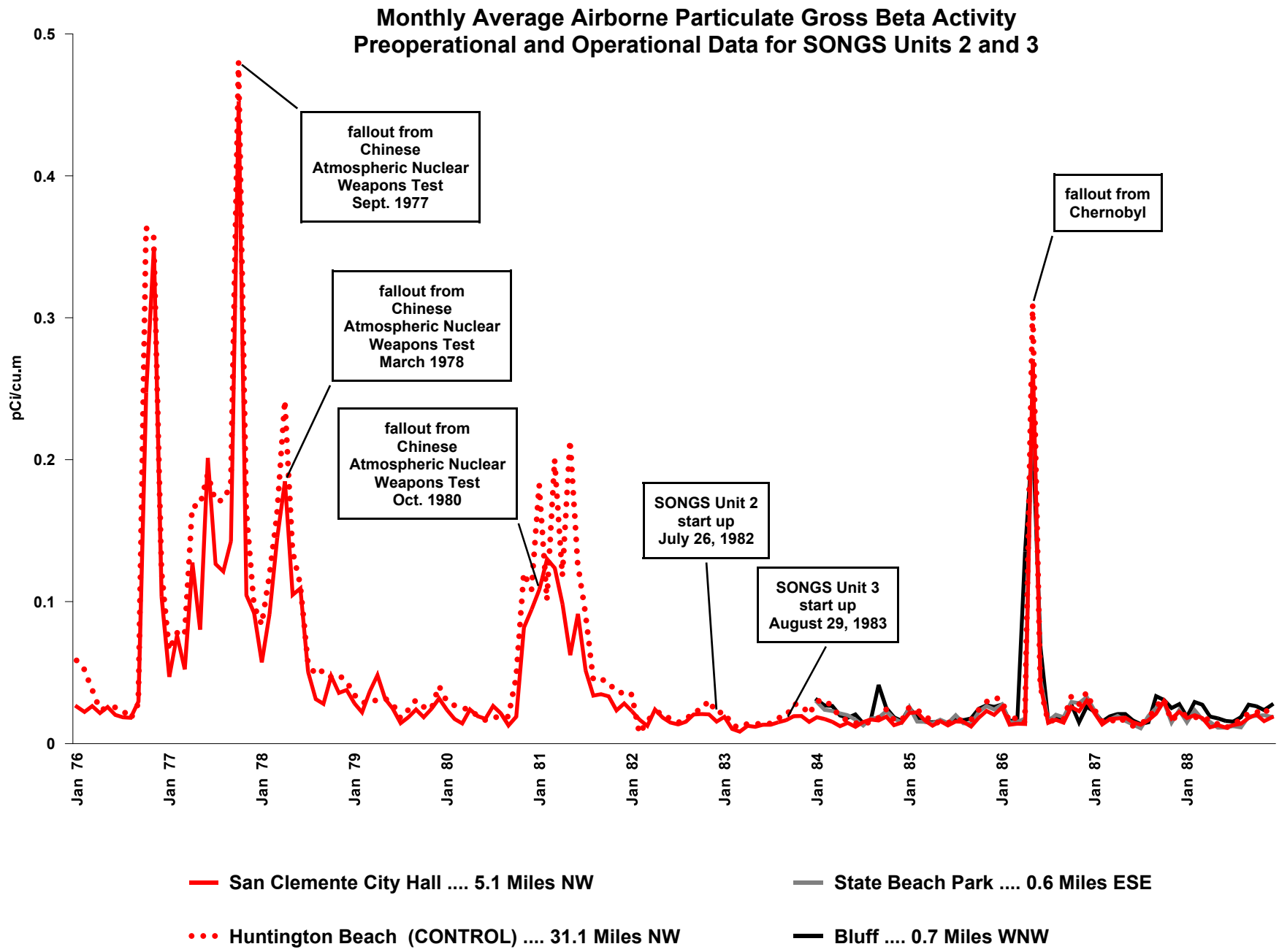

Monthly Average Airborne Particulate Gross Beta Activity
Preoperational and Operational Data for SONGS Units 2 and 3
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
fallout from Chinese Atmospheric Nuclear Weapons Test Sept. 1977
fallout from Chinese Atmospheric Nuclear Weapons Test March 1978
fallout from Chinese Atmospheric Nuclear Weapons Test Oct. 1980
SONGS Unit 2 start up July 26, 1982
SONGS Unit 3 start up August 29, 1983
fallout from Chernobyl
Jan 76
Jan 77
Jan 78
Jan 79
Jan 80
Jan 81
Jan 82
Jan 83
Jan 84
Jan 85
Jan 86
Jan 87
Jan 88
San Clemente City Hall .... 5.1 Miles NW
State Beach Park .... 0.6 Miles ESE
Huntington Beach (CONTROL) .... 31.1 Miles NW
Bluff .... 0.7 Miles WNW

Figure 3A

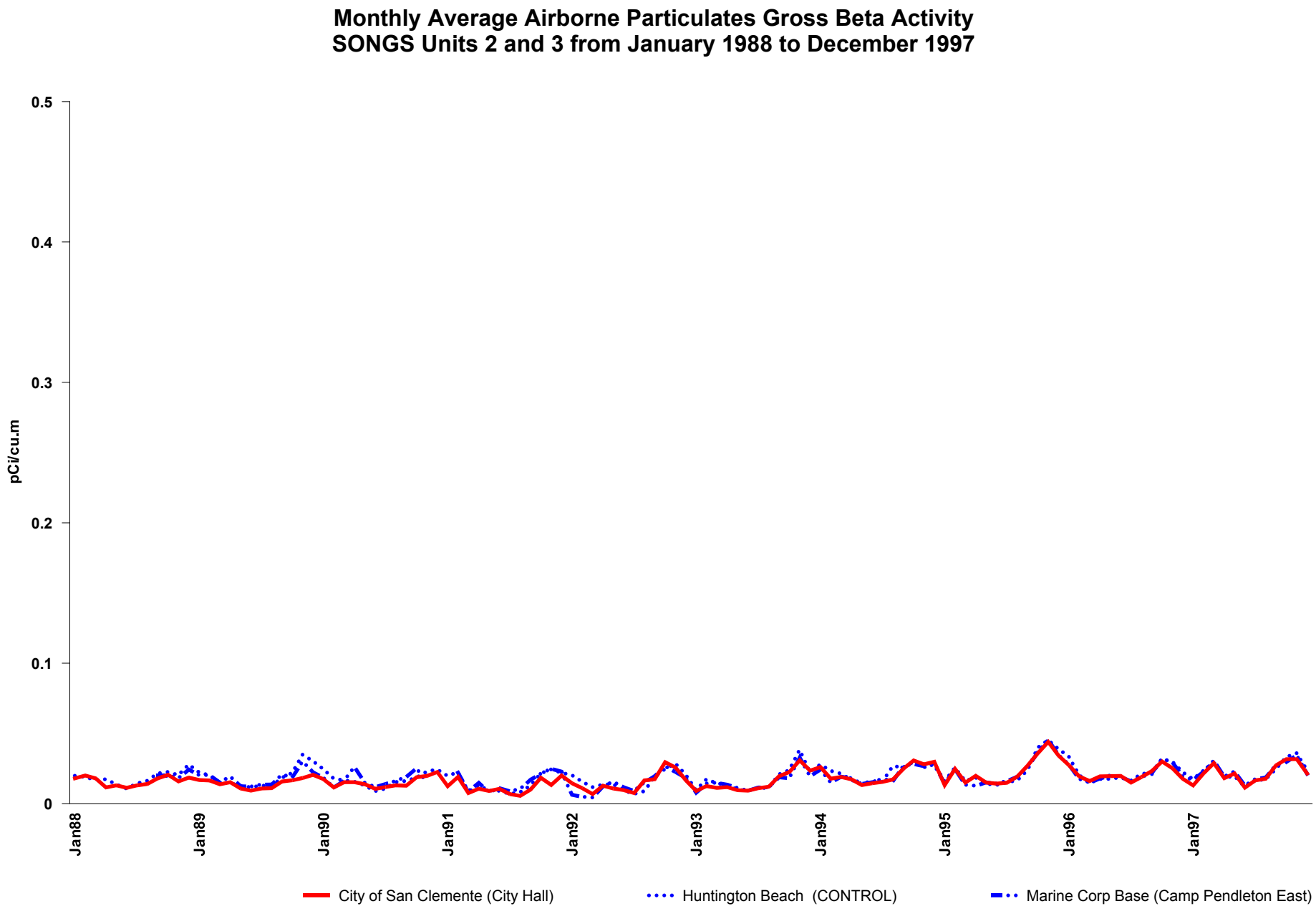

Monthly Average Airborne Particulates Gross Beta Activity
SONGS Units 2 and 3 from January 1988 to December 1997
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
Jan88
Jan89
Jan90
Jan91
Jan92
Jan93
Jan94
Jan95
Jan96
Jan97
City of San Clemente (City Hall)
Huntington Beach (CONTROL)
Marine Corp Base (Camp Pendleton East)

**Figure 3B**

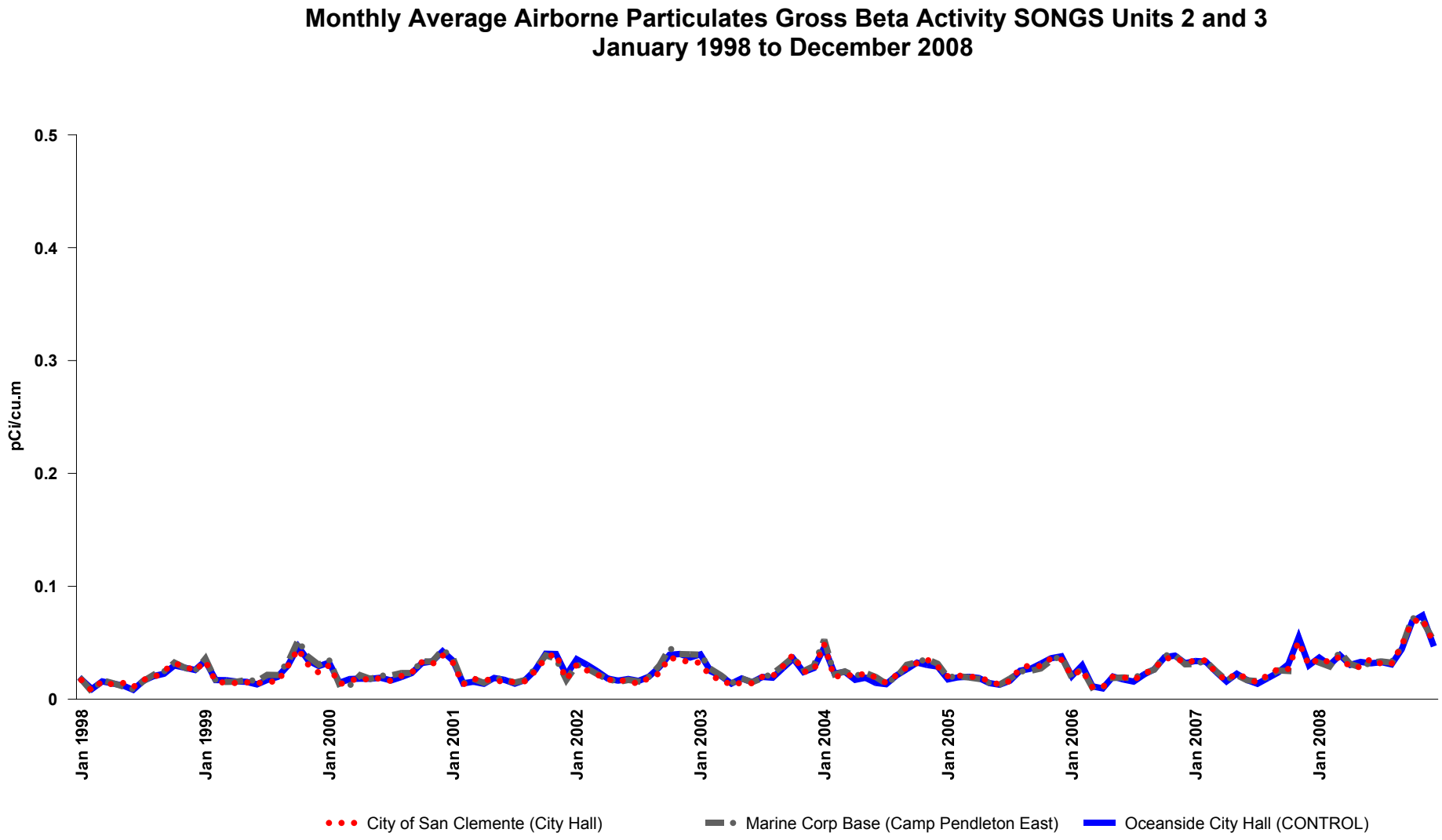

Monthly Average Airborne Particulates Gross Beta Activity SONGS Units 2 and 3
January 1998 to December 2008
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
Jan 1998
Jan 1999
Jan 2000
Jan 2001
Jan 2002
Jan 2003
Jan 2004
Jan 2005
Jan 2006
Jan 2007
Jan 2008
City of San Clemente (City Hall)
Marine Corp Base (Camp Pendleton East)
Oceanside City Hall (CONTROL)

**Figure 3C**

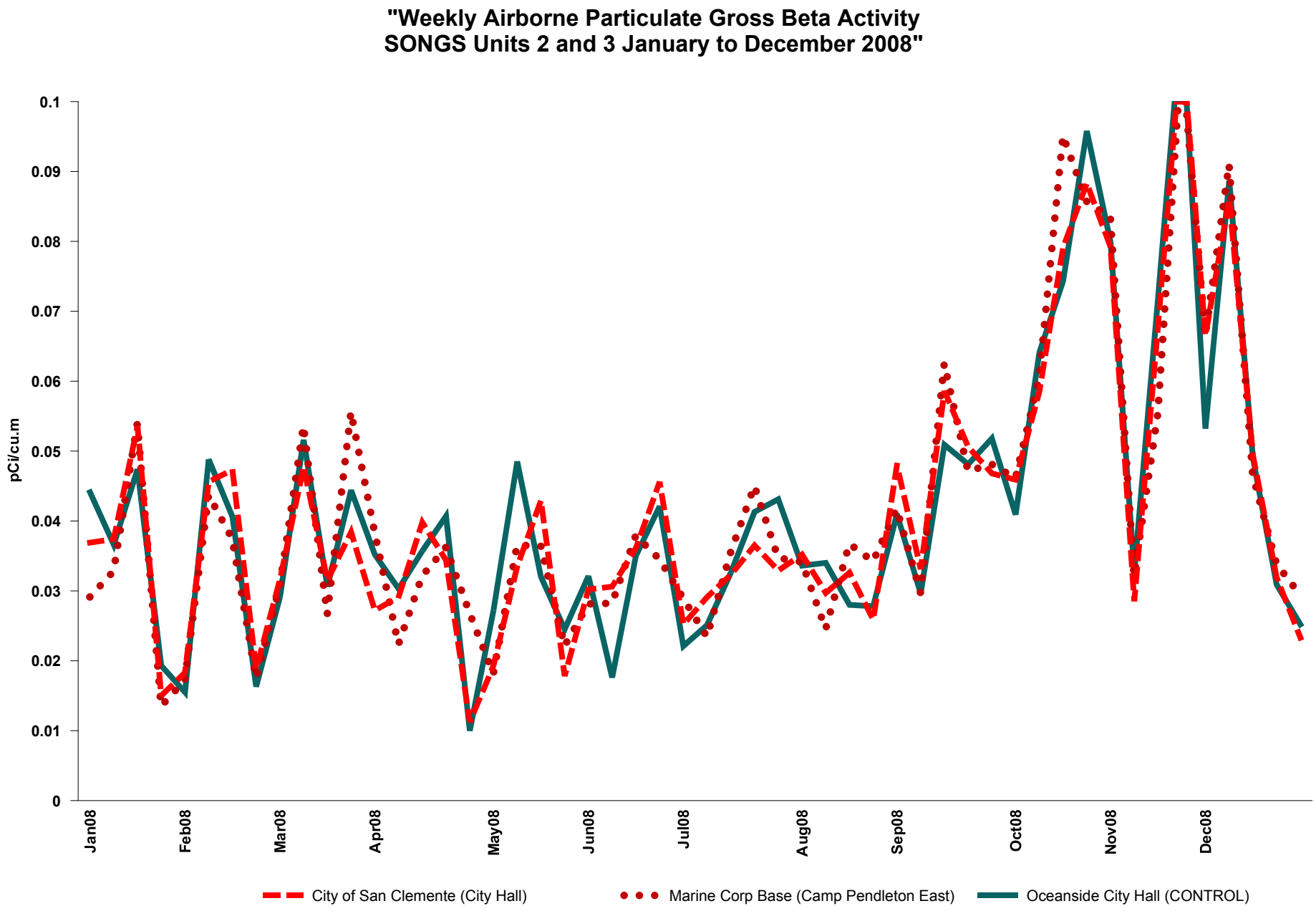

"Weekly Airborne Particulate Gross Beta Activity
SONGS Units 2 and 3 January to December 2008"
pCi/cu.m
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan08
Feb08
Mar08
Apr08
May08
Jun08
Jul08
Aug08
Sep08
Oct08
Nov08
Dec08
City of San Clemente (City Hall)
Marine Corp Base (Camp Pendleton East)
Oceanside City Hall (CONTROL)

**Figure 3D**

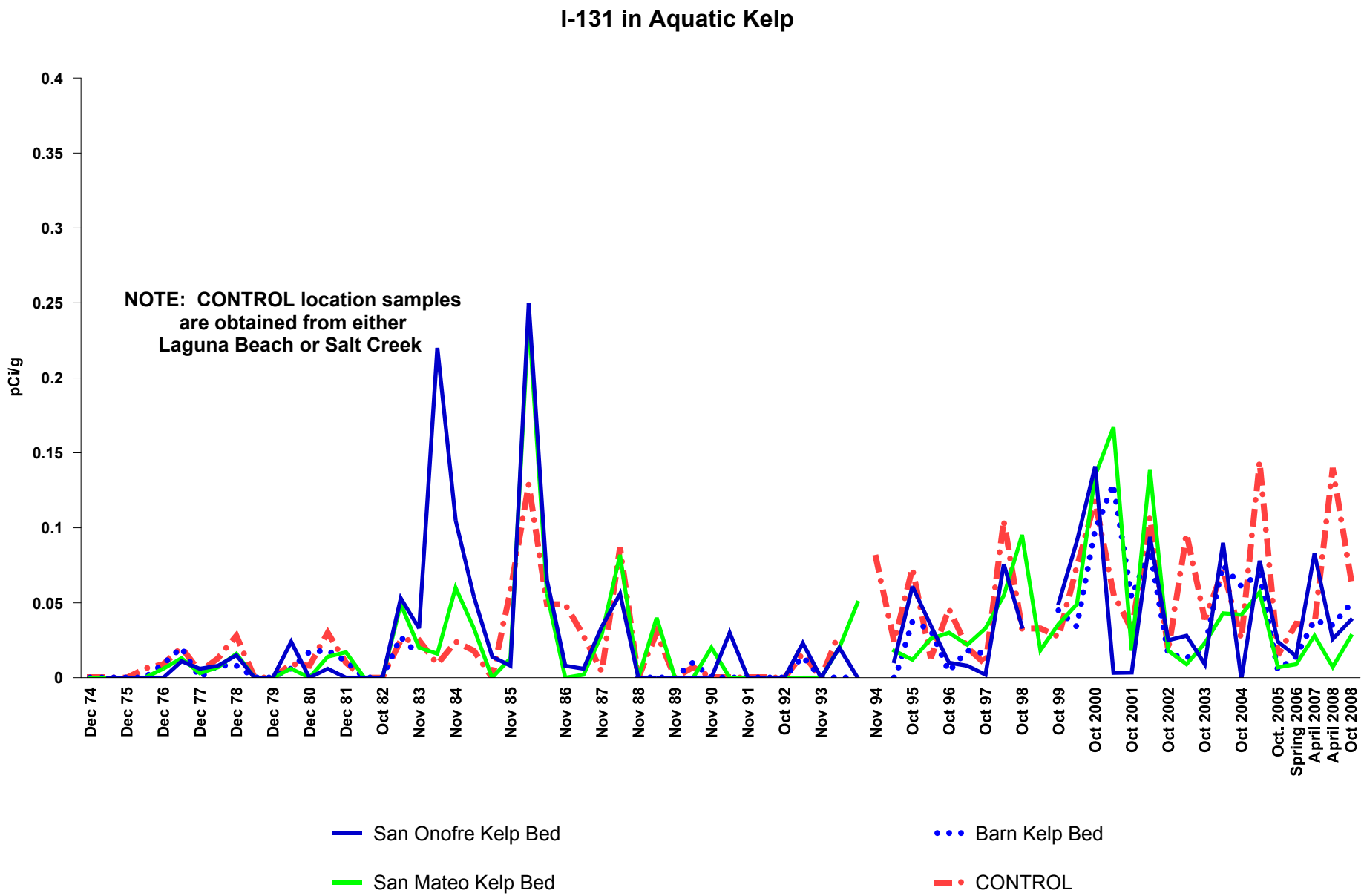

I-131 in Aquatic Kelp
pCi/g
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
NOTE: CONTROL location samples are obtained from either Laguna Beach or Salt Creek
Dec 74
Dec 75
Dec 76
Dec 77
Dec 78
Dec 79
Dec 80
Dec 81
Oct 82
Nov 83
Nov 84
Nov 85
Nov 86
Nov 87
Nov 88
Nov 89
Nov 90
Nov 91
Oct 92
Nov 93
Nov 94
Oct 95
Oct 96
Oct 97
Oct 98
Oct 99
Oct 2000
Oct 2001
Oct 2002
Oct 2003
Oct 2004
Oct. 2005
Spring 2006
April 2007
April 2008
Oct 2008
San Onofre Kelp Bed
Barn Kelp Bed
San Mateo Kelp Bed
CONTROL

**Figure 4**

## APPENDIX H

## ERRATA TO THE 2007 AREOR

All data required by the ODCM in 2007 was reported in the 2007 AREOR. There are no errata to be appended to the 2007 AREOR.

# APPENDIX I

## REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2008

## APPENDIX I

## REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2008

Requirements in the standard Technical Specifications adopted under the Technical Specifications Improvement Program include reporting results of those thermoluminescent dosimeters (TLDs) that are co-located with NRC dosimeters. The NRC no longer deploys TLDs in the environs of SONGS. Some SCE TLDs are located adjacent to the former NRC TLD locations and these SCE TLDs are listed below.

California Department of Public Health (DPH) also maintains a TLD program in the environs of SONGS.

The below listed quarterly TLD data is from the SCE TLDs adjacent to the DPH TLD programs. The NRC location numbers refer to the locations in the old NRC program.

**2008 Data from SCE TLDs**

| Location Number | Location Name | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
|---|---|---|---|---|---|
| SCE -1 , NRC -7, DPH #2 | San Clemente | 16.55 | 17.47 | 18.13 | 18.44 |
| SCE -2, NRC -23, DPH #8 | Camp San Mateo | 17.49 | 18.23 | 18.64 | 19.3 |
| SCE -3, NRC -19, DPH #9 | Camp San Onofre | 15.53 | 16.37 | 16.77 | 16.67 |
| SCE -6, DPH #10 | Old Route 101 (East-Southeast) | 11.41 | 11.56 | 12.51 | 11.3 |
| SCE 10, NRC -12, DPH #6 | San Onofre Surfing Beach | 16.23 | 16.08 | 17.94 | 16.45 |
| SCE 16, DPH #7* | ESE Site boundary | 18.36 | 17.3 | 17.2 | 18.92 |
| SCE 22, NRC 11, DPH #4 | Coast Guard Station | 16.96 | 17.29 | 18.96 | 18.97 |
| SCE -34, NRC -14, DPH #5 | San Onofre Elementary School | 16.26 | 16.28 | 16.23 | 16.54 |
| SCE 41, NRC 25, DPH #11** | Old Route 101 (Unit 3) | 14.32 | 15.14 | 16.62 | 15.46 |
| SCE 50, NRC 32, DPH #13 | Oceanside Fire Station | 15.17 | 15.94 | 16.66 | 16.83 |

* SCE 16 is approximately 15 meters from DHS 7. DHS 7 is across Basilone Rd.
** SCE 41 is approximately 120 meters from DHS 11. Results included per DHS request.

# Appendix J

# ISFSI (Independent Spent Fuel Storage Installation) TLD Data

## ISFSI (Independent Spent Fuel Storage Installation) TLD Data

Per 10 CFR 72.126, SONGS implemented an environmental 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. The pre-operational TLDs data are compared to the data obtained after the commencement of spent fuel storage in the ISFSI for the purposes of estimating the additional dose potentially attributable to the operation of the ISFSI.

Environmental dose rates are variable. The REMP TLD data show a seasonal variability that does not appear to be related to any activities at SONGS. Data from the REMP indicator and control TLDs increase and decrease in a synchronous manner. The data support the conclusion that macro-environmental factors are the causative agents for the variations. Refer to Figure 2a and 2b. The ISFSI TLD data gathered to date appears to follow a similar seasonal variability. Refer to Figures 6-1, 6-2, and 7a. In addition to environmental factors some non-ISFSI work activities at Unit 1 have elevated the pre-operational measured ISFSI TLD dose. 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 dose rates of TLDs 306 to 315. In addition, the removal of the Unit 1 reactor vessel in October 2002 caused a noticeable increase in the measured dose for TLDs 301 to 315. Refer to Tables J-1 and J-2 which list all the REMP and ISFSI TLD data within the 10 CFR 72 Controlled Area Boundary and the 10 CFR 50 EAB (Exclusion Area Boundary).

The measured dose rate for the ISFSI TLDs close to the ISFSI is consistent with the dose rate expected from radiological known work activities. The elevated dose rate from TLDs 336,337 and 338 is due to the movement of spent fuel into the ISFSI.

The TLDs close to the ISFSI foundation (TLDs 306 to 315) all showed a decrease in measured dose after the commencement of spent fuel storage in the ISFSI. Refer to Table J-1. This decrease in measured dose may be attributable to the aforementioned seasonal variability of environmental dose rates or it may be attributable to the decrease in non-ISFSI radioactive material work activity in the Unit 1 area.

In the first quarter 2004, 3 TLDs were placed on the perimeter fence 15 meters SW of the ISFSI module. These TLDs (336, 337, and 338) showed the highest measured dose in 2008. The closest publicly accessible location SW of the ISFSI is the San Onofre Beach access road. The TLDs located along the access road measured a dose indistinguishable from background in 2008.

The measured ISFSI TLD dose rate was compared to the calculated ISFSI dose rates (calculation SCE-23.0508). The measured dose rates correlate well with the calculated dose rates.

We conclude that dose attributable to the storage of spent fuel in the ISFSI is not measurable beyond the immediate area of the ISFSI and is well below regulatory limits. We further conclude that dose to a member of the general public attributable to all SONGS related radiological activities at the EAB is below 10 CFR 72.104 limits.

# TABLE J-1
# ISFSI TLD DATA

| ISFSI TLD Number Location | 2001 | 2002 | | | | 2003 | | | | 2004 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr (1) | 1st Qtr | 2nd Qtr | 3rd Qtr (2) | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
| TLD 301 (3) | 17.3 | 18.42 | 17.91 | 18.51 | 24.56 | 17.23 | 18.47 | 17.09 | 17.39 | 18.86 | 18 | 17.7 | 15.49 |
| TLD 302 (3) | 20.28 | 20.67 | 19.59 | 19.46 | 125.78 | 20.32 | 20.77 | 19.3 | 21.97 | 23.57 | 26.37 | 20.02 | 19.11 |
| TLD 303 (3) | 18.96 | 18.82 | 18.26 | 18.11 | 156.89 | 20.45 | 25.74 | 26.56 | 27.06 | 28.54 | 29.98 | 24.59 | 24.72 |
| TLD 304 (3) | 18.06 | 19.1 | 18.28 | 17.95 | 64.53 | 19.57 | 28.34 | 33.25 | 31.8 | 34.72 | 33.22 | 29.74 | 28.44 |
| TLD 305 (3) | 18.99 | 20.49 | 19.68 | 19.82 | 147.33 | | | | | | | | |
| TLD 306 (3) | 17.23 | 18.56 | 16.91 | 17.07 | 29.6 | 19.03 | 19.75 | 17.3 | 17.27 | 18.85 | 17.31 | 15.7 | 16.08 |
| TLD 307 (3) | 17.34 | 19.61 | 17.68 | 17.36 | 23.35 | 24.07 | 20.3 | 16.24 | 16.82 | 18.07 | 17.62 | 15.53 | 15.11 |
| TLD 308 (3) | 18.75 | 20.11 | 18.9 | 18.68 | 27.22 | 21.82 | 21.31 | 18.35 | 18.73 | 20.55 | 21.72 | 18.11 | 15.82 |
| TLD 309 (3) | 18.74 | 23.09 | 23.43 | 24.43 | 30.53 | 21.78 | 20.49 | 18.44 | 16.85 | 20.15 | 21.44 | 18.72 | 17.34 |
| TLD 310 (3) | 19.79 | 25.82 | 23.47 | 21.49 | 25.8 | 20.74 | 19.05 | 18.96 | 17.59 | 21.17 | 21.28 | 18.19 | 17.15 |
| TLD 311 (3) | 21.29 | 29.93 | 25.33 | 26.43 | 26.61 | 25.24 | 23.59 | 21.8 | 19.99 | 19.06 | 20.43 | 18.04 | 17.52 |
| TLD 312 (3) | 21.86 | 34.08 | 28.45 | 30.07 | 26.45 | 28.46 | 27.71 | 19.88 | 16.15 | 15.5 | 13.87 | 15.23 | 13.35 |
| TLD 313 (3) | 24.95 | 36.84 | 28.78 | 26.49 | 25.44 | 25.78 | 26.34 | 25.6 | 23.4 | 22.87 | 21.14 | 20.68 | 20.0 |
| TLD 314 (3) | 20.67 | 22.28 | 20.15 | 19.58 | 18.8 | 19.74 | 20.23 | 19.3 | 19.85 | 18.84 | 19.06 | 17.68 | 15.83 |
| TLD 315 (3) | 23.37 | 25.7 | 22.77 | 22.58 | 20.82 | 24.06 | 23.18 | 22.77 | 21.49 | 20.89 | 21.36 | 19.26 | 18.13 |
| TLD 316 (4) | 16.96 | 18.81 | 17.83 | 16.29 | 18.01 | 16.72 | 17.76 | 16.01 | 14.97 | 16.68 | 19.06 | 15.15 | 14.45 |
| TLD 317 (4) | 18.07 | 19.87 | 20.62 | 17.95 | 18.43 | 16.86 | 18.82 | 17.12 | 16.02 | 17.41 | 17.51 | 16.96 | 14.94 |
| TLD 318 (4) | 17.86 | 18.91 | 19.59 | 18.4 | 18.3 | 17.62 | 19.01 | 17.72 | 16.95 | 18.15 | 18.31 | 16.34 | 16.37 |
| TLD 319 (4) | 17.78 | 19.76 | 20.01 | 19.02 | 18.35 | 19.14 | 19.54 | 18.57 | 15.88 | 17.22 | 19.19 | 16.48 | 16.54 |
| TLD 320 (4) | 17.83 | 19.39 | 19.11 | 18.34 | 18.25 | 17.78 | 19.41 | 17.8 | 16.94 | 16.36 | 19.18 | 16.34 | 15.93 |
| TLD 321 (4) | 18.52 | 19.84 | 20.45 | 18.67 | 19.41 | 19.83 | 21.1 | 18.46 | 17.82 | 18.89 | 20.8 | 16.92 | 15.5 |
| TLD 336 | | | | | | | | | | 39.12 | 31.35 | 30.77 | 24.63 |
| TLD 337 | | | | | | | | | | 36.03 | 49.65 | 65.77 | 47.51 |
| TLD 338 | | | | | | | | | | 45.83 | 38.84 | 36.06 | 30.27 |

(1) Large Component Removal and start of the long term storage of the Unit 1 Reactor Vessel.
(2) Fuel loaded into the ISFSI pad September 2003.
(3) These TLDs are in an area where radiological materials have been stored or transported.
(4) These TLDs are not in the proximity of radiological activities.

# TABLE J-1
# ISFSI TLD DATA

| ISFSI TLD Number Location | 2005 | | | | 2006 | | | | 2007 | | | | 2008 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
| TLD 301 (3) | 22.05 | 33.23 | 31.2 | 27.44 | 31.54 | 26.99 | 20.41 | 18.96 | 18.11 | 15.62 | 19.39 | 15.76 | 16.09 | 15.69 | 17.96 | 17.59 |
| TLD 302 (3) | 31.04 | 45.99 | 41 | 40.43 | 40.3 | 35.93 | 28.72 | 20.75 | 19.98 | 17.1 | 20.76 | 16.98 | 17.43 | 19.22 | 19.57 | 19.55 |
| TLD 303 (3) | 33.14 | 49.45 | 41.54 | 38.53 | 39.16 | 34.51 | 29.14 | 25.08 | 24.93 | 21.13 | 20.21 | 18.09 | 18.2 | 21.83 | 20.85 | 20.74 |
| TLD 304 (3) | 34.63 | 42.62 | 41.1 | 37.05 | 36.66 | 37.95 | 29.07 | 29.71 | 27.48 | 25.27 | 21.85 | 16.89 | 17.64 | 19.77 | 20.4 | 19.6 |
| TLD 306 (3) | 19.92 | 20.4 | 20.44 | 19.24 | 19.68 | 24.01 | 17.65 | 18.5 | 19.04 | 15.95 | 19.56 | 17.00 | 17.42 | 18.59 | 19.04 | 19.55 |
| TLD 307 (3) | 20.26 | 24.94 | 22.08 | 20.98 | 21.48 | 23.22 | 16.98 | 16.66 | 16.93 | 14.97 | 19.26 | 19.07 | 17.72 | 25.3 | 27.32 | 24.1 |
| TLD 308 (3) | 21.81 | 25.3 | 23.88 | 23.1 | 23.42 | 23.89 | 18.01 | 17.82 | 18.00 | 14.94 | 20.56 | 20.41 | 18.42 | 19.22 | 19.72 | 20.14 |
| TLD 309 (3) | 22.1 | 20.61 | 19.53 | 18.14 | 18.95 | 22.54 | 17.08 | 19.25 | 17.83 | 16.86 | 19.76 | 19.09 | 17.09 | 19.56 | 20.43 | 19.67 |
| TLD 310 (3) | 20.66 | 20.91 | 21.08 | 20.26 | 20.27 | 24.21 | 17.92 | 19.01 | 19.21 | 17.36 | 20.63 | 19.22 | 17.03 | 19.33 | 19.54 | 19.95 |
| TLD 311 (3) | 21.85 | 20.94 | 20.61 | 19.35 | 19.48 | 23.91 | 17.82 | 19.49 | 19.51 | 16.88 | 19.27 | 18.08 | 16.88 | 18.23 | 19.26 | 18.04 |
| TLD 312 (3) | 16.88 | 15.67 | 15.57 | 13.81 | 14.99 | 19.36 | 16.18 | 16.08 | 15.29 | 13.47 | 15.84 | 14.24 | 13.13 | 13.72 | 14.6 | 14.62 |
| TLD 313 (3) | 26.97 | 26.36 | 26.45 | 25.93 | 26.33 | 33.12 | 36.28 | 25.34 | 22.97 | 20.26 | 20.33 | | | | | |
| TLD 314 (3) | 21.79 | 20.26 | 20.83 | 20.05 | 20.67 | 28.09 | 45.96 | 24.18 | 18.31 | 15.54 | 17.7 | 17.12 | 15.92 | 16.31 | 17.84 | 18.8 |
| TLD 315 (3) | 22.84 | 20.28 | 20.61 | 19.65 | 20.61 | 28.62 | 36.53 | 22.32 | 18.54 | 16.36 | 18.67 | 18.36 | 16.57 | 16.91 | 17.82 | 18.52 |
| TLD 316 (4) | 19.02 | 18.62 | 19.70 | 19.50 | 19.34 | 21.30 | 14.77 | 16.59 | 17.15 | 13.08 | 16.18 | 15.76 | 14.54 | 15.08 | 17.16 | 17.54 |
| TLD 317 (4) | 20.04 | 21.48 | 21.19 | 19.89 | 21.21 | 23.92 | 17.57 | 16.77 | 17.54 | 14.28 | 17.21 | 15.88 | 15.08 | 16.02 | 17.53 | 16.71 |
| TLD 318 (4) | 21.56 | 19.82 | 19.23 | 18.44 | 19.22 | 23.38 | 16.96 | 17.93 | 20.25 | 15.77 | 20.37 | 17.59 | 17.95 | 17.15 | 18.90 | 18.58 |
| TLD 319 (4) | 20.94 | 19.42 | 19.02 | 18.13 | 18.23 | 21.76 | 15.88 | 16.45 | 19.86 | 15.11 | 18.31 | 17.52 | 16.75 | 16.99 | 18.58 | 17.58 |
| TLD 320 (4) | 21.89 | 19.91 | 20.42 | 19.54 | 20.39 | 23.05 | 17.29 | 17.10 | 19.68 | 15.64 | 18.66 | 16.89 | 17.17 | 16.73 | 18.80 | 17.51 |
| TLD 321 (4) | 21.34 | 20.15 | 20.83 | 20.12 | 20.75 | 23.67 | 17.90 | 18.03 | 20.48 | 16.71 | 18.91 | 17.94 | 17.06 | 17.38 | 19.21 | 18.39 |
| TLD 322 | | | | | | | | | | | | | | | | 17.84 |
| TLD 323 | | | | | | | | | | | | | | | | 18.14 |
| TLD 324 | | | | | | | | | | | | | | | | 21.3 |
| TLD 325 | | | | | | | | | | | | | | | | 18.37 |
| TLD 326 | | | | | | | | | | | | | | | | 21.09 |
| TLD 336 | 39.5 | 63.71 | 67.54 | 73.3 | 78.47 | 51.74 | 61.25 | 34.02 | 60.62 | 61.1 | 64.19 | | | | | |
| TLD 337 | 54.46 | 64.07 | 59.43 | 68.36 | 62.62 | 92.87 | 116.8 | 44.67 | 54.8 | 39.09 | 43.46 | | | | | |
| TLD 338 | 40.18 | 44.51 | 42.75 | 46.49 | 42.78 | 45.02 | 51.58 | 36.63 | 34.45 | 26.48 | 29.42 | | | | | |

(1) Large Component Removal and start of the long term storage of the Unit 1 Reactor Vessel.
(2) Fuel loaded into the ISFSI pad September 2003.
(3) These TLDs are in an area where radiological materials have been stored or transported.
(4) These TLDs are not in the proximity of radiological activities.

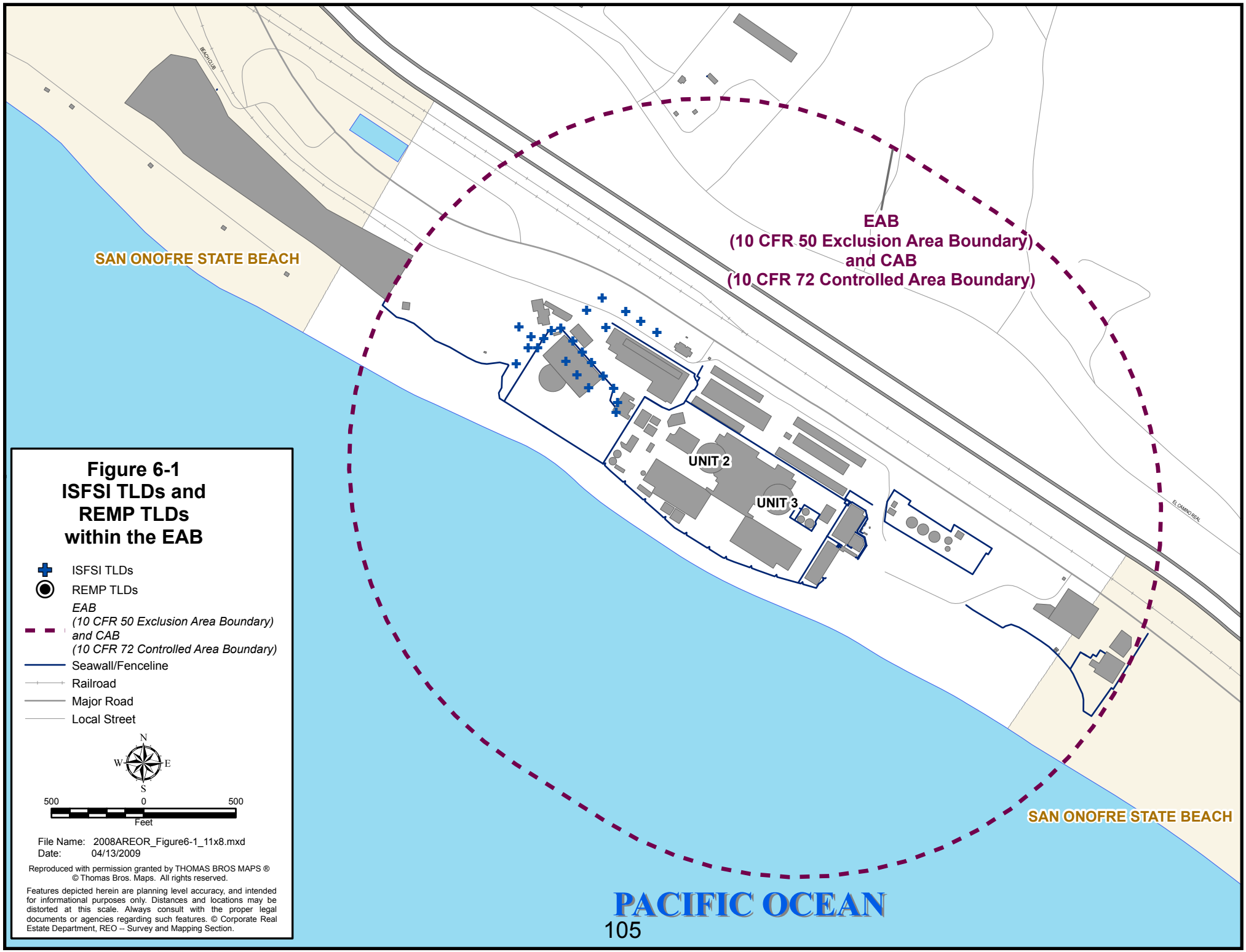
## TABLE J-2
## REMP TLDs WITHIN THE EAB

| REMP TLD Number Location | 2001 | | | | 2002 | | | | 2003 | | | | 2004 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr (1) | 1st Qtr | 2nd Qtr | 3rd Qtr (2) | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
| 11 | 13.61 | 15.63 | 13.89 | 16.57 | 15.39 | 17.2 | 15.17 | 14.38 | 13.89 | 17.43 | 15.29 | 14.93 | 16.02 | 15.35 | 15.52 | 14.26 |
| 12 | 13.59 | 16.28 | 14.81 | 15.79 | 15.75 | 16.4 | 16.01 | 13.93 | 14.96 | 17.64 | 16.04 | 15.19 | 16.49 | 16.25 | 15.01 | 14.22 |
| 13 | 28.13 | 33.16 | 38.84 | 31.06 | 31.03 | 37.64 | 38.2 | 22.62 | 27.26 | 28.38 | 33.11 | 21.08 | 21.67 | 20.34 | 22.45 | 22.84 |
| 15 | 15.63 | 18.37 | 16.07 | 17.76 | 17.32 | 20.82 | 16.79 | 15.63 | 16.52 | 19.11 | 15.44 | 16.36 | 17.37 | 16.23 | 19.52 | 16.95 |
| 16 | 17.46 | 18.16 | 19.61 | 17.66 | 17.14 | 18.25 | 17.91 | 13.61 | 15.04 | 18.48 | 17.77 | 15.53 | 19.27 | 17.62 | 16.31 | 15.37 |
| 41 | 13.51 | 16.47 | 14.3 | 14.63 | 15.24 | 17.41 | 15.13 | 13.32 | 15.98 | 16.41 | 14.32 | 15.03 | 16.26 | 14.45 | 14.85 | 13.85 |
| 55 | 17.11 | 19.37 | 15.93 | 18.98 | 20.11 | 19.89 | 17.67 | 17.84 | 18.08 | 19.86 | 18.04 | 18.2 | 20.06 | 16.67 | 18.67 | 16.72 |
| 56 | 16.39 | 19.17 | 15.57 | 18.77 | 18.11 | 20.12 | 17.31 | 17.05 | 17.84 | 19.71 | 17.11 | 17.26 | 19.12 | 17.63 | 17.63 | 16.69 |
| 57 | 15.88 | 18.51 | 16.29 | 19.19 | 17.96 | 19.09 | 16.03 | 15.8 | 16.18 | 17.44 | 16.69 | 15.85 | 17.8 | 16.64 | 15.56 | 16.69 |
| 58 | 16.29 | 18.97 | 16.22 | 17.45 | 17.4 | 18.65 | 16.39 | 15.88 | 16.75 | 18.94 | 17.39 | (3) | 18.17 | 17.66 | 18.08 | 15.88 |
| 59 | 14.65 | 17.56 | 16.14 | 16.54 | 17.45 | 18.31 | 17.12 | 16.11 | 16.88 | 18.79 | 17.23 | 15.51 | 19.0 | 20.07 | 18.18 | 17.08 |
| 73 | 22.97 | 25.29 | 22.41 | 22.71 | 22.94 | 23.48 | 24.9 | 21.47 | 22.1 | 23.91 | 22.53 | 22.47 | 23.02 | 22.02 | 23.64 | 20.67 |

(1) Large Component Removal and the start of the long term storage of the Unit 1 Reactor Vessel.
(2) Spent Fuel Storage started at the ISFSI
(3) TLD damaged; no data available.

## TABLE J-2
## REMP TLDs WITHIN THE EAB

| REMP TLD Number Location | 2005 | | | | 2006 | | | | 2007 | | | | 2008 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr |
| 11 | 15.96 | 15.49 | 16.04 | 14.38 | 15.44 | 16.62 | 15.06 | 17.08 | 16.07 | 14.14 | 17.28 | 14.29 | 15.68 | 14.68 | 15.61 | 15.66 |
| 12 | 17.79 | 16.14 | 16.59 | 14.81 | 14.87 | 18.82 | 13.82 | 17.3 | 17.12 | 14.21 | 17.7 | 14.75 | 15.76 | 16.28 | 17.14 | 16.66 |
| 13 | 24.28 | 29.32 | 25.68 | 17.95 | 23.52 | 31.94 | 34.84 | 28.16 | 32.85 | 24.77 | 27.52 | 30.7 | 28.29 | 28.45 | 24.57 | 28.26 |
| 15 | 20.94 | 19.06 | 19.29 | 17.7 | 18.84 | 20.97 | 18.69 | 20.14 | 21.28 | 18.98 | 21.51 | 18.99 | 20.06 | 20.67 | 19.78 | 21.31 |
| 16 | 22.12 | 18.18 | 17.2 | 16.16 | 15.78 | 20.39 | 19.88 | 20.84 | 22.69 | 18.43 | 19.25 | 17.58 | 18.36 | 17.3 | 17.2 | 18.92 |
| 41 | 16.66 | 17.04 | 15.45 | 14.47 | 14.76 | 17.71 | 14.95 | 15.84 | 16.12 | 14.82 | 17.12 | 14.98 | 14.32 | 15.14 | 16.62 | 15.46 |
| 55 | 21.64 | 21.73 | 19.07 | 20.51 | 20.95 | 21.69 | 18.44 | 16.78 | 19.99 | 16.64 | 20.34 | 15.34 | 18.53 | 19.4 | 18.38 | 18.89 |
| 56 | 20.66 | 21.39 | 19.59 | 18.75 | 20.7 | 22.99 | 18.84 | 17.76 | 19.5 | 16.73 | 19.76 | 15.79 | 16.78 | 19.01 | 17.75 | 18.63 |
| 57 | 21.4 | 21.79 | 19.86 | 19.1 | 18.73 | 21.63 | 17.7 | 18.41 | 20.02 | 16.89 | 21.00 | 16.84 | 18.71 | 19.37 | 18.22 | 18.69 |
| 58 | 20.19 | 20.15 | 19.93 | 18.2 | 17.71 | 20.78 | 16.78 | 18.16 | 19.53 | 16.32 | 21.4 | 17.44 | 18.03 | 18.06 | 19.64 | 19.33 |
| 59 | 21.18 | 22.58 | 21.52 | 20.35 | 20.07 | 22.08 | 17.89 | 19.74 | 19.94 | 17.93 | 20.53 | 16.59 | 18.04 | 17.67 | 18.96 | 20.03 |
| 73 | 26.83 | 24.81 | 23.35 | 22.34 | 21.12 | 23.52 | 24.27 | 25.2 | 26.60 | 22.96 | 24.05 | 20.37 | 24.05 | 22.59 | 21.95 | 22.48 |


SAN ONOFRE STATE BEACH
EAB
(10 CFR 50 Exclusion Area Boundary)
and CAB
(10 CFR 72 Controlled Area Boundary)
UNIT 2
UNIT 3
EL CAMINO REAL
SAN ONOFRE STATE BEACH
PACIFIC OCEAN
Figure 6-1
ISFSI TLDs and
REMP TLDs
within the EAB
ISFSI TLDs
REMP TLDs
EAB
(10 CFR 50 Exclusion Area Boundary)
and CAB
(10 CFR 72 Controlled Area Boundary)
Seawall/Fenceline
Railroad
Major Road
Local Street
N
W
E
S
500
0
500
Feet
File Name: 2008AREOR_Figure6-1_11x8.mxd
Date: 04/13/2009
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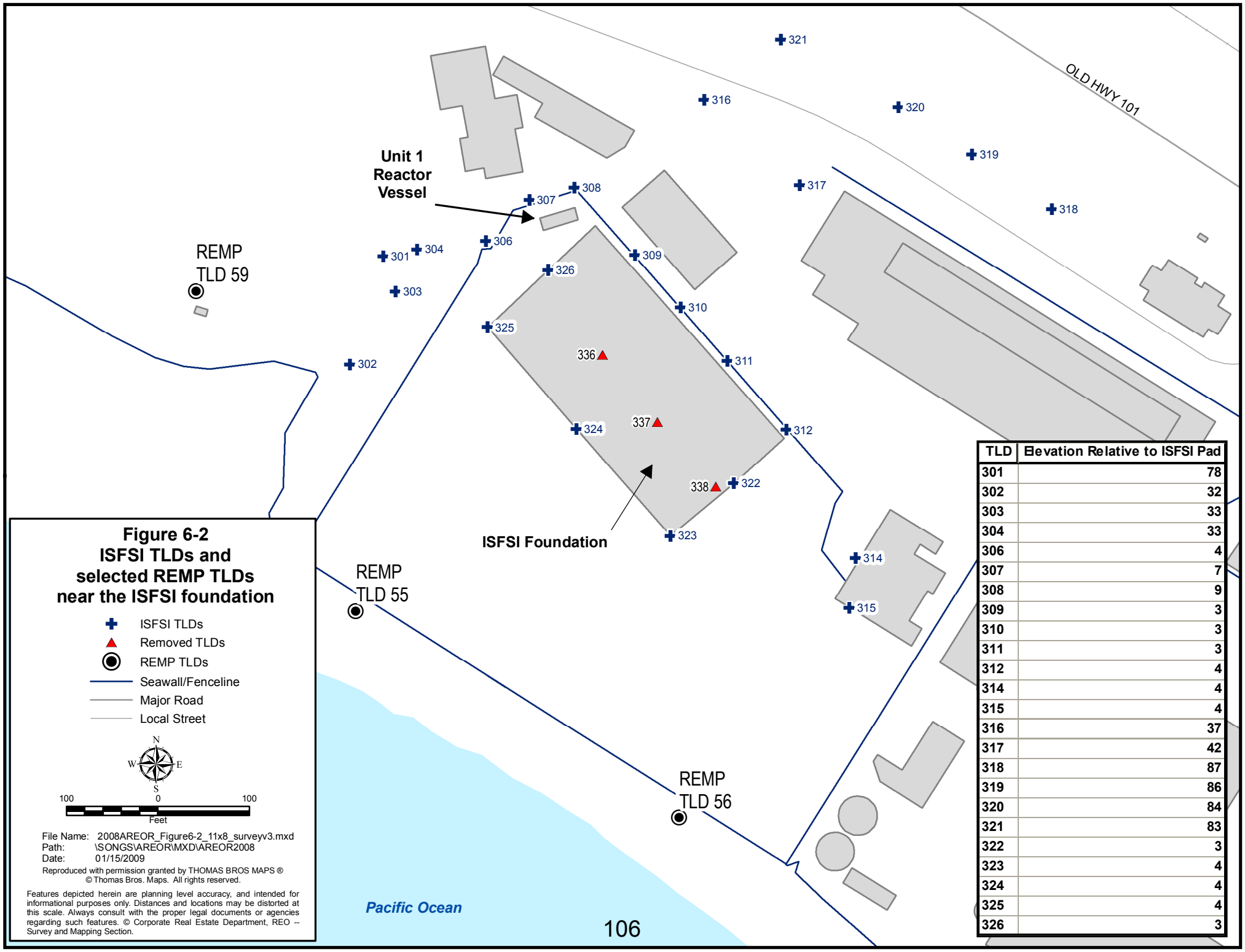


**Figure 6-2**
**ISFSI TLDs and selected REMP TLDs near the ISFSI foundation**

ISFSI TLDs
Removed TLDs
REMP TLDs
Seawall/Fenceline
Major Road
Local Street

| 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 |

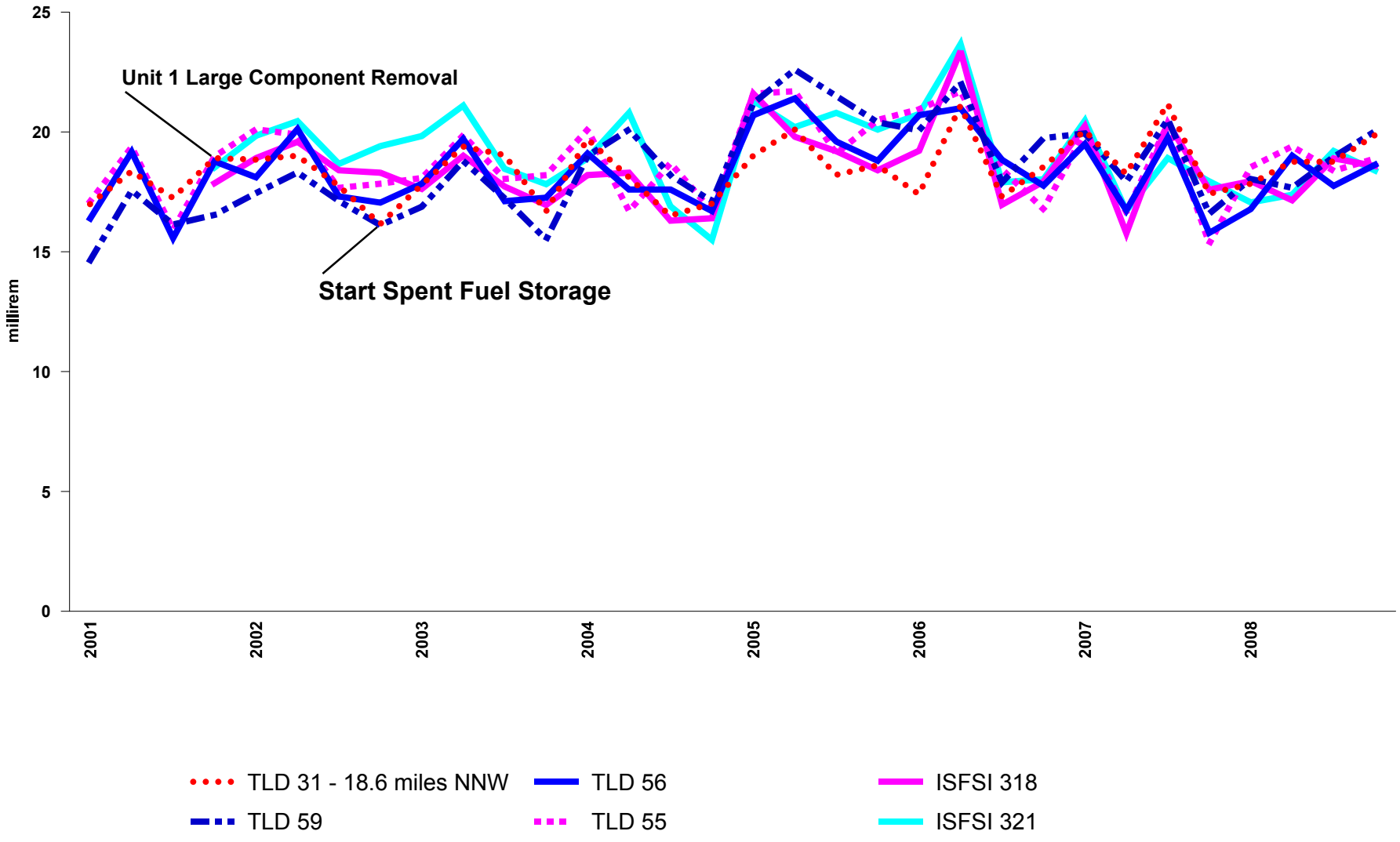
Direct Radiation Monitoring
ISFSI & Selected REMP TLDs - Quarterly Gamma Exposure (mR/ std quarter)
Unit 1 Large Component Removal
Start Spent Fuel Storage
millirem
25
20
15
10
5
0
2001
2002
2003
2004
2005
2006
2007
2008
TLD 31 - 18.6 miles NNW
TLD 56
ISFSI 318
TLD 59
TLD 55
ISFSI 321

**Figure 6A**

# Appendix K

# Local Drinking Water Wells

# Local Drinking Water Well Data

No drinking water pathway exists at SONGS.  Refer to Figures 7-1 and 7.2.

Analysis results for the protected area monitoring wells (Figure 7-2) are included in the SONGS effluent report.

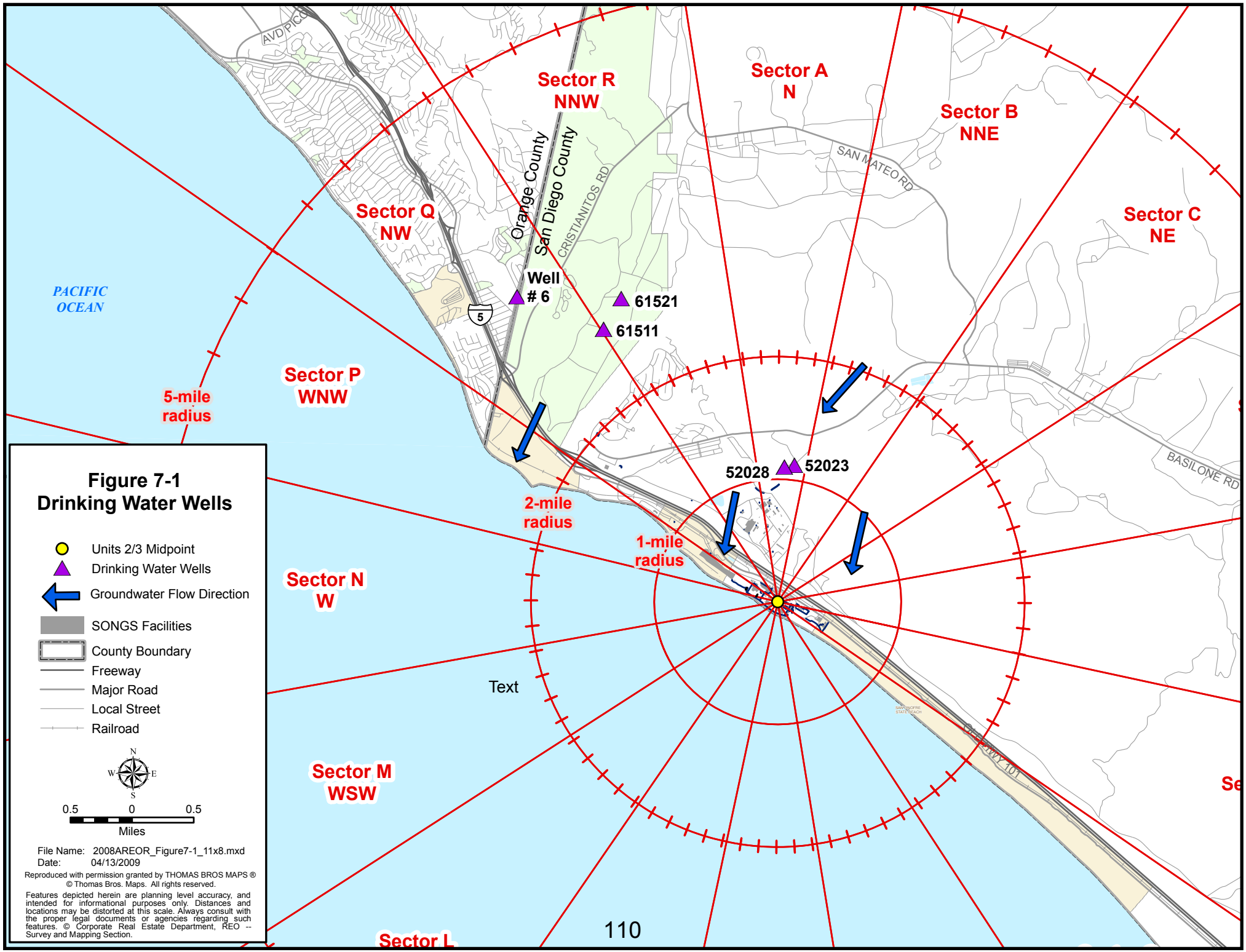


**Figure 7-1**
**Drinking Water Wells**

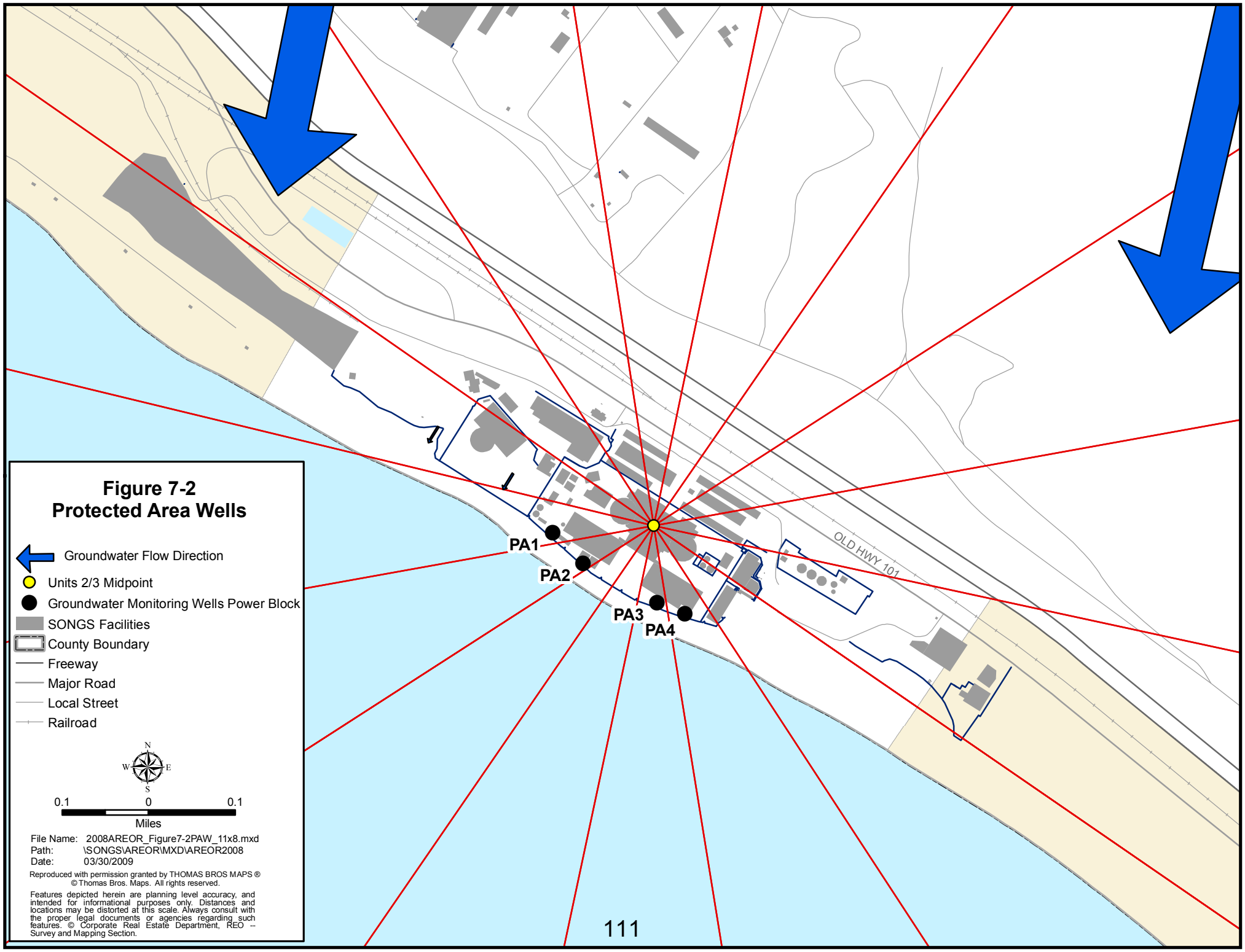
Figure 7-2
Protected Area Wells
Groundwater Flow Direction
Units 2/3 Midpoint
Groundwater Monitoring Wells Power Block
SONGS Facilities
County Boundary
Freeway
Major Road
Local Street
Railroad
N
W
E
S
0.1
0
0.1
Miles
File Name: 2008AREOR_Figure7-2PAW_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2008
Date: 03/30/2009
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PA1
PA2
PA3
PA4
OLD HWY 101