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Richard St. Onge
Director, Nuclear Regulatory Affairs and
Emergency Planning

May 14, 2013

10 CFR 50.36(a)

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

Subject: **Docket Nos. 50-206, 50-361, 50-362 and 72-41**
2012 Annual Radiological Environmental Operating Report
San Onofre Nuclear Generating Station (SONGS) Units 1, 2 and 3 and
Independent Spent Fuel Storage Facility

Dear Sir or Madam:

As required by 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 2012 Annual Radiological Environmental Operating Report (AREOR) for SONGS Units 1, 2 and 3.

The AREOR covers the operation of SONGS during January 1, 2012 through December 31, 2012 and includes summaries, interpretations, and analyses of trends of the results of the Radiological Environmental Monitoring Program.

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

This letter does not contain any commitments.

If you require any additional information, please contact, Licensing Lead, Mr. Mark Morgan, at (949) 368-6745.

Sincerely,

Enclosure as Stated

IE25
NM5526
NRR
NMSS

P.O. Box 128
San Clemente, CA 92674

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2012
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

May 2013

SOUTHERN CALIFORNIA EDISON

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2012 ANNUAL

RADIOLOGICAL ENVIRONMENTAL

OPERATING REPORT

San Onofre Nuclear Generating Station

UNITS 1, 2, & 3

Southern California Edison

An Edison International Company

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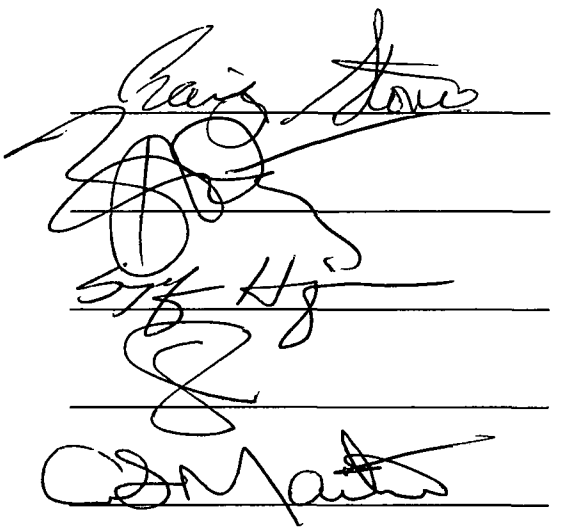

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Executive Summary

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 2012. We further conclude that dose to a member of the general public attributable to all SONGS related radiological activities is below regulatory limits.

Preparation of the 2012 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, including cesium-137 (Cs-137) in soil, as well as iodine-131 (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). These isotopes have been detected at indicator as well as control locations in past years. The naturally occurring radionuclides, including beryllium-7 (Be-7), potassium-40 (K-40), thorium-228 (Th-228), and thorium-230 (Th-230) were detected in both control and indicator locations at similar concentrations and are not related to the operation of SONGS. Refer to Appendix B for a more detailed discussion.

INTRODUCTION

SONGS consists of two pressurized water nuclear reactors housed in separate containment buildings. Unit 1 attained initial to criticality in June 1967, and was permanently retired from service in November 1992. The Unit 1 aboveground structures have been removed. Unit 2 attained initial criticality in July 1982 and Unit 3 in August 1983. Unit 2 was shut down for a planned refueling outage on January 9, 2012 and did not operate for the remainder of 2012 and Unit 3 was taken off-line after a steam generator tube leak on January 31, 2012 and not returned to service.

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 that have a potential radiation exposure pathway to a member of the general public. Thermoluminescent dosimeters (TLDs) are used to measure direct radiation levels. Sampled environmental media include soil, shoreline sediment (beach sand), air (particulate and iodine), local crops, non-migratory marine species, deer meat, 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 ODCM (Offsite Dose Calculation Manual).

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 2012 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 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.

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 fulfill the radiological environmental monitoring requirements of the ODCM.

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 selected with consideration given to site meteorology, local demography, and land uses. Refer to Appendix A for a complete list of REMP sample locations as described in Table 5-4 of the ODCM.

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

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. These limits are applicable to the sum of both liquid and gaseous effluents and direct radiation. As discussed in the 2012 SONGS Annual Radioactive Effluent Release Report, the dose to a member of the public as a result of the operation of SONGS are a small fraction of the dose standard 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 (TLDs)

  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 SCE (Southern California Edison). 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 2012 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 are expected to 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 achieved based on actual decay time, measured sample size, counting 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 2012 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 2012 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 2012 against the levels observed in preoperational 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 2012 has been negligible, and the resulting dose to a member of the general public is negligible.

REFERENCES

1. 10CFR50, Appendix I
2. Land Use Census for SONGS Units l, 2 and 3 Radiological Environmental Monitoring Program, October, 2012.
3. SONGS Offsite Dose Calculation Manual (ODCM) Revision 6, Section 5.0, 2010.
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, Camp Pendleton)	3.6	N
3	Camp San Onofre – (MCB, Camp Pendleton)	2.8	NE
4	Camp Horno – (MCB, Camp Pendleton)B	4.4	E
6	Old El Camino Real (AKA Old Highway 101)	3.0	ESE
8	Noncommissioned Officers' Beach Club	1.4	NW
10	Bluff (Adjacent to PIC #1)	0.7	WNW
11	Former Visitors' Center	0.4 **	NW
12	South Edge of Switchyard	0.2 **	E
13	Southeast Site Boundary (Bluff)	0.4 **	ESE
15	Southwest Site Boundary (Office Building)	0.1 **	SSE
16	East Southeast Site Boundary	0.4 **	ESE
19	San Clemente Highlands	4.9	NNW
22	Former US Coast Guard Station - San Mateo Point	2.7	WNW
23	SDG&E Service Center Yard	8.1	NW
31	Aurora Park - Mission Viejo	18.6	NNW
33	Camp Talega – (MCB, Camp Pendleton)	5.9	N
34	San Onofre School – (MCB, Camp Pendleton)	1.9	NW
35	Range 312 – (MCB, Camp Pendleton)	4.8	NNE
36	Range 208C – (MCB, Camp Pendleton)	4.1	NE
38	San Onofre State Beach Park	3.4	SE
40	SCE Training Center - Mesa (Adjacent to PIC #3)	0.7	NNW
41	Old Route 101 – East	0.3 **	E
44	Fallbrook Fire Station	17.7	E
46	San Onofre State Beach Park	1.0	SE
47	Camp Las Flores – (MCB, Camp Pendleton)	8.6	SE

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 4. 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)			
49	Camp Chappo – (MCB, Camp Pendleton)	12.9	ESE
50	Oceanside Fire Station (Control)	15.6	SE
53	San Diego County Operations Center	44.2	SE
54	Escondido Fire Station	31.8	ESE
55	San Onofre State Beach (U1 West)	0.2 **	WNW
56	San Onofre State Beach (U1 West)	0.2 **	W
57	San Onofre State Beach (Unit 2)	0.1 **	SW
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)	0.7	NNE
63	MCB - Camp Pendleton (Adjacent to PIC #6)	0.6	NE
64	MCB - Camp Pendleton (Adjacent to PIC #7)	0.6	ENE
65	MCB - Camp Pendleton (Adjacent to PIC #8)	0.7	E
66	San Onofre State Beach (Adjacent to PIC #9)	0.6	ESE
67	Former SONGS Evaporation Pond (Adjacent to PIC #2)	0.6	NW
68	Range 210C – (MCB, Camp Pendleton)	4.4	ENE
73	South Yard Facility	0.4 **	ESE
74	Oceanside City Hall (Backup Control)	15.6	SE
75	Gate 25 MCB	4.6	SE
76	El Camino Real Mobil Station	4.6	NW
77	Area 62 Heavy Lift Pad	4.2	N
78	Horno Canyon (AKA Sheep Valley)	4.4	ESE

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 4. Direction determined from degrees true north.

** Distances are within the Units 2/3 CAB/EAB (Controlled Area Boundary/Exclusion Area Boundary)

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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)
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
16	San Luis Rey Substation (Control)	16.7	SE
Soil Samples ***			
1	Camp San Onofre	2.8	NE
2	Old Route 101 – (East Southeast)	3.0	ESE
3	Basilone Road / I-5 Freeway Off ramp	2.0	NW
5	Former Visitors Center	0.4 **	NW
7	Prince of Peace Abbey (Control)	15	SE
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	2.0	NW
5	Oceanside City Hall (Control)	15.6	SE

* Distance (miles) and Direction (sector) are measured relative to Units 2/3 midpoint as described in the ODCM Rev. 4. Direction determined from degrees true north.
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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)
Shoreline Sediment (Beach Sand)			
1	San Onofre State Beach (Southeast)	0.6	SE
2	San Onofre Surfing Beach	0.8	WNW
3	San Onofre State Beach (Southeast)	3.5	SE
4	Newport Beach North End (Control)	29.2	NW
Local Crops			
2	Oceanside (Control)	15-25	SE to ESE
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
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	0.8	SSW
C	Unit 2 Outfall	1.6	SW
D	Unit 3 Outfall	1.2	SSW
E	Laguna Beach (Control)	17-19	NW
F	SONGS 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. 4. Direction determined from degrees true north.

** Distances are within the Units 2/3 CAB/EAB (Controlled Area Boundary/Exclusion Area Boundary)

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

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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

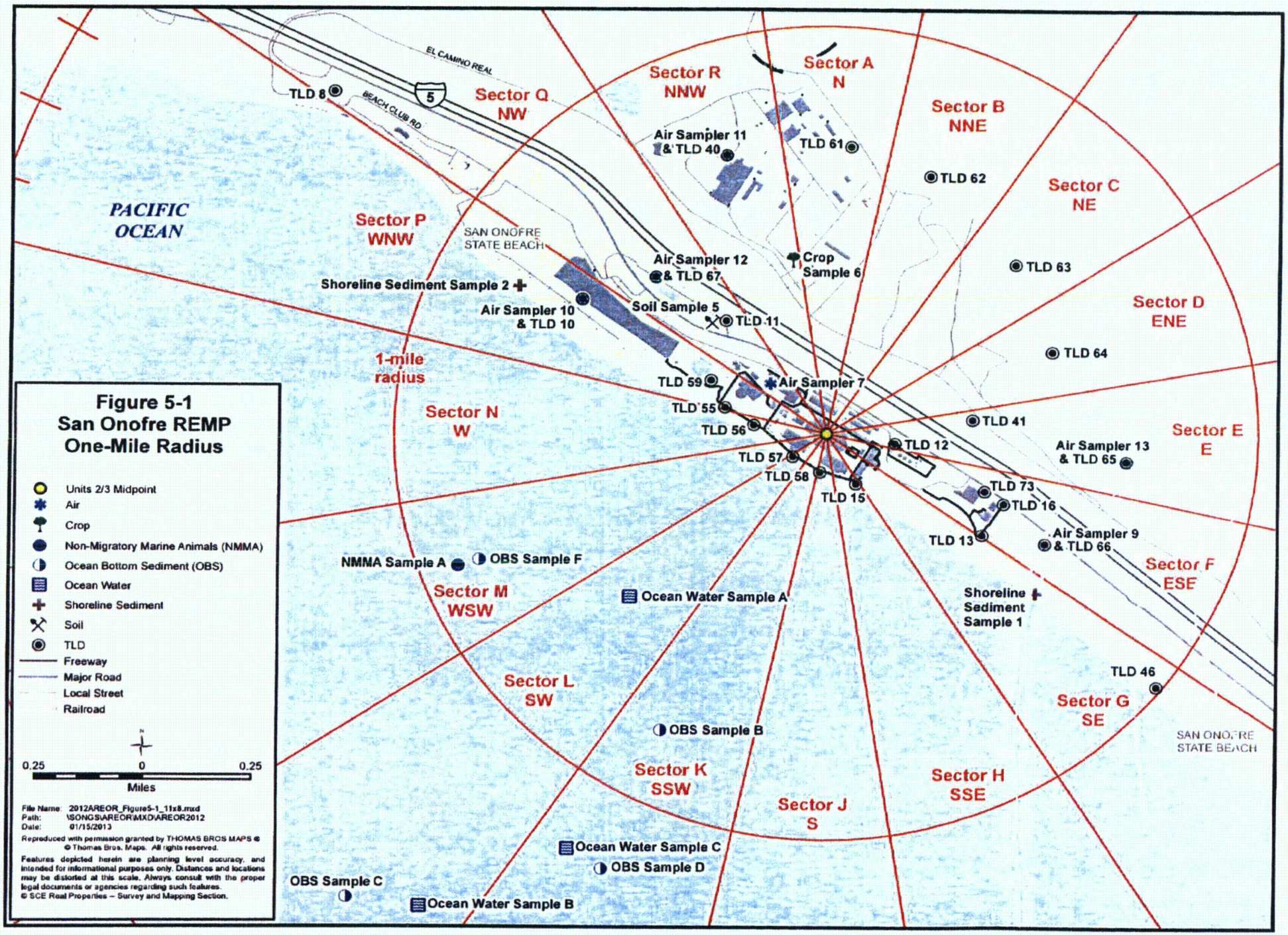
Figure 5-1
San Onofre REMP
One-Mile Radius
Units 2/3 Midpoint
Air
Crop
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Major Road
Local Street
Railroad
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0
0.25
Miles
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Date: 01/15/2013
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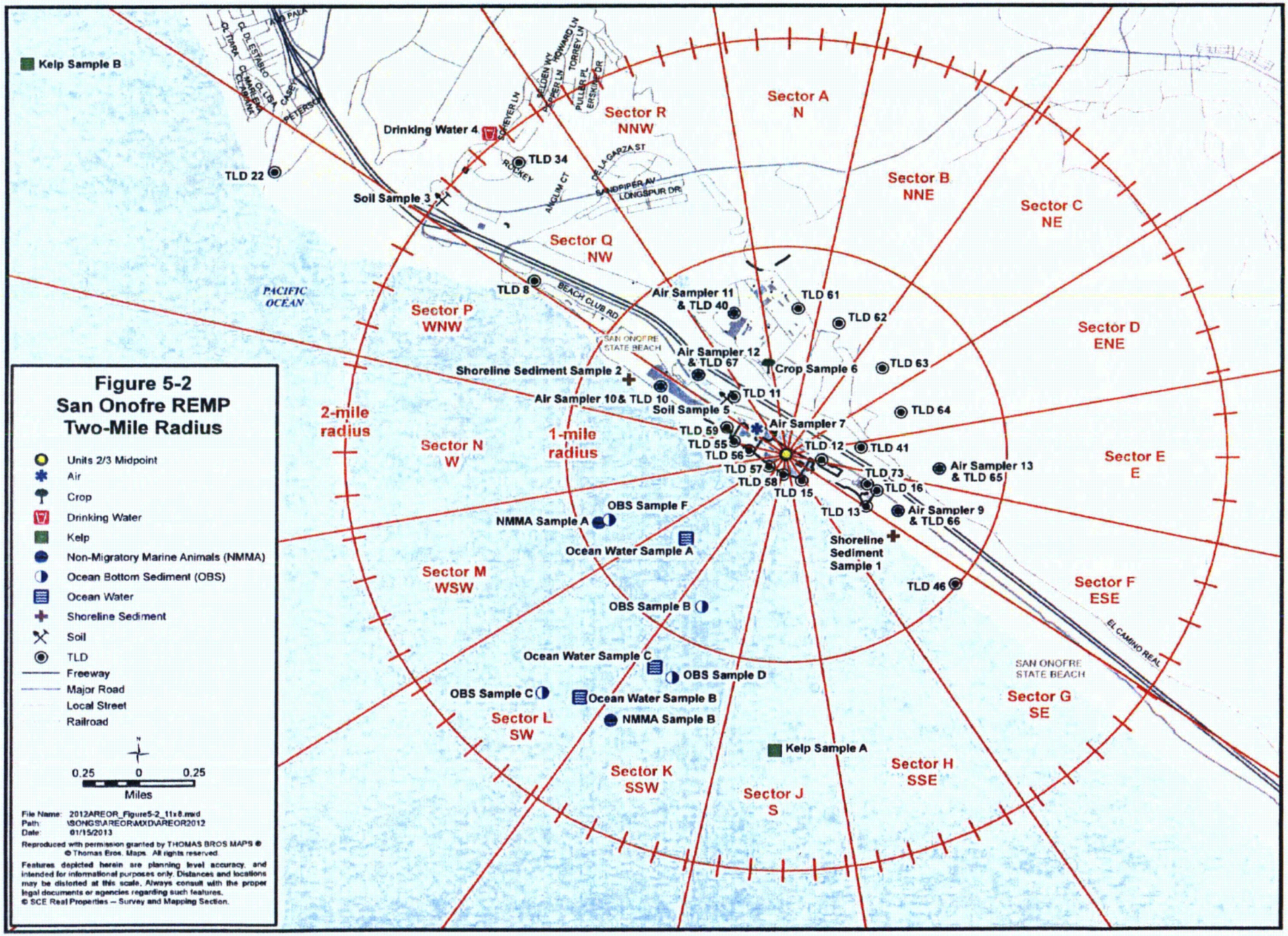
EL CAMINO REAL
BEACH CLUB RD
5
PACIFIC OCEAN
SAN ONOFRE STATE BEACH
Sector R NNW
Sector A N
Sector B NNE
Sector C NE
Sector D ENE
Sector E E
Sector F ESE
Sector G SE
Sector H SSE
Sector J S
Sector K SSW
Sector L SW
Sector M WSW
Sector N W
Sector P WNW
Sector Q NW
1-mile radius
TLD 8
Air Sampler 11 & TLD 40
TLD 61
TLD 62
TLD 63
TLD 64
Crop Sample 6
Air Sampler 12 & TLD 67
Shoreline Sediment Sample 2
Air Sampler 10 & TLD 10
Soil Sample 5
TLD 11
TLD 59
Air Sampler 7
TLD 55
TLD 56
TLD 57
TLD 58
TLD 15
TLD 41
TLD 12
Air Sampler 13 & TLD 65
TLD 73
TLD 16
TLD 13
Air Sampler 9 & TLD 66
Shoreline Sediment Sample 1
TLD 46
NMMA Sample A
OBS Sample F
Ocean Water Sample A
OBS Sample B
Ocean Water Sample C
OBS Sample D
OBS Sample C
Ocean Water Sample B


Kelp Sample B
Drinking Water 4
TLD 22
TLD 34
Soil Sample 3
TLD 8
PACIFIC OCEAN
Air Sampler 11 & TLD 40
TLD 61
TLD 62
Air Sampler 12 & TLD 67
Crop Sample 6
TLD 63
Shoreline Sediment Sample 2
Air Sampler 10 & TLD 10
Soil Sample 5
TLD 11
TLD 64
Air Sampler 7
TLD 59
TLD 55
TLD 56
TLD 57
TLD 58
TLD 12
TLD 41
TLD 73
Air Sampler 13 & TLD 65
TLD 16
TLD 15
TLD 13
Air Sampler 9 & TLD 66
OBS Sample F
NMMA Sample A
Ocean Water Sample A
Shoreline Sediment Sample 1
TLD 46
OBS Sample B
Ocean Water Sample C
OBS Sample D
OBS Sample C
Ocean Water Sample B
NMMA Sample B
Kelp Sample A
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
2-mile radius
1-mile radius
SAN ONOFRE STATE BEACH
EL CAMINO REAL
BEACH CLUB RD
Figure 5-2
San Onofre REMP
Two-Mile Radius
Units 2/3 Midpoint
Air
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
0.25 0 0.25
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Date: 01/15/2013
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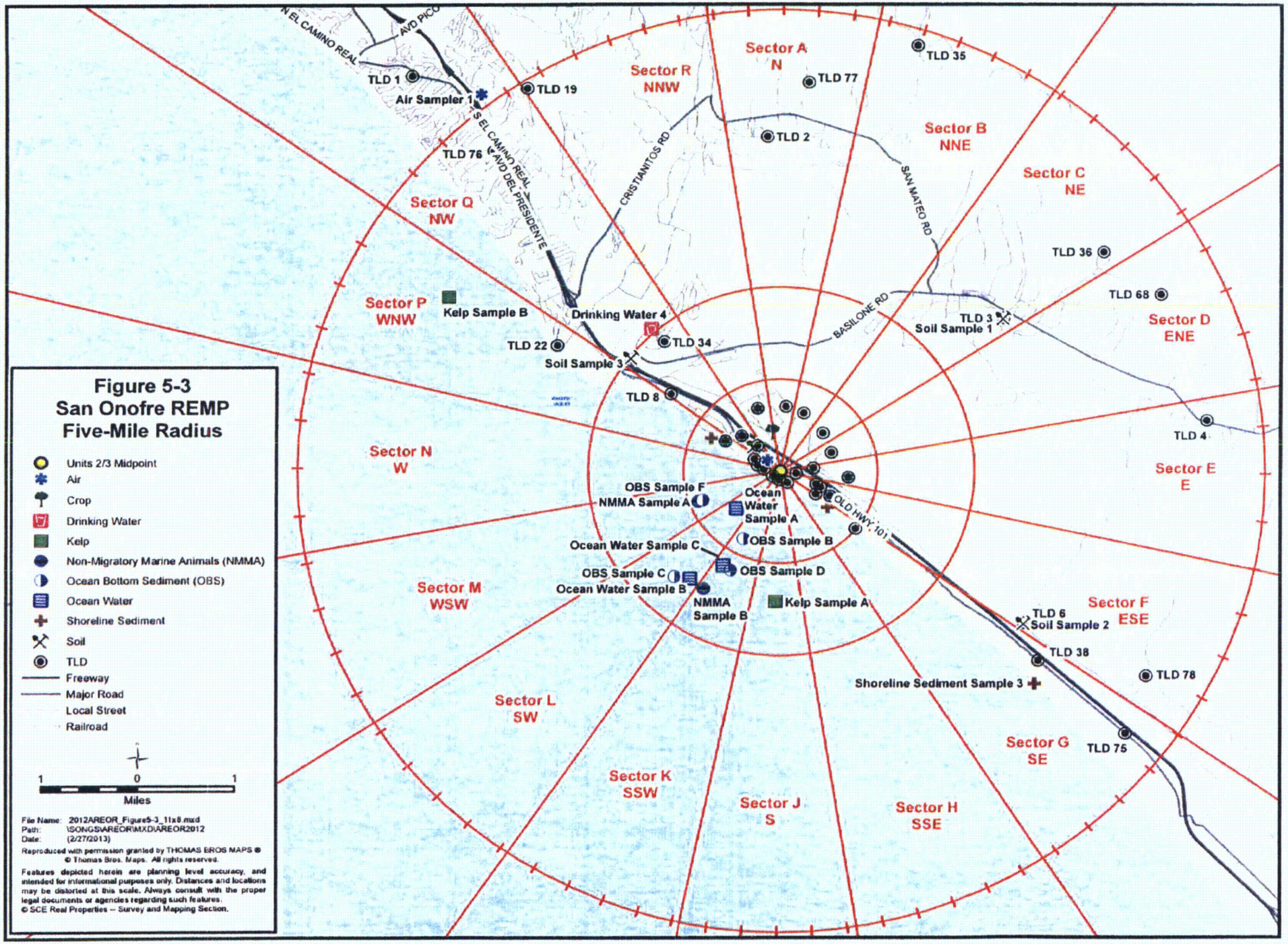
Figure 5-3
San Onofre REMP
Five-Mile Radius
Units 2/3 Midpoint
Air
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Major Road
Local Street
Railroad
1 0 1
Miles
File Name: 2012AREOR_Figure5-3_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2012
Date: (2/27/2013)
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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 1
TLD 2
TLD 3
TLD 4
TLD 6
TLD 8
TLD 19
TLD 22
TLD 34
TLD 35
TLD 36
TLD 38
TLD 68
TLD 75
TLD 76
TLD 77
TLD 78
Air Sampler 1
Drinking Water 4
Kelp Sample B
Soil Sample 1
Soil Sample 2
Soil Sample 3
OBS Sample F
NMMA Sample A
Ocean Water Sample A
OBS Sample B
Ocean Water Sample C
OBS Sample C
OBS Sample D
Ocean Water Sample B
NMMA Sample B
Kelp Sample A
Shoreline Sediment Sample 3
N EL CAMINO REAL
AVD PICO
S EL CAMINO REAL
AVD DEL PRESIDENTE
CRISTIANITOS RD
SAN MATEO RD
BASILONE RD
OLD HWY 101

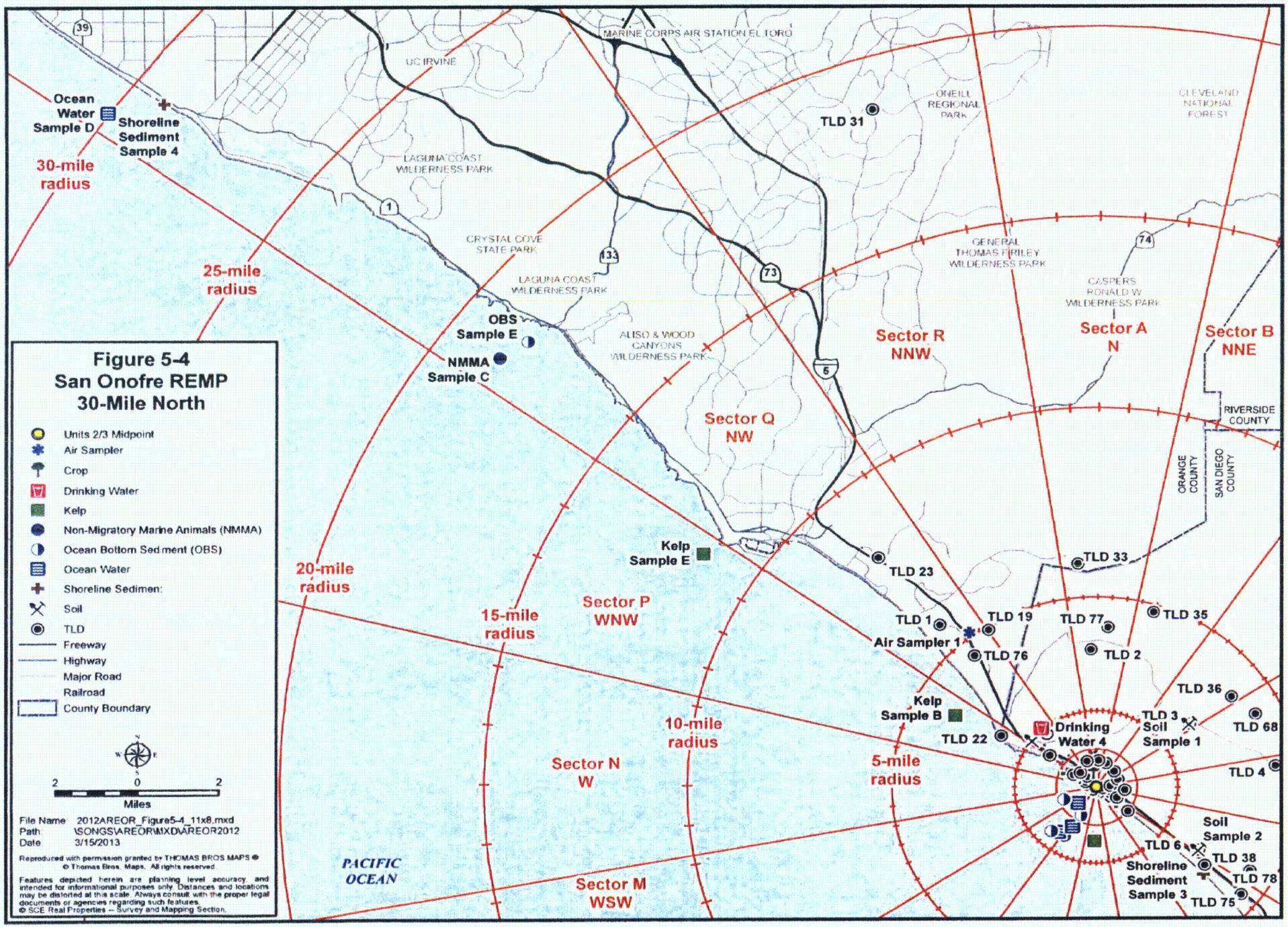
Figure 5-4
San Onofre REMP
30-Mile North
Units 2/3 Midpoint
Air Sampler
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sedimen:
Soil
TLD
Freeway
Highway
Major Road
Railroad
County Boundary
2 0 2
Miles
File Name: 2012AREOR_Figure5-4_11x8.mxd
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Date: 3/15/2013
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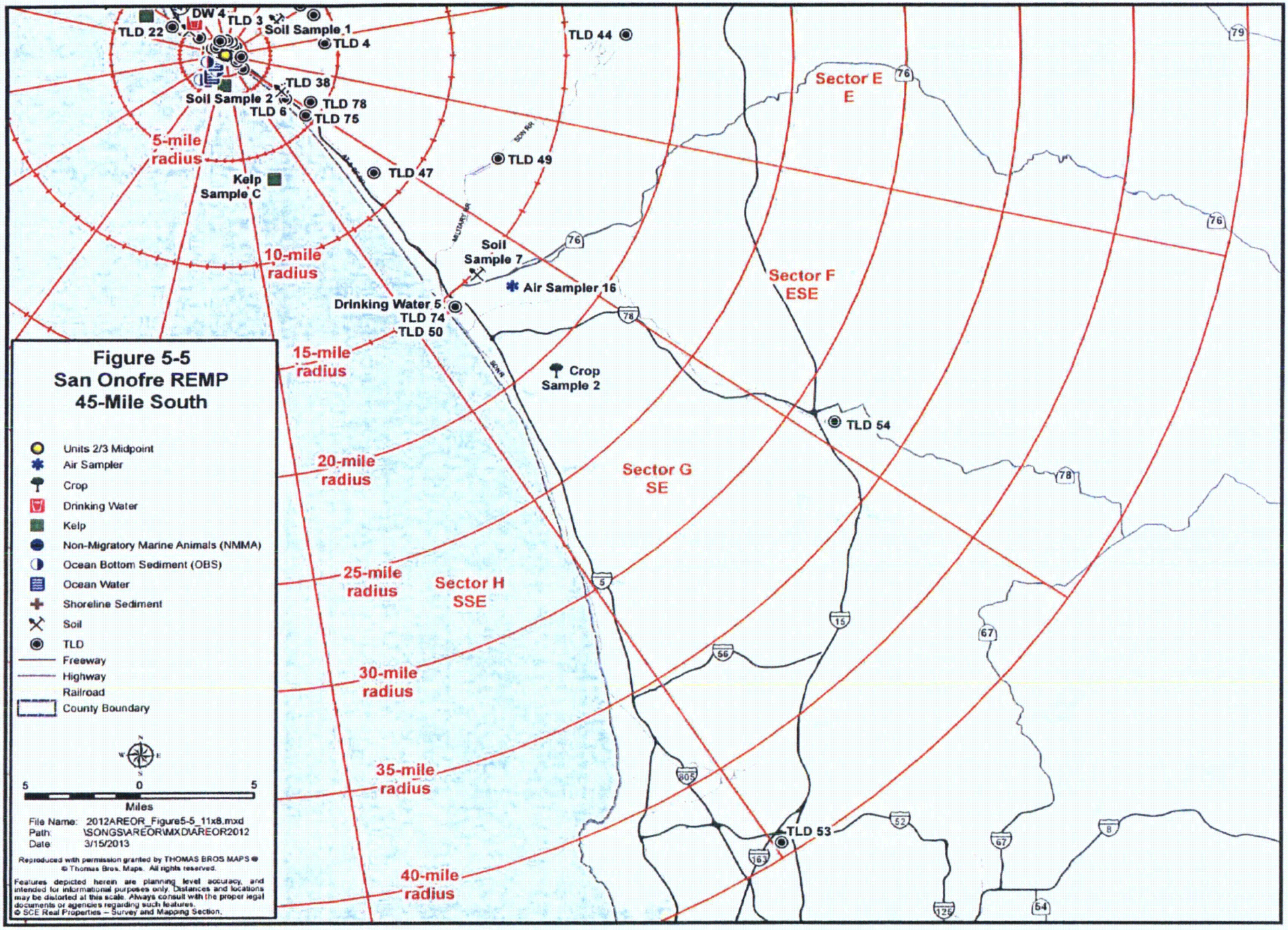
Ocean Water Sample D
Shoreline Sediment Sample 4
30-mile radius
25-mile radius
20-mile radius
15-mile radius
10-mile radius
5-mile radius
OBS Sample E
NMMA Sample C
Kelp Sample E
Kelp Sample B
Air Sampler 1
Drinking Water 4
Soil Sample 1
Soil Sample 2
Shoreline Sediment Sample 3
Sector R NNW
Sector A N
Sector B NNE
Sector Q NW
Sector P WNW
Sector N W
Sector M WSW
PACIFIC OCEAN
MARINE CORPS AIR STATION EL TORO
UC IRVINE
LAGUNA COAST WILDERNESS PARK
CRYSTAL COVE STATE PARK
ALISO & WOOD CANYONS WILDERNESS PARK
O'NEILL REGIONAL PARK
CLEVELAND NATIONAL FOREST
GENERAL THOMAS RILEY WILDERNESS PARK
CASPERS RONALD W WILDERNESS PARK
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY
TLD 31
TLD 23
TLD 33
TLD 1
TLD 19
TLD 77
TLD 35
TLD 76
TLD 2
TLD 36
TLD 22
TLD 3
TLD 68
TLD 4
TLD 6
TLD 38
TLD 78
TLD 75


DW 4
TLD 3
Soil Sample 1
TLD 22
TLD 4
TLD 44
TLD 38
Soil Sample 2
TLD 78
TLD 6
TLD 75
5-mile radius
TLD 49
TLD 47
Kelp Sample C
10-mile radius
Soil Sample 7
Air Sampler 16
Drinking Water 5
TLD 74
TLD 50
15-mile radius
Crop Sample 2
TLD 54
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
TLD 53
Figure 5-5
San Onofre REMP
45-Mile South
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
County Boundary
5
0
5
Miles
File Name: 2012AREOR_Figure5-5_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2012
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APPENDIX B

SUMMARY, RESULTS, AND DISCUSSIONS

OF 2012 ENVIRONMENTAL DATA

SUMMARY

To assess the changes or trends in the radioactivity level in the environment over the past year, the data from January 2012 to December 2012 were evaluated. The 2012 REMP data were evaluated according to the criteria described in NUREG/CR-4007 and with the methodology described by Currie (1968).* Excluding data attributable to factors external to SONGS, 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. The 2012 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 2012 appears in Table B-3.

The exceptions, summarized in Table B-2, include isotopically analyzed samples with station related activity reported and confirmed above the *a posteriori* MDC. The analysis results listed in Tables B-2 are attributable to sources external to SONGS (fallout from the nuclear accident at the Fukushima Daiichi Nuclear Power Station, or Chernobly, residual fallout from legacy atmospheric nuclear weapons testing, and discharge of medically administered I-131 from the San Juan Sewage Plant outfall). All of the 2012 REMP sample results with detectable plant related radionuclides have known sources external to SONGS. The radionuclides included in Table B-2 include I-131 in kelp (attributable to medically administered I-131 discharged in sewerage from the San Juan outfall), and Cs-137 in soil, deer meat, and marine animal flesh (attributable to residual nuclear weapons testing fallout and to Fukushima accident). 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. I-131 is a medically administered radionuclide which is often detected in sewage plant outfalls. The I-131 detected in the kelp samples is attributable to sewage plant discharges external to SONGS. Unit 2 was shut down for a planned refueling outage on January 9, 2012 and did not operate for the remainder of 2012 and Unit 3 was taken off-line after a steam generator tube leak on January 31, 2012. Cs-137 levels in marine animal flesh found in indicator samples closely mirror those found in control samples. We conclude that SONGS had a negligible radiological environmental impact during 2012.

Historical trending of data near and below the detection limits is necessarily limited. The concentration of radionuclides in the environs of SONGS has generally 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 occasionally showing levels 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 2012 ENVIRONMENTAL DATA

A. Direct Radiation

Calcium sulfate ($CaSO_4$) Thermoluminescent Dosimeters (TLDs) were placed at 49 locations and analyzed quarterly per ANSI-N545 standards. For each TLD location outside the exclusion area boundary a baseline value was computed using ten years of TLD data (2001 through 2010). The baseline is used to determine if radiation levels above the Lower Limit of Detection (LLD) for this media (5 mR per standard quarter and 10 mR per year) were observed during 2012.

TLDs located greater than five miles from SONGS are considered control TLDs. The indicator locations are selected as inner and outer rings as required by the ODCM. Additional TLDs are placed at locations of interest such as schools and hospitals. All 2012 control location TLD readings were LLD and all 2012 indicator location readings outside the EAB (Exclusion Area Boundary) were LLD.

The data indicate detectable direct radiation measurements in the immediate vicinity of SONGS. However, the hypothetical maximum associated exposure to a member of the general public, adjusted for occupancy, is less than 1 mR per year as measured by this sample media. TLD station #13 had the highest measured REMP TLD annual baseline adjusted exposure in 2012. The occupancy adjusted exposure for #13 is less than 1 mR per year. Refer to Table B-1 for a summary of all 2012 SONGS REMP TLD data.

Figures 2A and 2B compare environmental radiation levels of indicator and control locations for the operational year 2012 and for previous years. These figures show the close correlation between the control and indicator location TLD exposure data.

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.

Neutron dosimeters were placed at REMP TLD station 55 and at selected locations around the Independent Spent Fuel Storage Installation (ISFSI). All of the neutron TLD data in 2012 was less than detectable.

Direct Radiation baseline evaluation and estimation of natural background

An in-depth analysis of the environmental radiation results for the period of 2001 through 2010 was completed for all the monitoring locations. It can be inferred that if the standard deviation was low and no additional exposure above background was identified at a particular station, the average of that station's radiation exposure results should be equal to natural background (baseline) at that location. The baseline results for REMP TLDs have been summarized with the annual and quarterly values in the 2012 TLD Data Table. Natural background radiation is variable and a minor shift in location can yield a measurable change in background radiation. Therefore if a TLD is moved the baseline (background) for that location may be affected. In 2012 Control TLD 53 was moved approximately 100 yards because of construction and control TLD 54 was moved approximately 100 yards to a safer more appropriate location. No change in baseline dose was noted.

The baseline environmental exposure analysis of the 2001 through 2010 environmental TLD results included an assessment of the standard deviation of the quarterly results at each location. This is an appropriate methodology to determine the ability to detect radiation exposure above background. The highest value of three standard deviations for all of the 2001 through 2010 quarterly measurements was 4.8 mR and the highest value was 9.7 mR for the annual results, providing justification for baseline or *a priori* LLDs of 5 mR per quarter and 10 mR per year. The quarterly and annual results expressed in the 2012 Table B-1 as values of positive exposure above background or as a notation of <LLD if the background is not exceeded.

An empirical determination of the background baseline for stations within the Exclusion Area Boundary (EAB) is not possible due to the known plant related radiological activities (storage and transport of radioactive materials) that occurred during the baseline calculation study period. The average of the non-EAB stations close to the beach was approximately 15.0 mR per quarter. A value of 15.0 mR per quarter was conservatively selected as the baseline for the REMP stations located within the EAB.

In 1980 the Department of Energy (DOE) conducted an Aerial Radiological Survey of SONGS and the surrounding area. A current value of baseline / background value of 15.0 mR per standard quarter within the SONGS EAB is consistent with the 1980 gamma exposure rates reported by the DOE for the areas immediately north and south of SONGS, taking into account the reduction in environmental radioactivity and background dose rates caused by the decay of atmospheric nuclear weapons testing fallout since 1980.

TABLE B-1
2012 TLD Data

Table B-1 Baseline / Background corrected REMP TLD data														
#	Location	Dist. Miles	Quarterly Baseline	2012 Quarterly Results (mR)				Baseline Adjusted 2012 Quarterly Results (mR)				Annual Baseline	2012 Annual Total (mR)	Baseline Adjusted 2012 Total
				1	2	3	4	1	2	3	4			
1	City of San Clemente	5.7	17.5	18.2	17.4	18.2	17.6	<LLD	<LLD	<LLD	<LLD	69.9	71.3	<LLD
2	Camp San Mateo – MCB	3.6	18.6	19.5	17.0	19.7	17.8	<LLD	<LLD	<LLD	<LLD	74.4	74.0	<LLD
3	Camp San Onofre – MCB	2.8	16.4	17.4	15.5	16.9	15.7	<LLD	<LLD	<LLD	<LLD	65.5	65.4	<LLD
4	Camp Horno – MCB	4.4	18.1	18.6	16.4	19.2	16.8	<LLD	<LLD	<LLD	<LLD	72.3	71.0	<LLD
6	Old Route 101 (ESE)	3.0	11.4	12.6	10.2	13.1	10.5	<LLD	<LLD	<LLD	<LLD	45.6	46.3	<LLD
8	Noncommissioned Officers' Beach Club	1.4	15.4	17.1	17.4	17.2	15.9	<LLD	<LLD	<LLD	<LLD	61.8	67.6	<LLD
10	Bluff (Adjacent to PIC #1)	0.7	16.4	17.9	15.2	16.6	16.1	<LLD	<LLD	<LLD	<LLD	65.7	65.8	<LLD
19	San Clemente Highlands	4.9	17.8	18.9	17.8	19.0	17.7	<LLD	<LLD	<LLD	<LLD	71.3	73.4	<LLD
22	Former US Coast Guard Station	2.7	17.9	18.9	17.6	17.9	17.8	<LLD	<LLD	<LLD	<LLD	71.7	72.0	<LLD
23	SDG&E Service Center Yard	8.1	15.8	17.0	15.0	16.5	15.7	<LLD	<LLD	<LLD	<LLD	63.1	64.2	<LLD
31	Aurora Park - Mission Viejo (Control)	18.6	18.5	19.1	17.9	19.0	17.9	<LLD	<LLD	<LLD	<LLD	74.1	73.9	<LLD
33	Camp Talega – MCB	5.9	18.9	19.4	18.6	19.5	18.0	<LLD	<LLD	<LLD	<LLD	75.4	75.5	<LLD
34	San Onofre School – MCB	1.9	16.2	16.5	15.4	16.5	16.0	<LLD	<LLD	<LLD	<LLD	64.7	64.4	<LLD
35	Range 312 – MCB	4.8	16.9	17.6	15.2	15.9	14.0	<LLD	<LLD	<LLD	<LLD	67.5	62.8	<LLD
36	Range 208C – MCB	4.1	19.5	19.5	18.6	19.5	17.6	<LLD	<LLD	<LLD	<LLD	77.8	75.3	<LLD
38	San Onofre State Beach Park	3.4	14.3	16.1	13.1	14.2	14.1	<LLD	<LLD	<LLD	<LLD	57.2	57.5	<LLD
40	SCE Training Center - Mesa (Adjacent to PIC #3)	0.7	17.1	18.7	15.8	18.8	15.9	<LLD	<LLD	<LLD	<LLD	68.4	69.2	<LLD
44	Fallbrook Fire Station	17.7	14	15.0	14.5	14.4	15.4	<LLD	<LLD	<LLD	<LLD	56.0	59.3	<LLD
46	San Onofre State Beach Park	1.0	12.2	13.5	11.8	13.7	11.7	<LLD	<LLD	<LLD	<LLD	48.7	50.7	<LLD
47	Camp Las Flores – MCB	8.6	13.3	14.2	12.9	13.4	13.7	<LLD	<LLD	<LLD	<LLD	53.1	54.2	<LLD
49	Camp Chappo – MCB	12.9	14.2	16.0	14.3	14.7	14.8	<LLD	<LLD	<LLD	<LLD	56.9	59.7	<LLD
50	Oceanside Fire Station (Control)	15.6	16.6	17.6	16.0	17.4	15.8	<LLD	<LLD	<LLD	<LLD	66.3	66.9	<LLD
53	San Diego County Operations Center	44.2	18.2	19.1	18.5	18.7	20.0	<LLD	<LLD	<LLD	<LLD	72.9	76.3	<LLD
54	Escondido Fire Station	31.8	16.1	17.4	16.7	16.7	17.8	<LLD	<LLD	<LLD	<LLD	64.4	68.6	<LLD
61	Mesa - East Boundary (PIC #4)	0.7	15.4	16.0	14.4	15.7	14.3	<LLD	<LLD	<LLD	<LLD	61.7	60.4	<LLD
62	Camp Pendleton (PIC #5)	0.7	13.2	13.4	11.8	14.1	10.6	<LLD	<LLD	<LLD	<LLD	50.4	49.9	<LLD
63	Camp Pendleton (PIC #6)	0.6	13.9	14.5	13.2	15.9	12.3	<LLD	<LLD	<LLD	<LLD	55.5	55.9	<LLD
64	Camp Pendleton (PIC #7)	0.6	15	16.4	13.9	16.9	13.3	<LLD	<LLD	<LLD	<LLD	60.1	60.6	<LLD
65	Camp Pendleton (PIC #8)	0.7	13.4	14.7	12.4	15.1	12.3	<LLD	<LLD	<LLD	<LLD	53.8	54.5	<LLD

TABLE B-1
2012 TLD Data

Table B-1 Baseline / Background corrected REMP TLD data														
#	Location	Dist. Miles	Quarterly Baseline	2012 Quarterly Results (mR)				Baseline Adjusted 2012 Quarterly Results (mR)				Annual Baseline	2012 Annual Total (mR)	Baseline Adjusted 2012 Total
				1	2	3	4	1	2	3	4			
66	San Onofre State Beach (PIC #9)	0.6	14	16.22	12.91	15.54	12.29	<LLD	<LLD	<LLD	<LLD	55.6	56.96	<LLD
67	Former SONGS Evaporation Pond (PIC #2)	0.6	16.9	19.63	15.66	18.55	15.87	<LLD	<LLD	<LLD	<LLD	67.7	69.71	<LLD
68	Range 210C – MCB	4.4	15	16.1	14.67	16.17	13.4	<LLD	<LLD	<LLD	<LLD	60.2	60.34	<LLD
74	Oceanside City Hall (Backup Control)	15.6	13.3	14.42	14.1	14.02	12	<LLD	<LLD	<LLD	<LLD	53.4	54.54	<LLD
75	Gate 25 MCB	4.6	15.9	17.76	15.06	17.29	14.64	<LLD	<LLD	<LLD	<LLD	63.6	64.75	<LLD
76	El Camino Real Mobil Station	4.6	17.3	19.35	17.64	18.47	16.84	<LLD	<LLD	<LLD	<LLD	69.4	72.3	<LLD
77	Area 62 Heavy Lift Pad	4.2	19.2	20.52	18.61	19.67	17.24	<LLD	<LLD	<LLD	<LLD	76.9	76.04	<LLD
78	Horno Canyon	4.4	11.1	12.48	10.87	12.46	10.1	<LLD	<LLD	<LLD	<LLD	44.6	45.91	<LLD
11	Former Visitors' Center	0.4*	15	16.71	15.39	17.17	14.42	<LLD	<LLD	<LLD	<LLD	60	63.69	<LLD
12	South Edge of Switchyard	0.2*	15	17.71	15.65	16.77	16.61	<LLD	<LLD	<LLD	<LLD	60	66.74	<LLD
13	Southeast Site Boundary (Bluff)	0.4*	15	26.21	25.84	26.35	18.92	**11.21**	**10.84**	**11.35**	<LLD	60	97.32	37.32
15	Southeast Site Boundary (Office Bldg)	0.1*	15	21.9	20.19	18.76	17.84	**6.9**	**5.19**	<LLD	<LLD	60	78.69	18.69
16	East Southeast Site Boundary	0.4*	15	21.54	20.05	20.42	19.56	**6.54**	**5.05**	**5.42**	<LLD	60	81.57	21.57
41	Old Route 101 – East	0.3*	15	16.14	15.05	16.76	14.89	<LLD	<LLD	<LLD	<LLD	60	62.84	<LLD
55	San Onofre State Beach (U1 West)	0.2*	15	22.16	19.67	19.51	17.58	**7.16**	<LLD	<LLD	<LLD	60	78.92	18.92
56	San Onofre State Beach (U1 West)	0.2*	15	23.83	18.1	18.96	16	**8.83**	<LLD	<LLD	<LLD	60	76.89	16.89
57	San Onofre State Beach (Unit 2)	0.1*	15	20.42	18.48	17.54	16.26	**5.42**	<LLD	<LLD	<LLD	60	72.7	12.7
58	San Onofre State Beach (Unit 3)	0.1*	15	20.3	18.1	17.54	14.68	**5.3**	<LLD	<LLD	<LLD	60	70.62	10.62
59	SONGS Meteorological Tower	0.3*	15	22.57	20.17	20.92	19.7	**7.57**	**5.17**	**5.92**	<LLD	60	83.36	23.36
73	South Yard Facility	0.4*	15	24.73	24.58	23.71	22.19	**9.73**	**9.58**	**8.71**	**7.19**	60	95.21	35.21
	*Within Exclusion Area Boundary													

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

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

Independent Spent Fuel Storage Installation (ISFSI) 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 seven indicator locations and from one control location. The samples were analyzed for gross beta activity, I-131, and composited quarterly for gamma isotopic analysis. Sample locations were selected according to the requirements of the ODCM.

Gross beta analysis is a measure of total radioactivity of beta-emitting radionuclides in a sample. Beta radiation is emitted by many radionuclides, but beta decay gives a continuous energy spectrum rather than the discrete energy lines or peaks associated with gamma radiation. Gross beta measurements 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.

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 0.0118 to 0.0904 pCi/m^3, averaging 0.0380 pCi/m^3 of air. The concentrations of gross beta activity in the samples from the control location ranged from 0.0168 to 0.0927 pCi/m^3, averaging 0.0411 pCi/m^3 of air. Figure 3D shows the close correlation between indicator and control gross beta activity level during 2012 at different locations.

Per the requirements of the ODCM, Section 5, Table 5.1, an assessment was performed to determine whether the gross beta activity of the indicators exceeded 10 times the background (control location #16). The results showed that indicator locations maximum gross beta activity in air in 2012 was 0.0904 pCi/m^3 and the 2012 control location average was 0.0411 pCi/m^3, which is less than 10 times background. No action was required by the ODCM.

Indicator samples analyzed for I-131 showed a range of 0.0025 to 0.0203 pCi/m^3, with a mean of 0.0106 pCi/m^3, and control location average was 0.0124 pCi/m^3. No further action was required by the ODCM.

Quarterly composite gamma spectral 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 2012, only naturally occurring radionuclides were detected in the monthly gamma spectral analyses of ocean water. Monthly ocean water samples were also analyzed for tritium, consistent with the State of California Department of Public Health (DPH) split sample program. During 2012 all REMP ocean water sample results for plant related radionuclides were below the *a priori* LLD, and below the lower count specific *a posteriori* MDC. One quarterly composite tritium sample was below the *a priori* LLD but above the *a posteriori* MDC. The DPH monthly ocean water tritium sample results were all below the DPH reported Minimum Detectable Activity (MDA) for tritium and plant related radionuclides.

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 2012, 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 2012. The gross beta activity is due to naturally occurring radionuclides. The operation of SONGS had no impact on this sample medium.

E. Shoreline Sediment (Beach Sand)

Beach sand was collected semiannually in 2012 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 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. Naturally occurring K-40 and Th-228 were detected in ocean bottom sediment samples collected during 2012.

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 2012, all of the conduit sample analysis results were below the MDC for station related radionuclides.

We conclude that the operation of SONGS had no 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 1 outfall, the SONGS Units 2/3 outfall and from Laguna Beach control location. The flesh portion of each sample type was analyzed for gamma-emitting station-related and naturally occurring radionuclides. The results were subsequently reported to 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 2012. 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 2012 from the SONGS garden and from the control location 21 miles from SONGS Units 2/3 midpoint in sector F. No plant related radioactivity was detected in 2012 samples. Refer to Table B-4. It is concluded that 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 Visitors 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 2012 soil samples yielded naturally occurring K-40 and Th-228. Cs-137 was detected in two indicator samples, as well as the control sample.

Cs-137 in environmental sediment samples is attributable to residual nuclear weapons testing fallout or to the Fukushima accident. Refer to Table B-2.

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 2012, the operation of SONGS did not have a measurable effect on the environment as measured by this sample medium.

J. Kelp Sampling

Kelp was collected in April and October of 2012 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 2012 included K-40 and I-131. K-40 is naturally occurring and not related to the operation of SONGS. Refer to Table B-2.

I-131 has been detected at indicator and control locations in previous years. The I-131 data ocean water samples near SONGS have been consistently less than detectable. The northern control locations are too far away and in the predominantly upstream current direction for the I-131 activity to be attributable to SONGS. The control kelp sample stations near the San Juan Sewage Plant outfall have consistently yielded the highest I-131 activity. The San Juan outfall has consistently yielded I-131 at detectable levels. Refer to Table B-2 for a complete list of the 2012 kelp samples with detectable I-131activity and for the 2012 results for the San Juan Sewage Plant effluent sample I-131 analyses. I-131 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 Sewage Plant outfall, and the SONGS outfalls. The data strongly support the conclusion that the I-131 detected in kelp is attributable to medically administered I-131 discharged through the San Juan Sewage Plant outfall and not to the operation of SONGS.

K. Deer Sampling

Deer meat and bone samples were collected in 2012 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. The 2012 analysis results indicate residual fallout, Cs-137 from external anthropogenic factors such as nuclear weapons testing and Chernobyl or Fukushima Dai-Ichi, are the most likely cause for the one above *a posteriori* MDC data point. The deer meat and bone gamma isotopic data indicate that effects from the operation of SONGS were not detected in this sample 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 statistically equivalent, leading to the conclusion that Cs-137 in soil is attributable to residual fallout from external anthropogenic factors such as nuclear weapons testing, Chernobyl, and Fukushima Dai-Ichi.

Data from 2012 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 of medical administrations to the ocean from sewage treatment facilities. 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.

The data from air samplers close to SONGS, the data from air samplers further away, and the data from the Oceanside control sampler are statistically equal.

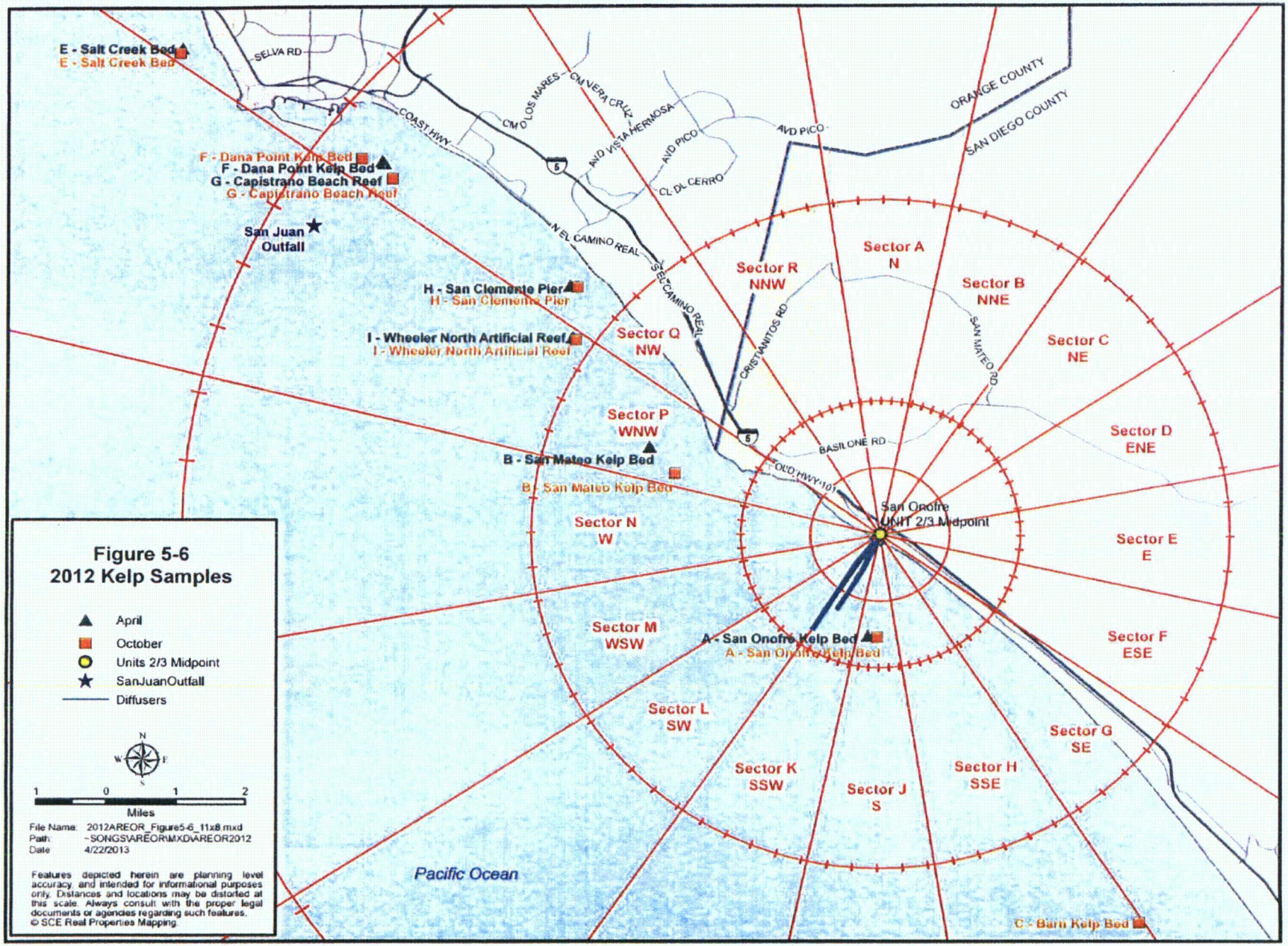
E - Salt Creek Bed
E - Salt Creek Bed
SELVA RD
COAST HWY
CM LOS MARES
CM VERA CRUZ
AVD VISTA HERMOSA
AVD PICO
CL DL CERRO
AVD PICO
ORANGE COUNTY
SAN DIEGO COUNTY
F - Dana Point Kelp Bed
F - Dana Point Kelp Bed
G - Capistrano Beach Reef
G - Capistrano Beach Reef
San Juan
Outfall
N EL CAMINO REAL
S EL CAMINO REAL
H - San Clemente Pier
H - San Clemente Pier
I - Wheeler North Artificial Reef
I - Wheeler North Artificial Reef
CRISTIANITOS RD
SAN MATEO RD
BASILONE RD
OLD HWY 101
B - San Mateo Kelp Bed
B - San Mateo Kelp Bed
San Onofre
UNIT 2/3 Midpoint
A - San Onofre Kelp Bed
A - San Onofre Kelp Bed
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
Pacific Ocean
C - Barn Kelp Bed
Figure 5-6
2012 Kelp Samples
April
October
Units 2/3 Midpoint
SanJuanOutfall
Diffusers
N
W
E
S
1 0 1 2
Miles
File Name: 2012AREOR_Figure5-6_11x8.mxd
Path: -SONGS\AREOR\MXD\AREOR2012
Date 4/22/2013
Features depicted herein are planning level accuracy, and intended for informational purposes only. Distances and locations may be distorted at this scale. Always consult with the proper legal documents or agencies regarding such features.
© SCE Real Properties Mapping.

TABLE B-2
Summary of Nuclear Power Plant related Gamma Isotopic Analyses confirmed above MDC

Sample Media & location	Radionuclide	Sample Value	MDC (*a posteriori*)
Aquatic Kelp San Onofre Kelp Bed Station A 16APR12	I-131	(38.5 ± 11) E-3 pCi/g	10 E-3 pCi/g
Aquatic Kelp San Mateo Kelp Bed Station B 16APR12	I-131	(20 ± 10) E-3 pCi/g	12 E-3 pCi/g
Aquatic Kelp Barn Kelp Bed Station C 16APR12	I-131	(32 ± 9) E-3 pCi/g	9 E-3 pCi/g
Aquatic Kelp Salt Creek Station E 16APR12	I-131	(52 ± 12) E-3 pCi/g	11 E-3 pCi/g
Aquatic Kelp Dana Point Kelp Bed Station F 16APR12	I-131	(56 ± 11) E-3 pCi/g	9 E-3 pCi/g
Aquatic Kelp Capistrano Beach Reef Station G 16APR12	I-131	(79 ± 11) E-3 pCi/g	7 E-3 pCi/g
Aquatic Kelp San Clemente Pier Station H 16APR12	I-131	(66 ± 12) E-3 pCi/g	11 E-3 pCi/g
Aquatic Kelp Wheeler North Artificial Reef Station I 16APR12	I-131	(47 ± 9) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp San Onofre Kelp Bed Station A 22MAY12[1]	I-131	(10± 6) E-3 pCi/g	6 E-3 pCi/g
Aquatic Kelp San Mateo Kelp Bed Station B 22MAY12[1]	I-131	(14 ± 6) E-3 pCi/g	6 E-3 pCi/g
Aquatic Kelp Salt Creek Bed Station E 22MAY12[1]	I-131	(11 ± 5) E-3 pCi/g	6 E-3 pCi/g
Aquatic Kelp Dana Point Kelp Bed Station F 22MAY12[1]	I-131	(28 ± 8) E-3 pCi/g	6 E-3 pCi/g
Aquatic Kelp Capistrano Beach Reef Station G 22MAY12[1]	I-131	(18 ± 6) E-3 pCi/g	6 E-3 pCi/g

TABLE B-2
Summary of Nuclear Power Plant related Gamma Isotopic Analyses confirmed above MDC

Sample Media & location	Radionuclide	Sample Value	MDC (*a posteriori*)
Aquatic Kelp San Clemente Pier Station H 22MAY12[1]	I-131	(13 ± 6) E-3 pCi/g	6 E-3 pCi/g
Aquatic Kelp Wheeler North Artificial Reef Station I 22MAY12[1]	I-131	(13 ± 7) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp San Onofre Kelp Bed Station A 15OCT12	I-131	(39 ± 9) E-3 pCi/g	7 E-3 pCi/g
Aquatic Kelp San Mateo Kelp Bed Station B 15OCT12	I-131	(16 ± 9) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp Barn Kelp Bed Station C 15OCT12	I-131	(24 ± 11) E-3 pCi/g	10 E-3 pCi/g
Aquatic Kelp Salt Creek Station E 15OCT12	I-131	(43 ± 9) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp Dana Point Kelp Bed Station F 15OCT12	I-131	(35 ± 8) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp Capistrano Beach Reef Station G 15OCT12	I-131	(28 ± 6) E-3 pCi/g	7 E-3 pCi/g
Aquatic Kelp San Clemente Pier Station H 15OCT12	I-131	(14 ± 6) E-3 pCi/g	8 E-3 pCi/g
Aquatic Kelp Wheeler North Artificial Reef Station I 15OCT12	I-131	(16 ± 6) E-3 pCi/g	6 E-3 pCi/g
San Juan Sewage2 Plant Discharge 22MAY12	I-131	(14800 ± 2620) E-3 pCi/l	2220 E-3 pCi/l
Soil Camp San Onofre Location # 1 27SEP12	Cs-137	(103 ± 38) E-3 pCi/g	43 E-3 pCi/g
Soil Prince of Peace Abbey Location # 7 27SEP12	Cs-137	(249 ± 56) E-3 pCi/g	42 E-3 pCi/g

TABLE B-2
Summary of Nuclear Power Plant related Gamma Isotopic Analyses confirmed above MDC

Sample Media & location	Radionuclide	Sample Value	MDC (*a posteriori*)
Deer Meat Indicator Location 29SEP12	Cs-137	(11 ± 4) E-3 pCi/g	4 E-3 pCi/g
Marine Animal Flesh Laguna Beach, Black Perch Station C 10APR12	Cs-137	(4 ± 4) E-3 pCi/g	4 E-3 pCi/g
Marine Animal Flesh Units 2&3 Outfall, Sand Bass Station B 24APR12	Cs-137	(4 ± 3) E-3 pCi/g	3 E-3 pCi/g
Marine Animal Flesh Laguna Beach, Sheephead Station C 9OCT12	Cs-137	(6 ± 3) E-3 pCi/g	3 E-3 pCi/g
Marine Animal Flesh Laguna Beach, Spiny Lobster Station C 9OCT12	Cs-137	(3 ± 2) E-3 pCi/g	3 E-3 pCi/g
Marine Animal Flesh Units 1 Outfall, Sheephead Station A 22OCT12	Cs-137	(6 ± 3) E-3 pCi/g	3 E-3 pCi/g
Marine Animal Flesh Units 2&3 Outfall, Spiny Lobster Station B 22OCT12	Cs-137	(3 ± 3) E-3 pCi/g	3 E-3 pCi/g
Air Filter San Luis Rey Substation Location #16 27MAR12	Cs-137	(0.4 ± 0.3) E-3 pCi/m3	0.3 E-3 pCi/m3
Ocean Water Unit 2 Outfall Location B 17SEP12	H-3	(404 ± 292) pCi/L	403 pCi/L

TABLE B-3

REMP SAMPLE ANALYSIS SUMMARY FOR 2012

Medium	Analysis Type	Sampling Frequency	# of Locations	Total # of Analyses in 2012 [1]
Direct Radiation	Dosimetry	Quarterly	49	196
Airborne Particulates	Gross Beta	Weekly	8	416
Charcoal Cartridge	I-131	Weekly	8	415
Airborne Particulates	Ge (Li) Scan	Quarterly	8	32
Ocean Water	Ge (Li) Scan, H-3	Monthly	4	52
Ocean Water	H-3	Quarterly	4	16
Drinking Water, Unfiltered	Ge (Li) Scan, H-3 Gross Beta	Monthly	2 2 2	25 25 25
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	12
Kelp	Ge (Li) Scan	Semi-Annually	8	23
Deer Meat	Ge (Li) Scan	Semi-Annually	18	18
Soil	Ge (Li) Scan	Annually	5	5

1. The total number of analyses listed above include samples not required by the ODCM, including San Clemente drinking water well samples (collection requested by the City of San Clemente), additional ocean water samples, additional ocean bottom sediment samples, additional crop samples, deer meat samples, and additional control kelp samples. The additional drinking water samples were not collected for all of 2012 because the San Clemente drinking water wells were not in service for all of 2012. Additional control kelp samples were obtained to track I-131 (iodine-131) activity in kelp attributable to municipal waste water discharges. Could not retrieve non-ODCM required I-131 cartridge from Station 11 Mesa EOF for one week because of equipment problems. Therefore, the total number of analyses will not always equal the product of the ODCM specified sample frequency times the total number of ODCM locations.

STATISTICAL SUMMARY OF REMP DATA FOR 2012

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2012 to 12/31/2012

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	Mean (Range)	Control Locations Mean (Range)	Number of Nonroutine Reported Measurements
Quarterly Gamma Exposure – Table 1A (mR/std quarter)							
	Gamma 196	5	16.91 (152/152) (10.1 – 26.35)	Southeast Site Boundary 0.4 Mi. ESE	24.33 (4/4) (18.92 – 26.35)	16.46 (44/44) (12.0 – 20.03)	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.

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Weekly Airborne Particulates Gross Beta Activity – Table 2 (pCi/m3)							
	Gross Beta 416	0.01	0.0380 (363/363) (0.0118 – 0.0904)	San Luis Rey Substation 16.7 Mi. SE	0.0411 (53/53) (0.0168 – 0.0927)	0.0411 (53/53) (0.0168 – 0.0927)	0

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Weekly Radioiodine I-131 Activity – Table 3 (pCi/m3)								
	I-131	415	0.07	0.0106 (22/363) (0.0025-0.0203)	Marine Corps Base (Camp Pendleton East) 0.7 Mi. E	0.0145 (2/52) (0.0093 – 0.0197)	0.0124 (5/52) (0.0077 – 0.0173)	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 is attributable to the nuclear accident at the Fukushima Daiichi Nuclear Power 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	Mean (Range)	Control Locations Mean (Range)	Number of Nonroutine Reported Measurements
Quarterly Comp. Airborne Particulates Gamma – Table 4A (pCi/m3)								
	Be-7	32		0.20 (28/28) (0.12 – 0.35)	AWS Roof Parking 0.18 Mi. NW	0.22 (4/4) (0.15 – 0.35)	0.21 (4/4) (0.17 – 0.29)	0
	Cs-134	32	0.05	3.41E-4 (4/28) (2.62E-4 – 4.09E-4)	Former SONGS Evaporation Pond 0.6 Mi. NW	4.03E-4 (1/4) (4.03E-4 – 4.03E-4)	<LLD (0/4 (-)	0
	Cs-137	32	0.06	2.77E-4 (4/28) (2.11E-4 – 3.12E-4)	San Luis Rey Substation 16.7 Mi. SE	3.76E-4 (1/4) (3.76E-4 – 3.76E-4)	3.76E-4 (1/4) (3.76E-4 – 3.76E-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 2012. Detectable Cs-137 at the control location is attributable to weapons testing fallout and is not attributable to the operation of SONGS.

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.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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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	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	2.94 (2/40) (2.25 – 3.63)	Unit 3 Conduit 0.1 Mi. SSW	3.63 (1/2) (3.63 - 3.63)	<LLD (0/12) (-)	0
	Co-58	52	15	0.91 (3/40) (0.80 – 1.09)	(B) Outfall - Unit 2 1.5 Mi. SW	1.09 (1/12) (1.09- 1.09)	<LLD (0/12) (-)	0
	Co-60	52	15	2.05 (4/40) (1.05 – 3.18)	(B) Outfall – Unit 2 1.5 Mi. SW	3.18 (1/12) (3.18 – 3.18)	<LLD (0/12) (-)	0
	Cs-134	52	15	1.82 (5/40) (1.22 – 2.65)	Unit 2 Conduit 0.1 Mi. SW	2.65 (1/2) (2.65 – 2.65)	1.43 (2/12) (1.42 – 1.43)	0
	Cs-137	52	18	1.46 (4/40) (0.84 – 2.55)	Unit 3 Conduit 0.1 Mi. SSW	2.55 (1/2) (2.55 - 2.55)	<LLD (0/12) (-)	0
	Fe-59	52	30	3.29 (2/40) (3.00 – 3.58)	(A) Station Discharge Outfall – Unit1 0.6 Mi. SW	3.29 (2/12) (3.00 – 3.58)	2.69 (2/12) (1.59 – 3.84)	0
	H-3	52	3000	<LLD (0/40) (-)	(D) Newport Beach 30 Mi. NW	217.00 (1/12) (217.00 - 217.00)	217.00 (1/12) (217.00 - 217.00)	0
	I-131	52	15	2.25 (1/40) (2.25 – 2.25)	Unit 3 Conduit 0.1 Mi. SSW	2.25 (1/2) (2.25 – 2.25)	1.35 (1/12) (1.35 – 1.35)	0
	La-140	52	15	2.94 (2/40) (2.25 – 3.63)	Unit 3 Conduit 0.1 Mi. SSW	3.63 (1/2) (3.63 – 3.63	<LLD (0/12) (-)	0
	Mn-54	52	15	<LLD (0/40) (-)	(D) Newport Beach 30 Mi. NW	1.21 (2/12) (0.84 – 1.59	1.21 (2/12) (0.84 – 1.59)	0
	Nb-95	52	15	1.44 (11/40) (0.90 – 2.13)	Unit 2 Conduit 0.1 Mi. SW	1.77 (1/2) (1.77 – 1.77)	1.30 (5/12) (0.80 - 1.72)	0
	Zn-65	52	30	4.13 (1/40) (4.13 – 4.13)	Unit 2 Conduit 0.1 Mi. SW	4.13 (1/2) (4.13 – 4.13)	<LLD (0/12) (-)	0
	Zr-95	52	15	2.58 (2/40) (1.91- 3.25)	(A) Station Discharge Outfall – Unit1 0.6 Mi. SW	3.25 (1/12) (3.25 – 3.25)	<LLD (0/12) (-)	0

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 2012 (K-40 & Th-230) and the radionuclides listed in the ODCM

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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Quarterly Composite Ocean Water Tritium Activity – Table 7 (pCi/l)								
	H-3	16	3000	315.00 (2/12) (226.00 – 404.00)	(Outfall – Unit 2 1.5 Mi. SW	404.00 (1/4) (404.00 – 404.00)	302.00 (1/4) (302.00 – 302.00)	0

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Monthly Drinking Water Analysis – Table 9A (pCi/l)								
	Ba-140	25	15	3.05 (1/13) (3.05 – 3.05)	Camp Pendleton 2.2 Mi. NNW	3.05 (1/12) (3.05 – 3.05)	2.13 (3/12) (1.42 – 3.31)	0
	Co-58	25	15	<LLD (13/13)	Oceanside (Control) 15.6 Mi. SE	0.97 (1/12) (0.97- 0.97)	0.97 (1/12) (0.97- 0.97)	0
	Co-60	25	15	<LLD (13/13)	Oceanside (Control) 15.6 Mi. SE	2.38 (2/12) (1.72 – 3.04)	2.38 (2/12) (1.72 – 3.04)	0
	Cs-134	25	15	1.24 (2/13) (0.99 - 1.48)	Camp Pendleton 2.2 Mi. NNW	1.24 (2/12) (0.99 – 1.48)	<LLD (0/12) (-)	0
	Cs-137	25	18	<LLD (13/13)	Oceanside (Control) 15.6 Mi. SE	1.65 (1/12) (1.65 – 1.65)	1.65 (1/12) (1.65 – 1.65)	0
	Fe-59	25	30	3.27 (1/13) (3.27 – 3.27)	Camp Pendleton 2.2 Mi. NNW	3.27 (1/12) (3.27 – 3.27)	2.29 (2/12) (2.06 – 2.52)	0
	Gross Beta	20	4	2.07 (7/10) (1.83 – 2.30)	Oceanside (Control) 15.6 Mi. SE	2.88 (9/10) (2.14 – 3.65)	2.88 (9/10) (2.14 – 3.65)	0
	H-3	25	3000	302.00 (1/13) (302.00 - 302.00)	Camp Pendleton 2.2 Mi. NNW	302.00 (1/12) (302.00 - 302.00)	<LLD (12/12)	0
	I-131	25	15	3.90 (1/13) (3.90 – 3.90)	Camp Pendleton 2.2 Mi. NNW	3.90 (1/12) (3.90 – 3.90)	2.18 (1/12) (2.18 – 2.18)	0
	K-40	25		32.00 (2/13) (28.30 – 35.70)	Camp Pendleton 2.2 Mi. NNW	32.00 (2/12) (28.30 – 35.70)	27.45 (2/12) (27.10 – 27.80)	0
	La-140	25	15	3.05 (1/13) (3.05 – 3.05)	Camp Pendleton 2.2 Mi. NNW	3.05 (1/12) (3.05 – 3.05)	2.13 (3/12) (1.42 – 3.31)	0
	Mn-54	25	15	<LLD (13/13)	All results <LLD	<LLD (1/1)	<LLD (12/12)	0
	Nb-95	25	15	2.17 (8/13) (1.37 – 3.26)	Camp Pendleton 2.2 Mi. NNW	2.28 (7/12) (1.41 – 3.26)	2.10 (3/12) (1.35 – 2.93)	0
	Zn-65	25	30	6.27 (1/13) (6.27 – 6.27)	Camp Pendleton 2.2 Mi. NNW	6.27 (1/12) 6.27 – 6.27)	2.03 (1/12) (2.03 – 2.03)	0
	Zr-95	25	15	2.52 (1/13) (2.52 - 2.52)	Oceanside (Control) 15.6 Mi. SE	2.53 (2/12) (2.11 – 2.94)	2.53 (2/12) (2.11 – 2.94)	0

During 2012 gross beta was confirmed above the *a posteriori* MDC in some drinking water samples. Gross beta is attributable to naturally occurring radionuclides e.g. K-40. All the other analysis results were less than detectable for SONGS related radionuclides.
This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2012 (Gross Beta) as well as those radionuclides listed in the ODCM.

Starting in October 2006 San Clemente drinking water 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.

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Semi-annual Shoreline Sediment Gamma Spectral Analysis – Table 10 (pCi/g)								
	Cs-134	8	0.15	0.0485 (5/6) (0.0301 - 0.11)	San Onofre State Beach 3.5 Mi. SE	0.0723 (2/2) (0.0375 – 0.11)	0.0569 (2/2) (0.0321 – 0.0817)	0
	Cs-137	8	0.18	<LLD (6/6)	All results <LLD	<LLD (2/2)	<LLD (2/2) (-)	0
	K-40	8		13.96 (6/6) (7.52 – 20.40)	San Onofre Surfing Beach 0.8 Mi. WNW	20.10 (2/2) (19.80 – 20.40)	19.45 (2/2) (16.40 – 22.50)	0
	Th-228	8		0.62 (6/6) (0.20 – 1.16)	Newport Beach North End 29.2 Mi. NW	1.01 (2/2) (0.49 – 1.53)	1.01 (2/2) (0.49 – 1.53)	0

During 2012 naturally occurring Ac-228, Bi-214, Pb-212, Pb-214, Ra-226, Ra-228, Th-230, Th-232, Tl-208, U-234.Th-228 and K-40 were detected 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 2012 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

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Deer Meat Analysis – Table 10A (pCi/l)							
	C-137	18	.011 (1/4)	Camp Pendleton 0.5 Mi SE	.011 (1/4)	<LLD	0

One deer muscle / bone sample was confirmed above the *a posteriori* MDC. All samples contained naturally occurring K-40. Cs-137 is attributable to residual weapons testing fallout.

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Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis – Table 11 (pCi/g)								
	Cs-134	14	0.15	0.0621 (7/12) (0.0410 – 0.0843)	(F) SONGS Upcoast 0.9 Mi. WSW	0.0751 (2/2) (0.0658 - 0.0843)	0.0296 (1/2) (0.0296 – 0.0296)	0
	Cs-137	14	0.18	0.0413 (1/12) (0.0413 – 0.0413)	(F) SONGS Upcoast 0.9 Mi. WSW	0.0413 (1/2) (0.0413 – 0. 0413)	<LLD (0/2) (-)	0
	K-40	14		15.97 (12/12) (14.00 – 20.80)	(E) Laguna Beach 18.2 Mi. NW	19.20 (2/2) (18.90 - 19.50)	19.20 (2/2) (18.90 - 19.50)	0
	Th-228	14		0.87 (12/12) (0.25 - 1.76)	(F) SONGS Upcoast 0.9 Mi. WSW	1.46 (2/2) (1.15 - 1.76)	0.40 (2/2) (0.29 - 0.51)	0

During 2012 naturally occurring Ac-228, Bi-214, Pb-212, Pb-214, Ra-226, Ra-228, Th-230, Th-232, Tl-208, U-234.Th-228 and K-40 were detected above the *a posteriori* MDC in most shoreline sediment samples. Cs-137 is attributable to residual weapons testing fallout.

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 2012 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

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Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g)								
Black Perch	Co-58	5	0.13	< LLD (0/3) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	Co-60	5	0.13	< LLD (0/3) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	Cs-134	5	0.13	< LLD (0/3) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	Cs-137	5	0.15	0.0030 (1/3) (0.0030 - 0.0030)	(C) Laguna Beach 18.2 Mi. NW	0.0043 (1/2) (0.0043 - 0.0043)	0.0043 (1/2) (0.0043 - 0.0043)	0
Black Perch	Fe-59	5	0.26	<LLD (0/3) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	K-40	5		3.28 (3/3) (3.10 - 3.49)	(A) Unit 1 Outfall 0.9 Mi. WSW	3.30 (2/2) (3.10 - 3.49)	3.27 (2/2) (3.23- 3.31)	0
Black Perch	Mn-54	5	0.13	<LLD (0/3) (-)	All results <LLD	< LLD (0/2) (-)	<LLD (0/2) (-)	0
Black Perch	Zn-65	5	0.26	< LLD (0/3) (-)	All results <LLD	< LLD (0/1) (-)	<LLD (0/2) (-)	0
California Mussel	Co-58	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Co-60	6	0.13	0.0032 (1/4) (0.0032 – 0.0032)	(A) Unit 1 Outfall 0.9 Mi. WSW	0.0032 (1/2) (0.0032 – 0.0032)	0.0027 (2/2) (0.0024 – 0.0030)	0
California Mussel	Cs-134	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Cs-137	6	0.15	0.0034 (1/4) (0.0034 – 0.0034)	(A) Unit 1 Outfall 0.9 Mi. WSW	0.0034 (1/2) (0.0034 – 0.0034)	0.0015 (1/2) (0.0015 – 0.0015)	0
California Mussel	Fe-59	6	0.26	<LLD (0/4) (-)	(C) Laguna Beach 18.2 Mi. NW	0.0038 (1/2) (0.0038 – 0.0038)	0.0038 (1/2) (0.0038 – 0.0038)	0
California Mussel	K-40	6		2.18 (4/4) (1.99 – 2.44)	(A) Unit 1 Outfall 0.9 Mi. WSW	2.29 (2/2) (2.14 – 2.44)	1.93 (2/2) (1.81 - 2.05)	0
Kelp Bass	Co-58	1	0.13	<LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Kelp Bass	Co-60	1	0.13	<LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0

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Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g)								
Black Perch	Co-58	5	0.13	< LLD (0/3) (-)	(C) Laguna Beach 18.2 Mi. NW	0.0040 (1/2) (0.0040 - 0.0040)	0.0040 (1/2) (0.0040 - 0.0040)	0
Black Perch	Co-60	5	0.13	< LLD (0/3) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/2) (-)	0
Kelp Bass	Cs-134	1	0.13	<LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Kelp Bass	Cs-137	1	0.15	<LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Kelp Bass	Fe-59	1	0.26	< LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Kelp Bass	K-40	1		3.58 (1/1) (3.58 - 3.58)	(A) Unit 1 Outfall 0.9 Mi. WSW	3.58 (1/1) (3.58 - 3.58)	< LLD (0/0) (-)	0
Kelp Bass	Mn-54	1	0.13	< LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Kelp Bass	Zn-65	1	0.26	<LLD (0/1) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/0) (-)	0
Sheephead	Co-58	4	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/2) (-)	0
Sheephead	Co-60	4	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/2) (-)	0
Sheephead	Cs-134	4	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/2) (-)	0
Sheephead	Cs-137	4	0.15	0.0051 (2/2) (0.0044 – 0.0059)	(A) Unit 1 Outfall 0.9 Mi. WSW	0.0059 (1/1) (0.0059 – 0.0059)	0.0044 (2/2) (0.0031 – 0.0057)	0
Sheephead	Fe-59	4	0.26	< LLD (0/2) (-)		< LLD (0/1) (-)	< LLD (0/2) (–)	0
Sheephead	K-40	4		3.73 (2/2) (3.44 – 4.02)	(B) Units 2 & 3 Outfall 1.5 Mi. SSW	4.02 (1/1) (4.02 – 4.02)	3.69 (2/2) (3.67 – 3.70)	0
Sheephead	Mn-54	4	0.13	< LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Sheephead	Zn-65	4	0.26	<LLD (0/2) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/2) (-)	0
Sand Bass	Co-58	2	0.13	< LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	<LLD (0/0) (-)	0

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Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g)								
Sand Bass	Co-60	2	0.13	0.0079 (1/2) (0.0079 – 0.0079)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0079 (1/2) (0.0079 – 0.0079)	< LLD (0/0) (-)	0
Sand Bass	Cs-134	2	0.13	0.0048 (1/2) (0.0048 – 0.0048)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0048 (1/2) (0.0048 – 0.0048)	< LLD (0/0) (-)	0
Sand Bass	Cs-137	2	0.15	0.0038 (1/2) (0.0038 – 0.0038)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0038 (1/2) (0.0038 – 0.0038)	< LLD (0/0) (-)	0
Sand Bass	Fe-59	2	0.26	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Sand Bass	K-40	2		3.87 (2/2) (3.78 – 3.96)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	3.87 (2/2) (3.78 – 3.96)	< LLD (0/0) (-)	0
Sand Bass	Mn-54	2	0.13	<LLD (0/2) (-)	All results <LLD	<LLD (0/2) (-)	< LLD (0/0) (-)	0
Sand Bass	Zn-65	2	0.26	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Spiny Lobster	Co-58	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Co-60	6	0.13	0.0047 (1/4) (0.0047 – 0.0047)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0047 (1/2) (0.0047 – 0.0047)	< LLD (0/2) (-)	0
Spiny Lobster	Cs-134	6	0.13	<LLD (0/4) (-)	(C) Laguna Beach 18.2 Mi. NW	0.0022 (1/2) (0.0022 – 0.0022)	0.0022 (1/2) (0.0022 – 0.0022)	0
Spiny Lobster	Cs-137	6	0.15	0.0035 (1/4) (0.0035 – 0.0035)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0035 (1/2) (0.0035 – 0.0035)	0.0033 (1/2) (0.0033 - 0.0033)	0
Spiny Lobster	Fe-59	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	K-40	6		3.39 (4/4) (3.13 - 3.57)	(C) Laguna Beach 18.2 Mi. NW	3.76 (2/2) (3.74 - 3.78)	3.76 (2/2) (3.74 - 3.78)	0
Spiny Lobster	Mn-54	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Zn-65	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0

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

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Semi-Annual Non-Migratory Marine Animals (Flesh) Analysis – Table 12A (pCi/g)								
California Mussel	Co-58	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Co-60	6	0.13	< LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Cs-134	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Cs-137	6	0.15	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Fe-59	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	K-40	6		2.29 (4/4) (2.10 - 2.61)	(A) Unit 1 Outfall 0.9 Mi. WSW	2.36 (2/2) (2.10 - 2.61)	2.14 (2/2) (2.10 - 2.18)	0
California Mussel	Mn-54	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Zn-65	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Kelp Bass	Co-58	2	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Co-60	2	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Cs-134	2	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Cs-137	2	0.15	0.0135 (1/2) (0.0135 – 0.0135)	(A) Unit 1 Outfall 0.9 Mi. WSW	0.0135 (1/2) (0.0135 – 0.0135)	< LLD (0/0) (-)	0
Kelp Bass	Fe-59	2	0.26	< LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	K-40	2		3.82 (2/2) (3.69 - 3.94)	(A) Unit 1 Outfall 0.9 Mi. WSW	3.82 (2/2) (3.69 - 3.94)	< LLD (0/0) (-)	0
Kelp Bass	Mn-54	2	0.13	< LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Zn-65	2	0.26	<LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/0) (-)	0

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2012 to 12/31/2012

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

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	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	4	0.13	< LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	<LLD (0/2) (-)	0
Sheephead	Co-60	4	0.13	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Sheephead	Cs-134	4	0.13	0.0090 (1/2) (0.0090 – 0.0090)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0090 (1/2) (0.0090 – 0.0090)	< LLD (0/2) (-)	0
Sheephead	Cs-137	4	0.15	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Sheephead	Fe-59	4	0.26	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Sheephead	K-40	4		3.51 (2/2) (3.48 – 3.54)	(C) Laguna Beach 18.2 Mi. NW	3.54 (2/2) (3.43 – 3.65)	3.54 (2/2) (3.43 – 3.65)	0
Sheephead	Mn-54	4	0.13	<LLD (0/2) (-)	(C) Laguna Beach 18.2 Mi. NW	0.0035 (1/2) (0.0035 - 0.0035)	0.0035 (1/2) (0.0035 - 0.0035)	0
Sheephead	Zn-65	4	0.26	<LLD (0/2) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Co-58	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Co-60	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Cs-134	6	0.13	0.0066 (1/4) (0.0066 – 0.0066)	(B) Units 2 and 3 Outfall 1.5Mi. SSW	0.0066 (1/2) (0.0066 – 0.0066)	< LLD (0/2) (-)	0
Spiny Lobster	Cs-137	6	0.15	<LLD (0/4) (-)	(C) Laguna Beach 18.2 Mi. NW	0.0036 (1/2) (0.0036 - 0.0036)	0.0036 (1/2) (0.0036 - 0.0036)	0
Spiny Lobster	Fe-59	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	K-40	6		3.26 (4/4) (2.98 - 3.71)	(C) Laguna Beach 18.2 Mi. NW	3.59 (2/2) (3.32 - 3.85)	3.59 (2/2) (3.32 - 3.85)	0
Spiny Lobster	Mn-54	6	0.13	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Zn-65	6	0.26	<LLD (0/4) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0

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

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2012 to 12/31/2012

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	Mean (Range)	Control Locations Mean (Range)	Number of Nonroutine Reported Measurements
Semi-Annual Local Crops Gamma Spectral Analysis - Table 13A (pCi/g)								
Lettuce	Cs-134	2	0.06	< LLD (0/0) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Lettuce	Cs-137	2	0.08	< LLD (0/0) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Lettuce	I-131	2	0.06	< LLD (0/0) (-)	All results <LLD	< LLD (0/2) (-)	< LLD (0/2) (-)	0
Lettuce	K-40	2		< LLD (0/0) (-)	South East of Oceanside 22 Mi. SE	1.99 (2/2) (0.83 - 3.15)	1.99 (2/2) (0.83 - 3.15)	0
Sorrel	Be-7	4		0.0975 (2/3) (0.0769 - 0.12)	SONGS Garden 0.4 Mi. NNW	0.0975 (2/3) (0.0769 - 0.12)	< LLD (0/1) (-)	0
Sorrel	Cs-134	4	0.06	< LLD (0/3) (-)	South East of Oceanside 22 Mi. SE	0.0051 (1/1) (0.0051 - 0.0051)	0.0051 (1/1) (0.0051 - 0.0051)	0
Sorrel	Cs-137	4	0.08	< LLD (0/3) (-)	All results <LLD	< LLD (0/3) (-)	< LLD (0/1) (-)	0
Sorrel	I-131	4	0.06	< LLD (0/3) (-)	All results <LLD	< LLD (0/1) (-)	< LLD (0/1) (-)	0
Sorrel	K-40	4		3.65 (3/3) (2.23 – 4.43)	South East of Oceanside 22 Mi. SE	3.92 (1/1) (3.92 – 3.92)	3.92 (1/1) (3.92 – 3.92)	0
Tomato	Cs-134	6	0.06	< LLD (0/3) (-)	South East of Oceanside 22 Mi. SE	0.0020 (1/3) (0.0020 – 0.0020)	0.0020 (1/3) (0.0020 – 0.0020)	0
Tomato	Cs-137	6	0.08	< LLD (0/3) (-)	South East of Oceanside 22 Mi. SE	0.0067 (1/3) (0.0067 – 0.0067)	0.0067 (1/3) (0.0067 – 0.0067)	0
Tomato	I-131	6	0.06	0.0043 (1/3) (0.0043 – 0.0043)	SONGS Garden 0.4 Mi. NNW	0.0043 (1/3) (0.0043 -0.0043)	< LLD (0/3) (-)	0
Tomato	K-40	6		2.36 (3/3) (2.23 – 2.43)	SONGS Garden 0.4 Mi. NNW	2.36 (3/3) (2.23 - 2.43)	1.71 (3/3) (0.91 - 2.64)	0

During 2012, naturally occurring K-40 (potassium 40) was confirmed above the *a posteriori* MDC in all local crop samples and Be-7 (Beryllium 7) was confirmed above the *a posteriori* MDC in some Sorrel samples only.

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 data in this table includes Cs-134, Cs-137, and I-131 analysis results greater than the MDC attributable to fallout from the nuclear accident at Fukushima.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2012 to 12/31/2012

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	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	0.0801 (4/4) (0.0415 - 0.15)	Camp San Onofre 2.6 Mi. NE	0.15 (1/1) (0.15 - 0.15)	0.0503 (1/1) (0. 0503 – 0. 0503)	0
	Cs-137	5	0.18	0.14 (2/4) (0.10 – 0.18)	Prince of Peace Abbey 15 Mi. SE	0.25 (1/1) (0.25 – 0.25)	0.25 (1/1) (0.25 – 0.25)	0
	K-40	5		17.84 (4/4) (9.06 – 24.30)	Camp San Onofre 2.6 Mi. NE	24.30 (1/1) (24.30 – 24.30)	3.63 (1/1) (3.63 – 3.63)	0
	Th-228	5		0.68 (4/4) (0.45 – 0.85)	Camp San Onofre 2.6 Mi. NE	0.85 (1/1) (0.85 – 0.85)	0.23 (1/1) (0.23 – 0.23)	0

During 2012 naturally occurring K-40, Ac-228, Bi-214, Pb-212, Pb-214, Ra-226, Ra-228, Th-230, Th-232, Tl-208, and U-234 were detected above the *a posteriori* MDC in most shoreline sediment samples.

Cs-137 (Cesium 137) was detected in three samples and is attributable to fallout from nuclear weapons testing and from Chernobyl.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2012 to 12/31/2012

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	Mean (Range)	Control Locations Mean (Range)	Number of Nonroutine Reported Measurements
Semi-Annual Kelp Analysis – Table 15 (pCi/g)								
	Cs-134	23	0.06	< LLD (0/8) (-)	E) Salt Creek (Control) 11 Mi. NW	0.0056 (1/3) (0.0056 - 0.0056)	0.0052 (2/15) (0.0049 – 0.0056)	0
	Cs-137	23	0.08	< LLD (0/8) (-)	(E) Salt Creek (Control) 11 Mi. NW	0.0046 (2/3) (0.0034 – 0.0059)	0.0044 (4/15) (0.0034 – 0.0059)	0
	I-131	23	0.06	0.0242 (8/8) (0.0105 - 0.0391)	Capistrano Beach Reef (G) 8.8 Mi. NW	0.0421 (3/3) (0.0185 – 0.0795)	0.0346 (15/15) (0.0112 – 0.0794)	0
	K-40	23		11.02 (8/8) (8.20 – 13.50)	San Clemente Pier (H) 5.8 Mi. NW	12.42 (3/3) (7.75 – 18.40)	10.56 (15/15) (5.59 – 18.40)	0

During 2012, naturally occurring K-40 (23 of 23) and Th-234 (18 of 23) were confirmed above the *a posteriori* MDC in kelp samples. I-131 (iodine 131) was also confirmed above the *a posteriori* MDC in all 15 control kelp samples. I-131 is known to be a constituent of sewage plant discharges due to medically administered I-131. The activity of I-131 in the control sample (Salt Creek – about 11 miles up coast from SONGS) has historically been higher than the I-131 activity in kelp closer to SONGS.

Additional samples were taken in the first half of 2012 in May to coincide with the sample date for the San Juan Outfall to identify the source of I-131 found in kelp in the control sites. In May 2012 Barn Kelp Bed was not available for sampling.

APPENDIX C

SUMMARY OF 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 vendors Quality Assurance manual. REMP sample analysis is performed by the Contracted Environmental Analysis Laboratory (CEAL) in accordance with the Laboratory Quality Assurance Plan. During 2012 the CEAL was General Engineering Laboratory (GEL). The CEAL for REMP TLDs was Stanford Dosimetry.

INTERLABORATORY CROSS-CHECK PROGRAM:

The CEAL participates in a number of independent cross check programs, including the National Institute of Standards and Technology (NIST) and Analytics cross-check programs. A summary of the cross check data is included in Table C-1.

One discrepancy was noted in the CEAL's fourth quarter cross check program report. The ratio for Sr-90 in milk did not meet the $\pm$ 25% criteria. GEL initiated CR 130206-759 and determined statistical limits for this particular type of sample cannot meet their typical $\pm$ 25% criteria. Proficiency testing data from 2007 to 2012 were reviewed and a new statistical criteria of – 50% - 125% was assigned for this sample medium. This does not affect the current SONGS REMP as there is no milk production for human consumption within 5 miles.

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

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	16.2 ± 1.22	12.9 ± 0.91	15.5 ± 0.58	12.3 ± 0.69
TLD 200	16.1 ± 1.26	13.3 ± 0.66	15.9 ± 0.86	12.3 ± 0.94

- Data are reported as mR per standard quarter ± 1 sigma

ANNUAL DUPLICATE TLDs

An annual duplicate TLD package is collocated with TLD 67.

TLD 67 average exposure in mR per standard quarter (July 2011 to July 2012)	**TLD 201 (annual duplicate) exposure in mR per standard quarter (July 2011 to July 2012)**
16.4	**15.8**

COMPARISON OF TLD TO PIC DATA,

PIC 3	PIC 4	PIC 6	PIC 8
18.7	17.1	14.8	10.1
TLD 40	TLD 61	TLD 63	TLD 65
18.7	16.0	14.5	14.7

PIC data converted to mR per standard quarter compared to the 4th Quarter co-located 2012 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 flow meters. When the flow meters are removed from service, the meter is calibrated and the calibration reports are reviewed for bias. This is an *a posteriori* review of the gas meter performance to evaluate method bias and to identify possible outlier analysis results. No anomalies in post calibration occurred.

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 • U.S.A.

Tel 404•352•8677
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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

First Quarter 2012
(Ref. Date 15-Mar-2012)

L. Tk 7 May 12

Levan Tkavadze, Nuclear Metrologist Date

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10040	I-131	8.93E+01 pCi	4.92E+00	9.42E+01 pCi	1.57E+00	0.95
I-131						
Cartridge						
GEL ID						
297802001						
E10041	Sr-89	7.94E+01 pCi/L	3.09E+00	7.99E+01 pCi/L	1.33E+00	0.99
Gamma	Sr-90	1.12E+01 pCi/L	1.29E+00	1.14E+01 pCi/L	1.90E-01	0.98
Milk						
GEL ID						
297802002						
E10042	I-131	1.02E+02 pCi/L	5.85E+00	9.25E+01 pCi/L	1.54E+00	1.10
Gamma	Ce-141	2.64E+02 pCi/L	1.22E+01	2.60E+02 pCi/L	4.34E+00	1.01
Milk	Cr-51	4.46E+02 pCi/L	3.07E+01	4.36E+02 pCi/L	7.28E+00	1.02
	Cs-134	1.31E+02 pCi/L	8.20E+00	1.49E+02 pCi/L	2.50E+00	0.88
GEL ID	Cs-137	1.62E+02 pCi/L	7.98E+00	1.59E+02 pCi/L	2.66E+00	1.02
297802003	Co-58	1.28E+02 pCi/L	8.20E+00	1.32E+02 pCi/L	2.20E+00	0.97
	Mn-54	1.99E+02 pCi/L	1.20E+01	1.95E+02 pCi/L	3.26E+00	1.02
	Fe-59	1.96E+02 pCi/L	1.67E+01	1.68E+02 pCi/L	2.81E+00	1.17
	Zn-65	3.50E+02 pCi/L	2.71E+01	3.33E+02 pCi/L	5.56E+00	1.05
	Co-60	2.90E+02 pCi/L	1.35E+01	2.79E+02 pCi/L	4.65E+00	1.04

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10043	I-131	1.01E+02 pCi/L	5.72E+00	9.38E+01 pCi/L	1.57E+00	1.08
Gamma	Ce-141	1.91E+02 pCi/L	9.10E+00	1.84E+02 pCi/L	3.07E+00	1.04
Water	Cr-51	3.34E+02 pCi/L	2.50E+01	3.09E+02 pCi/L	5.16E+00	1.08
	Cs-134	9.90E+01 pCi/L	6.44E+00	1.06E+02 pCi/L	1.77E+00	0.94
GEL ID	Cs-137	1.26E+02 pCi/L	6.73E+00	1.13E+02 pCi/L	1.88E+00	1.12
297802004	Co-58	9.55E+01 pCi/L	6.18E+00	9.34E+01 pCi/L	1.56E+00	1.02
	Mn-54	1.49E+02 pCi/L	9.42E+00	1.38E+02 pCi/L	2.31E+00	1.08
	Fe-59	1.40E+02 pCi/L	1.22E+01	1.19E+02 pCi/L	1.99E+00	1.18
	Zn-65	2.58E+02 pCi/L	1.89E+01	2.35E+02 pCi/L	3.93E+00	1.10
	Co-60	2.14E+02 pCi/L	1.01E+01	1.97E+02 pCi/L	3.29E+00	1.09

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

Second Quarter 2012
(Ref. Date 14-Jun-2012)

L. T 15 Aug 12

Levan Tkavadze, Nuclear Metrologist **Date**

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10175	I-131	9.67E+01 pCi	4.65E+00	9.72E+01 pCi	1.62E+00	0.99
I-131						
Cartridge						
GEL ID						
306080001						
E10176	Sr-89	1.11E+02 pCi/L	4.49E+00	9.98E+01 pCi/L	1.67E+00	1.11
Sr-89/90 w/maf*	Sr-90	1.06E+01 pCi/L	1.26E+00	1.27E+01 pCi/L	2.13E-01	0.83
Milk						
GEL ID						
306080002						
E10177	I-131	9.94E+01 pCi/L	5.65E+00	9.97E+01 pCi/L	1.66E+00	1.00
Gamma	Ce-141	8.62E+01 pCi/L	4.79E+00	8.22E+01 pCi/L	1.37E+00	1.05
Milk	Cr-51	3.76E+02 pCi/L	3.03E+01	4.02E+02 pCi/L	6.71E+00	0.94
	Cs-134	1.63E+02 pCi/L	1.01E+01	1.74E+02 pCi/L	2.91E+00	0.93
	Cs-137	2.08E+02 pCi/L	1.01E+01	2.12E+02 pCi/L	3.54E+00	0.98
	Co-58	8.94E+01 pCi/L	6.00E+00	9.23E+01 pCi/L	1.54E+00	0.97
GEL ID	Mn-54	1.27E+02 pCi/L	8.40E+00	1.32E+02 pCi/L	2.21E+00	0.96
306080003	Fe-59	1.46E+02 pCi/L	1.35E+01	1.28E+02 pCi/L	2.13E+00	1.14
	Zn-65	2.22E+02 pCi/L	1.85E+01	1.99E+02 pCi/L	3.33E+00	1.11
	Co-60	3.52E+02 pCi/L	1.59E+01	3.55E+02 pCi/L	5.93E+00	0.99

*maf = mixed activation/fission products

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10178	I-131	9.94E+01 pCi/L	5.94E+00	9.94E+01 pCi/L	1.66E+00	1.00
Gamma	Ce-141	1.31E+02 pCi/L	7.89E+00	1.12E+02 pCi/L	1.87E+00	1.17
Water	Cr-51	5.51E+02 pCi/L	3.81E+01	5.48E+02 pCi/L	9.14E+00	1.01
	Cs-134	2.22E+02 pCi/L	1.38E+01	2.38E+02 pCi/L	3.97E+00	0.93
	Cs-137	2.91E+02 pCi/L	1.47E+01	2.89E+02 pCi/L	4.82E+00	1.01
	Co-58	1.35E+02 pCi/L	8.93E+00	1.26E+02 pCi/L	2.10E+00	1.07
GEL ID	Mn-54	1.83E+02 pCi/L	1.19E+01	1.80E+02 pCi/L	3.01E+00	1.02
306080004	Fe-59	2.00E+02 pCi/L	1.78E+01	1.74E+02 pCi/L	2.91E+00	1.15
	Zn-65	2.94E+02 pCi/L	2.51E+01	2.72E+02 pCi/L	4.54E+00	1.08
	Co-60	5.04E+02 pCi/L	2.19E+01	4.84E+02 pCi/L	8.09E+00	1.04

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

Eckert & Ziegler
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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

Third Quarter 2012
(Ref. Date 13-Sep-2012)

L. Tk 6 Nov 12

Levan Tkavadze, Nuclear Metrologist Date

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10281	I-131	1.02E+02 pCi	5.04E+00	9.64E+01 pCi	1.61E+00	1.06
I-131						
Cartridge						
GEL ID						
311318001						
E10283	Sr-89	9.87E+01 pCi/L	2.41E+00	9.96E+01 pCi/L	1.66E+00	0.99
Sr-89/90 w/maf*	Sr-90	1.44E+01 pCi/L	7.80E-01	1.60E+01 pCi/L	2.68E-01	0.90
Milk						
GEL ID						
311318002						
E10284	I-131	9.69E+01 pCi/L	6.06E+00	9.96E+01 pCi/L	1.66E+00	0.97
Gamma	Ce-141	1.61E+02 pCi/L	8.35E+00	1.64E+02 pCi/L	2.73E+00	0.98
Milk	Cr-51	2.92E+02 pCi/L	2.51E+01	2.48E+02 pCi/L	4.14E+00	1.18
	Cs-134	9.85E+01 pCi/L	6.12E+00	1.08E+02 pCi/L	1.81E+00	0.91
	Cs-137	1.76E+02 pCi/L	8.46E+00	1.74E+02 pCi/L	2.91E+00	1.01
	Co-58	9.72E+01 pCi/L	5.98E+00	1.00E+02 pCi/L	1.68E+00	0.97
GEL ID	Mn-54	1.98E+02 pCi/L	1.15E+01	1.96E+02 pCi/L	3.27E+00	1.01
311318003	Fe-59	1.62E+02 pCi/L	1.35E+01	1.52E+02 pCi/L	2.53E+00	1.07
	Zn-65	2.08E+02 pCi/L	1.64E+01	1.92E+02 pCi/L	3.21E+00	1.08
	Co-60	1.59E+02 pCi/L	7.97E+00	1.52E+02 pCi/L	2.53E+00	1.05

*maf = mixed activation/fission products

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10285	I-131	1.10E+02 pCi/L	6.52E+00	9.99E+01 pCi/L	1.67E+00	1.10
Gamma	Ce-141	2.49E+02 pCi/L	1.21E+01	2.51E+02 pCi/L	4.19E+00	0.99
Water	Cr-51	3.75E+02 pCi/L	2.84E+01	3.80E+02 pCi/L	6.34E+00	0.99
	Cs-134	1.51E+02 pCi/L	8.74E+00	1.66E+02 pCi/L	2.77E+00	0.91
	Cs-137	2.72E+02 pCi/L	1.22E+01	2.67E+02 pCi/L	4.46E+00	1.02
	Co-58	1.56E+02 pCi/L	9.01E+00	1.54E+02 pCi/L	2.57E+00	1.01
GEL ID	Mn-54	3.16E+02 pCi/L	1.76E+01	3.00E+02 pCi/L	5.01E+00	1.05
311318004	Fe-59	2.65E+02 pCi/L	2.02E+01	2.33E+02 pCi/L	3.89E+00	1.14
	Zn-65	3.20E+02 pCi/L	2.35E+01	2.95E+02 pCi/L	4.92E+00	1.09
	Co-60	2.42E+02 pCi/L	1.12E+01	2.33E+02 pCi/L	3.89E+00	1.04

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

Fourth Quarter 2012
(Ref. Date 06-Dec-2012)

L. Tk 1 Feb 13

Levan Tkavadze, Nuclear Metrologist **Date**

ANA Form002 Rev. --

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10323	I-131	7.31E+01 pCi	9.26E-01	7.29E+01 pCi	1.22E+00	1.00
I-131						
Cartridge						
GEL ID						
316428001						
E10324	Sr-89	9.18E+01 pCi/L	4.05E+00	9.66E+01 pCi/L	1.61E+00	0.95
Sr-89/90 w/maf*	Sr-90	9.89E+00 pCi/L	1.53E+00	1.38E+01 pCi/L	2.31E-01	0.72
Milk						
GEL ID						
316428002						
*w/maf = with mixed activation/fission products						
E10325	I-131	9.57E+01 pCi/L	3.91E+00	9.00E+01 pCi/L	1.50E+00	1.06
Gamma	Ce-141	5.38E+01 pCi/L	2.27E+00	5.10E+01 pCi/L	8.52E-01	1.05
Milk	Cr-51	3.67E+02 pCi/L	1.84E+01	3.48E+02 pCi/L	5.80E+00	1.06
	Cs-134	1.54E+02 pCi/L	3.20E+00	1.65E+02 pCi/L	2.76E+00	0.93
	Cs-137	1.18E+02 pCi/L	3.56E+00	1.17E+02 pCi/L	1.95E+00	1.01
GEL ID	Co-58	9.85E+01 pCi/L	2.80E+00	9.85E+01 pCi/L	1.65E+00	1.00
316428003	Mn-54	1.16E+02 pCi/L	3.26E+00	1.16E+02 pCi/L	1.93E+00	1.00
	Fe-59	1.33E+02 pCi/L	5.21E+00	1.16E+02 pCi/L	1.93E+00	1.15
	Zn-65	1.96E+02 pCi/L	6.65E+00	1.86E+02 pCi/L	3.10E+00	1.05
	Co-60	1.73E+02 pCi/L	3.64E+00	1.70E+02 pCi/L	2.84E+00	1.02

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

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

SAMPLE	ANALYSIS	GEL VALUE	UNCERTAINTY (1 Sigma)	EZA VALUE	UNCERTAINTY (1 Sigma)	RATIO GEL: EZA
E10380	I-131	7.47E+01 pCi/L	3.60E+00	7.25E+01 pCi/L	1.21E+00	1.03
Gamma	Ce-141	5.33E+01 pCi/L	2.17E+00	5.32E+01 pCi/L	8.88E-01	1.00
Water	Cr-51	3.81E+02 pCi/L	1.89E+01	3.62E+02 pCi/L	6.05E+00	1.05
	Cs-134	1.57E+02 pCi/L	3.55E+00	1.73E+02 pCi/L	2.88E+00	0.91
	Cs-137	1.25E+02 pCi/L	2.99E+00	1.22E+02 pCi/L	2.03E+00	1.03
GEL ID	Co-58	1.02E+02 pCi/L	2.79E+00	1.03E+02 pCi/L	1.72E+00	0.99
316428004	Mn-54	1.28E+02 pCi/L	3.36E+00	1.21E+02 pCi/L	2.01E+00	1.06
	Fe-59	1.38E+02 pCi/L	5.82E+00	1.21E+02 pCi/L	2.01E+00	1.14
	Zn-65	2.13E+02 pCi/L	6.12E+00	1.94E+02 pCi/L	3.24E+00	1.10
	Co-60	1.80E+02 pCi/L	4.06E+00	1.77E+02 pCi/L	2.96E+00	1.01

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

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 2012 operational data obtained for SONGS Units 2/3.

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

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 2012 operational data are possible for each of the following exposure pathways to man: (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.

Preoperational data are higher than the operational data. The decrease in radioactivity is due primarily to the cessation of nuclear weapons testing and to the decay of fallout radionuclides. There is a close correlation between indicator and control data over several decades. See Figures 2A, 2B, 3A, 3B, 3C and 4. There are no indications of adverse effects from SONGS on the environment.

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 2012. (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 mR. The preoperational indicator average was 25.3 mR. The preoperational control range was 19.3 to 30.1 and the control mean was 23.1 mR. During the 2012 operational year for Units 2/3, the routine indicator TLD locations ranged from 10.1 to 26.4 mR, averaging 16.8 mR while the control locations ranged from 12.9 to 20.0 mR with an average of 16.7 mR. Outside the EAB all of the control and indicator TLD data is less than the calculated detection limit (5 mR per standard quarter) above the baseline background for each TLD location. Refer to Appendix B for a detailed discussion of the REMP TLD data.

Factors such as meteorology, local geology, the fallout from atmospheric nuclear weapons testing, and seasonal fluctuations account for the variability in the data 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 2012 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 compare the environmental radiation levels of selected indicator and control locations. Simultaneous variation in the radiation levels at both the control and indicator locations shows that the variations are due to factors external to SONGS. Outside the EAB the operation of SONGS had no detectable 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 36 years (January 1976 to December 2012). 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; the April 1986 Chernobyl accident and the March 11, 2011 Fukushima Dai-Ichi 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 factors external to SONGS.

C. Radioiodine

SONGS Units 2/3:

Most of the preoperational data for I-131 level were below the detection limit. Unit 2 was shut down for a planned refueling outage on January 9, 2012 and did not operate for the remainder of 2012 and unit 3 was taken off-line after a steam generator tube leak on January 31, 2012. SONGS had no effect on the environment as measured by the radioiodine cartridge data.

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, 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. One of the quarterly ocean water composite samples from the Unit 2 outfall had 404 pCi/l of tritium in September 2012 compared to a value of 302 pCi/l of tritium in the control sample from Newport Beach.

The data for all other SONGS related radionuclides at all ocean water locations during the 2012 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 2012 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 2012 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 8.1 pCi/g, averaging 0.79 pCi/g. Cs-137 was also detected in 16 of the 28 samples. The concentrations of Cs-137 in the samples ranged from 0.014 to 0.090 pCi/g, averaging 0.039 pCi/g. Cerium-144 (Ce-144) was found in two samples. The concentration of Ce-144 in the samples was 0.06 and 0.26 pCi/g, respectively.

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 2012 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 2012**
** **During January to December 2012 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 four 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 2012 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 2012 operational period, no SONGS related radionuclides were detected above the *a priori* LLD. Several samples in both the control and indicator locations were found above the *a posteriori* MDC. The data indicate no accumulation trends. The operation of SONGS Units 2/3 in 2012 had no impact on the environment as measured by this sample medium.

TABLE D-2

MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND 2012 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 SONGS related radionuclides	PreOp	< LLD	< LLD	< LLD	< LLD
	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 SONGS related radionuclides	PreOp	< LLD	< LLD	< LLD	< LLD
	Operational	< LLD	< LLD	< LLD	< LLD

* **PreOp = January 1979 to July 1982; Operational = January to December 2012. The species collected in 2012 were California Mussel, Black Perch, Sheephead, Kelp Bass, Barred Sand Bass, and Spiny Lobster.**

** **During January to December 2012 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 2012 OPERATIONAL DATA (SONGS UNITS 2/3)*

Mussel Flesh (Bay or California)**

		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	< LLD	< LLD	< LLD	< LLD

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 2012. The species collected in 2012 were California Mussel, Black Perch, Sheephead, Kelp Bass, Barred Sand Bass, and Spiny Lobster.**

** **During January to December 2012 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 2010 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 SONGS related radionuclides	PreOp Operational	< LLD ---	< LLD ---	< LLD ---	< LLD ---

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 SONGS related Radionuclides	PreOp Operational	< LLD ---	< LLD ---	< LLD ---	< LLD ---

* **PreOp = January 1979 to July 1982; Operational = January to December 2012**

** **Sea Hare and Keyhole Limpet samples were not collected in 2012**

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.

Samples collected in May and October, 2012 were < LLD for all plant related radionuclides. In June 2012, Cs-137 was detected in a control sample of tomato > *a posteriori* MDC, but <LLD. A recount was < *a posteriori* MDC. 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 at Salt Creek. After collection, the samples are analyzed by gamma-spectral analysis for naturally occurring and SONGS-related radionuclides. During 2012 four additional control sample locations were analyzed.

To assess the impact of SONGS operations on kelp, preoperational data were compared to 2012 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 2012 operational period, I-131 was detected in all samples. No other station related isotopes were detected in kelp samples during the 2012 operational period. Figure 4 (I31 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 locations. These data support the conclusion that during the Units 2/3 operational period, the detection of I-131 in kelp is due to factors external to SONGS.

K. Drinking Water

No plant related radionuclides were detected during the 2012 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-0.18	< LLD	0.25	0.25
All other measured SONGS related radionuclides	PreOp	< LLD	< LLD	< LLD	< LLD
	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	0.011– 0.039	0.024	0.011 – 0.079	0.035
Cs-137	PreOp	0.004-0.009	0.006	<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 2012**
LLD Lower Limit of Detection for operational data are listed in Appendix B.

APPENDIX E

DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS

IN 2012

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 2012, 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 2012 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 2012 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 16 (San Luis Rey Substation): Sampler # 16 had 4.82 hours of down time in 2012 due to external factors (electrical 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 2012 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 2012.

B. DIRECT RADIATION

No deviations were observed.

C. LOCAL CROPS

No deviations were observed.

D. SHORELINE SEDIMENTS

No deviations were observed.

E. DRINKING WATER

No deviations were observed.

F. SOIL

No deviations were observed.

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

The 2012 Land Use Census (LUC) was conducted in-house in accordance with Section 5.2 of the Offsite Dose Calculation Manual (ODCM) and per the Radiological Environmental Monitoring Program (REMP) Land Use Census Procedure, SO123-IX-1.20. The purpose of the Land Use Census is to identify radiation exposure pathways to humans. The methodology consists of reviewing aerial photographs of the study area and confirming data with the cognizant agency. This study is conducted annually. Information on how long a person or persons will be located at the nonresidential uses closer than the closest residence is also estimated by the appropriate person or agency.

Executive Summary

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

Definition of Uses

Residence is defined as any structure (single-family house, apartment, mobile home, barracks or similar unit) that is occupied by an individual(s) or resident(s) for three months (2,000 hours) or longer in a given year.

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

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

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

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

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

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

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

THE STUDY SCOPE

The study area includes land in both Orange and San Diego counties. The Orange County portion includes a portion of the city of San Clemente (population estimated to be 63,743 as of January 1, 2011) and the San Clemente State Park. The San Diego County portion includes much of the Camp Pendleton USMC base, San Onofre State Beach and Park, and SONGS itself.

The LUC map is divided into 16 sectors; A, B, C, D, E, F, G, H, J, K, L, M, N, P, Q, and R. The ODCM requires that the LUC identify the nearest residences, milk animals, meat animals, and vegetable gardens of at least 500 square feet, and other specified uses (campgrounds, employment, etc.) in each of the sectors within five miles of SONGS. Sectors A, B, C, D, E, and F include land almost exclusively within the boundaries of the Marine Corps Base Camp Pendleton. The study area in sector G includes the area along the coast south of SONGS. Sectors H, J, K, L, M, and N are the Pacific Ocean; no land uses possible. Sectors P, Q, and R include the City of San Clemente and part of Camp Pendleton.

METHODOLOGY

A review of the 2011 LUC and documentation notebook was conducted. Verification & revision of the 2011 data was accomplished by inquiry to the cognizant agency, organization, or individual possessing direct knowledge of the item being verified.

A vegetable garden census was performed by examining aerial photographs. Locations which appeared to correspond to garden locations were converted to street addresses. The identified locations were compared with the addresses evaluated in previous LUCs. One new garden was identified in 2012.

The closest residence was established in each sector by aerial photo review and by correspondence with USMC Camp Pendleton. The meat and milk animal survey was performed by contacting the natural resources office on Camp Pendleton and the Orange County Agriculture Department. Information on other uses was obtained by contacting the appropriate organizations.

The 2012 Land Use Census survey was prepared per SONGS procedure SO123-IX-1.20, revision 6.

SUMMARY OF CHANGES

Summary of Changes

1. LUC # G-15 – A new garden was identified 4.0 miles from Units 2/3 in Sector Q.
2. LUC # R-R2 - SONGS Camp Mesa was a Full Time Residence (FTR) in 2012.
3. LUC # R-R3 – The SONGS dry camping increased occupancy to 2136 hours for 2012.
4. LUC # O-2B UMCA surfcamp – The YMCA operated an overnight surf camp during 2012 at San Onofre State Park, group space #1, with a maximum estimated occupancy of 384 hours.
5. LUC # R-C2 – The Camp San Onofre Fire Station estimated maximum occupancy increased to 3984 hours per year.
6. LUC # 24 – The Christianitos Fire Station estimated maximum occupancy increased to 3984. This location is included in Table 2 for historical trending purposes only and is not mapped.
7. Updated Camp Pendleton hunting take data for the period July 1, 2011 to June 30, 2012 is listed in Table 3. Per the base wildlife biologist, the exact location of a particular kill is not known. The reported take area should be interpreted as an estimate of approximate location. Thus a deer reported as taken in hunting area Alpha 2 may actually have been taken in an adjacent hunting area (such as Romeo 3 or Bravo 3). There are no changes to the estimated distances from SONGS to the nearest vegetation potentially consumed by deer for 2012.

TABLE F-1
2012 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

Units 2/3 Sector	LUC #	Residence	Miles From U2/3	Estimated Hours of Maximum Occupancy
A	R-A1	Camp San Mateo	3.6	FTR
	R-A2	SONGS Camp Mesa	0.4	**FTR**
B				
C	R-C2	Camp San Onofre Fire Station	2.4	**3,984**
	R-C1	Camp San Onofre Barracks 524101	2.8	FTR
	R-C3	**Camp San Onofre Barracks**	**2.6**	**FTR**
D	R-D1	Camp San Onofre Barracks	3.0	FTR
E	R-E1	Camp Horno Barracks	4.1	FTR
F				
G				
	Sectors H, J, K, L,M, and N have no identified land uses These Sectors are primarily the Pacific Ocean and contain only a small portion of the plant site, and a beach walkway providing access for state beach park users north & south of SONGS.			
P	R-P3	San Onofre Rec Beach (SORB)	1.0	FTR
	R-P2	San Mateo Point Housing	2.7	FTR
	R-P1	Cotton Point Estates	2.7	FTR
Q	R-Q5	SORB Resident Employee	1.1	FTR
	R-Q2	San Onofre III housing	1.4	FTR
	R-Q3	San Mateo Point Housing	2.7	FTR
R	R-R2	SONGS Camp Mesa	0.4	**FTR**
	R-R3	SONGS Dry Camping PL12	0.7	**2136**
	R-R1	San Onofre III housing	1.3	FTR

Bold Text indicates changes from 2011 LUC Data as of 9-30-2012 FTR – Full Time Residence

TABLE F-2
2012 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

Units 2/3 Sector	LUC #	Gardens	Miles From U2/3
A			
B			
C			
D			
E			
F			
G			
	Sectors H, J, K, L,M, and N have no identified land uses These Sectors are primarily the Pacific Ocean and contain only a small portion of the plant site, and a beach walkway providing access for state beach park users north & south of SONGS.		
P	G-3	Cotton Point Estate	2.8
Q	G-8	2240 Ave Salvador	4.1
	G-5	1706 S Ola Vista	4.4
	G-6	1315 S Ola Vista	4.6
	G-15	**130 Calle del Pacifico**	**4.0**
R	G-10	SONGS Garden	0.4

Bold Text indicates changes from 2011 LUC Data as of 9-30-2012 FTR – Full Time Residence

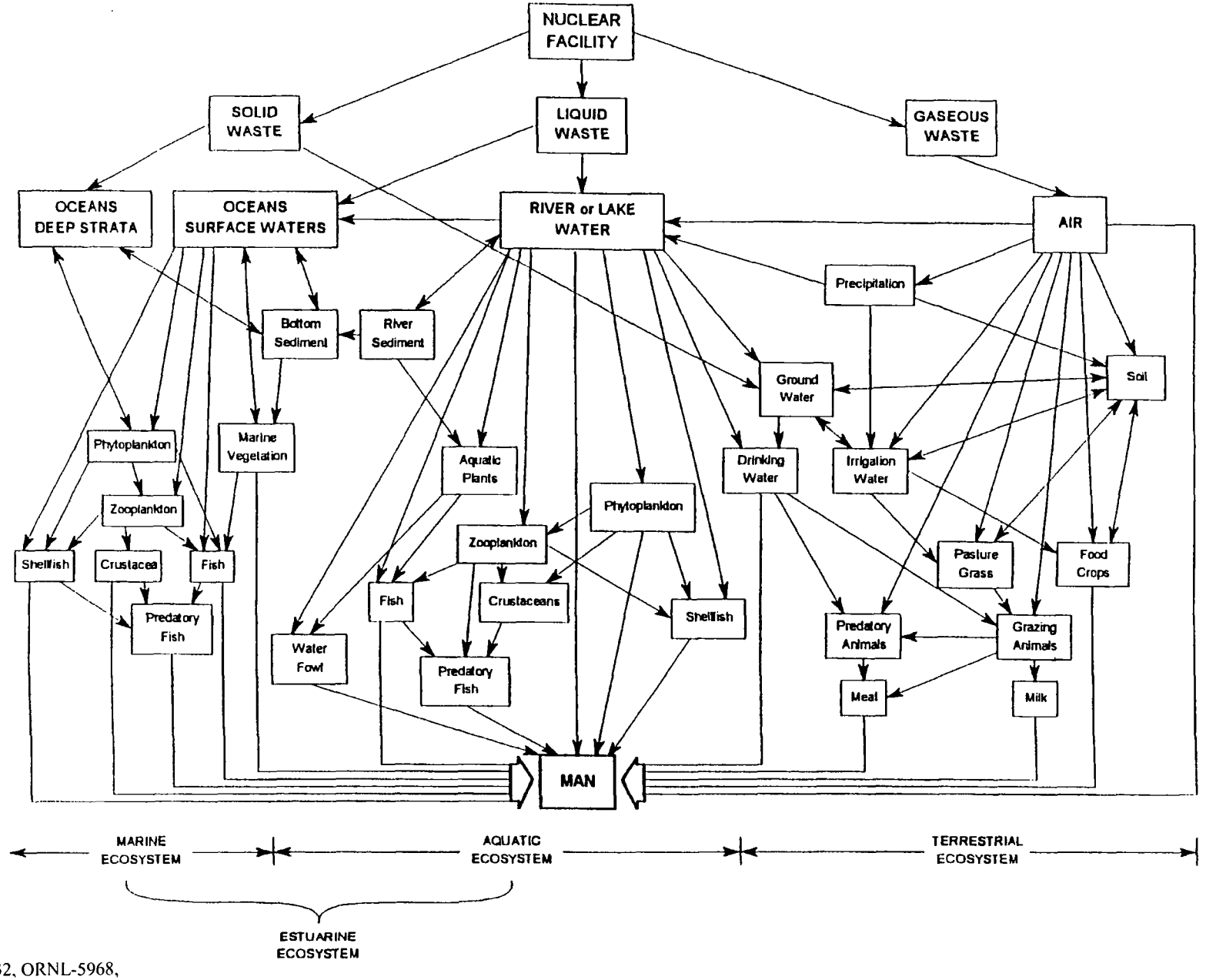
TABLE F-3
2012 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

Units 2/3 Sector	LUC #	Other Specified Uses	Miles From U2/3	Estimated Hours of Maximum Occupancy
A	O-8	Camp San Mateo Motor Pool	3.6	2,000
	22	SCE Land Uses	0.4	---
B	O-9	USMC CP Sanitary Land Fill	2.1	816
C	O-10	Camp San Onofre (STP #11)	2.2	2,000
D				
E	O-5	Camp Horno Motor Pool	4.0	2500
F	O-1	San Onofre State Beach Guard Shack	0.8	1,500
	31A	Border Patrol Checkpoint (NB)	1.9	2400
	31B	Hwy Patrol Weigh Sta (NB)	2.1	1,960
G	O-2	San Onofre Beach Campground	1.8	720
	32	Hwy Patrol Weigh Sta (SB)	2.1	1,960
	O-2A	Endless Summer Surf Camp (see notes) / Campground Host	2.8	4,380
	O-2B	**YMCA Surf Camp**	**2.0**	**384**
	Sectors H, J, K, L,M, and N have no identified land uses These Sectors are primarily the Pacific Ocean and contain only a small portion of the plant site, and a beach walkway providing access for state beach park users north & south of SONGS.			
P	O-6	Surf Beach (Lifeguard)	0.5	800
	3	Trestles Beach Lookout Tower	1.8	500
Q	O-3	State Park Office Trailer	0.6	2,000
	5	Surf Beach Guard Shack	0.7	1,500
	18	SORB Lifeguard Tower	1.2	2,000
	1A	SORB Campground Checkin	1.3	2000
R				

Bold Text indicates changes from 2011 LUC Data as of 9-30-2012 FTR – Full Time Residence

APPENDIX G

FIGURES FOR 2012



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

Figure 1. Potential Radiation Exposure Pathways Leading to Man

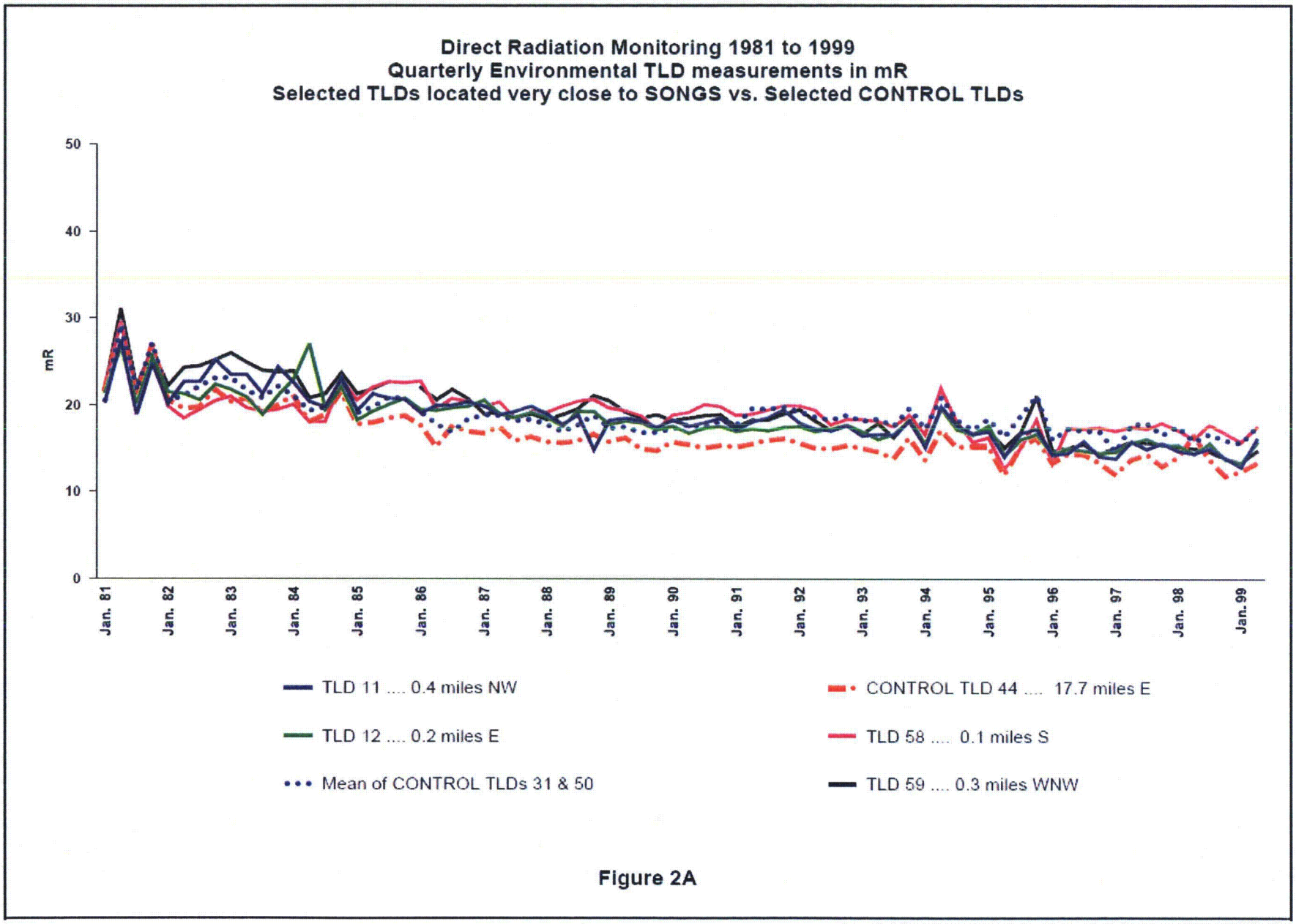

Direct Radiation Monitoring 1981 to 1999
Quarterly Environmental TLD measurements in mR
Selected TLDs located very close to SONGS vs. Selected CONTROL TLDs
mR
50
40
30
20
10
0
Jan. 81
Jan. 82
Jan. 83
Jan. 84
Jan. 85
Jan. 86
Jan. 87
Jan. 88
Jan. 89
Jan. 90
Jan. 91
Jan. 92
Jan. 93
Jan. 94
Jan. 95
Jan. 96
Jan. 97
Jan. 98
Jan. 99
TLD 11 .... 0.4 miles NW
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 2A

Direct Radiation Monitoring 1998 to 2012
Quarterly Environmental TLD measurements in mR
Selected TLDs located very close to SONGS vs. Selected CONTROL TLDs

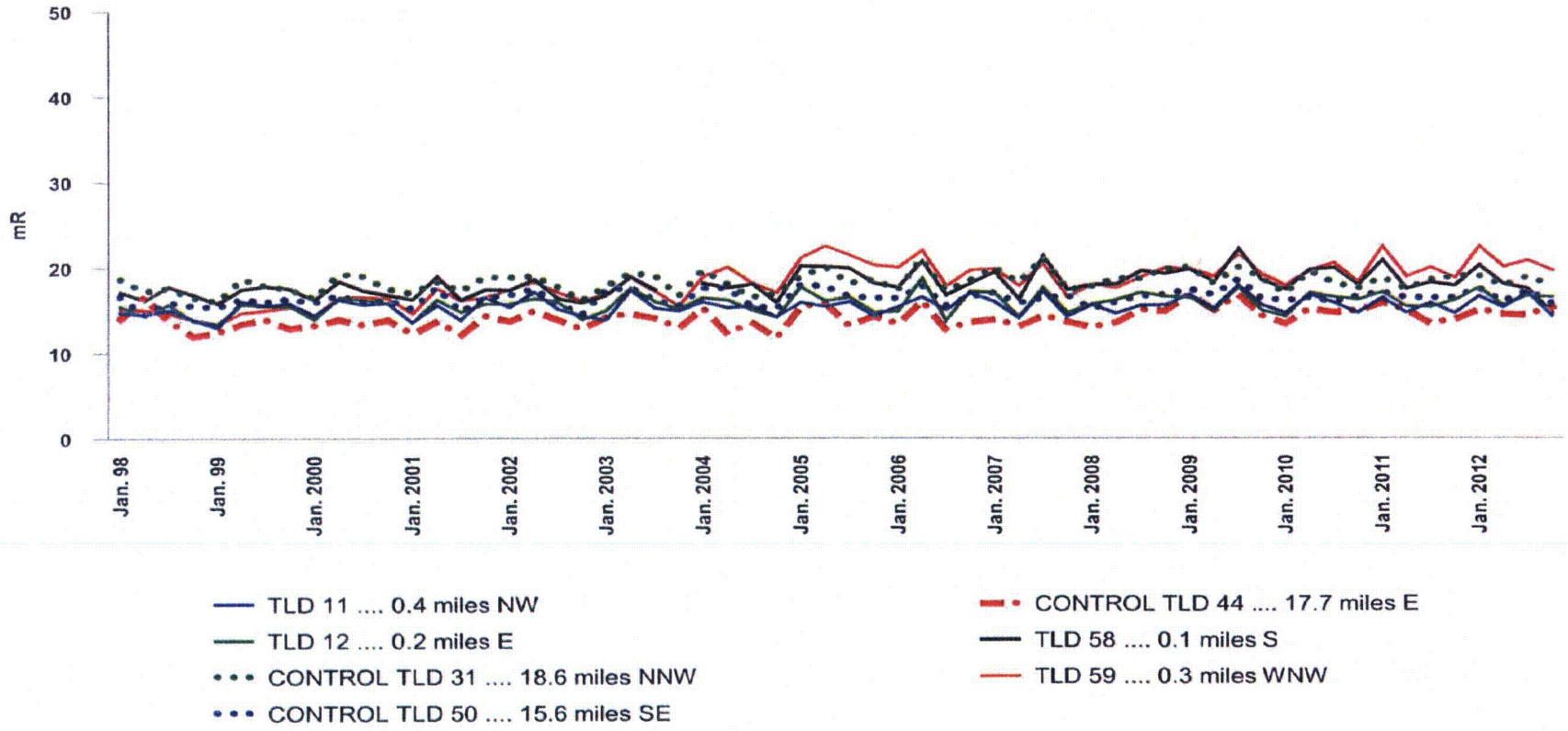


Figure 2B

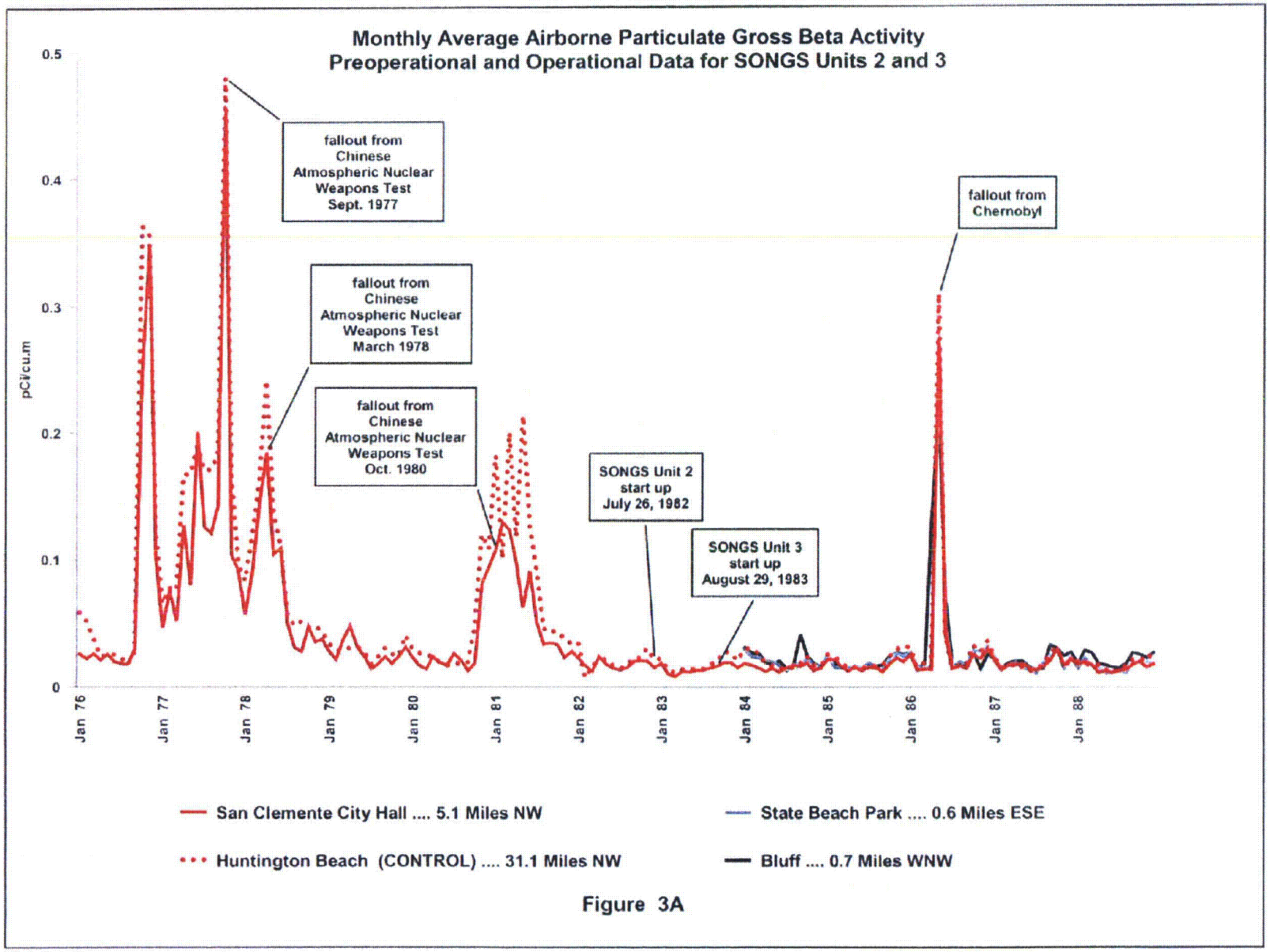

Monthly Average Airborne Particulate Gross Beta Activity
Preoperational and Operational Data for SONGS Units 2 and 3
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
fallout from Chinese Atmospheric Nuclear Weapons Test Sept. 1977
fallout from Chinese Atmospheric Nuclear Weapons Test March 1978
fallout from Chinese Atmospheric 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
Huntington Beach (CONTROL) .... 31.1 Miles NW
State Beach Park .... 0.6 Miles ESE
Bluff .... 0.7 Miles WNW

Figure 3A

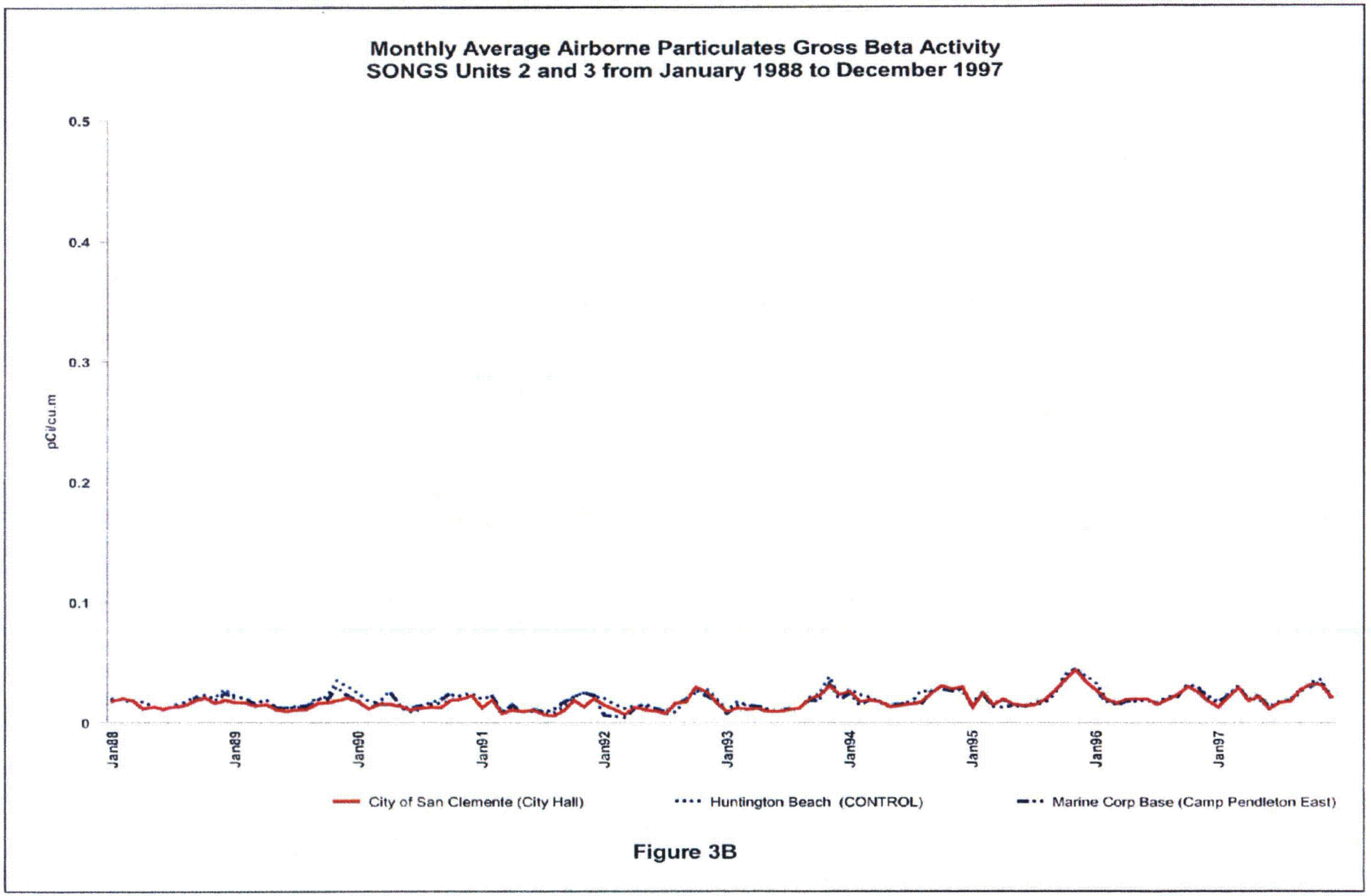

Monthly Average Airborne Particulates Gross Beta Activity
SONGS Units 2 and 3 from January 1988 to December 1997
0.5
0.4
0.3
0.2
0.1
0
pCi/cu.m
Jan88
Jan89
Jan90
Jan91
Jan92
Jan93
Jan94
Jan95
Jan96
Jan97
City of San Clemente (City Hall)
Huntington Beach (CONTROL)
Marine Corp Base (Camp Pendleton East)

Figure 3B

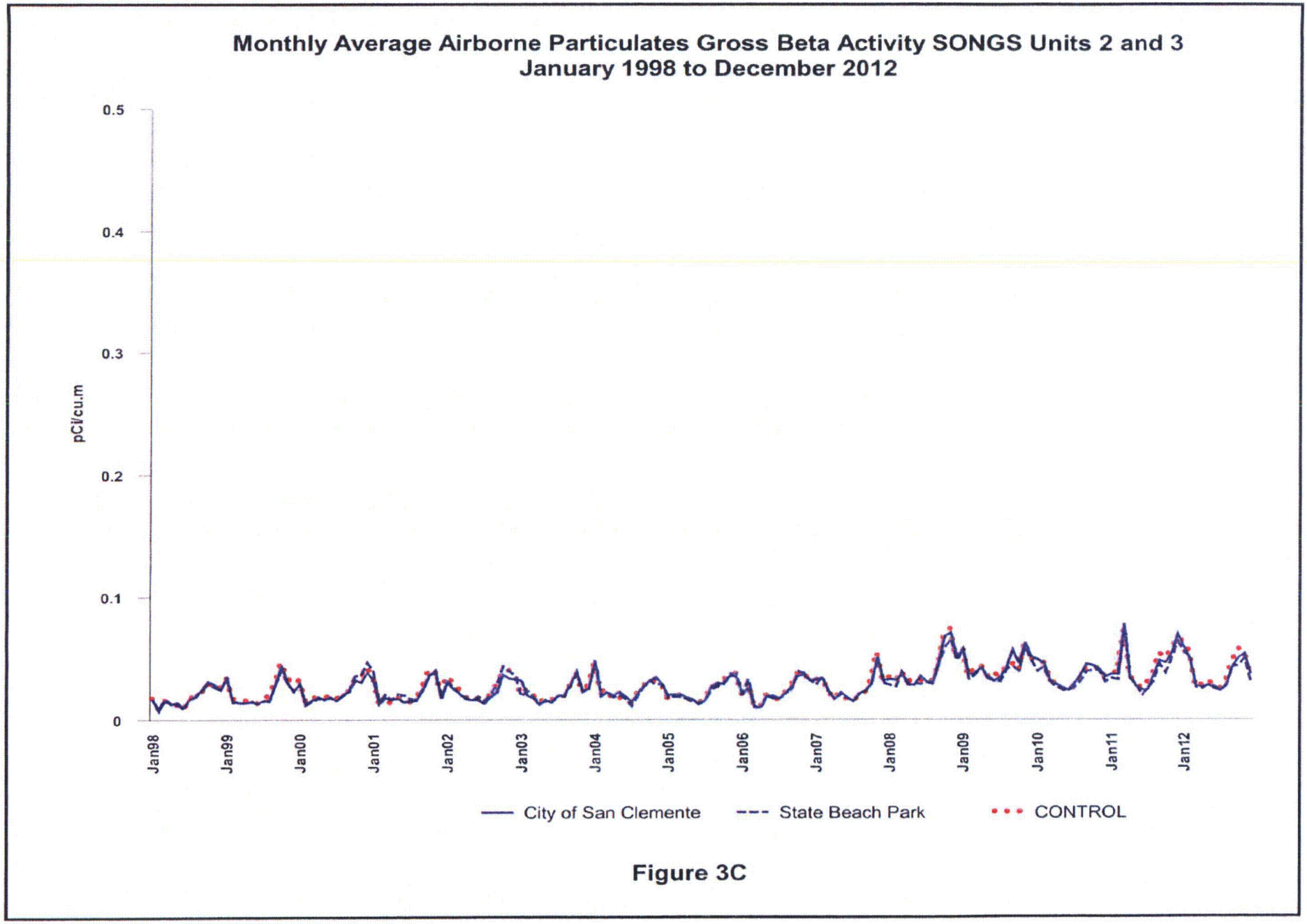

Monthly Average Airborne Particulates Gross Beta Activity SONGS Units 2 and 3
January 1998 to December 2012
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
Jan98
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
City of San Clemente
State Beach Park
CONTROL

Figure 3C

Weekly Airborne Particulate Gross Beta Activity
January 2011 to December 2012

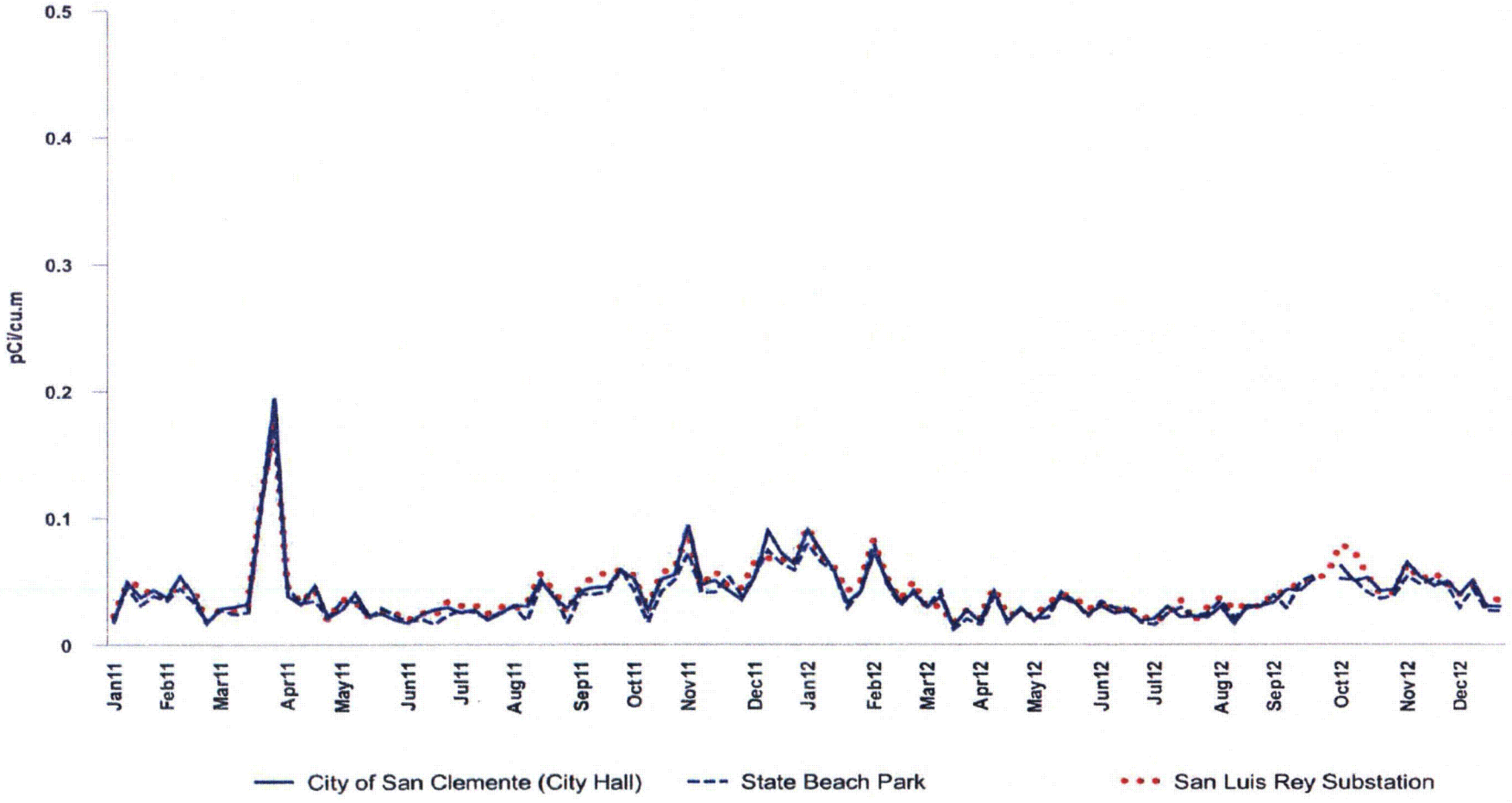


Figure 3D

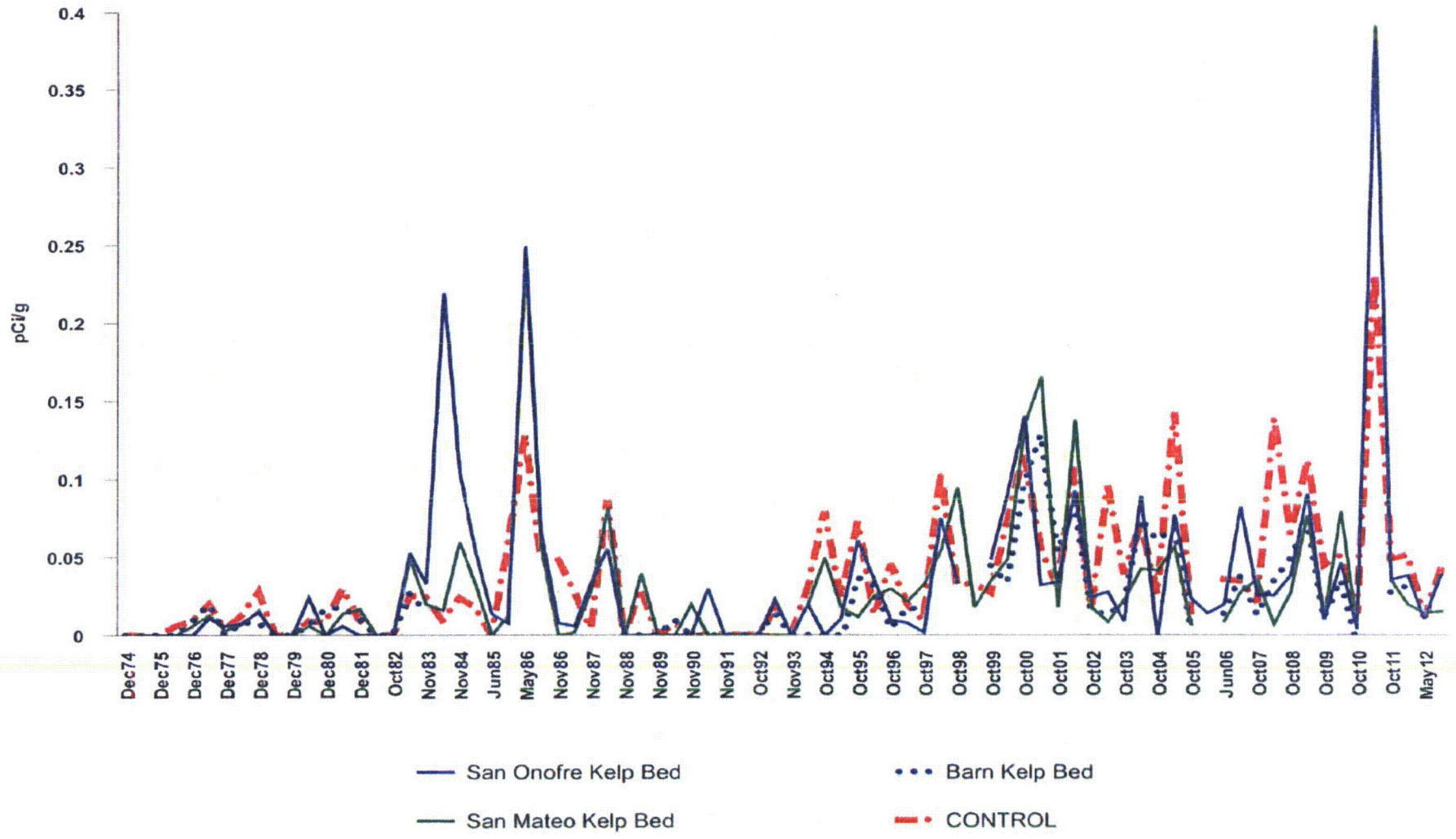

I-131 in Aquatic Kelp
pCi/g
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec74
Dec75
Dec76
Dec77
Dec78
Dec79
Dec80
Dec81
Oct82
Nov83
Nov84
Jun85
May86
Nov86
Nov87
Nov88
Nov89
Nov90
Nov91
Oct92
Nov93
Oct94
Oct95
Oct96
Oct97
Oct98
Oct99
Oct00
Oct01
Oct02
Oct03
Oct04
Oct05
Jun06
Oct07
Oct08
Oct09
Oct10
Oct11
May12
San Onofre Kelp Bed
Barn Kelp Bed
San Mateo Kelp Bed
CONTROL

Figure 4

APPENDIX H

ERRATA TO THE 2011 AREOR

All data required by the ODCM in 2011 was reported in the 2011 AREOR. There are no errata to be appended to the 2011 AREOR.

APPENDIX I

REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2012

APPENDIX I

REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2012

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

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.

2012 Data from SCE TLDs (mR/ standard quarter)

Location Number	Location Name	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
SCE -1 , NRC -7, DPH #2	San Clemente	18.1	16.8	16.7	17.3
SCE -2, NRC -23, DPH #8	Camp San Mateo	18.2	17.7	18.5	17.8
SCE -3, NRC -19, DPH #9	Camp San Onofre	16.4	15.4	16.5	15.5
SCE -6, DPH #10	Old Route 101 (East-Southeast)	12.0	10.6	11.3	10.6
SCE 10, NRC -12, DPH #6	San Onofre Surfing Beach	18.1	15.4	16.0	16.2
SCE 16, DPH #7*	ESE Site boundary	22.3	17.5	19.3	17.8
SCE 22, NRC 11, DPH #4	Coast Guard Station	18.7	16.5	17.7	17.9
SCE -34, NRC -14, DPH #5	San Onofre Elementary School	16.7	14.3	15.4	15.8
SCE 41, NRC 25, DPH #11**	Old Route 101 (Unit 3)	15.8	15.1	15.8	15.1
SCE 50, NRC 32, DPH #13	Oceanside Fire Station	17.1	16.5	16.5	16.5

* SCE 16 is approximately 15 meters from DPH 7. DPH 7 is across Basilone Rd

** SCE 41 is approximately 120 meters from DPH 11. Results included per DPH request

Appendix J

Independent Spent Fuel Storage Installation (ISFSI) TLD Data

Independent Spent Fuel Storage Installation (ISFSI) TLD Data

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

An evaluation of the entire REMP TLD database yielded estimated background exposure rate of approximately 15 mR / std quarter. However, some local variability within the CAB / EAB are to be attributable to factors external to SONGS (such as micro-geological variations). Another variable for the measured exposure rate is transit exposure to and from the TLD lab. The transit exposure is variable and is corrected by the lab but the issue of TLD shipment packaging geometry cannot be readily corrected. Therefore, a comparison of pre-operational data and operational data needs to be considered in conjunction with a comparison of ISFSI TLD data and the estimated baseline background exposure rate within the EAB. Using this information, we conclude that the exposure rate outside the CAB (10 CFR 72 Controlled Area Boundary) is less than detectable. The detection limits are 5 mR/standard quarter and 10 mR/year. The exposure attributable to the operation of the ISFSI as indicated by this media is not measurable beyond the immediate area of the ISFSI.

Environmental exposure rates are variable and small changes in TLD location can measurably change the data. The REMP TLD data show a seasonal variability that does not appear to be related to any activities at SONGS. The data support the conclusion that macro-environmental factors are the causative agents for the seasonal 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 6a. In addition to environmental factors, some non-ISFSI work activities at Unit 1 have elevated the pre-operational measured ISFSI TLD exposure. The storage and transport of radioactive materials and waste near the location of the ISFSI foundation area in 2001 and 2002 appears to have elevated the exposure rates of TLDs 306 to 315. In addition, the movement of the Unit 1 reactor vessel in October 2002 caused a noticeable increase in the measured exposure for TLDs 301 to 315. The measured exposure rate for the ISFSI TLDs close to the ISFSI is consistent with the exposure rate expected from known radiological work activities. The elevated exposure rate from TLDs 301, 302, 303, 304, 323, 324, 325, 326, 327 and 328 is primarily due to the movement and storage of used fuel at the ISFSI.

In the second quarter of 2011 additional TLDs 327 and 328 were placed along the fence on the southwest side of the ISFSI. These TLDs had the highest readings in 2012. The closest publicly accessible location is SW of the ISFSI along the San Onofre Beach access road, outside the plant's perimeter. The background corrected annual exposure for the access road TLDs 55 and 56 was 19 and 17 mR, respectively, in 2012. Assuming a maximum occupancy of 300 hours per year the dose to a member of the general public is < 1 mrem per year at this location as measured by the REMP TLDs.

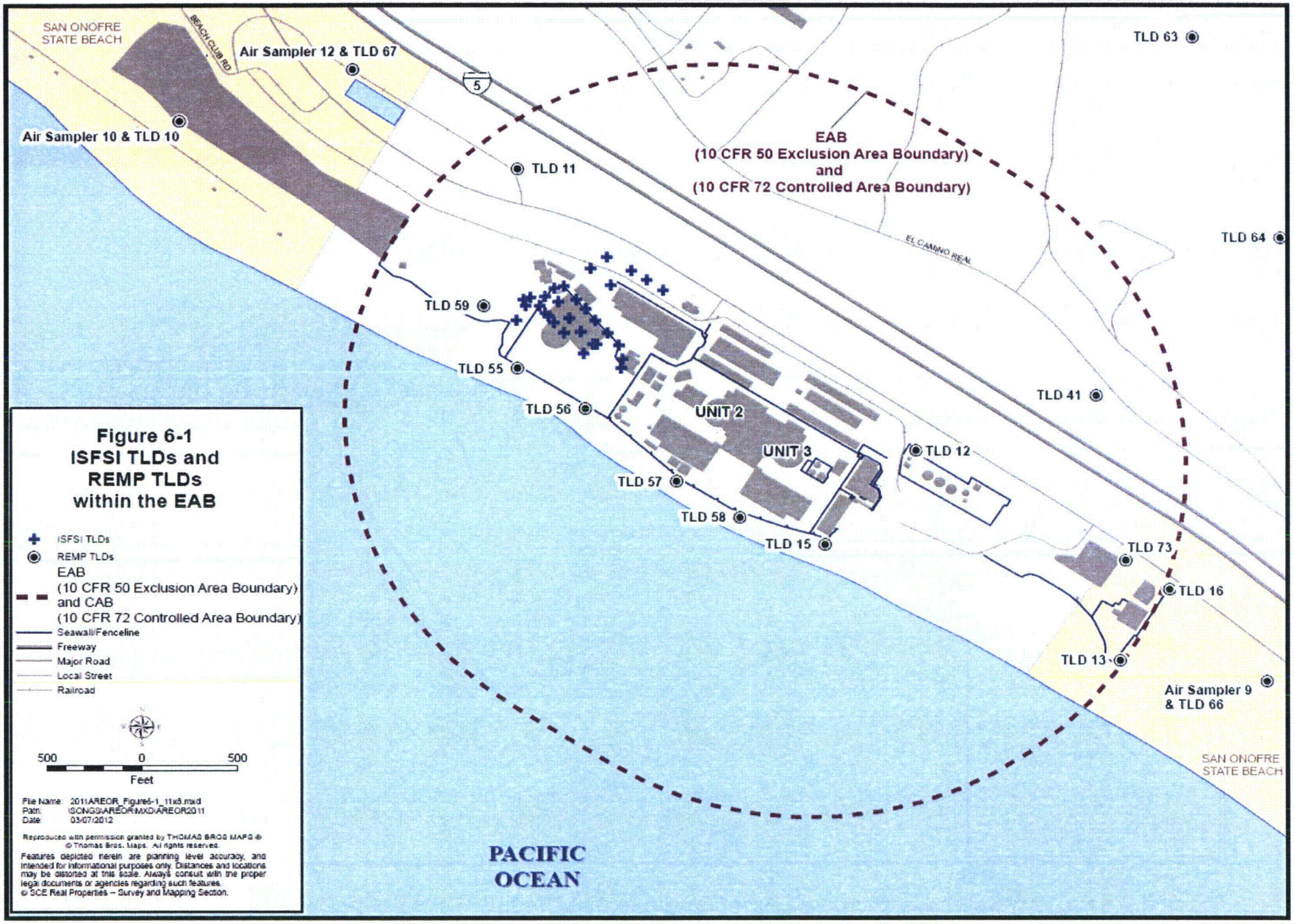
Starting in the fourth quarter 2010 neutron dosimeters were placed in ISFSI TLD canisters 311, 324, 325, and 326. In the second quarter 2011 neutron dosimeters were also placed adjacent to TLDs 327 and 328. The 2012 neutron exposure is below measurable levels for spent fuel in storage. Neutron exposure during fuel transfer is measurable at the fence surrounding the storage facility at low levels, typically a few mR per quarter. These measurements demonstrate that the neutron exposure is bounded by the projected neutron dose rates in calculation SCE-23-0508, is well within the limits specified in 10CFR72.104, and is consistent with known ISFSI radiological conditions. The measured ISFSI gamma TLD exposure rates were also determined to be consistent with the calculated ISFSI dose rates and known radiological conditions.

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

Table J-1

ISFSI TLD DATA

Location	Quarterly Background	2012 Quarterly Results (mR) 1	2	3	4	Background adjusted 2012 Quarterly Results (mR) 1	2	3	4	Annual Baseline	2012 Annual Total (mR)
ISFSI 301	15	29.78	29.26	28.23	21.71	14.26	14.26	13.23	6.71	60	108.98
ISFSI 302	15	82.52	77.23	77.55	50.35	67.52	62.23	62.55	35.35	60	287.65
ISFSI 303	15	47.68	50.19	45.8	35.04	32.68	35.19	30.8	20.04	60	178.71
ISFSI 304	15	36.82	38.35	37.54	28.66	21.82	23.35	22.54	13.66	60	141.37
ISFSI 306	15	32.61	30.15	31.14	24.83	17.61	15.15	16.14	9.83	60	118.73
ISFSI 307	15	21.39	25.91	23.06	17.8	6.39	10.91	8.06	<LLD	60	88.16
ISFSI 308	15	21.78	21.07	21.17	19.22	6.78	6.07	6.17	<LLD	60	83.24
ISFSI 309	15	22.4	20.72	21.78	18.52	7.4	5.72	6.78	<LLD	60	83.42
ISFSI 310	15	22.89	21.47	21.39	18.18	7.89	6.47	6.39	<LLD	60	83.93
ISFSI 311	15	21.59	18.97	19.52	17.81	6.59	<LLD	<LLD	<LLD	60	77.89
ISFSI 312	15	16.27	14.44	14.7	13.71	<LLD	<LLD	<LLD	<LLD	60	59.12
ISFSI 314	15	20.28	18.34	18.46	16.89	5.28	<LLD	<LLD	<LLD	60	73.97
ISFSI 315	15	20.24	18.14	17.69	16.79	5.24	<LLD	<LLD	<LLD	60	72.86
ISFSI 316	15	19.48	19.33	23.2	17.51	<LLD	<LLD	8.2	<LLD	60	79.52
ISFSI 317	15	23.5	24.17	24.92	18.04	8.5	9.17	9.92	<LLD	60	90.63
ISFSI 318	15	21.71	20.09	20.88	18.18	6.71	5.09	5.88	<LLD	60	80.86
ISFSI 319	15	22.62	20.16	21.12	18.01	7.62	5.16	6.12	<LLD	60	81.91
ISFSI 320	15	23.95	21.42	21.84	17.63	8.95	6.42	6.84	<LLD	60	84.84
ISFSI 321	15	23.27	22	23.28	18.62	8.27	7	8.28	<LLD	60	87.17
ISFSI 322	15	24.14	20.08	27.93	21.3	9.14	5.08	12.93	6.3	60	93.45
ISFSI 323	15	40.11	34.86	36.02	31.44	25.11	19.86	21.02	16.44	60	142.43
ISFSI 324	15	168.58	123.47	105.11	79.76	153.58	108.47	90.11	64.76	60	476.92
ISFSI 325	15	111.46	120.63	121.29	67.01	96.46	105.63	106.29	52.01	60	420.39
ISFSI 326	15	45.51	53.17	54.25	35.63	30.51	38.17	39.25	20.63	60	188.56
ISFSI 327	15	291.57	348.8	324.32	196.79	276.57	333.8	309.32	181.79	60	1161.48
ISFSI 328	15	174.64	211.39	207.9	102.09	159.64	196.39	192.9	87.09	60	696.02
55 San Onofre State Beach (U1 West)	15	22.16	19.67	19.51	17.58	**7.16**	<LLD	<LLD	<LLD	60	78.92
56 San Onofre State Beach (U1 West)	15	23.83	18.1	18.96	16	**8.83**	<LLD	<LLD	<LLD	60	76.89
57 San Onofre State Beach (Unit 2)	15	20.42	18.48	17.54	16.26	**5.42**	<LLD	<LLD	<LLD	60	72.7
59 SONGS Meteorological Tower	15	22.57	20.17	20.92	19.7	**7.57**	**5.17**	**5.92**	<LLD	60	83.36


SAN ONOFRE
STATE BEACH
BEACH CLUB RD
Air Sampler 12 & TLD 67
Air Sampler 10 & TLD 10
5
TLD 11
EAB
(10 CFR 50 Exclusion Area Boundary)
and
(10 CFR 72 Controlled Area Boundary)
TLD 63
TLD 64
EL CAMINO REAL
TLD 59
TLD 55
TLD 56
TLD 57
TLD 58
TLD 15
UNIT 2
UNIT 3
TLD 41
TLD 12
TLD 73
TLD 16
TLD 13
Air Sampler 9
& TLD 66
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
Freeway
Major Road
Local Street
Railroad
500
0
500
Feet
File Name: 2011AREOR_Figure6-1_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2011
Date: 03/07/2012
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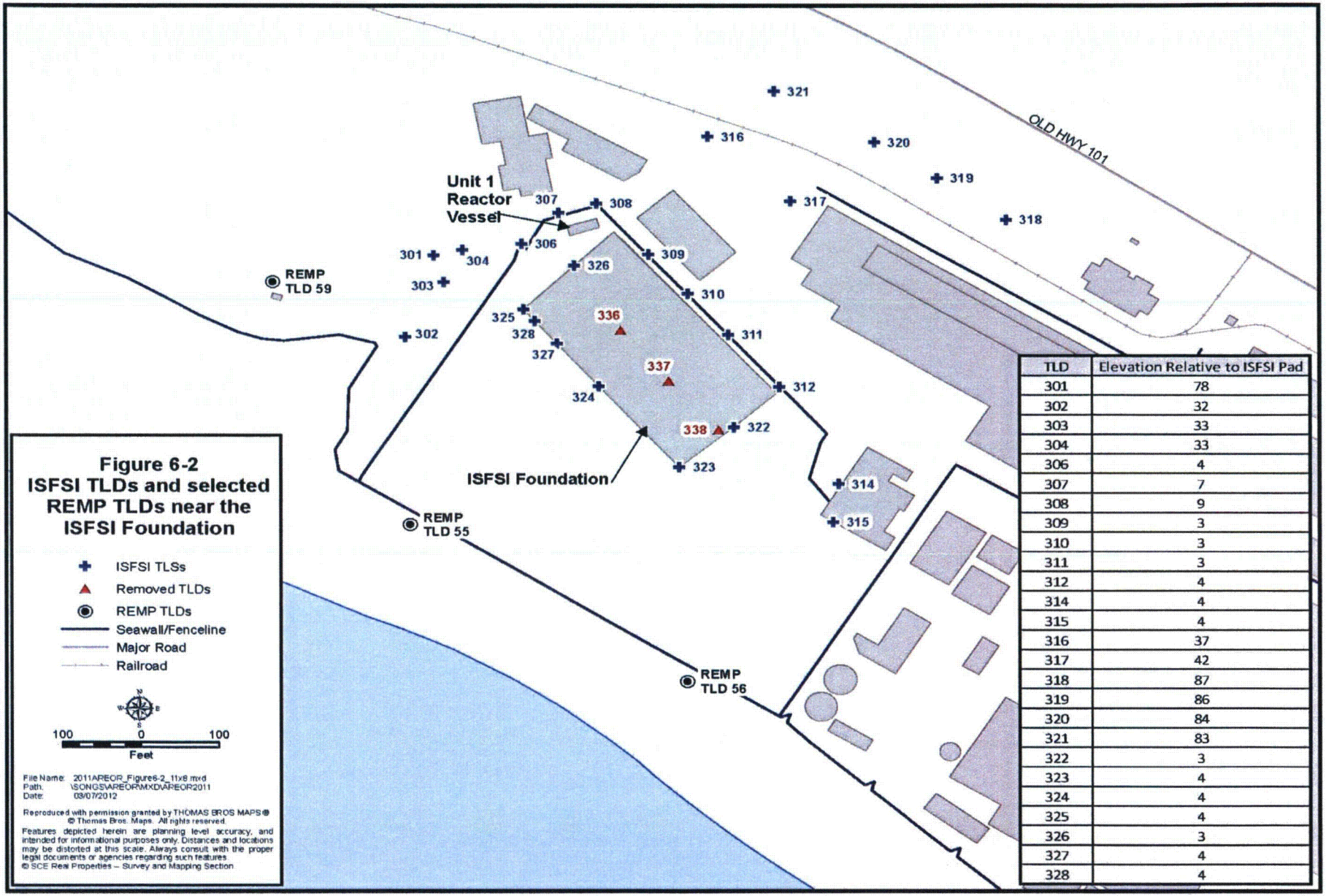


TLD	Elevation Relative to ISFSI Pad
301	78
302	32
303	33
304	33
306	4
307	7
308	9
309	3
310	3
311	3
312	4
314	4
315	4
316	37
317	42
318	87
319	86
320	84
321	83
322	3
323	4
324	4
325	4
326	3
327	4
328	4

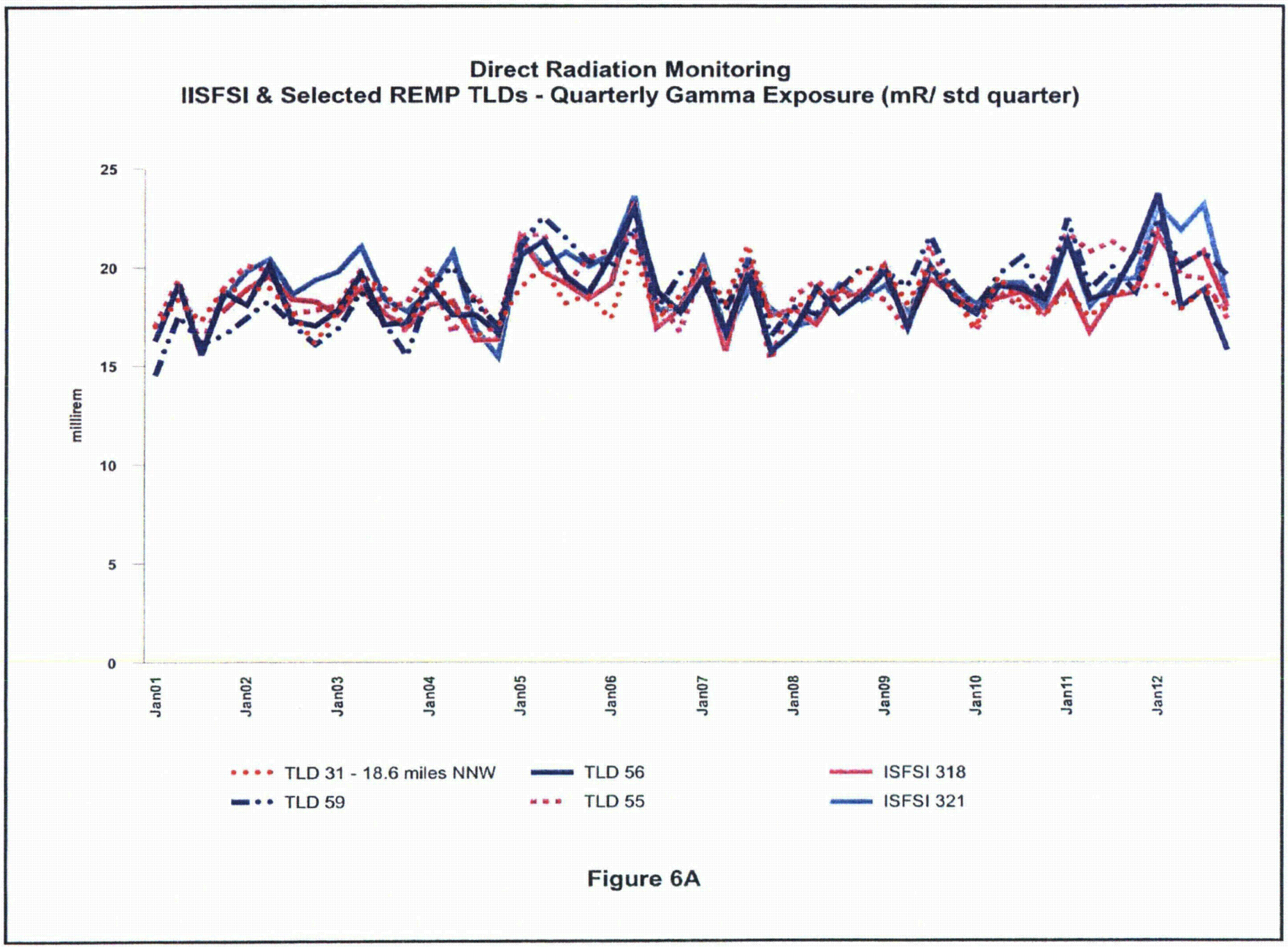

Direct Radiation Monitoring
IISFSI & Selected REMP TLDs - Quarterly Gamma Exposure (mR/ std quarter)
millirem
25
20
15
10
5
0
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
TLD 31 - 18.6 miles NNW
TLD 56
ISFSI 318
TLD 59
TLD 55
ISFSI 321

Figure 6A

Appendix K

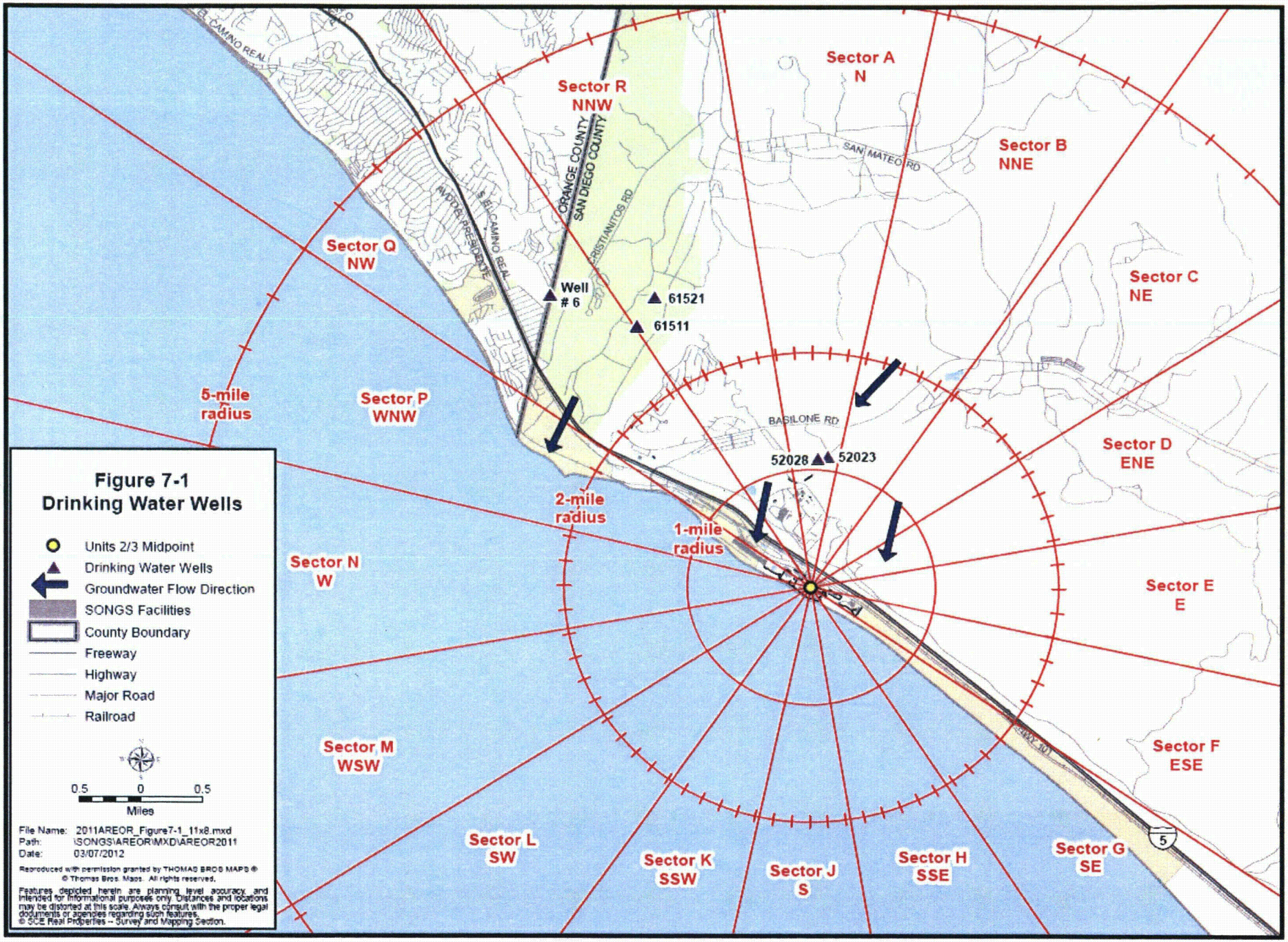
Offsite Ground Water Sampling

Offsite Groundwater Data

No drinking water pathway exists at SONGS. Refer to Figures 7-1 for a general indication of groundwater flow in the vicinity of SONGS.

In 2012 monthly ground water samples were taken at Camp Pendleton and Oceanside. The analysis results were less than detectable for tritium and plant related gamma emitters.

We conclude that the operation of SONGS had no impact on drinking water wells in the vicinity of SONGS.


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
Well
6
61521
61511
52028
52023
ORANGE COUNTY
SAN DIEGO COUNTY
CRISTIANITOS RD
SAN MATEO RD
BASILONE RD
EL CAMINO REAL
AUTOPISTA PRESIDENTE
Figure 7-1
Drinking Water Wells
Units 2/3 Midpoint
Drinking Water Wells
Groundwater Flow Direction
SONGS Facilities
County Boundary
Freeway
Highway
Major Road
Railroad
0.5 0 0.5
Miles
File Name: 2011AREOR_Figure7-1_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2011
Date: 03/07/2012
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