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

Tech Spec Section D6.9.1.3
Tech Spec Section 5.7.1.2

May 10, 2012

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**
2011 Annual Radiological Environmental Operating Report
San Onofre Nuclear Generating Station Units 1, 2 and 3 and
Independent Spent Fuel Storage Facility

Dear Sir or Madam:

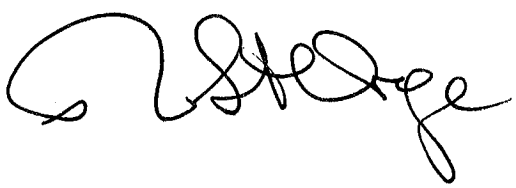
As required by Technical Specification (TS) Section D6.9.1.3 of San Onofre Nuclear Generating Station (SONGS) Unit 1 Facility Operating License DPR-13, and TS Section 5.7.1.2 of Facility Operating Licenses NPF-10 and NPF-15 for SONGS Units 2 and 3, respectively, this letter transmits the 2011 Annual Radiological Environmental Operating Report (AREOR) for SONGS Units 1, 2 and 3.

The AREOR covers the operation of SONGS during January 1, 2011 through December 31, 2011 and includes summaries, interpretations, and analyses of trends of the results of the Radiological Environmental Monitoring Program.

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

If you require any additional information, please contact Mr. Ryan I. Treadway at (949) 368-9985.

Sincerely,



P.O. Box 128
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Enclosure as Stated

cc: E. E. Collins, NRC Regional Administrator, Region IV
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2011
Radiological Environmental Operating Report

San Onofre Nuclear Generating Station

Southern California Edison

An Edison International Company

Docket Nos. 50-206, 50-361, 50-362

License Nos. DPR-13, NPF-10, NPF-15

April 2012

SOUTHERN CALIFORNIA EDISON®

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2011 ANNUAL

RADIOLOGICAL ENVIRONMENTAL

OPERATING REPORT

San Onofre Nuclear Generating Station

UNITS 1, 2, & 3

Southern California Edison

An Edison International Company

Prepared by: N. A. Hansen — May 3, 2012

Approved by: R. K. Heckler — 5/3/2012

Approved by: M. J. Johnson — 5/3/2012

Approved by: M. M. Lewis — 5/9/12

Approved by: S. M. Hoque — 5/9/2012

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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 2011. 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 2011 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* MDC (minimum detectable concentration) 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. Radioactivity attributed to the trans-Pacific migration of airborne material from the nuclear accident at the Fukushima Dai-Ichi Nuclear Power Station was also detected during 2011 and is not related to the operation of SONGS. The naturally occurring radionuclides, including beryllium-7 (Be-7), potassium-40 (K-40), and thorium-228 (Th-228), 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 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. Both units continued to operate throughout 2011.

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 & iodine), local crops, non-migratory marine species, kelp, drinking water, ocean water, and ocean bottom sediments. Each of the samples was analyzed for both naturally-occurring and SONGS-related radionuclides.

The REMP is conducted in accordance with Section 5.0 of the SONGS 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 2011 to ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the monitoring program are made if required by the results of this census. Appendix F of the report identifies changes to the census and the resultant dose increase, if any, to individuals from principal pathways of exposures in conformance with 10CFR Part 50, Appendix I, Section IV. B.3.

OBJECTIVES

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

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

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

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

SAMPLE COLLECTION

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

REGULATORY LIMITS, GUIDANCE, AND REQUIREMENTS

* 10CFR50

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

* 40CFR190

  The Environmental Protection Agency (EPA) has established environmental radiation protection standards for nuclear power plants in 40CFR190. These limits are applicable to the sum of both liquid and gaseous effluents and direct radiation. The environmental doses calculated at SONGS are a small fraction of the dose limits established by the EPA. refer to the 2011 SONGS Annual Radioactive Effluent Release Report for details.

* 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, Revision 1

  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 2011 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, Revision 1. 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, Revison 1. 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 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 2011 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; and accidents at other nuclear power plants. Radioactivity attributed to the trans-Pacific transport of airborne material from the Fukushima Dai-Ichi accident was detected in 2011.

Radiological environmental data collected throughout 2011 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 2011 against the levels observed in pre-operational years.

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

In comparing these findings to the conservatively-defined limits of the facility operating licenses, it is concluded that the radiological environmental impact of the operation of SONGS through 2011 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 2011.

3. SONGS Offsite Dose Calculation Manual (ODCM) Revision 4, Section 5.0, 2010.

4. SONGS Offsite Dose Calculation Manual (ODCM) Revision 5, Section 5.0, 2011.

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

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

APPENDIX A

SAMPLE TYPE AND SAMPLING LOCATION

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

	TYPE OF SAMPLE AND SAMPLING LOCATION (Omitted sample numbers are due to program modifications)	DISTANCE* (miles)	DIRECTION* (Sector)
Direct Radiation			
1	City of San Clemente (Former SDG&E Offices)	5.7	NW
2	Camp San Mateo – MCB	3.6	N
3	Camp San Onofre – MCB	2.8	NE
4	Camp Horno – MCB	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	Southeast 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	5.9	N
34	San Onofre School – MCB	1.9	NW
35	Range 312 – MCB	4.8	NNE
36	Range 208C – MCB	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	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	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	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
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.
** 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)
Shoreline Sediment (Beach Sand)			
1	San Onofre State Beach (SE)	0.6	SE
2	San Onofre Surfing Beach	0.8	WNW
3	San Onofre State Beach (SE)	3.5	SE
4	Newport Beach North End (Control)	29.2	NW
Local Crops			
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

* 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.
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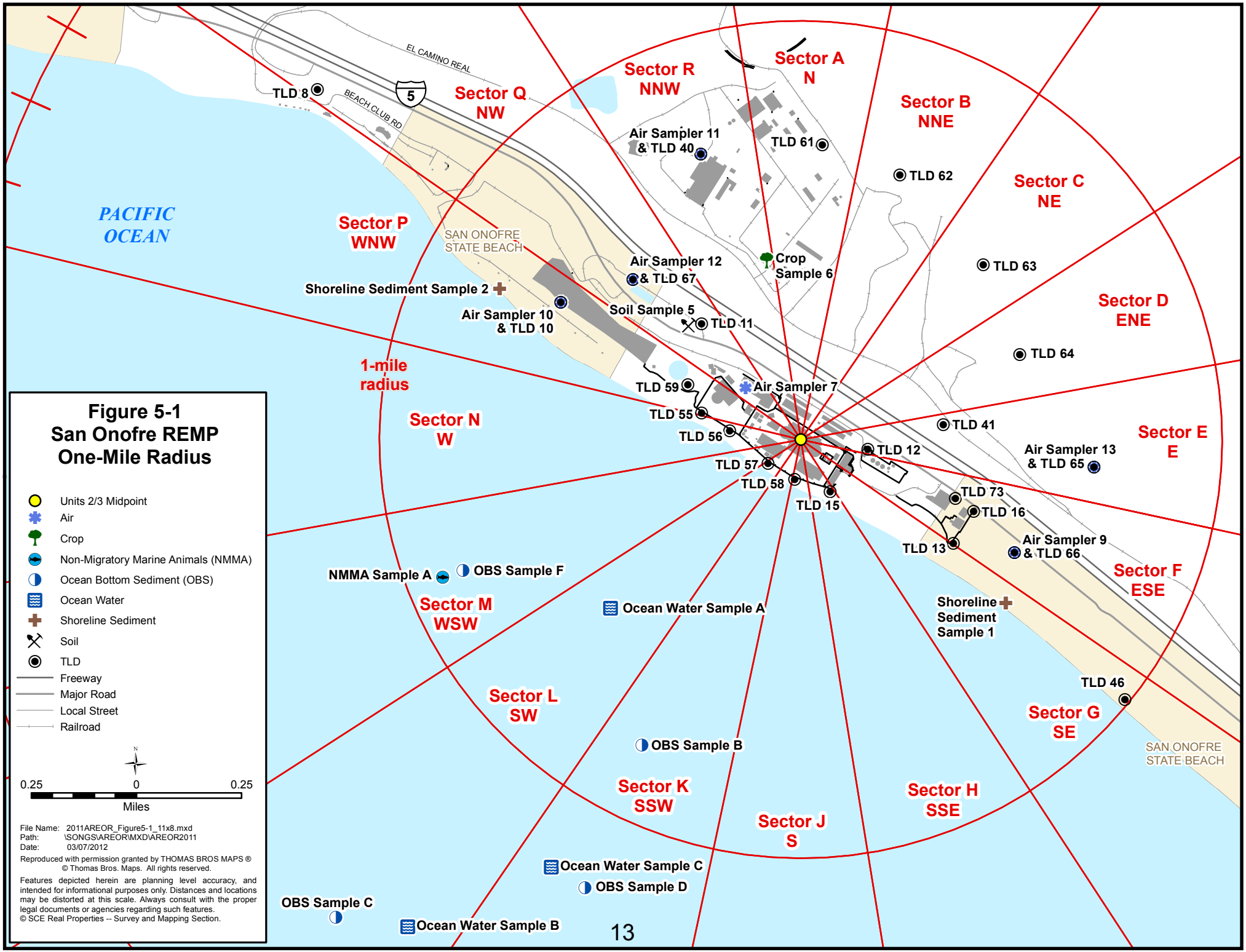
PIC Pressurized Ion Chamber

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


EL CAMINO REAL
BEACH CLUB RD
5
TLD 8
PACIFIC OCEAN
SAN ONOFRE STATE BEACH
Sector P WNW
Sector Q NW
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
1-mile radius
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 12
TLD 41
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
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
N
0.25
0
0.25
Miles
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Date: 03/07/2012
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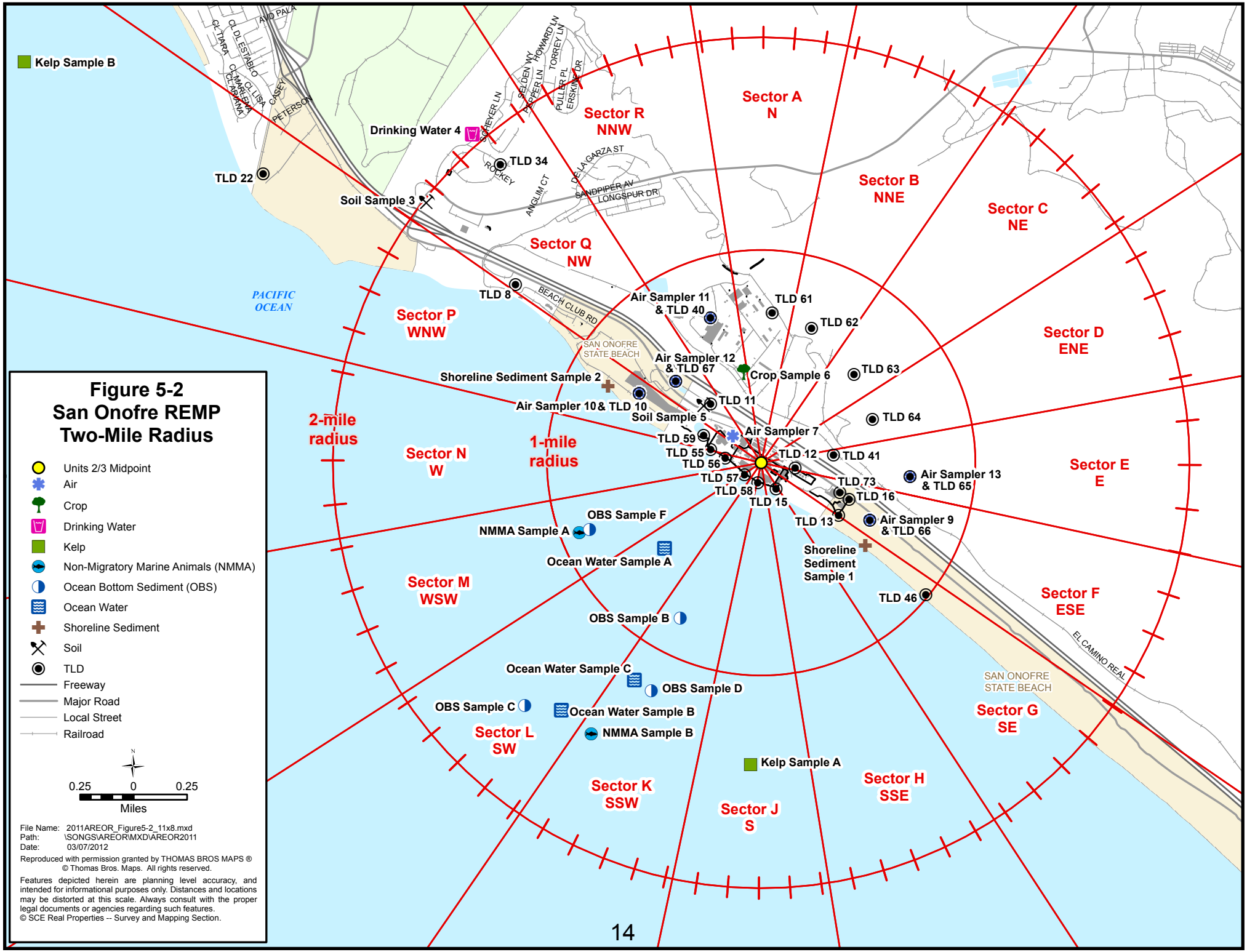
Kelp Sample B
Drinking Water 4
TLD 22
Soil Sample 3
TLD 34
TLD 8
PACIFIC OCEAN
Sector R NNW
Sector A N
Sector B NNE
Sector C NE
Sector D ENE
Sector E E
Sector F ESE
Sector G SE
Sector H SSE
Sector J S
Sector K SSW
Sector L SW
Sector M WSW
Sector N W
Sector P WNW
Sector Q NW
2-mile radius
1-mile radius
Air Sampler 11 & TLD 40
TLD 61
TLD 62
TLD 63
Air Sampler 12 & TLD 67
Crop Sample 6
Shoreline Sediment Sample 2
Air Sampler 10 & TLD 10
TLD 11
Soil Sample 5
TLD 64
Air Sampler 7
TLD 59
TLD 55
TLD 56
TLD 57
TLD 58
TLD 12
TLD 41
Air Sampler 13 & TLD 65
TLD 73
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
SAN ONOFRE STATE BEACH
BEACH CLUB RD
EL CAMINO REAL
A MD PALA
CL TIARA
CL DL ESTABLO
CL MARLENA
CL LISA
CASEY
PETERSON
SCHEYER LN
ROCKEY
ANGLIM CT
DE LA GARZA ST
SANDPIPER AV
LONGSPUR DR
SELDEN WY
HOWARD LN
TORREY LN
PULLER PL
ERSKINE DR
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
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Date: 03/07/2012
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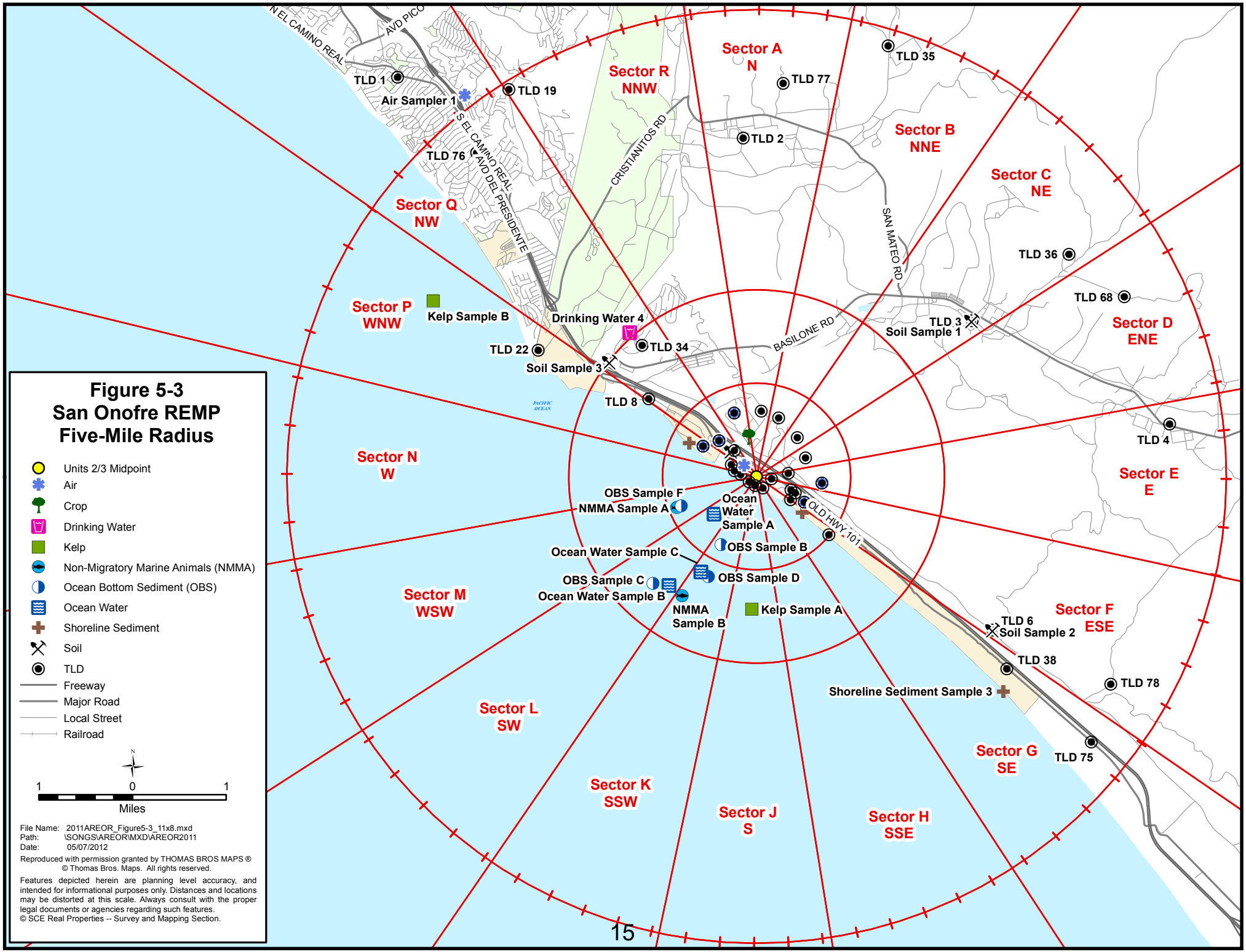
Figure 5-3
San Onofre REMP
Five-Mile Radius
Units 2/3 Midpoint
Air
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Major Road
Local Street
Railroad
1 0 1
Miles
File Name: 2011AREOR_Figure5-3_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2011
Date: 05/07/2012
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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 19
TLD 77
TLD 35
TLD 2
TLD 76
TLD 36
TLD 68
TLD 3
TLD 34
TLD 22
TLD 8
TLD 4
TLD 6
TLD 38
TLD 78
TLD 75
Air Sampler 1
Kelp Sample B
Drinking Water 4
Soil Sample 1
Soil Sample 3
OBS Sample F
NMMA Sample A
Ocean Water Sample A
OBS Sample B
Ocean Water Sample C
OBS Sample D
OBS Sample C
Ocean Water Sample B
NMMA Sample B
Kelp Sample A
Soil Sample 2
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
PACIFIC OCEAN

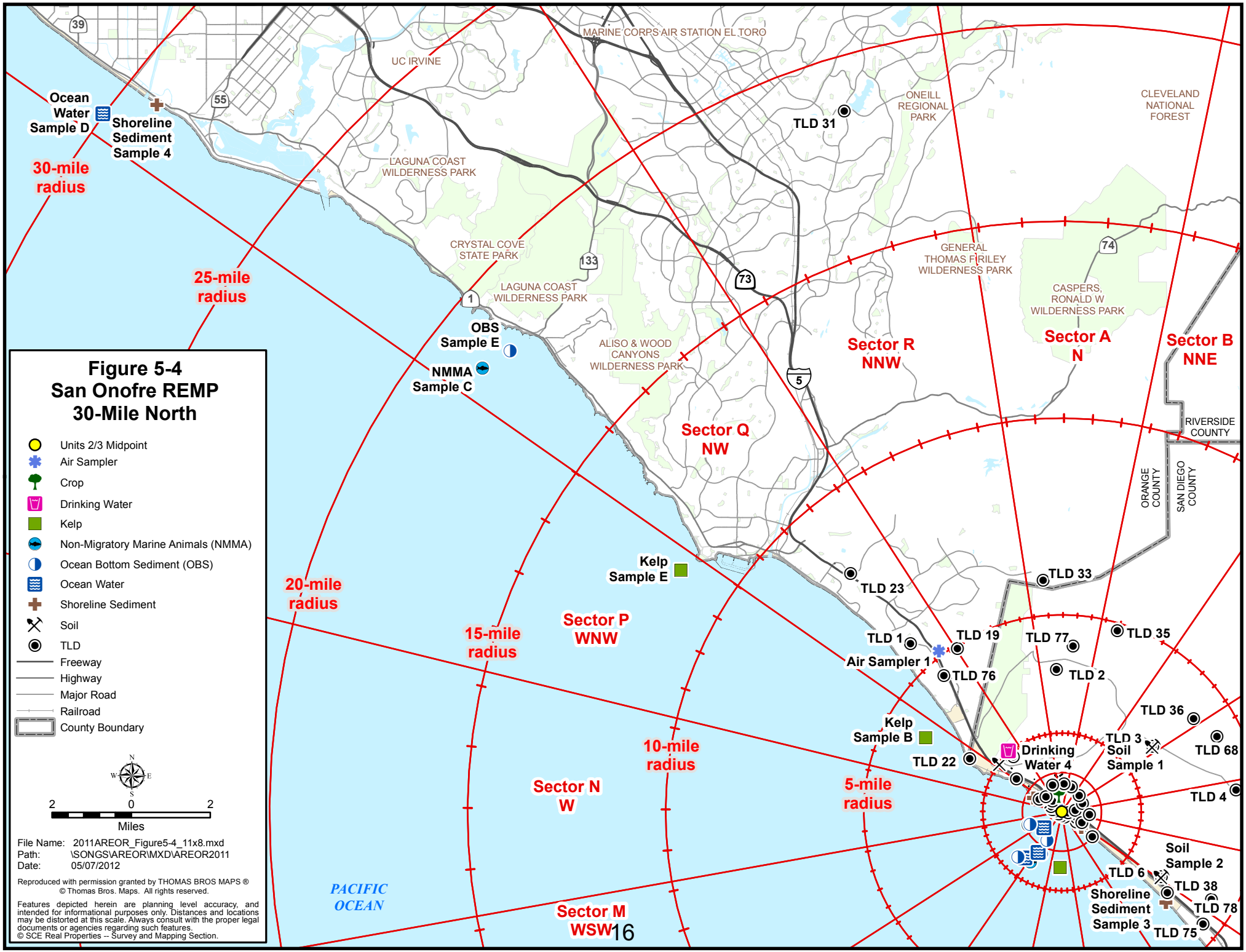
Figure 5-4
San Onofre REMP
30-Mile North
Units 2/3 Midpoint
Air Sampler
Crop
Drinking Water
Kelp
Non-Migratory Marine Animals (NMMA)
Ocean Bottom Sediment (OBS)
Ocean Water
Shoreline Sediment
Soil
TLD
Freeway
Highway
Major Road
Railroad
County Boundary
2 0 2
Miles
File Name: 2011AREOR_Figure5-4_11x8.mxd
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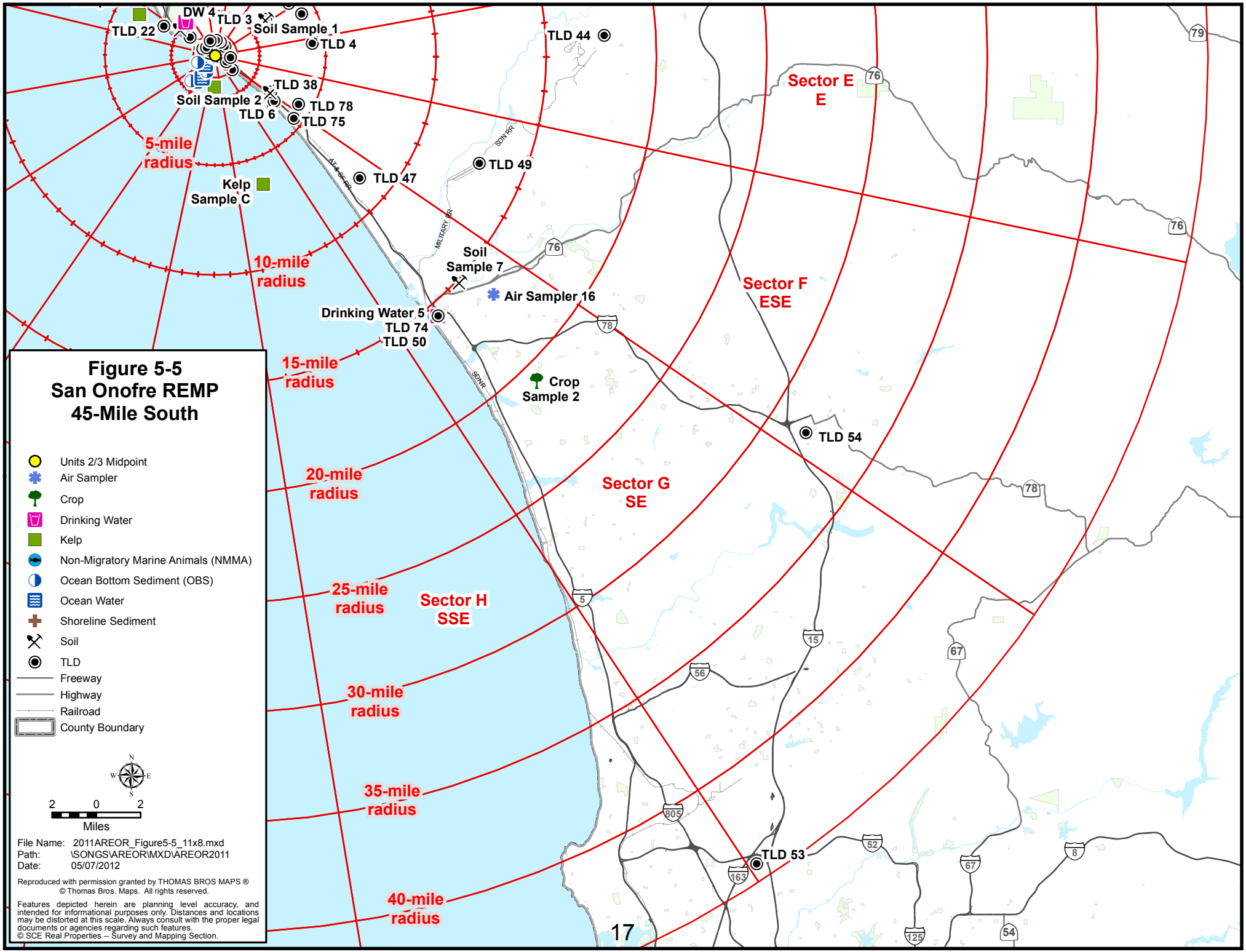
Ocean Water Sample D
Shoreline Sediment Sample 4
30-mile radius
25-mile radius
20-mile radius
15-mile radius
10-mile radius
5-mile radius
MARINE CORPS AIR STATION EL TORO
UC IRVINE
LAGUNA COAST WILDERNESS PARK
CRYSTAL COVE STATE PARK
ALISO & WOOD CANYONS WILDERNESS PARK
ONEILL REGIONAL PARK
CLEVELAND NATIONAL FOREST
GENERAL THOMAS FIRILEY WILDERNESS PARK
CASPERS, RONALD W WILDERNESS PARK
RIVERSIDE COUNTY
ORANGE COUNTY
SAN DIEGO COUNTY
PACIFIC OCEAN
TLD 31
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
TLD 1
TLD 2
TLD 3
TLD 4
TLD 6
TLD 19
TLD 22
TLD 23
TLD 33
TLD 35
TLD 36
TLD 38
TLD 68
TLD 75
TLD 76
TLD 77
TLD 78
Sector P WNW
Sector Q NW
Sector R NNW
Sector A N
Sector B NNE
Sector N W
Sector M WSW


DW 4
TLD 22
TLD 3
Soil Sample 1
TLD 4
TLD 44
TLD 38
Soil Sample 2
TLD 78
TLD 6
TLD 75
5-mile radius
Kelp Sample C
TLD 47
TLD 49
SDNRR
AT&SF RR
MILITARY RR
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
Sector H SSE
30-mile radius
35-mile radius
TLD 53
40-mile radius
Sector E E
Sector F ESE
Sector G SE
SDNR
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
N
W
E
S
2 0 2
Miles
File Name: 2011AREOR_Figure5-5_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2011
Date: 05/07/2012
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APPENDIX B

SUMMARY, RESULTS, AND DISCUSSIONS

OF 2011 ENVIRONMENTAL DATA

SUMMARY

To assess the changes or trends in the radioactivity level in the environment over the past year, the data from January 2011 to December 2011 were evaluated. The 2011 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 2011 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 2011 appears in Table B-3.

The exceptions, summarized in Table B-2 and in Table B-4, include isotopically analyzed samples with station related activity reported and confirmed above the *a posteriori* MDC. The analysis results listed in Tables B-2 and B-4 are attributable to sources external to SONGS (fallout from the nuclear accident at the Fukushima Daiichi Nuclear Power Station, residual fallout from legacy atmospheric nuclear weapons testing, residual fallout from Chernobyl, and discharge of medically administered I-131 from the San Juan Sewage Plant outfall). All of the 2011 REMP sample results with detectable licensed 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), Cs-137 in soil (attributable to residual nuclear weapons testing fallout and to Fukushima accident), Sr-90 in deer bone (attributable to residual nuclear weapons testing). Plant radionuclides directly attributable to the Fukushima Daiichi Nuclear Power Station accident are included in Table B-4. 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 background concentrations of 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. However the elevated I-131 activity in kelp detected during April 2011 may be partially attributable to fallout from the Fukushima accident. We conclude that SONGS had a negligible radiological environmental impact during 2011.

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

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

RESULTS AND DISCUSSIONS OF 2011 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 2011.

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 2011 control location TLD readings were LLD and all 2011 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 2011. The occupancy adjusted exposure for #13 is less than 1 mR per year. Refer to Table B-1 for a summary of all 2011 SONGS REMP TLD data.

Figures 2A and 2B compare environmental radiation levels of indicator and control locations for the operational year 2011 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 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 2011 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 2011 TLD Data Table. Natural background radiation is variable and a minor shift in location can yield a measurable change in background radiation. Therefore if a TLD is moved the baseline (background) for that location may be affected.

The baseline environmental exposure analysis of 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 natural background. The highest value of three standard deviations for all of the quarterly measurements was 4.8 mR and the highest value was 9.7 mR for the annual results, providing justification for *a priori* LLDs of 5 mR per quarter and 10 mR per year. The quarterly and annual results expressed in the 2011 Table B-1 as values of positive exposure above natural 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
2011 TLD Data

Table B-1 Baseline / Background corrected REMP TLD data														
#	Location	Dist. Miles	Quarterly Baseline	2011 Quarterly Results (mR)				Baseline Adjusted 2011 Quarterly Results (mR)				Annual Baseline	2011 Annual Total (mR)	Baseline Adjusted 2011 Total
				1	2	3	4	1	2	3	4			
1	City of San Clemente	5.7	17.5	18.1	16.8	16.7	17.3	<LLD	<LLD	<LLD	<LLD	69.9	68.9	<LLD
2	Camp San Mateo – MCB	3.5	18.6	18.2	17.7	18.5	17.8	<LLD	<LLD	<LLD	<LLD	74.4	72.1	<LLD
3	Camp San Onofre – MCB	2.6	16.4	16.4	15.4	16.5	15.5	<LLD	<LLD	<LLD	<LLD	65.5	63.8	<LLD
4	Camp Horno – MCB	4.5	18.1	17.6	17.5	17.2	17.2	<LLD	<LLD	<LLD	<LLD	72.3	69.5	<LLD
6	Old Route 101 (ESE)	3.0	11.4	12.0	10.6	11.3	10.6	<LLD	<LLD	<LLD	<LLD	45.6	44.6	<LLD
8	Noncommissioned Officers' Beach Club	1.4	15.4	16.2	15.9	16.1	17.0	<LLD	<LLD	<LLD	<LLD	61.8	65.1	<LLD
10	Bluff (Adjacent to PIC #1)	0.7	16.4	18.1	15.4	16.0	16.2	<LLD	<LLD	<LLD	<LLD	65.7	65.7	<LLD
19	San Clemente Highlands	5.0	17.8	18.7	17.5	17.7	17.9	<LLD	<LLD	<LLD	<LLD	71.3	71.7	<LLD
22	Former US Coast Guard Station	2.7	17.9	18.7	16.5	17.7	17.9	<LLD	<LLD	<LLD	<LLD	71.7	70.8	<LLD
23	SDG&E Service Center Yard	8.1	15.8	16.3	14.5	15.0	15.1	<LLD	<LLD	<LLD	<LLD	63.1	60.8	<LLD
31	Aurora Park - Mission Viejo (Control)	18.6	18.5	18.9	17.5	18.6	19.0	<LLD	<LLD	<LLD	<LLD	74.1	74.0	<LLD
33	Camp Talega – MCB	5.7	18.9	19.0	17.6	18.9	18.4	<LLD	<LLD	<LLD	<LLD	75.4	73.9	<LLD
34	San Onofre School – MCB	1.9	16.2	16.7	14.3	15.4	15.8	<LLD	<LLD	<LLD	<LLD	64.7	62.1	<LLD
35	Range 312 – MCB	4.7	16.9	17.7	16.5	16.7	16.4	<LLD	<LLD	<LLD	<LLD	67.5	67.2	<LLD
36	Range 208C – MCB	4.2	19.5	18.3	18.6	18.8	18.0	<LLD	<LLD	<LLD	<LLD	77.8	73.6	<LLD
38	San Onofre State Beach Park	3.3	14.3	15.0	13.7	13.1	13.6	<LLD	<LLD	<LLD	<LLD	57.2	55.4	<LLD
40	SCE Training Center - Mesa (Adjacent to PIC #3)	0.7	17.1	19.1	17.0	16.3	16.9	<LLD	<LLD	<LLD	<LLD	68.4	69.2	<LLD
44	Fallbrook Fire Station	17.7	14.0	15.9	15.0	13.4	13.9	<LLD	<LLD	<LLD	<LLD	56.0	58.2	<LLD
46	San Onofre State Beach Park	0.9	12.2	12.4	11.4	12.0	11.5	<LLD	<LLD	<LLD	<LLD	48.7	47.4	<LLD
47	Camp Las Flores – MCB	8.6	13.3	13.7	14.2	12.0	12.5	<LLD	<LLD	<LLD	<LLD	53.1	52.3	<LLD
49	Camp Chappo – MCB	12.8	14.2	15.7	14.3	13.1	14.5	<LLD	<LLD	<LLD	<LLD	56.9	57.6	<LLD
50	Oceanside Fire Station (Control)	15.6	16.6	17.1	16.5	16.5	16.5	<LLD	<LLD	<LLD	<LLD	66.3	66.6	<LLD
53	San Diego County Operations Center	44.3	18.2	17.7	16.8	16.0	17.8	<LLD	<LLD	<LLD	<LLD	72.9	68.3	<LLD
54	Escondido Fire Station	31.8	16.1	17.4	17.7	16.4	16.6	<LLD	<LLD	<LLD	<LLD	64.4	68.1	<LLD
61	Mesa - East Boundary (PIC #4)	0.6	15.4	15.5	12.8	14.1	14.2	<LLD	<LLD	<LLD	< LLD	61.7	56.6	<LLD
62	Camp Pendleton (PIC #5)	0.6	13.2	13.2	11.9	12.6	11.9	<LLD	<LLD	<LLD	<LLD	50.4	49.7	<LLD
63	Camp Pendleton (PIC #6)	0.6	13.9	14.0	13.0	13.0	13.0	<LLD	<LLD	<LLD	<LLD	55.5	53.1	<LLD

TABLE B-1
2011 TLD Data

Table B-1 Baseline / Background corrected REMP TLD data														
#	Location	Dist. Miles	Quarterly Baseline	2011 Quarterly Results (mR)				Baseline Adjusted 2011 Quarterly Results (mR)				Annual Baseline	2011 Annual Total (mR)	Baseline Adjusted 2011 Total
				1	2	3	4	1	2	3	4			
64	Camp Pendleton (PIC #7)	0.6	15.0	15.1	14.6	14.2	14.7	<LLD	<LLD	<LLD	<LLD	60.1	58.6	<LLD
65	Camp Pendleton (PIC #8)	0.7	13.4	14.2	13.1	13.1	12.6	<LLD	<LLD	<LLD	<LLD	53.8	52.9	<LLD
66	San Onofre State Beach (PIC #9)	0.6	14.0	14.3	12.6	13.6	13.1	<LLD	<LLD	<LLD	<LLD	55.6	53.7	<LLD
67	Former SONGS Evaporation Pond (PIC #2)	0.6	16.9	17.7	14.9	16.1	15.3	<LLD	<LLD	<LLD	<LLD	67.7	64.0	<LLD
68	Range 210C – MCB	4.3	15.0	15.6	14.9	15.3	14.1	<LLD	<LLD	<LLD	<LLD	60.2	59.9	<LLD
74	Oceanside City Hall (Backup Control)	15.6	13.3	14.2	12.7	13.5	12.8	<LLD	<LLD	<LLD	<LLD	53.4	53.1	<LLD
75	Gate 25 MCB	4.6	15.9	16.1	14.7	15.8	15.0	<LLD	<LLD	<LLD	<LLD	63.6	61.6	<LLD
76	El Camino Real Mobil Station	4.6	17.3	18.4	16.5	16.9	17.3	<LLD	<LLD	<LLD	<LLD	69.4	69.0	<LLD
77	Area 62 Heavy Lift Pad	4.3	19.2	19.3	18.2	18.8	17.2	<LLD	<LLD	<LLD	<LLD	76.9	73.4	<LLD
78	Horno Canyon	4.4	11.1	11.6	10.5	11.4	10.3	<LLD	<LLD	<LLD	<LLD	44.6	43.8	<LLD
	TLD within the site boundary (Baseline has been estimated)													
11	Former Visitors' Center	0.4*	15.0	16.6	14.8	15.9	14.7	<LLD	<LLD	<LLD	<LLD	60.0	61.9	<LLD
12	South Edge of Switchyard	0.2*	15.0	17.2	15.5	15.4	16.3	<LLD	<LLD	<LLD	<LLD	60.0	64.4	<LLD
13	Southeast Site Boundary (Bluff)	0.4*	15.0	26.9	29.5	30.1	21.7	**11.9**	**14.5**	**15.1**	**6.7**	60.0	108.1	48.1
15	Southeast Site Boundary (Office Bldg)	0.1*	15.0	22.5	18.3	20.3	20.5	**7.5**	<LLD	**5.3**	**5.5**	60.0	81.6	21.6
16	East Southeast Site Boundary	0.4*	15.0	22.3	17.5	19.3	17.8	**7.3**	<LLD	<LLD	<LLD	60.0	76.8	16.8
41	Old Route 101 – East	0.3*	15.0	15.8	15.1	15.8	15.1	<LLD	<LLD	<LLD	<LLD	60.0	61.7	<LLD
55	San Onofre State Beach (U1 West)	0.2*	15.0	21.8	20.9	21.4	20.5	**6.8**	**5.9**	**6.4**	**5.5**	60.0	84.5	24.5
56	San Onofre State Beach (U1 West)	0.2*	15.0	21.4	18.5	18.8	20.9	**6.4**	<LLD	<LLD	**5.9**	60.0	79.6	19.6
57	San Onofre State Beach (Unit 2)	0.1*	15.0	21.5	16.7	18.2	18.6	**6.5**	<LLD	<LLD	<LLD	60.0	75.0	15.0
58	San Onofre State Beach (Unit 3)	0.1*	15.0	20.9	17.5	18.3	17.9	**5.9**	<LLD	<LLD	<LLD	60.0	74.7	14.7
59	SONGS Meteorological Tower	0.3*	15.0	22.6	19.0	20.1	18.9	**7.6**	<LLD	**5.1**	<LLD	60.0	80.5	20.5
73	South Yard Facility	0.4*	15.0	25.2	22.2	21.6	21.4	**10.2**	**7.2**	**6.6**	**6.4**	60.0	90.3	30.3
	*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 two control locations. 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 0.0131 to 0.200 pCi/m^3, averaging 0.0426 pCi/m^3 of air. The concentrations of gross beta activity in the samples from the control locations ranged from 0.0186 to 0.170 pCi/m^3, averaging 0.0445 pCi/m^3 of air. Figure 3D shows the close correlation between indicator and control gross beta activity level during 2011 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 #15). The results showed that indicator locations maximum gross beta activity in air in 2011 was 0.20 pCi/m^3 and the 2010 control location average was 0.0367 pCi/m^3. No action was required by the ODCM. However, additional weekly gamma isotopic analyses were performed on selected air particulate media to monitor the trans-Pacific transport of releases from the Fukushima Dai-Ichi accident.

Airborne transportation of releases from the Fukushima Dai-Ichi releases resulted in detectable concentrations of I-131 during the weeks immediately following the accident. The results are listed in Table B-4. The remainder of the samples analyzed for I-131 were less than the *a posteriori* MDC.

Quarterly composite gamma spectral analyses yielded naturally occurring beryllium-7 (Be-7) above the *a posteriori* MDC. Fallout from the Fukushima accident was also detected during 2011. See Table B-4.

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 2011, 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 2011 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. The DPH monthly ocean water tritium sample results were all below the DPH reported Minimum Detectable Activity (MDA) for tritium and plant related radionuclides.

Naturally occurring potassium-40 (K-40) was detected in all ocean water samples obtained in 2011. Excluding naturally occurring radionuclides, the 2011 ocean water gamma isotopic database is statistically indistinguishable from a database with no detectable activity.

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

D. Drinking Water

In 2011, 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 that could be affected by the release of liquid effluent at SONGS.

No station related radionuclides were detected in drinking water during 2011. The gross beta activity is due to naturally occurring radionuclides. The drinking water gamma isotopic database is statistically indistinguishable from a database with zero activity. The operation of SONGS had no impact on this sample medium.

E. Shoreline Sediment (Beach Sand)

Beach sand was collected semiannually in 2011 from three indicator locations and from a control location situated in Newport Beach. After collection, the samples were analyzed for plant-related and naturally-occurring radionuclides. Naturally occurring K-40 and thorium-228 (Th-228) were detected in all samples. No plant related radionuclides were reported above the *a posteriori* MDC. The operation of SONGS had no impact on the environment as measured by this sample medium.

F. Ocean Bottom Sediments

Ten 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 2011.

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 2011, 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 l outfall, the SONGS Units 2/3 outfall and from Laguna Beach control location. The flesh portion of each sample type was analyzed for gamma-emitting station-related and naturally occurring radionuclides. The results were subsequently reported to SCE in terms of wet sample weights. Because results based on a wet sample weight are most useful for calculating doses, the results of sample analyses are summarized in terms of "as received" wet weights. No plant related radionuclides were detected above the *a posteriori* MDC.

Naturally-occurring K-40 was detected in most marine species samples collected during 2011. No plant related isotopes were reported above the *a posteriori* MDC. The operation of SONGS had no impact on the environment as measured by this sample medium. The potential dose to members of the public from consumption of marine species near SONGS is negligible.

H. Local Crops

Fleshy and leafy crops were collected semiannually in 2011 from the SONGS garden and from the control location 21 miles from SONGS Units 2/3 midpoint in sector F. Licensed material resulting from the trans-Pacific transport of airborne radioactivity due to the accident at the Fukushima Dai-Ichi plant was detected in the March 2011 indicator and control local crop samples. The control sample was purchased from a vegetable stand and the product was being sprayed with a misting device, potentially washing radioactivity from the samples and potentially causing a possible reduction is measured activity. In addition the samples were collected during the period of time when California was experiencing fallout from the Fukushima accident and the total integration period for the control local crop samples is unknown. The most salient radiological fact regarding the March 2011 local crop sample results is that licensed material was detected in both the control and in the indicator samples. No plant related radioactivity was detected in the June 2011 and December 2011 samples. Refer to Table B-4. It is concluded that in 2011 SONGS had no measurable impact on this sample medium.

I. Soil

To determine if there is evidence of a build-up of radionuclides in the land near SONGS, indicator soil samples were collected from the East Site Boundary (Former Visitor's center), Old Route 101,

Basilone Road, and Camp San Onofre. A control sample was obtained from Oceanside. Surface soil was collected from all indicator and control locations at the depth of 3 inches. The sampling protocol is consistent with the procedure described in HASL-300.

Soil samples were analyzed for naturally-occurring and SONGS-related radionuclides using gamma spectral analysis. All 2011 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. The concentrations of Cs-137 in soil has been elevated due to releases and the trans-Pacific transport of airborne radioactivity from the Fukushima Dai-Ichi 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 2011, 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 2011 from the San Onofre kelp bed, 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 2011 included K-40 and I-131. K-40 is naturally occurring and not related to the operation of SONGS. The elevated I-131 detected in April 2011 may be attributable to the transport of airborne radioactivity from the Fukushima accident. Refer to Table B-2.

I-131 has been detected at indicator and control locations in previous years. 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. The I-131 data ocean water samples near SONGS have been consistently been less than detectable. Refer to Table B-2 for a complete list of the 2011 kelp samples with detectable I-131activity and for the 2011 results from the 2011 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 2011 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 2011 analysis results indicate, the March 2011 accident at the Fukushima Dai-Ichi plant, from the Fukushima accident has affected this sample media. Refer to Table B-4 for the analysis results. 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 equal which leads to the conclusion that Cs-137 in soil is attributable to residual fallout from external anthropogenic factors such as nuclear weapons testing, the March 2011 accident at the Fukushima Dai-Ichi plant and Chernobyl. The predicted concentration for Cs-137 in soil (based on effluent data reported in the 2010 SONGS Annual Radioactive Effluent Release Report) is about 2 to 3 orders of magnitude lower than the measured concentration of Cs-137 in soil. The effluent based correlation calculation indicates that even if there were no Cs-137 in soil from sources external to SONGS, the Cs-137 concentration in soil attributable to the operation of SONGS would be undetectable and the resultant doses to individuals would be negligible.

Data from 2011 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 and to the transport of airborne materials released from the Fukushima Dai-Ichi accident. The data are consistent with the low levels of radio-iodine released from SONGS during 2011. 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.

Air particulate gross beta data increased briefly in the immediate aftermath of the Fukushima accident. Accordingly, a sample plan was developed and executed to analyze the weekly air particulate filter media for gamma emitters . 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. During the weeks immediately after the Fukushima accident I-131 was detected in the air sampler iodine cartridges at both the control and the indicator locations at substantially similar levels.

Most of the control and indicator samples of deer meat collected during 2011 yield greater than detectable Cs-134 and Cs-137. The Cs-134 to Cs-137 ratios for deer meat are substantially similar to the air sampler Cs-134 to Cs-137 ratios. The effluent based evaluation indicates that the Cs-134 and Cs-137 radioactivity in deer meat would be less than detectable if the data were attributable to SONGS and the resultant dose to individuals would be negligible. The atypical detection of these radionuclides in both indicator and control samples is credibly attributed to the trans-Pacific transport of airborne releases from Dai-Ichi, Fukushima following the March 11, 2011 Tohoku earthquake and is not related to the operation of San Onofre. The Sr-90 detected in one deer bone sample is consistent with activity that would be expected from legacy nuclear weapons fallout.

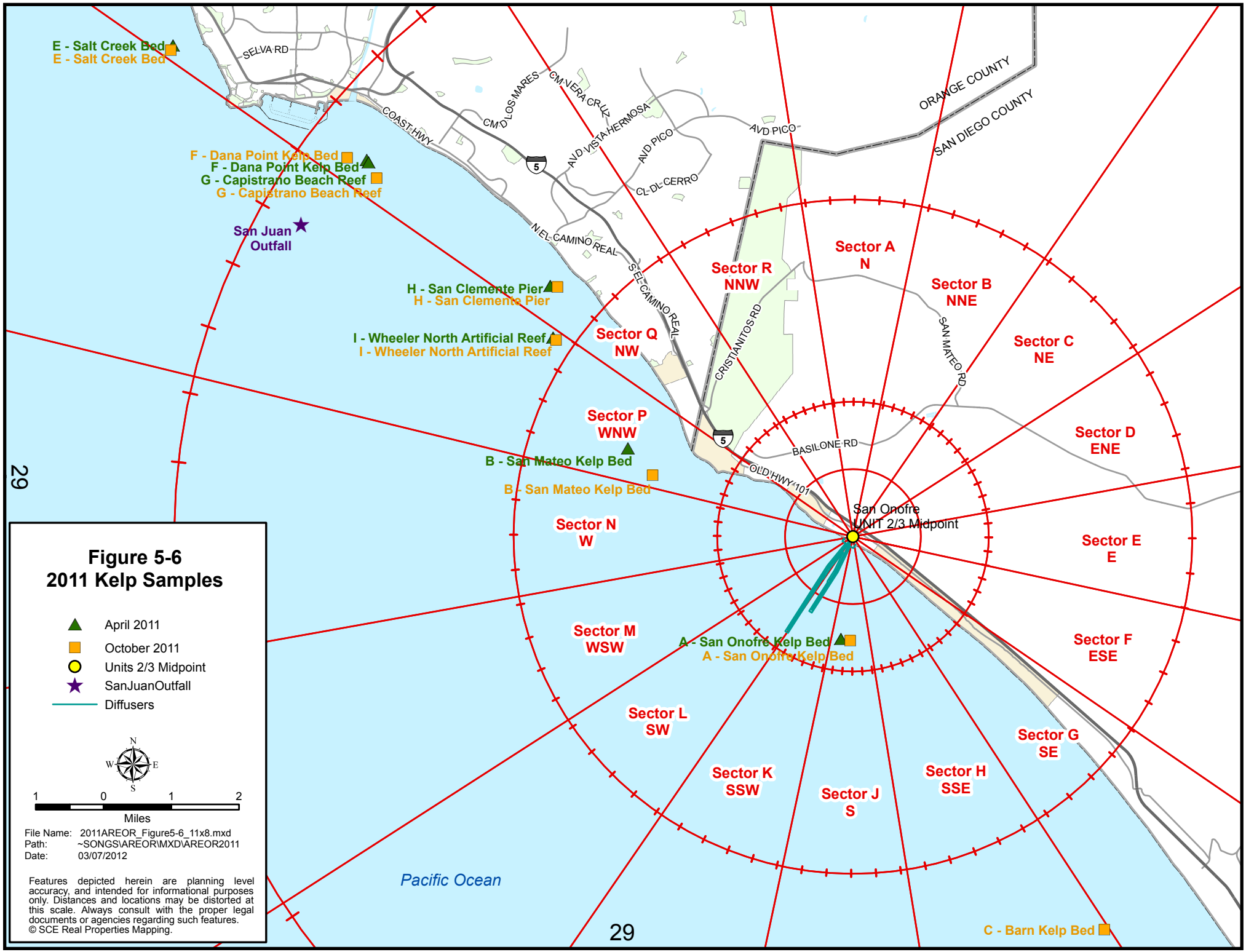
E - Salt Creek Bed
E - Salt Creek Bed
F - Dana Point Kelp Bed
F - Dana Point Kelp Bed
G - Capistrano Beach Reef
G - Capistrano Beach Reef
San Juan Outfall
H - San Clemente Pier
H - San Clemente Pier
I - Wheeler North Artificial Reef
I - Wheeler North Artificial Reef
B - San Mateo Kelp Bed
B - San Mateo Kelp Bed
A - San Onofre Kelp Bed
A - San Onofre Kelp Bed
C - Barn Kelp Bed
San Onofre
UNIT 2/3 Midpoint
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
SELVA RD
COAST HWY
CM DE LOS MARES
CM VERA CRUZ
AVD VISTA HERMOSA
AVD PICO
CL DL CERRO
AVD PICO
ORANGE COUNTY
SAN DIEGO COUNTY
N EL CAMINO REAL
S EL CAMINO REAL
CRISTIANITOS RD
SAN MATEO RD
BASILONE RD
OLD HWY 101
5
5
29
29
Pacific Ocean
Figure 5-6
2011 Kelp Samples
April 2011
October 2011
Units 2/3 Midpoint
SanJuanOutfall
Diffusers
N
W
E
S
1 0 1 2
Miles
File Name: 2011AREOR_Figure5-6_11x8.mxd
Path: ~SONGS\AREOR\MXD\AREOR2011
Date: 03/07/2012
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.
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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 18APR11	I-131	(384 ± 54) E-3 pCi/g	31 E-3 pCi/g
Aquatic Kelp San Mateo Kelp Bed Station B 18APR11	I-131	(392 ± 49) E-3 pCi/g	22 E-3 pCi/g
Aquatic Kelp Salt Creek Bed Station E 18APR11	I-131	(233 ± 37) E-3 pCi/g	23 E-3 pCi/g
Aquatic Kelp Dana Point Kelp Bed Station F 18APR11	I-131	(508 ± 55) E-3 pCi/g	21 E-3 pCi/g
Aquatic Kelp Capistrano Beach Reef Station G 18APR11	I-131	(472 ± 55) E-3 pCi/g	23 E-3 pCi/g
Aquatic Kelp San Clemente Pier Station H 18APR11	I-131	(333 ± 42) E-3 pCi/g	21 E-3 pCi/g
Aquatic Kelp Wheeler North Artificial Reef Station I 18APR11	I-131	(316 ± 41) E-3 pCi/g	20 E-3 pCi/g
Aquatic Kelp San Onofre Kelp Bed Station A 17OCT11	I-131	(36 ± 15) E-3 pCi/g	12 E-3 pCi/g
Aquatic Kelp San Mateo Kelp Bed Station B 17OCT11	I-131	(36 ± 13) E-3 pCi/g	14 E-3 pCi/g
Aquatic Kelp Barn Kelp Bed Station C 17OCT11	I-131	(28 ± 15) E-3 pCi/g	13 E-3 pCi/g
Aquatic Kelp Salt Creek Bed Station E 17OCT11	I-131	(49 ± 12) E-3 pCi/g	11 E-3 pCi/g
Aquatic Kelp Dana Point Kelp Bed Station F 17OCT11	I-131	(57 ± 17) E-3 pCi/g	15 E-3 pCi/g
Aquatic Kelp Capistrano Beach Reef Station G 17OCT11	I-131	(100 ± 21) E-3 pCi/g	14 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 17OCT11	I-131	(22 ± 16) E-3 pCi/g	17 E-3 pCi/g
Aquatic Kelp Wheeler North Artificial Reef Station I 17OCT11	I-131	(22 ± 14) E-3 pCi/g	16 E-3 pCi/g
San Juan Sewage Plant Discharge 27OCT11	I-131	(20800 ± 4220) E-3 pCi/l	3170 E-3 pCi/l
San Juan Sewage Plant Discharge 9NOV11	I-131	(7250 ± 2780) E-3 pCi/l	3350 E-3 pCi/l
Soil Camp San Onofre Location # 1 30SEP11	Cs-137	(124 ± 60) E-3 pCi/g	66 E-3 pCi/g
Soil Old El Camino Real Location #2 30SEP11	Cs-137	(314 ± 59) E-3 pCi/g	50 E-3 pCi/g
Soil Prince of Peace Abbey Location #7 30SEP11	Cs-137	(224 ± 45) E-3 pCi/g	38 E-3 pCi/g
Deer Bone Control Location 31AUG11	Sr-90	(298 ± 83) E-3 pCi/g	175 E-3 pCi/g

TABLE B-3

REMP SAMPLE ANALYSIS SUMMARY FOR 2011

Medium	Analysis Type	Sampling Frequency	# of Locations	Total # of Analyses in 2011 [1]
Direct Radiation	Dosimetry	Quarterly	49	196
Airborne Particulates	Gross Beta	Weekly	10	416
Charcoal Cartridge	I-131	Weekly	10	416
Airborne Particulates	Ge (Li) Scan	Quarterly	9	33
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	4 4 4	31 31 31
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	11
Kelp	Ge (Li) Scan	Semi-Annually	8	15
Soil	Ge (Li) Scan	Annually	5	5

1. The total number of analyses listed above includes 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, and additional control kelp samples. These samples were not collected for all of 2011 because the San Clemente drinking water wells were not in service for all of 2011. Additional control kelp samples were obtained to track I-131 (iodine-131) activity in kelp attributable to municipal waste water discharges. 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. This table does not include the special weekly air particulate gamma isotopic analyses performed to monitor the trans-Pacific transport of airborne radioactivity released from the Fukushima accident. There were a total of ten air particulate stations, including air sampler # 15 (sampled for one week in 2011) and air sampler # 30 (also sampled for one week in 2011 because REMP air sampler # 13 was out of service due to storm damage). Thus the total number of airborne analyses does not equal the frequency times the number of locations.

DETECTABLE ACTIVITY ATTRIBUTED TO THE TRANS-PACIFIC TRANSPORT OF AIRBORNE MATERIAL FROM THE FUKUSHIMA DAI-ICHI ACCIDENT

TABLE B-4

Date	Media	Location	Analyte	Distance/Direction from SONGS	Activity & Units	2 Sigma	MDC	*Analytical Remarks*
3/22/2011	Airborne particulate filter	7 AWS Roof	I-131	0.18 NW	0.0945 pCi/m^3	0.0165	0.00803	
3/22/2011	Airborne particulate filter	10 Bluff	I-131	0.7 WNW	0.0867 pCi/m^3	0.015	0.00776	
3/22/2011	Airborne particulate filter	11 Mesa EOF	I-131	0.7 NNW	0.0844 pCi/m^3	0.0154	0.00711	
3/22/2011	Airborne particulate filter	7 AWS Roof	Te-132	0.18 NW	0.0271 pCi/m^3	0.0153	0.013	
3/22/2011	Airborne particulate filter	11 Mesa EOF	Te-132	0.7 NNW	0.0366 pCi/m^3	0.0134	0.0088	
3/22/2011	Airborne particulate filter	11 Mesa EOF	Cs-134	0.7 NNW	0.0105 pCi/m^3	0.00685	0.00774	
3/29/2011	Airborne particulate filter	1 City of San Clemente (City Hall)	I-131	5.1 NW	0.0614 pCi/m^3	0.0132	0.00908	
3/29/2011	Airborne particulate filter	7 AWS Roof	I-131	0.18 NW	0.0622 pCi/m^3	0.0141	0.00746	
3/29/2011	Airborne particulate filter	9 State Beach Park	I-131	0.6 ESE	0.0627 pCi/m^3	0.0122	0.00773	
3/29/2011	Airborne particulate filter	10 Bluff	I-131	0.7 WNW	0.068 pCi/m^3	0.0137	0.00787	
3/29/2011	Airborne particulate filter	11 Mesa EOF	I-131	0.7 NNW	0. 0553 pCi/m^3	0.0111	0.0069	
3/29/2011	Airborne particulate filter	12 Former SONGS Evaporation Pond	I-131	0.6 NW	0. 0605 pCi/m^3	0.0129	0.0077	
3/29/2011	Airborne particulate filter	13 Marine Corps Base (Camp Pendleton East)	I-131	0.7 E	0. 074 pCi/m^3	0.013	0.00933	
3/29/2011	Airborne particulate filter	16 San Luis Rey Substation (CONTROL)[1]	I-131	16.7 SE	0. 0653 pCi/m^3	0.0143	0.00725	
3/29/2011	Airborne particulate filter	12 Former SONGS Evaporation Pond	Te-132	0.6 NW	0. 0184 pCi/m^3	0.0112	0.0137	
3/29/2011	Airborne particulate filter	16 San Luis Rey Substation (CONTROL)[1]	Te-132	16.7 SE	0. 0127 pCi/m^3	0.0111	0.012	
3/29/2011	Airborne particulate filter	1 City of San Clemente (City Hall)	Cs-134	5.1 NW	0. 0216 pCi/m^3	0.00819	0.00732	
3/29/2011	Airborne particulate filter	7 AWS Roof	Cs-134	0.18 NW	0. 00952 pCi/m^3	0.00886	0.00669	
3/29/2011	Airborne particulate filter	9 State Beach Park	Cs-134	0.6 ESE	0. 0127 pCi/m^3	0.00666	0.00698	
3/29/2011	Airborne particulate filter	10 Bluff	Cs-134	0.7 WNW	0. 015 pCi/m^3	0.00995	0.00886	
3/29/2011	Airborne particulate filter	11 Mesa EOF	Cs-134	0.7 NNW	0. 0154 pCi/m^3	0.00654	0.00436	
3/29/2011	Airborne particulate filter	12 Former SONGS Evaporation Pond	Cs-134	0.6 NW	0. 0241 pCi/m^3	0.0088	0.00762	
3/29/2011	Airborne particulate filter	13 Marine Corps Base (Camp Pendleton East)	Cs-134	0.7 E	0. 0266 pCi/m^3	0.00995	0.00874	
3/29/2011	Airborne particulate filter	16 San Luis Rey Substation (CONTROL)[1]	Cs-134	16.7 SE	0. 0124 pCi/m^3	0.0061	0.00561	
3/29/2011	Airborne particulate filter	1 City of San Clemente (City Hall)	Cs-137	5.1 NW	0. 0194 pCi/m^3	0.00855	0.00708	
3/29/2011	Airborne particulate filter	7 AWS Roof	Cs-137	0.18 NW	0. 0155 pCi/m^3	0.00721	0.00546	
3/29/2011	Airborne particulate filter	9 State Beach Park	Cs-137	0.6 ESE	0. 0167 pCi/m^3	0.00633	0.00532	

TABLE B-4

Date	Media	Location	Analyte	Distance/Direction from SONGS	Activity & Units	2 Sigma	MDC	*Analytical Remarks*
3/29/2011	Airborne particulate filter	10 Bluff	Cs-137	0.7 WNW	0. 0243 pCi/m^3	0.00802	0.00777	
3/29/2011	Airborne particulate filter	11 Mesa EOF	Cs-137	0.7 NNW	0. 0187 pCi/m^3	0.00618	0.00601	
3/29/2011	Airborne particulate filter	12 Former SONGS Evaporation Pond	Cs-137	0.6 NW	0. 019 pCi/m^3	0.00787	0.00603	
3/29/2011	Airborne particulate filter	13 Marine Corps Base (Camp Pendleton East)	Cs-137	0.7 E	0. 0223 pCi/m^3	0.00711	0.00709	
3/29/2011	Airborne particulate filter	16 San Luis Rey Substation (CONTROL)[1]	Cs-137	16.7 SE	0.0203 pCi/m^3	0.00627	0.00439	
3/22/2011	Air I-131 cartridge	1 City of San Clemente (City Hall)	I-131	5.1 NW	0.928 pCi/m^3	0.13	0.0247	
3/22/2011	Air I-131 cartridge	7 AWS Roof	I-131	0.18 NW	0.783 pCi/m^3	0.113	0.0193	
3/22/2011	Air I-131 cartridge	9 State Beach Park	I-131	0.6 ESE	0.843 pCi/m^3	0.105	0.0343	
3/22/2011	Air I-131 cartridge	10 Bluff	I-131	0.7 WNW	0.711 pCi/m^3	0.0922	0.0187	
3/22/2011	Air I-131 cartridge	11 Mesa EOF	I-131	0.7 NNW	0.867 pCi/m^3	0.113	0.0253	
3/22/2011	Air I-131 cartridge	12 Former SONGS Evaporation Pond	I-131	0.6 NW	0.867 pCi/m^3	0.146	0.0547	
3/22/2011	Air I-131 cartridge	13 Marine Corps Base (Camp Pendleton East)	I-131	0.7 E	0.876 pCi/m^3	0.111	0.0268	
3/22/2011	Air I-131 cartridge	16 San Luis Rey Substation (CONTROL)[1]	I-131	16.7 SE	0.804 pCi/m^3	0.108	0.0211	
3/29/2011	Air I-131 cartridge	1 City of San Clemente (City Hall)	I-131	5.1 NW	0.464 pCi/m^3	0.0688	0.0113	
3/29/2011	Air I-131 cartridge	7 AWS Roof	I-131	0.18 NW	0.369 pCi/m^3	0.0666	0.0228	
3/29/2011	Air I-131 cartridge	9 State Beach Park	I-131	0.6 ESE	0.401 pCi/m^3	0.0687	0.0237	
3/29/2011	Air I-131 cartridge	10 Bluff	I-131	0.7 WNW	0.424 pCi/m^3	0.0716	0.0277	
3/29/2011	Air I-131 cartridge	11 Mesa EOF	I-131	0.7 NNW	0.431 pCi/m^3	0.0689	0.022	
3/29/2011	Air I-131 cartridge	12 Former SONGS Evaporation Pond	I-131	0.6 NW	0.387 pCi/m^3	0.0666	0.0163	
3/29/2011	Air I-131 cartridge	13 Marine Corps Base (Camp Pendleton East)	I-131	0.7 E	0.439 pCi/m^3	0.0792	0.0301	
3/29/2011	Air I-131 cartridge	16 San Luis Rey Substation (CONTROL)[1]	I-131	16.7 SE	0.458 pCi/m^3	0.0751	0.0228	
4/5/2011	Air I-131 cartridge	1 City of San Clemente (City Hall)	I-131	5.1 NW	0.0919 pCi/m^3	0.036	0.02	
4/5/2011	Air I-131 cartridge	7 AWS Roof	I-131	0.18 NW	0.0934 pCi/m^3	0.0319	0.0126	
4/5/2011	Air I-131 cartridge	9 State Beach Park	I-131	0.6 ESE	0.0655 pCi/m^3	0.0258	0.0119	

TABLE B-4

Date	Media	Location	Analyte	Distance/Direction from SONGS	Activity & Units	2 Sigma	MDC	*Analytical Remarks*
4/5/2011	Air I-131 cartridge	10 Bluff	I-131	0.7 WNW	0.0526 pCi/m^3	0.0243	0.026	
4/5/2011	Air I-131 cartridge	11 Mesa EOF	I-131	0.7 NNW	0.0903 pCi/m^3	0.0404	0.0246	
4/5/2011	Air I-131 cartridge	12 Former SONGS Evaporation Pond	I-131	0.6 NW	0.0506 pCi/m^3	0.0301	0.0174	
4/5/2011	Air I-131 cartridge	13 Marine Corps Base (Camp Pendleton East)	I-131	0.7 E	0.0881 pCi/m^3	0.028	0.0245	
4/5/2011	Air I-131 cartridge	16 San Luis Rey Substation (CONTROL)[1]	I-131	16.7 SE	0.0988 pCi/m^3	0.0293	0.0277	
4/12/2011	Air I-131 cartridge	1 City of San Clemente (City Hall)	I-131	5.1 NW	0.0359 pCi/m^3	0.0172	0.0234	
4/12/2011	Air I-131 cartridge	11 Mesa EOF	I-131	0.7 NNW	0.0392 pCi/m^3	0.0138	0.019	
3/29/2011	Airborne particulate filter composite	12 Former SONGS Evaporation Pond	Cs-134	0.6 NW	0.00208 pCi/m^3	0.000716	0.000651	
3/29/2011	Airborne particulate filter composite	16 San Luis Rey Substation (CONTROL)[1]	Cs-134	16.7 SE	0.00237 pCi/m^3	0.000757	0.000629	
3/29/2011	Airborne particulate filter composite	1 City of San Clemente (City Hall)	Cs-134	5.1 NW	0.00245 pCi/m^3	0.000665	0.000612	
3/29/2011	Airborne particulate filter composite	13 Marine Corps Base (Camp Pendleton East)	Cs-134	0.7 E	0.00283 pCi/m^3	0.000962	0.000698	
3/29/2011	Airborne particulate filter composite	9 State Beach Park	Cs-134	0.6 ESE	0.00291 pCi/m^3	0.000724	0.000669	
3/29/2011	Airborne particulate filter composite	12 Former SONGS Evaporation Pond	Cs-137	0.6 NW	0.00198 pCi/m^3	0.000545	0.000394	
3/29/2011	Airborne particulate filter composite	9 State Beach Park	Cs-137	0.6 ESE	0.00221 pCi/m^3	0.000666	0.000474	
3/29/2011	Airborne particulate filter composite	16 San Luis Rey Substation (CONTROL)[1]	Cs-137	16.7 SE	0.00239 pCi/m^3	0.000535	0.000349	
3/29/2011	Airborne particulate filter composite	1 City of San Clemente (City Hall)	Cs-137	5.1 NW	0.00282 pCi/m^3	0.000706	0.000426	
3/29/2011	Airborne particulate filter composite	13 Marine Corps Base (Camp Pendleton East)	Cs-137	0.7 E	0.00321 pCi/m^3	0.000811	0.000494	
6/28/2011	Airborne particulate filter composite	16 San Luis Rey Substation (CONTROL)[1]	Cs-137	16.7 SE	0.000625 pCi/m^3	0.000512	0.000427	
5/21/2011	Deer	Deer Indicator Meat	Cs-134	< 5 miles	0.0367 pCi/g	0.00627	0.00421	
5/21/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.0346 pCi/g	0.0059	0.00387	
7/6/2011	Deer	Deer Control Meat	Cs-134	> 5 miles	0.0299 pCi/g	0.00657	0.00552	
7/6/2011	Deer	Deer Control Meat	Cs-137	> 5 miles	0.0318 pCi/g	0.00675	0.00458	

TABLE B-4

Date	Media	Location	Analyte	Distance/Direction from SONGS	Activity & Units	2 Sigma	MDC	*Analytical Remarks*
7/7/2011	Deer	Deer Indicator Meat	Cs-134	< 5 miles	0.0164 pCi/g	0.00528	0.00567	
7/7/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.0161 pCi/g	0.00427	0.00473	
8/1/2011	Deer	Deer Control Meat	Cs-134	> 5 miles	0.0152 pCi/g	0.00606	0.00582	
8/1/2011	Deer	Deer Control Meat	Cs-137	> 5 miles	0.0101 pCi/g	0.00561	0.00485	
8/9/2011	Deer	Deer Indicator Meat	Cs-134	< 5 miles	0.0165 pCi/g	0.00557	0.00531	
8/9/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.017 pCi/g	0.00621	0.00431	
8/31/2011	Deer	Deer Indicator Meat	Cs-134	< 5 miles	0.0108 pCi/g	0.00476	0.00297	
8/31/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.0103 pCi/g	0.00395	0.00394	
9/19/2011	Deer	Deer Indicator Meat	Cs-134	< 5 miles	0.0114 pCi/g	0.00485	0.00511	
9/19/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.0126 pCi/g	0.0047	0.00397	
9/20/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.00685 pCi/g	0.00406	0.00473	
9/26/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.011 pCi/g	0.00361	0.00368	
10/22/2011	Deer	Deer Control Meat	Cs-137	> 5 miles	0.0135 pCi/g	0.00801	0.00789	
11/12/2011	Deer	Deer Control Meat	Cs-137	> 5 miles	0.0344 pCi/g	0.0147	0.0113	
11/12/2011	Deer	Deer Indicator Meat	Cs-137	< 5 miles	0.015 pCi/g	0.0144	0.0115	
03/23/2011	Local Crops	SONGS Garden	I-131		0.247 pCi/g	0.026	0.00935	Sorrel
03/23/2011	Local Crops	SONGS Garden	Cs-134		0.0283 pCi/g	0.0111	0.00999	Sorrel
03/23/2011	Local Crops	SONGS Garden	Cs-137		0.0292 pCi/g	0.00868	0.00875	Sorrel
03/24/2011	Local Crops	Oceanside Control	I-131		0.062 pCi/g	0.0161	0.0151	Lettuce
03/24/2011	Local Crops	Oceanside Control	I-131		0.0184 pCi/g	0.00893	0.00836	Strawberry

STATISTICAL SUMMARY OF REMP DATA FOR 2011

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2011 to 12/31/2011

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
Weekly Airborne Particulates Gross Beta Activity – Table 2 (pCi/cu.m)								
	Be-7	35		0.11 (24/31) (0.0447 – 0.17)	Marine Corp Base (Camp Pendleton East) 0.7 Mi. E	0.12 (3/4) (0.10 – 0.14)	0.12 (3/4) (0.0673 – 0.16)	35
	Cs-134	35		0.0115 (15/31) (0.0040 – 0.0266)	Former SONGS Evaporation Pond 0.6 Mi. NW	0.0241 (1/4) (0.0241 – 0.0241)	0.0069 (3/4) (0.0040 – 0.0124)	35
	Cs-137	35		0.0124 (14/31) (0.0029 – 0.0243)	Bluff 0.7 WNW	0.0243 (1/5) (0. 0243 – 0. 0243)	0.0119 (2/4) (0.0035 – 0.0203)	35
	Gross Beta	416	0.01	0.0426 (363/363) (0.0131 – 0.20)	Substitute (AP 13 backup) 0.2 Mi. E	0.0502 (1/1) (0.0502 – 0.0502)	0.0445 (53/53) (0.0186 – 0.17)	0
	I-131	35		0.0519 (15/31) (0.0063 – 0.0945)	AWS Roof Parking 0.18 Mi. NW	0.0784 (2/5) (0.0622 – 0.0945)	0.0373 (2/4) (0.0093 – 0.0653)	35
	Te-132	24		0.0222 (5/21) (0.0117 – 0.0366)	Mesa EOF 0.7 NNW	0.0366 (1/3) (0.0366 – 0.0366)	0.0127 (1/3) (0. 0127 – 0. 0127)	24

Non-routine reported measurements include the special weekly gamma isotopic analyses performed to monitor the trans-Pacific transport of licensed material from the nuclear accident at the Fukushima Daiichi Nuclear Power Station.

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Reporting Period: 1/1/2011 to 12/31/2011

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
Weekly Radioiodine I-131 Activity – Table 3 (pCi/cu.m)								
	I-131	416	0.07	0.018 (55/363) (0.0083-0.93)	San Luis Rey Substation 16.7 Mi. SE	0.028 (5/52) (0.0208 – 0.80)	0.24 (6/53) (0.0144 – 0.80)	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 attributable to the nuclear accident at the Fukushima Daiichi Nuclear Power Station was detected during 2011 in this media.

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DOCKET NOS. 50-206, 50-361, 50-362
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Reporting Period: 1/1/2011 to 12/31/2011

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/cu.m)								
	Be-7	33		0.20 (29/29) (0.11 – 0.31)	Marine Corp Base (Camp Pendleton East) 0.7 Mi. E	0.22 (4/4) (0.15 – 0.31)	0.22 (4/4) (0.16 – 0.27)	0
	Cs-134	33	0.05	0.0013 (10/29) (2.29E-4 – 0.0029)	Marine Corp Base (Camp Pendleton Eastl) 0.7 Mi. E	0.0028 (1/4) (0.0028 – 0.0028)	0.0024 (1/4) (0.0024 – 0.0024)	0
	Cs-137	33	0.06	0.0012 (11/29) (2.76E-4 – 0.0032)	Marine Corp Base (Camp Pendleton Eastl) 0.7 Mi. E	0.0018 (2/4) (4.85E-4 – 0.0032)	0.0015 (2/4) (6.25E-4 – 0.0024)	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 2011. The results include detectable Cs-134 and Cs-137 attributable to the nuclear accident at Fukushima.

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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SAN DIEGO COUNTY, CALIFORNIA

Reporting Period: 1/1/2011 to 12/31/2011

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	1.37 (1/40) (1.37 - 1.37)	(D) Newport Beach 30 Mi. NW	2.22 (1/12) (2.22 - 2.22)	2.22 (1/12) (2.22 - 2.22)	0
	Co-58	52	15	<LLD (0/40) (-)	(D) Newport Beach 30 Mi. NW	1.23 (2/12) (1.17- 1.29)	1.23 (2/12) (1.17- 1.29)	0
	Co-60	52	15	1.83 (3/40) (1.47- 2.21)	(B) Outfall – Unit 2 1.5 Mi. SW	2.01 (2/12) (1.80- 2.21)	1.50 (3/12) (1.14- 1.75)	0
	Cs-134	52	15	1.46 (5/40) (0.96 - 2.49)	(A) Station Discharge Outfall - Unit 1 0.6 Mi. SW	1.54 (4/12) (0.96 – 2.49)	1.25 (2/12) (1.15 – 1.35)	0
	Cs-137	52	18	1.58 (2/40) (1.43 - 1.72)	(A) Station Discharge Outfall - Unit 1 0.6 Mi. SW	1.72 (1/12) (1.72 - 1.72)	1.35 (3/12) (1.13 - 1.77)	0
	Fe-59	52	30	<LLD (0/40) (-)		--- (0/2) (-)	< LLD (0/12) (-)	0
	H-3	52	3000	275.80 (5/40) (252.00 - 300.00)	(C) Outfall – Unit 3 1.2 Mi. SSW	300.00 (1/12) (300.00 - 300.00)	295.00 (1/12) (295.00 - 295.00)	0
	I-131	52	15	1.70 (1/40) (1.70 - 1.70)	(B) Outfall - Unit 2 1.5 Mi. SW	1.70 (1/12) (1.70 – 1.70)	<LLD (0/12) (-)	0
	K-40	52		353.60 (40/40) (293.00 – 397.00)	(A) Station Discharge Outfall - Unit 1 0.6 Mi. SW	359.83 (12/12) (310.00 – 397.00)	354.25 (12/12) (327.00 – 386.00)	0
	La-140	52	15	1.37 (1/40) (1.37 - 1.37)	(D) Newport Beach 30 Mi. NW	2.22 (1/12) (2.22 - 2.22)	2.22 (1/12) (2.22 - 2.22)	0
	Mn-54	52	15	1.95 (1/40) (1.95 - 1.95)	(B) Outfall - Unit 2 1.5 Mi. SW	1.95 (1/12) (1.95 - 1.95)	1.31 (1/12) (1.31 – 1.31)	0
	Nb-95	52	15	1.64 (8/40) (0.94 - 3.16)	(B) Outfall - Unit 2 1.5 Mi. SW	1.69 (2/12) (1.59 – 1.78)	0.99 (2/12) (0.93 - 1.04)	0
	Th-230	52		1061.96 (25/40) (247.00 - 2290.00)	(A) Station Discharge Outfall - Unit 1 0.6 Mi. SW	1199.33 (6/12) (247.00 – 1760.00)	1121.33 (9/12) (332.00 – 2110.00)	0

The naturally occurring radioactive isotope K-40 (potassium 40) was detected in all SONGS Ocean water samples analyzed in 2011. The analysis results for all other radionuclides were less than the detection limit.

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

This table is a statistical summary of the radionuclides detected in 2011 (K-40) and the radionuclides listed in the ODCM

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

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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)								
	Zn-65	52	30	< LLD (0/40) (-)		--- (0/12) (-)	<LLD (0/12) (-)	0
	Zr-95	52	15	3.00 (4/40) (1.82 - 4.05)	(C) Outfall- Unit 3 1.2 Mi. SSW	3.03 (3/12) (1.82 – 4.05)	2.29 (2/12) (1.91 – 2.67)	0

The naturally occurring radioactive isotope K-40 (Potassium 40) was detected in all SONGS Ocean water samples analyzed in 2011. The analysis results for all other radionuclides were less than the detection limit.

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

This table is a statistical summary of the radionuclides detected in 2011 (K-40) and the radionuclides listed in the ODCM

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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 Composite Ocean Water Tritium Activity – Table 7 (pCi/l)								
	H-3	16	3000	281.00 (3/12) (255.00 – 296.00)	(D) Newport Beach 30 Mi. NW	409.00 (2/4) (394.00 – 424.00)	409.00 (2/4) (394.00 – 424.00)	0

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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 Drinking Water Analysis – Table 9A (pCi/l)								
	Ba-140	31	15	2.39 (2/19) (1.80 - 2.98)	Camp Pendleton 2.2 Mi. NNW	2.39 (2/12) (1.80 - 2.98)	<LLD (0/12) (-)	0
	Co-58	31	15	1.07 (1/19) (1.07- 1.07)	Oceanside (Control) 15.6 Mi. SE	1.21 (1/12) (1.21- 1.21)	1.21 (1/12) (1.21- 1.21)	0
	Co-60	31	15	1.14 (3/19) (1.04- 1.28)	Oceanside (Control) 15.6 Mi. SE	1.88 (1/12) (1.88- 1.88)	1.88 (1/12) (1.88- 1.88)	0
	Cs-134	31	15	1.12 (3/19) (1.06 - 1.16)	Oceanside (Control) 15.6 Mi. SE	1.77 (2/12) (1.50 – 2.03)	1.77 (2/12) (1.50 – 2.03)	0
	Cs-137	31	18	<LLD (0/19) (-)		--- (0/12) (-)	<LLD (0/12) (-)	0
	Fe-59	31	30	<LLD (0/19) (-)	Oceanside (Control) 15.6 Mi. SE	1.67 (1/12) (1.67 - 1.67)	1.67 (1/12) (1.67 - 1.67)	0
	Gross Beta	31	4	4.21 (13/19) (1.73 - 10.20)	San Clemente Well #8 4 Mi. NNW	5.67 (7/7) (2.29 - 10.20)	3.65 (12/12) (2.25 – 5.02)	0
	H-3	31	3000	288.00 (2/19) (261.00 - 315.00)	Oceanside (Control) 15.6 Mi. SE	332.00 (3/12) (265.00 - 443.00)	332.00 (3/12) (265.00 - 443.00)	0
	I-131	31	15	2.34 (1/19) (2.34 – 2.34)	Camp Pendleton 2.2 Mi. NNW	2.34 (1/12) (2.34 – 2.34)	<LLD (0/12) (-)	0
	K-40	31		28.00 (3/19) (19.90 – 32.80)	Oceanside (Control) 15.6 Mi. SE	28.27 (3/12) (23.10 – 37.40)	28.27 (3/12) (23.10 – 37.40)	0
	La-140	31	15	2.39 (2/19) (1.80 - 2.98)	Camp Pendleton 2.2 Mi. NNW	2.39 (2/12) (1.80 - 2.98)	< LLD (0/12) (-)	0
	Mn-54	31	15	<LLD (0/19) (-)	Oceanside (Control) 15.6 Mi. SE	0.84 (1/12) (0.84 – 0.84)	0.84 (1/12) (0.84 – 0.84)	0
	Nb-95	31	15	3.82 (2/19) (3.73 - 3.91)	Camp Pendleton 2.2 Mi. NNW	3.82 (2/12) (3.73 – 3.91)	1.31 (1/12) (1.31 - 1.31)	0
	Zn-65	31	30	2.19 (1/19) (2.19 - 2.19)	San Clemente Well #8 4 Mi. NNW	2.19 (1/7) (2.19 - 2.19)	<LLD (0/12) (-)	0
	Zr-95	31	15	2.31 (3/19) (1.95 - 2.54)	San Clemente Well #8 4 Mi. NNW	2.44 (1/7) (2.44 – 2.44)	2.06 (2/12) (2.00 – 2.12)	0

During 2011 gross beta was confirmed above the *a posteriori* MDC in most drinking water samples. Gross beta is attributable to naturally occurring radionuclides. All the other analysis results were less than detectable for SONGS related radionuclides.

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

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2010 (Gross Beta) as well as those radionuclides listed in the ODCM

Starting in October 2006 San Clemente drinking water was sampled and analyzed at the request of 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	0.0674 (4/6) (0.0182 - 0.017)	Newport Beach Control 29.2 Mi. NW	0.14 (2/2) (0.12 – 0.16)	0.14 (2/2) (0.12 – 0.16)	0
	Cs-137	8	0.18	<LLD (0/6) (-)		--- (0/2) (-)	<LLD (0/2) (-)	0
	K-40	8		11.92 (6/6) (5.41 - 17.20)	Newport Beach Control 29.2 Mi. NW	18.05 (2/2) (18.00 - 18.10)	18.05 (2/2) (18.00 - 18.10)	0
	Th-228	8		0.78 (6/6) (0.24 - 2.43)	Newport Beach Control 29.2 Mi. NW	2.74 (2/2) (2.07 - 3.40)	2.74 (2/2) (2.07 - 3.40)	0

During 2011 naturally occurring thorium 228 (Th-228) and potassium 40 (K-40) were confirmed above the *a posteriori* MDC in most shoreline sediment samples.

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

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2011 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

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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
Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis – Table 11 (pCi/g)								
	Cs-134	14	0.15	0.0660 (9/12) (0.0235 – 0.15)	(F) SONGS Upcoast 0.9 Mi. WSW	0.11 (2/2) (0.0658 - 0.15)	<LLD (0/2) (-)	0
	Cs-137	14	0.18	0.0289 (1/12) (0.0289 – 0. 0289)	(D) Unit 3 Outfall 1.2 Mi. SSW	0.0289 (1/2) (0.0289 – 0. 0289)	0.0240 (1/2) (0. 0240 - 0. 0240)	0
	K-40	14		16.88 (12/12) (14.40 - 19.90)	Unit 2 Conduit 0.1 Mi. SW	18.60 (2/2) (17.30 - 19.90)	18.50 (2/2) (17.80 - 19.20)	0
	Th-228	14		0.97 (12/12) (0.63 - 1.92)	(F) SONGS Upcoast 0.9 Mi. WSW	1.41 (2/2) (0.90 - 1.92)	0.53 (2/2) (0.37 - 0.68)	0

During 2011, naturally occurring Th-228 (thorium 228) and K-40 (potassium 40) were confirmed above the *a posteriori* MDC in most ocean bottom sediment samples.

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

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2011 (K-40 and Th-228) as well as those radionuclides listed in the ODCM

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2011 to 12/31/2011

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)								
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) (-)		---- (0/1) (-)	< LLD (0/2) (-)	0
Black Perch	Cs-134	5	0.13	< LLD (0/3) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	Cs-137	5	0.15	0.0075 (1/3) (0.0075 - 0.0075)	(A) Unit 1 Outfall 0.9 Mi. WSW	0.0075 (1/2) (0.0075 - 0.0075)	< LLD (0/2) (-)	0
Black Perch	Fe-59	5	0.26	<LLD (0/3) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Black Perch	K-40	5		3.49 (3/3) (3.16 - 3.73)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	3.73 (1/1) (3.73 - 3.73)	3.65 (2/2) (3.45 - 3.84)	0
Black Perch	Mn-54	5	0.13	<LLD (0/3) (-)		---- (0/2) (-)	<LLD (0/2) (-)	0
Black Perch	Zn-65	5	0.26	< LLD (0/3) (-)		---- (0/2) (-)	<LLD (0/2) (-)	0
Blacksmith	Co-58	1	0.13	<LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0
Blacksmith	Co-60	1	0.13	<LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0
Blacksmith	Cs-134	1	0.13	<LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0
Blacksmith	Cs-137	1	0.15	0.0068 (1/1) (0.0068 - 0.0068)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	0.0068 (1/1) (0.0068 - 0.0068)	< LLD (0/0) (-)	0
Blacksmith	Fe-59	1	0.26	<LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0
Blacksmith	K-40	1		3.25 (1/1) (3.25 – 3.25)	(B) Units 2 and 3 Outfall 1.5 Mi. SSW	3.25 (1/1) (3.25 – 3.25)	< LLD (0/0) (-)	0
Blacksmith	Mn-54	1	0.13	< LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0
Blacksmith	Zn-65	1	0.26	< LLD (0/1) (-)		---- (0/1) (-)	< LLD (0/0) (-)	0

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

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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

Reporting Period: 1/1/2011 to 12/31/2011

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)								
California Mussel	Co-58	6	0.13	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Co-60	6	0.13	< LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Cs-134	6	0.13	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Cs-137	6	0.15	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Fe-59	6	0.26	<LLD (0/4) (-)		---- (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) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
California Mussel	Zn-65	6	0.26	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Kelp Bass	Co-58	2	0.13	<LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Co-60	2	0.13	<LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Cs-134	2	0.13	<LLD (0/2) (-)		---- (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) (-)		---- (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) (-)		---- (0/2) (-)	< LLD (0/0) (-)	0
Kelp Bass	Zn-65	2	0.26	<LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/0) (-)	0

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

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2011 to 12/31/2011

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) (-)		---- (0/2) (-)	<LLD (0/2) (-)	0
Sheephead	Co-60	4	0.13	<LLD (0/2) (-)		---- (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) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Sheephead	Fe-59	4	0.26	<LLD (0/2) (-)		---- (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) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Co-58	6	0.13	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Co-60	6	0.13	<LLD (0/4) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Cs-134	6	0.13	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) (-)		---- (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) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Spiny Lobster	Zn-65	6	0.26	<LLD (0/4) (-)		---- (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: 1/1/2011 to 12/31/2011

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	Be-7	3		< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.23 (1/3) (0.23 - 0.23)	0.23 (1/3) (0.23 - 0.23)	0
Lettuce	Cs-134	3	0.06	< LLD (0/0) (-)		---- (0/3) (-)	< LLD (0/3) (-)	0
Lettuce	Cs-137	3	0.08	< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.0120 (1/3) (0.0120 - 0.0120)	0.0120 (1/3) (0.0120 - 0.0120)	0
Lettuce	I-131	3	0.06	< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.0620 (1/3) (0.0620 - 0.0620)	0.0620 (1/3) (0.0620 - 0.0620)	0
Lettuce	K-40	3		< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	2.45 (3/3) (1.82 - 3.44)	2.45 (3/3) (1.82 - 3.44)	0
Lettuce	TI-208	3		< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.0180 (2/3) (0.0167 - 0.0193)	0.0180 (2/3) (0.0167 - 0.0193)	0
Sorrel	Be-7	3		0.35 (3/3) (0.21 - 0.53)	SONGS Garden 0.4 Mi. NNW	0.35 (3/3) (0.21-0.53)	< LLD (0/0) (-)	0
Sorrel	Cs-134	3	0.06	0.0283 (1/3) (0.0283 - 0.0283)	SONGS Garden 0.4 Mi. NNW	0.0283 (1/3) (0.0283 - 0.0283)	< LLD (0/0) (-)	0
Sorrel	Cs-137	3	0.08	0.0292 (1/3) (0.0292 - 0.0292)	SONGS Garden 0.4 Mi. NNW	0.0292 (1/3) (0.0292 - 0.0292)	< LLD (0/0) (-)	0
Sorrel	I-131	3	0.06	0.25 (1/3) (0.25 - 0.25)	SONGS Garden 0.4 Mi. NNW	0.25 (1/3) (0.25 - 0.25)	< LLD (0/0) (-)	0
Sorrel	K-40	3		3.98 (3/3) (3.36 - 4.31)	SONGS Garden 0.4 Mi. NNW	3.98 (3/3) (3.36 - 4.31)	< LLD (0/0) (-)	0
Strawberry	Be-7	1		< LLD (0/0) (-)		---- (0/1) (-)	< LLD (0/1) (-)	0
Strawberry	Cs-134	1	0.06	< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.0054 (1/1) (0.0054 - 0.0054)	0.0054 (1/1) (0.0054 - 0.0054)	0

During 2011, naturally occurring K-40 (potassium 40) and Be-7 (Beryllium 7) were confirmed above the *a posteriori* MDC in local crop samples.

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

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2011 (K-40) as well as those radionuclides listed in the ODCM

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2011 to 12/31/2011

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)								
Strawberry	Cs-137	1	0.08	< LLD (0/0) (-)		---- (0/1) (-)	< LLD (0/1) (-)	0
Strawberry	I-131	1	0.06	< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	0.0184 (1/1) (0.0184 - 0.0184)	0.0184 (1/1) (0.0184 - 0.0184)	0
Strawberry	K-40	1		< LLD (0/0) (-)	South East of Oceanside 22 Mi SE	1.40 (1/1) (1.40 - 1.40)	1.40 (1/1) (1.40 - 1.40)	0
Tomato	Be-7	4		0.0157 (1/2) (0. 0157 – 0.0157)	SONGS Garden 0.4 Mi. NNW	0.0157 (1/2) (0. 0157 – 0.0157)	0.0124 (1/2) (0. 0124 – 0.0124)	0
Tomato	Cs-134	4	0.06	< LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Tomato	Cs-137	4	0.08	< LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Tomato	I-131	4	0.06	< LLD (0/2) (-)		---- (0/2) (-)	< LLD (0/2) (-)	0
Tomato	K-40	4		2.29 (2/2) (1.85 - 2.73)	SONGS Garden 0.4 Mi. NNW	2.29 (2/2) (1.85 - 2.73)	1.90 (2/2) (1.50 - 2.30)	0

During 2011, naturally occurring K-40 (potassium 40) and Be-7 (Beryllium 7) were confirmed above the *a posteriori* MDC in local crop samples.

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

This table is a statistical summary of the analysis results confirmed above the *a posteriori* MDC in 2011 (K-40) as well as those radionuclides listed in the ODCM

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SAN ONOFRE NUCLEAR GENERATING STATION

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

Reporting Period: 1/1/2011 to 12/31/2011

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	0.0596 (3/4) (0.0518 - 0.0653)	Basilone Road/ I-5 Freeway Off ramp 2 Mi. NW	0.0653 (1/1) (0. 0653 - 0.0653)	0.0282 (1/1) (0. 0282 – 0. 0282)	0
	Cs-137	5	0.18	0.22 (2/4) (0.12 – 0.31)	Old Route 101 – East Southeast 3 Mi. ESE	0.31 (1/1) (0.31 – 0.31)	0.22 (1/1) (0.22 – 0.22)	0
	K-40	5		15.39 (4/4) (9.27 – 19.00)	Basilone Road/ I-5 Freeway Off ramp 2 Mi. NW	19.00 (1/1) (19.00 - 19.00)	2.34 (1/1) (2.34 – 2.34)	0
	Th-228	5		0.72 (4/4) (0.52 – 1.02)	Basilone Road/ I-5 Freeway Off ramp 2 Mi. NW	1.02 (1/1) (1.02 – 1.02)	0.18 (1/1) (0.18 – 0.18)	0

During 2010, naturally occurring Th-228 (thorium 228) and K-40 (potassium 40) were confirmed above the *a posteriori* MDC in all soil samples. Cs-137 (Cesium 137) was detected in three samples and is attributable to fallout from nuclear weapons testing and from Chernobyl.

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

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

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Reporting Period: 1/1/2011 to 12/31/2011

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	15	0.06	< LLD (0/5) (-)		---- (0/2) (-)	< LLD (0/10) (-)	0
	Cs-137	15	0.08	< LLD (0/5) (-)		---- (0/2) (-)	<LLD (0/10) (-)	0
	I-131	15	0.06	0.18 (5/5) (0.0275 - 0.39)	Capistrano Beach Reef (G) Mi	0.29 (2/2) (0.0999 – 0.47)	0.21 (10/10) (0.0221 – 0.51)	0
	K-40	15		11.05 (5/5) (9.88 – 13.10)	(E) Salt Creek (CONTROL) 11 Mi. NNW	13.97 (2/2) (13.00 – 14.93)	11.23 (10/10) (8.73 – 14.93)	0

During 2011, naturally occurring K-40 (potassium 40) were confirmed above the *a posteriori* MDC in all kelp samples. I-131 (iodine 131) was also confirmed above the *a posteriori* MDC in all 15 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. I-131 in kelp is attributable to sewage plant effluents.

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

***The April 2011 Capistrano Beach Reef sample was collected 9.0 miles NW. The October 2011 sample was 8.8 miles NW.

APPENDIX C

SUMMARY OF QUALITY CONTROL PROGRAMS

All REMP samples are collected, shipped, and analyzed in accordance with NRC Regulatory Guide 4.15, Revision 1. Marine radiological environmental samples are collected by a vendor, MBC Environmental, per the vendor's Quality Assurance manual. REMP sample analysis is performed by the Contracted Environmental Analysis Laboratory (CEAL) in accordance with the Laboratory Quality Assurance Plan. During 2011 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. The CEAL's performance meets the criteria described in Reg. Guide 4.15. Discrepancies and non-agreement results are resolved through a formal Condition Report evaluation process.

QUARTERLY DUPLICATE TLDs

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

DUPLICATE TLD DATA COMPARISON

	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
TLD 66	14.3 ± 1.0	12.6 ± 0.6	13.6 ± 1.0	13.1 ± 0.6
TLD 200	14.7 ± 1.2	13.4 ± 1.9	14.1 ± 0.9	13.0 ± 0.7

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

ANNUAL DUPLICATE TLDs

An annual duplicate TLD package is collocated with TLD 67.

TLD 67 average exposure in mR per standard quarter (July 2010 to July 2011)	**TLD 201 (annual duplicate) exposure in mR per standard quarter (July 2010 to July 2011)**
16.4	**15.8**

COMPARISON OF TLD TO PIC DATA,

PIC 3 18.1	PIC 4 16.3	PIC 6 15.0	PIC 8 11.3
TLD 40 16.90	TLD 61 14.2	TLD 63 13.0	TLD 65 12.6

PIC data converted to mR per standard quarter compared to the 4th Quarter co-located 2011 TLD data.

CALIBRATION OF AIR SAMPLER VOLUME METERS

The Shop Services and Instrumentation Division of SCE performs an annual calibration procedure using standards referenced to NIST on all REMP air sampler gas meters. When the gas meters are removed from service, the meter is calibrated and the calibration reports are reviewed for bias. This is an *a posteriori* review of the gas meter performance to evaluate method bias and to identify possible outlier analysis results. In 2011, one (1) gas meter failed to meet this criterion at all calibrated flow rates. A review of the affected gross beta data has revealed no meaningful anomalies. Thus no discernable impact to the REMP database or conclusions resulted from use of the out of tolerance gas meter.

TABLE C-1

ANALYTICS CROSS-CHECK PROGRAM SUMMARY

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Analytics

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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

First Quarter 2011
(Ref. Date 17-Mar-2011)

8-June-2011
Walter Levich, Interim QA Manager

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
E7468-278	I-131	9.73E+01 pCi/L	5.21E+00	9.40E+01 pCi/L	1.57E+00	1.04
Gamma	Ce-141	Analyzed but Not Present		Not Present		---
Water	Cr-51	2.16E+02 pCi/L	2.00E+01	1.96E+02 pCi/L	3.27E+00	1.10
	Cs-134	8.52E+01 pCi/L	4.67E+00	8.56E+01 pCi/L	1.43E+00	0.99
GEL ID	Cs-137	1.47E+02 pCi/L	7.46E+00	1.35E+02 pCi/L	2.25E+00	1.09
268293004	Co-58	7.71E+01 pCi/L	4.54E+00	7.44E+01 pCi/L	1.24E+00	1.04
	Mn-54	1.88E+02 pCi/L	9.29E+00	1.75E+02 pCi/L	2.92E+00	1.08
	Fe-59	1.26E+02 pCi/L	7.50E+00	1.15E+02 pCi/L	1.91E+00	1.10
	Zn-65	1.90E+02 pCi/L	1.00E+01	1.72E+02 pCi/L	2.87E+00	1.11
	Co-60	1.14E+02 pCi/L	5.95E+00	1.13E+02 pCi/L	1.88E+00	1.01
E7466-278	Sr-89	9.23E+01 pCi/L	2.32E+00	9.74E+01 pCi/L	1.63E+00	0.95
Sr-89/90 w/maf*	Sr-90	1.27E+01 pCi/L	2.01E+00	1.58E+01 pCi/L	2.64E-01	0.80
Milk						
GEL ID 268293002						
E7467-278	I-131	1.00E+02 pCi/L	5.81E+00	9.69E+01 pCi/L	1.62E+00	1.03
Gamma	Ce-141	Analyzed but Not Present		Not Present		---
Milk	Cr-51	3.27E+02 pCi/L	2.64E+01	2.98E+02 pCi/L	4.98E+00	1.10
	Cs-134	1.19E+02 pCi/L	6.87E+00	1.30E+02 pCi/L	2.18E+00	0.91
GEL ID	Cs-137	2.20E+02 pCi/L	1.02E+01	2.05E+02 pCi/L	3.43E+00	1.07
268293003	Co-58	1.18E+02 pCi/L	6.44E+00	1.13E+02 pCi/L	1.89E+00	1.04
	Mn-54	2.78E+02 pCi/L	1.43E+01	2.66E+02 pCi/L	4.45E+00	1.04
	Fe-59	1.94E+02 pCi/L	1.16E+01	1.75E+02 pCi/L	2.91E+00	1.11
	Zn-65	2.88E+02 pCi/L	1.53E+01	2.61E+02 pCi/L	4.36E+00	1.10
	Co-60	1.76E+02 pCi/L	8.61E+00	1.72E+02 pCi/L	2.87E+00	1.03
E7465-278	I-131	1.03E+02 pCi	5.85E+00	9.47E+01 pCi	1.58E+00	1.09
I-131						
Cartridge						
GEL ID 268293001						

*** maf = mixed activation/fission interferences**

First Quarter 2011 (Ref. Date 17-Mar-2011)

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RESULTS OF ENVIRONMENTAL

CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

Second Quarter 2011
(Ref. Date 16-Jun-2011)

Walter Levich 19-August-2011

Walter Levich, Interim QA Manager **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
E7859-278 I-131 Cartridge	I-131	8.17E+01 pCi	4.31E+00	8.65E+01 pCi	1.44E+00	0.95
GEL ID 280255001						
E7860-278 Sr-89/90 w/maf* Milk	Sr-89	9.68E+01 pCi/L	2.60E+00	1.03E+02 pCi/L	1.72E+00	0.94
	Sr-90	1.58E+01 pCi/L	7.97E-01	1.56E+01 pCi/L	2.61E-01	1.01
GEL ID 280255002						
E7861-278 Gamma Milk	I-131	9.00E+01 pCi/L	8.09E+00	1.03E+02 pCi/L	1.72E+00	0.87
	Ce-141	8.36E+01 pCi/L	5.97E+00	7.99E+01 pCi/L	1.33E+00	1.05
	Cr-51	2.39E+02 pCi/L	2.80E+01	2.06E+02 pCi/L	3.44E+00	1.16
	Cs-134	1.71E+02 pCi/L	9.36E+00	1.90E+02 pCi/L	3.17E+00	0.90
	Cs-137	1.43E+02 pCi/L	8.04E+00	1.38E+02 pCi/L	2.30E+00	1.04
GEL ID 280255003	Co-58	1.50E+02 pCi/L	8.29E+00	1.52E+02 pCi/L	2.53E+00	0.99
	Mn-54	1.32E+02 pCi/L	7.40E+00	1.38E+02 pCi/L	2.30E+00	0.96
	Fe-59	1.43E+02 pCi/L	1.02E+01	1.23E+02 pCi/L	2.06E+00	1.16
	Zn-65	2.76E+02 pCi/L	1.44E+01	2.61E+02 pCi/L	4.35E+00	1.06
	Co-60	1.92E+02 pCi/L	9.31E+00	1.95E+02 pCi/L	3.25E+00	0.99
E7862-278 Gamma Water	I-131	1.20E+02 pCi/L	1.28E+01	1.01E+02 pCi/L	1.68E+00	1.19
	Ce-141	9.30E+01 pCi/L	7.48E+00	9.35E+01 pCi/L	1.56E+00	0.99
	Cr-51	3.36E+02 pCi/L	4.05E+01	2.41E+02 pCi/L	4.03E+00	1.39
	Cs-134	2.02E+02 pCi/L	1.01E+01	2.22E+02 pCi/L	3.71E+00	0.91
GEL ID	Cs-137	1.73E+02 pCi/L	8.25E+00	1.61E+02 pCi/L	2.70E+00	1.07
280255004	Co-58	1.75E+02 pCi/L	9.04E+00	1.77E+02 pCi/L	2.96E+00	0.99
	Mn-54	1.66E+02 pCi/L	8.45E+00	1.61E+02 pCi/L	2.69E+00	1.03
	Fe-59	1.57E+02 pCi/L	1.04E+01	1.44E+02 pCi/L	2.41E+00	1.09
	Zn-65	3.47E+02 pCi/L	1.74E+01	3.05E+02 pCi/L	5.09E+00	1.14
	Co-60	2.38E+02 pCi/L	1.25E+01	2.28E+02 pCi/L	3.80E+00	1.05

*** maf = mixed activation/fission interferences**

Second Quarter 2011 (Ref. Date 16-Jun-2011)

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

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GEL LABORATORIES, LLC

Third Quarter 2011
(Ref. Date 15-Sep-2011)

L. Tkv — 16 Nov 2011

Levan Tkavadve, 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
E8095-278 I-131 Cartridge	I-131	7.69E+01 pCi	4.60E+00	8.02E+01 pCi	1.34E+00	0.96
GEL ID 286114001						
E8096-278 Sr-89/90 w/maf* Milk	Sr-89	9.51E+01 pCi/L	2.54E+00	9.08E+01 pCi/L	1.52E+00	1.05
	Sr-90	8.49E+00 pCi/L	6.86E-01	1.47E+01 pCi/L	2.45E-01	0.58
GEL ID 286114002						
E8097-278 Gamma Milk	I-131	8.59E+01 pCi/L	5.55E+00	8.92E+01 pCi/L	1.49E+00	0.96
	Ce-141	6.59E+01 pCi/L	3.94E+00	6.67E+01 pCi/L	1.11E+00	0.99
	Cr-51	2.18E+02 pCi/L	2.24E+01	2.26E+02 pCi/L	3.78E+00	0.96
	Cs-134	1.20E+02 pCi/L	7.58E+00	1.28E+02 pCi/L	2.14E+00	0.94
	Cs-137	1.23E+02 pCi/L	6.30E+00	1.14E+02 pCi/L	1.90E+00	1.08
GEL ID 286114003	Co-58	9.08E+01 pCi/L	5.97E+00	9.75E+01 pCi/L	1.63E+00	0.93
	Mn-54	1.57E+02 pCi/L	9.80E+00	1.51E+02 pCi/L	2.52E+00	1.04
	Fe-59	5.30E+01 pCi/L	6.79E+00	5.48E+01 pCi/L	9.15E-01	0.97
	Zn-65	1.88E+02 pCi/L	1.48E+01	1.80E+02 pCi/L	3.01E+00	1.04
	Co-60	1.51E+02 pCi/L	7.50E+00	1.57E+02 pCi/L	2.62E+00	0.96
E8098-278 Gamma Water	I-131	7.23E+01 pCi/L	6.25E+00	8.01E+01 pCi/L	1.34E+00	0.90
	Ce-141	9.06E+01 pCi/L	7.34E+00	9.15E+01 pCi/L	1.53E+00	0.99
	Cr-51	3.19E+02 pCi/L	3.08E+01	3.10E+02 pCi/L	5.18E+00	1.03
	Cs-134	1.57E+02 pCi/L	8.71E+00	1.76E+02 pCi/L	2.94E+00	0.89
	Cs-137	1.60E+02 pCi/L	8.08E+00	1.56E+02 pCi/L	2.61E+00	1.03
GEL ID 286114004	Co-58	1.34E+02 pCi/L	7.94E+00	1.34E+02 pCi/L	2.23E+00	1.00
	Mn-54	2.19E+02 pCi/L	1.16E+01	2.07E+02 pCi/L	3.46E+00	1.06
	Fe-59	9.04E+01 pCi/L	8.58E+00	7.52E+01 pCi/L	1.26E+00	1.20
	Zn-65	2.74E+02 pCi/L	1.53E+01	2.47E+02 pCi/L	4.13E+00	1.11
	Co-60	2.25E+02 pCi/L	1.20E+01	2.15E+02 pCi/L	3.60E+00	1.04

* maf = mixed activation/fission interferences

Third Quarter 2011 (Ref. Date 15-Sep-2011)

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

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CROSS CHECK PROGRAM

GEL LABORATORIES, LLC

Fourth Quarter 2011
(Ref. Date 08-Dec-2011)

FOR: 8 Feb 12

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
E8197-278 I-131 Cartridge	I-131	9.52E+01 pCi	4.40E+00	8.92E+01 pCi	1.49E+00	1.07
GEL ID 291783001						
E8198-278 Gamma Milk	Sr-89	8.78E+01 pCi/L	4.76E+00	8.96E+01 pCi/L	1.50E+00	0.98
	Sr-90	1.51E+01 pCi/L	2.15E+00	1.48E+01 pCi/L	2.47E-01	1.02
GEL ID 291783002						
E8199-278 Gamma Milk	I-131	9.36E+01 pCi/L	7.33E+00	9.02E+01 pCi/L	1.51E+00	1.04
	Cr-51	5.53E+02 pCi/L	3.58E+01	5.66E+02 pCi/L	9.45E+00	0.98
	Cs-134	1.59E+02 pCi/L	9.29E+00	1.71E+02 pCi/L	2.86E+00	0.93
	Cs-137	2.27E+02 pCi/L	1.07E+01	2.10E+02 pCi/L	3.50E+00	1.08
GEL ID 291783003	Co-58	2.18E+02 pCi/L	1.25E+01	2.21E+02 pCi/L	3.69E+00	0.99
	Mn-54	2.52E+02 pCi/L	1.46E+01	2.41E+02 pCi/L	4.02E+00	1.05
	Fe-59	1.90E+02 pCi/L	1.66E+01	1.83E+02 pCi/L	3.06E+00	1.04
	Zn-65	3.19E+02 pCi/L	2.63E+01	2.91E+02 pCi/L	4.87E+00	1.09
	Co-60	2.82E+02 pCi/L	1.32E+01	2.70E+02 pCi/L	4.51E+00	1.04
	Ce-141	1.00E-01 pCi/L	2.10E+00	Not Present		---

Fourth Quarter 2011 (Ref. Date 08-Dec-2011)

[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
E8200-278	I-131	8.44E+01 pCi/L	1.55E+01	8.87E+01 pCi/L	1.48E+00	0.95
Gamma	Cr-51	5.32E+02 pCi/L	6.55E+01	5.66E+02 pCi/L	9.45E+00	0.94
Water	Cs-134	1.56E+02 pCi/L	1.73E+01	1.71E+02 pCi/L	2.86E+00	0.91
	Cs-137	2.06E+02 pCi/L	1.87E+01	2.10E+02 pCi/L	3.50E+00	0.98
GEL ID	Co-58	2.02E+02 pCi/L	2.24E+01	2.21E+02 pCi/L	3.69E+00	0.92
291783004	Mn-54	2.50E+02 pCi/L	2.81E+01	2.41E+02 pCi/L	4.02E+00	1.04
	Fe-59	1.81E+02 pCi/L	3.10E+01	1.83E+02 pCi/L	3.06E+00	0.99
	Zn-65	2.95E+02 pCi/L	4.74E+01	2.91E+02 pCi/L	4.87E+00	1.01
	Co-60	2.58E+02 pCi/L	2.34E+01	2.70E+02 pCi/L	4.51E+00	0.96
	Ce-141	-9.60E-01 pCi/L	4.04E+00	Not Present		---

Fourth Quarter 2011 (Ref. Date 08-Dec-2011)

[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 2011 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 2011 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.

"The atypical detection of licensed material in both indicator and control samples of particulate matter, radioiodine cartridges, local crops and kelp is credibly attributed to the trans-Pacific transport of airborne releases from Dai-Ichi, Fukushima following the March 11, 2011 Tohoku earthquake and is not related to the operations of San Onofre."

When fallout from the Fukushima Daiichi nuclear accident are excluded the preoperational data are higher than the operational data. The decrease in radioactivity is due primarily to the cessation of nuclear weapons testing and to the decay of fallout radionuclides. There is a close correlation between indicator and control data over several decades. 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 2011. (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 2011 operational year for Units 2/3, the routine indicator TLD locations ranged from 10.3 to 30.1 mR, averaging 16.7 mR while the control locations ranged from 12.0 to 19.0 mR with an average of 16.0 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 2011 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. Fallout from the nuclear accident at Fukushima was detected in this sample medium during 2011.

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 2011). The data clearly show a close correlation between the indicator and control locations for the entire time period covered. The various spike increases in gross beta activity at all sample locations are closely grouped and timed to coincide with known events external to SONGS with worldwide radiological impact. These events include: Chinese atmospheric nuclear weapons testing on September 17, 1977; March 14, 1978; October 15, 1980; and the April 1986 Chernobyl accident. The graphs (Figures 3A, 3B and 3C) show that the environmental levels of gross beta remained substantially similar at both the indicator and the control locations over an extended period of time, with both control and indicator locations showing simultaneous variations of equal magnitude. The fluctuations in gross beta activity are not attributable to SONGS and are the result of factors external to SONGS.

C. Radioiodine

SONGS Units 2/3:

Most of the preoperational data for I-131 level were below the detection limit. During 2011 fallout from the nuclear accident at Fukushima was detected in this sample media. 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, which served as indicator locations, and from the Newport Beach control location. The ocean water samples are analyzed for naturally-occurring and station-related gamma-emitting radionuclides. They are composited quarterly and analyzed for tritium.

During the preoperational period, naturally-occurring potassium-40 was detected in each of the samples collected from both indicator and control locations. Other gamma-emitting radionuclides were detected in only one ocean water sample. In May 1980, Co-58, Co-60, Cs-l34, and Cs-137 were detected in an ocean water sample collected from the SONGS Unit l outfall. Concentrations of the radionuclides in this sample were 11, 6, 380, and 430 pCi/l, respectively. Tritium was also detected in two of the ocean water samples collected in May 1980 from the SONGS Unit 2 outfall and from the Newport Beach control location.

The data for all other SONGS related radionuclides at all ocean water locations during the 2011 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 2011 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 2011 operational period. Thus the impact of SONGS on the environment as measured by the sample medium is considered to be negligible.

F. Ocean Bottom Sediments

SONGS Units 2/3:

During the preoperational and operational periods, representative samples of ocean bottom sediments were collected semiannually from each of the Station discharge outfalls and from a control station in Laguna Beach. The samples were analyzed for naturally occurring and SONGS related radionuclides. The results of the analyses are listed in Table D-1B.

SONGS-related radionuclides were also detected in samples collected during preoperational period. Manganese-54 (Mn-54) was detected in 5 of the 28 samples. The concentrations of Mn-54 in these samples ranged from 0.015 to 0.49 pCi/g, averaging 0.13 pCi/g. Cobalt-58 (Co-58) was detected in nine samples. The concentration of Co-58 in the samples ranged from 0.013 to 1.16 pCi/g, averaging 0.20 pCi/g. Cobalt-60 (Co-60) was measured in 15 of the 28 samples. The concentration of Co-60 in the sample ranged from 0.014 to 8.l pCi/g, averaging 0.79 pCi/g. Cs-137 was also detected in 16 of the 28 samples. The concentrations of Cs-137 in the samples ranged from 0.014 to 0.090 pCi/g, averaging 0.039 pCi/g. Cerium-144 (Ce-144) was found in two samples. The concentration of Ce-144 in the samples was 0.06 and 0.26 pCi/g, respectively.

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

The concentration of station-related radionuclides in all ocean bottom sediment samples analyzed in 2011 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 2011**
****** **During January to December 2011 all station related Radionuclides from all sample locations were < LLD**
LLD **Lower limits of detection for operational data are listed in Appendix B.**

G. Marine Species (Flesh)

SONGS Units 2/3:

Non-migratory marine species were collected semi-annually near SONGS to determine the amount of radioactivity that could be consumed by man or that was present in the food chain to man. Marine species caught by the SONGS outfalls and from Laguna Beach include two species of adult fish, crustacea and mollusks. Upon collection, the flesh portion is analyzed for gamma-emitting, radionuclides as specified in the ODCM. The results are subsequently reported as pCi/gram wet weight.

Results for several marine species for both the preoperational and 2011 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 2011 operational period, no SONGS related radionuclides were detected at either the *a priori* LLD or the lower *a posteriori* MDC. The data indicate no accumulation trends. The operation of SONGS Units 2/3 in 2011 had no impact on the environment as measured by this sample medium.

TABLE D-2

MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND 2011 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 2011. The species collected in 2011 were California Mussel, Black Perch, Blacksmith, Sheephead, Kelp Bass, and Spiny Lobster.**

****** **During January to December 2011 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 2011 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 2011. The species collected in 2011 were California Mussel, Black Perch, Blacksmith, Sheephead, Kelp Bass, and Spiny Lobster.**

****** **During January to December 2011 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	PreOp	< LLD	< LLD	< LLD	< LLD
SONGS related radionuclides	Operational	---	---	---	---

Keyhole Limpet (Flesh)**

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

***** **PreOp = January 1979 to July 1982; Operational = January to December 2010**

****** **Sea Hare and Keyhole Limpet samples were not collected in 2011**

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

H. Local Crops

SONGS Units 2/3:

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

In the 2011 operational period fallout from the nuclear accident at the Fukushima Daiichi Nuclear Power Station was detected in local crop samples collected immediately after Fukushima. Samples collected in June and December 2011 were < MDC for all plant related radionuclides. The operation of SONGS had no impact on the environment as measured by this sample medium.

I. Soil

SONGS Units 2/3:

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

J. Kelp

SONGS Units 2/3:

Kelp is collected semiannually from three indicator locations and from a control location situated in Laguna Beach. After collection, the samples are analyzed by gamma-spectral analysis for naturally-occurring and SONGS-related radionuclides. During 2011 four additional control sample locations were analyzed.

To assess the impact of SONGS operations on kelp, preoperational data were compared to 2011 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 2011 operational period, I-131 was detected in all samples. No other station related isotopes were detected in kelp samples during the 2011 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 2011 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-0.31	0.22	0.22	0.22
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	0.0275– 0.39	0.18	0.0999 – 0.47	0.29
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 2011**
LLD Lower Limit of Detection for operational data are listed in Appendix B.

APPENDIX E

DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS

IN 2011

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 2011, 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 2011 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 2011 due to weekly sample collection, annual Preventive Maintenance (PM), and the annual gas meter change out was approximately 46 minutes for each sampler.

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

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

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

Air Sampler 9 (State Beach Park): Sampler # 9 had 10.7 hours of down time in 2011 due to external factors (electrical power outages).

Air Sampler 12 (Former SONGS Evaporation Pond): Sampler # 12 had 8.8 hours of down time in 2011 due to external factors (electrical power outages).

Air Sampler 13 (Camp Pendleton East): Sampler # 13 had 164.6 hours of down time in 2011 due to external factors (electrical power outages and storm damage). Air sampler # 30 was placed in service as a compensatory measure during the January 2011 storm damage outage period.

Air Sampler 16 (San Luis Rey Substation): Sampler # 16 had 10.4 hours of down time in 2011 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 2011 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 2011.

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 2011 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. The 2011 Land Use Census (LUC) changes did not identify any new land uses.

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 2010 LUC and documentation notebook was conducted. Verification & revision of the 2010 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. No new gardens were identified in 2011.

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 2011 Land Use Census survey was prepared per SONGS procedure SO123-IX-1.20, revision 6.

SUMMARY OF CHANGES

Summary of Changes

1. LUC # R-R3 – Camp Mesa Dry Camping had an estimated occupancy of 744 hours in 2011.
2. LUC # R-R2 - SONGS Camp Mesa. The total estimated maximum possible occupancy is 7296 hours for 2011.
3. LUC # O-2B YMCA surfcamp - The YMCA did not operate an overnight surf camp during 2011 at San Onofre State Park.
4. LUC # R-C3 – San Onofre barracks. The new barracks building in Camp San Onofre were occupied by USMC residents age 17 and older on October 1, 2011. This is a new land use location. The maximum possible estimated occupancy for 2011 is 2208 hours.
5. LUC # O-9 USMC Sanitary Land Fill – The estimated occupancy changed in 2011.
6. Updated Camp Pendleton hunting take data for the period July 1, 2010 to June 30, 2011 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 2011.

TABLE F-1
2011 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	**7,296**
B				
C	R-C2	Camp San Onofre Fire Station	2.4	3,744
	R-C1	Camp San Onofre Barracks 524101	2.8	FTR
	R-C3	**Camp San Onofre Barracks**	**2.6**	**2208**
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	**7,296**
	R-R3	SONGS Dry Camping PL12	0.7	**744**
	R-R1	San Onofre III housing	1.3	FTR

Bold Text indicates changes from 2010 LUC Data as of 9-30-2011 FTR – Full Time Residence

TABLE F-2
2011 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
R	G-10	SONGS Garden	0.4

Bold Text indicates changes from 2010 LUC Data as of 9-30-2011 FTR – Full Time Residence

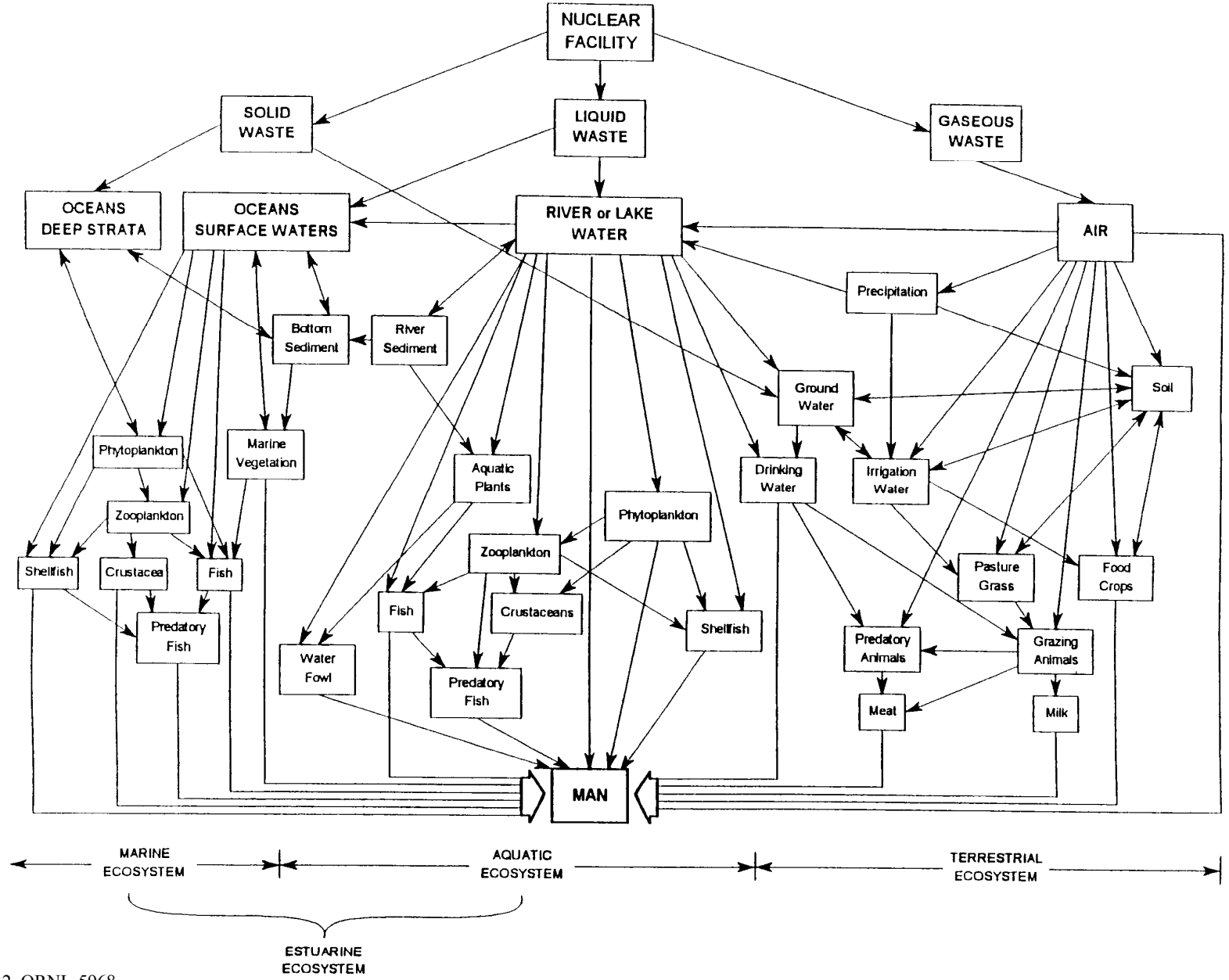
TABLE F-3
2011 SONGS Units 2/3 LUC Five-Mile Radius Summary Sheet

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**	**0**
	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 2010 LUC Data as of 9-30-2011 FTR – Full Time Residence

APPENDIX G

FIGURES FOR 2011



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

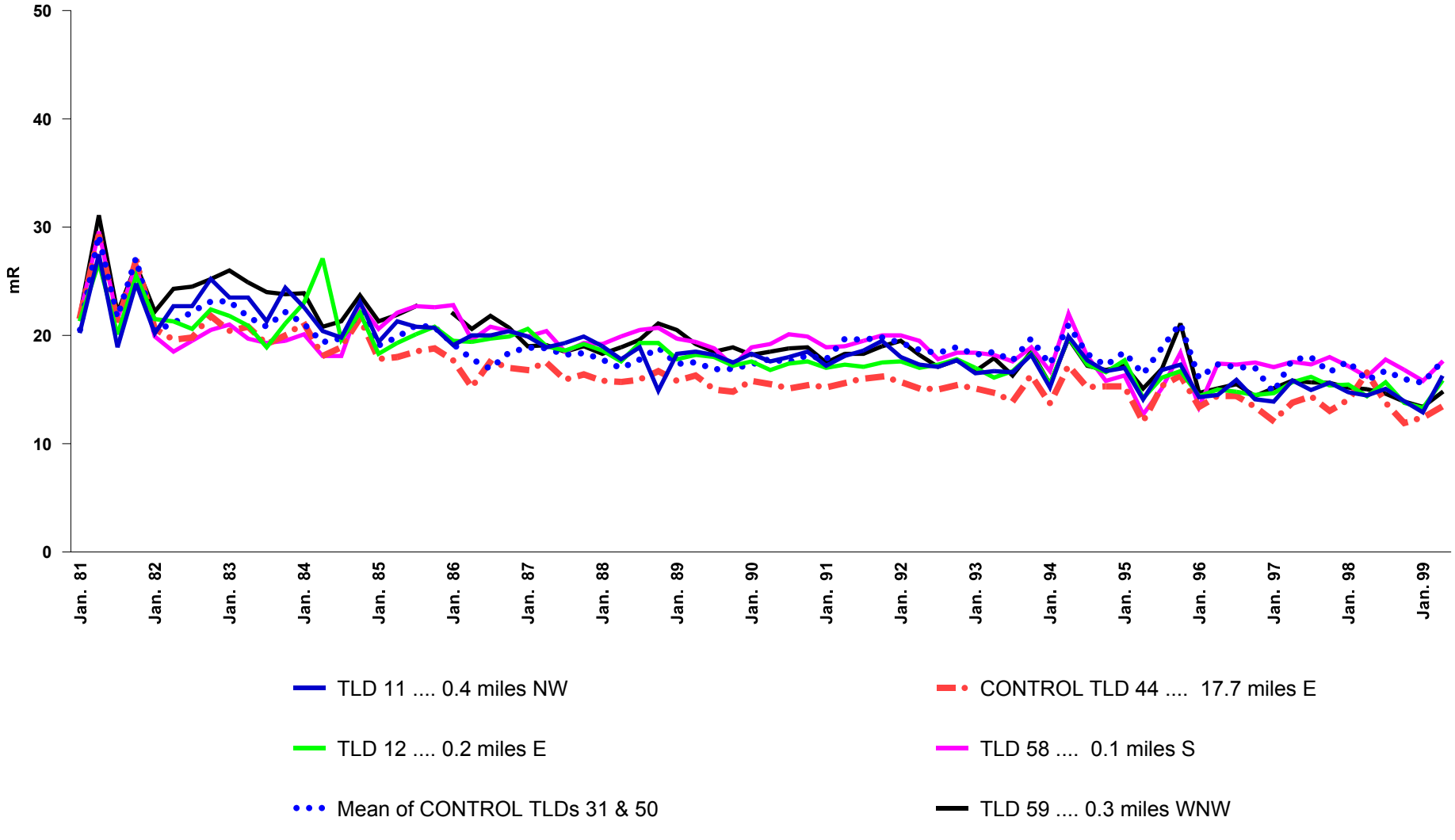


Figure 2A

Direct Radiation Monitoring 1998 to 2011
Quarterly Environmental TLD measurements in mR
Selected TLDs located very close to SONGS vs. Selected CONTROL TLDs

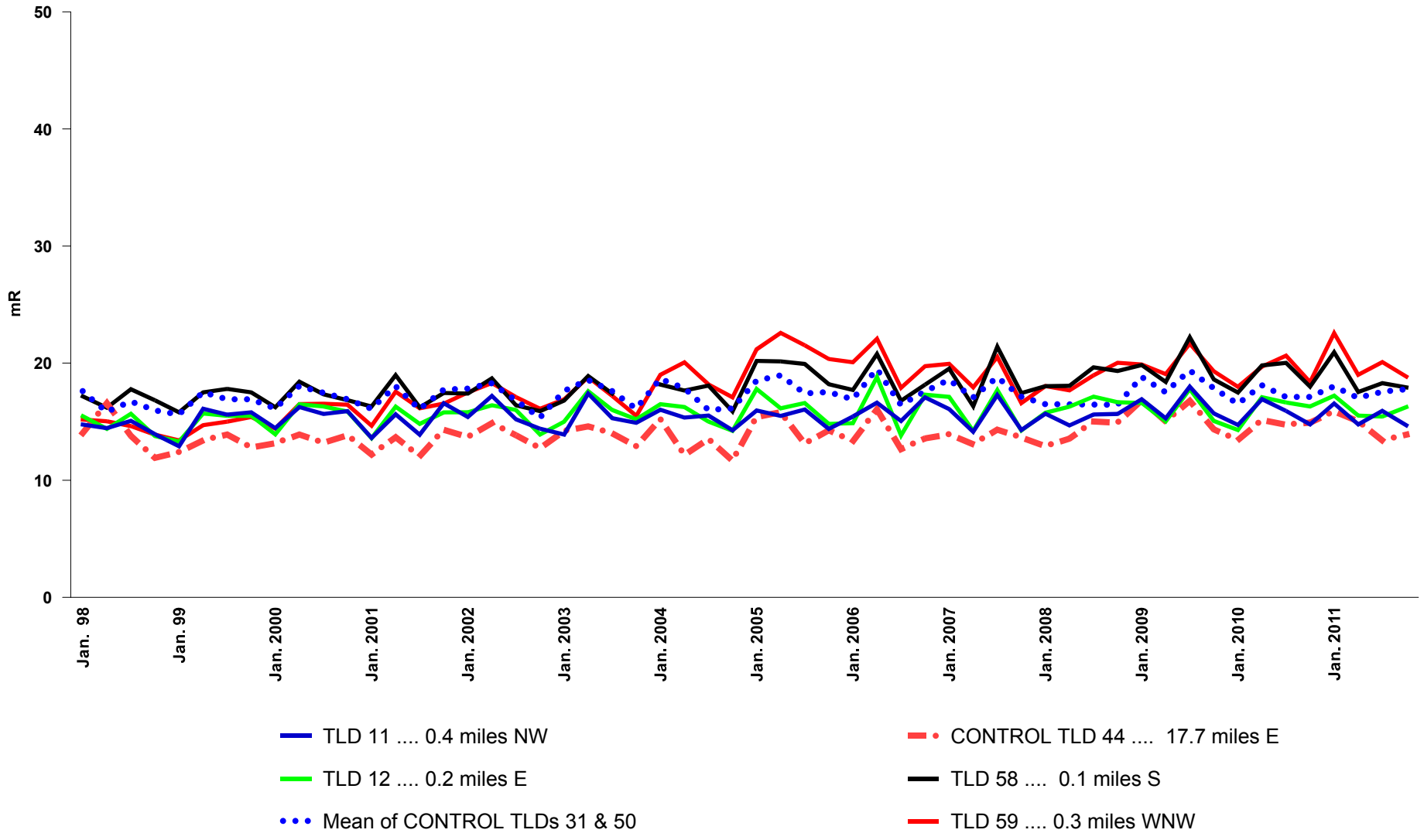


Figure 2B

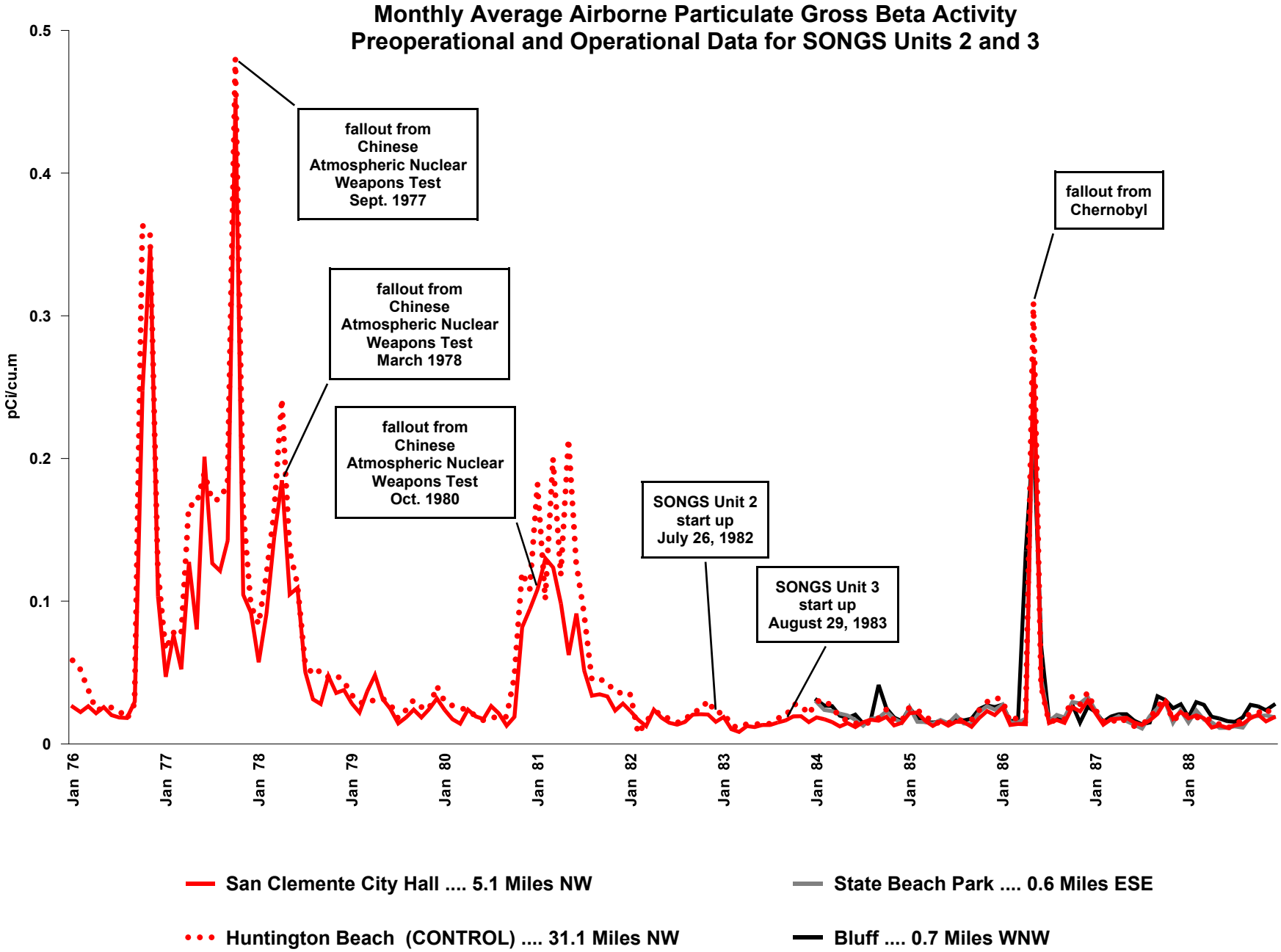

Monthly Average Airborne Particulate Gross Beta Activity
Preoperational and Operational Data for SONGS Units 2 and 3
pCi/cu.m
0.5
0.4
0.3
0.2
0.1
0
fallout from Chinese Atmospheric Nuclear Weapons Test Sept. 1977
fallout from Chinese Atmospheric Nuclear Weapons Test March 1978
fallout from Chinese Atmospheric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

Figure 3A

Monthly Average Airborne Particulates Gross Beta Activity
SONGS Units 2 and 3 from January 1988 to December 1997

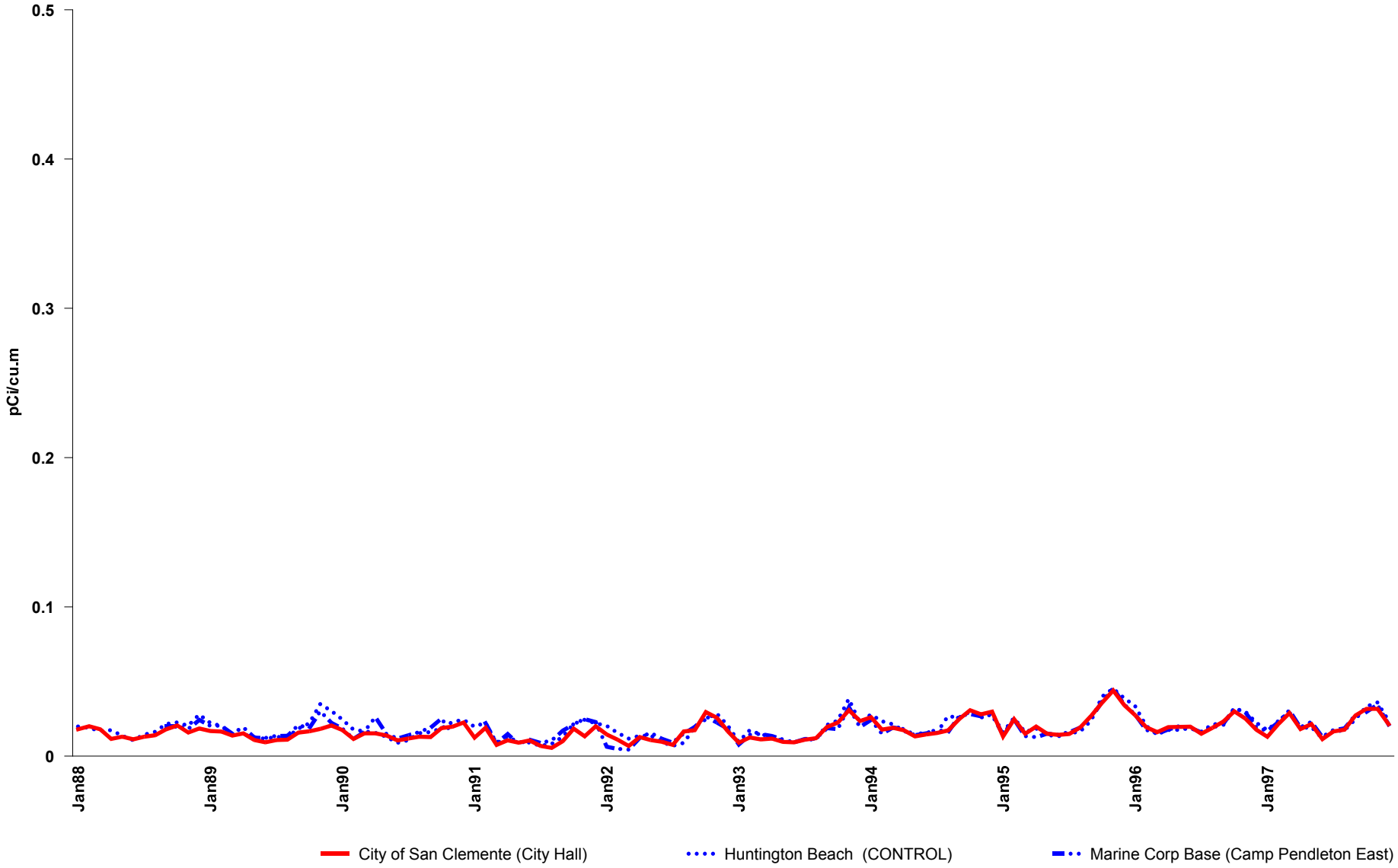


Figure 3B

Monthly Average Airborne Particulates Gross Beta Activity SONGS Units 2 and 3 January 1998 to to December 2011

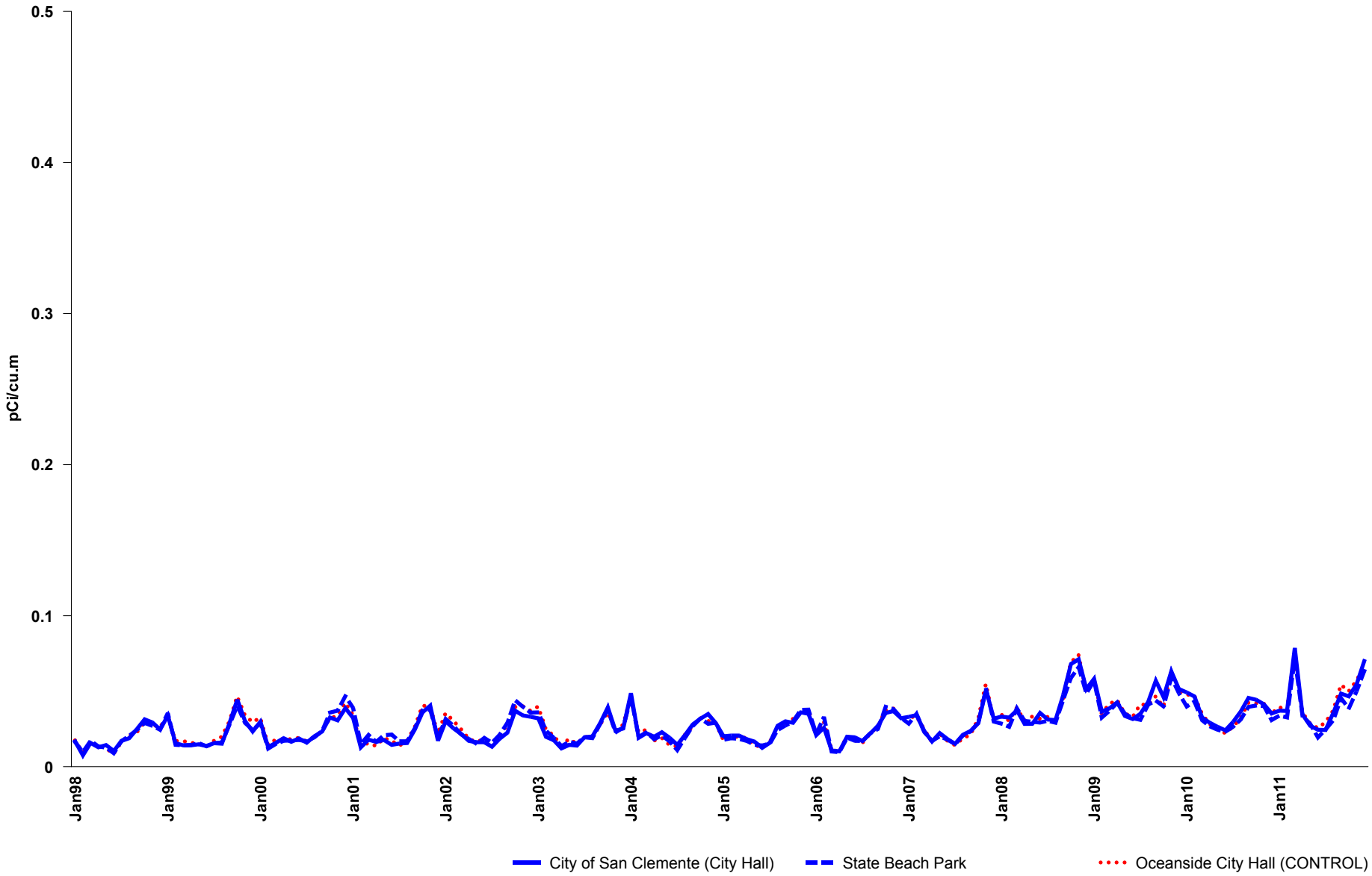


Figure 3 C

Weekly Airborne Particulate Gross Beta Activity
January to December 2011

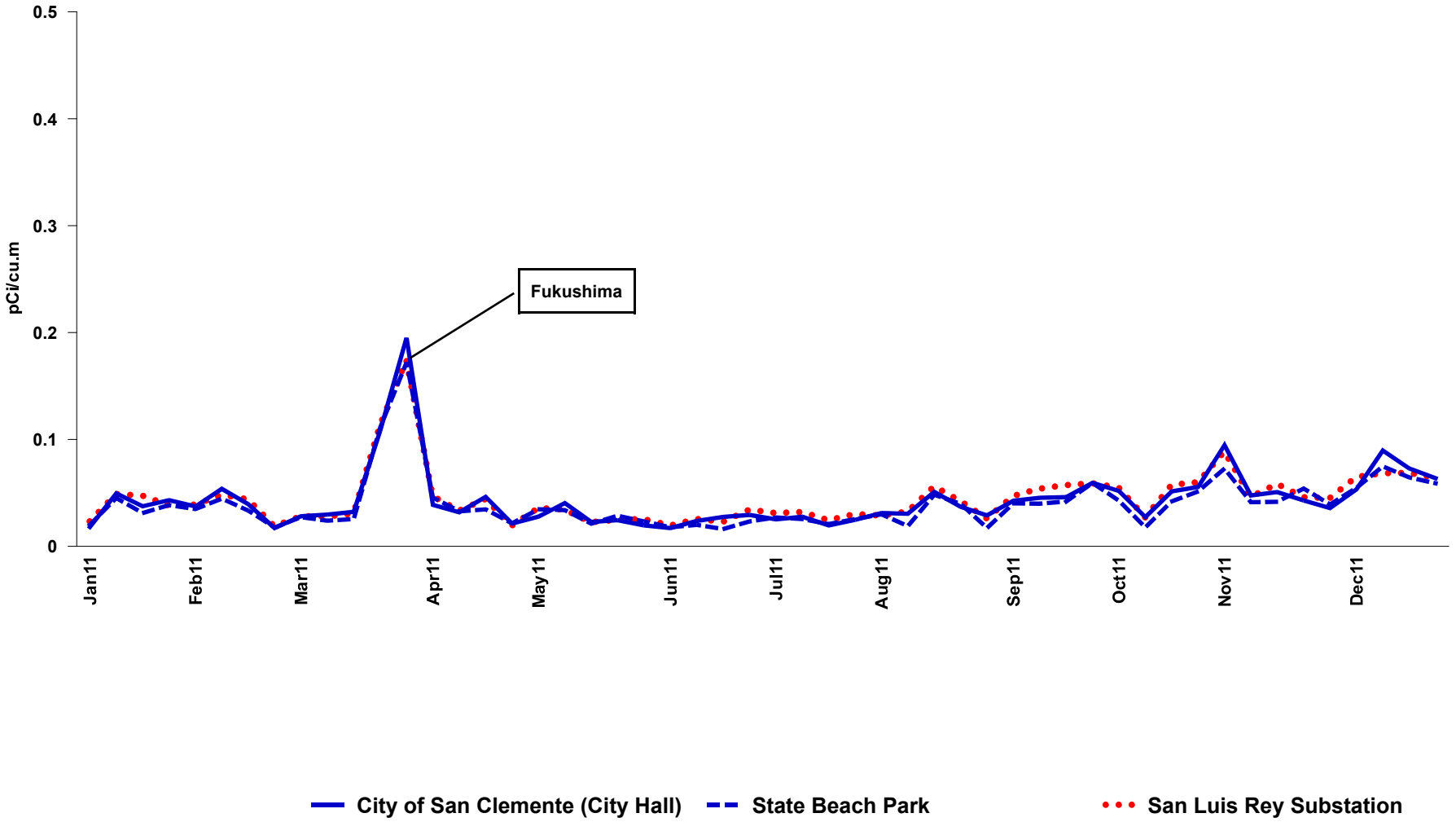


Figure 3D

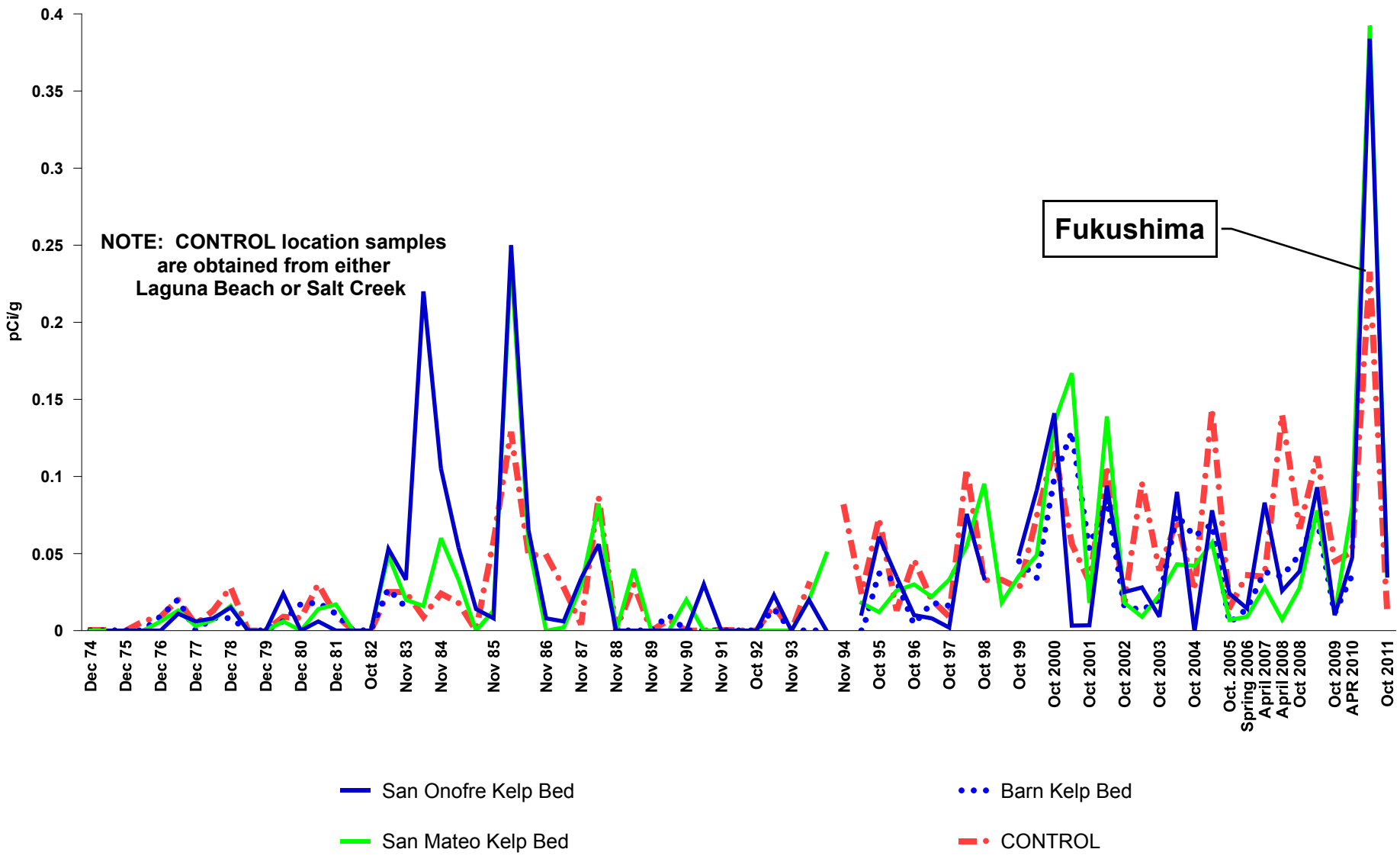

I-131 in Aquatic Kelp
pCi/g
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
NOTE: CONTROL location samples are obtained from either Laguna Beach or Salt Creek
Fukushima
Dec 74
Dec 75
Dec 76
Dec 77
Dec 78
Dec 79
Dec 80
Dec 81
Oct 82
Nov 83
Nov 84
Nov 85
Nov 86
Nov 87
Nov 88
Nov 89
Nov 90
Nov 91
Oct 92
Nov 93
Nov 94
Oct 95
Oct 96
Oct 97
Oct 98
Oct 99
Oct 2000
Oct 2001
Oct 2002
Oct 2003
Oct 2004
Oct. 2005
Spring 2006
April 2007
April 2008
Oct 2008
Oct 2009
APR 2010
Oct 2011
San Onofre Kelp Bed
Barn Kelp Bed
San Mateo Kelp Bed
CONTROL

Figure 4

APPENDIX H

ERRATA TO THE 2010 AREOR

All data required by the ODCM in 2010 was reported in the 2010 AREOR. There are no errata to be appended to the 2010 AREOR.

APPENDIX I

REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2011

APPENDIX I

REMP TLDs CO-LOCATED WITH DPH TLDs DURING 2011

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

2011 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 per standard quarter and 10 mR per 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.

During the first quarter 2011 the storage of the Unit 2 reactor head near the ISFSI in the North Industrial Area (NIA) elevated the exposure rate measurably in 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 2011. The closest publicly accessible location is SW of the ISFSI along the San Onofre Beach access road. The background corrected annual exposure for the access road TLDs 55 and 56 was 25 and 20 mR in 2011. 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.

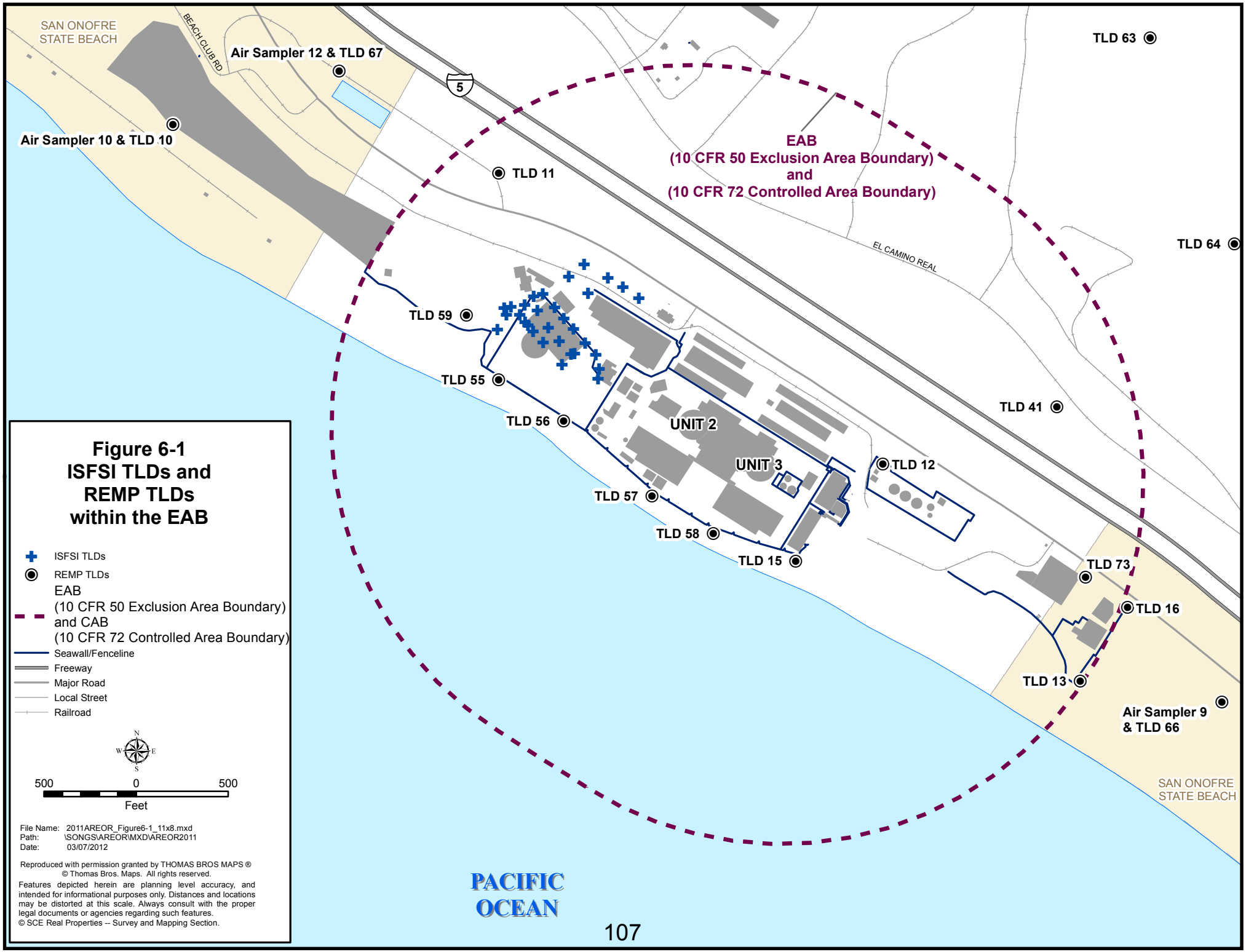
Starting in the fourth quarter 2010 neutron dosimeters were placed in ISFSI TLD canisters 311, 324, 325, and 326. In the second quarter 2011 neutron dosimeters were also placed adjacent to TLDs 327 and 328. The 2011 neutron exposure is below measurable levels for spent fuel in storage. Neutron exposure 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

ISFSI TLD DATA

Location	Quarterly Background	2011 Quarterly Results (mR) 1	2	3	4	Background adjusted 2011 Quarterly Results (mR) 1	2	3	4	Annual Baseline	2011 Annual Total (mR)	2011 Total
ISFSI 301	15.0	28.0	25.3	26.6	25.5	13.0	10.3	11.6	10.5	60.0	105.4	45.4
ISFSI 302	15.0	44.0	39.4	62.1	70.6	29.0	24.4	47.1	55.6	60.0	216.1	156.1
ISFSI 303	15.0	35.3	31.3	44.1	40.6	20.3	16.3	29.1	25.6	60.0	151.3	91.3
ISFSI 304	15.0	31.9	27.6	36.5	32.8	16.9	12.6	21.5	17.8	60.0	128.8	68.8
ISFSI 306	15.0	25.0	22.0	26.2	27.7	10.0	7.0	11.2	12.7	60.0	100.9	40.9
ISFSI 307	15.0	23.3	18.9	22.3	21.5	8.3	<LLD	7.3	6.5	60.0	86.0	26.0
ISFSI 308	15.0	21.0	18.3	20.6	19.8	6.0	<LLD	5.6	<LLD	60.0	79.7	19.7
ISFSI 309	15.0	21.1	18.2	20.3	19.5	6.1	<LLD	5.3	<LLD	60.0	79.1	19.1
ISFSI 310	15.0	20.0	18.5	19.9	19.1	<LLD	<LLD	<LLD	<LLD	60.0	77.5	17.5
ISFSI 311	15.0	19.6	18.1	18.4	18.8	<LLD	<LLD	<LLD	<LLD	60.0	74.9	14.9
ISFSI 312	15.0	15.3	13.8	14.5	14.4	<LLD	<LLD	<LLD	<LLD	60.0	58.0	<LLD
ISFSI 314	15.0	18.5	16.2	17.7	17.6	<LLD	<LLD	<LLD	<LLD	60.0	70.0	<LLD
ISFSI 315	15.0	18.9	16.8	17.8	17.2	< LLD	<LLD	<LLD	<LLD	60.0	70.7	10.7
ISFSI 316	15.0	16.5	15.8	17.6	16.3	<LLD	<LLD	<LLD	<LLD	60.0	66.2	<LLD
ISFSI 317	15.0	19.9	17.6	19.0	20.2	<LLD	<LLD	<LLD	5.2	60.0	76.7	16.7
ISFSI 318	15.0	19.3	16.8	18.6	18.8	<LLD	<LLD	<LLD	<LLD	60.0	73.5	13.5
ISFSI 319	15.0	20.7	17.2	18.8	18.6	5.7	<LLD	<LLD	<LLD	60.0	75.3	15.3
ISFSI 320	15.0	20.5	17.3	19.4	19.0	5.5	<LLD	<LLD	<LLD	60.0	76.2	16.2
ISFSI 321	15.0	21.5	18.1	19.4	19.6	6.5	<LLD	<LLD	<LLD	60.0	78.6	18.6
ISFSI 322	15.0	18.9	19.9	21.2	20.5	<LLD	<LLD	6.2	5.5	60.0	80.5	20.5
ISFSI 323	15.0	25.6	29.7	28.3	30.9	10.6	14.7	13.3	15.9	60.0	114.5	54.5
ISFSI 324	15.0	40.4	70.2	55.1	98.2	25.4	55.2	40.1	83.2	60.0	263.9	203.9
ISFSI 325	15.0	91.2	79.7	105.1	89.2	76.2	64.7	90.1	74.2	60.0	365.2	305.2
ISFSI 326	15.0	36.5	31.7	38.3	42.5	21.5	16.7	23.3	27.5	60.0	149.0	89.0
ISFSI 327	15.0		329.1	325.4	269.6	<LLD	314.1	310.4	254.6	60.0	1232.1	1172.1
ISFSI 328	15.0		153.4	177.7	162.6	<LLD	138.4	162.7	147.6	60.0	658.3	598.3
55 San Onofre State Beach (U1 West)	15.0	21.8	20.9	21.4	20.5	**6.8**	**5.9**	**6.4**	**5.5**	60.0	84.6	**24.6**
56 San Onofre State Beach (U1 West)	15.0	21.4	18.5	18.8	20.9	**6.4**	<LLD	<LLD	**5.9**	60.0	79.6	**19.6**
57 San Onofre State Beach (Unit 2)	15.0	21.5	16.7	18.2	18.6	**6.5**	<LLD	<LLD	<LLD	60.0	75.0	**15.0**
59 SONGS Meteorological Tower	15.0	22.6	19.0	20.1	18.9	**7.6**	<LLD	**5.1**	<LLD	60.0	80.6	**20.6**


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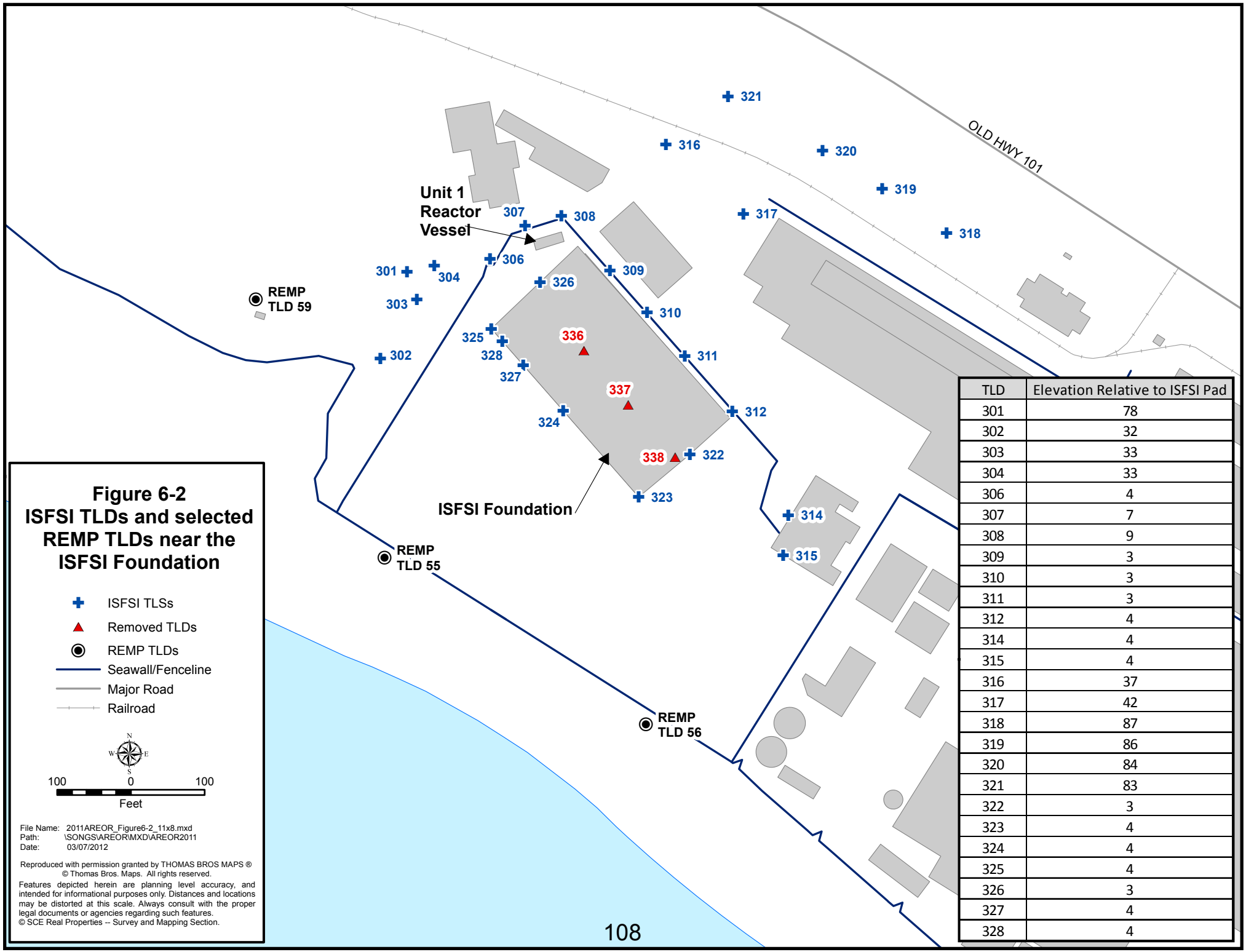

Figure 6-2
ISFSI TLDs and selected REMP TLDs near the ISFSI Foundation

ISFSI TLSs
Removed TLDs
REMP TLDs
Seawall/Fenceline
Major Road
Railroad

N
W E
S

100 0 100
Feet

File Name: 2011AREOR_Figure6-2_11x8.mxd
Path: \SONGS\AREOR\MXD\AREOR2011
Date: 03/07/2012

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.

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
ISFSI & Selected REMP TLDs - Quarterly Gamma Exposure (mR/ std quarter)

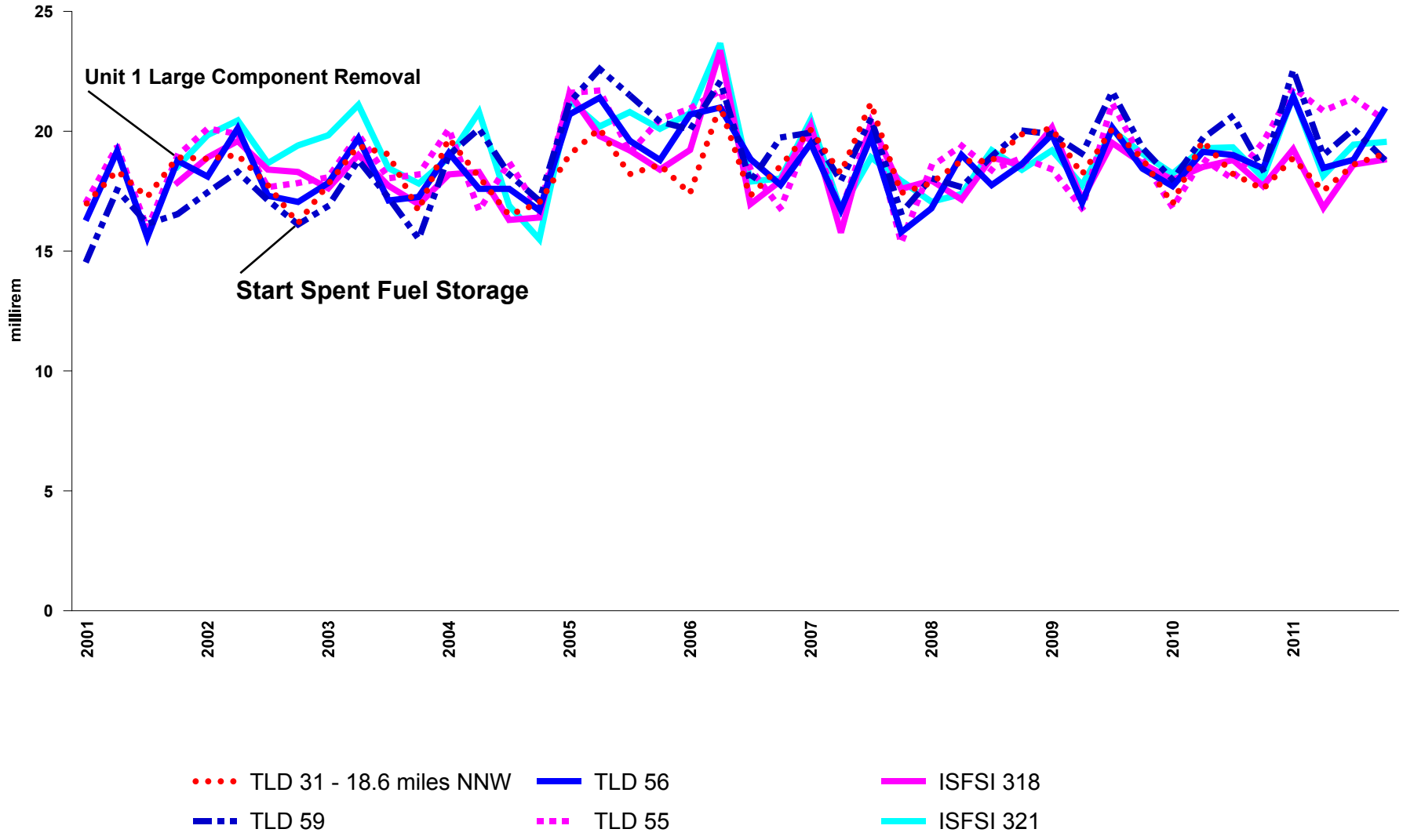

Figure 6A

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 2011 four (4) offsite groundwater and sediment samples were collected near the surf zone due southwest from the North Industrial Area (NIA). 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.