

**Enclosure 1:**

San Onofre Nuclear Generation Station  
Annual Radioactive Effluent Release Report  
2013  
January – December



# SAN ONOFRE NUCLEAR GENERATING STATION

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## PREFACE

San Onofre Nuclear Generating Station is located next to San Onofre State Beach, adjoining Camp Pendleton Marine Corps Base, in San Diego County, 64 miles south of Los Angeles, California. There were three operating pressurized water reactors with a total rated capacity of 2254 net megawatts electrical.

Southern California Edison notified the Nuclear Regulatory Commission (NRC) on June 12, 2013, that it had permanently ceased operation of Units 2 and 3 on June 7, 2013. The notification, called a Certification of Permanent Cessation of Power Operations, sets the stage for SCE to begin preparations for decommissioning.

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

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

Effective December 29, 2006, the City of Anaheim had transferred its ownership interests in San Onofre Units 2 and 3 and the entitlement to the Units 2 and 3 output, to Southern California Edison Company, except that it retains its ownership interests in its spent nuclear fuel and Units 2 and 3's independent spent fuel storage installation located on the facility's site. In addition, the City of Anaheim retains financial responsibility for its spent fuel and for a portion of the Units 2 and 3 decommissioning costs. The City of Anaheim remains a licensee for purposes of its retained interests and liabilities.

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## SECTION A. INTRODUCTION

This Annual Radioactive Effluent Release Report summarizes the gaseous and liquid radioactive effluent releases and radwaste shipments made from the San Onofre Nuclear Generating Station, Units 2 and 3. This report is prepared in the general format of USNRC Regulatory Guide 1.21, Revision 1, and includes:

1. Quarterly Summaries of Gaseous and Liquid Effluents for "Continuous" and "Batch" Modes of Release
2. Percent of Applicable Limits
3. Estimated Total Percent Error
4. Lower Limit of Detection Concentrations
5. Batch Release Summaries
6. Previous Radioactive Effluent Release Report Addendum
7. Radwaste Shipments
8. 10 CFR 50 Appendix I Requirements
9. Changes to Offsite Dose Calculation Manual

## SECTION B. GASEOUS EFFLUENTS

Table 1A, "Gaseous Effluents Summation of All Releases," provides a detailed listing of gaseous effluents released quarterly in four categories: fission and activation gases, iodine 131, particulates with half lives greater than eight days, and tritium. Listed for each of the four categories are:

- (1) the total curies released
- (2) the average release rate
- (3) the percent of applicable limit
- (4) the estimated total error

In addition, the particulate category lists the gross alpha radioactivity released for each quarter.

The methodology used to calculate the percent of Applicable Limit is presented in Section F of this report. The methodology used in Table 1A to calculate the estimated total error is presented in Section G of this report.

Table 1B, "Gaseous Effluents Elevated Release," has not been included in this report since San Onofre Nuclear Generating Station Units 2 and 3 do not conduct elevated releases.

Table 1C, "Gaseous Effluents Ground Level Releases," provides the systematic listing by radionuclide for the quantity of radioactivity released in three categories: fission gases, iodines, and particulates. The total radioactivity for each radionuclide is listed for each quarterly period by both "continuous" and "batch" modes of release.

Waste gas decay tank releases are considered to be "batch" releases. Containment purges and plant stack releases are considered to be "continuous" releases.

Table 1D, "Gaseous Effluents Lower Limit of Detection," provides a listing of lower limit of detection concentrations for radionuclides not detected in Tables 1A and 1C.

Table 1E, "Gaseous Effluents Radiation Doses at the Site Boundary," provides a quarterly summary of doses at the site boundary for this report period.

Table 1F, "Gaseous Effluents Batch Release Summary," provides summary information regarding batch releases conducted during this report period from San Onofre Nuclear Generating Station.

TABLE 1A

## GASEOUS EFFLUENTS SUMMATION OF ALL RELEASES

		Unit	First Quarter	Second Quarter	Estimated Total Error, %
<b>A. Fission and activation gases</b>					
1.	Total release	Ci	<LLD	1.13E-01	3.00E+01
2.	Average release rate for period	μCi/sec	N/A	1.44E-02	
3.	Percent of applicable limit	% MPC	N/A	2.30E-05	
4.	Percent Effluent Concentration Limit	% ECL	N/A	9.86E-06	
<b>B. Iodines</b>					
1.	Total I-131	Ci	<LLD	<LLD	1.90E+01
2.	Average release rate for period	μCi/sec	N/A	N/A	
3.	Percent of applicable limit	% MPC	N/A	N/A	
4.	Percent Effluent Concentration Limit	% ECL	N/A	N/A	
<b>C. Particulates</b>					
1.	Particulates with half-lives >8 days	Ci	<LLD	2.61E-05	1.60E+01
2.	Average release rate for period	μCi/sec	N/A	3.32E-06	
3.	Percent of applicable limit	% MPC	N/A	5.31E-06	
4.	Percent Effluent Concentration Limit	% ECL	N/A	3.19E-05	
5.	Gross alpha activity	Ci	<LLD	<LLD	5.00E+01
<b>D. Tritium</b>					
1.	Total release	Ci	5.40E+01	2.29E+01	2.50E+01
2.	Average release rate for period	μCi/sec	6.94E+00	2.91E+00	
3.	Percent of applicable limit	% MPC	1.67E-02	6.99E-03	
4.	Percent Effluent Concentration Limit	% ECL	3.33E-02	1.40E-02	

TABLE 1A (Continued)

## GASEOUS EFFLUENTS SUMMATION OF ALL RELEASES

		Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
<b>A. Fission and activation gases</b>					
1.	Total release	Ci	<LLD	<LLD	3.00E+01
2.	Average release rate for period	μCi/sec	N/A	N/A	
3.	Percent of applicable limit	% MPC	N/A	N/A	
4.	Percent Effluent Concentration Limit	% ECL	N/A	N/A	
<b>B. Iodines</b>					
1.	Total I-131	Ci	<LLD	<LLD	1.90E+01
2.	Average release rate for period	μCi/sec	N/A	N/A	
3.	Percent of applicable limit	% MPC	N/A	N/A	
4.	Percent Effluent Concentration Limit	% ECL	N/A	N/A	
<b>C. Particulates</b>					
1.	Particulates with half-lives >8 days	Ci	6.07E-06	3.01E-06	1.60E+01
2.	Average release rate for period	μCi/sec	7.64E-07	3.79E-07	
3.	Percent of applicable limit	% MPC	1.21E-06	6.06E-07	
4.	Percent Effluent Concentration Limit	% ECL	7.26E-06	3.64E-06	
5.	Gross alpha activity	Ci	<LLD	<LLD	5.00E+01
<b>D. Tritium</b>					
1.	Total release	Ci	1.88E+01	1.42E+01	2.50E+01
2.	Average release rate for period	μCi/sec	2.37E+00	1.79E+00	
3.	Percent of applicable limit	% MPC	5.68E-03	4.29E-03	
4.	Percent Effluent Concentration Limit	% ECL	1.14E-02	8.57E-03	



TABLE 1C

GASEOUS EFFLUENTS GROUND LEVEL RELEASES  
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
krypton-85	Ci	<LLD	<LLD	<LLD	<LLD
krypton-85m	Ci	<LLD	<LLD	<LLD	<LLD
krypton-87	Ci	<LLD	<LLD	<LLD	<LLD
krypton-88	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-138	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
2. Iodines					
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iodine-133	Ci	<LLD	<LLD	<LLD	<LLD
iodine-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 1D.

TABLE 1C (Continued)

GASEOUS EFFLUENTS-GROUND LEVEL RELEASES  
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
3. Particulates					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	2.61E-05	6.01E-06	3.01E-06
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	6.07E-08	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 1D.

TABLE 1C (Continued)

GASEOUS EFFLUENTS GROUND LEVEL RELEASES  
BATCH MODE \*

Radionuclides Released	Unit	First Quarter**	Second Quarter	Third Quarter **	Fourth Quarter**
1. Fission and activation gases					
krypton-85	Ci	N/A	1.13E-01	N/A	N/A
krypton-85m	Ci	N/A	<LLD	N/A	N/A
krypton-87	Ci	N/A	<LLD	N/A	N/A
krypton-88	Ci	N/A	<LLD	N/A	N/A
xenon-133	Ci	N/A	<LLD	N/A	N/A
xenon-133m	Ci	N/A	<LLD	N/A	N/A
xenon-135	Ci	N/A	<LLD	N/A	N/A
xenon-135m	Ci	N/A	<LLD	N/A	N/A
xenon-138	Ci	N/A	<LLD	N/A	N/A
Total for period	Ci	N/A	1.13E-01	N/A	N/A

LLD Lower Limit of Detection; see Table 1D.

\* Iodines and particulates are not analyzed prior to release via batch mode.

\*\* No batch releases were conducted in the first, third and fourth quarter of 2013.

TABLE 1D

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION  
CONTINUOUS and BATCH MODE

Radionuclides	Continuous Mode LLD ( $\mu\text{Ci/cc}$ )	Batch Mode LLD ( $\mu\text{Ci/cc}$ )
1. Fission and activation gases		
krypton-85	3.00E-05	*
krypton-85m	7.50E-08	2.40E-06
krypton-87	3.80E-07	1.10E-05
krypton-88	2.70E-07	8.70E-06
xenon-133	2.60E-07	5.50E-06
xenon-133m	6.00E-07	2.20E-05
xenon-135	7.70E-08	2.70E-06
xenon-135m	2.90E-06	3.20E-05
xenon-138	5.00E-06	6.90E-05
2. Iodines		
iodine-131	3.60E-13	N/A
iodine-133	3.50E-12	N/A
iodine-135	2.40E-10	N/A
3. Particulates		
barium-140	5.20E-13	N/A
cerium-141	6.30E-14	N/A
cerium-144	2.50E-13	N/A
cesium-134	1.40E-13	N/A
cesium-137	1.20E-13	N/A
cobalt-58	1.30E-13	N/A
cobalt-60	2.00E-13	N/A
iron-59	3.20E-13	N/A
lanthanum-140	9.90E-13	N/A
manganese-54	1.30E-13	N/A
molybdenum-99	7.60E-14	N/A

\* Radionuclide was >LLD in all quarters where batch releases were conducted.

TABLE 1D (Continued)

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION  
CONTINUOUS and BATCH MODE

Radionuclides	Continuous Mode LLD ( $\mu\text{Ci/cc}$ )	Batch Mode LLD ( $\mu\text{Ci/cc}$ )
3. Particulates (Continued)		
strontium-89	1.00E-11	N/A
strontium-90	1.00E-11	N/A
zinc-65	3.40E-13	N/A
4. alpha	1.00E-11	N/A

TABLE 1E

GASEOUS EFFLUENTS RADIATION DOSES AT THE SITE BOUNDARY

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Noble Gas					
1. Gamma Air Dose	mrad	0.00E+00	2.95E-07	0.00E+00	0.00E+00
2. Percent Applicable Limit	%	0.00E+00	2.95E-06	0.00E+00	0.00E+00
3. Beta Air Dose	mrad	0.00E+00	3.35E-05	0.00E+00	0.00E+00
4. Percent Applicable Limit	%	0.00E+00	1.67E-04	0.00E+00	0.00E+00
B. Tritium, Iodine, Particulates (at the nearest receptor)					
1. Organ Dose	mrem	6.97E-03	3.34E-03	2.63E-03	2.22E-03
2. Percent Applicable Limit	%	4.65E-02	2.23E-02	1.75E-02	1.48E-02

NOTE: Calculations performed in accordance with the ODCM utilizing the historical X/Q.

TABLE 1F

## GASEOUS EFFLUENTS BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	3 releases
2. Total time period for batch releases:	687 minutes
3. Maximum time period for a batch release:	310 minutes
4. Average time period for a batch release:	229 minutes
5. Minimum time period for a batch release:	146 minutes

## SECTION C. LIQUID EFFLUENTS

Table 2A, "Liquid Effluents Summation of All Releases," provides a detailed summary of liquid effluents released quarterly in three categories: fission and activation products, tritium, and dissolved and entrained gases. Listed for each of the three categories are:

- (1) the total curies released
- (2) the average diluted concentration
- (3) the percent of applicable limit
- (4) the estimated total error

In addition, Table 2A lists:

- (1) the gross alpha radioactivity
- (2) the volume of waste released (prior to dilution)
- (3) the volume of dilution water

The methodology used to calculate the percent of applicable limit is presented in Section F of this report. The methodology used to calculate the estimated total error in Table 2A is presented in Section G of this report.

Table 2B, "Liquid Effluents," provides the systematic listing by radionuclide for the quantity of radioactivity released in each category. The total radioactivity of each radionuclide released is listed for each quarterly period by both "continuous" and "batch" modes of release.

Table 2C, "Liquid Effluents Lower Limit of Detection," provides a listing of lower limit of detection concentrations for radionuclides not detected in Table 2B.

Table 2D, "Liquid Effluents Radiation Doses at the Liquid Site Boundary," presents a quarterly summary of doses at the Liquid Site Boundary for this report period.

Table 2E, "Liquid Effluents Batch Release Summary," provides summary information regarding batch releases conducted during this report period from San Onofre Nuclear Generating Station.

TABLE 2A

## LIQUID EFFLUENTS SUMMATION OF ALL RELEASES

		Unit	First Quarter	Second Quarter	Estimated Total Error, %
<b>A. Fission and activation products</b>					
1.	Total release (not including tritium, gases, alpha)	Ci	1.35E-04	1.85E-03	1.90E+01
2.	Average diluted concentration during period	µCi/ml	2.42E-13	4.68E-12	
3.	Percent of applicable limit	% MPC	1.70E-06	1.19E-05	
4.	Percent Effluent Concentration Limit	% ECL	2.51E-05	1.16E-04	
<b>B. Tritium</b>					
1.	Total release	Ci	2.22E-02	1.80E+01	1.90E+01
2.	Average diluted concentration during period	µCi/ml	3.99E-11	4.56E-08	
3.	Percent of applicable limit	% MPC	1.33E-06	1.52E-03	
4.	Percent Effluent Concentration Limit	% ECL	3.99E-06	4.56E-03	
<b>C. Dissolved and entrained gases</b>					
1.	Total release	Ci	<LLD	1.13E-02	1.90E+01
2.	Average diluted concentration during period	µCi/ml	N/A	2.86E-11	
3.	Percent of applicable limit	% MPC	N/A	1.43E-05	
4.	Percent Effluent Concentration Limit	% ECL	N/A	1.43E-05	
<b>D. Gross alpha activity</b>					
1.	Total release	Ci	<LLD	<LLD	5.00E+01
<b>E. Volume of waste released (batch &amp; continuous, prior to dilution)</b>					
		liters	1.64E+06	1.73E+06	5.00E+00
<b>F. Volume of dilution water used during period</b>					
		liters	5.57E+11	3.95E+11	5.00E+00

## NOTES:

- 1) NIA weekly composite sample was discarded ending the week of 7-1-13. The monthly composite was made up using the remaining grab samples for the week. The curies released are included in Table 2A. Notification 20252993.
- 2) LLD Lower Limit of Detection; see Table 2C.



TABLE 2A (Continued)

## LIQUID EFFLUENTS SUMMATION OF ALL RELEASES

		Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
<b>A. Fission and activation products</b>					
1.	Total release (not including tritium, gases, alpha)	Ci	7.19E-02	1.92E-03	1.90E+01
2.	Average diluted concentration during period	μCi/ml	3.13E-10	1.10E-10	
3.	Percent of applicable limit	% MPC	5.60E-04	2.15E-04	
4.	Percent Effluent Concentration Limit	% ECL	5.23E-03	2.00E-03	
<b>B. Tritium</b>					
1.	Total release	Ci	6.41E+02	1.17E+01	1.90E+01
2.	Average diluted concentration during period	μCi/ml	2.79E-06	6.72E-07	
3.	Percent of applicable limit	% MPC	9.29E-02	2.24E-02	
4.	Percent Effluent Concentration Limit	% ECL	2.79E-01	6.72E-02	
<b>C. Dissolved and entrained gases</b>					
1.	Total release	Ci	1.27E-01	<LLD	1.90E+01
2.	Average diluted concentration during period	μCi/ml	5.52E-10	N/A	
3.	Percent of applicable limit	% MPC	2.76E-04	N/A	
4.	Percent Effluent Concentration Limit	% ECL	2.76E-04	N/A	
<b>D. Gross alpha activity</b>					
1.	Total release	Ci	<LLD	<LLD	5.00E+01
<b>E. Volume of waste released (batch &amp; continuous, prior to dilution)</b>					
		liters	2.97E+06	1.22E+06	5.00E+00
<b>F. Volume of dilution water used during period</b>					
		liters	2.30E+11	1.74E+10	5.00E+00

LLD Lower Limit of Detection; see Table 2C.

TABLE 2B

LIQUID EFFLUENTS  
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation products					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	<LLD	7.42E-05	<LLD	<LLD
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	<LLD	<LLD
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
technetium-99m	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	7.42E-05	<LLD	<LLD
2. Dissolved and entrained gases					
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 2C.

TABLE 2B (Continued)

LIQUID EFFLUENTS  
BATCH MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation products					
antimony-125	Ci	<LLD	4.28E-04	7.60E-03	9.38E-05
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	4.50E-05	<LLD	5.32E-05	<LLD
cesium-137	Ci	8.96E-05	1.25E-05	8.26E-04	<LLD
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-57	Ci	<LLD	<LLD	3.34E-04	1.03E-05
cobalt-58	Ci	<LLD	1.28E-04	2.55E-03	3.69E-05
cobalt-60	Ci	<LLD	1.01E-03	3.07E-02	9.71E-04
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	2.25E-02	6.33E-04
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	1.32E-04	6.51E-03	1.25E-04
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	<LLD	1.65E-05	4.31E-04	<LLD
silver-110m	Ci	<LLD	4.91E-05	4.27E-04	4.74E-05
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
technetium-99m	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.35E-04	1.78E-03	7.19E-02	1.92E-03
2. Dissolved and entrained gases					
krypton-85	Ci	<LLD	1.13E-02	1.27E-01	<LLD
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	1.13E-02	1.27E-01	<LLD

LLD Lower Limit of Detection; see Table 2C.

TABLE 2C

## LIQUID EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD ( $\mu\text{Ci/cc}$ )	Batch Mode LLD ( $\mu\text{Ci/cc}$ )
1. Fission and activation products		
antimony-125	N/A	1.30E-07
barium-140	3.00E-07	2.50E-07
cerium-141	4.60E-08	4.30E-08
cerium-144	1.90E-07	1.90E-07
cesium-134	8.00E-08	7.90E-08
cesium-137	6.80E-08	6.80E-08
chromium-51	3.50E-07	3.20E-07
cobalt-57	N/A	2.40E-08
cobalt-58	7.20E-08	7.00E-08
cobalt-60	1.00E-07	1.00E-07
iodine-131	6.10E-08	4.60E-08
iron-55	1.00E-06	1.00E-06
iron-59	1.70E-07	1.60E-07
lanthanum-140	5.80E-07	1.90E-07
manganese-54	7.10E-08	7.10E-08
molybdenum-99	6.10E-08	2.80E-08
niobium-95	7.20E-08	6.80E-08
strontium-89	5.00E-08	5.00E-08
strontium-90	5.00E-08	5.00E-08
technetium-99m	6.20E-08	2.90E-08
zinc-65	1.80E-07	1.80E-07
zirconium-95	1.20E-07	1.20E-07
2. Dissolved and entrained gases		
krypton-85	N/A	3.10E-05
xenon-133	2.60E-07	2.60E-07
xenon-135	9.40E-08	9.40E-08
3. gross alpha		
	1.00E-07	1.00E-07

N/A Radionuclide not detected in this mode of releases

TABLE 2D

## LIQUID EFFLUENTS RADIATION DOSES AT THE LIQUID SITE BOUNDARY

	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A.					
1. Total body dose	mrem	1.04E-05	1.09E-04	6.00E-03	1.78E-03
2. Percent Applicable Limit	%	3.46E-04	3.64E-03	2.00E-01	5.92E-02
B.					
1. Limiting organ dose	mrem	1.44E-05	6.97E-04	2.46E-02	1.08E-02
2. Percent Applicable Limit	%	1.44E-04	6.97E-03	2.46E-01	1.08E-01
3. Limiting organ for period		Liver	GI/LLI	GI/LLI	GI/LLI

TABLE 2E

LIQUID EFFLUENTS BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	56 releases
2. Total time period for batch releases:	14564 minutes
3. Maximum time period for a batch release:	681 minutes
4. Average time period for a batch release:	260 minutes
5. Minimum time period for a batch release:	6 minutes
6. Average saltwater flow during batch releases:	387000 gpm

## SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

Per NEI 07-07, Groundwater Protection, Industry Groundwater Protection Initiative-Final Guidance Document, Rev. 0, August 2007 it was determined that all data generated is required to be documented in the Annual Radioactive Effluent Release Report. The addendums for the years 2010, 2011 and 2012 includes the analyses for Gross Alpha, Uranium, other transuranics and Hard to Detects. These parameters were implemented in 2010.

For the years of 2008 and 2009, it was noted that the analyses for Gross Beta was not documented in their respective Annual Radiological Effluent Release Reports.

The primary document providing guidance for effluent reporting and dose calculation methodology is Regulatory Guide 1.1.09, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I. An examination of the database in RG 1.109 shows a lengthy list of radionuclides, specifically Table A-1 (bioaccumulation factors), Table E-1 (transfer factors), Table E-6 (ground factors), Tables E-7, E-8, E-9, E-10 (inhalation factors), and Table E-11, E-12, E-13 and E-14 (ingestion factors). Uranium, as a naturally occurring radionuclide does not appear in any of the tables. Only fission products and activation products associated with commercial nuclear power plants appear in these tables. As such, there is no regulatory guidance to calculate dose if uranium was a plant-related nuclide present in effluents. The uranium reported in the groundwater is of natural origin. The relative ratios of U-234, U-235, and U-238 show that the groundwater ratios are similar to ratios for natural uranium: 56% U-234, 2.8% U-235 and 41% U-238 by activity in groundwater compared to 49% U-234, 2.2% U-235, and 49% U-238 by activity in natural uranium. Compare the ratios from 3.5% enriched uranium, expected in commercial nuclear fuel: 82% U-234, 3.4% U-235 and 15% U-238, it is evident that the groundwater activity ratios are closer to natural uranium and do not correlate with ratios from the enriched uranium. In conclusion, the uranium in groundwater is of natural origin and not from plant operation.

## 2012 ARERR

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
3/3/2012	GW-NIA-1	9.13E+00	<LLD
	GW-NIA-2	6.31E+00	4.53E+00
3/10/2012	NIA-4	1.91E+01	3.56E+00
	NIA-5	-	2.12E+01
	NIA-6	6.59E+00	5.70E+00
3/12/2012	GW-OCA-1	<LLD	5.72E+00
3/15/2012	GW-OCA-2	<LLD	1.08E+01
3/23/2012	GW-OCA-3	<LLD	<LLD
3/29/2012	GW-PA-3	2.54E+01	1.91E+01
	GW-PA-4	9.73E+00	4.68E+00
3/30/2012	GW-PA-1	5.65E+00	2.40E+01
	GW-PA-2	1.14E+01	3.70E+01
6/21/2012	GW-OCA-3	<LLD	<LLD
6/23/2012	GW-PA-3	2.27E+01	1.77E+01
6/24/2012	GW-PA-1	<LLD	1.68E+01
	GW-PA-2	1.09E+01	4.06E+01
6/26/2012	GW-NIA-1	9.33E+00	3.92E+00
6/27/2012	GW-PA-4	4.38E+00	3.97E+00
6/27/2012	GW-OCA-1	<LLD	7.89E+00
6/28/2012	GW-OCA-2	<LLD	8.83E+00
8/24/2012	GW-NIA-1	4.82E+00	<LLD
8/27/2012	GW-NIA-2	1.25E+01	5.90E+00
8/29/2012	GW-PA-4	<LLD	<LLD
8/30/2012	GW-PA-1	<LLD	1.03E+01
	GW-PA-2	1.10E+01	2.28E+01
	GW-PA-3	1.10E+01	4.55E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
= Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter



**2012 ARERR (Continued)**

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
8/31/2012	GW-OCA-2	3.12E+00	7.64E+00
9/5/2012	GW-OCA-3	<LLD	<LLD
9/13/2012	GW-OCA-1	<LLD	5.85E+00
11/27/2012	GW-NIA-1	8.84E+00	<LLD
	GW-NIA-2	1.85E+01	9.32E+00
12/6/2012	GW-OCA-1	<LLD	6.09E+00
12/7/2012	GW-OCA-2	4.27E+00	2.01E+01
12/12/2012	GW-OCA-3	5.14E+00	5.19E+00
12/14/2012	GW-PA-2	4.15E+00	1.87E+01
	GW-PA-3	1.30E+01	7.60E+00
12/15/2012	GW-PA-1	4.89E+00	2.34E+01
12/17/2012	GW-PA-4	6.33E+00	4.12E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
 = Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter

**2012 ARERR (Continued)**

Sample Date	Location	U-233/234 pCi/L	U-235/236 pCi/L	U-238 pCi/L	All other transuranics
3/10/2012	NIA-5	5.84E+00	<LLD	6.05E+00	<LLD
3/29/2012	GW-PA-3	7.48E+00	<LLD	6.92E+00	<LLD
3/30/2012	GW-PA-1	1.58E+01	1.11E+00	1.45E+01	<LLD
	GW-PA-2	2.11E+01	<LLD	1.69E+01	<LLD
6/23/2012	GW-PA-3	6.15E+00	<LLD	5.68E+00	<LLD
6/24/2012	GW-PA-1	1.48E+01	<LLD	1.04E+01	<LLD
	GW-PA-2	2.27E+01	<LLD	2.13E+01	<LLD
8/24/2012	GW-NIA-1	<LLD	<LLD	<LLD	<LLD
8/27/2012	GW-NIA-2	2.44E+00	<LLD	2.67E+00	<LLD
8/29/2012	GW-PA-4	1.19E+00	<LLD	1.08E+00	<LLD
8/30/2012	GW-PA-1	1.30E+01	<LLD	1.20E+01	<LLD
	GW-PA-2	2.15E+01	<LLD	2.06E+01	<LLD
	GW-PA-3	6.29E+00	<LLD	5.27E+00	<LLD
8/31/2012	GW-OCA-2	8.16E+00	<LLD	6.07E+00	<LLD
9/5/2012	GW-OCA-3	1.35E+00	<LLD	1.06E+00	<LLD
9/13/2012	GW-OCA-1	2.60E+00	<LLD	1.76E+00	<LLD
12/7/2012	GW-OCA-2	8.25E+00	<LLD	6.82E+00	<LLD
12/14/2012	GW-PA-2	2.17E+01	1.10E+00	1.87E+01	<LLD
12/15/2012	GW-PA-1	1.21E+01	<LLD	1.08E+01	<LLD

Sample Date	Location	Hard to detect, pCi/L (Ni-63, Fe-55, Sr-89/Sr-90)
8/24/2012	GW-NIA-1	<LLD
8/27/2012	GW-NIA-2	<LLD
8/29/2012	GW-PA-4	<LLD
8/30/2012	GW-PA-1	<LLD
	GW-PA-2	<LLD
	GW-PA-3	<LLD
8/31/2012	GW-OCA-2	<LLD
9/5/2012	GW-OCA-3	<LLD
9/13/2012	GW-OCA-1	<LLD

**2011 ARERR**

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
1/8/2011	NIA-3	9.46E+00	4.96E+00
	NIA-4	3.85E+01	8.91E+00
	NIA-6	5.80E+00	4.65E+00
	NIA-8	2.26E+01	1.51E+01
	NIA-9	6.25E+00	5.71E+00
1/16/2011	NIA-4	3.28E+01	6.13E+00
	NIA-6	8.74E+00	9.36E+00
	NIA-7	4.17E+01	1.69E+00
	NIA-8	1.25E+01	9.18E+00
	NIA-9	<LLD	4.54E+00
1/17/2011	NIA-10	1.87E+01	<LLD
	NIA-11	3.66E+01	9.46E+00
1/22/2011	NIA-3	1.08E+01	8.31E+00
	NIA-4	3.53E+01	5.90E+00
	NIA-5	1.59E+01	7.12E+00
	NIA-6	1.43E+01	6.86E+00
	NIA-7	3.67E+01	<LLD
	NIA-8	1.09E+01	1.07E+01
	NIA-9	<LLD	7.03E+00
1/29/2011	NIA-7	2.19E+01	<LLD
2/12/2011	GW-NIA-1	4.56E+00	6.02E+00
	GW-NIA-2	7.98E+00	<LLD
3/3/2011	GW-PA-1	6.14E+00	1.31E+00
	GW-PA-2	1.79E+01	2.74E+00
	GW-PA-3	3.59E+01	1.99E+00
3/4/2011	GW-PA-4	1.35E+01	5.34E+00
3/13/2011	NIA-6	1.09E+01	5.40E+00
3/30/2011	GW-OCA-2	4.04E+00	1.05E+01
	GW-OCA-3	<LLD	3.79E+00
3/31/2011	GW-NIA-1	1.08E+01	<LLD
	GW-NIA-2	6.92E+00	<LLD
	GW-OCA-1	<LLD	6.52E+00
6/11/2011	GW-NIA-1	1.04E+01	4.78E+00
	GW-NIA-2	9.97E+00	<LLD
6/17/2011	GW-OCA-2	4.58E+00	7.27E+00
6/20/2011	GW-OCA-1	4.71E+00	4.90E+00
6/23/2011	GW-OCA-3	<LLD	<LLD

**2011 ARERR (Continued)**

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
6/24/2011	GW-PA-1	1.09E+01	1.83E+01
	GW-PA-2	1.52E+01	2.12E+01
	GW-PA-3	3.68E+01	1.73E+01
	GW-PA-4	9.26E+00	5.54E+00
8/6/2011	GW-NIA-1	1.39E+01	<LLD
	GW-NIA-2	1.43E+01	<LLD
8/11/2011	GW-PA-4	1.26E+01	7.20E+00
9/19/2011	GW-OCA-1	<LLD	6.43E+00
9/21/2011	GW-OCA-3	<LLD	<LLD
9/22/2011	GW-PA-1	1.03E+01	1.75E+01
	GW-PA-2	1.73E+01	2.65E+01
	GW-PA-3	3.11E+01	1.77E+01
	GW-PA-4	9.97E+00	6.91E+00
9/26/2011	GW-OCA-2	6.39E+00	1.21E+01
12/15/2011	GW-PA-2	1.72E+01	3.46E+01
	GW-PA-3	2.31E+01	7.34E+00
12/16/2011	GW-PA-1	9.56E+00	2.74E+01
12/18/2011	GW-NIA-1	1.14E+01	5.83E+00
	GW-NIA-2	1.25E+01	<LLD
12/22/2011	GW-OCA-3	<LLD	<LLD
12/23/2011	GW-OCA-1	<LLD	6.86E+00
12/23/2011	GW-OCA-2	6.68E+00	1.41E+01

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
= Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter

**2011 ARERR (Continued)**

Sample Date	Location	U-233/234 pCi/L	U-235/236 pCi/L	U-238 pCi/L	All other transuranics
1/8/2011	NIA-8	8.76E+00	<LLD	7.94E+00	<LLD
3/3/2011	GW-PA-2	1.34E+01	<LLD	1.51E+01	<LLD
	GW-PA-3	1.28E+01	1.01E+00	1.06E+01	<LLD
6/24/2011	GW-PA-1	7.82E+00	<LLD	6.59E+00	<LLD
	GW-PA-2	1.68E+01	<LLD	1.51E+01	<LLD
	GW-PA-3	9.35E+00	<LLD	1.05E+01	<LLD
9/19/2011	GW-OCA-1	2.71E+00	<LLD	1.70E+00	<LLD
9/21/2011	GW-OCA-3	<LLD	<LLD	<LLD	<LLD
9/22/2011	GW-PA-1	9.36E+00	1.40E+00	8.58E+00	<LLD
	GW-PA-2	1.26E+01	<LLD	1.10E+01	<LLD
	GW-PA-3	8.75E+00	<LLD	7.24E+00	<LLD
	GW-PA-4	1.57E+00	<LLD	1.43E+00	<LLD
9/26/2011	GW-OCA-2	5.18E+00	<LLD	4.12E+00	<LLD
12/15/2011	GW-PA-2	1.34E+01	1.16E+00	1.36E+01	<LLD
12/16/2011	GW-PA-1	1.03E+01	<LLD	1.04E+02	<LLD

Sample Date	Location	Hard to detect, pCi/L (Ni-63, Fe-55, Sr-89/Sr-90)
9/19/2011	GW-OCA-1	<LLD
9/21/2011	GW-OCA-3	<LLD
9/22/2011	GW-PA-1	<LLD
	GW-PA-2	<LLD
	GW-PA-3	<LLD
	GW-PA-4	<LLD
9/26/2011	GW-OCA-2	<LLD

## 2010 ARERR

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
3/11/2010	GW-OCA-1	<LLD	-
	GW-OCA-2	<LLD	-
3/15/2010	GW-NIA-1	1.18E+01	-
	GW-NIA-2	7.12E+00	-
3/26/2010	GW-PA-1	<LLD	-
	GW-PA-2	5.41E+00	-
	GW-PA-3	3.71E+01	-
	GW-PA-4	<LLD	-
3/29/2010	GW-OCA-3	<LLD	-
6/14/2010	GW-OCA-1	6.89E+00	8.98E+00
	GW-OCA-2	<LLD	7.24E+00
6/16/2010	GW-OCA-3	<LLD	-
6/23/2010	GW-NIA-1	9.42E+00	-
	GW-NIA-2	8.77+00	-
6/24/2010	GW-PA-1	<LLD	-
	GW-PA-2	8.28E+00	-
	GW-PA-3	3.68E+01	-
	GW-PA-4	6.25E+00	-
9/8/2010	GW-NIA-1	1.74E+01	5.67E+00
	GW-NIA-2	1.07E+01	<LLD
9/10/2010	GW-PA-1	8.88E+00	1.91E+01
9/13/2010	GW-PA-2	4.86E+00	2.88E+01
	GW-PA-3	3.02E+01	1.58E+01
	GW-PA-4	4.83E+00	6.56E+00
9/20/2010	GW-OCA-1	6.22E+00	6.05E+00
	GW-OCA-2	4.62E+00	6.72E+00
	GW-OCA-3	9.08E+00	3.09E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
= Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter

**2010 ARERR (Continued)**

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
10/14/2010	NIA-3	1.14E+01	1.46E+01
	NIA-4	2.62E+01	4.39E+00
	NIA-5	2.00E+01	9.27E+00
10/21/2010	GW-NIA-1	1.10E+01	<LLD
	GW-NIA-2	7.41E+00	<LLD
12/23/2010	NIA-4	4.16E+01	5.62E+00
	NIA-6	1.16E+01	9.64E+00
	NIA-10	1.88E+01	<LLD
	NIA-11	3.92E+01	9.82E+00
	GW-NIA-1	8.57E+00	3.95E+00
12/27/2010	NIA-5	2.11E+01	1.02E+01
	GW-NIA-1	1.12E+01	4.99E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
= Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter

**2010 ARERR (Continued)**

Sample Date	Location	U-233/234 pCi/L	U-235/236 pCi/L	U-238 pCi/L	All other transuranics
9/13/2010	GW-PA-2	1.87E+01	1.01E+00	1.39E+01	<LLD

Sample Date	Location	Hard to detect, pCi/L (Ni-63, Fe-55, Sr-89/Sr-90)
3/26/2010	GW-PA-1	<LLD
	GW-PA-2	<LLD
	GW-PA-3	<LLD
	GW-PA-4	<LLD



## 2009 ARERR

Sample Date	Location	Gross Beta, pCi/L
3/21/2009	GW-OCA-1	<LLD
	GW-OCA-2	<LLD
3/23/2009	GW-OCA-3	<LLD
3/26/2009	GW-PA-3	1.60E+01
	GW-PA-4	8.69E+00
3/27/2009	GW-PA-1	<LLD
	GW-PA-2	<LLD
6/5/2009	GW-OCA-2	<LLD
6/8/2009	GW-OCA-1	4.77E+00
6/10/2009	GW-NIA-1	1.65E+01
	GW-NIA-2	7.72E+00
6/11/2009	GW-OCA-3	<LLD
6/12/2009	GW-PA-1	<LLD
	GW-PA-2	5.40E+00
	GW-PA-3	7.86E+00
	GW-PA-4	4.99E+00
7/15/2009	GW-NIA-1	8.31E+00
	GW-NIA-2	<LLD
8/6/2009	GW-NIA-1	3.16E+01
	GW-NIA-2	9.55E-01
8/14/2009	GW-NIA-1	2.45E+01
	GW-NIA-2	<LLD
8/20/2009	GW-NIA-1	2.45E+01
	GW-NIA-2	6.42E+00
8/27/2009	GW-NIA-1	1.78E+01
	GW-NIA-2	4.92E+00
9/3/2009	GW-NIA-1	2.13E+01
	GW-NIA-2	1.24E+01

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l

pCi/L = indicated picocuries per liter

**2009 ARERR (Continued)**

Sample Date	Location	Gross Beta, pCi/L
9/10/2009	GW-PA-1	<LLD
	GW-PA-2	1.31E+01
	GW-PA-3	1.15E+01
	GW-PA-4	1.50E+01
9/24/2009	GW-OCA-3	<LLD
9/25/2009	GW-OCA-1	1.36E+01
	GW-OCA-2	1.43E+01
12/3/2009	GW-NIA-1	1.19E+01
	GW-NIA-2	4.36E+00
12/9/2009	GW-OCA-3	<LLD
12/10/2009	GW-OCA-1	<LLD
	GW-OCA-2	<LLD
12/14/2009	GW-PA-1	<LLD
	GW-PA-2	9.11E+00
	GW-PA-3	3.42E+01
	GW-PA-4	1.12E+01

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pCi/l

pCi/L = indicated picocuries per liter

### 2008 ARERR

Sample Date	Location	Gross Beta, pCi/L
12/29/2008	GW- OCA- 3	<LLD
12/30/2008	GW- PA- 1	5.20E+00
	GW-PA- 2	5.55E+00
	GW-PA-3	1.53E+01
	GW-PA-4	1.14E+01
12/31/2008	GW-OCA-1	<LLD
	GW-OCA-2	<LLD

### 2007 ARERR

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
10/18/2007	GW-OCA-2	<LLD	<LLD
11/29/2007	GW-OCA-1	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

**SECTION E. RADWASTE SHIPMENTS**

**TABLE 3 (Units 2 & 3)**

**SOLID WASTE AND IRRADIATED FUEL SHIPMENT**

**A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)**

1. Type of waste	Unit	12 month period	Estimated total error (%)
a. Spent resins, filter sludges	m <sup>3</sup>	55.884	3.00E+01
	Ci	1.188E+03	
b. Dry active waste (DAW), compactable and non compactable	m <sup>3</sup>	256.665	3.00E+01
	Ci	1.28E+01	
c. Irradiated components	m <sup>3</sup>	N/A	N/A
	Ci	N/A	
d. Other: Filters	m <sup>3</sup>	29.705	3.00E+01
	Ci	7.278E+01	

**Notes:**

Total curie content estimated.

Shipments included: Dry Active Waste (DAW), U2 Original Reactor Head, Spent Resin and Miscellaneous Filters. DAW packaged and shipped in various size General Design Containers and One (1) Type A Shipping Cask, U2 Original Reactor Head packaged and shipped in a General Design Package, Spent Resin packaged in certified burial containers and shipped in Type A shipping casks, Miscellaneous Filters packaged in certified burial containers and shipped in Type A shipping casks.

N/A No shipment made.

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)

2a. Estimate of major nuclide composition: Spent Resin		
tritium	%	7.60E-02
americium-241	%	2.00E-04
antimony-124	%	0.00E+00
antimony-125	%	2.60E-01
carbon-14	%	7.72E-01
cerium-144	%	2.31E-02
cesium-134	%	1.64E+00
cesium-137	%	1.29E+01
chromium-51	%	0.00E+00
cobalt-57	%	1.66E-02
cobalt-58	%	1.30E-02
cobalt-60	%	6.67E+00
curium-242	%	0.00E+00
curium-243/244	%	0.00E+00
europium-152	%	0.00E+00
hafnium-181	%	0.00E+00
iodine-131	%	0.00E+00
iron-55	%	1.12E+01
iron-59	%	0.00E+00
manganese-54	%	3.07E-01
nickel-59	%	4.83E-01
nickel-63	%	6.56E+01
niobium-94	%	0.00E+00
niobium-95	%	0.00E+00
plutonium-238	%	0.00E+00
plutonium-239/40	%	1.00E-04
plutonium-241	%	1.00E-04
radium-226	%	0.00E+00
radium-228	%	0.00E+00
ruthenium-103	%	0.00E+00
strontium-89	%	0.00E+00
strontium-90	%	3.18E-02
technetium-99	%	5.10E-03

thorium-230	%	0.00E+00
tin-113	%	0.00E+00
zinc-65	%	0.00E+00
zirconium-95	%	0.00E+00

2b. Estimate of major nuclide composition: Dry Active Waste (DAW), compactable and non-compactable		
tritium	%	1.37E-01
americium-241	%	0.00E+00
antimony-124	%	0.00E+00
antimony-125	%	2.29E-01
carbon-14	%	1.30E+00
cerium-144	%	2.30E-03
cesium-134	%	1.58E-02
cesium-137	%	6.80E-01
chromium-51	%	1.20E-01
cobalt-57	%	1.07E-01
cobalt-58	%	5.95E-01
cobalt-60	%	2.92E+01
curium-242	%	0.00E+00
curium-243/244	%	0.00E+00
europium-152	%	1.00E-02
hafnium-181	%	0.00E+00
iodine-131	%	0.00E+00
iron-55	%	3.28E+01
iron-59	%	1.04E-02
manganese-54	%	1.63E+00
Nickel-59	%	1.76E-01
nickel-63	%	3.21E+01
niobium-94	%	1.00E-04
niobium-95	%	2.54E-02
plutonium-238	%	0.00E+00
plutonium-239/40	%	0.00E+00
plutonium-241	%	0.00E+00
radium-226	%	3.00E-04
radium-228	%	3.00E-04
ruthenium-103	%	0.00E+00
strontium-89	%	0.00E+00
strontium-90	%	2.60E-03
technetium-99	%	8.11E-01
thorium-230	%	3.00E-04

tin-113	%	7.20E-03
zinc-65	%	6.94E-02
zirconium-95	%	2.36E-02
2c. Not Applicable (Irridated Components)	%	N/A



2d. Estimate of major nuclide composition: Filters		
tritium	%	1.80E-03
americium-241	%	5.00E-04
antimony-124	%	0.00E+00
antimony-125	%	8.40E-01
carbon-14	%	8.60E-03
cerium-144	%	3.40E-03
cesium-134	%	9.60E-03
cesium-137	%	5.06E-01
chromium-51	%	2.53E-02
cobalt-57	%	2.51E+00
cobalt-58	%	2.45E-01
cobalt-60	%	1.25E+01
curium-242	%	0.00E+00
curium-243/244	%	1.10E-03
europium-152	%	0.00E+00
hafnium-181	%	0.00E+00
iodine-131	%	0.00E+00
iron-55	%	3.01E+01
iron-59	%	0.00E+00
manganese-54	%	3.04E-01
nickel-59	%	6.30E-01
nickel-63	%	5.19E+01
niobium-94	%	3.50E-03
niobium-95	%	6.30E-03
plutonium-238	%	4.00E-04
plutonium-239/40	%	2.00E-04
plutonium-241	%	3.97E-02
radium-226	%	0.00E+00
radium-228	%	0.00E+00
ruthenium-103	%	0.00E+00
strontium-89	%	2.00E-04
strontium-90	%	1.08E-02
technetium-99	%	2.13E-01
thorium-230	%	0.00E+00
tin-113	%	4.50E-03

zinc-65	%	1.52E-02
zirconium-95	%	5.80E-03

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)

3. Solid Waste Disposition			
Unit	Number of Shipments	Mode of Transportation	Destination
2 & 3 DAW	3	Tractor/ Trailer	Energy Solutions, Clive Utah Burial Site
	1	Type A Cask	
2 & 3 DAW	6	Tractor/Trailer	Energy Solutions, Oakridge TN, Volume Reduction Services
2 & 3 DAW	1	Enclosed Van	PermaFix Environmental Services
2 & 3 Resin	1	Type A Cask	Energy Solutions, Clive Utah Burial Site
	13	Type A Cask	Waste Control Specialists, Andrews, TX Burial Site
2 & 3 Filters	7	Type A Cask	Toxco Materials Management, Oakridge TN

\* SONGS maintains a contract with **Energy Solutions, TOXCO, and PermaFix Environmental Services** that provides volume reduction services. Processed DAW volume was shipped from the **Energy Solutions Oakridge, TN** facility to the **Energy Solutions Clive, Utah Burial Site** using 17 shipments. Those 17 shipments included waste from other generators, SCE's waste volume was a small fraction of the total waste included in these shipments. Processed Miscellaneous Filters volume was shipped from **TOXCO Materials Management** Facility to the **Energy Solutions Clive, Utah Burial Site** using 7 shipments. Waste shipped to **PermaFix Environmental Services** was not processed in 2013.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	No shipments were made	N/A

C. DEWATERING

Number of Containers	Solidification Agent
14	N/A

**SECTION E. RADWASTE SHIPMENTS**

**TABLE 3 (COMMON)**

**SOLID WASTE AND IRRADIATED FUEL SHIPMENT**

**A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)**

1. Type of waste	Unit	12 month period	Estimated total error (%)
a. Spent resins, filter sludges , evaporator bottoms	m <sup>3</sup>	N/A	N/A
	Ci	N/A	
b. Dry active waste (DAW), compactable and non-compactable	m <sup>3</sup>	N/A	N/A
	Ci	N/A	
c. Irradiated components	m <sup>3</sup>	N/A	N/A
	Ci	N/A	
d. Other: Filters	m <sup>3</sup>	N/A	N/A
	Ci	N/A	

N/A No shipment made.

2. Estimate of major nuclide composition (by type of waste)		
a. not applicable	%	N/A
b. not applicable	%	N/A
c. not applicable	%	N/A
d. not applicable	%	N/A

3. Solid Waste Disposition (SONGS 1, 2, and 3)		
Number of Shipments	Mode of Transportation	Destination
None	No shipments were made	N/A

SOLID WASTE AND IRRADIATED FUEL SHIPMENT

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	No shipments were made	N/A

C. DEWATERING

Number of Containers	Solidification Agent
None	N/A

D. CHANGES TO THE PROCESS CONTROL PROGRAM AT SAN ONOFRE UNITS 1, 2 & 3

No changes were made that affected the Process Control Program

REFERENCES:

1. Unit 1 Technical Specifications, section D6.13.2.
2. Units 2 and 3 License Controlled Specifications, section 5.0.103.2.2.
3. Procedure SO123-VII-8.5.1 (Rev. 10 EC2) "Radwaste Process Control Program".
4. Procedure SO123-VII-8.1.6 (Rev. 6 EC2) "Radioactive Waste Shipment Data For The Annual Effluent Release Report"
5. Regulatory Guide 1.21, Rev. 1, June 1974.

## SECTION F. APPLICABLE LIMITS

### Gaseous Effluents Applicable Limits

The percent of Applicable Limits, tabulated in Sections A, B, C, and D of Table 1A, were calculated using the following equation:

- % Applicable Limit = 
$$\frac{(\text{Rel Rate}) (X/Q) (100)}{\text{MPC}_{\text{eff}}}$$

where: Rel Rate = total curies released in each category and each quarter, divided by the seconds in a quarter; the value in Sections A.2, B.2, C.2 and D.2 of Table 1A,  $\mu\text{Ci}/\text{sec}$ .

X/Q =  $4.80\text{E-}6 \text{ sec}/\text{m}^3$ ; the annual average atmospheric dispersion defined in the ODCM.

- $\text{MPC}_{\text{eff}}$  = 
$$\frac{1}{\sum_{i=1}^n \frac{F_i}{\text{MPC}_i}}$$

where:  $F_i$  = fractional abundance of the  $i^{\text{th}}$  radionuclide obtained by dividing the activity (curies) for each radionuclide,  $C_i$ , by the sum of all the isotopic activity,  $C_T$ .

n = total number of radionuclides identified

$\text{MPC}_i$  = Maximum Permissible Concentration (MPC) of the  $i^{\text{th}}$  radionuclide from 10 CFR 20 (20.1-20.602), Appendix B, Table II, Column 1.

- % ECL = 
$$\frac{(\text{Rel Rate}) (X/Q) (100)}{\text{ECL}_{\text{eff}}}$$

where: Rel Rate = total curies released in each category and each quarter, divided by the seconds in a quarter; the value in Sections A.2, B.2, C.2 and D.2 of Table 1A,  $\mu\text{Ci}/\text{sec}$ .

X/Q =  $4.80\text{E-}06 \text{ sec}/\text{m}^3$ ; the annual average atmospheric dispersion defined in the ODCM.

- $\text{ECL}_{\text{eff}}$  = 
$$\frac{1}{\sum_{i=1}^n \frac{F_i}{\text{ECL}_i}}$$

where:  $F_i$  = fractional abundance of the  $i^{\text{th}}$  radionuclide obtained by dividing the activity (curies) for each radionuclide,  $C_i$ , by the sum of all the isotopic activity,  $C_T$ .

n = total number of radionuclides identified

$\text{ECL}_i$  = Effluent Concentration Limit (ECL) of the  $i^{\text{th}}$  radionuclide from 10 CFR 20 (20.1001-20.2402), Appendix B, Table 2, Column 1.

## SECTION F. APPLICABLE LIMITS (Continued)

### Liquid Effluents Applicable Limits

The percent of Applicable Limits, tabulated in Sections A, B, and C of Table 2A, were calculated using the following equations:

- % Applicable Limit =  $\frac{(\text{Dil Conc}) (100)}{\text{MPC}_{\text{eff}}}$

where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A,  $\mu\text{Ci/ml}$ .
- $\text{MPC}_{\text{eff}}$  =  $\frac{1}{\sum_{i=1}^n \frac{F_i}{\text{MPC}_i}}$

where:  $F_i$  = fractional abundance of the  $i^{\text{th}}$  radionuclide obtained by dividing the activity (curies) for each radionuclide,  $C_i$ , by the sum of all the isotopic activity,  $C_T$ .

$n$  = total number of radionuclides identified

$\text{MPC}_i$  = Maximum Permissible Concentration (MPC) of the  $i^{\text{th}}$  radionuclide from 10 CFR 20 (20.1-20.602), Appendix B, Table II, Column 2.
- % ECL =  $\frac{(\text{Dil Conc}) (100)}{\text{ECL}_{\text{eff}}}$

where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A,  $\mu\text{Ci/ml}$ .
- $\text{ECL}_{\text{eff}}$  =  $\frac{1}{\sum_{i=1}^n \frac{F_i}{\text{ECL}_i}}$

where:  $F_i$  = fractional abundance of the  $i^{\text{th}}$  radionuclide obtained by dividing the activity (curies) for each radionuclide,  $C_i$ , by the sum of all the isotopic activity,  $C_T$ .

$n$  = total number of radionuclides identified

$\text{ECL}_i$  = Effluent Concentration Limit (ECL) of the  $i^{\text{th}}$  radionuclide from 10 CFR 20 (20.1001-20.2402), Appendix B, Table 2, Column 2.

SECTION F. APPLICABLE LIMITS (Continued)

APPENDIX A

GASEOUS EFFLUENTS – APPLICABLE LIMITS

- A. Table 1A lists the total curies released and the release rate. The percent of applicable limit compares the release concentration limits of 10 CFR 20 Appendix B, Table II, Column 1.
- B. Table 1E lists the air doses as calculated using the historical X/Q. the air dose due to noble gases released in gaseous effluents from SONGS (per reactor) to areas at and beyond the site boundary shall be limited to the following values:
1. During any calendar quarter:  $\leq 5$  mrad for gamma radiation and  $\leq 10$  mrad for beta radiation.
  2. During any calendar year:  $\leq 10$  mrad for gamma radiation and  $\leq 20$  mrad for beta radiation.
- C. The dose to a Member of the Public from iodines, tritium, and all radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from SONGS (per reactor) to areas at and beyond the site boundary shall be limited to the following values:
1. During any calendar quarter:  $\leq 7.5$  mrem to any organ.
  2. During any calendar year:  $\leq 15$  mrem to any organ.



SECTION F. APPLICABLE LIMITS (Continued)

APPENDIX A (Continued)

LIQUID EFFLUENTS – APPLICABLE LIMITS

- A. Table 2A lists the total curies released, the diluted concentration, and percent of applicable limit. The percent of applicable limit compares the diluted concentration of radioactive material released to the concentrations specified in 10 CFR 20 Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration is limited to 2.00E-04  $\mu\text{Ci/ml}$ .
- B. Table 2D lists the doses due to liquid releases. The dose commitment to a Member of the Public from radioactive materials in liquid effluent release from SONG (per reactor) to unrestricted areas shall be limited to the following values:
1. During any calendar quarter:  $\leq 1.5$  mrem to the total body and  $\leq 5$  mrem to any organ.
  2. During any calendar year:  $\leq 3$  mrem to the total body and  $\leq 10$  mrem to any organ.

## SECTION G. ESTIMATION OF ERROR

Estimations of the error in reported values of gaseous and liquid effluents releases have been made.

Sources of error for gaseous effluents batch releases are:

- (1) tank volumes
- (2) sampling
- (3) counting
- (4) calibration

Sources of error for gaseous effluents - continuous releases are:

- (1) fan flow rate
- (2) sampling
- (3) counting
- (4) calibration
- (5) differential pressure drop

Sources of error for liquid effluents - batch releases are:

- (1) tank volumes
- (2) sampling
- (3) counting
- (4) calibration

Sources of error for liquid effluents - continuous releases are:

- (1) dilution flow rate
- (2) sampling
- (3) counting
- (4) calibration

These sources of error are independent, and thus, the total error is calculated according to the following formula:

$$\text{Total Error} = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 \dots \sigma_i^2}$$

where:  $\sigma_i$  = Error associated with each component.

## SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS

Table 1 in Section H presents the quarterly and annual maximum dose to an individual. Six different categories are presented:

- (1) Liquid Effluents - Whole Body
- (2) Liquid Effluents - Organ
- (3) Airborne Effluents - Tritium, Iodines and Particulates
- (4) Noble Gases - Gamma
- (5) Noble Gases - Beta
- (6) Direct Radiation

The doses for categories 1 and 2 were calculated using the methodology of the ODCM; these data are also presented in Table 2D. Categories 3, 4, and 5 were calculated utilizing RETDAS (Radioactive Effluent Tracking and Dose Assessment Software), Regulatory Guide 1.109 methodology, and concurrent meteorology. Table 1E of gaseous effluents previously presented, however, lists data similar to categories 3, 4 and 5 using methods described in the ODCM and the historical meteorology (X/Q). Category 6 presents direct dose data measured by TLD dosimeters. Each portion of each category is footnoted to briefly describe each maximum individual dose presented.

For members of the public, per the ODCM, who may at times be within the site boundary<sup>1</sup>, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary. For members of the public who traverse the site boundary via highway I-5, the residency time shall be considered negligible and hence the dose "0".

Table 2 in Section H presents the percent of Applicable Limits for each dose presented in Table 1.

<sup>1</sup> ODCM Figures 1-2 & 2-2.

TABLE 1

SOURCE	Dose * (millirems)				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS	1)	2)	3)	4)	5)
Whole Body	1.04E-05	1.09E-04	6.00E-03	1.78E-03	7.90E-03
Organ	6)	7)	8)	9)	10)
	1.44E-05	6.97E-04	2.46E-02	1.08E-02	3.61E-02
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	1.59E-02	4.56E-03	6.33E-03	5.16E-03	3.19E-02
NOBLE GASES **	16)	17)	18)	19)	20)
Gamma	0.00E+00	4.41E-07	0.00E+00	0.00E+00	4.41E-07
Beta	21)	22)	23)	24)	25)
	0.00E+00	5.00E-05	0.00E+00	0.00E+00	5.00E-05
DIRECT RADIATION	26)	27)	28)	29)	30)
	1.34E-02	1.84E-02	1.10E-01	3.79E-02	1.59E-01

\* The numbered footnotes below briefly explain how each maximum dose was calculated, including the organ and the predominant pathway(s).

\*\* Noble gas doses due to airborne effluent are in units of mrad, reflecting the air dose.

1. This value was calculated using the methodology of the ODCM.
2. This value was calculated using the methodology of the ODCM.
3. This value was calculated using the methodology of the ODCM.
4. This value was calculated using the methodology of the ODCM.
5. This value was calculated using the methodology of the ODCM.
6. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose primarily by the saltwater fish pathway.
7. This value was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
8. This value was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
9. This value was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
10. This value was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.

11. The maximum organ dose was to a child's liver and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
12. The maximum organ dose was to a child's GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
13. The maximum organ dose was to a child's GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
14. The maximum organ dose was to a child's GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
15. The maximum organ dose was to a child's GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
16. There was no noble gas activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+00 mrad.
17. The maximum air dose to a landward sector for gamma radiation was located in the NNE sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109. The maximum air dose for gamma radiation was located in the seaward SSW sector, with a value of 4.90E-07 mrad.
18. There was no noble gas activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+00 mrad.
19. There was no noble gas activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+00 mrad.
20. The maximum air dose to a landward sector for gamma radiation was located in the NNE sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109. The maximum air dose for gamma radiation was located in the seaward SSW sector, with a value of 4.90E-07 mrad.
21. There was no noble gas activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+00 mrad.
22. The maximum air dose to a landward sector for beta radiation was located in the NNE sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109. The maximum air dose for beta radiation was located in the seaward SSW sector, with a value of 5.55E-05 mrad.
23. There was no noble gas activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+00 mrad.
24. There was no noble gas activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+00 mrad.
25. The maximum air dose to a landward sector for beta radiation was located in the NNE sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109. The maximum air dose for beta radiation was located in the seaward SSW sector, with a value of 5.55E-05 mrad.
26. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 20 hours per year; highest dose was measured at the Site Boundary in the ESE sector.
27. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 20 hours per year; highest dose was measured at the Site Boundary in the ESE sector.
28. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.
29. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.
30. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

TABLE 2

SOURCE	Percent Applicable Limit				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	3.46E-04	3.64E-03	2.00E-01	5.92E-02	1.32E-01
Organ	1.44E-04	6.97E-03	2.46E-01	1.08E-01	1.81E-01
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	1.06E-01	3.04E-02	4.22E-02	3.44E-02	1.06E-01
NOBLE GASES					
Gamma	0.00E+00	4.41E-06	0.00E+00	0.00E+00	2.21E-06
Beta	0.00E+00	2.50E-04	0.00E+00	0.00E+00	1.25E-04

NOTE: Direct Radiation is not specifically addressed in the Applicable Limits.

## SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

Revision 7 to the SONGS Offsite Dose Calculation Manual (ODCM) was issued on September 23, 2013. This revision incorporated the following: 1) 2012 Land Use Census changes, 2) Dilution flow rate changes and an administratively controlled limit on liquid radwaste discharge flow rate, 3) Figure 4-7 for particulate process filters handling changes, 4) Component identification for Waste Gas Holdup System Process flow rate monitoring device addition, 5) addition of two bases documents to appendix B, and 6) editorial changes to formulas (1-9) through (1-12) and consistent nomenclature for the NIA Yard Sump.

50.59 review was not required; EOE reviews were required and performed for the changes.

None of the changes impacted the accuracy or reliability of effluent dose or setpoint calculations. The level of radioactive effluent control required by 10CFR20, 40CFR190, 10CFR50.36a and Appendix I to 10CFR50 will be maintained.

Throughout the document, change bars indicated the following types of changes:

- A Addition
- D Deletion
- F Editorial/Format change
- R Revision

Page #	changes due to new Revision	Reason
Title pages	Revised from previous revision to Rev 7	R
1-9	Revised dilution flow rate	R
1-13	Revised dilution and radwaste discharge flow rates	R
1-14	Revised dilution flow rate	R
1-17	Revised dilution flow rate	R
1-18	Revised equations (1-9) through (1-12), denoting SG instead of B	F
1-18	Revised dilution flow rate	R
1-20	Revised dilution flow rate	R
1-22	Revised dilution flow rate	R
2-29	Revised U2&3 Controlling Factors per 2012 Land Use Census	R
4-2	Added "NIA" to Table 4-1 instruments 1f and 2f for consistency	F
4-6	Added "NIA" to Table 4-1 instruments 1f and 2f for consistency	F
4-10	Added the component identification "2/3FIT7202" for the waste gas holdup system process flow rate monitoring device to Table 4-3 Instrument 1.b	R
4-22	Revised Figure 4-7 to add alternate particulate filter processing methods as described in FSAR	R
5-18	Revised location 76 in Table 5-4 to indicate change in use	F

**SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL (Continued)**

<b>Page #</b>	<b>changes due to new Revision</b>	<b>Reason</b>
Appendix A		
Cover	Revised to Revision 7	R
Ai	Revised references and page numbers	R
A1-10	Added per Land Use Census (LUC)	A
A1-12	Revised per LUC	R
A1-14	Revised per LUC	R
A1-16	Revised per LUC	R
A1-17	Revised per LUC	R
A1-19	Revised per LUC	R
A1-20	Revised per LUC	R
A1-21	Revised per LUC	R
A1-22	Revised per LUC	R
A1-23	Revised per LUC	R
A1-25	Revised per LUC	R
A1-26	Added per LUC	A
A1-27	Revised per LUC	R
A1-28	Revised per LUC	R
A1-29	Revised per LUC	R
A1-30	Revised per LUC	R
A1-31	Revised per LUC	R
A1-32	Revised per LUC	R
A1-33	Revised per LUC	R
A1-34	Revised per LUC	R
A1-35	Revised per LUC	R
A1-36	Revised per LUC	R
A1-39	Revised per LUC	R
A1-41	Revised per LUC	R
A1-43	Revised per LUC	R



**SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL (Continued)**

<b>Page #</b>	<b>changes due to new Revision</b>	<b>Reason</b>
Appendix B		
Cover	Revised to Revision 7	A
Bi	Revised to add section 7 and section 8 to Table of Contents	A
B7-1	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-2	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-3	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-4	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-5	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-6	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-7	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A
B7-8	Added criteria for the Units 2/3 Liquid Monitor Setpoint Data Transmittal	A

## SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

There were no major changes to the radioactive waste treatment systems as defined and provided by the responsible engineering organization and/or any applicable Effluent ODCM Evaluation.

## SECTION K. MISCELLANEOUS

### Abnormal Releases

There were no reported abnormal releases of gaseous or liquid effluent radioactive materials from the site to unrestricted areas.

SECTION K. MISCELLANEOUS (Continued)

EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE  
GREATER THAN 30 DAYS

January 1, 2013 - December 31, 2013

For the effluent monitoring instrumentation where the inoperability period is indicated as ending 12/31/13, the date represents the end of the reporting period. Not all of the instruments were returned to service at that time.

Instrument	Inoperability Period	Inoperability Cause	Explanation
2FT-7870H Condenser Evacuation System High Range Process Flow Rate Monitor	4/17/00–12/31/13	Inoperable process flow measuring device due to inadequate instrument range (design deficiency)	Design deficiency caused process flow instrument to be inoperable when the vacuum pump is running. Flow monitor works properly during normal operations. Isokinetic conditions are maintained during vacuum pump operation by automatic insertion of substitute flow value whenever the vacuum pump is running. .
2RT-7870 Condenser Evacuation System Noble Gas Activity Monitor	11/16/12– 12/31/13	Wide Range Gas Monitor out of service for outage activities.	Monitor not required during this period since the plant was not in Modes 1-4.
2RT-7818 Condenser Evacuation System Noble Gas Activity Monitor	12/5/12–12/31/13	Out of service for outage	Monitor not required during this period since the plant was not in Modes 1-4.
2RT-6753 Steam Generator E089 Blowdown Effluent Line Gross Radioactivity Monitor	1/6/12–12/31/13	Jumpers installed for outage	The radiation monitors are declared inoperable by Operations when the monitor's alarm and automatic functions are bypassed to support outage activities. Channel Functional Test cannot be performed with jumpers installed.

SECTION K. MISCELLANEOUS (Continued)

EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE  
GREATER THAN 30 DAYS (Continued)

January 1, 2013 - December 31, 2013

Instrument	Inoperability Period	Inoperability Cause	Explanation
2RT-6759 Steam Generator E088 Blowdown Effluent Gross Radioactivity Monitor	1/6/12-12/31/13	Jumpers installed for outage	The radiation monitors are declared inoperable by Operations when the monitor's alarm and automatic functions are bypassed to support outage activities. Channel Functional Test cannot be performed with jumpers installed.
3FT-7870H Condenser Evacuation System High Range Process Flow Rate Monitor	04/17/00-12/31/13	Inoperable process flow measuring device due to inadequate instrument range (design deficiency)	Design deficiency caused process flow instrument to be inoperable when the vacuum pump is running. Flow monitor works properly during normal operations. Isokinetic conditions are maintained during vacuum pump operation by automatic insertion of substitute flow value whenever the vacuum pump is running.
3RT-7870 Condenser Evacuation System Iodine and Particulate Samplers	2/14/12-12/31/13	Out of service for outage  During channel functional test, Mid/High Range Sample Flow was lower than the acceptance criteria.	Monitor not required during this period since the plant was not in Modes 1-4.  Valve S3131MU219 in the low flow position did not meet the test acceptance criteria. Repair of this valve will not be done unless requested. 2(3)RT-7870 is presently not being maintained.
3RT-7818 Condenser Evacuation System Noble Gas Activity Monitor	3/20/12 - 12/31/13	Low sample flow due to a faulty connector crimp on the flow control valve wiring harness.  Monitor remained inoperable due to overdue surveillance	Monitor not required during this period since the plant was not in Modes 1-4. Repaired faulty crimp. Obsolete spare parts. Parts for corroded wiring harness taken from abandoned in place equipment Not required while Defueled.

SECTION K. MISCELLANEOUS (Continued)

EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE  
GREATER THAN 30 DAYS (Continued)

January 1, 2013 - December 31, 2013

Instrument	Inoperability Period	Inoperability Cause	Explanation
3RT-6753 Steam Generator E089 Blowdown Effluent Gross Radioactivity Monitor	1/31/12 – 12/31/13	Jumpers installed for outage.	The radiation monitors are declared inoperable by Operations when the monitor's alarm and automatic functions are bypassed to support outage activities. Channel Functional Test cannot be performed with jumpers installed.
3RT-6759 Steam Generator E088 Blowdown Effluent Gross Radioactivity Monitor	1/31/12 – 12/31/13	Jumpers installed for outage.	The radiation monitors are declared inoperable by Operations when the monitor's alarm and automatic functions are bypassed to support outage activities. Channel Functional Test cannot be performed with jumpers installed.
2/3RE-7808 Plant Vent Stack Particulate/Iodine Channel	11/17/13-12/17/13	Particulate and Iodine Inop due to failed heat trace	Inoperable Radmonitors were not tracked on daily briefing sheets and Operations focus list. Radiation Monitors are included in Shift Manager Turnover to ensure 30 days is not exceeded.
3RE-7828 Containment Purge Particulate & Iodine Channel	2/5/13 - 3/9/13	Non-functional due to heat trace	Heat Trace Controller 3TCJ731 was replaced and calibrated satisfactory under work order 801023583. The Resistive Temperature Device circuitry resistance was measured and documented.
2RE-7865 Plant Vent Stack Particulate & Iodine Channel	3/6/13 - 4/6/13	Over temperature condition/alarm	Found Thermal Couple Junction (2TCJ396-1) operating normally. The high temperature alarm was found reset and the controller was maintaining temperature within the required band. I&C used the extended time to investigate and ensure the alarm was spurious.
	5/11/13 - 7/15/13	Over temperature condition/alarm	The Thermal Couple Junction (2TCJ396-1) Resistive Temperature Device was replaced. Replacement parts were on backorder.

SECTION K. MISCELLANEOUS (Continued)

EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE  
GREATER THAN 30 DAYS (Continued)

January 1, 2013 - December 31, 2013

Instrument	Inoperability Period	Inoperability Cause	Explanation
3APC-3772 Turbine Plant Sump Compositor	3/4/13 - 4/5/13	Not operating	Rebuilt compositor and was completed on 3/6/2013 to restore functionality but paperwork did not get processed until 4/2/2013
3RE-7865 Plant Vent Stack Monitor	7/28/13 -10/10/13	Batteries not functional	No Safety Related batteries were in stock. Took greater than 30 days to resolve to resolve the battery issue.
3RE-7821 Turbine Plant Sump Monitor	10/17/13 to 12/4/13	Failed Timer	Parts availability issues for Compositor 3AY5887 and return to service was postponed.
2RE-7828 Containment Purge Monitor Gas Channel	11/22/2013-current	Maintenance Plans (MPs) deferred to future dates	Containment Purge Stack Radiation Monitors have their Maintenance Plans deferred to future dates. The monitors are no abandoned and will remain available and left in place to operate in the event of a mode change from the defueled status. The Reactor Coolant System (RCS) was removed from service and is required to be in service to have fuel in containment. THere have no functions when the fuel is removed from containment.
3RE-7828 Containment Purge Monitor Gas Channel	11/22/2013-current	Maintenance Plans (MPs) deferred to future dates	Containment Purge Stack Radiation Monitors have their Maintenance Plans deferred to future dates. The monitors are no abandoned and will remain available and left in place to operate in the event of a mode change from the defueled status. The Reactor Coolant System (RCS) was removed from service and is required to be in service to have fuel in containment. THere have no functions when the fuel is removed from containment.
2RE-7828 Containment Purge Particulate and Iodine Channel	9/7/2013-current	Maintenance Plans (MPs) deferred to future dates	Containment Purge Stack Radiation Monitors have their Maintenance Plans deferred to future dates. The monitors are no abandoned and will remain available and left in place to operate in the event of a mode change from the defueled status. The Reactor Coolant System (RCS) was removed from service and is required to be in service to have fuel in containment. THere have no functions when the fuel is removed from containment.

<p>3RE-7828 Containment Purge Particulate and Iodine Channel</p>	<p>12/07/2013-current</p>	<p>Maintenance Plans (MPs) deferred to future dates</p>	<p>Containment Purge Stack Radiation Monitors have their Maintenance Plans deferred to future dates. The monitors are no abandoned and will remain available and left in place to operate in the event of a mode change from the defueled status. The Reactor Coolant System (RCS) was removed from service and is required to be in service to have fuel in containment. THere have no functions when the fuel is removed from containment.</p>
<p>2/2RIT-7202 Waste Gas Holdup System Process Flow Rate Monitoring Device</p>	<p>11/05/2013-current</p>	<p>Maintenance Surveillance</p>	<p>Due to SONGS decommissioning and Waste Gas System is no longer in-service the surveillances were cancelled. This action is documented under the SONGS Corrective Action Program NN# 202652024</p>

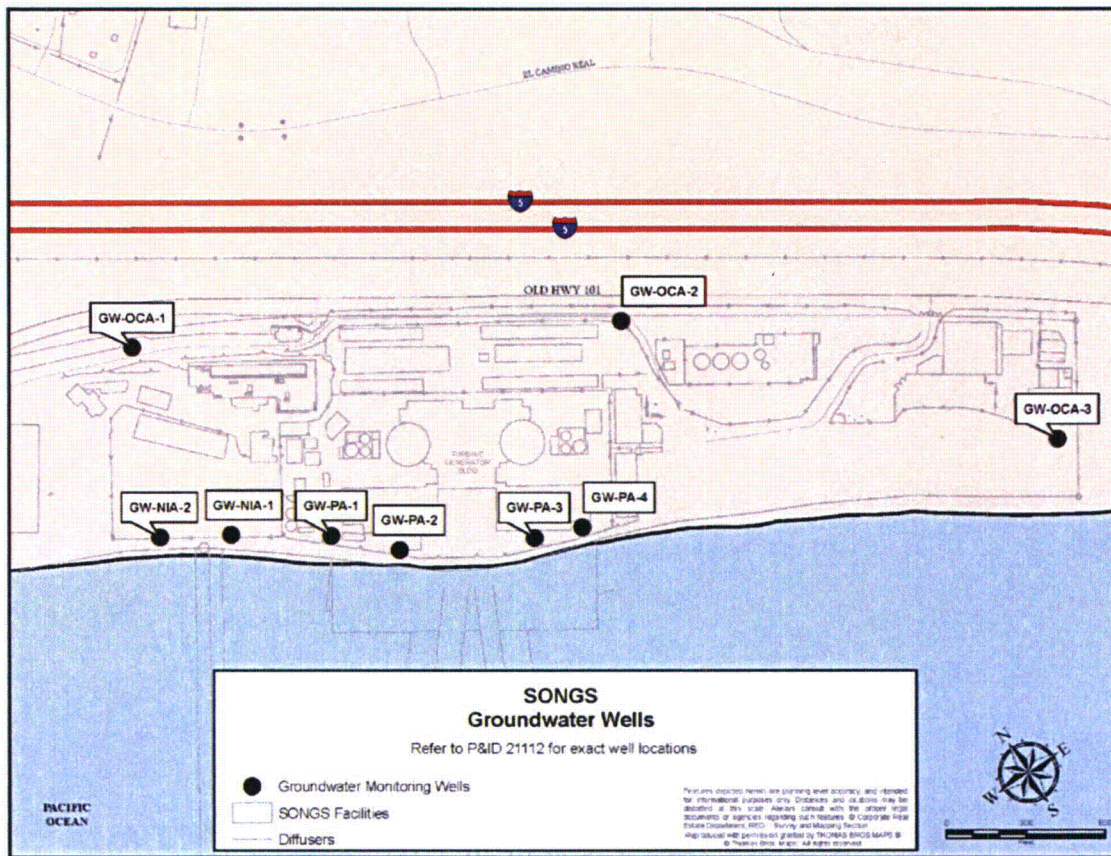


SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES

This section provides results of on-site samples of ground water that were obtained as part of SCE's implementation of the voluntary industry Ground Water Protection Initiative. The sample locations and the frequency of sampling may change over time. The ground water beneath SONGS is not a source of drinking water.

Ground water sample data indicated the presence of low but detectable levels of tritium in shallow ground water in the area formerly occupied by Unit 1. The concentrations of tritium are well below all regulatory limits. An investigation was performed to characterize these low concentrations of tritium and to identify the potential source. The investigation determined that the low concentrations are present in the shallow ground water situated generally between the former Unit 1 containment and fuel handling building, and extend towards the seawall. An extraction plan has been implemented to initiate hydraulic containment of the plume and to facilitate monitoring and documentation of any changes in tritium concentration. Extraction of the shallow ground water beneath the former Unit 1 area is being performed and the resultant water is managed and discharged through an ODCM-credited release point. Any tritium in the wastewater is included in Tables 2A, 2B and 2D and the dose included in Section H, 10 CFR 50 Appendix I Requirements Table 1 of the ARERR.



SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES

January 1, 2013 – December 31, 2013

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
1/2/13	GW-NIA-2	<LLD	<LLD
	NIA-5	4.83E-6	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
1/3/13	NIA-3	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
1/5/13	GW-NIA-1	<LLD	<LLD
	NIA-8	2.32E-6	<LLD
	NIA-9	<LLD	<LLD
1/6/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
1/7/13	GW-NIA-2	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
1/11/13	NIA-6	<LLD	<LLD
	NIA-7	<LLD	<LLD
1/12/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
1/13/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
1/15/13	GW-NIA-2	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
1/18/13	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
1/19/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
1/20/13	GW-NIA-2	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
1/21/13	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
1/22/13	NIA-3	<LLD	<LLD
	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD

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*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
1/26/13	GW-NIA-1	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
1/27/13	NIA-6	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
1/28/13	GW-NIA-2	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
1/29/13	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
2/1/13	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
2/2/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-7	<LLD	<LLD
2/3/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
2/4/13	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-11	<LLD	<LLD
2/5/13	GW-NIA-2	2.05E-06	<LLD
	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

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*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
2/9/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
2/10/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
2/11/13	NIA-3	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-7	<LLD	<LLD
2/12/13	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
2/16/13	GW-NIA-1	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
2/17/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
2/19/13	GW-NIA-2	<LLD	<LLD
	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD

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*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
2/22/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
2/23/13	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
2/24/13	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
2/25/13	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
2/26/13	GW-OCA-1	<LLD	<LLD
3/1/13	NIA-4	<LLD	<LLD
	NIA-6	<LLD	<LLD
3/2/13	GW-NIA-1	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-8	2.30E-06	<LLD
	NIA-9	<LLD	<LLD
3/11/13	GW-NIA-2	2.22E-06	<LLD
	NIA-11	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD

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GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
3/12/13	GW-NIA-1	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
3/13/13	GW-OCA-2	<LLD	<LLD
	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	2.21E-06	<LLD
3/15/13	GW-PA-1	<LLD	<LLD
	GW-PA-2	<LLD	<LLD
	GW-PA-3	<LLD	<LLD
	GW-PA-4	<LLD	<LLD
3/18/13	GW-OCA-3	<LLD	<LLD
4/4/13	GW-NIA-2	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-12	<LLD	<LLD
	NIA-13	<LLD	<LLD
4/5/13	GW-NIA-1	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-13	<LLD	<LLD
5/8/13	GW-NIA-2	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
5/9/13	GW-NIA-1	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
5/13/13	NIA-7	<LLD	<LLD
	NIA-10	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
5/14/13	GW-OCA-1	<LLD	<LLD
	GW-OCA-2	<LLD	<LLD
	GW-OCA-3	<LLD	<LLD
5/15/13	NIA-3	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-9	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
5/16/13	GW-PA-1	<LLD	<LLD
	GW-PA-2	<LLD	<LLD
	GW-PA-3	<LLD	<LLD
5/21/13	GW-PA-4	<LLD	<LLD
6/10/13	GW-NIA-2	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
6/11/13	GW-NIA-1	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
7/1/13	GW-OCA-1	<LLD	<LLD
	GW-OCA-2	<LLD	<LLD
	GW-OCA-3	<LLD	<LLD
7/2/13	GW-PA-1	<LLD	<LLD
	GW-PA-2	<LLD	<LLD
	GW-PA-3	<LLD	<LLD
	GW-PA-4	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter



ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
7/3/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
7/9/13	NIA-10	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-12	<LLD	<LLD
	NIA-13	<LLD	<LLD
	NIA-14	<LLD	<LLD
7/10/13	NIA-3	<LLD	<LLD
	NIA-8	2.43E-06	<LLD
	NIA-9	<LLD	<LLD
	NIA-15	<LLD	<LLD
7/15/13	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-7	<LLD	<LLD
8/14/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
8/22/13	GW-PA-3	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

**ONSITE GROUND WATER SAMPLES (Continued)**

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
9/4/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
10/16/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
11/12/13	NIA-6	<LLD	<LLD
	NIA-7	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-9	<LLD	<LLD
	NIA-10	<LLD	<LLD
11/13/13	GW-OCA-1	<LLD	<LLD
	GW-OCA-2	<LLD	<LLD
	GW-OCA-3	<LLD	<LLD
11/14/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-3	<LLD	<LLD
	NIA-4	<LLD	<LLD
	NIA-5	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Tritium Activity, $\mu\text{Ci/ml}$	Gamma Activity, $\mu\text{Ci/ml}$
11/18/13	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD
	NIA-EXT-14	<LLD	<LLD
	NIA-EXT-15	<LLD	<LLD
11/20/13	GW-PA-1	<LLD	<LLD
	GW-PA-2	<LLD	<LLD
	GW-PA-3	<LLD	<LLD
	GW-PA-4	<LLD	<LLD
12/9/13	GW-NIA-1	<LLD	<LLD
	GW-NIA-2	<LLD	<LLD
	NIA-5	<LLD	<LLD
	NIA-6	<LLD	<LLD
	NIA-8	<LLD	<LLD
	NIA-11	<LLD	<LLD
	NIA-EXT-12	<LLD	<LLD
	NIA-EXT-13	<LLD	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = H-3: 3.0E-06  $\mu\text{Ci/ml}$

$\mu\text{Ci/ml}$  = indicated microcuries per milliliter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
2/26/13	GW-OCA-1	<LLD	6.29E+00
3/13/13	GW-OCA-2	<LLD	1.81E+01
	GW-NIA-1	1.11E+01	<LLD
	GW-NIA-2	1.20E+01	6.80E+00
3/15/13	GW-PA-1	1.03E+01	3.36E+01
	GW-PA-2	5.85E+00	4.01E+01
	GW-PA-3	2.28E+01	1.27E+01
	GW-PA-4	7.44E+00	4.12E+00
3/18/13	GW-OCA-3	<LLD	3.50E+00
5/8/13	GW-NIA-2	1.78E+01	9.54E+00
5/9/13	GW-NIA-1	8.14E+00	<LLD
5/14/13	GW-OCA-1	5.32E+00	7.19E+00
	GW-OCA-2	8.50E+00	1.72E+01
	GW-OCA-3	4.45E+00	<LLD
5/16/13	GW-PA-1	1.26E+01	3.23E+01
	GW-PA-2	2.08E+01	5.25E+01
	GW-PA-3	2.06E+01	7.83E+00
5/21/13	GW-PA-4	5.79E+00	<LLD
7/1/13	GW-OCA-1	<LLD	4.17E+00
	GW-OCA-2	<LLD	8.03E+00
	GW-OCA-3	<LLD	4.23E+00
7/2/13	GW-PA-1	5.65E+00	3.39E+01
	GW-PA-2	1.27E+01	6.20E+01
	GW-PA-3	4.07E+01	1.43E+01
	GW-PA-4	6.80E+00	3.14E+00
7/3/13	GW-NIA-1	8.47E+00	<LLD
	GW-NIA-2	1.66E+01	5.87E+00
8/22/13	GW-PA-3	2.96E+01	7.87E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0pci/l  
= Gross Alpha 3.0 pci/l

pCi/L = indicated picocuries per liter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Gross Beta, pCi/L	Gross Alpha, pCi/L
11/13/13	GW-OCA-1	4.84E+00	7.56E+00
	GW-OCA-2	5.55E+00	1.17E+01
	GW-OCA-3	<LLD	<LLD
11/14/13	GW-NIA-1	1.28E+01	<LLD
	GW-NIA-2	2.67E+01	<LLD
11/20/13	GW-PA-1	7.91E+00	2.19E+01
	GW-PA-2	2.17E+01	4.19E+01
	GW-PA-3	1.91E+01	<LLD
	GW-PA-4	<LLD	3.80E+00

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

*a priori* LLD = Gross Beta: 4.0 pci/l  
= Gross Alpha: 3.0 pci/l

pCi/L = indicated picocuries per liter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	U-233/234 pCi/L	U-235/236 pCi/L	U-238 pCi/L	All other transuranics
3/13/13	GW-OCA-2	9.77E+00	<LLD	7.21E+00	<LLD
3/15/13	GW-PA-1	1.43E+01	<LLD	1.29E+01	<LLD
	GW-PA-2	2.72E+01	1.02E+00	2.30E+01	<LLD
5/14/13	GW-OCA-2	9.58E+00	<LLD	7.30E+00	<LLD
5/16/13	GW-PA-1	1.36E+01	<LLD	1.12E+01	<LLD
	GW-PA-2	2.51E+01	<LLD	2.29E+01	<LLD
7/2/13	GW-PA-1	1.42E+01	<LLD	1.21E+01	<LLD
	GW-PA-2	2.59E+01	1.13E+00	2.43E+01	<LLD
11/13/13	GW-OCA-1	2.77E+00	<LLD	2.12E+00	<LLD
	GW-OCA-2	7.09E+00	<LLD	4.40E+00	<LLD
	GW-OCA-3	1.09E+00	<LLD	1.02E+00	<LLD
11/14/13	GW-NIA-1	<LLD	<LLD	<LLD	<LLD
	GW-NIA-2	2.00E+00	<LLD	2.89E+00	<LLD
11/20/13	GW-PA-1	1.39E+01	<LLD	1.39E+01	<LLD
	GW-PA-2	2.53E+01	1.01E+00	2.14E+01	<LLD
	GW-PA-3	1.53E+00	<LLD	2.23E+00	<LLD
	GW-PA-4	2.94E+00	<LLD	2.29E+00	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

pCi/L = indicated picocuries per liter

ONSITE GROUND WATER SAMPLES (Continued)

Sample Date	Location	Hard to detect, pCi/L (Ni-63, Fe-55, Sr-89/Sr-90)
11/13/13	GW-OCA-1	<LLD
	GW-OCA-2	<LLD
	GW-OCA-3	<LLD
11/14/13	GW-NIA-1	<LLD
	GW-NIA-2	<LLD
11/20/13	GW-PA-1	<LLD
	GW-PA-2	<LLD
	GW-PA-3	<LLD
	GW-PA-4	<LLD

GW-OCA = Wells installed in the Owner Controlled Area to implement the Ground Water Protection Initiative.

GW-PA = Wells installed in the Protected Area to implement the Ground Water Protection Initiative.

GW-NIA = Wells installed in the North Industrial Area to implement the Ground Water Protection Initiative.

NIA and NIA-EXT = Temporary investigation wells installed in the North Industrial Area

pCi/L = indicated picocuries per liter

Note. Per NEI 07-07, Groundwater Protection, Industry Groundwater Protection Initiative-Final Guidance Document, Rev. 0, August 2007 all data generated is required to be documented in the Annual Radioactive Effluent Release Report.

The primary document providing guidance for effluent reporting and dose calculation methodology is Regulatory Guide 1.1.09, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I. An examination of the database in RG 1.109 shows a lengthy list of radionuclides, specifically Table A-1 (bioaccumulation factors), Table E-1 (transfer factors), Table E-6 (ground factors), Tables E-7, E-8, E-9, E-10 (inhalation factors), and Table E-11, E-12, E-13 and E-14 (ingestion factors). Uranium, is a naturally occurring radionuclide does not appear in any of the tables. Only fission products and activation products associated with commercial nuclear power plants appear in these tables. As such, there is no regulatory guidance to calculate uranium dose as a plant-related nuclide present in effluents. The uranium reported in the groundwater is of natural origin. The relative ratios of U-234, U-235, and U-238 show that the groundwater ratios are similar to ratios for natural uranium: 56% U-234, 2.8% U-235 and 41% U-238 by activity in groundwater compared to 49% U-234, 2.2% U-235, and 49% U-238 by activity in natural uranium. Compare the ratios from 3.5% enriched uranium, expected in commercial nuclear fuel: 82% U-234, 3.4% U-235 and 15% U-238, it is evident that the groundwater activity ratios are closer to natural uranium and do not correlate with ratios from the enriched uranium. In conclusion, the uranium in groundwater is of natural origin and not from plant operation.

SECTION K. MISCELLANEOUS (Continued)

40 CFR 190 REQUIREMENTS

The Table below presents the annual site-wide doses and percent of ODCM Specification limits to members of the public. These values were calculated utilizing doses resulting from all effluent pathways and direct radiation. The different categories presented are: (1) Total Body, (2) Limiting Organ, and (3) Thyroid.

Dose Category	Units	Year
1. Total Body		
a. Total Body Dose	mrem	6.65E-01
b. Percent ODCM Specification Limit	%	2.66E+00
2. Limiting Organ		
a. Organ Dose (GI-LLI)	mrem	6.80E-02
b. Percent ODCM Specification Limit	%	2.72E-01
3. Thyroid		
a. Thyroid Dose	mrem	3.46E-02
b. Percent ODCM Specification Limit	%	4.61E-02



SECTION K. MISCELLANEOUS (Continued)

CARBON-14

In June, 2009, the NRC revised its guidance in Regulatory Guide (RG) 1.21, "Measuring, Evaluating and Reporting Radioactivity In Solid Wastes And Releases Of Radioactive Materials In Liquid And Gaseous Effluents From Light-Water-Cooled Nuclear Power Plants", Revision 2. RG 1.21 explains, that in part, the quantity of carbon-14 (C-14) discharged can be estimated by sample measurements or by use of a normalized C-14 source term and scaling factors based on power generation or estimated by use of the GALE code from NUREG-0017. The dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste is not required. Revision 2 to RG 1.21 guidance includes:

- If sampling is performed, the sampling frequency may be adjusted to that interval that allows adequate measurement and reporting of effluents.
- If estimating C-14 based on scaling factors and fission rates, a precise and detailed evaluation of C-14 is not necessary. It is not necessary to calculate uncertainties for C-14 or to include C-14 uncertainty in any subsequent calculation of overall uncertainty.

Electric Power Research Institute (EPRI) Technical Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents," was used to estimate the production and release quantities of C-14.

C-14 calculated production, discharge parameters and resulting dose are reported here, separately from tables 1, 1A, 1C, 1E, 2 and 40CFR190 table 1.

Calculated C-14 production , Ci/EFPY <sup>(1)</sup>	U2 = 0 U3 = 0
2013 Unit capacity factors	U2 = 0 U3 = 0
Fraction release of produced C-14 to atmosphere	0.98
C-14 chemical form fraction assumed	Organic = 0.80 Inorganic = 0.20
C-14 curies released to atmosphere	U2 = 0 U3 = 0
Critical receptor dose (mrem)	0

(1) Effective Full Power Year

## SECTION L. SONGS CONCLUSIONS

- Gaseous releases totaled  $1.10\text{E}+02$  curies of which noble gases were  $1.13\text{E}-01$  curies, iodines were  $0.00\text{E}+00$  curies, particulates were  $3.52\text{E}-05$  curies and tritium was  $1.10\text{E}+02$  curies.
- The radiation doses from gaseous releases to a landward sector were: (a) gamma air dose:  $4.41\text{E}-07$  mrad at the site boundary, (b) beta air dose:  $5.00\text{E}-05$  mrad at the site boundary, (c) organ dose (child GI-LLI):  $3.19\text{E}-02$  mrem at the highest receptor.
- Airborne carbon-14 release was projected at  $0.00\text{E}+00$  curies.
- Liquid releases totaled  $6.70\text{E}+02$  curies of which particulates and iodines were  $7.58\text{E}-02$  curies, tritium was  $6.70\text{E}+02$  curies, and noble gases were  $1.39\text{E}-01$  curies.
- The radiation doses from liquid releases were: (a) total body:  $7.90\text{E}-03$  mrem, (b) limiting organ (GI-LLI):  $3.61\text{E}-02$  mrem.
- The radioactive releases and resulting doses generated from Units 2 and 3 were below the Applicable Limits for both gaseous and liquid effluents.
- SONGS Units 2 and 3 made 32 radwaste shipments to Energy Solutions (Utah), Energy Solutions (Tenn.), Toxco Materials Management (Tenn), Waste Control Specialist (Texas), and PermaFix Environmental Services. Waste shipped to PermaFix Environmental Services was not processed in 2013. The total volume of the shipments was  $3.42\text{E}+02$  cubic meters containing  $1.27\text{E}+03$  curies of radioactivity. There were no Unit 1 or common radwaste shipments.
- Meteorological conditions during the year were typical for SONGS. Meteorological dispersion was good 31% of the time, fair 43% of the time and poor 26% of the time.
- The results of samples taken from on-site ground water wells in support of the Industry Ground Water Protection Initiative are reported in Section K. The total volume of groundwater and dewatering wells released from the site in 2013 through an ODCM credited release point was 4,083,843 gallons.
- The results of on-site ground water samples taken in support of the industry Ground Water Protection Initiative are reported in Section K. There are low but detectable concentrations of tritium that have been identified in shallow ground water the area formerly occupied by Unit 1. The ground water beneath SONGS is not a source of drinking water. The affected shallow ground water is being extracted and released under the radioactive effluent control program and is accounted for in this ARERR.
- The net result from the analysis of these effluent releases indicates that the operation of SONGS has met all the requirements of the applicable regulations that ensure adequate protection of the health of members of the public.

## METEOROLOGY

The meteorology of the San Onofre Nuclear Generating Station for each of the four quarters, 2013 is described in this section. Meteorological measurements have been made according to the guidance provided in USNRC Regulatory Guide 1.23, "Onsite Meteorological Programs." A summary report of the meteorological measurements taken during each calendar quarter are presented in Table 4A as joint frequency distribution (JFD) of wind direction and wind speed by atmospheric stability class.

Hourly meteorological data for batch releases have been recorded for the periods of actual release. These data are available, as well as the hourly data for the Annual Report, but have not been included in this report because of the bulk of data records.

Table 4A lists the joint frequency distribution for each quarter, 2013. Each page of Table 4A represents the data for the individual stability classes: A, B, C, D, E, F, and G. The last page of each section is the JFD for all the stability classes. The wind speeds have been measured at the 10 meter level, and the stability classes are defined by the temperature differential between the 10 meter and 40 meter levels.

January - March  
Table 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13010100-13033123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A  
EXTREMELY UNSTABLE (DT/DZ ≤ - 1.9 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	3	0	0	1	0	0	0	0	4
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	1	0	0	0	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	1	0	1	0	0	0	0	0	2
SSE	0	0	0	0	0	1	8	0	1	0	0	0	10
S	0	0	0	0	5	13	17	4	0	0	0	0	39
SSW	0	0	0	1	5	19	21	0	0	0	0	0	46
SW	1	0	0	1	13	24	17	1	0	0	0	0	57
WSW	0	0	0	0	9	27	29	1	2	0	0	0	68
W	0	0	0	0	9	51	69	4	4	0	0	0	137
WNW	0	0	0	0	1	27	49	10	2	0	0	0	89
NW	0	0	0	0	0	0	2	5	0	0	0	0	7
NNW	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTALS	1	0	0	2	47	162	214	26	9	0	0	0	461

NUMBER OF VALID HOURS 461 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 461

PASQUILL B  
MODERATELY UNSTABLE ( - 1.9 < DT/DZ ≤ - 1.7 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	1	0	0	0	1	1	0	0	0	0	3
ENE	0	0	0	0	0	0	1	0	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	1	0	0	0	0	1
SSE	0	0	0	0	0	0	2	0	0	0	0	0	2
S	0	0	0	0	0	1	4	2	0	0	0	0	7
SSW	0	0	0	0	0	3	4	0	0	0	0	0	7
SW	0	0	0	0	4	1	0	1	0	0	0	0	6
WSW	0	0	0	0	1	3	1	0	0	0	0	0	5
W	0	0	0	0	2	0	0	0	0	0	0	0	2
WNW	0	0	0	0	0	0	3	0	0	0	0	0	3
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	0	1	1	0	0	0	0	0	0	2
TOTALS	0	0	1	0	8	9	17	5	0	0	0	0	40

NUMBER OF VALID HOURS 40 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 40

January - March  
Table 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13010100-13033123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL C  
SLIGHTLY UNSTABLE (  $-1.7 < DT/DZ \leq -1.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	1	0	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	1	0	0	0	0	0	0	1
SSE	0	0	0	1	0	1	1	1	0	0	0	0	4
S	0	0	0	0	0	5	5	0	0	0	0	0	10
SSW	0	0	0	0	2	1	1	0	0	0	0	0	4
SW	0	0	0	1	1	3	0	1	0	0	0	0	6
WSW	0	0	0	0	1	0	3	1	0	0	0	0	5
W	0	0	0	0	1	1	2	1	0	0	0	0	5
WNW	0	0	0	0	2	2	1	1	1	0	0	0	7
NW	0	0	0	0	1	4	1	0	0	0	0	0	6
NNW	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTALS	0	0	0	3	8	19	15	5	1	0	0	0	51

NUMBER OF VALID HOURS 51 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 51

PASQUILL D  
NEUTRAL (  $-1.5 < DT/DZ \leq -0.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	3	1	1	0	0	0	0	0	7
NNE	0	0	0	1	7	5	2	0	0	0	0	0	15
NE	0	0	0	3	1	3	0	0	1	0	0	0	8
ENE	0	0	0	2	3	1	0	0	0	0	0	0	6
E	0	0	0	1	2	2	3	0	0	0	0	0	8
ESE	0	0	0	0	4	7	15	1	0	0	0	0	27
SE	0	0	2	3	6	9	23	1	0	0	0	0	44
SSE	0	0	0	2	8	16	34	7	0	0	0	0	67
S	0	0	1	5	8	5	13	3	1	0	0	0	36
SSW	0	0	0	4	6	7	9	6	0	0	0	0	32
SW	0	0	1	1	4	10	12	7	0	0	0	0	35
WSW	0	1	0	4	5	9	12	2	5	0	0	0	38
W	0	0	2	5	8	9	4	6	3	0	0	0	37
WNW	0	0	0	3	6	15	6	9	5	3	0	0	47
NW	0	0	0	2	6	9	9	2	1	1	0	0	30
NNW	0	0	0	1	5	6	3	0	0	0	0	0	15
TOTALS	0	1	6	39	82	114	146	44	16	4	0	0	452

NUMBER OF VALID HOURS 452 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 452

January - March  
Table 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13010100-13033123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL E  
SLIGHTLY STABLE ( - 0.5 < DT/DZ ≤ 1.5 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	11	10	9	2	0	0	0	0	0	32
NNE	0	0	4	8	14	19	8	0	0	0	0	0	53
NE	0	0	2	6	4	5	1	7	3	0	0	0	28
ENE	0	0	5	2	3	3	4	0	0	0	0	0	17
E	0	0	1	3	6	4	2	0	0	0	0	0	16
ESE	0	0	0	3	7	9	1	0	0	0	0	0	20
SE	0	0	0	4	4	9	5	0	0	0	0	0	22
SSE	0	0	1	2	1	4	5	1	0	0	0	0	14
S	0	0	2	1	3	4	0	0	0	0	0	0	10
SSW	0	0	0	1	1	0	0	0	0	0	0	0	2
SW	0	0	1	1	1	1	0	0	0	0	0	0	4
WSW	0	1	2	3	0	3	0	0	0	0	0	0	9
W	0	0	1	2	4	1	2	0	0	0	0	0	10
WNW	0	0	1	4	5	4	9	0	1	0	0	0	24
NW	0	0	1	2	4	8	4	1	0	0	0	0	20
NNW	0	0	1	7	6	10	5	2	0	0	0	0	31
TOTALS	0	1	22	60	73	93	48	11	4	0	0	0	312

NUMBER OF VALID HOURS 312 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 312

PASQUILL F  
MODERATELY STABLE (1.5 < DT/DZ ≤ 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	7	4	7	0	0	0	0	0	20
NNE	0	0	2	13	25	42	17	0	0	0	0	0	99
NE	0	0	1	11	12	12	2	2	0	0	0	0	40
ENE	0	0	0	11	4	8	0	0	0	0	0	0	23
E	0	0	1	5	5	6	0	0	0	0	0	0	17
ESE	0	0	1	1	2	2	0	0	0	0	0	0	6
SE	0	0	1	3	2	2	1	1	0	0	0	0	10
SSE	0	0	0	2	0	4	2	0	0	0	0	0	8
S	0	0	0	1	0	0	1	0	0	0	0	0	2
SSW	0	0	2	0	4	1	0	0	0	0	0	0	7
SW	0	0	1	3	0	1	0	0	0	0	0	0	5
WSW	0	0	0	4	3	1	0	0	0	0	0	0	8
W	0	0	0	1	2	1	0	0	0	0	0	0	4
WNW	0	0	0	2	4	13	1	0	0	0	0	0	20
NW	0	0	2	0	2	3	5	1	0	0	0	0	13
NNW	0	0	0	2	2	5	1	0	0	0	0	0	10
TOTALS	0	0	11	61	74	105	37	4	0	0	0	0	292

NUMBER OF VALID HOURS 292 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 292

January - March  
Table 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13010100-13033123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL G  
EXTREMELY STABLE (DT/DZ > 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	3	2	5	7	0	0	0	0	0	17
NNE	0	0	1	2	4	135	201	4	0	0	0	0	347
NE	0	1	1	8	10	24	13	1	0	0	0	0	58
ENE	0	0	4	2	5	5	2	0	0	0	0	0	18
E	0	0	1	2	6	4	1	0	0	0	0	0	14
ESE	0	0	1	4	4	2	0	0	0	0	0	0	11
SE	0	0	1	2	1	0	2	0	0	0	0	0	6
SSE	0	0	0	2	0	0	0	1	0	0	0	0	3
S	0	0	1	1	2	0	0	0	0	0	0	0	4
SSW	0	1	2	2	3	0	1	0	0	0	0	0	9
SW	0	0	0	6	1	2	0	0	0	0	0	0	9
WSW	0	0	0	1	0	1	0	0	0	0	0	0	2
W	0	0	0	4	4	1	0	0	0	0	0	0	9
WNW	0	0	0	2	6	9	3	0	0	0	0	0	20
NW	0	0	0	1	1	3	3	0	0	0	0	0	8
NNW	0	0	0	6	5	4	1	1	0	0	0	0	17
TOTALS	0	2	12	48	54	195	234	7	0	0	0	0	552

NUMBER OF VALID HOURS	552	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	552

ALL STABILITY CLASSES, ALL DT/DZ  
WIND SPEED (M/S) AT 10 METER LEVEL

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	18	22	19	17	0	0	0	0	0	76
NNE	0	0	7	24	53	201	228	5	0	0	0	0	518
NE	0	1	5	28	27	45	17	11	4	0	0	0	138
ENE	0	0	9	17	16	17	7	0	0	0	0	0	66
E	0	0	3	11	19	16	6	0	0	0	0	0	55
ESE	0	0	2	9	17	20	16	1	0	0	0	0	65
SE	0	0	4	12	14	21	32	3	0	0	0	0	86
SSE	0	0	1	9	9	26	52	10	1	0	0	0	108
S	0	0	4	8	18	28	40	9	1	0	0	0	108
SSW	0	1	4	8	21	31	36	6	0	0	0	0	107
SW	1	0	3	13	24	42	29	10	0	0	0	0	122
WSW	0	2	2	12	19	44	45	4	7	0	0	0	135
W	0	0	3	12	30	64	77	11	7	0	0	0	204
WNW	0	0	1	11	24	70	72	20	9	3	0	0	210
NW	0	0	3	5	14	27	25	9	1	1	0	0	85
NNW	0	0	1	16	19	26	12	3	0	0	0	0	77
TOTALS	1	4	52	213	346	697	711	102	30	4	0	0	2160

NUMBER OF VALID HOURS	2160	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	2160

April - June  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13040100-13063023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A  
EXTREMELY UNSTABLE (DT/DZ ≤ - 1.9 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	1	0	0	0	0	0	0	1
NNE	0	0	0	1	0	0	0	0	0	0	0	0	1
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	1	0	0	0	0	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	0	1	0	0	0	0	0	1
SSE	0	0	0	0	0	1	6	5	2	0	0	0	14
S	0	0	0	1	1	14	32	33	4	0	0	0	85
SSW	0	0	0	2	4	23	67	11	0	0	0	0	107
SW	0	0	0	1	4	37	75	0	0	0	0	0	117
WSW	0	0	0	2	5	46	103	1	1	0	0	0	158
W	0	0	1	0	2	32	109	11	2	0	0	0	157
WNW	0	0	0	1	0	7	37	19	0	0	0	0	64
NW	0	0	0	0	1	1	2	0	1	0	0	0	5
NNW	0	0	0	0	2	0	0	0	0	0	0	0	2
TOTALS	0	0	1	10	19	162	432	80	10	0	0	0	714

NUMBER OF VALID HOURS 714 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 714

PASQUILL B  
MODERATELY UNSTABLE ( - 1.9 < DT/DZ ≤ - 1.7 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	1	1	0	0	0	0	0	2
SSE	0	0	0	0	0	1	3	4	3	0	0	0	11
S	0	0	0	0	0	1	13	5	0	0	0	0	19
SSW	0	0	0	0	1	7	9	1	0	0	0	0	18
SW	0	0	0	2	3	6	2	0	0	0	0	0	13
WSW	0	0	0	0	0	5	1	0	0	0	0	0	6
W	0	0	0	0	1	4	0	0	0	1	0	0	6
WNW	0	0	0	0	1	1	2	0	0	0	0	0	4
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	2	6	26	33	10	3	1	0	0	81

NUMBER OF VALID HOURS 81 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 81



April - June  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13040100-13063023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL C  
SLIGHTLY UNSTABLE (  $-1.7 < DT/DZ \leq -1.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	1	0	0	0	0	0	0	0	1
E	0	0	0	1	0	0	0	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	1	1	0	0	0	0	0	0	2
SSE	0	0	0	0	0	2	2	6	3	0	0	0	13
S	0	0	0	0	5	7	17	6	3	0	0	0	38
SSW	0	0	0	0	3	7	7	3	0	0	0	0	20
SW	0	0	0	1	1	4	8	0	1	0	0	0	15
WSW	0	0	0	1	3	6	1	0	0	0	0	0	11
W	0	0	0	1	2	4	2	0	0	0	0	0	9
WNW	0	0	0	0	3	1	1	0	0	0	0	0	5
NW	0	0	0	0	1	4	2	3	0	0	0	0	10
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	0	0	0	5	20	36	40	18	7	0	0	0	126

NUMBER OF VALID HOURS 126 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 126

PASQUILL D  
NEUTRAL (  $-1.5 < DT/DZ \leq -0.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	6	9	3	0	0	0	0	0	0	19
NNE	0	0	0	8	9	12	0	0	0	0	0	0	29
NE	0	0	0	3	3	2	0	1	0	0	0	0	9
ENE	0	0	0	2	5	0	0	0	0	0	0	0	7
E	0	0	0	2	4	11	6	0	0	0	0	0	23
ESE	0	0	0	4	4	34	23	0	0	0	0	0	65
SE	0	0	0	4	6	49	82	13	1	0	0	0	155
SSE	0	0	0	2	10	41	103	45	8	0	0	0	209
S	0	0	1	5	7	43	79	23	2	0	0	0	160
SSW	0	0	0	9	9	28	26	3	1	0	0	0	76
SW	0	0	0	2	8	14	2	6	0	0	0	0	32
WSW	0	0	2	10	5	10	0	3	0	0	0	0	30
W	0	0	0	2	6	4	0	0	1	0	0	0	13
WNW	0	0	1	2	5	4	5	0	0	0	0	0	17
NW	0	0	1	6	3	4	15	1	1	0	0	0	31
NNW	0	0	1	3	7	5	1	0	0	0	0	0	17
TOTALS	0	0	7	70	100	264	342	95	14	0	0	0	892

NUMBER OF VALID HOURS 892 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 892

April - June  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13040100-13063023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL E  
SLIGHTLY STABLE (  $-0.5 < DT/DZ \leq 1.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	11	0	0	0	0	0	0	0	13
NNE	0	1	0	7	19	16	1	0	0	0	0	0	44
NE	0	0	0	6	5	2	0	0	1	0	0	0	14
ENE	0	0	0	3	1	2	0	0	0	0	0	0	6
E	0	0	0	1	1	3	2	0	0	0	0	0	7
ESE	0	0	1	0	4	6	0	0	0	0	0	0	11
SE	0	0	0	0	2	3	2	0	0	0	0	0	7
SSE	0	0	0	0	5	2	1	0	0	0	0	0	8
S	0	0	0	0	2	7	1	0	0	0	0	0	10
SSW	0	0	1	2	1	10	1	0	0	0	0	0	15
SW	0	0	0	1	3	2	0	0	0	0	0	0	6
WSW	0	0	0	0	3	1	0	0	0	0	0	0	4
W	0	0	1	0	1	3	1	0	0	0	0	0	6
WNW	0	0	0	0	2	7	7	0	0	0	0	0	16
NW	0	1	0	4	1	2	1	3	0	0	0	0	12
NNW	0	0	0	5	2	4	3	1	0	0	0	0	15
TOTALS	0	2	3	31	63	70	20	4	1	0	0	0	194

NUMBER OF VALID HOURS 194 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 194

PASQUILL F  
MODERATELY STABLE ( $1.5 < DT/DZ \leq 4.0$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	1	3	0	0	0	0	0	0	4
NNE	0	0	1	3	19	22	3	0	0	0	0	0	48
NE	0	0	0	5	3	2	2	0	0	0	0	0	12
ENE	0	0	0	1	1	0	0	0	0	0	0	0	2
E	0	0	1	1	0	0	1	0	0	0	0	0	3
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	1	0	0	0	0	0	0	0	0	0	1
S	0	1	0	1	0	0	1	0	0	0	0	0	3
SSW	0	0	0	1	2	0	0	0	0	0	0	0	3
SW	0	0	0	1	1	0	0	0	0	0	0	0	2
WSW	0	0	0	0	1	0	0	0	0	0	0	0	1
W	0	0	0	0	0	0	1	0	0	0	0	0	1
WNW	0	0	0	0	0	0	1	0	0	0	0	0	1
NW	0	0	0	1	0	0	0	0	0	0	0	0	1
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	0	1	3	16	28	27	9	0	0	0	0	0	84

NUMBER OF VALID HOURS 84 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 84

April - June  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13040100-13063023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL G  
EXTREMELY STABLE (DT/DZ > 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	0	0	1	0	0	0	0	0	3
NNE	0	0	0	3	1	28	24	0	0	0	0	0	56
NE	0	0	0	2	1	4	1	1	0	0	0	0	9
ENE	0	0	0	0	1	1	0	0	0	0	0	0	2
E	0	0	0	0	0	1	0	0	0	0	0	0	1
ESE	0	0	0	2	0	0	0	0	0	0	0	0	2
SE	0	0	1	1	0	0	1	0	0	0	0	0	3
SSE	0	1	0	0	0	0	0	0	0	0	0	0	1
S	0	0	0	1	0	0	1	0	0	0	0	0	2
SSW	0	0	0	2	0	0	0	0	0	0	0	0	2
SW	0	0	0	0	0	1	0	0	0	0	0	0	1
WSW	0	0	1	2	1	0	0	0	0	0	0	0	4
W	0	0	0	1	1	0	0	0	0	0	0	0	2
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	1	1	2	1	0	0	0	0	5
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	1	2	16	6	36	30	2	0	0	0	0	93

NUMBER OF VALID HOURS 93 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 93

ALL STABILITY CLASSES, ALL DT/DZ  
WIND SPEED (M/S) AT 10 METER LEVEL

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	10	21	7	1	0	0	0	0	0	40
NNE	0	1	1	22	48	78	28	0	0	0	0	0	178
NE	0	0	0	16	12	10	4	2	1	0	0	0	45
ENE	0	0	0	7	9	3	0	0	0	0	0	0	19
E	0	0	1	5	5	15	9	0	0	0	0	0	35
ESE	0	0	1	8	8	40	23	0	0	0	0	0	80
SE	0	0	1	5	9	54	87	13	1	0	0	0	170
SSE	0	1	1	2	15	47	115	60	16	0	0	0	257
S	0	1	1	8	15	72	144	67	9	0	0	0	317
SSW	0	0	1	16	20	75	110	18	1	0	0	0	241
SW	0	0	0	8	20	64	87	6	1	0	0	0	186
WSW	0	0	3	15	18	68	105	4	1	0	0	0	214
W	0	0	2	4	13	47	113	11	3	1	0	0	194
WNW	0	0	1	3	11	20	53	19	0	0	0	0	107
NW	0	1	1	11	7	12	23	8	2	0	0	0	65
NNW	0	0	1	10	11	9	4	1	0	0	0	0	36
TOTALS	0	4	16	150	242	621	906	209	35	1	0	0	2184

NUMBER OF VALID HOURS 2184 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 2184

July - September  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13070100-13093023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A  
EXTREMELY UNSTABLE (DT/DZ ≤ - 1.9 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	1	1	1	1	0	0	0	0	4
S	0	0	0	2	2	2	11	2	1	0	0	0	20
SSW	0	0	0	2	3	8	12	0	0	0	0	0	25
SW	0	0	0	7	10	29	32	0	0	0	0	0	78
WSW	0	0	0	2	11	74	63	0	0	0	0	0	150
W	0	0	0	0	11	103	82	0	0	0	0	0	196
WNW	0	0	0	1	4	51	112	4	0	0	0	0	172
NW	0	0	0	0	0	2	6	1	0	0	0	0	9
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	14	42	270	319	8	1	0	0	0	654

NUMBER OF VALID HOURS 654 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 654

PASQUILL B  
MODERATELY UNSTABLE ( - 1.9 < DT/DZ ≤ - 1.7 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	1	0	0	0	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	1	0	0	0	0	0	0	0	1
SSE	0	0	0	0	1	1	1	1	0	0	0	0	4
S	0	0	0	1	1	0	4	0	1	0	0	0	7
SSW	0	0	0	0	1	5	3	0	0	0	0	0	9
SW	0	0	0	0	2	3	4	0	0	0	0	0	9
WSW	0	0	0	2	2	5	2	0	0	0	0	0	11
W	0	0	0	0	4	2	0	0	0	0	0	0	6
WNW	0	0	0	0	0	2	6	0	0	0	0	0	8
NW	0	0	0	0	1	0	2	0	0	0	0	0	3
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	4	13	18	22	1	1	0	0	0	59

NUMBER OF VALID HOURS 59 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 59

July - September  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13070100-13093023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL C  
SLIGHTLY UNSTABLE ( $-1.7 < DT/DZ \leq -1.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	1	0	0	0	0	0	0	0	2
NNE	0	0	0	0	0	1	0	0	0	0	0	0	1
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	1	0	0	0	0	0	0	1
SSE	0	0	0	0	1	0	1	1	0	0	0	0	3
S	0	0	0	1	1	1	5	0	0	0	0	0	8
SSW	0	0	0	0	1	8	4	0	0	0	0	0	13
SW	0	0	0	1	4	12	4	0	0	0	0	0	21
WSW	0	0	0	2	2	8	1	0	0	0	0	0	13
W	0	0	1	0	6	8	0	0	0	0	0	0	15
WNW	0	0	0	0	2	7	1	0	0	0	0	0	10
NW	0	0	0	0	1	0	4	0	0	0	0	0	5
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	1	5	19	46	20	1	0	0	0	0	92

NUMBER OF VALID HOURS 92 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 92

PASQUILL D  
NEUTRAL ( $-1.5 < DT/DZ \leq -0.5$  °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	4	13	11	1	0	0	0	0	0	0	29
NNE	0	0	3	10	20	8	0	0	0	0	0	0	41
NE	0	0	0	6	7	4	0	0	0	0	0	0	17
ENE	0	0	0	4	0	0	0	0	0	0	0	0	4
E	0	2	0	3	2	3	0	0	0	0	0	0	10
ESE	0	0	1	2	4	3	3	0	0	0	0	0	13
SE	0	0	1	4	10	25	15	11	0	0	0	0	66
SSE	0	0	3	2	22	34	25	3	3	0	0	0	92
S	0	0	2	7	13	43	19	5	0	0	0	0	89
SSW	0	0	4	11	21	39	8	1	0	0	0	0	84
SW	0	0	0	10	18	14	5	0	0	0	0	0	47
WSW	0	0	3	19	15	8	0	0	0	0	0	0	45
W	0	0	3	24	28	11	12	0	0	0	0	0	78
WNW	0	0	3	18	34	30	10	0	0	0	0	0	95
NW	0	1	8	29	17	18	9	1	0	0	0	0	83
NNW	0	0	0	19	6	5	1	0	0	0	0	0	31
TOTALS	0	3	35	181	228	246	107	21	3	0	0	0	824

NUMBER OF VALID HOURS 824 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 824

July - September  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13070100-13093023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL E  
SLIGHTLY STABLE ( - 0.5 < DT/DZ ≤ 1.5 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	10	5	4	1	0	0	0	0	0	21
NNE	0	0	4	18	23	3	0	0	0	0	0	0	48
NE	0	0	2	6	2	0	0	0	0	0	0	0	10
ENE	0	2	4	2	3	1	0	0	0	0	0	0	12
E	0	0	2	2	2	2	0	0	0	0	0	0	8
ESE	0	0	3	4	1	3	1	0	0	0	0	0	12
SE	0	0	1	2	4	6	5	0	0	0	0	0	18
SSE	0	1	2	6	15	5	3	0	0	0	0	0	32
S	0	3	2	11	7	1	0	0	0	0	0	0	24
SSW	0	1	3	5	4	0	0	0	0	0	0	0	13
SW	0	1	1	6	2	1	0	0	0	0	0	0	11
WSW	0	1	7	15	4	3	0	0	0	0	0	0	30
W	0	0	7	7	3	0	0	0	0	0	0	0	17
WNW	0	1	1	15	4	5	0	0	0	0	0	0	26
NW	0	0	1	6	2	5	2	0	0	0	0	0	16
NNW	0	0	3	6	7	5	1	0	0	0	0	0	22
TOTALS	0	10	44	121	88	44	13	0	0	0	0	0	320

NUMBER OF VALID HOURS 320 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 320

PASQUILL F  
MODERATELY STABLE (1.5 < DT/DZ ≤ 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	3	5	1	0	0	0	0	0	10
NNE	0	0	1	16	27	29	1	0	0	0	0	0	74
NE	0	0	0	5	4	1	0	0	0	0	0	0	10
ENE	0	0	0	2	5	2	0	0	0	0	0	0	9
E	0	0	2	1	1	1	0	0	0	0	0	0	5
ESE	0	0	0	0	1	1	0	0	0	0	0	0	2
SE	0	0	0	0	4	1	2	0	0	0	0	0	7
SSE	0	0	1	4	3	4	2	0	0	0	0	0	14
S	0	0	0	3	2	1	1	0	0	0	0	0	7
SSW	0	0	0	2	0	1	0	0	0	0	0	0	3
SW	0	0	0	2	0	0	0	0	0	0	0	0	2
WSW	0	0	0	0	0	2	0	0	0	0	0	0	2
W	0	0	1	1	0	0	1	0	0	0	0	0	3
WNW	0	0	0	1	2	1	3	0	0	0	0	0	7
NW	0	0	1	2	1	3	2	0	0	0	0	0	9
NNW	0	0	1	0	1	4	0	0	0	0	0	0	6
TOTALS	0	0	7	40	54	56	13	0	0	0	0	0	170

NUMBER OF VALID HOURS 170 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 170

July - September  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13070100-13093023  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL G  
EXTREMELY STABLE (DT/DZ > 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	1	1	4	0	0	0	0	0	7
NNE	0	0	1	1	3	28	22	1	0	0	0	0	56
NE	0	0	0	3	0	0	0	0	0	0	0	0	3
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	1	0	0	0	0	0	0	0	1
ESE	0	0	0	2	0	1	0	0	0	0	0	0	3
SE	0	0	0	0	2	0	0	0	0	0	0	0	2
SSE	0	0	0	1	0	0	1	0	0	0	0	0	2
S	0	0	0	2	0	0	0	0	0	0	0	0	2
SSW	0	0	0	2	0	0	0	0	0	0	0	0	2
SW	0	0	0	1	2	0	1	0	0	0	0	0	4
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	1	0	0	0	0	0	0	0	0	1
WNW	0	0	0	1	0	1	1	0	0	0	0	0	3
NW	0	0	0	1	1	0	0	0	0	0	0	0	2
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	0	0	1	17	10	31	29	1	0	0	0	0	89

NUMBER OF VALID HOURS	89	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	89

ALL STABILITY CLASSES, ALL DT/DZ  
WIND SPEED (M/S) AT 10 METER LEVEL

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	5	26	21	11	6	0	0	0	0	0	69
NNE	0	0	9	45	73	69	23	1	0	0	0	0	220
NE	0	0	2	21	13	5	0	0	0	0	0	0	41
ENE	0	2	4	8	8	3	0	0	0	0	0	0	25
E	0	2	4	6	6	6	0	0	0	0	0	0	24
ESE	0	0	4	8	6	8	4	0	0	0	0	0	30
SE	0	0	2	6	21	33	22	11	0	0	0	0	95
SSE	0	1	6	13	43	45	34	6	3	0	0	0	151
S	0	3	4	27	26	48	40	7	2	0	0	0	157
SSW	0	1	7	22	30	61	27	1	0	0	0	0	149
SW	0	1	1	27	38	59	46	0	0	0	0	0	172
WSW	0	1	10	40	34	100	66	0	0	0	0	0	251
W	0	0	12	33	52	124	95	0	0	0	0	0	316
WNW	0	1	4	36	46	97	133	4	0	0	0	0	321
NW	0	1	10	38	23	28	25	2	0	0	0	0	127
NNW	0	0	4	26	14	14	2	0	0	0	0	0	60
TOTALS	0	13	88	382	454	711	523	32	5	0	0	0	2208

NUMBER OF VALID HOURS	2208	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	2208

October - December  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13100100-13123123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A  
EXTREMELY UNSTABLE (DT/DZ ≤ - 1.9 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	1	0	0	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	2	0	0	0	0	0	2
SSE	0	0	0	1	0	2	1	2	0	0	0	0	6
S	0	0	0	1	2	13	30	5	0	0	0	0	51
SSW	0	0	0	1	3	6	16	2	0	0	0	0	28
SW	0	0	0	1	6	9	12	2	0	0	0	0	30
WSW	0	0	0	1	21	34	11	2	0	0	0	0	69
W	0	0	0	1	5	56	42	0	0	0	0	0	104
WNW	0	0	0	0	3	30	48	1	0	0	0	0	82
NW	0	0	0	0	1	3	0	1	0	0	0	0	5
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	6	41	154	162	15	0	0	0	0	378

NUMBER OF VALID HOURS 378 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 378

PASQUILL B  
MODERATELY UNSTABLE (- 1.9 < DT/DZ ≤ - 1.7 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	1	0	0	0	2	0	0	0	0	3
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	1	2	0	0	0	0	3
S	0	0	0	0	0	0	1	1	0	0	0	0	2
SSW	0	0	0	1	0	0	2	1	0	0	0	0	4
SW	0	0	0	0	1	2	1	0	0	0	0	0	4
WSW	0	0	0	0	1	0	0	0	0	0	0	0	1
W	0	0	0	0	1	3	0	0	0	0	0	0	4
WNW	0	0	0	0	0	8	1	0	0	0	0	0	9
NW	0	0	0	0	1	1	0	0	0	0	0	0	2
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	3	4	14	6	6	0	0	0	0	33

NUMBER OF VALID HOURS 33 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 33



October - December  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13100100-13123123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL C  
SLIGHTLY UNSTABLE ( - 1.7 < DT/DZ ≤ - 1.5 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	1	0	0	0	0	0	1
NE	0	0	0	1	0	0	0	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	2	2	4	0	0	0	0	8
S	0	0	0	1	0	1	1	1	0	0	0	0	4
SSW	0	0	0	0	0	0	1	0	0	0	0	0	1
SW	0	0	0	1	1	1	0	1	1	0	0	0	5
WSW	0	0	0	2	1	0	0	0	1	0	0	0	4
W	0	0	0	0	1	1	0	0	0	0	0	0	2
WNW	0	0	0	1	0	2	1	0	0	0	0	0	4
NW	0	0	0	0	0	2	0	0	0	0	0	0	2
NNW	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTALS	0	0	0	6	3	10	6	7	2	0	0	0	34

NUMBER OF VALID HOURS	34	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	34

PASQUILL D  
NEUTRAL ( - 1.5 < DT/DZ ≤ - 0.5 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	5	2	2	0	0	0	0	0	11
NNE	0	0	1	0	3	4	3	0	0	0	0	0	11
NE	0	0	0	0	3	1	2	1	0	0	0	0	7
ENE	0	0	0	2	0	0	1	1	0	0	0	0	4
E	0	0	0	3	0	2	0	0	0	0	0	0	5
ESE	0	0	1	0	0	11	8	0	0	0	0	0	20
SE	0	0	0	1	2	16	33	13	2	0	0	0	67
SSE	0	0	0	3	1	10	28	16	4	0	0	0	62
S	0	0	0	1	2	7	18	6	0	0	0	0	34
SSW	0	0	0	2	2	4	9	12	7	0	0	0	36
SW	0	0	0	5	4	6	13	12	6	0	0	0	46
WSW	0	0	0	1	6	4	6	8	1	0	0	0	26
W	0	0	0	3	5	6	5	5	1	0	0	0	25
WNW	0	0	0	1	6	13	0	3	1	0	0	0	24
NW	0	0	1	2	8	6	14	1	0	0	0	0	32
NNW	0	0	0	4	7	8	3	0	0	0	0	0	22
TOTALS	0	0	3	30	54	100	145	78	22	0	0	0	432

NUMBER OF VALID HOURS	432	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	432

October - December  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13100100-13123123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL E  
SLIGHTLY STABLE ( - 0.5 < DT/DZ ≤ 1.5 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	2	4	8	8	0	0	0	0	0	0	22
NNE	0	0	2	7	18	18	17	3	1	0	0	0	66
NE	0	0	1	1	7	0	2	7	0	0	0	0	18
ENE	0	0	1	6	3	2	1	0	0	0	0	0	13
E	0	0	0	3	8	5	0	0	0	0	0	0	16
ESE	0	0	1	3	3	9	5	0	0	0	0	0	21
SE	0	0	0	7	4	9	11	2	0	0	0	0	33
SSE	0	0	2	1	2	7	4	2	0	0	0	0	18
S	0	0	0	4	3	3	1	0	0	0	0	0	11
SSW	0	0	0	3	1	0	0	0	0	0	0	0	4
SW	0	0	0	3	0	2	0	1	0	0	0	0	6
WSW	0	0	0	3	1	0	1	1	0	0	0	0	6
W	0	0	1	2	2	3	2	10	2	0	0	0	22
WNW	0	0	0	5	4	20	1	1	2	0	0	0	33
NW	0	0	1	1	5	7	10	0	0	0	0	0	24
NNW	0	1	0	3	2	6	1	0	0	0	0	0	13
TOTALS	0	1	11	56	71	99	56	27	5	0	0	0	326

NUMBER OF VALID HOURS 326 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 326

PASQUILL F  
MODERATELY STABLE (1.5 < DT/DZ ≤ 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	10	3	6	3	0	0	0	0	0	23
NNE	0	0	1	16	43	69	9	1	0	0	0	0	139
NE	0	0	2	25	19	8	4	5	0	0	0	0	63
ENE	0	0	2	6	11	13	0	1	0	0	0	0	33
E	0	0	1	6	10	6	1	0	0	0	0	0	24
ESE	0	0	0	2	1	3	0	0	0	0	0	0	6
SE	0	0	0	0	3	0	2	0	0	0	0	0	5
SSE	0	0	1	2	6	1	1	1	0	0	0	0	12
S	0	0	0	4	3	3	0	0	0	0	0	0	10
SSW	0	0	0	4	0	0	1	0	0	0	0	0	5
SW	0	0	0	2	3	1	0	0	0	0	0	0	6
WSW	0	0	2	4	4	3	0	0	0	0	0	0	13
W	0	0	0	4	0	1	1	0	0	0	0	0	6
WNW	0	0	1	5	5	10	3	0	0	0	0	0	24
NW	0	0	1	4	2	6	3	0	0	0	0	0	16
NNW	0	0	1	1	4	6	3	0	0	0	0	0	15
TOTALS	0	0	13	95	117	136	31	8	0	0	0	0	400

NUMBER OF VALID HOURS 400 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 400

October - December  
TABLE 4A

SITE: SAN ONOFRE  
PERIOD OF RECORD 13100100-13123123  
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL G  
EXTREMELY STABLE (DT/DZ > 4.0 °C/100 METERS)

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	4	3	10	13	0	0	0	0	0	30
NNE	0	0	0	4	14	152	181	6	0	0	0	0	357
NE	0	0	0	5	25	32	10	0	0	0	0	0	72
ENE	0	0	0	6	12	5	7	0	0	0	0	0	30
E	0	0	1	2	4	7	4	0	0	0	0	0	18
ESE	0	0	0	3	4	1	1	0	0	0	0	0	9
SE	0	0	0	0	2	1	1	0	0	0	0	0	4
SSE	0	0	0	1	2	1	2	0	0	0	0	0	6
S	0	0	0	2	1	1	0	0	0	0	0	0	4
SSW	0	0	1	6	0	2	3	0	0	0	0	0	12
SW	0	0	0	3	2	0	0	0	0	0	0	0	5
WSW	0	0	0	4	1	0	1	0	0	0	0	0	6
W	0	0	0	3	4	3	1	0	0	0	0	0	11
WNW	0	0	0	3	3	8	4	0	0	0	0	0	18
NW	0	0	2	1	4	7	0	0	0	0	0	0	14
NNW	0	0	0	1	2	2	4	0	0	0	0	0	9
TOTALS	0	0	4	48	83	232	232	6	0	0	0	0	605

NUMBER OF VALID HOURS 605 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 605

ALL STABILITY CLASSES, ALL DT/DZ  
WIND SPEED (M/S) AT 10 METER LEVEL

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	3	20	19	26	18	0	0	0	0	0	86
NNE	0	0	4	27	78	243	211	10	1	0	0	0	574
NE	0	0	3	33	54	41	18	15	0	0	0	0	164
ENE	0	0	3	20	26	21	9	3	0	0	0	0	82
E	0	0	2	14	22	20	5	0	0	0	0	0	63
ESE	0	0	2	9	8	24	14	0	0	0	0	0	57
SE	0	0	0	8	11	26	49	15	2	0	0	0	111
SSE	0	0	3	8	11	23	39	27	4	0	0	0	115
S	0	0	0	13	11	28	51	13	0	0	0	0	116
SSW	0	0	1	17	6	12	32	15	7	0	0	0	90
SW	0	0	0	15	17	21	26	16	7	0	0	0	102
WSW	0	0	2	15	35	41	19	11	2	0	0	0	125
W	0	0	1	13	18	73	51	15	3	0	0	0	174
WNW	0	0	1	15	21	91	58	5	3	0	0	0	194
NW	0	0	5	8	21	32	27	2	0	0	0	0	95
NNW	0	1	1	9	15	23	11	0	0	0	0	0	60
TOTALS	0	1	31	244	373	745	638	147	29	0	0	0	2208

NUMBER OF VALID HOURS 2208 NUMBER OF CALMS 0  
NUMBER OF INVALID HOURS 0 TOTAL HOURS FOR THE PERIOD 2208