

April 25, 2019

10 CFR 50.36(a)

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

Subject: **Annual Radioactive Effluent Release Report – 2018**
San Onofre Nuclear Generating Station (SONGS), Units 1, 2 and 3
Docket Nos. 50-206, 50-361 and 50-362

In accordance with 10 CFR 50.36(a), San Onofre Nuclear Generating Station (SONGS) Unit 1 Permanently Defueled Technical Specification (TS) Section D6.9.1.4, and SONGS Units 2 and 3 Permanently Defueled TS Section 5.7.1.3, Southern California Edison (SCE) is submitting the Annual Radioactive Effluent Release Report - 2018 (ARERR) for SONGS, Units 1, 2, and 3 (Enclosure 1). The period of the report is January 1, 2018 through December 31, 2018.

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.

Additionally, in accordance with SONGS Unit 1 Permanently Defueled TS Section D6.14.2.3 and SONGS Units 2 and 3 Permanently Defueled TS Section 5.5.2.1.1(c), the SONGS Offsite Dose Calculation Manual (ODCM) Revision 13, issued November 8, 2018, is included with this submittal. There were no changes to the ODCM in 2018 after Revision 13 was issued.

Change bars, as required by TS Section D6.14.2.3 and TS Section 5.5.2.1.1(c), are included on all affected pages.

There are no commitments in this letter or the enclosure.

If you have any questions, please contact me at (949) 368-6945.

Sincerely,



Enclosures:

- 1) San Onofre Nuclear Generation Station, Annual Radioactive Effluent Release Report 2018
- 2) Offsite Dose Calculation Manual Nuclear Organization San Onofre Nuclear Generation Station (SONGS) SO123-ODCM Revision 13, November 2018
- 3) Offsite Dose Calculation Manual Nuclear Organization San Onofre Nuclear Generation Station Appendix A, Ri Tables, SO123-ODCM-A, Revision 13, November 2018
- 4) Offsite Dose Calculation Manual Nuclear Organization San Onofre Nuclear Generation Station (SONGS) Appendix B Supplemental Information for Effluent Controls, SO123-ODCM-B, Revision 9, August 2016

cc: S. A. Morris, Regional Administrator, NRC Region IV
M. G. Vaaler, NRC Project Manager
I. Schneider, California Department of Public Health



SAN ONOFRE NUCLEAR GENERATING STATION

Annual Radioactive Effluent Release Report

2018

January - December

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.

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 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, remaining monitored effluent pathways were permanently removed from service. Currently, Unit 1 effluent pathway is routed to Units 2 or 3. 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 29, 1983, and April 1, 1984, respectively. The twin units are owned by Southern California (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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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

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

These are acronyms used throughout the Annual Radioactive Effluent Release Report.

AL	Applicable Limit
ALARA	As Low As Reasonably Achievable
AR	Action Request
ARERR	Annual Radioactive Effluent Release Report
Ci	Curies
CR	Condition Report
DAS	Data Acquisition System
DEC	Decommissioning
ECL	Effluent Concentration Limit
GI-LLI	Gastrointestinal Tract-Lower Large Intestine
GPI	Groundwater Protection Initiative
ISFSI	Independent Spent Fuel Storage Installation
LLD	Lower Limit of Detection
m ³	Meter cubed
MPC	Maximum Permissible Concentrations
mRAD	One thousandth Radiation Absorbed Dose
mREM	One thousandth of a Roentgen Equivalent Man
N/A	Not Applicable
GW-NIA	North Industrial Area formally know as Unit 1
NN	Nuclear Notification used in site's corrective action program
ODCM	Offsite Dose Calculation Manual
PCS	Plant Computer System
TLD	Thermoluminescent Dosimeter
uCi/sec	Micro Curies per second
X/Q	Chi over q
SYF	South Yard Facility

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

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 for continuous mode of release. 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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

**TABLE 1A
GASEOUS EFFLUENTS SUMMATION OF ALL RELEASES**

	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation gases						
1. Total release	Ci	< LLD	< LLD	< LLD	< LLD	3.00E+01
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A	
3. Percent of applicable limit	% MPC	N/A	N/A	N/A	N/A	
4. Percent Effluent Concentration Limit	% ECL	N/A	N/A	N/A	N/A	
B. Iodines						
1. Total I-131	Ci	< LLD	< LLD	< LLD	< LLD	1.90E+01
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A	
3. Percent of applicable limit	% MPC	N/A	N/A	N/A	N/A	
4. Percent Effluent Concentration Limit	% ECL	N/A	N/A	N/A	N/A	
C. Particulates						
1. Particulates with half-lives >8 days	Ci	3.73E-06	< LLD	< LLD	< LLD	1.60E+01
2. Average release rate for period	μCi/sec	4.80E-07	N/A	N/A	N/A	
3. Percent of applicable limit	% MPC	4.60E-07	N/A	N/A	N/A	
4. Percent Effluent Concentration Limit	% ECL	1.15E-06	N/A	N/A	N/A	
5. Gross alpha activity	Ci	< LLD	< LLD	< LLD	< LLD	5.00E+01
D. Tritium						
1. Total release	Ci	3.77E+00	1.85E+00	3.86E-01	1.37E+00	2.50E+01
2. Average release rate for period	μCi/sec	4.85E-01	2.35E-01	4.86E-02	1.72E-01	
3. Percent of applicable limit	% MPC	1.16E-03	5.65E-04	1.17E-04	4.14E-04	
4. Percent Effluent Concentration Limit	% ECL	2.33E-03	1.13E-03	2.33E-04	8.27E-04	

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TABLE 1C

**GASEOUS EFFLUENTS GROUND LEVEL RELEASES
BATCH MODE**

Batch gaseous releases were not performed at SONGS

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TABLE 1C (Continued)

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
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	3.73E-06	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	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
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.

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TABLE 1D

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD (μCi/cc)	Batch Mode LLD (μCi/cc)
1. Fission and activation gases		
krypton-85	2.20E-05	N/A
krypton-85m	5.50E-08	N/A
krypton-87	2.80E-07	N/A
krypton-88	2.00E-07	N/A
xenon-133	1.50E-07	N/A
xenon-133m	4.40E-07	N/A
xenon-135	5.70E-08	N/A
xenon-135m	2.10E-06	N/A
xenon-138	3.70E-06	N/A
2. Iodines		
iodine-131	2.40E-13	N/A
iodine-133	2.30E-12	N/A
iodine-135	1.60E-10	N/A
3. Particulates		
barium-140	5.00E-13	N/A
cerium-141	6.00E-14	N/A
cerium-144	2.40E-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	1.00E-12	N/A
manganese-54	1.30E-13	N/A
molybdenum-99	7.20E-14	N/A
strontium-89	1.00E-11	N/A
strontium-90	1.00E-11	N/A
zinc-65	3.40E-13	N/A
4. Tritium	N/A	N/A
5. Alpha	1.00E-11	N/A

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

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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	mrads	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Percent of Applicable Limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Beta Air Dose	mrads	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4. Percent Applicable Limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium, Iodine, Particulates (at the nearest receptor)					
1. Organ Dose	mrem	1.60E-04	7.57E-05	1.58E-05	4.35E-05
2. Percent of Applicable Limit	%	1.07E-03	5.04E-04	1.05E-04	2.90E-04

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

TABLE 1F

GASEOUS EFFLUENTS BATCH RELEASE SUMMARY

Batch gaseous releases were not performed at SONGS.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2A
LIQUID EFFLUENTS SUMMATION OF ALL RELEASES

		Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation products							
1.	Total release (not including tritium, gases, alpha)	Ci	<LLD	5.37E-04	3.87E-04	3.71E-05	1.90E+01
2.	Average diluted concentration during period	µCi/ml	N/A	6.78E-11	8.23E-11	5.00E-12	
3.	Percent of applicable limit	% MPC	N/A	3.47E-04	4.61E-04	2.50E-05	
4.	Percent Effluent Concentration Limit	% ECL	N/A	5.91E-03	8.07E-03	5.00E-04	
B. Tritium							
1.	Total release	Ci	<LLD	1.54E-01	1.68E-01	3.11E-04	1.90E+01
2.	Average diluted concentration during period	µCi/ml	N/A	1.94E-08	3.57E-08	4.19E-11	
3.	Percent of applicable limit	% MPC	N/A	6.47E-04	1.19E-03	1.40E-06	
4.	Percent Effluent Concentration Limit	% ECL	N/A	1.94E-03	3.57E-03	4.19E-06	
C. Dissolved and entrained gases							
1.	Total release	Ci	<LLD	<LLD	<LLD	<LLD	1.90E+01
2.	Average diluted concentration during period	µCi/ml	N/A	N/A	N/A	N/A	
3.	Percent of applicable limit	% MPC	N/A	N/A	N/A	N/A	
4.	Percent Effluent Concentration Limit	% ECL	N/A	N/A	N/A	N/A	
D. Gross alpha activity							
1.	Total release	Ci	<LLD	<LLD	<LLD	<LLD	5.00E+01
E.	Volume of waste released (batch & continuous, prior to dilution)	liters	4.57E+06	2.57E+06	2.17E+06	4.71E+06	5.00E+00
F.	Volume of dilution water used during period	liters	7.66E+09	7.93E+09	4.70E+09	7.42E+09	5.00E+00

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

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	4.06E-05	4.31E-05	<LLD
cesium-137	Ci	<LLD	3.87E-04	3.25E-04	3.71E-05
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	1.10E-04	1.89E-05	<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	5.38E-04	3.87E-04	3.71E-05
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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2B (Continued)

LIQUID EFFLUENTS BATCH MODE *

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

* No liquid batch releases were conducted in 2018.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2C

LIQUID EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD (μCi/cc)	Batch Mode * LLD (μCi/cc)
1. Fission and activation products		
barium-140	3.30E-07	N/A
cerium-141	4.80E-08	N/A
cerium-144	2.00E-07	N/A
cesium-134	8.60E-08	N/A
cesium-137	7.30E-08	N/A
chromium-51	3.70E-07	N/A
cobalt-58	7.80E-08	N/A
cobalt-60	1.10E-07	N/A
iodine-131	6.50E-08	N/A
iron-55	1.00E-06	N/A
iron-59	1.80E-07	N/A
lanthanum-140	6.40E-07	N/A
manganese-54	7.70E-08	N/A
molybdenum-99	6.30E-08	N/A
niobium-95	7.80E-08	N/A
strontium-89	5.00E-08	N/A
strontium-90	5.00E-08	N/A
technetium-99m	6.50E-08	N/A
zinc-65	2.00E-07	N/A
zirconium-95	1.30E-07	N/A
2. Dissolved and entrained gases		
xenon-133	2.50E-07	N/A
xenon-135	9.70E-08	N/A
3. Tritium	1.00E-05	N/A
4. Gross Alpha	1.00E-07	N/A

* No liquid batch releases were conducted in 2018.

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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	0.00E+00	1.10E-03	1.44E-03	1.37E-04
2.	Percent of Applicable Limit	%	0.00E+00	3.66E-02	4.79E-02	4.55E-03
B.						
1.	Limiting organ dose	mrem	0.00E+00	1.51E-03	2.09E-03	2.09E-04
2.	Limiting organ for period		N/A	LIVER	LIVER	LIVER
3.	Percent of Applicable Limit	%	0.00E+00	1.51E-02	2.09E-02	2.09E-03

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TABLE 2E

LIQUID EFFLUENTS BATCH RELEASE SUMMARY *

	12 month period
1. Number of batch releases:	N/A release
2. Total time period for batch releases:	N/A minutes
3. Maximum time period for a batch release:	N/A minutes
4. Average time period for a batch release:	N/A minutes
5. Minimum time period for a batch release:	N/A minutes
6. Average saltwater flow during batch releases:	N/A gpm

* No liquid batch releases were conducted in 2018.

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SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

SONGS Sample Garden Relocation

In 2015 the SONGS Garden was moved to a new location due to returning parts of the SONGS Mesa to the Department of the Navy. A new location on the Mesa was selected and an evaluation was performed to justify the move. This evaluation was completed in September 2015 and the ODCM was revised in November 2015 to identify the change. The 2016 and 2017 ARERRs section C.2 states that the SONGS indicator garden was relocated. This should have been reported in 2015 ARERR and not 2016 or 2017 ARERRs. (CR# SDS-000319)

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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 sludge, evaporator bottoms	m ³	N/A	N/A
	Ci	N/A	
b. Dry active waste (DAW), compactable and non-compactable	m ³	7.97E+02	30%
	Ci	1.23E+00	
c. Irradiated components	m ³	N/A	N/A
	Ci	N/A	
d. Other: Filters	m ³	1.17E+00	30%
	Ci	2.63E+01	

NOTE:

Shipments include: Dry Active Waste (DAW) and Filters.

N/A: No shipments containing these items made in 2018.

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

2a. Estimate of major nuclide composition (U2 and U3 Resin) There were no resin shipments in 2018		
2b. Estimate of major nuclide composition [U2 and 3 Dry Active Waste (DAW)]		
Tritium (H3)	%	7.41E-04
Carbon-14	%	1.60E+00
Iron-55	%	1.20E+01
Cobalt-60	%	8.48E+00
Nickel-63	%	6.13E+01
Strontium-90	%	2.11E-02
Technetium-99	%	1.85E-04
Iodine -129	%	2.40E-06
Cesium-137	%	1.57E+01
Plutonium-238	%	1.24E-02
Americium-241	%	1.62E-02
2c. Estimate of major nuclide composition (U2 and U3 Irradiated Components) There were no irradiated components shipments in 2018		
2d. Estimate of major nuclide composition (U2 and U3 Filters)		
Tritium (H3)	%	9.42E-03
Carbon-14	%	1.64E+00
Iron-55	%	4.84E+01
Cobalt-60	%	1.12E+01
Nickel-59	%	2.86E-01
Nickel-63	%	3.68E+01
Strontium-90	%	9.53E-03
Niobium-94	%	1.66E-02
Technetium-99	%	2.48E-03
Cesium-137	%	1.12E+00
Plutonium-238	%	4.43E-03
Plutonium-239	%	3.97E-03
Plutonium-241	%	1.49E-01
Americium-241	%	1.06E-02
Curium-242	%	1.35E-06
Curium-243	%	1.36E-02

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3. Solid Waste Disposition		
Number of Shipments	Mode of Transportation	Destination
1*	Type A Cask	Waste Control Specialist (WCS) Texas Disposal Site
33**	Tractor Trailer	EnergySolutions LLC, Clive Utah Disposal Site
1***	Tractor Trailer	EnergySolutions LLC, Clive Utah Disposal Site

Notes:

* One shipment was made in 2018 from EnergySolutions LLC Bear Creek Operations (BCO) to WCS Texas Disposal Site.

** Thirty-Three shipments were made in 2018 from San Onofre (SONGS SDS) to EnergySolutions Clive Utah Disposal Site.

*** One shipment was made in 2018 from EnergySolutions LLC Bear Creek Operations to EnergySolutions Clive Utah Disposal Site.

SONGS SDS maintains a contract with a vendor (BCO) that provides volume reduction services. Four Type A Cask Shipments were made from SONGS SDS to BCO for volume reduction of the wastes (filters/DAW). Upon completion of the volume reduction services, BCO made one shipment* to WCS for disposal. Additionally BCO made one shipment*** to Clive from a 2016 SONGS shipment that had been sent to BCO. SONGS' waste volume was comingled with other generator's waste in these two BCO disposal shipments.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	No shipments were made in 2018	N/A

C. DEWATERING

Number of Containers	Solidification Agent
None	N/A

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

- 1) Changes made to the Process Control Program: There were no changes made to the Process Control Program in 2018.
- 2) References:
 - a. Procedure SO123-VII-20, Radiation Protection Program
 - b. Procedure SDS-WM1-PCD-0018, Radwaste Process Control Program
 - c. Procedure SDS-CH2-PCD-1005, Annual Radioactive Effluent Release Report
 - d. Regulatory Guide 1.21, Rev. 1-June 1974

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SAN ONOFRE NUCLEAR GENERATING STATION

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 (%MPC) =
$$\frac{(\text{Rel Rate}) (X/Q) (100)}{\text{MPC}_{\text{eff}} * (1\text{E}+6)}$$

where: Rel Rate = total microcuries 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.
 $1\text{E}+6$ = conversion from m^3 to cc

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

where: F_i = fractional concentration of the i^{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
 MPC_i = Maximum Permissible Concentration (MPC) of the i^{th} radionuclide from 10 CFR 20 (20.1-20.602), Appendix B, Table II, Column 1.

- % Applicable Limit (% ECL) =
$$\frac{(\text{Rel Rate}) (X/Q) (100)}{\text{ECL}_{\text{eff}} * (1\text{E}+6)}$$

where: Rel Rate = total microcuries 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.
 $1\text{E}+6$ = conversion from m^3 to cc

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

where: F_i = fractional concentration of the i^{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
 ECL_i = Effluent Concentration Limit (ECL) of the i^{th} radionuclide from 10 CFR 20 (20.1001-20.2402), Appendix B, Table 2, Column 1.

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

where: Dil Conc = total microcuries 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, $\mu\text{Ci/ml}$.

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

where: F_i = fractional concentration of the i^{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

MPC_i = Maximum Permissible Concentration (MPC) of the i^{th} radionuclide from 10 CFR 20 (20.1-20.602), Appendix B, Table II, Column 2.

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

where: Dil Conc = total microcuries 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, $\mu\text{Ci/ml}$.

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

where: F_i = fractional concentration of the i^{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

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

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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 unit) to areas at and beyond the site boundary shall be limited to the following values:
 - 1. During any calendar quarter: ≤ 5 mrad for gamma radiation and
 ≤ 10 mrad for beta radiation.
 - 2. During any calendar year: ≤ 10 mrad for gamma radiation and
 ≤ 20 mrad for beta radiation.
- C. The dose to a Member of the Public from iodines, tritium, and radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from SONGS (per unit) to areas at and beyond the site boundary shall be limited to the following values:
 - 1. During any calendar quarter: ≤ 7.5 mrem to any organ.
 - 2. During any calendar year: ≤ 15 mrem to any organ.

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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 $2.00\text{E-}04 \mu\text{Ci/ml}$.
- B. Table 2D lists the doses due to liquid releases. The dose commitment to a Member of the Public from radioactive materials in liquid effluents released from SONGS (per unit) to unrestricted areas shall be limited to the following values:
1. During any calendar quarter:
 $\leq 1.5 \text{ mrem to the total body and}$
 $\leq 5 \text{ mrem to any organ.}$
 2. During any calendar year:
 $\leq 3 \text{ mrem to the total body and}$
 $\leq 10 \text{ mrem to any organ.}$

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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:

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

where: σ_i = Error associated with each component.

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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

Each portion of each category is footnoted to briefly describe each maximum individual dose presented.

The doses for each category are derived as follows:

- A. Categories 1 and 2 are calculated using the ODCM methodology. In addition, this data is presented in Table 2D.
- B. Categories 3, 4, and 5 are calculated utilizing RETDAS, Regulatory Guide 1.109 methodology, and concurrent meteorology. However, Table 1E of (Gaseous Effluents, Section B) lists data similar to categories 3, 4, and 5 using methods described in the ODCM and the historical meteorology (X/Q).
- C. Category 6 presents direct dose data measured by TLD dosimeters.

For individuals who may, at times, be within the Site boundary, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the Site boundary¹. For members of the public who traverse the Site boundary (e.g., via highway I-5), the residency time is considered negligible and hence the dose is "0."

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

¹ ODCM Figures 1-2 and 2-2

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TABLE 1

SOURCE	Dose * (millirems)				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS	1)	2)	3)	4)	5)
Whole Body	0.00E+00	1.10E-03	1.44E-03	1.37E-04	2.67E-03
Organ	6)	7)	8)	9)	10)
	0.00E+00	1.51E-03	2.09E-03	2.09E-04	3.81E-03
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	1.51E-03	8.20E-04	1.59E-04	3.41E-04	2.83E-03
NOBLE GASES **	16)	17)	18)	19)	20)
Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	21)	22)	23)	24)	25)
	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
DIRECT RADIATION	26)	27)	28)	29)	30)
	8.18E-02	9.13E-02	2.92E-02	6.17E-02	2.64E-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. No liquid radioactive effluent releases occurred during this quarter.
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. No liquid radioactive effluent releases occurred during this quarter.
7. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
8. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.

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9. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
10. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
11. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI 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 Liver, Thyroid, Kidney, Lung, and 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 Liver, Thyroid, Kidney, Lung, and 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 Liver, Thyroid, Kidney, Lung, and 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 Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
16. No noble gas radioactive effluent releases occurred during this quarter.
17. No noble gas radioactive effluent releases occurred during this quarter.
18. No noble gas radioactive effluent releases occurred during this quarter.
19. No noble gas radioactive effluent releases occurred during this quarter.
20. No noble gas radioactive effluent releases occurred during this year.
21. No noble gas radioactive effluent releases occurred during this quarter.
22. No noble gas radioactive effluent releases occurred during this quarter.
23. No noble gas radioactive effluent releases occurred during this quarter.
24. No noble gas radioactive effluent releases occurred during this quarter.
25. No noble gas radioactive effluent releases occurred during this year.
26. 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.
27. 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.
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.

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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.

NOTES:

- 1) TLD #15, located at the southeast boundary of the San Onofre site was removed from its location in May 2018 to prevent damage due to construction activities. The TLD was shipped for analysis and was replaced in July concurrent with the quarterly TLD changeout. (CR SDS-000225)
- 2) TLD 22, (former USCG Station San Mateo) was removed from its station by an unknown external action sometime during the 2nd Q 2018. (CR SDS-000225)
- 3) On 7/18/18 the Unit 2 Containment Escape Hatch Air Sampler was discovered not running. The duration is estimated to be approximately 10 minutes. Air flow at the time was verified to be into containment due to the personnel hatch being open and the Radwaste Building Ventilation Unit in service. Therefore there was no unmonitored release. (CR SDS-000267)
- 4) North end of radwaste rollup door was found off it's track from 4 feet off the floor to about 6 feet off the floor. Air flow was found to be into radwaste and monitored via the Plant Vent Stack. Therefore there was no unmonitored release. (AR 0318 – 12649)

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TABLE 2

SOURCE	Percent Applicable Limit				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	0.00E+00	3.66E-02	4.79E-02	4.55E-03	4.45E-02
Organ	0.00E+00	1.51E-02	2.09E-02	2.09E-03	1.90E-02
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	1.01E-02	5.46E-03	1.06E-03	2.27E-03	1.89E-02
NOBLE GASES					
Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

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SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

In accordance with Permanently Defueled Technical Specification 5.5.2.1, two revisions to the SONGS Offsite Dose Calculation Manual were prepared and approved.

ODCM effluent screens were performed for each revision to ensure the site's regulatory requirements of the Defueled Technical Specifications and license basis were not challenged. These changes to the ODCM and Appendices have been documented in the SDS Electronic Documentation Management System.

Revision 12

This revision incorporates the following:

1. The saltwater dilution pumps are unable to achieve the 28,000 gpm for radwaste releases. ODCM screen was performed under AR# 0416-89584.
2. Editorial comment states that the Primary Makeup Storage Tanks are also referred to as Spent Fuel Pool Makeup Water Tanks.
3. Environment Section 5.0, Figures 5-1 through 5-3 were changed to reflect the location change of SONGS REMP garden. The ODCM screen was performed under NN#203063159-084.
4. Appendix A Sandra Sewell to Brian Metz Memorandum for file, 2016 Dose Parameters for San Onofre Units 2 and 3, dated November 30, 2016. This change was performed under NN#203379028.

None of the changes in these revisions will adversely affect the accuracy or reliability of effluent dose calculations or set point determinations. Your approval for these revisions is requested.

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

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

PAGE	DESCRIPTION OF CHANGE	REASON
Cover	Updated revision number and effective date.	F
1-2	Table 1-1 NOTE: Primary Plant Makeup Storage tanks are also known as Spent Fuel Pool Makeup Water Tanks.	F
1-9	Remove wording "and/or 14,000 gpm per saltwater cooling pumps". Saltwater Cooling pumps are no longer in service.	D
1-9	Change wording "For radwaste discharges, the dilution water flow of 14,000 gpm shall be used and aligned to the same outfall.	R
1-13	Remove wording "and/or 14,000 gpm per saltwater cooling pumps". Saltwater Cooling pumps are no longer in service.	D
1-13	Change wording "For radwaste discharges, the dilution water flow of 14,000 gpm shall be used and aligned to the same outfall.	R
1-16	Remove wording "and/or 14,000 gpm per saltwater cooling pumps". Saltwater Cooling pumps are no longer in service.	D
1-17	Remove wording "and/or 14,000 gpm per saltwater cooling pumps". Saltwater Cooling pumps are no longer in service.	D
4-19	Primary Plant Makeup Storage tanks are also known as Spent Fuel Pool Makeup Water Tanks.	F
5-22	Update Figure 5-1 due to location change for SONGS garden.	R
5-23	Update Figure 5-2 due to location change for SONGS garden.	R
5-24	Update Figure 5-3 due to location change for SONGS garden.	R
Appendix A	Updated reference for 2016 Dose Parameters for San Onofre Units 2 and 3, dated November 30, 2016.	R

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Revision 13

This revision incorporates the following:

1. Clarification of Turbine Plant Sump Compositor Channel Check requirement when the Turbine Plant Sump is secured (Table 4-2, Note 5). SDS-CH2-EVA-0006.
2. Modification to South Yard Facility process flow channel calibration. SDS-CH2-EVA-0007.
3. Modification to South Yard Facility sample flow channel functional test requirements. SDS-CH2-EVA-0007.
4. Removal of daily Containment Tritium Analysis Requirement with Refueling Canal Flooded. SDS-CH2-EVA-0009.
5. Update to Controlling Location Factors (Table 2-6) based on 2018 Land Use Census data.
6. Update to R_i Tables in Appendix A based on 2018 Land Use Census data.

None of the changes in these revisions will adversely affect the accuracy or reliability of effluent dose calculations or set point determinations.

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

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

PAGE	DESCRIPTION OF CHANGE	REASON
Cover	Updated revision number and effective date.	F
2-2	Table 2-1 NOTE: Removed reference to note c for Containment Main Purge – 42" Weekly Grab.	D
2-4	Deleted note c, removing requirement for daily containment tritium analysis with refueling canal flooded.	D
2-22	Updated Controlling Location Factors based on 2018 Land Use Census data.	R
4-8	Added clarification to note 5 for Turbine Plant Sump compositor channel checks with the Turbine Plant Sump out of service.	R
4-16	Deleted channel calibration requirement for South Yard Facility Work Area Process Flow Rate Monitoring Device.	D
4-16	Deleted channel functional test requirement for South Yard Facility Work Area Sample Flow Rate Monitoring Device.	D
4-16	Deleted channel functional test requirement for South Yard Facility Work Area Process Flow Rate Monitoring Device.	D
4-19	Added box to show Portable Radwaste Treatment System to Figure 4-5.	A
4-20	Replaced note concerning 7865 monitoring for containment with note describing sources of air collected by the Plant Vent Stack.	R
App. A	Updated R _i Tables based on 2018 Land Use Census data.	R

The Land Use Census (LUC) for 2018 did not identify a new location with a higher calculated or committed dose than those calculated for the locations evaluated in the previous revision to the ODCM. Therefore, no new location is reported per ODCM 5.2.1.

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SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

Changes to the Liquid Radioactive Waste Treatment System

The original San Onofre Nuclear Generating Station (SONGS) Liquid Radwaste Processing System has been retired from service. A stand-alone liquid radwaste processing (LRWP) skid system has been installed to process liquids currently stored onsite and liquids generated throughout Decommissioning and Dismantlement (D&D) activities at SONGS. The LRWP skid is a single pass, non-slucible design using disposable canisters. The skid is expected to be placed in service in the Spring of 2019.

A Processing Skid had been included under the scope of Cold and Dark NECP 801249768; however, it was included in the DSAR Chapter 11 as a 'Future' installation. Design Plan SDS-EN1-EDP-0005 later installed the LRWP and modified the system design as described in Cold & Dark NECP 801249768 to employ existing storage tanks and provide additional conservative safety features associated with the already analyzed process for discharge of radioactive effluent.

Liquid radwaste will be pumped from Tank T-064 to the vendor supplied liquid radwaste skid using pump P-180. The processed water from the LRWP skid will be pumped into tanks T-075 or T-076. These tanks currently serve as batch release tanks and will continue to do so. Once approved for release, P-188 will pump the processed water through the Radwaste Discharge Line to the Unit 2 Outfall. The release will be monitored by radiation monitor 2/3RE7813.

The location for the LRWP skid is partially in room 335B, and partially in the adjacent room 335A, located in the Radiation Storage Area south and approximately 100 feet away from the Truck Bay in the Unit 2/3 Auxiliary Building Radwaste Area at the 37 foot elevation. This area is relatively close to the two connection points installed under the Cold and Dark Engineering Change Package NECP 801249768. Flexible hose will be used to provide input to and output from the LRWP. The hose is rated for the same temperature and pressure as the system design piping. Use of flexible hose is consistent with Reg. Guide 1.143, Table 1.

To address ALARA concerns, SDS Work Control may install shielding around the LRWP skid, using SDS Radiation Protection (RP) group guidance, to minimize exposure to personnel. Additional shielding will be added in the future based on operational experience.

The installation and operation of the LRWP skid using portions of the MLWS is consistent with DSAR Chapter 11, subsection 11.1.1.1, parts A and B, which describes collection and processing liquid radwaste and discharging to the environment while remaining consistent with ALARA principles (DSAR CH 12). The installation and operation of the LRWP skid also does not impact DSAR Chapter 15 Accident Analysis, subsection 15.1.1.2.1 which identifies a secondary tank rupture as a limiting fault. In addition, none of the repurposed equipment will be used in a manner different from their current design basis. This includes pumps P-180 and P-188, and Tanks T-064, T-075 and T-076.

A 10 CFR50.59 screen (SDS-50.59-2018-0001) addressed the aspects of implementing the additional modifications performed under Design Plan SDS-EN1-EDP-0005 which includes the following:

- Installation of the LRWP skid and modifications to areas where the LRWP skid will be installed,
- Providing piping modifications to stainless steel piping at two locations in order to provide a once-through system alignment rather than batch-cycling, (this improves process throughput efficiency)
- Re-establishing an air-operated valve to automatically isolate discharge flow upon the receipt of high radiation levels from the liquid effluent discharge rad monitor, (this provides a more positive isolation over the current approved design which only de-energizes pump P-188)
- Re-establishing a second air-operated valve which has been modified to automatically isolate discharge flow upon the unexpected loss of power to the Saltwater Dilution Pumps

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- Updating applicable operating procedures and DSAR sections applicable to the LRWP skid and effluent discharge piping

Technical Evaluation SDS-EN1-EVA-0021 evaluated the risks associated with the SWD system for releasing processed liquid radwaste. To reduce risk, Design Plan SDS-EN1-EDP-0029 will replace the SWD pressure transmitters [early 2019] to provide a more reliable low flow alarm. Procedurally, the instrumentation will be calibrated and/or checked on a prescribed frequency [depending on the transmitter type] to verify that the instruments are within specification.

An Effluent/ODCM Evaluation addressed impacts to the Radiological Effluent Control Program (RECP) and ODCM. The evaluation determined the following:

- Dose and curie calculations are based on the concentration of isotopes to be released. The tanks are isolated, recirculated without further treatment and sampled prior to release. Therefore, there is no change in methodology used to calculate dose or curies.
- Radiation monitor 2/3RE-7813 will continue to be used to monitor releases per the ODCM. The method for deriving routine setpoints is unchanged. A non-release setpoint will be maintained based on being slightly above background but less than the typical concentration contained in a release to ensure no unexpected release occurs. Release setpoints will be based on the measured concentration of the tank to be released. The methodology used to calculate ODCM maximum setpoints for a radiation monitor is unchanged. The method for generating release permits remains unchanged. Procedural controls require two SWD pumps for releases. Release permits and corresponding setpoints will be based on one pump to ensure dose and curie limits are not impacted by loss of a pump during releases. In the case where a pump is lost during a release, the release is secured to minimize dose impact.
- Sample requirements remain unchanged. A tank is isolated, recirculated without further treatment and sampled prior to release. Compensatory sampling requirements continue to include two independent samples and an independent valve line-up prior to release.
- Instrumentation requirements, including scheduled maintenance, actions for inoperability, requirements remain unchanged in the ODCM and related procedures
- Reporting frequencies and content remain unchanged.
- The Miscellaneous Waste Evaporator Condensate Monitor Tanks (MWECD) T075/076 already exist in the ODCM as credited release points. These tanks will be the release origin for radioactive liquid radwaste.
- This change does not conflict with or adversely affect any regulatory direction or guidance in the ODCM. The ODCM remains unchanged. Existing requirements will remain in place with no additions or deletions.

Although the change is primarily related to the actual processing of radioactive liquid waste using a new skid with no changes to ODCM or RECP requirements, an additional evaluation (SDS-CH2-EVA-0004) was performed to demonstrate the expected curies released and the expected exposure to individuals in the unrestricted area. The criteria used to determine whether further processing is required are contained in SDS-CH2-PCD-1004, Generating Effluent Release Permits Using the Release Permit Computer. The Release Permit Computer flags any particulate and iodine concentration greater than $2\text{E-}5 \mu\text{Ci/ml}$ and requires specific approval prior to releasing liquids with a particulate and iodine concentration above that level. This ensures that curies released remain ALARA.

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SDS-CH2-EVA-0004 requires:

- Dilution flow to be maintained greater than or equal to 14000 gpm. However, permits will be generated using 7000 gpm to ensure ODCM requirements are not violated upon loss of a dilution pump or low flow.
- A liquid radioactive waste release will be secured upon loss of any dilution pump.
- Release flow is expected to be maintained between 75 - 80 gpm. However, permits will be generated using 120 gpm to ensure ODCM requirements are not violated.

These administrative requirements were applied to the dose calculations used to generate the information below.

- SDS-CH2-PCD-1006 provides instruction for Dose Determination and 31-Day Dose Calculations that ensure radioactive liquids are processed prior to release to maintain exposure to individuals in the unrestricted area as low as reasonably achievable (ALARA). For the purposes of evaluating quarterly and annual dose impact, SDS-CH2-EVA-0004 assumes that the entire volume of radioactive liquids currently in the LRW tanks will be released in the same quarter. The expected dose results from these releases should be below two percent of the quarterly limit and below one percent of the annual limit as shown below:

Annual Dose Summary - Liquid

Month	Dose	Month Dose Limit	% Month Limit
Whole Body, mrem	4.67E-02	1	4.67E+00
Organ, mrem	1.33E-01	3.3	4.04E+00
Quarter	Dose	Quarter Dose Limit	% Quarter Limit
Whole Body, mrem	4.67E-02	3	1.56E+00
Organ, mrem	1.33E-01	10	1.33E+00
Year	Dose	Year Dose Limit	% Year Limit
Whole Body, mrem	4.67E-02	6	7.79E-01
Organ, mrem	1.33E-01	20	6.67E-01

- Further, it is expected that the liquids will be processed to significantly lower concentrations than those used for this evaluation, resulting in significantly lower dose projections.

For the purposes of the 31-day dose projection calculation, the total dose from all tanks combined is spread over three months in order to approximate expected dose for each month. An additional 31-day dose projection calculation was performed to demonstrate the effect of releasing Spent Fuel Pool water after all fuel has been removed. The Isotopic concentrations used are from the Unit 2 Spent Fuel Pool as its concentration is higher in all Isotopes. In both cases, the projected 31-day dose calculations indicate the ability to remain below the two percent threshold also provided in the ODCM (<0.06 mrem/qtr whole body and <0.2 mrem/qtr organ). Further, it is expected that the liquids will be processed to significantly lower concentrations than those used for this evaluation, resulting in significantly lower dose projections.

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31-day dose

Month	Whole Body	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
2	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
1	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
Total	3.89E-03	2.07E-03	4.21E-03	7.18E-04	1.71E-03	1.07E-03	1.11E-02
ODCM Limit	0.06	0.2	0.2	0.2	0.2	0.2	0.2
31-day	6%	1%	2%	0%	1%	1%	6%

31-day dose (Including SFP)

Month	Whole Body	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI
12	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
11	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
10	1.56E-02	8.27E-03	1.68E-02	2.87E-03	6.86E-03	4.28E-03	4.45E-02
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	4.12E-02	3.93E-02	5.93E-02	3.00E-03	2.19E-02	9.27E-03	1.10E-02
4	4.12E-02	3.93E-02	5.93E-02	3.00E-03	2.19E-02	9.27E-03	1.10E-02
3	4.12E-02	3.93E-02	5.93E-02	3.00E-03	2.19E-02	9.27E-03	1.10E-02
2	4.12E-02	3.93E-02	5.93E-02	3.00E-03	2.19E-02	9.27E-03	1.10E-02
1	4.12E-02	3.93E-02	5.93E-02	3.00E-03	2.19E-02	9.27E-03	1.10E-02
Total	2.11E-02	1.84E-02	2.89E-02	1.97E-03	1.08E-02	4.93E-03	1.57E-02
ODCM Limit	0.06	0.2	0.2	0.2	0.2	0.2	0.2
31-day	35%	9%	14%	1%	5%	2%	8%

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SECTION K. MISCELLANEOUS

ABNORMAL RELEASES

On 5/14/2018 the Unit 2 Turbine Plant Sump (TPS) pump was placed in automatic. As a result the pump started and ran for approximately 1 minute until it stopped on low sump level actuation. During this 1 minute of run time, the discharge line leaked approximately 2 gallons of water to the ground, near the Oil/Water Separator. Samples from the TPS did not indicate the presence of radioactive material and the volume of water leaked to the ground did not cause impact to the Groundwater Protection Program. (CR SDS-000231)

Radiation Monitor 2RE7821 (TPS Rad Monitor) was found isolated with the inlet valve S22419MU019 closed and the Flush connection isolation valve S22419MU186 closed. The monitor had been out of service for maintenance and had been returned to service on 6/21/18 at 1535. U2 East Turbine Plant Sump pump 2P048 was secured at 0742 on 6/22/18. During the time the Turbine Plant Sump pump was in automatic and 2902 gallons of water was discharged. Samples analyzed immediately before and after the release along with the weekly composite analysis indicate that the concentrations of gamma activity would not have caused a radiation monitor alarm or isolation trip signal. (CR SDS-000251)

During a facility walk-down, the South Yard Facility ventilation fans were found to be running as expected; however, the dampers were found closed, effectively isolating the ventilation system from the building. While the actual process flow rate could not be determined. There was indication that some flow was at a slightly negative pressure. Therefore, air samples collected from the ventilation system were assumed to be a valid measurement of any effluent release. Samples taken during this time did not indicate the release of any radioactive material. (CR SDS-000264)

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EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 2018 - December 31, 2018

Instrument	Inoperability Period	Inoperability Cause	Explanation
Meteorological Tower Temperature Probes	08/25/2018-11/15/2018	Delta-Delta Temperature intermittently >0.5 °C	Due to trouble shooting and parts lead time. (AR 0818-96600, 0818-49722, 0818-46424, 0918-36355, 0918-56917)
2/3RE-7813 Liquid Radwaste Radiation Monitor FE7643 Process Flow	6/20/2018 - Present	Implementing Engineering Design Plan	Due to modifications to the radwaste treatment system. Note that no radwaste releases were performed in this timeframe. (SDS-EN1-EDP-0005, AR 0618-76884)
2RE-7865 Plant Vent Stack Radiation Monitor	8/4/2018 – 9/6/2018	Heat Trace temperature cycling	Long term issue related to environmental conditions. (AR 0818-88274)

SYFRU-7904 South Yard Facility Work Area

Non-functional due to abandoned equipment from 2012 – 11/2018

This instrumentation was abandoned in approximately 2012 when all work with radioactive material ceased. Compensatory measures were put in place to continuously monitor the building since it still contained radioactive materials; however, there were no effluent releases. ODCM Specification 4.1.1, Action b requires that equipment non-functional for greater than 30 days be reported in the Annual Radioactive Effluent Release Report (ARERR). Since the instrumentation was not required due to the absence of effluent releases, the ODCM reporting requirement was not applied. When work with radioactive material had resumed at the SYF (6/25/2018), the instrumentation requirements became effective and the compensatory action was implemented. Since that instrumentation is no longer able to perform its required function and will not be maintained, the ODCM was revised to clarify current instrumentation requirements (11/8/2018) (CR SDS-000249)

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SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES

In 2007, the Nuclear Energy Institute (NEI) established a standard for monitoring and reporting radioactive isotopes in groundwater titled NEI Groundwater Protection Initiative, NEI 07-07. It has been established that there is no drinking water pathway for groundwater underneath SONGS. However, the site implemented the groundwater protection industry standard. 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 Groundwater Monitoring Wells that are in the Groundwater Protection Initiative are NIA-1, NIA-2, NIA-12, NIA-13, PA-1, PA-2, PA-3, PA-4, OCA-1, OCA-2, and OCA-3. These wells are sampled on a quarterly basis.

Groundwater sample data indicated the presence of low, but detectable levels of tritium in shallow ground water in the area formerly occupied by Unit 1 known as the North Industrial Area (NIA). The concentrations of tritium are well below regulatory limits.

Low tritium concentrations are present in the shallow ground water situated between the former Unit 1 Containment and Fuel Handling Building, and extend towards the seawall. Although these samples indicate the presence of tritium, the sample results were at concentrations below the Environmental Protection Agency drinking water limit of 20,000 pCi/l.

The site continues to sample and analyze the groundwater monitoring wells in accordance to the site's Groundwater Monitoring Program. In addition, the site samples, analyzes and documents other groundwater wells that are identified as investigatory wells. The groundwater investigatory wells analysis results are documented in this report. The groundwater investigatory wells are identified as NIA-3 through NIA-15.

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SECTION K. MISCELLANEOUS (Continued)ONSITE GROUND WATER SAMPLES

January 1, 2018 – December 31, 2018

Location	Sample Date	Tritium Activity pCi/L	Gamma Activity pCi/L	Gross Beta, pCi/L	Gross Alpha, pCi/L
GW-NIA-1	03/21/18	<MDC	<MDC	4.58E+00	<MDC
GW-NIA-1	06/20/18	<MDC	<MDC	6.94E+00	3.42E+00
GW-NIA-1	08/02/18	<MDC	<MDC	9.43E+00	<MDC
GW-NIA-1	10/18/18	<MDC	<MDC	9.29E+00	2.53E+00
GW-NIA-2	03/21/18	6.62E+02	<MDC	1.07E+01	3.55E+00
GW-NIA-2	06/20/18	7.74E+02	<MDC	1.06E+01	<MDC
GW-NIA-2	08/09/18	8.36E+02	<MDC	1.06E+01	<MDC
GW-NIA-2	10/18/18	1.05E+03	<MDC	5.19E+00	<MDC
GW-NIA-12	03/21/18	6.91E+02	<MDC	7.37E+00	4.01E+00
GW-NIA-12	06/18/18	3.18E+02	<MDC	8.44E+00	<MDC
GW-NIA-12	08/06/18	<MDC	<MDC	7.45E+00	8.29E+00
GW-NIA-12	10/22/18	<MDC	<MDC	4.31E+00	<MDC
GW-NIA-13	03/21/18	<MDC	<MDC	1.05E+01	4.19E+00
GW-NIA-13	06/19/18	6.75E+02	<MDC	9.29E+00	3.87E+00
GW-NIA-13	08/08/18	7.92E+02	<MDC	7.77E+00	5.09E+00
GW-NIA-13	10/22/18	<MDC	<MDC	5.56E+00	<MDC
GW-OCA-1	03/05/18	<MDC	<MDC	<MDC	<MDC
GW-OCA-1	06/11/18	<MDC	<MDC	5.36E+00	5.18E+00
GW-OCA-1	08/23/18	<MDC	<MDC	3.95E+00	6.38E+00
GW-OCA-1	10/17/18	<MDC	<MDC	<MDC	7.02E+00
GW-OCA-2	03/01/18	<MDC	<MDC	<MDC	6.65E+00
GW-OCA-2	06/13/18	<MDC	<MDC	2.05E+00	5.60E+00
GW-OCA-2	08/20/18	<MDC	<MDC	2.95E+00	8.69E+00
GW-OCA-2	10/11/18	<MDC	<MDC	3.55E+00	6.71E+00
GW-OCA-3	03/05/18	<MDC	<MDC	3.21E+00	4.60E+00
GW-OCA-3	06/14/18	<MDC	<MDC	2.66E+00	<MDC
GW-OCA-3	08/22/18	<MDC	<MDC	<MDC	<MDC
GW-OCA-3	10/15/18	<MDC	<MDC	4.31E+00	3.94E+00
GW-PA-1	03/15/18	<MDC	<MDC	5.89E+00	1.15E+01
GW-PA-1	06/25/18	<MDC	<MDC	8.12E+00	1.04E+01
GW-PA-1	09/06/18	<MDC	<MDC	8.42E+00	1.15E+01
GW-PA-1	10/24/18	<MDC	<MDC	8.95E+00	1.33E+01
GW-PA-2	03/15/18	<MDC	<MDC	2.88E+01	4.79E+01

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Location	Sample Date	Tritium Activity pCi/L	Gamma Activity pCi/L	Gross Beta, pCi/L	Gross Alpha, pCi/L
GW-PA-2	06/25/18	<MDC	<MDC	2.39E+01	3.06E+01
GW-PA-2	09/06/18	<MDC	<MDC	2.43E+01	3.61E+01
GW-PA-2	10/29/18	<MDC	<MDC	2.40E+01	5.26E+01
GW-PA-3	03/14/18	<MDC	<MDC	1.48E+01	7.36E+00
GW-PA-3	06/27/18	<MDC	<MDC	2.46E+01	1.02E+01
GW-PA-3	09/06/18	<MDC	<MDC	2.03E+01	1.09E+01
GW-PA-3	10/31/18	<MDC	<MDC	1.58E+01	9.57E+00
GW-PA-4	03/14/18	<MDC	<MDC	8.41E+00	4.90E+00
GW-PA-4	06/27/18	<MDC	<MDC	1.40E+01	5.38E+00
GW-PA-4	07/26/18	<MDC	<MDC	8.89E+00	2.55E+00
GW-PA-4	10/24/18	<MDC	<MDC	6.48E+00	<MDC
NIA-3	08/09/18	<MDC	N/A	N/A	N/A
NIA-4	08/13/18	<MDC	N/A	N/A	N/A
NIA-5	08/15/18	<MDC	N/A	N/A	N/A
NIA-6	08/13/18	<MDC	N/A	N/A	N/A
NIA-7	09/19/18	<MDC	N/A	N/A	N/A
NIA-10	08/15/18	<MDC	N/A	N/A	N/A
NIA-11	08/15/18	<MDC	N/A	N/A	N/A
NIA-14	9/19/18	<MDC	N/A	N/A	N/A
NIA-15	9/19/18	<MDC	N/A	N/A	N/A

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 = Temporary investigation wells installed in the North Industrial Area.

a priori LLD = H-3: 3000 pCi/l
= Gross Beta: 4.0 pCi/l
= Gross Alpha: 3.0 pCi/l

Values above MDC are reported as calculated

The Beta and Alpha reported are of natural origin and not from plant operation based on the laboratory analyses.

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ONSITE GROUND WATER SAMPLES (Continued)

Location	Sample Date	Hard to detect, pCi/L (Ni-63, Fe-55, Sr-89 and or Sr-90)
GW-NIA-1	03/21/18	<MDC
GW-NIA-1	08/02/18	<MDC
GW-NIA-2	03/21/18	<MDC
GW-NIA-2	08/09/18	<MDC
GW-NIA-12	03/21/18	<MDC
GW-NIA-12	08/06/18	<MDC
GW-NIA-13	03/21/18	<MDC
GW-NIA-13	08/08/18	<MDC
GW-OCA-1	08/23/18	<MDC
GW-OCA-2	08/20/18	<MDC
GW-OCA-3	08/22/18	<MDC
GW-PA-1	03/15/18	<MDC
GW-PA-1	06/25/18	<MDC
GW-PA-2	09/06/18	<MDC
GW-PA-3	03/14/18	<MDC
GW-PA-3	06/27/18	<MDC
GW-PA-4	03/14/18	<MDC
GW-PA-4	06/27/18	<MDC

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.

a priori LLD = Ni-63: 50 pCi/L
= Fe-55: 200 pCi/L
= SR-89/SR-90: 2 pCi/L

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SAN ONOFRE NUCLEAR GENERATING STATION

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	7.61E-01
b. Percent ODCM Specification Limit	%	3.04E+00
2. Limiting Organ		
a. Organ Dose (All except thyroid) (Liver)	mrem	4.11E-03
b. Percent ODCM Specification Limit	%	1.64E-02
3. Thyroid		
a. Thyroid Dose	mrem	3.21E-04
b. Percent ODCM Specification Limit	%	4.28E-04

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SAN ONOFRE NUCLEAR GENERATING STATION

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 40 CFR 190 Table 1.

Calculated C-14 production , Ci/EFPY ⁽¹⁾	U2 = 0 U3 = 0
2018 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 ⁽²⁾ [Child (bone)], mrem	0

(1) Effective Full Power Year

NOTE: Units have been shutdown since January 9, 2012 for Unit 2 and January 31, 2012 for Unit 3.

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SAN ONOFRE NUCLEAR GENERATING STATION

SECTION L. SONGS CONCLUSIONS

- 1) Gaseous releases (excluding carbon-14) totaled 7.38E+00 curies of which noble gases were 0.00E+00 curies, particulates were 3.73E-06 curies, iodines were 0.00E+00 curies, and tritium was 7.38E+00 curies.
- 2) The radiation doses from gaseous releases were: (a) gamma air dose: 0.00E+00 mrad at the site boundary, (b) beta air dose: 0.00E+00 mrad at the site boundary, (c) organ dose (Child - Liver, Thyroid, Kidney, Lung, and GI-LLI): 2.95E-04 mrem at the highest receptor.
- 3) Airborne carbon-14 release was projected at 0.00E+00 curies due to the fact that both units have been permanently shut down since January 2012.
- 4) Liquid releases totaled 3.24E-01 curies of which particulates were 9.62E-04 curies, iodines were 0.00E+00 curies, tritium was 3.23E-01 curies, and noble gases were 0.00E+00 curies.
- 5) The radiation doses from liquid releases were: (a) total body: 2.67E-03 mrem, (b) limiting organ (LIVER): 3.81E-03 mrem.
- 6) The radioactive releases and resulting doses generated from Units 2 and 3 were below the Applicable Limits for both gaseous and liquid effluents.
- 7) One shipment was made from EnergySolutions LLC Bear Creek Operations (BCO) to WCS Texas Disposal Site. Thirty-Three shipments were made from San Onofre (SONGS SDS) to EnergySolutions Clive Utah Disposal Site. One shipment was made from EnergySolutions LLC Bear Creek Operations to EnergySolutions Clive Utah Disposal Site. These shipments included 797 cubic meters of Dry Active Waste containing 1.23 curies of radioactivity and 1.17 cubic meters of Filters containing 26.3 curies of radioactivity.
- 8) Meteorological conditions during the year were typical for SONGS. Meteorological dispersion was good 36% of the time, fair 38% of the time and poor 26% of the time.
- 9) 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. There are low but detectable concentrations of tritium identified in the shallow ground water area formerly occupied by Unit 1 that is currently identified as the North Industrial Area. The ground water beneath SONGS is not a source of drinking water. On April 28, 2015, the extraction pumps were secured to evaluate the impact of groundwater extraction. There was no groundwater or dewatering well effluent discharges from the site during 2018. The site continues to sample, analyze and document the results of the groundwater monitoring wells in accordance to the site's Groundwater Monitoring Program.
- 10) 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.

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SAN ONOFRE NUCLEAR GENERATING STATION

METEOROLOGY

The meteorology of the San Onofre Nuclear Generating Station for each of the four quarters, 2018 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.

The hourly data for the Annual Report is available, 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, 2018. 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 shows 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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

January - March Table 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18010100-18033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
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	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	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	0	1	2	0	0	0	0	0	3
SSE	0	0	0	0	1	1	13	3	0	0	0	0	18
S	0	0	0	1	3	12	26	2	0	0	0	0	44
SSW	0	0	0	2	9	13	15	0	0	0	0	0	39
SW	0	0	0	2	11	22	10	4	0	0	0	0	49
WSW	0	0	0	4	18	17	19	5	0	0	0	0	63
W	0	0	0	1	9	64	50	1	4	0	0	0	129
WNW	0	0	0	0	3	32	58	12	8	0	0	0	113
NW	0	0	0	0	0	3	6	0	1	0	0	0	10
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	12	54	165	200	27	13	0	0	0	471

NUMBER OF VALID HOURS	472	NUMBER OF CALMS	1
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	472

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0	1	0	0	0	0	1
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	0	0	0	0	0	0
SSE	0	0	0	0	0	1	4	1	0	0	0	0	6
S	0	0	0	0	0	1	4	1	0	0	0	0	6
SSW	0	0	0	0	0	1	2	2	0	0	0	0	5
SW	0	0	0	0	0	1	1	0	0	0	0	0	2
WSW	0	0	0	0	0	0	2	1	0	0	0	0	3
W	0	0	0	0	0	2	1	0	0	0	0	0	3
WNW	0	0	0	0	0	5	0	0	0	0	0	0	5
NW	0	0	0	0	0	1	0	2	1	0	0	0	4
NNW	0	0	0	0	0	0	2	0	0	0	0	0	2
TOTALS	0	0	0	0	0	12	17	9	1	0	0	0	39

NUMBER OF VALID HOURS	40	NUMBER OF CALMS	1
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	40

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

January - March Table 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18010100-18033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	1	0	1	1	0	0	0	0	0	0	3
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
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	1	2	2	0	0	0	0	5
SSE	0	0	0	0	1	0	3	3	0	0	0	0	7
S	0	0	0	0	0	1	1	2	0	0	0	0	4
SSW	0	0	0	0	1	2	0	0	0	1	0	0	4
SW	0	0	0	2	0	1	2	0	0	0	0	0	5
WSW	0	1	0	0	1	1	10	3	1	0	0	0	17
W	0	0	0	2	2	0	4	2	0	0	0	0	10
WNW	0	0	0	0	0	4	3	0	0	0	0	0	7
NW	0	0	0	0	1	3	3	0	0	0	0	0	7
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	1	1	4	7	14	29	12	1	1	0	0	70

NUMBER OF VALID HOURS	71	NUMBER OF CALMS	1
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	71

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	2	0	2	3	4	5	1	0	0	0	0	0	17
NNE	2	0	0	2	3	1	1	1	0	0	0	0	10
NE	0	0	0	4	1	3	1	1	0	0	0	0	10
ENE	2	0	0	1	1	1	0	0	0	0	0	0	5
E	2	2	0	1	3	2	1	0	0	0	0	0	11
ESE	1	0	2	2	3	4	9	2	1	0	0	0	24
SE	0	0	2	3	1	12	20	1	0	0	0	0	39
SSE	0	0	1	2	4	13	14	3	0	0	0	0	37
S	0	0	0	5	5	4	6	3	0	0	0	0	23
SSW	0	0	1	1	4	5	8	0	1	2	1	0	23
SW	0	0	1	6	4	6	11	6	0	1	0	0	35
WSW	0	0	3	2	3	4	12	13	2	1	0	0	40
W	0	2	0	1	5	5	6	11	3	0	0	0	33
WNW	0	1	2	1	3	16	17	3	6	0	0	0	49
NW	0	0	1	3	1	18	12	4	2	0	0	0	41
NNW	0	1	1	2	3	7	2	1	0	0	0	0	17
TOTALS	9	6	16	39	48	106	121	49	15	4	1	0	414

NUMBER OF VALID HOURS	419	NUMBER OF CALMS	5
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	419

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METEOROLOGY

January - March
Table 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18010100-18033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	3	4	9	9	5	0	0	0	0	0	30
NNE	0	0	3	6	14	11	6	1	0	0	0	0	41
NE	0	3	2	4	7	1	3	0	0	0	0	0	20
ENE	0	0	5	10	4	5	0	0	0	0	0	0	24
E	1	0	3	13	6	6	1	0	1	0	0	0	31
ESE	0	0	0	6	7	4	3	3	0	0	0	0	23
SE	0	0	0	1	5	3	4	1	1	0	0	0	15
SSE	1	1	0	7	4	0	2	0	0	0	0	0	15
S	0	0	1	5	4	1	0	0	0	0	0	0	11
SSW	1	0	2	4	1	0	1	0	0	0	0	0	9
SW	0	0	3	1	3	1	1	0	0	0	0	0	9
WSW	0	0	1	0	3	1	0	0	0	0	0	0	5
W	0	1	0	5	6	0	0	0	0	0	0	0	12
WNW	1	0	1	4	4	9	4	0	0	0	0	0	23
NW	0	0	2	4	1	6	6	1	0	0	0	0	20
NNW	0	0	2	5	4	12	6	0	0	0	0	0	29
TOTALS	4	5	28	79	82	69	42	6	2	0	0	0	317

NUMBER OF VALID HOURS	317	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	317

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	5	2	9	3	0	0	0	0	0	19
NNE	0	0	1	13	27	63	18	1	0	0	0	0	123
NE	0	0	2	16	18	4	3	5	0	0	0	0	48
ENE	0	0	2	12	5	3	1	0	0	0	0	0	23
E	0	1	2	3	3	1	1	0	0	0	0	0	11
ESE	0	0	1	5	0	1	1	0	0	0	0	0	8
SE	0	0	0	2	0	4	0	0	0	0	0	0	6
SSE	0	1	2	0	1	1	1	1	0	0	0	0	7
S	0	0	0	3	0	0	0	0	0	0	0	0	3
SSW	1	0	0	4	1	0	0	0	0	0	0	0	6
SW	0	1	0	3	2	0	0	0	0	0	0	0	6
WSW	0	0	0	1	1	0	0	0	0	0	0	0	2
W	0	0	0	2	2	1	0	0	0	0	0	0	5
WNW	0	0	0	3	4	8	4	0	0	0	0	0	19
NW	0	0	1	2	5	0	1	1	0	0	0	0	10
NNW	0	0	1	3	3	3	0	0	0	0	0	0	10
TOTALS	1	3	12	77	74	98	33	8	0	0	0	0	306

NUMBER OF VALID HOURS	306	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	306

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METEOROLOGY

January - March
Table 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18010100-18033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	1	5	3	8	0	0	0	0	0	17
NNE	0	1	1	2	6	126	214	23	0	0	0	0	373
NE	0	0	0	2	7	26	17	3	0	0	0	0	55
ENE	0	0	0	4	5	7	1	0	0	0	0	0	17
E	0	0	0	0	3	2	1	0	0	0	0	0	6
ESE	0	1	0	1	3	1	2	0	0	0	0	0	8
SE	0	0	0	2	2	0	1	0	0	0	0	0	5
SSE	0	0	0	2	1	0	0	0	0	0	0	0	3
S	0	1	0	1	0	2	1	0	0	0	0	0	5
SSW	0	1	0	3	0	0	2	0	0	0	0	0	6
SW	0	1	0	0	0	3	0	0	0	0	0	0	4
WSW	0	0	0	1	1	2	0	0	0	0	0	0	4
W	0	0	0	0	1	0	5	0	0	0	0	0	6
WNW	0	0	0	0	2	9	1	0	0	0	0	0	12
NW	0	0	0	1	0	3	0	0	0	0	0	0	4
NNW	0	0	0	0	1	6	1	0	0	0	0	0	8
TOTALS	0	5	1	20	37	190	254	26	0	0	0	0	533

NUMBER OF VALID HOURS	535	NUMBER OF CALMS	2
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	535

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	2	0	5	13	20	26	17	0	0	0	0	0	83
NNE	2	1	6	23	51	202	240	27	0	0	0	0	552
NE	0	3	4	26	33	34	24	10	0	0	0	0	134
ENE	2	0	7	28	15	16	4	0	0	0	0	0	72
E	3	3	5	18	15	11	4	0	1	0	0	0	60
ESE	1	1	3	14	13	10	15	5	1	0	0	0	63
SE	0	0	2	8	8	21	29	4	1	0	0	0	73
SSE	1	2	3	11	12	16	37	11	0	0	0	0	93
S	0	1	1	15	12	21	38	8	0	0	0	0	96
SSW	2	1	3	14	16	21	28	2	1	3	1	0	92
SW	0	2	4	14	20	34	25	10	0	1	0	0	110
WSW	0	1	4	8	27	25	43	22	3	1	0	0	134
W	0	3	0	11	25	72	66	14	7	0	0	0	198
WNW	1	1	3	8	16	83	87	15	14	0	0	0	228
NW	0	0	4	10	8	34	28	8	4	0	0	0	96
NNW	0	1	4	10	11	28	11	1	0	0	0	0	66
TOTALS	14	20	58	231	302	654	696	137	32	5	1	0	2150

NUMBER OF VALID HOURS	2160	NUMBER OF CALMS	10
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	2160

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METEOROLOGY

April - June

TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18040100-18063023
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A
EXTREMELY UNSTABLE ($DT/DZ \leq -1.9$ °C/100 METERS)

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	1	0	0	0	0	0	0	1
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	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	0	1	1	3	0	0	0	0	0	5
SE	0	0	0	0	0	4	2	0	2	0	0	0	8
SSE	0	0	0	0	3	12	14	8	1	0	0	0	38
S	0	0	0	0	3	13	31	21	3	0	0	0	71
SSW	0	0	3	0	4	13	44	10	0	0	0	0	74
SW	0	1	2	4	6	34	57	0	0	0	0	0	104
WSW	0	0	1	7	14	70	68	0	0	0	0	0	160
W	0	0	0	2	12	60	100	2	0	0	0	0	176
WNW	0	0	0	3	2	15	42	27	5	0	0	0	94
NW	0	0	0	0	1	1	3	11	2	0	0	0	18
NNW	0	0	0	0	0	1	1	0	0	0	0	0	2
TOTALS	0	1	6	17	46	225	365	79	13	0	0	0	752

NUMBER OF VALID HOURS	752	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	752

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	1	1	1	0	0	0	0	0	0	0	3
O	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	1	0	0	0	0	0	0	0	1
ESE	0	0	0	0	0	0	2	0	0	0	0	0	2
SE	0	0	0	2	0	0	4	1	0	0	0	0	7
SSE	0	0	0	0	1	2	8	2	4	0	0	0	17
S	1	0	0	0	3	5	5	5	2	0	0	0	21
SSW	0	0	0	1	3	11	10	3	0	0	0	0	28
SW	0	0	0	0	3	4	10	0	0	0	0	0	17
WSW	0	1	0	0	3	0	0	0	0	0	0	0	4
W	0	0	2	1	2	4	1	0	0	0	0	0	10
WNW	0	0	0	0	1	3	2	0	0	0	0	0	6
NW	0	0	0	0	0	1	2	2	0	0	0	0	5
NNW	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTALS	1	1	3	5	18	31	44	13	6	0	0	0	122

NUMBER OF VALID HOURS	122	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	122

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

April - June

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 18040100-18063023
 WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	1	0	0	0	0	0	0	0	1
NE	0	0	1	0	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	1	2	0	0	0	0	0	3
ESE	0	0	0	1	0	2	2	0	0	0	0	0	5
SE	0	0	0	0	3	3	4	1	0	0	0	0	11
SSE	0	0	0	0	3	13	15	8	5	0	0	0	44
S	0	0	0	1	5	5	11	8	2	0	0	0	32
SSW	1	0	0	3	6	7	7	0	0	0	0	0	24
SW	0	0	0	6	4	6	2	2	0	0	0	0	20
WSW	0	0	0	2	2	2	0	1	0	0	0	0	7
W	0	0	0	4	5	2	0	0	0	0	0	0	11
WNW	0	1	0	3	4	3	1	1	0	0	0	0	13
NW	0	0	1	1	2	5	3	2	1	0	0	0	15
NNW	0	0	0	0	1	0	0	0	0	0	0	0	1
TOTALS	1	1	2	21	36	49	47	23	8	0	0	0	188

NUMBER OF VALID HOURS	188	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	188

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	1	0	14	12	1	0	0	0	0	0	0	28
NNE	0	0	1	6	9	9	1	0	0	0	0	0	26
NE	1	0	0	9	5	4	0	0	0	0	0	0	19
ENE	0	0	1	5	3	3	0	0	0	0	0	0	12
E	0	0	2	8	8	14	3	0	0	0	0	0	35
ESE	0	0	1	6	11	27	26	1	0	0	0	0	72
SE	0	1	3	9	21	54	36	4	0	0	0	0	128
SSE	1	1	3	5	21	26	46	4	3	0	0	0	110
S	1	1	0	6	15	19	32	7	3	0	0	0	84
SSW	0	3	1	9	9	12	14	5	0	0	0	0	53
SW	1	0	2	6	8	8	0	1	0	0	0	0	26
WSW	1	0	2	8	5	3	1	0	0	0	0	0	20
W	3	2	1	4	8	6	1	0	0	0	0	0	25
WNW	2	1	2	7	5	3	3	1	0	0	0	0	24
NW	3	1	2	11	5	7	7	7	0	0	0	0	43
NNW	0	2	4	5	9	8	4	0	0	0	0	0	32
TOTALS	13	13	25	118	154	204	174	30	6	0	0	0	737

NUMBER OF VALID HOURS	737	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	737

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

April - June

TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18040100-18063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	1	0	5	3	3	1	0	0	0	0	0	0	13
NNE	1	2	5	8	15	21	2	0	0	0	0	0	54
NE	0	2	1	4	3	1	0	0	0	0	0	0	11
ENE	1	0	2	4	3	3	0	0	0	0	0	0	13
E	0	0	0	2	3	1	0	0	0	0	0	0	6
ESE	1	0	0	3	1	3	0	0	0	0	0	0	8
SE	1	1	1	0	1	1	1	1	0	0	0	0	7
SSE	0	0	0	2	1	0	1	0	0	0	0	0	4
S	2	0	0	1	1	0	0	0	0	0	0	0	4
SSW	0	1	1	1	0	0	0	0	0	0	0	0	3
SW	1	2	1	1	0	0	0	0	0	0	0	0	5
WSW	1	0	1	0	1	1	0	0	0	0	0	0	4
W	0	1	1	5	1	1	0	0	0	0	0	0	9
WNW	0	2	1	0	0	1	3	0	0	0	0	0	7
NW	0	0	1	1	1	1	2	0	0	0	0	0	6
NNW	0	0	0	3	0	2	0	0	0	0	0	0	5
TOTALS	9	11	20	38	34	37	9	1	0	0	0	0	159

NUMBER OF VALID HOURS	159	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	159

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	1	0	0	2	1	3	1	0	0	0	0	0	8
NNE	1	0	2	9	25	30	3	0	0	0	0	0	70
NE	0	3	4	8	3	0	0	0	0	0	0	0	18
ENE	1	0	0	1	2	0	0	0	0	0	0	0	4
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	1	0	1	1	0	0	0	0	0	0	0	3
SSE	0	0	0	0	1	0	0	0	0	0	0	0	1
S	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	1	0	0	1	0	0	0	0	0	0	0	0	2
SW	0	0	0	0	1	0	0	0	0	0	0	0	1
WSW	0	0	0	2	0	1	1	0	0	0	0	0	4
W	0	0	0	2	1	2	1	0	0	0	0	0	6
WNW	0	1	1	1	1	1	2	0	0	0	0	0	7
NW	0	1	1	1	0	0	1	0	0	0	0	0	4
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	4	6	8	28	36	37	9	0	0	0	0	0	128

NUMBER OF VALID HOURS	128	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	128

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

April - June

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 18040100-18063023
 WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	0	1	0	0	0	0	0	1
NNE	0	0	0	1	11	19	40	0	0	0	0	0	71
NE	0	0	1	3	2	4	1	0	0	0	0	0	11
ENE	0	0	0	0	4	1	0	0	0	0	0	0	5
E	0	0	0	1	1	0	0	0	0	0	0	0	2
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	0	0	0	0	0	0	0	1
S	0	1	0	0	0	0	0	0	0	0	0	0	1
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	1	0	0	0	0	0	0	0	1
W	0	0	0	3	0	0	0	0	0	0	0	0	3
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	0	1	1	9	20	24	43	0	0	0	0	0	98

NUMBER OF VALID HOURS	98	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	98

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	2	1	6	20	17	6	2	0	0	0	0	0	54
NNE	2	2	8	24	61	79	46	0	0	0	0	0	222
NE	1	5	7	24	13	9	1	0	0	0	0	0	60
ENE	2	0	3	11	12	7	0	0	0	0	0	0	35
E	0	0	2	11	13	16	5	0	0	0	0	0	47
ESE	1	0	1	10	13	33	33	1	0	0	0	0	92
SE	1	3	4	12	26	62	47	7	2	0	0	0	164
SSE	1	1	3	7	31	53	84	22	13	0	0	0	215
S	4	2	0	8	27	42	79	41	10	0	0	0	213
SSW	2	4	5	15	22	43	75	18	0	0	0	0	184
SW	2	3	5	17	22	52	69	3	0	0	0	0	173
WSW	2	1	4	19	26	77	70	1	0	0	0	0	200
W	3	3	4	21	29	75	103	2	0	0	0	0	240
WNW	2	5	4	14	13	26	53	29	5	0	0	0	151
NW	3	2	5	14	9	15	19	22	3	0	0	0	92
NNW	0	2	4	9	10	12	5	0	0	0	0	0	42
TOTALS	28	34	65	236	344	607	691	146	33	0	0	0	2184

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18070100-18093023
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A
EXTREMELY UNSTABLE ($DT/DZ \leq -1.9$ °C/100 METERS)

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	1	1	0	0	0	0	0	2
NNE	0	0	0	2	2	3	0	0	0	0	0	0	7
NE	0	0	0	1	0	1	1	0	0	0	0	0	3
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	1	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	2	2	5	4	0	0	0	0	13
S	0	0	0	1	2	4	20	1	0	0	0	0	28
SSW	0	0	1	2	1	13	29	2	0	0	0	0	48
SW	0	0	0	2	4	31	32	0	0	0	0	0	69
WSW	0	0	0	3	12	94	99	1	0	0	0	0	209
W	0	0	0	2	10	78	122	5	0	0	0	0	217
WNW	0	1	0	0	2	6	41	12	0	0	0	0	62
NW	0	0	0	0	1	1	3	6	0	0	0	0	11
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	1	1	13	37	235	354	31	0	0	0	0	672

NUMBER OF VALID HOURS	672	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	672

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	1	1	1	0	0	0	0	0	0	3
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	0	1	0	0	0	0	0	0	1
SSE	0	0	0	0	2	0	1	0	0	0	0	0	3
S	0	0	1	1	2	3	3	1	0	0	0	0	11
SSW	0	0	0	1	2	3	6	1	0	0	0	0	13
SW	0	0	0	2	3	11	7	0	0	0	0	0	23
WSW	0	0	0	2	2	3	2	0	0	0	0	0	9
W	0	0	1	0	0	7	1	0	0	0	0	0	9
WNW	0	0	0	0	0	2	1	0	0	0	0	0	3
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTALS	0	0	2	8	12	32	21	2	0	0	0	0	77

NUMBER OF VALID HOURS	77	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	77

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

July - September TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18070100-18093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	1	0	0	0	0	0	0	0	0	1
NNE	0	0	0	1	0	2	0	0	0	0	0	0	3
NE	0	0	1	0	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	2	0	0	0	0	0	0	2
SE	0	0	0	0	0	5	2	0	0	0	0	0	7
SSE	0	0	0	1	0	4	5	0	0	0	0	0	10
S	0	0	0	0	0	4	8	0	0	0	0	0	12
SSW	0	0	0	2	4	9	2	1	0	0	0	0	18
SW	0	0	1	2	2	6	5	0	0	0	0	0	16
WSW	0	0	2	2	3	2	1	0	0	0	0	0	10
W	0	0	0	5	1	2	0	0	0	0	0	0	8
WNW	0	0	0	1	0	2	1	0	0	0	0	0	4
NW	0	0	0	0	1	3	1	0	0	0	0	0	5
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	0	0	4	16	11	41	25	1	0	0	0	0	98

NUMBER OF VALID HOURS	98	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	98

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	1	1	5	8	4	1	0	0	0	0	0	20
NNE	0	1	0	6	6	16	4	0	0	0	0	0	33
NE	0	1	1	4	3	1	0	0	0	0	0	0	10
ENE	0	0	0	2	2	3	0	0	0	0	0	0	7
E	0	0	0	3	8	2	0	0	0	0	0	0	13
ESE	0	0	0	7	7	14	1	0	0	0	0	0	29
SE	0	0	0	5	15	36	20	0	0	0	0	0	76
SSE	0	0	0	9	10	34	28	1	0	0	0	0	82
S	0	0	0	8	20	24	14	0	0	0	0	0	66
SSW	0	0	0	8	9	21	12	0	0	0	0	0	50
SW	0	0	2	8	5	19	10	0	0	0	0	0	44
WSW	0	0	1	10	11	10	2	0	0	0	0	0	34
W	0	0	2	5	11	14	12	1	0	0	0	0	45
WNW	0	2	0	4	7	12	19	0	0	0	0	0	44
NW	0	1	2	7	5	10	5	0	0	0	0	0	30
NNW	0	1	2	7	7	3	0	0	0	0	0	0	20
TOTALS	0	7	11	98	134	223	128	2	0	0	0	0	603

NUMBER OF VALID HOURS	603	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	603

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

July - September TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18070100-18093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	1	5	7	3	0	0	0	0	0	0	16
NNE	0	0	1	23	23	23	3	0	0	0	0	0	73
NE	1	0	1	12	6	0	0	0	0	0	0	0	20
ENE	0	1	0	5	4	1	0	0	0	0	0	0	11
E	0	0	0	4	6	2	0	0	0	0	0	0	12
ESE	0	0	1	4	10	1	0	0	0	0	0	0	16
SE	0	0	0	5	7	14	13	4	0	0	0	0	43
SSE	0	2	0	5	8	8	8	1	0	0	0	0	32
S	0	1	0	5	5	4	4	0	0	0	0	0	19
SSW	0	0	3	1	9	6	8	0	0	0	0	0	27
SW	0	0	4	5	4	3	5	0	0	0	0	0	21
WSW	0	0	3	5	4	2	6	0	0	0	0	0	20
W	0	0	2	9	8	3	4	0	0	0	0	0	26
WNW	0	1	1	3	6	8	0	0	0	0	0	0	19
NW	0	2	1	10	4	4	2	0	0	0	0	0	23
NNW	0	0	1	4	6	2	0	0	0	0	0	0	13
TOTALS	1	7	19	105	117	84	53	5	0	0	0	0	391

NUMBER OF VALID HOURS	391	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	391

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	2	11	10	5	0	0	0	0	0	0	28
NNE	0	0	0	13	29	36	1	0	0	0	0	0	79
NE	0	0	2	4	3	2	0	0	0	0	0	0	11
ENE	0	0	0	1	1	1	0	0	0	0	0	0	3
E	0	0	0	3	1	0	1	0	0	0	0	0	5
ESE	0	0	0	0	2	3	1	0	0	0	0	0	6
SE	0	0	0	1	2	9	9	3	0	0	0	0	24
SSE	0	0	0	3	1	3	4	1	1	0	0	0	13
S	0	0	0	1	4	2	7	0	0	0	0	0	14
SSW	0	0	2	2	1	0	1	0	0	0	0	0	6
SW	0	0	1	1	0	3	2	0	0	0	0	0	7
WSW	0	1	0	2	4	1	2	0	0	0	0	0	10
W	0	0	0	1	0	1	8	0	0	0	0	0	10
WNW	0	0	1	2	1	5	2	0	0	0	0	0	11
NW	0	0	1	3	5	11	1	0	0	0	0	0	21
NNW	0	0	0	2	2	4	0	0	0	0	0	0	8
TOTALS	0	1	9	50	66	86	39	4	1	0	0	0	256

NUMBER OF VALID HOURS	256	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	256

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18070100-18093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	1	1	5	4	0	0	0	0	0	11
NNE	0	0	1	1	6	29	27	0	0	0	0	0	64
NE	0	0	0	1	2	3	0	0	0	0	0	0	6
ENE	0	0	0	0	1	1	1	0	0	0	0	0	3
E	0	0	0	1	0	2	0	0	0	0	0	0	3
ESE	0	0	0	1	1	0	1	0	0	0	0	0	3
SE	0	0	0	0	0	0	2	3	0	0	0	0	5
SSE	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	1	0	0	0	0	0	0	0	0	1
SW	0	0	0	0	1	0	0	0	0	0	0	0	1
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	1	0	0	0	0	0	0	1
WNW	0	1	0	0	0	1	1	0	0	0	0	0	3
NW	0	0	0	2	1	1	0	0	0	0	0	0	4
NNW	0	1	0	5	0	0	0	0	0	0	0	0	6
TOTALS	0	2	1	13	13	43	36	3	0	0	0	0	111

NUMBER OF VALID HOURS	111	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	111

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	1	4	23	26	18	6	0	0	0	0	0	78
NNE	0	1	2	47	67	110	35	0	0	0	0	0	262
NE	1	1	5	23	14	7	1	0	0	0	0	0	52
ENE	0	1	0	8	9	6	1	0	0	0	0	0	25
E	0	0	0	11	15	6	1	0	0	0	0	0	33
ESE	0	0	1	12	20	21	3	0	0	0	0	0	57
SE	0	0	0	11	24	65	47	10	0	0	0	0	157
SSE	0	2	0	18	23	51	51	7	1	0	0	0	153
S	0	1	1	16	33	41	56	2	0	0	0	0	150
SSW	0	0	6	17	26	52	58	4	0	0	0	0	163
SW	0	0	8	20	19	73	61	0	0	0	0	0	181
WSW	0	1	6	24	36	112	112	1	0	0	0	0	292
W	0	0	5	22	30	106	147	6	0	0	0	0	316
WNW	0	5	2	10	16	36	65	12	0	0	0	0	146
NW	0	3	4	22	17	30	12	6	0	0	0	0	94
NNW	0	2	3	19	15	10	0	0	0	0	0	0	49
TOTALS	1	18	47	303	390	744	656	48	1	0	0	0	2208

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

October - December

TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18100100-18123123
WIND SPEED (M/S) AT 10 METER LEVEL

PASQUILL A
EXTREMELY UNSTABLE ($DT/DZ \leq -1.9$ °C/100 METERS)

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	1	1	0	0	0	0	0	0	0	2
NNE	0	0	0	1	0	0	2	3	0	0	0	0	6
NE	0	0	0	2	1	2	2	0	1	0	0	0	8
ENE	0	0	0	0	1	0	0	0	0	0	0	0	1
E	0	0	0	1	0	1	0	0	0	0	0	0	2
ESE	0	0	0	1	0	0	1	0	0	0	0	0	2
SE	0	0	0	1	2	5	3	1	0	0	0	0	12
SSE	0	0	0	0	3	7	13	2	0	0	0	0	25
S	0	0	0	3	6	7	14	2	0	0	0	0	32
SSW	0	0	0	4	6	13	7	0	1	2	0	0	33
SW	0	0	0	7	17	23	11	2	1	0	0	0	61
WSW	0	0	0	6	18	41	24	0	1	0	0	0	90
W	0	0	0	7	21	58	40	2	2	0	0	0	130
WNW	0	0	0	0	5	49	82	4	0	0	0	0	140
NW	0	0	0	0	6	7	14	1	0	0	0	0	28
NNW	0	0	0	2	2	2	1	0	0	0	0	0	7
TOTALS	0	0	0	36	89	215	214	17	6	2	0	0	579

NUMBER OF VALID HOURS	579	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	579

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	1	0	1	0	0	0	0	0	0	2
NNE	0	0	0	0	0	0	2	0	0	0	0	0	2
NE	0	0	0	0	1	0	0	1	0	0	0	0	2
ENE	0	0	0	0	0	1	0	0	0	0	0	0	1
E	0	0	0	0	0	1	0	0	0	0	0	0	1
ESE	0	0	0	0	0	3	0	0	0	0	0	0	3
SE	0	0	0	0	0	1	1	0	0	0	0	0	2
SSE	0	0	0	2	0	1	0	0	0	0	0	0	3
S	0	0	0	0	2	4	3	3	0	0	0	0	12
SSW	0	0	0	1	0	4	2	0	0	0	0	0	7
SW	0	0	0	1	0	2	1	0	0	0	0	0	4
WSW	0	0	0	0	0	1	0	0	0	0	0	0	1
W	0	0	0	0	0	0	0	0	1	0	0	0	1
WNW	0	0	0	0	0	0	2	0	0	0	0	0	2
NW	0	0	0	0	0	1	2	1	0	0	0	0	4
NNW	0	0	0	0	0	1	2	0	0	0	0	0	3
TOTALS	0	0	0	5	3	21	15	5	1	0	0	0	50

NUMBER OF VALID HOURS	50	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	50

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

October - December

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 18100100-18123123
 WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	1	0	0	0	0	0	0	0	1
NNE	0	0	0	0	0	0	1	1	1	0	0	0	3
NE	0	0	0	0	0	1	2	1	0	0	0	0	4
ENE	0	0	0	0	0	1	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	2	0	0	0	0	0	0	2
SE	0	0	0	0	0	1	2	0	0	0	0	0	3
SSE	0	0	0	0	0	3	2	2	0	0	0	0	7
S	0	0	0	0	0	1	2	0	0	0	0	0	3
SSW	0	0	0	0	0	4	2	0	0	0	0	0	6
SW	0	0	0	0	1	2	1	0	0	0	0	0	4
WSW	0	0	0	0	0	1	0	0	1	0	0	0	2
W	0	0	0	1	0	0	0	1	1	0	0	0	3
WNW	0	0	0	2	0	2	2	2	0	0	0	0	8
NW	0	0	0	0	0	4	3	0	0	0	0	0	7
NNW	0	0	0	0	4	2	0	0	0	0	0	0	6
TOTALS	0	0	0	4	6	24	17	7	3	0	0	0	61

NUMBER OF VALID HOURS	61	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	61

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	1	4	3	4	2	1	0	0	0	0	15
NNE	0	0	1	1	2	7	3	3	0	0	0	0	17
NE	0	0	0	1	2	2	0	1	2	0	0	0	8
ENE	0	0	0	2	1	4	3	0	0	0	0	0	10
E	0	1	0	0	3	1	1	1	2	0	0	0	9
ESE	0	0	0	1	3	6	14	4	3	0	0	0	31
SE	0	1	0	0	4	12	25	0	2	0	0	0	44
SSE	0	0	1	2	1	5	12	1	0	0	0	0	22
S	0	0	0	3	5	3	6	2	0	0	0	0	19
SSW	1	0	0	2	2	4	3	0	0	0	0	0	12
SW	0	0	0	2	0	5	0	1	0	0	0	0	8
WSW	0	0	0	1	4	2	2	0	0	0	0	0	9
W	0	0	0	3	1	2	0	2	3	0	0	0	11
WNW	0	0	2	3	4	4	2	3	2	0	0	0	20
NW	0	0	0	1	4	9	11	2	2	0	0	0	29
NNW	0	0	0	2	7	10	5	0	0	0	0	0	24
TOTALS	1	2	5	28	46	80	89	21	16	0	0	0	288

NUMBER OF VALID HOURS	288	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	288

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

October - December

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 18100100-18123123
 WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	3	4	10	9	2	1	0	0	0	0	29
NNE	0	0	0	9	23	38	20	4	0	0	0	0	94
NE	0	0	1	11	9	4	12	8	3	1	0	0	49
ENE	0	1	1	4	4	3	1	1	1	0	0	0	16
E	0	0	1	5	2	5	2	2	0	0	0	0	17
ESE	0	0	2	3	6	12	7	1	0	0	0	0	31
SE	0	0	0	0	4	11	12	2	0	0	0	0	29
SSE	0	0	1	2	4	10	4	2	0	0	0	0	23
S	0	0	0	3	1	6	0	1	0	0	0	0	11
SSW	0	0	0	3	5	1	1	0	0	0	0	0	10
SW	0	0	0	0	2	0	2	0	0	0	0	0	4
WSW	0	0	0	4	2	4	2	0	0	0	0	0	12
W	0	0	0	3	6	1	0	1	4	0	0	0	15
WNW	0	0	1	1	4	7	3	0	1	0	0	0	17
NW	0	0	1	0	3	2	3	0	0	0	0	0	9
NNW	0	0	0	6	4	3	4	0	0	0	0	0	17
TOTALS	0	1	11	58	89	116	75	23	9	1	0	0	383

NUMBER OF VALID HOURS	383	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	383

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	3	3	6	8	5	0	0	0	0	0	25
NNE	0	0	0	5	31	104	30	1	0	0	0	0	171
NE	0	0	0	12	27	15	3	1	0	0	0	0	58
ENE	0	0	0	3	7	3	1	0	0	0	0	0	14
E	0	0	0	2	3	0	0	0	0	0	0	0	5
ESE	0	0	0	1	2	2	1	0	0	0	0	0	6
SE	0	0	1	0	3	1	0	0	0	0	0	0	5
SSE	0	0	0	1	2	0	1	0	0	0	0	0	4
S	0	0	0	0	3	1	0	0	0	0	0	0	4
SSW	0	0	0	1	3	1	1	0	0	0	0	0	6
SW	0	0	0	2	2	0	0	0	0	0	0	0	4
WSW	0	0	0	1	2	0	1	0	0	0	0	0	4
W	0	0	0	3	1	0	1	0	0	0	0	0	5
WNW	0	0	0	3	1	5	1	0	0	0	0	0	10
NW	0	0	0	1	4	4	0	0	0	0	0	0	9
NNW	0	0	0	2	4	4	0	0	0	0	0	0	10
TOTALS	0	0	4	40	101	148	45	2	0	0	0	0	340

NUMBER OF VALID HOURS	340	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	340

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

October - December

TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 18100100-18123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	0	0	1	3	5	0	0	0	0	0	9
NNE	0	0	0	3	19	152	229	7	0	0	0	0	410
NE	0	0	0	3	7	22	17	0	0	0	0	0	49
ENE	0	0	0	0	4	3	0	0	0	0	0	0	7
E	0	0	0	0	0	2	5	0	0	0	0	0	7
ESE	0	0	0	1	0	1	1	1	0	0	0	0	4
SE	0	0	2	0	1	1	1	0	0	0	0	0	5
SSE	0	0	0	0	0	1	0	0	0	0	0	0	1
S	0	0	0	1	0	1	0	0	0	0	0	0	2
SSW	0	0	0	0	1	0	0	0	0	0	0	0	1
SW	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	2	1	0	0	0	0	0	0	0	3
W	0	0	0	0	0	1	1	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	1	0	0	0	0	0	3
NNW	0	0	0	0	0	2	2	0	0	0	0	0	4
TOTALS	0	0	2	10	35	190	262	8	0	0	0	0	507

NUMBER OF VALID HOURS	507	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	507

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

Wind	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
Dir	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	7	13	22	25	14	2	0	0	0	0	83
NNE	0	0	1	19	75	301	287	19	1	0	0	0	703
NE	0	0	1	29	47	46	36	12	6	1	0	0	178
ENE	0	1	1	9	17	15	5	1	1	0	0	0	50
E	0	1	1	9	8	10	8	3	2	0	0	0	42
ESE	0	0	2	7	11	26	24	6	3	0	0	0	79
SE	0	1	3	1	14	32	44	3	2	0	0	0	100
SSE	0	0	2	7	10	27	32	7	0	0	0	0	85
S	0	0	0	10	17	23	25	8	0	0	0	0	83
SSW	1	0	0	11	17	27	16	0	1	2	0	0	75
SW	0	0	0	12	22	32	15	3	1	0	0	0	85
WSW	0	0	0	14	27	49	29	0	2	0	0	0	121
W	0	0	0	17	29	62	42	6	11	0	0	0	167
WNW	0	0	3	9	14	67	92	9	3	0	0	0	197
NW	0	0	1	2	18	28	34	4	2	0	0	0	89
NNW	0	0	0	12	21	24	14	0	0	0	0	0	71
TOTALS	1	3	22	181	369	794	717	83	35	3	0	0	2208

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