

10 CFR 50.36(a)

April 28, 2020

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

Subject: **Annual Radioactive Effluent Release Report – 2019**
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 - 2019 (ARERR) for SONGS, Units 1, 2, and 3 (Enclosure 1). The period of the report is January 1, 2019 through December 31, 2019.

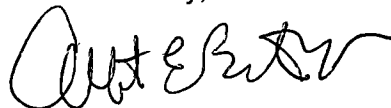
The net result from the analysis of these effluent releases indicates that the operation of SONGS has met all the requirements of the applicable regulations that ensure adequate protection of the health of members of the public.

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), require revisions made to the SONGS Offsite Dose Calculation Manual (ODCM) for this reporting period to be submitted with the ARERR. There were no revisions made to the SONGS ODCM during this reporting period.

There are no commitments in this letter or the enclosure.

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

Sincerely,



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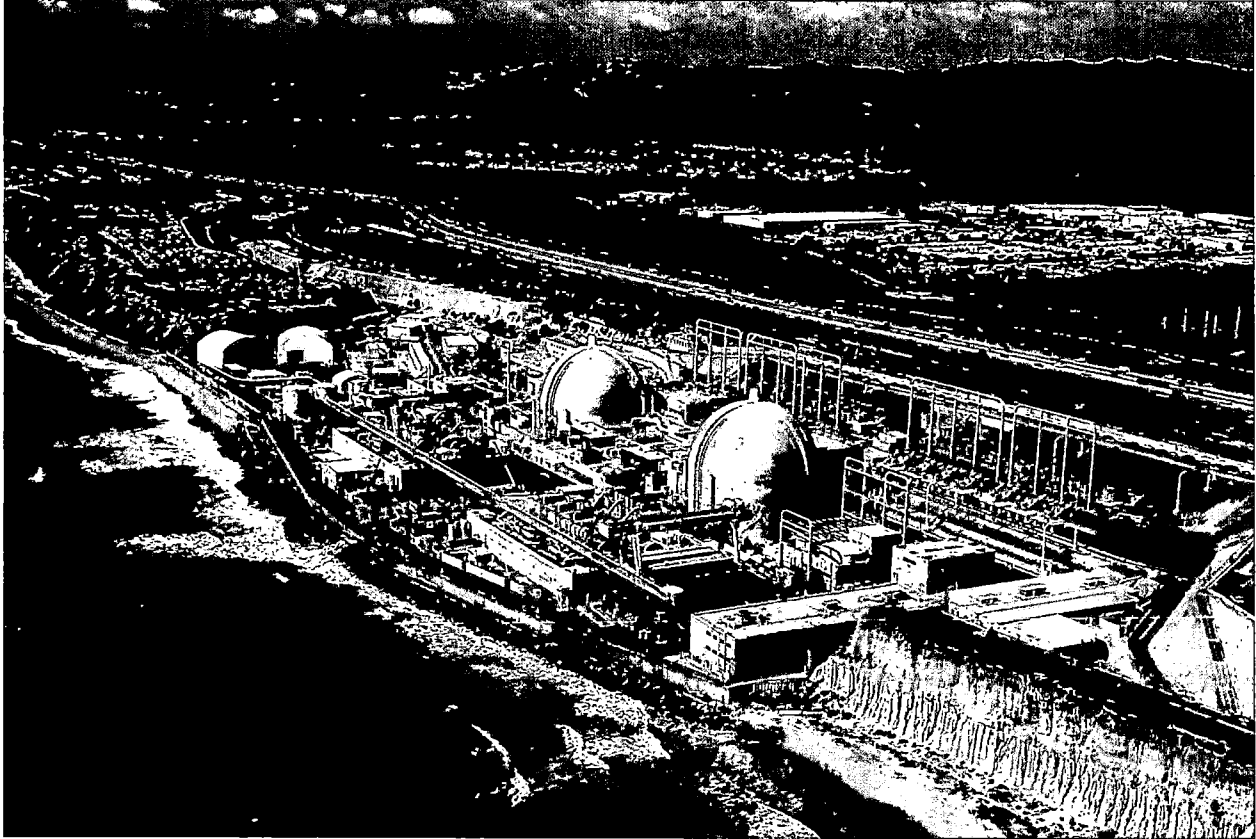
Enclosures:

- 1) San Onofre Nuclear Generation Station, Annual Radioactive Effluent Release Report 2019

cc: S. Morris, Regional Administrator, NRC Region IV
R. Chang, NRC Project Manager
A. M. Snyder NRC Project Manager
R. K. Lupo, California Department of Public Health

Enclosure 1

San Onofre Nuclear Generation Station
Annual Radioactive Effluent Release Report
2019
January - December



SAN ONOFRE NUCLEAR GENERATING STATION

Annual Radioactive Effluent Release Report

2019

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 Unit 2. 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 – 2019

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 – 2019

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 – 2019

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	< LLD	< LLD	3.01E-06	< LLD	1.60E+01
2. Average release rate for period	µCi/sec	N/A	N/A	3.79E-07	N/A	
3. Percent of applicable limit	% MPC	N/A	N/A	3.64E-07	N/A	
4. Percent Effluent Concentration Limit	% ECL	N/A	N/A	9.09E-07	N/A	
5. Gross alpha activity	Ci	< LLD	< LLD	< LLD	< LLD	5.00E+01
D. Tritium						
1. Total release	Ci	1.30E+00	2.35E-01	2.14E+00	6.61E+00	2.50E+01
2. Average release rate for period	µCi/sec	1.67E-01	2.99E-02	2.69E-01	8.32E-01	
3. Percent of applicable limit	% MPC	4.01E-04	7.17E-05	6.46E-04	2.00E-03	
4. Percent Effluent Concentration Limit	% ECL	8.02E-04	1.43E-04	1.29E-03	3.99E-03	

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1C

**GASEOUS EFFLUENTS GROUND LEVEL RELEASES
BATCH MODE**

Batch gaseous releases were not performed at SONGS

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

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	<LLD	<LLD	3.01E-06	<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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1D

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD ($\mu\text{Ci/cc}$)	Batch Mode LLD ($\mu\text{Ci/cc}$)
1. Fission and activation gases		
krypton-85	2.20E-05	N/A
krypton-85m	5.50E-08	N/A
krypton-87	2.70E-07	N/A
krypton-88	1.90E-07	N/A
xenon-133	1.40E-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	2.30E-13	N/A
iodine-133	2.20E-12	N/A
iodine-135	1.50E-10	N/A
3. Particulates		
barium-140	4.80E-13	N/A
cerium-141	5.80E-14	N/A
cerium-144	2.30E-13	N/A
cesium-134	1.30E-13	N/A
cesium-137	1.10E-13	N/A
cobalt-58	1.20E-13	N/A
cobalt-60	1.90E-13	N/A
iron-59	3.00E-13	N/A
lanthanum-140	9.70E-13	N/A
manganese-54	1.20E-13	N/A
molybdenum-99	7.00E-14	N/A
strontium-89	1.00E-11	N/A
strontium-90	1.00E-11	N/A
zinc-65	3.20E-13	N/A
4. Tritium	N/A	N/A
5. Alpha	1.00E-11	N/A

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1E

GASEOUS EFFLUENTS RADIATION DOSES AT THE SITE BOUNDARY

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Noble Gas					
1. Gamma Air Dose	Mrad	0.00E+00	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	Mrad	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	3.71E-05	6.69E-06	6.41E-05	1.88E-04
2. Percent of Applicable Limit	%	2.47E-04	4.46E-05	4.27E-04	1.25E-03

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 – 2019

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 – 2019

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	1.12E-05	2.39E-05	<LLD	1.68E-05	1.90E+01
2. Average diluted concentration during period	µCi/ml	1.55E-12	2.99E-12	N/A	2.07E-12	
3. Percent of applicable limit	% MPC	7.74E-06	1.50E-05	N/A	9.10E-6	
4. Percent Effluent Concentration Limit	% ECL	1.55E-04	2.99E-04	N/A	1.57E-4	
B. Tritium						
1. Total release	Ci	<LLD	8.69E-03	<LLD	2.47E-03	1.90E+01
2. Average diluted concentration during period	µCi/ml	N/A	1.09E-09	N/A	3.04E-10	
3. Percent of applicable limit	% MPC	N/A	3.63E-05	N/A	1.01E-05	
4. Percent Effluent Concentration Limit	% ECL	N/A	1.09E-04	N/A	3.04E-05	
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	1.18E+07	2.80E+06	1.26E+06	8.33E+06	5.00E+00
F. Volume of dilution water used during period						
	liters	7.23E+09	7.98E+09	8.15E+09	8.11E+09	5.00E+00

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

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	<LLD	<LLD	<LLD
cesium-137	Ci	1.12E-05	2.39E-05	<LLD	9.43E-06
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	<LLD	<LLD
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
technetium-99m	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.12E-05	2.39E-05	<LLD	9.43E-06
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 – 2019

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	<LLD
cerium-141	Ci	N/A	N/A	N/A	<LLD
cerium-144	Ci	N/A	N/A	N/A	<LLD
cesium-134	Ci	N/A	N/A	N/A	<LLD
cesium-137	Ci	N/A	N/A	N/A	1.26E-06
chromium-51	Ci	N/A	N/A	N/A	<LLD
cobalt-58	Ci	N/A	N/A	N/A	<LLD
cobalt-60	Ci	N/A	N/A	N/A	6.09E-06
iodine-131	Ci	N/A	N/A	N/A	<LLD
iron-55	Ci	N/A	N/A	N/A	<LLD
iron-59	Ci	N/A	N/A	N/A	<LLD
lanthanum-140	Ci	N/A	N/A	N/A	<LLD
manganese-54	Ci	N/A	N/A	N/A	<LLD
molybdenum-99	Ci	N/A	N/A	N/A	<LLD
niobium-95	Ci	N/A	N/A	N/A	<LLD
strontium-89	Ci	N/A	N/A	N/A	<LLD
strontium-90	Ci	N/A	N/A	N/A	<LLD
technetium-99m	Ci	N/A	N/A	N/A	<LLD
zinc-65	Ci	N/A	N/A	N/A	<LLD
zirconium-95	Ci	N/A	N/A	N/A	<LLD
Total for period	Ci	N/A	N/A	N/A	7.35E-06
2. Dissolved and entrained gases					
xenon-133	Ci	N/A	N/A	N/A	<LLD
xenon-135	Ci	N/A	N/A	N/A	<LLD
Total for period	Ci	N/A	N/A	N/A	<LLD

LLD Lower Limit of Detection; see Table 2C.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2C

LIQUID EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD ($\mu\text{Ci/cc}$)	Batch Mode LLD ($\mu\text{Ci/cc}$)
1. Fission and activation products		
barium-140	3.30E-07	2.70E-07
cerium-141	4.50E-08	4.40E-08
cerium-144	1.90E-07	1.90E-07
cesium-134	8.50E-08	8.50E-08
cesium-137	7.30E-08	7.30E-08
chromium-51	3.60E-07	3.30E-07
cobalt-58	7.70E-08	7.50E-08
cobalt-60	1.10E-07	1.10E-07
iodine-131	6.40E-08	4.80E-08
iron-55	1.00E-06	1.00E-06
iron-59	1.80E-07	1.70E-07
lanthanum-140	6.40E-07	2.10E-07
manganese-54	7.60E-08	7.60E-08
molybdenum-99	6.00E-08	2.90E-08
niobium-95	7.70E-08	7.20E-08
strontium-89	5.00E-08	5.00E-08
strontium-90	5.00E-08	5.00E-08
technetium-99m	6.10E-08	3.00E-08
zinc-65	1.90E-07	1.90E-07
zirconium-95	1.30E-07	1.30E-07
2. Dissolved and entrained gases		
xenon-133	2.50E-07	2.50E-07
xenon-135	9.60E-08	9.60E-08
3. Tritium	1.00E-05	1.00E-05
4. Gross Alpha	1.00E-07	1.00E-07

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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	2.55E-05	5.33E-05	0.00E+00	2.83E-05
2. Percent of Applicable Limit	%	8.50E-04	1.78E-03	0.00E+00	9.43E-04
B.					
1. Limiting organ dose	mrem	3.90E-05	8.12E-05	0.00E+00	5.29E-05
2. Limiting organ for period		Liver	Liver	N/A	GI-LLI
3. Percent of Applicable Limit	%	3.90E-04	8.12E-04	0.00E+00	5.29E-04

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TABLE 2E

LIQUID EFFLUENTS BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	1 release
2. Total time period for batch releases:	47 minutes
3. Maximum time period for a batch release:	47 minutes
4. Average time period for a batch release:	47 minutes
5. Minimum time period for a batch release:	47 minutes
6. Average saltwater flow during batch releases:	16741 gpm

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SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

- The following corrections are to 2018 ARERR Table 2B "Liquid Effluents Continuous Mode" where <LLD values were reported.

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation products					
Total for period	Ci	<LLD	5.37E-04	3.87E-04	3.71E-05

- The following correction is to 2018 ARERR Section L "SONGS Conclusions" where incorrect radiation dose at the highest receptor was reported.

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): 2.83E-03 mrem at the highest receptor.

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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	6.56E+01	30%
	Ci	2.19E-02	
c. Irradiated components	m ³	N/A	N/A
	Ci	N/A	
d. Other: Filters	m ³	N/A	N/A
	Ci	N/A	

N/A: No shipments containing these items made in 2019.

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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 2019		
2b. Estimate of major nuclide composition [U2 and 3 Dry Active Waste (DAW)]		
Carbon-14	%	1.41E+00
Iron-55	%	5.24E+00
Cobalt-60	%	6.83E+00
Nickel-63	%	6.82E+01
Antimony-125	%	5.00E-01
Cesium-134	%	1.50E-01
Cesium-137	%	1.76E+01
Cerium-144	%	3.00E-02
Plutonium-238	%	2.00E-02
Americium-241	%	2.00E-02
2c. Estimate of major nuclide composition (U2 and U3 Irradiated Components) There were no irradiated components shipments in 2019		
2d. Estimate of major nuclide composition (U2 and U3 Filters) There were no filter shipments in 2019		

3. Solid Waste Disposition		
Number of Shipments	Mode of Transportation	Destination
2*	Tractor Trailer	EnergySolutions LLC, Clive Utah Disposal Site

Notes:

* Two shipments were made in 2019 from San Onofre (SONGS SDS) to EnergySolutions Clive Utah Disposal Site.

SONGS SDS maintains a contract with a vendor Bear Creek Operations (BCO) that provides volume reduction services. No shipments were made from SONGS SDS to BCO for volume reduction in 2019. No shipment were made from BCO to direct burial on SONGS SDS behalf in 2019.

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B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	No shipments were made in 2019	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 that impacted the Process Control Program in 2019.
- 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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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.

1E+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.

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

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

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	2.55E-05	5.33E-05	0.00E+00	2.83E-05	1.07E-04
Organ	6)	7)	8)	9)	10)
	3.90E-05	8.12E-05	0.00E+00	5.29E-05	1.57E-04
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	3.97E-04	4.39E-05	6.66E-04	1.62E-03	2.73E-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)
	6.57E-02	9.07E-02	6.45E-02	8.38E-02	3.05E-01

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

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

1. This value was calculated using the methodology of the ODCM.
2. This value was calculated using the methodology of the ODCM.
3. No liquid radioactive effluent releases occurred during this quarter.
4. This value was calculated using the methodology of the ODCM.
5. This value was calculated using the methodology of the ODCM.
6. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
7. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
8. No liquid radioactive effluent releases occurred during this quarter.
9. This value was calculated using the methodology of the ODCM; the GI-LLI 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 and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

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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 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.
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 11, (former Visitor Center) was removed from its station by an unknown external action sometime during the 2nd Q 2019. (CR SDS-000593)
- 2) The South Yard Facility weekly particulate filter collected on 4/10/19 was not centered in filter holder. Since the filter was only slightly off-set, sample flow bypassing the filter was minimal and a sufficient amount of sample was collected for analysis. The gamma scan identified only natural isotopes and the activities were very similar to previous sample results. There has been no licensed material detected in these samples for many years. (CR SDS-000522, AR 0419-43754)
- 3) The Unit 2 Containment Purge required weekly noble gas and tritium samples were not collected on 6/25/19. Containment ventilation was in service for a maximum of 45 minutes. Noble gas and tritium samples from U2 Containment were obtained and analyzed on 7/9/19. Noble gas activity was < MDA and tritium activity was >MDA and were consistent with prior containment samples. The tritium activity was used to determine curies released and dose to the public per the SO123-ODCM (CR SDS-000585, AR 0719-52997)

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TABLE 2

SOURCE	Percent Applicable Limit				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	8.50E-04	1.78E-03	0.00E+00	9.43E-04	1.79E-03
Organ	3.90E-04	8.12E-04	0.00E+00	5.29E-04	7.84E-04
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	2.65E-03	2.92E-04	4.44E-03	1.08E-02	9.10E-03
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

There were no changes to the SONGS Offsite Dose Calculation Manual in 2019.

The Land Use Census (LUC) for 2019 identified a new location with a higher calculated or committed dose than those calculated for the locations evaluated in the previous revision to the ODCM due to change in occupancy factor from 0.2466 to 1.0. Therefore, this new location is reported per ODCM 5.2.1 and will be incorporated in the next feasible revision to the ODCM.

TABLE 2-6 UNITS 2&3 CONTROLLING LOCATION FACTORS ¹		
Radionuclide	$\sum_k R_{ik} W_k$ mrem/yr per $\mu\text{Ci/sec}$	Use:
H-3	1.29E-03	Q: Sorb Rec Beach
Cr-51	4.43E-02	Q: Sorb Rec Beach
Mn-54	8.98E+00	Q: Sorb Rec Beach
Co-57	1.73E+00	Q: Sorb Rec Beach
Co-58	3.19E+00	Q: Sorb Rec Beach
Co-60	1.19E+02	Q: Sorb Rec Beach
Sr-89	1.75E+01	Q: SC Res with Garden
Sr-90	6.88E+02	Q: SC Res with Garden
Zr-95	3.92E+00	Q: Sorb Rec Beach
Nb-95	9.03E+00	E: Deer Consumer/Hunter
Ru-103	1.43E+01	E: Deer Consumer/Hunter
Te-129M	6.49E+00	E: Deer Consumer/Hunter
Cs-134	3.41E+01	Q: Sorb Rec Beach
Cs-136	7.68E-01	Q: Sorb Rec Beach
Cs-137	5.01E+01	Q: Sorb Rec Beach
Ba-140	2.09E+00	Q: Sorb Rec Beach
Ce-141	6.74E-01	Q: Sorb Rec Beach
Ce-144	1.32E+01	Q: Sorb Rec Beach
I-131	2.58E+01	Q: SC Res with Garden
I-132	1.94E-01	Q: Sorb Rec Beach
I-133	3.77E+00	Q: Sorb Rec Beach
I-134	5.27E-02	Q: Sorb Rec Beach
I-135	7.95E-01	Q: Sorb Rec Beach
UN-ID	4.94E+00	Q: Sorb Rec Beach

¹ These values to be used in manual calculations are the maximum $\sum_k R_{ik} W_k$ for all locations based on the most restrictive age group.

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SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

There were no changes to the Liquid Radioactive Waste Treatment System in 2019.

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SECTION K. MISCELLANEOUS

ABNORMAL RELEASES

There were no abnormal releases from SONGS in 2019.

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EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 2019 - December 31, 2019

Instrument	Inoperability Period	Inoperability Cause	Explanation
Meteorological Tower Temperature Probes	05/20/19 – 10/24/2019	10 Meter Air Temperature Channel 2 reading low	Due to troubleshooting and parts lead time. (AR 0519-80240, 1019-22236)
2/3RE-7813 Liquid Radwaste Radiation Monitor FE7643 Process Flow	06/20/2018 – 04/09/19	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 *
3RE-7828 Unit 3 Containment Purge Radiation Monitor	10/20/2019 – Present	Heat Trace over- temperature condition	Requires assessment and long preparation time due to location of failed equipment (MWP SDS-1019-58129-1, ARs 1019-60997, 1119-25832)
NIA Yard Drain Sump Effluent Flow Instrument 2/3FQI-6095	09/23/19 -10/30/19	Instrument failure during performance of Channel Functional Test	NIA process flow element and control panel required replacement with new equipment (Order SDS-9019-92182-2 with attached ECP, AR 1019-58101, 0919-92182)

Note:

* Design change reported in 2018 ARERR

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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, 2019 – December 31, 2019

Location	Sample Date	Tritium Activity pCi/L	Gamma Activity pCi/L	Gross Beta, pCi/L	Gross Alpha, pCi/L
GW-NIA-1	02/07/19	<MDC	<MDC	9.11E+00	7.49E+00
GW-NIA-1	06/03/19	<MDC	<MDC	1.12E+01	6.08E+00
GW-NIA-1	08/15/19	<MDC	<MDC	7.87E+00	<MDC
GW-NIA-1	11/07/19	<MDC	<MDC	1.36E+01	8.03E+00
GW-NIA-2	02/06/19	6.48E+02	<MDC	1.02E+01	8.49E+00
GW-NIA-2	06/03/19	<MDC	<MDC	8.22E+00	5.83E+00
GW-NIA-2	08/20/19	<MDC	<MDC	8.21E+00	3.41E+00
GW-NIA-2	11/06/19	<MDC	<MDC	9.95E+00	7.72E+00
GW-NIA-12	02/06/19	<MDC	<MDC	5.52E+00	<MDC
GW-NIA-12	05/29/19	<MDC	<MDC	7.20E+00	6.67E+00
GW-NIA-12	08/19/19	<MDC	<MDC	5.25E+00	<MDC
GW-NIA-12	11/06/19	<MDC	<MDC	3.97E+00	<MDC
GW-NIA-13	02/07/19	<MDC	<MDC	7.92E+00	6.05E+00
GW-NIA-13	05/29/19	4.72E+02	<MDC	1.63E+01	<MDC
GW-NIA-13	08/19/19	<MDC	<MDC	5.71E+00	3.81E+00
GW-NIA-13	11/06/19	<MDC	<MDC	8.71E+00	<MDC
GW-OCA-1	01/24/19	<MDC	<MDC	<MDC	1.49E+01
GW-OCA-1	04/17/19	<MDC	<MDC	<MDC	6.52E+00
GW-OCA-1	08/14/19	<MDC	<MDC	5.14E+00	1.12E+01
GW-OCA-1	10/31/19	<MDC	<MDC	8.31E+00	1.06E+01
GW-OCA-2	01/23/19	<MDC	<MDC	<MDC	8.57E+00
GW-OCA-2	04/10/19	<MDC	<MDC	2.86E+00	7.85E+00
GW-OCA-2	08/12/19	<MDC	<MDC	<MDC	4.28E+00
GW-OCA-2	10/30/19	<MDC	<MDC	9.15E+00	5.91E+00
GW-OCA-3	01/30/19	<MDC	<MDC	3.37E+00	3.95E+00
GW-OCA-3	05/29/19	<MDC	<MDC	2.85E+00	<MDC
GW-OCA-3	08/14/19	<MDC	<MDC	<MDC	3.86E+00
GW-OCA-3	10/28/19	<MDC	<MDC	7.74E+00	6.10E+00
GW-PA-1	02/11/19	<MDC	<MDC	8.53E+00	1.09E+01
GW-PA-1	06/05/19	<MDC	<MDC	6.28E+00	1.16E+01
GW-PA-1	08/22/19	<MDC	<MDC	4.60E+00	1.41E+01
GW-PA-1	11/14/19	<MDC	<MDC	7.11E+00	8.46E+00
GW-PA-2	02/27/19	<MDC	<MDC	1.91E+01	5.02E+01

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SAN ONOFRE NUCLEAR GENERATING STATION

Location	Sample Date	Tritium Activity pCi/L	Gamma Activity pCi/L	Gross Beta, pCi/L	Gross Alpha, pCi/L
GW-PA-2	06/05/19	<MDC	<MDC	2.03E+01	5.79E+01
GW-PA-2	08/22/19	<MDC	<MDC	2.03E+01	6.23E+01
GW-PA-2	11/18/19	<MDC	<MDC	1.69E+01	7.23E+01
GW-PA-3	02/28/19	<MDC	<MDC	8.00E+01	5.30E+01
GW-PA-3	06/06/19	<MDC	<MDC	2.38E+01	2.35E+01
GW-PA-3	08/26/19	<MDC	<MDC	2.52E+01	<MDC
GW-PA-3	12/11/19	<MDC	<MDC	2.51E+01	2.15E+01
GW-PA-4	03/04/19	<MDC	<MDC	6.55E+00	3.06E+00
GW-PA-4	06/06/19	<MDC	<MDC	1.55E+01	9.38E+00
GW-PA-4	08/26/19	<MDC	<MDC	1.38E+01	<MDC
GW-PA-4	12/09/19	<MDC	<MDC	1.16E+01	6.02E+00
NIA-3	08/28/19	<MDC	N/A	N/A	N/A
NIA-4	08/28/19	<MDC	N/A	N/A	N/A
NIA-5	09/18/19	<MDC	N/A	N/A	N/A
NIA-6	03/25/19	<MDC	N/A	N/A	N/A
NIA-6	08/28/19	<MDC	N/A	N/A	N/A
NIA-7	09/18/19	<MDC	N/A	N/A	N/A
NIA-10	09/16/19	<MDC	N/A	N/A	N/A
NIA-11	03/25/19	2.54E+02	N/A	N/A	N/A
NIA-11	09/16/19	<MDC	N/A	N/A	N/A
NIA-14	09/18/19	<MDC	N/A	N/A	N/A
NIA-15	09/18/19	<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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SAN ONOFRE NUCLEAR GENERATING STATION

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	02/07/19	<MDC
GW-NIA-2	02/06/19	<MDC
GW-NIA-12	02/06/19	<MDC
GW-NIA-13	02/07/19	<MDC
GW-OCA-1	01/24/19	<MDC
GW-OCA-2	01/23/19	<MDC
GW-OCA-3	01/30/19	<MDC
GW-PA-1	02/11/19	<MDC
GW-PA-2	02/27/19	<MDC
GW-PA-3	02/28/19	<MDC
GW-PA-4	03/04/19	<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	7.99E-01
b. Percent ODCM Specification Limit	%	3.20E+00
2. Limiting Organ		
a. Organ Dose (All except thyroid) (Liver)	mrem	4.53E-04
b. Percent ODCM Specification Limit	%	1.81E-03
3. Thyroid		
a. Thyroid Dose	mrem	2.97E-04
b. Percent ODCM Specification Limit	%	3.96E-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
2019 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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

SECTION L. SONGS CONCLUSIONS

- 1) Gaseous releases (excluding carbon-14) totaled $1.03\text{E}+01$ curies of which noble gases were $0.00\text{E}+00$ curies, particulates were $3.01\text{E}-06$ curies, iodines were $0.00\text{E}+00$ curies, and tritium was $1.03\text{E}+01$ curies.
- 2) The radiation doses from gaseous releases were: (a) gamma air dose: $0.00\text{E}+00$ mrad at the site boundary, (b) beta air dose: $0.00\text{E}+00$ mrad at the site boundary, (c) organ dose (Child - Liver): $2.73\text{E}-03$ mrem at the highest receptor.
- 3) Airborne carbon-14 release was projected at $0.00\text{E}+00$ curies due to the fact that both units have been permanently shut down since January 2012.
- 4) Liquid releases totaled $1.13\text{E}-02$ curies of which particulates were $5.19\text{E}-05$ curies, iodines were $0.00\text{E}+00$ curies, tritium was $1.12\text{E}-02$ curies, and noble gases were $0.00\text{E}+00$ curies.
- 5) The radiation doses from liquid releases were: (a) total body: $1.07\text{E}-04$ mrem, (b) limiting organ (LIVER): $1.57\text{E}-04$ 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) Two shipments were made from San Onofre (SONGS SDS) to EnergySolutions Clive Utah Disposal Site. These shipments included 65.6 cubic meters of Dry Active Waste containing $2.19\text{E}-02$ curies of radioactivity.
- 8) Meteorological conditions during the year were typical for SONGS. Meteorological dispersion was good 35% of the time, fair 35% of the time and poor 30% 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 2019. 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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

SAN ONOFRE NUCLEAR GENERATING STATION

METEOROLOGY

The meteorology of the San Onofre Nuclear Generating Station for each of the four quarters, 2019 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, 2019. 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 – 2019

METEOROLOGY

**January - March
Table 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19010100-19033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	1	0	0	0	0	0	0	0	1
NNE	0	0	0	0	0	1	0	0	0	0	0	0	1
NE	0	0	0	0	1	0	0	0	0	0	0	0	1
ENE	0	0	0	0	1	0	1	0	0	0	0	0	2
E	0	0	0	1	0	0	0	0	0	0	0	0	1
ESE	0	0	0	1	0	0	1	0	0	0	0	0	2
SE	0	0	0	0	4	2	7	8	2	0	0	0	23
SSE	0	0	0	0	0	3	8	7	2	0	3	0	23
S	0	0	0	2	2	11	10	3	3	0	0	0	31
SSW	0	0	0	1	9	6	7	1	1	0	0	0	25
SW	0	0	0	3	10	20	11	2	0	0	0	0	46
WSW	0	0	1	4	12	29	33	0	0	0	0	0	79
W	0	0	0	3	5	47	57	2	1	1	0	0	116
WNW	0	0	0	3	4	35	58	16	5	0	0	0	121
NW	0	0	0	0	1	6	10	4	1	0	0	0	22
NNW	0	0	0	0	2	1	1	0	0	0	0	0	4
TOTALS	0	0	1	18	52	161	204	43	15	1	3	0	498

NUMBER OF VALID HOURS	498	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	498

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	1	1	0	1	0	0	0	0	3
NNE	0	0	0	1	0	0	0	0	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	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	1	0	0	0	0	0	1
SE	0	0	0	1	1	2	13	3	0	0	0	0	20
SSE	0	0	0	0	1	2	3	3	1	0	2	0	12
S	0	0	0	1	1	0	2	2	2	0	1	0	9
SSW	0	0	0	0	2	2	1	0	0	0	0	0	5
SW	0	0	0	1	0	4	3	0	0	0	0	0	8
WSW	0	0	0	1	1	0	0	1	0	0	0	0	3
W	0	0	0	1	1	2	3	2	0	0	0	0	9
WNW	0	0	0	2	2	1	5	1	0	0	0	0	11
NW	0	0	0	0	0	0	5	0	0	0	0	0	5
NNW	0	0	0	0	0	0	2	0	0	0	0	0	2
TOTALS	0	0	0	8	10	14	38	14	3	0	3	0	90

NUMBER OF VALID HOURS	90	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	90

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**January - March
Table 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19010100-19033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	1	0	0	0	0	0	0	0	2
NNE	0	0	0	0	2	0	0	0	1	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	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	3	0	0	0	0	0	3
SE	0	0	0	0	0	1	7	2	3	0	0	0	13
SSE	0	0	0	0	0	3	2	1	3	0	0	0	9
S	0	0	0	0	3	3	2	1	0	1	0	0	10
SSW	0	0	0	0	0	1	2	0	0	0	0	0	3
SW	0	0	0	0	1	0	3	0	0	0	0	0	4
WSW	0	0	0	0	1	1	0	0	0	0	0	0	2
W	0	0	0	0	0	0	2	0	2	0	0	0	4
WNW	0	0	0	0	1	3	3	0	0	0	0	0	7
NW	0	0	0	0	1	1	2	0	0	0	0	0	4
NNW	0	0	0	1	2	0	0	0	0	0	0	0	3
TOTALS	0	0	0	2	12	13	26	4	9	1	0	0	67

NUMBER OF VALID HOURS	67	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	67

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	7	6	0	1	0	0	0	0	14
NNE	0	0	1	2	5	8	4	0	0	0	0	0	20
NE	0	0	2	0	0	2	3	1	1	0	0	0	9
ENE	0	0	1	1	0	1	2	0	0	0	0	0	5
E	0	0	0	0	1	2	1	0	1	0	0	0	5
ESE	0	0	1	0	2	3	14	8	2	0	0	0	30
SE	0	0	0	1	0	4	28	31	7	2	0	0	73
SSE	0	0	0	0	2	7	8	8	3	1	2	1	32
S	0	0	0	1	4	1	4	3	0	1	0	0	14
SSW	0	0	0	2	6	5	3	2	4	0	0	0	22
SW	0	0	2	3	1	6	5	5	3	0	0	0	25
WSW	0	0	0	4	2	3	6	9	2	0	0	0	26
W	0	0	0	3	3	7	6	7	6	2	0	0	34
WNW	0	0	0	4	2	5	7	6	1	0	0	0	25
NW	0	0	0	1	3	10	5	2	1	0	0	0	22
NNW	0	0	0	2	3	8	3	0	0	0	0	0	16
TOTALS	0	0	7	24	41	78	99	83	31	6	2	1	372

NUMBER OF VALID HOURS	372	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	372

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**January - March
Table 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19010100-19033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	4	11	14	5	0	0	0	0	0	34
NNE	0	0	0	14	20	29	16	0	0	0	0	0	79
NE	0	0	0	3	5	5	2	3	2	0	0	0	20
ENE	0	0	0	2	4	7	1	1	1	0	0	0	16
E	0	0	0	1	6	8	5	7	5	0	0	0	32
ESE	0	0	0	2	1	5	2	1	4	0	0	0	15
SE	0	0	0	2	0	2	2	3	3	0	0	0	12
SSE	0	0	0	2	1	4	4	2	3	0	0	0	16
S	0	0	1	1	3	1	0	0	0	0	0	0	6
SSW	0	0	1	3	1	2	0	0	0	0	0	0	7
SW	0	0	1	4	3	0	0	0	0	0	0	0	8
WSW	0	0	1	2	2	1	1	2	0	0	0	0	9
W	0	0	0	1	2	1	1	1	9	0	0	0	15
WNW	0	1	1	5	4	5	9	6	8	1	0	0	40
NW	0	0	2	3	6	5	5	5	3	0	0	0	29
NNW	0	0	0	5	5	6	8	3	0	0	0	0	27
TOTALS	0	1	7	54	74	95	61	34	38	1	0	0	365

NUMBER OF VALID HOURS	365	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	365

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	6	7	5	5	0	0	0	0	0	23
NNE	0	0	0	5	26	62	25	0	0	0	0	0	118
NE	0	0	1	8	14	11	2	0	0	0	0	0	36
ENE	0	0	0	5	4	5	1	0	0	0	0	0	15
E	0	0	0	3	1	1	2	0	0	0	0	0	7
ESE	0	0	0	1	3	2	0	0	0	0	0	0	6
SE	0	0	1	0	1	0	0	0	0	0	0	0	2
SSE	0	0	0	1	0	1	1	0	0	0	0	0	3
S	0	0	0	2	1	0	1	0	0	0	0	0	4
SSW	0	0	0	2	0	2	0	0	0	0	0	0	4
SW	0	0	0	3	0	1	0	0	0	0	0	0	4
WSW	0	0	0	1	1	2	1	0	0	0	0	0	5
W	0	0	0	3	0	0	1	0	0	0	0	0	4
WNW	0	0	0	1	2	2	1	0	0	0	0	0	6
NW	0	0	0	4	2	3	1	0	1	0	0	0	11
NNW	0	0	1	2	0	0	0	0	0	0	0	0	3
TOTALS	0	0	3	47	62	97	41	0	1	0	0	0	251

NUMBER OF VALID HOURS	251	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	251

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**January - March
Table 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19010100-19033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	2	3	5	5	0	0	0	0	0	15
NNE	0	0	0	2	5	114	285	14	0	0	0	0	420
NE	0	0	0	4	11	12	15	1	0	0	0	0	43
ENE	0	0	0	1	4	3	1	0	0	0	0	0	9
E	0	0	0	0	2	1	1	0	0	0	0	0	4
ESE	0	0	0	2	1	0	0	1	0	0	0	0	4
SE	0	0	0	0	0	0	2	0	0	0	0	0	2
SSE	0	0	0	0	0	1	0	0	0	0	0	0	1
S	0	0	0	0	0	2	3	0	0	0	0	0	5
SSW	0	0	0	0	1	0	1	0	0	0	0	0	2
SW	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	3	0	0	0	0	0	3
W	0	0	0	0	0	1	2	0	0	0	0	0	3
WNW	0	0	0	1	0	1	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	1	1	1	0	0	0	0	0	3
TOTALS	0	0	0	12	28	141	320	16	0	0	0	0	517

NUMBER OF VALID HOURS	517	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	517

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	13	31	31	15	2	0	0	0	0	92
NNE	0	0	1	24	58	214	330	14	1	0	0	0	642
NE	0	0	3	15	31	30	22	6	3	0	0	0	110
ENE	0	0	1	9	13	16	6	1	1	0	0	0	47
E	0	0	0	5	10	12	9	7	6	0	0	0	49
ESE	0	0	1	6	7	10	21	10	6	0	0	0	61
SE	0	0	1	4	6	11	59	47	15	2	0	0	145
SSE	0	0	0	3	4	21	26	21	12	1	7	1	96
S	0	0	1	7	14	18	22	9	5	2	1	0	79
SSW	0	0	1	8	19	18	14	3	5	0	0	0	68
SW	0	0	3	14	15	31	22	7	3	0	0	0	95
WSW	0	0	2	12	19	36	44	12	2	0	0	0	127
W	0	0	0	11	11	58	72	12	18	3	0	0	185
WNW	0	1	1	16	15	52	84	29	14	1	0	0	213
NW	0	0	2	8	13	25	28	11	6	0	0	0	93
NNW	0	0	1	10	13	16	15	3	0	0	0	0	58
TOTALS	0	1	18	165	279	599	789	194	97	9	8	1	2160

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**April - June
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19040100-19063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
	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	1	0	2	1	0	0	0	0	0	0	4
NE	0	0	1	2	1	1	0	0	0	0	0	0	5
ENE	0	0	0	1	2	1	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	1	0	0	0	0	0	0	1
SE	0	0	0	2	3	6	3	0	0	0	0	0	14
SSE	0	0	0	0	0	8	8	2	0	0	0	0	18
S	0	0	0	3	3	12	19	1	0	0	0	0	38
SSW	0	0	0	1	7	12	16	0	0	0	0	0	36
SW	0	0	0	2	7	25	30	0	0	0	0	0	64
WSW	0	0	0	0	10	77	94	1	0	0	0	0	182
W	0	0	0	4	4	40	113	2	0	0	0	0	163
WNW	0	0	0	4	0	20	66	10	1	0	0	0	101
NW	0	0	0	1	3	4	7	3	3	0	0	0	21
NNW	0	1	0	1	1	1	0	0	0	0	0	0	4
TOTALS	0	1	2	22	43	209	356	19	4	0	0	0	656

NUMBER OF VALID HOURS	656	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	656

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

Wind Dir	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	1	0	1	1	0	0	0	0	0	0	3
0	0	0	0	0	1	1	1	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	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	1	0	1	0	0	0	0	0	2
SE	0	0	0	0	4	4	3	1	0	0	0	0	12
SSE	0	0	0	0	1	5	1	0	0	0	0	0	7
S	0	0	0	0	2	11	1	0	0	0	0	0	14
SSW	0	0	0	1	2	3	7	1	0	0	0	0	14
SW	0	0	0	0	2	5	12	0	0	0	0	0	19
WSW	0	0	0	2	0	2	4	2	0	0	0	0	10
W	0	0	0	2	1	4	3	0	0	0	0	0	10
WNW	0	0	0	0	0	5	2	0	0	0	0	0	7
NW	0	0	0	0	0	0	3	1	0	0	0	0	4
NNW	0	0	0	1	0	1	0	0	0	0	0	0	2
TOTALS	0	0	1	6	15	42	38	5	0	0	0	0	107

NUMBER OF VALID HOURS	107	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	107

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

April - June TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 19040100-19063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
	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	2	0	2	0	0	0	0	0	0	4
NE	0	0	0	0	1	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	1	1	0	0	0	0	0	0	2
ESE	0	0	0	1	3	1	0	0	0	0	0	0	5
SE	0	0	0	0	2	5	5	0	0	0	0	0	12
SSE	0	0	0	2	0	5	2	0	0	0	0	0	9
S	0	0	1	2	2	6	1	0	0	0	0	0	12
SSW	0	0	0	0	2	4	5	0	0	0	0	0	11
SW	0	0	0	3	0	5	11	0	0	0	0	0	19
WSW	0	0	0	1	3	3	3	0	0	0	0	0	10
W	0	0	0	1	1	2	0	0	0	0	0	0	4
WNW	0	0	0	1	0	4	0	2	0	0	0	0	7
NW	0	0	0	0	0	0	1	1	0	0	0	0	2
NNW	0	0	0	0	1	0	0	0	0	0	0	0	1
TOTALS	0	0	1	13	17	38	28	3	0	0	0	0	100

NUMBER OF VALID HOURS	100	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	100

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

Wind Dir	0.22	0.51	0.76	1.1	1.6	2.1	3.1	5.1	7.1	10.1	13.1	>18	TOTAL
	0.5	0.75	1	1.5	2	3	5	7	10	13	18		
N	0	0	3	7	1	3	0	0	0	0	0	0	14
NNE	0	0	1	8	9	9	0	0	0	0	0	0	27
NE	0	0	0	3	1	5	0	0	0	0	0	0	9
ENE	0	0	0	3	3	1	0	0	1	0	0	0	8
E	0	0	0	4	2	1	1	0	0	0	0	0	8
ESE	0	0	2	2	3	2	3	0	0	0	0	0	12
SE	0	0	0	4	5	18	10	0	0	0	0	0	37
SSE	0	0	0	3	9	13	16	1	1	0	0	0	43
S	0	0	0	6	3	7	18	2	0	0	0	0	36
SSW	0	0	1	3	12	20	13	0	0	0	0	0	49
SW	0	0	1	9	13	21	29	0	0	0	0	0	73
WSW	0	0	2	5	7	20	13	2	0	0	0	0	49
W	0	0	1	5	5	5	7	4	0	0	0	0	27
WNW	0	0	2	4	9	5	6	4	0	0	0	0	30
NW	0	0	2	5	5	4	2	2	0	0	0	0	20
NNW	0	0	1	4	6	5	3	0	0	0	0	0	19
TOTALS	0	0	16	75	93	139	121	15	2	0	0	0	461

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT - 2019

METEOROLOGY

**April - June
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19040100-19063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	3	9	7	7	0	0	0	0	0	0	26
NNE	0	0	3	11	21	26	7	0	0	0	0	0	68
NE	0	0	1	3	5	1	0	0	0	0	0	0	10
ENE	0	0	0	2	6	2	0	0	0	0	0	0	10
E	0	0	0	3	6	6	0	0	0	0	0	0	15
ESE	0	0	0	1	4	6	1	0	0	0	0	0	12
SE	0	0	0	3	5	14	14	3	0	0	0	0	39
SSE	1	1	1	8	9	29	6	1	1	0	0	0	57
S	0	0	1	7	11	25	5	1	0	0	0	0	50
SSW	0	0	1	11	7	26	12	5	1	0	0	0	63
SW	0	0	2	7	11	10	8	2	0	0	0	0	40
WSW	0	1	3	7	7	10	7	2	0	0	0	0	37
W	0	1	1	10	2	7	1	4	0	0	0	0	26
WNW	0	1	2	6	9	7	3	5	0	0	0	0	33
NW	0	0	4	8	2	5	7	2	0	0	0	0	28
NNW	0	0	0	2	1	3	3	0	0	0	0	0	9
TOTALS	1	4	22	98	113	184	74	25	2	0	0	0	523

NUMBER OF VALID HOURS	523	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	523

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	1	0	3	4	3	3	0	0	0	0	0	14
NNE	0	0	0	8	25	35	9	1	0	0	0	0	78
NE	0	0	0	7	7	2	1	0	0	0	0	0	17
ENE	0	0	0	2	2	0	0	0	0	0	0	0	4
E	0	0	0	2	1	3	0	0	0	0	0	0	6
ESE	0	0	0	0	0	2	1	0	0	0	0	0	3
SE	0	0	1	1	1	1	1	0	0	0	0	0	5
SSE	0	0	0	2	6	1	0	0	0	0	0	0	9
S	1	0	0	2	1	0	0	0	0	0	0	0	4
SSW	0	0	1	2	1	1	1	0	0	0	0	0	6
SW	0	0	0	0	2	0	0	0	0	0	0	0	2
WSW	0	0	0	3	1	1	0	0	0	0	0	0	5
W	0	0	0	0	2	2	1	0	0	0	0	0	5
WNW	0	0	0	3	1	2	2	2	0	0	0	0	10
NW	0	0	0	2	1	1	1	0	0	0	0	0	5
NNW	0	1	0	2	0	3	0	0	0	0	0	0	6
TOTALS	1	2	2	39	55	57	20	3	0	0	0	0	179

NUMBER OF VALID HOURS	179	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	179

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**April - June
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19040100-19063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	1	0	2	0	0	0	0	0	3
NNE	0	0	0	0	9	64	51	2	0	0	0	0	126
NE	0	0	0	1	5	4	2	0	0	0	0	0	12
ENE	0	0	0	1	0	1	0	0	0	0	0	0	2
E	0	0	0	0	2	1	0	0	0	0	0	0	3
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	1	0	0	0	0	0	1
S	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	1	0	0	0	0	0	0	0	1
WSW	0	0	0	0	1	1	0	0	0	0	0	0	2
W	0	0	0	0	2	1	0	0	0	0	0	0	3
WNW	0	0	0	0	1	1	0	0	0	0	0	0	2
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	2	0	0	0	0	0	0	0	2
TOTALS	0	0	0	3	24	73	56	2	0	0	0	0	158

NUMBER OF VALID HOURS	158	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	158

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	1	7	20	15	14	5	0	0	0	0	0	62
NNE	0	0	5	29	67	138	68	3	0	0	0	0	310
NE	0	0	2	16	20	13	3	0	0	0	0	0	54
ENE	0	0	0	9	13	5	0	0	1	0	0	0	28
E	0	0	0	9	12	12	1	0	0	0	0	0	34
ESE	0	0	2	5	11	12	6	0	0	0	0	0	36
SE	0	0	1	10	20	48	36	4	0	0	0	0	119
SSE	1	1	1	15	25	61	34	4	2	0	0	0	144
S	1	0	2	20	22	61	44	4	0	0	0	0	154
SSW	0	0	3	18	31	66	54	6	1	0	0	0	179
SW	0	0	3	21	36	66	90	2	0	0	0	0	218
WSW	0	1	5	18	29	114	121	7	0	0	0	0	295
W	0	1	2	22	17	61	125	10	0	0	0	0	238
WNW	0	1	4	18	20	44	79	23	1	0	0	0	190
NW	0	0	6	16	11	14	21	9	3	0	0	0	80
NNW	0	2	1	10	11	13	6	0	0	0	0	0	43
TOTALS	2	7	44	256	360	742	693	72	8	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 – 2019

METEOROLOGY

**July - September
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19070100-19093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	2	0	0	0	0	0	0	0	0	3
NNE	0	0	0	5	4	8	0	0	0	0	0	0	17
NE	0	0	0	1	5	2	0	0	0	0	0	0	8
ENE	0	0	0	1	1	0	0	0	0	0	0	0	2
E	0	0	0	4	2	3	1	0	0	0	0	0	10
ESE	0	0	0	0	2	11	5	0	0	0	0	0	18
SE	0	0	1	1	4	21	23	2	0	0	0	0	52
SSE	0	0	0	3	4	7	13	7	2	0	0	0	36
S	0	0	0	5	4	19	15	8	0	0	0	0	51
SSW	0	0	1	4	7	12	26	2	0	0	0	0	52
SW	0	0	0	5	13	21	33	1	0	0	0	0	73
WSW	0	0	0	3	13	85	59	3	0	0	0	0	163
W	0	0	0	2	8	78	125	0	0	0	0	0	213
WNW	0	0	1	3	6	32	72	4	0	0	0	0	118
NW	0	0	0	3	2	6	8	0	0	0	0	0	19
NNW	0	0	1	2	1	3	0	0	0	0	0	0	7
TOTALS	0	0	5	44	76	308	380	27	2	0	0	0	842

NUMBER OF VALID HOURS	842	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	842

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	1	0	0	0	0	0	0	0	1
NNE	0	0	0	0	1	0	0	0	0	0	0	0	1
NE	0	0	0	0	1	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	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	1	1	1	0	0	0	0	0	3
SSE	0	0	0	0	0	1	2	0	0	0	0	0	3
S	0	0	0	0	0	0	2	2	0	0	0	0	4
SSW	0	0	0	0	1	3	4	1	0	0	0	0	9
SW	0	0	0	0	0	3	2	1	0	0	0	0	6
WSW	0	0	0	0	1	3	0	0	0	0	0	0	4
W	0	0	0	0	1	4	0	0	0	0	0	0	5
WNW	0	0	0	0	0	1	2	0	0	0	0	0	3
NW	0	0	0	0	1	1	0	0	0	0	0	0	2
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	0	8	20	13	4	0	0	0	0	45

NUMBER OF VALID HOURS	45	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	45

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT - 2019

METEOROLOGY

**July - September
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19070100-19093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	1	1	0	0	0	0	0	0	2
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	1	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	2	0	0	0	0	0	0	2
SSE	0	0	0	0	0	0	3	0	0	0	0	0	3
S	0	0	0	0	1	0	2	3	0	0	0	0	6
SSW	0	0	0	1	1	3	5	3	0	0	0	0	13
SW	0	0	0	0	0	3	5	3	0	0	0	0	11
WSW	0	0	0	0	5	3	0	0	0	0	0	0	8
W	0	0	0	0	0	5	3	0	0	0	0	0	8
WNW	0	0	0	0	1	1	3	0	0	0	0	0	5
NW	0	0	0	1	0	1	0	0	0	0	0	0	2
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	2	9	20	21	9	0	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 Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	3	1	2	0	0	0	0	0	0	6
NNE	0	0	0	6	9	6	0	0	0	0	0	0	21
NE	0	0	0	0	5	2	0	0	0	0	0	0	7
ENE	0	0	0	3	1	2	0	0	0	0	0	0	6
E	0	0	0	1	1	2	1	0	0	0	0	0	5
ESE	0	0	0	1	3	2	0	0	0	0	0	0	6
SE	0	0	1	0	3	11	1	0	0	0	0	0	16
SSE	0	0	0	1	10	16	10	5	0	0	0	0	42
S	0	0	1	3	1	8	20	4	0	0	0	0	37
SSW	0	0	0	1	4	10	9	1	0	0	0	0	25
SW	0	0	1	1	4	15	4	1	0	0	0	0	26
WSW	0	0	0	3	9	13	5	0	0	0	0	0	30
W	0	0	0	2	7	9	5	0	0	0	0	0	23
WNW	0	0	1	3	3	10	0	0	0	0	0	0	17
NW	0	0	0	1	1	4	1	1	0	0	0	0	8
NNW	0	0	0	1	3	2	0	0	0	0	0	0	6
TOTALS	0	0	4	30	65	114	56	12	0	0	0	0	281

NUMBER OF VALID HOURS	281	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	281

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**July - September
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19070100-19093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	12	5	3	0	0	0	0	0	0	20
NNE	0	0	0	7	15	25	4	0	0	0	0	0	51
NE	0	0	2	2	10	2	0	0	0	0	0	0	16
ENE	0	0	0	3	2	3	0	1	0	0	0	0	9
E	0	0	0	2	1	0	0	0	0	0	0	0	3
ESE	0	0	0	2	6	3	0	0	0	0	0	0	11
SE	0	0	0	3	6	16	8	0	0	0	0	0	33
SSE	0	0	1	7	11	18	14	1	0	0	0	0	52
S	0	0	0	7	5	14	21	2	0	0	0	0	49
SSW	0	0	0	5	5	15	17	2	0	0	0	0	44
SW	0	0	0	2	10	12	18	0	0	0	0	0	42
WSW	0	0	1	3	10	7	0	0	0	0	0	0	21
W	0	0	0	6	4	7	1	0	0	0	0	0	18
WNW	0	0	1	3	7	13	3	0	0	0	0	0	27
NW	0	0	0	4	8	2	2	0	0	0	0	0	16
NNW	0	0	1	9	5	3	3	0	0	0	0	0	21
TOTALS	0	0	6	77	110	143	91	6	0	0	0	0	433

NUMBER OF VALID HOURS	433	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	433

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	6	7	3	0	0	0	0	0	0	16
NNE	0	0	0	10	33	45	9	0	0	0	0	0	97
NE	0	0	1	6	12	8	0	0	0	0	0	0	27
ENE	0	0	0	6	8	2	1	0	0	0	0	0	17
E	0	0	0	3	7	2	0	0	0	0	0	0	12
ESE	0	0	0	5	1	10	1	0	0	0	0	0	17
SE	0	0	1	2	4	13	6	0	0	0	0	0	26
SSE	0	0	1	7	13	13	12	3	0	0	0	0	49
S	0	0	0	2	11	6	5	4	0	0	0	0	28
SSW	0	0	0	4	3	11	1	0	0	0	0	0	19
SW	0	0	0	5	3	5	2	0	0	0	0	0	15
WSW	0	0	0	3	5	3	0	0	0	0	0	0	11
W	0	0	0	3	5	5	0	0	0	0	0	0	13
WNW	0	0	0	10	10	2	2	0	0	0	0	0	24
NW	0	0	3	9	6	3	1	0	0	0	0	0	22
NNW	0	0	0	5	2	3	0	0	0	0	0	0	10
TOTALS	0	0	6	86	130	134	40	7	0	0	0	0	403

NUMBER OF VALID HOURS	403	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	403

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**July - September
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19070100-19093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	3	2	0	0	0	0	0	0	5
NNE	0	0	0	5	11	31	24	0	0	0	0	0	71
NE	0	0	0	3	2	14	1	0	0	0	0	0	20
ENE	0	0	0	0	2	1	1	0	0	0	0	0	4
E	0	0	0	0	1	1	0	0	0	0	0	0	2
ESE	0	0	0	1	0	0	0	0	0	0	0	0	1
SE	0	0	0	0	0	1	0	0	0	0	0	0	1
SSE	0	0	0	2	2	1	1	0	0	0	0	0	6
S	0	0	0	2	3	1	0	0	0	0	0	0	6
SSW	0	0	0	3	0	0	0	0	0	0	0	0	3
SW	0	0	0	1	0	0	1	0	0	0	0	0	2
WSW	0	0	1	1	0	0	0	0	0	0	0	0	2
W	0	0	0	1	2	2	0	0	0	0	0	0	5
WNW	0	0	0	3	2	0	1	0	0	0	0	0	6
NW	0	0	0	1	1	2	1	0	0	0	0	0	5
NNW	0	0	0	0	3	1	0	0	0	0	0	0	4
TOTALS	0	0	1	23	32	57	30	0	0	0	0	0	143

NUMBER OF VALID HOURS	143	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	143

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	1	23	17	10	0	0	0	0	0	0	51
NNE	0	0	0	33	74	116	37	0	0	0	0	0	260
NE	0	0	3	12	35	28	1	0	0	0	0	0	79
ENE	0	0	0	13	14	8	2	1	0	0	0	0	38
E	0	0	0	10	12	10	2	0	0	0	0	0	34
ESE	0	0	0	9	12	28	6	0	0	0	0	0	55
SE	0	0	3	6	18	65	39	2	0	0	0	0	133
SSE	0	0	2	20	40	56	55	16	2	0	0	0	191
S	0	0	1	19	25	48	65	23	0	0	0	0	181
SSW	0	0	1	18	21	54	62	9	0	0	0	0	165
SW	0	0	1	14	30	59	65	6	0	0	0	0	175
WSW	0	0	2	13	43	114	64	3	0	0	0	0	239
W	0	0	0	14	27	110	134	0	0	0	0	0	285
WNW	0	0	3	22	29	59	83	4	0	0	0	0	200
NW	0	0	3	19	19	19	13	1	0	0	0	0	74
NNW	0	0	2	17	14	12	3	0	0	0	0	0	48
TOTALS	0	0	22	262	430	796	631	65	2	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 – 2019

METEOROLOGY

**October - December
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19100100-19123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	0	2	0	0	0	0	0	0	3
NNE	0	0	0	0	0	0	2	0	0	0	0	0	2
NE	0	0	0	0	0	1	1	0	1	0	0	0	3
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	1	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	1	0	3	0	1	0	0	0	0	5
SSE	0	0	0	1	2	2	6	4	0	0	0	0	15
S	0	0	0	3	1	6	15	2	1	0	0	0	28
SSW	0	0	0	4	6	13	7	3	3	0	0	0	36
SW	0	0	1	2	7	10	7	0	0	0	0	0	27
WSW	0	0	0	1	17	19	14	0	0	0	0	0	51
W	0	0	0	2	15	57	22	1	0	0	0	0	97
WNW	0	0	1	3	8	62	77	2	0	0	0	0	153
NW	0	0	0	1	1	7	9	1	0	0	0	0	19
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	2	19	57	183	162	14	5	0	0	0	442

NUMBER OF VALID HOURS	442	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	442

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	0	0	0	0	0	0	0	0	1
NNE	0	0	0	0	0	2	1	0	0	0	0	0	3
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	1	0	1	0	0	0	0	2
SE	0	0	0	0	1	0	0	3	0	0	0	0	4
SSE	0	0	0	0	1	4	7	3	0	0	0	0	15
S	0	0	0	0	0	1	5	2	0	0	0	0	8
SSW	0	0	0	1	3	1	2	0	0	0	0	0	7
SW	0	0	0	0	0	3	3	0	0	0	0	0	6
WSW	0	0	0	1	0	1	0	0	0	0	0	0	2
W	0	0	0	0	0	3	1	0	0	0	0	0	4
WNW	0	0	0	2	0	1	0	1	0	0	0	0	4
NW	0	0	0	0	0	2	1	2	0	0	0	0	5
NNW	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTALS	0	0	0	5	5	20	21	13	0	0	0	0	64

NUMBER OF VALID HOURS	64	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	64

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**October - December
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19100100-19123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	1	0	0	0	0	0	0	0	1
NE	0	0	0	0	0	0	1	2	1	0	0	0	4
ENE	0	0	0	0	0	0	0	2	0	0	0	0	2
E	0	0	0	0	0	1	0	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0	1	0	0	0	0	1
SE	0	0	1	0	0	2	0	3	0	0	0	0	6
SSE	0	0	1	0	0	6	2	3	0	0	0	0	12
S	0	0	0	0	0	2	4	1	0	0	0	0	7
SSW	0	0	1	1	0	2	3	1	1	0	0	0	9
SW	0	0	0	0	4	2	0	1	0	0	0	0	7
WSW	0	0	0	1	1	0	0	0	1	0	0	0	3
W	0	0	0	0	3	3	1	0	1	0	0	0	8
WNW	0	0	0	0	2	3	2	0	0	0	0	0	7
NW	0	0	0	1	1	1	3	0	0	0	0	0	6
NNW	0	0	0	1	0	1	0	0	0	0	0	0	2
TOTALS	0	0	3	4	12	23	16	14	4	0	0	0	76

NUMBER OF VALID HOURS	76	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	76

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	4	5	4	3	0	0	0	0	0	16
NNE	0	0	0	1	4	8	9	0	0	0	0	0	22
NE	0	0	1	2	1	0	4	1	1	2	0	0	12
ENE	0	0	1	1	0	3	1	4	0	0	0	0	10
E	0	0	0	1	4	4	2	0	0	0	0	0	11
ESE	0	0	0	0	4	6	8	2	3	1	0	0	24
SE	0	0	0	2	4	17	18	8	9	0	0	0	58
SSE	0	0	0	0	2	13	9	3	1	0	0	0	28
S	0	1	0	3	1	3	8	2	2	0	0	0	20
SSW	0	0	1	2	4	3	2	0	3	1	0	0	16
SW	0	0	0	2	5	4	2	0	1	0	0	0	14
WSW	0	0	2	1	0	1	1	0	7	1	0	0	13
W	0	1	0	5	1	0	1	1	0	0	0	0	9
WNW	0	0	1	2	2	6	14	0	0	0	0	0	25
NW	0	0	0	3	5	8	6	2	0	0	0	0	24
NNW	0	0	0	2	2	12	6	0	0	0	0	0	22
TOTALS	0	2	6	31	44	92	94	23	27	5	0	0	324

NUMBER OF VALID HOURS	324	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	324

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**October - December
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19100100-19123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	1	0	1	8	13	6	0	0	0	0	0	29
NNE	0	0	0	7	14	17	11	0	0	0	0	0	49
NE	0	0	1	3	8	15	9	3	1	0	0	0	40
ENE	0	0	1	1	1	6	3	2	3	0	0	0	17
E	0	0	0	3	7	7	4	2	1	2	0	0	26
ESE	0	0	0	2	4	6	2	1	0	0	0	0	15
SE	0	0	1	0	2	4	12	4	0	0	0	0	23
SSE	0	0	1	3	2	2	7	5	1	0	0	0	21
S	0	0	0	2	3	1	1	0	0	0	0	0	7
SSW	0	0	0	3	1	0	0	1	0	0	0	0	5
SW	0	0	0	2	1	2	1	0	0	0	0	0	6
WSW	0	0	0	2	5	1	0	0	0	0	0	0	8
W	0	0	1	2	1	1	1	0	0	0	0	0	6
WNW	0	1	0	1	2	3	5	0	0	0	0	0	12
NW	0	0	1	1	2	9	3	0	0	0	0	0	16
NNW	0	0	0	3	1	7	2	1	0	0	0	0	14
TOTALS	0	2	6	36	62	94	67	19	6	2	0	0	294

NUMBER OF VALID HOURS	294	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	294

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	2	2	8	6	1	0	0	0	0	0	19
NNE	0	0	1	9	26	51	21	0	0	0	0	0	108
NE	0	0	3	13	17	22	13	4	0	0	0	0	72
ENE	0	0	0	8	8	6	1	0	1	0	0	0	24
E	0	0	1	3	7	0	1	0	0	0	0	0	12
ESE	0	0	1	1	0	2	1	0	0	0	0	0	5
SE	0	0	0	3	2	2	3	0	0	0	0	0	10
SSE	0	0	0	0	1	3	3	0	0	0	0	0	7
S	0	0	1	1	1	1	0	0	0	0	0	0	4
SSW	0	1	0	2	2	0	1	0	0	0	0	0	6
SW	0	0	1	0	1	0	1	0	0	0	0	0	3
WSW	0	0	0	3	3	1	0	0	0	0	0	0	7
W	0	0	0	1	1	2	0	0	0	0	0	0	4
WNW	0	0	1	2	6	9	0	0	0	0	0	0	18
NW	0	0	0	1	0	1	2	0	0	0	0	0	4
NNW	0	0	0	2	4	3	1	0	0	0	0	0	10
TOTALS	0	1	11	51	87	109	49	4	1	0	0	0	313

NUMBER OF VALID HOURS	313	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	313

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2019

METEOROLOGY

**October - December
TABLE 4A**

SITE: SAN ONOFRE
PERIOD OF RECORD 19100100-19123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	0	0	1	1	5	8	0	0	0	0	0	15
NNE	0	0	0	4	8	106	251	8	0	0	0	0	377
NE	0	0	3	6	17	80	72	1	0	0	0	0	179
ENE	0	0	0	8	9	8	7	0	0	0	0	0	32
E	0	0	0	2	3	5	1	0	0	0	0	0	11
ESE	0	0	0	2	6	5	0	1	0	0	0	0	14
SE	0	0	0	1	0	2	0	0	0	0	0	0	3
SSE	0	0	0	2	2	4	2	0	0	0	0	0	10
S	0	0	0	1	2	3	0	0	0	0	0	0	6
SSW	0	0	2	1	2	1	0	0	0	0	0	0	6
SW	0	0	0	1	0	1	1	0	0	0	0	0	3
WSW	0	0	0	2	2	2	0	0	0	0	0	0	6
W	0	0	0	0	1	1	0	0	0	0	0	0	2
WNW	0	0	0	0	0	5	3	1	0	0	0	0	9
NW	0	1	0	1	4	3	2	0	0	0	0	0	11
NNW	0	0	0	2	2	3	4	0	0	0	0	0	11
TOTALS	0	1	5	34	59	234	351	11	0	0	0	0	695

NUMBER OF VALID HOURS	695	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	0	TOTAL HOURS FOR THE PERIOD	695

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

Wind Dir	0.22 0.5	0.51 0.75	0.76 1	1.1 1.5	1.6 2	2.1 3	3.1 5	5.1 7	7.1 10	10.1 13	13.1 18	>18	TOTAL
N	0	1	2	10	22	30	18	0	0	0	0	0	83
NNE	0	0	1	21	53	184	295	8	0	0	0	0	562
NE	0	0	8	24	43	118	100	12	4	2	0	0	311
ENE	0	0	2	18	18	23	13	8	4	0	0	0	86
E	0	0	1	9	21	18	8	2	1	2	0	0	62
ESE	0	0	1	5	14	20	13	6	3	1	0	0	63
SE	0	0	2	7	9	30	33	19	9	0	0	0	109
SSE	0	0	2	6	10	34	36	18	2	0	0	0	108
S	0	1	1	10	8	17	33	7	3	0	0	0	80
SSW	0	1	4	14	18	20	15	5	7	1	0	0	85
SW	0	0	2	7	18	22	15	1	1	0	0	0	66
WSW	0	0	2	11	28	25	15	0	8	1	0	0	90
W	0	1	1	10	22	67	26	2	1	0	0	0	130
WNW	0	1	3	10	20	89	101	4	0	0	0	0	228
NW	0	1	1	8	13	31	26	5	0	0	0	0	85
NNW	0	0	0	10	9	27	13	1	0	0	0	0	60
TOTALS	0	6	33	180	326	755	760	98	43	7	0	0	2208

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