SOUTHERN CALIFORNIA EDISON®
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Al Bates
Manager
Regulatory Affairs

10 CFR 50.36(a)

April 28, 2022

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

Subject: **Annual Radioactive Effluent Release Report – 2021**
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), Southern California Edison (SCE) is submitting the Annual Radioactive Effluent Release Report - 2021 (ARERR) for SONGS, Units 1, 2, and 3 (Enclosure 1). The period of the report is January 1, 2021 through December 31, 2021. A separate ARERR was submitted for the SONGS Independent Spent Fuel Storage Installation (ISFSI) on February 24, 2022 which had no effluent releases.

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

There are no commitments in this letter or the enclosure.

If you have any questions, please contact me at (949) 368-7024.

Sincerely,

Enclosures:

1) San Onofre Nuclear Generation Station, Annual Radioactive Effluent Release Report - 2021

cc: S. Morris, Regional Administrator, NRC Region IV
A. Snyder, NRC Project Manager, SONGS Units 1, 2 and 3
R. K. Lupo, California Department of Public Health

P. O. Box 128
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Enclosure 1

San Onofre Nuclear Generation Station
Annual Radioactive Effluent Release Report
2021
January - December

SAN ONOFRE NUCLEAR GENERATING STATION

Annual Radioactive Effluent Release Report

2021

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. By August 7, 2020, all fuel was transferred to the Independent Spent Fuel Storage Installation (ISFSI).

Unit 1 was supplied by Westinghouse Electric Company and began commercial operation on January 1, 1968. The unit was permanently shut down 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 in August 1983, and April 1984, respectively. The twin units are owned by Southern California Edison (78.21%), San Diego Gas and Electric (20%), and the City of Riverside (1.79%).

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

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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

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 Effluents for Continuous and Batch Modes of Release
2. Quarterly Summaries of Liquid Effluents for Continuous and Batch Modes of Release
3. Percent of Applicable Limits
4. Estimated Total 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 and abbreviations 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
AREOR	Annual Radiological Environmental Operating Report
Ci	Curies
CR	Condition Report
DAS	Data Acquisition System
ECL	Effluent Concentration Limit
GI-LLI	Gastrointestinal Tract-Lower Large Intestine
GPI	Groundwater Protection Initiative
ISFSI	Independent Spent Fuel Storage Installation
LCS	Licensee Controlled Specifications
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
NIA	North Industrial Area formerly known as Unit 1
ODCM	Offsite Dose Calculation Manual
pCi/l	Pico Curies per liter
SYF	South Yard Facility
TLD	Thermoluminescent Dosimeter
µCi/sec	Micro Curies per second
X/Q	Chi over Q

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. Batch releases have been included because of the release of gaseous check sources and as a result of abnormal airborne radioactive releases reported in Section K.

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

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

Table 1F “Gaseous Effluents Batch Release Summary,” provides data on the time periods for Batch Releases. Releases designated as Batch Releases included a release of noble gas check sources and two abnormal releases.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

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	N/A	N/A	1.73E-04	N/A	9.40E+00
2.	Average release rate for period	µCi/sec	N/A	N/A	2.18E-05	N/A	
3.	Percent of applicable limit	% MPC	N/A	N/A	1.52E-07	N/A	
4.	Percent Effluent Concentration Limit	% ECL	N/A	N/A	6.53E-08	N/A	
B.	Iodines						
1.	Total I-131	Ci	N/A	N/A	N/A	N/A	N/A
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	1.20E-04	4.94E-05	2.04E-06	3.09E-04	3.00E+01
2.	Average release rate for period	µCi/sec	1.54E-05	6.28E-06	2.57E-07	3.88E-05	
3.	Percent of applicable limit	% MPC	2.61E-05	1.52E-05	2.69E-07	1.19E-04	
4.	Percent Effluent Concentration Limit	% ECL	6.31E-05	5.08E-05	2.69E-07	3.31E-04	
5.	Gross alpha activity	Ci	< LLD	< LLD	< LLD	< LLD	3.70E+01
D.	Tritium						
1.	Total release	Ci	9.13E-01	< LLD	< LLD	< LLD	2.30E+01
2.	Average release rate for period	µCi/sec	1.17E-01	N/A	N/A	N/A	
3.	Percent of applicable limit	% MPC	1.23E-03	N/A	N/A	N/A	
4.	Percent Effluent Concentration Limit	% ECL	2.47E-03	N/A	N/A	N/A	

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1C

GASEOUS EFFLUENTS GROUND LEVEL RELEASES
BATCH MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
krypton-85	Ci	N/A	N/A	1.73E-04	N/A
Total for period	Ci	N/A	N/A	1.73E-04	N/A
2. Iodines					
Total for period	Ci	N/A	N/A	N/A	N/A
3. Particulates					
cerium-144	Ci	N/A	<LLD	N/A	N/A
cesium-134	Ci	N/A	<LLD	N/A	N/A
cesium-137	Ci	N/A	6.48E-06	N/A	N/A
cobalt-58	Ci	N/A	<LLD	N/A	N/A
cobalt-60	Ci	N/A	<LLD	N/A	N/A
manganese-54	Ci	N/A	<LLD	N/A	N/A
nickel-63	Ci	N/A	3.20E-06	N/A	N/A
strontium-90	Ci	N/A	<LLD	N/A	N/A
zinc-65	Ci	N/A	<LLD	N/A	N/A
Total for period	Ci	N/A	9.68E-06	N/A	N/A

LLD Lower Limit of Detection; see Table 1D.

Note 1: Fission and activation gas (krypton-85) curies are a result of release of gaseous check sources from Plant Vent Stack. Requirement for sampling and analysis of Fission and activation gases removed from ODCM.

Note 2: Requirement for sampling and analysis of Iodines removed from ODCM.

Note 3: Particulate curies are a result of abnormal releases from Unit 3 Containment Building Equipment Hatch in June 2021 as reported in Section K.

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					
Total for period	Ci	N/A	N/A	N/A	N/A
2. Iodines					
Total for period	Ci	N/A	N/A	N/A	N/A
3. Particulates					
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	1.36E-05	3.12E-06	<LLD	1.59E-04
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	5.79E-06	6.28E-06	<LLD	1.97E-05
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
nickel-63	Ci	1.00E-04	3.03E-05	2.04E-06	1.30E-04
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.20E-04	3.97E-05	2.04E-06	3.09E-04

LLD Lower Limit of Detection; see Table 1D.

Note 1: Requirement for sampling and analysis of Fission and activation gases removed from ODCM.

Note 2: Requirement for sampling and analysis of Iodines removed from ODCM.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1D

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD (µCi/cc)	Batch Mode LLD (µCi/cc)
1. Fission and activation gases	N/A	N/A
2. Iodines	N/A	N/A
3. Particulates		
cerium-144	4.40E-13	2.90E-12
cesium-134	2.60E-13	1.70E-12
cesium-137	2.20E-13	N/A
cobalt-58	2.40E-13	1.50E-12
cobalt-60	3.60E-13	2.40E-12
manganese-54	2.30E-13	1.50E-12
strontium-90	1.00E-11	1.00E-11
zinc-65	5.90E-13	4.00E-12
4. Tritium	7.20E-08	N/A
5. Alpha	1.00E-11	N/A

Note 1: Requirement for sampling and analysis of Fission and activation gases removed from ODCM.

Note 2: Requirement for sampling and analysis of Iodines removed from ODCM.

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	1.98E-09	0.00E+00
2.	Percent of Applicable Limit	%	0.00E+00	0.00E+00	1.98E-08	0.00E+00
3.	Beta Air Dose	mrad	0.00E+00	0.00E+00	2.24E-07	0.00E+00
4.	Percent Applicable Limit	%	0.00E+00	0.00E+00	1.12E-06	0.00E+00
B.	Tritium, Iodine, Particulates (at the nearest receptor)					
1.	Organ Dose	mrem	5.13E-04	1.82E-04	7.38E-06	9.83E-04
2.	Percent of Applicable Limit	%	3.42E-03	1.22E-03	4.92E-05	6.55E-03

Note: Calculations performed in accordance with the ODCM utilizing χ/Q and D/Q based on historical meteorological data.

TABLE 1F

GASEOUS EFFLUENTS BATCH RELEASE SUMMARY

		12-month period All Releases	
1.	Number of batch releases:	3	releases
2.	Total time period for batch releases:	965	minutes
3.	Maximum time period for a batch release:	480	minutes
4.	Average time period for a batch release:	322	minutes
5.	Minimum time period for a batch release:	5	minutes

Note 1: Release of gaseous check sources from Plant Vent Stack and two abnormal releases from Unit 3 Containment Building Equipment Hatch. Abnormal releases reported in Section K.

Note 2: The two abnormal releases were assumed to occur over 8 hours and the gaseous check sources were assumed to be released over a 5-minute period (for conservatism).

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 – 2021

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	<LLD	<LLD	<LLD	2.20E01
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	
B. Tritium						
1. Total release	Ci	<LLD	<LLD	<LLD	<LLD	2.30E01
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	
C. Dissolved and entrained gases						
1. Total release	Ci	N/A	N/A	N/A	N/A	N/A
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	3.20E01
E. Volume of waste released (batch & continuous, prior to dilution)	liters	3.88E+06	1.75E+06	5.48E+05	1.93E+06	5.00E+00
F. Volume of dilution water used during period	liters	7.54E+09	8.14E+09	8.00E+09	5.01E+09	5.00E+00

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

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					
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
nickel-63	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
2. Dissolved and entrained gases					
Total for period	Ci	N/A	N/A	N/A	N/A

LLD Lower Limit of Detection; see Table 2C.

Note: Requirement for sampling and analysis of Dissolved and entrained gases removed from ODCM. Dissolved and entrained gases shall be reported if detected.

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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					
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
cobalt-58	Ci	N/A	N/A	N/A	N/A
cobalt-60	Ci	N/A	N/A	N/A	N/A
iron-55	Ci	N/A	N/A	N/A	N/A
manganese-54	Ci	N/A	N/A	N/A	N/A
nickel-63	Ci	N/A	N/A	N/A	N/A
strontium-90	Ci	N/A	N/A	N/A	N/A
zinc-65	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					
Total for period	Ci	N/A	N/A	N/A	N/A

Note: Batch liquid releases were not performed at SONGS during 2021.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

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		
cerium-144	2.00E-07	N/A
cesium-134	9.20E-08	N/A
cesium-137	7.90E-08	N/A
cobalt-58	8.40E-08	N/A
cobalt-60	1.20E-07	N/A
iron-55	1.00E-06	N/A
manganese-54	8.20E-08	N/A
nickel-63	1.00E-06	N/A
strontium-90	5.00E-08	N/A
zinc-65	2.00E-07	N/A
2. Dissolved and entrained gases		
3. Tritium	1.00E-05	N/A
4. Gross Alpha	1.00E-07	N/A

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	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
B.					
1. Limiting organ dose	mrem	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Limiting organ for period		N/A	N/A	N/A	N/A
3. Percent of Applicable Limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2E

LIQUID EFFLUENTS BATCH RELEASE SUMMARY

		12-month period All Releases
1.	Number of batch releases:	0 releases
2.	Total time period for batch releases:	0 minutes
3.	Maximum time period for a batch release:	0 minutes
4.	Average time period for a batch release:	0 minutes
5.	Minimum time period for a batch release:	0 minutes
6.	Average saltwater flow during batch releases:	N/A

Note: Batch liquid releases were not performed at SONGS during 2021.

SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

2015 ARERR – METEOROLOGY

Joint Frequency Table number of hours was not reported correctly.

Period	Pasquill	Wind Direction or Total Hrs	Wind Speed	Reported	Corrected
Jan-March	A	NNE	1.6 - 2	10	1
Jan-March	B	WSW	7.1 - 10	1	0
Jan-March	C	S	3.1 - 5	0	1
Jan-March	C	NNW	5.1 - 7	1	0
Jan-March	C	Total Hrs	5.1 - 7	4	1
Jul-Sept	F	WSW	0.22 – 0.5	6	0
Jul-Sept	G	WSW	0.22 – 0.5	4	0

Note: The errors were found during review of data used for calculation of Historical Dispersion and Deposition Coefficients. The errors do not significantly affect the results of dose calculations as reported in the 2020 ARERR using historical meteorology.

2020 ARERR - EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE GREATER THAN 30 DAYS

UNIT 2 Containment Purge monitor was not reported as out of service for greater than 30 days in the 2020 ARERR. Instruments associated with the liquid radwaste radiation monitor were also not reported as non-functional; the liquid radwaste instruments were intentionally isolated and no releases were performed while the instruments were non-functional.

January 1, 2020 - December 31, 2020

Instrument	Inoperability Period	Inoperability Cause	Explanation
Unit 2 Containment Purge Radiation Monitor 2RE-7828	10/27/2020-01/11/2021	Loss of isokinetic conditions due to reduced process flow caused by clogged exhaust prefilters	Process flow could not be maintained in a range that maintained isokinetic flow conditions
Liquid Radwaste Radiation Monitor 2/3RT-7813 and Flow Indicator FE7643	11/19/2020 – 12/31/2020	The Liquid Radwaste Radiation Monitor was intentionally isolated in November 2020 and calibrations were not performed at the scheduled frequencies	No liquid radwaste discharges were planned to occur during this period and the monitor was intentionally secured.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2021

SAN ONOFRE NUCLEAR GENERATING STATION

SECTION E. RADWASTE SHIPMENTS

TABLE 3 (Units 1, 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	1.04E+04	30%
	Ci	4.02E+00	
c. Irradiated components	m^3	1.07E+00	30%
	Ci	4.60E+00	
d. Other	m^3	N/A	N/A
	Ci	N/A	

N/A: No waste of this type was shipped for burial in 2021.

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

2a. Estimate of major nuclide composition [Resin]
There were no shipments of resin for final burial or disposal in 2021

2b. Estimate of major nuclide composition [Dry Active Waste (DAW)]		
Nuclide	**Percent**	**Activity (Ci)**
Carbon-14	19.84%	7.98E-01
Iron-55	11.54%	4.64E-01
Cobalt-60	10.24%	4.12E-01
Nickel-63	51.04%	2.05E+00
Cesium-137	6.26%	2.52E-01

2c. Estimate of major nuclide composition [Irradiated Components]		
Nuclide	**Percent**	**Activity (Ci)**
Iron-55	63.08%	2.90E+00
Cobalt-60	20.35%	9.36E-01
Nickel-63	15.48%	7.12E-01

2d. Estimate of major nuclide composition [Other]
There were no shipments of material in the category 'other' for final burial or disposal in 2021

Note: For the tables above, major nuclides are those contributing ≥1% of the total activity for a given waste type.

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

3. Solid Waste Disposition			
Number of Shipments	Mode of Transportation	Destination	Notes
159	Rail	Energy*Solutions* LLC, Clive Utah Disposal Site	1
2	Tractor Trailer	From Bear Creek Operations to Clive Utah Disposal Site	2

Note 1: 159 shipments were made in 2021 from SONGS directly to EnergySolutions Clive, Utah Disposal Site

Note 2: SONGS maintains a contract with Energy*Solutions* Services (Bear Creek Operations) that provides volume reduction services. The processed volume was shipped from Energy*Solutions* Services facility to Energy*Solutions* Clive. Those shipments may include waste from other generators.

- Three shipments were made in 2021 from SONGS to Energy*Solutions* LLC Bear Creek Operations.
  - Two of the three shipments are still being processed for burial.
  - One of the three shipments was processed at Bear Creek Operations during 2021 and subsequently sent to Energy*Solutions* Clive, Utah Disposal Site in two separate shipments.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
None	No shipments were made in 2021	N/A

C. DEWATERING

Number of Containers	Solidification Agent
None	N/A

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

1) Changes made to the Process Control Program: Administrative and editorial changes only. There were no changes made that impacted the Process Control Program in 2021.

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

  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, µCi/sec.

  X/Q = 2.10E-05 sec/m^3; the annual average atmospheric dispersion defined in the ODCM.

  1E+6 = conversion from m^3 to cc

- $MPC_{eff} = \frac{1}{\sum_{i=1}^{n} \frac{F_i}{MPC_i}}$

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

  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, µCi/sec.

  X/Q = 2.10E-05 sec/m^3; the annual average atmospheric dispersion defined in the ODCM.

  1E+6 = conversion from m^3 to cc

- $ECL_{eff} = \frac{1}{\sum_{i=1}^{n} \frac{F_i}{ECL_i}}$

  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.

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, µCi/ml.

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

  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, µCi/ml.

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

  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.

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.

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 µCi/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.

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 - continuous releases are:

(1) Fan flow rate
(2) Calibration
(3) Counting
(4) Sampling
(5) Differential pressure drop
(6) Filter Digestion
(7) Plateout

Sources of error for liquid effluents - batch releases are:

(1) Tank volume
(2) Calibration
(3) Counting
(4) Sampling
(5) Release Flowrate
(6) Dilution Flowrate
(7) Sample Preparation [H3, GA]

Sources of error for liquid effluents - continuous releases are:

(1) Calibration
(2) Counting
(3) Sampling
(4) Release Flowrate
(5) Dilution flow rate
(6) Sample Preparation [H3, GA]

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

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

Where: Error is the 1 Sigma error associated with each process.

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 NRCDose3, NUREG-0133 methodology, and historical meteorology. Table IE of (Gaseous Effluents, Section B) lists data similar to categories 3, 4, and 5 using methods described in the ODCM and 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 boundary[1]. 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

SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS (Continued)

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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	6)	7)	8)	9)	10)
Organ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	1.17E-04	6.78E-05	1.06E-06	5.96E-04	7.80E-04
NOBLE GASES **	16)	17)	18)	19)	20)
Gamma	0.00E+00	0.00E+00	1.98E-09	0.00E+00	1.98E-09
	21)	22)	23)	24)	25)
Beta	0.00E+00	0.00E+00	2.25E-07	0.00E+00	2.25E-07
	26)	27)	28)	29)	30)
DIRECT RADIATION	ND	ND	ND	ND	ND

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

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

1. This value was calculated using the methodology of the ODCM.
2. This value was calculated using the methodology of the ODCM.
3. This value was calculated using the methodology of the ODCM.
4. This value was calculated using the methodology of the ODCM.
5. This value was calculated using the methodology of the ODCM.
6. This value was calculated using the methodology of the ODCM.
7. This value was calculated using the methodology of the ODCM.
8. This value was calculated using the methodology of the ODCM.
9. This value was calculated using the methodology of the ODCM.
10. This value was calculated using the methodology of the ODCM.
11. The maximum organ dose was to a Teen's Skin and was located in the NW sector. This was calculated using the assumptions of USNRC NUREG-0133.

SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS (Continued)

12. The maximum organ dose was to the Skin for All Age Groups and was located in the NW sector. This was calculated using the assumptions of USNRC NUREG-0133.
13. The maximum organ dose was to a Child's Bone and was located in the WNW sector. This was calculated using the assumptions of USNRC NUREG-0133.
14. The maximum organ dose was to the Skin for All Age Groups and was located in the NW sector. This was calculated using the assumptions of USNRC NUREG-0133.
15. The maximum organ dose was to a Teen's Skin and was located in the NW sector. This was calculated using the assumptions of USNRC NUREG-0133.
16. No noble gas radioactive effluent releases occurred during this quarter.
17. No noble gas radioactive effluent releases occurred during this quarter.
18. The maximum air dose for gamma radiation was located in the ENE sector at the site boundary. This was calculated using the assumptions of USNRC NUREG-0133.
19. No noble gas radioactive effluent releases occurred during this quarter.
20. The maximum air dose for gamma radiation was located in the ENE sector at the site boundary. This was calculated using the assumptions of USNRC NUREG-0133.
21. No noble gas radioactive effluent releases occurred during this quarter.
22. No noble gas radioactive effluent releases occurred during this quarter.
23. The maximum air dose for beta radiation was located in the ENE sector at the site boundary. This was calculated using the assumptions of USNRC NUREG-0133.
24. No noble gas radioactive effluent releases occurred during this quarter.
25. The maximum air dose for beta radiation was located in the ENE sector at the site boundary. This was calculated using the assumptions of USNRC NUREG-0133.
26. TLD doses reported as Not Detected per ANSI/HPS N13.37-2014 are reported in the 2021 SONGS AREOR. Net dose per ODCM section 3.4.1.2 would be 0.13 mrem based on 300 hours per year occupancy at the seawall (WNW sector). TLDs 55 and 78 were removed from its station by an unknown external action during 1st quarter 2021. The 1Q21 dose for TLD 55 and 78 were estimated based on the average of the other three quarters.
27. TLD doses reported as Not Detected per ANSI/HPS N13.37-2014 are reported in the 2021 SONGS AREOR. Net dose per ODCM section 3.4.1.2 would be 0.12 mrem based on 300 hours per year occupancy at the seawall (WNW sector).
28. TLD doses reported as Not Detected per ANSI/HPS N13.37-2014 are reported in the 2021 SONGS AREOR. Net dose per ODCM section 3.4.1.2 would be 0.15 mrem based on 300 hours per year occupancy at the seawall (WNW sector).
29. TLD doses reported as Not Detected per ANSI/HPS N13.37-2014 are reported in the 2021 SONGS AREOR. Net dose per ODCM section 3.4.1.2 would be 0.13 mrem based on 300 hours per year occupancy at the seawall (WNW sector).

SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS (Continued)

30. TLD doses reported as Not Detected per ANSI/HPS N13.37-2014 are reported in the 2021 SONGS AREOR. Net dose per ODCM section 3.4.1.2 would be 0.53 mrem based on 300 hours per year occupancy at the seawall (WNW sector). TLDs 55 and 78 were removed from its station by an unknown external action during 1st quarter 2021. The 1Q21 dose for TLD 55 was estimated based on the average of the other three quarters.

Note: The SONGS ODCM currently provides methodology for calculating direct radiation doses by subtracting background TLD results (5-50 miles from the site) from the indicator results. SONGS has adopted ANSI/HPS N13.37-2014 methodology for determining facility related dose to a Member of the Public in the AREOR; this methodology has been endorsed by RG-4.13 Rev. 2 for evaluating dose to the public in the unrestricted area. For 2021, the reported dose is Not Detected (ND) based on the AREOR procedure. The doses calculated per the ODCM net-dose methodology are provided as footnotes to Table 1.

TABLE 2

	Percent Applicable Limit				
SOURCE	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Organ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	7.77E-04	4.52E-04	7.07E-06	3.97E-03	2.60E-03
NOBLE GASES					
Gamma	0.00E+00	0.00E+00	1.98E-08	0.00E+00	9.90E-09
Beta	0.00E+00	0.00E+00	1.13E-06	0.00E+00	5.63E-07

Note: Direct Radiation is not specifically addressed in the 10 CFR 50 Appendix I Limits.

SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

There were no changes to the SONGS ODCM in 2021.

Changes due to the Land Use Census

The Land Use Census (LUC) for 2021 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. The Dose Assessment for the 2021 LUC was performed using the NRCDose3/GASPAR II program. Therefore, no new location is reported per ODCM 5.2.1.

SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

Changes to the Liquid Radioactive Waste Treatment System

The were no changes to SONGS Radioactive Waste Treatment Systems in 2021.

SAN ONOFRE NUCLEAR GENERATING STATION

SECTION K. MISCELLANEOUS

ABNORMAL RELEASES

On 06/21/2021 and 06/22/2021, during decommissioning activities, licensed material (Cs-137 and Ni-63) was identified on particulate filters used for airborne sampling of the general area of the Unit 3 Containment Building Equipment Hatch. The containment ventilation was in service; however, it was determined a small amount of licensed material was released offsite from the equipment hatch. The licensed material was quantified at levels below the ODCM required LLDs and the resultant dose and curies are included in this ARERR.

EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 2021 - December 31, 2021

Instrument	Inoperability Period	Inoperability Cause	Explanation
Unit 2 Containment Purge Radiation Monitor 2RE-7828	10/27/2020-01/11/2021	Loss of isokinetic conditions due to reduced process flow caused by clogged exhaust prefilters	Process flow could not be maintained in a range that maintained isokinetic flow conditions. Prefilters were on order with a long lead time.
Unit 2 Turbine Plant Sump Radiation Monitor 2RE-7821, Compositor 2APC-5887 and Flow Totalizer 2FQI-5887	06/21/2021-12/31/2021	Removal of electric power to Unit 2 Turbine Building	Turbine building was electrically isolated for industrial safety purposes in support of demolition work.
Liquid Radwaste Radiation Monitor 2/3RT-7813 and Flow Indicator FE7643	01/01/2021 – 12/31/2021	The Liquid Radwaste Radiation Monitor was intentionally isolated in November 2020 and calibrations were not performed at the scheduled frequencies	No liquid radwaste discharges were planned to occur during 2021 and the monitor was intentionally secured.

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.

Historical groundwater sample data has 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 have historically been found in the shallow ground water situated between the former Unit 1 Containment and Fuel Handling Building, extending towards the seawall. Although these samples indicated the presence of tritium, the sample results were at concentrations below the Environmental Protection Agency drinking water limit of 20,000 pCi/l. Results from 2021 show one detectible tritium result from NIA-5 and no gamma activity in Groundwater Monitoring Well samples.

The site continues to sample and analyze the groundwater monitoring wells in accordance with 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-7, NIA-10, NIA-11, NIA-14, and NIA-15. Results from 2021 identified tritium in NIA-5 groundwater sample greater than MDC but less than LLD.

SAN ONOFRE NUCLEAR GENERATING STATION

SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES (Continued)

January 1, 2021 – December 31, 2021

Location	Sample Date	Tritium Activity pCi/l	Gamma Activity pCi/l
GW-NIA-1	01/28/21	<MDC	N/A
GW-NIA-1	05/17/21	<MDC	N/A
GW-NIA-1	08/16/21	<MDC	N/A
GW-NIA-1	10/28/21	<MDC	N/A
GW-NIA-2	01/27/21	<MDC	N/A
GW-NIA-2	05/20/21	<MDC	N/A
GW-NIA-2	08/09/21	<MDC	N/A
GW-NIA-2	11/01/21	<MDC	N/A
GW-NIA-12	01/27/21	<MDC	N/A
GW-NIA-12	05/20/21	<MDC	N/A
GW-NIA-12	08/09/21	<MDC	N/A
GW-NIA-12	11/01/21	<MDC	N/A
GW-NIA-13	01/27/21	<MDC	N/A
GW-NIA-13	05/17/21	<MDC	N/A
GW-NIA-13	08/16/21	<MDC	N/A
GW-NIA-13	10/28/21	<MDC	N/A
GW-OCA-1	01/21/21	<MDC	N/A
GW-OCA-1	04/28/21	<MDC	N/A
GW-OCA-1	08/05/21	<MDC	N/A
GW-OCA-1	10/27/21	<MDC	N/A
GW-OCA-2	01/21/21	<MDC	N/A
GW-OCA-2	04/19/21	<MDC	N/A
GW-OCA-2	08/04/21	<MDC	N/A
GW-OCA-2	10/21/21	<MDC	N/A
GW-OCA-3	01/18/21	<MDC	N/A
GW-OCA-3	04/29/21	<MDC	N/A
GW-OCA-3	08/02/21	<MDC	N/A
GW-OCA-3	10/20/21	<MDC	N/A
GW-PA-1	01/13/21	<MDC	<MDC
GW-PA-1	05/31/21	<MDC	<MDC
GW-PA-1	07/21/21	<MDC	<MDC
GW-PA-1	11/03/21	<MDC	<MDC
GW-PA-2	01/13/21	<MDC	<MDC

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SAN ONOFRE NUCLEAR GENERATING STATION

SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES (Continued)

January 1, 2021 – December 31, 2021

Location	Sample Date	Tritium Activity pCi/l	Gamma Activity pCi/l
GW-PA-2	05/31/21	<MDC	<MDC
GW-PA-2	07/22/21	<MDC	<MDC
GW-PA-2	11/11/21	<MDC	<MDC
GW-PA-3	01/14/21	<MDC	<MDC
GW-PA-3	05/05/21	<MDC	<MDC
GW-PA-3	07/22/21	<MDC	<MDC
GW-PA-3	11/04/21	<MDC	<MDC
GW-PA-4	01/14/21	<MDC	<MDC
GW-PA-4	05/06/21	<MDC	<MDC
GW-PA-4	07/28/21	<MDC	<MDC
GW-PA-4	11/08/21	<MDC	<MDC
NIA-3	02/10/21	<MDC	N/A
NIA-4	02/04/21	<MDC	N/A
NIA-5	02/10/21	7.35E+02	N/A
NIA-6	02/04/21	<MDC	N/A
NIA-7	02/11/21	<MDC	N/A
NIA-10	02/01/21	<MDC	N/A
NIA-11	02/01/21	<MDC	N/A
NIA-14	02/11/21	<MDC	N/A
NIA-15	02/11/21	<MDC	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

Values above Minimum Detectable Concentration (MDC) are reported as calculated

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 liquid, gaseous particulate and tritium, and noble gas effluent pathways, Total Effective Dose Equivalent (TEDE) resulting from the offshore portion of the U1 Circulating Water System, and direct radiation dose measured using environmental TLDs. 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	7.97E-02
	b. Percent ODCM Specification Limit	%	3.19E-01
2.	Limiting Organ		
	a. Organ Dose (All except thyroid) (Bone)	mrem	7.80E-04
	b. Percent ODCM Specification Limit	%	3.12E-03
3.	Thyroid		
	a. Thyroid Dose	mrem	7.80E-04
	b. Percent ODCM Specification Limit	%	1.04E-03

Note: The 40 CFR 190 dose determination above used TLD dose of 0.00E+00 mrem based on annual dose determination of Not Detected shown in Table 1 on page 24. If using the net dose methodology from the ODCM, Total Body dose would be 6.11E-01 mrem.

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 3 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
2021 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 [Child (bone)], mrem	0

(1) Effective Full Power Year

Note: Units have been shut down since January 9, 2012 for Unit 2 and January 31, 2012 for Unit 3.

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SECTION L. SONGS CONCLUSIONS

1) Gaseous releases (excluding carbon-14) totaled 9.32E-01 curies of which noble gases were 1.73E-04 curies, particulates were 4.80E-04 curies, iodines were 0.00E+00 curies, and tritium was 9.31E-01 curies.

2) The radiation doses from gaseous releases were: (a) gamma air dose: 1.98E-09 mrad at the site boundary, (b) beta air dose: 2.25-E-07 mrad at the site boundary, (c) organ dose (Teen - Skin): 7.80E-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 2 and 3 have been permanently shut down since January 2012.

4) Liquid releases totaled 0.00E+00 curies of which particulates were 0.00E+00 curies, iodines were 0.00E+00 curies, tritium was 0.00E+00 curies, and noble gases were 0.00E+00 curies.

5) The radiation doses from liquid releases were: (a) total body: 0.00E+00 mrem, (b) limiting organ (N/A): 0.00E+00 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) A total of 159 shipments of solid radioactive waste were made from SONGS in 2021 via rail to Energy*Solutions* Clive, Utah disposal site. Two shipments of processed waste were made from Bear Creek Operations on behalf of SONGS in 2021 via tractor trailer to Energy*Solutions* Clive, Utah disposal site. These shipments included 1.04E+04 m^3 (predominantly Dry Active Waste by volume) and 8.62E+00 Ci (predominantly Dry Active Waste and Irradiated Components by activity).

8) 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. One groundwater sample in 2021 indicated detectible concentrations of tritium and is reported in Section K. No groundwater samples indicated detectable concentrations of gamma emitting nuclides. 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 were no groundwater or dewatering well effluent discharges from the site during 2021. The site continues to sample, analyze, and document the results of the groundwater monitoring wells in accordance with the site's Groundwater Monitoring Program.

9) 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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METEOROLOGY

The Offsite Dose Calculation Manual (ODCM) has required the use of concurrent meteorology since its inception. This is appropriate and reasonable for an operating reactor site that performs intermittent and varied releases, specifically batch waste gas releases and containment ventilation.

Units 2 and 3 ceased commercial operation in January 2012. Fuel was removed from both reactors and placed in the Spent Fuel Pools and, as of 2020, all fuel has been transferred to the ISFSI. The Gaseous Radwaste System (GRWS) was removed from service in November 2015. Containment ventilation operation was changed in 2018 to establish the containment ventilation as a continuous release pathway. Therefore, gaseous batch releases are no longer performed. All gaseous releases are now continuous.

Based on the guidance provided in Regulatory Guide 1.111 and NUREG-0133 and considering current station conditions, it is reasonable and acceptable to utilize historical meteorology rather than concurrent meteorology. To support this change, an evaluation of SONGS historical meteorology was performed in 2020, along with an independent evaluation of the need for concurrent meteorology. The results of those evaluations support the removal of concurrent meteorology requirements from the ODCM.

Since the weather patterns have not substantially changed and the deposition and dispersion coefficients have been updated with recent data, and batch releases are no longer performed at SONGS, the use of historical meteorology is the preferred method for determining offsite dose. As such, the meteorological tower is no longer needed for the purpose of routine release calculations.

Alternate Meteorology Data

In the case of an event having the potential of a radiological release during decommissioning, it is prudent to have some method for determining actual meteorological conditions to ensure accurate calculations. Additionally, the historical weather will be evaluated over time to ensure conditions do not significantly change. In order to meet these two conditions, alternate local sources of weather data were evaluated. The weather station with the most favorable data as compared to SONGS was found to be KNXF, Mcolf Camp Pendleton (Red Beach) Airport; this station has similar elevation and distance to the shoreline. The data from the two stations tracked reasonably well and it has been concluded that this other station can be used for alternate weather data in the future.