



SAN ONOFRE NUCLEAR GENERATING STATION

Annual Radioactive Effluent Release Report

1998

January - December

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PREFACE

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

Unit 1, rated at 410 net megawatts electrical, was supplied by Westinghouse Electric Company and began commercial operation on January 1, 1968. The unit was permanently shutdown on November 30, 1992. It is owned by Southern California Edison (80%) and San Diego Gas and Electric (20%).

Unit 2 and Unit 3 were supplied by Combustion Engineering, Inc., with turbine generators supplied by G.E.C. Turbine Generators, Ltd., of England. The units began commercial operation on August 18, 1983, and April 1, 1984, respectively and are rated at 1127 net megawatts electrical each. The twin units are owned by Southern California Edison (75.05%), San Diego Gas and Electric (20%), City of Anaheim (3.16%), and the City of Riverside (1.79%).

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SECTION A. INTRODUCTION

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

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

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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 Unit 1 does not conduct elevated releases.

Table 1C, "Gaseous Effluents-Ground Level Releases," provides the systematic listing of radionuclide for the quantity of radioactivity released in three categories: fission gases, iodines, and particulates. The total radioactivity for each radionuclide is listed for each quarterly period by "continuous" mode of release. Plant stack releases are considered to be "continuous" releases. As of 8/4/93, "batch" mode releases are no longer conducted because of the permanent shutdown of the reactor.

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 for continuous mode releases only.

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," has been deleted. "Batch" mode releases are no longer conducted as of 8/4/93, due to the permanent shutdown of the reactor.

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TABLE 1A

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	First Quarter	Second Quarter	Estimated Total Error, %
A. Fission and activation gases				
1. Total release	Ci	<LLD	<LLD	3.00E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
B. Iodines				
1. Total iodine-131	Ci	<LLD	<LLD	1.90E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
C. Particulates				
1. Particulates with half-lives >8 days	Ci	<LLD	<LLD	1.60E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
5. Gross alpha activity	Ci	<LLD	<LLD	5.00E+1
D. Tritium				
1. Total release	Ci	4.12E-1	<LLD	2.50E+1
2. Average release rate for period	μCi/sec	5.30E-2	0.00E0	
3. Percent of applicable limit	% MPC	3.44E-4	0.00E0	
4. Percent Effluent Concentration Limit	% ECL	6.89E-4	0.00E0	

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TABLE 1A (Continued)

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation gases				
1. Total release	Ci	<LLD	<LLD	3.00E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
B. Iodines				
1. Total iodine-131	Ci	<LLD	<LLD	1.90E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
C. Particulates				
1. Particulates with half-lives >8 days	Ci	<LLD	<LLD	1.60E+1
2. Average release rate for period	μCi/sec	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
5. Gross alpha activity	Ci	1.03E-7	8.71E-8	5.00E+1
D. Tritium				
1. Total release	Ci	<LLD	1.20E+0	2.50E+1
2. Average release rate for period	μCi/sec	0.00E+0	1.51E-1	
3. Percent of applicable limit	% MPC	0.00E+0	9.81E-4	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	1.96E-3	

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TABLE 1C

GASEOUS EFFLUENTS-GROUND LEVEL RELEASES
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
krypton-85	Ci	<LLD	<LLD	<LLD	<LLD
krypton-85m	Ci	<LLD	<LLD	<LLD	<LLD
krypton-87	Ci	<LLD	<LLD	<LLD	<LLD
krypton-88	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-138	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
2. Iodines					
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iodine-133	Ci	<LLD	<LLD	<LLD	<LLD
iodine-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
3. Particulates					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<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.

NOTE: Due to the permanent shutdown of S.O.N.G.S. 1, "BATCH MODE" releases are no longer conducted.

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TABLE 1D

GASEOUS EFFLUENTS-LOWER LIMIT OF DETECTION
CONTINUOUS MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation gases	
krypton-85	2.00E-5
krypton-85m	4.80E-8
krypton-87	2.50E-7
krypton-88	1.70E-7
xenon-133	1.20E-7
xenon-133m	3.90E-7
xenon-135	5.00E-8
xenon-135m	2.00E-6
xenon-138	3.30E-6
2. Iodines	
iodine-131	1.90E-13
iodine-133	1.20E-12
iodine-135	3.20E-11
3. Particulates	
barium-140	4.60E-13
cerium-141	5.80E-14
cerium-144	2.40E-13
cesium-134	1.40E-13
cesium-137	1.10E-13
cobalt-58	1.30E-13
cobalt-60	2.00E-13
iron-59	3.10E-13
lanthanum-140	7.60E-13
manganese-54	1.30E-13
molybdenum-99	6.10E-14
strontium-89	1.00E-14
strontium-90	1.00E-15
zinc-65	3.30E-13
4. gross alpha	1.00E-14

TE: Due to the permanent shutdown of S.O.N.G.S. 1, "BATCH MODE" releases are no longer conducted.

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TABLE 1E

GASEOUS EFFLUENTS-RADIATION DOSES AT THE SITE BOUNDARY

	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Noble Gas					
1. Gamma Air Dose	mrad	0.00E+0	0.00E+0	0.00E+0	0.00E+0
2. Percent Applicable Limit	%	0.00E+0	0.00E+0	0.00E+0	0.00E+0
3. Beta Air Dose	mrad	0.00E+0	0.00E+0	0.00E+0	0.00E+0
4. Percent Applicable Limit	%	0.00E+0	0.00E+0	0.00E+0	0.00E+0
B. Tritium, Iodine, Particulates (at the nearest receptor)					
1. Organ Dose	mrem	1.88E-5	0.00E+0	0.00E+0	5.47E-5
2. Percent Applicable Limit	%	2.51E-4	0.00E+0	0.00E+0	7.29E-4

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

TABLE 1F

GASEOUS EFFLUENTS-BATCH RELEASE SUMMARY

NOTE: Due to the permanent shutdown of S.O.N.G.S. 1, "BATCH MODE" releases are no longer conducted.

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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 Unit 1.

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TABLE 2A

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	First Quarter	Second Quarter	Estimated Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, gases, alpha)	Ci	2.98E-4	1.65E-6	1.90E+1
2. Average diluted concentration during period	μCi/ml	1.99E-10	1.08E-12	
3. Percent of applicable limit	% MPC	3.31E-4	1.80E-6	
4. Percent Effluent Concentration Limit	% ECL	1.99E-2	1.08E-4	
B. Tritium				
1. Total release	Ci	9.60E-3	<LLD	1.90E+1
2. Average diluted concentration during period	μCi/ml	6.40E-9	0.00E+0	
3. Percent of applicable limit	% MPC	2.13E-4	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	6.40E-4	0.00E+0	
C. Dissolved and entrained gases				
1. Total release	Ci	<LLD	<LLD	1.90E+1
2. Average diluted concentration during period	μCi/ml	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	5.00E+1
E. Volume of waste released (batch & continuous, prior to dilution)				
	liters	1.57E+7	9.27E+6	5.00E+0
F. Volume of dilution water used during period				
	liters	1.50E+9	1.53E+9	5.00E+0

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TABLE 2A (Continued)

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, gases, alpha)	Ci	3.14E-5	2.31E-4	1.90E+1
2. Average diluted concentration during period	$\mu\text{Ci/ml}$	1.74E-11	1.54E-10	
3. Percent of applicable limit	% MPC	3.93E-5	2.57E-4	
4. Percent Effluent Concentration Limit	% ECL	1.24E-3	1.54E-2	
B. Tritium				
1. Total release	Ci	<LLD	<LLD	1.90E+1
2. Average diluted concentration during period	$\mu\text{Ci/ml}$	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
C. Dissolved and entrained gases				
1. Total release	Ci	<LLD	<LLD	1.90E+1
2. Average diluted concentration during period	$\mu\text{Ci/ml}$	0.00E+0	0.00E+0	
3. Percent of applicable limit	% MPC	0.00E+0	0.00E+0	
4. Percent Effluent Concentration Limit	% ECL	0.00E+0	0.00E+0	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	5.00E+1
E. Volume of waste released (batch & continuous, prior to dilution)				
	liters	6.47E+5	2.56E+6	5.00E+0
F. Volume of dilution water used during period				
	liters	1.80E+9	1.50E+9	5.00E+0

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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	1.02E-6	<LLD
cesium-137	Ci	2.98E-4	1.65E-6	2.07E-5	2.31E-4
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	9.68E-6	<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	2.98E-4	1.65E-6	3.14E-5	2.31E-4
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.

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

LLD Lower Limit of Detection; see Table 2C.

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TABLE 2C

LIQUID EFFLUENTS-LOWER LIMIT OF DETECTION
CONTINUOUS MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation products	
barium-140	4.10E-7
cerium-141	6.70E-8
cerium-144	2.70E-7
cesium-134	1.10E-7
chromium-51	4.70E-7
cobalt-58	9.70E-8
cobalt-60	1.40E-7
iodine-131	8.10E-8
iron-55	1.00E-6
iron-59	2.30E-7
lanthanum-140	7.50E-7
manganese-54	9.60E-8
molybdenum-99	8.80E-8
niobium-95	9.70E-8
strontium-89	5.00E-8
strontium-90	1.00E-8
technetium-99m	9.00E-8
zinc-65	2.40E-7
zirconium-95	1.70E-7
2. Dissolved and entrained gases	
xenon-133	3.00E-7
xenon-135	1.30E-7
3. gross alpha	1.00E-7

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TABLE 2C (Continued)

LIQUID EFFLUENTS-LOWER LIMIT OF DETECTION
BATCH MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation products	
barium-140	3.20E-7
cerium-141	6.10E-8
cerium-144	2.70E-7
cesium-134	1.10E-7
cesium-137	9.10E-8
chromium-51	4.20E-7
cobalt-58	9.30E-8
cobalt-60	1.40E-7
iodine-131	5.70E-8
iron-55	1.00E-6
iron-59	2.10E-7
lanthanum-140	1.70E-7
manganese-54	9.50E-8
molybdenum-99	3.40E-8
niobium-95	8.90E-8
strontium-89	5.00E-8
strontium-90	1.00E-8
technetium-99m	3.40E-8
zinc-65	2.40E-7
zirconium-95	1.60E-7
2. Dissolved and entrained gases	
xenon-133	3.00E-7
xenon-135	1.30E-7
3. gross alpha	
	1.00E-7

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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	2.70E-3	1.70E-5	2.39E-4	2.28E-3
2. Percent Applicable Limit	%	1.80E-1	1.14E-3	1.59E-2	1.52E-1
B.					
1. Limiting organ dose	mrem	4.13E-3	2.60E-5	3.43E-4	3.48E-3
2. Percent Applicable Limit	%	8.26E-2	5.20E-4	6.85E-3	6.95E-2
3. Limiting organ for period		Liver	Liver	Liver	Liver

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TABLE 2E

LIQUID EFFLUENTS-BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	0 release
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:	0 gpm

SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

None

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SECTION E. RADWASTE SHIPMENTS

TABLE 3

SOLID WASTE AND IRRADIATED FUEL SHIPMENT

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

1. Type of waste	Unit	12 month period	Estimated total error (%)
a. Spent resins, filter sludges, evaporator bottoms	m ³	N/A	N/A
	Ci	N/A	
b. Dry compressible waste, contaminated equipment	m ³	N/A	N/A
	Ci	N/A	
c. Irradiated components, control rods	m ³	N/A	N/A
	Ci	N/A	
d. Other	m ³	N/A	N/A
	Ci	N/A	

N/A No shipment made.

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

3. Solid Waste Disposition

See COMMON section of this report

B. IRRADIATED FUEL SHIPMENTS (Disposition)

See COMMON section of this report

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SECTION F. APPLICABLE LIMITS

Gaseous Effluents - Applicable Limits

The percent of Applicable Limits, tabulated in Sections A.3, B.3, C.3, and D.3 of Table 1A, was calculated using the following equation:

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

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

X/Q = $1.30\text{E-}5 \text{ sec/m}^3$; the annual average atmospheric dispersion defined in the Unit 1 ODCM, Rev. 13.

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

where: F_i = fractional abundance 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.

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

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

X/Q = $1.30\text{E-}5 \text{ sec/m}^3$; the annual average atmospheric dispersion defined in the Unit 1 ODCM, Rev. 13.

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

where: F_i = fractional abundance 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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Liquid Effluents - Applicable Limits

The percent of Applicable Limits, tabulated in Sections A.3, B.3, and C.3 of Table 2A, were calculated using the following equations:

- $\% \text{ Applicable Limit} = \frac{(\text{Dil Conc}) (100)}{\text{MPC}_{\text{eff}}}$
 - where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, $\mu\text{Ci/ml}$.

- $\text{MPC}_{\text{eff}} = \frac{1}{\sum_{i=1}^n \frac{F_i}{\text{MPC}_i}}$
 - where: F_i = fractional abundance of the i^{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 Table II, Column 2.

- $\% \text{ ECL} = \frac{(\text{Dil Conc}) (100)}{\text{ECL}_{\text{eff}}}$
 - where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, $\mu\text{Ci/ml}$.

- $\text{ECL}_{\text{eff}} = \frac{1}{\sum_{i=1}^n \frac{F_i}{\text{ECL}_i}}$
 - where: F_i = fractional abundance of the i^{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 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

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

For 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. For members of the public who traverse the site boundary via highway I-5, the residency time shall be considered negligible and hence the dose "0".

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 1

TABLE 1

SOURCE	Dose * (millirems)				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS	1)	2)	3)	4)	5)
Whole Body	2.70E-3	1.70E-5	2.39E-4	2.28E-3	5.24E-3
Organ	6)	7)	8)	9)	10)
Organ	4.13E-3	2.60E-5	3.43E-4	3.48E-3	7.98E-3
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	2.06E-4	0.00E+0	0.00E+0	3.05E-4	5.11E-4
NOBLE GASES **	16)	17)	18)	19)	20)
Gamma	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Beta	21)	22)	23)	24)	25)
Beta	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
DIRECT RADIATION	26)	27)	28)	29)	30)
DIRECT RADIATION	1.23E-1	1.60E-1	1.69E-1	1.29E-1	5.80E-1

* 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 data was calculated using the methodology of the ODCM.

2. This data was calculated using the methodology of the ODCM.

3. This data was calculated using the methodology of the ODCM.

4. This data was calculated using the methodology of the ODCM.

5. This data was calculated using the methodology of the ODCM.

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6. This data was calculated using the methodology of the ODCM; the liver received the maximum dose primarily by the saltwater fish pathway.
7. This data was calculated using the methodology of the ODCM; the liver received the maximum dose primarily by the saltwater fish pathway.
8. This data was calculated using the methodology of the ODCM; the liver received the maximum dose primarily by the saltwater fish pathway.
9. This data was calculated using the methodology of the ODCM; the liver received the maximum dose primarily by the saltwater fish pathway.
10. This data was calculated using the methodology of the ODCM; the liver received the maximum dose primarily by the saltwater fish pathway.
11. The maximum organ dose was to a child's thyroid and was located in the NW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
12. There was no activity detected during the release period, therefore the reported organ dose was 0.00E+0 mrem.
13. There was no activity detected during the release period, therefore the reported organ dose was 0.00E+0 mrem.
14. The maximum organ dose was to a child's thyroid and was located in the NW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
15. The maximum organ dose was to a child's thyroid and was located in the NW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
16. There was no activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+0 mrad.
17. There was no activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+0 mrad.
18. There was no activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+0 mrad.
19. There was no activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+0 mrad.
20. There was no activity detected during the release period, therefore the reported air dose for gamma radiation was 0.00E+0 mrad.
21. There was no activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+0 mrad.
22. There was no activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+0 mrad.
23. There was no activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+0 mrad.
24. There was no activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+0 mrad.

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- There was no activity detected during the release period, therefore the reported air dose for beta radiation was 0.00E+0 mrad.
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 W 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 N 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 NE 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 S 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 as a composite of the highest sectors for each quarter.

TABLE 2

SOURCE	Percent Applicable Limit				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	1.80E-1	1.14E-3	1.59E-2	1.52E-1	1.75E-1
Organ	8.26E-2	5.20E-4	6.85E-3	6.95E-2	7.98E-2
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	2.75E-3	0.00E+0	0.00E+0	4.07E-3	3.41E-3
NOBLE GASES					
Gamma	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Beta	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 1

SECTION I. CHANGES TO OFFSITE DOSE CALCULATION MANUAL

On February 27, 1998, revision 13 to the Unit 1 Offsite Dose Calculation Manual (ODCM) was adopted and published. Incorporated into this revision were:

1. changes due to the 1997 Land Use Census;
2. changes in reporting requirements for the Radiological Environmental Monitoring Program to reflect the guidance of NUREG 0472;
3. removal of references to a 1994 memo by P.K. Chang on sampling of airborne discharge paths;
4. removal of R1219/20/21;
5. changes in frequency for compensatory action for process flow monitors.

Safety evaluations were generated for the last four items. Per NRC Generic Letter 89-01, no safety review was required or performed for editorial changes or changes due to the annual Land Use Census.

The following is a complete list of changes:

Page	CHANGE
	Removed the following previously blank pages. Page number given is the old page number from Rev. 11: 1-17, 1-20, 2-11, 2-16, 2-17, 2-18, 2-29, 2-42, 2-43, 2-46, 2-49, 2-54, 2-57, 2-69
TOC	Table of Contents - Update page numbers due to removal of previously blank pages
1-11	Removed circ pump flow values from definition of F, reduced Salt Pump flow from 3500 to 3000
1-14	Reduced Salt Pump flow from 3500 to 3000
1-14	Changed equations to allow only one rad waste tank release at a time, format
1-21	Updated radiation monitor calibration constants due to routine maintenance
2-12	Deleted RT-1219. Pages intentionally blank.
2-28	Updated Controlling Locations Factors and Uses mostly due to Outage Workers
2-30	Sector P, decreased adult occupancy from 2000 hr/yr to 667 hr/yr for Surf Beach lifeguard
2-31	Sector P, moved "51 Area" Beach Check-In to Sector Q. Page left intentionally blank
2-33	Sector Q, Surf Beach/Guard Shack, updated child and teen inhalation pathway
	Sector Q, added Outage Workers for transient plant workers
2-35	Sector Q, increased adult occupancy for Recreation Building Staff from 2000 hr/yr to 6 month residence
	Sector Q, moved "51 Area" Beach Check-In from Sector P
2-40	Sector Q, replaced residential use, no garden with new residential garden. Changed X/Q and D/Q
2-44	Sector R, revised distance resulting in changed D/Q and X/Q for San Clemente Ranch
2-45	Sector R, decreased adult occupancy from 3500 hr/yr to 3380 hr/yr for SC Ranch Packing Personnel
2-52	Sector C, Camp San Onofre Fr Stn distance from 2.5 to 2.6 miles
2-60	Sector E, revised distance resulting in changed D/Q and X/Q for Sheep Meat/Shepherd
2-63	Sector F, revised distance resulting in changed D/Q and X/Q for Sheep Meat/Shepherd
2-59	Sector G, decreased adult occupancy from 8760 hr/yr to 2000 hr/yr for beach lifeguard (resident)
4-3	Changed action 20 from 4 hours to 12 hours for process flow, split requirement into process flow and sample flow
4-8	Removed Radiation Monitors R-1219 and 1221, Removed Clarification Letter 14.
4-11	Removed Radiation Monitors R-1219 and 1221
4-13	Changed drawing to reflect actual plant configuration and operation
4-14	Changed drawing to reflect actual plant configuration and operation
4-15	Changed drawing to reflect actual plant configuration and operation
5-2	Reworded action 5.1.1.b per E Goldin Memo
5-2	Reworded actions 5.2.1.b.1 and .2 per E Goldin Memo

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 1

- 18 Deleted Huntington Beach Generating Station, Changed San Clemente General Hospital to Samaritan Hospital, Changed several distances and directions based on GPS information
- 5-19 Changed several distances based on GPS information
- 5-20 Added Oceanside City Hall (Backup CONTROL) to replace Huntington Beach, Changed several distances and directions based on GPS information
- 5-21 Deleted Camp San Onofre, Huntington Beach Generating Station, and Units 2 and 3 SwitchYard. Added Mesa Medical Facility and Oceanside City Hall. Changed several distances and directions based on GPS information
- 5-22 Deleted Huntington Beach (CONTROL), added Oceanside (CONTROL). Changed several distances and directions based on GPS information, deleted Cotton point Estates Gardens from Local Crops section
- 5-23 Changed several distances and directions based on GPS information
- 5-26 Added a new 1 mile radius map

SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

- There were no changes to the Unit 1 Radioactive Waste Treatment Systems during the reporting period, January 1, 1998 to December 31, 1998.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 1

SECTION K. MISCELLANEOUS

• Unplanned, Uncontrolled Release from Yard Drain Sump (YDS)

The Unit 1 Yard Drain sump overflowed to the PMF Catch Basis due to heavy rainfall on 13 occasions in 1998:

Start Date/Time	Stop Date/Time	Duration (minutes)	Activity ($\mu\text{Ci/ml}$)	Estimated Release (curies)	Estimated Whole Body Dose (mrem)	Estimated Liver Dose (mrem)
02/03/98 @ 0853	02/03/98 @ 1058	125	<LLD	0.00E+0	0.00E+0	0.00E+0
02/06/98 @ 1331	02/06/98 @ 1401	30	<LLD	0.00E+0	0.00E+0	0.00E+0
02/14/98 @ 1253	02/14/98 @ 1347	54	<LLD	0.00E+0	0.00E+0	0.00E+0
02/19/98 @ 2248	02/19/98 @ 2303	15	<LLD	0.00E+0	0.00E+0	0.00E+0
02/23/98 @ 0815	02/23/98 @ 0839	24	<LLD	0.00E+0	0.00E+0	0.00E+0
02/23/98 @ 1815	02/23/98 @ 1844	29	<LLD	0.00E+0	0.00E+0	0.00E+0
02/23/98 @ 1958	02/23/98 @ 2032	34	<LLD	0.00E+0	0.00E+0	0.00E+0
02/23/98 @ 2050	02/23/98 @ 2243	113	<LLD	0.00E+0	0.00E+0	0.00E+0
02/23/98 @ 2318	02/24/98 @ 0006	48	<LLD	0.00E+0	0.00E+0	0.00E+0
03/25/98 @ 1247	03/25/98 @ 1315	28	5.11E-8	7.52E-5	8.66E-4	1.32E-3
04/11/98 @ 1842	04/11/98 @ 1854	12	<LLD	0.00E+0	0.00E+0	0.00E+0
05/05/98 @ 1026	05/05/98 @ 1058	32	<LLD	0.00E+0	0.00E+0	0.00E+0
11/08/98 @ 0636	11/08/98 @ 0651	15	1.20E-7	1.95E-4	1.93E-3	2.94E-3

Based on conservative assumptions, there were no significant dose consequences as a result of these releases.

EFFLUENT RADIATION MONITORS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 1998 - December 31, 1998

S.O.N.G.S. 1			
Monitor	Inoperability Period	Inoperability Cause	Explanation
R-1254 Plant Vent Stack Monitor	02/07/96 - 6/1/98	Heat trace inoperable	Required electrical panel rework and parts replacement. Radiation monitor remained functional.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 1

SECTION L. S.O.N.G.S. 1 CONCLUSIONS

- Gaseous releases totaled $1.61\text{E}+0$ curies of which noble gases were $0.00\text{E}+0$ curies, iodines were $0.00\text{E}+0$ curies, particulates were $0.00\text{E}+0$ curies, and tritium was $1.61\text{E}+0$ curies.
- The radiation doses from gaseous releases were: (a) gamma air dose: $0.00\text{E}+0$ mrad at the site boundary, (b) beta air dose: $0.00\text{E}+0$ mrad at the site boundary, organ dose: $5.11\text{E}-4$ mrem at the nearest receptor.
- Liquid releases totaled $1.02\text{E}-2$ curies of which particulates and iodines were $5.62\text{E}-4$ curies, tritium was $9.60\text{E}-3$ curies, and noble gases were $0.00\text{E}+0$ curies.
- The radiation doses from liquid releases were: (a) total body: $5.24\text{E}-3$ mrem, (b) limiting organ: $7.98\text{E}-3$ mrem.
- The radioactive releases and resulting doses generated from Unit 1 were below the Applicable Limits for both gaseous and liquid effluents.

S.O.N.G.S. 2 and 3



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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

January - December

SECTION A. INTRODUCTION

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

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

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 of radionuclide for the quantity of radioactivity released in three categories: fission gases, iodines, and particulates. The total radioactivity for each radionuclide is listed for each quarterly period by both "continuous" and "batch" modes of release.

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

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

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

Table 1F, "Gaseous Effluents-Batch Release Summary," provides summary information regarding batch releases conducted during this report period from San Onofre Nuclear Generating Station Units 2 and 3.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1A

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	First Quarter	Second Quarter	Estimated Total Error, %
A. Fission and activation gases				
1. Total release	Ci	1.62E+2	6.45E+1	3.00E+1
2. Average release rate for period	μCi/sec	2.08E+1	8.20E+0	
3. Percent of applicable limit	% MPC	3.85E-2	1.34E-2	
4. Percent Effluent Concentration Limit	% ECL	4.36E-2	9.03E-3	
B. Iodines ⁽¹⁾				
1. Total iodine-131	Ci	9.93E-3	4.94E-5	1.90E+1
2. Average release rate for period	μCi/sec	1.28E-3	6.28E-6	
3. Percent of applicable limit	% MPC	6.13E-3	3.02E-5	
4. Percent Effluent Concentration Limit	% ECL	3.06E-3	1.51E-5	
C. Particulates ⁽¹⁾				
1. Particulates with half-lives >8 days	Ci	5.57E-5	1.01E-5	1.60E+1
2. Average release rate for period	μCi/sec	7.17E-6	1.29E-6	
3. Percent of applicable limit	% MPC	4.35E-6	3.42E-7	
4. Percent Effluent Concentration Limit	% ECL	1.87E-5	8.38E-7	
5. Gross alpha activity	Ci	7.68E-8	8.04E-7	5.00E+1
D. Tritium				
1. Total release	Ci	2.26E+1	2.95E+0	2.50E+1
2. Average release rate for period	μCi/sec	2.91E+0	3.75E-1	
3. Percent of applicable limit	% MPC	6.98E-3	9.00E-4	
4. Percent Effluent Concentration Limit	% ECL	1.40E-2	1.80E-3	

(1) Unit 3 Condenser Air Ejector particulate and iodine samples from 3/6/98 @ 1643 to 3/8/98 @ 0348 were collected. The unit was in Mode 4 and there was no measurable activity in the previous samples. The incident is documented in AR 980400912.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1A (Continued)

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation gases				
1. Total release	Ci	1.25E+2	7.22E+1	3.00E+1
2. Average release rate for period	μCi/sec	1.57E+1	9.08E+0	
3. Percent of applicable limit	% MPC	2.54E-2	2.19E-2	
4. Percent Effluent Concentration Limit	% ECL	1.64E-2	3.28E-2	
B. Iodines				
1. Total iodine-131	Ci	1.78E-3	4.87E-4	1.90E+1
2. Average release rate for period	μCi/sec	2.24E-4	6.13E-5	
3. Percent of applicable limit	% MPC	1.07E-3	2.94E-4	
4. Percent Effluent Concentration Limit	% ECL	5.37E-4	1.47E-4	
C. Particulates ⁽²⁾				
1. Particulates with half-lives >8 days	Ci	7.70E-6	4.80E-6	1.60E+1
2. Average release rate for period	μCi/sec	9.69E-7	6.04E-7	
3. Percent of applicable limit	% MPC	2.38E-7	9.77E-7	
4. Percent Effluent Concentration Limit	% ECL	4.65E-7	5.80E-6	
5. Gross alpha activity	Ci	8.63E-7	1.61E-6	5.00E+1
D. Tritium				
1. Total release	Ci	2.18E+0	3.03E-1	2.50E+1
2. Average release rate for period	μCi/sec	2.74E-1	3.81E-2	
3. Percent of applicable limit	% MPC	6.58E-4	9.15E-5	
4. Percent Effluent Concentration Limit	% ECL	1.32E-3	1.83E-4	

Unit 3 Condenser Air Ejector particulate filter from 10/26/98 @ 1609 to 10/29/98 @ 0735 was improperly installed. There was no measurable activity in the previous or subsequent samples. This incident is documented in AR 981002021.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1C

GASEOUS EFFLUENTS-GROUND LEVEL RELEASES
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
argon-41	Ci	3.89E+0	1.97E-1	2.33E-1	3.02E+0
krypton-85	Ci	<LLD	<LLD	<LLD	<LLD
krypton-85m	Ci	<LLD	8.40E-5	<LLD	<LLD
krypton-87	Ci	<LLD	<LLD	<LLD	<LLD
krypton-88	Ci	<LLD	<LLD	<LLD	<LLD
xenon-131m	Ci	<LLD	<LLD	6.01E-2	<LLD
xenon-133	Ci	1.50E+2	6.38E+1	1.24E+2	5.90E+1
xenon-133m	Ci	4.02E-1	<LLD	4.42E-1	<LLD
xenon-135	Ci	1.84E-1	<LLD	3.99E-2	8.39E+0
xenon-135m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-138	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.55E+2	6.40E+1	1.25E+2	7.04E+1
2. Iodines					
iodine-131	Ci	9.93E-3	4.94E-5	1.78E-3	4.87E-4
iodine-132	Ci	4.73E-3	<LLD	2.29E-5	3.77E-5
iodine-133	Ci	2.98E-4	5.99E-5	1.59E-4	1.92E-4
iodine-135	Ci	1.29E-6	<LLD	<LLD	<LLD
Total for period	Ci	1.50E-2	1.09E-4	1.96E-3	7.17E-4

LLD Lower Limit of Detection; see Table 1D.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1C (Continued)

GASEOUS EFFLUENTS-GROUND LEVEL RELEASES
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
3. Particulates					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
bromine-82	Ci	1.01E-4	2.61E-5	2.85E-5	2.06E-4
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	3.93E-6	<LLD	<LLD	<LLD
cesium-138	Ci	<LLD	<LLD	1.36E-5	<LLD
cobalt-58	Ci	3.75E-5	9.96E-6	7.70E-6	<LLD
cobalt-60	Ci	1.21E-5	1.88E-7	<LLD	4.80E-6
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	1.64E-6	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
rubidium-88	Ci	5.82E-4	5.58E-6	<LLD	9.54E-6
strontium-89	Ci	5.68E-7	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
strontium-92	Ci	<LLD	<LLD	1.95E-7	<LLD
technetium-99m	Ci	<LLD	<LLD	2.80E-8	<LLD
yttrium-92	Ci	2.36E-5	1.57E-5	2.26E-5	8.07E-6
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 1D.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1C (Continued)

GASEOUS EFFLUENTS-GROUND LEVEL RELEASES
 BATCH MODE *

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
krypton-85	Ci	4.00E-1	4.76E-1	4.02E-1	1.79E+0
krypton-85m	Ci	<LLD	<LLD	<LLD	<LLD
krypton-87	Ci	<LLD	<LLD	<LLD	<LLD
krypton-88	Ci	<LLD	<LLD	<LLD	<LLD
xenon-131m	Ci	1.12E-1	<LLD	<LLD	<LLD
xenon-133	Ci	6.30E+0	3.04E-3	<LLD	7.64E-3
xenon-133m	Ci	4.21E-2	<LLD	<LLD	<LLD
xenon-135	Ci	2.77E-4	<LLD	<LLD	<LLD
xenon-135m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-138	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	6.86E+0	4.79E-1	4.02E-1	1.80E+0

LLD Lower Limit of Detection; see Table 1D.

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1D

GASEOUS EFFLUENTS-LOWER LIMIT OF DETECTION
CONTINUOUS MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation gases	
krypton-85	2.00E-5
krypton-85m	4.80E-8
krypton-87	2.50E-7
krypton-88	1.70E-7
xenon-131m	1.60E-6
xenon-133m	3.90E-7
xenon-135	5.00E-8
xenon-135m	2.00E-6
xenon-138	3.30E-6
2. Iodines	
iodine-132	2.00E-11
iodine-135	3.20E-11
3. Particulates	
barium-140	2.90E-13
cerium-141	3.60E-14
cerium-144	1.50E-13
cesium-134	8.70E-14
cesium-137	7.10E-14
cesium-138	6.10E-10
cobalt-58	7.80E-14
cobalt-60	1.20E-13
iron-59	1.90E-13
lanthanum-140	4.70E-13
manganese-54	7.80E-14
molybdenum-99	3.80E-14
rubidium-88	4.30E-08
strontium-89	1.00E-13
strontium-90	1.00E-14
strontium-92	1.10E-11
technicium-99m	4.50E-13
zinc-65	2.10E-13

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1D (Continued)

GASEOUS EFFLUENTS-LOWER LIMIT OF DETECTION
BATCH MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation gases	
krypton-85m	2.60E-6
krypton-87	1.30E-5
krypton-88	9.20E-6
xenon-131m	9.40E-5
xenon-133	6.80E-6
xenon-133m	2.30E-5
xenon-135	3.00E-6
xenon-135m	4.00E-5
xenon-138	5.70E-5

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1E

GASEOUS EFFLUENTS-RADIATION DOSES AT THE SITE BOUNDARY

	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Noble Gas					
1. Gamma Air Dose	mrad	1.40E-2	3.70E-3	7.01E-3	9.90E-3
2. Percent Applicable Limit	%	1.40E-1	3.70E-2	7.01E-2	9.90E-2
3. Beta Air Dose	mrad	2.72E-2	1.04E-2	2.01E-2	1.46E-2
4. Percent Applicable Limit	%	1.36E-1	5.22E-2	1.01E-1	7.32E-2
B. Tritium, Iodine, Particulates (at the nearest receptor)					
1. Organ Dose	mrem	5.21E-3	1.19E-4	1.11E-3	3.21E-4
2. Percent Applicable Limit	%	3.47E-2	7.94E-4	7.41E-3	2.14E-3

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 1F

GASEOUS EFFLUENTS-BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	8 releases
2. Total time period for batch releases:	3130 minutes
3. Maximum time period for a batch release:	508 minutes
4. Average time period for a batch release:	391 minutes
5. Minimum time period for a batch release:	312 minutes

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

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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 Units 2 and 3.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 2A

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	First Quarter	Second Quarter	Estimated Total Error, %
A. Fission and activation products ⁽¹⁾				
1. Total release (not including tritium, gases, alpha)	Ci	5.66E-2	4.30E-2	1.90E+1
2. Average diluted concentration during period	μCi/ml	8.92E-11	5.68E-11	
3. Percent of applicable limit	% MPC	2.77E-4	1.45E-4	
4. Percent Effluent Concentration Limit	% ECL	7.31E-4	3.74E-4	
B. Tritium ⁽¹⁾				
1. Total release	Ci	3.49E+2	3.31E+2	1.90E+1
2. Average diluted concentration during period	μCi/ml	5.51E-7	4.38E-7	
3. Percent of applicable limit	% MPC	1.84E-2	1.46E-2	
4. Percent Effluent Concentration Limit	% ECL	5.51E-2	4.38E-2	
C. Dissolved and entrained gases				
1. Total release	Ci	1.12E-2	5.39E-2	1.90E+1
2. Average diluted concentration during period	μCi/ml	1.77E-11	7.13E-11	
3. Percent of applicable limit	% MPC	8.83E-6	3.56E-5	
4. Percent Effluent Concentration Limit	% ECL	8.83E-6	3.56E-5	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	5.00E+1
E. Volume of waste released (batch & continuous, prior to dilution)				
	liters	6.09E+7	6.55E+7	5.00E+0
F. Volume of dilution water used during period				
	liters	6.34E+11	7.56E+11	5.00E+0

(1) An individual daily sample was not included in the Unit 3 Turbine Plant Sump weekly composite for weeks 1/5/98-1/12/98 and 1/12/98-1/19/98. There was no measurable activity in the resulting composites and the previous or subsequent weeks' composites. These incidents are documented in AR 980201803 and AR 9802011810.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 2A (Continued)

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	Third Quarter	Fourth Quarter	Estimated Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, gases, alpha)	Ci	7.24E-2	4.29E-2	1.90E+1
2. Average diluted concentration during period	μCi/ml	9.67E-11	5.53E-11	
3. Percent of applicable limit	% MPC	3.62E-4	1.75E-4	
4. Percent Effluent Concentration Limit	% ECL	1.49E-3	4.63E-4	
B. Tritium				
1. Total release	Ci	3.78E+2	4.77E+2	1.90E+1
2. Average diluted concentration during period	μCi/ml	5.05E-7	6.15E-7	
3. Percent of applicable limit	% MPC	1.68E-2	2.05E-2	
4. Percent Effluent Concentration Limit	% ECL	5.05E-2	6.15E-2	
C. Dissolved and entrained gases				
1. Total release	Ci	3.62E-2	1.53E-1	1.90E+1
2. Average diluted concentration during period	μCi/ml	4.84E-11	1.98E-10	
3. Percent of applicable limit	% MPC	2.42E-5	9.88E-5	
4. Percent Effluent Concentration Limit	% ECL	2.42E-5	9.88E-5	
D. Gross alpha radioactivity				
1. Total release	Ci	<LLD	<LLD	5.00E+1
E. Volume of waste released (batch & continuous, prior to dilution)				
E. Volume of waste released (batch & continuous, prior to dilution)	liters	6.70E+7	7.15E+7	5.00E+0
F. Volume of dilution water used during period				
F. Volume of dilution water used during period	liters	7.48E+11	7.76E+11	5.00E+0

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

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	7.86E-5	<LLD	<LLD	<LLD
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	<LLD	<LLD
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	8.09E-4	<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	8.88E-4	<LLD	<LLD	<LLD
2. Dissolved and entrained gases					
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 2C.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 2B (Continued)

LIQUID EFFLUENTS
BATCH MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation products					
antimony-124	Ci	2.37E-4	1.83E-4	2.16E-4	2.41E-4
antimony-125	Ci	2.15E-2	1.58E-2	2.31E-2	2.04E-2
barium-140	Ci	<LLD	<LLD	3.21E-4	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	4.44E-4	2.15E-4	1.59E-3	6.09E-4
cesium-136	Ci	<LLD	<LLD	2.11E-4	<LLD
cesium-137	Ci	7.78E-4	3.82E-4	1.83E-3	9.88E-4
chromium-51	Ci	8.32E-4	3.88E-3	1.86E-3	2.59E-3
cobalt-58	Ci	2.86E-3	8.95E-3	1.57E-2	3.90E-3
cobalt-60	Ci	5.08E-3	2.78E-3	3.23E-3	2.51E-3
iodine-131	Ci	<LLD	<LLD	4.22E-3	<LLD
iodine-132	Ci	<LLD	<LLD	5.52E-5	<LLD
iodine-133	Ci	<LLD	<LLD	1.63E-3	<LLD
iodine-135	Ci	<LLD	<LLD	1.49E-4	<LLD
iron-55	Ci	1.94E-2	7.97E-3	1.65E-2	1.00E-2
iron-59	Ci	<LLD	1.22E-4	7.60E-4	1.82E-4
lanthanum-140	Ci	<LLD	<LLD	7.15E-5	<LLD
manganese-54	Ci	9.09E-4	6.18E-4	4.49E-4	2.84E-4
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	1.18E-3	7.86E-4	5.63E-5	5.70E-4
niobium-97	Ci	<LLD	<LLD	6.96E-5	1.59E-4
silver-110m	Ci	1.75E-3	6.29E-4	2.96E-4	4.48E-5
sodium-24	Ci	<LLD	<LLD	4.70E-5	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
strontium-92	Ci	2.81E-5	<LLD	<LLD	<LLD
technetium-99m	Ci	<LLD	<LLD	<LLD	<LLD
tellurium-132	Ci	1.32E-5	<LLD	<LLD	<LLD
tin-113	Ci	1.72E-4	6.14E-5	<LLD	<LLD
tin-117m	Ci	<LLD	5.20E-5	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
zirconium-95	Ci	4.69E-4	5.06E-4	<LLD	4.54E-4
zirconium-97	Ci	3.05E-5	<LLD	3.74E-6	<LLD
Total for period	Ci	5.57E-2	4.30E-2	7.24E-2	4.29E-2

LLD Lower Limit of Detection; see Table 2C.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 2B (Continued)

LIQUID EFFLUENTS
BATCH MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2. Dissolved and entrained gases					
krypton-85	Ci	<LLD	<LLD	<LLD	1.01E-2
xenon-131m	Ci	<LLD	<LLD	<LLD	6.25E-3
xenon-133	Ci	1.12E-2	5.39E-2	3.57E-2	1.37E-1
xenon-135	Ci	<LLD	<LLD	5.05E-4	<LLD
Total for period	Ci	1.12E-2	5.39E-2	3.62E-2	1.53E-1

LLD Lower Limit of Detection; see Table 2C.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

TABLE 2C

LIQUID EFFLUENTS-LOWER LIMIT OF DETECTION
CONTINUOUS MODE

Radionuclides	LLD ($\mu\text{Ci/cc}$)
1. Fission and activation products	
barium-140	4.10E-7
cerium-141	6.70E-8
cerium-144	2.70E-7
cesium-134	1.10E-7
cesium-137	9.10E-8
chromium-51	4.70E-7
cobalt-58	9.70E-8
cobalt-60	1.40E-7
iodine-131	8.10E-8
iron-55	1.00E-6
iron-59	2.30E-7
lanthanum-140	7.50E-7
manganese-54	9.60E-8
molybdenum-99	8.80E-8
niobium-95	9.70E-8
strontium-89	5.00E-8
strontium-90	1.00E-8
technetium-99m	9.00E-8
zinc-65	2.40E-7
zirconium-95	1.70E-7
2. Dissolved and entrained gases	
xenon-133	3.00E-7
xenon-135	1.30E-7
3. gross alpha	
	1.00E-7

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TABLE 2C (Continued)

LIQUID EFFLUENTS-LOWER LIMIT OF DETECTION
BATCH MODE

Radionuclides	LLD ($\mu\text{Ci}/\text{cc}$)
1. Fission and activation products	
barium-140	3.20E-7
cerium-141	6.10E-8
cerium-144	2.70E-7
cesium-136	1.50E-7
iodine-131	5.70E-8
iodine-132	2.90E-7
iodine-133	8.40E-8
iodine-135	7.40E-7
iron-59	2.10E-7
lanthanum-140	1.70E-7
molybdenum-99	3.40E-8
niobium-97	9.40E-8
sodium-24	1.70E-7
strontium-89	5.00E-8
strontium-90	1.00E-8
strontium-92	5.00E-7
technetium-99m	3.40E-8
tellurium-132	3.90E-8
tin-113	7.50E-8
tin-117m	3.40E-8
zinc-65	2.40E-7
zirconium-95	1.60E-7
zirconium-97	1.10E-7
2. Dissolved and entrained gases	
krypton-85	4.30E-5
xenon-131m	4.50E-6
xenon-135	1.30E-7
3. gross alpha	1.00E-7

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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	1.77E-3	1.18E-3	2.20E-3	1.56E-3
2. Percent Applicable Limit	%	5.92E-2	3.94E-2	7.35E-2	5.20E-2
B.					
1. Limiting organ dose	mrem	1.04E-2	5.71E-3	8.59E-3	3.98E-3
2. Percent Applicable Limit	%	1.04E-1	5.71E-2	8.59E-2	3.98E-2
3. Limiting organ for period		GI-LLI	GI-LLI	GI-LLI	GI-LLI

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TABLE 2E

LIQUID EFFLUENTS-BATCH RELEASE SUMMARY

	12 month period
1. Number of batch releases:	36 releases
2. Total time period for batch releases:	11,293 minutes
3. Maximum time period for a batch release:	791 minutes
4. Average time period for a batch release:	314 minutes
5. Minimum time period for a batch release:	88 minutes
6. Average saltwater flow during batch releases:	7.18E+5 gpm

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SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM (1997)

During calibration, the Unit 2 E089 Steam Generator blowdown flow meter was determined to be out of tolerance and was reading 41 gpm lower than actual flow. In 1997 there were five releases which required flow rate correction. The updated curie and dose values for first quarter releases are provided below. Fourth quarter releases were <MDA and the volume of waste released (batch & continuous, prior to dilution) increased from 1.03E+7 liters to 1.06E+7 liters. This is documented per AR 980603658.

TABLE 2A (1997)
LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	Unit	First Quarter
A. Fission and activation products		
1. Total release (not including tritium, gases, alpha)	Ci	1.72E-1
2. Average diluted concentration during period	μCi/ml	7.52E-11
3. Percent of applicable limit	% MPC	1.21E-4
4. Percent Effluent Concentration Limit	% ECL	5.54E-4
E. Volume of waste released (batch & continuous, prior to dilution) (1)		
	liters	3.24E+7

The volume of waste released was reported as 3.12E+4 liters instead of 3.12E+7 liters. The value reported above includes the typographical error correction.

TABLE 2B (1997)
LIQUID EFFLUENTS
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter
1. Fission and activation products		
antimony-125	Ci	2.98E-3
cesium-134	Ci	3.07E-4
cesium-137	Ci	2.98E-4
cobalt-57	Ci	7.37E-5
cobalt-58	Ci	3.96E-2
cobalt-60	Ci	2.00E-3
manganese-54	Ci	8.89E-4
niobium-95	Ci	3.53E-4
tin-113	Ci	1.29E-4
Total for period	Ci	4.66E-2

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TABLE 2D (1997)
LIQUID EFFLUENTS-RADIATION DOSES AT THE LIQUID SITE BOUNDARY

	Unit	First Quarter
A.		
1. Total body dose	mrem	4.63E-3
2. Percent Applicable Limit	%	1.54E-1
B.		
1. Limiting organ dose	mrem	2.18E-2
2. Percent Applicable Limit	%	2.18E-1
3. Limiting organ for period		GI-LLI

SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS
TABLE 1 (1997)

SOURCE	Dose (millirems)	
	First Quarter	Year
LIQUID EFFLUENTS		
Whole Body	¹⁾ 4.63E-3	⁵⁾ 7.93E-3
Organ	⁶⁾ 2.18E-2	¹⁰⁾ 6.12E-2

1,5. This data was calculated using the methodology of the ODCM.

6,10. This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.

TABLE 2 (1997)

SOURCE	Percent Applicable Limit	
	First Quarter	Year
LIQUID EFFLUENTS		
Whole Body	1.54E-1	1.32E-1
Organ	2.18E-1	3.06E-1

SECTION L. S.O.N.G.S. 2/3 CONCLUSIONS (1997)

- Liquid releases totaled 3.08E+2 curies of which particulates and iodines were 3.29E-1 curies, tritium was 3.08E+2 curies, and noble gases were 3.50E-1 curies.
- The radiation doses from liquid releases were: (a) total body: 7.93E-3 mrem, (b) limiting organ: 6.12E-2 mrem.

COMMON CONCLUSIONS (1997)

- Liquid releases from S.O.N.G.S. 1, 2 and 3 totaled 3.08E+2 curies of which particulates and iodines were 3.29E-1 curies, tritium was 3.08E+2 curies, and noble gases were 3.50E-1 curies.

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SECTION E. RADWASTE SHIPMENTS

TABLE 3

SOLID WASTE AND IRRADIATED FUEL SHIPMENT

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

1. Type of waste	Unit	12 month period	Estimated total error (%)
a. Spent resins, filter sludges, evaporator bottoms ^(#)	m ³	3.10E-1	3.00E+1
	Ci	1.10E-4	
b. Dry active waste (DAW), compatible and non-compatible ^(#)	m ³	2.90E+1	3.00E+1
	Ci	1.02E+0	
c. Irradiated components, control rods	m ³	N/A	N/A
	Ci	N/A	
d. Other	m ³	N/A	N/A
	Ci	N/A	

Note: Total curie content estimated.

(#) Material packaged in strong, tight containers of various sizes.

N/A No shipment made.

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

2. Estimate of major nuclide composition (by type of waste)		
a. antimony-125	%	1.21E+0
cesium-134	%	2.76E-2
cesium-137	%	2.13E+0
cobalt-58	%	1.62E-3
cobalt-60	%	9.65E+1
iodine-131	%	3.03E-3
manganese-54	%	1.84E-3
yttrium-91	%	1.38E-1
b. americium-241	%	9.80E-4
antimony-124	%	4.11E-3
antimony-125	%	8.63E-1
carbon-14	%	3.08E-1
cerium-141	%	2.44E-3
cerium-144	%	4.07E-1
cesium-134	%	3.04E+0
cesium-137	%	7.76E+0
chromium-51	%	1.85E+0
cobalt-57	%	2.10E-3
cobalt-58	%	2.39E+1
cobalt-60	%	7.29E+0
curium-242	%	7.88E-4
curium-243/244	%	2.74E-3
iron-55	%	3.80E+1
iron-59	%	2.47E-2
manganese-54	%	1.43E+0
nickel-63	%	1.45E+1
niobium-95	%	1.53E-1
plutonium-238	%	9.33E-4
plutonium-239/240	%	1.46E-3
plutonium-241	%	1.34E-1
silver-110m	%	5.79E-4
strontium-89	%	3.82E-4
strontium-90	%	2.68E-2
tin-113	%	9.40E-3
tritium	%	1.79E-1
zirconium-95	%	8.92E-2
c. not applicable	%	0.00E+0
d. not applicable	%	0.00E+0

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

3. Solid Waste Disposition

See COMMON section of this report

B. IRRADIATED FUEL SHIPMENTS (Disposition)

See COMMON section of this report

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SECTION F. APPLICABLE LIMITS

Gaseous Effluents - Applicable Limits

The percent of Applicable Limits, tabulated in Sections A.3, B.3, C.3, and D.3 of Table 1A, was calculated using the following equation:

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

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

X/Q = $4.80\text{E}-6 \text{ sec}/\text{m}^3$; the annual average atmospheric dispersion defined in the Units 2&3 ODCM, Rev. 31.

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

where: F_i = fractional abundance 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 radionuclide from 10 CFR 20 (20.1-20.602), Appendix B, Table II, Column 1.

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

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

X/Q = $4.80\text{E}-6 \text{ sec}/\text{m}^3$; the annual average atmospheric dispersion defined in the Units 2&3 ODCM, Rev. 31.

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

where: F_i = fractional abundance 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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Liquid Effluents - Applicable Limits

The percent of Applicable Limits, tabulated in Sections A.3, B.3, and C.3 of Table 2A, were calculated using the following equations:

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

where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, $\mu\text{Ci/ml}$.

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

where: F_i = fractional abundance of the i^{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.

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

where: Dil Conc = total curies released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, $\mu\text{Ci/ml}$.

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

where: F_i = fractional abundance of the i^{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 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

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

For 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. For members of the public who traverse the site boundary via highway I-5, the residency time shall be considered negligible and hence the dose "0".

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

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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	1.77E-3	1.18E-3	2.20E-3	1.56E-3	6.72E-3
Organ	6)	7)	8)	9)	10)
Organ	1.04E-2	5.71E-3	8.59E-3	3.98E-3	2.87E-2
AIRBORNE EFFLUENTS	11)	12)	13)	14)	15)
Tritium, Iodines, and Particulates	1.49E-2	1.58E-3	1.96E-3	5.22E-4	1.74E-2
NOBLE GASES **	16)	17)	18)	19)	20)
Gamma	6.64E-3	1.42E-3	2.65E-3	3.61E-3	1.34E-2
Beta	21)	22)	23)	24)	25)
Beta	1.23E-2	3.97E-3	7.48E-3	5.38E-3	2.76E-2
DIRECT RADIATION	26)	27)	28)	29)	30)
DIRECT RADIATION	1.23E-1	1.60E-1	1.69E-1	1.29E-1	5.80E-1

* 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 data was calculated using the methodology of the ODCM.
2. This data was calculated using the methodology of the ODCM.
3. This data was calculated using the methodology of the ODCM.
4. This data was calculated using the methodology of the ODCM.
5. This data was calculated using the methodology of the ODCM.

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- This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
7. This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
 8. This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
 9. This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
 10. This data was calculated using the methodology of the ODCM; the GI-LLI received the maximum dose primarily by the saltwater fish pathway.
 11. The maximum organ dose was to a child's thyroid and was located in the ESE sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
 12. The maximum organ dose was to a child's thyroid 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 thyroid and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
 14. The maximum organ dose was to a child's thyroid and was located in the ESE sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
 15. The maximum organ dose was to a child's thyroid and was located in the ESE sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.
 16. The maximum air dose for gamma radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 17. The maximum air dose for gamma radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 18. The maximum air dose for gamma radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 19. The maximum air dose for gamma radiation was located in the SSW sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 20. The maximum air dose for gamma radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 21. The maximum air dose for beta radiation was located in the ENE sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 22. The maximum air dose for beta radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 23. The maximum air dose for beta radiation was located in the E sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
 24. The maximum air dose for beta radiation was located in the SSW sector, at the exclusion area boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.

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25. The maximum air dose for beta radiation was located in the E sector, at the exclusion boundary, and calculated using the assumptions of the USNRC Regulatory Guide 1.109.
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 W 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 N 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 NE 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 S 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 as a composite of the highest sectors for each quarter.

TABLE 2

SOURCE	Percent Applicable Limit				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS					
Whole Body	5.92E-2	3.94E-2	7.35E-2	5.20E-2	1.12E-1
Organ	1.04E-1	5.71E-2	8.59E-2	3.98E-2	1.44E-1
AIRBORNE EFFLUENTS					
Tritium, Iodines, and Particulates	9.94E-2	1.05E-2	1.31E-2	3.48E-3	5.80E-2
NOBLE GASES					
Gamma	6.64E-2	1.42E-2	2.65E-2	3.61E-2	6.70E-2
Beta	6.13E-2	1.98E-2	3.74E-2	2.69E-2	6.90E-2

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

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SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

On February 27, 1998, revision 31 to the Units 2/3 Offsite Dose Calculation Manual (ODCM) was adopted and published. Incorporated into this revision were:

1. changes to reflect actual operation of the plant: removal of all references to oil incineration and concurrent release of multiple radwaste tanks;
2. editorial changes: previous revisions left blank pages, mixed fonts, inconsistent spacing, etc. Pages were renumbered accordingly;
3. changes to definitions to reflect TSIP;
4. changes due to the 1997 Land Use Census;
5. changes in reporting requirements for the Radiological Environmental Monitoring Program to reflect the guidance of NUREG 0472;
6. removal of references to Clarification Letter 14 on sampling of airborne discharge paths;
7. changes in frequency for compensatory action for process flow monitors.

Safety evaluations were provided for the last three items. Per NRC Generic Letter 89-01, no safety review was required or performed for editorial changes or changes made to reflect actual plant operation or changes due to the annual Land Use Census.

The following is a complete list of the changes:

Page	CHANGE
Intro	Changed wording to more accurately reflect the purposes of the ODCM
2-11	Reworded step 4 for clarification, added equation 4a for CPM_{max} format
1-12	Changed equations to allow only one rad waste tank release at a time in order to more accurately reflect plant operating practices, format
1-13	Consolidated all information on previous page, page intentionally blank
1-14	Removed blank page
1-17	Reworded step 4 for clarification, added equation 4a for CPM_{max} format
1-18	Removed blank page
1-20	Removed blank page
1-25	Updated Liquid Effluent radiation monitor calibration constants
2-2	Removed sampling and analysis requirements for incinerated oil since waste oil has never been incinerated at SONGS
2-4	Deleted lines h and I referring to incinerated oil.
2-6	Deleted 2.3.1.c referring to incinerated oil.
2-11	Revised section on administrative factors and added an explanation of their use
2-12	Consolidated footnotes for equations 2-1 and 2-2
2-13	Added equation 2-5 for CPM_{max}
2-14	Revised equation 2-3 based on new equations 2-1 and 2-2
2-16	Moved definition of admin factor to previous page
2-17	Added equation id number to existing equation, format
2-19	Deleted extraneous lines
2-20	Added equation id number to existing equation
2-21	Added equation 2-5 for CPM_{max}
2-22	Changed wording in definition of factors to more accurately reflect their meaning, revised equation 2-3 for simplification
23	Added 'Plant' to Vent Stack Monitor
27	Consolidated all information on previous page, pages intentionally blank
2-32	Moved all information to previous page, left page intentionally blank
2-35	Updated Controlling Location Factors in accordance with the 1997 Land Use Census
2-36	Sector P Surf Beach/Lifeguard: adult occupancy factor decreased

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

- 2-39 Sector Q Rec. Bldg. Staff: adult occupancy factor increases
- 2-44 Removed blank page
- 2-45 Sector Q S. C. Resident with Garden: new location + garden
Sector Q added Outage Worker for transient plant workers
- 2-50 SC Ranch Packing: adult occupancy factor decreased
- 2-51 Removed blank page
- 2-52 Removed blank page
- 2-54 Removed blank page
- 2-56 Removed blank page
- 2-62 Removed blank page
- 2-65 Removed blank page
- 2-74 Sector G San Onofre State Beach Campground: adult occupancy factor decreased
- 2-76 Removed blank page
- 2-77 Removed blank page
- 4-4 Changed action 31 to from 4 hours to 12 hours for process flow, split requirement into process flow and sample flow
- 4-8 removed reference to the canceled Clarification Letter 14
- 4-9 removed reference to the canceled Clarification Letter 14
- 4-11 Changed action 36 to from 8 hours to 12 hours for process flow, split requirement into process flow and sample flow
- 4-15 Added notes 6, 7, and 8 pertaining to post DCP 7022 source checks and channel functional test
- 4-17 Revised drawing format, no new information added.
- 4-18 Revised drawing format, no new information added.
- 4-19 Revised drawing format, no new information added.
- 5-2 Reworded action 5.1.1d per E Goldin memo
- 5-3 Format only
- 5-11 Reworded actions 5.2.1a and b per E Goldin memo
- 5-15 Deleted Huntington Beach Generating Station, Changed San Clemente General Hospital Samaritan Hospital, Changed several distances and directions based on GPS information
- 5-16 Changed several distances based on GPS information
- 5-17 Added Oceanside City Hall (Backup CONTROL), Changed several distances and directions based on GPS information
- 5-18 Deleted Camp San Onofre, Huntington Beach Generating Station, and Units 2 and 3 SwitchYard. Added Mesa Medical Facility and Oceanside City Hall. Changed several distances and directions based on GPS information
- 5-19 Deleted Huntington Beach (CONTROL), added Oceanside (CONTROL). Changed several distances and directions based on GPS information, deleted Cotton Point Estates Gardens fro Local Crops section
- 5-20 Changed several distances and directions based on GPS information
- 5-23 Added a new 1 mile radius map

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S.O.N.G.S. 2 and 3

SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

- There were no changes to the Units 2&3 Radioactive Waste Treatment Systems during the reporting period, January 1, 1998 to December 31, 1998.

SECTION K. MISCELLANEOUS

- Improper Sampling of Unit 2 Turbine Plant Sump (TPS) System

On 2/6/98, with the TPS radiation monitor, 2RT-7821, inoperable, a compensatory sample was obtained from the TPS discharge line compositor sample bottle instead of directly from the TPS. The ODCM requires a grab sample every 12 hours. The time between properly collected samples was 15 hours and 40 minutes. Samples taken for several days before and after this incident were <MDA. This incident is documented in Action Request (AR) 980201214.

- Missed Dilution Flow Surveillance

A surveillance to determine the required operating dilution flow pumps once per 12 hours was missed. This surveillance was performed for batch releases but had not been proceduralized for continuous release pathways. Radiation monitor setpoints typically require less dilution than actually exists. This surveillance has been added to station procedures and a detailed ODCM surveillance audit has been performed. This incident is documented in AR 980401703 and Licensee Event Report (LER) 2-1998-006.

- Non-isokinetic Sampling on Condenser Air Ejector Monitors

During UFSAR Design Basis Document review, Condenser Air Ejector monitors, 2(3)RT-7870, particulate and iodine (P&I) samples were identified to be non-isokinetic at normal air ejector flow. A design error had made the samples isokinetic during vacuum pump operation only. New sample probe nozzles are scheduled to be installed during 1999 outages. In the interim, compensatory particulate and iodine samples are being obtained. Review of release data determined that there have been no significant dose consequences from airborne releases at SONGS 2 and 3. Noble gas radiation monitor functions are unaffected by this condition. This incident is documented in ARs 980701509 and 980701514 AND LER 2-1998-015.

- Non-isokinetic Sampling on Containment Purge Monitors

During UFSAR Design Basis Document review, Containment Purge monitors, 2(3)RT-7865, P&I samples were identified to be non-isokinetic when selected to main purge. These monitors (both 2RT-7865 and 3RT-7865) have only been used for containment main purge 4 times in the last eight years. Procedures and release permit software have been modified to prohibit the use of these monitors for containment main purge. Review of release data determined that there have been no significant dose consequences from airborne releases at SONGS 2 and 3. Noble gas radiation monitor functions were unaffected by this condition. This incident is documented in ARs 980701530 and 980701531 and LER 2-1998-015.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

- Missed Duplicate Sample Due to Monitor Inoperability (CSRA# C-98-0238-3)

On 9/20/98, a Clean Sump Release Authorization (CSRA) was generated to release the Unit 3 Full Flow Condensate Polishing Demineralizer Holdup Tank utilizing only one sample. Radiation monitor 3RT-7817 was inoperable, requiring duplicate samples to be obtained prior to release. The sample obtained showed less than minimum detectable activity and therefore there was no dose impact. To prevent recurrence, new release permit software requires verification of duplicate samples. This incident is documented in AR 980901251.

- Valve Not Fully Locked Shut

On 8/9/98, during weekly surveillance, Steam Generator 2E-089 blowdown via the flash tank bypass line isolation valve (S21301MU619) was found closed, but the lock not fully shut. The lock appeared to be locked, however, when handled, the lock opened. The ODCM requires samples be taken unless this valve is verified locked shut once every 31 days. The last time this valve was operated was February 1998 and there were no indications that it had been opened since then. No volume was estimated to have been released and therefore no dose impact resulted. This incident is documented in AR 980800502.

- Missed Sample Flow Verification on Auxiliary Sampling Equipment

On 10/6/98, the particulate and iodine sample flow was not verified at the proper interval for the Unit 3 condenser air ejector (CAE). Upon further investigation, it was identified that compensatory sample flow verification had not been proceduralized for either the plant vent stack or CAE since initial plant operation. Site procedures have been modified to include this requirement. This incident is documented in AR 981000410 and LER 1-1998-005.

- Inadvertent Waste Gas Decay Tank Discharge to Atmosphere

On 4/13/98, Waste Gas Decay Tank, T-085, inadvertently discharged to the Unit 3 Containment due to an improper valve line up. Investigation determined the discharge began when a valve was operated while performing an LLRT. A containment purge was in progress with a monitor to ensure the release was less than site limits. A conservative duration and sample analysis were used to estimate the curies released and the resultant dose. This incident is documented in AR 980301204. Procedures were revised to utilize caution tags to prevent recurrence.

Start Date/Time	Stop Date/Time	Duration (minutes)	Activity ($\mu\text{Ci/cc}$)	Estimated Release (curies)	Estimated Gamma Dose (mrad)	Estimated Beta Dose (mrad)
3/13/98 @ 1130	3/13/98 @ 1950	500	4.46E-2	6.66E+0	3.44E-4	1.10E-3

- Late Transient Sample Collection Due to Plant Conditions

On 9/21/98, a Unit 2 post-transient ODCM required particulate and iodine sample of containment purge was collected one hour late due to a conflict with outage activities. When the sample was due, a critical evolution was in progress and securing containment purge to allow sample collection could not be supported and delayed sample collection. This incident is documented in AR 980901460. To prevent recurrence, this sample requirement has been added to the detailed outage activity list.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

EFFLUENT RADIATION MONITORS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 1998 - December 31, 1998

S.O.N.G.S. 2			
Monitor	Inoperability Period	Inoperability Cause	Explanation
2RT-7821 Turbine Plant Sump Monitor	12/11/97 - 01/20/98	Frequent low flow alarms during releases	Monitor inoperable due to sample line repeatedly plugged by debris. Sample line was replaced.
2RT-7828 Containment Purge Monitor	01/23/89 - 01/26/98	Improper channel functional test	Main purge valves were not properly surveilled due to procedure error, surveillance performed during 1998 mid-cycle outage. LER-2-1997-007.
	08/08/83 - 12/05/98	Non-isokinetic sample flow during containment venting (mini-purge with fans off)	Non-isokinetic sample flow during containment venting. Procedures and monitor software modified to restrict venting within isokinetic flow limits. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015
	11/19/98 - 12/19/98	Low sample flow failure during containment venting	During containment venting, sample pump tripped due to low flow. Testing was performed and limits set to ensure isokinetic sample flow.
2RT-7865 Containment Purge (Plant Vent Stack) Monitor	02/28/89 - 01/26/98	Improper channel functional test	Main purge valves were not properly surveilled due to procedure error, surveillance performed during 1998 mid-cycle outage. LER-2-1997-007.
	08/08/83 - 09/30/98	Non-isokinetic sample flow during main containment purge	UFSAR Design Basis Document review identified non-isokinetic sample flow during main purge. Procedures changed to prevent use of monitor for main containment purge. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015
2RT-7870 Condenser Air Ejector Monitor	08/08/83 - 02/18/99	Non-isokinetic sample flow during normal air ejector operation	UFSAR Design Basis Document review identified non-isokinetic sample flow during normal air ejector operation. New sample probe nozzle installed during 1999 outage. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

EFFLUENT RADIATION MONITORS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 1998 - December 31, 1998

S.O.N.G.S. 2			
Monitor	Inoperability Period	Inoperability Cause	Explanation
2RT-7870 Condenser Air Ejector Process Flow Monitor	02/22/98 - 05/04/98	Process flow indication	Installed new flow probe. Radiation monitor functions were operable during this period using default flow values.
	08/15/98 - 12/30/98	Process flow indication	Replaced flow probes. Radiation monitor functions were operable during this period using default flow values.
S.O.N.G.S. 3			
Monitor	Inoperability Period	Inoperability Cause	Explanation
3RT-7817 BPS/FFCPD Discharge Monitor	09/16/98 - 10/21/98	Monitor failure	Electrical and recurrent sample flow problems.
3RT-7828 Containment Purge Monitor	04/01/84 - 01/13/99	Non-isokinetic sample flow during containment venting (mini-purge with fans off)	Non-isokinetic sample flow during containment venting. Procedures and monitor software modified to restrict venting within isokinetic flow limits. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015
3RT-7865 Plant Vent Stack (Containment Purge) Monitor	04/01/84 - 09/30/98	Non-isokinetic sample flow during main containment purge	UFSAR Design Basis Document review identified non-isokinetic sample flow during main purge. Procedures changed to prevent use of monitor for main containment purge. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015
3RT-7870 Condenser Air Ejector	04/01/84 - present	Non-isokinetic sample flow during normal air ejector operation	UFSAR Design Basis Document review identified non-isokinetic sample flow during normal air ejector operation. New sample probe nozzle installed during 1999 outage. Noble gas radiation monitor functions were operable during this period. LER-2-1998-015

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

S.O.N.G.S. 2 and 3

SECTION L. S.O.N.G.S. 2 and 3 CONCLUSIONS

- Gaseous releases totaled $4.52E+2$ curies of which noble gases were $4.24E+2$ curies, iodines were $1.22E-2$ curies, particulates were $7.83E-5$ curies, and tritium was $2.80E+1$ curies.
- The radiation doses from gaseous releases were: (a) gamma air dose: $1.34E-2$ mrad at the site boundary, (b) beta air dose: $2.76E-2$ mrad at the site boundary, (c) organ dose: $1.74E-2$ mrem at the nearest receptor.
- Liquid releases totaled $1.54E+3$ curies of which particulates and iodines were $2.15E-1$ curies, tritium was $1.54E+3$ curies, and noble gases were $2.54E-1$ curies.
- The radiation doses from liquid releases were: (a) total body: $5.42E-3$ mrem, (b) limiting organ: $2.55E-2$ mrem.
- The radioactive releases and resulting doses generated from Units 2 and 3 were below the Applicable Limits for both gaseous and liquid effluents.

COMMON



ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

COMMON RADWASTE SHIPMENTS

TABLE 3

SOLID WASTE AND IRRADIATED FUEL SHIPMENT

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

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

N/A No shipment made.

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

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

3. Solid Waste Disposition (S.O.N.G.S. 1, 2, and 3)		
Number of Shipments	Mode of Transportation	Destination
1 *	Kindrick Trucking Company Truck/Trailer	Barnwell, SC
1 *	Kindrick Trucking Company Truck/Trailer	Envirocare, UT
2 #	Hitman Trucking Company Truck/Trailer	Envirocare, UT
1 #	Kindrick Trucking Company Truck/Trailer	Barnwell, SC

* All waste packaged at SONGS is staged at one location. The shipments of dry active waste made for Units 2&3 may contain a small fraction of Unit 1 waste and therefore is not reported separately.

SONGS maintains contracts with vendors (GTS/ATG) that provide volume reduction services. These shipments were made from their processing facility. The 3 shipments made from these facilities included waste from other generators. SONGS's waste volume was a small fraction of the total waste volume of these shipments.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

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

C. DEWATERING

Number of Containers	Solidification Agent
2	N/A

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

None.

REFERENCES:

1. Unit 1 Technical Specifications, section D6.13.2.
2. Units 2 and 3 Technical Specifications, section 6.13.2.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

COMMON 40 CFR 190 REQUIREMENTS

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

Dose Category	Units	Year
1. Total Body		
a. Total Body Dose	mrem	6.21E-1
b. Percent ODCM Specification Limit	%	2.49E+0
2. Limiting Organ		
a. Organ Dose (GI-LLI)	mrem	2.93E-2
b. Percent ODCM Specification Limit	%	1.17E-1
3. Thyroid		
a. Thyroid Dose	mrem	1.22E-2
b. Percent ODCM Specification Limit	%	1.62E-2

In addition to the dose calculated in the table above, there is the potential for incremental exposure to the public through disposal of certain solid materials at a facility outside the sphere of influence of airborne and liquid pathways. For example, Southern California Edison collects marine debris on the screens of the circulating water system and gathers dirt and sweepings during housekeeping activities. From time to time, extremely low levels of radioactivity have been detected in these wastes, placing their disposal outside NRC jurisdiction as described in 10 CFR 61. The Department of Health Services for the State of California has evaluated the potential impact to the public attributable to disposing of these materials at a municipal facility and concluded that the maximum exposure to individuals living or working at the facility is an acceptably small fraction of the designated safe limits.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

COMMON CONCLUSIONS

- Gaseous releases from S.O.N.G.S. 1, 2 and 3 totaled $4.54E+2$ curies of which noble gases were $4.24E+2$ curies, iodines were $1.22E-2$ curies, particulates were $7.83E-5$ curies, and tritium was $2.96E+1$ curies.
- Liquid releases from S.O.N.G.S. 1, 2 and 3 totaled $1.54E+3$ curies of which particulates and iodines were $2.16E-1$ curies, tritium was $1.54E+3$ curies, and noble gases were $2.54E-1$ curies.
- Radioactive releases and resulting doses generated from S.O.N.G.S. 1, 2 and 3 were below the Applicable Limits for both gaseous and liquid effluents.
- S.O.N.G.S. 1, 2 and 3 made 2 radwaste shipments to Barnwell, SC and 3 shipments to Envirocare, UT. Total volume was $2.93E+1$ cubic meters containing $1.02E+0$ curies of radioactivity.
- Meteorological conditions during the year were typical for S.O.N.G.S. Meteorological dispersion was good 30% of the time, fair 43% of the time and poor 27% of the time.
- The net result from the analysis of these effluent releases indicates that the operation of S.O.N.G.S. 1, 2 and 3 has met all the requirements of the applicable regulations and therefore has not resulted in any detrimental effects on the environment.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

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 released concentrations to the 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 S.O.N.G.S. (per reactor) 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 all radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from S.O.N.G.S. (per reactor) 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.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

COMMON

APPENDIX A (Continued)

LIQUID EFFLUENTS - APPLICABLE LIMITS

- A. Table 2A lists the total curies released, the diluted concentration, and percent of the applicable limit. The percent of applicable limit compares the diluted concentration of radioactive material released to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration is limited to $2.00\text{E-}4$ $\mu\text{Ci/ml}$.
- B. Table 2D lists doses due to liquid releases. The dose commitment to a Member of the Public from radioactive materials in liquid effluents released from S.O.N.G.S. (per reactor) 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.

METEOROLOGY



METEOROLOGY

The meteorology of the San Onofre Nuclear Generating Station for each of the four quarters, 1998 is described in this section. Meteorological measurements have been made according to the guidance provided in USNRC Regulatory Guide 1.23, "Onsite Meteorological Programs." A summary report of the meteorological measurements taken during each calendar quarter are presented in Table 4A as joint frequency distribution (JFD) of wind direction and wind speed by atmospheric stability class.

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

Table 4A lists the joint frequency distribution for each quarter, 1997. Each page of Table 4A represents the data for the individual stability classes: A, B, C, D, E, F, and G. The last page of each section is the JFD for all the stability classes. The wind speeds have been measured at the 10-meter level, and the stability classes are defined by the temperature differential between the 10-meter and 40-meter levels.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

January - March
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 97123124-98033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	1	0	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	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	1	0	0	0	0	0	0	1
SE	0	0	0	0	0	2	3	1	0	0	0	0	6
SSE	1	0	0	0	1	3	5	4	0	0	0	0	13
S	0	0	0	3	1	16	17	8	0	0	0	0	45
SSW	0	0	1	1	3	9	7	0	0	0	0	0	21
SW	0	0	0	0	3	13	5	0	0	0	0	0	21
WSW	0	1	1	1	13	30	14	1	0	0	0	0	61
W	0	0	0	0	4	46	52	17	7	0	0	0	126
WNW	0	0	0	0	0	5	28	28	5	0	0	0	66
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	1	0	0	0	0	0	0	0	0	1
TOTALS	1	1	2	6	25	126	131	59	12	0	0	0	363

NUMBER OF VALID HOURS 363
NUMBER OF INVALID HOURS 4

NUMBER OF CALMS 3
TOTAL HOURS FOR THE PERIOD 2160

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	1	0	1	0	0	0	0	2
SSE	0	0	0	1	0	1	3	1	0	0	0	0	6
S	0	0	0	0	1	2	3	3	0	0	0	0	9
SSW	0	0	1	0	2	1	6	1	0	0	0	0	11
SW	0	0	0	0	2	1	2	0	0	0	0	0	5
WSW	0	0	0	2	0	1	0	0	0	0	0	0	3
W	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	1	2	0	3	3	0	0	0	9
NW	0	0	0	0	0	1	1	1	0	0	0	0	3
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	1	3	6	10	15	10	3	0	0	0	48

NUMBER OF VALID HOURS 48
NUMBER OF INVALID HOURS 4

NUMBER OF CALMS 3
TOTAL HOURS FOR THE PERIOD 2160

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

January - March
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 97123124-98033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	2	1	0	0	0	0	0	3
SSE	0	0	0	0	0	1	9	1	1	0	0	0	12
S	0	0	0	2	0	2	3	2	0	0	0	0	9
SSW	0	0	0	1	0	3	2	0	1	0	0	0	7
SW	0	0	0	0	0	0	2	0	0	0	0	0	2
WSW	0	0	0	1	1	0	2	0	0	0	0	0	4
W	0	0	0	1	1	0	1	2	3	0	0	0	8
WNW	0	0	0	0	0	0	2	2	1	0	0	0	5
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	5	2	8	23	7	6	0	0	0	0

NUMBER OF VALID HOURS 51
 NUMBER OF INVALID HOURS 4
 NUMBER OF CALMS
 TOTAL HOURS FOR THE PERIOD 2160

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	1	2	3	2	4	4	6	1	0	0	0	0	23
NNE	0	0	0	2	5	3	5	1	0	0	0	0	16
NE	0	0	0	0	0	1	2	0	0	0	0	0	3
ENE	0	0	0	2	5	1	0	0	0	0	0	0	8
E	0	0	0	1	0	2	0	0	1	0	0	0	4
ESE	0	0	1	1	2	8	19	4	4	1	0	0	40
SE	1	0	1	4	4	10	42	37	13	1	0	0	113
SSE	0	0	0	3	3	8	24	14	5	6	12	0	75
S	0	2	3	2	1	4	15	14	12	4	6	0	63
SSW	0	1	1	4	5	7	11	15	19	6	1	0	70
SW	4	1	1	7	5	11	12	18	9	3	0	0	71
WSW	0	0	1	3	6	2	2	10	3	2	0	0	29
W	1	1	0	2	3	3	3	8	10	0	0	0	31
WNW	1	0	1	3	1	12	7	13	3	2	0	0	43
NW	0	2	0	3	0	6	14	6	1	0	0	0	32
NNW	0	1	1	6	1	2	4	0	0	0	0	0	15
TOTALS	8	10	13	45	45	84	166	141	80	25	19	0	636

NUMBER OF VALID HOURS 636
 NUMBER OF INVALID HOURS 4
 NUMBER OF CALMS
 TOTAL HOURS FOR THE PERIOD 2160

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

January - March
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 97123124-98033123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	3	1	0	6	8	10	8	1	0	0	0	0	37
NNE	1	1	3	14	19	23	21	0	1	0	0	0	83
NE	2	0	0	6	5	3	3	0	0	0	0	0	19
ENE	0	0	0	5	2	2	0	0	0	0	0	0	9
E	0	1	1	1	0	13	6	0	0	0	0	0	22
ESE	0	0	0	1	1	4	5	0	0	0	0	0	11
SE	0	0	1	4	0	3	5	1	1	0	0	0	15
SSE	0	0	0	0	0	4	1	1	0	0	0	0	6
S	0	0	0	0	2	1	0	0	0	1	0	0	4
SSW	0	0	0	0	1	1	0	0	0	0	0	0	2
SW	0	0	0	0	0	1	0	0	0	0	0	0	1
WSW	1	0	0	2	0	0	0	2	2	0	0	0	7
W	0	0	0	0	0	1	3	0	7	0	0	0	11
WNW	0	0	0	1	0	2	3	1	11	4	0	0	22
NW	0	0	0	1	0	2	2	1	4	0	0	0	10
NNW	0	1	1	3	0	5	4	1	0	0	0	0	15
TOTALS	7	4	6	44	38	75	61	8	26	5	0	0	274

NUMBER OF VALID HOURS 274 NUMBER OF CALMS 3
NUMBER OF INVALID HOURS 4 TOTAL HOURS FOR THE PERIOD 2160

PASQUILL F
MODERATELY STABLE ($1.5 \leq DT/DZ \leq -0.5$ °C/100 METERS)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	1	1	1	1	8	4	0	0	0	0	0	16
NNE	1	0	2	13	33	79	24	1	0	0	0	0	153
NE	1	2	2	9	9	7	0	0	0	0	0	0	30
ENE	1	0	1	1	1	1	0	0	0	0	0	0	5
E	1	1	1	1	1	0	0	0	0	0	0	0	5
ESE	0	0	1	0	1	0	0	0	0	0	0	0	2
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	1	0	0	0	0	0	0	1
S	0	0	0	1	0	0	0	0	0	0	0	0	1
SSW	0	0	1	0	0	0	0	0	0	0	0	0	1
SW	0	0	0	1	0	0	0	0	0	0	0	0	1
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	1	1	0	0	0	0	0	0	2
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	1	0	0	1	0	0	0	0	0	2
TOTALS	4	4	9	28	47	97	29	1	0	0	0	0	219

NUMBER OF VALID HOURS 219 NUMBER OF CALMS 3
NUMBER OF INVALID HOURS 4 TOTAL HOURS FOR THE PERIOD 2160

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

January - March

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 97123124-98033123
 WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	2	8	0	0	0	0	0	10
NNE	1	0	0	3	21	199	293	20	0	0	0	0	537
NE	1	0	0	7	4	2	4	0	0	0	0	0	18
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	2	0	0	10	25	203	305	20	0	0	0	0	570

NUMBER OF VALID HOURS 565
 NUMBER OF INVALID HOURS 4
 NUMBER OF CALMS 5
 TOTAL HOURS FOR THE PERIOD 2160

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	4	4	4	9	13	25	26	2	0	0	0	0	87
NNE	3	1	5	32	78	304	343	22	1	0	0	0	789
NE	4	2	2	22	18	13	9	0	0	0	0	0	70
ENE	1	0	1	8	8	4	0	0	0	0	0	0	22
E	1	2	2	3	1	15	6	0	1	0	0	0	31
ESE	0	0	2	2	4	13	24	4	4	1	0	0	54
SE	1	0	2	8	4	18	51	40	14	1	0	0	139
SSE	1	0	0	4	4	18	42	21	6	6	12	0	114
S	0	2	3	8	5	25	38	27	12	5	6	0	131
SSW	0	1	4	6	11	21	26	16	20	6	1	0	112
SW	4	1	1	8	10	26	21	18	9	3	0	0	101
WSW	1	1	2	9	20	33	18	13	5	2	0	0	104
W	1	1	0	3	9	51	59	27	27	0	0	0	178
WNW	1	0	1	4	2	21	40	47	23	6	0	0	145
NW	0	2	0	4	0	9	18	8	5	0	0	0	46
NNW	0	2	2	11	1	7	9	1	0	0	0	0	33
TOTALS	22	19	31	141	188	603	730	246	127	30	19	0	2156

NUMBER OF VALID HOURS 2156
 NUMBER OF INVALID HOURS 4
 NUMBER OF CALMS 5
 TOTAL HOURS FOR THE PERIOD 2160

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

April - June
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98033124-98063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	1	0	0	0	0	0	0	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	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	0	0	0	0	0	0	1
SE	0	0	0	0	0	2	1	0	0	0	0	0	3
SSE	0	0	0	0	1	2	10	1	0	0	0	0	14
S	0	0	0	0	6	13	33	3	0	1	0	0	56
SSW	0	0	0	1	4	13	22	1	0	0	0	0	41
SW	0	0	1	3	9	35	43	1	0	0	0	0	92
WSW	0	0	0	2	3	71	86	7	4	0	0	0	173
W	0	0	0	0	8	88	115	9	0	0	0	0	220
WNW	0	0	0	0	1	10	44	14	1	0	0	0	70
NW	0	0	0	0	0	0	1	1	0	0	0	0	2
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	1	0	1	6	33	234	355	37	5	1	0	0	673

NUMBER OF VALID HOURS 673 NUMBER OF CALMS 0
NUMBER OF INVALID HOURS 4 TOTAL HOURS FOR THE PERIOD 2184

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	1	0	0	0	0	0	0	1
SSE	0	0	0	0	0	1	5	1	0	0	0	0	7
S	0	0	0	1	1	1	6	0	0	0	0	0	9
SSW	0	0	0	0	0	8	10	0	0	1	0	0	19
SW	0	0	0	0	0	7	9	0	0	0	0	0	16
WSW	0	0	0	1	2	4	2	0	0	0	0	0	9
W	0	0	0	0	1	5	0	0	0	0	0	0	6
WNW	0	0	0	0	0	3	2	2	0	0	0	0	7
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	2	4	30	35	3	0	1	0	0	75

NUMBER OF VALID HOURS 75 NUMBER OF CALMS 0
NUMBER OF INVALID HOURS 4 TOTAL HOURS FOR THE PERIOD 2184

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

April - June
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98033124-98063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>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	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	1	1	1	0	0	0	3
SSE	0	0	0	0	1	2	7	0	0	0	0	0	10
S	0	0	0	2	1	3	1	3	1	0	0	0	11
SSW	0	0	0	0	0	9	10	1	0	0	0	0	20
SW	0	0	1	0	1	5	5	1	0	0	0	0	13
WSW	0	0	0	1	1	2	0	0	0	0	0	0	4
W	0	0	0	2	0	4	2	1	0	0	0	0	9
WNW	0	0	0	0	1	5	3	0	0	0	0	0	9
NW	0	0	0	0	0	1	2	0	0	0	0	0	3
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	1	5	6	31	31	7	2	0	0	0	

NUMBER OF VALID HOURS	83	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2184

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	1	2	11	10	4	1	0	0	0	0	0	29
NNE	0	0	3	13	10	14	4	0	0	0	0	0	44
NE	0	0	0	5	2	2	0	0	0	0	0	0	9
ENE	0	0	2	2	3	4	0	0	0	0	0	0	11
E	0	0	0	1	3	2	3	0	0	0	0	0	9
ESE	0	1	2	1	6	6	3	0	1	0	0	0	20
SE	0	4	2	4	11	23	27	6	4	1	0	0	82
SSE	0	0	3	8	10	20	24	6	2	0	1	0	74
S	0	1	1	6	5	17	23	6	4	1	0	0	64
SSW	0	0	0	4	5	17	28	10	2	1	0	0	69
SW	0	0	4	10	11	18	16	3	0	0	0	0	62
WSW	0	2	2	8	9	14	8	11	1	0	0	0	55
W	0	0	2	7	5	9	15	13	1	0	0	0	52
WNW	0	0	2	5	5	20	16	5	1	0	0	0	54
NW	0	0	2	5	9	14	22	1	0	0	0	0	53
NNW	0	3	0	6	4	6	3	0	0	0	0	0	22
TOTALS	0	12	27	96	108	190	193	61	16	4	2	0	709

NUMBER OF VALID HOURS	709	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2184

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

April - June
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98033124-98063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	2	6	8	9	0	0	0	0	0	0	25
NNE	1	3	2	21	26	25	3	0	0	0	0	0	81
NE	0	0	4	2	3	0	0	0	0	0	0	0	9
ENE	0	0	2	0	3	3	0	0	0	0	0	0	8
E	0	0	4	0	2	6	2	0	0	0	0	0	14
ESE	0	1	0	4	1	2	1	0	0	0	0	0	9
SE	0	0	0	2	1	6	8	1	0	0	0	0	18
SSE	0	0	0	1	1	3	3	0	0	0	0	0	8
S	0	0	0	1	0	0	0	0	0	0	0	0	1
SSW	0	0	0	1	0	0	1	0	0	0	0	0	2
SW	0	0	0	1	0	0	0	0	0	0	0	0	1
WSW	0	0	0	0	1	0	1	0	0	0	0	0	2
W	0	0	0	0	1	1	0	0	0	0	0	0	2
WNW	0	0	0	0	0	1	0	1	3	0	0	0	5
NW	0	0	0	0	3	1	1	0	0	0	0	0	5
NNW	1	0	0	1	0	5	0	0	0	0	0	0	7
TOTALS	2	4	14	40	50	62	20	2	3	0	0	0	197

NUMBER OF VALID HOURS	197	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2184

PASQUILL F MODERATELY STABLE ($1.5 \leq DT/DZ \leq -0.5$ °C/100 METERS)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	1	2	2	4	0	0	0	0	0	0	9
NNE	0	2	0	16	33	53	10	0	0	0	0	0	114
NE	0	0	4	8	2	3	0	0	0	0	0	0	17
ENE	0	0	0	1	3	0	0	0	0	0	0	0	4
E	0	0	0	1	0	0	0	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	1	0	0	0	0	0	0	0	0	0	1
SSE	0	0	0	0	0	1	0	0	0	0	0	0	1
S	0	0	0	2	0	0	0	0	0	0	0	0	2
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	1	0	0	0	0	0	0	0	0	1
WSW	0	0	0	0	1	0	0	0	0	0	0	0	1
W	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	2	6	31	41	61	10	0	0	0	0	0	151

NUMBER OF VALID HOURS	151	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2184

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

April - June
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98033124-98063023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	1	0	0	0	0	0	0	0	0	1
NNE	0	0	0	3	24	184	74	0	0	0	0	0	285
NE	0	0	0	2	1	2	0	0	0	0	0	0	5
ENE	0	0	1	0	0	0	0	0	0	0	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	1	6	25	186	74	0	0	0	0	0	2

NUMBER OF VALID HOURS	292	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2184

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	1	1	5	20	20	17	1	0	0	0	0	0	65
NNE	1	5	5	53	94	276	91	0	0	0	0	0	525
NE	0	0	8	17	8	7	0	0	0	0	0	0	40
ENE	0	0	5	3	9	7	0	0	0	0	0	0	24
E	0	0	4	2	5	8	5	0	0	0	0	0	24
ESE	0	2	2	5	8	8	4	0	1	0	0	0	30
SE	0	4	3	6	12	32	37	8	5	1	0	0	108
SSE	0	0	3	9	13	29	49	8	2	0	1	0	114
S	0	1	1	12	13	34	63	12	5	2	0	0	143
SSW	0	0	0	6	9	47	71	12	2	3	1	0	151
SW	0	0	6	15	21	65	73	5	0	0	0	0	185
WSW	0	2	2	12	17	91	97	18	5	0	0	0	244
W	0	0	2	9	15	107	132	23	1	0	0	0	289
WNW	0	0	2	5	7	39	65	22	5	0	0	0	145
NW	0	0	2	5	12	16	27	2	0	0	0	0	64
NNW	1	3	0	7	4	11	3	0	0	0	0	0	29
TOTALS	3	18	50	186	267	794	718	110	26	6	2	0	2180

NUMBER OF VALID HOURS	2180	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	4	TOTAL HOURS FOR THE PERIOD	2180

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98063024-98093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>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	1	1	0	0	0	0	0	2
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	1	2	1	0	0	0	4
SSE	0	0	0	1	0	0	1	2	3	0	0	0	7
S	0	0	0	1	0	5	14	8	13	4	0	0	45
SSW	0	0	0	2	1	8	10	6	4	1	0	0	32
SW	0	0	0	2	7	29	15	12	2	0	0	0	67
WSW	0	0	0	0	9	50	42	28	9	0	0	0	138
W	0	0	0	0	11	63	83	58	33	0	0	0	248
WNW	0	0	0	0	0	6	41	30	22	0	0	0	99
NW	0	0	0	0	0	0	1	0	5	0	0	0	6
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	6	29	162	209	146	92	5	0	0	649

NUMBER OF VALID HOURS	649	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	1	0	0	0	0	0	0	1
SSE	0	0	0	0	0	0	1	0	1	0	0	0	2
S	0	0	0	0	0	2	1	0	1	0	0	0	4
SSW	0	0	0	1	1	3	3	2	0	1	0	0	11
SW	0	0	0	1	0	6	1	1	0	0	0	0	9
WSW	0	0	0	0	3	5	2	0	0	0	0	0	10
W	0	0	0	0	2	2	2	1	0	0	0	0	7
WNW	0	0	0	0	2	1	0	2	1	0	0	0	6
NW	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	2	8	20	11	7	3	1	0	0	52

NUMBER OF VALID HOURS	52	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98063024-98093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	1	1	0	0	0	0	0	2
NNE	0	0	0	0	1	0	1	2	0	0	0	0	4
NE	0	0	0	0	0	0	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	1	0	1	0	0	0	0	0	2
SSE	0	0	0	1	0	0	1	0	0	1	0	0	3
S	0	0	0	0	1	2	2	1	0	1	1	0	8
SSW	0	0	0	0	1	7	2	2	0	0	0	0	12
SW	0	0	0	0	1	3	5	5	0	0	0	0	14
WSW	0	0	0	0	5	4	6	1	0	0	0	0	16
W	0	0	0	1	3	5	3	2	0	0	0	0	14
WNW	0	0	0	2	2	2	3	2	0	0	0	0	11
NW	0	0	0	0	0	1	3	5	0	0	0	0	9
NNW	0	0	0	0	0	0	0	1	0	0	0	0	1
TOTALS	0	0	0	4	15	25	29	21	0	2	1	0	

NUMBER OF VALID HOURS	97	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	1	5	6	6	10	17	1	0	0	0	0	46
NNE	0	1	1	5	12	13	21	3	0	0	0	0	56
NE	0	1	0	7	1	4	1	0	0	0	0	0	14
ENE	0	0	0	4	3	0	0	0	0	0	0	0	7
E	0	0	0	3	2	2	1	0	0	0	0	0	8
ESE	0	0	2	2	1	5	4	2	0	0	0	0	16
SE	1	0	2	9	8	16	25	25	9	0	0	0	95
SSE	0	0	1	7	11	26	40	11	13	5	0	0	114
S	1	0	1	7	12	16	20	9	8	7	0	0	81
SSW	0	1	2	7	14	20	23	4	2	0	0	0	73
SW	0	0	4	9	8	17	8	1	1	0	0	0	48
WSW	1	2	1	18	15	10	7	0	0	0	0	0	54
W	1	0	5	21	19	7	13	6	0	0	0	0	72
WNW	0	1	2	14	15	12	23	3	2	1	0	0	73
NW	0	0	2	11	9	3	14	10	9	0	0	0	58
NNW	1	0	1	5	8	9	2	3	1	0	0	0	30
TOTALS	5	7	29	135	144	170	219	78	45	13	0	0	845

NUMBER OF VALID HOURS	845	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98063024-98093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	1	5	5	7	5	1	0	0	0	0	24
NNE	0	0	0	4	15	29	23	10	3	1	0	0	85
NE	0	0	1	1	4	7	2	0	0	0	2	0	17
ENE	0	1	0	1	1	0	1	0	0	0	0	0	4
E	0	0	0	4	3	2	1	0	0	0	0	0	10
ESE	0	1	1	3	0	1	2	1	0	0	0	0	9
SE	0	0	0	2	3	12	11	10	2	1	0	0	41
SSE	0	0	1	2	0	11	20	7	3	0	1	0	45
S	0	0	1	6	2	4	9	5	0	0	0	0	27
SSW	0	0	0	4	2	1	4	0	0	0	0	0	11
SW	0	1	0	1	2	4	0	0	0	0	0	0	8
WSW	0	0	0	5	3	4	0	0	0	0	0	0	12
W	0	1	1	3	1	3	1	2	0	0	0	0	12
WNW	0	1	0	3	2	6	0	3	1	0	0	0	16
NW	0	0	1	1	0	0	4	0	0	0	0	0	6
NNW	0	0	1	2	3	2	1	2	0	0	1	0	12
TOTALS	0	5	8	47	46	93	84	41	9	2	4	0	339

NUMBER OF VALID HOURS	339	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

PASQUILL F MODERATELY STABLE ($1.5 \leq DT/DZ \leq -0.5$ °C/100 METERS)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	1	2	3	0	1	0	0	0	7
NNE	0	0	0	3	4	19	42	10	1	0	0	0	79
NE	0	0	0	0	2	3	5	0	0	0	0	0	10
ENE	0	0	0	1	0	1	0	0	0	0	0	0	2
E	0	0	0	0	1	0	0	0	0	0	0	0	1
ESE	0	0	0	0	0	1	1	0	0	0	0	0	2
SE	0	0	0	0	1	0	1	2	1	2	0	0	7
SSE	0	0	0	0	1	4	2	0	0	0	0	0	7
S	0	0	0	0	0	1	2	0	0	0	0	0	3
SSW	0	0	0	0	0	1	0	0	0	0	0	0	1
SW	0	0	0	1	1	0	0	0	0	0	0	0	2
WSW	0	0	0	0	1	0	0	0	0	0	0	0	1
W	0	0	0	0	0	1	1	0	0	0	0	0	2
WNW	0	0	0	0	1	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	0	1	0	0	0	1	0	0	2
TOTALS	0	0	0	5	13	35	58	12	3	3	0	0	129

NUMBER OF VALID HOURS	129	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	2	TOTAL HOURS FOR THE PERIOD	2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

July - September
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98063024-98093023
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	1	0	0	0	0	2	0	0	0	3
NNE	0	0	0	0	0	5	27	35	10	0	1	0	78
NE	0	0	0	0	0	2	0	0	0	0	0	0	2
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	1	0	0	0	0	0	0	1
S	0	0	0	0	0	0	1	0	0	0	0	0	1
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	2	0	0	0	0	0	0	0	2
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	1	2	0	0	0	0	3
WNW	0	0	0	0	0	2	1	1	0	0	0	0	4
NW	0	0	0	0	0	0	1	0	0	0	0	0	1
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	1	2	10	31	38	12	0	1	0	

NUMBER OF VALID HOURS 95
NUMBER OF INVALID HOURS 2
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	1	6	12	12	20	26	2	3	0	0	0	82
NNE	0	1	1	12	33	66	114	61	14	1	1	0	304
NE	0	1	1	8	7	17	11	0	0	0	2	0	47
ENE	0	1	0	6	4	1	1	0	0	0	0	0	13
E	0	0	0	7	6	4	2	0	0	0	0	0	19
ESE	0	1	3	5	1	7	7	3	0	0	0	0	27
SE	1	0	2	11	13	29	39	39	13	3	0	0	150
SSE	0	0	2	11	12	42	65	20	12	6	1	0	179
S	1	0	2	14	15	30	49	23	22	12	1	0	169
SSW	0	1	2	14	19	40	42	14	6	2	0	0	140
SW	0	1	4	14	21	59	29	19	3	0	0	0	150
WSW	1	2	1	23	36	73	57	29	9	0	0	0	231
W	1	1	6	25	36	81	104	71	33	0	0	0	358
WNW	0	2	2	19	22	30	69	41	26	1	0	0	212
NW	0	0	3	12	9	4	23	15	14	0	0	0	80
NNW	1	0	2	7	11	12	3	6	1	1	1	0	45
TOTALS	5	12	37	200	257	515	641	343	164	26	6	0	2208

NUMBER OF VALID HOURS 2206
NUMBER OF INVALID HOURS 2
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

October - December
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98093024-98123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOTAL
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	1	1	0	1	0	0	0	0	3
SSE	0	0	0	0	0	0	2	2	5	0	0	0	9
S	0	0	0	0	0	1	10	14	18	1	0	0	44
SSW	0	0	0	0	0	5	8	18	9	0	0	0	40
SW	0	0	0	0	0	2	20	16	4	0	0	0	42
WSW	0	0	0	0	0	7	34	26	6	0	0	0	73
W	0	0	0	0	0	2	59	75	16	0	0	0	152
WNW	0	0	0	0	0	2	13	35	27	4	0	0	81
NW	0	0	0	0	0	0	0	2	3	2	2	1	10
NNW	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTALS	0	0	0	0	1	20	146	190	88	7	3	1	456

NUMBER OF VALID HOURS 456 NUMBER OF CALMS 0
NUMBER OF INVALID HOURS 3 TOTAL HOURS FOR THE PERIOD 2208

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

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOTAL
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	0	0	0	0	0	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0	0	1	0	1	0	2
NE	0	0	0	0	0	0	0	0	1	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	1	0	0	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	2	0	1	0	0	3
SSE	0	0	0	0	0	0	0	1	8	2	0	0	11
S	0	0	0	0	0	2	0	0	2	0	0	0	4
SSW	0	0	0	0	0	0	3	1	2	1	0	0	7
SW	0	0	0	0	1	0	2	2	3	2	0	0	10
WSW	0	0	0	0	0	2	1	0	0	0	0	0	3
W	0	0	0	0	0	2	1	0	0	0	0	0	3
WNW	0	0	0	0	0	0	2	1	1	1	0	0	5
NW	0	0	0	0	0	0	1	2	1	0	2	0	6
NNW	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	0	1	6	10	9	19	8	3	0	56

NUMBER OF VALID HOURS 56 NUMBER OF CALMS 0
NUMBER OF INVALID HOURS 3 TOTAL HOURS FOR THE PERIOD 2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

October - December
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98093024-98123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	0	0	0	1	0	1	0	2
NNE	0	0	0	0	0	0	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0	0	1	0	0	0	1
ENE	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	1	0	0	5	3	1	0	0	10
S	0	0	0	0	0	0	0	1	2	0	0	0	3
SSW	0	0	0	0	0	0	0	2	0	0	0	0	2
SW	0	0	0	0	1	1	4	1	2	0	0	0	9
WSW	0	0	0	0	0	1	2	0	0	0	0	0	3
W	0	0	0	0	0	0	2	1	2	0	0	0	5
WNW	0	0	0	0	0	0	2	1	1	0	0	0	4
NW	0	0	0	0	0	1	0	0	2	1	1	0	5
NNW	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTALS	0	0	0	0	2	4	10	12	14	2	2	0	

NUMBER OF VALID HOURS 46
NUMBER OF INVALID HOURS 3
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	1	0	6	6	1	3	3	0	0	20
NNE	0	0	0	0	1	4	7	6	8	2	2	0	30
NE	0	0	0	0	1	3	7	2	2	0	1	0	16
ENE	0	0	0	0	1	1	0	0	2	0	0	0	4
E	0	0	0	0	0	0	3	4	0	0	0	0	7
ESE	0	0	1	1	0	1	4	4	2	0	0	0	13
SE	0	0	0	0	1	1	16	17	13	7	9	1	65
SSE	1	0	0	0	1	1	10	13	9	6	3	1	45
S	0	0	0	1	0	4	6	3	10	9	1	0	34
SSW	0	0	0	0	0	3	5	6	9	5	5	1	34
SW	0	0	0	0	3	7	3	5	8	5	1	0	32
WSW	0	0	0	1	2	4	8	7	1	5	3	0	31
W	0	0	0	0	0	7	7	3	2	1	3	1	24
WNW	0	0	1	1	1	0	6	7	3	3	2	0	24
NW	0	0	0	1	1	4	20	17	10	6	1	1	61
NNW	0	0	0	0	1	5	7	4	0	0	1	0	18
TOTALS	1	0	2	6	13	51	115	99	82	52	32	5	459

NUMBER OF VALID HOURS 458
NUMBER OF INVALID HOURS 3
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

October - December

TABLE 4A

SITE: SAN ONOFRE
 PERIOD OF RECORD 98093024-98123123
 WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	2	2	6	8	2	5	1	0	0	26
NNE	0	0	0	0	9	14	36	11	7	0	1	0	78
NE	0	0	0	3	2	6	8	3	0	1	2	0	25
ENE	0	0	0	2	1	5	2	1	2	3	0	0	16
E	0	0	0	2	2	6	8	6	0	0	0	0	24
ESE	0	0	1	0	1	3	8	7	0	0	0	0	20
SE	0	0	0	0	1	4	5	8	4	3	0	0	25
SSE	0	0	0	1	1	1	7	1	1	0	0	0	12
S	0	0	0	0	0	4	3	1	1	0	0	1	10
SSW	0	0	0	0	0	3	2	0	0	0	0	0	5
SW	0	0	0	0	0	1	1	0	1	0	0	0	3
WSW	0	0	0	0	2	3	1	0	0	0	0	0	6
W	0	0	0	0	0	0	6	0	0	3	0	1	10
WNW	0	0	0	0	0	1	2	3	0	0	0	0	6
NW	0	0	0	0	0	0	2	3	5	2	1	0	13
NNW	0	0	0	2	0	1	5	4	1	0	0	0	13
TOTALS	0	0	1	12	21	58	104	50	27	13	4	2	292

NUMBER OF VALID HOURS	292	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	3	TOTAL HOURS FOR THE PERIOD	2208

PASQUILL F MODERATELY STABLE ($1.5 \leq DT/DZ \leq -0.5$ °C/100 METERS)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	1	4	5	5	6	0	0	0	0	21
NNE	0	0	0	1	7	17	82	38	8	2	0	0	155
NE	0	0	1	5	6	35	18	2	5	1	0	0	73
ENE	0	0	0	0	2	8	4	2	1	0	0	0	17
E	0	0	0	0	1	6	0	0	0	0	0	0	7
ESE	0	0	0	0	1	3	0	0	0	0	0	0	4
SE	0	0	0	0	0	2	0	0	0	0	0	0	2
SSE	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	3	0	0	0	0	0	3
SSW	0	0	0	0	0	0	1	0	0	0	0	0	1
SW	0	0	0	0	1	1	0	0	0	0	0	0	2
WSW	0	0	0	0	0	1	0	0	0	0	0	0	1
W	0	0	0	0	1	0	3	0	0	0	0	0	4
WNW	0	0	0	0	0	1	1	2	1	0	0	0	5
NW	0	0	0	0	0	1	1	1	0	0	0	0	3
NNW	0	0	0	0	1	1	3	0	0	0	0	0	5
TOTALS	0	0	1	7	24	81	121	51	15	3	0	0	303

NUMBER OF VALID HOURS	303	NUMBER OF CALMS	0
NUMBER OF INVALID HOURS	3	TOTAL HOURS FOR THE PERIOD	2208

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (1998)

METEOROLOGY

October - December
TABLE 4A

SITE: SAN ONOFRE
PERIOD OF RECORD 98093024-98123123
WIND SPEED (M/S) AT 10 METER LEVEL

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	0	0	1	5	5	6	4	0	0	21
NNE	0	0	0	0	3	14	104	210	116	16	1	0	464
NE	0	0	0	0	3	11	28	14	12	0	0	0	68
ENE	0	0	0	0	1	3	6	0	0	0	0	0	10
E	0	0	0	0	3	3	3	0	0	0	0	0	9
ESE	0	0	0	0	1	1	1	0	0	0	0	0	3
SE	0	0	0	0	1	1	1	0	0	0	0	0	3
SSE	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	2	1	0	0	0	0	0	3
SSW	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	1	0	0	0	0	0	1
WSW	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	1	0	1	0	0	0	0	2
WNW	0	0	0	0	1	0	1	0	0	0	0	0	2
NW	0	0	0	0	0	1	1	1	0	0	0	0	3
NNW	0	0	0	0	0	1	1	2	1	0	0	0	5
TOTALS	0	0	0	0	13	39	153	233	135	20	1	0	5

NUMBER OF VALID HOURS 594
NUMBER OF INVALID HOURS 3
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208

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

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	0	4	6	18	24	14	15	8	1	0	90
NNE	0	0	0	1	20	49	229	267	140	20	5	0	731
NE	0	0	1	8	12	55	61	21	21	2	3	0	184
ENE	0	0	0	2	5	17	12	3	5	4	0	0	48
E	0	0	0	2	6	15	14	10	0	0	0	0	47
ESE	0	0	2	1	3	8	13	11	2	0	0	0	40
SE	0	0	0	0	4	9	22	28	17	11	9	1	101
SSE	1	0	0	1	3	2	19	22	26	9	3	1	87
S	0	0	0	1	0	13	23	19	33	10	1	1	101
SSW	0	0	0	0	0	11	19	27	20	6	5	1	89
SW	0	0	0	0	6	12	31	24	18	7	1	0	99
WSW	0	0	0	1	4	18	46	33	7	5	3	0	117
W	0	0	0	0	1	12	78	80	20	4	3	2	200
WNW	0	0	1	1	2	4	27	49	33	8	2	0	127
NW	0	0	0	1	1	7	25	26	21	11	7	2	101
NNW	0	0	0	2	2	9	16	10	2	0	2	0	43
TOTALS	1	0	4	25	75	259	659	644	380	105	45	8	2208

NUMBER OF VALID HOURS 2205
NUMBER OF INVALID HOURS 3
NUMBER OF CALMS 0
TOTAL HOURS FOR THE PERIOD 2208