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Al Bates
Manager
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10 CFR 50.36(a)

April 25, 2019

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

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

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

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

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

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

There are no commitments in this letter or the enclosure.

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

Sincerely,

IE48
A009
NMSS01
NRR
NMSS

P. O. Box 128
San Clemente, CA 92672

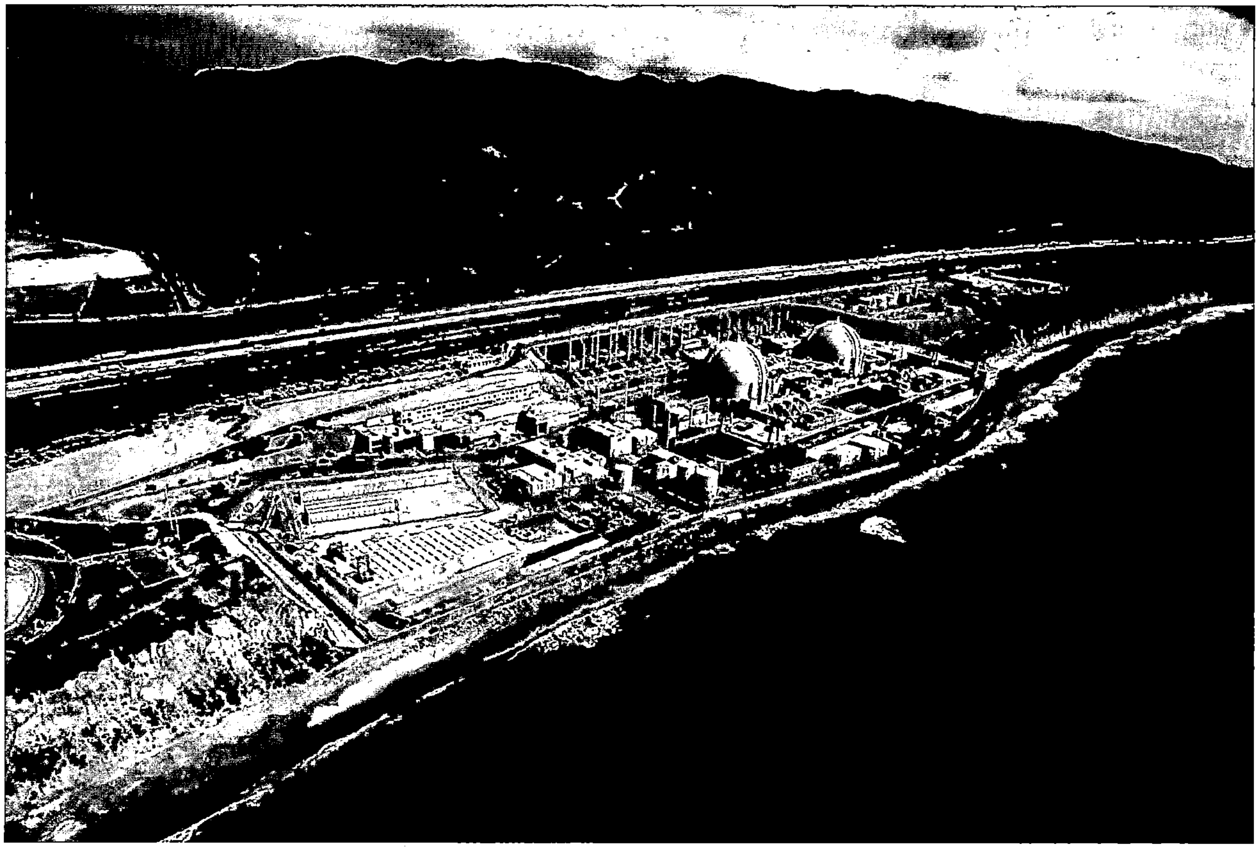
Enclosures:

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

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

Enclosure 1

San Onofre Nuclear Generation Station
Annual Radioactive Effluent Release Report
2018
January - December



SAN ONOFRE NUCLEAR GENERATING STATION

Annual Radioactive Effluent Release Report

2018

January - December

PREFACE

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

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

Unit 1 was supplied by Westinghouse Electric Company and began commercial operation on January 1, 1968. The unit was permanently shutdown on November 30, 1992. By August 31, 2004, all fuel was transferred to the Independent Spent Fuel Storage Installation (ISFSI). By November 29, 2006, remaining monitored effluent pathways were permanently removed from service. Currently, Unit 1 effluent pathway is routed to Units 2 or 3. Unit 1 is owned by Southern California Edison (80%) and San Diego Gas and Electric (20%).

Unit 2 and Unit 3 were supplied by Combustion Engineering, Inc., with turbine generators supplied by G.E.C. Turbine Generators, Ltd., of England. The units began commercial operation on August 29, 1983, and April 1, 1984, respectively. The twin units are owned by Southern California (78.21%), San Diego Gas and Electric (20%), and the City of Riverside (1.79%).

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

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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

SECTION A. INTRODUCTION

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

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

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

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

SECTION B. GASEOUS EFFLUENTS

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

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

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

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

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

Table 1C, "Gaseous Effluents Ground Level Releases," provides the systematic listing by radionuclide for the quantity of radioactivity released in three categories: fission gases, iodines, and particulates. The total radioactivity for each radionuclide is listed for each quarterly period for continuous mode of release. Containment purges and plant stack releases are considered to be continuous releases.

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

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1A
GASEOUS EFFLUENTS SUMMATION OF ALL RELEASES

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1C

GASEOUS EFFLUENTS GROUND LEVEL RELEASES
BATCH MODE

Batch gaseous releases were not performed at SONGS

TABLE 1C (Continued)

GASEOUS EFFLUENTS GROUND LEVEL RELEASES
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation gases					
krypton-85	Ci	<LLD	<LLD	<LLD	<LLD
krypton-85m	Ci	<LLD	<LLD	<LLD	<LLD
krypton-87	Ci	<LLD	<LLD	<LLD	<LLD
krypton-88	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-133m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135m	Ci	<LLD	<LLD	<LLD	<LLD
xenon-138	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
2. Iodines					
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iodine-133	Ci	<LLD	<LLD	<LLD	<LLD
iodine-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD
3. Particulates					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
cesium-137	Ci	3.73E-06	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	<LLD	<LLD	<LLD
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 1D.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1D

GASEOUS EFFLUENTS LOWER LIMIT OF DETECTION

Radionuclides	Continuous Mode LLD (µCi/cc)	Batch Mode LLD (µCi/cc)
1. Fission and activation gases		
krypton-85	2.20E-05	N/A
krypton-85m	5.50E-08	N/A
krypton-87	2.80E-07	N/A
krypton-88	2.00E-07	N/A
xenon-133	1.50E-07	N/A
xenon-133m	4.40E-07	N/A
xenon-135	5.70E-08	N/A
xenon-135m	2.10E-06	N/A
xenon-138	3.70E-06	N/A
2. Iodines		
iodine-131	2.40E-13	N/A
iodine-133	2.30E-12	N/A
iodine-135	1.60E-10	N/A
3. Particulates		
barium-140	5.00E-13	N/A
cerium-141	6.00E-14	N/A
cerium-144	2.40E-13	N/A
cesium-134	1.40E-13	N/A
cesium-137	1.20E-13	N/A
cobalt-58	1.30E-13	N/A
cobalt-60	2.00E-13	N/A
iron-59	3.20E-13	N/A
lanthanum-140	1.00E-12	N/A
manganese-54	1.30E-13	N/A
molybdenum-99	7.20E-14	N/A
strontium-89	1.00E-11	N/A
strontium-90	1.00E-11	N/A
zinc-65	3.40E-13	N/A
4. Tritium	N/A	N/A
5. Alpha	1.00E-11	N/A

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 1E

GASEOUS EFFLUENTS RADIATION DOSES AT THE SITE BOUNDARY

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Noble Gas					
1. Gamma Air Dose	mrad	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Percent of Applicable Limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Beta Air Dose	mrad	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4. Percent Applicable Limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium, Iodine, Particulates (at the nearest receptor)					
1. Organ Dose	mrem	1.60E-04	7.57E-05	1.58E-05	4.35E-05
2. Percent of Applicable Limit	%	1.07E-03	5.04E-04	1.05E-04	2.90E-04

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

TABLE 1F

GASEOUS EFFLUENTS BATCH RELEASE SUMMARY

Batch gaseous releases were not performed at SONGS.

SECTION C. LIQUID EFFLUENTS

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

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

In addition, Table 2A lists:

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

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

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

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

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

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

TABLE 2A
LIQUID EFFLUENTS SUMMATION OF ALL RELEASES

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2B

LIQUID EFFLUENTS
CONTINUOUS MODE

Radionuclides Released	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Fission and activation products					
barium-140	Ci	<LLD	<LLD	<LLD	<LLD
cerium-141	Ci	<LLD	<LLD	<LLD	<LLD
cerium-144	Ci	<LLD	<LLD	<LLD	<LLD
cesium-134	Ci	<LLD	4.06E-05	4.31E-05	<LLD
cesium-137	Ci	<LLD	3.87E-04	3.25E-04	3.71E-05
chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
cobalt-60	Ci	<LLD	1.10E-04	1.89E-05	<LLD
iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
iron-55	Ci	<LLD	<LLD	<LLD	<LLD
iron-59	Ci	<LLD	<LLD	<LLD	<LLD
lanthanum-140	Ci	<LLD	<LLD	<LLD	<LLD
manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
molybdenum-99	Ci	<LLD	<LLD	<LLD	<LLD
niobium-95	Ci	<LLD	<LLD	<LLD	<LLD
strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
technetium-99m	Ci	<LLD	<LLD	<LLD	<LLD
zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	5.38E-04	3.87E-04	3.71E-05
2. Dissolved and entrained gases					
xenon-133	Ci	<LLD	<LLD	<LLD	<LLD
xenon-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	<LLD	<LLD	<LLD	<LLD

LLD Lower Limit of Detection; see Table 2C.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2B (Continued)

LIQUID EFFLUENTS
BATCH MODE *

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

* No liquid batch releases were conducted in 2018.

TABLE 2C

LIQUID EFFLUENTS LOWER LIMIT OF DETECTION

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

* No liquid batch releases were conducted in 2018.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2D

LIQUID EFFLUENTS RADIATION DOSES AT THE LIQUID SITE BOUNDARY

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

SAN ONOFRE NUCLEAR GENERATING STATION

TABLE 2E

LIQUID EFFLUENTS BATCH RELEASE SUMMARY *

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

* No liquid batch releases were conducted in 2018.

SECTION D. PREVIOUS RADIOACTIVE EFFLUENT RELEASE REPORT ADDENDUM

SONGS Sample Garden Relocation

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

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SECTION E. RADWASTE SHIPMENTS

TABLE 3 (Units 2 & 3)

SOLID WASTE AND IRRADIATED FUEL SHIPMENT

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

1. Type of waste	Unit	12 month period	Estimated total error (%)
a. Spent resins, filter sludge, evaporator bottoms	m^3	N/A	N/A
	Ci	N/A	
b. Dry active waste (DAW), compactable and non-compactable	m^3	7.97E+02	30%
	Ci	1.23E+00	
c. Irradiated components	m^3	N/A	N/A
	Ci	N/A	
d. Other: Filters	m^3	1.17E+00	30%
	Ci	2.63E+01	

NOTE:
Shipments include: Dry Active Waste (DAW) and Filters.
N/A: No shipments containing these items made in 2018.

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

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

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

Notes:

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

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

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

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

B. IRRADIATED FUEL SHIPMENTS (Disposition)

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

C. DEWATERING

Number of Containers	Solidification Agent
None	N/A

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

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

SECTION F. APPLICABLE LIMITS

Gaseous Effluents Applicable Limits

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

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

where: Rel Rate = total microcuries released in each category and each quarter, divided by the seconds in a quarter; the value in Sections A.2, B.2, C.2 and D.2 of Table 1A, µCi/sec.

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

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

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

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

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

where: Rel Rate = total microcuries released in each category and each quarter, divided by the seconds in a quarter; the value in Sections A.2, B.2, C.2 and D.2 of Table 1A, µCi/sec.

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

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

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

where: F_i = fractional concentration of the ith 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 ith radionuclide from 10 CFR 20 (20.1001-20.2402), Appendix B, Table 2, Column 1.

SECTION F. APPLICABLE LIMITS (Continued)

Liquid Effluents Applicable Limits

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

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

  where: Dil Conc = total microcuries released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, µCi/ml.

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

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

  n = total number of radionuclides identified

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

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

  where: Dil Conc = total microcuries released in each category and each quarter divided by the total volume released (sum of Sections E and F in Table 2A); the value in Sections A.2, B.2, and C.2 of Table 2A, µCi/ml.

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

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

  n = total number of radionuclides identified

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

SECTION F. APPLICABLE LIMITS (Continued)

APPENDIX A

GASEOUS EFFLUENTS – APPLICABLE LIMITS

A. Table 1A lists the total curies released and the release rate. The percent of applicable limit compares the release concentration limits of 10 CFR 20 Appendix B, Table II, Column 1.

B. Table 1E lists the air doses as calculated using the historical X/Q. The air dose due to noble gases released in gaseous effluents from SONGS (per unit) to areas at and beyond the site boundary shall be limited to the following values:

   1. During any calendar quarter: ≤ 5 mrad for gamma radiation and ≤ 10 mrad for beta radiation.
   2. During any calendar year: ≤ 10 mrad for gamma radiation and ≤ 20 mrad for beta radiation.

C. The dose to a Member of the Public from iodines, tritium, and radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from SONGS (per unit) to areas at and beyond the site boundary shall be limited to the following values:

   1. During any calendar quarter: ≤ 7.5 mrem to any organ.
   2. During any calendar year: ≤ 15 mrem to any organ.

SECTION F. APPLICABLE LIMITS (Continued)

APPENDIX A (Continued)

LIQUID EFFLUENTS – APPLICABLE LIMITS

A. Table 2A lists the total curies released, the diluted concentration, and percent of applicable limit. The percent of applicable limit compares the diluted concentration of radioactive material released to the concentrations specified in 10 CFR 20 Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained gases. For dissolved or entrained noble gases, the concentration is limited to 2.00E-04 µCi/ml.

B. Table 2D lists the doses due to liquid releases. The dose commitment to a Member of the Public from radioactive materials in liquid effluents released from SONGS (per unit) to unrestricted areas shall be limited to the following values:

1. During any calendar quarter: ≤ 1.5 mrem to the total body and ≤ 5 mrem to any organ.
2. During any calendar year: ≤ 3 mrem to the total body and ≤ 10 mrem to any organ.

SECTION G. ESTIMATION OF ERROR

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

Sources of error for gaseous effluents 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:

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

where: σ_i = Error associated with each component.

SECTION H. 10 CFR 50 APPENDIX I REQUIREMENTS

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

(1) Liquid Effluents - Whole Body

(2) Liquid Effluents - Organ

(3) Airborne Effluents - Tritium, Iodines and Particulates

(4) Noble Gases - Gamma

(5) Noble Gases - Beta

(6) Direct Radiation

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

The doses for each category are derived as follows:

A. Categories 1 and 2 are calculated using the ODCM methodology. In addition, this data is presented in Table 2D.

B. Categories 3, 4, and 5 are calculated utilizing RETDAS, Regulatory Guide 1.109 methodology, and concurrent meteorology. However, Table IE of (Gaseous Effluents, Section B) lists data similar to categories 3, 4, and 5 using methods described in the ODCM and the historical meteorology (X/Q).

C. Category 6 presents direct dose data measured by TLD dosimeters.

For individuals who may, at times, be within the Site boundary, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the Site boundary[1]. For members of the public who traverse the Site boundary (e.g., via highway I-5), the residency time is considered negligible and hence the dose is "0."

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

[1] ODCM Figures 1-2 and 2-2

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TABLE 1

SOURCE	Dose * (millirems)				
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year
LIQUID EFFLUENTS Whole Body	1) 0.00E+00	2) 1.10E-03	3) 1.44E-03	4) 1.37E-04	5) 2.67E-03
Organ	6) 0.00E+00	7) 1.51E-03	8) 2.09E-03	9) 2.09E-04	10) 3.81E-03
AIRBORNE EFFLUENTS Tritium, Iodines, and Particulates	11) 1.51E-03	12) 8.20E-04	13) 1.59E-04	14) 3.41E-04	15) 2.83E-03
NOBLE GASES ** Gamma	16) 0.00E+00	17) 0.00E+00	18) 0.00E+00	19) 0.00E+00	20) 0.00E+00
Beta	21) 0.00E+00	22) 0.00E+00	23) 0.00E+00	24) 0.00E+00	25) 0.00E+00
DIRECT RADIATION	26) 8.18E-02	27) 9.13E-02	28) 2.92E-02	29) 6.17E-02	30) 2.64E-01

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

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

1. No liquid radioactive effluent releases occurred during this quarter.
2. This value was calculated using the methodology of the ODCM.
3. This value was calculated using the methodology of the ODCM.
4. This value was calculated using the methodology of the ODCM.
5. This value was calculated using the methodology of the ODCM.
6. No liquid radioactive effluent releases occurred during this quarter.
7. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.
8. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.

9. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.

10. This value was calculated using the methodology of the ODCM; the Liver received the maximum dose.

11. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

12. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

13. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

14. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

15. The maximum organ dose was to a child's Liver, Thyroid, Kidney, Lung, and GI-LLI and was located in the NNW sector. This was calculated using the assumptions of USNRC Regulatory Guide 1.109.

16. No noble gas radioactive effluent releases occurred during this quarter.

17. No noble gas radioactive effluent releases occurred during this quarter.

18. No noble gas radioactive effluent releases occurred during this quarter.

19. No noble gas radioactive effluent releases occurred during this quarter.

20. No noble gas radioactive effluent releases occurred during this year.

21. No noble gas radioactive effluent releases occurred during this quarter.

22. No noble gas radioactive effluent releases occurred during this quarter.

23. No noble gas radioactive effluent releases occurred during this quarter.

24. No noble gas radioactive effluent releases occurred during this quarter.

25. No noble gas radioactive effluent releases occurred during this year.

26. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

27. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

28. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

29. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

30. Measurements were made using TLD dosimeters; values are presented as site wide dose and are prorated to 300 hours per year; highest dose was measured at the Site Boundary in the WNW sector.

NOTES:

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

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TABLE 2

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

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

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SECTION I. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

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

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

Revision 12

This revision incorporates the following:

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

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

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

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

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

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Revision 13

This revision incorporates the following:

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

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

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

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

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

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

SECTION J. CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

Changes to the Liquid Radioactive Waste Treatment System

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

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

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

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

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

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

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

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

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

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

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

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

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

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SDS-CH2-EVA-0004 requires:

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

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

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

Annual Dose Summary - Liquid

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

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

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

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31-day dose

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

31-day dose (Including SFP)

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

SECTION K. MISCELLANEOUS

ABNORMAL RELEASES

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

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

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

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EFFLUENT MONITORING INSTRUMENTS OUT OF SERVICE GREATER THAN 30 DAYS

January 1, 2018 - December 31, 2018

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

SYFRU-7904 South Yard Facility Work Area

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

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

SECTION K. MISCELLANEOUS (Continued)

ONSITE GROUND WATER SAMPLES

In 2007, the Nuclear Energy Institute (NEI) established a standard for monitoring and reporting radioactive isotopes in groundwater titled NEI Groundwater Protection Initiative, NEI 07-07. It has been established that there is no drinking water pathway for groundwater underneath SONGS. However, the site implemented the groundwater protection industry standard. This section provides results of on-site samples of ground water that were obtained as part of SCE's implementation of the voluntary industry Ground Water Protection Initiative. The sample locations and the frequency of sampling may change over time. The Groundwater Monitoring Wells that are in the Groundwater Protection Initiative are NIA-1, NIA-2, NIA-12, NIA-13, PA-1, PA-2, PA-3, PA-4, OCA-1, OCA-2, and OCA-3. These wells are sampled on a quarterly basis.

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

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

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

ONSITE GROUND WATER SAMPLES

January 1, 2018 – December 31, 2018

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

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

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

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

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

NIA = Temporary investigation wells installed in the North Industrial Area.

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

Values above MDC are reported as calculated

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

ONSITE GROUND WATER SAMPLES (Continued)

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

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

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

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

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

SECTION K. MISCELLANEOUS (Continued)

40 CFR 190 REQUIREMENTS

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

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

SECTION K. MISCELLANEOUS (Continued)

CARBON-14

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

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

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

C-14 calculated production, discharge parameters and resulting dose are reported here, separately from tables 1, 1A, 1C, 1E, 2 and 40 CFR 190 Table 1.

Calculated C-14 production , Ci/EFPY(1)	U2 = 0 U3 = 0
2018 Unit capacity factors	U2 = 0 U3 = 0
Fraction release of produced C-14 to atmosphere	0.98
C-14 chemical form fraction assumed	Organic = 0.80 Inorganic = 0.20
C-14 curies released to atmosphere	U2 = 0 U3 = 0
Critical receptor dose(2) [Child (bone)], mrem	0

(1) Effective Full Power Year
NOTE: Units have been shutdown since January 9, 2012 for Unit 2 and January 31, 2012 for Unit 3.

SECTION L. SONGS CONCLUSIONS

1) Gaseous releases (excluding carbon-14) totaled 7.38E+00 curies of which noble gases were 0.00E+00 curies, particulates were 3.73E-06 curies, iodines were 0.00E+00 curies, and tritium was 7.38E+00 curies.

2) The radiation doses from gaseous releases were: (a) gamma air dose: 0.00E+00 mrad at the site boundary, (b) beta air dose: 0.00E+00 mrad at the site boundary, (c) organ dose (Child - Liver, Thyroid, Kidney, Lung, and GI-LLI): 2.95E-04 mrem at the highest receptor.

3) Airborne carbon-14 release was projected at 0.00E+00 curies due to the fact that both units have been permanently shut down since January 2012.

4) Liquid releases totaled 3.24E-01 curies of which particulates were 9.62E-04 curies, iodines were 0.00E+00 curies, tritium was 3.23E-01 curies, and noble gases were 0.00E+00 curies.

5) The radiation doses from liquid releases were: (a) total body: 2.67E-03 mrem, (b) limiting organ (LIVER): 3.81E-03 mrem.

6) The radioactive releases and resulting doses generated from Units 2 and 3 were below the Applicable Limits for both gaseous and liquid effluents.

7) One shipment was made from Energy*Solutions* LLC Bear Creek Operations (BCO) to WCS Texas Disposal Site. Thirty-Three shipments were made from San Onofre (SONGS SDS) to EnergySolutions Clive Utah Disposal Site. One shipment was made from Energy*Solutions* LLC Bear Creek Operations to Energy*Solutions* Clive Utah Disposal Site. These shipments included 797 cubic meters of Dry Active Waste containing 1.23 curies of radioactivity and 1.17 cubic meters of Filters containing 26.3 curies of radioactivity.

8) Meteorological conditions during the year were typical for SONGS. Meteorological dispersion was good 36% of the time, fair 38% of the time and poor 26% of the time.

9) The results of samples taken from on-site ground water wells in support of the Industry Ground Water Protection Initiative are reported in Section K. There are low but detectable concentrations of tritium identified in the shallow ground water area formerly occupied by Unit 1 that is currently identified as the North Industrial Area. The ground water beneath SONGS is not a source of drinking water. On April 28, 2015, the extraction pumps were secured to evaluate the impact of groundwater extraction. There was no groundwater or dewatering well effluent discharges from the site during 2018. The site continues to sample, analyze and document the results of the groundwater monitoring wells in accordance to the site's Groundwater Monitoring Program.

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

SAN ONOFRE NUCLEAR GENERATING STATION

METEOROLOGY

The meteorology of the San Onofre Nuclear Generating Station for each of the four quarters, 2018 is described in this section. Meteorological measurements have been made according to the guidance provided in USNRC Regulatory Guide 1.23, "Onsite Meteorological Programs." A summary report of the meteorological measurements taken during each calendar quarter are presented in Table 4A as joint frequency distribution (JFD) of wind direction and wind speed by atmospheric stability class.

The hourly data for the Annual Report is available, but have not been included in this report because of the bulk of data records.

Table 4A lists the joint frequency distribution for each quarter, 2018. Each page of Table 4A represents the data for the individual stability classes: A, B, C, D, E, F, and G. The last page of each section shows the JFD for all the stability classes. The wind speeds have been measured at the 10 meter level, and the stability classes are defined by the temperature differential between the 10 meter and 40 meter levels.

METEOROLOGY

January - March
Table 4A

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

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

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

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

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

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

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

METEOROLOGY

January - March
Table 4A

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

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

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

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

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

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

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

METEOROLOGY

January - March
Table 4A

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

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

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

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

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

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

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

January - March
Table 4A

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

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

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

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

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

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

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

METEOROLOGY

April - June
TABLE 4A

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

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

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

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

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

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

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

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT – 2018

METEOROLOGY

April - June
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

April - June
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

April - June
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

July - September
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

July - September
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

July - September
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

July - September
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

October - December
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

October - December
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

October - December
TABLE 4A

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

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

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

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

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

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

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

METEOROLOGY

October - December
TABLE 4A

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

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

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

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

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

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

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

Enclosure 2

Offsite Dose Calculation Manual Nuclear Organization
San Onofre Nuclear Generation Station (SONGS)
SO123-ODCM Revision 13, November 2018

November 8, 2018

Mr. Tom Palmisano

SUBJECT: San Onofre Nuclear Generating Station (SONGS) Offsite Dose Calculation Manual (ODCM) and Appendices: SO123-ODCM Revision 13, SO123-ODCM-A Revision 13, and SO123-ODCM-B Revision 9

In accordance with Permanently Defueled Technical Specification 5.5.2.1, revisions to the SONGS Offsite Dose Calculation Manual have been prepared and reviewed for your approval.

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

This revision incorporates the following:

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

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

Please contact me if there are any questions.

(Approved electronically)
Robert L. McCann
ODCM/REMP Specialist (SDS)

(Approved electronically)
Steven Vaughan
Manager, Radiation Protection and Waste

Approved by: *(Approved electronically)*
Thomas J. Palmisano
Vice President Decommissioning and Chief Nuclear Officer

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

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

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

OFFSITE DOSE CALCULATION MANUAL

NUCLEAR ORGANIZATION

SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)

SO123-ODCM
Revision 13
11/2018

ODCM

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INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is a supporting document of the RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS (NUREG 0472). The ODCM enumerates dose and concentration specifications, instrument requirements, as well as describes the methodology and parameters to be used in the calculation of offsite doses from radioactive liquid and airborne effluents consistent with Reg. Guide 1.109 and NUREG 0133. In order to meet release limits, it additionally provides calculations for liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. The environmental section contains the requirements for the radiological environmental monitoring program.

The ODCM will be maintained at the Site for use as a document of Specifications and acceptable methodologies and calculations to be used in implementing the Specifications. Changes in the calculational methods or parameters will be incorporated into the ODCM in order to assure that the ODCM represents current methodology.

1.0 **LIQUID EFFLUENTS**

1.1 CONCENTRATION

SPECIFICATION

1.1.1 The concentration of radioactive material released from the site (see Figure 1-2) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2 x 10^{-4} microcuries/ml total activity.

APPLICABILITY: At all times

ACTION:

a. With the concentration of radioactive material released from the site exceeding the above limits, immediately restore the concentration to within the above limits.

SURVEILLANCE REQUIREMENTS

.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 1-1.

.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in Section 1.4 to assure that the concentrations at the point of release are maintained within the limits of Specification 1.1.1.

TABLE 1-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
A. Batch Waste Release[d,h]	P Each Batch	P Each Batch	Principal Gamma Emitters[f]	$5x10^{-7}$
			I-131	$1x10^{-6}$
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma emitters)	$1x10^{-5}$
	P Each Batch	M Composite[b,g]	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	P Each Batch	Q Composite[b,g]	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

NOTE BATCH RELEASE POINTS: Primary Plant Makeup Storage Tanks (T055/56), also known as Spent Fuel Pool Makeup Water Tanks, and Miscellaneous Waste Evaporator Condensate Monitor Tanks (T075/76).

B. Continuous Release[e,h]	D Grab Sample	W Composite[c,g]	Principal Gamma Emitters[f]	$5x10^{-7}$
			I-131	$1x10^{-6}$
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma emitters)	$1x10^{-5}$
	D Grab Sample	M Composite[c,g]	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	D Grab Sample	Q Composite[c,g]	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

NOTE CONTINUOUS RELEASE POINT: Unit 2 Turbine Plant Sump

TABLE 1-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
C. Continuous Release[e,h] North Industrial Area Yard Drain Sump	3 x W Grab Sample	W Composite[b,g]	Principal Gamma Emitters[f]	$5x10^{-7}$
	3 x W Grab Sample	M Composite[b,g]	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	3 x W Grab Sample	Q Composite[b,g]	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

TABLE 1-1 (Continued)

TABLE NOTATION

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 S_b}{E * V * 2.22 x 10^6 * Y * \exp(-\lambda \Delta \tau)}$$

where:

LLD	=	"a priori" lower limit of detection as defined above (as microcurie per unit mass or volume),
S_b	=	standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute),
E	=	counting efficiency (as counts per transformation),
V	=	sample size (in units of mass or volume),
2.22×10^6	=	number of transformations per minute per microcurie,
Y	=	fractional radiochemical yield (when applicable),
λ	=	radioactive decay constant for the particular radionuclide, and
Δt	=	elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples).

The value of S_b used in the calculation of the LLD for a particular measurement system shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance.

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of the measurement system and not as a posteriori (after the fact) limit for a particular measurement.#

#For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, HASL-300 (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" Anal. Chem. 40, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report ARH-2537 (June 22, 1972).

TABLE NOTATION (Continued)

b. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

c. To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

d. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed, by a method described in the ODCM, to assure representative sampling.

e. A continuous release is the discharge of liquid wastes of a nondiscrete volume; e.g., from a volume of system that has an input flow during the continuous release.

f. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, and those isotopes listed in Reg. Guide 1.21, shall also be identified and reported.

g. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

h. There shall be no liquid discharges across the beach; liquid may only be discharged through the approved outfall(s).

* DELETED

** DELETED

*** DELETED

1.2 DOSE

SPECIFICATION

1.2.1 The dose or dose commitment to an individual from radioactive materials in liquid effluents released, from each unit, from the site (see Figure 1-2) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ.

APPLICABILITY: At all times

ACTION:

a. With calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, in lieu of any other report required by Technical Specification Section 5.7.1, prepare and submit to the Commission within 30 days, a Special Report which identifies the cause(s) for exceeding the limit(s) and defines the corrective actions taken to reduce the releases and the proposed actions to be taken to assure that subsequent releases will be in compliance with Specification 1.2.1.

SURVEILLANCE REQUIREMENT

.1 Dose Calculation. Cumulative dose contributions from liquid effluents shall be determined in accordance with Section 1.5 at least once per 31 days.

1.0 **LIQUID EFFLUENTS** (Continued)

1.3 LIQUID WASTE TREATMENT

SPECIFICATION

1.3.1 The portable liquid radwaste treatment system shall be FUNCTIONAL. The appropriate portions of the system shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent from the site (see Figure 1-2) when averaged over 31 days, would exceed 0.06 mrem to the total body or 0.2 mrem to any organ.*

APPLICABILITY: At all times

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits, in lieu of any other report required by Technical Specification Section 5.7.1, prepare and submit to the Commission within 30 days, a Special Report which includes the following information:

   1. Explanation of why liquid radwaste was being discharged without treatment, identification of the non-FUNCTIONAL equipment or subsystems and the reason for non-FUNCTIONALITY,

   2. Action(s) taken to restore the non-FUNCTIONAL equipment to FUNCTIONAL status, and

   3. Summary description of action(s) taken to prevent a recurrence.

SURVEILLANCE REQUIREMENTS

.1 Doses due to liquid releases shall be projected at least once per 31 days, in accordance with Section 3.1.

.2 The appropriate portions of the portable liquid radwaste treatment system shall be demonstrated FUNCTIONAL by operating the liquid radwaste treatment system equipment for at least 15-minutes prior to processing liquids. The processed liquids shall then be evaluated for batch release.

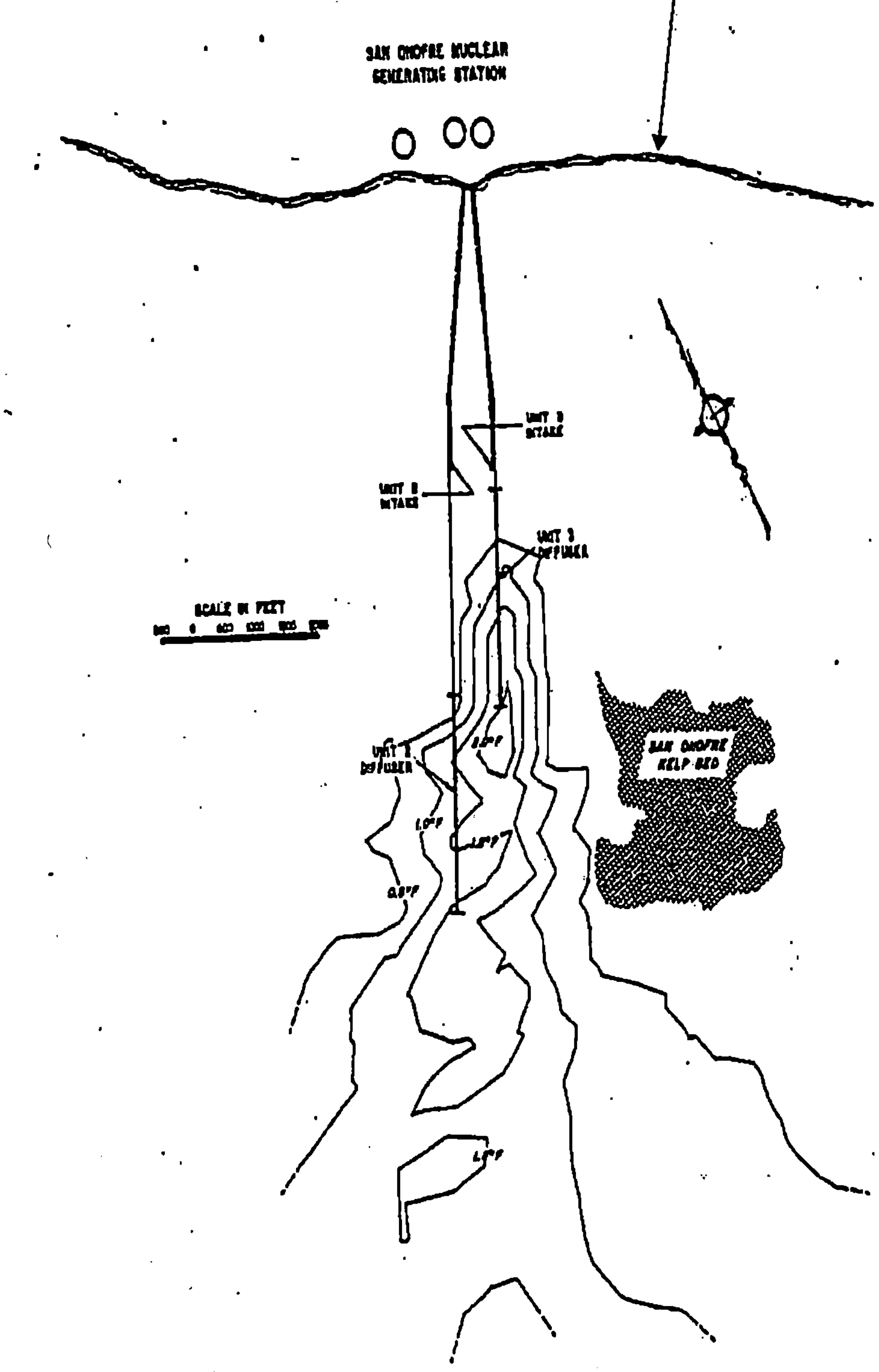
*Per unit

SITE BOUNDARY FOR LIQUID EFFLUENTS

Figure 1-2

NIA, UNIT 2 & UNIT 3

SITE BOUNDARY for Liquid Effluents (waterfront on Property Line)



1.0 **LIQUID EFFLUENTS** (Continued)

1.4 LIQUID EFFLUENT MONITOR METHODS OF SETPOINT CALCULATION

Liquid Effluent Line Monitor provides alarm and automatic termination of release prior to exceeding the concentration limits specified in 10 CFR 20, Appendix B, Table II, Column 2 at the release point to the unrestricted area. To meet this specification and for the purpose of implementation of Specification 1.1.1, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$\left[\frac{C_m R}{F+R}\right] \leq MPC_{eff} \qquad \textbf{(1-1)}$$

where:

C_m = setpoint, representative of a radionuclide concentration for the radiation monitor measuring the radioactivity in the waste effluent line prior to dilution and subsequent release, µCi/ml

R = permissible waste effluent flow rate at the radiation monitor location, in volume per unit time in the same units as for F

F = dilution water flow in volume per unit time.
= 7,000 gpm per saltwater dilution pump*

*The value used in the determination of F takes into account factors such as frictional losses, pump inefficiency, and tidal flow, and provides reasonable assurance that the radioactive release concentration is not underestimated. For radwaste discharges, the dilution water flow of 14,000 gpm shall be used and aligned to the same outfall.

NOTE: Since the values of R are much smaller than F, the term (F + R) in equation (1-1) may be replaced by F.

1.0 **LIQUID EFFLUENTS** (Continued)

1.4 LIQUID EFFLUENT MONITOR METHODS OF SETPOINT CALCULATION (Continued)

MPC_{eff} = effective effluent maximum concentration permissible limit (µCi/ml) at the release point to the unrestricted area for the radionuclide mixture being released:

$$= \left[\frac{1}{\sum_{i=1}^{n} \frac{F_i}{MPC_i}} \right] \quad \textbf{(1-2)}$$

where:

n = number of radionuclides identified in sample analysis

F_i = fractional concentration of the i^{th} radionuclide as obtained by sample analysis

MPC_i = MPC of the i^{th} radionuclide (10 CFR 20, App B, Table II, Column 2)

Administrative values are used to reduce each setpoint to account for the potential activity released simultaneously from the following release points:

RW_{7813} = Radwaste Effluent discharge

T_2 = Unit 2 Turbine Plant Sump

Y = NIA Yard Drain Sump

The sum of the administrative values is limited to 1.0 to ensure that the total concentration from all release points to the plant discharge will not result in a release exceeding the limits of 10 CFR 20, Appendix B, Table II, Column 2. The administrative values shall be assigned such that:

$(RW_{7813} + T_2 + Y) < 1.0$.

The administrative values shall be periodically reviewed based on actual release data and revised as necessary.

1.0 **LIQUID EFFLUENTS** (Continued)

1.4.1 Batch Release Setpoint Determination

The waste flow (R) and monitor setpoint (C_m) are set to meet the condition of equation (1-1) for the MPC_{eff} limit. The method by which this is accomplished as follows:

STEP 1: The isotopic concentration for each batch tank (or sump) to be released is obtained from the sum of the measured concentrations in the tank (or sump) as determined by analysis.

$$C = \left(\sum_i C'_{\gamma i}\right) + \left(C_\alpha\right) + \left(C_s\right) + \left(C_t\right) + \left(C_{Fe}\right) + \left(C_{Xe}\right) \quad \textbf{(1-3)}$$

where:

C = total concentration in each batch tank, µCi/ml

$\Sigma_i C'_{\gamma i}$ = sum of the measured concentrations for each radionuclide, i, in the gamma spectrum, excluding Xe-133, µCi/ml

C_α = gross alpha concentration determined in the previous monthly composite sample, µCi/ml

C_s = Sr-89 and Sr-90 concentrations as determined in the previous quarterly composite sample, µCi/ml

C_t = H-3 concentration as determined in the previous monthly composite sample, or as measured in the sample taken prior to release, µCi/ml

C_{Fe} = Fe-55 concentration as determined in the previous quarterly composite sample, µCi/ml

C_{Xe} = Xe-133 concentration as determined by isotopic analysis, µCi/ml

1.0 **LIQUID EFFLUENTS** (Continued)

1.4.1 **Batch Release Setpoint Determination** (Continued)

STEP 2: The effective MPC (MPC_{eff}) for each batch tank (or sump) is determined using:

$$MPC_{eff} = \frac{1}{\sum_i \left(\frac{C_{\gamma i}/C}{MPC_{\gamma i}}\right) + \left(\frac{C_S/C}{MPC_s}\right) + \left(\frac{C_t/C}{MPC_t}\right) + \left(\frac{C_\alpha/C}{MPC_\alpha}\right) + \left(\frac{C_{Fe}/C}{MPC_{Fe}}\right)} \quad \textbf{(1-4)}$$

where:

$MPC_{\gamma i}$,
MPC_s, = the limiting concentrations of the appropriate radionuclide from 10 CFR 20, Appendix B, Table II, Column 2
MPC_t,
MPC_{Fe},
MPC_α

NOTE: For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-4 µCi/ml total activity.

STEP 3: The setpoint, C_m (µCi/ml) for each batch release radioactivity monitor may now be specified based on the respective values of C, $\Sigma_i C'_{\gamma i}$, F, MPC_{eff}, and R to provide compliance with the limits of 10 CFR 20, Appendix B, Table II, Column 2.

1.0 **LIQUID EFFLUENTS** (Continued)

1.4.1.1 Radwaste Discharge Line Monitor (2/3RT-7813)

The value for C_m, the concentration limit at the detector, is determined by using:

$$C_m \leq \frac{(RW_{7813})(F)(\sum_i C'_{yi})}{(R)\left(\frac{C}{MPC_{eff}}\right)} \tag{1-6}$$

where:

RW_{7813} = Radwaste Effluent discharge administrative value

F = dilution water flow in volume per unit time
= 7,000 gpm per saltwater dilution pump**

** The value used in the determination of F takes into account factors such as frictional losses, pump inefficiency, and tidal flow, and provides reasonable assurance that the radioactive release concentration is not underestimated. For radwaste discharges, the dilution water flow of 14,000 gpm shall be used and aligned to the same outfall.

C = total concentration in each batch sample

$\Sigma_i C'_{yi}$ = total gamma isotopic concentration, excluding Xe-133, μCi/ml

R = typical effluent release rate
Values of R for each tank are as follows:
Primary Plant Makeup Tank = 160 gpm (per pump)
Condensate Monitor Tank = 100 gpm (per pump)
The maximum liquid radwaste release discharge flow rate will be administratively limited to less than 95 gpm

MPC_{eff} = from equation (1-4)

NOTE: If $C_m \leq \Sigma_i C'_{yi}$, then no release is possible. To increase C_m, increase the administrative value RW_{7813}, and/or increase dilution flow F (by running more dilution pumps in the applicable discharge structure), and/or decrease the effluent flow rate R and recalculate C_m using the new RW_{7813}, F, R as applicable and equation (1-6).

1.4.1.2 Blowdown Processing System Neutralization Sump/Full Flow Condensate Polisher Demineralizer (FFCPD) Sump Discharge Line Monitor (Batch) (2RT-7817, 3RT-7817) – **DELETED**

1.4.2 Continuous Release Setpoint Determination

NOTE
Specific grab sample may be used instead of weekly composite to enable TPS or NIA setpoint to be set.

The waste flow (R) and monitor setpoint (C_m) are set to meet the condition of equation (1-1) for the effective MPC (MPC_{eff}) limit. The method by which this is accomplished is as follows:

STEP 1: The isotopic concentration for the continuous releases are obtained for each release stream (turbine plant sump, and NIA yard drain sump) from the sum of the respective measured concentrations as determined by analysis:

$$C = \left(\sum_i C'_{\gamma i}\right) + (C_\alpha) + (C_s) + (C_t) + (C_{Fe}) + (C_{Xe}) \qquad \textbf{(1-3)}$$

where:

C = total concentration (µCi/ml)

$\Sigma_i C'_{\gamma i}$ = total gamma activity associated with each radionuclide, i, in the weekly composite analysis for the release stream, excluding Xe-133, µCi/ml

C_α = total measured gross alpha concentration determined from the previous monthly composite analysis for the release stream, µCi/ml

C_s = total measured concentration of Sr-89 and Sr-90 as determined from the previous quarterly composite analysis for the release stream, µCi/ml

C_t = total measured H-3 concentration determined from the previous weekly or monthly composite analysis for the release stream, µCi/ml

C_{Fe} = total Fe-55 concentration as determined in the previous quarterly composite sample for the release stream, µCi/ml

C_{Xe} = Xe-133 concentration as determined by isotopic analysis, µCi/ml

1.0 **LIQUID EFFLUENTS** (Continued)

1.4.2 **Continuous Release Setpoint Determination** (Continued)

STEP 2: The effective MPC (MPC_{eff}) for each release stream (turbine plant sump or NIA yard drain sump) is determined using:

$$MPC_{eff} = \frac{1}{\sum_i \left(\frac{C_{yi}/C}{MPC_{yi}}\right) + \left(\frac{C_S/C}{MPC_s}\right) + \left(\frac{C_t/C}{MPC_t}\right) + \left(\frac{C_\alpha/C}{MPC_\alpha}\right) + \left(\frac{C_{Fe}/C}{MPC_{Fe}}\right)} \quad \textbf{(1-4)}$$

where:

MPC_{yi}, MPC_s, MPC_t, MPC_{Fe}, MPC_α = the limiting concentrations of the appropriate radionuclide from 10 CFR 20, Appendix B, Table II, Column 2

STEP 3: The setpoint C_m (µCi/ml) for each continuous release radioactivity monitor may now be specified based on the respective values of C, $\Sigma_i C'_{yi}$, F, MPC_{eff}, and R to provide compliance with the limits of 10 CFR 20, Appendix B, Table II, Column 2.

1.4.2.1 Blowdown Processing System Neutralization Sump Discharge Line Monitors (2RT-7817, 3RT-7817) -- **DELETED**

1.4.2.2 Steam Generator Blowdown Bypass Discharge Line Monitors (2RT-6753, 2RT-6759, 3RT-6753, 3RT-6759) -- **DELETED**

1.4.2.3 Turbine Plant Sump Monitor (2RT-7821)

The value for C_2 (Unit 2), the concentration limit at the Unit 2 detector, is determined by using:

$$C_2 \le \frac{(T_2)(F)(\sum_i C'_{yi})}{(R)(C/MPC_{eff})} \qquad \textbf{(1-13)}$$

Equation 1-14 **DELETED**

where:

C_2	=	instantaneous concentration at detector 2RT-7821 in µCi/cc
T_2	=	Unit 2 Turbine Plant Sump administrative value
F	=	dilution water flow in volume per unit time
	=	7,000 gpm per saltwater dilution pump
$\Sigma_i C'_{yi}$	=	total gamma isotopic concentration, excluding Xe-133, µCi/ml, (STEP 1)
R	=	effluent flow rate, gpm, (STEP 1), typical flow rate:
	=	300 gpm
C	=	total concentration, µCi/ml
MPC_{eff}	=	value of MPC_{eff} from equation (1-4) for the sample analysis

NOTE: If $C_2 \le \Sigma_i C'_{yi}$, then no release is possible. To increase C_2, increase the administrative value T_2, and/or increase dilution flow F (by running more dilution pumps), and/or decrease the effluent flow rate, R, and recalculate C_2 using the new T_2, F, R as applicable and equation (1-13). A minimum of 7,000 gpm flow shall be used for continuous releases. If there is a loss of dilution flow, then operations start another pump or SHALL terminate all continuous liquid effluent releases.

1.4.2.4 NIA Yard Drain Sump Monitor (2/3RT-2101)

There is one Yard Drain Sump on site, located in the North Industrial Area. It is released through the Unit 2 outfall. The same radiation monitor is used for either outfall.

The value for C_{YDS}, the concentration limit at the detector, is determined by using:

$$C_{YDS} \le \frac{(Y)(F)(\sum_i C'_{yi})}{(R)(C/MPC_{eff})} \qquad \textbf{(1-15)}$$

where:

C_{YDS}	=	instantaneous concentration at detector 2/3RT-2101 in µCi/ml
Y	=	NIA Yard Drain Sump administrative value
F	=	dilution water flow in volume per unit time
	=	7,000 gpm per saltwater dilution pump
$\Sigma_i C'_{yi}$	=	total gamma isotopic concentration, µCi/ml (STEP 1)
R	=	effluent flow rate, gpm, typical flow rates:
	=	4100 gpm
C	=	total concentration, µCi/ml
MPC_{eff}	=	value of MPC_{eff} from equation (1-4) for the sample analysis

NOTE: If $C_{YDS} \le \Sigma_i C'_{yi}$, then no release is possible. To increase C_{YDS}, increase the administrative value, Y, and/or increase dilution flow F (by running more dilution pumps), and/or decrease the effluent flow rate, R, and recalculate C_{YDS} using the new Y, F, R as applicable and equation (1-15). A minimum of 7,000 gpm flow shall be used for continuous releases. If there is a loss of dilution flow, then operations start another pump or SHALL terminate all continuous liquid effluent releases.

1.0 **LIQUID EFFLUENTS** (Continued)

TABLE 1-3

Liquid Effluent Radiation Monitor Calibration Constants [a]
(µCi/cc/cpm)
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1.0 LIQUID EFFLUENTS (Continued)

1.5 DOSE CALCULATION FOR LIQUID EFFLUENTS

The liquid releases considered in the following dose calculations are described in Section 1.4. The dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas are calculated for the purpose of implementing Specification 1.2.1 using the following expression.

$$D_\tau = \sum_i \left[A_{i\tau} \sum_j \left(\Delta t_j C_{ij} F_j\right)\right] \qquad \textbf{(1-16)}$$

where:

$A_{i\tau}$ = Site-related adult ingestion dose commitment factor to the total body or an organ, τ, for each identified principal gamma and beta emitter, i, from Table 1-4 in mrem/hr per µCi/ml.

C_{ij} = average concentration of radionuclide, i, in the undiluted liquid effluent during time period, Δt_j, in µCi/ml.

D_τ = dose commitment to the total body or an organ, τ, from the liquid effluent for the time period, Δt_j, in mrem.

F_j = near field average dilution factor (actually mixing ratio) for C_{ij} during the time period, Δt_j. This factor is the ratio of the maximum undiluted liquid waste flow during time period, Δt_j, to the average flow from the site discharge structure to unrestricted receiving waters,

$$\text{or: } \left(\frac{\text{maximum liquid radioactive waste flow}}{\text{discharge structure exit flow}}\right)$$

Δt_j = length of the j^{th} time period over which C_{ij} and F_j are averaged for all liquid releases, in hours.

TABLE 1-4

DOSE COMMITMENT FACTORS*, $A_{i\tau}$
(mrem/hr per µCi/ml)

Radionuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
H-3		2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1
Na-24	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1
Cr-51			5.58E+0	3.34E+0	1.23E+0	7.40E+0	1.40E+3
Mn-54		7.06E+3	1.35E+3		2.10E+3		2.16E+4
Mn-56		1.78E+2	3.15E+1		2.26E+2		5.67E+3
Fe-55	5.11E+4	3.53E+4	8.23E+3			1.97E+4	2.03E+4
Fe-59	8.06E+4	1.90E+5	7.27E+4			5.30E+4	6.32E+5
Co-57		1.42E+2	2.36E+2				3.59E+3
Co-58		6.03E+2	1.35E+3				1.22E+4
Co-60		1.73E+3	3.82E+3				3.25E+4
Cu-64		2.14E+2	1.01E+2		5.40E+2		1.83E+4
Zn-65	1.61E+5	5.13E+5	2.32E+5		3.43E+5		3.23E+5
Br-84			9.39E-2				7.37E-7
Rb-88		1.79E+0	9.49E-1				2.47E-11
Sr-89	4.99E+3		1.43E+2				8.00E+2
Sr-90	1.23E+5		3.01E+4				3.55E+3
Sr-91	9.18E+1		3.71E+0				4.37E+2
Sr-92	3.48E+1		1.51E+0				6.90E+2
Y-90	6.06E+0		1.63E-1				6.42E+4
Y-91m	5.73E-2		2.22E-3				1.68E-1
Y-92	5.32E-1		1.56E-2				9.32E+3
Zr-95	1.59E+1	5.11E+0	3.46E+0		8.02E+0		1.62E+4
Zr-97	8.81E-1	1.78E-1	8.13E-2		2.68E-1		5.51E+4
Nb-95	1.84E+0	1.03E+0	5.51E-1		1.01E+0		6.22E+3
Nb-95m	1.84E+0	1.03E+0	5.51E-1		1.01E+0		6.22E+3
Nb-97	1.55E-2	3.91E-3	1.43E-3		4.56E-3		1.44E+1
Mo-99		1.28E+2	2.43E+1		2.89E+2		2.96E+2
Tc-99m	1.30E-2	3.66E-2	4.66E-1		5.56E-1	1.79E-2	2.17E+1
Ru-103	1.07E+2		4.60E+1		4.07E+2		1.25E+4
Ru-106	1.59E+3		2.01E+2		3.06E+3		1.03E+5
Ag-110m	1.42E+3	1.32E+3	7.82E+2		2.59E+3		5.37E+5

NOTE: where no value is given, no data are available.

* Source: Reg. Guide 1.109, Table E-11, Table A-1
USNRC NUREG-0172, Table 4
ICRP-30, Part 3, Supplement A

Methodology: USNRC NUREG-0133, Section 4.3.1

TABLE 1-4
(Continued)

DOSE COMMITMENT FACTORS*, A_{iT}
(mrem/hr per µCi/ml)

Radionuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Sn-113							2.26E+5
Sn-117m							2.26E+5
Sb-124	2.76E+2	5.22E+0	1.09E+2	6.70E-1		2.15E+2	7.84E+3
Sb-125	1.77E+2	1.97E+0	4.20E+1	1.79E-1		1.36E+2	1.94E+3
Te-129m	9.31E+2	3.47E+2	1.47E+2	3.20E+2	3.89E+3		4.69E+3
Te-132	2.04E+2	1.32E+2	1.24E+2	1.46E+2	1.27E+3		6.24E+3
I-131	2.18E+2	3.12E+2	1.79E+2	1.02E+5	5.35E+2		8.23E+1
I-132	1.06E+1	2.85E+1	9.96E+0	9.96E+2	4.54E+1		5.35E+0
I-133	7.45E+1	1.30E+2	3.95E+1	1.90E+4	2.26E+2		1.16E+2
I-134	5.56E+0	1.51E+1	5.40E+0	2.62E+2	2.40E+1		1.32E-2
I-135	2.32E+1	6.08E+1	2.24E+1	4.01E+3	9.75E+1		6.87E+1
Cs-134	6.84E+3	1.63E+4	1.33E+4		5.27E+3	1.75E+3	2.85E+2
Cs-136	7.16E+2	2.83E+3	2.04E+3		1.57E+3	2.16E+2	3.21E+2
Cs-137	8.77E+3	1.20E+4	7.85E+3		4.07E+3	1.35E+3	2.32E+2
Cs-138	6.07E+0	1.20E+1	5.94E+0		8.81E+0	8.70E-1	5.12E-5
Ba-139	7.85E+0	5.59E-3	2.30E-1		5.23E-3	3.17E-3	1.39E+1
Ba-140	1.64E+3	2.06E+0	1.08E+2		7.02E-1	1.18E+0	3.38E+3
La-140	1.57E+0	7.94E-1	2.10E-1				5.83E+4
Ce-141	3.43E+0	2.32E+0	2.63E-1		1.08E+0		8.86E+3
Ce-143	6.04E-1	4.46E+2	4.94E-2		1.97E-1		1.67E+4
Ce-144	1.79E+2	7.47E+1	9.59E+0		4.43E+1		6.04E+4
Nd-147	3.96E+0	4.58E+0	2.74E-1		2.68E+0		2.20E+4
W-187	9.16E+0	7.66E+0	2.68E+0				2.51E+3
Np-239	3.53E-2	3.47E-3	1.91E-3		1.08E-2		7.11E+2

NOTE: where no value is given, no data are available.

* Source: Reg. Guide 1.109, Table E-11, Table A-1
USNRC NUREG-0172, Table 4
ICRP-30, Part 3, Supplement A

Methodology: USNRC NUREG-0133, Section 4.3.1

1.0 **LIQUID EFFLUENTS** (Continued)

1.6 REPRESENTATIVE SAMPLING

Prior to sampling of a batch release, each batch shall be thoroughly mixed to assure representative sampling in accordance with the requirements of Reg. Guide 1.21 and NUREG-0800, Section 11.5. The methodology for mixing and sampling is described in SDS-CH2-PGM-1005 and SDS-CH2-PCD-1004.

2.0 **GASEOUS EFFLUENTS**

2.1 DOSE RATE

SPECIFICATION

2.1.1 The dose rate in unrestricted areas due to radioactive materials released in gaseous effluents from the site (see Figure 2-2) shall be limited to the following:

a. For Noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and

b. For all radioiodines, Tritium and for all radioactive materials in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

APPLICABILITY: At all times

ACTION:

a. With dose rate(s) exceeding the above limits, immediately decrease the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

.1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with Section 2.7.

.2 The dose rate due to radioiodines, Tritium and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with Section 2.7 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 2-1.

TABLE 2-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
Continuous	*	*	Principal Gamma Emitters[g]	$1x10^{-4}$
	*	*	Tritium	$1x10^{-6}$
	Continuous[f] Sampler	W[d] Charcoal Sample	I-131	$1x10^{-12}$
			I-133	$1x10^{-10}$
	Continuous[f] Sampler	W[d] Particulate Sample	Principal Gamma Emitters[g] (I-131 and Others)	$1x10^{-11}$
	Continuous[f] Sampler	M Composite Particulate Sample	Gross Alpha	$1x10^{-11}$
	Continuous[f] Sampler	Q Composite Particulate Sample	Sr-89 and Sr-90	$1x10^{-11}$
	Continuous[f] Monitor	Noble Gas Monitor	Noble Gases Gross Beta and Gamma	$1x10^{-6}$

*Sampling frequencies for Noble gases and Tritium are:

Containment Main Purge - 42"	: Weekly Grab
Plant Vent Stack	: Weekly Grab[e]
South Yard Facility	: Particulate and Iodine sampling only[h]

TABLE 2-1 (Continued)

TABLE NOTATION

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\ S_b}{E * V * 2.22\ \times 10^6 * Y * \exp\ (-\lambda \Delta \tau)}$$

where:

LLD = "a priori" lower limit of detection as defined above (as microcurie per unit mass or volume),

S_b = standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute),

E = counting efficiency (as counts per transformation),

V = sample size (in units of mass or volume),

2.22×10^6 = number of transformations per minute per microcurie,

Y = fractional radiochemical yield (when applicable),

λ = radioactive decay constant for the particular radionuclide, and

Δt = elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples).

The value of S_b used in the calculation of the LLD for a particular measurement system shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance.

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an <u>a priori</u> (before the fact) limit representing the capability of the measurement system and not as <u>a posteriori</u> (after the fact) limit for a particular measurement.**

**For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, <u>HASL-300</u> (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" <u>Anal. Chem. 40</u>, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report <u>ARH-2537</u> (June 22, 1972).

b. **DELETED**

c. **DELETED**

d. Air samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing (or after removal from sampler).

e. Representative Tritium grab samples shall be taken at least once per 7 days from the spent fuel pool area, whenever spent fuel is in the spent fuel pool. In the event grab samples cannot be collected, estimate Tritium releases from the SFP area by assuming all SFP makeup water replaces tritiated water loss.

f. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Specifications 2.1.1, 2.2.1, 2.3.1.

g. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

h. Radioactive airborne effluents only expected to be particulate and iodine.

i. **DELETED**

2.0 **GASEOUS EFFLUENTS** (Continued)

2.2 DOSE - NOBLE GASES

SPECIFICATION

2.2.1 The air dose due to Noble gases released in gaseous effluents, from each decommissioning unit, from the site (see Figure 2-2) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation and,

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

APPLICABILITY: At all times

ACTION:

a. With calculated air dose from radioactive Noble gases in gaseous effluents exceeding any of the above limits, in lieu of any other report required by Technical Specification Section 5.7.1, prepare and submit to the Commission within 30 days, a Special Report which identifies the cause(s) for exceeding the limit(s) and defines the corrective actions taken to reduce releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with Specification 2.2.1.

SURVEILLANCE REQUIREMENT

.1 Dose Calculations Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with Section 2.8 at least once per 31 days.

2.0 **GASEOUS EFFLUENTS** (Continued)

2.3 DOSE - RADIOIODINES, RADIOACTIVE MATERIALS IN PARTICULATE FORM AND TRITIUM

SPECIFICATION

2.3.1 The dose to an individual from Tritium, radioiodines and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, from the Site (see Figure 2-2) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ, and

b. During any calendar year: Less than or equal to 15 mrem to any organ.

APPLICABILITY: At all times

ACTION:

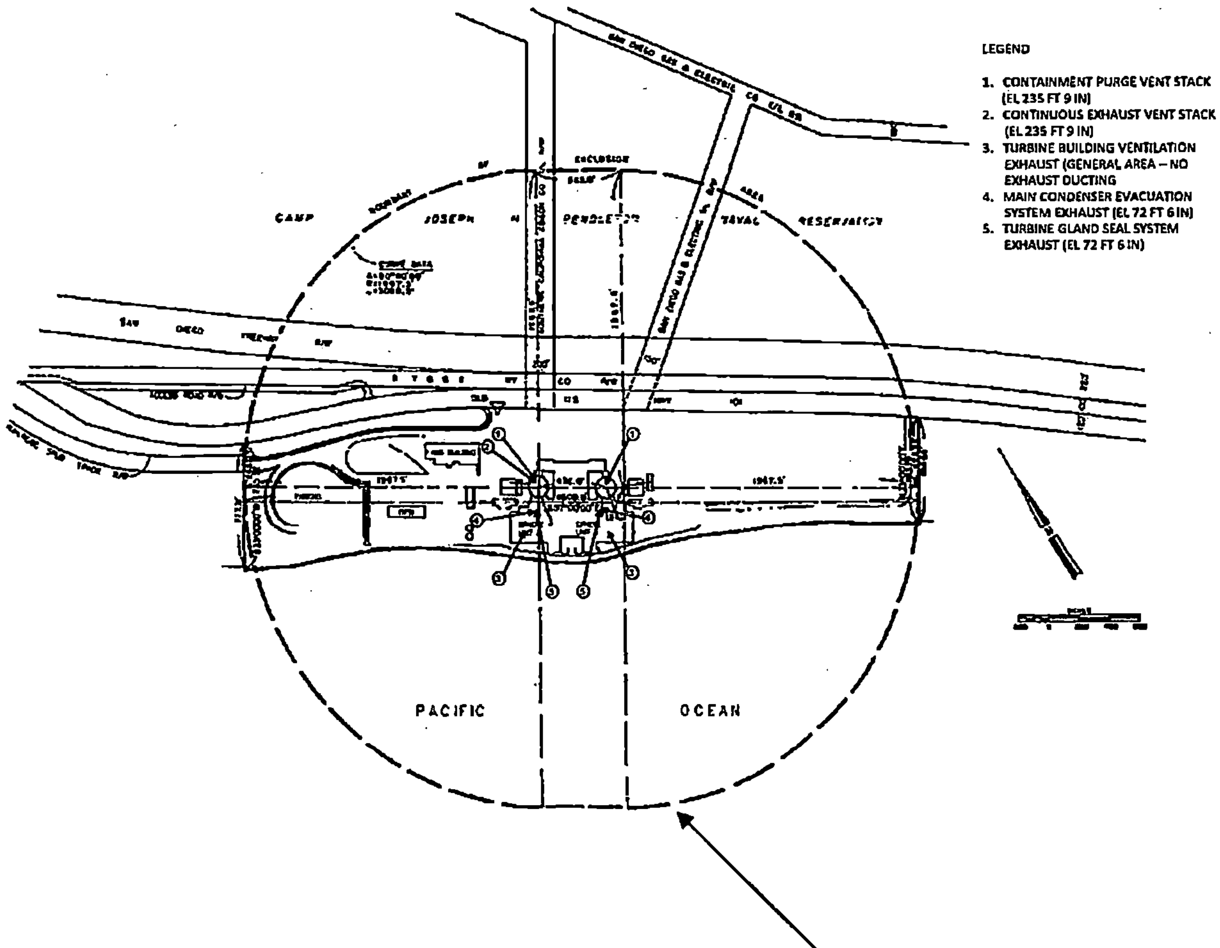
a. With the calculated dose from the release of Tritium, radioiodines, and radioactive materials in particulate form, with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, in lieu of any other report required by Technical Specification Section 5.7.1, prepare and submit to the Commission within 30 days, a Special Report which identifies the cause(s) for exceeding the limit and defines the corrective actions taken to reduce releases and the proposed actions to be taken to assure that subsequent releases will be in compliance with Specification 2.3.1.

SURVEILLANCE REQUIREMENT

.1 Dose Calculations Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with Section 2.8 at least once per 31 days.

2.4 GASEOUS RADWASTE TREATMENT -- **DELETED**

SAN ONOFRE NUCLEAR GENERATING STATION
SITE BOUNDARY FOR GASEOUS EFFLUENTS
Figure 2-2



SITE BOUNDARY for Gaseous Effluents

SO123-ODCM
Revision 9
11/2015

2.6 METHODS OF CALCULATION FOR GASEOUS EFFLUENT MONITOR SETPOINTS

Administrative values are used to reduce each setpoint to account for the potential activity released simultaneously from the following release points:

PVS = Plant Vent Stack
CP = Containment Purge (see NOTE on page 2-11)
SY = South Yard

The sum of the administrative values is limited to 1.0 to ensure the total concentration from all release points on site to the environment will not result in a release exceeding the limits of Specification 2.1.1. The sum total of all these administrative values for the site shall be less than or equal to 1.0.

The administrative values shall be periodically reviewed based on actual release data and revised as necessary.

2.6.1 Plant Vent Stack - 2/3RT-7808G, 2RT-7865-1, 3RT-7865-1

For the purpose of implementation of Specification 2.1.1, the alarm setpoint level for Noble gas monitors is based on the gaseous effluent flow rate and the meteorological dispersion factor.

Total Body

The concentration at the detector corresponding to a 500 mrem/yr total body dose rate at the exclusion area boundary is determined by:

$$C_{det} = \frac{(PVS)\left(2120\,\frac{cfm}{m^3\,/sec}\right)(500\,mrem\,/yr)(10^{-6}\,m^3\,/cc)}{(flowrate,\ cfm)(X/Q\,,sec/m^3)\left[\Sigma_i\left(K_i\frac{mrem\,/yr}{\mu Ci\,/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]}$$

(2-1)

Skin

The concentration at the detector corresponding to a 3000 mrem/yr skin dose rate at the exclusion area boundary is determined by:

$$C_{det} = \frac{(PVS)\left(2120\,\frac{cfm}{m^3\,/sec}\right)(3000\,mrem\,/yr)(10^{-6}m^3\,/cc)}{(flowrate,\ cfm)(X/Q\,,\sec/m^3)\left[\Sigma_i\left(L_i + 1.1M_i,\frac{mrem\,/yr}{\mu Ci\,/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]}$$

(2-2)

2.0 **GASEOUS EFFLUENTS** (Continued)

2.6.1 **Plant Vent Stack - 2/3RT-7808G, 2RT-7865-1, 3RT-7865-1** (Continued)

where:

C_{det}	=	the instantaneous concentration at the detector, µCi/cc
PVS	=	an administrative value used to account for potential activity from other gaseous release pathways, typically 0.38.
K_i	=	total body dose conversion factor from Table 2-4 for the i^{th} gamma emitting Noble gas, mrem/yr per µCi/m^3
L_i	=	skin Dose Conversion Factor from Table 2-4 for the i^{th} Noble gas, mrem/yr per µCi/m^3
M_i	=	air Dose Conversion Factor from Table 2-4 for the i^{th} Noble gas, mrem/yr per µCi/m^3
1.1	=	conversion factor to convert gamma air dose to skin dose
C_i	=	concentration of the i^{th} Noble gas as determined by sample analysis, µCi/cc
C_{tot}	=	total concentration of Noble gases as determined by sample analysis, µCi/cc = $\Sigma_i C_i$
flow rate	=	total plant vent stack flow rate, cfm,
	=	typically 164,000 cfm
2120	=	conversion constant, cfm per m^3/sec
500 mrem/yr	=	total body dose rate limit, as specified by Specification 2.1.1a
3000 mrem/y	=	skin dose rate limit as specified by Specification 2.1.1a
X/Q	=	historical annual average dispersion factor for any landward sector, sec/m^3 from midpoint between Unit 2 and 3
	=	4.8E-6 sec/m^3

2.6.1.1 Maximum Permissible Alarm Setpoint for 2/3RT-7808G, 2RT-7865-1 and 3RT-7865-1

The smaller of the values of C_{det} from equations (2-1) and (2-2) shall be used to determine the maximum permissible monitor alarm setpoint.

The maximum release rate (µCi/sec) for Plant Vent Stack Monitors is determined by converting the concentration at the detector, C_{det} (µCi/cc) to an equivalent release rate in µCi/sec, as follows:

$$A_{max} = \frac{(C_{det}, \mu Ci/cc)(\text{flow rate, cfm})(28320)}{(S)(60)}$$

where:

A_{max}	=	maximum permissible release rate, µCi/sec
C_{det}	=	smaller of the values of C_{det} determined in equations (2-1) and (2-2).
flow rate	=	plant vent stack flow rate (cfm) used in equations (2-1) and (2-2)
28320	=	conversion from ft^3 to cc
60	=	conversion from minutes to seconds
S	=	correction factor to compensate for the split flow between Unit 2 and Unit 3 Plant Vent Stacks, typically 2 for split stack monitoring and 1 for combined stack monitoring

The release rate setpoint shall not be set greater than the maximum release rate determined above, when the monitor is being used to meet the requirements of Specification 2.1.1.

2.0 GASEOUS EFFLUENTS (Continued)

2.6.2 Condenser Evacuation System - 2RT-7818, 2RT-7870-1, 3RT-7818 or 3RT-7870-1 -- DELETED

2.6.3 Containment Purge - 2RT-7828, 3RT-7828

For the purpose of implementation of Specification 2.1.1, the alarm setpoint level for Noble gas monitors is based on the gaseous effluent flow rate and the meteorological dispersion factor.

The concentration at the detector corresponding to a total body dose rate of 500 mrem/yr at the exclusion boundary is determined by using:

Total Body

$$C_{det2} = \frac{(CP)(P_2)\left(2120\ \frac{cfm}{m^3/sec}\right)(500\ mrem/yr)(10^{-6}m^3/cc)}{(flow\ rate,\ cfm)(X/Q, \sec/m^3)\left[\Sigma_i\left(K_i\ \frac{mrem/yr}{\mu Ci/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]} \tag{2-7}$$

$$C_{det3} = \frac{(CP)(P_3)\left(2120\ \frac{cfm}{m^3/sec}\right)(500\ mrem/yr)(10^{-6}m^3/cc)}{(flow\ rate,\ cfm)(X/Q, \sec/m^3)\left[\Sigma_i\left(K_i\ \frac{mrem/yr}{\mu Ci/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]} \tag{2-8}$$

The concentration at the detector corresponding to a 3000 mrem/yr skin dose rate at the exclusion area boundary is determined by using:

Skin

$$C_{det2} = \frac{(CP)(P_2)\left(2120\ \frac{cfm}{m^3/sec}\right)(3000\ mrem/yr)(10^{-6}m^3/cc)}{(flow\ rate,\ cfm)(X/Q, \sec/m^3)\left[\Sigma_i\left(L_i + 1.1M_i, \frac{mrem/yr}{\mu Ci/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]} \tag{2-9}$$

$$C_{det3} = \frac{(CP)(P_3)\left(2120\ \frac{cfm}{m^3/sec}\right)(3000\ mrem/yr)(10^{-6}m^3/cc)}{(flow\ rate,\ cfm)(X/Q, \sec/m^3)\left[\Sigma_i\left(L_i + 1.1M_i, \frac{mrem/yr}{\mu Ci/m^3}\right)\left(\frac{C_i}{C_{tot}}\right)\right]} \tag{2-10}$$

2.6.3 Containment Purge - 2RT-7828, 3RT-7828 (Continued)

where:

C_{det2} = instantaneous concentration of the Unit 2 detector, µCi/cc.

C_{det3} = instantaneous concentration of the Unit 3 detector, µCi/cc.

CP = administrative value used to account for potential activity from other gaseous release pathways, typically 0.38.

P_2 and P_3 are administrative values used to account for simultaneous purges of both SONGS 2 and SONGS 3. The fractions P_2 and P_3 will be assigned such that $P_2 + P_3 \leq 1.0$.

Flow rate = 50,000 cfm

Other parameters are as specified in 2.6.1 above. The smaller of the values of maximum permissible C_{det2} from equation (2-7) or (2-9) and C_{det3} from equations (2-8) or (2-10) is to be used in determining the maximum permissible monitor alarm setpoints.

2.6.3.1 Maximum Permissible Alarm Setting for 2(3)RT-7828

The maximum permissible alarm setting for RT-7828 is in µCi/cc and is the smaller values of C_{det} (µCi/cc) from equations 2-7 and 2-9 for Unit 2 or equations 2-8 and 2-10 for Unit 3.

2.6.4 Waste Gas Header - 3RT-7865-1, 2/3RT-7808 -- DELETED

2.0 **GASEOUS EFFLUENTS** (Continued)

Table 2-3

Gaseous Effluent Radiation Monitor Calibration Constants[a]
(µCi/cc/cpm)

DELETED

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2.0 **GASEOUS EFFLUENTS** (Continued)

2.7 GASEOUS EFFLUENT DOSE RATE

The methodology used for the purpose of implementation of Specification 2.1.1 for the dose rate above background to an individual in an unrestricted area is calculated by using the following expressions:

2.7.1 **For Noble Gas:**

$$\dot{D}_{TB}=\Sigma_i\left[K_i\ (\overline{X/Q})\ \dot{Q}_i\right] \tag{2-13}$$

$$\dot{D}_S=\left[\Sigma_i(L_i+1.1M_i)(\overline{X/Q})\dot{Q}_i\right] \tag{2-14}$$

where:

$\dot{D}_{TB}$	=	total body dose rate in unrestricted areas due to radioactive materials released in gaseous effluents, mrem/yr
$\dot{D}_S$	=	skin dose rate in unrestricted areas due to radioactive materials released in gaseous effluents, mrem/yr
K_i	=	the total body dose factor due to gamma emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrem/yr per μCi/m^3
L_i	=	skin dose factor due to the beta emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrem/yr per μCi/m^3
M_i	=	air dose factor due to gamma emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrad/yr per μCi/m^3 (conversion constant of 1.1 mrem/mrad converts air dose to skin dose.)
$\dot{Q}_i$	=	measured or calculated release rate of radionuclide, i, for either continuous or batch gaseous effluents, in μCi/sec
$(\overline{X/Q})$	=	Maximum annual average atmospheric dispersion factor for any landward sector or distance at or beyond the unrestricted area boundary.
	=	4.8E-6 sec/m^3 for Units 2 and 3
	=	8.0E-5 sec/m^3 for South Yard Facility

2.7.2 For All Radioiodines, Tritium, and for All Radioactive Materials in Particulate Form with Half Lives Greater than Eight Days:

$$\dot{D}_O = \Sigma_i \left[\sum_k (P_{ik}\overline{W}_k)\,\dot{Q}_i\right] \qquad \textbf{(2-15)}$$

where:

$\dot{D}_O$ = organ dose rate in unrestricted areas due to radioactive materials released in gaseous effluents, mrem/yr

$\dot{Q}_i$ = measured or calculated release rate of radionuclide, i, for either continuous or batch gaseous effluents, µCi/sec

P_{ik} = dose parameter for radionuclide, i, for pathway, k, from Table 2-5 for the inhalation pathway in mrem/yr per µCi/m³. The dose factors are based on the critical individual organ and the child age group.

$\overline{W}_k$ = highest calculated annual average dispersion $(\overline{X/Q})$ or deposition $(\overline{D/Q})$ factor for estimating the dose to an individual at or beyond the unrestricted area boundary for pathway k.

= $(\overline{X/Q})$, 4.8E-6 sec/m³ for Units 2/3 for the inhalation pathway. The location is the unrestricted area in the NW sector.

= $(\overline{X/Q})$, 8.0E-5 sec/m³ for South Yard Facility for the inhalation pathway. The location is the unrestricted area in the E sector.

= $(\overline{X/Q})$, 1.3E-5 sec/m³ for the NIA (Unit 1) for the inhalation pathway. The location is the unrestricted area in the NW sector. (Historical value)

= $(\overline{D/Q})$, 4.3E-8 m⁻² for Units 2/3 for the food and ground plane pathways. The location is the unrestricted area in the E sector.

= $(\overline{D/Q})$, 8.0E-7 m⁻² for South Yard Facility for the food and ground plane pathways. The location is the unrestricted area in the E sector.

= $(\overline{X/Q})$, 7.2E-8 sec/m³ for NIA (Unit 1) for the food and ground pathways. The location is the unrestricted area in the NW sector. (Historical value)

2.0 **GASEOUS EFFLUENTS** (Continued)

2.8 GASEOUS EFFLUENT DOSE CALCULATION

2.8.1 **Dose from Noble Gas In Gaseous Effluents**

The gaseous releases considered in the following dose calculations are described in Section 2.6. The air dose in unrestricted areas due to noble gases released in gaseous effluents is calculated using the following expressions:

2.8.1.1 For Historical Meteorology:

$$D_\gamma = 3.17 * 10^{-8}\ \Sigma_i M_i \left[(\overline{X/Q})Q_i\right] \quad \textbf{(2-16)}$$

$$D_\beta = 3.17 * 10^{-8}\ \Sigma_i N_i \left[(\overline{X/Q})Q_i\right] \quad \textbf{(2-17)}$$

where:

D_γ = total gamma air dose from gaseous effluents, mrad

D_β = total beta air dose from gaseous effluents, mrad

3.17×10^{-8} = inverse seconds per year

M_i = air dose factor due to gamma emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrad/yr per µCi/m^3

N_i = air dose due to beta emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrad/yr per µCi/m^3

$(\overline{X/Q})$ = Maximum annual average atmospheric dispersion factor for any landward sector or distance at or beyond the unrestricted area boundary.
= 4.8E-6 sec/m^3 for Units 2 and 3
= 8.0E-5 sec/m^3 for South Yard Facility

Q_i = amount of Noble gas radionuclide, i, released in gaseous effluents, µCi.

2.0 **GASEOUS EFFLUENTS** (Continued)

2.8.1.2 For Meteorology Concurrent with Release:

NOTE: Consistent with the methodology provided in Reg. Guide 1.109 and the following equations, quality affecting computer software is used to perform the actual calculations.

$$D_{\gamma\theta} = 1.14 * 10^{-4} \Sigma_i M_i \left[\sum_j \left(\Delta t_j (X/Q)_{j\theta} \dot{Q}_{ij}\right)\right] \quad \textbf{(2-18)}$$

$$D_{\beta\theta} = 1.14 * 10^{-4} \Sigma_i N_i \left[\sum_j \left(\Delta t_j (X/Q)_{j\theta} \dot{Q}_{ij}\right)\right] \quad \textbf{(2-19)}$$

where:

$D_{\gamma\theta}$ = total gamma air dose from gaseous effluents in sector θ, mrad

$D_{\beta\theta}$ = total beta air dose from gaseous effluents in sector θ, mrad

$1.14x10^{-4}$ = inverse hours/year

M_i = air dose factor due to gamma emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrad/yr per $\mu Ci/m^3$

N_i = air dose factor due to beta emissions from Table 2-4 for each identified Noble gas radionuclide, i, in mrad/yr per $\mu Ci/m^3$

Δt_j = length of the j^{th} time period over which $(X/Q)_{j\theta}$ and $\dot{Q}_{ij}$ are averaged for gaseous releases in hours

$(X/Q)_{j\theta}$ = atmospheric dispersion factor for time period Δt_j at exclusion boundary location in landward sector θ, which is determined by concurrent meteorology, sec/m^3

$\dot{Q}_{ij}$ = average release rate of radionuclide, i, in gaseous effluents during time period, Δt_j, µCi/sec

2.8.2 Dose from Tritium, Radioiodines, and Radioactive Materials in Particulate Form with Half Lives Greater than Eight Days in Gaseous Effluents

The dose to an individual from Tritium, radioiodines and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released to unrestricted areas is calculated using the following expressions:

2.8.2.1 For Historical Meteorology:

$$D_O = 3.17 * 10^{-8} \sum_i \left[\sum_k (R_{ik} \, W_K) Q_i \right] \qquad \textbf{(2-20)}$$

where:

D_o = total projected dose from gaseous effluents to an individual, mrem

$3.17x10^{-8}$ = year/second

Q_i = amount of each radionuclide, i, (Tritium, radioiodine, radioactive material in particulate form with half-lives greater than eight days), released in gaseous effluents, µCi

$\Sigma_k R_{ik} W_k$ = sum of all pathways, k, for radionuclide, i, of the R_i W product, in mrem/yr per µCi/sec. The $\Sigma_k R_{ik} W_k$ value for each radionuclide, i, is given in Table 2-6 for Units 2/3, Table 2-7 (refer to Appendix B) for South Yard Facility, and Table 2-8 (refer to Appendix B) for the North Industrial Area (Unit 1 historical value). The value given is the maximum $\Sigma_k R_{ik} W_k$ for all locations and is based on the most restrictive age groups.

R_{ik} = dose factor for each identified radionuclide, i, for pathway k, (for the inhalation pathway in mrem/yr per µCi/m^3 and for the food and ground plane pathways in m^2-mrem/yr per µCi/sec), at the controlling location. The R_{ik}'s for each controlling location for each age group are given in Appendix A. Data in these tables are derived using the NRC code, PARTS. (See the annual update of revised R_i parameters based on changes in the Land Use Census provided by Radiation Protection.)

W_k = annual average dispersion $(\overline{X/Q})$ or deposition $(\overline{D/Q})$ factor for estimating the dose to an individual at the controlling location for pathway k.
= $(\overline{X/Q})$ for the inhalation pathway in sec/m^3. The $(\overline{X/Q})$ for each controlling location is given in Appendix A.
= $(\overline{D/Q})$ for the food and ground plane pathways in m^{-2}. The $(\overline{D/Q})$ for each controlling location is given in Appendix A.

2.8.2.2 For Meteorology Concurrent with Releases:

NOTE: Consistent with the methodology provided in Reg. Guide 1.109 and the following equations, quality affecting computer software is used to perform the actual calculations.

$$D_\theta = 1.14 \times 10^{-4} \sum_i^l \sum_j^m \sum_k^n \left[(\Delta t_j)(R_{ik\theta})(W_{jk\theta})\left(\dot{Q}_{ij}\right) \right] \quad \textbf{(2-21)}$$

where:

D_θ = total annual dose from gaseous effluents to an individual in sector θ, mrem.

Δt_j = length of the j^{th} period over which $W_{jk\theta}$ and $\dot{Q}_{ij}$ are averaged for gaseous released, hours

$\dot{Q}_{ij}$ = average release rate of radionuclide, i, in gaseous effluents during time period Δt_j, µCi/sec

$R_{ik\theta}$ = dose factor for each identified radionuclide i, for pathway k for sector θ (for the inhalation pathway in mrem/yr per µCi/m^3 and for the food and ground plane pathways in m^2 mrem/yr per µCi/sec) at the controlling location. A listing of R_{ik} for the controlling locations in each landward sector for each group is given in Appendix A. The θ is determined by the concurrent meteorology.

$W_{jk\theta}$ = dispersion $(\overline{X/Q})$ or deposition $(\overline{D/Q})$ factor for the time period Δt_j for each pathway k for calculating the dose to an individual at the controlling location in sector θ using concurrent meteorological conditions.
= $(\overline{X/Q})$ for the inhalation pathway, sec/m^3
= $(\overline{D/Q})$ for the food and ground plane pathways, m^{-2}

TABLE 2-4

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS**

Radionuclide	Total Body Dose Factor K_i (mrem/yr per $\mu Ci/m^3$)	Skin Dose Factor L_i (mrem/yr per $\mu Ci/m^3$)	Gamma Air Dose Factor M_i (mrad/yr per $\mu Ci/m^3$)	Beta Air Dose Factor N_i (mrad/yr per $\mu Ci/m^3$)
Kr-85m	1.17E+3	1.46E+3	1.23E+3	1.97E+3
Kr-85	1.61E+1	1.34E+3	1.72E+1	1.95E+3
Kr-87	5.92E+3	9.73E+3	6.17E+3	1.03E+4
Kr-88	1.47E+4	2.37E+3	1.52E+4	2.93E+3
Xe-131m	9.15E+1	4.76E+2	1.56E+2	1.11E+3
Xe-133m	2.51E+2	9.94E+2	3.27E+2	1.48E+3
Xe-133	2.94E+2	3.06E+2	3.53E+2	1.05E+3
Xe-135m	3.12E+3	7.11E+2	3.36E+3	7.39E+2
Xe-135	1.81E+3	1.86E+3	1.92E+3	2.46E+3
Xe-138	8.83E+3	4.13E+3	9.21E+3	4.75E+3
Ar-41	8.84E+3	2.69E+3	9.30E+3	3.28E+3

**Source: USNRC Reg. Guide 1.109, Table B-1

TABLE 2-5

DOSE PARAMETER P_{IK}*

CHILD AGE GROUP
CRITICAL ORGAN

Radionuclide	Inhalation Pathway (mrem/yr per µCi/m³)	Radionuclide	Inhalation Pathway (mrem/yr per µCi/m³)
H-3	1.1E+3	I -131	1.6E+7
Cr-51	1.7E+4	I -132	1.9E+5
Mn-54	1.6E+6	I -133	3.8E+6
Co-57	5.1E+5	I -134	5.1E+4
Co-58	1.1E+6	I -135	7.9E+5
Co-60	7.1E+6	Cs-134	1.0E+6
Sr-89	2.2E+6	Cs-136	1.7E+5
Sr-90	1.0E+8	Cs-137	9.1E+5
Zr-95	2.2E+6	Ba-140	1.7E+6
Nb-95	6.1E+5	Ce-141	5.4E+5
Ru-103	6.6E+5	Ce-144	1.2E+7
Te-129m	1.8E+6		

*Source: USNRC NUREG-0133, Section 5.2.1.1

TABLE 2-6

UNITS 2&3 CONTROLLING LOCATION FACTORS[1]

Radionuclide	$\Sigma_k R_{ik} W_k$ mrem/yr per µCi/sec	Use:
H-3	8.97E-4	Q: San Onofre III Housing
Cr-51	3.00E-2	Q: San Onofre III Housing
Mn-54	6.00E+0	Q: San Onofre III Housing
Co-57	1.14E+0	Q: San Onofre III Housing
Co-58	2.15E+0	Q: San Onofre III Housing
Co-60	7.86E+1	Q: San Onofre III Housing
Sr-89	1.75E+1	Q: SC Res with Garden
Sr-90	6.88E+2	Q: SC Res with Garden
Zr-95	2.69E+0	Q: San Onofre III Housing
Nb-95	9.03E+0	E: Deer Consumer/Hunter
Ru-103	1.43E+1	E: Deer Consumer/Hunter
Te-129m	6.49E+0	E: Deer Consumer/Hunter
Cs-134	2.25E+1	Q: San Onofre III Housing
Cs-136	5.07E-1	Q: San Onofre III Housing
Cs-137	3.31E+1	Q: San Onofre III Housing
Ba-140	1.45E+0	Q: San Onofre III Housing
Ce-141	4.67E-1	Q: San Onofre III Housing
Ce-144	9.20E+0	Q: San Onofre III Housing
I -131	2.58E+1	Q: SC Res with Garden
I -132	1.35E-1	Q: San Onofre III Housing
I -133	2.63E+0	Q: San Onofre III Housing
I -134	3.67E-2	Q: San Onofre III Housing
I -135	5.53E-1	Q: San Onofre III Housing
UN-ID	3.30E+0	Q: San Onofre III Housing

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

TABLE 2-7

SOUTH YARD FACILITY CONTROLLING LOCATION FACTORS[1]

(Moved to Appendix B)

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TABLE 2-8

NORTH INDUSTRIAL AREA (UNIT 1) CONTROLLING LOCATION FACTORS[1]

(Moved to Appendix B)

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3.0 **PROJECTED DOSES**

3.1 LIQUID DOSE PROJECTION

The methodology used for projecting a liquid dose over 31 days for Specification 1.3.1 is as follows:

.1 Determine the monthly total body and organ doses resulting from releases during the previous 12 months.

.2 Projected dose = Previous 12 months' dose divided by 12 for the total body and each organ.

3.2 GASEOUS DOSE PROJECTION

The methodology used for projecting a gaseous dose over 31 days for Specification 2.4.1 is as follows:

.1 Determine the monthly gamma, beta and organ dose resulting from releases during the previous 12 months.

.2 Projected dose = Previous 12 months' dose divided by 12 for the gamma, beta and organ doses.

3.0 **PROJECTED DOSES** (Continued)

3.3 TOTAL DOSE

SPECIFICATION

3.3.1 The dose or dose commitment to any member of the public, due to releases of radioactivity and radiation, from Uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem) over 12 consecutive months.

APPLICABILITY: At all times

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specifications 1.2.1a, 1.2.1b, 2.2.1a, 2.2.1b, 2.3.1a, or 2.3.1b in lieu of any other report required by Specification 6.9.1, prepare and submit a Special Report to the Director, Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, within 30 days, which defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the limits of Specification 3.3.1. This Special Report shall include an analysis which estimates the radiation exposure (dose) to a member of the public from Uranium fuel cycle sources (including all effluent pathways and direct radiation) for a 12 consecutive month period that includes the release(s) covered by this report. If the estimated dose(s) exceeds the limits of Specification 3.3.1, and if the release condition resulting in violation of 40 CFR 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR 190 and including the specified information of paragraph 190.11(b). Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete. The variance only relates to the limits of 40 CFR 190, and does not apply in any way to the requirements for dose limitation of 10 CFR Part 20, as addressed elsewhere in this ODCM.

SURVEILLANCE REQUIREMENT

.1 Dose Calculations Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with surveillance 1.2.1.1, 2.2.1.1, and 2.3.1.1.

3.4 TOTAL DOSE CALCULATIONS

3.4.1 Total Dose to Most Likely Member of the Public

The total annual dose or total dose commitment to any member of the public, due to releases of radioactivity and to radiation, from Uranium fuel cycle sources within 5 miles of the Site is calculated using the following expressions. This methodology is used to meet the dose limitations of 40 CFR 190 per 12 consecutive months. The transportation of radioactive material is excluded from the dose calculations.

The Annual Total Dose is determined monthly for maximum organ (gas and liquid), whole body (gas and liquid), and thyroid (gas and liquid) to verify the Site total is less than or equal to 25 mrem, 25 mrem, and 75 mrem respectively.

3.4.1.1 Annual Total Organ Dose [D_{TOT} (O)]

$$D_{TOT}(O) = \sum_{l=1}^{12}\sum_{j=1}^{2/3}\left[D_{jl}(OG) + D_{jl}(OL) + D_{jl}^{H-3}(OG)^{*}\right] \quad \text{(3-1)}$$

where:

*NOTE: D_{jl}^{H-3} (OG) = 0 for bone

$$D_{jl}(OG) = K \sum_{i=1}^{n} C_i \sum_k R_{ik} W_k \quad \text{(3-2)}$$

i = each isotope in specific organ category

j = NIA, Unit 2 and Unit 3

l = months 1 - 12 (to be summed over the most recent 12 months)

$$K = 3.168E-2 \ \frac{\text{year - } \mu\text{Ci}}{\text{sec - Ci}}$$

3.4.1 **Total Dose to Most Likely Member of the Public** (Continued)

3.4.1.1 Annual Total Organ Dose [D_{TOT} (O)] (Continued)

n = number of isotopes in the specified organ category

C_i = total particulate gas curies released for the month

$\Sigma_k R_{ik} W_k$ = SONGS controlling location factors (Tables 2-6, 2-7*, or 2-8*).

$D_{jl}(OL)$ = liquid organ dose for the specified organ in mrem for the month. [Equation (1-16)]

$D_{jl}^{H-3}(OG)$* = gas organ dose from Tritium in mrem for the month. [Equation (2-15)]

* Found in Appendix B

3.4.1.2 Annual Total Whole Body Dose [D_{TOT} (WB)]

$$D_{TOT}(WB) = \sum_{l=1}^{12} \sum_{j=1}^{2/3} \left[D_{jl}(WBL) + D_{jl}^{H-3}(OG) + 0.9 D_{jl}(\gamma) \right] + D(U1) + D(DIRECT) \qquad \textbf{(3-3)}$$

where:

j = NIA, Unit 2 and Unit 3

l = months 1 - 12, to be summed over the most recent 12 months

$D_{jl}(WBL)$ = liquid whole body organ dose in mrem for the whole month. [Equation (1-16)]

$D_{jl}^{H-3}(OG)$ = gas organ dose from Tritium in mrem for the month. [Equation (2-15)]

$D_{jl}(\gamma)$ = gamma air dose in mrad for the month. 0.9 converts mrad to mrem. [Equation (2-16)]

D(U1) = 0.494 mrem/yr, Total Effective Dose Equivalent from the offshore portion of the Unit 1 Circulating Water System.

Reference: Safety Evaluation related to Amendment No. 165 to Facility Operating License No. DPR-13, SCE, SONGS Unit 1

3.0 **PROJECTED DOSES** (Continued)

3.4 TOTAL DOSE CALCULATIONS (Continued)

3.4.1 **Total Dose to Most Likely Member of the Public** (Continued)

3.4.1.2 Annual Total Whole Body Dose [D_{TOT}(WB)] (Continued)

$$D(DIRECT)^* = \sum_{q=1}^{4} \left[\max[\, D(beach)_i\,] - \frac{\sum_{p=1}^{n} D(bkgd)_i}{n} \right] 0.0342 \qquad \textbf{(3-4)}$$

p = for all TLDs per quarter
q = for Quarters 1-4

*Direct Radiation

The direct radiation levels are evaluated most recently using Thulium-doped TLDs. The TLDs are placed at a minimum of 30 locations around the site. The average dose measured by TLDs 5 to 50 miles from the site is used as background. These sites are subject to change.

The background is subtracted from the highest reading TLD within 5 miles of the site (generally numbers 55 through 58). This value is the direct dose but must be prorated by the occupancy factor.

Example: Beach time (west boundary, seawall) of 300 hrs/yr, east and north boundaries of 20 hrs/yr, or 8 hrs/yr for the south boundary and west fence of parking lot 1 (top of bluff).

Reference: E. M. Goldin Memorandum for File, "Occupancy Factors at San Onofre Owner Controlled Area Boundaries," dated October 1, 1991.

3.4.1.3 Annual Total Thyroid Dose [D_{TOT} (T)]

$$D_{TOT}(T) = \sum_{l=1}^{12} \sum_{j=1}^{2/3} \left[D_{jl}(OG) + D_{jl}(OL)\right]$$

(3-5)

where:

j	=	NIA, Unit 2 and Unit 3
l	=	months 1 - 12 (to be summed over the most recent 12 months)
D_{jl} (OG)	=	thyroid organ dose from gaseous iodine for the month in mrem. [equation (2-20)]
D_{jl} (OL)	=	liquid thyroid organ dose for the month in mrem. [Equation (1-16)]

4.0 **EQUIPMENT**

4.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

SPECIFICATION

4.1.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 4-1 shall be FUNCTIONAL with their alarm/trip setpoints set to ensure the limits of Specification 1.1.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with Section 1.4.

APPLICABILITY: At all times

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, immediately suspend the release of radioactive liquid effluents monitored by the affected channel or declare the channel non-FUNCTIONAL.

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels FUNCTIONAL, take the ACTION shown in Table 4-1. Exert best efforts to return the instrument to FUNCTIONAL status within 30 days and, additionally, if the non-FUNCTIONAL instrument(s) remain non-FUNCTIONAL for greater than 30 days, explain in the next Annual Radioactive Effluent Release Report why the non-FUNCTIONALITY was not corrected in a timely manner.

c. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels FUNCTIONAL and either the appropriate ACTION items in Table 4-1 not taken or the necessary surveillances not performed at the specified frequency prescribed in Table 4-2, perform an evaluation based on the significance of the event in accordance with the site Corrective Action Program.

SURVEILLANCE REQUIREMENTS

.1 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated FUNCTIONAL by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4-2.

.2 At least once per 12 hours and within 1 hour after a change in pump operation that affects dilution flow has been completed, all pumps required to be providing dilution to meet the site radioactive effluent concentration limits of Specification 1.1.1 shall be determined to be operating and providing dilution to the discharge structure.

TABLE 4-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT*		MINIMUM CHANNELS FUNCTIONAL	ACTION
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a.	Liquid Radwaste Effluent Line** - 2/3RT-7813*	1	28
b.	Steam Generator Blowdown Processing System (Neutralization Sump) Full Flow Condensate Polisher Effluent Line - 2(3)RT-7817 -- **DELETED**		
c.	Turbine Plant Sump Effluent Line - 2RT-7821*	1	30
d.	Steam Generator (E088) Blowdown Effluent Line - 2(3)RT-6759 -- **DELETED**		
e.	Steam Generator (E089) Blowdown Effluent Line - 2(3)RT-6753 -- **DELETED**		
f.	NIA Yard Drain Sump - 2/3RT-2101*	1	44
2.	PROCESS FLOW RATE MEASUREMENT DEVICES		
a.	Liquid Radwaste Effluent Line** - FE7643	1	31
b.	Steam Generator Blowdown Processing System (Neutralization Sump), Full Flow Condensate Polisher Effluent Line -- **DELETED**		
c.	Turbine Plant Sump Effluent Line -2FQI5887	1	31
d.	Steam Generator (E088) Blowdown Bypass Effluent Line -- **DELETED**		
e.	Steam Generator (E089) Blowdown Bypass Effluent Line -- **DELETED**		
f.	NIA Yard Drain Sump Effluent Line 2/3FQI-6095	1	31

TABLE 4-1 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT*	MINIMUM CHANNELS FUNCTIONAL	ACTION
3.	COMMAND DATA ACQUISITION SYSTEM (CDAS) (Effluent Monitor Alarms)	1	32
4.	UNIT 2 PLANT COMPUTER SYSTEM (CONTROL ROOM ALARM ANNUNCIATION) – **DELETED**		
5.	CONTINUOUS COMPOSITE SAMPLERS		
	a. Turbine Plant Sumps Effluent Line- 2APC-5887	1	33
	b. Blowdown Processing System Neutralization Sump - 2(3) APC 377 -- **DELETED**		
	c. Steam Generator (E088) Blowdown to Bypass, Steam Generator (E088) Blowdown - 2(3) APC 4077 -- **DELETED**		
	d. Steam Generator (E089) Blowdown to Bypass, Steam Generator (E089) Blowdown - 2(3) APC 4076 -- **DELETED**		

TABLE 4-1 (Continued)

TABLE NOTATION

* Monitor Recorders are not required for the FUNCTIONALITY of the monitor, providing the non-FUNCTIONAL recorder does not cause the monitor to become non-FUNCTIONAL (i.e., feedback signal). As long as the monitor has indication, alarm capability (if applicable), proper response (based on surveillance requirements) and isolation function (if applicable), the loss of the recorder does not render the monitor non-FUNCTIONAL.

** Liquid effluent discharged through Rad Monitor 2/3RE-7813 will have been processed, sampled, and authorized by Liquid Release Permit prior to discharge from the site.

ACTION 28 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirements, effluent releases may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Specification 1.1.1 and

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculation and discharge line valving;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 29 - DELETED

ACTION 30 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided that at least once per 12 hours, grab samples are collected and analyzed within 4 hours of collection time for gross radioactivity (beta or gamma) at a limit of detection of at least 10^{-7} microcuries/ml.

TABLE 4-1 (Continued)

TABLE NOTATION (Continued)

ACTION 31 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided the process flow rate is estimated at least once per 12 hours during actual releases. In addition, a new flow estimate shall be made within 1 hour after a change that affects process flow has been completed. Pump curves may be used to estimate process flow.

Loss of process flow instrument(s) results in the associated gross activity monitor becoming non-FUNCTIONAL. Perform the compensatory action for the non-FUNCTIONAL gross activity monitor in addition to this compensatory action. [2RT-7821, 2/3RT-7813]

ACTION 32 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided the monitor is verified FUNCTIONAL by performing a channel check at least once per 4 hours during actual releases.

ACTION 33 - With the number of channels FUNCTIONAL less than required by the Minimum channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided grab samples are collected daily, and composited and analyzed weekly:

a. at least once per 24 hours, not to exceed 30 hours

ACTION 44 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided that, at least once per 12 hours, grab samples are collected and analyzed within 4 hours of collection time for gross radioactivity (beta or gamma) at a lower limit of detection of at least 10^{-7} microcurie/ml).

TABLE 4-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

NOTE: Frequency notations are found in Table 6-2, Frequency Notation.

INSTRUMENT**	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. GROSS BETA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a. Liquid Radwaste Effluents Line - 2/3RT-7813	D	P$^{(6)}$	R$^{(2)}$	Q$^{(1)}$
b. Steam Generator Blowdown Processing System (Neutralization Sump), Full Flow Condensate Polisher Effluent Line - 2(3)RT-7817 **DELETED**				
c. Turbine Plant Sump Effluent Line - 2RT-7821	D	M$^{(6)}$	R$^{(2)}$	Q$^{(1)}$
d. Steam Generator (E088) Blowdown Bypass Effluent Line - 2(3)RT-6759 -- **DELETED**				
e. Steam Generator (E089) Blowdown Bypass Effluent Line - 2(3)RT-6753 -- **DELETED**				
f. NIA Yard Drain Sump Effluent Line - 2/3RT-2101	D	M$^{(6)}$	R$^{(2)}$	Q$^{(1)}$
2. PROCESS FLOW RATE MEASUREMENT DEVICES				
a. Liquid Radwaste Effluent Line	D$^{(3)}$	N/A	R	Q
b. Steam Generator Blowdown Processing System (Neutralization Sump), Full Flow Condensate Polisher Effluent Line -- **DELETED**				
c. Turbine Plant Sump Effluent Line	D$^{(3)}$	N/A	R	Q
d. Steam Generator (E088) Blowdown Bypass Effluent Line **DELETED**				
e. Steam Generator (E089) Blowdown Bypass Effluent Line **DELETED**				
f. NIA Yard Drain Sump Effluent Line	D$^{(3)}$	N/A	R	Q

TABLE 4-2 (Continued)
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	INSTRUMENT**	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
3.	COMMAND DATA ACQUISITION SYSTEM (CDAS) (Effluent Monitor Alarms)	D	N/A	N/A(4)	Q
4.	UNIT 2 PLANT COMPUTER SYSTEM (CONTROL ROOM ALARM ANNUNCIATION) **DELETED**				
5.	CONTINUOUS COMPOSITE SAMPLERS				
	a. Turbine Plant Sump 2APC-5887	D(5)	N/A	R	Q
	b. Blowdown Processing System Neutralization Sump - 2(3) APC 3772 **DELETED**				
	c. Steam Generator (E088) Blowdown to Bypass, Steam Generator (E088) Blowdown - 2(3) APC 4077 **DELETED**				
	d. Steam Generator (E089) Blowdown to Bypass, Steam Generator (E089) Blowdown - 2(3) APC 4076 **DELETED**				

TABLE 4-2 (Continued)

TABLE NOTATION

** Monitor Recorders are not required for the FUNCTIONALITY of the monitor, providing the non-FUNCTIONAL recorder does not cause the monitor to become non-FUNCTIONAL (i.e., feedback signal). As long as the monitor has indication, alarm capability (if applicable), proper response (based on surveillance requirements) and isolation function (if applicable), the loss of the recorder does not render the monitor non-FUNCTIONAL.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate verification of effluent path isolation actuation signal, automatic pathway isolation, and Control Room/Command Center alarm annunciation if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Circuit failure.

Down scale failure testing is bounded by administrative limitation on monitor setpoint which ensure monitor alarm and release termination occur prior to reaching the level of monitor saturation.

If the instrument controls are not in the operate mode, procedures shall require that the channel be declared non-FUNCTIONAL.

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATIONs, sources that have been related to the initial calibration shall be used.

(3) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic, or batch releases are made.

(4) The Command Data Acquisition System (CDAS) software and hardware do not require CHANNEL CALIBRATION. The CDAS software is quality affecting and controlled by the site Software Modification Request process under procedures SO123-V-4.71, Software Development and Maintenance. The CDAS hardware is installed plant equipment and controlled by the site design change process using procedure SDS-EN1-PCD-0001.

(5) CHANNEL CHECK shall consist of verifying compositor switch positions and installed counter setting, and comparing integrator readings to sample volume collected at least once per 24 hours on days in which releases are made.

(6) MGPI monitors have automatic and continuous source check to meet this requirement.

4.0 **EQUIPMENT** (Continued)

4.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

SPECIFICATION

4.2.1 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 4-3 shall be FUNCTIONAL with their alarm/trip setpoints set to ensure that the limits of Specification 2.1.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with ODCM.

APPLICABILITY: At all times

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel non-FUNCTIONAL.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels FUNCTIONAL, take the ACTION shown in Table 4-3. Exert best efforts to return the instrument to FUNCTIONAL status within 30 days and, additionally, if the non-FUNCTIONAL instrument(s) remain non-FUNCTIONAL for greater than 30 days, explain in the next Annual Radioactive Effluent Release Report why the non-FUNCTIONALITY was not corrected in a timely manner.

c. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels FUNCTIONAL and either the appropriate ACTION items in Table 4-3 not taken or the necessary surveillances not performed at the specified frequency prescribed in Table 4-4, perform an evaluation based on the significance of the event in accordance with the site Corrective Action Program.

SURVEILLANCE REQUIREMENT

.1 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated FUNCTIONAL by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4-4.

TABLE 4-3
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT***		MINIMUM CHANNELS FUNCTIONAL***	APPLICABILITY	ACTION
1.	WASTE GAS HOLDUP SYSTEM **DELETED**			
a.	Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release - 2/3RT-7808, or 3RT-7865-1 **DELETED**			
b.	Process Flow Rate Monitoring Device - 2/3FIT7202 **DELETED**			
2.	CONDENSER EVACUATION SYSTEM **DELETED**			
a.	Noble Gas Activity Monitor - 2(3)RT-7818, or 2(3)RT-7870-1 **DELETED**			
b.	Iodine Sampler **DELETED**			
c.	Particulate Sampler **DELETED**			
d.	Associated P&I Sample Flow Measuring Device **DELETED**			
e.	Process Flow Rate Monitoring Device **DELETED**			
3.	PLANT VENT STACK			
a.	Noble Gas Activity Monitor - 2/3RT-7808G, or 2RT-7865-1 and 3RT-7865-1	1(2)	*	37
b.	Iodine Sampler	1(2)	*	40
c.	Particulate Sampler	1(2)	*	40
d.	Associated P&I Sample Flow Measuring Device	1(2)	*	36b
e.	Process Flow Rate Monitoring Device - 2/3RT-7808G, or 2RT-7865-1 and 3RT-7865-1	1	*	36a
4.	CONTAINMENT PURGE SYSTEM(3)			
a.	Noble Gas Activity Monitor - Providing Alarm - 2(3)RT-7828	1	**	37
b.	Iodine Sampler	1	**	40
c.	Particulate Sampler	1	**	40
d.	Associated P&I Sample Flow Measuring Device	1	**	36b
e.	Process Flow Rate Monitoring Device	1	**	36a

TABLE 4-3 (Continued)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT***	MINIMUM CHANNELS FUNCTIONAL***	APPLICABILITY	ACTION
5. COMMAND DATA ACQUISITION SYSTEM (CDAS) (Effluent Monitor Alarm)	1	*	42
6. SOUTH YARD FACILITY (SYF) WORK AREA (SYFRU 7904)			
a. Iodine Sampler	1	*	40
b. Particulate Sampler	1	*	40
c. Associated P&I Sample Flow Measuring Device	1	*	41b
d. Process Flow Rate Monitoring Device	1	*	41a
7. SOUTH YARD FACILITY (SYF) DECONTAMINATION UNIT SYFRU-7905 **DELETED**			
a. Iodine Sampler **DELETED**			
b. Particulate Sampler **DELETED**			
c. Associated P&I Sample Flow Measuring Device **DELETED**			
d. Process Flow Rate Monitoring Device **DELETED**			

TABLE 4-3 (Continued)

TABLE NOTATION

* At all times.

** When Containment Purge is in progress.

*** Monitor Recorders are not required for the FUNCTIONALITY of the monitor, providing the non-FUNCTIONAL recorder does not cause the monitor to become non-FUNCTIONAL (i.e., feedback signal). As long as the monitor has indication, alarm capability (if applicable), proper response (based on surveillance requirements) and isolation function (if applicable), the loss of the recorder does not render the monitor non-FUNCTIONAL.

(1) **DELETED**

(2) Due to unequal mixing in the Plant Vent Stack, both 2RT-7865-1 and 3RT-7865-1 are required to be FUNCTIONAL when 2/3RT-7808G is non-FUNCTIONAL.

(3) Units 2(3)RT-7865-1 can no longer monitor containment purge. Cold and Dark Rad Waste Building HVAC NECP 801249775 Order 801429213 disabled the ability to sample the containment purge stack by failing close the purge stack sample valves.

ACTION 35 - **DELETED**

ACTION 36 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided:

a. The process flow rate is estimated at least once per 12 hours during actual releases. In addition, a new flow estimate shall be made within 1 hour after a change that affects process flow has been completed. System design characteristics may be used to estimate process flow.

b. The particulate and Iodine (P&I) sample flow rate is estimated or verified at least once per 12 hours during actual releases.

ACTION 37 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours.

ACTION 38 - **DELETED**

ACTION 40 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via the effected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table 2-1.

TABLE 4-3 (Continued)

TABLE NOTATION

ACTION 41 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided:

a. The process flow rate is estimated at least once per 12 hours when working with radioactive materials in the South Yard Facility Building. System design characteristics may be used to estimate flow.

b. The particulate and iodine (P&I) sample flow rate is estimated at least once per 12 hours when working with radioactive materials in the South Yard Facility Building.

ACTION 42 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via this pathway may continue provided the monitor is verified FUNCTIONAL by performing a channel check at least once per 4 hours during actual releases.

TABLE 4-4

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

NOTE: Frequency notations are found in Table 6-2, Frequency Notation.

INSTRUMENT***	CHANNEL CHECK	SOURCE CHECK	CHANNELS CALIBRATION	CHANNEL FUNCTIONAL TEST	APPLICABILITY
1. WASTE GAS HOLDUP SYSTEM **DELETED**					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release - 2/3RT-7808, 3RT-7865-1 **DELETED**					
b. Process Flow Rate Monitoring Device **DELETED**					
2. CONDENSER EVACUATION SYSTEM **DELETED**					
a. Noble Gas Activity Monitor - 2(3)RT-7818, 2(3)RT-7870-1 **DELETED**					
b. Iodine Sampler **DELETED**					
c. Particulate Sampler **DELETED**					
d. Associated Sample Flow Measuring Device **DELETED**					
e. Process Flow Rate Monitoring Device (2(3)RT-7870-1) **DELETED**					

TABLE 4-4 (Continued)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	INSTRUMENT***	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	APPLICABILITY
3.	PLANT VENT STACK					
a.	Noble Gas Activity Monitor - 2/3RT-7808G, 2RT-7865-1, 3RT-7865-1	D	M(7)	R(3)	Q(2)	*
b.	Iodine Sampler	W	NA	NA	NA	*
c.	Particulate Sampler	W	NA	NA	NA	*
d.	Associated Sample Flow Measuring Device	D	NA	R	Q	*
e.	Process Flow Rate Monitoring Device	D	NA	R	Q	*
4.	CONTAINMENT PURGE SYSTEM****					
a.	Noble Gas Activity Monitor - Providing Alarm - 2(3)RT-7828	D	M	R(3)	Q(1)	*
b.	Iodine Sampler	W	NA	NA	NA	*
c.	Particulate Sampler	W	NA	NA	NA	*
d.	Process Flow Rate Monitoring Device	D	NA	R	Q	*
e.	Associated Sample Flow Measuring Device	D	NA	R	Q	*

TABLE 4-4 (Continued)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT***	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	APPLICABILITY
5. SOUTH YARD FACILITY (SYF) WORK AREA (SYFRU 7904)					
a. Iodine Sampler	W	NA	NA	NA	*
b. Particulate Sampler	W	NA	NA	NA	*
c. Process Flow Rate Monitoring Device	D(5)	NA	NA	NA	*
d. Associated Sample Flow Measuring Device	D(5)	NA	R	NA	*
6. SOUTH YARD FACILITY (SYF) DECONTAMINATION UNIT (SYF 7905) **DELETED**					
a. Iodine Sampler **DELETED**					
b. Particulate Sampler **DELETED**					
c. Process Flow Rate Monitoring Device **DELETED**					
d. Associated Sample Flow Measuring Device **DELETED**					

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TABLE 4-4 (Continued)

TABLE NOTATION

* At all times.

** **DELETED**

*** Monitor Recorders are not required for the FUNCTIONALITY of the monitor, providing the non-FUNCTIONAL recorder does not cause the monitor to become non-FUNCTIONAL (i.e., feedback signal). As long as the monitor has indication, alarm capability (if applicable), proper response (based on surveillance requirements) and isolation function (if applicable), the loss of the recorder does not render the monitor non-FUNCTIONAL.

**** Units 2(3)RT-7865-1 can no longer monitor containment purge. Cold and Dark Rad Waste Building HVAC NECP 801249775 Order 801429213 disabled the ability to sample the containment purge stack by failing close the purge stack sample valves.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate trip actuation signal, automatic fan trip and Control Room/Command Center alarm annunciation if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm setpoint.
2. Circuit failure.

Down scale failure testing is bounded by administrative limitation on monitor setpoints which ensure monitor alarm and release termination occur prior to reaching the level of monitor saturation.

If the instrument controls are not set in the operate mode, procedures shall call for declaring the channel non-FUNCTIONAL.

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that Control Room/Command Center alarm annunciation occurs if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm setpoint.
2. Circuit failure.

Down scale failure testing is bounded by administrative limitation on monitor setpoints which ensure monitor alarm and release termination occur prior to reaching the level of monitor saturation.

If the instrument controls are not set in the operate mode, procedures shall call for declaring the channel non-FUNCTIONAL.

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATIONs, sources that have been related to the initial calibration shall be used.

(4) **DELETED**

(5) Daily checks only required during times of working with radioactive materials in the South Yard Facility Building.

(6) **DELETED**

(7) MGPI monitors have automatic and continuous source check to meet this requirement.

4.0 **EQUIPMENT** (Continued)

4.3 FUNCTIONALITY OF RADIOACTIVE WASTE EQUIPMENT

The flow diagrams defining the treatment paths and the components of the radioactive liquid, gaseous, and solid waste management systems are shown in Figures 4-5 thru 4-7.

SONGS RADIOACTIVE LIQUID WASTE EFFLUENT SYSTEMS

Figure 4-5

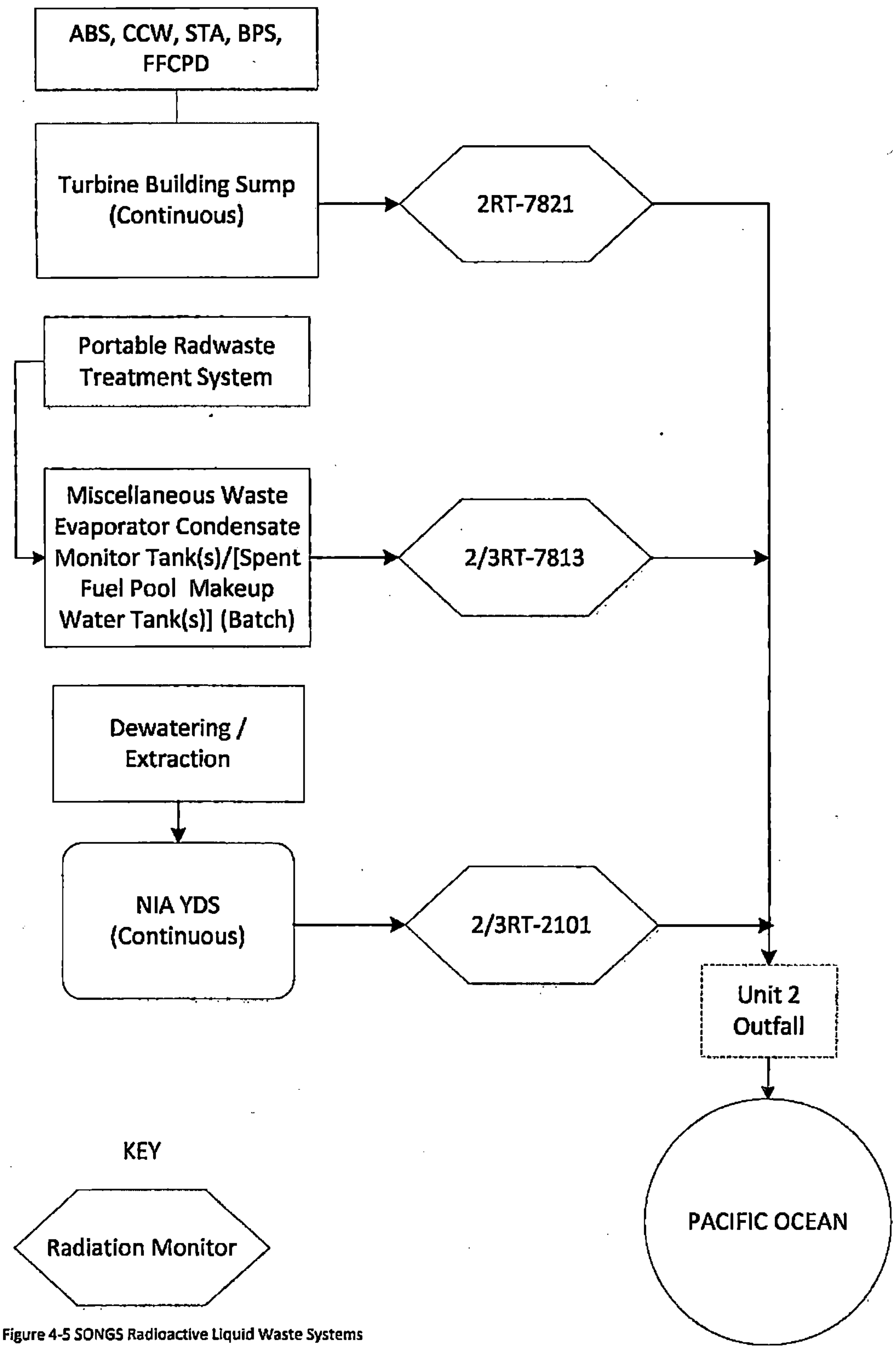


Figure 4-5 SONGS Radioactive Liquid Waste Systems

SONGS RADIOACTIVE GASEOUS WASTE EFFLUENT SYSTEMS

Figure 4-6

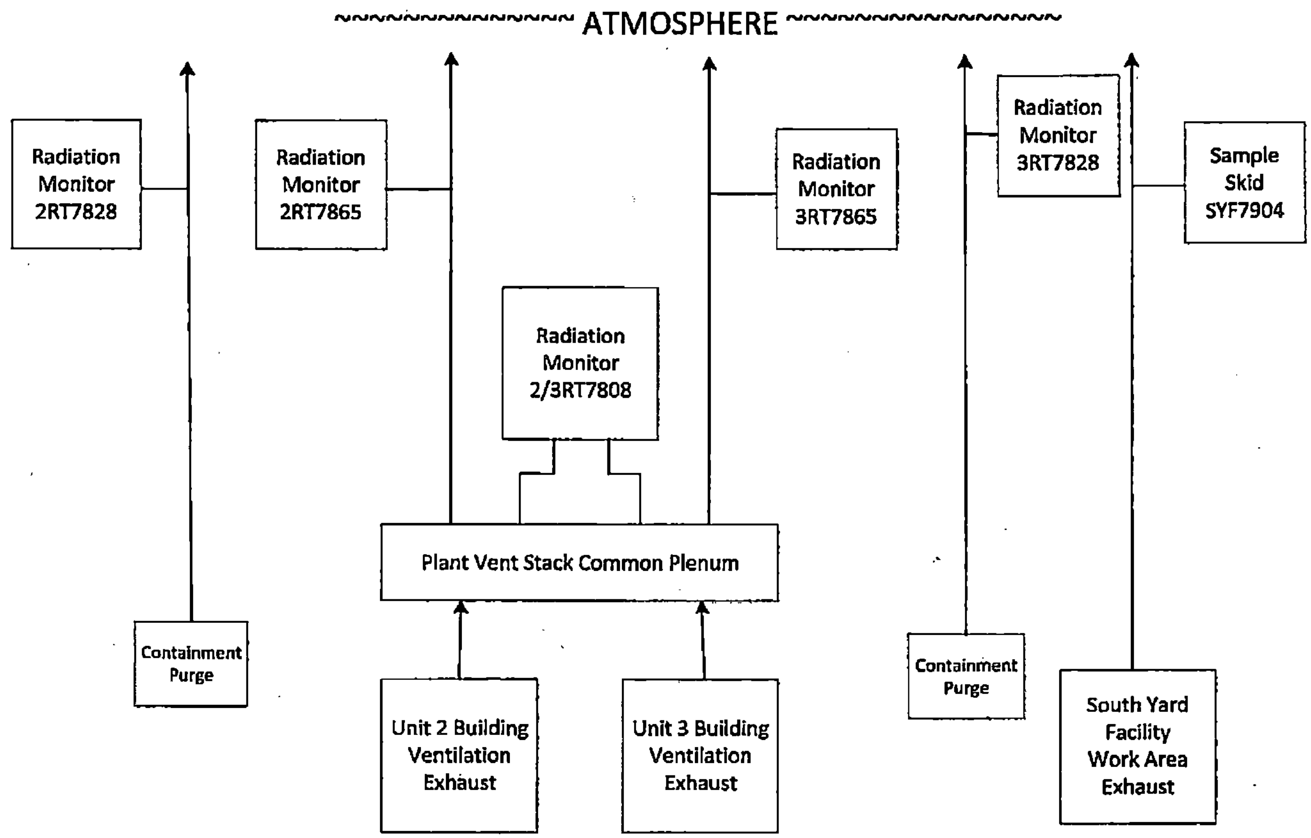
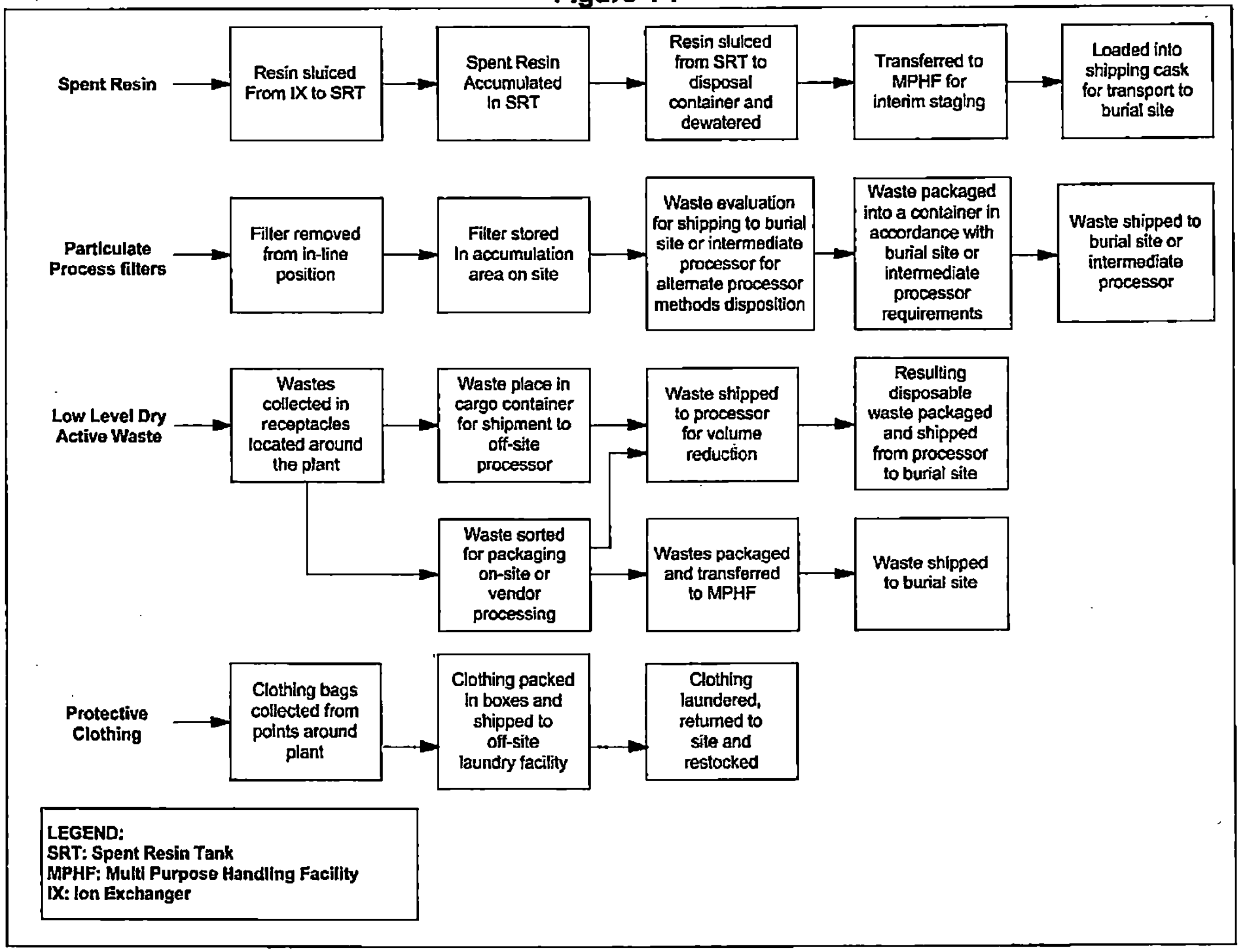


Figure 4-6 SONGS Radioactive Gaseous Waste Treatment Systems

Units 2 and Unit 3 Building Ventilation Exhaust sources include, but are not limited to, gases from the Spent Fuel Buildings, Penetrations Buildings, Radwaste Building, Safety Equipment Buildings, and Containment Buildings when personnel hatch is open.

SOLID WASTE HANDLING
Figure 4-7



5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

5.1 MONITORING PROGRAM

SPECIFICATION

5.1.1 The radiological environmental monitoring program shall be conducted as specified in Table 5-1. The requirements are applicable at all times.

APPLICABILITY: At all times

ACTION:

a. Should the radiological environmental monitoring program not be conducted as specified in Table 5-1, in lieu of any other report required by Technical Specification Section 5.7.1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report (see Section 5.4), a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. Should the level of radioactivity in an environmental sampling medium exceed the reporting levels of Table 5-2 when averaged over any calendar quarter, in lieu of any other report required by Unit 1 Permanently Defueled Technical Specification D6.9.1 or Units 2 and 3 Technical Specification Section 5.7.1, prepare and submit to the Commission, within 30 days from the end of the affected calendar quarter a Report pursuant to 10 CFR 50.73. When more than one of the radionuclides in Table 5-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{limit level (1)}} + \frac{\text{concentration (2)}}{\text{limit level (2)}} + \ldots \geq 1.0$$

c. When radionuclides other than those in Table 5-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to an individual is equal to or greater than the calendar year limits of Specification(s) 1.2.1, 2.2.1, or 2.3.1, as appropriate. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report (see Section 5.4).

ACTION: (Continued)

d. With fresh leafy vegetable samples or fleshy vegetable samples unavailable from one or more of the sample locations required by Table 5-1, identify specific locations for obtaining replacement samples and add them within 30 days to the Radiological Environmental Monitoring Program given in the ODCM. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Unit 1 Permanently Defueled Technical Specification D6.9.1 or Units 2 and 3 Technical Specification 5.7.1, submit in the next Annual Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples and justifying the selection of the new location(s) for obtaining samples.

SURVEILLANCE REQUIREMENT

.1 The radiological environmental monitoring samples shall be collected pursuant to Table 5-1 from the locations given in Table 5-4 and Figures 5-1 through 5-5 and shall be analyzed pursuant to the requirements of Tables 5-1 and 5-3.

<u>TABLE 5-1</u>

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Sample Locations[a]	Sampling and Collection Frequency[a]	Type and Frequency of Analyses
1. AIRBORNE Radioiodine and Particulates	Samples from at least 5 locations: 3 samples from offsite locations (in different sectors) of the highest calculated annual average ground level D/Q. 1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q. 1 sample from a control location 15-30 km (10-20 miles) distant and in the least prevalent wind direction[c].	Continuous operation of sampler with sample collection as required by dust loading, but at least once per 7 days[d].	Radioiodine cartridge. Analyze at least once per 7 days for I-131. Particulate sampler. Analyze for gross beta radioactivity > 24 hours following filter change. Perform gamma isotopic[b] analysis on each sample when gross beta activity is > 10 times the yearly mean of control samples. Perform gamma isotopic analysis on composite (by location) sample at least once per 92 days.
2. DIRECT RADIATION[e]	At least 30 locations including an inner ring of stations in the general area of the site boundary and an outer ring approximately in the 4 to 5 mile range from the site with a station in each sector of each ring. The balance of the stations is in special interest areas such as population centers, nearby residences, schools, and in 2 or 3 areas to serve as control stations.	At least once per 92 days.	Gamma dose. At least once per 92 days.

TABLE 5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Sample Locations[a]	Sampling and Collection Frequency[a]	Type and Frequency of Analyses
3. WATERBORNE			
a. Ocean	4 locations	At least once per month and composited[f] quarterly.	Gamma isotopic analysis of each monthly sample. Tritium analysis of composite sample at least once per 92 days.
b. Drinking[g]	2 locations	Monthly at each location.	Gamma isotopic and Tritium analyses of each sample.
c. Sediment	4 locations from Shoreline	At least once per 184 days.	Gamma isotopic analysis of each sample.
d. Ocean	5 locations Bottom Sediments	At least once per 184 days.	Gamma isotopic analysis of each sample.

TABLE 5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Sample Locations[a]	Sampling and Collection Frequency[a]	Type and Frequency of Analyses
4. INGESTION			
a. Animals Nonmigratory Marine	3 locations	One sample in season, or at least once per 184 days if not seasonal. One sample of each of the following species: 1. Fish-2 adult species such as perch or sheephead. 2. Crustaceae-such as crab or lobster. 3. Mollusks-such as limpets, seahares or clams.	Gamma isotopic analysis on edible portions.
b. Local Crops	2 locations	Representative vegetables, normally 1 leafy and 1 fleshy collected at harvest time. At least 2 vegetables collected semiannually from each location.	Gamma isotopic analysis on edible portions semiannually and I-131 analysis for leafy crops.

TABLE 5-1 (Continued)

TABLE NOTATION

a. Sample locations are indicated on Figures 5-1 through 5-5.

b. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

c. The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites which provide valid background data may be substituted.

d. Canisters for the collection of radioiodine in air are subject to channeling. These devices should be carefully checked before operation in the field or several should be mounted in series to prevent loss of Iodine.

e. Reg. Guide 4.13 (Revision 0) provides minimum acceptable performance criteria for thermoluminescence dosimetry (TLD) systems used for environmental monitoring. One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purpose of this table, a thermoluminescent dosimeter may be considered to be one phosphor and two or more phosphors in a packet may be considered as two or more dosimeters. Film badges should not be used for measuring direct radiation.

f. Composite samples should be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

g. No drinking water pathway exists at SONGS.

TABLE 5-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Marine Animals (pCi/Kg, wet)	Local Crops (pCi/Kg, wet)
H-3	2×10^{4}[(a)]			
Mn-54	1×10^3		3×10^4	
Fe-59	4×10^2		1×10^4	
Co-58	1×10^3		3×10^4	
Co-60	3×10^2		1×10^4	
Zn-65	3×10^2		2×10^4	
Zr-95, Nb-95	4×10^2			
I-131	2[(b)]	0.9		1×10^2
Cs-134	30	10	1×10^3	1×10^3
Cs-137	50	20	2×10^3	2×10^3
Ba-140, La-140	2×10^2			

(a) For drinking water samples. This is 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.
(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 5-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[c]

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)[a]

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Marine Animals (pCi/Kg, wet)	Local Crops (pCi/Kg, wet)	Sediment (pCi/Kg, dry)
gross beta	4	1×10^{-2}			
H-3	2000[b]				
Mn-54	15		130		
Fe-59	30		260		
Co-58, 60	15		130		
Zn-65	30		260		
Zr-95, Nb-95	15				
I-131	1[d]	7×10^{-2}		60	
Cs-134	15	5×10^{-2}	130	60	150
Cs-137	18	6×10^{-2}	150	80	180
Ba-140, La-140	15				

TABLE 5-3 (Continued)

TABLE NOTATION

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 S_b}{E * V * 2.22x10^6 * Y * \exp(-\lambda \Delta \tau)}$$

where:

LLD = "a priori" lower limit of detection as defined above (as microcurie per unit mass or volume)

S_b = standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E = counting efficiency (as counts per transformation)

V = sample size (in units of mass or volume)

2.22×10^6 = number of transformations per minute per microcurie

Y = fractional radiochemical yield (when applicable)

λ = radioactive decay constant for the particular radionuclide

Δt = elapsed time between midpoint of sample collection or end of the collection period and time of counting (for environmental samples, not plant effluents)

The value of S_b used in the calculation of the LLD for a detection system shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance. In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples (e.g., Potassium-40 in milk samples). Typical values of E, V, Y and Δt shall be used in the calculations.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of the measurement system and not as a posteriori (after the fact) limit for a particular measurement.*

* For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, HASL-300 (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" Anal. Chem. 40, 586-93 (1968).

TABLE 5-3 (Continued)

TABLE NOTATION (Continued)

b. If no drinking water pathway exists, a value of 3000 pCi/l may be used.

c. Other peaks which are measurable and identifiable, together with the radionuclides in Table 5-3, shall be identified and reported.

d. If no drinking water pathway exists, a value of 15 pCi/l may be used.

5.0 **RADIOLOGICAL ENVIRONMENTAL MONITORING** (Continued)

5.2 LAND USE CENSUS

SPECIFICATION

5.2.1 A land use census shall be conducted and shall identify the location of the nearest milk animal, the nearest residence and the nearest garden* of greater than 500 square feet producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of five miles.

APPLICABILITY: At all times

ACTION:

a. With the land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Specification 2.3.1, pursuant to Unit 1 Permanently Defueled Technical Specification D6.9.1 or Units 2 and 3 Technical Specification 5.7.1, identify the new locations in the next Annual Radioactive Effluent Release Report.

b. With the land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Specification 5.1, add the new location within 30 days to the Radiological Environmental Monitoring Program given in the ODCM. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s) via the same exposure pathway, may be deleted from this monitoring program after October 31, of the year in which this Land Use Census was conducted. Pursuant to Technical Specification 5.7.1, submit in the next Annual Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table(s) for the ODCM reflecting the new location(s) with information supporting the change in sampling locations.

SURVEILLANCE REQUIREMENT

.1 The land use census shall be conducted at least once per 12 months between the dates of June 1 and October 1 using that information which will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities.

*Broad leaf vegetation sampling may be performed at the site boundary in the direction sector with the highest D/Q in lieu of the garden census.

5.0 **RADIOLOGICAL ENVIRONMENTAL MONITORING** (Continued)

5.3 INTERLABORATORY COMPARISON PROGRAM

SPECIFICATION

5.3.1 Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that complies with Reg. Guide 4.15.

APPLICABILITY: At all times

ACTION:

a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report.

SURVEILLANCE REQUIREMENT

.1 A summary of the results obtained as part of the above required Interlaboratory Comparison Program and in accordance with Section 5.4.1 of this document shall be included in the Annual Radiological Environmental Operating Report (see Section 5.4).

5.0 **RADIOLOGICAL ENVIRONMENTAL MONITORING** (Continued)

5.4 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT*

5.4.1 The annual radiological environmental operating report shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by Section 5.2. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The annual radiological environmental operating reports shall include summarized and tabulated results in the Radiological Assessment Branch Technical Position, Revision 1, November 1979, of all radiological environmental samples taken during the report period. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following: a summary description of the radiological environmental monitoring program; a map of all sampling locations keyed to a table giving distances and directions from the mid-point of reactor Units 2 and 3; and the results of licensee participation in the Interlaboratory Comparison Program, required by Section 5.3.

* A single submittal may be made for a multiple unit station, combining those sections that are common to all units at the station.

5.0 **RADIOLOGICAL ENVIRONMENTAL MONITORING** (Continued)

5.5 SAMPLE LOCATIONS

The Radiological Environmental Monitoring Sample Locations are identified in Figures 5-1 through 5-5. These sample locations are described in Table 5-4 and indicate the distance in miles and the direction, determined from degrees true north, from the center of the Units 2 and 3 building complex. Table 5-6 gives the sector and direction designation for the Radiological Environmental Monitoring Sample Location on Map, Figures 5-1 through 5-5.

TABLE 5-4

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION		DISTANCE* (miles)	DIRECTION*
Direct Radiation			
1	City of San Clemente (Former SDG&E Offices)	5.7	NW
2	Camp San Mateo (MCB, Camp Pendleton)	3.6	N
3	Camp San Onofre (MCB, Camp Pendleton)	2.8	NE
4	Camp Horno (MCB, Camp Pendleton)	4.4	E
6	Old El Camino Real (AKA Old Route 101)	3.0	ESE
8	Noncommissioned Officers' Beach Club	1.4	NW
10	Bluff (Adjacent to Former PIC #1)	0.7	WNW
11	Former Visitors' Center	0.4**	NW
12	South Edge of Switchyard	0.2**	E
13	Southeast Site boundary (Bluff)	0.4**	ESE
15	Southeast Site Boundary (Office Building)	0.1**	SSE
16	East Southeast Site Boundary	0.4**	ESE
17	DELETED	-	-
18	DELETED	-	-
19	San Clemente Highlands	4.9	NNW
22	Former U.S. Coast Guard Station - San Mateo Point	2.7	WNW
23	SDG&E Service Center Yard	8.1	NW
31	Aurora Park-Mission Viejo	18.6	NNW
33	Camp Talega (MCB, Camp Pendleton)	5.9	N
34	San Onofre School (MCB, Camp Pendleton)	1.9	NW
35	Range 312 (MCB, Camp Pendleton)	4.8	NNE
36	Range 208C (MCB, Camp Pendleton)	4.1	NE
38	San Onofre State Beach Park	3.4	SE
40	SCE Training Center - Mesa (Adjacent to Former PIC #3)	0.7	NNW
41	Old Route 101 - East	0.3**	E
44	Fallbrook Fire Station	17.7	E
46	San Onofre State Beach Park	1.0	SE
47	Camp Las Flores (MCB, Camp Pendleton)	8.6	SE

TABLE 5-4 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION		DISTANCE* (miles)	DIRECTION*
Direct Radiation (Continued)			
49	Camp Chappo (MCB, Camp Pendleton)	12.9	ESE
50	Oceanside Fire Station (CONTROL)	15.6	SE
53	San Diego County Operations Center	44.2	SE
54	Escondido Fire Station	31.8	ESE
55	San Onofre State Beach (Unit 1, West)	0.2**	WNW
56	San Onofre State Beach (Unit 1, West)	0.2**	W
57	San Onofre State Beach (Unit 2)	0.1**	SW
58	San Onofre State Beach (Unit 3)	0.1**	S
59	SONGS Meteorological Tower	0.3**	WNW
60	DELETED	-	-
61	Mesa - East Boundary (Adjacent to Former PIC #4)	0.7	N
62	MCB - Camp Pendleton (Adjacent to Former PIC #5)	0.7	NNE
63	MCB - Camp Pendleton (Adjacent to Former PIC #6)	0.6	NE
64	MCB - Camp Pendleton (Adjacent to Former PIC #7)	0.6	ENE
65	MCB - Camp Pendleton (Adjacent to Former PIC #8)	0.7	E
66	San Onofre State Beach (Adjacent to Former PIC #9)	0.6	ESE
67	Former SONGS Evaporation Pond (Adjacent to Former PIC #2)	0.6	NW
68	Range 210C (MCB, Camp Pendleton)	4.4	ENE
73	South Yard Facility	0.4**	ESE
74	Oceanside City Hall (Backup CONTROL)	15.6	SE
75	Gate 25 MCB	4.6	SE
76	Former El Camino Real Mobil Station	4.6	NW
77	Area 62 Heavy lift pad	4.2	N
78	Horno Canyon (AKA Sheep Valley)	4.4	ESE

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true north.

** Distances are within the Units 2 and 3 Site Boundary (0.4 mile in all sectors) and not required by Technical Specification.

TABLE 5-4 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION		DISTANCE* (miles)	DIRECTION*
Airborne			
1	City of San Clemente (City Hall)	5.1	NW
7	AWS Roof	0.18**	NW
9	State Beach Park	0.6	ESE
10	Bluff	0.7	WNW
11	Mesa EOF	0.7	NNW
12	Former SONGS Evaporation Pond	0.6	NW
13	Marine Corps Base (Camp Pendleton East)	0.7	E
14	DELETED	-	-
15	DELETED	-	-
16	San Luis Rey Substation (CONTROL)	16.7	SE
Soil Samples†			
1	Camp San Onofre	2.8	NE
2	Old Route 101 - (East Southeast)	3.0	ESE
3	Basilone Road/I-5 Freeway Offramp	2.0	NW
5	Former Visitor's Center	0.4**	NW
6	DELETED	-	-
7	Prince of Peace Abbey (CONTROL)	15	SE
Ocean Water			
A	Station Discharge Outfall - Unit 1	0.6	SW
B	Outfall - Unit 2	1.5	SW
C	Outfall - Unit 3	1.2	SSW
D	Newport Beach (CONTROL)	30.0	NW

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true north.

** Distances are within the Units 2 and 3 Site boundary (0.4 mile in all sectors) and not required by Technical Specification.

† Soil Samples are not required by Technical Specifications.

TABLE 5-4 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION		DISTANCE* (miles)	DIRECTION*
Drinking Water			
4	Camp Pendleton Drinking Water.Reservoir	2.0	NW
5	Oceanside City Hall (new CONTROL)	15.6	SE
Shoreline Sediment (Beach Sand)			
1	San Onofre State Beach (Southeast)	0.6	SE
2	San Onofre Surfing Beach	0.8	WNW
3	San Onofre State Beach (Southeast)	3.5	SE
4	Newport Beach (North End) (CONTROL)	29.2	NW
Local Crops			
1	DELETED	-	-
2	Oceanside (CONTROL)**	15 to 25	SE to ESE
4	DELETED	-	-
6	SONGS Garden***	0.7	NNW

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true north.

** Control location should be in Sector G or F, 15 to 25 miles from site. The control location will be selected based on sample availability. The exact location shall be noted in the Annual Radiological Environmental Operating Report.

*** The SONGS Garden, location 6, for local crops, was relocated 0.1 miles west and 0.3 miles north to remain on controlled property with irrigation in September 2015 and remains at the site boundary. Prior to September 2015, SONGS Garden, location 6, was just inside the east border of Sector R, 0.4 miles out from the E-50 building.

TABLE 5-4 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION		DISTANCE* (miles)	DIRECTION*
Non-Migratory Marine Animals			
A	Unit 1 Outfall	0.9	WSW
B	Units 2 and 3 Outfall	1.5	SSW
C	Laguna Beach (CONTROL)**	20 to 25	WNW to NW
Kelp†			
A	San Onofre Kelp Bed	1.5	S
B	San Mateo Kelp Bed	3.8	WNW
C	Barn Kelp Bed	6.3	SSE to SE
D	DELETED	-	-
E	Salt Creek (CONTROL)	11 to 13	WNW to NW
Ocean Bottom Sediments			
A	DELETED	-	-
B	Unit 1 Outfall	0.8	SSW
C	Unit 2 Outfall	1.6	SW
D	Unit 3 Outfall	1.2	SSW
E	Laguna Beach (CONTROL)	20 to 25	NW
F	SONGS Upcoast	0.9	WSW

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true north.

** A location more distant from SONGS in the WNW to NW direction may be used as the CONTROL location.

† Kelp samples are not required by Technical Specifications.

TABLE 5-5

PIC - RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS
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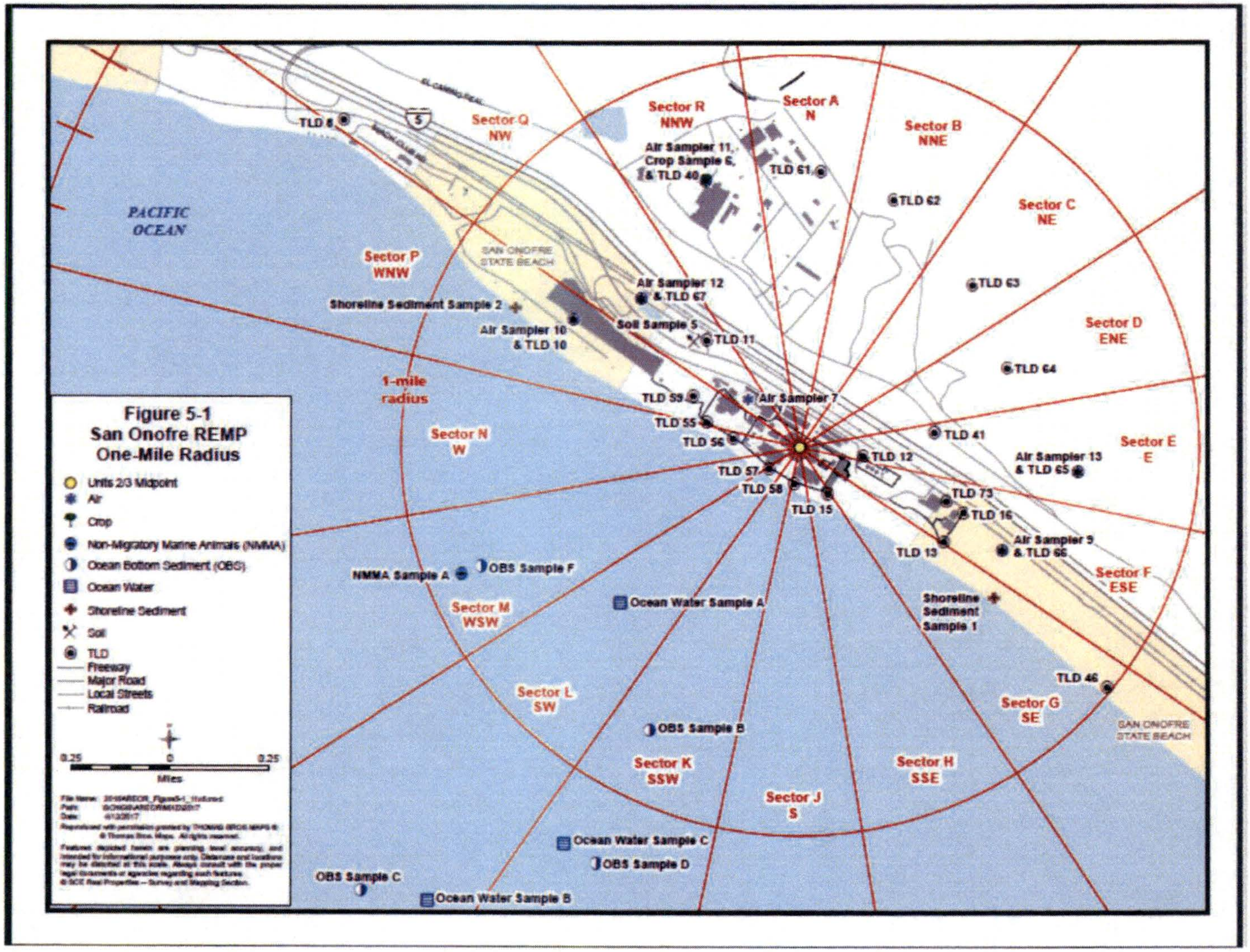
TABLE 5-6

SECTOR AND DIRECTION DESIGNATION FOR RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATION MAP

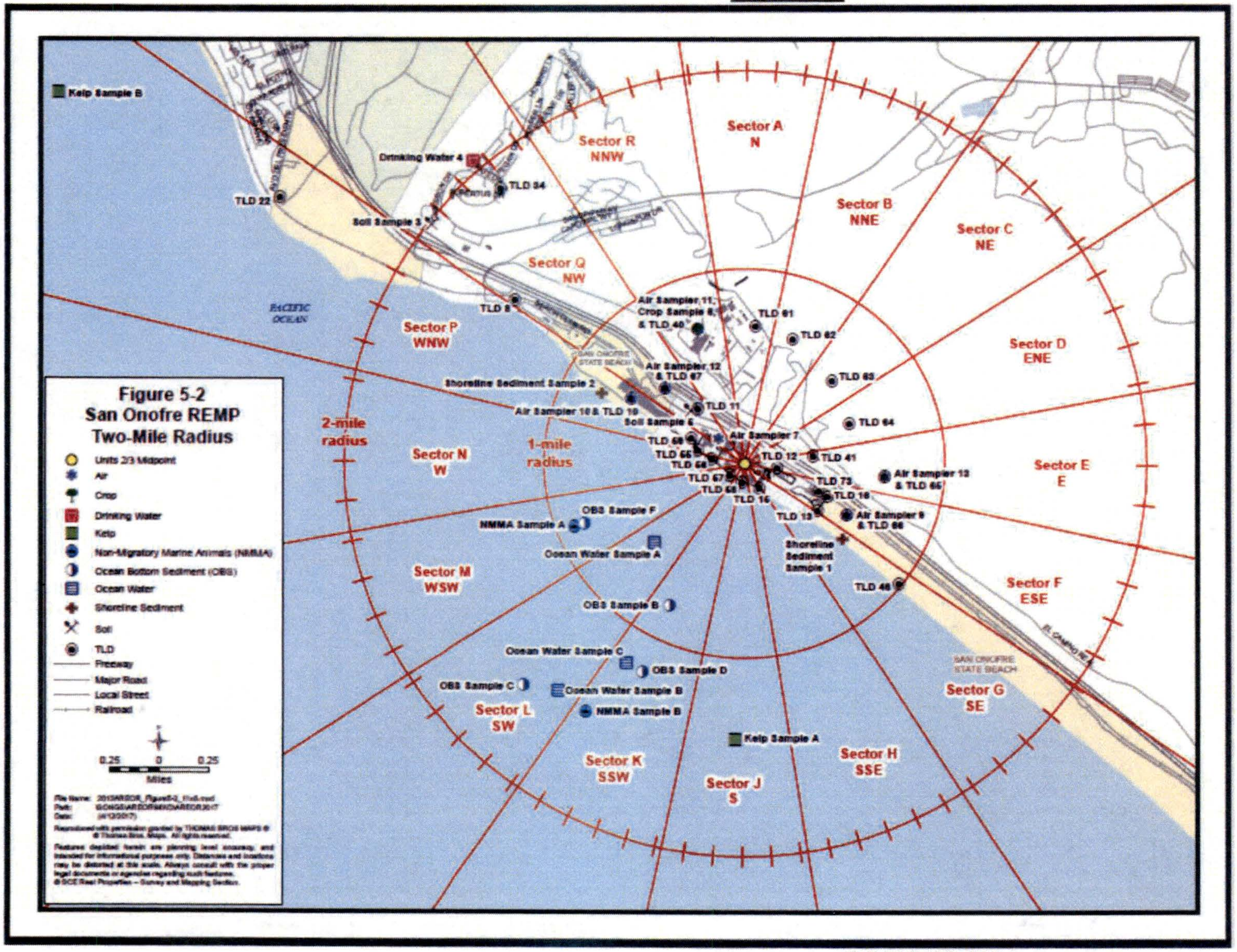
DEGREES TRUE NORTH FROM SONGS 2 AND 3 MID-POINT			NOMENCLATURE	
Sector Limit	Center Line	Sector Limit	22.5° Sector*	Direction
348.75	0 & 360	11.25	A	N
11.25	22.5	33.75	B	NNE
33.75	45.0	56.25	C	NE
56.25	67.5	78.75	D	ENE
78.75	90.0	101.25	E	E
101.25	112.0	123.75	F	ESE
123.75	135.0	146.25	G	SE
146.25	157.0	168.75	H	SSE
168.75	180.0	191.25	J	S
191.25	202.5	213.75	K	SSW
213.75	225.0	236.25	L	SW
236.25	247.5	258.75	M	WSW
258.75	270.0	281.25	N	W
281.25	292.5	303.75	P	WNW
303.75	315.0	326.25	Q	NW
326.25	337.5	348.75	R	NNW

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true North.

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS
1 MILE RADIUS
Figure 5-1



RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS
2 MILE RADIUS
Figure 5-2



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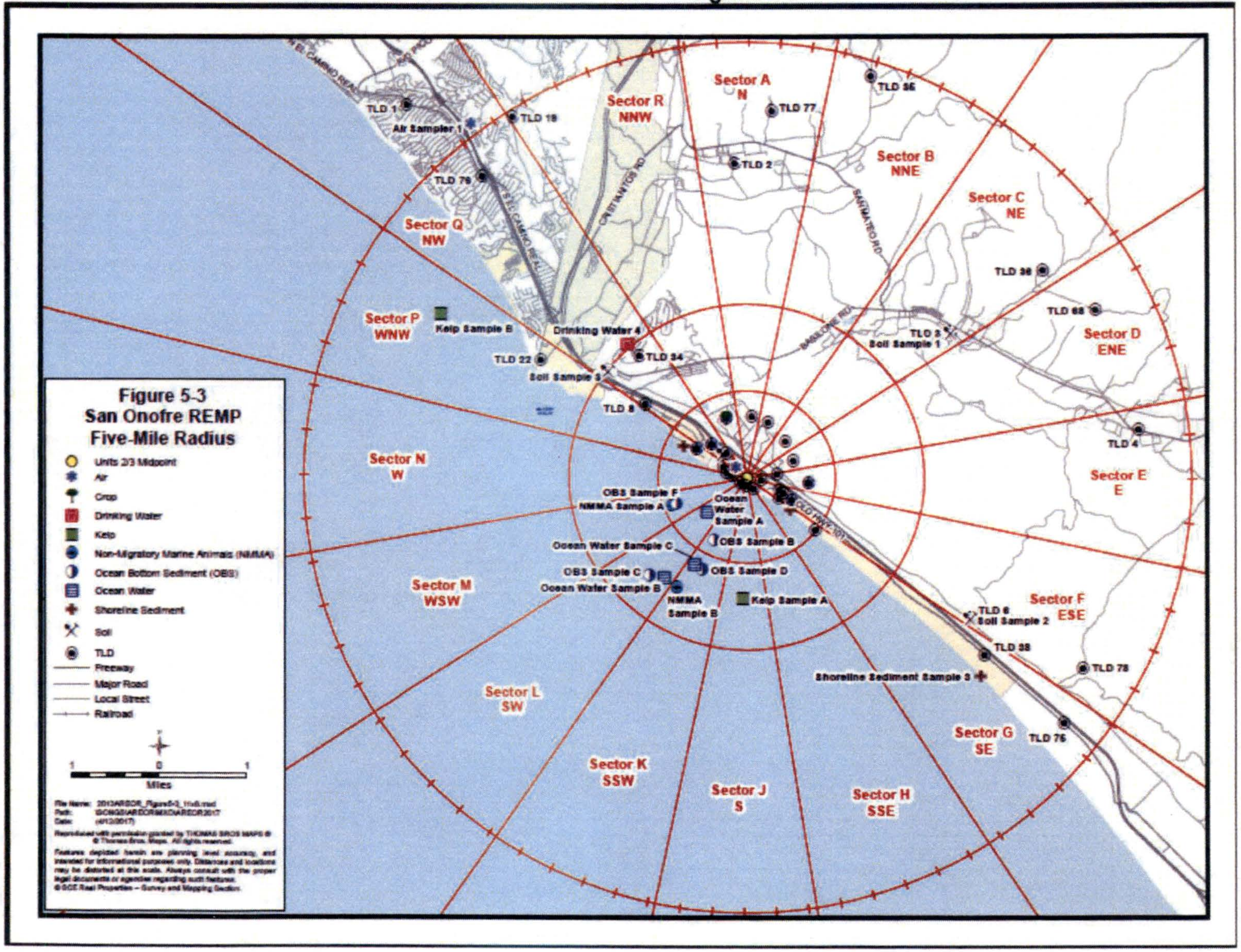
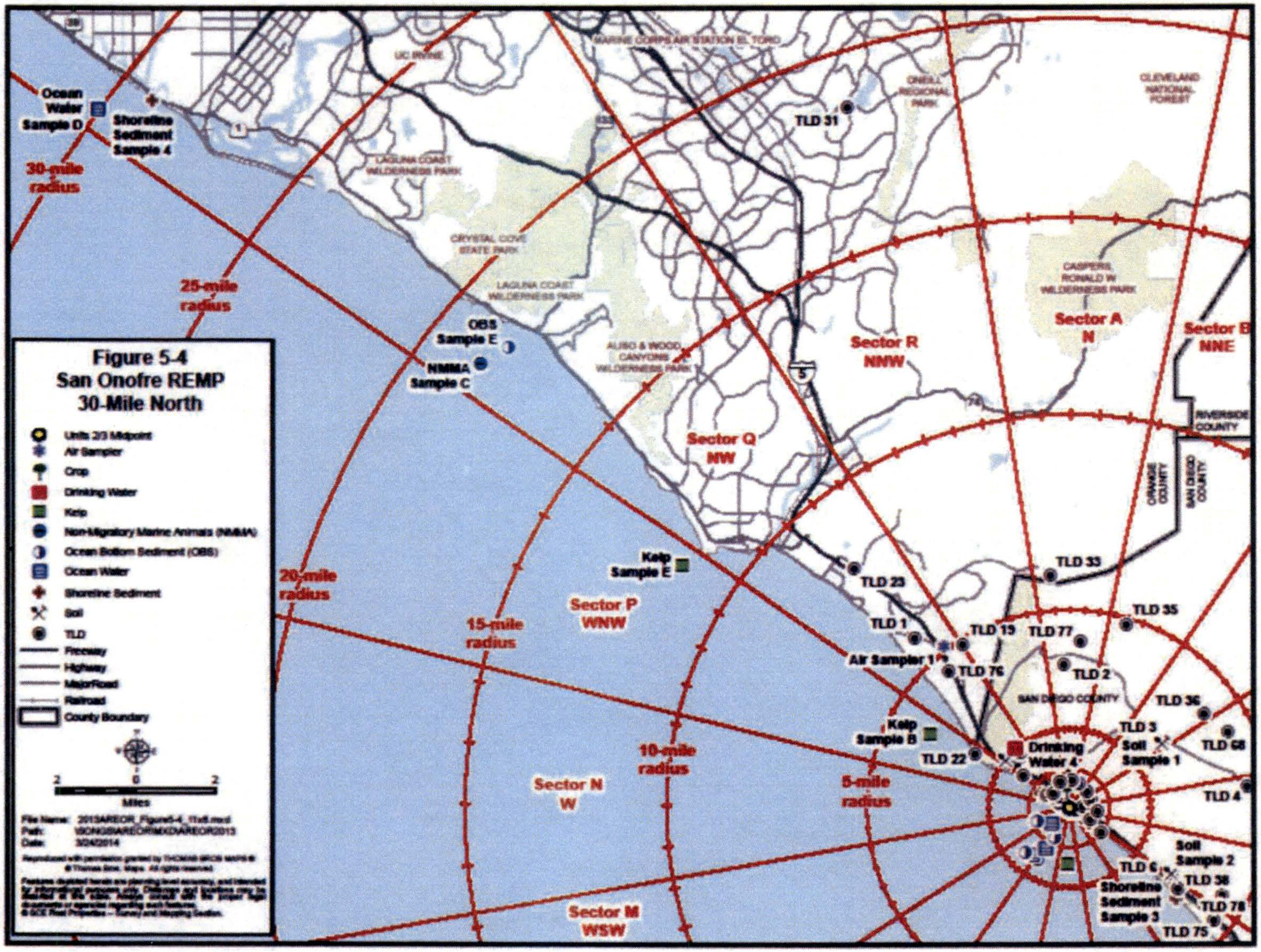
RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS
5 MILE RADIUS
Figure 5-3



RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS - ORANGE COUNTY

Figure 5-4



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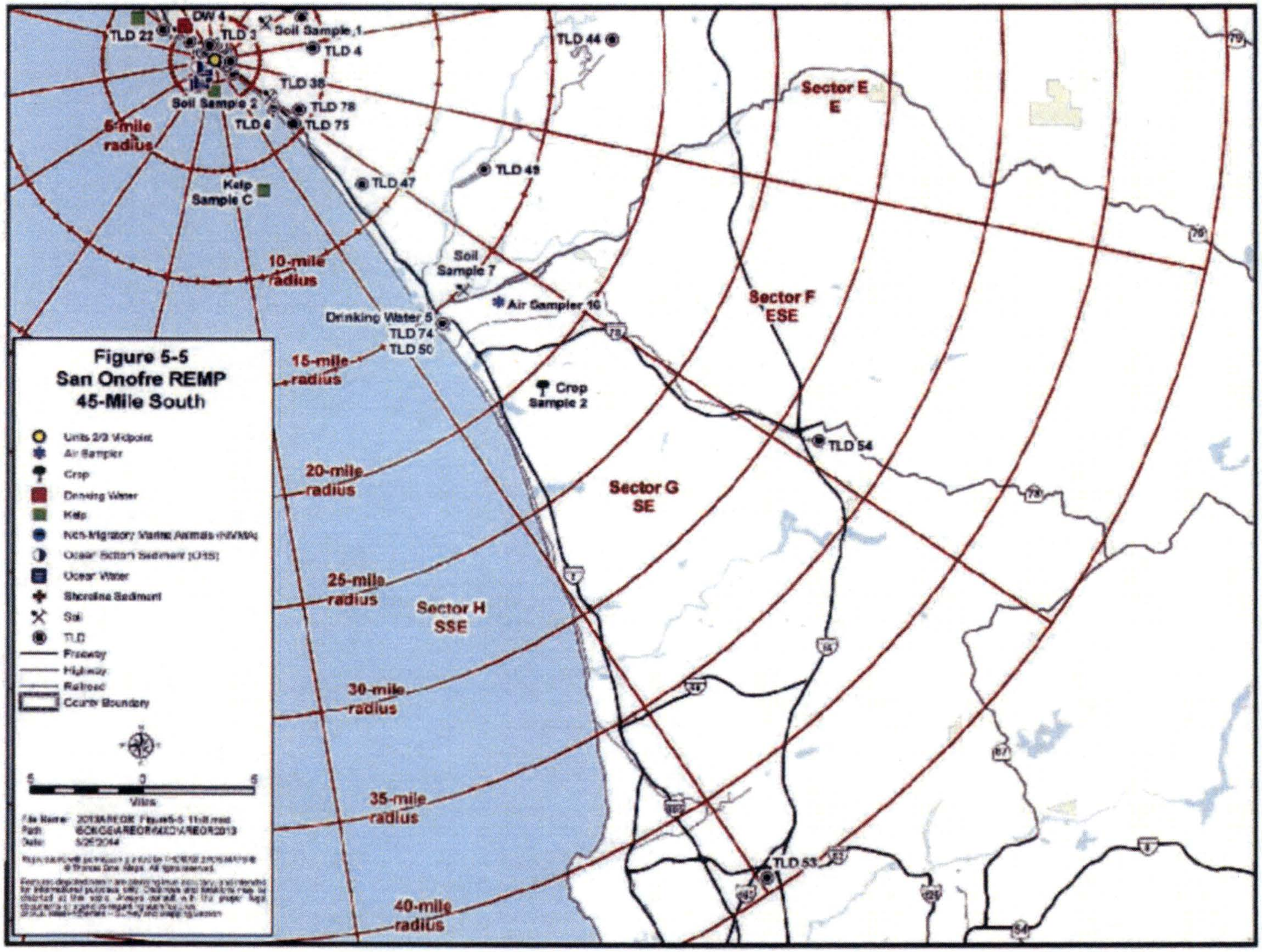
RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS - SAN DIEGO COUNTY

Figure 5-5



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6.0 **ADMINISTRATIVE**

6.1 DEFINITIONS

The defined terms of this section appear in capitalized type and are applicable through these Specifications.

ACTION

6.1.1 ACTION shall be that part of a specification which prescribes remedial measures required under designated conditions.

CHANNEL CALIBRATION

6.1.2 A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds with the necessary range and accuracy to known values of the parameter which the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the sensor and alarm and/or trip functions, and shall include the CHANNEL FUNCTIONAL TEST. The CHANNEL CALIBRATION may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

CHANNEL CHECK

6.1.3 A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

CHANNEL FUNCTIONAL TEST

6.1.4 A CHANNEL FUNCTIONAL TEST shall be:

a. Analog channels - the injection of a simulated signal into channel as close to the sensor as practicable to verify FUNCTIONALITY, including alarm and/or trip functions.

b. Bistable channels - the injection of a simulated signal into the sensor to verify FUNCTIONALITY, including alarm and/or trip functions.

c. Digital computer channels - the exercising of the digital computer hardware using diagnostic programs and the injection of simulated process data into the channel to verify FUNCTIONALITY.

6.0 **ADMINISTRATIVE** (Continued)

6.1 DEFINITIONS (Continued)

FREQUENCY NOTATION

6.1.5 The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table 6.2.

FUNCTIONAL - FUNCTIONALITY

6.1.6 A system, subsystem, train, component or device shall be FUNCTIONAL or have FUNCTIONALITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication and other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

MEMBERS OF THE PUBLIC

6.1.7 MEMBER(S) OF THE PUBLIC shall include all individuals who by virtue of their occupational status have no formal association with the plant. This category complies with the requirements of 10 CFR 50 and shall include non-employees of the licensee who are permitted to use portions of the site for recreational, occupational, or purposes not associated with plant functions. This category shall not include non-employees such as vending machine servicemen or postmen who, as part of their formal job function, occasionally enter an area that is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials.

PURGE - PURGING

6.1.8 PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

SITE BOUNDARY

6.1.9 The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee.

SOLIDIFICATION

6.1.10 SOLIDIFICATION shall be the conversion of radioactive wastes from liquid systems to a homogeneous (uniformly distributed), monolithic, immobilized solid with definite volume and shape, bounded by a stable surface of distinct outline on all sides (free-standing).

6.0 **ADMINISTRATIVE** (Continued)

6.1 DEFINITIONS (Continued)

SOURCE CHECK

6.1.11 For Sorrento Electronics digital monitors a SOURCE CHECK shall be the verification of proper computer response to a check source request. [2(3)RT-7828, 2(3)RT-7865-1]

For MGPI monitors a SOURCE CHECK shall be the verification of proper computer response to the continuous internal detector, monitor calibration and electrical checks. [2RT-7821, 2/3RT-7813, 2/3RT-7808G, 2/3RT-2101]

SURVEILLANCE REQUIREMENT: MEETING SPECIFIED FREQUENCY

6.1.12 The Specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met.

For Frequencies specified as "once," the above interval extension does not apply.

If a Completion Time requires periodic performance on a "once per ..." basis, the above Frequency extension applies to each performance after the initial performance.

This provision is not intended to be used repeatedly as a convenient means to extend surveillance intervals beyond those specified. Additionally, it does not apply to any Action Statements.

VENTILATION EXHAUST TREATMENT SYSTEM

6.1.13 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through HEPA filters for the purpose of removing Iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on Noble gas effluents).

NOTE: There are no longer any permanent ventilation exhaust treatment systems. Local mobile ventilation exhaust treatment system will be used on an as needed bases when outdoor activities have the potential for gaseous effluent releases.

6.0 **ADMINISTRATIVE** (Continued)

6.1 DEFINITIONS (Continued)

VENTING

6.1.14 VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent used in system names does not imply a VENTING process.

TABLE 6-1

OPERATIONAL MODES
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TABLE 6-2

FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours
D	At least once per 24 hours
W	At least once per 7 days
M	At least once per 31 days
Q	At least once per 92 days
SA	At least once per 184 days
R	At least once per 18 months*
P	Completed prior to each release
N.A.	Not applicable
3 x W	At least once per 72 hours 3 times per week (usually M, W, F).

*A month is defined as a 31-day period.

6.2 ADMINISTRATIVE CONTROLS

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT*

6.2.1 Routine radioactive effluent release reports covering the operation of the unit during the previous calendar year shall be submitted before May 1 of each year.

6.2.2 The radioactive effluent release reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Reg. Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof.

The radioactive effluent release report shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing of wind speed, wind direction, and atmospheric stability, and precipitation (if measured) on magnetic tape, or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Figure 1-2 and 2-2) during the report period. All assumptions used in making these assessments (i.e., specific activity, exposure time and location) shall be included in these reports. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents (as determined by sampling frequency and measurement) shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

* A single submittal may be made for a multiple unit station. The submittal should combine those sections that are common to all units at the Station; however, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

6.2 ADMINISTRATIVE CONTROLS (Continued)

6.2.2 (Continued)

The radioactive effluent release report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby Uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous 12 consecutive months to show conformance with 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operation. Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Reg. Guide 1.109, Rev. 1.

The radioactive effluents release shall include the following information for each type of solid waste shipped offsite during the report period:

a. Container volume,

b. Total curie quantity (specify whether determined by measurement or estimate),

c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Type of waste (e.g., spent resin, compacted dry waste, evaporator bottoms),

e. Type of container (e.g., LSA, Type A, Type B, Large Quantity), and

f. Solidification Agent (e.g., cement, urea formaldehyde).

The radioactive effluent release report shall include unplanned releases from the site to unrestricted areas of radioactive materials in gaseous and liquid effluents made during the reporting period.

The radioactive effluent release reports shall include any changes to the PROCESS CONTROL PROGRAM (PCP) made during the reporting period.

6.0 **ADMINISTRATIVE** (Continued)

6.3 MAJOR CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS (Liquid and Gaseous)

Licensee initiated major changes to the radioactive waste systems (liquid and gaseous):

1. Shall be reported to the Commission in the Annual Radioactive Effluent Release Report for the period in which the evaluation was performed. The discussion of each change shall contain:

    a. A summary of the evaluation that led to the determination that the change could be made in accordance with applicable regulations;

    b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

    c. A detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

    d. An evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents that differ from those previously predicted in the license application and amendments thereto;

    e. An evaluation of the change which shows the expected maximum exposures to individual in the unrestricted area and to the general population that differ from those previously estimated in the license application and amendments thereto;

    f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents to the actual release for the period prior to when the changes are to be made;

    g. An estimate of the exposure to plant operating personnel as a result of the change; and

    h. Documentation of the fact that the change was reviewed and found acceptable

2. Shall become effective upon review and acceptance.

6.0 **ADMINISTRATIVE** (Continued)

6.4 BASES

LIQUID EFFLUENTS

CONCENTRATION (1.1)

6.4.1 This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR 50, to an individual, and (2) the limits of 10 CFR 20.106(e) to the population. The concentration limit for dissolved or entrained Noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

DOSE (1.2)

6.4.2 This specification is provided to implement the requirements of Section II.A, III.A ,and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Reg. Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Reg. Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

This specification applies to the release of liquid effluents from each reactor at the site. For units with shared radwaste treatment systems, the liquid effluents from the shared system are proportioned among the units sharing that system.

LIQUID WASTE TREATMENT (1.3)

6.4.3 The FUNCTIONALITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

GASEOUS EFFLUENTS

DOSE RATE (2.1)

6.4.4 This specification is provided to ensure that the dose at any time at the site boundary from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 for unrestricted areas. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area, either within or outside the site boundary, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 [10 CFR Part 20.106(b)]. 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. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the site boundary to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

This specification applies to the release of gaseous effluents from all reactors at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

DOSE - NOBLE GASES (2.2)

6.4.5 This specification is provided to implement the requirements of Sections II.B, III.A, and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure the releases of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Reg. Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Reg. Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. 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". The ODCM equations provided for determining the air doses at the SITE BOUNDARY are based upon the historical average atmospheric conditions.

DOSE - RADIOIODINES, RADIOACTIVE MATERIALS IN PARTICULATE FORM AND TRITIUM (2.3)

6.4.6 This specification is provided to implement the requirements of Sections II.C, III.A, and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methods for calculating the doses due to the actual

6.4 BASES (Continued)

release rates of the subject materials are consistent with the methodology provided in Reg. Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Reg. Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for radioiodines, radioactive materials in particulate form and Tritium are dependent on the existing radionuclide pathways to man, in the unrestricted area. The pathways which were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

GASEOUS RADWASTE TREATMENT (2.4) **DELETED**

TOTAL DOSE (3.3)

6.4.7 This specification is provided to meet the dose limitations of 40 CFR 190. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the design objective doses of Appendix I. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a member of the public will exceed the dose limits of 40 CFR 190 if the individual reactors remain within the reporting requirement level. The Special Report will describe a course of action which should result in the limitation of dose to a member of the public for 12 consecutive months to within the 40 CFR 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the member of the public from other Uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any member of the public is estimated to exceed the requirements of 40 CFR 190, the Special Report with a request for a variance in accordance with the provisions of 40 CFR 190.11, is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected. An individual is not considered a member of the public during any period in which he/she is engaged in carrying out any operation which is part of the nuclear fuel cycle.

6.4 BASES (Continued)

RADIOACTIVE LIQUID EFFLUENT INSTRUMENTATION (4.1)

6.4.8 The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

RADIOACTIVE GASEOUS EFFLUENT INSTRUMENTATION (4.2)

6.4.9 The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

MONITORING PROGRAM (5.1)

6.4.10 The radiological monitoring program required by this specification provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides, which lead to the highest potential radiation exposures of individuals resulting from the station operation. This monitoring program thereby supplements the radiological effluent monitoring program by verifying the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

6.0 **ADMINISTRATIVE** (Continued)

6.4 BASES (Continued)

The detection capabilities required by Table 5-1 are state-of-the-art for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

LAND USE CENSUS (5.2)

6.4.11 This specification is provided to ensure that changes in the use of UNRESTRICTED AREAS are identified and that modifications to the monitoring program are made if required by the results of this census. The best survey information from the door-to-door, aerial or consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 500 square feet provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Reg. Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were used,

1) that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and

2) a vegetation yield of 2 kg/square meter.

INTERLABORATORY COMPARISON PROGRAM (5.3)

6.4.12 The requirement for participation in an Interlaboratory Comparison Program is provided to ensure independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

Enclosure 3

Offsite Dose Calculation Manual
Nuclear Organization
San Onofre Nuclear Generation Station
Appendix A
Ri Tables
SO123-ODCM-A, Revision 13, November 2018

OFFSITE DOSE CALCULATION MANUAL

NUCLEAR ORGANIZATION

SAN ONOFRE NUCLEAR GENERATING STATION

APPENDIX A

R_i TABLES

ODCM APPENDIX A

TABLE OF CONTENTS

*R_i Tables based on Parts Code results for 2018 Land Use Census (SDS-CH2-REC-0002).

TABLE 1-1
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'P'

PATHWAY: SURF BEACH/LIFE GUARD DISTANCE: .5 MILES

X/Q : 1.3E-06 SEC/(M**3) D/Q : 5.5E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	7.8E+00	0.0E+00	4.2E+01	0.0E+00	1.2E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	1.2E+02	3.2E+04	6.9E+02	1.5E+05	1.3E+03	4.2E+05
MN 54	0.0E+00	0.0E+00	1.1E+04	9.5E+06	6.5E+04	4.5E+07	1.3E+05	1.3E+08
CO 57	0.0E+00	0.0E+00	9.1E+01	2.4E+06	1.0E+03	1.1E+07	2.9E+03	3.1E+07
CO 58	0.0E+00	0.0E+00	7.6E+03	2.6E+06	4.4E+04	1.2E+07	8.5E+04	3.5E+07
CO 60	0.0E+00	0.0E+00	4.9E+04	1.5E+08	2.9E+05	7.0E+08	5.4E+05	2.0E+09
SR 89	0.0E+00	0.0E+00	1.5E+04	1.5E+02	7.9E+04	7.1E+02	1.3E+05	2.0E+03
SR 90	0.0E+00	0.0E+00	1.0E+05	0.0E+00	5.4E+05	0.0E+00	8.8E+05	0.0E+00
ZR 95	0.0E+00	0.0E+00	1.5E+04	1.7E+06	8.8E+04	8.2E+06	1.6E+05	2.3E+07
NB 95	0.0E+00	0.0E+00	4.2E+03	9.4E+05	2.5E+04	4.5E+06	4.6E+04	1.2E+07
RU 103	0.0E+00	0.0E+00	4.6E+03	7.5E+05	2.6E+04	3.6E+06	4.6E+04	9.9E+06
TE 129M	0.0E+00	0.0E+00	1.2E+04	1.4E+05	6.5E+04	6.4E+05	1.1E+05	1.8E+06
CS 134	0.0E+00	0.0E+00	8.3E+02	4.7E+07	4.8E+03	2.2E+08	8.9E+03	6.2E+08
CS 136	0.0E+00	0.0E+00	1.0E+02	1.0E+06	5.8E+02	4.9E+06	1.1E+03	1.4E+07
CS 137	0.0E+00	0.0E+00	7.2E+02	7.1E+07	4.0E+03	3.4E+08	6.9E+03	9.4E+08
BA 140	0.0E+00	0.0E+00	1.2E+04	1.4E+05	6.6E+04	6.7E+05	1.2E+05	1.9E+06
CE 141	0.0E+00	0.0E+00	3.8E+03	9.4E+04	2.0E+04	4.5E+05	3.3E+04	1.2E+06
CE 144	0.0E+00	0.0E+00	8.2E+04	4.8E+05	4.4E+05	2.3E+06	7.1E+05	6.4E+06
I 131	0.0E+00	0.0E+00	1.1E+05	1.2E+05	4.8E+05	5.6E+05	1.1E+06	1.6E+06
I 132	0.0E+00	0.0E+00	1.3E+03	8.5E+03	4.9E+03	4.1E+04	1.0E+04	1.1E+05
I 133	0.0E+00	0.0E+00	2.7E+04	1.7E+04	9.5E+04	8.0E+04	2.0E+05	2.2E+05
I 134	0.0E+00	0.0E+00	3.5E+02	3.1E+03	1.3E+03	1.5E+04	2.7E+03	4.1E+04
I 135	0.0E+00	0.0E+00	5.5E+03	1.7E+04	2.0E+04	8.2E+04	4.1E+04	2.3E+05
UN-ID*	0.0E+00	0.0E+00	6.9E+03	5.1E+06	4.1E+04	2.4E+07	7.9E+04	6.8E+07

TABLE 1-1
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'P'

PATHWAY: SORB CAMPGROUND DISTANCE: 1.0 MILES

X/Q : 4.4E-07 SEC/(M**3) D/Q : 1.7E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	1.6E+02	0.0E+00	2.8E+02	0.0E+00	3.1E+02	0.0E+00	3.1E+02	0.0E+00
CR 51	3.2E+03	1.1E+06	4.2E+03	1.1E+06	5.2E+03	1.1E+06	3.6E+03	1.1E+06
MN 54	2.5E+05	3.4E+08	3.9E+05	3.4E+08	4.9E+05	3.4E+08	3.5E+05	3.4E+08
CO 57	1.2E+03	8.5E+07	3.3E+03	8.5E+07	7.8E+03	8.5E+07	7.8E+03	8.5E+07
CO 58	1.9E+05	9.4E+07	2.7E+05	9.4E+07	3.3E+05	9.4E+07	2.3E+05	9.4E+07
CO 60	1.1E+06	5.3E+09	1.7E+06	5.3E+09	2.2E+06	5.3E+09	1.5E+06	5.3E+09
SR 89	5.0E+05	5.3E+03	5.3E+05	5.3E+03	6.0E+05	5.3E+03	3.5E+05	5.3E+03
SR 90	2.8E+06	0.0E+00	3.6E+06	0.0E+00	4.1E+06	0.0E+00	2.4E+06	0.0E+00
ZR 95	4.3E+05	6.2E+07	5.5E+05	6.2E+07	6.6E+05	6.2E+07	4.4E+05	6.2E+07
NB 95	1.2E+05	3.4E+07	1.5E+05	3.4E+07	1.9E+05	3.4E+07	1.2E+05	3.4E+07
RU 103	1.4E+05	2.7E+07	1.6E+05	2.7E+07	1.9E+05	2.7E+07	1.2E+05	2.7E+07
TE 129M	4.1E+05	4.8E+06	4.3E+05	4.8E+06	4.9E+05	4.8E+06	3.0E+05	4.8E+06
CS 134	2.0E+04	1.7E+09	3.0E+04	1.7E+09	3.6E+04	1.7E+09	2.4E+04	1.7E+09
CS 136	2.9E+03	3.7E+07	3.6E+03	3.7E+07	4.4E+03	3.7E+07	3.0E+03	3.7E+07
CS 137	1.8E+04	2.5E+09	2.6E+04	2.5E+09	3.0E+04	2.5E+09	1.9E+04	2.5E+09
BA 140	3.9E+05	5.1E+06	4.3E+05	5.1E+06	5.0E+05	5.1E+06	3.1E+05	5.1E+06
CE 141	1.3E+05	3.4E+06	1.3E+05	3.4E+06	1.5E+05	3.4E+06	8.9E+04	3.4E+06
CE 144	2.4E+06	1.7E+07	2.9E+06	1.7E+07	3.3E+06	1.7E+07	1.9E+06	1.7E+07
I 131	3.7E+06	4.2E+06	4.0E+06	4.2E+06	3.6E+06	4.2E+06	2.9E+06	4.2E+06
I 132	4.2E+04	3.1E+05	4.8E+04	3.1E+05	3.7E+04	3.1E+05	2.8E+04	3.1E+05
I 133	8.8E+05	6.0E+05	9.5E+05	6.0E+05	7.2E+05	6.0E+05	5.3E+05	6.0E+05
I 134	1.1E+04	1.1E+05	1.3E+04	1.1E+05	9.7E+03	1.1E+05	7.4E+03	1.1E+05
I 135	1.7E+05	6.2E+05	2.0E+05	6.2E+05	1.5E+05	6.2E+05	1.1E+05	6.2E+05
UN-ID*	1.6E+05	1.8E+08	2.5E+05	1.8E+08	3.1E+05	1.8E+08	2.1E+05	1.8E+08

TABLE 1-1
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'P'

PATHWAY: SAN MATEO POINT HOUS DISTANCE: 2.7 MILES

X/Q : 1.1E-07 SEC/(M**3) D/Q : 3.2E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	1.3E+04	4.7E+06	1.7E+04	4.7E+06	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	1.0E+06	1.4E+09	1.6E+06	1.4E+09	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	3.4E+08	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	3.8E+08	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.2E+10	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	2.2E+04	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	1.1E+07	0.0E+00	1.5E+07	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	1.8E+06	2.5E+08	2.2E+06	2.5E+08	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	4.8E+05	1.4E+08	6.1E+05	1.4E+08	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	1.1E+08	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.0E+07	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	8.0E+04	6.8E+09	1.2E+05	6.8E+09	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	1.2E+04	1.5E+08	1.5E+04	1.5E+08	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	1.0E+10	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	2.1E+07	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	5.2E+05	1.4E+07	5.4E+05	1.4E+07	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	9.8E+06	7.0E+07	1.2E+07	7.0E+07	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	1.5E+07	1.7E+07	1.6E+07	1.7E+07	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	2.4E+06	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	2.5E+06	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	7.5E+08	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-1
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'P'

PATHWAY: COTTON POINT GARDENS DISTANCE: 2.8 MILES

X/Q : 1.0E-07 SEC/(M**3) D/Q : 3.0E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	4.0E+03	1.3E+03	2.6E+03	1.3E+03	2.3E+03
CR 51	1.3E+04	4.7E+06	1.7E+04	1.1E+07	2.1E+04	1.5E+07	1.4E+04	1.6E+07
MN 54	1.0E+06	1.4E+09	1.6E+06	2.0E+09	2.0E+06	2.3E+09	1.4E+06	2.3E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	5.8E+08	3.1E+04	6.6E+08	3.1E+04	6.3E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	7.5E+08	1.3E+06	9.7E+08	9.3E+05	9.9E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.4E+10	8.7E+06	2.5E+10	6.0E+06	2.5E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	3.5E+10	2.4E+06	1.5E+10	1.4E+06	9.8E+09
SR 90	1.1E+07	0.0E+00	1.5E+07	1.4E+12	1.6E+07	8.3E+11	9.6E+06	6.7E+11
ZR 95	1.8E+06	2.5E+08	2.2E+06	1.1E+09	2.7E+06	1.5E+09	1.8E+06	1.4E+09
NB 95	4.8E+05	1.4E+08	6.1E+05	4.3E+08	7.5E+05	5.9E+08	5.0E+05	6.1E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	5.0E+08	7.8E+05	6.8E+08	5.0E+05	6.6E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.9E+09	2.0E+06	1.8E+09	1.2E+06	1.2E+09
CS 134	8.0E+04	6.8E+09	1.2E+05	3.2E+10	1.5E+05	2.3E+10	9.8E+04	1.8E+10
CS 136	1.2E+04	1.5E+08	1.5E+04	3.7E+08	1.8E+04	3.2E+08	1.2E+04	3.2E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	3.4E+10	1.2E+05	2.4E+10	7.5E+04	1.9E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	3.0E+08	2.0E+06	2.3E+08	1.3E+06	2.8E+08
CE 141	5.2E+05	1.4E+07	5.4E+05	4.2E+08	6.1E+05	5.5E+08	3.6E+05	5.2E+08
CE 144	9.8E+06	7.0E+07	1.2E+07	1.0E+10	1.3E+07	1.3E+10	7.8E+06	1.1E+10
I 131	1.5E+07	1.7E+07	1.6E+07	4.8E+10	1.5E+07	3.1E+10	1.2E+07	3.8E+10
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	8.1E+08	2.9E+06	4.6E+08	2.2E+06	5.3E+08
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	1.2E+07	6.2E+05	8.2E+06	4.5E+05	9.1E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	3.5E+09	1.2E+06	2.6E+09	8.6E+05	2.0E+09

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: ST PARK OFFICE TRLR DISTANCE: .6 MILES

X/Q : 2.1E-06 SEC/(M**3) D/Q : 1.2 E-08 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SURF BEACH/GUARD SHACK DISTANCE: .7 MILES

X/Q : 1.8E-06 SEC/(M**3) D/Q : 9.8E-09/M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	7.8E+00	0.0E+00	4.2E+01	0.0E+00	2.2E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	1.2E+02	3.2E+04	6.9E+02	1.5E+05	2.5E+03	8.0E+05
MN 54	0.0E+00	0.0E+00	1.1E+04	9.5E+06	6.5E+04	4.5E+07	2.4E+05	2.4E+08
CO 57	0.0E+00	0.0E+00	9.1E+01	2.4E+06	1.0E+03	1.1E+07	5.4E+03	5.9E+07
CO 58	0.0E+00	0.0E+00	7.6E+03	2.6E+06	4.4E+04	1.2E+07	1.6E+05	6.5E+07
CO 60	0.0E+00	0.0E+00	4.9E+04	1.5E+08	2.9E+05	7.0E+08	1.0E+06	3.7E+09
SR 89	0.0E+00	0.0E+00	1.5E+04	1.5E+02	7.9E+04	7.1E+02	2.4E+05	3.7E+03
SR 90	0.0E+00	0.0E+00	1.0E+05	0.0E+00	5.4E+05	0.0E+00	1.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	1.5E+04	1.7E+06	8.8E+04	8.2E+06	3.0E+05	4.3E+07
NB 95	0.0E+00	0.0E+00	4.2E+03	9.4E+05	2.5E+04	4.5E+06	8.6E+04	2.3E+07
RU 103	0.0E+00	0.0E+00	4.6E+03	7.5E+05	2.6E+04	3.6E+06	8.6E+04	1.9E+07
TE 129M	0.0E+00	0.0E+00	1.2E+04	1.4E+05	6.5E+04	6.4E+05	2.1E+05	3.4E+06
CS 134	0.0E+00	0.0E+00	8.3E+02	4.7E+07	4.8E+03	2.2E+08	1.7E+04	1.2E+09
CS 136	0.0E+00	0.0E+00	1.0E+02	1.0E+06	5.8E+02	4.9E+06	2.1E+03	2.6E+07
CS 137	0.0E+00	0.0E+00	7.2E+02	7.1E+07	4.0E+03	3.4E+08	1.3E+04	1.8E+09
BA 140	0.0E+00	0.0E+00	1.2E+04	1.4E+05	6.6E+04	6.7E+05	2.2E+05	3.5E+06
CE 141	0.0E+00	0.0E+00	3.8E+03	9.4E+04	2.0E+04	4.5E+05	6.2E+04	2.3E+06
CE 144	0.0E+00	0.0E+00	8.2E+04	4.8E+05	4.4E+05	2.3E+06	1.3E+06	1.2E+07
I 131	0.0E+00	0.0E+00	1.1E+05	1.2E+05	4.8E+05	5.6E+05	2.0E+06	2.9E+06
I 132	0.0E+00	0.0E+00	1.3E+03	8.5E+03	4.9E+03	4.1E+04	2.0E+04	2.1E+05
I 133	0.0E+00	0.0E+00	2.7E+04	1.7E+04	9.5E+04	8.0E+04	3.7E+05	4.2E+05
I 134	0.0E+00	0.0E+00	3.5E+02	3.1E+03	1.3E+03	1.5E+04	5.1E+03	7.7E+04
I 135	0.0E+00	0.0E+00	5.5E+03	1.7E+04	2.0E+04	8.2E+04	7.7E+04	4.3E+05
UN-ID*	0.0E+00	0.0E+00	6.9E+03	5.1E+06	4.1E+04	2.4E+07	1.5E+05	1.3E+08

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SORB REC BEACH DISTANCE: 1.1 MILES

X/Q : 9.9E-07 SEC/(M**3) D/Q : 5.0E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	1.6E+02	0.0E+00	2.8E+02	0.0E+00	3.1E+02	0.0E+00	3.1E+02	0.0E+00
CR 51	3.2E+03	1.1E+06	4.2E+03	1.1E+06	5.2E+03	1.1E+06	3.6E+03	1.1E+06
MN 54	2.5E+05	3.4E+08	3.9E+05	3.4E+08	4.9E+05	3.4E+08	3.5E+05	3.4E+08
CO 57	1.2E+03	8.5E+07	3.3E+03	8.5E+07	7.8E+03	8.5E+07	7.8E+03	8.5E+07
CO 58	1.9E+05	9.4E+07	2.7E+05	9.4E+07	3.3E+05	9.4E+07	2.3E+05	9.4E+07
CO 60	1.1E+06	5.3E+09	1.7E+06	5.3E+09	2.2E+06	5.3E+09	1.5E+06	5.3E+09
SR 89	5.0E+05	5.3E+03	5.3E+05	5.3E+03	6.0E+05	5.3E+03	3.5E+05	5.3E+03
SR 90	2.8E+06	0.0E+00	3.6E+06	0.0E+00	4.1E+06	0.0E+00	2.4E+06	0.0E+00
ZR 95	4.3E+05	6.2E+07	5.5E+05	6.2E+07	6.6E+05	6.2E+07	4.4E+05	6.2E+07
NB 95	1.2E+05	3.4E+07	1.5E+05	3.4E+07	1.9E+05	3.4E+07	1.2E+05	3.4E+07
RU 103	1.4E+05	2.7E+07	1.6E+05	2.7E+07	1.9E+05	2.7E+07	1.2E+05	2.7E+07
TE 129M	4.1E+05	4.8E+06	4.3E+05	4.8E+06	4.9E+05	4.8E+06	3.0E+05	4.8E+06
CS 134	2.0E+04	1.7E+09	3.0E+04	1.7E+09	3.6E+04	1.7E+09	2.4E+04	1.7E+09
CS 136	2.9E+03	3.7E+07	3.6E+03	3.7E+07	4.4E+03	3.7E+07	3.0E+03	3.7E+07
CS 137	1.8E+04	2.5E+09	2.6E+04	2.5E+09	3.0E+04	2.5E+09	1.9E+04	2.5E+09
BA 140	3.9E+05	5.1E+06	4.3E+05	5.1E+06	5.0E+05	5.1E+06	3.1E+05	5.1E+06
CE 141	1.3E+05	3.4E+06	1.3E+05	3.4E+06	1.5E+05	3.4E+06	8.9E+04	3.4E+06
CE 144	2.4E+06	1.7E+07	2.9E+06	1.7E+07	3.3E+06	1.7E+07	1.9E+06	1.7E+07
I 131	3.7E+06	4.2E+06	4.0E+06	4.2E+06	3.6E+06	4.2E+06	2.9E+06	4.2E+06
I 132	4.2E+04	3.1E+05	4.8E+04	3.1E+05	3.7E+04	3.1E+05	2.8E+04	3.1E+05
I 133	8.8E+05	6.0E+05	9.5E+05	6.0E+05	7.2E+05	6.0E+05	5.3E+05	6.0E+05
I 134	1.1E+04	1.1E+05	1.3E+04	1.1E+05	9.7E+03	1.1E+05	7.4E+03	1.1E+05
I 135	1.7E+05	6.2E+05	2.0E+05	6.2E+05	1.5E+05	6.2E+05	1.1E+05	6.2E+05
UN-ID*	1.6E+05	1.8E+08	2.5E+05	1.8E+08	3.1E+05	1.8E+08	2.1E+05	1.8E+08

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SORB CAMPGROUND CK IN DISTANCE: 1.3 MILES

X/Q : 7.9E-07 SEC/(M**3) D/Q : 3.9E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SAN ONOFRE III HOUSING DISTANCE: 1.4 MILES

X/Q : 6.9E-07 SEC/(M**3) D/Q : 3.3E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	1.3E+04	4.7E+06	1.7E+04	4.7E+06	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	1.0E+06	1.4E+09	1.6E+06	1.4E+09	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	3.4E+08	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	3.8E+08	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.2E+10	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	2.2E+04	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	1.1E+07	0.0E+00	1.5E+07	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	1.8E+06	2.5E+08	2.2E+06	2.5E+08	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	4.8E+05	1.4E+08	6.1E+05	1.4E+08	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	1.1E+08	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.0E+07	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	8.0E+04	6.8E+09	1.2E+05	6.8E+09	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	1.2E+04	1.5E+08	1.5E+04	1.5E+08	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	1.0E+10	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	2.1E+07	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	5.2E+05	1.4E+07	5.4E+05	1.4E+07	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	9.8E+06	7.0E+07	1.2E+07	7.0E+07	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	1.5E+07	1.7E+07	1.6E+07	1.7E+07	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	2.4E+06	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	2.5E+06	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	7.5E+08	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-2
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SC RES. WITH GARDEN DISTANCE: 4.0 MILES

X/Q : 1.4E-07 SEC/(M**3) D/Q : 4.9E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	4.0E+03	1.3E+03	2.6E+03	1.3E+03	2.3E+03
CR 51	1.3E+04	4.7E+06	1.7E+04	1.1E+07	2.1E+04	1.5E+07	1.4E+04	1.6E+07
MN 54	1.0E+06	1.4E+09	1.6E+06	2.0E+09	2.0E+06	2.3E+09	1.4E+06	2.3E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	5.8E+08	3.1E+04	6.6E+08	3.1E+04	6.3E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	7.5E+08	1.3E+06	9.7E+08	9.3E+05	9.9E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.4E+10	8.7E+06	2.5E+10	6.0E+06	2.5E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	3.5E+10	2.4E+06	1.5E+10	1.4E+06	9.8E+09
SR 90	1.1E+07	0.0E+00	1.5E+07	1.4E+12	1.6E+07	8.3E+11	9.6E+06	6.7E+11
ZR 95	1.8E+06	2.5E+08	2.2E+06	1.1E+09	2.7E+06	1.5E+09	1.8E+06	1.4E+09
NB 95	4.8E+05	1.4E+08	6.1E+05	4.3E+08	7.5E+05	5.9E+08	5.0E+05	6.1E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	5.0E+08	7.8E+05	6.8E+08	5.0E+05	6.6E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.9E+09	2.0E+06	1.8E+09	1.2E+06	1.2E+09
CS 134	8.0E+04	6.8E+09	1.2E+05	3.2E+10	1.5E+05	2.3E+10	9.8E+04	1.8E+10
CS 136	1.2E+04	1.5E+08	1.5E+04	3.7E+08	1.8E+04	3.2E+08	1.2E+04	3.2E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	3.4E+10	1.2E+05	2.4E+10	7.5E+04	1.9E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	3.0E+08	2.0E+06	2.3E+08	1.3E+06	2.8E+08
CE 141	5.2E+05	1.4E+07	5.4E+05	4.2E+08	6.1E+05	5.5E+08	3.6E+05	5.2E+08
CE 144	9.8E+06	7.0E+07	1.2E+07	1.0E+10	1.3E+07	1.3E+10	7.8E+06	1.1E+10
I 131	1.5E+07	1.7E+07	1.6E+07	4.8E+10	1.5E+07	3.1E+10	1.2E+07	3.8E+10
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	8.1E+08	2.9E+06	4.6E+08	2.2E+06	5.3E+08
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	1.2E+07	6.2E+05	8.2E+06	4.5E+05	9.1E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	3.5E+09	1.2E+06	2.6E+09	8.6E+05	2.0E+09

TABLE 1-3
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'Q'

PATHWAY: SC RES. WITH GARDEN DISTANCE: 4.0 MILES

X/Q : 1.4E-07 SEC/(M**3) D/Q : 4.9E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	4.0E+03	1.3E+03	2.6E+03	1.3E+03	2.3E+03
CR 51	1.3E+04	4.7E+06	1.7E+04	1.1E+07	2.1E+04	1.5E+07	1.4E+04	1.6E+07
MN 54	1.0E+06	1.4E+09	1.6E+06	2.0E+09	2.0E+06	2.3E+09	1.4E+06	2.3E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	5.8E+08	3.1E+04	6.6E+08	3.1E+04	6.3E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	7.5E+08	1.3E+06	9.7E+08	9.3E+05	9.9E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.4E+10	8.7E+06	2.5E+10	6.0E+06	2.5E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	3.5E+10	2.4E+06	1.5E+10	1.4E+06	9.8E+09
SR 90	1.1E+07	0.0E+00	1.5E+07	1.4E+12	1.6E+07	8.3E+11	9.6E+06	6.7E+11
ZR 95	1.8E+06	2.5E+08	2.2E+06	1.1E+09	2.7E+06	1.5E+09	1.8E+06	1.4E+09
NB 95	4.8E+05	1.4E+08	6.1E+05	4.3E+08	7.5E+05	5.9E+08	5.0E+05	6.1E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	5.0E+08	7.8E+05	6.8E+08	5.0E+05	6.6E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.9E+09	2.0E+06	1.8E+09	1.2E+06	1.2E+09
CS 134	8.0E+04	6.8E+09	1.2E+05	3.2E+10	1.5E+05	2.3E+10	9.8E+04	1.8E+10
CS 136	1.2E+04	1.5E+08	1.5E+04	3.7E+08	1.8E+04	3.2E+08	1.2E+04	3.2E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	3.4E+10	1.2E+05	2.4E+10	7.5E+04	1.9E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	3.0E+08	2.0E+06	2.3E+08	1.3E+06	2.8E+08
CE 141	5.2E+05	1.4E+07	5.4E+05	4.2E+08	6.1E+05	5.5E+08	3.6E+05	5.2E+08
CE 144	9.8E+06	7.0E+07	1.2E+07	1.0E+10	1.3E+07	1.3E+10	7.8E+06	1.1E+10
I 131	1.5E+07	1.7E+07	1.6E+07	4.8E+10	1.5E+07	3.1E+10	1.2E+07	3.8E+10
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	8.1E+08	2.9E+06	4.6E+08	2.2E+06	5.3E+08
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	1.2E+07	6.2E+05	8.2E+06	4.5E+05	9.1E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	3.5E+09	1.2E+06	2.6E+09	8.6E+05	2.0E+09

TABLE 1-3
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'R'

PATHWAY: SAN ONOFRE III HOUSING DISTANCE: 1.3 MILES

X/Q : 5.2E-07 SEC/(M**3) D/Q : 3.0E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	6.5E+02	0.0E+00	1.1E+03	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	1.3E+04	4.7E+06	1.7E+04	4.7E+06	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	1.0E+06	1.4E+09	1.6E+06	1.4E+09	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	4.9E+03	3.4E+08	1.3E+04	3.4E+08	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	7.8E+05	3.8E+08	1.1E+06	3.8E+08	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	4.5E+06	2.2E+10	7.1E+06	2.2E+10	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	2.0E+06	2.2E+04	2.2E+06	2.2E+04	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	1.1E+07	0.0E+00	1.5E+07	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	1.8E+06	2.5E+08	2.2E+06	2.5E+08	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	4.8E+05	1.4E+08	6.1E+05	1.4E+08	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	5.5E+05	1.1E+08	6.6E+05	1.1E+08	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	1.7E+06	2.0E+07	1.8E+06	2.0E+07	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	8.0E+04	6.8E+09	1.2E+05	6.8E+09	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	1.2E+04	1.5E+08	1.5E+04	1.5E+08	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	7.1E+04	1.0E+10	1.0E+05	1.0E+10	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	1.6E+06	2.1E+07	1.7E+06	2.1E+07	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	5.2E+05	1.4E+07	5.4E+05	1.4E+07	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	9.8E+06	7.0E+07	1.2E+07	7.0E+07	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	1.5E+07	1.7E+07	1.6E+07	1.7E+07	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	1.7E+05	1.2E+06	1.9E+05	1.2E+06	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	3.6E+06	2.4E+06	3.8E+06	2.4E+06	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	4.5E+04	4.5E+05	5.1E+04	4.5E+05	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	7.0E+05	2.5E+06	7.9E+05	2.5E+06	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	6.5E+05	7.5E+08	1.0E+06	7.5E+08	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-3
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'R'

PATHWAY: DEER CONSUMER/HUNTER DISTANCE: 1.8 MILES

X/Q : 3.1E-07 SEC/(M**3) D/Q : 2.0E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	1.5E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	1.7E+02	2.4E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	1.6E+04	1.9E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	3.6E+02	1.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	1.1E+04	4.1E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	6.9E+04	3.8E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	1.6E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	1.1E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	2.1E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	5.9E+03	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	5.9E+03	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	1.4E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	1.1E+03	2.3E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	1.4E+02	7.2E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	8.7E+02	2.3E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	1.5E+04	7.0E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	4.2E+03	4.0E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	9.0E+04	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	1.4E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.4E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	2.5E+04	2.8E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E+02	5.2E+03
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	5.2E+03	2.9E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.0E+04	1.3E+08

TABLE 1-4
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'A'

PATHWAY: DEER CONSUMER/HUNTER   DISTANCE: 1.8 MILES

X/Q : .2.1E-07 SEC/(M**3)   D/Q : 1.5E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	1.5E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	1.7E+02	2.4E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	1.6E+04	1.9E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	3.6E+02	1.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	1.1E+04	4.1E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	6.9E+04	3.8E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	1.6E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	1.1E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	2.1E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	5.9E+03	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	5.9E+03	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	1.4E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	1.1E+03	2.3E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	1.4E+02	7.2E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	8.7E+02	2.3E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	1.5E+04	7.0E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	4.2E+03	4.0E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	9.0E+04	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	1.4E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.4E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	2.5E+04	2.8E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E+02	5.2E+03
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	5.2E+03	2.9E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.0E+04	1.3E+08

TABLE 1-4
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'A'

PATHWAY: CAMP SAN MATEO RES DISTANCE: 3.6 MILES

X/Q : 7.2E-08 SEC/(M**3) D/Q : 4.1E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-4
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'A'

PATHWAY: CAMP SAN MATEO MP DISTANCE: 3.6 MILES

X/Q : 7.2E-08 SEC/(M**3) D/Q : 4.1E-10 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-5
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'B'

PATHWAY: DEER CONSUMER/HUNTER DISTANCE: 1.6 MILES

X/Q : 2.0E-07 SEC/(M**3) D/Q : 1.8E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	1.5E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	1.7E+02	2.4E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	1.6E+04	1.9E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	3.6E+02	1.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	1.1E+04	4.1E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	6.9E+04	3.8E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	1.6E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	1.1E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	2.1E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	5.9E+03	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	5.9E+03	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	1.4E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	1.1E+03	2.3E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	1.4E+02	7.2E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	8.7E+02	2.3E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	1.5E+04	7.0E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	4.2E+03	4.0E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	9.0E+04	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	1.4E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.4E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	2.5E+04	2.8E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E+02	5.2E+03
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	5.2E+03	2.9E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.0E+04	1.3E+08

TABLE 1-5
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'B'

PATHWAY: SANITARY LANDFILL   DISTANCE: 2.1 MILES

X/Q : 1.3E-07 SEC/(M**3)   D/Q : 1.1E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	4.3E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+05	1.3E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+03	3.2E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E+04	3.5E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E+05	2.0E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+05	2.0E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.9E+05	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+05	2.3E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.7E+04	1.3E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.7E+04	1.0E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+05	1.8E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+03	6.4E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+03	1.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.0E+03	9.6E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	1.9E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E+04	1.3E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+05	6.5E+06
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+06	1.6E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+04	1.2E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	2.3E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+03	4.2E+04
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E+04	2.3E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.1E+04	6.9E+07

TABLE 1-6
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'C'

PATHWAY: SEWAGE TREAT.FACILITY DISTANCE: 2.2 MILES

X/Q : 1.3E-07 SEC/(M**3) D/Q : 1.2E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-6
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'C'

PATHWAY: CAMP SAN ONOFRE FR.STN DISTANCE: 2.4 MILES

X/Q : 1.1E-07 SEC/(M**3) D/Q : 1.0E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+04	4.7E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	1.4E+09
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E+04	3.4E+08
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.3E+05	3.8E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E+06	2.2E+10
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	2.2E+04
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	2.5E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E+05	1.4E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E+05	1.1E+08
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06	2.0E+07
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.8E+04	6.8E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+04	1.5E+08
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E+04	1.0E+10
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	2.1E+07
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E+05	1.4E+07
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E+06	7.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+07	1.7E+07
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+05	1.2E+06
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	2.4E+06
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+04	4.5E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E+05	2.5E+06
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E+05	7.5E+08

TABLE 1-6
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'C'

PATHWAY: CAMP SAN ONOFRE barr   DISTANCE: 2.6 MILES

X/Q : 9.7E-08 SEC/(M**3)   D/Q : 8.9E-10 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-7
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'C'

PATHWAY: DEER CONSUMER/HUNTER DISTANCE: 3.0 MILES

X/Q : 7.8E-08 SEC/(M**3) D/Q : 6.8E-10 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	2.8E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	3.2E+02	2.9E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	3.1E+04	3.4E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	7.0E+02	2.1E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	2.1E+04	4.5E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	1.3E+05	6.2E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	3.1E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	2.2E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	4.0E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	1.1E+04	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	1.1E+04	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	2.8E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	2.2E+03	3.0E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	2.7E+02	8.8E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	1.7E+03	3.5E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	2.8E+04	7.2E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	8.1E+03	4.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	1.7E+05	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	2.7E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+03	2.8E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	4.8E+04	5.5E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E+02	1.0E+04
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	1.0E+04	5.6E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.9E+04	1.4E+08

TABLE 1-7
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'D'

PATHWAY: CAMP SAN ONOFRE barr DISTANCE: 3.0 MILES

X/Q : 6.9E-08 SEC/(M**3) D/Q : 7.2E-10 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-8
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'E'

PATHWAY: DEER CONSUMER/HUNTER DISTANCE: .8 MILES

X/Q : 7.1E-07 SEC/(M**3) D/Q : 1.1E-08 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	2.8E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	3.2E+02	2.9E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	3.1E+04	3.4E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	7.0E+02	2.1E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	2.1E+04	4.5E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	1.3E+05	6.2E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	3.1E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	2.2E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	4.0E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	1.1E+04	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	1.1E+04	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	2.8E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	2.2E+03	3.0E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	2.7E+02	8.8E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	1.7E+03	3.5E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	2.8E+04	7.2E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	8.1E+03	4.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	1.7E+05	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	2.7E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+03	2.8E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	4.8E+04	5.5E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E+02	1.0E+04
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	1.0E+04	5.6E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.9E+04	1.4E+08

TABLE 1-8
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'E'

PATHWAY: CAMP HORNO MOTOR POOL DISTANCE: 4.0 MILES

X/Q : 7.7E-08 SEC/(M**3) D/Q : 7.5E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.1E+03	1.3E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	3.9E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.0E+03	9.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+05	1.1E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+06	6.1E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	6.2E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E+05	7.2E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+05	3.9E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+05	3.1E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E+05	5.6E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+04	1.9E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E+03	4.3E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+04	2.9E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E+05	5.9E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	3.9E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	2.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E+06	4.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+04	3.5E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E+05	7.0E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.5E+03	1.3E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+05	7.2E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E+05	2.1E+08

TABLE 1-8
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'E'

PATHWAY: CAMP HORNO   DISTANCE: 4.1 MILES

X/Q : 7.5E-08 SEC/(M**3)   D/Q : 7.2E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	0.0E+00	1.3E+03	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+04	4.7E+06	1.4E+04	4.7E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	1.4E+09	1.4E+06	1.4E+09
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E+04	3.4E+08	3.1E+04	3.4E+08
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	3.8E+08	9.3E+05	3.8E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.7E+06	2.2E+10	6.0E+06	2.2E+10
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E+06	2.2E+04	1.4E+06	2.2E+04
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+07	0.0E+00	9.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	2.5E+08	1.8E+06	2.5E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E+05	1.4E+08	5.0E+05	1.4E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E+05	1.1E+08	5.0E+05	1.1E+08
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.0E+07	1.2E+06	2.0E+07
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	6.8E+09	9.8E+04	6.8E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+04	1.5E+08	1.2E+04	1.5E+08
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	1.0E+10	7.5E+04	1.0E+10
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.1E+07	1.3E+06	2.1E+07
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E+05	1.4E+07	3.6E+05	1.4E+07
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+07	7.0E+07	7.8E+06	7.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+07	1.7E+07	1.2E+07	1.7E+07
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	1.2E+06	1.1E+05	1.2E+06
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+06	2.4E+06	2.2E+06	2.4E+06
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+04	4.5E+05	3.0E+04	4.5E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E+05	2.5E+06	4.5E+05	2.5E+06
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06	7.5E+08	8.6E+05	7.5E+08

TABLE 1-9
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'F'

PATHWAY: SO ST. PK./GUARD SHACK DISTANCE: .8 MILES

X/Q : 8.1E-07 SEC/(M**3) D/Q : 7.0E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E+03	8.0E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E+05	2.4E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.4E+03	5.9E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+05	6.5E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+06	3.7E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E+05	3.7E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+05	4.3E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E+04	2.3E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E+04	1.9E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	3.4E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	1.2E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+03	2.6E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+04	1.8E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+05	3.5E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E+04	2.3E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	1.2E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+06	2.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+04	2.1E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+05	4.2E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E+03	7.7E+04
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E+04	4.3E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+05	1.3E+08

TABLE 1-9
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'F'

PATHWAY: DEER CONSUMER/HUNTER DISTANCE: 1.5 MILES

X/Q : 3.6E-07 SEC/(M**3) D/Q : 2.8E-09 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	2.8E+01	0.0E+00	2.3E+01	2.4E+01	3.9E+01
CR 51	0.0E+00	0.0E+00	0.0E+00	5.0E+04	0.0E+00	1.0E+05	2.8E+02	2.8E+05
MN 54	0.0E+00	0.0E+00	0.0E+00	7.7E+05	0.0E+00	1.4E+06	2.7E+04	2.9E+07
CO 57	0.0E+00	0.0E+00	0.0E+00	4.6E+06	0.0E+00	8.0E+06	6.0E+02	2.0E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00	1.9E+07	1.8E+04	4.4E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	3.6E+07	0.0E+00	7.2E+07	1.1E+05	5.5E+08
SR 89	0.0E+00	0.0E+00	0.0E+00	4.9E+07	0.0E+00	2.6E+07	2.7E+04	3.1E+07
SR 90	0.0E+00	0.0E+00	0.0E+00	1.0E+09	0.0E+00	8.0E+08	1.8E+05	1.2E+09
ZR 95	0.0E+00	0.0E+00	0.0E+00	6.2E+07	0.0E+00	1.1E+08	3.4E+04	2.0E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	2.3E+08	0.0E+00	4.5E+08	9.6E+03	8.2E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	4.2E+08	0.0E+00	7.5E+08	9.6E+03	1.3E+09
TE 129M	0.0E+00	0.0E+00	0.0E+00	5.9E+08	0.0E+00	4.5E+08	2.4E+04	5.3E+08
CS 134	0.0E+00	0.0E+00	0.0E+00	1.4E+08	0.0E+00	1.2E+08	1.9E+03	2.8E+08
CS 136	0.0E+00	0.0E+00	0.0E+00	5.1E+06	0.0E+00	4.2E+06	2.3E+02	8.3E+06
CS 137	0.0E+00	0.0E+00	0.0E+00	1.2E+08	0.0E+00	9.3E+07	1.4E+03	3.1E+08
BA 140	0.0E+00	0.0E+00	0.0E+00	5.0E+06	0.0E+00	4.2E+06	2.4E+04	7.2E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	1.5E+06	0.0E+00	2.4E+06	6.9E+03	4.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	1.8E+07	0.0E+00	2.9E+07	1.5E+05	4.8E+07
I 131	0.0E+00	0.0E+00	0.0E+00	6.5E+08	0.0E+00	4.3E+08	2.3E+05	5.9E+08
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+03	2.4E+04
I 133	0.0E+00	0.0E+00	0.0E+00	1.6E+01	0.0E+00	8.6E+00	4.1E+04	4.7E+04
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.7E+02	8.6E+03
I 135	0.0E+00	0.0E+00	0.0E+00	1.1E-15	0.0E+00	6.3E-16	8.6E+03	4.8E+04
UN-ID*	0.0E+00	0.0E+00	0.0E+00	1.1E+08	0.0E+00	9.4E+07	1.7E+04	1.4E+08

TABLE 1-9
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'F'

PATHWAY: BORDER PATROL CHECKPT. DISTANCE: 1.9 MILES

X/Q : 2.6E-07 SEC/(M**3) D/Q : 1.9E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-10
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'G'

PATHWAY: SAN ONOFRE BCH CAMPGD   DISTANCE: 1.8 MILES

X/Q : 2.3E-07 SEC/(M**3)   D/Q : 1.0E-09 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	5.3E+01	0.0E+00	9.2E+01	0.0E+00	1.0E+02	0.0E+00	1.0E+02	0.0E+00
CR 51	1.1E+03	3.8E+05	1.4E+03	3.8E+05	1.7E+03	3.8E+05	1.2E+03	3.8E+05
MN 54	8.2E+04	1.1E+08	1.3E+05	1.1E+08	1.6E+05	1.1E+08	1.2E+05	1.1E+08
CO 57	4.0E+02	2.8E+07	1.1E+03	2.8E+07	2.6E+03	2.8E+07	2.6E+03	2.8E+07
CO 58	6.4E+04	3.1E+07	9.1E+04	3.1E+07	1.1E+05	3.1E+07	7.6E+04	3.1E+07
CO 60	3.7E+05	1.8E+09	5.8E+05	1.8E+09	7.2E+05	1.8E+09	4.9E+05	1.8E+09
SR 89	1.7E+05	1.8E+03	1.8E+05	1.8E+03	2.0E+05	1.8E+03	1.2E+05	1.8E+03
SR 90	9.2E+05	0.0E+00	1.2E+06	0.0E+00	1.4E+06	0.0E+00	7.9E+05	0.0E+00
ZR 95	1.4E+05	2.1E+07	1.8E+05	2.1E+07	2.2E+05	2.1E+07	1.5E+05	2.1E+07
NB 95	3.9E+04	1.1E+07	5.0E+04	1.1E+07	6.2E+04	1.1E+07	4.1E+04	1.1E+07
RU 103	4.5E+04	8.9E+06	5.4E+04	8.9E+06	6.4E+04	8.9E+06	4.1E+04	8.9E+06
TE 129M	1.4E+05	1.6E+06	1.4E+05	1.6E+06	1.6E+05	1.6E+06	1.0E+05	1.6E+06
CS 134	6.5E+03	5.6E+08	9.9E+03	5.6E+08	1.2E+04	5.6E+08	8.0E+03	5.6E+08
CS 136	9.7E+02	1.2E+07	1.2E+03	1.2E+07	1.5E+03	1.2E+07	9.9E+02	1.2E+07
CS 137	5.9E+03	8.5E+08	8.5E+03	8.5E+08	9.9E+03	8.5E+08	6.2E+03	8.5E+08
BA 140	1.3E+05	1.7E+06	1.4E+05	1.7E+06	1.7E+05	1.7E+06	1.0E+05	1.7E+06
CE 141	4.2E+04	1.1E+06	4.5E+04	1.1E+06	5.0E+04	1.1E+06	3.0E+04	1.1E+06
CE 144	8.1E+05	5.7E+06	9.8E+05	5.7E+06	1.1E+06	5.7E+06	6.4E+05	5.7E+06
I 131	1.2E+06	1.4E+06	1.3E+06	1.4E+06	1.2E+06	1.4E+06	9.8E+05	1.4E+06
I 132	1.4E+04	1.0E+05	1.6E+04	1.0E+05	1.2E+04	1.0E+05	9.4E+03	1.0E+05
I 133	2.9E+05	2.0E+05	3.2E+05	2.0E+05	2.4E+05	2.0E+05	1.8E+05	2.0E+05
I 134	3.7E+03	3.7E+04	4.2E+03	3.7E+04	3.2E+03	3.7E+04	2.5E+03	3.7E+04
I 135	5.7E+04	2.1E+05	6.5E+04	2.1E+05	5.1E+04	2.1E+05	3.7E+04	2.1E+05
UN-ID*	5.3E+04	6.1E+07	8.2E+04	6.1E+07	1.0E+05	6.1E+07	7.1E+04	6.1E+07

TABLE 1-10
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'G'

PATHWAY: HWY PATROL WEIGH STN   DISTANCE: 2.1 MILES

X/Q : 1.8E-07 SEC/(M**3)   D/Q : 7.5E-10 /M**(2)

RADIO-	INFANT		CHILD		TEEN		ADULT	
NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E+03	1.1E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	3.2E+08
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E+03	7.8E+07
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E+05	8.7E+07
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	4.9E+09
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E+05	4.9E+03
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E+05	5.7E+07
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	3.1E+07
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+05	2.5E+07
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E+05	4.5E+06
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+04	1.6E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+03	3.4E+07
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+04	2.3E+09
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E+05	4.7E+06
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E+04	3.1E+06
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	1.6E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E+06	3.9E+06
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E+04	2.8E+05
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E+05	5.6E+05
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E+03	1.0E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+05	5.8E+05
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+05	1.7E+08

TABLE 1-10
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'G'

PATHWAY: ENDLS SUM SURFCAMP/RES DISTANCE: 2.8 MILES

X/Q : 1.2E-07 SEC/(M**3) D/Q : 4.5E-10 /M**(2)

	INFANT		CHILD		TEEN		ADULT	
RADIO-NUCLIDE	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	INHALATION (MREM/YR PER UCI/M3)	FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	4.6E+01	0.0E+00	5.2E+01	0.0E+00	4.2E+02	0.0E+00
CR 51	0.0E+00	0.0E+00	7.0E+02	1.9E+05	8.6E+02	1.9E+05	4.7E+03	1.5E+06
MN 54	0.0E+00	0.0E+00	6.5E+04	5.7E+07	8.2E+04	5.7E+07	4.6E+05	4.5E+08
CO 57	0.0E+00	0.0E+00	5.4E+02	1.4E+07	1.3E+03	1.4E+07	1.0E+04	1.1E+08
CO 58	0.0E+00	0.0E+00	4.5E+04	1.6E+07	5.5E+04	1.6E+07	3.1E+05	1.2E+08
CO 60	0.0E+00	0.0E+00	2.9E+05	8.8E+08	3.6E+05	8.8E+08	2.0E+06	7.1E+09
SR 89	0.0E+00	0.0E+00	8.9E+04	8.9E+02	9.9E+04	8.9E+02	4.6E+05	7.1E+03
SR 90	0.0E+00	0.0E+00	6.1E+05	0.0E+00	6.8E+05	0.0E+00	3.2E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	9.2E+04	1.0E+07	1.1E+05	1.0E+07	5.8E+05	8.3E+07
NB 95	0.0E+00	0.0E+00	2.5E+04	5.6E+06	3.1E+04	5.6E+06	1.7E+05	4.5E+07
RU 103	0.0E+00	0.0E+00	2.7E+04	4.5E+06	3.2E+04	4.5E+06	1.7E+05	3.6E+07
TE 129M	0.0E+00	0.0E+00	7.2E+04	8.1E+05	8.1E+04	8.1E+05	4.1E+05	6.5E+06
CS 134	0.0E+00	0.0E+00	5.0E+03	2.8E+08	6.0E+03	2.8E+08	3.2E+04	2.2E+09
CS 136	0.0E+00	0.0E+00	6.0E+02	6.2E+06	7.3E+02	6.2E+06	3.9E+03	4.9E+07
CS 137	0.0E+00	0.0E+00	4.3E+03	4.2E+08	5.0E+03	4.2E+08	2.5E+04	3.4E+09
BA 140	0.0E+00	0.0E+00	7.2E+04	8.4E+05	8.4E+04	8.4E+05	4.2E+05	6.8E+06
CE 141	0.0E+00	0.0E+00	2.2E+04	5.6E+05	2.5E+04	5.6E+05	1.2E+05	4.5E+06
CE 144	0.0E+00	0.0E+00	4.9E+05	2.9E+06	5.5E+05	2.9E+06	2.6E+06	2.3E+07
I 131	0.0E+00	0.0E+00	6.7E+05	7.1E+05	6.0E+05	7.1E+05	3.9E+06	5.7E+06
I 132	0.0E+00	0.0E+00	8.0E+03	5.1E+04	6.2E+03	5.1E+04	3.8E+04	4.1E+05
I 133	0.0E+00	0.0E+00	1.6E+05	1.0E+05	1.2E+05	1.0E+05	7.1E+05	8.1E+05
I 134	0.0E+00	0.0E+00	2.1E+03	1.8E+04	1.6E+03	1.8E+04	9.8E+03	1.5E+05
I 135	0.0E+00	0.0E+00	3.3E+04	1.0E+05	2.6E+04	1.0E+05	1.5E+05	8.3E+05
UN-ID*	0.0E+00	0.0E+00	4.1E+04	3.1E+07	5.1E+04	3.1E+07	2.8E+05	2.5E+08

TABLE 1-10
UNITS 2&3

DOSE PARAMETER R(I) FOR SECTOR 'G'

PATHWAY: STATE PARK HOST DISTANCE: 2.9 MILES

X/Q : 1.1E-07 SEC/(M**3) D/Q : 4.2E-10 /M**(2)

RADIO-NUCLIDE	INFANT INHALATION (MREM/YR PER UCI/M3)	INFANT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	CHILD INHALATION (MREM/YR PER UCI/M3)	CHILD FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	TEEN INHALATION (MREM/YR PER UCI/M3)	TEEN FOOD & GROUND (M2.MREM/YR PER UCI/SEC)	ADULT INHALATION (MREM/YR PER UCI/M3)	ADULT FOOD & GROUND (M2.MREM/YR PER UCI/SEC)
H 3**	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	0.0E+00
CR 51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+04	4.7E+06
MN 54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	1.4E+09
CO 57	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E+04	3.4E+08
CO 58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.3E+05	3.8E+08
CO 60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E+06	2.2E+10
SR 89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E+06	2.2E+04
SR 90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.6E+06	0.0E+00
ZR 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+06	2.5E+08
NB 95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E+05	1.4E+08
RU 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E+05	1.1E+08
TE 129M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+06	2.0E+07
CS 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.8E+04	6.8E+09
CS 136	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+04	1.5E+08
CS 137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E+04	1.0E+10
BA 140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+06	2.1E+07
CE 141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E+05	1.4E+07
CE 144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E+06	7.0E+07
I 131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+07	1.7E+07
I 132	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E+05	1.2E+06
I 133	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E+06	2.4E+06
I 134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+04	4.5E+05
I 135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E+05	2.5E+06
UN-ID*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E+05	7.5E+08

Enclosure 4

Offsite Dose Calculation Manual
Nuclear Organization
San Onofre Nuclear Generation Station (SONGS)
Appendix B,
Supplemental Information for Effluent Controls
SO123-ODCM-B, Revision 9, August 2016

OFFSITE DOSE CALCULATION MANUAL

NUCLEAR ORGANIZATION

SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)

APPENDIX B

SUPPLEMENTAL INFORMATION FOR EFFLUENT CONTROLS

ODCM APPENDIX B

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ODCM APPENDIX B

TABLE OF CONTENTS

TABLE 1-1
UNITS 2 & 3 DOSE PARAMETER R; FOR SECTOR P

Apri1 23, 1993

TO: DARYL DICK, SONGS Effluent Engineering

SUBJECT: RECOMMENDED EFFLUENT CONCENTRATION FROM 10CFR20 APPENDIX B, TABLE 2, FOR SETPOINT CALCULATIONS

Daryl,

I have indicated on the attached table which effluent concentration limits (ECLs) are recommended for use when calculating radiation monitor setpoint values for liquid and airborne radioactive effluent releases from SONGS.

For simplicity's sake, when the station implements the new 10CFR20, ECLs should be used exclusively. In cases where more than one value is listed (based on retention) in Appendix B, Table 2, the most conservative value is recommended for routine calculations. Under conditions which require more flexibility, actual chemical and physical characteristics of the release stream may be considered to allow use of a more representative value. It is recommended that each of these instances be documented. Since no ECLs are provided in Column 2 for dissolved and entrained gases in liquids, per NUREG 1301, ·Offsite Dose Calculation manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors·, Specification 3.11.1.1, a value of 2E-4 uCi/ml should be used.

If there are any questions, please call me at 50512.

Kathleen Yhip
HPE Engineer

cc: HPE Files

TABLE 1-1
UNITS 2 & 3 DOSE PARAMETER R; FOR SECTOR P

GAS AND LIQUID EFFLUENT CONCENTRATION LIMIT (ECI) VALUES						
	ISOTOPE	GAS ECL	GAS MPC	ISOTOPE	LIQUID ECL	LIQUID MPC
		(ECL)	(MPC)		(ECL)	(MPC)
1	H-3	1E-7	2E-7	H-3	1E-3	3E-3
2	Na-24	7E-9	5E-9	Na-24	5E-5	3E-5
3	Ar-41	1E-8	4E-8	Ar-41		2E-4
4	Sc-46	3E-10	8E-10	Sc-46	1E-5	4E-5
5	Cr-51	6E-8 d 3E-8 w, a	8E-8	Cr-51	5E-4	2E-3
6	Mn-54	1E-9	1E-9	Mn-54	3E-5	1E-4
7	Mn-56	2E-8 d 3E-8 w	2E-8	Mn-56	7E-5	1E-4
8	Fe-55	3E-9 d 6E-9 w	3E-8	Fe-55	1E-4	8E-4
9	Fe-59	5E-10 d 7E-10 w	2E-9	Fe-59	1E-5	5E-5
10	Co-57	4E-9 w 9E-10 a	6E-9	Co-57	6E-5	4E-4
11	Co-58	2E-9 w 1E-9 a	2E-9	Co-58	2E-5	9E-5
12	Co-60	2E-10 w 5E-11 a	3E-10	Co-60	3E-6	3E-5
13	Cu-64	4E-8 d 3E-8 w, a	4E-8	Cu-64	2E-4	2E-4
14	Zn-65	4E-10	2E-9	Zn-65	5E-6	1E-4
15	Br-82	6E-9 d 5E-9 w	6E-9	Br-82	4E-5	4E-5
16	Br-84	8E-8 d 9E-8 w	3E-8	Br-84	4E-4	2E-4
17	Kr-85	7E-7	3E-7	Kr-85		2E-4
18	Kr-85m	1E-7	1E-7	Kr-85m		2E-4
19	Kr-87	2E-8	2E-8	Nr-87		2E-4
20	Kr-88	9E-8	2E-8	Kr-88		2E-4
21	Rb-88	9E-8	2E-4	Rb-88	4E-4	2E-4

GAS AND LIQUID EFFLUENT CONCENTRATION LIMIT (ECl) VALUES						
	ISOTOPE	GAS ECL	GAS MPC	ISOTOPE	LIQUID ECL	LIQUID MPC
		(ECL)	(MPC)		(ECL)	(MPC)
22	Rb-89	2E-7	2E-4	Rb-89	9E-4	2E-4
23	Sr-89	1E-9 d 2E-10 a	3E-10	Sr-89	8E-6	3E-6
24	Sr-90	3E-11 d 6E-12 a	3E-11	Sr-90	5E-7	3E-7
25	Sr-91	8E-9 d 5E-9 a	9E-9	Sr-91	2E-5	5E-5
26	Sr-92	1E-8 d 9E-8 a	1E-8	Sr-92	4E-5	6E-5
27	Y-90	9E10	3E-9	Y-90	7E-6	2E-5
28	Y-91m	3E-7 w 2E-7 a	6E-7	Y-91m	2E-3	3E-3
29	Y-92	1E-8	1E-8	Y-92	4E-5	6E-5
30	Zr-95	4E-10 d, a 5E-10 w	1E-9	Zr-95	2E-5	6E-5
31	Zr-97	3E-9 d 2E-9 w, a	3E-9	Zr-97	9E-6	2E-5
32	Nb-95	2E-9	3E-9	Nb-95	3E-5	1E-4
33	Nb-95m	4E-9 w 3E-9 a	1E-10	Nb-95m	3E-5	3E-6
34	Nb-97	1E-7	2E-7	Nb-97	3E-4	9E-4
35	Mo-99	4E-9 d 2E-9 a	7E-9	Mo-99	2E-5	4E-5
36	Tc-99m	2E-7 d 3E-7 w	5E-7	Tc-99m	1E-3	3E-3
37	Ru-103	2E-9 d 1E-9 w 9E-10 a	3E-9	Ru-103	3E-5	8E-5
38	Ru-106	1E-10 d 8e-11 w 2E-11 a	2E-10	Ru-106	3E-6	1E-5
39	Ag-110m	2E-10 d 3E-10 w 1E-10 a	3E-10	Ag-110m	6E-6	3E-5
40	Sn-113	2E-9 d 8E-10 w	2E-9	Sn-113	3E-5	9E-5

GAS AND LIQUID EFFLUENT CONCENTRATION LIMIT (ECl) VALUES						
	ISOTOPE	GAS ECL	GAS MPC	ISOTOPE	LIQUID ECL	LIQUID MPC
		(ECL)	(MPC)		(ECL)	(MPC)
41	Sn-117m	3E-9 d 2E-9 w	1E-10	Sn-117m	3E-5	3E-6
42	Sb-122	3E-9 d 2E-9 w	5E-9	Sb-122	1E-5	3E-5
43	Sb-124	1E-9 d 3E-10 w	7E-10	Sb-124	7E-6	2E-5
44	Sb-125	3E-9 d 7E-10 w	9E-10	Sb-125	3E-5	1E-4
45	Xe-131m	2E-6	4E-7	Xe-131m		2E-4
46	Xe-133	5E-7	3E-7	Xe-133		2E-4
47	Xe-133m	6E-7	3E-7	Xe-133m		2E-4
48	Xe-135	7E-8	1E-7	Xe135		2E-4
49	Xe-135m	4E-8	3E-8	Xe-135m		2E-4
50	Xe-138	2E-8	3E-8	Xe138		2E-4
51	Te-129m	9E-10 d 3E-10 w	1E-9	Te-129m	7E-6	2E-5
52	Te-132	1E-9 d 9E-10	4E-9	Te-132	9E-6	2E-5
53	I-131	2E-10	1E-10	I-131	1E-6	3E-7
54	I-132	2E-8	3E-9	I-132	1E-4	8E-6
55	I-133	1E-9	4E-10	I-133	7E-6	1E-6
56	I-134	6E-8	6E-9	I-134	4E-4	2E-5
57	I-135	6E-9	1E-9	I-135	3E-5	4E-6
58	Cs-134	2E-10	4E-10	Cs-134	9E-7	9E-6
59	Cs-136	9E-10	6E-9	Cs-136	6E-6	6E-5
60	Cs-137	2E-10	5E-10	Cs-137	1E-6	2E-5
61	Cs-138	8E-8	3E-8	Cs-138	4E-4	2E-4
62	Ba-139	4E-8	3E-8	Ba-139	2E-4	2E-4
63	Ba-140	2E-9	1E-9	Ba-140	8E-6	2E-5
64	La-140	2E-9	4E-9	La-140	9E-6	2E-5
65	Ce-141	1E-9 w 8E-10 a	5E-9	Ce-141	3E-5	9E-5

GAS AND LIQUID EFFLUENT CONCENTRATION LIMIT (ECl) VALUES						
	ISOTOPE	GAS ECL	GAS MPC	ISOTOPE	LIQUID ECL	LIQUID MPC
		(ECL)	(MPC)		(ECL)	(MPC)
66	Ce-143	3E-9 w 2E-9 a	7E-9	Ce-143	2E-5	4E-5
67	Ce-144	4E-11 w 2E-11 a	2E-10	Ce-144	3E-6	1E-5
68	Nd-147	1E-9	8E-9	Nd-147	2E-5	6E-5
69	W-187	1E-8	1E-8	W-187	3E-5	6E-5
70	Np-239	3E-9	2E-8	Np-239	2E-5	1E-4
71	ALPHA	1E-15	2E-14	ALPHA	2E-9	3E-8

June 14, 1993

J. CLARK
P. KNAPP

SUBJECT: Impact of new 10 CFR 20 upon SONGS Effluent Control Limits

INTRODUCTION

The New 10 CFR 20 is mandated to be implemented by all licensees by January 1, 1994. Unit 1 Technical Specification (T5) 6.B.4.f. (2) AND (7) and Units 2 and 3 TS 6.8.4.e. (2) and (7) require programs which set limits on concentrations of liquid and gaseous releases from the site according to 10 CFR 20 Appendix B, Table II. Questions have been asked of licensing regarding the effect of the new regulation upon SONGS Effluent Control Limits, and if it is necessary to revise the TS prior to implementation of the new rule.

EXECUTIVE SUMMARY

Licensing has reviewed the applicable TS and the new 10 CFR 20. As a result of the above, Licensing has concluded that SCE is not required to obtain amendments to the TS as a result of implementation of the revised Part 20. The new Part 20 permits the existing TS cited above to be amended at any time SCE deems appropriate.

The above conclusion is in agreement with the position presented to NRC Staff by NUMARC during a meeting earlier this month. Preliminary comments from the NRC staff indicate their concurrence. The NRC is expected to issue meeting minutes by mid-June, showing their concurrence.

LICENSING ISSUE

Revised Part 20 [20.1008) (b)] generally requires that the license condition and TS references to the old Part 20, Sections 20.1-20.601 should be considered to have been replaced by comparable references to the new Part 20, Sections 20.1001-20.2401. The revised Part 20 [20.1008(c)] requires that any TS that is more restrictive than a requirement in the revised Part 20 remains in force until there is a TS change through a license amendment.

The limit on annually averaged radioactivity concentrations in effluents to unrestricted areas, which is a requirement in the old Part 20 (20.106), has been changed to an optional method [20.1302(b)(2)(i)] of demonstrating compliance with the annual dose limit specified in 20.1301 and is no longer ITSELF a requirement in the revised Part 20.

SONGS TS require that effluent concentrations be maintained below the indicated level at all times. "At all times" is reasonably accepted as meaning that averaging beyond instrument response times is not permitted. The revised Part 20 contains NO comparable "at all times" concentration limit.

The SONGS TS, by not permitting any arbitrary averaging period, are therefore MORE RESTRICTIVE than the revised part 20 limits.

Accordingly, since the SONGS TS are more restrictive than the revised Part 20, the provision of 20.1008(c) applies, with the result that the TS remains in effect, as is, until it is revised, or the license is renewed. With this conclusion, SONGS may exercise any of the following options:

1. NOT request any TS changes, with the result that SONGS must still establish setpoints in accordance with 10 CFR 20, Appendix B, Table II.

2. Request an amendment to section 6.8.4 changing the reference to the "revised" Part 20, Appendix B, Table 2.

3. Request an amendment to the Tech Specs of units 2/3, and NOT of 1, or vice versa.

4. Upon approval by the NRC, implement any of the above Tech Spec changes irrespective of the implementation date of the revised 10 CFR 20.

This memo does not intend to say that any requirements of 10 CFR 20 and 40 CFR 190 are invalid, including those limits pertaining to dose to members of the public, and applicable survey methods to confirm conformance with those limits.

E. S. MEDLING

cc: W. Marsh
D. Dick
S. Hetterick
P. Chang
L. Bray
NLFS
CDM

MEMORANDUM FOR FILE

September 10, 1997

SUBJECT: Radiological Environmental Monitoring Program Bases

REFERENCES:

1. Letter from Jack B. Moore, SCE to US Atomic Energy Commission, Proposed Environmental Technical Specifications, February 21, 1974.
2. Memorandum from E. S. Medling to D. F. Pilmer, Environmental Air Sampler Placement, October 28, 1983.
3. Memorandum from M. Goeders to E. S. Medling, Air Sampler Location Determination, August 22, 1988.
4. Memorandum from R. M. Rosenblum to H. W. Newton, Reassessment of the REMP Locations, October 28, 1992.
5. Memorandum from M. Goeders to E. M. Goldin, Bases for Selection of REMP Sample Locations, February 28, 1994.
6. Updated Final Safety Analysis Report, San Onofre Nuclear Generating Station Units 2/3. Page 2.3H-1 (Appendix 2.3H).
7. UFSAR/UFHA Change Request No. SAR23-581. Add 1979-1983 meteorological data to the UFSAR.
8. Letter from K. P. Baskin, SCE to US Nuclear Regulatory Commission, February 26, 1982.
9. Final Environmental Statement, San Onofre Nuclear Generating Station Units 2 and 3, NUREG-0490, US Nuclear Regulatory Commission, 1981.
10. Final Environmental Statement, San Onofre Nuclear Generating Station Unit 1, US Atomic Energy Commission, 1973.
11. Environmental Report - Operating License Stage, San Onofre Nuclear Generating Station, Sections 6.1 and 6.2.

12. Letter from H. L Ottoson, SCE to Joseph O. Ward, California Department of Health, Proposed Radiological Environmental Monitoring Program, May 19, 1976.

13. Letter from Edgar D. Bailey, California Department of Health Services to Eric M. Goldin, SCE, Environmental Radiation Monitoring, February 10,1993.

14. Memorandum from M. Goeders to E. M. Goldin, Modification of SONGS Radiological Environmental Monitoring (REM) Sample Analysis Program, November 25, 1992.

15. Memorandum from E. M. Goldin to M. J. Johnson, Deletion of Unnecessary REMP Sample Analyses, January 8, 1996.

INTRODUCTION

The Offsite Dose Calculation Manuals (ODCM) contain Radiological Effluent Technical Specifications (RETS) that require monitoring the environs of the power plant. The RETS are based on standards published by the US Nuclear Regulatory Commission (NRC) in Regulatory Guide 4.8, Regulatory Guide 1.109, NUREG-0800, NUREG-0133, NUREG-0472, and NUREG-1301. Between the time of publication of the first RETS (Reg Guide 4.8 in 1975) and the latest version (NUREG-1301 in 1991) a number of changes took place in the precise wording for the Radiological Environmental Monitoring Program (REMP). Concurrent with those changes, San Onofre Nuclear Generating Station incorporated RETS first in the Technical Specifications and later, upon implementation of Generic Letter 89-01, in the ODCMs. This memorandum reviews the-REMP as it exits and either cites references or provides the logic behind the construction of the program. The majority of the original RETS for Unit 1 was proposed in a letter to the Atomic Energy Commission (Reference 1) in which the REMP sampling and analysis program was detailed.

While the portion of the Unit 1 and Units 2/3 ODCMs dealing with REMP are not precisely identical in verbiage, the REMP sample requirements are the same. Sample locations, collection frequency and analyses are identified in a table in each ODCM. The table is divided into four sections for the pathways that could permit human exposure to radionuclides. Each section below describes the basis for the sample locations and/or provides appropriate references. A brief note follows each sample type with a description in general terms of differences between the San Onofre program and the standard program in regulatory guidance documents.

AIRBORNE: Five samples.

Indicator Locations:

ODCM Requirement: Three samples from offsite locations (in different sectors) of the highest calculated annual average ground level D/Q.

See Reference 2 for an early documented basis for air sampler placement for Units 2/3. Reference 3 contains an evaluation of Units 2/3 air sampler locations based on the revised 1979-1983 meteorological database.

References 4 and 5 contains a more detailed evaluation of air sampler location using the five year average meteorological database (1979 through 1983 inclusive). Units 2/3 requires air samplers in Sectors E, F, and Q. Note that these sectors are the #2, #3, and #4 ranked deposition coefficients (D/Q) calculated for the Exclusion Area Boundary (EAB). The corresponding air samplers are numbers 13, 9, and 12. The highest ranked D/Q is offshore in the SSW direction (sector K), a location that cannot be sampled and does not represent a pathway for human exposure.

The three landward sectors with the highest D/Q values for Unit 1 are Q, R and A using the five year average meteorological database (1979 through 1983 inclusive). Note again that the highest D/Q is found in the offshore sector K in the SSW direction. Because the Unit 1 release point is offset from the center of the Exclusion Area Boundary (EAB), the Unit 1 sectors do not completely match the sectors for Units 2/3. Therefore, the air sampler for sector Q is air sampler #12, for sector R also #12 (on the border between Q and R), and A is air sampler #11.

Air sampler #12 appears to have been intended to satisfy both Units 2/3 and Unit 1 requirements. With regard to Unit 1, air sampler #12 is located very close to the boundary of two sectors that each require sampling. However, to ensure complete ODCM compliance, a new air sampler was installed in sector R in 1997, air sampler #14.

Local Community:

ODCM Requirement: One sample from the vicinity of a community having the highest calculated annual average ground level D/Q.

Air sampler #1 in the City of San Clemente satisfies this requirement. It is located in sector Q for both Unit 1 and Units 2/3. Reference 4 identified Sector

Q as having the highest landward D/Q for Unit 1 (Sector K, offshore has the highest D/Q). For Units 2/3, Sector Q has the third highest D/Q. The highest is Sector K (offshore), the second highest D/Q is Sector E. Since Sector E has no community within ten miles, the air sampler location in Sector Q in the Northwest direction is appropriate. Since deposition, D/Q, decreases with increasing distance, a Distant community in Sector E will have a D/Q value considerably lower than the closer community in Sector Q. Reference 3 provided early documentation that air sampler #1 met this particular ODCM requirement.

Control Locations:

ODCM Requirement: One sample from a control location 15-30 km (10-20 miles) distant and in the least prevalent wind direction*. The footnote (*) reads: The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites which provide valid background data may be substituted.

At the time the Unit 1 REMP was being developed, regulatory guidance did not specify air sampler locations according to the ODCM wording above. In Reference 1, proposed RETS included a control air sampler location in Huntington Beach. The Huntington Beach Generating Station is an SCE facility, providing an easy and secure location and access. Therefore, during the subsequent licensing of Units 2/3, the draft RETS that were part of the Units 2/3 license application included identification of Huntington Beach as the location for the control air sampler. The meteorological database used was a 1973-1976 three year average in which Sector P had the lowest wind prevalence for landward sectors. Therefore, although Huntington Beach was somewhat farther than the precise ODCM wording, it was an appropriate location for a control because it complied with the logic described in the footnote and because it provided continuity in data (the existing Unit 1 program).

Upon adoption of the 1979 through 1983 five year average meteorological database, Huntington Beach remained the control location for the same reasons just stated: continuity in data and sufficient distance to provide appropriate control data. The newer meteorological database, however, indicated that Sector Q was now the fifth least prevalent wind direction. Higher Sectors included (in order of decreasing wind prevalence) M (offshore), N (offshore), H (offshore), P (mostly offshore), L (offshore), G (southeast), J (offshore), B (north northeast), C (northeast), A (north), and finally Sector Q (northwest). Note that Sectors A, B and C are landward sectors on Marine Corps Base Camp Pendleton. These Sectors, at a considerably higher elevation when sufficiently distant, would not be representative of the coastal location. Therefore, upon elimination of the offshore Sectors and the landward Sectors B, C, and A, the two primary Sectors remaining are G and Q. To meet the ODCM requirement without regard for the footnote guidance, Sector G would appear to be preferable over Q. However, again noting the footnote guidance, the continuity of data, and the sufficiently distant location, Sector Q adequately meets the, ODCM requirement. Finally, due to the imminent sale of the Huntington Beach Generating Station, the control air sample will being relocated to Sector G (denoted as Air Sampler #14).

Since Unit 1 and Units 2/3 have the same meteorological database (even though the EAB D/Q and X/Q values differ), the logic above applies to Unit 1 as well. References 3, 4 and 5 have all documented the REMP air sampler locations.

The following table presents the frequency of wind direction for both the 1973-1976 and 1979-1983 databases, Sectors with an asterisk (*) are offshore.

RANKED BY PERCENT FREQUENCY		Data from Reference 6	
Dates: *1/25/73-1/24/76*		Sectors	
Wind From	Percent Frequency	From	To
E	1.6	E	N*
ESE	2.2	F	P
ENE	2.9	D	M*
NNW	3.2	R	H*
N	3.4	A	J*
SE	4.9	G	Q
SW	5.3	L*	C
SSW	6.1	K*	B
NW	6.1	Q	G
WSW	6.4	M*	D
S	6.5	J*	A
SSE	7	H*	R
W	8.6	N*	E
WNW	10.8	P	F
NNE	10.9	B	K*
NE	14	C	L*
Total	99.9		

RANKED BY PERCENT FREQUENCY		Data from Reference 7	
Dates: *1/1/79-12/31/83*		Sectors	
Wind From	Percent Frequency	From	To
ENE	1.5	D	M*
E	1.7	E	N*
NNW	2	R	H*
ESE	2.4	F	P
NE	3.1	C	L*
NW	3.7	Q	G
N	4.6	A	J*
SSW	5.6	K*	B
SW	5.8	L*	C
S	6.1	J*	A
SE	6.9	G	Q
SSE	7	H*	R
WNW	7.3	P	F
WSW	7.5	M*	D
W	11.1	N*	E
NNE	23.7	B	K*
Total	100		

The ODCM requirements for airborne samples are consistent with the standard requirements in NUREG-0472 and NUREG-1301. Some variations in the wording exists, but the overall airborne sampling and analysis program is very close to that in the guidance documents.

DIRECT RADIATION: Thirty locations,

Inner Ring:

ODCM Requirement: An inner ring of stations in the general area of the site boundary.

References 4 and 5 documented the location of thermoluminescent dosimeters (TLD) in an inner ring around both Unit 1 and Units 2/3. Note that in order to accommodate one TLD in each sector for both Unit 1 and Units 2/3, some TLDs identified in given sectors for Units 2/3 are in different sectors for Unit 1. Due to presence of the Interstate Freeway and other obstacles, some TLDs are only located in the general vicinity of the EAB, as permitted by the ODCM. The tables below reproduce the data from Reference 4, as updated by a Global Positioning System for more precise distances. Note also that Reference 4 identified the fact that some sectors are over the ocean and cannot be monitored by TLD. Therefore, the sectors that are monitored are only those on land.

UNIT 1 INNER RING			
Direction from Site (sector)	Distance (miles)	TLD Number	Location
WNW (P)	0.39	10	PIC #1
NW (Q)	1.22	8	Beach Club
NNW (R)	0.30	67	PIC #2
N (A)	0.54	40	PIC #3
NNE (B)	0.63	61	PIC #4
NE (C)	0.66	62	PIC #5
ENE (D)	0.72	63	PIC #6
E (E)	0.76	64	PIC #7
ESE (F)	0.86	66	PIC #9
SE (G)	1.28	46	State Beach

UNITS 2/3 INNER RING			
Direction from Site (sector)	Distance (miles)	TLD Number	Location
WNW (P)	0.675	10	PIC #1
NW (Q)	0.55	67	PIC #2
NNW (R)	0.72	40	PIC #3
N (A)	0.70	61	PIC #4
NNE (B)	0.65	62	PIC #5
NE (C)	0.58	63	PIC #6
ENE (D)	0.54	64	PIC #7
E (E)	0.70	65	PIC #8
ESE (F)	0.58	66	PIC #9
SE (G)	1.0	46	State Beach

Outer Ring:

ODCM Requirement: An outer ring in the four to five mile range from the Site with a station in each sector of each ring.

References 4 and 5 documented the location of thermoluminescent dosimeters (TLD) in an outer ring around both Unit 1 and Units 2/3. As with the inner ring, in order to accommodate one TLD in each sector for both Unit 1 and Units 2/3, some TLDs identified in given sectors for Units 2/3 are indifferent sectors for Unit 1. Due to presence of the Interstate Freeway and other obstacles, some TLDs are located in a general range of four to five miles, as permitted by the ODCM. The tables below reproduce the data from Reference 4.

UNIT 1 OUTER RING			
Direction from Site (sector)	Distance (miles)	TLD Number	Location
WNW (P)	2.42	22	San Mateo Point
NW (Q)	5.33	1	San Clemente
NNW (R)	4.76	19	San Clemente Highlands
N (A)	3.38	2	Camp San Mateo
NNE (B)	4.66	35	Range 312
NE (C)	4.32	36	Range 208C
ENE (D)	4.48	68	Range 210C
E (E)	4.73	4	Camp Horno
ESE (F)	3.28	6	Old Route 101
SE (G)	3.58	38	State Beach

UNITS 2/3 OUTER RING			
Direction (sector)	Distance (miles)	TLD Number	Location
WNW (P)	2.7	22	San Mateo Point
NW (Q)	5.6	1	San Clemente
NNW (R)	5.0	19	San Clemente Highlands
N (A)	5.7	33	Camp Talega
NNE (B)	4.7	35	Range 312
NE (C)	4.2	36	Range 208C
ENE (D)	4.3	68	Range 210C
E (E)	4.5	4	Camp Horno
ESE (F)	3.0	6	Old Route 101
SE (G)	3.3	38	State Beach

Balance:

> ODCM Requirement: The balance of the stations are in areas of specific interest such as population centers, nearby residences, schools, and two or three areas to serve as controls.
>
> The remaining TLDs are located in other regions of interest (Marine Corps Camps), schools (San Onofre School), a hospital in San Clemente, several locations close to the plant, and several locations sufficiently distant to provide adequate controls. References 4 and 5 identified the logic for selecting those stations.

The direct radiation program is close to that in NUREG-0472 and NUREG-1301. The major difference is that the San Onofre program has fewer TLDs placed around the plant due to the seaward sectors. The ocean, and consequent lack of pathway for direct radiation measurement, limits the number of TLD locations.

WATERBORNE: Four categories.

Ocean

REMP Requirement: Four Locations

There are four ocean water sample locations, one at each Unit outfall and one control in the Newport Beach area. Note that these locations were based on the program originally proposed in Reference 1. The "indicator" locations should be near the respective outfalls but outside of the turbulent discharge area. The pathway for exposure, as discussed in Reference 1, is from swimming and a small amount of ingestion of seawater.

Drinking Water

REMP Requirement: Two Locations

Reference 8 noted that there is no reliable surface water in the vicinity of San Onofre. Moreover, there is no drinking water pathway for the area near San Onofre (Reference 9, pages 2-3, 2-4). Nevertheless, in accordance with Reference 8, samples are taken from nearby wells to monitor ground water. There are two locations sampled for drinking water. Until recently, two "indicator" locations were sampled for drinking water and a third sample was taken from the Huntington Beach area as a control. In 1997, the best "drinking water" location was identified as local wells about 2.4 miles from San Onofre on Camp Pendleton. As discussed in Reference 9, the flow of groundwater is toward the ocean such that it is not likely that any discharges from San Onofre, should that ever occur, could contaminate groundwater.

Sediment from Shoreline

REMP Requirement: Four Locations

Three samples are taken in the vicinity of San Onofre with a fourth sample taken at an appropriate control location (Newport Beach). The indicator locations are slightly upcoast (~0.2 miles from Units 2/3 midpoint at the San Onofre Surf Beach), downcoast (~0.8 miles from the midpoint at the San Onofre State Beach) and farther downcoast (~3.5 miles from the midpoint also on the State Beach). Because the predominant ocean current is downcoast (Reference 19, page 2-3), indicator samples are preferentially taken downcoast. The control is therefore appropriately taken upcoast at a sufficient distance (Newport Beach at

~29 miles). Reference 1 pointed out that this sample is intended to detect any human exposure by direct radiation (from sunbathing).

Ocean Bottom Sediments

REMP Requirement: Five Locations

Ocean bottom sediments are collected at four indicator locations and one control location. Two indicator locations are near the Unit 1 outfall and one each at Unit 2 and Unit 3 outfalls. The control location is at Laguna Beach which is about 18 miles upcoast and sufficiently distant to be unaffected by plant operation. Reference 1 noted that ocean bottom sediment could contribute to human exposure through marine plants and animals.

In addition to the ODCM required samples, ocean water and ocean bottom sediment samples have been taken near the shore at the Units 2/3 discharge structure. The purpose was to monitor any potential accumulation of radioactivity due to the presence of a defect in the discharge conduit. This defect allows some *very* limited discharge closer to shore than the designed discharge locations. After accumulation of sufficient negative data, this optional sampling program may be discontinued.

As discussed *above*, due to the location of San Onofre on the coast, the waterborne pathways differ from a typical land bound plant. Consequently the REMP samples required by the ODCMs for these media differ from the standard programs described in NUREG-0472 and NUREG-1301.

INGESTION: Two categories

Nonmigratory Marine Animals

REMP Requirement: Three locations

Nonmigratory marine animals are collected at two indicator locations and one control location. The indicator locations are at the Unit 1 outfall and the vicinity of the Units 2 and 3 outfalls. The control location is at Laguna Beach, which is about 18 miles upcoast and sufficiently distant to be unaffected by plant operation. Nonmigratory marine animals provide a potential pathway for human exposure through ingestion.

The types of animals collected are specified in the ODCMs (Fish, Crustacea, and Mollusks) and depend on the species available. Reference 1 noted that the samples may be taken within 2 miles of the discharge outfall. This flexibility is important to ensure the ability to find the appropriate samples during the defined sampling period.

Local Crops

REMP Requirement-Two-locations

Representative vegetables, normally one leafy and one fleshy are collected at harvest time at two locations. The locations are one indicator and one control. The control has typically been a truck farm in the Oceanside area, over 20 miles distant in the downcoast direction. The indicator location has usually been the San Clemente Ranch at 2.6 miles in the northwest direction. These indicator and control locations were specified in the original program in Reference 1. Because of the required ODCM analysis for the highest radiation exposure contribution, samples may also be taken from the Cotton Point Estates gardens, residential gardens at 2.8 miles in the west northwest direction,

The lack of milk cows in the area around San Onofre and the limitations in vegetable crops cause the ODCM requirements to differ from the standard programs in NUREG-0472 and NUREG-1301.

ADDITIONAL SAMPLES

The program has historically collected two types of samples that are not required by the ODCMs. These are kelp samples and soil samples. Kelp samples were originally specified in Reference 1 and have been collected for many years because of the commercially harvested kelp bed near San Onofre. Kelp is used in many consumer products. Should any accumulation of radioactivity in kelp occur, it would be important to monitor and assess potential exposure to the public.

Soil samples have also been historically taken in the vicinity of SONGS. The purpose is to evaluate whether there might be any accumulation of radioactivity in the soil around the plant. There are four indicator locations and one control.

The original program as described in Reference 1 also included jackrabbit samples. The animals' thyroids were evaluated for the presence of Iodine-131 and femurs were evaluated tor Strontium-89 and Strontium-90. This sampling medium and associated analysis was eliminated.

The original REMP was described in the Unit 1 Final Environmental Statement (Reference 10). The Units 2/3 program was described in the Environmental Report, Operating License Stage or ER-OLS (Reference 11). The ER-OLS described the early sampling for soil and kelp that are no longer required by the ODCMs or by regulatory guidance, and other sample types no longer collected (such as jackrabbits). Much of the present program was built upon the early programs for the sake of continuity. Moreover, the older program at Unit 1 was used as the preoperational program for Units 2/3. The State of California Department of Health has also required environmental monitoring around commercial nuclear power plants. See Reference 12 for the proposal to the State for the REMP. The California agency also collects and analyzes some samples of certain media. Reference 13 is representative of the level of detail for this confirmatory program.

For all the above reasons, the REMP has been built on existing programs and requirements rather than simply starting fresh when new regulatory guidance was issued.

SAMPLE ANALYSES

Samples are analyzed according to ODCM requirements. In the past, many analytical practices were employed that were not required. Several memoranda were written to justify elimination of these unnecessary sample analyses. References 14 and 15 describe elimination of unnecessary analytical procedures. After the deletion of unnecessary analyses, the requirements of the ODCMs match the guidance in NUREG-0472 and NUREG-1301 relatively closely.

E. M. GOLDIN

Attachment
cc: E. S. Medling
M. J. Johnson
D. Dick
K. C. Yhip
N. A. Hansen
HPE/CDM Files

DEVELOPMENTAL RESOURCES

The following documents were not specifically referred to in the text. They are, however, helpful in a complete description of the development of the REMP and in some cases provide a basis for specified aspects of the REMP.

1. Letter from M. O. Medford, SCE to NRC, Radiological Effluent Technical Specifications, December 12, 1983.
2. Letter from NRC to K. P. Baskin, Offsite Dose Calculation Manual, October 2, 1984.
3. Letter from NRC to K. P. Baskin, Offsite Dose Calculation Manual, August 30, 1985.
4. Memorandum from E. S. Medling to D. L. Cox, Request for Amendment to SONGS Units 2/3 Technical Specifications, September 16, 1988.
5. Memorandum from J. Brown to K. Yhip, Critical Organ for 40CFR190 Evaluation of Gaseous Effluent Dose, April 2, 1991.
6. Memorandum from W. Edwards to K. Yhip, Calcium Sulfate vs Lithium Fluoride TLD Comparison, September 17, 1991.
7. Memorandum for File, M. Goeders, Channeling in Radioiodine Charcoal Cartridges, December 30,1993
8. Memorandum from M. Goeders to E. M. Goldin, Justification for Not Collecting Leafy Vegetables at SONGS, March 15, 1994.
9. Memorandum from E. M. Goldin to P. K. Chang and M. J. Johnson, Revision of Tables for Environmental Sample Analyses, June 7, 1996.
10. Memorandum from M. J. Johnson to E. Goldin, Revision of the Radiological Environmental Monitoring Program (REMP) Sample Locations, January 21, 1997.

Subject: Approval of Offsite Dose Calculation Manual Changes, April 27, 2010

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

Ross T. Ridenoure
Senior Vice President and CNO
San Onofre Nuclear Generating Station

April 27, 2010

MESSR: L. L. MCCANN

SUBJECT: Offsite Dose Calculation Manual (ODCM) Approval Designee

Technical Specification 5.5.2.1.1 "Licensee-initiated changes to the ODCM," Section 5.5.2.1.1.b requires licensee-initiated changes to the ODCM to become effective upon review and approval by the corporate officer with direct responsibility for the plant or designee.

Consistent with the above, effective May 5th, 2010, Doug Bauder is assigned as my designee for approval of ODCM revisions.

cc:

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R. J. St Onge
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Memorandum for File

SUBJECT: Units 2/3 Building/Ventilation Envelopes/Turbine/MSIV Areas, Revision 1 — January 13, 2012

BACKGROUND

Units 2/3 consists of the following building/ventilation envelopes/areas: Control Room Complex Ventilation; Control Building Ventilation; Radwaste Building Ventilation; Safety Equipment Building Ventilation System; Penetration Building Ventilation System; MSIV/Turbine Building General Areas; Electrical Tunnels; Fuel Handling Building Ventilation System; Containment Purge System; and Tendon Gallery Ventilation System.

Occasionally, a potential pathway is created for an unplanned and/or unmonitored release of airborne radioactive material directly to atmosphere through open doors, building air leakage, steam leak. In addition, there are also planned but unmonitored releases of airborne radioactive material that result from system operation as designed but occur infrequently and are impractical to monitor.

For each one of the ventilation envelope/areas, the following documents form the regulatory guidance or licensing basis:

1. 10 CFR 20 and 10 CFR 50 (subpart 50.34, 50.34a, 50.36a, appendix A GDC 60 and 64, and Appendix I) require that licensees establish programs and instruments to control and monitor radioactive effluents under normal operation, anticipated operational occurrences, and accident conditions.

2. The UFSAR commits to providing an effluent monitoring system which is designed to perform to meet the requirements of 10 CFR 20, 10 CFR 50, and follow the recommendations of Regulatory Guide (RG) 1.21 Revision 1. Additionally, guidance from NUREG-0800, NUREG-0472, NUREG-0133, and RG 1.109 were used in the development of the radiological effluents specifications and the ODCM.

3. NUREG-0800, Standard Review Plan, recognizes that there are some unmonitored release points, such as containment leakage, and that "continuous gaseous effluent monitors are not required for open structures, such as PWR turbine buildings or atmospheric vents for liquid waste tanks containing treated or processed liquid waste and located outside of buildings." As a practical consideration, is the regulatory guidance recognizes that there may be release points that cannot be monitored because (a) instrumentation may not exist that could reliably function under the operating conditions of the system that is being monitored or (b) because the concentrations are typically below concentrations that can be reliably determined, particularly in-line. These releases are not anticipated to result in a significant amount (curies) of activity being released or in a significant dose to the public.

4. Section 9.4 and Section 11.3 of the UFSAR recognize that there are building leakages and steam leaks, which are not monitored, to the outside atmosphere.

5. 10 CFR 20 provides airborne Derived Air Concentration (DAC) limits for station workers within the radiologically controlled area, which is controlled by the health physics radiation protection program, as well as Maximum Permissible Concentration (MPC) limits for a member of the public in the unrestricted area, which is assessed by the effluent program.

   For example, Xe-133 is an isotope most likely to cause an airborne problem for building/ventilation envelopes/areas. One DAC Xe-133 = 1E-4 uCi/cc for the radiologically controlled area and one MPC = 3E-7 uCi/cc for the unrestricted area. Station Health Physics (HP) procedure considers 25% DAC an airborne radioactivity area. The unmonitored effluent impact is based on this criterion and the affected envelope exhaust ventilation flowrate. The actual or estimated flowrate and isotopes are determined when Effluent

Engineering implements SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release.

For steam leaks or steam releases from equipment (e.g. ADVs or Auxiliary Feedwater pump turbines, tritium (^3H) is the most likely isotope present and potentially released in the absence of a primary to secondary leak. One DAC H-3 = 2E-5 uCi/cc for the radiologically controlled area and one MPC = 2E-7 uCi/cc for the unrestricted area. The effluent impact for steam releases are evaluated in Attachments A and C

- For 60 hours of Auxiliary Feedwater Pumps operation per year, the effluent impact is 6.58E-7 mrem during the year at the controlling location (Camp Mesa)
- For 100 hours of Atmospheric Dump Valves operation at full capacity per year, the effluent impact is 6.58E-5 mrem during the year at the controlling location (Camp Mesa)

While these examples are provided for Xe-133 and H-3, it holds true for other isotopes as well.

NUISANCE PATHWAYS

Nuisance pathways are releases that occur passively and are expected to result in insignificant doses to the public, generally less than 1% of the ALARA standards in 10 CFR 50 Appendix I. Because the concentration of licensed material in these sources is typically below RETS LLDs or the total quantity of licensed material that could be released is very small, it is impractical to monitor or control these incremental releases. Examples of nuisance pathways include:

- Diffusion across the surface of water contained in an open sump
- Normal leakage from a PWR turbine building
- Atmospheric vent valves on tanks containing treated or processed liquid waste

In several of the ventilation envelopes discussed below, the ventilation exhaust is routed to the plant vent stack for discharge. The plant vent stack is an ODCM-credited release point that is routinely sampled and is equipped with in-line instrumentation that monitors the discharge to ensure that the release meets all regulatory requirements.

Control Room Complex Ventilation (Units 2/3)

The Control Room Complex Ventilation System envelopes the areas, equipment and materials to which the control room operator could require access during an emergency. The control room is maintained at a slightly positive pressure by a normal supply fan and exhausted to the atmosphere at 2700 cfm. Of all the areas in this envelope, the Turbine Laboratory is kept at a slightly negative pressure relative to the other areas, because it is a potentially airborne radioactive area. This negative pressure is maintained by an exhaust fan dedicated to the lab; the exhaust of this fan (about 1050 cfm) is directed to the Plant Vent Stack. The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

Although the Turbine Laboratory is considered a potentially airborne radioactive area, due to administrative practices that limit operation with primary to secondary leakage, it does not typically present an airborne issue. A primary to secondary leak is the only credible source term to the lab. However, the steam generator sample passes through a flow orifice and a pressure control valve, and when the sample reaches the Turbine Lab, it is at ambient pressure. As a result, the likelihood of an airborne issue for radioactive materials is remote.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactivity. If airborne at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Control Room Complex Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 2700 cfm, the effluent impact at the site boundary is no greater than 5.13E-6 mrem/hr

> 1E-4 uCi/cc * 0.25 * 2700 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 5.13E-6 mrem/hr

Control Building Ventilation (Units 2(3)

The Control Building Ventilation System serves the Control Building except for the Control Room Complex Ventilation Envelope. It includes the following subsystem:

Consistent with standard ALARA practices, ESF Switchgear Room Normal and Emergency Cooling subsystem, ESF Battery Rooms Normal and Emergency Ventilation subsystem, Switchgear Room Ventilation subsystem, Communication Battery Room Ventilation subsystem, HP Computer Air Conditioning subsystem, Communication Room Air Conditioning subsystem, Cable Spreading and Electrical Room Ventilation subsystem, Chiller Rooms Normal and Emergency Ventilation subsystems, Public Address and Communication Rooms Air Conditioning subsystem, and Health Physics and Locker Room Air Conditioning subsystem. Several potentially airborne radioactive zones in the Health Physics and Locker Room areas are maintained at a slightly negative pressure relative to other areas and are exhausted (about 14,000 cfm) to the Plant Vent Stack. The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

Areas include: central liquid sampling room, radioactive chemical laboratory, restrooms, corridor, personnel decontamination areas and decontamination monitor area. Plant experience has shown these areas rarely, if ever, pose an airborne issue for radioactive materials. All other areas are not potentially airborne radioactive and are exhausted by normal exhaust fans at about 110,000 cfm to the atmosphere.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactivity. If airborne radioactive material at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the extremely unlikely event that the entire Control Building Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 110,000 cfm, the effluent impact at the site boundary is no greater than 2.09E-4 mrem/hr.

> 1E-4 uCi/cc * 0.25 * 110000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 2.09E-4 mrem/hr

Radwaste Building Ventilation (Units 2/3)

The Radwaste Ventilation System serves the Radwaste Building and is comprised of several subsystems: Radwaste Area Ventilation subsystem, Post Accident Sampling Laboratory Air Conditioning subsystem, Control Element Drive Mechanism Control System Room Air Conditioning subsystem, Radwaste Building Addition Ventilation subsystem, and Charging and Boric Acid Pump Rooms Emergency Ventilation.

Relative to other building/ventilation envelopes, the Radwaste envelope has a higher potential for unmonitored releases since it contains most, if not all, of the systems and components associated with liquid (such as hold up tanks) and gas processing (such as waste gas compressor and decay tanks) involving licensed material. As a result, consistent with standard ALARA practices, the entire envelope is considered potentially airborne radioactive and is maintained under a negative pressure relative to other adjacent building/ventilation envelopes. This envelope is normally exhausted (about 78,100 cfm) to the Plant Vent Stack. The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

Due to this envelope's higher potential to become airborne, additional design, procedural, and administrative controls are implemented to ensure a negative pressure is maintained to minimize ex-filtration to the outside atmosphere. For example: The ventilation supply and exhaust units are interlocked to operate in pairs. A supply unit cannot operate without an exhaust unit, which is at a higher capacity to maintain a slightly negative pressure, also operating. The Radwaste Truck Bay dampers are interlocked with the truck bay door, a boundary door to the outside atmosphere. The dampers cannot be opened when the roll up door is open and the roll up door cannot be opened when the dampers are open. Operations Instruction SO23-1-5, "Auxiliary Building Normal HVAC System Operation," provides explicit directions on the Radwaste/Truck Bay ventilation envelope to ensure a negative pressure envelope is maintained. If Radwaste HVAC is lost, an immediate action is directed by this procedure to close all Radwaste doors leading to adjacent buildings and to outside areas. Operations Instructions SO23-15-60.B, "Annunciator Panel," directs that Effluent Engineering be notified for a potential unplanned or uncontrolled release if Radwaste HVAC is lost. As an additional note, signs are posted on appropriate radwaste envelope doors to remind station personnel to keep doors closed when egress or ingress is not required.

Based on the relative potential for radioactive material to become airborne, the design and procedural controls that are being implemented are proper and adequate.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If airborne radioactive material at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope and concurrent with a loss of Radwaste HVAC, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Radwaste Ventilation envelope is determined to contain or exceed the 25% DAC HP threshold for an airborne radiation area and concurrent with a loss of Radwaste HVAC, at an exhaust rate of 78100 cfm from the Radwaste Building Ventilation Envelope, the effluent impact at the site boundary is no greater than 1.48E-4 mrem/hr. Note: Upon loss of Radwaste HVAC, there is essentially no differential pressure between the Radwaste Envelope and outside atmosphere.

1E-4 uCi/cc * 0.25 * 78100 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 1.48E-4 mrem/hr

Safety Equipment Building Ventilation System (Per Unit)

The Safety Equipment Building Ventilation System include these subsystems: the safety injection pump rooms, the component cooling water pump rooms, the safety equipment building heat exchanger rooms and piping rooms, the safety equipment building air conditioning equipment room, the safety equipment building lobby area air conditioning subsystem, and the elevator room (Unit 2 only).

Under normal operation, this ventilation envelope is not considered potentially airborne radioactive. In the unlikely event of an accident condition, particularly with fuel failure, safety injection system actuation followed by a breach of pressure boundary equipment or components in the safety equipment building can potentially result in airborne radioactive material. For this reason, the exhaust of this envelope is directed to the Plant Vent Stack by the Penetration and Safety Equipment Exhaust Fan (about 9000 cfm per Unit). The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment. The only excepted area is the elevator equipment room (Unit 2 only), that draws outside air directly and exhausts (1160 cfm) directly to the outside atmosphere.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If airborne radioactive material at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Safety Equipment Building Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 9000 cfm, the effluent impact at the site boundary is no greater than 1.71E-5 mrem/hr Note: Upon loss of Safety Equipment Building HVAC, there is essentially no differential pressure between the Safety Equipment Building envelope and outside atmosphere.

1E-4 uCi/cc * 0.25 * 9000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 1.71E-5 mrem/hr

Penetration Building Ventilation System (Per Unit)

The Penetration Building Ventilation System includes these subsystems: Penetration Building Air Conditioning Subsystem, and Penetration Area Cooling Subsystem. This envelope is normally not considered potentially airborne radioactive. However, in the unlikely event of a breach of integrity in a mechanical or electrical penetration, the potential exists for an airborne concern. For this reason, this envelope is exhausted (about 9000 cfm per Unit) to the Plant Vent Stack. The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment..

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If airborne radioactive material at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Penetration Building Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 9000 cfm, the effluent impact at the site boundary is no greater than 1.71E-5 mrem/hr. Note: Upon loss of Penetration Building HVAC, there is essentially no differential pressure between the Penetration Envelope and outside atmosphere.

> 1E-4 uCi/cc * 0.25 * 9000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 1.71E-5 mrem/hr

Electrical Tunnel Ventilation (Units 2/3)

The Electrical Tunnel Ventilation System includes these subsystems: Safety Equipment Building (SEB) Electrical Tunnel, and the Access Building and Underground Cable Tunnel. The potential airborne radioactive concern would be if either of these structures were to become flooded with water containing licensed material, including tritium. They are exhausted directly to the environment with the SEB tunnel at a normal rate of about 11,000 cfm and the Access Building and Underground Cable tunnel at a normal rate of about 17,000 cfm.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If the Safety Equipment Building (SEB) Electrical Tunnel, or the Access Building and Underground Cable Tunnel becomes flooded with water containing licensed material, including tritium, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Electrical Tunnel Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 28000 cfm, the effluent impact at the site boundary is no greater than 5.32E-5 mrem/hr.

> 1E-4 uCi/cc * 0.25 * 28000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 5.32E-5 mrem/hr

Fuel Handling Building Ventilation System (Per Unit)

Barring the loss of the Fuel Handling Building Ventilation System or an accident and emergency condition such as a fuel handling accident, the Fuel Handling Building Ventilation envelope does not present an airborne radioactive material concern. This ventilation is exhausted (about 26,000 cfm) to the Plant Vent Stack with the option to route the air through a HEPA filter system The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If airborne radioactive material at 25% DAC or higher is detected by HP or Area Radiation Monitors in this ventilation envelope, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Fuel Handling Building Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 26000 cfm, the effluent impact at the site boundary is no greater than 4.94E-5 mrem/hr. Note: Upon loss of Fuel Handling Building HVAC, there is essentially no differential pressure between the Fuel Handling Building Envelope and outside atmosphere.

1E-4 uCi/cc * 0.25 * 26000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 4.94E-5 mrem/hr

Tendon Gallery Ventilation System

This system is operated continuously to maintain personnel habitability in the Tendon Gallery. A potential airborne radioactive concern would be if the Tendon Gallery became flooded with water containing licensed material, including tritium. The exhaust (about 5000 cfm) goes directly to outside atmosphere.

Effluent Controls: For this envelope, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities in the absence of airborne radioactive materials. If the Tendon gallery becomes flooded with water containing licensed material, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the entire Tendon Galley Ventilation envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 5000 cfm, the effluent impact at the site boundary is no greater than 9.50E-6 mrem/hr.

1E-4 uCi/cc * 0.25 * 5000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 9.50E-6 mrem/hr

MSIV/Turbine Building General Area (Per Unit)

Since these areas are open structures that contain equipment and components to support the steam and power conversion cycle, there is the potential for an unmonitored airborne release. Under typical operating conditions, there is detectable tritium present in the steam and power conversion system due to migration across the steam generator tubes. The concentration(s) of licensed material in the main condenser evacuation system, main steam line monitors, steam generator blowdown monitor and sampling system are determined by sampling the condensate and feedwater systems.

It is also possible for this system to contain licensed material as a result of primary to secondary leak. Section 11.3 of the UFSAR indicates that the preponderance of the primary to secondary gaseous radioactivity will be released through the Main Condenser Evacuation System. The Main Condenser Evacuation System is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment. The other turbine area flow paths listed in UFSAR Section 11.3 represent the following percentages in terms of curies released to the atmosphere relative to the Main Condenser Evacuation System on an annual basis:

a. Turbine Building Steam Leakage: 2.4% (1,700 lbm/hr)

b. Turbine Gland Seal Steam System: 1% (708 lbm/hr)

As is the case for the steam and power conversion systems mentioned earlier in this section, samples of feedwater and condensate systems are routinely collected and analyzed to determine levels of radioactivity in these systems.

Unmonitored Effluent Impact: In the absence of a primary to secondary leak where tritium activity is released from the Unit 2 and 3 turbine building steam leakage and Turbine Gland Seal Steam system occur for 8760 hrs/yr the effluent impact at the controlling location (Camp Mesa) would be 9.14E-6 mrem/yr (Attachment B)

PLANNED BUT UNMONITORED RELEASES

Section 10 of the UFSAR also discusses three other main steam flowpaths: steam driven auxiliary feedwater pump, main steam safeties, and atmospheric dump valves (ADV). Samples of feedwater and condensate systems are routinely collected and analyzed to determine levels of radioactivity in these systems.

There are systems or components that, integral to their operation as designed, are more likely to have a radioactive release during the use of the equipment but, due to operating conditions, monitoring for licensed material cannot practicably be accomplished. As previously discussed, regulatory guidance recognizes that there may be release points that cannot be monitored because (a) instrumentation may not exist that could reliably function under the operating conditions of the system that is being monitored or (b) because the concentrations are typically below concentrations that can be reliably determined, particularly by in-line instruments. These releases are not anticipated to result in a significant amount (curies) of activity being released or in a significant dose to the public.

<u>Steam Driven Auxiliary Feedwater Pump</u>

In an accident scenario or for quarterly IST surveillance, operation of the steam driven auxiliary feedwater pump may be required. The exhaust of the steam driven pump turbine goes to outside atmosphere. Typically, in an accident scenario, the other two electric driven auxiliary feedwater pumps will be used unless the accident involves a loss of power, Although the main steam supply rate to the turbine pump is not explicitly provided in the UFSAR or other readily available documents, based on the maximum pump flow conditions in Section 10.4 of the UFSAR for accident mitigation, the maximum steam flow rate to the pump can be calculated to be about 25,000 lbm/hr (Attachment A).

Assuming these planned releases occur 6 times per year for 60 hours, 4 times for IST and 2 times for abnormal/accident conditions, a total of 1.5 E6 lbm of steam would have been exhausted to the atmosphere.

Since the main steam flowrate is approximately 1.5E7 lbm/hr, for a primary to secondary leak, this would represent about 0.2% of the noble gas activity released through the Main Condenser Evacuation System. The Main Condenser Evacuation System is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment

In the absence of a primary to secondary leak, where tritium activity is released in the steam but not from the Main Condenser Evacuation System, this would represent about 0.01% of the airborne tritium activity released from the Plant Vent Stack. (Attachment A) The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

The conclusion is that similar to turbine building steam leakage and the turbine gland seal steam system, operation of the steam driven auxiliary feedwater pump does not constitute a significant or major release flowpath. However, since these are planned but unmonitored releases and the secondary systems normally contain tritium, each release shall be evaluated per the Corrective Action Program to determine if the dose and curies released should be included in the Annual Radioactive Effluent Release Report.

In the unlikely event of an abnormal/accident condition when the steam drive auxiliary feedwater pump is needed:

- subsequent to an emergency event declaration, Effluent Engineering will implement SO123-III-5.22.23, "Determining a Source Term for Offsite Dose Calculations in an Accident Situation,"

- subsequent to the emergency event, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material ". All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Main Steam Safety Valves

There are a total of 18 main steam safety valves per unit with a maximum total of 1.5 E7 lbm/hr of relieving capacity during an accident or abnormal scenario depending on plant condition such as decay heat history, etc,. Actuation of the valves is an unlikely event (unplanned release) supported by plant experience. During the dual unit trip from full power in September, 2011, the Steam Bypass Control System relieved excess steam to the Main Condensers. No Main Steam Safety Valves opened during this event.

If the main steam safety valves are used, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release.

In the unlikely event of an abnormal/accident condition when the main steam safety valves are needed for decay heat removal:

- subsequent to an emergency event declaration, Effluent Engineering will implement SO123-III-5.22.23, "Determining a Source Term for Offsite Dose Calculations in an Accident Situation,"

- subsequent to the emergency event, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material ". All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Atmospheric Dump Valves

There are two atmospheric dump valves per unit with a maximum total of 1.5 E6 lbm/hr of relieving capacity during an accident or abnormal scenario depending on plant condition such as decay heat history, etc. Under normal operations, these valves typically are not used since the main condenser is available. Even if they are used during normal plant operations, they are throttled to a fraction of the maximum relieving capacity.

For a primary to secondary leak and assuming that the dump valves are operated 10 hours per year at full capacity, a total of 1.5 E7 lbm of steam would be exhausted to the atmosphere. Since the main steam flowrate is approximately 1.5E7 lbm/hr, this represents about 10 % of the noble gas activity released through the Main Condenser Evacuation System.

In the absence of a primary to secondary leak, where tritium activity is not released through the Main Condenser Evacuation System, operation of the dump valves for 100 hours per year at full capacity would represent about 1 % of the airborne tritium activity released through the Plant Vent Stack. (Attachment C) The Plant Vent Stack is an ODCM-credited release point that is periodically sampled per the ODCM and is monitored prior to discharge to the environment.

Therefore, for normal operation, the conclusion is similar to turbine building steam leakage, the turbine gland seal steam system, and the steam driven aux feedwater pump, operation of the atmospheric dump valves does not constitute a significant or major release flowpath. However, since use of the ADVs are planned releases and the secondary systems normally contain tritium, each release shall be evaluated per the Corrective Action Program to determine if the dose and curies released should be included in the Annual Radioactive Effluent Release Report. Refer to Attachment D to calculate the steam flowrate from the ADVs.

In the unlikely event of an abnormal/accident condition when the atmospheric dump valves are needed to assist the main steam safeties for decay heat removal:

- subsequent to an emergency event declaration, Effluent Engineering will implement SO123-III-5.22.23, "Determining a Source Term for Offsite Dose Calculations in an Accident Situation,"
- subsequent to the emergency event, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material ". All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Containment with Equipment Hatch Open and No Purge in Progress (Per Unit)

With its inherent source term, the containment envelope is an ODCM-credited release point. Mini and normal purges of the containment are conducted through a monitored and sampled flowpath prior to release. The mini purge is exhausted at a rate of about 2000 CFM, and the normal purge at about 40,000 cfm. When shutdown to Mode 5, primarily for a refueling outage, the purge system supplies the containment with outside air through the equipment hatch. When the hatch is open, auxiliary air samplers at the hatch are continuously sampling for particulate and iodine activity.

Effluent Controls: If concentrations of licensed material are detected around the equipment hatch opening, Effluent Engineering will implement SO123-III-5.25, "Evaluation and Reporting of Abnormal Releases of Radioactive Material," for a potentially unplanned or uncontrolled release. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

Unmonitored Effluent Impact: In the unlikely event that the containment envelope is contaminated to the 25% DAC HP threshold for an airborne radiation area, at an exhaust rate of 40000 CFM, the effluent impact at the site boundary is no greater than 7.60E-5 mrem/hr. Note: Upon loss of containment purge, there is essentially no differential pressure between the Containment Envelope and outside atmosphere

1E-4 uCi/cc * 0.25 * 40000 cfm * 2.832E4 cc/ft^3 * 1 min/60 sec * 4.8E-6 sec/m^3 * 294 mrem/yr per uCi/m3 * 1 yr/8766 hrs = 7.60E-5 mrem/hr

North Industrial Area (formerly Unit 1)

Unit 1 was permanently shutdown in November 1992 and systems containing or potentially containing licensed material have been drained and removed or abandoned in place. Used fuel from Unit 1 is stored in the ISFSI. Barring a fuel handling accident in the ISFSI, there is simply no credible airborne source term.

Occasionally, work is performed in the North Industrial Area (Unit 1) on large components for Units 2 or 3. Each major work activity that has the potential to result in airborne radioactivity shall have an Effluent Evaluation (EOE) performed.

CONCLUSION

The evaluation of the Units 2/3 building ventilation envelopes/areas with a potential for an unmonitored airborne release has determined that:

1. The design of the building ventilation envelopes, turbine building/MSIV areas does not assume that they are air-leak tight or steam-leak tight. Building air leakage/steam leaks are unavoidable facts of plant operations. However, they are not significant or major radioactive effluent flowpaths and cannot practicably be monitored and sampled.

2. In the absence of airborne radioactive materials, doors may be opened for personnel and equipment ingress/egress, operational and maintenance activities.

3. The adoption of 25% DAC Health Physics criterion for an airborne area within the radiologically controlled area as a threshold for an evaluation of a potentially unplanned or uncontrolled effluent release from an unmonitored flowpath is proper and appropriate. Performing an evaluation and taking actions at this point will further mitigate the impact of any potentially unplanned or uncontrolled release to a member of the public.

4. Additional design and procedural controls are implemented for the radwaste and containment open to atmosphere with purge in progress envelopes. This attention reflects the inherently higher potential for an unplanned or uncontrolled release from an unmonitored flowpath directly to the atmosphere.

5. Planned but unmonitored releases such as the use of main steam safety valves or atmospheric dump valves or auxiliary feedwater pump or opening of containment with no purge in progress will be evaluated case-by-case using approved station procedures. All unplanned or unmonitored releases of radioactive material that meet the criteria in RG 1.21 rev 1 will be included in the applicable Annual Radioactive Effluent Release Report.

If you have any questions or concerns regarding this matter, please contact James Demlow at 86780.

J. Demlow

1/13/2012
Date

Attachment: A	Units 2 and 3 Steam Driven Aux Feedwater Pump Release Calculation
Attachment B	Units 2 and 3 Turbine Gland Seal Steam System Release Calculation
Attachment C	Units 2 and 3 Atmospheric Dump Valve Release Calculation
Attachment D	Units 2 and 3 Atmospheric Dump Valve Steam Flowrate Calculation

cc: L. McCann
K. Yhip
J. Scott
CDM

Units 2 and 3 Steam Driven Aux Feedwater Pump Calculation

Steam Flow Rate

Although the main steam flowrate to the Units 2 and 3 Steam Driven Aux Feedwater Pump turbine is not provided in the UFSAR or other available references, the expected maximum flowrate can be calculated based on accident design conditions provided in Section 10.4 of the UFSAR.

For accident conditions, using main steam from the steam generator to the turbine and exhausting the steam to atmosphere, the pump is designed to draw from the condensate storage tank (ambient conditions of 80 F water at atmospheric pressure) at a rate of 500 gpm for a steam generator pressure of 1172 psia or 700 gpm for a steam generator pressure of 1000 psia. Applying the conservation of energy principle, the work done by the main steam on the turbine can be equated to the work done by the pump in transporting the condensate storage tank fluid to the steam generator.

The work done by the steam on the turbine is:

M x delta h

where M is main steam mass flowrate, delta h is the change in enthalpy of the steam between steam generator pressure and atmospheric pressure.

The work done by the pump on the fluid is:

F * v * delta P

where F is the pump flowrate, v is the specific volume of the condensate tank water at 80° F, delta P is the change in pressure from atmospheric to steam Generator pressure. Using a steam table, for the two flow conditions described in the UFSAR, the maximum steam flowrate to the aux feedwater pump turbine may be calculated. It turns out to be about 25,000 lbm/hr.

Attachment A

Assumptions

- Each unit pumps are operated 6 times per year for 60 hours
- 2.5E4 lbm/hr is discharged
- No detectable Primary to Secondary Leak
- Steam Generator tritium activity is 1E-5 uCi/cc due to diffusion
- 82 Ci/yr of gaseous ^3H released from Plant Vent Stack (2010 ARERR)
- 870 Ci/yr of liquid ^3H released (2010 ARERR)
- Condensed steam is contained in air as water vapor at 100% humidity

  Since tritium is not released from the Condenser Evacuation System, only non-condensable gases, the Plant Vent Stack is used for this calculation.

Data

- 1lbm of saturated steam = 334 ft^3 (Steam Tables)
- 1 m^3 of air contains 30 g water vapor at 30 C° (100% humidity)
- 1 ft^3 = 0.02813 m^3

Calculations

Tritium Release Rate into atmosphere

2.5E4 lbm/hr * 334 ft^3/lbm * 0.02813 m3/ft^3 * 30 g/m^3 * 1E-5 uCi/cc * 1hr/3600 sec

= 2.0E-2 uCi/sec

Tritium Curies released into atmosphere

2.0E-2 uCi/sec * 60 hrs * 3600 sec/hr * 1E-6 Ci/uCi * 2 units = 8.6E-3 Ci

Percent of Tritium Curies Released from Plant Vent Stack

8.6E-3 Ci / 82 Ci (PVS) * 100 = 1E-2%

Effluent Impact

Dose (Camp Mesa)

2.0E-2 uCi/sec * 4.81E-3 mrem/yr per uCi/sec * 1 yr/8766 hrs * 60 hrs = 6.58E-7 mrem per year

4.81E-3 mrem/yr per uCi/sec from ODCM Table 2-6

Attachment B

Units 2 and 3 Turbine Building Leakage and Gland Seal Steam System Release Calculation

Assumptions

- Each unit seal steam operated for 8766 hrs/yr
- 2408 lbm/hr is discharged
- No detectable Primary to Secondary Leak
- Steam Generator tritium activity is 1E-5 uCi/cc due to diffusion
- 82 Ci/yr of gaseous ^{3}H released from Plant Vent Stack (2010 ARERR)
- 870 Ci/yr of liquid ^{3}H released (2010 ARERR)
- Condensed steam is contained in air as water vapor at 100% humidity

Since tritium is not released from the Condenser Evacuation System, only non-condensable gases, the Plant Vent Stack is used for this calculation.

Data

- 1lbm of saturated steam = 334 ft^3 (Steam Tables)
- 1 m^3 of air contains 30 g water vapor at 30 C^o (100% humidity)
- 1 ft^3 = 0.02813 m^3

Calculations

Tritium Release Rate into atmosphere

2408 lbm/hr * 334 ft^3/lbm * 0.02813 m3/ft^3 * 30 g/m^3 * 1E-5 uCi/cc * 1hr/3600 sec

= 1.9E-3 uCi/sec

Effluent Impact

Dose (Camp Mesa)

^{3}H: 1.9E-3 uCi/sec * 4.81E-3 mrem/yr per uCi/sec = 9.14E-6 mrem/yr

4.81E-3 mrem/yr per uCi/sec from ODCM Table 2-6

Attachment C

Units 2 and 3 Atmospheric Dump Valve Release Calculation

There are two atmospheric dump valves per unit with a maximum total of 1.5 E6 lbm/hr of relieving capacity depending on plant condition such as decay heat history, etc. If the valves are used during normal plant operations, they are throttled to a fraction of the maximum relieving capacity. Secondary systems tritium activity is due to diffusion across the Steam Generator tubes.

Assumptions

- Each unit dump valves are operated continuously at 100% for 100 hours per year
- 1.5E6 lbm/hr is discharged
- No detectable Primary to Secondary Leak
- Steam Generator tritium activity is 1E-5 uCi/cc due to diffusion
- 82 Ci/yr of gaseous ^3H released from Plant Vent Stack (2010 ARERR)
- 870 Ci/yr of liquid ^3H released (2010 ARERR)
- Condensed steam is contained in air as water vapor at 100% humidity

  Since tritium is not released from the Condenser Evacuation System, only non-condensable gases, the Plant Vent Stack is used for this calculation.

Data

- 1lbm of saturated steam = 334 ft^3 (Steam Tables)
- 1lbm = 2200 g
- 1 m^3 of air contains 30 g water vapor at 30 C° (100% humidity)
- 1 ft^3 = 0.02813 m^3

Calculations

Tritium Release Rate into atmosphere

1.5E6 lbm/hr * 334 ft^3/lbm * 0.02813 m3/ft^3 * 30 g/m^3 * 1E-5 uCi/cc * 1hr/3600 sec

= 1.2 uCi/sec

Tritium Curies released into atmosphere

1.2 uCi/sec * 100 hrs * 3600 sec/hr * 1E-6 Ci/uCi * 2 units = 0.8 Ci

Percent of Tritium Curies Released from Plant Vent Stack

0.8 Ci / 82 Ci (PVS) * 100 = 1.0%

Effluent Impact

Dose (Camp Mesa)

1.2 uCi/sec * 4.81E-3 mrem/yr per uCi/sec * 1 yr/8766 hrs * 100 hrs = 6.58E-5 mrem for the year

4.81E-3 mrem/yr per uCi/sec from ODCM Table 2-6

Attachment D

Units 2 and 3 Atmospheric Dump Valve Steam Flowrate Calculation

NN 201286374 SPT 5

Results:

The Tab "Summary Table" to Microsoft Excel spreadsheet "stmflow.xls" attached to this notification SPT assignment contains the table/methodology to estimate steam flow out of an Atmospheric Dump Valve (ADV) for various valve positions and steam generator pressure ranges.

Background:

Steam Flow instruments are not very accurate at the low flows of an ADVs, therefore it was decided the best/most accurate way to determine ADV flows at various ADV positions and steam pressures was to utilize the SONGS Simulator to attain flow values. The rational is that the simulator is model for SONGS so it should provide good predicted values.

Twelve simulator runs were completed. One run for each of the following ADV open positions: 5%, 10%, 15%, 25%, 30%, 35%, 45%, 55%, 65%, 80%, 90%, and 100%. The runs were started with simulator set for normal operating temperature (NOT) and pressure (NOP) with plant in Mode 3. The ADVS were run up to position slightly above the runs ADV position. For example for the 5% run, then ADV was at 5.1% open. The steam generator pressure was then allowed to drift down. The files from these runs data files were pulled. The data files contain five data columns. Data columns were for time into the run, ADV #1 position open, ADV #2 position open, Flow from ADV #1 in million lbm/hr, Flow from ADV #2 in million lbm/hr, steam generator #1 pressure in psia, and steam generator #2 pressure in psia. Simulator George Marengo provided these data files to Main Steam System Engineer Danny Lowenberg.

(Those files are being stored in the "reference" section of the Main Steam System Notebook. To get to these files go to data3 on sos2/ME&SE Library/Engineering Notebooks/ MSTM/References. The spreadsheet "stmflow.xls" will also be stored here.)

Each file was used as input for the applicable valve position tab on Microsoft Excel spreadsheet "stmflow.xls". It was observed at very high pressures that the ADV flow increased with decreasing pressure until a certain pressure was reached based on ADV valve position, then ADV flow would start to decrease with decreasing pressure. For the generation of the applicable valve position tab on Microsoft Excel spreadsheet "stmflow.xls" the steam generator pressure of highest steam flow was identified. Data fields from the data files for various pressures were copied onto the applicable valve position tab on spreadsheet "stmflow.xls". The data fields were always at slightly higher pressure then pressure desired ensuring conservative flows were attained. On the valve position tab the data was then summarized in table by using ADV #1 flow and ADV #1 pressure with the pressure rounded to down to whole value. The maximum pressure in the table was pressure that had the highest flow. This summary table from the individual valve position tab was then used as input to the Summary Table in the "Summary Table" tab of the spreadsheet.

Units 2 and 3 Atmospheric Dump Valve Steam Flowrate Calculation

NN 201286374 SPT 5

The Summary Table results were compared to results attained from actual ADV flow test on the units during the 1986/1987 time frame. Memorandum for File dated March 26, 1987, Subject: Atmospheric Dump Valve Capacity San Onofre Nuclear Generating station, Units 2 & 3 contains summary flow results of the testing corrected to 900 psia. The 100% open nominal flows in lbm/hr were 816,478 (3HV8419); 804,240 (3HV8421); 885,660 (2HV8419); and 800,320 (2HV8421). The Summary Table value for 100% open at 900 psia of 837,690 compares favorably with the as found test values.

The Memorandum for File provides additional flows corrected to 900 psia of other valve positions for 2HV8419 and 3HV8419. A comparison of the test nominal flow values at various positions to Summary Table flow values is provided below. Again the Summary Table values compare favorably with the test values.

			Summary Table	
Valve	Position	Flow	Position	Flow
3HV8419	68%	546,809	65%	543,370
3HV8419	50%	354,861	45%	375,350
3HV8419	40%	231,596	35%	289,730
2HV8419	64%	583,040	65%	543,370
2HV8419	23%	119,860	25%	208,420

The methodology for use is conservative in that it will in generally give greater values for flow than expected. The only non-conservative direction is that for brief open spikes in valve position (<15 seconds), the maximum valve position does not have to be used. The methodology for use is contain at top of the Table on the Summary Table and is repeated below.

Usage instructions

Enter Column for percent valve open and row associated for associated S/G pressure (PI1013/1023) read the corresponding million Lbms/hr in flow. If actual pressure >max reading for associated valve position, then use the highest flow value for that valve position. When actual steam generator pressure is not listed, then use the pressure in table that is just above actual.

When actual percent open is not listed, then use the percent open in the table that is just above actual. For large changes in ADV position or steam pressure, then use smaller duration to give better estimate of flow. Duration should not be greater than 15 minutes unless steam pressure is stable. Typically should use the highest open position during an duration. If the highest open position was held for less than 15 seconds, can use the highest position that valve was at or above for at least 15 seconds assuming duration period for flow calculation is at least 5 minutes.

Written by: Danny Lowenberg

Peer reviewed by: Wayne Hampton 3/16/11

SOUTHERN CALIFORNIA EDISON

San Onofre Nuclear Generating Station Carbon-14 Production, Release and Offsite Dose Calculation Methodology

Prepared by: Wayne Hamilton 6/18/12 Date

Reviewed by: Kathy Yhip 6/18/2012 Date

Approved by: James Domlow 6-18-2012 Date

This paper documents the methodology to estimate carbon-14 (C-14) production and C-14 gaseous waste effluent source terms at San Onofre Nuclear Generating Station (SONGS). The C-14 effluent source terms are used to estimate radiological doses from C-14 in site gaseous waste effluents. These estimates were generated in order to meet NRC requirements to incorporate C-14 in nuclear power plant 2010 Annual Radioactive Effluent Release Reports (ARERRs). The C-14 production and effluent source term estimates were based on EPRI methodology provided in EPRI Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents," December 2010. This document is applicable for estimating C-14 gaseous release activity and dose components for inclusion in future site ARERRs.

1.0 Scope

This paper documents the methodology for estimating carbon-14 (C-14) production and C-14 gaseous waste effluent source terms at SONGS Unit 2 and Unit 3. C-14 effluent source terms are used to estimate radiological doses from C-14 in site gaseous waste effluents. These estimates are generated in order to meet NRC requirements to incorporate C-14 in nuclear power plant 2010 Annual Radioactive Effluent Release Reports (ARERRs). The C-14 production and effluent source term estimates are based on EPRI methodology provided in EPRI Report 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents, December 2010. This paper is applicable for estimating C-14 gaseous release activity and dose components for inclusion in future SONGS ARERRs.

2.0 Background - NRC Updated Guidance on Reporting Routine Releases

NRC regulations establish limits for radionuclides that potentially could be released from a nuclear power plant. There are a limited number of radionuclides that are released in sufficient quantities and concentrations at any site to warrant reporting to the agency. Under guidance issued by the NRC in 1974, nuclear power plants treated all radionuclides as "principal radionuclides" and performed sensitivity analysis to determine the radionuclides that had to be included in their annual reports.

In June 2009, the NRC provided revised guidance in Regulatory Guide 1.21, Measuring, Evaluating and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, (RG 1.21) Revision 2, establishing a risk-informed approach for identifying principal radionuclides. SCE is not committed to implementation of Revision 2 of RG 1.21; SCE is committed to RG 1.21 Revision 1. However, there is new guidance in Revision 2 on the reporting of C-14 releases that is informative and useful in the preparation of the Annual Radioactive Effluent Release Report.

In Section 1.8 of Revision 2 of this document, the NRC revised guidance states, "if adopting a risk-informed perspective, a radionuclide is considered a principal radionuclide if it contributes either (1) greater than 1% of quarterly or yearly dose limits or (2) greater than 1% of the activity of all radionuclides in the type of effluent being considered."

In Section 1.9 of Revision 2t, the NRC states, "Radioactive effluents from commercial nuclear power plants...have decreased to the point that carbon-14 is likely to be a principal radionuclide...in gaseous effluents." In other words, while releases of carbon-14 have not increased, licensees' actions to reduce the quantity of radioactive effluents have been sufficiently successful that the decline in releases of other radionuclides now makes carbon-14 a more significant contributor in relative terms.

The same section goes on to state, "Carbon-14 releases in PWRs occur primarily as a mix of organic carbon and carbon dioxide released from the waste gas system ...Because the dose contribution of carbon-14 in liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of carbon-14 in liquid radioactive waste is not required." {emphasis added}

Section 1.9 of this report also specifies that, "The quantity of carbon-14 discharged can be estimated by sample measurements or by use of a normalized carbon-14 source term and scaling factors based on power generation..., or estimated by use of the GALE code from NUREG-0017." {emphasis added}

The NRC has clarified to EPRI and NEI that C-14 production estimates may be made using EPRI methodology (provided in EPRI Report 1021106). The EPRI methodology was developed because the GALE code from NUREG-0017 has no provision for C-14 production or release as a function of reactor power. The EPRI methodology estimates full power C-14 production rates for BWRs and PWRs using (1) either two or three unit specific core neutron flux energy groups, (2) "effective" neutron cross sections for the neutron energy groups, and (3) unit specific coolant mass exposed to the core neutron flux. The EPRI report also summarizes distribution of C-14 source terms for gaseous, liquid and solid releases in BWRs and PWRs based on C-14 measurements cited in literature.

3.0 EPRI Methodology for Estimating C-14 Production Rate in PWRs

Equation 1 is used to calculate the maximum annual production rate of C-14, PR_{MAX}, in curies for each unit (operating at full power (FP) for one year) via the $^{17}O(n,\alpha)^{14}C$ and $^{14}N(n,p)^{14}C$ reactions.

$$PR_{MAX} = \frac{N \bullet [\sigma_{th} \bullet \varphi_{th} + \sigma_i \bullet \varphi_i + \sigma_f \bullet \varphi_f] \bullet 1.0E\text{-}24 \bullet \lambda \bullet M \bullet 3.1536E{+}7}{3.7E{+}10}, \ Ci/yr \qquad [Eq\ 1]$$

where:

N	=	1.27E+22 atoms ^{17}O/kg H_2O or 4.284E+19 atoms ^{14}N/kg-ppm N
σ_{th}	=	"effective" thermal neutron cross-section (Table 2),
φ_{th}	=	"core average" thermal neutron flux at FP (Table 3), n/cm^2-s
σ_i	=	"effective" intermediate neutron cross-section (Table 2),
φ_i	=	"core average" intermediate neutron flux at FP (Table 3), n/cm^2-sec
σ_f	=	"effective" fast neutron cross-section (Table 2),
φ_f	=	"core average" fast neutron flux at FP (Table 3), n/cm^2-sec
1.0E-24	=	conversion factor, 1.0E-24 cm^2/barn
λ	=	C-14 decay constant, 3.833E-12/sec
M	=	total "active coolant mass" exposed to neutron flux, kg
3.1536E+7	=	conversion factor, 3.1536E+7 sec/yr (365 days/yr).
3.7E+10	=	conversion factor, 3.7E+10 disintegrations/sec-Ci

Table 1. SONGS Active Coolant Mass[a] and 100% Full Power Values

	Active Coolant Volume[a]	Active Coolant Mass[c]	Thermal Power
Unit 2	784 ft^3 [b]	15881.5 kg	3438 MWt
Unit 3	784 ft^3 [b]	15881.5 kg	3438 MWt

(a) Active coolant volume is the portion of reactor coolant exposed to the core neutron flux.
(b) Active coolant volume from N-0220-030 ECN A54033
(c) Active coolant mass = Active coolant volume (ft^3) x density correction at 100% power (20.257 kg/ft^3)

Table 2. "Effective" Neutron Cross-Sections for C-14 Production in PWRs[a]

Unit	Cross-Section[b]	$^{17}O(n,\alpha)^{14}C$ Reaction	$^{14}N(n,p)^{14}C$ Reaction
2 and 3	Thermal	0.121 barns	0.951 barns
	Intermediate	0.0291 barns	0.0379 barns
	Fast	0.1124 barns	0.0436 barns

(a) Values from EPRI Report 1021106 based on EPRI methodology.
(b) Thermal ≤0.625 eV, Intermediate >0.625 eV and < 1 Mev, Fast > 1 Mev

Table 3. "Core Average" Neutron Flux Values

Unit Cycle	Neutron Flux[a]	BOC n/cm^{2}s	MOC n/cm^{2}s	EOC n/cm^{2}s	Average n/cm^{2}s
U2 C17	FP thermal flux	3.482E+13	3.684E+13	4.355E+13	3.840E+13
	FP intermediate flux[b]	2.040E+14	2.094E+14	2.129E+14	2.088E+14
	FP fast flux[c]	7.356E+13	7.550E+13	7.677E+13	7.528E+13
U3 C17	FP thermal flux	3.428E+13	3.645E+13	4.369E+13	3.814E+13
	FP intermediate flux[b]	1.985E+14	2.064E+14	2.099E+14	2.049E+14
	FP fast flux [c]	7.155E+13	7.441E+13	7.568E+13	7.388E+13

(a) Full Power (FP) flux values from Plant Data Tables (M-38097, Unit 2 and M-38097, Unit 3) - Two neutron flux energy groups are listed: thermal (≤0.625 eV) and intermediate + fast (>0.625 eV).
(b) Intermediate = intermediate + fast (I+F) x 0.75
(c) Fast = (I+F) x 0.25

3.1 RCS Nitrogen Calculation

During power operation, coolant ammonia concentrations average between 0.6 and 1 ppm. Equation 2 estimates the C-14 production via the $^{14}N(n,p)^{14}C$ reaction using the yearly average ammonia concentration.

RCS N, ppm = (ppm ammonia) • (14 g N / 17 g NH_3) *[Eq 2]*

3.2 RCS/VCT Nitrogen Calculation

During power operation, coolant nitrogen concentrations are estimated from Volume Control Tank (VCT) overpressure. Equation 3 estimates the C-14 production via the $^{14}N(n,p)^{14}C$ reaction using the yearly average VCT pressure, temperature and percent N^2.

RCS N, ppm = (VCT N_2,mole fraction) • (28.01g N_2/mole) • (1E6 mg/kg) / (18.02 g H_2O/mole) *[Eq 3]*

where:

VCT N_2, mole fraction = (VCT N_2, atm) / [Henry's Constant (N_2), atm- mole N_2 / mole H_2O]

Henry's Constant, N_2 = [-3.6024 • (VCT Temp, deg F)^2 + 1284.6 • VCT Temp, deg F + 9290.5] atm – mole N_2 / mole H_2O

(VCT N_2, atm) = [(VCT N_2, %)/100) • (VCT pressure, psig +14.7) / 14.7

3.3 Calculation Results for Estimating C-14 Production Rates

Using the EPRI methodology described above in equation 1, the annual C-14 production rates in each of the unit are calculated. The results are reported in the ARERR.

For each unit, the cycle-averages of the maximum annual C-14 production rate are used for estimating gaseous pathway C-14 activity releases and dose contributions in the ARERR

The maximum annual C-14 production rate values are calculated using a PWR spreadsheet developed for EPRI by NWT Corporation for utility information purposes.

4.0 Estimating C-14 Gaseous Releases

For PWRs, EPRI Report 1021106 summarized the distribution of C-14 in release pathways as follows: gaseous 90% to 98%, liquid <1% and solid 2% to 10%. The report also states that 5% to 30% of C-14 in PWR gaseous waste effluents exists in the carbon dioxide form, which contributes to population dose via photosynthesis uptake in the food consumption cycle. EPRI Report 105715, Characterization of Carbon-14 Generated by the Nuclear Power Industry, November 1995, cited that the carbon dioxide form of C-14 averaged 20% in effluents from eight US and German PWRs.

For SONGS, C-14 gaseous dose calculations in the ARERRs are made using the following assumptions for each unit: (1) continuous release of the estimated C-14 generated during power operation based the number of effective full power days (EFPDs) for the period, (2) maximum C-14 activity literature values for gaseous releases cited in EPRI Report 11021106 (98%), and (3) average fraction of C-14 as carbon dioxide for gaseous releases referenced in EPRI Report 105715 (20%).

4.1 Equation 4 estimates the C-14 activity released, $A_{C\text{-}14}$, into the gaseous pathway during the time period for each unit.

$$A_{C\text{-}14} = PR_{MAX} \bullet 0.98 \bullet EFPD \,/\, \text{time period, days} \qquad \text{[Eq 4]}$$

where:

PR_{MAX}	=	maximum annual production rate of C-14, *Ci/yr*
0.98	=	fraction C-14 in PWR gaseous pathway releases (maximum literature value in EPRI Report 1021106,
EFPD	=	number of effective full power days for the unit during the time period, e.g. quarterly or yearly, days
Time period	=	number of days during the time period, e.g. quarterly or yearly, days

4.2 Equation 5 estimates the C-14 activity released in carbon dioxide form, $A_{C\text{-}14,\,CO2}$, into the gaseous pathway during the time period for each unit.

$$A_{C\text{-}14,\,CO2} = A_{C\text{-}14} \bullet 0.20,\ Ci \text{ (for time period)} \qquad \text{[Eq 5]}$$

where:

$A_{C\text{-}14}$	=	C-14 activity released into the gaseous pathway during the time period for each unit, *Ci/yr*
0.20	=	fraction of C-14 as carbon dioxide in PWR gaseous pathway releases (average value in EPRI Report 105715)

5.0 C-14 Gaseous Releases Dose Calculations

5.1 C-14 Inhalation Dose Calculation (Reg. Guide 1.109 Eq. C-3)

$C^{i}_{14}(r,\theta) = 3.17 \times 10^{4} \bullet Qi_{C\text{-}14} \bullet [X/Q](r,\theta)$

where:

$C^{i}_{14}(r,\theta)$	=	annual average ground-level concentration of C-14 in air at location (r,θ), pCi/m^3
$Qi_{C\text{-}14}$	=	release rate of C-14, Ci/yr, (*$A_{C\text{-}14}$ from Eq. 4*)
$[X/Q](r,\theta)$	=	average atmosphere dispersion factor at location (r,θ), sec/m^3 (using concurrent meteorology from RETDAS program), this value is not decayed or depleted since C-14 is released as organic (CH_3, etc) or inorganic (CO_2) and isotope C-14 half-life is greater than 5000 years

5.2 C-14 Food Pathway Dose Calculations

- Per the 2011 Land Use Census, the Milk pathway does not currently exist at SONGS

5.2.1 <u>C-14 Concentration in Vegetation</u> (Reg. Guide 1.109 Eq. C-8)

The concentration of C-14 in vegetation is calculated by assuming that its ratio to the natural carbon in vegetation is the same as the ratio of C-14 to natural carbon in the atmosphere surrounding the vegetation. (Reg Guide 1.109 Eq. C-8)

$C^{v}_{14}(r,\theta) = 3.17 \times 10^{7} \bullet p \bullet Q_{14} \bullet [X/Q](r,\theta) \bullet 0.11 / 0.16$

where:

$C^{v}_{14}(r,\theta)$	=	the concentration of C-14 in vegetation grown at location (r,θ), pCi/kg
p	=	1, fractional equilibrium ratio, (continuous release)
Q_{14}	=	annual release rate of C-14 as CO_2, Ci/yr (*$A_{C\text{-}14,\ CO2}$ from Eq. 5*)
$[X/Q](r,\theta)$	=	average atmosphere dispersion factor at location (r,θ), sec/m^3 (using concurrent meteorology from RETDAS program)
0.11	=	fraction of the total plant mass that is natural carbon
0.16	=	concentration of natural carbon in the atmosphere, g/m^3
3.17×10^{7}	=	1E+12 pCi/Ci • 1E+3 g/kg / 3.15E+7 sec/yr

5.2.2 <u>C-14 Concentration in Milk</u> (Reg. Guide 1.109 Eq. C-10)

$C^{m}_{14}(r,\theta) = F_m \bullet C^{v}_{14}(r,\theta) \bullet Q_f \bullet \exp\text{-}\lambda_i t_f$

where:

$C^{m}_{14}(r,\theta)$	=	the concentration of C-14 in milk at location (r,θ), pCi/liter
$C^{v}_{14}(r,\theta)$	=	the concentration of C-14 in animal feed, for C-14 this is the concentration of C-14 in vegetation grown at location (r,θ), pCi/kg
F_m	=	average fraction of daily intake of C-14 which appears in milk, Reg. Guide 1.109 Table E-1, (carbon = 1.2E-2)
Q_f	=	amount of feed consumed by animal per day, Reg. Guide 1.109 Table E-3, (cow = 50 kg/day)
$\exp\text{-}\lambda_i t_f$	=	1, due to C-14 half-life greater than 5000 years

5.2.3 <u>C-14 Concentration In Meat</u> (Reg. Guide 1.109 Eq. C-12)

$C^F_{14}(r,\theta) = F_f \bullet C^v_{14}(r,\theta) \bullet Q_f \bullet exp\text{-}\lambda_i t_f$

where:

$C^m_{14}(r,\theta)$	=	the concentration of C-14 in animal flesh at location (r,θ), pCi/kg
$C^v_{14}(r,\theta)$	=	the concentration of C-14 in animal feed, for C-14 this is the concentration of C-14 in vegetation grown at location (r,θ), pCi/kg
F_m	=	average fraction of daily intake of C-14 which appears in each, kilogram of flesh, Reg. Guide 1.109 Table E-1 (carbon = 3.1E-2)
Q_f	=	amount of feed consumed by animal per day, Reg. Guide 1.109 Table E-3 (cow = 50 kg/day)
$exp\text{-}\lambda_i t_f$	=	1, due to C-14 half-life greater than 5000 years

5.2.4 Annual C-14 Dose by Food Exposure Pathway (Reg. Guide 1.109 Eq. C-13)

Leafy Vegetables = $DFI_{C\text{-}14ja} \bullet U^v_a \bullet f_g \bullet C^v_{14}(r,\theta)$

Milk = $DFI_{C\text{-}14ja} \bullet U^m_a \bullet C^m_{14}(r,\theta)$

Meat = $DFI_{C\text{-}14ja} \bullet U^F_a \bullet C^F_{14}(r,\theta)$

Non-Leafy Vegetables = $DFI_{C\text{-}14ja} \bullet U^L_a \bullet f_l \bullet C^v_{14}(r,\theta)$

where:

$DFI_{C\text{-}14ja}$ = C-14 dose conversion factor for organ (j) and age group (a) Reg. Guide 1.109 Tables E-11 through E-14

where the following are from Reg. Guide 1.109 Table E-15:

U^v_a	=	ingestion rate of non-leafy vegetables by age group (a), kg/yr
f_g	=	0.76, fraction of non-leafy vegetables ingested grown in garden
U^m_a	=	ingestion rate of milk by age group (a), liters/yr
U^F_a	=	ingestion rate of meat by age group (a), kg/yr
U^L_a	=	ingestion rate of leafy vegetables by age group (a), kg/yr
f_l	=	1.0, fraction of leafy vegetables ingested grown in garden

5.2.5 C-14 Total Dose

The C-14 total dose in mrem at receptor (r,θ) is the sum of the exposure pathways which exist at that location per the Land Use Census. The highest receptor annual dose, age group, critical organ, sector and exposure pathway are reported in the ARERR.

6.0 References

6.1 Regulatory Guide 1.21, Measuring, Evaluating and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, Revision 2

6.2 Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluation Compliance with 10 CFR Part 50, Appendix I, Revision 1

6.3 EPRI Report 1024827, Carbon-14 Dose Calculation Methods at Nuclear Power Plants, April 2012

6.4 EPRI Report 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents, December 2010

6.5 EPRI Report 105715, Characterization of Carbon-14 Generated by the Nuclear Power Industry, November 1995

6.6 N-0220-030 Rev. 0 ECN A54033, SONGS Units 2 and 3 Transient Analysis Model (TAM): Reactor Coolant System Volumes

6.7 M-38097 Rev. 39, Plant Physics Data Book Unit 2 Cycle 17

6.8 M-38098 Rev. 29, Plant Physics Data Book Unit 3 Cycle 16

6.9 Radiological and Dose Assessment Software (RETDAS), Version 3.6, Canberra Industries, Inc.

February 2001

SUBJECT: Offsite Dose Calculation Manual Changes
Safety Evaluation for Modifying References to 10 CFR 50.59

INTRODUCTION

In 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 50.59, "Changes, Tests and Experiments," contains requirements for the process by which licensees may make changes to their facilities and procedures as described in the safety analysis report, without prior NRC approval, under certain conditions. The rule was promulgated in 1962 and revised in 1968.

A proposed new rule was published for comment in October 1998. Following consideration of public comments, on October 4, 1999 the NRC issued a final revision to 10 CFR 50.59 that will become effective March 12, 2001. The new program is scheduled for implementation at San Onofre on July 31, 2001.

DISCUSSION

Following publication of the revised rule, the Nuclear Energy Institute (NEI) submitted a guidance document for the implementation of 10 CFR 50.59 and requested NRC endorsement through a regulatory guide. Subsequently, NEI submitted document NEI 96-07 for endorsement.

According to Regulatory Guide 1.187, Revision 1 of NEI 96-07, "Guidelines for 10 CFR 50.59 Evaluations," dated November 2000, provides methods that are acceptable to the NRC staff for complying with the provisions of 10 CFR 50.59.

The new 10 CFR 50.59 (c) (4) states: The provisions in this section do not apply to changes to the facility or procedures when the applicable regulations establish more specific criteria for accomplishing such changes. NEI 96-07 clarifies that statement to include 'Offsite Dose Calculation Manual changes controlled by technical specifications_.' San Onofre Licensee Controlled Specification 5.5.2.1.1 provides the specific criteria for accomplishing ODCM changes.

5.5.2.1.1 Licensee-initiated changes to the ODCM:

a. Shall be documented and records of reviews performed shall be retained. This documentation shall contain:
   1. Sufficient information to support the change(s) together with the appropriate analyses or evaluations justifying the change(s);
   2. A determination that the change(s) maintain the levels of radioactive effluent control required by 10 CFR 20.106, 40 CFR 190, 10 CFR 50.36a, and 10 CFR 50, Appendix I, and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.
   3. Documentation of the fact that the change has been reviewed and found acceptable.

b. Shall become effective upon review and approval by the Vice President-Nuclear Generation or his designee.
c. Shall be submitted to the NRC in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Radioactive Effluent Release Report for the period of the report in which any change in the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (i.e. •• month and year) the change was implemented.

February 2001

SUBJECT: Offsite Dose Calculation Manual Changes
Safety Evaluation for Modifying References to 10 CFR 50.59

To reflect the changes in the regulatory guidance, ODCM section 6.3.1.1.a will be changed as follows:

from:
"A summary of the evaluation that led to the determination that the change could be made in accordance **with 10 CFR 50.59**";

to:
"A summary of the evaluation that led to the determination that the change could be made in accordance **with applicable regulations**".

As part of the implementation of the revised 10 CFR 50.59, a separate procedure is being implemented for effluent evaluations. Included in the procedure will be a checklist of related regulations, regulatory guidance, and licensing basis documents to ensure a comprehensive review. The effluent evaluations will be performed by qualified personnel for changes to the ODCM as well as design changes. Other regulatory guidance documents (e.g. NRC Information Bulletin 80-10, NRC Information Circular 80-18, NRC Generic Letter 81-38) also refer to performing a 10 CFR 50.59 evaluation for situations that could affect the control of radioactive effluents. Wherever the regulatory guidance refers to a 10 CFR 50.59 evaluation that addresses the potential for creating or modifying the control of radioactive effluents, an effluent evaluation using the new procedure will be performed instead.

CONCLUSION
The purpose of the ODCM is to ensure compliance with regulations regarding dose and curies released, setpoint calculations, sampling and monitoring of effluent pathways, and control and maintenance of radiation monitors. This new method of change evaluation more directly addresses these issues through a set of review questions developed as a method for evaluating changes to the ODCM. These questions will replace the 50.59 evaluation and will be used to assess the effects related to ODCM changes.

Effluent evaluations will be performed by qualified personnel in accordance with a site procedure to ensure compliance with all applicable regulations and regulatory guidance. As such, there will be no increase in radioactive effluents released to the environment and no increase in dose to a member of the public.

February 2001

SUBJECT: Offsite Dose Calculation Manual Changes
Safety Evaluation for Modifying References to 10 CFR 50.59

1. May the proposed activity increase the probability of occurrence of an accident evaluated previously in the safety analysis report?

No.

The Licensee Controlled Specifications provide the guidance necessary to ensure that ODCM changes reflect the requirements of the specific controlling regulations. The ODCM has no effect on the probability of accidents and therefore this change will not increase the probability of occurrence of any previously evaluated accident.

2. May the proposed activity increase the consequences of an accident evaluated previously in the safety analysis report?

No.

The proposed change is an administrative change that does not affect operation of equipment or the facility. It does not influence any credible accident at Units 2/3 - a release due to leakage or failure of a radioactive waste system (section 15.7.3.2); and the postulated failure of a liquid tank (section 15.7.3.3). As such, this activity cannot increase the consequences of an accident previously evaluated in the UFSAR.

3. May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety evaluated previously in the safety analysis report?

No.

The ODCM has no effect on the operability of any equipment. It provides guidance for determining whether some equipment important to safety is operable and in some cases provides compensatory action to mitigate for inoperable equipment used to collect, transfer, treat, or discharge radioactive effluents. Therefore this change has will not increase the probability of occurrence of a malfunction of equipment important to safety.

4. May the proposed activity increase the consequences of a malfunction of equipment important to safety evaluated previously in the safety analysis report?

No.

The ODCM does not alter operation of important to safety equipment nor does it change the frequency of operation of the equipment, it cannot increase the consequence of a malfunction of equipment important to safety evaluated previously in the safety analysis report.

5. May the proposed activity create the possibility of an accident of a different type than any evaluated previously in the safety analysis report?

No.

Operation of plant equipment is not modified by this activity and therefore cannot create the possibility of an accident of a different type than any evaluated previously in the safety analysis report.

SUBJECT: Offsite Dose Calculation Manual Changes
Safety Evaluation for Modifying References to 10 CFR 50.59

6. May the proposed activity create the possibility of a malfunction of equipment important to safety of a different type than any evaluated previously in the safety analysis report?

No.

The ODCM does not alter operation of important to safety equipment nor does it change the frequency of operation of the equipment. The proposed change creates a set of screening questions that ensure that ODCM and design changes are reviewed for their effect related to applicable regulations and controlling documents. These questions require review of specific regulations, licenses, and safety analysis reports. Changes to the new method will not create the possibility of a malfunction of equipment important to safety of a different type than any evaluated previously.

7. Does the proposed activity reduce the margin of safety as defined in the basis for technical specification?

No.

The Licensee Controlled Specification currently requires and will continue to require (1) justification for ODCM changes, (2) no adverse impact to effluent controls, and (3) documentation of adequate review for acceptability. Currently, changes to the ODCM are evaluated using the 10 CFR 50.59 process.

The current process ensures that the ODCM provides adequate instruction to ensure that the requirements of applicable regulations are fulfilled. The proposed process will specifically callout each regulation against which changes to the ODCM are to be evaluated. Evaluating ODCM changes against these criteria has been, and will continue to be, the standard. The new method simply will ensure that all applicable requirements are considered. Chemistry procedures changes and review question development are in progress that will ensure the Technical Specification requirements are met and that there is no reduction in the margin of safety. There will be no resultant dose to a member of the public and no reduction in the margin of safety for any licensing specification or in the control of radioactive effluents as required by 10 CFR 20 and 10 CFR 50.

Title: Site Boundary Sample Garden Relocation.

Activity/Document Number/NN: 203063159-084

Brief description of activity: The garden relocation is needed to accommodate changes in the owner controlled area, and the need to provide irrigation for sample viability in drought conditions. The new location remains in the same downwind sector (highest D/Q sector) as the current garden location (Sample collection performed in lieu of milk sampling due to the absence of dairy farms within 30 miles of the station). This new location is in the same sector as the current garden (location #6), but in the middle of sector R (NNW) vs. near the border with sector A (N). However, dispersion modelling assumes a sector average value across the width of the sector at a given distance thereby averaging out small differences in the compass direction within a primary wind sector. The new location is also further out (0.7 miles from the center point between the Unit 2 and Unit 3 vent release points vs 0.4 miles from the current site boundary garden which is necessary to accommodate changes in the owner controlled area). The additional distance does not change this garden as the controlling location for most radionuclides. This new location is adjacent to air sampling station #11 and will be designated location 6'; a location with functional irrigation. This will ensure adequate samples during harvest; a challenge during the 6 year drought with the current garden location 6. This location is also located on SONGS controlled property enclosed with a chain link fence. With the decommissioning and deconstruction of SONGS structures on the MESA, the current garden is no longer on property controlled by SONGS; it is on property returned to the Department of the Navy. The ODCM will note the date of the location switch, and it will be mentioned in the annual AREOR so that any trend shifts/changes in analytical results not otherwise accounted for may be attributed to the increased distance from the plant.

New SONGS Garden Location, 6', at AP sample location 11.

Performed by Qualified Screener: David A. Montt Date: 01/15/2015
Independent Reviewer: Mark Strum Date: 01/19/2015
Approved by Supervisor, Effluent Engineering (or designee)
Carla Cook Date: 07/15/2015

November 4, 2014

B. D. METZ

SUBJECT: Correlation – Effluents and Environmental Data

REFERENCES:

1. Memorandum M Goeders to EM Goldin, February 28, 1994, Documentation of the Correlation Study for 1992
2. Memorandum for File, EM Goldin, February 13, 2004, Compliance with 10 CFR 50, Appendix I, Section IV B, AR 040101459-1
3. SO123-IX-1.10, Review, Analysis and Reporting of Radiological Environmental Monitoring Program (REMP) Data, Rev. 10
4. 2013 Annual Radiological Environmental Operating Report, San Onofre Nuclear Generating Station Units 1, 2, & 3, May 2014

OBJECTIVE: Regulations in 10 CFR 50, Appendix I, Section IV B, Subparagraph 2 requires "data on measurable levels of radiation and radioactive materials in the environment to evaluate the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals . . ." This memorandum reviews the evaluation of the relationship between effluent releases and doses as assayed by the Radiological Environmental Monitoring Program (REMP).

DISCUSSION

In the 1990's, each year an analysis was performed to determine the relationship between effluent releases and environmental sample results. An example of a very rigorous calculation may be found in Reference 1. That level of evaluation was determined to be unnecessary (Reference 2) as long as actions were in place to trigger an evaluation if environmental samples exceeded some predetermined values. This position was developed because:

- Based on an anecdotal industry survey, many nuclear plants in the US do not conduct any specific evaluation on an annual basis (existing REMP and Effluent program controls satisfy the requirement)
- REMP samples rarely indicate any detectable plant-related radioactivity in the plant environs (i.e. there can be no public dose if there is no detectable radioactivity in the immediate environment)
- Many plants trigger an evaluation when REMP samples exceed investigation levels

In order to ensure that a proper evaluation would be completed if necessary, Reference 2 recommended procedure changes to incorporate action levels. That was completed and the following requirements are in place:

Procedure SO123-IX-1.10 (Reference 3) includes the following requirements:

6.2.2.2.4 IF any REMP sample results exceed administrative limits and are verified to be above the detection limit, THEN the Radiological Effluent and Environmental Specialist or designee SHALL either resolve the issue by laboratory recounts or additional sampling, or generate a Notification with a task assigned to the Radiological Effluent and Environmental Specialist or designee to evaluate the data.

6.2.2.2.5 If any REMP sample results exceed the administrative limit(s) and the results are also greater than the detection limits then generate an additional task assigned to Radiation Protection requesting a peer check of the Radiological Effluent and Engineering Specialists' evaluation.

6.2.2.2.6 A summary of the data evaluation shall be included in the Annual Radiological Environmental Operating Report (AREOR).

6.2.2.2.7 The investigation SHALL compare the expected concentration of radionuclides in REMP samples to that actually observed, or provide a basis for explaining why the detection of radionuclides in the REMP sample(s) should be expected at the observed levels.

These procedural requirements adequately implement the regulatory requirements for an evaluation of the relationship, should one ever need to be completed.

SONGS COMPLIANCE FOR 2013

The 2013 Annual Radiological Environmental Operating Report (Reference 4) included the following verbiage (page 29):

L. Correlation of Effluent Concentrations to Concentrations in the Environment

In accordance with 10 CFR 50 Appendix I, IV.b.2 data on measurable levels of radiation and radioactive materials in the environment have been evaluated to determine the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure.

The REMP soil Cs-137 levels in the control and indicator samples are statistically equivalent, leading to the conclusion that Cs-137 in soil is attributable to residual fallout from external anthropogenic factors such as nuclear weapons testing, Chernobyl, and Fukushima Dai-Ichi.

Data from 2013 continue to support the historical conclusion that the measured concentration of I-131 in kelp is not increasing near SONGS, and is not statistically higher around SONGS than it is at the control locations. I-131 in kelp is due to the release of medical administrations to the ocean from sewage treatment facilities. The effluent based correlation calculation indicates that I-131 activity in kelp attributable to the operation of SONGS would be undetectable and the resultant doses to individuals would be negligible.

> The data from air samplers close to SONGS, the data from air samplers further away, and the data from the Oceanside control sampler are statistically equal.

This wording addresses the question regarding the evaluation but not very clearly. Therefore, the following section, applicable to the calendar year 2013, is recommended for future AREORs:

> REMP samples, both terrestrial and marine, indicated no accumulation of plant-related radioactivity in the environs. No samples, as shown in Table B-2, exceeded investigation levels and, in fact, all samples with detectable activity were not statistically different from controls and were therefore attributed to non-plant-related sources – past nuclear weapons fallout, Chernobyl, Fukushima, and medical iodine releases in sewerage. As such, the operations of SONGS did not have any measurable effect on the environment.
>
> The regulatory requirement to evaluate the relationship between quantities of radioactive materials released in effluents and the resultant radiation doses to individuals may be summarized by the following conclusion:
>
> Effluent program releases are evaluated annually to determine the receptor(s) with the highest hypothetical dose. REMP samples collected through the year indicated no significant accumulation of plant-related radioactivity above control locations, therefore providing assurance that the effluent program projections are consistent with radiological environmental measurements. The concentrations of plant-related radioactivity in environmental samples were less than expected based on effluent releases, further demonstrating program conservatism.

Prepared by
November 4, 2014

Eric Goldin, CHP

Reviewed by

Sandy Sewell, CHP

cc: C. A. Cook
J. B. Janke
J.B. Moore (BHI)

Remove Controlling Location Factors Tables 2-7 and 2-8 (South Yard Facility and North Industrial Area) and Associated Ri Tables in Appendix A from the ODCM

References:

1. 12/11/94 EM Goldin to PK Chang, Southyard Facility Dispersion and Deposition Factors for Potential Normal Gaseous Effluent Releases; Determination of Compliance with 10 CFR 50, Appendix I
2. 2/7/07 JW Scott to D Dick, 2007 Dose Parameters for SONGS Unit 1 and Units 2/3
3. 2/11/08 JW Scott to D Dick, 2008 Dose Parameters for San Onofre Nuclear Generating Station
4. 2/9/11 JW Scott to L McCann, 2011 Dose Parameters for San Onofre Nuclear Generating Station South Yard Facility and North Industrial Area
5. NRC Regulatory Guide 1.21, Rev. 1, Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste

Background:

The original Offsite Dose Calculation Manual (ODCM) applied to SONGS Unit 1 only. Once Units 2/3 were operating, a separate ODCM was created for those two newer units. In later years, dose parameter tables (R_i) and effluent calculation provisions were added to the ODCM for the South Yard Facility (SYF), see Reference 1 for the earliest analysis. Eventually after Unit 1 was permanently retired from service, the Unit 1 ODCM was combined with the Units 2/3 ODCM and a sitewide document was created (References 2 and 3). The area that housed Unit 1, designated as the North Industrial Area or NIA after Unit demolition, was used for potentially contaminated equipment staging, such that eventually dose parameters tables for the NIA were included in the single ODCM in place of the Unit 1 tables.

Discussion:

In late 2014, radioactively contaminated equipment was removed from the NIA and that area was released from Restricted Area (RA) designation. Some of the SYF was also removed from RA status to support equipment staging for SONGS decommissioning. There is no longer an airborne radioactive effluent source at either the NIA or the SYF. Therefore, there is no need for Controlling Location Factors or R_i tables in the ODCM for these two areas.

The Glossary in the most recent Reference 5 (Revision 2, 2009) defines the points that require monitoring:

> significant release point—Any location, from which radioactive material is released, that contributes greater than 1 percent of the activity discharged from all the release points for a particular type of effluent considered. Regulatory Guide 1.109 lists the three types of effluent as (1) liquid effluents, (2) noble gases discharged to the atmosphere in gaseous radioactive waste, and (3) all other radionuclides discharged to the atmosphere in gaseous radioactive waste.

Even the Revision 1 (1974) of that Regulatory Guide noted that:

Continuous monitoring should be conducted along principal gaseous effluent discharge paths.

Since the NIA no longer has any radioactive material other than the Unit 1 Reactor Pressure Vessel, a sealed solid radioactive waste container and the ISFSI, housing only sealed airtight canisters, and the SYF is no longer used for any significant radioactive equipment refurbishment, neither of these locations is considered a "significant release point" nor a "principal discharge path" and therefore do not require airborne effluent monitoring. As such, there is no need for controlling location factors or dose parameters specific to either area in the ODCM. Note that Reference 4 pointed out that there were no airborne effluent releases from the SYF even in 2011 during supporting operations of Units 2/3.

CONCLUSION:

Remove the NIA and SYF Controlling Location Factors and Ri tables from the SONGS ODCM.

Other SYF and NIA dose calculation parameters may remain in the ODCM in case some radiological work is conducted in either location in the future during decommissioning support activities. When the facility is no longer going to be used to support radiological work, the SYF and NIA offsite dose calculation provisions may be removed as well.

Remove Controlling Location Factors Tables 2-7 and 2-8 (South Yard Facility and North Industrial Area) and Associated Ri Tables in Appendix A from the ODCM

TABLE 2-7

SOUTH YARD FACILITY CONTROLLING LOCATION FACTORS[1]

Radionuclide	$\Sigma_k R_{ik} W_k$ mrem/yr per µCi/sec	Use:
H -3	1.43E-3	R: Camp Mesa
Cr-51	5.65E-2	R: Camp Mesa
Mn-54	1.21E+1	R: Camp Mesa
Co-57	2.45E+0	R: Camp Mesa
Co-58	4.13E+0	R: Camp Mesa
Co-60	1.66E+2	R: Camp Mesa
Sr-89	8.59E+0	P: Cotton Point Gardens
Sr-90	3.37E+2	P: Cotton Point Gardens
Zr-95	4.74E+0	R: Camp Mesa
Nb-95	1.82E+0	R: Camp Mesa
Ru-103	1.64E+0	R: Camp Mesa
Te-129m	2.34E+0	R: Camp Mesa
Cs-134	4.84E+1	R: Camp Mesa
Cs-136	1.08E+0	R: Camp Mesa
Cs-137	7.11E+1	R: Camp Mesa
Ba-140	2.35E+0	R: Camp Mesa
Ce-141	7.70E-1	R: Camp Mesa
Ce-144	1.48E+1	R: Camp Mesa
I -131	1.77E+1	R: Camp Mesa
I -132	2.18E-1	R: Camp Mesa
I -133	4.20E+0	R: Camp Mesa
I -134	5.93E-2	R: Camp Mesa
I -135	8.87E-1	R: Camp Mesa
UN-ID	6.65E+0	R: Camp Mesa

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

Remove Controlling Location Factors Tables 2-7 and 2-8 (South Yard Facility and North Industrial Area) and Associated Ri Tables in Appendix A from the ODCM

TABLE 2-8

NORTH INDUSTRIAL AREA (UNIT 1) CONTROLLING LOCATION FACTORS[1]

Radionuclide	$\Sigma_k R_{ik} W_k$ mrem/yr per µCi/sec	Use:
H -3	5.46E-3	A: Camp Mesa
Cr-51	2.42E-1	B: Camp Mesa
Mn-54	5.54E+1	B: Camp Mesa
Co-57	1.17E+1	B: Camp Mesa
Co-58	1.80E+1	B: Camp Mesa
Co-60	7.82E+2	B: Camp Mesa
Sr-89	1.82E+1	Q: SC Res. With Garden
Sr-90	7.16E+2	Q: SC Res. With Garden
Zr-95	1.93E+1	A: Camp Mesa
Nb-95	7.68E+0	B: Camp Mesa
Ru-103	6.80E+0	A: Camp Mesa
Te-129m	9.04E+0	A: Camp Mesa
Cs-134	2.32E+2	B: Camp Mesa
Cs-136	5.17E+0	B: Camp Mesa
Cs-137	3.40E+2	B: Camp Mesa
Ba-140	9.07E+0	A: Camp Mesa
Ce-141	3.01E+0	A: Camp Mesa
Ce-144	5.68E+1	A: Camp Mesa
I -131	6.77E+1	A: Camp Mesa
I -132	8.36E-1	A: Camp Mesa
I -133	1.60E+1	A: Camp Mesa
I -134	2.29E-1	A: Camp Mesa
I -135	3.40E+0	A: Camp Mesa
UN-ID	3.02E+1	B: Camp Mesa

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

RADWASTE PROCESSING TECHNIQUES AIRBORNE EFFLUENT EVALUATION

December 20, 1999

INTRODUCTION

Decommissioning of Unit 1 will involve the removal of equipment, systems, and structures that are contaminated or have previously been contaminated or exposed to radioactive materials. Dismantlement and disposition of the resultant materials and wastes may include physically cutting the components, decontamination of the items, and packaging for shipment and disposal.

This Memo to File evaluates the potential for creating radioactive effluents (airborne and liquids) from several preparation and packaging methods. This memo does not address processing or handling of mixed wastes (both radioactive and hazardous). This memo does not address work activities other than those performed at previously analyzed and established locations; it does not, for example, consider work performed outside the owner controlled area located on the Grant of Easement. This memo provides recommendations to ensure compliance with regulatory requirements for the control of radioactive effluents and a generic evaluation of those methods with regards to the requirements of 10 CFR 50.59.

DISCUSSION

Title 10 to the Code of Federal Regulations Part 50 Appendix A specifies the design criteria for construction and operation of a nuclear power plant. In particular, General Design Criteria 63 and 64 respectively require monitoring of radioactive waste systems and associated handling areas and effluent discharge paths. There are also several regulatory guidance documents (NUREG-0472, NUREG-0800 section 11.4, and Reg Guide 1.143) that reiterate the need for monitoring either the waste treatment systems' discharge or the exhaust of building(s) that house those systems.

Treatment techniques used to reduce or remove radioactivity from contaminated materials and equipment are considered radwaste processes. As such, either the exhaust from those systems used to perform the processing or treatment or the exhaust from the buildings in which the systems are housed must be monitored. Previous documents[1, 2] generated at the site have also evaluated radwaste treatment techniques and provided recommendations for effluent controls. The reader should review those documents in addition to this memo for guidance; the constraints established in reference 1 are considered applicable.

Whenever possible, radwaste processes (e.g. treatment, decontamination, and packaging) shall be conducted inside buildings that exhaust through an ODCM-credited release point and are monitored and sampled isokinetically. At the same time, the existing buildings cannot accommodate all of the components being removed or the processing equipment. It is likely that temporary work enclosures will be established outside of the existing buildings with monitored HVAC system (radwaste auxiliary building, containment). Unfortunately, it is not always practical to duct the exhaust from the work enclosure to a monitored building for discharge through the Plant Vent Stack.

Because of the time since shutdown (November 1992), noble gases are no longer produced and the radioiodines have decayed away. Work activities, particularly those that use mechanical or abrasive methods, can generate and resuspend radioactive particulate matter. To remove the particulate matter prior to discharge to atmosphere, HEPA units shall be placed on the exhaust from each work enclosure or on the discharge from the equipment itself. The HEPA units are commercially rated at a minimum of 99% efficiency and must be periodically verified to ensure integrity and loading within design specifications. For work performed in temporary enclosures or unmonitored buildings, surface contamination levels shall be maintained within the limits established in the referenced design calculation for a closest analyzed location[2]. For destructive decontamination methods, the contamination limits for the CO_2 blast room at the South Yard Facility (sheet 9v) should be applied. According to the Unit 1 Decommissioning Project radwaste team[3], total contamination levels are not expected to exceed 1E6 dpm/100 cm^2.

As discussed previously, the only anticipated airborne effluents attributable to these work activities are in particulate form. Regulatory Guide 1.21 and Regulatory Guide 1.97 note that instantaneous monitoring for particulate matter or radioiodines is not typically considered practical due to technological limitations. Accordingly, sampling will be used instead of monitoring to determine whether or not there has been a release of airborne effluents due to radwaste processing and handling, and to quantify the amount of activity released. Continuous samples for particulate matter will be taken downstream of the HEPA units for each work enclosure and analyzed weekly as an effluent sample. Any activity detected will be reported to the NRC in the Annual Radioactive Effluent Release Report in accordance with 10 CFR 50.36a.

Work activities that generate or involve liquids shall include measures to control spills and prevent an unmonitored release to local area drains and subsequently the unrestricted area. As appropriate, measures may include temporary berms or secondary containment. Waste water generated by decommissioning activities shall be disposed of properly in accordance with established Station procedures to prevent violation of either NRC requirements or conditions of the NPDES permit. In addition, care must be taken to prevent the inadvertent contamination of radioactively "clean" systems like domestic water supply and the sanitary sewer system. Radioactive liquids or wastewater generated from a radwaste treatment process shall not be released to the storm or yard drains.

Written procedures must be developed for the performance of the activities discussed in this document. Additionally, if a work location is established or a treatment technique is used for a period that extends (or is anticipated to extend) beyond the Defueled Safety Analysis Report (DSAR) update cycle (2 years), the DSAR should be updated to reflect the new techniques or work areas not already described. Changes to treatment techniques or systems (equipment, piping) that are used to transfer, treat, dispose of, or store radioactive wastes require a review of this evaluation or performance of a separate evaluation per NRC IE Bulletin 80-18 and 10 CFR 50.59. Failure to review and modify this evaluation, establish procedures, or update the DSAR may result in violation of regulatory or administrative requirements.

RADWASTE PROCESSING TECHNIQUES AIRBORNE EFFLUENT EVALUATION

TECHNIQUE	DESCRIPTION	AIRBORNE MONITORING	LIQUID MONITORING[c]	COMMENTS
Splitter	Mechanical sawing/cutting to open pipes >3" in diameter	Y[a]	N	
Shearing, sawing, torch cutting	Mechanical process to adjust size of structural steel, piping, conduit, cable trays, sheet metal, and concrete	Y[a]	N	Work enclosure
Abrasive blasting	Physical removal of surface coating and/or contamination from carbon steel, typically 2'*1.5'*10' sections.	Y[a]	N	Verify booth integrity. Perform HEPA checks. May be hazardous waste.
Bead blasting	Physical process to remove surface coating and/or contamination from non-ferrous materials, small parts etc	Y[a]	N	Verify booth integrity. Perform HEPA checks. May be hazardous waste
Washing surface treatment	Cleaning using mild liquid chemicals on non-ferrous materials, small parts, instrument parts, etc	N	Y	
Surface wiping	Manual removal of contamination from flat surfaces	N	Y	May create mixed waste
Crushing metal	Mechanical crushing of <10" CS & SS pipe, 200 tons	Y[a]	N	Work enclosure. Perform HEPA checks.
Concrete rubblizer	Mechanical crushing of concrete blocks containing rebar	Y[a]	N	Dust control measures
Shredding (DAW)	Mechanical shredding of soft materials	Y[b]	N	Perform HEPA checks
Compaction	Volume reduction of DAW etc in 55 or 100 gal drums as part of packaging	Y[b]	N	Perform HEPA checks. Use established locations
Handling	Hoppers, conveyors, forklifts for moving equipment, waste, containers etc from one location to another	N	N	Use established controls
Container refurbishment	Routine maintenance to ensure container integrity	Y[a]	N	Use established controls and locations

[a] Monitored HVAC or local air samples
[b] Monitored HVAC required
[c] Monitored release point or routing to liquid radwaste treatment or spill prevention measures

The above table summarizes the processes considered in this memo to file.

Kathleen Yhip

Kathleen Yhip, HP&E

cc: D. Dick, Effluent Engineering
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EFFLUENT SAFETY EVALUATION

1. **May the proposed activity increase the probability of occurrence of an accident evaluated previously in the SAR?**

NO.
The only remaining Unit 1 accident that is evaluated in the DSAR is the Fuel Handling accident. The proposed decontamination and packaging activities will not affect the Fuel Handling accident nor can they increase the probability of the accident occurring.

2. **May the proposed activity increase the consequences of an accident evaluated previously in the SAR?**

NO
The proposed activities to dismantle equipment at Unit 1 and, as necessary, reduce or remove radioactivity from the materials prior to final disposal are similar to existing decontamination techniques used at SONGS. These radwaste processes involve activity inventories well below that considered in the Fuel Handling scenario at Unit 1. Furthermore, the dose consequences of the Fuel Handling accident are in no way affected by the proposed activities.

3. **May the proposed activity increase the probability of occurrences of a malfunction of equipment important to safety evaluated previously in the SAR?**

NO
The Unit 1 DSAR describes existing techniques for decontamination used at SONGS. None of the systems or equipment used to perform these processes is considered important to safety. As such, there is no change in the probability of important to safety equipment malfunctioning nor is there any change in failure modes of such equipment.

4. **May the proposed activity increase the consequences of malfunction of equipment important to safety evaluated previously in the SAR?**

NO
The Unit 1 DSAR describes existing techniques for decontamination used at SONGS. None of the systems or equipment used to perform these processes is considered important to safety. As such, the proposed activities cannot increase the consequences of a malfunction of important to safety equipment.

5. **May the proposed activity create the possibility of an accident of a different type than any evaluated previously in the SAR?**

NO
Neither the Unit 1 DSAR nor the Units 2/3 UFSAR consider removal of activity from equipment and/or materials as credible initiators of an accident. In particular, design calculation N-0320-007[3] considered these activities within the Unit 1 Protected Area, in addition to the Units 2/3 Protected Area and the South Yard Facility. The design basis fire involved the HEPA unit on the exhaust from the work enclosure. As such, this accident type has been previously considered and evaluated in the DSAR.

6. **May the proposed activity create the possibility of a malfunction of equipment important to safety of a different type than evaluated previously in the SAR?**

NO
Equipment used to reduce or remove activity from materials is not considered important to safety. The proposed radwaste processes cannot therefore create the possibility of a malfunction of equipment different from scenarios previously considered in the DSAR.

7. **Does the proposed activity reduce the margin of safety as defined in the basis for any technical specification?**

NO
Radwaste processes performed in a building with drains to the liquid radwaste treatment system and an HVAC that is discharged through the Plant Vent Stack are already monitored in accordance with the station's effluent control program.

Work activities that are performed in temporary enclosures, or outside of buildings with a monitored HVAC system require implement of other measures and controls. In all cases where liquids are used or waste is generated, spill control measures will be implemented and existing Station procedures followed for disposal. For techniques that may generate particulate activity, local air sampling will be performed in the immediate area or at the exhaust from the temporary work enclosure. Any use of HEPA filters will also require periodic checks to verify the filters' integrity and performance within design specifications. Closed loop systems or containment booths will likewise be verified periodically to be intact and without significant leakage. Dust control measures and worker protection procedures will also be implemented, as appropriate, to minimize the spread of contamination and the release of activity.

The South Yard Facility calculation N-0320-007 considered the consequences of working on radioactively contaminated material inside and outside monitored buildings. Contamination levels on equipment and materials handled and processed using the proposed techniques will be maintained below the limits established in the calculation.

Given the constraints discussed above, the limits of 10 CFR 20 and the Unit 1 Offsite Dose Calculation Manual will not be exceeded. Therefore, there is no reduction in the margin of safety for any licensing specification.

8. **Does the proposed change foreclose a decommissioning option?**

NO.
The proposed activity does not affect the configuration of the plant or the safe maintenance of the spent fuel. The radwaste treatment techniques considered in the Memo to File may be used during the decommissioning process.

9. **Does the proposed change involve a major structural change to radioactive components of the facility?**

NO
No physical equipment additions or removals are implemented with this change. Temporary work

enclosures may be erected to house the processing equipment and work activities but these will not involve a major structural change to radioactive components in the facility.

10. **Does the proposed change substantially increase the cost of decommissioning?**

NO.
The handling and disposition of equipment, systems, and structures removed from Unit 1 is an integral part of decommissioning. As such, the processing of radwaste should have been included in decommissioning cost estimates.

11. **Does the proposed change cause any significant environmental impact not previously reviewed?**

NO
The proposed work activities will be performed in accordance with existing Station programs for the control of hazardous and radioactive effluents. There will be no measurable impact to the environment or the health and safety of the public.

12. **Does the proposed change violate the terms of the existing license or 10 CFR 50.59 as applied to the existing license?**

NO
The radiological effluent controls program is contained predominantly in the ODCM. The proposed processing of radwaste will be performed to ensure the control of radioactive effluents and hazardous materials. The change is also justified per 10 CFR 50.59 in this document.

REFERENCES

1."Evaluation of Solid Radwaste Processes and Decontamination Techniques", Memo to File by E.M. Goldin, dated 12/4/1995

2.Airborne Source Term for South Yard Shops Facility and Outdoor Activities, NEDO calculation N-0320-007, revision A, dated 4/16/95

3."Re: Effluent Control Issues" email from Linda Bray to Kathy Yhip and Daryl Dick, dated 6/15/1999

AIRBORNE EFFLUENT CONTROLS DURING DECOMMISSIONING

HP&E Position Paper
September 27, 2000

INTRODUCTION

San Onofre Unit 1 ceased commercial operation in November 1992 and was placed in SAFSTOR until June 1999 when decommissioning began. In the time since shutdown, noble gases are no longer produced and radioiodines have decayed away. Releases from the waste gas system are no longer performed and the current sources to the plant vent stack include the spent fuel storage building, containment, and the radwaste auxiliary building. Since 1994, there has been no detectable beta-gamma activity in the particulate samples taken from the plant vent stack[1].

Active decommissioning of the Unit involves dismantlement of systems and equipment for disposal in addition to demolition of various structures. As warranted, components and structures are decontaminated by a variety of methods prior to disposal off-site. Currently, handling and processing of contaminated material and/or equipment does not require effluent controls[2,3] unless removable particulate activity levels exceed 1.5E5 dpm/100 cm^2 and/or removable iodines exceed 2.8E4 dpm/100 cm^2.

This memorandum evaluates the potential for airborne radioactive effluents from the various decommissioning and decontamination techniques and recommends measures to control and minimize unmonitored releases. It does not consider the use of explosives or wrecking balls for demolition nor does it address the potential for creating hazardous waste/effluents from processing of mixed waste.

DISCUSSION

Regulatory Requirements

Title 10 to the Code of Federal Regulations Part 50 Appendix A specifies the design criteria for construction and operation of a nuclear power plant. In particular, General Design Criteria 63 and 64 respectively require monitoring of radioactive waste systems and associated handling areas and effluent discharge paths. There are also several regulatory guidance documents (NUREG-0472, NUREG-0800 section 11.4, and Reg Guide 1.143) that reiterate the need for monitoring either the waste treatment systems' discharge or the exhaust of building(s) that house those systems. Using the data collected from monitoring and routine sampling of the effluent release points, total activity released and the resultant potential dose to a member of the public is then reported to the NRC in the Annual Radioactive Effluent Release Report as required by 10 CFR 50.36a and 10 CFR 50 Appendix I.

Decontamination techniques used to reduce or remove radioactivity from contaminated materials and equipment are considered radwaste processes. Radioactive waste treatment systems or methods are also described in the DSAR as required by 10 CFR 50.34(b). Changes to systems or techniques used to collect, transfer, process, or dispose of radioactive wastes must be evaluated in accordance with 10 CFR 50.59 and reported in the Annual Radioactive Effluent Release Report as required by specification 6.3.3 of the Unit 1 Offsite Dose Calculation Manual (ODCM).

Airborne Controls

Whenever reasonably achievable, radwaste processes shall be conducted inside monitored buildings.[‡]

Liquids should be removed or drained prior to dismantling equipment or structures. If liquid cannot be removed prior to dismantling or if liquids are used in the treatment, decontamination, or demolition technique, spill control measures (berms, drip collection bags, etc) must be implemented to prevent unplanned, unmonitored liquid releases. Surface wetting during building demolition should be performed so that the surface is dampened but no run-off or puddles are generated.

Work processes performed in monitored building/structure

There are no effluent control restrictions whenever the work is performed in a monitored building. Containment, the spent fuel building, and the radwaste auxiliary building are designed to ensure the building's atmosphere is vented through the Unit 1 Plant Vent Stack, the Offsite Dose Calculation Manual (ODCM)-credited airborne release point. If negative pressure in a monitored building is lost, work on contaminated equipment above 25,000 dpm/100 cm^2 loose surface contamination (fixed plus removable contamination ≥250,000 dpm/100 cm^2) should be delayed until negative pressure can be restored and maintained, or stopped until contamination control measures required for work outside of monitored buildings are implemented.

Work processes performed outside of a monitored building/structure

From time to time, some of the components being removed or the processing equipment cannot be physically accommodated within the existing facilities. In addition, the buildings themselves will eventually require dismantlement. For those rare instances where the controls recommended below cannot be practically implemented, a case by case evaluation may be used.

One or more contamination control measures are required for working on components or buildings with removable contamination levels greater than or equal to 25,000 dpm/100 cm^2 (or fixed plus removable contamination ≥250,000 dpm/100 cm^2) to minimize the potential for unmonitored releases of airborne radioactive effluents. In principle, these measures attempt to reduce the amount of material that can be suspended or to reduce the amount of resuspended

[‡]A monitored building is one that is under negative pressure and whose exhaust is routed to an ODCM-credited release point (Plant Vent Stack at Unit 1). The Plant Vent Stack is equipped with a continuous radiation monitor and sampled isokinetically for particulates and radioiodines.

material available for release. Contamination control measures include the use of fixatives, local ventilation controls, and temporary work enclosures.

Examples of contamination control measures include:

a. Fixatives:
   - paints
   - coatings
   - sealants
   - grout

b. Local ventilation controls:
   - elephant trunks/portable HVAC units with filtered[‡‡] exhaust
   - vacuums with filtered exhaust

c. Enclosures:
   - tents with filtered exhaust
   - plastic bags enclosing pipes with filtered exhaust
   - plastic/fabric cover for doors/large openings in buildings
   - air curtain for doors/large openings in buildings

While it is unlikely that any radioactive particulate matter will actually be released from the site when prudent contamination control measures are implemented, continuous local air samples should be taken during work activities performed outside of a monitored building.

The contamination control measures that are used should ensure that airborne radioactivity levels do not exceed 0.05 beta-gamma DAC or detectable levels of alpha DAC. If either of these thresholds is exceeded, additional control measures shall be implemented to meet these thresholds within a reasonable period of time. Additionally, if the air samples show levels greater than 0.05 beta-gamma DAC or detectable levels of alpha DAC, they should be counted as effluent samples. The sample results should be provided to Effluent Engineering for evaluation.

As decommissioning progresses, openings will be created in monitored buildings. Mitigation efforts should be taken to minimize the potential for unmonitored releases and ensure continued compliance with the requirements of 10 CFR 20 and 10 CFR 50 to monitor and measure releases from Unit 1. For example, large openings (equipment hatch, temporary holes) should be covered with plastic or fabric or an air curtain established near the opening to maintain a negative pressure. Smaller openings like containment penetrations should be sealed and pipes containing internal contamination ≥25,000 dpm/100 cm^2 (250,000 dpm/100 cm^2 fixed plus removable)should be covered or equivalent measures taken to prevent the spread of loose contamination.

The recommended threshold of 25,000 dpm/100 cm^2 loose surface contamination (250,000 dpm/100 cm^2 fixed plus removable) ensures that the limits of 10 CFR 20 and 10 CFR 50

[‡‡] "Filtered exhaust" refers to use of either a HEPA filter or Torit dust collector or an equivalent device capable of removing >99% of the particulate matter from the discharge

Appendix I will be met. Additionally, it also satisfies ALARA cost considerations since the HP division currently implements control measures for worker protection purposes at similar levels[4].

Contamination control measures are recommended, but not required, for work below removable levels of 25,000 dpm/100 cm^2.

In addition to the controls recommended above, other measures may be implemented during the demolition of buildings for non-radiological purposes. Dust abatement is frequently required by the local air quality regulators (San Diego Air Pollution Control District for SONGS) to minimize adverse impacts. Typical dust control involves the use of water to dampen the building surface or the rubble which would also reduce the particle-associated activity available for release from the site and the potential for public exposure.

Consequence Analysis

In the unlikely event that the contamination control measures fail, the potential radioactivity released from working on equipment/structures contaminated up to 1.5E6 dpm/100 cm^2 total activity was also evaluated. A conservative calculation (see Appendix A) was performed assuming that level of contamination over a 200 sq ft surface, distributed in one (1) cubic meter of air, and released instantaneously (1 second) to the environment. Resuspension values found in the literature range from 0.5 to 1E-6; a value of 1E-3 for beta-gamma surface contamination[5] was used. As seen on sheet 6 of Appendix A, the resultant organ dose for that single event (1.7E-3 mrem) was below the limits in 10 CFR 50 Appendix I.

CONCLUSION

Decommissioning Unit 1 involves the dismantlement of equipment and systems and the demolition of structures, some of which will be contaminated. Decontamination and resizing of the components may also be performed prior to disposal. On occasion, the components and portions of the systems may not be physically accommodated in the existing buildings. Furthermore, the aboveground structures themselves will ultimately be removed. These activities must, by default, occur outside of the buildings with a monitored HVAC system and they create the potential for unmonitored releases of radioactive airborne effluents from Unit 1. For work that must occur outside of a monitored building, prudent control measures are recommended to minimize the spread of contamination and minimize the potential for the release of airborne particulates while maintaining dose to the public as low as is reasonably achievable (ALARA).

Contamination control measures are required for work on equipment and/or structures with ≥ 25,000 dpm/100 cm^2 removable contamination (≥250,000 dpm/100 cm^2 fixed plus removable contamination). One or more contamination control measures such as fixatives, local ventilation measures, and enclosures shall be used to ensure that air samples taken during the work activity do not exceed 0.05 beta-gamma DAC or detectable levels of alpha DACs. If either of these detection thresholds is exceeded, additional control measures shall be implemented to minimize airborne radioactivity within a reasonable time frame.

Contamination control measures are also recommended below 25,000 dpm/100 cm^2 removable contamination to minimize personnel exposure:

Kathleen Yhip, HP&E

REFERENCES

1. Annual Radioactive Effluent Release Reports 1994-1999

2. "Handling and Working on Radioactive Material Outside Monitored Buildings" Memo to file, J. R. Clark, April 26, 1993.

3. SO123-VIII-20.10 "Radiological Work Planning and Controls" Revision 4

4. SO123-VII-20.9 "Radiological Surveys" Revision 5

5. "Air Sampling in the Workplace" NUREG-1400 draft report for comment, October 1991

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5

Appendix A

CONSEQUENCE ANALYSIS
for
AIRBORNE EFFLUENT CONTROLS DURING DECOMMISSIONING

Performed by: Kathleen Yhip, HP&E

Verified by: Tycho Kent, Effluent Engineering

AIRBORNE EFFLUENT CONTROLS DURING DECOMMISSIONING

METHODOLOGY:

STEP 1 Calculate current isotopic distribution for U1 DAW

a. Knowing the isotopic distribution of U1 DAW, correct for decay since time of sample analysis

Ai = Ai0*e^(-lambda*t)

where A is the activity at time t
Ao is the activity at time t=0
lambda = 0.693/half-life of isotope
t is the time elapsed since initial analysis

b Normalize isotopic ratios Ai' = Ai/sum(Ai)

c Calculate the average isotope distribution from the three samples (1/93, 8/94, 4/12/89)

STEP 2 Calculate maximum contamination levels not to exceed 10 CFR 20

a Use methodology in Calculation N-0320-007 "Airborne Source Terms for South Yard Facility and Outdoor Activities"

CL = (1 MPC * Release Duration * 1E6 cm3/m3)/(Ai'/MPC * Release Fraction * X/Q)

where CL is the activity limit not to exceed 1 MPC (or ECL)
Release Duration is assumed to be 1 second
Ai' is the normalized, decay corrected abundance (from step 1 above)
MPC is the MPC value from 10 CFR 20 (or ECL)
Release Fraction is amount resuspended due to work activity
X/Q is the dispersion factor

b To convert activity limit into a contamination level
CL' = [(CL * 2.22E6 dpm/uCi)/(surface area)]*100 cm2

where surface area is assumed to be no greater than 200 sq ft affected by work activity

c To ensure that site releases remain below the limits of 10 CFR 20
multiply CL (or CL') by U1 administrative factor, 0.03

STEP 3 Calculate public dose impact if contaminated material were released off-site

a Q = [(Ai' * CL)/V] * f

where Q is the release rate of isotope i
V is the volume released, assumed to be 1 cubic meter
f is the flow rate, assumed to be 1 cubic meter per second

b. Using the methodology in section 2 of the U1 ODCM

Do = sum for each isotope, i [(sum for each pathway (P * W)) * Q * t]

where D is the organ dose rate for this work activity
P is the dose parameter for isotope i for pathway k (table 2-4 of the U1 ODCM)
W is the highest calculated dispersion parameter for pathway k at or beyond the site boundary (U1 ODCM)
see table 2-5 of U1 ODCM for (sum for each pathway (P * W))
Q is the release rate for each isotope i

U1 DAW ISOTOPIC DISTRIBUTION										
	HALFLIFE	Jan-93	to 4/1/2000		Sep-84	to 4/1/2000		4/12/99	to 4/1/2000	
	(1981 Kocher)	Abd		N. Abdn	Abd		N. Abdn	activity		N. Abdn
H3	4.485E+03	3.096E-03	2.057E-03	4.485E-03	3.601E-04	2.628E-04	4.487E-04	2.690E-04	2.546E-04	2.362E-03
C14	2.083E+06	6.738E-03	6.732E-03	1.468E-02	1.743E-03	1.742E-03	2.974E-03			
Mn54	3.127E+02	2.581E-03	7.313E-06	1.595E-05	1.118E-03	1.220E-05	2.083E-05			
Fe55	9.862E+02	1.908E-02	2.970E-03	6.476E-03	1.166E-01	2.782E-02	4.751E-02	3.400E-04	2.649E-04	2.458E-03
Co58	7.080E+01	3.404E-02	1.904E-13	4.153E-13						
Co60	1.925E+03	1.359E-05	5.241E-06	1.143E-05	4.363E-02	2.094E-02	3.576E-02	1.280E-03	1.109E-03	1.029E-02
Ni63	3.656E+04	7.326E-03	6.968E-03	1.519E-02	6.834E-02	6.575E-02	1.123E-01	1.600E-03	1.589E-03	1.474E-02
Sr89	5.055E+01	4.970E-04	8.641E-20	1.884E-19						
Sr90	1.045E+04	2.535E-04	2.127E-04	4.637E-04	1.730E-04	1.511E-04	2.580E-04	9.600E-05	9.377E-05	8.699E-04
Cs134	7.531E+02	4.300E-01	3.764E-02	8.208E-02	2.750E-01	4.212E-02	7.192E-02	9.670E-03	6.975E-03	6.471E-02
Cs137	1.102E+04	4.746E-01	4.018E-01	8.762E-01	4.817E-01	4.237E-01	7.235E-01	9.970E-02	9.750E-02	9.045E-01
Pu238	3.205E+04	7.729E-06	7.299E-06	1.592E-05	1.049E-04	1.004E-04	1.714E-04	1.800E-06	1.786E-06	1.657E-05
Pu239/240	2.399E+06	2.261E-06	2.259E-06	4.926E-06	3.491E-05	3.489E-05	5.957E-05	2.100E-06	2.100E-06	1.948E-05
Pu241	5.260E+03	2.531E-04	1.786E-04	3.894E-04	3.672E-03	2.807E-03	4.793E-03			
Pu242	1.373E+08				2.693E-07	2.693E-07	4.598E-07			
Am241	1.579E+05	4.515E-06	4.463E-06	9.731E-06	8.681E-05	8.604E-05	1.469E-04			
Cm242	1.630E+02	2.123E-06	2.751E-11	5.898E-11	1.578E-04	2.712E-08	4.630E-08			
Cm243/244	1.041E+04	2.843E-06	2.384E-06	5.198E-06	1.205E-04	1.052E-04	1.796E-04			
U233/234	8.930E+07				1.921E-07	1.921E-07	3.280E-07			
U238	1.632E+12				9.741E-08	9.741E-08	1.663E-07			
TOTAL		9.785E-01	4.586E-01	1.000E+00	9.928E-01	5.857E-01	1.000E+00	1.129E-01	1.078E-01	1.000E+00

	Jan-93	Sep-94	4/12/99	AI'
	N. Abdn	N. Abdn	N. Abdn	Average
H3	4.485E-03	4.487E-04	2.362E-03	2.432E-03
C14	1.468E-02	2.974E-03		5.884E-03
Mn54	1.595E-05	2.083E-05		1.226E-05
Fe55	6.476E-03	4.751E-02	2.458E-03	1.881E-02
Co58	4.153E-13			1.384E-13
Co60	1.143E-05	3.576E-02	1.029E-02	1.535E-02
Ni63	1.519E-02	1.123E-01	1.474E-02	4.740E-02
Sr89	1.884E-19			6.281E-20
Sr90	4.637E-04	2.580E-04	8.699E-04	5.305E-04
Cs134	8.208E-02	7.192E-02	6.471E-02	7.291E-02
Cs137	8.762E-01	7.235E-01	9.045E-01	8.347E-01
Pu238	1.592E-05	1.714E-04	1.657E-05	6.796E-05
Pu239/240	4.926E-06	5.957E-05	1.948E-05	2.799E-05
Pu241	3.894E-04	4.793E-03		1.727E-03
Pu242		4.598E-07		1.533E-07
Am241	9.731E-06	1.469E-04		5.221E-05
Cm242	5.898E-11	4.630E-08		1.545E-08
Cm243/244	5.198E-06	1.796E-04		6.181E-05
U233/234		3.280E-07		1.093E-07
U238		1.663E-07		5.544E-08
TOTAL	1.000E+00	1.000E+00	1.000E+00	1.000E+00

USING METHODOLOGY DESCRIBED IN CALCULATION N-0320-007					
	Af (DAW)	MPC* (uCi/ml)	Af/MPC (ml/uCi)	ECL* (uCi/ml)	Af/ECL (ml/uCi)
H3	2.43E-03	2.00E-07	1.22E+04	1.00E-07	2.43E+04
C14	5.88E-03	1.00E-07	5.88E+04	3.00E-09	1.96E+06
Mn54	1.23E-05	1.00E-09	1.23E+04	1.00E-09	1.23E+04
Fe55	1.88E-02	3.00E-08	6.27E+05	3.00E-09	6.27E+06
Co60	1.54E-02	3.00E-10	5.12E+07	5.00E-11	3.07E+08
Ni63	4.74E-02	2.00E-09	2.37E+07	1.00E-09	4.74E+07
Sr90	5.31E-04	3.00E-11	1.77E+07	6.00E-12	8.84E+07
Cs134	7.29E-02	4.00E-10	1.82E+08	2.00E-10	3.65E+08
Cs137	8.35E-01	5.00E-10	1.67E+09	2.00E-10	4.17E+09
Pu238	6.80E-05	1.00E-12	6.80E+07	2.00E-14	3.40E+09
Pu239/240	2.80E-05	1.00E-12	2.80E+07	2.00E-14	1.40E+09
Pu241	1.73E-03	1.00E-09	1.73E+06	8.00E-13	2.16E+09
Pu242	1.53E-07	1.00E-12	1.53E+05	8.00E-13	1.92E+05
Am241	5.22E-05	4.00E-12	1.31E+07	2.00E-14	2.61E+09
Cm242	1.55E-08	6.00E-12	2.58E+03	4.00E-13	3.88E+04
Cm243/244	6.16E-05	3.00E-12	2.05E+07	2.00E-14	3.08E+09
TOTAL	1.00E+00		2.08E+09		1.76E+10

* most conservative value except for alpha emitters that are assumed to be insoluble

Surface area	200	sq ft (assumed maximum area affected by the activity)		
Release fraction	1.00E-03	surface contaminated beta-gamma (draft NUREG-1400, 1991)		
X/Q	1.30E-05	sec/m3 (U1 ODCM)		
MPC	CL = (1 MPC * Release Duration * 1E6 cm3/m3)/(Af/MPC * Release Fraction * X/Q)			
	CL =	(1 MPC * 1 sec * 1E6 cm3/m3)/(2.08E9 * 1E-3 * 1.3E-5)		
	=	3.70E+04	uCi	
	CL1 = 0.03 * CL			
	=	1.11E+03	uCi	
	=	(CL1 uCi * 2.22E6 dpm/uCi)/(surface area)		
	=	1.33E+04	dpm	
	or	1.33E+06	dpm/100 cm2	total due to particulate
ECL	CL = (1 ECL * Release Duration * 1E6 cm3/m3)/(Af/ECL * Release Fraction * X/Q)			
	CL =	(1 ECL * 1 sec * 1E6 cm3/m3)/(1.76E10 * 1E-3 * 1.3E-5)		
	=	4.36E+03	uCi	
	CL1 = 0.03 * CL			
	=	1.31E+02		
	=	(CL uCi * 2.22E6 dpm/uCi)/(surface area)		
	=	1.56E+03	dpm	
	or	1.56E+05	dpm/100 cm2	total due to particulate

RELEASE SHEET - MPC LIMIT												
U1 DAW corrected to 4/2000					UNIT	1						
	Ai'	MPC conc	ECL conc		SOURCE	DEMOLITION						
H3	2.43E-03	2.70E-06	3.18E-07									
C14	5.88E-03	6.54E-06	7.70E-07		HIST X/Q	1.30E-05	sec/m3					
Mn54	1.23E-05	1.36E-08	1.60E-09		DURATION	1.0	sec					
Fe55	1.88E-02	2.09E-05	2.46E-06		RELEASE RATE	1	m3/sec					
Co60	1.54E-02	1.71E-05	2.01E-06									
Ni63	4.74E-02	5.27E-05	6.20E-06									
Sr90	5.31E-04	5.90E-07	6.94E-08									
Cs134	7.29E-02	8.10E-05	9.54E-06					AFTER DISP	CURIES	REL RATE	%	REL RATE
Cs137	8.35E-01	9.28E-04	1.09E-04		ISOTOPE	MPC	CONC	uCi/cc	ELEASE	Ci/sec		uCi/sec
Pu238	6.80E-05	7.55E-08	8.89E-09		H-3	2.00E-07	2.703E-06	3.514E-11	2.703E-06	2.703E-06	2.45E-03	2.70E+00
Pu239/240	2.80E-05	3.11E-08	3.66E-09		ALPHA	1.00E-12	2.153E-06	2.799E-11	2.153E-06	2.153E-06	1.95E-03	2.15E+00
Pu241	1.73E-03	1.92E-06	2.26E-07		MN-54	1.00E-09	1.362E-08	1.771E-13	1.362E-08	1.362E-08	1.23E-05	1.36E-02
Pu242	1.53E-07	1.70E-10	2.01E-11		FE-55	3.00E-08	2.091E-05	2.718E-10	2.091E-05	2.091E-05	1.89E-02	2.09E+01
Am241	5.22E-05	5.80E-08	6.83E-09		CO-60	3.00E-10	1.706E-05	2.218E-10	1.706E-05	1.706E-05	1.54E-02	1.71E+01
Cm242	1.55E-08	1.72E-11	2.02E-12		NI-63	2.00E-09	5.27E-05	6.848E-10	5.268E-05	5.268E-05	4.77E-02	5.27E+01
Cm243/244	6.16E-05	6.85E-08	8.06E-09		SR-90	3.00E-11	5.896E-07	7.665E-12	5.896E-07	5.896E-07	5.34E-04	5.90E-01
					CS-134	4.00E-10	8.103E-05	1.053E-09	8.103E-05	8.103E-05	7.33E-02	8.10E+01
TOTAL	1.00E+00	1.11E-03	1.31E-04		CS-137	5.00E-10	9.277E-04	1.206E-08	9.277E-04	9.277E-04	8.40E-01	9.28E+02
					TOTAL		1.105E-03	1.436E-08	1.105E-03	1.105E-03		1.10E+03
MPC limit (uCi)	1.11E+03											
ECL limit (uCi)	1.31E+02					ERikWk	ACTIVITY	Release Rate				Organ Dose
						mrem/yr/uCi/s	uCi	uCi/sec				mrem
Disp. Vol (cm3)	1.00E+06				H-3	1.18E-03	2.70E+00	2.70E+00			H-3	1.01E-10
					MN-54	7.84E+00	1.36E-02	1.36E-02			MN-54	3.39E-09
					CO-60	1.03E+02	1.71E+01	1.71E+01			CO-60	5.57E-05
					SR-90	2.08E+03	5.90E-01	5.90E-01			SR-90	3.89E-05
					CS-134	3.84E+01	8.10E+01	8.10E+01			CS-134	9.86E-05
					CS-137	4.38E+01	9.28E+02	9.28E+02			CS-137	1.29E-03
											TOTAL	1.48E-03

RELEASE SHEET - ECL LIMIT

U1 DAW corrected to 4/2000			
	Ai'	MPC conc	ECL conc
H3	2.43E-03	2.70E-06	3.18E-07
C14	5.88E-03	6.54E-06	7.70E-07
Mn54	1.23E-05	1.36E-08	1.60E-09
Fe55	1.88E-02	2.09E-05	2.46E-06
Co60	1.54E-02	1.71E-05	2.01E-06
Ni63	4.74E-02	5.27E-05	6.20E-06
Sr90	5.31E-04	5.90E-07	6.94E-08
Cs134	7.29E-02	8.10E-05	9.54E-06
Cs137	8.35E-01	9.28E-04	1.09E-04
Pu238	6.80E-05	7.55E-08	8.89E-09
Pu239/240	2.80E-05	3.11E-08	3.66E-09
Pu241	1.73E-03	1.92E-06	2.26E-07
Pu242	1.53E-07	1.70E-10	2.01E-11
Am241	5.22E-05	5.80E-08	6.83E-09
Cm242	1.55E-08	1.72E-11	2.02E-12
Cm243/244	6.16E-05	6.85E-08	8.06E-09
TOTAL	1.00E+00	1.11E-03	1.31E-04
MPC limit (uCi)	1.11E+03		
ECL limit (uCi)	1.31E+02		
Disp. Vol (cm3)	1.00E+06		

UNIT	1	
SOURCE	DEMOLITION	
HIST X/Q	1.30E-05	sec/m3
DURATION	1.0	sec
RELEASE RATE	1	m3/sec

ISOTOPE	ECL	CONC	AFTER DISP uCi/cc	CURIES ELEASE	REL RATE Ci/sec	%	REL RATE uCi/sec
H-3	1.00E-07	3.182E-07	4.137E-12	3.182E-07	3.182E-07	2.45E-03	3.18E-01
ALPHA	2.00E-14	2.535E-07	3.295E-12	2.535E-07	2.535E-07	1.95E-03	2.53E-01
MN-54	1.00E-09	1.604E-09	2.085E-14	1.604E-09	1.604E-09	1.23E-05	1.60E-03
FE-55	3.00E-09	2.462E-06	3.200E-11	2.462E-06	2.462E-06	1.89E-02	2.46E+00
CO-60	5.00E-11	2.009E-06	2.611E-11	2.009E-06	2.009E-06	1.54E-02	2.01E+00
NI-63	1.00E-09	6.20E-06	8.062E-11	6.202E-06	6.202E-06	4.77E-02	6.20E+00
SR-90	6.00E-12	6.942E-08	9.024E-13	6.942E-08	6.942E-08	5.34E-04	6.94E-02
CS-134	2.00E-10	9.539E-06	1.240E-10	9.539E-06	9.539E-06	7.33E-02	9.54E+00
CS-137	2.00E-10	1.092E-04	1.420E-09	1.092E-04	1.092E-04	8.40E-01	1.09E+02
TOTAL		1.301E-04	1.691E-09	1.301E-04	1.301E-04		1.30E+02

	ERikWk	ACTIVITY	Release Rate		Organ Dose
	mrem/yr/uCi/s	uCi	uCi/sec		mrem
H-3	1.18E-03	3.18E-01	3.18E-01	H-3	1.19E-11
MN-54	7.84E+00	1.60E-03	1.60E-03	MN-54	3.99E-10
CO-60	1.03E+02	2.01E+00	2.01E+00	CO-60	6.56E-06
SR-90	2.08E+03	6.94E-02	6.94E-02	SR-90	4.58E-06
CS-134	3.84E+01	9.54E+00	9.54E+00	CS-134	1.16E-05
CS-137	4.38E+01	1.09E+02	1.09E+02	CS-137	1.52E-04
				TOTAL	1.74E-04

RELEASE SHEET - 1.5E6 dpm/100 cm2												
U1 DAW corrected to 4/2000					UNIT	1						
	Ai'	MPC conc	ECL conc		SOURCE	DEMOLITION						
H3	2.43E-03	3.05E-06	3.05E-06									
C14	5.88E-03	7.38E-06	7.38E-06		HIST X/Q	1.30E-05	sec/m3					
Mn54	1.23E-05	1.54E-08	1.54E-08		DURATION	1.0	sec					
Fe55	1.88E-02	2.36E-05	2.36E-05		RELEASE RATE	1	m3/sec					
Co60	1.54E-02	1.93E-05	1.93E-05									
Ni63	4.74E-02	5.95E-05	5.95E-05									
Sr90	5.31E-04	6.66E-07	6.66E-07									
Cs134	7.29E-02	9.15E-05	9.15E-05					AFTER DISP	CURIES	REL RATE	%	REL RATE
Cs137	8.35E-01	1.05E-03	1.05E-03		ISOTOPE	MPC	CONC	uCi/cc	ELEASE	Ci/sec		uCi/sec
Pu238	6.80E-05	8.53E-08	8.53E-08		H-3	2.00E-07	3.052E-06	3.968E-11	3.052E-06	3.052E-06	2.45E-03	3.05E+00
Pu239/240	2.80E-05	3.51E-08	3.51E-08		ALPHA	1.00E-12	2.431E-06	3.161E-11	2.431E-06	2.431E-06	1.95E-03	2.43E+00
Pu241	1.73E-03	2.17E-06	2.17E-06		MN-54	1.00E-09	1.538E-08	2.000E-13	1.538E-08	1.538E-08	1.23E-05	1.54E-02
Pu242	1.53E-07	1.92E-10	1.92E-10		FE-55	3.00E-08	2.361E-05	3.070E-10	2.361E-05	2.361E-05	1.89E-02	2.36E+01
Am241	5.22E-05	6.55E-08	6.55E-08		CO-60	3.00E-10	1.927E-05	2.505E-10	1.927E-05	1.927E-05	1.54E-02	1.93E+01
Cm242	1.55E-08	1.94E-11	1.94E-11		NI-63	2.00E-09	5.95E-05	7.733E-10	5.949E-05	5.949E-05	4.77E-02	5.95E+01
Cm243/244	6.16E-05	7.73E-08	7.73E-08		SR-90	3.00E-11	6.658E-07	8.656E-12	6.658E-07	6.658E-07	5.34E-04	6.66E-01
					CS-134	4.00E-10	9.150E-05	1.189E-09	9.150E-05	9.150E-05	7.33E-02	9.15E+01
TOTAL	1.00E+00	1.25E-03	1.25E-03		CS-137	5.00E-10	1.048E-03	1.362E-08	1.048E-03	1.048E-03	8.40E-01	1.05E+03
					TOTAL		1.248E-03	1.622E-08	1.248E-03	1.248E-03		1.25E+03
MPC limit (uCi)	1.26E+03											
ECL limit (uCi)	1.26E+03					ERikWk	ACTIVITY	Release Rate				Organ Dose
						mrem/yr/uCi's	uCi	uCi/sec				mrem
Disp. Vol (cm3)	1.00E+06				H-3	1.18E-03	3.05E+00	3.05E+00			H-3	1.14E-10
					MN-54	7.84E+00	1.54E-02	1.54E-02			MN-54	3.82E-09
					CO-60	1.03E+02	1.93E+01	1.93E+01			CO-60	6.29E-05
					SR-90	2.08E+03	6.66E-01	6.66E-01			SR-90	4.39E-05
					CS-134	3.84E+01	9.15E+01	9.15E+01			CS-134	1.11E-04
					CS-137	4.38E+01	1.05E+03	1.05E+03			CS-137	1.45E-03
											TOTAL	1.67E-03

December 13, 2013

J. A. CAREY

SUBJECT: Airborne Contamination from Decommissioning Activities

REFERENCES:

1. Airborne Effluent Controls During Decommissioning, K. Yhip, September 27, 2000
2. Airborne Source Term for South Yard Shops Facility and Outdoor Activities, Calculation N-0320-007, Rev. 1, April 28, 1995
3. SONGS Health Physics Procedure SO123-VII-20.10, Radiological Work Planning and Controls
4. Radwaste Processing Techniques – Airborne Effluent Evaluation, K. Yhip, December 20, 1999

PROBLEM STATEMENT

Reference 1 provided a conservative limit of 250,000 dpm/100 cm^2 total contamination (fixed plus removable) for surfaces that may be worked upon during decommissioning without having to consider additional engineered controls to mitigate airborne releases. The paper further specified the engineered controls that may be employed for contamination levels above that criterion and was written when the majority of radioactive work at the San Onofre Nuclear Generating Station (SONGS) Unit 1 decommissioning took place inside monitored buildings. Now, access to effluent monitored buildings may not be achievable for large items and for demolition of some non-power block buildings themselves. This memorandum reviews the guidelines in Reference 1 considering the current state of facilities at the SONGS site and applies limits from a more rigorous formal calculation (Ref. 2) for assessing off-site impacts from airborne releases. The provided guidance supports continued safe work, ensures compliance with effluent controls, while minimizing production restrictions.

EVALUATION

Revision 0 of Calculation N-0320-007, Airborne Source Term for South Yard Shops and Outdoor Activities (January 4, 1993) was originally initiated to evaluate the impact of work in the South Yard because that facility is located in close proximity to site boundaries. The calculation also included an evaluation of performing some radiological work in the Protected Areas but outside of monitored buildings. The calculation was significantly revised in 1995 (Reference 2) to account for a source term with reactor coolant contaminated equipment and to also address mixed waste processing.

The center of the Unit 1 Protected Area (now the North Industrial Area or NIA) was closer to the Site Boundary than the Units 2/3 Protected Area (PA) center. Therefore, the limits for Unit 1 were more restrictive than those for Units 2/3. The calculation included two major cases each for Unit 1 and for Units 2/3, the first for "normal" activities (machining, drilling, sawing, grinding) and the second for a "design basis" event (a fire) in which the resuspended radioactivity was much greater.

With the permanent shutdown of SONGS Units 2 and 3, some demolition work will be conducted in the NIA. In order to ship certain items for disposal, some size reduction may be required. For example, the Unit 2 reactor head vent ducting and the reactor head lift rig are too big to fit on transport vehicles. The means to cut these items into small enough pieces may include sawing and crushing but also could include torch cutting.

The limits for the normal case apply (10 CFR Part 20 airborne effluent concentration limits or ECLs) for sawing and crushing but the larger release factor for the design basis accident is more appropriate for aggressive work such as torch cutting. Since the rest of the parameters (wind speed, stability class, X/Q, etc.) that enter into the evaluation are not significantly different, the impact from these activities in the NIA can be estimated by ratioing the "normal" case to the "design basis" accident release factor. The normal case was based on a release factor of 1×10^{-6}. The design basis accident (fire) was evaluated using a release factor of 1×10^{-3}. (Note that the calculation also used a release fraction of 5×10^{-6} for carbon dioxide pellet blasting for decontamination that could be applicable for aggressive decontamination measures in the area.) If all other parameters are left intact, for the aggressive activities, dividing the limiting surface contamination by a factor of 1000 will result in an estimate of the contamination (total contamination, not just removable) that results in an offsite airborne concentration of 1 ECL. Note also that the isotopic distribution used in the calculation was based on the Units 2/3 dry active waste (DAW) composite profile. This profile is dominated by 137Cs, 134Cs, and 60Co. This radionuclide profile is appropriate for the Units 2/3 components under consideration and to the remote potential for contamination on building surfaces in the Units 2/3 PA. It is worth noting that the temporary structures in the NIA are not subject to radioactive contamination but when they are removed, the Units 2/3 radionuclide profile is applicable because these structures, in some cases, housed Units 2/3 components and not Unit 1 components (that would have a different radionuclide distribution).

The surface contamination limit for work under normal conditions (machining, drilling, sawing, grinding) was 1.3×10^{11} dpm/100 cm^2 (from results table on page 7, Reference 2). Therefore, dividing by 1000 to account for potentially significantly higher releases during aggressive operations on contaminated surfaces yields ~ 1×10^8 dpm/100 cm^2. Note this value is not as high as the design basis event in the calculation due to the continued use of normal atmospheric dispersion parameters. Even if a safety margin of 10 is applied to account for larger surface areas (the calculation assumed a 2 square yard surface resuspended every second), the limiting total surface contamination level is still ~ 1×10^7 dpm/100 cm^2 for work in the NIA. This is comparable to the limitation in SONGS Health Physics Procedure SO123-VII-20.10 (Ref. 3) that includes a criterion of 1.5×10^6 dpm/100 cm^2 for loose surface contamination on work outside an effluent-monitored building (equivalent to 1.5×10^7 dpm/100 cm^2 total contamination) and applies site-wide, not just for the NIA. The administrative value of 250,000 dpm/100 cm^2 total contamination from Reference 1 is therefore conservatively low by a factor of 40.

Working in the Units 2/3 PA, for example the demolition of non-power block buildings, is bounded by the above evaluation because of the greater distance to the Site Boundary (raises the atmospheric dispersion X/Q by greater than a factor of 3). Reference 2, page 7 includes results for the Units 2/3 PA that are higher than the NIA results by this factor of 3. Moreover, aggressive decontamination will not be required in the Units 2/3 PA since the material is not contaminated (i.e. demolition of support buildings).

Lastly, these results and limits apply to offsite airborne concentrations and not to local worker protection. Limits for local worker airborne contamination controls may be considerably more restrictive. Local contamination controls may also be required to prevent releases to yard areas or storm drains.

RECOMMENDATIONS

Work on contaminated components or work to demolish buildings may be performed on surfaces with total contamination levels up to 1×10^7 dpm/100 cm^2, raised from the currently conservative 250,000 dpm/100 cm^2 (total contamination, fixed plus removable). In addition, an initial limit for torch cutting steel (for example, the head lift rig) may be established also at 1×10^7 dpm/100 cm^2. While torch cutting may cause a relatively high resuspension rate, this activity will affect only small areas at any given time. As before, local air samples should be taken to evaluate the conditions early in the demolition and cutting processes to ensure the controls are adequate. Adjustment may be necessary in the unlikely event that radioactive contamination is discovered on air samples taken during decontamination or demolition. If airborne contamination levels are not significant (defined to be greater than 0.1 DAC in the general work area), then the contamination levels could be raised higher subject to approval by the Radiological Effluent and Environmental Specialist, but should not exceed 1×10^8 dpm/100 cm^2, for loose surface contamination, 1% of the limit suggested in Reference 2. As always, ALARA principles such as decontamination should be used on the local surfaces that are subject to cutting or other activities that might resuspend radioactivity. If practical, engineered controls should be employed such as containment enclosures, HEPA ventilation units, fixatives, or spray/mist to prevent resuspension. Reference 4 tabulates many decontamination operations along with recommendations on work enclosures and air sampling.

CONCLUSION

- Employ local air samplers
- Decontaminate surfaces to the extent practical
- Utilize containment enclosures if available
- Draw air through HEPA units if practical
- Employ mist/spray or fixatives if necessary
- Limits for contamination:
  - 1×10^7 dpm/100 cm^2 (total activity, fixed plus removable)
  - 1.5×10^6 dpm/100 cm^2 (removable activity limit in Ref. 3)
  - Higher levels may be used if air samples support and Effluent Engineering approves, particularly in the Units 2/3 Protected Area
  - The previously identified administrative limit of 250,000 dpm/100 cm^2 (total contamination, fixed plus removable) may be adequate for the majority of the work in the yard areas
- This evaluation applies to surface contamination. Be aware of any possibility for activated material that would not apply to this evaluation.

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