Technical Specification 5.6.3
Technical Requirements Manual 3.7.102.4

aps

Palo Verde
Nuclear Generating Station
PO Box 52034
Phoenix, Arizona 85072-2034
Mail Station 7636

102-07491 TNW/MDD/TMJ
April 21, 2017

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, 3 and Independent Spent Fuel Storage Installation
Docket Nos. STN 50-528/529/530 and 72-44
Annual Radioactive Effluent Release Report 2016

In accordance with Technical Specification 5.6.3, the annual radioactive effluent release report for 2016 is enclosed.

PVNGS Technical Requirement Manual section 3.7.102.4 requires an annual report to be prepared and submitted if sealed source or fission detector leakage tests reveal the presence of greater than or equal to 0.005 micro curies of removable radiation. There were no events in 2016 that met this reporting threshold.

No new commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Michael DiLorenzo, Licensing Section Leader, at (623) 393-3495.

Sincerely,

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Enclosure: Palo Verde Nuclear Generating Station Units 1, 2 and 3 2016 Annual Radioactive Effluent Release Report

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	A. V. Godwin	Arizona Radiation Regulatory Agency (ARRA)
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Enclosure

Palo Verde Nuclear Generating Station
Units 1, 2, & 3
2016 Annual Radioactive Effluent Release Report

PALO VERDE NUCLEAR GENERATING STATION
UNITS 1, 2 AND 3

2016

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

USNRC Docket No. STN 50-528/529/530
RCTSAI 1566

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INTRODUCTION

This report summarizes effluent and waste disposal source term data, meteorological data, and doses from radioactive effluents for the Palo Verde Nuclear Generating Station (PVNGS) for the period of January through December 2016. The data presented meets the reporting requirements of Regulatory Guide 1.21 (Revision 1, June 1974) of the U.S. Nuclear Regulatory Commission and the PVNGS Technical Specifications.

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Letter No. 212-00789-WFQ/RHM, “1989 PVNGS Evaporation Pan Data,” Jan. 1989.

Offsite Dose Calculation Manual Palo Verde Nuclear Generating Station Units 1, 2 and 3, Rev. 27.

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Calculation 13-NC-CH-0200, Rev 7,FSAR - Primary Coolant Activities (PCA)

APPENDIX A

SOURCE TERMS
AND
EFFLUENT AND WASTE DISPOSAL REPORTS

Supplemental Information

1.0 REGULATORY LIMITS

1.1 Liquid Releases

1.1.1 PVNGS ODCM Requirement 3.2

The concentration of radioactive material discharged from secondary system liquid waste to the circulating water system shall be limited to:

5.0E-07 µCi/ml for principal gamma-emitters (except Ce-144)

3.0E-06 µCi/ml for Ce-144

1.0E-06 µCi/ml for I-131.

1.0E-03 µCi/ml for H-3

The concentration of radioactive material discharged from secondary system liquid waste to the onsite evaporation ponds shall be limited to:

2.0E-06 µCi/ml for Cs-134

2.0E-06 µCi/ml for Cs-137

The concentrations specified in 10 CFR Part 20.1001-20.2402, Appendix B, Table 2, Column 2, for all other isotopes

1.1.2 PVNGS ODCM Requirement 4.4

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor, to areas at and beyond the SITE BOUNDARY 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.

1.2 Gaseous Releases

1.2.1 PVNGS ODCM Requirement 3.1

The dose rate due to radioactive materials released in gaseous effluents from the site 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 I-131 and I-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

1.2.2 PVNGS ODCM Requirement 4.1

The air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY 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.

1.2.3 PVNGS ODCM Requirement 4.2

The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, to areas at and beyond the SITE BOUNDARY 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.

1.2.4 PVNGS ODCM Requirement 4.3

The GASEOUS RADWASTE SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent air doses due to gaseous effluent releases, from each reactor unit, from the site, when averaged over 31 days, would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases, from each reactor unit, to areas at and beyond the SITE BOUNDARY when averaged over 31 days, would exceed 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

1.3 Total Dose

1.3.1 PVNGS ODCM Requirement 5.1

The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to direct 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.

2.0 MAXIMUM PERMISSIBLE CONCENTRATIONS

Air: Release Concentrations are limited to dose rate limits described in section 1.2.1 of this report.

3.0 AVERAGE ENERGY

The average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases is not applicable to PVNGS.

4.0 MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY IN GASEOUS EFFLUENTS

For continuous releases, sampling is in accordance with PVNGS ODCM Table 3-1. Particulate and iodine radionuclides are sampled continuously at the Plant Vent and Fuel Building exhaust points. The particulate filters and charcoal cartridges are exchanged for analysis at least four times per month. Noble gas and tritium are sampled at least once per 31 days. The hourly average Radiation Monitoring System (RMS) effluent monitor readings are used, when available, to account for increases and decreases in noble gas concentrations between noble gas grab samples. The tritium concentration is assumed constant between sampling periods.

For batch releases, sampling is also in accordance with PVNGS ODCM Table 3-1. For containment purges, the noble gas concentration may be adjusted to account for decreases or increases in concentration during the purge using RMS readings. The volume of air released during the purge is determined using the exhaust fan rated flow rate. For Waste Gas Decay Tank releases, the volume released is corrected to standard pressure.

Effective January 1, 2004, Containment Purge release permits are updated by removing the permit pre-release particulate and iodine activity. This eliminates double accounting for the Containment Purge particulate and iodine activity at the Plant Vent but allows the particulate and iodine activity to be included in the Containment Purge pre-release dose projection.

The Lower Limit of Detection (LLD) of a measurement system is defined in Table 3 - 1 of the PVNGS ODCM. An average LLD for each radionuclide is provided in Table 3.

5.0 BATCH RELEASES

5.1 Gaseous

Batch release durations are presented in Table 2.

5.2 Liquid

None.

6.0 ABNORMAL RELEASES

None

7.0 OFFSITE DOSE CALCULATION MANUAL AND PROCESS CONTROL PROGRAM (PCP) REVISIONS

7.1 The Offsite Dose Calculation Manual (ODCM) was revised in 2016. A complete copy of the ODCM is attached as Appendix E of this report. Revision 27 of the ODCM went effective on 3/25/2016.

7.1 There were no revisions to the Process Control Program (PCP) in 2016.

8.0 EFFLUENTS AND SOLID WASTES

8.1 Gaseous Effluents

Gaseous effluent information is presented in Table 1 through Table 41. Included in these tables are summaries of the effluents and estimated total error.

8.2 Liquid Effluents

There were no liquid effluent releases beyond the Site Boundary from PVNGS.

8.3 Solid Waste

Solid waste shipments are summarized in Table 42.

9.0 MISCELLANEOUS INFORMATION

9.1 EVAPORATION PONDS

Releases made to the Evaporation Ponds are limited to the concentrations specified in PVNGS ODCM Requirement 3.2. The Evaporation Ponds were monitored in accordance with PVNGS ODCM Requirement 6.1.

The average historical evaporation is approximately 12 inches, per pond, for each of the first and fourth quarters, and 33 inches, per pond, for each of the second and third quarters. Evaporation Pond One is approximately 250 acres. This equates to 3.08E+11 cc evaporated from Pond One for each of the first and fourth quarters and 8.48E+11 cc evaporated from Pond One for each of the second and third quarters. Evaporation Pond Two is approximately 235 acres. The amount evaporated from Pond Two is 2.90E+11 cc for each of the first and fourth quarters and 7.97E+11 cc for each of the second and third quarters.

Evaporation Pond Three is constructed of two smaller ponds of 90 acres each (3A and 3B). The amount evaporated from each section of Pond Three is 1.11E+11 cc for each of the first and fourth quarters and 3.05E+11 cc for each of the second and third quarters.

Using a site boundary X/Q of 5.0E-05 sec/m^3 for the evaporation ponds and equation 4-3 from the ODCM, the dose from the evaporation ponds to a hypothetical individual at the site boundary, for all pathways, is summarized in Table 1.

9.2 RADIATION MONITORING SYSTEM SETPOINT VERIFICATION

Current effluent monitor noble gas channel alert alarm setpoints are based on an assumed one percent failed fuel source term. The current method used for the setpoint values are more reliable than basing the setpoints upon the constantly varying values of the actual noble gas source term presented in Table 38.

9.3 RCS RADIOIODINE (TRM T5.0.600)

There were no cases where primary coolant specific activity exceeded the Technical Specification 3.4.17 limits during the reporting period.

9.4 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)

There are no radioactive effluents from the NAC-UMS System. Direct dose at the Site Boundary is reported in the Annual Radiological Environmental Operating Report.

9.5 MAJOR CHANGES TO THE RADIOACTIVE WASTE SYSTEMS (liquid, gaseous, and solid).

None.

9.6 SAMPLES RESULTS FROM GROUNDWATER WELLS THAT ARE NOT DESCRIBED IN THE ODCM AS PART OF THE REMP (NEI 07-07, Industry Groundwater Protection Initiative, August 2007), are included in Appendix D. This initiative provides added assurance that groundwater will not be adversely affected by PVNGS operations.

There were no NEI 07-07 reportable leaks or spills. There were no positive sample results.

9.7 REPORT ADDENDUM

There were two addendums to this report. The first is a correction to the 2013 ARERR and the second is a correction to the 2013 ARERR.

10.0 DISCUSSION

10.1 Unit One

Unit One operated with a refueling outage (1R19) from April 9, 2016 to May 14, 2016.

Maintenance outages:
1M20A September 7, 2016 to September 13, 2016

Estimated number of fuel defects (source: INPO, CDE)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

10.2 Unit Two

Unit Two operated without a refueling outage during 2016.

Maintenance outages:
NONE

Estimated number of fuel defects (source: INPO, CDE)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

10.3 Unit Three

Unit Three operated with a refueling outage (3R19) from October 8, 2016 to November 5, 2016.

Maintenance outages:
3M19A September 19, 2016 to September 23, 2016.

Estimated number of fuel defects (source: INPO, CDE)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

10.4 Carbon-14

Carbon-14 is formed naturally in the upper atmosphere and also is formed in operating nuclear reactors.

Carbon-14 is not a new power plant emission. Because the overall quantity of radioactive releases has steadily decreased due to improvements in power plant operations, carbon-14 may now qualify as a "principal radionuclide" under revised federal regulatory guidance. The levels of other releases have declined, so carbon-14 releases, expressed as a percentage of total releases, have the potential to achieve "principal radionuclide" status (anything greater than one percent of overall radioactivity in effluents) per updated federal regulatory guidance.

The radiation dose to the public from carbon-14 is much lower than regulatory limits and has been a very small contributor to the total radiation dose that Americans receive each year from natural and man-made sources.

Studies by the United Nations Scientific Committee on the Effects of Atomic Radiation, the National Research Council's BEIR VII study group and the National Council on Radiation Protection and Measurements all show that the risk associated with low-dose radiation from natural and man-made sources, including nuclear power plants, is negligible.

Radiation is measured in units called millirem. The average American is exposed to 620 millirem of radiation every year. Approximately 311 millirem of this comes from natural sources. The majority of the remaining dose (approximately 300 millirem) comes from medical procedures such as CAT scans. Less than one-tenth of a percent of all radiation exposure is from nuclear facilities. Reference: NCRPReport No. 160, Table 1.1.

Starting with the 2010 Annual Radioactive Effluent Release Report, PVNGS will include the estimated exposure from carbon-14 in the Appendix C, dose calculations. The PVNGS calculated production of carbon-14 is 18.5 Curies per cycle (500 days) or 13.5 curies per year. Based on published literature, twenty percent (20%) of the carbon-14 released is assumed to be in an inorganic form (CO_2). PVNGS will use an estimated value of 2.7 curies of carbon-14 released, per reactor, per year. The 2.7 curies will be divided equally between each quarter (0.68 curies per reactor, per quarter). Appendix C, dose calculations include this estimated carbon-14 dose. Appendix C also includes the dose excluding carbon-14 for comparison with historical reports.

10.5 Tritium

PVNGS does not have a liquid release pathway. Removal of tritium is performed by operation of the Boric Acid Concentrator (BAC) in the release mode. Comparison of PVNGS annual tritium Curies released to other utilities should be made only after summing both liquid and gaseous tritium Curies released.

10.6 Dose Summary

Dose for 2016 was primarily due to the release of tritium. Tritium production is estimated to be 1000 curies per reactor per year. In order to control plant tritium concentrations, tritium releases should match tritium production. For 2016, PVNGS released a total of 2360 curies of tritium (see Table 39).

Total dose due to releases from all three Units for 2016 were higher than 2015, primarily due to increased releases of tritium.

Table 1: Evaporation Pond Data					
Evaporation Pond 1 (1A, 1B, 1C)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	3.22E+11	8.85E+11	8.85E+11	3.22E+11	
Tritium Concentration (uCi/cc)	2.84E-06	4.23E-06	2.38E-06	2.38E-06	
Tritium Curies	3.22E-01	1.26E+00	7.22E-01	2.63E-01	2.57E+00
Evaporation Pond 2 (2A and 2B)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	2.49E+11	7.97E+11	7.97E+11	2.90E+11	
Tritium Concentration (uCi/cc)	1.36E-06	1.32E-06	1.80E-06	2.88E-06	
Tritium curies	1.73E-01	4.60E-01	5.99E-01	3.66E-01	1.60E+00
Evaporation Pond 3 (3A and 3B)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	2.20E+11	3.05E+11	3.05E+11	1.11E+11	
3B Tritium Concentration (uCi/cc)	1.48E-06	1.51E-06	2.88E-06	2.27E-06	
3B Tritium curies	1.63E-01	4.55E-01	8.69E-01	2.49E-01	1.74E+00
Dose (mRem)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Pond 1	3.80E-03	1.34E-02	8.60E-03	3.13E-03	2.89E-02
Pond 2	2.40E-03	6.38E-03	8.31E-03	5.08E-03	2.22E-02
Pond 3	2.26E-03	6.31E-03	1.20E-02	3.45E-03	2.41E-02
Total	8.46E-03	2.61E-02	2.90E-02	1.17E-02	7.52E-02

Table 2: Batch Release Data			
All times are in hours	Unit 1	Unit 2	Unit 3
January - June			
Number of batch releases	44	20	16
Total time period for batch releases	1901.21	58.82	76.17
Maximum time period for a batch release	168.00	35.27	53.70
Average time period for a batch release	43.21	2.94	4.76
Minimum time period for a batch release	0.10	0.31	0.60
July - December			
Number of batch releases	23	24	47
Total time period for batch releases	322.13	1184.67	1908.40
Maximum time period for a batch release	100.85	1045.92	168.00
Average time period for a batch release	14.01	49.36	40.60
Minimum time period for a batch release	0.57	0.57	0.02
January - December			
Number of batch releases	67	44	63
Total time period for batch releases	2223.34	1243.50	1984.57
Maximum time period for a batch release	168.00	1045.92	168.00
Average time period for a batch release	33.18	28.26	31.50
Minimum time period for a batch release	0.10	0.31	0.02

Table 3: Units 1, 2 & 3 Gaseous Effluents Average Lower Limit Of Detection					
µCi/cc					
Nuclide	Continuous	Batch	Nuclide	Continuous	Batch
Antimony-122	2.20E-13	1.90E-11	Argon-41	4.50E-08	4.50E-08
Antimony-124	8.40E-14	1.70E-11	Krypton-85	7.40E-06	7.40E-06
Barium-140	3.40E-13	5.70E-11	Krypton-85m	2.20E-08	2.20E-08
Bromine-82	3.30E-13	1.40E-11	Krypton-87	5.70E-08	5.70E-08
Cerium-141	8.70E-14	3.10E-11	Krypton-88	7.40E-08	7.40E-08
Cerium-144	3.60E-13	6.50E-11	Xenon-125	2.20E-08	2.20E-08
Cesium-134	1.00E-13	2.60E-11	Xenon-127	2.10E-08	2.10E-08
Cesium-137	8.10E-14	1.70E-11	Xenon-131m	9.10E-07	9.10E-07
Cesium-138	5.20E-10	7.30E-10	Xenon-133	6.30E-08	6.30E-08
Chromium-51	6.90E-13	1.40E-10	Xenon-133m	1.90E-07	1.90E-07
Cobalt-58	8.50E-14	1.70E-11	Xenon-135	2.00E-08	2.00E-08
Cobalt-60	1.00E-13	1.90E-11	Xenon-135m	8.90E-08	8.90E-08
Iron-59	1.70E-13	3.20E-11	Xenon-138	2.00E-07	2.00E-07
Lanthanum-140	2.80E-13	2.10E-11	Iodine-131	8.00E-14	7.00E-12
Manganese-54	8.30E-14	1.70E-11	Iodine-132	6.60E-12	1.90E-11
Molybdenum-99	2.40E-13	2.80E-11	Iodine-133	4.70E-13	1.10E-11
Niobium-95	8.70E-14	1.80E-11	Iodine-134	5.90E-11	8.20E-11
Rubidium-88	1.90E-08	1.90E-08	Iodine-135	7.00E-12	5.50E-11
Ruthenium-103	7.40E-14	1.50E-11			
Strontium-89	2.15E-15	(1)			
Strontium-90	5.60E-16	(1)			
Tellurium-123m	6.60E-14	1.50E-11			
Tritium	3.80E-07	3.80E-07			
Zinc-65	1.90E-13	3.80E-11			
Zirconium-95	1.80E-13	4.10E-11			
Gross Alpha	3.60E-15	(1)			
(1) Not required for batch releases.					

Table 4: Unit 1 Gaseous Effluents - Summation Of All Releases							
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total For Year	Est. Total Error % (1)
A. Fission & activation gases							
1. Total release	Ci	1.14E-01	4.67E-01	6.17E-02	5.42E-02	6.97E-01	3.54E+01
2. Average release rate for period	µCi/sec	1.45E-02	5.94E-02	7.76E-03	6.82E-03	2.20E-02	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
B. Iodine 131							
1. Total Iodine 131	Ci	< LLD	1.72E-05	< LLD	< LLD	1.72E-05	3.32E+01
2. Average release rate for period	µCi/sec	< LLD	2.19E-06	< LLD	< LLD	5.44E-07	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
C. Particulates							
1. Particulates with half- lives > 8 days	Ci	1.33E-06	1.03E-02	1.52E-06	< LLD	1.03E-02	3.43E+01
2. Average release rate for period	µCi/sec	1.69E-07	1.31E-03	1.91E-07	< LLD	3.25E-04	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
4. Gross Alpha radioactivity	Ci	**< LLD**	**1.46E-07**	**< LLD**	**< LLD**	**< LLD**	
D. Tritium							
1. Total release	Ci	4.95E+02	3.49E+02	1.08E+02	1.03E+02	1.06E+03	3.85E+01
2. Average release rate for period	µCi/sec	6.30E+01	4.44E+01	1.36E+01	1.30E+01	3.35E+01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
(1) Estimated total error methodology is presented in Table 40.							
(2) See Table 11 for percent of ODCM Requirement limits.							

Table 5: Unit 1 Gaseous Effluents - Ground Level Releases - Continuous - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	6.18E-02	< LLD	< LLD	6.18E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**6.18E-02**	**< LLD**	**< LLD**	**6.18E-02**
2. Iodines						
I-131	Ci	< LLD	1.72E-05	< LLD	< LLD	1.72E-05
I-132	Ci	< LLD	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**2.90E-04**	**< LLD**	**< LLD**	**2.90E-04**

Table 6: Unit 1 Gaseous Effluents - Ground Level Releases - Continuous - Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3.Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	< LLD	1.59E-03	1.52E-06	< LLD	1.59E-03
Co-60	Ci	1.33E-06	5.21E-04	< LLD	< LLD	5.22E-04
Cr-51	Ci	< LLD	5.72E-03	< LLD	< LLD	5.72E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	9.54E-05	< LLD	< LLD	9.54E-05
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	1.31E-04	< LLD	< LLD	1.31E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	1.98E-04	< LLD	< LLD	1.98E-04
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	1.32E-04	< LLD	< LLD	1.32E-04
Total	Ci	**1.33E-06**	**8.47E-03**	**1.52E-06**	**< LLD**	**8.47E-03**
4.Tritium						
H-3	Ci	2.58E+01	3.73E+01	3.86E+01	2.27E+01	1.24E+02

Table 7: Unit 1 Gaseous Effluents - Ground Level Releases - Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	1.14E-01	2.38E-01	6.14E-02	5.42E-02	4.68E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	3.28E-04	1.61E-01	2.28E-04	< LLD	1.62E-01
Xe-133m	Ci	< LLD	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	< LLD	3.33E-03	< LLD	< LLD	3.33E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**1.14E-01**	**4.05E-01**	**6.16E-02**	**5.42E-02**	**6.35E-01**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 8: Unit 1 Gaseous Effluents - Ground Level Releases - Batch - Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	1.53E-05	< LLD	< LLD	1.53E-05
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	4.01E-04	< LLD	< LLD	4.01E-04
Co-60	Ci	< LLD	1.52E-04	< LLD	< LLD	1.52E-04
Cr-51	Ci	< LLD	1.15E-03	< LLD	< LLD	1.15E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	8.86E-06	< LLD	< LLD	8.86E-06
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	3.44E-05	< LLD	< LLD	3.44E-05
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	5.04E-05	< LLD	< LLD	5.04E-05
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Sr-90	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	5.29E-06	< LLD	< LLD	5.29E-06
Total	Ci	**< LLD**	**1.82E-03**	**< LLD**	**< LLD**	**1.82E-03**
4.Tritium						
H-3	Ci	4.69E+02	3.11E+02	6.96E+01	8.06E+01	9.30E+02
Note 1 - Not required for batch releases						

Table 9: Unit 1 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	1.14E-01	2.38E-01	6.14E-02	5.42E-02	4.68E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	3.28E-04	2.23E-01	2.28E-04	< LLD	2.23E-01
Xe-133m	Ci	< LLD	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	< LLD	3.33E-03	< LLD	< LLD	3.33E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**1.14E-01**	**4.66E-01**	**6.16E-02**	**5.42E-02**	**6.97E-01**
2. Iodines						
I-131	Ci	< LLD	1.72E-05	< LLD	< LLD	1.72E-05
I-132	Ci	< LLD	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**2.90E-04**	**< LLD**	**< LLD**	**2.90E-04**

Table 10: Unit 1 Gaseous Effluents - Continuous and Batch -Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	1.53E-05	< LLD	< LLD	1.53E-05
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	< LLD	1.99E-03	1.52E-06	1.52E-06	1.99E-03
Co-60	Ci	1.33E-06	6.73E-04	< LLD	< LLD	6.74E-04
Cr-51	Ci	< LLD	6.87E-03	< LLD	< LLD	6.87E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	1.04E-04	< LLD	< LLD	1.04E-04
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	1.65E-04	< LLD	< LLD	1.65E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	2.48E-04	< LLD	< LLD	2.48E-04
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	1.37E-04	< LLD	< LLD	1.37E-04
Total	Ci	**1.33E-06**	**1.03E-02**	**1.52E-06**	**1.52E-06**	**1.03E-02**
Total > 8 days	Ci	**1.33E-06**	**1.03E-02**	**1.52E-06**	**< LLD**	**1.03E-02**
4.Tritium						
H-3	Ci	4.95E+02	3.48E+02	1.08E+02	1.03E+02	1.05E+03

Table 11: Unit 1 Radiation Doses At And Beyond The Site Boundary						
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
Gamma Air Dose	mrad	2.99E-04	6.50E-04	1.61E-04	1.42E-04	1.25E-03
ODCM Req 4.1 Limit	mrad	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
% ODCM Limit	%	**5.98E-03**	**1.30E-02**	**3.22E-03**	**2.84E-03**	**1.25E-02**
Beta Air Dose	mrad	1.06E-04	2.90E-04	5.70E-05	5.02E-05	5.03E-04
ODCM Req 4.1 Limit	mrad	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
% ODCM Limit	%	**1.06E-03**	**2.90E-03**	**5.70E-04**	**5.02E-04**	**2.52E-03**
Maximum Organ Dose (excluding skin)	mrem	**1.78E-01**	**1.29E-01**	**3.88E-02**	**3.71E-02**	**3.83E-01**
Age		Teen	Teen	Teen	Teen	Teen
Organ		Thyroid	Lung	Thyroid	Thyroid	Lung
ODCM Req. 4.2 Limit	mrem	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit	%	**2.37E+00**	**1.72E+00**	**5.17E-01**	**4.95E-01**	**2.55E+00**

Calculations are based on parameters and methodologies of the ODCM using historical meteorology. Dose is calculated to a hypothetical individual. In contrast, Appendix C dose calculations are based on concurrent meteorology, a real individual, and only the actual pathways present.

Table 12: Unit 2 Gaseous Effluents - Summation Of All Releases							
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total For Year	Est. Total Error % (1)
A. Fission & activation gases							
1. Total release	Ci	8.56E-02	7.08E-02	9.60E-02	8.95E-02	3.42E-01	**3.54E+01**
2. Average release rate for period	µCi/sec	1.09E-02	9.00E-03	1.21E-02	1.13E-02	1.08E-02	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
B. Iodine 131							
1. Total Iodine 131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD	**3.32E+01**
2. Average release rate for period	µCi/sec	< LLD	< LLD	< LLD	< LLD	< LLD	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
C. Particulates							
1. Particulates with half- lives > 8 days	Ci	< LLD	< LLD	< LLD	< LLD	< LLD	**3.43E+01**
2. Average release rate for period	µCi/sec	< LLD	< LLD	< LLD	< LLD	< LLD	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
4. Gross Alpha radioactivity	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**	
D. Tritium							
1. Total release	Ci	4.52E+01	2.93E+01	8.12E+01	9.55E+01	2.51E+02	**3.85E+01**
2. Average release rate for period	µCi/sec	5.75E+00	3.73E+00	1.02E+01	1.20E+01	7.94E+00	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
(1) Estimated total error methodology is presented in Table 40.							
(2) See Table 19 for percent of ODCM Requirement limits.							

Table 13: Unit 2 Gaseous Effluents - Ground Level Releases - Continuous - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 14: Unit 2 Gaseous Effluents - Ground Level Releases - Continuous - Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-60	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cr-51	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
4. Tritium						
H-3	Ci	3.01E+01	2.93E+01	2.11E+01	1.85E+01	9.90E+01

Table 15: Unit 2 Gaseous Effluents - Ground Level Releases - Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	7.12E-02	4.88E-02	7.50E-02	7.21E-02	2.67E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	1.43E-02	1.02E-02	2.09E-02	1.74E-02	6.28E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	1.33E-04	5.78E-05	1.91E-04
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**8.55E-02**	**5.90E-02**	**9.60E-02**	**8.96E-02**	**3.30E-01**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 16: Unit 2 Gaseous Effluents - Ground Level Releases - Batch - Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-60	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cr-51	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Sr-90	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
4. Tritium						
H-3	Ci	1.50E+01	1.89E-02	6.00E+01	7.69E+01	1.52E+02
Note 1 - Not required for batch releases						

Table 17:
Unit 2
Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines

Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	7.12E-02	4.88E-02	7.50E-02	7.21E-02	2.67E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	1.43E-02	1.02E-02	2.09E-02	1.74E-02	6.28E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	1.33E-04	5.78E-05	1.91E-04
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**8.55E-02**	**5.90E-02**	**9.60E-02**	**8.96E-02**	**3.30E-01**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 18: Unit 2 Gaseous Effluents - Continuous and Batch -Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-60	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cr-51	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
Total > 8 days	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
4. Tritium						
H-3	Ci	4.51E+01	2.93E+01	8.11E+01	9.54E+01	2.51E+02

Table 19: Unit 2 Radiation Doses At And Beyond The Site Boundary						
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
Unit 2		Q1	Q2	Q3	Q4	year
Gamma Air Dose	mrad	1.89E-04	1.56E-04	1.99E-04	1.91E-04	7.34E-04
ODCM Req 4.1 Limit	mrad	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
% ODCM Limit	%	**3.78E-03**	**3.12E-03**	**3.98E-03**	**3.82E-03**	**7.34E-03**
Beta Air Dose	mrad	7.03E-05	5.80E-05	7.57E-05	7.20E-05	2.76E-04
ODCM Req 4.1 Limit	mrad	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
% ODCM Limit	%	**7.03E-04**	**5.80E-04**	**7.57E-04**	**7.20E-04**	**1.38E-03**
Maximum Organ Dose (excluding skin)	mrem	1.62E-02	1.05E-02	2.91E-02	3.42E-02	9.01E-02
Age		Teen	Teen	Teen	Teen	Teen
Organ		Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
ODCM Req. 4.2 Limit	%	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit	%	**2.16E-01**	**1.40E-01**	**3.88E-01**	**4.56E-01**	**6.01E-01**

Calculations are based on parameters and methodologies of the ODCM using historical meteorology. Dose is calculated to a hypothetical individual. In contrast, Appendix C dose calculations are based on concurrent meteorology, a real individual, and only the actual pathways present.

Table 20: Unit 3 Gaseous Effluents - Summation Of All Releases							
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total For Year	Est. Total Error % (1)
A. Fission & activation gases							
1. Total release	Ci	4.38E-02	4.81E-02	8.04E-02	1.03E-01	2.76E-01	**3.54E+01**
2. Average release rate for period	µCi/sec	5.57E-03	6.12E-03	1.01E-02	1.30E-02	8.73E-03	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
B. Iodine 131							
1. Total Iodine 131	Ci	< LLD	< LLD	< LLD	2.35E-05	2.35E-05	**3.32E+01**
2. Average release rate for period	µCi/sec	< LLD	< LLD	< LLD	2.96E-06	7.43E-07	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
C. Particulates							
1. Particulates with half- lives > 8 days	Ci	< LLD	< LLD	< LLD	1.40E-04	1.40E-04	**3.43E+01**
2. Average release rate for period	µCi/sec	< LLD	< LLD	< LLD	1.76E-05	4.41E-06	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
4. Gross Alpha radioactivity	Ci	**< LLD**	**1.68E-08**	**< LLD**	**< LLD**	**< LLD**	
D. Tritium							
1. Total release	Ci	6.92E+01	2.73E+01	5.82E+02	3.71E+02	1.05E+03	**3.85E+01**
2. Average release rate for period	µCi/sec	8.80E+00	3.47E+00	7.32E+01	4.67E+01	3.32E+01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
(1) Estimated total error methodology is presented in Table 40.							
(2) See Table 27 for percent of ODCM Requirement limits.							

Table 21: Unit 3 Gaseous Effluents - Ground Level Releases - Continuous - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	2.35E-05	2.35E-05
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**3.28E-05**	**3.28E-05**

Table 22: Unit 3 **Gaseous Effluents - Ground Level Releases - Continuous - Particulates**						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	2.19E-05	2.19E-05
Co-60	Ci	< LLD	< LLD	< LLD	7.52E-06	7.52E-06
Cr-51	Ci	< LLD	< LLD	< LLD	4.49E-06	4.49E-06
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Os-191	Ci	< LLD	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**3.53E-05**	**3.53E-05**
4. Tritium						
H-3	Ci	2.92E+01	2.73E+01	2.43E+01	1.09E+02	1.90E+02

Table 23: Unit 3 Gaseous Effluents - Ground Level Releases - Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	4.38E-02	4.81E-02	8.04E-02	5.10E-02	2.23E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	< LLD	< LLD	5.23E-02	5.23E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**4.38E-02**	**4.81E-02**	**8.04E-02**	**1.03E-01**	**2.76E-01**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 24: Unit 3 Gaseous Effluents - Ground Level Releases - Batch - Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	3.07E-06	3.07E-06
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	3.33E-05	3.33E-05
Co-60	Ci	< LLD	< LLD	< LLD	2.27E-05	2.27E-05
Cr-51	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	1.34E-07	1.34E-07
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	2.72E-05	2.72E-05
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Sr-90	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	2.09E-05	2.09E-05
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**1.07E-04**	**1.07E-04**
4. Tritium						
H-3	Ci	4.00E+01	2.48E-02	5.58E+02	2.62E+02	8.60E+02
Note 1 - Not required for batch releases						

Table 25:
Unit 3
Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines

Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	4.38E-02	4.81E-02	8.04E-02	5.10E-02	2.23E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	< LLD	< LLD	5.23E-02	5.23E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**4.38E-02**	**4.81E-02**	**8.04E-02**	**1.03E-01**	**2.76E-01**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	2.35E-05	2.35E-05
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**3.28E-05**	**3.28E-05**

Table 26: Unit 3 Gaseous Effluents - Continuous and Batch -Particulates						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	3.07E-06	3.07E-06
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	< LLD	< LLD	5.52E-05	5.52E-05
Co-60	Ci	< LLD	< LLD	< LLD	3.02E-05	3.02E-05
Cr-51	Ci	< LLD	< LLD	< LLD	4.49E-06	4.49E-06
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	< LLD	< LLD	1.34E-07	1.34E-07
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	< LLD	< LLD	2.72E-05	2.72E-05
Os-191	Ci	< LLD	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	< LLD	< LLD	2.09E-05	2.09E-05
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**1.43E-04**	**1.43E-04**
Total > 8 days	Ci	**< LLD**	**< LLD**	**< LLD**	**1.40E-04**	**1.40E-04**
4. Tritium						
H-3	Ci	6.92E+01	2.73E+01	5.82E+02	3.71E+02	1.05E+03

Table 27: Unit 3 Radiation Doses At And Beyond The Site Boundary						
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
Gamma Air Dose	mrad	1.15E-04	1.26E-04	2.11E-04	1.39E-04	5.92E-04
ODCM Req 4.1 Limit	mrad	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
% ODCM Limit	%	**2.30E-03**	**2.52E-03**	**4.22E-03**	**2.78E-03**	**5.92E-03**
Beta Air Dose	mrad	4.06E-05	4.46E-05	7.45E-05	6.28E-05	2.22E-04
ODCM Req 4.1 Limit	mrad	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
% ODCM Limit	%	**4.06E-04**	**4.46E-04**	**7.45E-04**	**6.28E-04**	**1.11E-03**
Maximum Organ Dose (excluding skin)	mrem	2.48E-02	9.80E-03	2.09E-01	1.33E-01	3.77E-01
Age		Teen	Teen	Teen	Teen	Teen
Organ		Thyroid	Thyroid	Thyroid	Thyroid	Thyroid
ODCM Req. 4.2 Limit	mrem	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit	%	**3.31E-01**	**1.31E-01**	**2.79E+00**	**1.77E+00**	**2.51E+00**

Calculations are based on parameters and methodologies of the ODCM using historical meteorology. Dose is calculated to a hypothetical individual. In contrast, Appendix C dose calculations are based on concurrent meteorology, a real individual, and only the actual pathways present.

Table 28: Units 1, 2, and 3 Gaseous Effluents - Continuous - Fission Gases and Iodines - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	< LLD	6.18E-02	< LLD	< LLD	6.18E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**6.18E-02**	**< LLD**	**< LLD**	**6.18E-02**
2. Iodines						
I-131	Ci	< LLD	1.72E-05	< LLD	2.35E-05	4.07E-05
I-132	Ci	< LLD	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**2.90E-04**	**< LLD**	**3.28E-05**	**3.23E-04**

Table 29: Units 1, 2, and 3 Gaseous Effluents - Continuous - Particulates - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	< LLD	1.59E-03	1.52E-06	2.19E-05	1.61E-03
Co-60	Ci	1.33E-06	5.21E-04	< LLD	7.52E-06	5.30E-04
Cr-51	Ci	< LLD	5.72E-03	< LLD	4.49E-06	5.72E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	9.54E-05	< LLD	< LLD	9.54E-05
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	1.31E-04	< LLD	< LLD	1.31E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	1.98E-04	< LLD	< LLD	1.98E-04
Os-191	Ci	< LLD	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	1.32E-04	< LLD	< LLD	1.32E-04
Total	Ci	**1.33E-06**	**8.47E-03**	**1.52E-06**	**3.53E-05**	**8.51E-03**
4. Tritium						
H-3	Ci	8.51E+01	9.39E+01	8.40E+01	1.50E+02	4.13E+02

Table 30: Units 1, 2, and 3 Gaseous Effluents - Batch - Fission Gases and Iodines - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	2.29E-01	3.35E-01	2.17E-01	1.77E-01	9.58E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	1.46E-02	1.71E-01	2.11E-02	6.97E-02	2.77E-01
Xe-133m	Ci	< LLD	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	< LLD	3.33E-03	1.33E-04	5.78E-05	3.52E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**2.44E-01**	**5.12E-01**	**2.38E-01**	**2.47E-01**	**1.24E+00**
2. Iodines						
I-131	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 31: Units 1, 2, and 3 Gaseous Effluents - Batch - Particulates - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	1.53E-05	< LLD	3.07E-06	1.84E-05
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	< LLD	4.01E-04	< LLD	3.33E-05	4.34E-04
Co-60	Ci	< LLD	1.52E-04	< LLD	2.27E-05	1.75E-04
Cr-51	Ci	< LLD	1.15E-03	< LLD	< LLD	1.15E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	8.86E-06	< LLD	< LLD	8.86E-06
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	3.44E-05	< LLD	1.34E-07	3.45E-05
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	5.04E-05	< LLD	2.72E-05	7.76E-05
Os-191	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Sr-90	Ci	Note 1	Note 1	Note 1	Note 1	Note 1
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	5.29E-06	< LLD	2.09E-05	2.62E-05
Total	Ci	**< LLD**	**1.82E-03**	**< LLD**	**1.07E-04**	**1.92E-03**
4. Tritium						
H-3	Ci	5.24E+02	3.11E+02	6.88E+02	4.20E+02	1.94E+03
Note 1 - Not required for batch releases						

Table 32: Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	2.29E-01	3.35E-01	2.17E-01	1.77E-01	9.58E-01
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	1.46E-02	2.33E-01	2.11E-02	6.97E-02	3.38E-01
Xe-133m	Ci	< LLD	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	< LLD	3.33E-03	1.33E-04	5.78E-05	3.52E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**2.44E-01**	**5.73E-01**	**2.38E-01**	**2.47E-01**	**1.30E+00**
2. Iodines						
I-131	Ci	< LLD	1.72E-05	< LLD	2.35E-05	4.07E-05
I-132	Ci	< LLD	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**2.90E-04**	**< LLD**	**3.28E-05**	**3.23E-04**

Table 33: Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Particulates - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
3. Particulates						
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	1.53E-05	< LLD	3.07E-06	1.84E-05
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	< LLD	1.99E-03	< LLD	5.52E-05	2.05E-03
Co-60	Ci	1.33E-06	6.73E-04	< LLD	3.02E-05	7.05E-04
Cr-51	Ci	< LLD	6.87E-03	< LLD	4.49E-06	6.87E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	< LLD	1.04E-04	< LLD	< LLD	1.04E-04
La-140	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	< LLD	1.65E-04	< LLD	1.34E-07	1.66E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	< LLD	2.48E-04	< LLD	2.72E-05	2.76E-04
Os-191	Ci	< LLD	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	< LLD	1.37E-04	< LLD	2.09E-05	1.58E-04
Total	Ci	**1.33E-06**	**1.03E-02**	**< LLD**	**1.43E-04**	**1.04E-02**
Total > 8 days	Ci	**1.33E-06**	**1.03E-02**	**< LLD**	**1.40E-04**	**1.04E-02**
4. Tritium						
H-3	Ci	6.09E+02	4.05E+02	7.72E+02	5.70E+02	2.36E+03

Table 34: Units 1, 2 and 3 Gaseous Effluents- Continuous - Fission Gases and Iodine - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
1. Fission gases					
Ar-41	Ci	< LLD	< LLD	< LLD	< LLD
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	< LLD	< LLD	< LLD	< LLD
Xe-133	Ci	6.18E-02	< LLD	< LLD	6.18E-02
Xe-133m	Ci	< LLD	< LLD	< LLD	< LLD
Xe-135	Ci	< LLD	< LLD	< LLD	< LLD
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD
Total	Ci	**6.18E-02**	**< LLD**	**< LLD**	**6.18E-02**
2. Iodines					
I-131	Ci	1.72E-05	< LLD	2.35E-05	4.07E-05
I-132	Ci	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD
Total	Ci	**2.90E-04**	**< LLD**	**3.28E-05**	**3.23E-04**

Table 35: Units 1, 2 and 3 Gaseous Effluents- Continuous - Particulates - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
3. Particulates					
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	< LLD	< LLD	< LLD	< LLD
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	1.59E-03	< LLD	2.19E-05	1.62E-03
Co-60	Ci	5.22E-04	< LLD	7.52E-06	5.29E-04
Cr-51	Ci	5.72E-03	< LLD	4.49E-06	5.72E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	9.54E-05	< LLD	< LLD	9.54E-05
La-140	Ci	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	1.31E-04	< LLD	< LLD	1.31E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	1.98E-04	< LLD	< LLD	1.98E-04
Os-191	Ci	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	1.32E-04	< LLD	< LLD	1.32E-04
Total	Ci	**8.47E-03**	**< LLD**	**3.53E-05**	**8.51E-03**
4. Tritium					
H-3	Ci	1.24E+02	9.91E+01	1.89E+02	4.13E+02

Table 36: Units 1, 2 and 3 Gaseous Effluents- Batch - Fission Gases and Iodine - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
1. Fission gases					
Ar-41	Ci	5.43E+00	2.77E-01	2.35E-01	5.94E+00
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	1.62E-01	6.47E-02	5.23E-02	2.79E-01
Xe-133m	Ci	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	3.33E-03	1.90E-04	< LLD	3.52E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD
Xe-138		< LLD	< LLD	< LLD	< LLD
Total	Ci	**5.60E+00**	**3.42E-01**	**2.87E-01**	**6.23E+00**
2. Iodines					
I-131	Ci	< LLD	< LLD	< LLD	< LLD
I-132	Ci	< LLD	< LLD	< LLD	< LLD
I-133	Ci	< LLD	< LLD	< LLD	< LLD
I-134	Ci	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD
Total	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**

Table 37: Units 1, 2 and 3 Gaseous Effluents- Batch - Particulates - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1,2 and 3
3. Particulates					
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	1.44E-03	< LLD	4.20E-06	1.44E-03
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	< LLD	< LLD	< LLD	< LLD
Co-58	Ci	4.01E-04	< LLD	3.33E-05	4.34E-04
Co-60	Ci	1.52E-04	< LLD	2.27E-05	1.75E-04
Cr-51	Ci	1.15E-03	< LLD	< LLD	1.15E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	8.86E-06	< LLD	< LLD	8.86E-06
La-140	Ci	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	3.44E-05	< LLD	1.34E-07	3.46E-05
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	5.04E-05	< LLD	2.72E-05	7.76E-05
Os-191	Ci	< LLD	< LLD	< LLD	< LLD
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	< LLD	< LLD	< LLD	< LLD
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	Note 1	Note 1	Note 1	Note 1
Sr-90	Ci	Note 1	Note 1	Note 1	Note 1
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	5.29E-06	< LLD	2.09E-05	2.62E-05
Total	Ci	**3.24E-03**	**< LLD**	**1.08E-04**	**3.34E-03**
4. Tritium					
H-3	Ci	9.31E+02	1.52E+02	9.44E+02	2.03E+03
Note 1 - Not required for batch releases					

Table 38: Units 1, 2 and 3 Gaseous Effluents- Continuous and Batch - Fission Gases and Iodine - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
1. Fission gases					
Ar-41	Ci	5.43E+00	2.77E-01	2.35E-01	5.94E+00
Kr-83m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85	Ci	< LLD	< LLD	< LLD	< LLD
Kr-85m	Ci	< LLD	< LLD	< LLD	< LLD
Kr-87	Ci	< LLD	< LLD	< LLD	< LLD
Kr-88	Ci	< LLD	< LLD	< LLD	< LLD
Kr-89	Ci	< LLD	< LLD	< LLD	< LLD
Kr-90	Ci	< LLD	< LLD	< LLD	< LLD
Xe-131m	Ci	1.24E-03	< LLD	< LLD	1.24E-03
Xe-133	Ci	2.24E-01	6.47E-02	5.23E-02	3.41E-01
Xe-133m	Ci	1.02E-03	< LLD	< LLD	1.02E-03
Xe-135	Ci	3.33E-03	1.90E-04	< LLD	3.52E-03
Xe-135m	Ci	< LLD	< LLD	< LLD	< LLD
Xe-137	Ci	< LLD	< LLD	< LLD	< LLD
Xe-138	Ci	< LLD	< LLD	< LLD	< LLD
Total	Ci	**5.66E+00**	**3.42E-01**	**2.87E-01**	**6.29E+00**
2. Iodines					
I-131	Ci	1.72E-05	< LLD	2.35E-05	4.07E-05
I-132	Ci	2.73E-04	< LLD	< LLD	2.73E-04
I-133	Ci	< LLD	< LLD	9.27E-06	9.27E-06
I-134	Ci	< LLD	< LLD	< LLD	< LLD
I-135	Ci	< LLD	< LLD	< LLD	< LLD
Total	Ci	**2.90E-04**	**< LLD**	**3.28E-05**	**3.23E-04**

Table 39: Units 1, 2 and 3 Gaseous Effluents - Continuous and Batch - Particulates - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
3. Particulates					
Ag-110m	Ci	< LLD	< LLD	< LLD	< LLD
Ba-140	Ci	< LLD	< LLD	< LLD	< LLD
Br-82	Ci	1.44E-03	< LLD	4.20E-06	1.44E-03
Ce-141	Ci	< LLD	< LLD	< LLD	< LLD
Ce-144	Ci	< LLD	< LLD	< LLD	< LLD
Co-57	Ci	4.88E-06	< LLD	< LLD	4.88E-06
Co-58	Ci	1.99E-03	< LLD	5.52E-05	2.05E-03
Co-60	Ci	6.74E-04	< LLD	3.02E-05	7.04E-04
Cr-51	Ci	6.86E-03	< LLD	4.49E-06	6.87E-03
Cs-134	Ci	< LLD	< LLD	< LLD	< LLD
Cs-136	Ci	< LLD	< LLD	< LLD	< LLD
Cs-137	Ci	< LLD	< LLD	< LLD	< LLD
Cs-138	Ci	< LLD	< LLD	< LLD	< LLD
Fe-59	Ci	1.04E-04	< LLD	< LLD	1.04E-04
La-140	Ci	< LLD	< LLD	< LLD	< LLD
Mn-54	Ci	1.65E-04	< LLD	1.34E-07	1.65E-04
Mo-99	Ci	< LLD	< LLD	< LLD	< LLD
Nb-95	Ci	2.48E-04	< LLD	2.72E-05	2.75E-04
Os-191	Ci	< LLD	< LLD	1.38E-06	1.38E-06
Rb-88	Ci	< LLD	< LLD	< LLD	< LLD
Ru-103	Ci	< LLD	< LLD	< LLD	< LLD
Ru-106	Ci	< LLD	< LLD	< LLD	< LLD
Sb-122	Ci	< LLD	< LLD	< LLD	< LLD
Sb-124	Ci	7.86E-05	< LLD	< LLD	7.86E-05
Sb-125	Ci	< LLD	< LLD	< LLD	< LLD
Se-75	Ci	< LLD	< LLD	< LLD	< LLD
Sn-113m	Ci	< LLD	< LLD	< LLD	< LLD
Sr-89	Ci	< LLD	< LLD	< LLD	< LLD
Sr-90	Ci	< LLD	< LLD	< LLD	< LLD
Tc-99m	Ci	< LLD	< LLD	< LLD	< LLD
Te-123m	Ci	< LLD	< LLD	< LLD	< LLD
Zn-65	Ci	< LLD	< LLD	< LLD	< LLD
Zr-95	Ci	1.37E-04	< LLD	2.09E-05	1.58E-04
Total	Ci	**1.17E-02**	**< LLD**	**1.44E-04**	**1.19E-02**
Total > 8 days	Ci	**1.33E-06**	**1.03E-02**	**1.52E-06**	**1.03E-02**
4. Tritium					
H-3	Ci	1.06E+03	2.51E+02	1.13E+03	2.44E+03

Table 40:
Estimation of Total Percent Error

The estimated total error is calculated as follows:

Total Percent Error = $(E_1^2 + E_2^2 + E_3^2 + ... + E_n^2)^{1/2}$

Where E_n = Percent error associated with each contributing parameter.

Parameters contributing to errors in the measurement of gaseous effluents; process flow rates, sample collection, analytical counting and tank volumes.

The following values (%) were used for error calculations.

Fission & Act gases	I-131	Particulates	Tritium	
25	25	25	25	Sample counting error
10	10	10	10	Counting system calibration error
5	5	5	5	Counting system source error
20	N/A	N/A	N/A	Temperature/volume correction error
10	10	10	10	Process flow measuring device (1)
N/A	15	15	15	Sample flow measuring device
N/A	5	N/A	N/A	Iodine collection efficiency error
N/A	N/A	10	N/A	Plateout error
N/A	N/A	N/A	20	Bubbler collection efficiency error
N/A	N/A	N/A	2	Sample volume transfer error (pipette)
N/A	N/A	N/A	2	Sample volume error (graduate)
Note 1 - % of full scale				

Table 41: Effluent Monitoring Instrumentation Out Of Service Greater Than 30 Days				
Unit	Instrument	Date span of inoperability	Cause of inoperability	Explanation
2	Unit 2 Fuel Building Ventilation Flow transmitter 2JHFBFT0093**I XMITR	2/11/2016 through 4/14/2016	Condition Report 16-02244 documents the flow transmitter failing its acceptance criteria for FUNCTIONALITY due to low flow indication.	Condition Report 16-03957 determined that a ventilation inspection panel was found open, however, it took greater than 30 days to find and fix the problem.

Table 42:
Solid Waste Summary

A. Solid Waste Shipped Offsite For Burial Or Disposal (not irradiated fuel)

1.0 Type of Waste	Unit	Jan-Dec 2016	estimated total error %
1.a. Spent resin, filters, sludges, evaporator bottoms, etc.	m3	9.25E+01	2.50E+01
	Ci	2.12E+02	2.50E+01
1.b. Dry compressible waste, contaminated equipment, etc	m3	5.87E+02	2.50E+01
	Ci	1.19E+01	2.50E+01
1.c. Irradiated components, control rods, etc.	m3	3.56E-01	2.50E+01
	Ci	6.05E+00	2.50E+01
1.d. Other (Oil)	m3	5.36E+00	2.50E+01
	Ci	8.12E-07	2.50E+01

2.0 Estimate of major nuclide composition

2.a. Spent resin, filters, sludge, evaporator bottoms, etc.			
Nuclide Name	Percent Abundance	Curies	Estimated Total Error %
Ni-63	5.24E+01	1.11E+02	2.50E+01
Fe-55	1.76E+01	3.72E+01	2.50E+01
Co-60	1.28E+01	2.71E+01	2.50E+01
Co-58	6.82E+00	1.44E+01	2.50E+01
Cs-137	3.11E+00	6.58E+00	2.50E+01
C-14	2.19E+00	4.64E+00	2.50E+01
Mn-54	1.44E+00	3.06E+00	2.50E+01
Sb-125	1.40E+00	2.96E+00	2.50E+01
H-3	1.33E+00	2.81E+00	2.50E+01
Co-57	6.21E-01	1.31E+00	2.50E+01
Ni-59	6.74E-02	1.43E-01	2.50E+01
Sr-90	5.56E-02	1.18E-01	2.50E+01
Tc-99	5.25E-02	1.11E-01	2.50E+01
Ce-144	4.87E-02	1.03E-01	2.50E+01
Pu-241	1.74E-02	3.68E-02	2.50E+01
Ag-110m	1.68E-02	3.57E-02	2.50E+01
Cs-134	1.44E-02	3.05E-02	2.50E+01
Zr-95	1.32E-02	2.79E-02	2.50E+01
I-129	1.21E-02	2.57E-02	2.50E+01
Cr-51	8.18E-03	1.73E-02	2.50E+01
Zn-65	7.61E-03	1.61E-02	2.50E+01
Nb-95	7.21E-03	1.53E-02	2.50E+01
Sn-113	3.06E-03	6.48E-03	2.50E+01
Sb-124	2.82E-03	5.96E-03	2.50E+01
Am-241	1.22E-03	2.58E-03	2.50E+01
Pu-238	7.64E-04	1.62E-03	2.50E+01
Cm-243	6.56E-04	1.39E-03	2.50E+01
Pu-239	4.91E-04	1.04E-03	2.50E+01
Fe-59	4.33E-04	9.17E-04	2.50E+01
Sr-89	2.41E-04	5.11E-04	2.50E+01
Am-243	5.62E-05	1.19E-04	2.50E+01
Cm-242	2.11E-05	4.47E-05	2.50E+01
Te-123m	7.65E-06	1.62E-05	2.50E+01
Pu-242	6.89E-06	1.46E-05	2.50E+01
Be-7	4.16E-11	8.81E-11	2.50E+01
Hf-181	8.41E-18	1.78E-17	2.50E+01
Ru-103	2.99E-27	6.32E-27	2.50E+01
Ce-141	5.48E-30	1.16E-29	2.50E+01
	Total	2.12E+02	

2.b. Dry compressible waste, contaminated equip, etc.			
Nuclide Name	Percent Abundance	Curies	Estimated Total Error %
Cr-51	4.87E+01	5.82E+00	2.50E+01
Co-58	1.41E+01	1.69E+00	2.50E+01
Nb-95	1.25E+01	1.50E+00	2.50E+01
Zr-95	1.07E+01	1.27E+00	2.50E+01
Co-60	7.57E+00	9.05E-01	2.50E+01
Fe-55	2.04E+00	2.44E-01	2.50E+01
Mn-54	1.52E+00	1.82E-01	2.50E+01
Fe-59	7.88E-01	9.42E-02	2.50E+01
Ni-63	4.70E-01	5.62E-02	2.50E+01
H-3	2.90E-01	3.47E-02	2.50E+01
Sn-113	2.25E-01	2.69E-02	2.50E+01
Sb-125	1.84E-01	2.20E-02	2.50E+01
Zn-65	1.67E-01	1.99E-02	2.50E+01
Ce-144	1.56E-01	1.86E-02	2.50E+01
C-14	1.45E-01	1.73E-02	2.50E+01
Hf-181	9.76E-02	1.17E-02	2.50E+01
Te-123m	6.54E-02	7.82E-03	2.50E+01
Sb-124	6.05E-02	7.23E-03	2.50E+01
Co-57	5.36E-02	6.40E-03	2.50E+01
Cs-137	3.84E-02	4.59E-03	2.50E+01
Tc-99	3.53E-02	4.22E-03	2.50E+01
Sr-90	8.52E-03	1.02E-03	2.50E+01
I-129	7.06E-03	8.44E-04	2.50E+01
Cm-242	2.16E-04	2.58E-05	2.50E+01
Pu-239	8.84E-05	1.06E-05	2.50E+01
Am-241	7.03E-05	8.40E-06	2.50E+01
Sc-46	6.53E-05	7.80E-06	2.50E+01
Cm-243	5.98E-05	7.14E-06	2.50E+01
Sr-89	1.58E-05	1.89E-06	2.50E+01
Pu-241	1.73E-06	2.07E-07	2.50E+01
Pu-238	1.82E-08	2.18E-09	2.50E+01
	1.00E+02	1.19E+01	

2.c. Irradiated components, control rods, etc.			
Nuclide Name	Percent Abundance	Curies	Estimated Total Error %
Co-60	7.14E+01	4.32E+00	2.50E+01
Fe-55	1.75E+01	1.06E+00	2.50E+01
Ni-63	9.50E+00	5.75E-01	2.50E+01
Cr-51	4.69E-01	2.84E-02	2.50E+01
Co-58	4.26E-01	2.58E-02	2.50E+01
Zr-95	3.01E-01	1.82E-02	2.50E+01
Nb-95	1.80E-01	1.09E-02	2.50E+01
Mn-54	8.28E-02	5.01E-03	2.50E+01
Ni-59	6.21E-02	3.76E-03	2.50E+01
H-3	2.15E-02	1.30E-03	2.50E+01
C-14	2.08E-02	1.26E-03	2.50E+01
Fe-59	1.56E-02	9.44E-04	2.50E+01
Sb-125	1.07E-02	6.47E-04	2.50E+01
Sn-113	8.99E-03	5.44E-04	2.50E+01
Zn-65	8.42E-03	5.10E-04	2.50E+01
Ce-144	7.14E-03	4.32E-04	2.50E+01
Co-57	2.73E-03	1.65E-04	2.50E+01
Te-123m	2.66E-03	1.61E-04	2.50E+01
Cs-137	2.21E-03	1.34E-04	2.50E+01
Hf-181	1.82E-03	1.10E-04	2.50E+01
Sb-124	1.62E-03	9.80E-05	2.50E+01
Nb-94	1.05E-03	6.35E-05	2.50E+01
Sr-90	5.24E-04	3.17E-05	2.50E+01
I-129	9.71E-05	5.88E-06	2.50E+01
Tc-99	6.31E-05	3.82E-06	2.50E+01
Cm-242	9.90E-06	5.99E-07	2.50E+01
Pu-239	5.48E-06	3.32E-07	2.50E+01
Am-241	4.34E-06	2.63E-07	2.50E+01
Cm-243	3.68E-06	2.23E-07	2.50E+01
Ta-182	2.73E-11	1.65E-12	2.50E+01
	Total	6.05E+00	

2.d. Other (Soil/Oil)			
Nuclide Name	Percent Abundance	Curies	Estimated Total Error %
H-3	6.70E+01	7.93E-04	2.50E+01
Tc-99	2.43E+01	2.88E-04	2.50E+01
C-14	8.53E+00	1.01E-04	2.50E+01
I-129	1.01E-01	1.19E-06	2.50E+01
Cs-137	2.95E-02	3.49E-07	2.50E+01
Sb-125	2.95E-02	3.49E-07	2.50E+01
Co-60	9.63E-03	1.14E-07	2.50E+01
	Total	1.18E-03	

3.b Irradiated Fuel Shipments: None

3.c Supplemental Information:

Number of Shipments	Mode Of Transport	Destination
11	Highway	EnergySolutions, UT (BWF)
20	Highway	EnergySolutions, UT (Treatment Facility)
3	Highway	EnergySolutions, UT (CWF)
8	Highway	Waste Control Specialist, TX (CWDF)
1	Highway	EnergySolutions, TN

BWF = Bulk Waste Facility
CWF = Containerized Waste Facility
CWDF = Containerized Waste Dispoal Facility
TSD = Treatment, Storage, Disposal

1) Container Volume in M^3 by Waste Class

	Waste Class A	Waste Class B	Waste Class C
a. material	8.10E+01	1.03E+01	1.20E+00
b. material	5.87E+02	0	0
c. material	3.56E-01	0	0
d. material	5.36E+00	0	0

2) Container Activity in Ci by Waste Class (calculated)

	Waste Class A	Waste Class B	Waste Class C
a. material	5.13E+00	1.63E+02	4.39E+01
b. material	1.19E+01	0	0
c. material	6.05E+00	0	0
d. material	8.12E-07	0	0

3) Principal Radionuclides

a. material	See section 2.0 of the report
b. material	See section 2.0 of the report
c. material	See section 2.0 of the report
d. material	See section 2.0 of the report

4) Source of waste and processing employed

a. material	spent resin-dewatered/dried, mechanical filters-no processing, concentrates-dried,concentrates as a liquid-no processing employed
b. material	non-compacted dry active waste - no processing employed
c. material	Activated material - no processing empoyed
d. material	Oil - no processing empoyed

5) Type of Container

a. material	(1) Metal Tank or Liner transported as LSA-I, (10) Type A transportation casks transported as LSA-I, (12) Type A transportation casks transported as LSA-II, (4)Type A tranportation casks transported as Type A
b. material	(20) 20' sea land containers transported as LSA-I, (3) Type A tranportation casks transported as Type A
c. material	(1) Type A transportation casks transported as LSA-I
d. material	(1) Type A tranportation casks transported as Exempt Quantity

6) Solidification agent or absorbent

a. material	No solidification agents or absorbents used to process material
b. material	No solidification agents or absorbents used to process material
c. material	No solidification agents or absorbents used to process material
d. material	No solidification agents or absorbents used to process material

APPENDIX B

METEOROLOGY

JOINT FREQUENCY DISTRIBUTION TABLES

The tables presented in this section are results obtained from processing the hourly meteorological data collected at the Palo Verde Nuclear Generating Station for the period of January - December 2016. The joint frequency distribution (JFD) tables represent the frequency, in terms of the number of observations, that a particular wind speed, wind direction, and stability category occurred simultaneously. On a quarterly, semiannual and annual basis, the JFDs were produced for 35-foot wind speed and wind direction by atmospheric stability class corresponding to the seven Pasquill stability categories, and for wind speed and wind direction for all stability classes combined. Atmospheric stability was classified per Regulatory Guide 1.23, using the 200-foot to 35-foot temperature difference (delta T).

In accordance with NUREG-0133, the batch releases for the year were considered as “long term,” since the batch releases are sufficiently random in both time of day and duration. Consequently, the JFDs for the batch releases for all quarters are the same as for the continuous releases.

Discussion

A summary of 2016 Joint Frequency Distribution (JFD) shows a somewhat typical, but variable year. Of the 8784 hours available, 223 hours of data were lost due to data being overwritten for an effective 97.6% data recovery.

The average 35 foot mean wind speed was 6.7 mph. Distribution of directions was spread over the compass with a predominant direction (3 sectors of 22.5 degrees each) centered on southwest (29.9%). A secondary maximum of three sectors centered on the north contained 26.9% of the total. Southwesterly flow winds averaged higher speeds with the most frequent speed at 10 mph. With the northerly directions, the highest frequency occurred at 4.0 mph.

Stability class summary:

Stability class E, F, G, (stable categories) 59.1%.
Stability class G, (extremely stable) 25.2%.
Stability class A, B, C, (unstable categories) 21.8%.
Stability class D, (neutral category) 19.1%.

Overall stable conditions (E,F,G) existed for the year.

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 3/31/2016

*** 1ST QRTR ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.51- 5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.51- 6.50	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
6.51- 8.50	0	0	0	0	0	2	0	2	2	0	1	3	1	0	0	0	11
8.51-11.50	1	0	0	0	0	1	0	0	0	1	4	1	5	4	3	1	21
11.51-14.50	0	0	0	0	0	0	0	0	0	1	6	5	1	0	2	1	16
14.51-20.50	0	0	0	0	0	0	0	0	0	4	0	2	0	3	0	3	12
>20.50	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTAL	1	0	0	0	0	3	0	2	2	8	11	11	7	7	5	5	62

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
4.51- 5.50	0	1	0	1	0	0	0	1	0	1	0	0	0	1	1	0	6
5.51- 6.50	0	1	0	0	0	0	0	1	4	1	3	2	1	0	0	0	13
6.51- 8.50	0	1	3	3	1	1	0	2	1	3	6	4	2	1	0	0	28
8.51-11.50	0	1	0	1	0	1	0	0	0	2	3	4	1	1	0	2	16
11.51-14.50	0	0	0	0	0	0	0	0	0	2	5	1	0	0	0	0	8
14.51-20.50	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
>20.50	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
TOTAL	0	4	3	5	1	2	0	4	6	11	18	11	4	3	1	2	75

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
3.51- 4.50	0	0	0	0	0	0	0	0	1	2	1	2	2	0	0	1	9
4.51- 5.50	1	0	1	3	3	0	1	2	6	4	2	0	1	0	0	3	27
5.51- 6.50	2	2	4	1	1	1	0	2	5	8	5	2	0	1	0	2	36
6.51- 8.50	0	3	4	2	4	2	2	0	4	3	3	2	0	1	0	1	31
8.51-11.50	0	0	4	1	1	1	0	0	2	1	0	0	0	0	0	0	10
11.51-14.50	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	0	5
14.51-20.50	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	4
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	5	13	7	9	4	3	4	18	20	16	7	4	3	0	7	124

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 3/31/2016

*** 1ST QRTR ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1.51- 2.50	1	1	2	0	0	0	2	3	2	5	5	2	2	0	1	2	28
2.51- 3.50	12	4	1	3	3	3	5	7	16	15	13	8	3	6	2	5	106
3.51- 4.50	5	5	7	5	0	1	2	3	13	18	11	4	5	1	6	3	89
4.51- 5.50	6	11	9	5	1	1	6	5	9	7	9	4	2	3	1	3	82
5.51- 6.50	2	3	8	3	0	1	0	2	3	9	5	5	0	1	2	1	45
6.51- 8.50	5	4	5	6	1	0	0	0	2	3	6	4	3	1	1	1	42
8.51-11.50	0	0	4	1	6	3	0	0	0	4	6	6	4	0	2	1	37
11.51-14.50	0	0	0	1	4	0	0	0	0	4	7	3	2	0	0	1	22
14.51-20.50	0	0	0	0	6	0	0	0	2	3	2	1	4	6	0	0	24
>20.50	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
TOTAL	31	28	37	24	21	9	15	20	47	71	64	37	25	18	15	17	479

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	1	0	0	0	0	0	1	1	0	0	2	0	5
1.51- 2.50	5	4	0	0	1	0	0	2	0	2	1	5	0	2	2	1	25
2.51- 3.50	3	2	1	1	0	0	0	0	0	5	4	7	5	5	6	1	40
3.51- 4.50	3	1	0	1	0	0	0	0	2	5	6	6	3	2	5	4	38
4.51- 5.50	3	3	1	1	1	0	0	0	7	9	4	2	1	1	2	3	38
5.51- 6.50	2	2	2	0	0	0	0	0	1	2	4	0	0	3	2	2	20
6.51- 8.50	1	3	1	1	0	1	0	1	3	7	7	6	8	3	2	1	45
8.51-11.50	2	2	1	3	0	3	1	0	0	4	7	4	6	4	1	1	39
11.51-14.50	0	1	0	4	2	0	0	0	0	3	5	2	1	13	1	0	32
14.51-20.50	0	0	0	0	13	0	0	0	1	2	8	3	3	4	0	0	34
>20.50	0	0	0	0	1	0	0	0	3	0	2	2	0	0	0	0	8
TOTAL	19	18	6	11	19	4	1	3	17	39	49	38	27	37	23	13	324

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	4	2	0	0	0	0	0	1	1	1	3	3	2	5	3	3	28
2.51- 3.50	4	1	1	3	2	0	0	1	0	2	5	2	5	4	13	7	50
3.51- 4.50	4	2	1	0	0	0	0	0	1	4	5	3	3	2	10	10	45
4.51- 5.50	4	0	1	0	0	0	1	0	1	5	2	4	3	1	5	4	31
5.51- 6.50	1	4	2	0	0	0	0	0	0	6	4	3	4	3	4	5	36
6.51- 8.50	2	3	1	2	1	0	0	2	0	6	10	10	2	5	5	7	56
8.51-11.50	0	1	0	0	0	0	0	0	0	11	4	1	1	9	4	4	35
11.51-14.50	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	4
14.51-20.50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	19	13	6	5	4	0	1	4	3	36	33	26	21	29	44	42	286

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 3/31/2016

*** 1ST QRTR ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3
1.51- 2.50	11	3	3	1	2	0	0	0	0	2	1	4	6	7	16	18	74
2.51- 3.50	49	11	8	5	2	3	1	2	2	5	3	1	8	19	34	48	201
3.51- 4.50	68	13	3	3	1	1	1	2	1	2	1	2	7	12	26	71	214
4.51- 5.50	66	14	2	2	0	1	0	0	1	1	3	3	2	5	17	38	155
5.51- 6.50	36	19	3	1	0	0	0	0	0	2	1	1	2	5	5	12	87
6.51- 8.50	42	10	1	0	0	0	0	0	1	2	1	1	1	0	1	12	72
8.51-11.50	13	10	1	0	0	0	0	0	0	2	0	0	0	0	0	2	28
11.51-14.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	285	81	21	12	5	5	2	4	5	16	10	12	26	49	100	201	834

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	1	1	0	1	0	0	0	0	0	1	1	0	1	3	0	9
1.51- 2.50	22	10	5	1	3	0	2	6	3	10	10	14	10	14	22	24	156
2.51- 3.50	68	18	11	12	7	6	6	10	18	27	25	19	21	34	55	61	398
3.51- 4.50	80	21	11	9	1	2	3	5	19	31	24	17	20	17	47	89	396
4.51- 5.50	80	29	14	12	5	2	8	8	24	27	20	13	9	11	26	51	339
5.51- 6.50	43	31	19	5	1	2	0	5	13	29	22	13	7	13	13	22	238
6.51- 8.50	50	24	15	14	7	6	2	7	13	24	34	30	17	11	9	22	285
8.51-11.50	16	14	10	6	7	9	1	0	2	25	24	16	17	18	10	11	186
11.51-14.50	0	1	0	5	6	0	0	0	0	12	26	11	6	13	3	4	87
14.51-20.50	0	0	0	0	20	0	0	0	3	11	13	6	7	14	0	3	77
>20.50	0	0	0	0	1	0	0	0	3	5	2	2	0	0	0	0	13
TOTAL	359	149	86	64	59	27	22	41	98	201	201	142	114	146	188	287	2184

TOTAL NUMBER OF OBSERVATIONS: 2184
TOTAL NUMBER OF VALID OBSERVATIONS: 2184
TOTAL NUMBER OF MISSING OBSERVATIONS: 0
PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %
MEAN WIND SPEED FOR THIS PERIOD: 5.9 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
2.84	3.43	5.68	21.93	14.84	13.10	38.19

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	1	0	0	0	0	3	0	2	2	8	11	11	7	7	5	5	0
B	0	4	3	5	1	2	0	4	6	11	18	11	4	3	1	2	0
C	4	5	13	7	9	4	3	4	18	20	16	7	4	3	0	7	0
D	31	28	37	24	21	9	15	20	47	71	64	37	25	18	15	17	0
E	19	18	6	11	19	4	1	3	17	39	49	38	27	37	23	13	0
F	19	13	6	5	4	0	1	4	3	36	33	26	21	29	44	42	0
G	285	81	21	12	5	5	2	4	5	16	10	12	26	49	100	201	0
TOTAL	359	149	86	64	59	27	22	41	98	201	201	142	114	146	188	287	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 4/01/2016 TO 6/30/2016

*** 2ND QRTR ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.51- 5.50	0	0	0	1	1	1	2	1	3	0	1	0	0	0	0	0	10
5.51- 6.50	0	1	0	0	2	0	1	6	13	7	4	0	0	0	0	0	34
6.51- 8.50	0	0	1	4	3	2	6	8	25	10	18	4	3	3	1	0	88
8.51-11.50	0	1	0	4	8	9	0	4	8	18	21	9	5	0	2	1	90
11.51-14.50	1	1	5	1	1	1	4	0	7	13	16	5	3	3	4	2	67
14.51-20.50	0	0	5	3	2	2	0	1	5	8	3	0	2	1	0	1	33
>20.50	0	0	1	0	0	0	0	0	0	1	6	1	0	1	1	0	11
TOTAL	1	3	12	13	17	15	13	20	61	57	69	19	13	8	8	4	333

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
4.51- 5.50	0	0	1	2	1	1	1	4	12	0	2	1	1	0	0	1	27
5.51- 6.50	1	1	0	2	1	1	2	3	17	9	4	5	1	2	2	0	51
6.51- 8.50	0	1	2	2	2	5	1	3	9	10	8	4	4	1	0	0	52
8.51-11.50	0	0	2	3	3	2	3	2	2	10	9	2	2	0	0	0	40
11.51-14.50	0	1	0	0	1	3	0	1	0	4	4	0	0	2	0	0	16
14.51-20.50	0	0	2	0	1	0	0	0	0	3	3	1	0	0	0	0	10
>20.50	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	3
TOTAL	1	3	7	9	9	13	7	13	40	37	31	13	8	6	2	1	200

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
3.51- 4.50	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	5
4.51- 5.50	1	0	2	2	1	1	2	4	11	7	0	1	0	1	1	0	34
5.51- 6.50	0	0	2	1	0	0	1	1	6	11	2	5	3	1	0	0	33
6.51- 8.50	0	1	4	5	3	1	1	1	4	6	2	3	3	1	1	0	36
8.51-11.50	0	0	2	1	2	3	1	2	1	4	2	2	3	0	0	0	23
11.51-14.50	1	0	1	0	3	0	1	0	0	2	4	0	0	0	0	0	12
14.51-20.50	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	4
>20.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTAL	2	1	11	9	9	5	6	8	24	33	15	11	9	4	2	0	149

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 4/01/2016 TO 6/30/2016

*** 2ND QRTR ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	3
1.51- 2.50	0	0	0	1	0	1	4	0	1	1	0	0	3	1	0	0	12
2.51- 3.50	2	1	3	1	3	1	5	4	4	5	6	1	2	2	0	4	44
3.51- 4.50	2	4	4	2	2	4	3	3	8	6	6	2	2	0	0	1	49
4.51- 5.50	0	4	2	0	2	2	3	3	3	10	7	2	3	1	0	0	42
5.51- 6.50	0	0	3	3	0	3	1	0	5	2	2	2	2	1	1	1	26
6.51- 8.50	0	1	4	6	2	0	1	1	4	3	5	4	2	1	0	0	34
8.51-11.50	0	3	2	2	2	5	2	3	2	7	5	4	7	2	0	0	46
11.51-14.50	0	0	1	2	1	0	0	1	2	5	6	1	2	3	0	1	25
14.51-20.50	1	2	1	1	0	2	2	0	2	5	11	2	0	0	2	0	31
>20.50	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	4
TOTAL	6	15	20	18	12	18	22	16	31	46	50	18	23	11	3	7	316

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
1.51- 2.50	0	1	0	1	2	2	0	1	1	0	1	0	2	2	0	2	15
2.51- 3.50	4	3	0	1	2	1	2	0	0	0	0	1	3	1	7	2	27
3.51- 4.50	0	1	1	1	3	1	0	1	2	1	1	0	0	2	3	1	18
4.51- 5.50	1	1	1	0	0	0	1	0	1	4	4	1	0	1	2	0	17
5.51- 6.50	2	3	4	0	0	0	2	1	3	4	6	5	3	2	1	1	37
6.51- 8.50	3	3	13	3	2	1	3	2	4	9	21	5	6	2	0	3	80
8.51-11.50	4	4	5	3	0	1	2	2	4	12	33	13	8	2	1	7	101
11.51-14.50	4	0	3	0	2	2	3	1	5	14	17	1	0	4	9	4	69
14.51-20.50	1	0	0	0	5	0	0	2	0	6	12	1	2	2	5	3	39
>20.50	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
TOTAL	19	16	28	10	17	8	13	11	20	50	95	27	24	18	28	23	407

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	3
1.51- 2.50	1	0	0	2	0	1	4	0	1	0	2	2	3	1	2	1	20
2.51- 3.50	5	6	1	4	2	3	3	1	1	1	3	2	5	5	4	6	52
3.51- 4.50	3	2	0	4	1	3	0	0	0	7	5	3	2	5	0	2	37
4.51- 5.50	1	5	5	1	1	1	3	0	0	4	10	9	3	4	1	4	52
5.51- 6.50	3	5	6	3	1	1	3	1	1	6	9	8	3	2	0	5	57
6.51- 8.50	4	5	6	2	0	2	1	0	2	14	20	4	4	2	4	1	71
8.51-11.50	3	0	2	2	0	1	0	0	1	7	16	6	3	3	5	5	54
11.51-14.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.51-20.50	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	20	23	21	20	5	13	14	2	6	39	66	34	23	22	16	24	348

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 4/01/2016 TO 6/30/2016

*** 2ND QRTR ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2
1.51- 2.50	4	2	0	0	2	1	1	0	0	0	0	1	3	3	2	4	23
2.51- 3.50	21	1	1	3	3	7	4	2	0	0	3	1	0	9	7	8	70
3.51- 4.50	25	9	5	5	0	4	6	0	0	2	3	6	4	6	9	15	99
4.51- 5.50	29	10	2	2	1	4	7	0	0	0	3	1	1	1	4	10	75
5.51- 6.50	11	5	2	0	1	0	2	2	1	1	0	2	0	1	0	4	32
6.51- 8.50	4	2	2	2	1	0	1	1	0	1	0	1	1	0	0	4	20
8.51-11.50	3	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	6
11.51-14.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	97	30	12	13	8	17	22	5	1	4	9	12	9	20	24	45	328

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	0	2	2	0	1	2	0	0	1	0	0	0	0	1	0	10
1.51- 2.50	5	3	0	4	4	5	9	1	3	1	3	3	11	7	4	7	70
2.51- 3.50	32	11	5	9	10	12	14	7	5	6	12	5	10	18	18	20	194
3.51- 4.50	30	16	10	12	6	12	9	4	12	18	17	11	8	13	12	19	209
4.51- 5.50	32	20	13	8	7	10	19	12	30	25	27	15	8	8	8	15	257
5.51- 6.50	17	15	17	9	5	5	12	14	46	40	27	27	12	9	4	11	270
6.51- 8.50	11	13	32	24	13	11	14	16	48	53	74	25	23	10	6	8	381
8.51-11.50	10	9	13	16	15	21	8	13	18	58	86	36	28	7	9	13	360
11.51-14.50	6	2	10	3	8	7	8	3	14	38	47	7	5	12	13	7	190
14.51-20.50	2	2	8	5	8	4	2	3	7	23	33	4	4	3	7	4	119
>20.50	0	0	1	0	1	1	0	2	0	3	9	1	0	2	1	0	21
TOTAL	146	91	111	92	77	89	97	75	183	266	335	134	109	89	83	104	2081

TOTAL NUMBER OF OBSERVATIONS: 2088
TOTAL NUMBER OF VALID OBSERVATIONS: 2081
TOTAL NUMBER OF MISSING OBSERVATIONS: 7
PERCENT DATA RECOVERY FOR THIS PERIOD: 99.7 %
MEAN WIND SPEED FOR THIS PERIOD: 7.6 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
16.00	9.61	7.16	15.19	19.56	16.72	15.76

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	1	3	12	13	17	15	13	20	61	57	69	19	13	8	8	4	0
B	1	3	7	9	9	13	7	13	40	37	31	13	8	6	2	1	0
C	2	1	11	9	9	5	6	8	24	33	15	11	9	4	2	0	0
D	6	15	20	18	12	18	22	16	31	46	50	18	23	11	3	7	0
E	19	16	28	10	17	8	13	11	20	50	95	27	24	18	28	23	0
F	20	23	21	20	5	13	14	2	6	39	66	34	23	22	16	24	0
G	97	30	12	13	8	17	22	5	1	4	9	12	9	20	24	45	0
TOTAL	146	91	111	92	77	89	97	75	183	266	335	134	109	89	83	104	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 6/30/2016

*** 1ST SEMI ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.51- 5.50	0	0	0	1	1	1	2	1	3	0	1	0	0	0	0	0	10
5.51- 6.50	0	1	0	0	2	0	1	6	13	8	4	0	0	0	0	0	35
6.51- 8.50	0	0	1	4	3	4	6	10	27	10	19	7	4	3	1	0	99
8.51-11.50	1	1	0	4	8	10	0	4	8	19	25	10	10	4	5	2	111
11.51-14.50	1	1	5	1	1	1	4	0	7	14	22	10	4	3	6	3	83
14.51-20.50	0	0	5	3	2	2	0	1	5	12	3	2	2	4	0	4	45
>20.50	0	0	1	0	0	0	0	0	0	2	6	1	0	1	1	0	12
TOTAL	2	3	12	13	17	18	13	22	63	65	80	30	20	15	13	9	395

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2
4.51- 5.50	0	1	1	3	1	1	1	5	12	1	2	1	1	1	1	1	33
5.51- 6.50	1	2	0	2	1	1	2	4	21	10	7	7	2	2	2	0	64
6.51- 8.50	0	2	5	5	3	6	1	5	10	13	14	8	6	2	0	0	80
8.51-11.50	0	1	2	4	3	3	3	2	2	12	12	6	3	1	0	2	56
11.51-14.50	0	1	0	0	1	3	0	1	0	6	9	1	0	2	0	0	24
14.51-20.50	0	0	2	0	1	0	0	0	0	4	4	1	0	0	0	0	12
>20.50	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	4
TOTAL	1	7	10	14	10	15	7	17	46	48	49	24	12	9	3	3	275

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
3.51- 4.50	0	0	0	0	0	0	0	0	3	4	2	2	2	0	0	1	14
4.51- 5.50	2	0	3	5	4	1	3	6	17	11	2	1	1	1	1	3	61
5.51- 6.50	2	2	6	2	1	1	1	3	11	19	7	7	3	2	0	2	69
6.51- 8.50	0	4	8	7	7	3	3	1	8	9	5	5	3	2	1	1	67
8.51-11.50	0	0	6	2	3	4	1	2	3	5	2	2	3	0	0	0	33
11.51-14.50	1	0	1	0	3	0	1	0	0	3	7	0	1	0	0	0	17
14.51-20.50	0	0	0	0	0	0	0	0	0	2	5	0	0	1	0	0	8
>20.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTAL	6	6	24	16	18	9	9	12	42	53	31	18	13	7	2	7	273

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 6/30/2016

*** 1ST SEMI ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	4
1.51- 2.50	1	1	2	1	0	1	6	3	3	6	5	2	5	1	1	2	40
2.51- 3.50	14	5	4	4	6	4	10	11	20	20	19	9	5	8	2	9	150
3.51- 4.50	7	9	11	7	2	5	5	6	21	24	17	6	7	1	6	4	138
4.51- 5.50	6	15	11	5	3	3	9	8	12	17	16	6	5	4	1	3	124
5.51- 6.50	2	3	11	6	0	4	1	2	8	11	7	7	2	2	3	2	71
6.51- 8.50	5	5	9	12	3	0	1	1	6	6	11	8	5	2	1	1	76
8.51-11.50	0	3	6	3	8	8	2	3	2	11	11	10	11	2	2	1	83
11.51-14.50	0	0	1	3	5	0	0	1	2	9	13	4	4	3	0	2	47
14.51-20.50	1	2	1	1	6	2	2	0	4	8	13	3	4	6	2	0	55
>20.50	0	0	0	0	0	0	0	1	0	4	2	0	0	0	0	0	7
TOTAL	37	43	57	42	33	27	37	36	78	117	114	55	48	29	18	24	795

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	1	0	0	0	0	0	1	1	0	0	2	0	7
1.51- 2.50	5	5	0	1	3	2	0	3	1	2	2	5	2	4	2	3	40
2.51- 3.50	7	5	1	2	2	1	2	0	0	5	4	8	8	6	13	3	67
3.51- 4.50	3	2	1	2	3	1	0	1	4	6	7	6	3	4	8	5	56
4.51- 5.50	4	4	2	1	1	0	1	0	8	13	8	3	1	2	4	3	55
5.51- 6.50	4	5	6	0	0	0	2	1	4	6	10	5	3	5	3	3	57
6.51- 8.50	4	6	14	4	2	2	3	3	7	16	28	11	14	5	2	4	125
8.51-11.50	6	6	6	6	0	4	3	2	4	16	40	17	14	6	2	8	140
11.51-14.50	4	1	3	4	4	2	3	1	5	17	22	3	1	17	10	4	101
14.51-20.50	1	0	0	0	18	0	0	2	1	8	20	4	5	6	5	3	73
>20.50	0	0	0	0	2	0	0	1	3	0	2	2	0	0	0	0	10
TOTAL	38	34	34	21	36	12	14	14	37	89	144	65	51	55	51	36	731

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	3
1.51- 2.50	5	2	0	2	0	1	4	1	2	1	5	5	5	6	5	4	48
2.51- 3.50	9	7	2	7	4	3	3	2	1	3	8	4	10	9	17	13	102
3.51- 4.50	7	4	1	4	1	3	0	0	1	11	10	6	5	7	10	12	82
4.51- 5.50	5	5	6	1	1	1	4	0	1	9	12	13	6	5	6	8	83
5.51- 6.50	4	9	8	3	1	1	3	1	1	12	13	11	7	5	4	10	93
6.51- 8.50	6	8	7	4	1	2	1	2	2	20	30	14	6	7	9	8	127
8.51-11.50	3	1	2	2	0	1	0	0	1	18	20	7	4	12	9	9	89
11.51-14.50	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	4
14.51-20.50	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	3
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	39	36	27	25	9	13	15	6	9	75	99	60	44	51	60	66	634

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 6/30/2016

*** 1ST SEMI ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	1	0	0	0	0	1	0	0	0	0	0	0	1	2	0	5
1.51- 2.50	15	5	3	1	4	1	1	0	0	2	1	5	9	10	18	22	97
2.51- 3.50	70	12	9	8	5	10	5	4	2	5	6	2	8	28	41	56	271
3.51- 4.50	93	22	8	8	1	5	7	2	1	4	4	8	11	18	35	86	313
4.51- 5.50	95	24	4	4	1	5	7	0	1	1	6	4	3	6	21	48	230
5.51- 6.50	47	24	5	1	1	0	2	2	1	3	1	3	2	6	5	16	119
6.51- 8.50	46	12	3	2	1	0	1	1	1	3	1	2	2	0	1	16	92
8.51-11.50	16	11	1	1	0	0	0	0	0	2	0	0	0	0	1	2	34
11.51-14.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	382	111	33	25	13	22	24	9	6	20	19	24	35	69	124	246	1162

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	1	3	2	1	1	2	0	0	1	1	1	0	1	4	0	19
1.51- 2.50	27	13	5	5	7	5	11	7	6	11	13	17	21	21	26	31	226
2.51- 3.50	100	29	16	21	17	18	20	17	23	33	37	24	31	52	73	81	592
3.51- 4.50	110	37	21	21	7	14	12	9	31	49	41	28	28	30	59	108	605
4.51- 5.50	112	49	27	20	12	12	27	20	54	52	47	28	17	19	34	66	596
5.51- 6.50	60	46	36	14	6	7	12	19	59	69	49	40	19	22	17	33	508
6.51- 8.50	61	37	47	38	20	17	16	23	61	77	108	55	40	21	15	30	666
8.51-11.50	26	23	23	22	22	30	9	13	20	83	110	52	45	25	19	24	546
11.51-14.50	6	3	10	8	14	7	8	3	14	50	73	18	11	25	16	11	277
14.51-20.50	2	2	8	5	28	4	2	3	10	34	46	10	11	17	7	7	196
>20.50	0	0	1	0	2	1	0	2	3	8	11	3	0	2	1	0	34
TOTAL	505	240	197	156	136	116	119	116	281	467	536	276	223	235	271	391	4265

TOTAL NUMBER OF OBSERVATIONS: 4272
TOTAL NUMBER OF VALID OBSERVATIONS: 4265
TOTAL NUMBER OF MISSING OBSERVATIONS: 7
PERCENT DATA RECOVERY FOR THIS PERIOD: 99.8 %
MEAN WIND SPEED FOR THIS PERIOD: 6.8 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
9.26	6.45	6.40	18.64	17.14	14.87	27.25

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	2	3	12	13	17	18	13	22	63	65	80	30	20	15	13	9	0
B	1	7	10	14	10	15	7	17	46	48	49	24	12	9	3	3	0
C	6	6	24	16	18	9	9	12	42	53	31	18	13	7	2	7	0
D	37	43	57	42	33	27	37	36	78	117	114	55	48	29	18	24	0
E	38	34	34	21	36	12	14	14	37	89	144	65	51	55	51	36	0
F	39	36	27	25	9	13	15	6	9	75	99	60	44	51	60	66	0
G	382	111	33	25	13	22	24	9	6	20	19	24	35	69	124	246	0
TOTAL	505	240	197	156	136	116	119	116	281	467	536	276	223	235	271	391	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 9/30/2016

*** 3RD QRTR ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4.51- 5.50	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3
5.51- 6.50	0	0	0	2	2	4	3	7	14	5	1	2	0	0	0	1	41
6.51- 8.50	1	2	1	2	4	10	9	18	24	18	18	10	5	3	2	1	128
8.51-11.50	0	1	0	0	3	18	1	5	11	15	26	15	11	3	2	2	113
11.51-14.50	0	0	0	0	1	2	0	2	0	3	12	4	1	0	0	0	25
14.51-20.50	0	0	0	1	0	0	0	1	0	2	3	0	0	0	0	0	7
>20.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	2	3	3	5	10	34	14	34	49	43	60	31	17	6	4	4	319

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.51- 5.50	1	0	0	0	0	0	2	3	6	2	2	0	1	0	0	1	18
5.51- 6.50	0	2	2	0	1	0	0	3	10	6	7	1	1	1	0	0	34
6.51- 8.50	0	2	1	4	3	5	4	5	8	8	13	7	4	0	0	1	65
8.51-11.50	0	0	2	3	3	6	0	0	4	6	17	9	2	2	0	0	54
11.51-14.50	0	0	1	0	1	1	1	0	4	3	7	1	0	0	0	0	19
14.51-20.50	0	0	0	0	2	0	0	1	0	0	2	0	0	0	0	0	5
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	4	6	7	10	12	7	12	32	25	48	18	8	3	0	2	195

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	1	0	0	1	1	0	0	0	0	0	1	0	1	0	5
4.51- 5.50	0	1	1	0	1	1	3	2	8	5	3	1	0	0	2	2	30
5.51- 6.50	1	0	0	0	2	0	1	1	8	4	6	4	1	0	0	1	29
6.51- 8.50	0	1	2	2	1	2	2	1	5	12	14	2	3	1	2	0	50
8.51-11.50	0	1	0	1	0	0	0	0	1	5	11	0	1	0	0	0	20
11.51-14.50	1	1	1	0	4	0	0	0	1	0	3	0	0	0	0	0	11
14.51-20.50	1	0	0	0	3	1	0	1	0	1	1	0	0	0	0	0	8
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	4	5	3	11	5	7	5	23	27	38	7	6	1	5	3	153

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 9/30/2016

*** 3RD QRTR ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	2	0	0	3	1	0	0	0	1	0	1	1	1	3	0	1	14
2.51- 3.50	2	1	2	1	1	1	0	3	5	5	1	2	4	2	5	2	37
3.51- 4.50	2	2	2	3	2	2	1	1	8	5	6	2	1	4	0	3	44
4.51- 5.50	2	1	3	2	3	2	0	1	6	7	7	6	2	2	0	3	47
5.51- 6.50	1	2	1	0	0	0	0	2	5	7	9	6	2	1	1	1	38
6.51- 8.50	2	1	2	2	4	4	3	1	9	6	14	3	4	1	2	0	58
8.51-11.50	3	4	2	3	6	4	1	0	4	16	22	7	3	2	1	0	78
11.51-14.50	1	6	4	1	16	4	0	2	1	2	20	4	0	0	0	0	61
14.51-20.50	0	3	0	2	11	1	3	3	1	0	22	2	1	0	1	1	51
>20.50	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2
TOTAL	15	20	16	17	44	19	8	14	40	48	102	33	18	15	10	11	430

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
1.51- 2.50	2	1	1	0	2	1	0	0	2	0	0	1	1	4	2	5	22
2.51- 3.50	7	1	3	2	0	1	0	0	1	0	4	2	2	4	8	3	38
3.51- 4.50	4	4	1	1	2	1	0	0	3	2	4	9	6	2	3	3	45
4.51- 5.50	5	1	4	1	1	2	1	0	2	9	12	6	2	1	2	1	50
5.51- 6.50	6	2	5	2	1	4	0	3	2	14	10	6	3	1	3	1	63
6.51- 8.50	3	5	3	6	7	6	2	6	4	18	36	7	4	2	2	2	113
8.51-11.50	3	2	3	10	14	6	4	4	4	25	62	15	1	4	1	3	161
11.51-14.50	2	0	0	3	21	4	3	1	0	9	33	7	0	1	0	1	85
14.51-20.50	3	2	2	0	18	4	0	0	1	2	9	0	0	0	0	0	41
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	35	18	22	25	66	29	10	14	20	79	170	53	19	19	21	19	619

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
1.51- 2.50	3	1	1	0	1	0	1	0	0	0	3	1	3	3	2	1	20
2.51- 3.50	5	1	2	3	0	0	0	2	0	2	3	4	2	1	4	5	34
3.51- 4.50	6	5	4	0	0	0	0	0	0	3	3	5	7	8	7	5	53
4.51- 5.50	10	6	3	2	0	0	1	1	3	6	15	4	3	3	3	2	62
5.51- 6.50	1	4	1	1	0	0	1	1	1	3	7	2	2	0	2	3	29
6.51- 8.50	6	2	2	1	0	0	2	0	1	8	21	6	3	1	1	0	54
8.51-11.50	1	3	1	0	0	0	0	0	0	2	9	2	0	2	0	0	20
11.51-14.50	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	1	5
14.51-20.50	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	34	23	14	7	2	0	6	5	5	24	61	25	20	18	20	17	281

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION
JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 9/30/2016

*** 3RD QRTR ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	4	0	0	0	0	0	0	0	0	0	0	1	0	0	5	3	13
2.51- 3.50	5	5	1	1	0	1	0	0	0	0	2	0	1	4	5	10	35
3.51- 4.50	24	5	1	1	0	0	0	0	1	0	0	1	2	0	1	8	44
4.51- 5.50	20	12	2	0	0	0	0	0	1	0	1	2	0	0	4	5	47
5.51- 6.50	7	5	2	0	0	0	0	0	1	0	1	1	0	0	0	2	19
6.51- 8.50	11	6	0	0	0	0	0	0	0	1	2	0	0	0	0	2	22
8.51-11.50	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
11.51-14.50	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	76	33	6	3	0	1	0	0	3	1	6	5	3	4	16	30	187

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
1.51- 2.50	11	2	2	3	4	1	1	0	3	0	4	4	5	10	9	10	69
2.51- 3.50	19	8	8	7	1	3	0	5	6	7	10	8	9	11	22	20	144
3.51- 4.50	36	16	10	5	4	4	2	1	12	10	13	17	17	14	12	19	192
4.51- 5.50	38	21	14	5	5	5	8	8	26	29	40	19	8	6	11	14	257
5.51- 6.50	16	15	11	5	6	8	5	17	41	39	41	22	9	3	6	9	253
6.51- 8.50	23	19	11	17	19	27	22	31	51	71	118	35	23	8	9	6	490
8.51-11.50	11	11	8	17	26	34	6	9	24	69	147	48	18	13	4	5	450
11.51-14.50	5	8	6	5	44	11	5	5	6	17	75	17	1	1	0	2	208
14.51-20.50	6	5	2	3	34	6	3	6	2	5	37	2	1	0	1	1	114
>20.50	1	0	0	0	0	1	0	1	0	0	0	0	0	0	2	0	5
TOTAL	166	105	72	67	143	100	52	84	172	247	485	172	91	66	76	86	2184

TOTAL NUMBER OF OBSERVATIONS: 2184
TOTAL NUMBER OF VALID OBSERVATIONS: 2184
TOTAL NUMBER OF MISSING OBSERVATIONS: 0
PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %
MEAN WIND SPEED FOR THIS PERIOD: 7.8 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
14.61	8.93	7.01	19.69	28.34	12.87	8.56

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	2	3	3	5	10	34	14	34	49	43	60	31	17	6	4	4	0
B	1	4	6	7	10	12	7	12	32	25	48	18	8	3	0	2	0
C	3	4	5	3	11	5	7	5	23	27	38	7	6	1	5	3	0
D	15	20	16	17	44	19	8	14	40	48	102	33	18	15	10	11	0
E	35	18	22	25	66	29	10	14	20	79	170	53	19	19	21	19	0
F	34	23	14	7	2	0	6	5	5	24	61	25	20	18	20	17	0
G	76	33	6	3	0	1	0	0	3	1	6	5	3	4	16	30	0
TOTAL	166	105	72	67	143	100	52	84	172	247	485	172	91	66	76	86	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 10/01/2016 TO 12/31/2016

*** 4TH QRTR ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.51- 5.50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
5.51- 6.50	0	0	0	1	0	0	2	1	1	0	0	0	0	0	0	0	5
6.51- 8.50	0	0	1	0	2	1	6	4	2	0	2	0	0	0	2	0	20
8.51-11.50	0	0	0	1	0	3	0	0	0	1	0	0	1	2	0	1	9
11.51-14.50	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	3
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	1	2	3	4	8	5	3	1	3	0	2	3	2	1	38

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2
4.51- 5.50	0	0	0	2	1	1	1	4	5	0	1	0	0	0	1	2	18
5.51- 6.50	0	0	2	2	1	1	3	4	2	2	0	1	0	0	0	0	18
6.51- 8.50	0	0	0	5	5	2	3	6	0	7	2	0	0	0	0	1	31
8.51-11.50	1	0	0	0	5	0	1	0	0	3	3	0	0	0	1	0	14
11.51-14.50	0	0	0	1	3	0	0	1	0	0	1	0	0	0	0	0	6
14.51-20.50	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	3	12	15	4	9	15	7	13	7	1	0	0	2	3	92

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
3.51- 4.50	0	0	0	0	0	2	3	6	6	4	1	0	1	1	1	0	25
4.51- 5.50	1	2	2	5	2	0	1	8	10	3	0	1	1	1	1	0	38
5.51- 6.50	0	1	0	1	0	1	0	3	1	0	1	0	1	0	1	1	11
6.51- 8.50	0	0	2	3	1	0	1	0	2	2	3	1	0	0	1	1	17
8.51-11.50	0	1	4	0	3	2	0	0	0	3	4	0	0	0	0	2	19
11.51-14.50	0	1	0	0	7	0	0	0	0	2	0	1	0	1	0	1	13
14.51-20.50	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	3
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	5	8	9	14	5	5	17	19	14	12	3	3	3	4	5	127

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 10/01/2016 TO 12/31/2016

*** 4TH QRTR ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	1	2	2	1	1	0	1	3	1	0	5	2	0	0	3	2	24
2.51- 3.50	10	2	3	5	2	1	1	4	6	9	7	6	10	8	2	7	83
3.51- 4.50	6	4	7	3	1	2	1	4	13	11	6	1	2	3	5	8	77
4.51- 5.50	1	3	4	3	3	1	4	3	3	4	6	4	3	1	0	4	47
5.51- 6.50	3	1	4	3	0	1	0	0	3	4	4	4	1	1	1	0	30
6.51- 8.50	5	4	1	2	1	3	1	1	2	5	12	4	1	0	3	3	48
8.51-11.50	0	1	6	3	5	1	2	0	0	4	8	3	1	1	1	2	38
11.51-14.50	0	1	0	1	15	3	2	0	0	0	9	3	2	0	0	0	36
14.51-20.50	0	0	1	0	18	0	1	0	1	1	2	1	0	0	0	0	25
>20.50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	26	18	28	21	47	12	13	15	29	38	59	28	20	14	15	26	409

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
1.51- 2.50	5	4	0	1	0	1	1	1	2	3	7	4	5	11	4	1	50
2.51- 3.50	3	2	0	1	1	3	0	1	4	3	3	3	3	4	2	6	39
3.51- 4.50	8	6	1	2	1	0	0	1	3	3	5	4	2	4	6	3	49
4.51- 5.50	1	6	0	2	0	0	1	3	2	2	8	7	1	0	3	5	41
5.51- 6.50	3	3	3	2	0	0	0	1	2	2	3	4	3	2	1	0	29
6.51- 8.50	4	3	4	2	2	3	1	1	0	5	9	3	3	0	1	1	42
8.51-11.50	1	2	0	3	6	8	1	1	3	3	2	3	0	1	1	2	37
11.51-14.50	0	1	1	0	6	4	1	0	0	1	1	5	1	1	1	0	23
14.51-20.50	0	0	0	0	6	0	0	0	0	1	6	1	0	3	0	1	18
>20.50	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	0	5
TOTAL	25	27	9	13	22	19	5	9	17	23	44	35	19	29	19	19	334

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
1.51- 2.50	5	3	6	0	1	1	0	3	1	0	1	7	3	8	7	2	48
2.51- 3.50	11	4	4	0	0	0	2	0	0	2	3	2	5	7	5	4	49
3.51- 4.50	8	1	2	4	1	0	0	0	4	1	7	5	7	5	11	8	64
4.51- 5.50	7	1	3	0	1	0	0	0	2	2	9	6	0	2	5	3	41
5.51- 6.50	5	0	0	0	1	0	0	0	0	2	6	3	2	3	2	6	30
6.51- 8.50	4	1	2	5	0	0	1	0	1	4	10	2	1	2	4	5	42
8.51-11.50	1	2	3	4	0	0	1	1	0	0	2	0	1	2	0	3	20
11.51-14.50	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	4
14.51-20.50	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	5
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	41	12	21	15	9	1	4	4	8	12	38	25	19	29	34	32	304

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 10/01/2016 TO 12/31/2016

*** 4TH QRTR ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	4
1.51- 2.50	20	12	3	2	1	1	1	1	2	2	2	4	8	15	16	20	110
2.51- 3.50	56	17	3	4	0	0	0	3	1	1	5	4	6	22	36	53	211
3.51- 4.50	79	37	5	6	2	1	0	1	2	1	3	0	10	7	20	52	226
4.51- 5.50	45	30	4	1	0	0	0	0	0	0	1	0	1	1	3	24	110
5.51- 6.50	23	14	7	2	0	0	0	0	0	1	0	1	0	0	4	10	62
6.51- 8.50	26	19	2	2	0	0	0	0	0	0	0	0	0	0	1	13	63
8.51-11.50	5	8	5	1	0	0	0	0	0	0	0	0	0	0	0	2	21
11.51-14.50	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	254	137	29	19	3	2	1	5	5	5	11	9	27	45	80	176	808

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	2	6
1.51- 2.50	31	21	11	4	3	3	3	8	6	5	15	17	16	34	30	25	232
2.51- 3.50	80	25	10	10	3	4	3	8	11	15	19	15	24	41	45	70	383
3.51- 4.50	101	48	15	15	5	5	5	12	28	21	22	10	22	20	43	71	443
4.51- 5.50	55	42	13	13	8	2	7	18	22	11	25	18	6	5	13	38	296
5.51- 6.50	34	19	16	11	2	3	5	9	9	11	14	13	7	6	9	17	185
6.51- 8.50	39	27	12	19	11	9	13	12	7	23	38	10	5	2	12	24	263
8.51-11.50	8	14	18	12	19	14	5	2	3	14	19	6	3	6	3	12	158
11.51-14.50	0	3	2	4	32	7	3	1	0	3	12	9	4	3	1	2	86
14.51-20.50	0	0	2	3	29	0	1	0	1	2	10	2	0	3	0	1	54
>20.50	0	0	0	0	1	0	0	0	0	0	0	1	1	3	0	0	6
TOTAL	348	199	99	91	113	47	45	70	88	106	174	101	90	123	156	262	2112

TOTAL NUMBER OF OBSERVATIONS: 2112
TOTAL NUMBER OF VALID OBSERVATIONS: 2112
TOTAL NUMBER OF MISSING OBSERVATIONS: 0
PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %
MEAN WIND SPEED FOR THIS PERIOD: 5.6 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
1.80	4.36	6.01	19.37	15.81	14.39	38.26

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	0	0	1	2	3	4	8	5	3	1	3	0	2	3	2	1	0
B	1	0	3	12	15	4	9	15	7	13	7	1	0	0	2	3	0
C	1	5	8	9	14	5	5	17	19	14	12	3	3	3	4	5	0
D	26	18	28	21	47	12	13	15	29	38	59	28	20	14	15	26	0
E	25	27	9	13	22	19	5	9	17	23	44	35	19	29	19	19	0
F	41	12	21	15	9	1	4	4	8	12	38	25	19	29	34	32	0
G	254	137	29	19	3	2	1	5	5	5	11	9	27	45	80	176	0
TOTAL	348	199	99	91	113	47	45	70	88	106	174	101	90	123	156	262	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION
JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 12/31/2016

*** 2ND SEMI ***
STABILITY CLASS A
STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4.51- 5.50	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	4
5.51- 6.50	0	0	0	3	2	4	5	8	15	5	1	2	0	0	0	1	46
6.51- 8.50	1	2	2	2	6	11	15	22	26	18	20	10	5	3	4	1	148
8.51-11.50	0	1	0	1	3	21	1	5	11	16	26	15	12	5	2	3	122
11.51-14.50	0	0	0	0	1	2	0	2	0	3	13	4	2	1	0	0	28
14.51-20.50	0	0	0	1	0	0	0	1	0	2	3	0	0	0	0	0	7
>20.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	2	3	4	7	13	38	22	39	52	44	63	31	19	9	6	5	357

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2
4.51- 5.50	1	0	0	2	1	1	3	7	11	2	3	0	1	0	1	3	36
5.51- 6.50	0	2	4	2	2	1	3	7	12	8	7	2	1	1	0	0	52
6.51- 8.50	0	2	1	9	8	7	7	11	8	15	15	7	4	0	0	2	96
8.51-11.50	1	0	2	3	8	6	1	0	4	9	20	9	2	2	1	0	68
11.51-14.50	0	0	1	1	4	1	1	1	4	3	8	1	0	0	0	0	25
14.51-20.50	0	0	1	2	2	0	0	1	0	0	2	0	0	0	0	0	8
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	4	9	19	25	16	16	27	39	38	55	19	8	3	2	5	287

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
3.51- 4.50	0	0	1	0	0	3	4	6	6	4	1	0	2	1	2	0	30
4.51- 5.50	1	3	3	5	3	1	4	10	18	8	3	2	1	1	3	2	68
5.51- 6.50	1	1	0	1	2	1	1	4	9	4	7	4	2	0	1	2	40
6.51- 8.50	0	1	4	5	2	2	3	1	7	14	17	3	3	1	3	1	67
8.51-11.50	0	2	4	1	3	2	0	0	1	8	15	0	1	0	0	2	39
11.51-14.50	1	2	1	0	11	0	0	0	1	2	3	1	0	1	0	1	24
14.51-20.50	1	0	0	0	4	1	0	1	0	1	3	0	0	0	0	0	11
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	9	13	12	25	10	12	22	42	41	50	10	9	4	9	8	280

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 12/31/2016

*** 2ND SEMI ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	3	2	2	4	2	0	1	3	2	0	6	3	1	3	3	3	38
2.51- 3.50	12	3	5	6	3	2	1	7	11	14	8	8	14	10	7	9	120
3.51- 4.50	8	6	9	6	3	4	2	5	21	16	12	3	3	7	5	11	121
4.51- 5.50	3	4	7	5	6	3	4	4	9	11	13	10	5	3	0	7	94
5.51- 6.50	4	3	5	3	0	1	0	2	8	11	13	10	3	2	2	1	68
6.51- 8.50	7	5	3	4	5	7	4	2	11	11	26	7	5	1	5	3	106
8.51-11.50	3	5	8	6	11	5	3	0	4	20	30	10	4	3	2	2	116
11.51-14.50	1	7	4	2	31	7	2	2	1	2	29	7	2	0	0	0	97
14.51-20.50	0	3	1	2	29	1	4	3	2	1	24	3	1	0	1	1	76
>20.50	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	3
TOTAL	41	38	44	38	91	31	21	29	69	86	161	61	38	29	25	37	839

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
1.51- 2.50	7	5	1	1	2	2	1	1	4	3	7	5	6	15	6	6	72
2.51- 3.50	10	3	3	3	1	4	0	1	5	3	7	5	5	8	10	9	77
3.51- 4.50	12	10	2	3	3	1	0	1	6	5	9	13	8	6	9	6	94
4.51- 5.50	6	7	4	3	1	2	2	3	4	11	20	13	3	1	5	6	91
5.51- 6.50	9	5	8	4	1	4	0	4	4	16	13	10	6	3	4	1	92
6.51- 8.50	7	8	7	8	9	9	3	7	4	23	45	10	7	2	3	3	155
8.51-11.50	4	4	3	13	20	14	5	5	7	28	64	18	1	5	2	5	198
11.51-14.50	2	1	1	3	27	8	4	1	0	10	34	12	1	2	1	1	108
14.51-20.50	3	2	2	0	24	4	0	0	1	3	15	1	0	3	0	1	59
>20.50	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	0	5
TOTAL	60	45	31	38	88	48	15	23	37	102	214	88	38	48	40	38	953

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2
1.51- 2.50	8	4	7	0	2	1	1	3	1	0	4	8	6	11	9	3	68
2.51- 3.50	16	5	6	3	0	0	2	2	0	4	6	6	7	8	9	9	83
3.51- 4.50	14	6	6	4	1	0	0	0	4	4	10	10	14	13	18	13	117
4.51- 5.50	17	7	6	2	1	0	1	1	5	8	24	10	3	5	8	5	103
5.51- 6.50	6	4	1	1	1	0	1	1	1	5	13	5	4	3	4	9	59
6.51- 8.50	10	3	4	6	0	0	3	0	2	12	31	8	4	3	5	5	96
8.51-11.50	2	5	4	4	0	0	1	1	0	2	11	2	1	4	0	3	40
11.51-14.50	0	1	1	1	2	0	1	0	0	0	0	1	0	0	0	2	9
14.51-20.50	2	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	7
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	75	35	35	22	11	1	10	9	13	36	99	50	39	47	54	49	585

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION
JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 7/01/2016 TO 12/31/2016

*** 2ND SEMI ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	4
1.51- 2.50	24	12	3	2	1	1	1	1	2	2	2	5	8	15	21	23	123
2.51- 3.50	61	22	4	5	0	1	0	3	1	1	7	4	7	26	41	63	246
3.51- 4.50	103	42	6	7	2	1	0	1	3	1	3	1	12	7	21	60	270
4.51- 5.50	65	42	6	1	0	0	0	0	1	0	2	2	1	1	7	29	157
5.51- 6.50	30	19	9	2	0	0	0	0	1	1	1	2	0	0	4	12	81
6.51- 8.50	37	25	2	2	0	0	0	0	0	1	2	0	0	0	1	15	85
8.51-11.50	9	8	5	1	0	0	0	0	0	0	0	0	0	0	0	2	25
11.51-14.50	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	330	170	35	22	3	3	1	5	8	6	17	14	30	49	96	206	995

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	1	2	1	0	0	2	0	0	2	8
1.51- 2.50	42	23	13	7	7	4	4	8	9	5	19	21	21	44	39	35	301
2.51- 3.50	99	33	18	17	4	7	3	13	17	22	29	23	33	52	67	90	527
3.51- 4.50	137	64	25	20	9	9	7	13	40	31	35	27	39	34	55	90	635
4.51- 5.50	93	63	27	18	13	7	15	26	48	40	65	37	14	11	24	52	553
5.51- 6.50	50	34	27	16	8	11	10	26	50	50	55	35	16	9	15	26	438
6.51- 8.50	62	46	23	36	30	36	35	43	58	94	156	45	28	10	21	30	753
8.51-11.50	19	25	26	29	45	48	11	11	27	83	166	54	21	19	7	17	608
11.51-14.50	5	11	8	9	76	18	8	6	6	20	87	26	5	4	1	4	294
14.51-20.50	6	5	4	6	63	6	4	6	3	7	47	4	1	3	1	2	168
>20.50	1	0	0	0	1	1	0	1	0	0	0	1	1	3	2	0	11
TOTAL	514	304	171	158	256	147	97	154	260	353	659	273	181	189	232	348	4296

TOTAL NUMBER OF OBSERVATIONS: 4296
TOTAL NUMBER OF VALID OBSERVATIONS: 4296
TOTAL NUMBER OF MISSING OBSERVATIONS: 0
PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %
MEAN WIND SPEED FOR THIS PERIOD: 6.7 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
8.31	6.68	6.52	19.53	22.18	13.62	23.16

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	2	3	4	7	13	38	22	39	52	44	63	31	19	9	6	5	0
B	2	4	9	19	25	16	16	27	39	38	55	19	8	3	2	5	0
C	4	9	13	12	25	10	12	22	42	41	50	10	9	4	9	8	0
D	41	38	44	38	91	31	21	29	69	86	161	61	38	29	25	37	0
E	60	45	31	38	88	48	15	23	37	102	214	88	38	48	40	38	0
F	75	35	35	22	11	1	10	9	13	36	99	50	39	47	54	49	0
G	330	170	35	22	3	3	1	5	8	6	17	14	30	49	96	206	0
TOTAL	514	304	171	158	256	147	97	154	260	353	659	273	181	189	232	348	0

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION
JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 12/31/2016

*** ANNUAL ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4.51- 5.50	0	0	1	1	2	1	3	2	3	0	1	0	0	0	0	0	14
5.51- 6.50	0	1	0	3	4	4	6	14	28	13	5	2	0	0	0	1	81
6.51- 8.50	1	2	3	6	9	15	21	32	53	28	39	17	9	6	5	1	247
8.51-11.50	1	2	0	5	11	31	1	9	19	35	51	25	22	9	7	5	233
11.51-14.50	1	1	5	1	2	3	4	2	7	17	35	14	6	4	6	3	111
14.51-20.50	0	0	5	4	2	2	0	2	5	14	6	2	2	4	0	4	52
>20.50	1	0	1	0	0	0	0	0	0	2	6	1	0	1	1	0	13
TOTAL	4	6	16	20	30	56	35	61	115	109	143	61	39	24	19	14	752

STABILITY CLASS B

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.51- 4.50	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	4
4.51- 5.50	1	1	1	5	2	2	4	12	23	3	5	1	2	1	2	4	69
5.51- 6.50	1	4	4	4	3	2	5	11	33	18	14	9	3	3	2	0	116
6.51- 8.50	0	4	6	14	11	13	8	16	18	28	29	15	10	2	0	2	176
8.51-11.50	1	1	4	7	11	9	4	2	6	21	32	15	5	3	1	2	124
11.51-14.50	0	1	1	1	5	4	1	2	4	9	17	2	0	2	0	0	49
14.51-20.50	0	0	3	2	3	0	0	1	0	4	6	1	0	0	0	0	20
>20.50	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	4
TOTAL	3	11	19	33	35	31	23	44	85	86	104	43	20	12	5	8	562

STABILITY CLASS C

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.51- 2.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2.51- 3.50	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3
3.51- 4.50	0	0	1	0	0	3	4	6	9	8	3	2	4	1	2	1	44
4.51- 5.50	3	3	6	10	7	2	7	16	35	19	5	3	2	2	4	5	129
5.51- 6.50	3	3	6	3	3	2	2	7	20	23	14	11	5	2	1	4	109
6.51- 8.50	0	5	12	12	9	5	6	2	15	23	22	8	6	3	4	2	134
8.51-11.50	0	2	10	3	6	6	1	2	4	13	17	2	4	0	0	2	72
11.51-14.50	2	2	2	0	14	0	1	0	1	5	10	1	1	1	0	1	41
14.51-20.50	1	0	0	0	4	1	0	1	0	3	8	0	0	1	0	0	19
>20.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
TOTAL	10	15	37	28	43	19	21	34	84	94	81	28	22	11	11	15	553

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 12/31/2016

*** ANNUAL ***

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	4
1.51- 2.50	4	3	4	5	2	1	7	6	5	6	11	5	6	4	4	5	78
2.51- 3.50	26	8	9	10	9	6	11	18	31	34	27	17	19	18	9	18	270
3.51- 4.50	15	15	20	13	5	9	7	11	42	40	29	9	10	8	11	15	259
4.51- 5.50	9	19	18	10	9	6	13	12	21	28	29	16	10	7	1	10	218
5.51- 6.50	6	6	16	9	0	5	1	4	16	22	20	17	5	4	5	3	139
6.51- 8.50	12	10	12	16	8	7	5	3	17	17	37	15	10	3	6	4	182
8.51-11.50	3	8	14	9	19	13	5	3	6	31	41	20	15	5	4	3	199
11.51-14.50	1	7	5	5	36	7	2	3	3	11	42	11	6	3	0	2	144
14.51-20.50	1	5	2	3	35	3	6	3	6	9	37	6	5	6	3	1	131
>20.50	0	0	0	0	1	1	0	2	0	4	2	0	0	0	0	0	10
TOTAL	78	81	101	80	124	58	58	65	147	203	275	116	86	58	43	61	1634

STABILITY CLASS E

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	1	0	0	0	2	0	1	1	0	0	2	0	9
1.51- 2.50	12	10	1	2	5	4	1	4	5	5	9	10	8	19	8	9	112
2.51- 3.50	17	8	4	5	3	5	2	1	5	8	11	13	13	14	23	12	144
3.51- 4.50	15	12	3	5	6	2	0	2	10	11	16	19	11	10	17	11	150
4.51- 5.50	10	11	6	4	2	2	3	3	12	24	28	16	4	3	9	9	146
5.51- 6.50	13	10	14	4	1	4	2	5	8	22	23	15	9	8	7	4	149
6.51- 8.50	11	14	21	12	11	11	6	10	11	39	73	21	21	7	5	7	280
8.51-11.50	10	10	9	19	20	18	8	7	11	44	104	35	15	11	4	13	338
11.51-14.50	6	2	4	7	31	10	7	2	5	27	56	15	2	19	11	5	209
14.51-20.50	4	2	2	0	42	4	0	2	2	11	35	5	5	9	5	4	132
>20.50	0	0	0	0	2	0	0	1	3	0	2	3	1	3	0	0	15
TOTAL	98	79	65	59	124	60	29	37	74	191	358	153	89	103	91	74	1684

STABILITY CLASS F

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	5
1.51- 2.50	13	6	7	2	2	2	5	4	3	1	9	13	11	17	14	7	116
2.51- 3.50	25	12	8	10	4	3	5	4	1	7	14	10	17	17	26	22	185
3.51- 4.50	21	10	7	8	2	3	0	0	5	15	20	16	19	20	28	25	199
4.51- 5.50	22	12	12	3	2	1	5	1	6	17	36	23	9	10	14	13	186
5.51- 6.50	10	13	9	4	2	1	4	2	2	17	26	16	11	8	8	19	152
6.51- 8.50	16	11	11	10	1	2	4	2	4	32	61	22	10	10	14	13	223
8.51-11.50	5	6	6	6	0	1	1	1	1	20	31	9	5	16	9	12	129
11.51-14.50	0	1	1	1	2	0	1	0	0	1	0	1	1	0	0	4	13
14.51-20.50	2	0	0	2	5	0	0	0	0	0	1	0	0	0	0	0	10
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	114	71	62	47	20	14	25	15	22	111	198	110	83	98	114	115	1219

ARIZONA PUBLIC SERVICE CO. - PALO VERDE NUCLEAR GENERATING STATION

JOINT FREQUENCY DISTRIBUTION FOR THE PERIOD 1/01/2016 TO 12/31/2016

*** ANNUAL ***

STABILITY CLASS G

STABILITY BASED ON: DELTA T BETWEEN 200.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: .75 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	0	1	0	0	0	0	1	0	0	0	0	0	2	1	2	2	9
1.51- 2.50	39	17	6	3	5	2	2	1	2	4	3	10	17	25	39	45	220
2.51- 3.50	131	34	13	13	5	11	5	7	3	6	13	6	15	54	82	119	517
3.51- 4.50	196	64	14	15	3	6	7	3	4	5	7	9	23	25	56	146	583
4.51- 5.50	160	66	10	5	1	5	7	0	2	1	8	6	4	7	28	77	387
5.51- 6.50	77	43	14	3	1	0	2	2	2	4	2	5	2	6	9	28	200
6.51- 8.50	83	37	5	4	1	0	1	1	1	4	3	2	2	0	2	31	177
8.51-11.50	25	19	6	2	0	0	0	0	0	2	0	0	0	0	1	4	59
11.51-14.50	1	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	4
14.51-20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>20.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL	712	281	68	47	16	25	25	14	14	26	36	38	65	118	220	452	2157

STABILITY CLASS ALL

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
.76- 1.50	1	1	3	2	1	1	2	1	2	2	1	1	2	1	4	2	27
1.51- 2.50	69	36	18	12	14	9	15	15	15	16	32	38	42	65	65	66	527
2.51- 3.50	199	62	34	38	21	25	23	30	40	55	66	47	64	104	140	171	1119
3.51- 4.50	247	101	46	41	16	23	19	22	71	80	76	55	67	64	114	198	1240
4.51- 5.50	205	112	54	38	25	19	42	46	102	92	112	65	31	30	58	118	1149
5.51- 6.50	110	80	63	30	14	18	22	45	109	119	104	75	35	31	32	59	946
6.51- 8.50	123	83	70	74	50	53	51	66	119	171	264	100	68	31	36	60	1419
8.51-11.50	45	48	49	51	67	78	20	24	47	166	276	106	66	44	26	41	1154
11.51-14.50	11	14	18	17	90	25	16	9	20	70	160	44	16	29	17	15	571
14.51-20.50	8	7	12	11	91	10	6	9	13	41	93	14	12	20	8	9	364
>20.50	1	0	1	0	3	2	0	3	3	8	11	4	1	5	3	0	45
TOTAL	1019	544	368	314	392	263	216	270	541	820	1195	549	404	424	503	739	8561

TOTAL NUMBER OF OBSERVATIONS: 8568
TOTAL NUMBER OF VALID OBSERVATIONS: 8561
TOTAL NUMBER OF MISSING OBSERVATIONS: 7
PERCENT DATA RECOVERY FOR THIS PERIOD: 99.9 %
MEAN WIND SPEED FOR THIS PERIOD: 6.7 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
8.78	6.56	6.46	19.09	19.67	14.24	25.20

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	4	6	16	20	30	56	35	61	115	109	143	61	39	24	19	14	0
B	3	11	19	33	35	31	23	44	85	86	104	43	20	12	5	8	0
C	10	15	37	28	43	19	21	34	84	94	81	28	22	11	11	15	0
D	78	81	101	80	124	58	58	65	147	203	275	116	86	58	43	61	0
E	98	79	65	59	124	60	29	37	74	191	358	153	89	103	91	74	0
F	114	71	62	47	20	14	25	15	22	111	198	110	83	98	114	115	0
G	712	281	68	47	16	25	25	14	14	26	36	38	65	118	220	452	0
TOTAL	1019	544	368	314	392	263	216	270	541	820	1195	549	404	424	503	739	0

APPENDIX C

DOSE CALCULATIONS

GASEOUS EFFLUENT DOSE CALCULATIONS

Doses to the maximum individual and the surrounding population resulting from the release of radioactive material in gaseous effluents from the Palo Verde Nuclear Generating Station were calculated using the GASPAR computer program. The radionuclides considered in the dose calculations were tritium, iodine-131, iodine-132, iodine-133, iodine-135, all noble gases, and particulates having a half-life greater than eight days and for which dose factors are contained in NUREG-0172. Locations selected for individual dose calculations included for each sector, the site boundary, and within five miles, if present, the nearest residence, the nearest garden, and the nearest milk animal. GASPAR implements the radiological dose models of Regulatory Guide 1.109 to determine the radiation exposure to man from four principal atmospheric exposure pathways: plume, ground deposition, inhalation, and ingestion. Doses to the maximum individual and the population were calculated as a function of age group and pathway for significant body organs.

Table 43 presents the doses on a quarterly, semiannual and annual basis for the Energy Information Center. An occupancy factor of 1.0 (implying continuous occupancy over the entire year) was considered for the Energy Information Center and the exposure pathways considered to calculate its doses were plume, ground deposition, and inhalation. Dose to the special location for 2016 was 1.65 millirem. This is well within the 25 mrem/yr limit of 40 CFR 190.

Table 44 presents the population dose.

Table 45 summarizes the individual doses and compares the result to PVNGS ODCM Requirement limits. The site boundary and residence locations for which data are presented represent the highest annual doses.

Based on results obtained by placing TLDs on the site boundary in each sector, the net dose for this reporting period, from direct-radiation, (plume and ground deposition) from all three units was indistinguishable from preoperational values of 8 - 14 µR/hr (17 - 30 mR/Std Qtr).

There were no liquid effluents associated with the operation of this facility.

Dose Calculation Models

The GASPAR computer code was used to evaluate the radiological consequences of the routine release of gaseous effluents. GASPAR implements the dose calculational methodologies of Regulatory Guide 1.109, Revision 1.

Source terms for each quarter are combined with station-specific demographic data and each quarter's atmospheric diffusion estimates for gaseous dose calculations.

Atmospheric diffusion estimates are generated by the XOQDOQ computer code using onsite meteorological data as input. Additional input to GASPAR includes the following site-specific data:

0 to 5 mile nearest residence, milk animal and garden in each of the 16 compass sectors, based on the 2016 Land Use Census.

0 to 10 mile population from the PVNGS Emergency Plan, Rev 47.

The 10 to 50 mile population distribution from the PVNGS UFSAR, Figure 2.1-12.

The population distribution of metropolitan Phoenix greater than 50 miles from PVNGS, based on the 1980 federal census results, is conservatively included in the 40 to 50 mile sectors (NE=123; ENE=140,097; E=621,130; ESE=8,392).

Absolute humidity of 6.0 g/m^3 from the PVNGS UFSAR, Table 2.3-16.

The fraction of the year that vegetables are grown (0.667) from the PVNGS ER-OL, Section 2.1.3.4, Table 2.1-8.

The fraction of daily feed derived from pasture while on pasture (0.35) and length of grazing season for milk animals beyond 5 miles (0.75) from the PVNGS ER-OL, Section 2.1.3.4.3.

The fraction of daily feed derived from pasture while on pasture (0.05) and length of grazing season for meat animals (0.25) from the PVNGS ER-OL, Section 2.1.3.4.4.

There were three (3) sectors containing milk animal (goat or cow) locations within five (5) miles. For calculation purposes these milk animals are assumed to be fed 100% on pasture grass during the year.

Other values used for input to GASPAR are default values from Regulatory Guide 1.109, Rev. 1.

Table 43:
Doses To Special Locations For 2016

ENERGY INFORMATION CENTER LOCATED ONSITE 0.45 MILE S FROM UNIT 1, 0.29 MILE SSE FROM UNIT 2 AND 0.20 MILE ESE FROM UNIT 3.

(MREM)	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
1ST QUARTER								
ADULT	6.71E-01	6.71E-01	1.22E-03	6.71E-01	6.71E-01	6.71E-01	6.71E-01	6.71E-01
TEEN	6.75E-01	6.75E-01	1.22E-03	6.75E-01	6.75E-01	6.75E-01	6.75E-01	6.76E-01
CHILD	5.97E-01	5.97E-01	1.22E-03	5.97E-01	5.97E-01	5.97E-01	5.97E-01	5.98E-01
INFANT	3.44E-01	3.44E-01	1.22E-03	3.44E-01	3.44E-01	3.44E-01	3.44E-01	3.44E-01
2ND QUARTER								
ADULT	1.95E-01	1.95E-01	9.72E-03	1.95E-01	1.95E-01	1.95E-01	1.97E-01	1.97E-01
TEEN	1.97E-01	1.97E-01	9.72E-03	1.97E-01	1.97E-01	1.97E-01	2.01E-01	1.99E-01
CHILD	1.75E-01	1.75E-01	9.72E-03	1.75E-01	1.75E-01	1.75E-01	1.78E-01	1.77E-01
INFANT	1.05E-01	1.05E-01	9.72E-03	1.05E-01	1.05E-01	1.05E-01	1.07E-01	1.07E-01
1ST SEMI-ANNUAL								
ADULT	8.66E-01	8.66E-01	1.09E-02	8.66E-01	8.66E-01	8.66E-01	8.68E-01	8.69E-01
TEEN	8.72E-01	8.72E-01	1.09E-02	8.72E-01	8.72E-01	8.72E-01	8.76E-01	8.75E-01
CHILD	7.72E-01	7.72E-01	1.09E-02	7.72E-01	7.72E-01	7.72E-01	7.75E-01	7.75E-01
INFANT	4.49E-01	4.49E-01	1.09E-02	4.49E-01	4.49E-01	4.49E-01	4.50E-01	4.51E-01
3RD QUARTER								
ADULT	2.30E-01	2.30E-01	3.39E-04	2.30E-01	2.30E-01	2.30E-01	2.30E-01	2.31E-01
TEEN	2.32E-01	2.32E-01	3.39E-04	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01
CHILD	2.05E-01	2.05E-01	3.39E-04	2.05E-01	2.05E-01	2.05E-01	2.05E-01	2.05E-01
INFANT	1.18E-01	1.18E-01	3.39E-04	1.18E-01	1.18E-01	1.18E-01	1.18E-01	1.18E-01
4TH QUARTER								
ADULT	5.56E-01	5.56E-01	2.08E-03	5.56E-01	5.56E-01	5.56E-01	5.56E-01	5.56E-01
TEEN	5.60E-01	5.60E-01	2.08E-03	5.60E-01	5.60E-01	5.60E-01	5.60E-01	5.60E-01
CHILD	4.95E-01	4.95E-01	2.08E-03	4.95E-01	4.95E-01	4.96E-01	4.96E-01	4.95E-01
INFANT	2.86E-01	2.86E-01	2.08E-03	2.86E-01	2.86E-01	2.86E-01	2.86E-01	1.29E-01
2ND SEMI-ANNUAL								
ADULT	7.86E-01	7.86E-01	2.42E-03	7.86E-01	7.86E-01	7.86E-01	7.86E-01	7.86E-01
TEEN	7.92E-01	7.92E-01	2.42E-03	7.92E-01	7.92E-01	7.92E-01	7.92E-01	7.92E-01
CHILD	7.00E-01	7.00E-01	2.42E-03	7.00E-01	7.00E-01	7.01E-01	7.01E-01	6.99E-01
INFANT	4.04E-01	4.04E-01	2.42E-03	4.04E-01	4.04E-01	4.04E-01	4.04E-01	2.47E-01
ANNUAL								
ADULT	1.65E+00	1.65E+00	1.34E-02	1.65E+00	1.65E+00	1.65E+00	1.65E+00	1.65E+00
TEEN	1.66E+00	1.66E+00	1.34E-02	1.66E+00	1.66E+00	1.66E+00	1.67E+00	1.67E+00
CHILD	1.47E+00	1.47E+00	1.34E-02	1.47E+00	1.47E+00	1.47E+00	1.48E+00	1.47E+00
INFANT	8.52E-01	8.52E-01	1.34E-02	8.52E-01	8.52E-01	8.52E-01	8.54E-01	6.98E-01

Table 44:
Integrated Population Dose for 2016

January through March

PLUME	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1.20E-04	2.23E-04
	0.00%	0.00%	90.84%	0.00%	0.00%	0.00%	0.00%	0.00%
GROUND	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.42E-05
	0.00%	0.00%	9.16%	0.00%	0.00%	0.00%	0.00%	0.00%
INHAL	2.15E+00	2.15E+00	< LLD	2.15E+00	2.15E+00	2.15E+00	2.15E+00	2.15E+00
	25.83%	25.83%	0.00%	25.83%	25.83%	25.83%	25.83%	25.83%
VEGET	5.33E+00	5.33E+00	< LLD	5.33E+00	5.33E+00	5.33E+00	5.33E+00	5.33E+00
	64.04%	64.04%	0.00%	64.04%	64.04%	64.04%	64.04%	64.04%
COW MILK	5.79E-01	5.79E-01	< LLD	5.79E-01	5.79E-01	5.79E-01	5.79E-01	5.79E-01
	6.96%	6.96%	0.00%	6.96%	6.96%	6.96%	6.96%	6.96%
MEAT	2.64E-01	2.64E-01	< LLD	2.64E-01	2.64E-01	2.64E-01	2.64E-01	2.64E-01
	3.17%	3.17%	0.00%	3.17%	3.17%	3.17%	3.17%	3.17%
TOTAL	8.33E+00	8.33E+00	1.32E-04	8.33E+00	8.33E+00	8.33E+00	8.33E+00	8.33E+00
PER CAPITA DOSE (REM)	4.25E-06	4.25E-06	6.74E-11	4.25E-06	4.25E-06	4.25E-06	4.25E-06	4.25E-06

April through June

PLUME	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	4.23E-04
	0.01%	0.01%	2.48%	0.01%	0.01%	0.01%	0.01%	0.02%
GROUND	7.29E-03	7.29E-03	7.29E-03	7.29E-03	7.29E-03	7.29E-03	7.29E-03	8.57E-03
	0.26%	0.26%	96.94%	0.26%	0.26%	0.26%	0.26%	0.31%
INHAL	8.24E-01	8.24E-01	2.14E-05	8.24E-01	8.24E-01	8.24E-01	8.30E-01	8.24E-01
	29.90%	29.89%	0.28%	29.90%	29.90%	29.90%	30.05%	29.88%
VEGET	1.65E+00	1.66E+00	2.11E-05	1.65E+00	1.65E+00	1.65E+00	1.65E+00	1.65E+00
	60.04%	60.05%	0.28%	60.04%	60.04%	60.04%	59.91%	60.01%
COW	2.08E-01	2.08E-01	5.34E-07	2.08E-01	2.08E-01	2.08E-01	2.08E-01	2.08E-01
	7.56%	7.56%	0.01%	7.56%	7.56%	7.56%	7.55%	7.56%
MEAT	6.14E-02	6.14E-02	3.47E-07	6.14E-02	6.14E-02	6.14E-02	6.14E-02	6.14E-02
	2.23%	2.23%	0.00%	2.23%	2.23%	2.23%	2.22%	2.23%
TOTAL	2.76E+00	2.76E+00	7.52E-03	2.76E+00	2.75E+00	2.76E+00	2.76E+00	2.76E+00
PER CAPITA DOSE (REM)	1.41E-06	1.41E-06	3.84E-09	1.41E-06	1.40E-06	1.41E-06	1.41E-06	1.41E-06

Table 44: (continued) Integrated Population Dose for 2016

January through June

PLUME	3.07E-04	3.07E-04	3.07E-04	3.07E-04	3.07E-04	3.07E-04	3.07E-04	6.45E-04
	0.00%	0.00%	4.01%	0.00%	0.00%	0.00%	0.00%	0.01%
GROUND	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03	7.30E-03	8.59E-03
	0.07%	0.07%	95.42%	0.07%	0.07%	0.07%	0.07%	0.08%
INHAL	2.97E+00	2.98E+00	2.14E-05	2.97E+00	2.97E+00	2.98E+00	2.98E+00	2.97E+00
	26.84%	26.84%	0.28%	26.84%	26.84%	26.84%	26.88%	26.84%
VEGET	6.99E+00	6.99E+00	2.11E-05	6.99E+00	6.99E+00	6.99E+00	6.99E+00	6.99E+00
	63.04%	63.05%	0.28%	63.04%	63.04%	63.04%	63.01%	63.03%
COW	7.88E-01	7.88E-01	5.34E-07	7.88E-01	7.88E-01	7.88E-01	7.88E-01	7.88E-01
	7.11%	7.10%	0.01%	7.11%	7.11%	7.11%	7.10%	7.10%
MEAT	3.26E-01	3.26E-01	3.47E-07	3.26E-01	3.26E-01	3.26E-01	3.26E-01	3.26E-01
	2.94%	2.94%	0.00%	2.94%	2.94%	2.94%	2.94%	2.94%
TOTAL	1.11E+01	1.11E+01	7.65E-03	1.11E+01	1.11E+01	1.11E+01	1.11E+01	1.11E+01
PER CAPITA DOSE (REM)	5.67E-06	5.67E-06	3.91E-09	5.67E-06	5.67E-06	5.67E-06	5.67E-06	5.67E-06

July through September

PLUME	6.45E-05	6.45E-05	6.45E-05	6.45E-05	6.45E-05	6.45E-05	6.45E-05	1.19E-04
	0.00%	0.00%	99.59%	0.00%	0.00%	0.00%	0.00%	0.00%
GROUND	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	2.66E-07	3.11E-07
	0.00%	0.00%	0.41%	0.00%	0.00%	0.00%	0.00%	0.00%
INHAL	8.81E-01	8.81E-01	< LLD	8.81E-01	8.81E-01	8.81E-01	8.81E-01	8.81E-01
	29.86%	29.86%	0.00%	29.86%	29.86%	29.86%	29.86%	29.86%
VEGET	1.78E+00	1.78E+00	< LLD	1.78E+00	1.78E+00	1.78E+00	1.78E+00	1.78E+00
	60.44%	60.44%	0.00%	60.44%	60.44%	60.44%	60.44%	60.44%
COW	2.14E-01	2.14E-01	< LLD	2.14E-01	2.14E-01	2.14E-01	2.14E-01	2.14E-01
	7.27%	7.27%	0.00%	7.27%	7.27%	7.27%	7.27%	7.27%
MEAT	7.19E-02	7.19E-02	< LLD	7.19E-02	7.19E-02	7.19E-02	7.19E-02	7.19E-02
	2.44%	2.44%	0.00%	2.44%	2.44%	2.44%	2.44%	2.44%
TOTAL	2.95E+00	2.95E+00	6.47E-05	2.95E+00	2.95E+00	2.95E+00	2.95E+00	2.95E+00
PER CAPITA DOSE (REM)	1.51E-06	1.51E-06	3.30E-11	1.51E-06	1.51E-06	1.51E-06	1.51E-06	1.51E-06

Table 44: (continued) Integrated Population Dose for 2016

October through December

PLUME	1.11E-04	1.11E-04	1.11E-04	1.11E-04	1.11E-04	1.11E-04	1.11E-04	2.49E-04
	0.00%	0.00%	31.22%	0.00%	0.00%	0.00%	0.00%	0.00%
GROUND	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.77E-04
	0.00%	0.00%	66.34%	0.00%	0.00%	0.00%	0.00%	0.00%
INHAL	2.41E+00	2.41E+00	6.97E-06	2.41E+00	2.41E+00	2.42E+00	2.41E+00	2.41E+00
	27.37%	27.37%	1.97%	27.37%	27.37%	27.37%	27.37%	27.37%
VEGET	5.48E+00	5.48E+00	1.50E-06	5.48E+00	5.48E+00	5.48E+00	5.48E+00	5.48E+00
	62.11%	62.11%	0.42%	62.11%	62.11%	62.10%	62.10%	62.11%
COW MILK	6.71E-01	6.71E-01	1.59E-07	6.71E-01	6.71E-01	6.71E-01	6.71E-01	6.71E-01
	7.61%	7.61%	0.04%	7.61%	7.61%	7.61%	7.61%	7.61%
MEAT	2.57E-01	2.57E-01	2.06E-09	2.57E-01	2.57E-01	2.57E-01	2.57E-01	2.57E-01
	2.92%	2.92%	0.00%	2.92%	2.92%	2.92%	2.92%	2.92%
TOTAL	8.82E+00	8.82E+00	3.54E-04	8.82E+00	8.82E+00	8.82E+00	8.82E+00	8.82E+00
PER CAPITA DOSE (REM)	4.50E-06	4.50E-06	1.81E-10	4.50E-06	4.50E-06	4.50E-06	4.50E-06	4.50E-06

July through December

PLUME	1.75E-04	1.75E-04	1.75E-04	1.75E-04	1.75E-04	1.75E-04	1.75E-04	3.68E-04
	0.00%	0.00%	41.78%	0.00%	0.00%	0.00%	0.00%	0.00%
GROUND	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.35E-04	2.77E-04
	0.00%	0.00%	56.16%	0.00%	0.00%	0.00%	0.00%	0.00%
INHAL	3.30E+00	3.30E+00	6.97E-06	3.30E+00	3.30E+00	3.30E+00	3.30E+00	3.30E+00
	27.99%	27.99%	1.66%	27.99%	27.99%	27.99%	27.99%	27.99%
VEGET	7.26E+00	7.26E+00	1.50E-06	7.26E+00	7.26E+00	7.26E+00	7.26E+00	7.26E+00
	61.69%	61.69%	0.36%	61.69%	61.69%	61.69%	61.69%	61.69%
COW	8.85E-01	8.85E-01	1.59E-07	8.85E-01	8.85E-01	8.86E-01	8.85E-01	8.85E-01
	7.52%	7.52%	0.04%	7.52%	7.52%	7.52%	7.52%	7.52%
MEAT	3.29E-01	3.29E-01	2.06E-09	3.29E-01	3.29E-01	3.29E-01	3.29E-01	3.29E-01
	2.80%	2.80%	0.00%	2.80%	2.80%	2.80%	2.80%	2.80%
TOTAL	1.18E+01	1.18E+01	4.19E-04	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01
PER CAPITA DOSE (REM)	6.02E-06	6.02E-06	2.14E-10	6.02E-06	6.02E-06	6.02E-06	6.02E-06	6.02E-06

Table 44: (continued)
Integrated Population Dose for 2016

January through December

PLUME	4.82E-04	4.82E-04	4.82E-04	4.82E-04	4.82E-04	4.82E-04	4.82E-04	1.01E-03
	0.00%	0.00%	5.97%	0.00%	0.00%	0.00%	0.00%	0.00%
GROUND	7.54E-03	7.54E-03	7.54E-03	7.54E-03	7.54E-03	7.54E-03	7.54E-03	8.86E-03
	0.03%	0.03%	93.39%	0.03%	0.03%	0.03%	0.03%	0.04%
INHAL	6.27E+00	6.27E+00	2.84E-05	6.27E+00	6.27E+00	6.27E+00	6.28E+00	6.27E+00
	27.43%	27.43%	0.35%	27.43%	27.43%	27.44%	27.45%	27.43%
VEGET	1.43E+01	1.43E+01	2.26E-05	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01
	62.35%	62.35%	0.28%	62.35%	62.35%	62.34%	62.33%	62.34%
COW	1.67E+00	1.67E+00	6.93E-07	1.67E+00	1.67E+00	1.67E+00	1.67E+00	1.67E+00
	7.32%	7.32%	0.01%	7.32%	7.32%	7.32%	7.32%	7.32%
MEAT	6.55E-01	6.55E-01	3.49E-07	6.55E-01	6.55E-01	6.55E-01	6.55E-01	6.55E-01
	2.87%	2.87%	0.00%	2.87%	2.87%	2.87%	2.86%	2.87%
TOTAL	2.29E+01	2.29E+01	8.07E-03	2.29E+01	2.29E+01	2.29E+01	2.29E+01	2.29E+01
PER CAPITA DOSE (REM)	1.17E-05	1.17E-05	4.12E-09	1.17E-05	1.17E-05	1.17E-05	1.17E-05	1.17E-05

Table 45: Summary of Individual Doses for 2016						
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
Gamma Air Dose	**mrad**	5.07E-04	3.29E-04	1.23E-04	3.72E-04	1.17E-03
ODCM Req. 4.1 Limit	mrad	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
% ODCM Limit	%	1.01E-02	6.58E-03	2.46E-03	7.44E-03	1.17E-02
Beta Air Dose	**mrad**	1.82E-04	1.41E-04	4.46E-05	1.49E-04	4.53E-04
ODCM Req. 4.1 Limit	mrad	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
% ODCM Limit	%	1.82E-03	1.41E-03	4.46E-04	1.49E-03	2.27E-03
Maximum Individual						
Total Body	mrem	3.37E-04	2.18E-04	8.14E-05	2.47E-04	7.78E-04
Skin	mrem	5.41E-04	3.57E-04	1.31E-04	3.99E-04	1.26E-03
Site Boundary Location						
Unit 1	miles	1.70 SSE	0.78 NW	1.40 SSW	1.70 SSE	1.70 SSE
Unit 2	miles	1.88 SSE	0.74 NW	1.14 SSW	1.88 SSE	1.88 SSE
Unit 3	miles	1.73 SSE	0.65 NW	1.00 SSW	1.73 SSE	1.73 SSE
Maximum Organ Dose (excluding skin)	Age	Infant	Infant	Infant	Teen	Teen
	Organ	Bone	Bone	Bone	Thyroid (2)	Lung
	mrem	1.85E-01	1.01E-01	7.94E-02	1.90E-01	4.86E-01
ODCM Req. 4.2 Limit	mrem	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit (1)	%	2.47E+00	1.35E+00	1.06E+00	2.53E+00	3.24E+00
Location						
Unit 1	miles	2.84 NNE	2.84 NNE	2.84 NNE	2.74 S	2.74 S
Unit 2	miles	3.05 NNE	3.05 NNE	3.05 NNE	2.56 S	2.56 S
Unit 3	miles	3.28 NNE	3.28 NNE	3.28 NNE	2.35 S	2.35 S
Maximum Organ Dose excluding C-14 (3) (excluding skin)	Age	Teen	Infant	Teen	Teen	Teen
	Organ	Thyroid (2)	Thyroid	Thyroid (2)	Thyroid (2)	Lung
	mrem	1.74E-01	4.88E-02	7.41E-02	1.90E-01	4.86E-01
ODCM Req. 4.2 Limit		7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit (1)		2.32E+00	6.51E-01	9.88E-01	2.53E+00	3.24E+00
Organ dose from tritium only for Unit 2 location above	**mrem**	1.74E-01	4.72E-02	7.41E-02	1.90E-01	4.84E-01
Fraction of organ dose from tritium only for Unit 2 location above(2,3)	%	100.00%	96.72%	100.00%	100.00%	99.59%
X/Q for Unit 2 location above	sec/m^3	8.75E-07	4.73E-07	3.76E-07	7.96E-06	5.16E-06
D/Q for Unit 2 location above	m^{-2}	1.31E-09	1.82E-09	1.61E-09	2.58E-09	1.86E-09

Note 1: ODCM Requirement 5.1 has higher limits than ODCM Requirement 4.2, therefore the percent of limits are more conservative based on ODCM Requirement 4.2 than on ODCM Requirement 5.1.

Note 2: All organs except bone

Note 3 Refer to discussion in section 10.4

APPENDIX D

NEI 07-07 GROUNDWATER PROTECTION INITIATIVE SAMPLING

3

AERIAL PHOTO: HELICOPTER PHOTOS, FEBRUARY 2014

EXPLANATION

PVNGS Well Locations and Aquifer Monitored

- Shallow Aquifer Well
- 85-Acre WSR Piezometer
- Palo Verde Clay Aquifer Well
- Regional Aquifer Well
- PVNGS Boundary

FIGURE 1
SITE MAP

Brown AND Caldwell

PALO VERDE NUCLEAR GENERATING STATION
ARIZONA PUBLIC SERVICES

Field Sample ID	Location ID	Sample Date	Parameter Name		Report Result	Report Units	Detected	Sample Purpose
PV-APP-10-0216	APP-10	02/04/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-10-0216	APP-10	02/04/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-10-0216	APP-10	02/04/2016	Cobalt-60	<	2.0	pCi/L	N	REG
PV-APP-10-0216	APP-10	02/04/2016	Cesium-134	<	2.1	pCi/L	N	REG
PV-APP-10-0516	APP-10	05/26/2016	Tritium	<	287	pCi/L	N	REG
PV-APP-10-0516	APP-10	05/26/2016	Cesium-137	<	2.1	pCi/L	N	REG
PV-APP-10-0516	APP-10	05/26/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-10-0516	APP-10	05/26/2016	Cesium-134	<	1.7	pCi/L	N	REG
PV-APP-10-0916	APP-10	09/21/2016	Tritium	<	288	pCi/L	N	REG
PV-APP-10-0916	APP-10	09/21/2016	Cesium-137	<	1.5	pCi/L	N	REG
PV-APP-10-0916	APP-10	09/21/2016	Cobalt-60	<	0.5	pCi/L	N	REG
PV-APP-10-0916	APP-10	09/21/2016	Cesium-134	<	1.3	pCi/L	N	REG
PV-APP-10-1116	APP-10	11/16/2016	Tritium	<	308	pCi/L	N	REG
PV-APP-10-1116	APP-10	11/16/2016	Cesium-137	<	1.5	pCi/L	N	REG
PV-APP-10-1116	APP-10	11/16/2016	Cobalt-60	<	0.7	pCi/L	N	REG
PV-APP-10-1116	APP-10	11/16/2016	Cesium-134	<	1.0	pCi/L	N	REG
PV-APP-12-0216	APP-12	02/04/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-12-0216	APP-12	02/04/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-12-0216	APP-12	02/04/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-12-0216	APP-12	02/04/2016	Cesium-134	<	1.6	pCi/L	N	REG
PV-APP-12-0516	APP-12	05/26/2016	Tritium	<	287	pCi/L	N	REG
PV-APP-12-0516	APP-12	05/26/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-12-0516	APP-12	05/26/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-12-0516	APP-12	05/26/2016	Cesium-134	<	1.5	pCi/L	N	REG
PV-APP-12-0916	APP-12	09/21/2016	Tritium	<	288	pCi/L	N	REG
PV-APP-12-0916	APP-12	09/21/2016	Cesium-137	<	0.8	pCi/L	N	REG
PV-APP-12-0916	APP-12	09/21/2016	Cobalt-60	<	0.5	pCi/L	N	REG
PV-APP-12-0916	APP-12	09/21/2016	Cesium-134	<	1.1	pCi/L	N	REG
PV-APP-12-1116	APP-12	11/08/2016	Tritium	<	289	pCi/L	N	
PV-APP-12-1116	APP-12	11/08/2016	Cesium-137	<	1.0	pCi/L	N	
PV-APP-12-1116	APP-12	11/08/2016	Cobalt-60	<	1.2	pCi/L	N	
PV-APP-12-1116	APP-12	11/08/2016	Cesium-134	<	10.0	pCi/L	N	
PV-APP-15-0216	APP-15	02/01/2016	Tritium	<	242	pCi/L	N	REG
PV-APP-15-0216	APP-15	02/01/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-15-0216	APP-15	02/01/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-15-0216	APP-15	02/01/2016	Cesium-134	<	1.4	pCi/L	N	REG
PV-APP-15-1016	APP-15	10/04/2016	Tritium	<	288.0	pCi/L	N	
PV-APP-15-1016	APP-15	10/04/2016	Cesium-137	<	1.4	pCi/L	N	
PV-APP-15-1016	APP-15	10/04/2016	Cobalt-60	<	1.1	pCi/L	N	
PV-APP-15-1016	APP-15	10/04/2016	Cesium-134	<	1.0	pCi/L	N	
PV-APP-18-0316	APP-18	03/16/2016	Tritium	<	287	pCi/L	N	REG

PV-APP-18-0316	APP-18	03/16/2016	Cesium-137	<	3.4	pCi/L	N	REG
PV-APP-18-0316	APP-18	03/16/2016	Cobalt-60	<	1.3	pCi/L	N	REG
PV-APP-18-0316	APP-18	03/16/2016	Cesium-134	<	2.8	pCi/L	N	REG
PV-APP-18-1116	APP-18	11/02/2016	Tritium	<	285	pCi/L	N	REG
PV-APP-18-1116	APP-18	11/02/2016	Cesium-137	<	0.9	pCi/L	N	REG
PV-APP-18-1116	APP-18	11/02/2016	Cobalt-60	<	0.3	pCi/L	N	REG
PV-APP-18-1116	APP-18	11/02/2016	Cesium-134	<	1.0	pCi/L	N	REG
PV-APP-19-0216	APP-19	02/03/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-19-0216	APP-19	02/03/2016	Cesium-137	<	1.1	pCi/L	N	REG
PV-APP-19-0216	APP-19	02/03/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-19-0216	APP-19	02/03/2016	Cesium-134	<	2.1	pCi/L	N	REG
PV-APP-19-1116	APP-19	11/16/2016	Tritium	<	308	pCi/L	N	REG
PV-APP-19-1116	APP-19	11/16/2016	Cesium-137	<	0.5	pCi/L	N	REG
PV-APP-19-1116	APP-19	11/16/2016	Cobalt-60	<	0.8	pCi/L	N	REG
PV-APP-19-1116	APP-19	11/16/2016	Cesium-134	<	1.0	pCi/L	N	REG
PV-APP-20-0216	APP-20	02/10/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-20-0216	APP-20	02/10/2016	Cesium-137	<	1.4	pCi/L	N	REG
PV-APP-20-0216	APP-20	02/10/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-20-0216	APP-20	02/10/2016	Cesium-134	<	1.7	pCi/L	N	REG
PV-APP-20-1116	APP-20	11/02/2016	Tritium	<	285	pCi/L	N	REG
PV-APP-20-1116	APP-20	11/02/2016	Cesium-137	<	1.1	pCi/L	N	REG
PV-APP-20-1116	APP-20	11/02/2016	Cobalt-60	<	1.0	pCi/L	N	REG
PV-APP-20-1116	APP-20	11/02/2016	Cesium-134	<	0.8	pCi/L	N	REG
PV-APP-21-0216	APP-21	02/10/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-21-0216	APP-21	02/10/2016	Cesium-137	<	1.2	pCi/L	N	REG
PV-APP-21-0216	APP-21	02/10/2016	Cobalt-60	<	1.5	pCi/L	N	REG
PV-APP-21-0216	APP-21	02/10/2016	Cesium-134	<	1.2	pCi/L	N	REG
PV-APP-21-1116	APP-21	11/02/2016	Tritium	<	285	pCi/L	N	REG
PV-APP-21-1116	APP-21	11/02/2016	Cesium-137	<	0.9	pCi/L	N	REG
PV-APP-21-1116	APP-21	11/02/2016	Cobalt-60	<	1.0	pCi/L	N	REG
PV-APP-21-1116	APP-21	11/02/2016	Cesium-134	<	0.9	pCi/L	N	REG
PV-APP-22-0216	APP-22	02/22/2016	Tritium	<	299	pCi/L	N	REG
PV-APP-22-0216	APP-22	02/22/2016	Cesium-137	<	1.2	pCi/L	N	REG
PV-APP-22-0216	APP-22	02/22/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-22-0216	APP-22	02/22/2016	Cesium-134	<	1.7	pCi/L	N	REG
PV-APP-22-1016	APP-22	10/04/2016	Tritium	<	288	pCi/L	N	
PV-APP-22-1016	APP-22	10/04/2016	Cesium-137	<	1.4	pCi/L	N	
PV-APP-22-1016	APP-22	10/04/2016	Cobalt-60	<	0.8	pCi/L	N	
PV-APP-22-1016	APP-22	10/04/2016	Cesium-134	<	1.0	pCi/L	N	
PV-APP-23-0216	APP-23	02/10/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-23-0216	APP-23	02/10/2016	Cesium-137	<	1.3	pCi/L	N	REG
PV-APP-23-0216	APP-23	02/10/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-23-0216	APP-23	02/10/2016	Cesium-134	<	1.8	pCi/L	N	REG
PV-APP-23-1016	APP-23	10/12/2016	Tritium	<	288	pCi/L	N	REG

PV-APP-23-1016	APP-23	10/12/2016	Cesium-137	<	0.8	pCi/L	N	REG
PV-APP-23-1016	APP-23	10/12/2016	Cobalt-60	<	0.8	pCi/L	N	REG
PV-APP-23-1016	APP-23	10/12/2016	Cesium-134	<	0.7	pCi/L	N	REG
PV-APP-3-0216	APP-3	02/11/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-3-0216	APP-3	02/11/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-3-0216	APP-3	02/11/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-3-0216	APP-3	02/11/2016	Cesium-134	<	1.7	pCi/L	N	REG
PV-APP-4R-0216	APP-4R	02/11/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-4R-0216	APP-4R	02/11/2016	Cesium-137	<	1.1	pCi/L	N	REG
PV-APP-4R-0216	APP-4R	02/11/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-4R-0216	APP-4R	02/11/2016	Cesium-134	<	2.7	pCi/L	N	REG
PV-APP-4R-1116	APP-4R	11/01/2016	Tritium	<	285	pCi/L	N	
PV-APP-4R-1116	APP-4R	11/01/2016	Cesium-137	<	1.7	pCi/L	N	
PV-APP-4R-1116	APP-4R	11/01/2016	Cobalt-60	<	0.3	pCi/L	N	
PV-APP-4R-1116	APP-4R	11/01/2016	Cesium-134	<	1.4	pCi/L	N	
PV-APP-5-0216	APP-5	02/23/2016	Tritium	<	299	pCi/L	N	REG
PV-APP-5-0216	APP-5	02/23/2016	Cesium-137	<	1.8	pCi/L	N	REG
PV-APP-5-0216	APP-5	02/23/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-5-0216	APP-5	02/23/2016	Cesium-134	<	2.9	pCi/L	N	REG
PV-APP-7-0216	APP-7	02/09/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-7-0216	APP-7	02/09/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-7-0216	APP-7	02/09/2016	Cobalt-60	<	1.5	pCi/L	N	REG
PV-APP-7-0216	APP-7	02/09/2016	Cesium-134	<	1.9	pCi/L	N	REG
PV-APP-9-0216	APP-9	02/04/2016	Tritium	<	303	pCi/L	N	REG
PV-APP-9-0216	APP-9	02/04/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-9-0216	APP-9	02/04/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-9-0216	APP-9	02/04/2016	Cesium-134	<	2.8	pCi/L	N	REG
PV-APP-9-0516	APP-9	05/26/2016	Tritium	<	287	pCi/L	N	REG
PV-APP-9-0516	APP-9	05/26/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-APP-9-0516	APP-9	05/26/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-APP-9-0516	APP-9	05/26/2016	Cesium-134	<	2.4	pCi/L	N	REG
PV-APP-9-0916	APP-9	09/21/2016	Tritium	<	288	pCi/L	N	REG
PV-APP-9-0916	APP-9	09/21/2016	Cesium-137	<	1.7	pCi/L	N	REG
PV-APP-9-0916	APP-9	09/21/2016	Cobalt-60	<	0.9	pCi/L	N	REG
PV-APP-9-0916	APP-9	09/21/2016	Cesium-134	<	1.6	pCi/L	N	REG
PV-APP-9-1116	APP-9	11/18/2016	Tritium	<	308	pCi/L	N	REG
PV-APP-9-1116	APP-9	11/18/2016	Cesium-137	<	1.3	pCi/L	N	REG
PV-APP-9-1116	APP-9	11/18/2016	Cobalt-60	<	0.7	pCi/L	N	REG
PV-APP-9-1116	APP-9	11/18/2016	Cesium-134	<	1.7	pCi/L	N	REG
PV-PV-14H-0216	PV-14H	02/01/2016	Tritium	<	242	pCi/L	N	REG
PV-PV-14H-0216	PV-14H	02/01/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-PV-14H-0216	PV-14H	02/01/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-PV-14H-0216	PV-14H	02/01/2016	Cesium-134	<	1.6	pCi/L	N	REG
PV-PV-14H-1016	PV-14H	10/04/2016	Tritium	<	288	pCi/L	N	

PV-PV-14H-1016	PV-14H	10/04/2016	Cesium-137	<	0.8	pCi/L	N	
PV-PV-14H-1016	PV-14H	10/042016	Cobalt-60	<	0.8	pCi/L	N	
PV-PV-14H-1016	PV-14H	10/04/2016	Cesium-134	<	0.8	pCi/L	N	
PV-PV-195A-0216	PV-195A	02/01/2016	Tritium	<	242	pCi/L	N	REG
PV-PV-195A-0216	PV-195A	02/01/2016	Cesium-137	<	2.1	pCi/L	N	REG
PV-PV-195A-0216	PV-195A	02/01/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-PV-195A-0216	PV-195A	02/01/2016	Cesium-134	<	1.3	pCi/L	N	REG
PV-PV-195A-1016	PV-195A	10/04/2016	Tritium	<	288	pCi/L	N	
PV-PV-195A-1016	PV-195A	10/04/2016	Cesium-137	<	0.3	pCi/L	N	
PV-PV-195A-1016	PV-195A	10/04/2016	Cobalt-60	<	0.7	pCi/L	N	
PV-PV-195A-1016	PV-195A	10/04/2016	Cesium-134	<	1.0	pCi/L	N	
PV-PV-198AR-0316	PV-198AR	03/16/2016	Tritium	<	287	pCi/L	N	REG
PV-PV-198AR-0316	PV-198AR	03/16/2016	Cesium-137	<	3.1	pCi/L	N	REG
PV-PV-198AR-0316	PV-198AR	03/16/2016	Cobalt-60	<	1.3	pCi/L	N	REG
PV-PV-198AR-0316	PV-198AR	03/16/2016	Cesium-134	<	1.6	pCi/L	N	REG
PV-PV-34H-0216	PV-34H	02/23/2016	Tritium	<	299	pCi/L	N	REG
PV-PV-34H-0216	PV-34H	02/23/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-PV-34H-0216	PV-34H	02/23/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-PV-34H-0216	PV-34H	02/23/2016	Cesium-134	<	1.8	pCi/L	N	REG
PV-PV-R2AR-0216	PV-R2AR	02/03/2016	Tritium	<	303	pCi/L	N	REG
PV-PV-R2AR-0216	PV-R2AR	02/03/2016	Cesium-137	<	1.0	pCi/L	N	REG
PV-PV-R2AR-0216	PV-R2AR	02/03/2016	Cobalt-60	<	1.4	pCi/L	N	REG
PV-PV-R2AR-0216	PV-R2AR	02/03/2016	Cesium-134	<	1.9	pCi/L	N	REG
PV-PV-R2AR-1016	PV-R2AR	10/12/2016	Tritium	<	288	pCi/L	N	REG
PV-PV-R2AR-1016	PV-R2AR	10/12/2016	Cesium-137	<	0.5	pCi/L	N	REG
PV-PV-R2AR-1016	PV-R2AR	10/12/2016	Cobalt-60	<	0.5	pCi/L	N	REG
PV-PV-R2AR-1016	PV-R2AR	10/12/2016	Cesium-134	<	0.5	pCi/L	N	REG
PV-PV-193A-1116	PV-193A	11/08/2016	Tritium	<	289	pCi/L	N	

PV-PV-193A-1116	PV-193A	11/08/2016	Cesium-137	<	0.8	pCi/L	N	
PV-PV-193A-1116	PV-193A	11/08/2016	Cobalt-60	<	0.2	pCi/L	N	
PV-PV-193A-1116	PV-193A	11/08/2016	Cesium-134	<	0.9	pCi/L	N	
PV-PV-Q8-1116	PV-Q8	11/08/2016	Tritium	<	289	pCi/L	N	
PV-PV-Q8-1116	PV-Q8	11/08/2016	Cesium-137	<	1.7	pCi/L	N	
PV-PV-Q8-1116	PV-Q8	11/08/2016	Cobalt-60	<	1.9	pCi/L	N	
PV-PV-Q8-1116	PV-Q8	11/08/2016	Cesium-134	<	1.6	pCi/L	N	

APPENDIX E

2015 ANNUAL RADIOLOGICAL EFFLUENT RELEASE REPORT CORRECTION

OFFSITE DOSE CALCULATION MANUAL
PALO VERDE NUCLEAR GENERATING STATION
UNITS 1, 2, AND 3

REVISION 27

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1.0 INTRODUCTION

The Offsite Dose Calculation Manual (ODCM) implements the program elements which are required by the Administrative Controls section of the Technical Specifications. The ODCM contains the operational requirements, the surveillance requirements, and actions required if the operational requirements are not met for the Radioactive Effluent Controls Program and the Radiological Environmental Monitoring Program to assure compliance with 10 CFR 20.1302, 40 CFR Part 190, 10 CFR 50.36a, and Appendix I to 10 CFR Part 50. The Technical Specifications, Section 3.0, also apply to the ODCM. Substitute the word "Requirements" for "Limiting Condition for Operation." It should be noted that the hot and cold shutdown and operability requirements in Technical Specification 3.0.3 and 3.0.4 do not apply to any of the requirements contained in this ODCM. The ODCM also contains descriptions of the information that should be included in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by the Technical Specifications.

The ODCM provides the parameters and methodology to be used in calculating offsite doses resulting from radioactive effluents, in the calculation of gaseous effluent monitor Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program. Included are methods for determining air, whole body, and organ dose at the controlling location due to plant effluents to assure compliance with the regulatory requirements detailed in the ODCM. Methods are included for performing dose projections to assure compliance with the gaseous treatment system operability sections of the ODCM. The ODCM utilizes information from NRC Regulatory 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," October 1977, and NRC NUREG 0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978. NUREG 0133 utilizes some of the key information in Regulatory Guide 1.109 to provide methods which were used in the preparation of the radiological effluent Technical Specifications and which have now been transferred to the ODCM in accordance with NRC Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program," January 31, 1989, and NUREG 1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," Generic Letter 89-01, Supplement No. 1, April 1991. Further guidance for the implementation of the new 10 CFR Part 20, effective January 1, 1994, was obtained from the Federal Register, Vol. 58, December 23, 1993. It is recognized that this is only draft guidance, however, it is the only guidance for referencing the new 10 CFR 20 in the ODCM.

1.1 Liquid Effluent Pathways

Dose calculation methodology for radioactive liquid effluents is not included in this manual due to the desert location of the plant, the hydrology of the area, and the fact that there are no liquid releases to areas at or beyond the SITE BOUNDARY during normal operation. All liquid discharges to the onsite evaporation ponds are controlled by Section 3.2. The impact of postulated accidental seepages on the groundwater system, and in particular on the existing wells located in the 5-mile zone around the site area has been calculated and analyzed in Section 2.4.13.3 of the PVNGS FSAR.

If plant operating conditions become such that the likelihood of a liquid effluent pathway is created, then dose calculation methodology for this pathway will be added to this manual.

1.2 Gaseous Effluent Pathways

All gaseous effluents are treated as ground level releases and are considered to be “long-term” as discussed in NUREG-0133, “Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.” This includes the containment purge and Waste Gas Decay Tank releases as well as the normal ventilation system and condenser vacuum exhaust releases. All releases are either greater than 500 hours in duration or are made at random, not depending upon atmospheric conditions or time of day. The releases are lumped together and calculated as an entity. Historical annual average X/Q values are used throughout this manual for all gaseous effluent setpoint and dose calculations. Airborne releases are further subdivided into two subclasses:

1.2.1 Iodine-131, Iodine-133, Tritium and Radionuclides in Particulate Form with Half-lives Greater than Eight Days

In this model, a controlling location is identified for assessing the maximum exposure to a MEMBER OF THE PUBLIC for the various pathways and to critical organs. Infant exposure occurs through inhalation and any actual milk pathway. Child, teenager and adult exposure derives from inhalation, consumed vegetation pathways, and any actual milk and meat pathways. Dose to each of the seven organs listed in Regulatory Guide 1.109 (bone, liver, total body, thyroid, kidney, lung and GI-LLI) are computed from individual nuclide contributions in each sector. The largest of the organ doses in any sector is compared to 10 CFR 50, Appendix I design objectives. The release rates of these nuclides will be converted to instantaneous dose rates for comparison to the limits of 10 CFR 20.

1.2.2 Noble Gases

The air dose from both the beta and gamma radiation component of the noble gases will be assessed and compared to the 10 CFR 50, Appendix I design objectives. The noble gas release rate will be converted to instantaneous dose rates for comparison to the limits of 10 CFR 20.

Section 2.0 of this manual discusses the methodology to be used in determining effluent monitor alarm/trip setpoints to assure compliance with the 10 CFR Part 20 limits as implemented in Section 3.0. Section 4.0 discusses the methods to assure releases are As Low As Reasonably Achievable (ALARA) in accordance with Appendix I to 10 CFR Part 50. Methods are described in Section 5.0 for determining the annual cumulative dose to a MEMBER OF THE PUBLIC from gaseous effluents and direct radiation to assure compliance with 40 CFR Part 190.

The requirements for the Annual Radiological Effluent Release Report and the Radiological Environmental Monitoring Program, including the Annual Land Use Census and the Interlaboratory Comparison Program, and the Annual Environmental Report are described in Sections 6.0 and 7.0 of this manual.

1.3 Nuisance Pathways

This section addresses the potential release pathways which should not contribute more than 10% of the doses evaluated in this manual. Table 1-1 lists examples of potential release pathways. The ODCM methodology for calculation of doses will be applied to an applicable release pathway if a likely potential arises for contributing more than 10% of the doses evaluated in this manual.

TABLE 1-1

NUISANCE PATHWAYS

(EXAMPLES)

Evaporation Pond

Cooling Towers

Laundry/Decon Building Exhaust

Unmonitored Secondary System Steam Vents/Reliefs

Turbine Building Ventilation Exhaust

Unmonitored Tank Atmospheric Vents

Dry Active Waste Processing and Storage (DAWPS) Building

Respirator Cleaning Facility

Secondary Side Decontamination Equipment

Low Level Radioactive Material Storage Facility

Outage Support Facility

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1.4 Meteorology

Historical annual average atmospheric dispersion (X/Q) and deposition (D/Q) data, based on nine years of meteorological data, and given in Table 3-2 for each of the three nuclear generating units are used to demonstrate compliance with the ODCM Requirements. These Requirements include:

Section 2.0	Gaseous Effluent Monitor Setpoints;
Section 3.0	Gaseous and Liquid Effluent - Dose Rate
Section 4.0	Gaseous and Liquid Effluent - Dose
Section 5.0	Total Dose and Dose to Public Onsite

Sections 2.0 and 3.0 specify utilizing the highest X/Q or D/Q meteorological dispersion parameter at the Site Boundary for any of the three units as applicable. Using the highest dispersion parameter for any of the units provides a conservative assumption to assure compliance with the higher 10 CFR Part 20 limits.

Section 4.0 specifies utilizing the highest X/Q at the Site Boundary for the particular unit, from Table 3-2 for noble gases. The highest X/Q and D/Q are utilized for the particular unit's releases as applicable for gases other than noble gases (iodines, particulates, and tritium) for the controlling pathway's location (site boundary using Table 3-2 or other controlling locations using Table 4-16, 4-17, or 4-18).

Section 5.0 specifies utilizing the highest X/Q for the particular unit's releases at the controlling location from Table 4-16, 4-17, or 4-18, for noble gases. The highest X/Q and D/Q are utilized for the particular unit's releases as applicable for gases other than noble gases at the controlling pathway's location using Table 4-16, 4-17, or 4-18.

Section 7.0 requires that 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.

2.0 GASEOUS EFFLUENT MONITOR SETPOINTS

2.1 Requirements: Gaseous Monitors

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 2-1 shall be FUNCTIONAL with their alarm/trip setpoints set to ensure that the dose requirements in Section 3.0 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section 2.1.2.

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Applicability: As shown in Table 2-1.

Action:

a. With the low range radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Requirement, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel nonfunctional, or change the setpoint so it is acceptably conservative.

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b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels FUNCTIONAL, take the ACTION shown in Table 2-1. Restore the nonfunctional instrumentation to FUNCTIONAL status within 30 days or, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why this nonfunctionality was not corrected within the time specified.

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2.1.1 Surveillance Requirements

a. 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 2-2.

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b. The specified Frequency for each Surveillance Requirement is met if the Surveillance Requirement 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 "Prior to each release," the above interval extension does not apply.

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.

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TABLE 2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS FUNCTIONAL	APPLICABILITY	ACTION
1. GASEOUS RADWASTE SYSTEM			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release #RU-12	1	#	35
b. Flow Rate Monitor	1	#	36
2. NOT USED			
3. DELETED			
4. PLANT VENT SYSTEM			
A. Low Range Monitors			
a. Noble Gas Activity Monitor #RU-143	1	*	37
b. Iodine Sampler	1	*	40
c. Particulate Sampler	1	*	40
d. Flow Rate Monitor	1	*	36
e. Sampler Flow Rate Measuring Device	1	*	36
B. High Range Monitors			
a. Noble Gas Activity Monitor #RU-144	1	*	42
b. Iodine Sampler	1	*	42
c. Particulate Sampler	1	*	42
d. Sampler Flow Rate Measuring Device	1	*	42

TABLE 2-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS FUNCTIONAL	APPLICABILITY	ACTION
5. FUEL BUILDING VENTILATION SYSTEM			
A. Low Range Monitors			
a. Noble Gas Activity Monitor #RU-145	1	##	37, 41
b. Iodine Sampler	1	##	40
c. Particulate Sample	1	##	40
d. Flow Rate Monitor	1	##	36
e. Sampler Flow Rate Measuring Device	1	##	36
B. High Range Monitors			
a. Noble Gas Activity Monitor #RU-146	1	##	42
b. Iodine Sampler	1	##	42
c. Particulate Sample	1	##	42
d. Sampler Flow Rate Measuring Device	1	##	42

Table 2-1 (Continued)

TABLE NOTATION

- * At all times.
- ** During GASEOUS RADWASTE SYSTEM operation
- *** Whenever the condenser air removal system is in operation, or whenever turbine glands are being supplied with steam from sources other than the auxiliary boiler(s).
- \# During waste gas release.
- \## In MODES 1, 2, 3, and 4 or when irradiated fuel is in the fuel storage pool.

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ACTION 35 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, the contents of the tank(s) may be released to the environment provided that prior to initiating the release:

a. At least two independent samples of the tanks contents are analyzed, and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup;

Otherwise, suspend release of radioactive effluents via this pathway.

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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 the flow rate is estimated at least once per 4 hours.

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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 the actions of (a) or (b) or (c) are performed:

a. Initiate the Preplanned Alternate Sampling Program to monitor the appropriate parameter(s).

b. Place moveable air monitors in-line.

c. Either take grab samples at least once per 12 hours, OR obtain gas channel monitor readings locally at least once per 12 hours if the channel is functional locally but nonfunctional due to loss of communication with the minicomputer. The surveillance requirements of Section 2.1.1 must be performed at the required frequencies for the channel to be functional locally.

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ACTION 38 - NOT USED

ACTION 39 - NOT USED

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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 3-1 within one hour after the channel has been declared nonfunctional.

MAR 2016

ACTION 41 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirements, comply with Technical Requirements Manual TLCO 3.3.108.

Table 2-1 (Continued)

TABLE NOTATION

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ACTION 42 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement initiate the Preplanned Alternate Sampling Program to monitor the appropriate parameter(s) within 72 hours, and:

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a. Either restore the nonfunctional channel(s) to FUNCTIONAL status within 7 days of the event, or

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b. Prepare and submit a Special Report to the Commission within 14 days following the event outlining the action(s) taken, the cause of the nonfunctionality, and the plans and schedule for restoring the system to FUNCTIONAL status.

TABLE 2-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODE IN WHICH SURVEILLANCE IS REQUIRED
1. GASEOUS RADWASTE SYSTEM					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release RU-12	P	P(7)	R(3)	Q(1),(2),P###	#
b. Flow Rate Monitor	P	N.A.	R	Q,P###	#
2. DELETED					
3. DELETED					
4. PLANT VENT SYSTEM (RU-143 and RU-144)					
a. Noble Gas Activity Monitor	D(5)	M(7)	R(3)	Q(2)	*
b. Iodine Sampler	N.A.	N.A.	N.A.	N.A.	*
c. Particulate Sampler	N.A.	N.A.	N.A.	N.A.	*
d. Flow Rate Monitor	D(6)	N.A.	R	Q	*
e. Sampler Flow Rate Measuring Device	D(6)	N.A.	R	Q	*
5. FUEL BUILDING VENTILATION SYSTEM (RU-145 and RU-146)					
a. Noble Gas Activity Monitor	D(5)	M(7)	R(3)	Q(2)	##
b. Iodine Sampler	N.A.	N.A.	N.A.	N.A.	##
c. Particulate Sample	N.A.	N.A.	N.A.	N.A.	##
d. Flow Rate Monitor	D(6)	N.A.	R	Q	##
e. Sampler Flow Rate Measuring Device	D(6)	N.A.	R	Q	##

Table 2-2 (Continued)

TABLE NOTATION

*	At all times.
**	During GASEOUS RADWASTE SYSTEM operation
***	Whenever the condenser air removal system is in operation, or whenever turbine glands are being supplied with steam from sources other than the auxiliary boiler(s).
#	During waste gas release.
##	In MODES 1, 2, 3, and 4 or when irradiated fuel is in the fuel storage pool.
###	Functional test should consist of, but not be limited to, a verification of system isolation capability by the insertion of a simulated alarm condition.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway occurs if the instrument indicates measured levels above the alarm/trip setpoint.

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

1. Instrument indicates measured levels above the alarm setpoint.
2. Circuit failure.
3. Instrument indicates a downscale failure.
4. Instrument controls not set in operate mode.

(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 (NIST) 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 CALIBRATION, sources that have been related to the initial calibration may be used in lieu of the reference standards associated with the initial calibration.

(4) NOT USED

(5) The channel check for channels in standby status shall consist of verification that the channel is on-line and reachable.

(6) Daily channel check not required for flow monitors in standby status.

(7) LED may be utilized as the check source in lieu of a source of increased activity.

2.1.2 Implementation of the Requirements

The general methodology for establishing low range gaseous effluent monitor setpoints is based upon a site release rate limit in μCi/sec derived from site specific meteorological dispersion conditions, radioisotopic distribution, and whole body and skin dose factors. The high alarm of the low range monitors will alarm/trip when the release rate from an individual vent will result in exceeding the limits in Section 3.1. 80% of Section 3.1 limits is considered to be the site release rate limit. The site release rate limit will be allocated among the licensed units' release points. The unit release rate limit will then be utilized for the determination of gaseous effluent monitor setpoints. A fraction of the unit release rate limit is then allotted to each release point and its monitor alert setpoint (μCi/cc) is derived using actual or fan design flow rates.

Administrative values are used to reduce each setpoint to account for the potential activity in other releases. These administrative values shall be reviewed based on actual release data.

For the purpose of implementation of Section 2.1, the alarm setpoint levels for low range effluent noble gas monitors are established to ensure that personnel are alerted when the noble gas releases are at a rate such that if the releases would continue for the year they would approach the total body dose rate of 500 mrem/yr and 3000 mrem/yr skin dose in Section 3.1. The equations in Section 3.1 of this manual provide the methodology for calculating the gaseous effluent dose rate.

The evaluation of doses due to releases of radioactive material can be simplified by the use of equivalent dose factors as defined in Section 2.1.2.1.

The equivalent dose factors will be evaluated periodically to assure that the best information on isotopic distribution is being used for the dose equivalent value.

2.1.2.1 Equivalent Dose Factor Determination

The equivalent whole body dose factor is calculated as follows:

$$K_{eq} = \sum_i [(K_i)(f_i)] \qquad (2\text{-}1)$$

Where:

K_{eq} = the equivalent whole body dose factor weighted by historical radionuclide distribution in releases in mrem/yr per μCi/m^3.

K_i = the whole body dose factor due to gamma emissions for each identified noble gas radionuclide i, in mrem/yr per μCi/m^3 from Table 3-3.

f_i = the fraction of noble gas radionuclide i in the total noble gas radionuclide mix.

The equivalent skin dose factor is calculated as follows:

$$(L + 1.1M)_{eq} = \sum_i [(L_i + 1.1M_i)(f_i)] \qquad (2\text{-}2)$$

Where:

$(L+1.1M)_{eq}$ = the equivalent skin dose factor due to beta and gamma emissions from all noble gases released, weighted by the historical radionuclide distribution in releases in mrem/yr per μCi/m^3.

L_i = the skin dose factor due to the beta emissions for each identified noble gas radionuclide i, in mrem/yr per μCi/m^3 from Table 3-3.

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

f_i = the fraction of noble gas radionuclide i in the total noble gas radionuclide mix.

1.1 = unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose.

2.1.2.2 Site Release Rate Limit (Q_{SITE})

The release rates corresponding to 80% of the whole body (Q_{WB}) and skin (Q_{SK}) dose rate limits are calculated using the equivalent dose factors defined in Section 2.1.2.1. The site release rate limit (Q_{SITE}) is the lower of Q_{WB} or Q_{SK}, thus assuring that the more restrictive dose rate limit will not be exceeded.

The Q_{SITE} is established as follows:

$$Q_{SITE,WB} = \frac{(D_{WB})(0.8)}{(K_{eq})(X/Q)_{SITE}} \tag{2-3}$$

Where:

$Q_{SITE,WB}$ = the site release rate, in µCi/sec, that would deliver a dose rate 80% of the whole body dose rate limit, D_{WB}.

D_{WB} = whole body dose rate limit of 500 mrem/yr.

K_{eq} = equivalent whole body dose factor, in mrem/yr per µCi/m^3 weighted by the historical radionuclide distribution.

$(X/Q)_{SITE}$ = 8.91E-06, the highest calculated annual average dispersion parameter, in sec/m^3, at the Site Boundary for any of the 3 units, from Table 3-2.

0.8 = administrative factor to compensate for any unexpected variability in the radionuclide mix and to ensure that Site Boundary dose rate limits will not be exceeded.

$$Q_{SITE,SK} = \frac{(D_{SK})(0.8)}{(L + 1.1M)_{eq}(X/Q)_{SITE}} \tag{2-4}$$

Where:

$Q_{SITE,SK}$ = the site release rate limit, in µCi/sec, that would deliver a dose rate 80% of the skin dose rate limit, D_{SK}.

D_{SK} = skin dose rate limit of 3000 mrem/yr.

$(L+1.1M)_{eq}$ = equivalent skin dose factor, in mrem/yr per µCi/m^3, weighted by the radionuclide distribution.

$(X/Q)_{SITE}$ = 8.91E-06, the highest calculated annual average dispersion parameter, in sec/m^3, at the Site Boundary for any of the three units, from Table 3-2.

0.8 = administrative factor to compensate for any unexpected variability in the radionuclide mix and to ensure that Site Boundary dose rate limits will not be exceeded.

After determination of the Q_{SITE} whole body and skin dose rates (equations 2-3 and 2-4, respectively), the most conservative result will be used as Q_{SITE}, the site release rate limit.

2.1.2.3 Unit Release Rate Limits (Q_{UNIT})

Typically Q_{SITE} will be divided equally among operating units. If operational history dictates a larger fraction of the Q_{SITE} be assigned to a specific unit then a weighted average of each unit's contribution to the Q_{SITE} will be utilized to determine the Q_{UNIT}.

$$Q_{UNIT} = (f_{UNIT})\,(Q_{SITE}) \tag{2-5}$$

Where:

Q_{UNIT} = unit release rate limit, in µCi/sec.

f_{UNIT} = the fraction ($\leq$ 1) of noble gas historically released from a specific operating unit to the total of all noble gas released from the site.

Q_{SITE} = the site release rate limit, in µCi/sec determined in Section 2.1.2.2.

2.1.2.4 Setpoint Determination

To comply with the requirements in Section 2.1, the alarm/trip setpoints can now be established using the unit release rate limit (Q_{UNIT}) to ensure that the noble gas releases do not exceed the dose rate limits.

To allow for multiple sources of releases from different or common release points, the effluent monitor setpoint includes an administrative factor which allocates a percentage of the unit release rate limit to each of the release sources. Monitor setpoints will also be adjusted in accordance with Nuclear Administrative and Technical Manual procedures to account for monitor-specific characteristics.

<u>Monitors RU-143 and RU-145</u>

The alarm/trip setpoint for Monitors RU-143 and RU-145 is calculated as follows:

$$\begin{matrix}\text{Monitor}\\ \text{Setpoint}\end{matrix} \leq \frac{(Q_{UNIT})(a)}{(472)(\text{Flow Rate})} \tag{2-6}$$

Where:

Monitor

Setpoint = the setpoint for the effluent monitor, in µCi/cc, which provides a safe margin of assurance that the allowable dose rate limits will not be exceeded.

Q_{UNIT} = unit release rate limit, in µCi/sec, as determined in Section 2.1.2.3.

Flow Rate = the flow rate, in cfm, from flow rate monitors or the fan design flow rate for the release source under consideration.

472 = conversion factor, cubic centimeter/second per cubic feet/minute.

a = fraction of Q_{UNIT} allocated for a specific release point. The sum of these administrative values shall be less than or equal to one.

Monitor RU-12

The alarm/trip setpoint for Monitor RU-12, the Waste Gas Decay Tank Monitor, is calculated as follows:

$$\begin{matrix}\text{Monitor}\\ \text{setpoint}\end{matrix} \le \frac{[(Q_{UNIT})(a)(0.9) - (H)(PF)(472)]}{(\text{Flow Rate})(472)} \qquad (2\text{-}7)$$

Where:

Monitor

Setpoint	=	the setpoint for the monitor, in µCi/cc at STP, which provides a safe margin of assurance that the allowable dose rate limits will not be exceeded.
Q_{UNIT}	=	unit release rate limit, in µCi/sec, as determined in Section 2.1.2.3.
Flow Rate	=	flow rate, in cfm at STP at which the tank will be released.
PF	=	the current process flow of the plant vent in CFM.
H	=	the current plant vent monitor concentration in µCi/cc.
a	=	fraction of Q_{UNIT} allocated for a specific release point. This administrative value should be equal to or less than the administrative value used for the Plant Vent.
0.9	=	an administrative value to account for potential increases in activity from other contributors to the same release point.
472	=	conversion factor, cubic centimeter/second per cubic feet/minute.

If there is no release associated with this monitor, the monitor setpoint should be established as close as practical to background to prevent spurious alarms, and yet assure an alarm should an inadvertent release occur.

2.1.2.5 Monitor Calibration

The Radiation Level Conversion Factor (RLF) for each monitor is entered into the Radiation Monitoring System Database and may change whenever the monitor is calibrated. Calibration is performed in accordance with Nuclear Administrative and Technical Manual procedures.

3.0 GASEOUS AND LIQUID EFFLUENT DOSE RATES

3.1 Requirements: Gaseous Effluents

The dose rate due to radioactive materials released in gaseous effluents from the site (see Figure 6-4 and Figure 6-5) shall be limited to the following:

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

b. For I-131 and I-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

Applicability: At all times.

Action:

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

3.1.1 Surveillance Requirements

a. The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methods contained in Section 3.1.2.

b. The dose rate due to I-131, I-133, tritium and all radionuclides 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 the methods contained in Section 3.1.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3-1.

3.1.2 Implementation of the Requirements

Noble Gases

Noble gas activity monitor setpoints are established at release rates which permit corrective action to be taken before exceeding the 10 CFR 20 annual dose limits as described in Section 2.0. The requirements for sampling and analysis of continuous and batch effluent releases are given in Table 3-1. The methods for sampling and analysis of continuous and batch effluent releases are given in the Nuclear Administrative and Technical Manual procedures. The dose rate in unrestricted areas shall be determined using the following equations.

For whole body dose rate:

$$D_{WB} = \sum_i [(K_i)(X/Q)_{SITE}(Q_i)] \quad (3\text{-}1)$$

For skin dose rate:

$$D_{SK} = \sum_i [(L_i + 1.1M_i)(X/Q)_{SITE}(Q_i)] \quad (3\text{-}2)$$

Where:

K_i = the whole body dose factor due to gamma emissions for each identified noble gas radionuclide i, in mrem/yr per µCi/m^3 from Table 3-3.

Q_i = the release rate of radionuclide i, in µCi/sec.

$(X/Q)_{SITE}$ = 8.91E-06, the highest calculated annual average dispersion parameter, in sec/m^3, for any of the three units, from Table 3-2.

D_{WB} = the annual whole body dose rate (mrem/yr.).

L_i = the skin dose factor due to the beta emissions for each identified noble gas radionuclide i, in mrem/yr per µCi/m^3 from Table 3-3.

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

D_{SK} = the annual skin dose rate (mrem/yr).

1.1 = unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose.

I-131, I-133, tritium and radionuclides in particulate form with half-lives greater than 8 days

The methods for sampling and analysis of continuous and batch releases for I-131, I-133, tritium and radionuclides in particulate form with half-lives greater than 8 days, are given in the applicable Nuclear Administrative and Technical Manual procedures. Additional monthly and quarterly analyses shall be performed in accordance with Table 3-1. The total organ dose rate in unrestricted areas shall be determined by the following equation:

$$D_o = \sum_i [(P_i)(X/Q)_{SITE}(Q_i)] \quad (3\text{-}3)$$

Where:

P_i = the dose factor, in mrem/yr per µCi/m^3, for radionuclide i, for the inhalation pathway, from Table 3-4.

$(X/Q)_{SITE}$ = 8.91E-06, the highest calculated annual average dispersion parameter, in sec/m^3, at the Site Boundary, for any of the three units,

Q_i = the release rate of radionuclide i, in µCi/sec

D_o = the total organ dose rate (mrem/yr).

TABLE 3-1

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]
A. Waste Gas Storage	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[g]	1.0E-04
B. Containment Purge	P Each Purge[b,c] Grab Sample	P Each Purge[b,c]	Principal Gamma Emitters[g]	1.0E-04
			H-3	1.0E-06
C. 1. DELETED **2. Plant Vent** **3. Fuel Bldg. Exhaust**	M[b,e] Grab Sample	M[b]	Principal Gamma Emitters[g]	1.0E-04
			H-3	1.0E-06
	Continuous[f]	4/M[d] Charcoal Sample	I-131	1.0E-12
			I-133	1.0E-10
	Continuous[f]	4/M[d] Particulate Sample	Principal Gamma Emitters[g] (I-131, Others)	1.0E-11
	Continuous[f]	M Composite Particulate Sample	Gross Alpha	1.0E-11
	Continuous[f]	Q Composite Particulate Sample	Sr-89, Sr-90	1.0E-11
D. All Radwaste Types as listed in A., B., and C., above.	Continuous[f]	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1.0E-06

Table 3-1 (Continued)

TABLE NOTATION

a The LLD is the smallest concentration of radioactive material in a sample that will yield a net count (above system background) 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):

$$LLD = \frac{4.66\ s_b}{E * V * 2.22E6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the a priori lower limit of detection as defined above (as µCi per unit mass or volume). Current literature defines the LLD as the detection capability for the instrumentation only and the MDC minimum detectable concentration, as the detection capability for a given instrument, procedure and type of sample.

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

E is the counting efficiency (as counts per transformation),

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

2.22E6 is the number of transformations per minute per microcurie,

Y is the fractional radiochemical yield (when applicable),

λ is the radioactive decay constant for the particular radionuclide, and

Δt is the elapsed time between the 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 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 should include the typical contributions of other radionuclides normally present in the samples. 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 a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Table 3-1 (Continued)

TABLE NOTATION

b Analyses shall also be performed following SHUTDOWN, STARTUP, or a THERMAL POWER change exceeding 15% of the RATED THERMAL POWER within a 1-hour period if 1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has increased more than a factor of 3; and 2) the noble gas activity monitor on the plant vent shows that effluent activity has increased by more than a factor of 3. If the associated noble gas vent monitor is nonfunctional, samples must be obtained as soon as possible. Analyses shall be performed within a four-hour period. This requirement does not apply to the Fuel Building Exhaust.

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c Sampling and analyses shall also be performed at least once per 31 days when purging time exceeds 30 days continuous.

d Samples shall be changed at least 4 times a month and analyses shall be completed within 48 hours after changing (or after removal from sampler). When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10.

e Tritium grab samples shall be taken at least monthly from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

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 Requirements 3.1, 4.1 and 4.2 of the ODCM.

g The principal gamma emitters for which the LLD specification applies include 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 in the Annual Radioactive Effluent Release Report.

TABLE 3-2

DISPERSION AND DEPOSITION PARAMETERS FOR LONG TERM RELEASES

AT THE SITE BOUNDARY

DIRECTION	DISTANCE (METERS)	UNIT 1 X/Q (SEC/m^3)	D/Q (m^{-2})	UNIT 2 DISTANCE (METERS)	X/Q (SEC/m^3)	D/Q (m^{-2})	UNIT 3 DISTANCE (METERS)	X/Q (SEC/m^3)	D/Q (m^{-2})
N	1037	4.93E-06	9.24E-09	1318	3.85E-06	6.17E-09	1661	3.54E-06	4.86E-09
NNE	1057	4.14E-06	1.19E-08	1342	3.18E-06	7.93E-09	1693	2.86E-06	6.23E-09
NE	2206	2.84E-06	6.84E-09	2545	2.42E-06	5.34E-09	2756	2.21E-06	4.65E-09
ENE	1967	2.51E-06	4.43E-09	2206	2.22E-06	3.64E-09	2337	2.08E-06	3.30E-09
E	1927	2.56E-06	3.24E-09	2163	2.27E-06	2.66E-09	2290	2.14E-06	2.41E-09
ESE	1967	2.61E-06	2.46E-09	2067	2.32E-06	2.11E-09	2023	2.37E-06	2.10E-09
SE	2049	3.56E-06	2.36E-09	2101	3.47E-06	2.26E-09	2256	3.24E-06	2.00E-09
SSE	2730	3.80E-06	1.58E-09	3026	3.43E-06	1.32E-09	2786	3.72E-06	1.52E-09
S	3006	5.07E-06	1.78E-09	2699	5.16E-06	1.97E-09	2346	5.90E-06	2.51E-09
SSW	2258	6.52E-06	3.20E-09	1836	7.90E-06	4.56E-09	1607	8.91E-06	5.73E-09
SW	1487	7.47E-06	5.65E-09	1208	7.72E-06	6.88E-09	1057	8.68E-06	8.61E-09
WSW	1251	4.52E-06	5.93E-09	1014	5.55E-06	8.44E-09	889	5.34E-06	8.83E-09
W	1225	4.73E-06	9.49E-09	993	5.86E-06	1.34E-08	871	6.72E-06	1.67E-08
WNW	1244	3.76E-06	6.76E-09	1010	4.67E-06	9.60E-09	885	5.37E-06	1.19E-08
NW	1254	3.43E-06	5.87E-09	1191	3.62E-06	6.40E-09	1045	4.17E-06	7.98E-09
NNW	1069	3.70E-06	7.26E-09	1342	2.85E-06	4.87E-09	1561	2.93E-06	4.58E-09

Reference: Distances are from the PVNGS ER-OL, Table 2.3-33. Dispersion and Deposition parameters are from a September, 1985, calculation by NUS Corporation based on 9 years of meteorological data; NUS Corporation letter NUS-ANPP-1386, dated October 4, 1985.

TABLE 3-3

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS

Radionuclide	Whole Body Dose Factor K_i $\frac{mrem\text{-}m^3}{yr\text{-}\mu Ci}$	Skin Dose Factor L_i $\frac{mrem\text{-}m^3}{yr\text{-}\mu Ci}$	Gamma Air Dose Factor M_i $\frac{mrad\text{-}m^3}{yr\text{-}\mu Ci}$	Beta Air Dose Factor N_i $\frac{mrad\text{-}m^3}{yr\text{-}\mu Ci}$
Kr-83m	7.56E-02	------------	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-13lm	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

Reference: Regulatory Guide 1.109, Table B-1.

TABLE 3-4

P_i VALUES FOR THE INHALATION PATHWAY

(mrem/yr/μCi/m^3)

NUCLIDE	Age Group	Organ	P_i
H-3	TEEN	LIVER	1.27E+03
CR-51	TEEN	LUNG	2.10E+04
MN-54	TEEN	LUNG	1.98E+06
FE-59	TEEN	LUNG	1.53E+06
CO-58	TEEN	LUNG	1.34E+06
CO-60	TEEN	LUNG	8.72E+06
ZN-65	TEEN	LUNG	1.24E+06
SR-89	TEEN	LUNG	2.42E+06
SR-90	TEEN	BONE	1.08E+08
ZR-95	TEEN	LUNG	2.69E+06
SB-124	TEEN	LUNG	3.85E+06
I-131	CHILD	THYROID	1.62E+07
I-133	CHILD	THYROID	3.85E+06
CS-134	TEEN	LIVER	1.13E+06
CS-137	CHILD	BONE	9.07E+05
BA-140	TEEN	LUNG	2.03E+06
CE-141	TEEN	LUNG	6.14E+05
CE-144	TEEN	LUNG	1.34E+07

3.2 Requirements: Secondary System Liquid Waste Discharges To Onsite Evaporation Ponds or Circulating Water System - Concentration

The concentration of radioactive material discharged from secondary system liquid waste to the circulating water system shall be limited to:

5.0E-07 µCi/ml for the principal gamma emitters (except Ce-144)

3.0E-06 µCi/ml for Ce-144

1.0E-06 µCi/ml for I-131

1.0E-03 µCi/ml for H-3

The concentration of radioactive material discharged from secondary system liquid waste to the onsite evaporation ponds shall be limited to:

2.0E-06 µCi/ml for Cs-134

2.0E-06 µCi/ml for Cs-137

The concentrations specified in 10 CFR Part 20.1001-20.2402, Appendix B, Table 2, Column 2, for all other isotopes

Applicability: At all times.

Action:

When any secondary system liquid waste discharge pathway concentration determined in accordance with the surveillance requirements given below exceeds the above Requirements, divert that discharge pathway to the liquid radwaste system without delay or terminate the discharge.

3.2.1 Surveillance Requirements

a. Secondary system liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 3-5.

3.2.2 Implementation of the Requirements

This requirement is implemented by Nuclear Administrative and Technical Manual procedures.

TABLE 3-5

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Secondary System Liquid Release Pathway	Destination	Sampling & Analysis Frequency	Notes	Type Of Activity Analysis	Lower Limit Of Detection (LLD)[a] (μCi/ml)
1. Chemical Waste Neutralizer Tank (CWNT)[b]	Retention Tank	P Each Batch		Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	liquid radwaste	N. A.			
2. Steam Generator Blowdown Low TDS Sump[b]	circ. water	P Each Batch	1	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	CWNT	N. A.			
3. Condensate					
a. Condensate Polishing Low TDS Sump[b]	circ. water	P Each Batch	3	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	CWNT	N. A.			
b. Initial Backwash	(low TDS sump) to circ. water	P Each Discharge		Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	(low TDS sump) to CWNT	N. A.			
c. Pre-service rinse effluent	Retention Tank through SC-N-V069	P Each Discharge	2	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	condenser through SC-N-UV232	N. A.			
d. Overboard condensate	circ water through CD-N-V194	P Each Discharge		Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	Retention Tank through SC-N-V079	P Each Discharge	2		
4. Turbine Building Sump[d]	Retention Tank	D Grab Sample	3	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	CWNT	N. A.			

TABLE 3-5

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Secondary System Liquid Release Pathway	Destination	Sampling & Analysis Frequency	Notes	Type Of Activity Analysis	Lower Limit Of Detection (LLD)[a] (μCi/ml)
5. North & South Condenser Area Sumps[d]	Retention Tank	D Grab Sample	3	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
	CWNT	N. A.			
6. Steam Generator Blowdown to Retention Tank	Retention Tank through SC-N-V064	P Each Discharge	2	Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05
7. Retention Tank to Evaporation Pond	evaporation pond	P Each Batch		Principal Gamma Emitters[c] I-131 H-3	5.0E-07 1.0E-06 1.0E-05

1 Sampling and analysis are required only when concentration for chemical waste neutralizer tank or steam generator activity exceeds the requirement

2 RU-200 shall be demonstrated FUNCTIONAL by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 3-6. The Alarm/Trip setpoints for RU-200 are set to ensure that the concentrations in the Retention Tanks do not exceed the Requirement

3 Sampling and analysis are required only when concentration for chemical waste neutralizer tank or condensate activity exceeds the requirement

Table 3-5 (Continued)

TABLE NOTATION

a The LLD is defined as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, 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:

$$LLD = \frac{4.66\ s_b}{E * V * 2.22E6 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the “a priori” lower limit of detection as defined above as microcuries per unit mass or volume,

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate as counts per minute,

E is the counting efficiency as counts per disintegration,

V is the sample size in units of mass or volume,

2.22E6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt is the elapsed time between midpoint of sample collection and time of counting.

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 a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

b 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 to assure representative sampling.

c The principal gamma emitters for which the LLD specification applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 3.0E-06. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report.

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

TABLE 3-6

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional Test	Mode in which Surveillance is Required
RU-200	P	N. A.	R	Q	See Table 3-7

TABLE 3-7

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

SURVEILLANCE REQUIREMENTS

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Secondary System Liquid Release Pathway	Mode in which Surveillance is Required	Action if RU-200 is nonfunctional
Pre-service rinse to Retention Tanks	At All Times	Obtain grab sample at least once per 12 hours and analyze in accordance with section 3.2
Condensate overboard to Retention Tanks	1-4	Obtain grab sample at least once per 12 hours and analyses in accordance with section 3.2
Steam Generator Blowdown/Drain to Retention Tanks	At All Times	Modes 1-4: Suspend the release Modes 5,6 & defueled: Obtain grab sample at least once per 12 hours and analyze in accordance with section 3.2

4.0 GASEOUS & LIQUID EFFLUENTS - DOSE

4.1 Requirements: Noble Gases

The air dose due to noble gases released in gaseous effluents, from each reactor unit to areas at and beyond the SITE BOUNDARY (see Figure 6-4 and Figure 6-5) shall be limited to the following:

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

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

Applicability: At all times.

Action:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

4.1.1 Surveillance Requirements

a. Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology contained in Section 4.1.2 at least once per 31 days.

4.1.2 Implementation of the Requirement: Noble Gas

The air dose in unrestricted areas beyond the site boundary due to noble gases released in gaseous effluents from each unit during any specified time period shall be determined by the following equations:

For gamma radiation:

$$D\gamma_u = (3.17E\text{-}08) \Sigma_i [(M_i)(X/Q)_{UNIT}(Q_i)] \quad (4\text{-}1)$$

For beta radiation:

$$D\beta_u = (3.17E\text{-}08) \Sigma_i [(N_i)(X/Q)_{UNIT}(Q_i)] \quad (4\text{-}2)$$

Where:

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

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

$(X/Q)_{UNIT}$ = the highest calculated annual average dispersion parameter, in sec/m^3, at the site boundary for the particular Unit, from Table 3-2. Optionally, the highest value may be used for any Unit calculation.

=7.47E-06 from Unit l
=7.90E-06 from Unit 2
=8.91E-06 from Unit 3

$D\gamma_u$ = the total gamma air dose, for the particular unit, in mrad, due to noble gases released in gaseous effluents for a specified time period at the SITE BOUNDARY.

$D\beta_u$ = the total beta air dose, for the particular unit, in mrad, due to noble gases released in gaseous effluents for a specified time period at the SITE BOUNDARY.

Q_i = the integrated release, from the particular unit, in µCi, of each identified noble gas radionuclide i, in gaseous effluents for a specified time period.

3.17E-08 = the inverse of seconds in a year (yr/sec).

The cumulative gamma air dose and beta air dose for a quarterly or annual evaluation shall be based on the calculated dose contribution from each specified time period occurring during the reporting time period.

4.2 Requirement: Iodine-131, Iodine-133, Tritium, and All Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days

The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 6-4 and Figure 6-5) shall be limited to the following:

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

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

Applicability: At all times.

Action:

With the calculated dose from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

4.2.1 Surveillance Requirements

a. Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters contained in Section 4.2.2 at least once per 31 days.

4.2.2 Implementation of the Requirement

The organ dose to an individual from I-131, I-133, tritium, and all radionuclides in particulate form, with half-lives greater than eight days, in gaseous effluents released to unrestricted areas from each reactor unit is calculated using the following expressions:

$$D_{ou} = (3.17E\text{-}08) \Sigma_i [\Sigma_k (R_{ik} W_k) (Qi)] \quad (4\text{-}3)$$

Where:

D_{ou} = the total accumulated organ dose from gaseous effluents for a particular unit, to a MEMBER OF THE PUBLIC, in mrem, at the SITE BOUNDARY or at the controlling location.

Q_i = the quantity of radionuclide i, in µCi, released in gaseous effluents from a particular unit.

R_{ik} = the 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, except H-3, which has units of mrem/yr per µCi/m^3) at the controlling location. The R_{ik}'s for each age group are given in Tables 4-1 through 4-15.

3.17E-08 = the inverse of seconds per year (yr/sec).

W_k = the highest annual average dispersion or deposition parameter for the particular Unit, used for estimating the dose at the site boundary or to a MEMBER OF THE PUBLIC at the controlling location for the particular Unit. Optionally, the highest value may be used for any Unit calculation.

= $(X/Q)_{UNIT}$, in sec/m^3 for the inhalation pathway and for all tritium calculations, for organ dose at the site boundary, from Table 3-2.

=7.47E-06 from Unit 1
=7.90E-06 from Unit 2
=8.91E-06 from Unit 3

= $(X/Q)_{UNIT}$, in sec/m^3 for the inhalation pathway and for all tritium calculations, for organ dose at the controlling location, from Table 4-16, 4-17 or 4-18.

=2.92E-06 from Unit 1
=2.19E-06 from Unit 2
=2.31E-06 from Unit 3

= $(D/Q)_{UNIT}$, in m^{-2}, for the food and ground plane pathways, for organ dose at the site boundary, from Table 3-2.

=1.19E-08 from Unit 1
=1.34E-08 from Unit 2
=1.67E-08 from Unit 3

= $(D/Q)_{UNIT}$, in m^{-2}, for the food and ground plane pathways, for organ dose at the controlling location, from Table 4-16, 4-17, or 4-18.

=3.25E-09 from Unit 1
=3.88E-10 from Unit 2
=4.21E-10 from Unit 3

Residences, vegetable gardens and milk animals located within 5 miles of the site will be identified during the annual land use census. The controlling pathway and location will be identified and will be used for all MEMBER OF THE PUBLIC dose evaluations.

The R_i values were calculated in accordance with the methodologies in NUREG-0133. The following site specific information was used to calculate R_i:

	Value
The length of the grazing season for milk animals (f_s). Ref. ER-OL, Section 2.1.3.4.3	0.75
The length of the grazing season for meat animals (f_s). Ref. ER-OL, Section 2.1.3.4.4	0.25
The fraction of daily feed derived from pasture while on pasture for milk animals (f_p). Ref. ER-OL, Section 2.1.3.4.3	0.35
The fraction of daily feed derived from pasture while on pasture for meat animals (f_p). Ref. ER-OL, Section 2.1.3.4.3	0.05
The fraction of year vegetables are grown, (f_l) approximation. Ref. ER-OL, Section 2.1.3.4, Table 2.1-8.	0.667
The annual absolute humidity (g/m^3), H, Ref. UFSAR, Table 2.3-16	6

4.3 Requirements: Gaseous Radwaste Treatment

The GASEOUS RADWASTE SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent air doses due to gaseous effluent releases, from each reactor unit, from the site (see Figure 6-4 and Figure 6-5) when averaged over 31 days, would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 6-4 and Figure 6-5) when averaged over 31 days would exceed 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

Applicability: At all times:

Action:

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, a Special Report which includes the following information:

a. Identification of the nonfunctional equipment or subsystems and the reason for nonfunctionality,

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b. Action(s) taken to restore the nonfunctional equipment to FUNCTIONAL status, and

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

4.3.1 Surveillance Requirements

a. Doses due to gaseous releases from the site shall be projected at least once per 31 days, in accordance with the methodology and parameters in Section 4.3.2.

4.3.2 Implementation of the Requirement

Where possible, consideration for expected operational evolutions (i.e., outages, etc.) should be taken in the dose projections.

Dose Projection - Noble Gases

The air dose, in mrads is determined using the methodology described in Section 4.1.2 of this manual. This information is used to determine an air dose projection for the next 31 days using the following equations:

For gamma radiation:

$$31 \text{ day } \gamma = D\gamma \pm CD\gamma \qquad (4\text{-}4)$$

For beta radiation:

$$31 \text{ day } \beta = D\beta \pm CD\beta \qquad (4\text{-}5)$$

Where:

$D\gamma$ = the total gamma air dose in mrads at the site boundary due to noble gases released in gaseous effluents for the previous 31 days.

$D\beta$ = the total beta air dose in mrads at the site boundary due to noble gases released in gaseous effluents for the previous 31 days.

$CD\gamma$ = any current or projected change in gamma air dose, in mrads, due to noble gases released in gaseous effluents, which could have a significant impact on 31 day γ.

$CD\beta$ = any current or projected change in beta air dose, in mrads, due to noble gases released in gaseous effluents, which could have a significant impact on 31 day β.

When performing the 31 day dose projection using the Gaseous Radioactive Effluent Tracking System (GRETS), $D\gamma$ and $D\beta$ will include the dose from any release permits that fall within the selected 31 day time period. As a result, the actual dose projection will often be based on the accumulated dose for a time period greater than 31 days.

Dose Projection - I-131, I-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days

The organ dose, in mrem, is determined using the methodology described in Section 4.2.2 of this manual. This information is used to determine an organ dose projection for the next 31 days using the following equation:

$$31day_o = D_o \pm CD_o \qquad (4\text{-}6)$$

Where:

D_o = the total organ dose due to I-131, I-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days in mrem, released in gaseous effluents for the previous 31 days.

CD_o = any current or projected change in organ dose, in mrem, which could have a significant impact on 31 day_o.

When performing the 31 day dose projection using the Gaseous Radioactive Effluent Tracking System (GRETS), D_o will include the dose from any release permits that fall within the selected 31 day time period. As a result, the actual dose projection will often be based on the accumulated dose for a time period greater than 31 days.

TABLE 4-1

Ri DOSE CONVERSION FACTORS FOR THE GROUND PLANE PATHWAY

NUCLIDE	T. BODY	SKIN
H-3	0.00E+00	0.00E+00
CR-51	4.66E+06	5.51E+06
MN-54	1.39E+09	1.63E+09
FE-59	2.73E+08	3.21E+08
CO-58	3.79E+08	4.44E+08
CO-60	2.15E+10	2.53E+10
ZN-65	7.47E+08	8.59E+08
SR-89	2.16E+04	2.51E+04
SR-90	0.00E+00	0.00E+00
ZR-95	2.45E+08	2.84E+08
SB-124	5.98E+08	6.90E+08
I-131	1.72E+07	2.09E+07
I-133	2.45E+06	2.98E+06
CS-134	6.86E+09	8.00E+09
CS-137	1.03E+10	1.20E+10
BA-140	2.05E+07	2.35E+07
CE-141	1.37E+07	1.54E+07
CE-144	6.95E+07	8.04E+07

TABLE 4-2

Ri DOSE CONVERSION FACTORS FOR THE VEGETATION

PATHWAY - ADULT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.87E+03	2.87E+03	2.87E+03	2.87E+03	2.87E+03	2.87E+03
CR-51	0.00E+00	0.00E+00	4.00E+04	2.39E+04	8.82E+03	5.31E+04	1.01E+07
MN-54	0.00E+00	2.97E+08	5.66E+07	0.00E+00	8.83E+07	0.00E+00	9.09E+08
FE-59	1.14E+08	2.68E+08	1.03E+08	0.00E+00	0.00E+00	7.49E+07	8.93E+08
CO-58	0.00E+00	2.84E+07	6.38E+07	0.00E+00	0.00E+00	0.00E+00	5.76E+08
CO-60	0.00E+00	1.59E+08	3.51E+08	0.00E+00	0.00E+00	0.00E+00	2.99E+09
ZN-65	3.00E+08	9.56E+08	4.32E+08	0.00E+00	6.39E+08	0.00E+00	6.02E+08
SR-89	9.08E+09	0.00E+00	2.61E+08	0.00E+00	0.00E+00	0.00E+00	1.46E+09
SR-90	5.76E+11	0.00E+00	1.41E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
ZR-95	1.08E+06	3.47E+05	2.35E+05	0.00E+00	5.45E+05	0.00E+00	1.10E+09
SB-124	9.53E+07	1.80E+06	3.78E+07	2.31E+05	0.00E+00	7.42E+07	2.71E+09
I-131	5.49E+07	7.85E+07	4.50E+07	2.57E+10	1.35E+08	0.00E+00	2.07E+07
I-133	1.39E+06	2.42E+06	7.38E+05	3.56E+08	4.22E+06	0.00E+00	2.17E+06
CS-134	4.44E+09	1.06E+10	8.64E+09	0.00E+00	3.42E+09	1.13E+09	1.85E+08
CS-137	6.06E+09	8.29E+09	5.43E+09	0.00E+00	2.81E+09	9.36E+08	1.60E+08
BA-140	9.43E+07	1.19E+05	6.18E+06	0.00E+00	4.03E+04	6.78E+04	1.94E+08
CE-141	1.73E+05	1.17E+05	1.33E+04	0.00E+00	5.44E+04	0.00E+00	4.48E+08
CE-144	3.12E+07	1.30E+07	1.67E+06	0.00E+00	7.73E+06	0.00E+00	1.05E+10

TABLE 4-3

Ri DOSE CONVERSION FACTORS FOR THE VEGETATION

PATHWAY - TEEN RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.36E+03	3.36E+03	3.36E+03	3.36E+03	3.36E+03	3.36E+03
CR-51	0.00E+00	0.00E+00	5.60E+04	3.11E+04	1.23E+04	7.99E+04	9.41E+06
MN-54	0.00E+00	4.41E+08	8.74E+07	0.00E+00	1.31E+08	0.00E+00	9.04E+08
FE-59	1.69E+08	3.94E+08	1.52E+08	0.00E+00	0.00E+00	1.24E+08	9.31E+08
CO-58	0.00E+00	4.16E+07	9.59E+07	0.00E+00	0.00E+00	0.00E+00	5.74E+08
CO-60	0.00E+00	2.42E+08	5.45E+08	0.00E+00	0.00E+00	0.00E+00	3.15E+09
ZN-65	4.11E+08	1.43E+09	6.65E+08	0.00E+00	9.12E+08	0.00E+00	6.04E+08
SR-89	1.43E+10	0.00E+00	4.10E+08	0.00E+00	0.00E+00	0.00E+00	1.70E+09
SR-90	7.30E+11	0.00E+00	1.80E+11	0.00E+00	0.00E+00	0.00E+00	2.05E+10
ZR-95	1.64E+06	5.17E+05	3.56E+05	0.00E+00	7.60E+05	0.00E+00	1.19E+09
SB-124	1.47E+08	2.70E+06	5.73E+07	3.33E+05	0.00E+00	1.28E+08	2.96E+09
I-131	5.29E+07	7.41E+07	3.98E+07	2.16E+10	1.28E+08	0.00E+00	1.47E+07
I-133	1.29E+06	2.19E+06	6.68E+05	3.06E+08	3.84E+06	0.00E+00	1.66E+06
CS-134	6.90E+09	1.62E+10	7.53E+09	0.00E+00	5.16E+09	1.97E+09	2.02E+08
CS-137	9.86E+09	1.31E+10	4.57E+09	0.00E+00	4.46E+09	1.73E+09	1.87E+08
BA-140	1.07E+08	1.31E+05	6.88E+06	0.00E+00	4.44E+04	8.80E+04	1.65E+08
CE-141	2.61E+05	1.74E+05	2.00E+04	0.00E+00	8.19E+04	0.00E+00	4.98E+08
CE-144	5.11E+07	2.12E+07	2.75E+06	0.00E+00	1.26E+07	0.00E+00	1.29E+10

TABLE 4-4

Ri DOSE CONVERSION FACTORS FOR THE VEGETATION

PATHWAY - CHILD RECEPTOR

NUCLIDES	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	5.23E+03	5.23E+03	5.23E+03	5.23E+03	5.23E+03	5.23E+03
CR-51	0.00E+00	0.00E+00	1.08E+05	6.02E+04	1.64E+04	1.10E+05	5.75E+06
MN-54	0.00E+00	6.49E+08	1.73E+08	0.00E+00	1.82E+08	0.00E+00	5.45E+08
FE-59	3.79E+08	6.13E+08	3.05E+08	0.00E+00	0.00E+00	1.78E+08	6.38E+08
CO-58	0.00E+00	6.21E+07	1.90E+08	0.00E+00	0.00E+00	0.00E+00	3.62E+08
CO-60	0.00E+00	3.70E+08	1.09E+09	0.00E+00	0.00E+00	0.00E+00	2.05E+09
ZN-65	7.93E+08	2.11E+09	1.31E+09	0.00E+00	1.33E+09	0.00E+00	3.71E+08
SR-89	3.44E+10	0.00E+00	9.83E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+09
SR-90	1.22E+12	0.00E+00	3.09E+11	0.00E+00	0.00E+00	0.00E+00	1.64E+10
ZR-95	3.72E+06	8.17E+05	7.27E+05	0.00E+00	1.17E+06	0.00E+00	8.52E+08
SB-124	3.38E+08	4.39E+06	1.19E+08	7.47E+05	0.00E+00	1.88E+08	2.12E+09
I-131	9.95E+07	1.00E+08	5.68E+07	3.31E+10	1.64E+08	0.00E+00	8.90E+06
I-133	2.36E+06	2.91E+06	1.10E+06	5.41E+08	4.85E+06	0.00E+00	1.17E+06
CS-134	1.57E+10	2.57E+10	5.43E+09	0.00E+00	7.98E+09	2.86E+09	1.39E+08
CS-137	2.34E+10	2.24E+10	3.31E+09	0.00E+00	7.31E+09	2.63E+09	1.40E+08
BA-140	2.20E+08	1.93E+05	1.28E+07	0.00E+00	6.27E+04	1.15E+05	1.11E+08
CE-141	6.15E+05	3.07E+05	4.55E+04	0.00E+00	1.34E+05	0.00E+00	3.83E+08
CE-144	1.24E+08	3.89E+07	6.62E+06	0.00E+00	2.15E+07	0.00E+00	1.01E+10

TABLE 4-5

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MEAT PATHWAY - ADULT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	4.33E+02	4.33E+02	4.33E+02	4.33E+02	4.33E+02	4.33E+02
CR-51	0.00E+00	0.00E+00	3.44E+02	2.06E+02	7.58E+01	4.57E+02	8.65E+04
MN-54	0.00E+00	2.71E+06	5.18E+05	0.00E+00	8.08E+05	0.00E+00	8.31E+06
FE-59	2.60E+07	6.11E+07	2.34E+07	0.00E+00	0.00E+00	1.71E+07	2.04E+08
CO-58	0.00E+00	2.84E+06	6.36E+06	0.00E+00	0.00E+00	0.00E+00	5.75E+07
CO-60	0.00E+00	2.61E+07	5.76E+07	0.00E+00	0.00E+00	0.00E+00	4.90E+08
ZN-65	9.97E+07	3.17E+08	1.43E+08	0.00E+00	2.12E+08	0.00E+00	2.00E+08
SR-89	3.41E+07	0.00E+00	9.79E+05	0.00E+00	0.00E+00	0.00E+00	5.47E+06
SR-90	4.43E+09	0.00E+00	1.09E+09	0.00E+00	0.00E+00	0.00E+00	1.28E+08
ZR-95	2.68E+05	8.58E+04	5.81E+04	0.00E+00	1.35E+05	0.00E+00	2.72E+08
SB-124	2.67E+06	5.05E+04	1.06E+06	6.48E+03	0.00E+00	2.08E+06	7.59E+07
I-131	1.36E+05	1.94E+05	1.11E+05	6.37E+07	3.33E+05	0.00E+00	5.13E+04
I-133	4.56E-03	7.94E-03	2.42E-03	1.17E+00	1.39E-02	0.00E+00	7.14E-03
CS-134	2.17E+08	5.17E+08	4.23E+08	0.00E+00	1.67E+08	5.56E+07	9.05E+06
CS-137	3.11E+08	4.25E+08	2.78E+08	0.00E+00	1.44E+08	4.79E+07	8.22E+06
BA-140	4.35E+05	5.46E+02	2.85E+04	0.00E+00	1.86E+02	3.13E+02	8.95E+05
CE-141	8.87E+02	6.00E+02	6.80E+01	0.00E+00	2.79E+02	0.00E+00	2.29E+06
CE-144	4.23E+05	1.77E+05	2.27E+04	0.00E+00	1.05E+05	0.00E+00	1.43E+08

TABLE 4-6

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MEAT PATHWAY - TEEN RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.58E+02	2.58E+02	2.58E+02	2.58E+02	2.58E+02	2.58E+02
CR-51	0.00E+00	0.00E+00	2.75E+02	1.53E+02	6.03E+01	3.93E+02	4.62E+04
MN-54	0.00E+00	2.07E+06	4.11E+05	0.00E+00	6.18E+05	0.00E+00	4.25E+06
FE-59	2.08E+07	4.85E+07	1.87E+07	0.00E+00	0.00E+00	1.53E+07	1.15E+08
CO-58	0.00E+00	2.19E+06	5.04E+06	0.00E+00	0.00E+00	0.00E+00	3.02E+07
CO-60	0.00E+00	2.03E+07	4.56E+07	0.00E+00	0.00E+00	0.00E+00	2.64E+08
ZN-65	7.01E+07	2.43E+08	1.14E+08	0.00E+00	1.56E+08	0.00E+00	1.03E+08
SR-89	2.88E+07	0.00E+00	8.24E+05	0.00E+00	0.00E+00	0.00E+00	3.43E+06
SR-90	2.87E+09	0.00E+00	7.08E+08	0.00E+00	0.00E+00	0.00E+00	8.05E+07
ZR-95	2.14E+05	6.76E+04	4.65E+04	0.00E+00	9.93E+04	0.00E+00	1.56E+08
SB-124	2.18E+06	4.02E+04	8.52E+05	4.95E+03	0.00E+00	1.91E+06	4.40E+07
I-131	1.13E+05	1.58E+05	8.49E+04	4.61E+07	2.72E+05	0.00E+00	3.13E+04
I-133	3.82E-03	6.48E-03	1.98E-03	9.04E-01	1.14E-02	0.00E+00	4.90E-03
CS-134	1.73E+08	4.07E+08	1.89E+08	0.00E+00	1.29E+08	4.94E+07	5.06E+06
CS-137	2.58E+08	3.43E+08	1.20E+08	0.00E+00	1.17E+08	4.54E+07	4.88E+06
BA-140	3.59E+05	4.40E+02	2.31E+04	0.00E+00	1.49E+02	2.96E+02	5.54E+05
CE-141	7.45E+02	4.97E+02	5.71E+01	0.00E+00	2.34E+02	0.00E+00	1.42E+06
CE-144	3.56E+05	1.47E+05	1.91E+04	0.00E+00	8.80E+04	0.00E+00	8.96E+07

TABLE 4-7

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MEAT

PATHWAY - CHILD RECEPTOR

NUCLIDES	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.12E+02	3.12E+02	3.12E+02	3.12E+02	3.12E+02	3.12E+02
CR-51	0.00E+00	0.00E+00	4.29E+02	2.38E+02	6.51E+01	4.35E+02	2.28E+04
MN-54	0.00E+00	2.37E+06	6.31E+05	0.00E+00	6.64E+05	0.00E+00	1.99E+06
FE-59	3.68E+07	5.96E+07	2.97E+07	0.00E+00	0.00E+00	1.73E+07	6.20E+07
CO-58	0.00E+00	2.55E+06	7.82E+06	0.00E+00	0.00E+00	0.00E+00	1.49E+07
CO-60	0.00E+00	2.40E+07	7.09E+07	0.00E+00	0.00E+00	0.00E+00	1.33E+08
ZN-65	1.05E+08	2.80E+08	1.74E+08	0.00E+00	1.77E+08	0.00E+00	4.92E+07
SR-89	5.45E+07	0.00E+00	1.56E+06	0.00E+00	0.00E+00	0.00E+00	2.11E+06
SR-90	3.70E+09	0.00E+00	9.39E+08	0.00E+00	0.00E+00	0.00E+00	4.99E+07
ZR-95	3.81E+05	8.36E+04	7.45E+04	0.00E+00	1.20E+05	0.00E+00	8.73E+07
SB-124	3.95E+06	5.12E+04	1.38E+06	8.72E+03	0.00E+00	2.19E+06	2.47E+07
I-131	2.09E+05	2.11E+05	1.20E+05	6.96E+07	3.46E+05	0.00E+00	1.87E+04
I-133	7.09E-03	8.77E-03	3.32E-03	1.63E+00	1.46E-02	0.00E+00	3.53E-03
CS-134	3.05E+08	5.00E+08	1.06E+08	0.00E+00	1.55E+08	5.56E+07	2.70E+06
CS-137	4.75E+08	4.55E+08	6.71E+07	0.00E+00	1.48E+08	5.33E+07	2.85E+06
BA-140	6.63E+05	5.81E+02	3.87E+04	0.00E+00	1.89E+02	3.46E+02	3.36E+05
CE-141	1.40E+03	6.99E+02	1.04E+02	0.00E+00	3.07E+02	0.00E+00	8.72E+05
CE-144	6.72E+05	2.11E+05	3.58E+04	0.00E+00	1.17E+05	0.00E+00	5.49E+07

TABLE 4-8

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MILK

PATHWAY - ADULT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.02E+03
CR-51	0.00E+00	0.00E+00	8.28E+03	4.95E+03	1.82E+03	1.10E+04	2.08E+06
MN-54	0.00E+00	3.99E+06	7.61E+05	0.00E+00	1.19E+06	0.00E+00	1.22E+07
FE-59	9.69E+06	2.28E+07	8.73E+06	0.00E+00	0.00E+00	6.36E+06	7.59E+07
CO-58	0.00E+00	1.74E+06	3.90E+06	0.00E+00	0.00E+00	0.00E+00	3.53E+07
CO-60	0.00E+00	8.41E+06	1.85E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
ZN-65	6.34E+08	2.02E+09	9.12E+08	0.00E+00	1.35E+09	0.00E+00	1.27E+09
SR-89	4.90E+08	0.00E+00	1.41E+07	0.00E+00	0.00E+00	0.00E+00	7.86E+07
SR-90	2.43E+10	0.00E+00	5.96E+09	0.00E+00	0.00E+00	0.00E+00	7.02E+08
ZR-95	3.39E+02	1.09E+02	7.37E+01	0.00E+00	1.71E+02	0.00E+00	3.45E+05
SB-124	9.11E+06	1.72E+05	3.61E+06	2.21E+04	0.00E+00	7.09E+06	2.59E+08
I-131	7.77E+07	1.11E+08	6.37E+07	3.64E+10	1.91E+08	0.00E+00	2.93E+07
I-133	1.02E+06	1.77E+06	5.39E+05	2.60E+08	3.08E+06	0.00E+00	1.59E+06
CS-134	2.83E+09	6.73E+09	5.50E+09	0.00E+00	2.18E+09	7.23E+08	1.18E+08
CS-137	3.83E+09	5.24E+09	3.43E+09	0.00E+00	1.78E+09	5.91E+08	1.01E+08
BA-140	7.11E+06	8.93E+03	4.66E+05	0.00E+00	3.04E+03	5.11E+03	1.46E+07
CE-141	8.73E+03	5.90E+03	6.70E+02	0.00E+00	2.74E+03	0.00E+00	2.26E+07
CE-144	1.01E+06	4.21E+05	5.41E+04	0.00E+00	2.50E+05	0.00E+00	3.41E+08

TABLE 4-9

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MILK

PATHWAY - TEEN RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.33E+03	1.33E+03	1.33E+03	1.33E+03	1.33E+03	1.33E+03
CR-51	0.00E+00	0.00E+00	1.45E+04	8.03E+03	3.17E+03	2.06E+04	2.43E+06
MN-54	0.00E+00	6.64E+06	1.32E+06	0.00E+00	1.98E+06	0.00E+00	1.36E+07
FE-59	1.69E+07	3.95E+07	1.52E+07	0.00E+00	0.00E+00	1.24E+07	9.33E+07
CO-58	0.00E+00	2.93E+06	6.76E+06	0.00E+00	0.00E+00	0.00E+00	4.04E+07
CO-60	0.00E+00	1.42E+07	3.21E+07	0.00E+00	0.00E+00	0.00E+00	1.86E+08
ZN-65	9.74E+08	3.38E+09	1.58E+09	0.00E+00	2.17E+09	0.00E+00	1.43E+09
SR-89	9.03E+08	0.00E+00	2.59E+07	0.00E+00	0.00E+00	0.00E+00	1.08E+08
SR-90	3.43E+10	0.00E+00	8.48E+09	0.00E+00	0.00E+00	0.00E+00	9.64E+08
ZR-95	5.94E+02	1.87E+02	1.29E+02	0.00E+00	2.75E+02	0.00E+00	4.32E+05
SB-124	1.62E+07	2.99E+05	6.34E+06	3.69E+04	0.00E+00	1.42E+07	3.27E+08
I-131	1.41E+08	1.98E+08	1.06E+08	5.76E+10	3.40E+08	0.00E+00	3.91E+07
I-133	1.86E+06	3.15E+06	9.60E+05	4.39E+08	5.52E+06	0.00E+00	2.38E+06
CS-134	4.91E+09	1.16E+10	5.36E+09	0.00E+00	3.67E+09	1.40E+09	1.44E+08
CS-137	6.95E+09	9.24E+09	3.22E+09	0.00E+00	3.15E+09	1.22E+09	1.32E+08
BA-140	1.28E+07	1.57E+04	8.27E+05	0.00E+00	5.33E+03	1.06E+04	1.98E+07
CE-141	1.60E+04	1.07E+04	1.23E+03	0.00E+00	5.03E+03	0.00E+00	3.06E+07
CE-144	1.86E+06	7.68E+05	9.97E+04	0.00E+00	4.59E+05	0.00E+00	4.67E+08

TABLE 4-10

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MILK

PATHWAY - CHILD RECEPTOR

NUCLIDES	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.09E+03	2.09E+03	2.09E+03	2.09E+03	2.09E+03	2.09E+03
CR-51	0.00E+00	0.00E+00	2.95E+04	1.64E+04	4.47E+03	2.99E+04	1.56E+06
MN-54	0.00E+00	9.94E+06	2.65E+06	0.00E+00	2.79E+06	0.00E+00	8.34E+06
FE-59	3.92E+07	6.35E+07	3.16E+07	0.00E+00	0.00E+00	1.84E+07	6.61E+07
CO-58	0.00E+00	4.48E+06	1.37E+07	0.00E+00	0.00E+00	0.00E+00	2.61E+07
CO-60	0.00E+00	2.21E+07	6.52E+07	0.00E+00	0.00E+00	0.00E+00	1.23E+08
ZN-65	1.91E+09	5.09E+09	3.17E+09	0.00E+00	3.21E+09	0.00E+00	8.95E+08
SR-89	2.23E+09	0.00E+00	6.38E+07	0.00E+00	0.00E+00	0.00E+00	8.65E+07
SR-90	5.80E+10	0.00E+00	1.47E+10	0.00E+00	0.00E+00	0.00E+00	7.81E+08
ZR-95	1.38E+03	3.03E+02	2.70E+02	0.00E+00	4.34E+02	0.00E+00	3.16E+05
SB-124	3.84E+07	4.99E+05	1.35E+07	8.49E+04	0.00E+00	2.13E+07	2.41E+08
I-131	3.42E+08	3.44E+08	1.96E+08	1.14E+11	5.65E+08	0.00E+00	3.06E+07
I-133	4.51E+06	5.57E+06	2.11E+06	1.04E+09	9.29E+06	0.00E+00	2.25E+06
CS-134	1.13E+10	1.86E+10	3.92E+09	0.00E+00	5.76E+09	2.07E+09	1.00E+08
CS-137	1.67E+10	1.60E+10	2.36E+09	0.00E+00	5.22E+09	1.88E+09	1.00E+08
BA-140	3.10E+07	2.71E+04	1.81E+06	0.00E+00	8.83E+03	1.62E+04	1.57E+07
CE-141	3.94E+04	1.97E+04	2.92E+03	0.00E+00	8.62E+03	0.00E+00	2.45E+07
CE-144	4.57E+06	1.43E+06	2.44E+05	0.00E+00	7.94E+05	0.00E+00	3.74E+08

TABLE 4-11

Ri DOSE CONVERSION FACTORS FOR THE GRASS-COW-MILK PATHWAY - INFANT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.18E+03	3.18E+03	3.18E+03	3.18E+03	3.18E+03	3.18E+03
CR-51	0.00E+00	0.00E+00	4.67E+04	3.05E+04	6.66E+03	5.93E+04	1.36E+06
MN-54	0.00E+00	1.85E+07	4.19E+06	0.00E+00	4.10E+06	0.00E+00	6.79E+06
FE-59	7.32E+07	1.28E+08	5.04E+07	0.00E+00	0.00E+00	3.78E+07	6.11E+07
CO-58	0.00E+00	8.96E+06	2.23E+07	0.00E+00	0.00E+00	0.00E+00	2.23E+07
CO-60	0.00E+00	4.52E+07	1.07E+08	0.00E+00	0.00E+00	0.00E+00	1.07E+08
ZN-65	2.57E+09	8.81E+09	4.06E+09	0.00E+00	4.27E+09	0.00E+00	7.44E+09
SR-89	4.25E+09	0.00E+00	1.22E+08	0.00E+00	0.00E+00	0.00E+00	8.74E+07
SR-90	6.31E+10	0.00E+00	1.61E+10	0.00E+00	0.00E+00	0.00E+00	7.88E+08
ZR-95	2.45E+03	5.97E+02	4.23E+02	0.00E+00	6.43E+02	0.00E+00	2.97E+05
SB-124	7.41E+07	1.09E+06	2.30E+07	1.97E+05	0.00E+00	4.64E+07	2.29E+08
I-131	7.14E+08	8.42E+08	3.70E+08	2.77E+11	9.83E+08	0.00E+00	3.00E+07
I-133	9.52E+06	1.39E+07	4.06E+06	2.52E+09	1.63E+07	0.00E+00	2.35E+06
CS-134	1.82E+10	3.40E+10	3.44E+09	0.00E+00	8.76E+09	3.59E+09	9.24E+07
CS-137	2.67E+10	3.13E+10	2.22E+09	0.00E+00	8.39E+09	3.40E+09	9.78E+07
BA-140	6.37E+07	6.37E+04	3.28E+06	0.00E+00	1.51E+04	3.91E+04	1.57E+07
CE-141	7.81E+04	4.77E+04	5.61E+03	0.00E+00	1.47E+04	0.00E+00	2.46E+07
CE-144	6.55E+06	2.68E+06	3.67E+05	0.00E+00	1.08E+06	0.00E+00	3.76E+08

TABLE 4-12

Ri DOSE CONVERSION FACTORS FOR THE INHALATION

PATHWAY - ADULT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
SB-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05

TABLE 4-13

Ri DOSE CONVERSION FACTORS FOR THE INHALATION

PATHWAY - TEEN RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
SB-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.85E+06	3.98E+05
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05

TABLE 4-14

Ri DOSE CONVERSION FACTORS FOR THE INHALATION

PATHWAY - CHILD RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
SB-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05

TABLE 4-15

Ri DOSE CONVERSION FACTORS FOR THE INHALATION

PATHWAY - INFANT RECEPTOR

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
SB-124	3.79E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	5.91E+04
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05

TABLE 4-16

PALO VERDE NUCLEAR GENERATING STATION DISPERSION

AND DEPOSITION PARAMETERS FOR LONG TERM RELEASES

AT THE NEAREST PATHWAY LOCATIONS CENTERED ON UNIT 1

DIRECTION	X/Q (Sec/m^3)	RESIDENCE(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	GARDEN(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	MILK(b) Dist. Miles	D/Q (m^{-2})
N	2.92E-06	1.4	3.25E-09	2.92E-06	1.4	3.25E-09	7.03E-07	(a)	3.48E-10
NNE	1.81E-06	1.8	2.88E-09	4.70E-07	(a)	4.04E-10	4.70E-07	(a)	4.04E-10
NE	1.95E-06	1.9	3.85E-09	1.76E-06	2.1	3.29E-09	5.77E-07	(a)	6.51E-10
ENE	1.03E-06	2.7	1.08E-09	1.03E-06	2.7	1.08E-09	3.86E-07	(a)	2.86E-10
E	9.39E-07	2.8	6.68E-10	3.71E-07	(a)	1.87E-10	3.71E-07	(a)	1.87E-10
ESE	6.37E-07	3.7	2.84E-10	4.12E-07	4.6	1.60E-10	4.12E-07	4.6	1.60E-10 goat
SE	8.83E-07	4.1	2.61E-10	8.83E-07	4.1	2.61E-10	5.84E-07	(a)	1.52E-10
SSE	1.27E-06	4.7	2.61E-10	1.09E-06	(a)	2.15E-10	1.09E-06	(a)	2.15E-10
S	2.58E-06	4.6	4.85E-10	2.09E-06	5.2	3.59E-10	2.13E-06	5.1	3.71E-10 cow
SSW	3.26E-06	3.5	8.26E-10	2.28E-06	(a)	4.53E-10	2.28E-06	(a)	4.53E-10
SW	2.80E-06	2.9	9.10E-10	1.58E-06	(a)	3.56E-10	1.58E-06	(a)	3.56E-10
WSW	1.95E-06	2.6	1.09E-09	8.55E-07	(a)	3.18E-10	8.55E-07	(a)	3.18E-10
W	7.54E-07	(a)	4.44E-10	7.54E-07	(a)	4.44E-10	7.54E-07	(a)	4.44E-10
WNW	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10
NW	8.24E-07	3.8	5.25E-10	7.55E-07	4.1	4.61E-10	6.02E-07	(a)	3.27E-10
NNW	1.46E-06	2.0	1.47E-09	5.20E-07	(a)	3.04E-10	5.20E-07	(a)	3.04E-10

(a) 5-mile value used since there is no pathway located within the sector up to five miles.

(b) Controlling locations are discussed in Appendix A.

References: 1984 Land Use Census (letter ANPM-21221-JRM/LEB). NUS Corporation letters NUS-ANPP-1385 and NUS-ANPP-1386.

TABLE 4-17

PALO VERDE NUCLEAR GENERATING STATION DISPERSION AND DEPOSITION PARAMETERS FOR LONG TERM RELEASES AT THE NEAREST PATHWAY LOCATIONS CENTERED ON UNIT 2

DIRECTION	X/Q (Sec/m^3)	RESIDENCE(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	GARDEN(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	MILK(b) Dist. Miles	D/Q (m^{-2})
N	2.73E-06	1.5	2.92E-09	2.39E-06	1.7	2.35E-09	7.03E-07	(a)	3.48E-10
NNE	2.20E-06	1.5	3.87E-09	2.20E-06	1.5	3.87E-09	4.70E-07	(a)	4.04E-10
NE	1.85E-06	2.0	3.55E-09	1.57E-06	2.3	2.78E-09	5.77E-07	(a)	6.51E-10
ENE	1.03E-06	2.7	1.08E-09	1.03E-06	2.7	1.08E-09	3.86E-07	(a)	2.86E-10
E	8.80E-07	3.0	6.06E-10	3.71E-07	(a)	1.87E-10	3.71E-07	(a)	1.87E-10
ESE	6.25E-07	3.7	2.76E-10	3.96E-07	4.7	1.51E-10	3.96E-07	4.7	1.51E-10 goat
SE	9.06E-07	4.0	2.72E-10	9.06E-07	4.0	2.72E-10	5.84E-07	(a)	1.52E-10
SSE	1.34E-06	4.5	2.81E-10	1.09E-06	(a)	2.15E-10	1.09E-06	(a)	2.15E-10
S	2.63E-06	4.5	5.01E-10	2.19E-06	5.0	3.88E-10	2.19E-06	5.0	3.88E-10 cow
SSW	3.48E-06	3.2	9.19E-10	2.28E-06	(a)	4.53E-10	2.28E-06	(a)	4.53E-10
SW	2.93E-06	2.7	9.75E-10	1.58E-06	(a)	3.56E-10	1.58E-06	(a)	3.56E-10
WSW	2.01E-06	2.5	1.16E-09	8.55E-07	(a)	3.18E-10	8.55E-07	(a)	3.18E-10
W	7.54E-07	(a)	4.44E-10	7.54E-07	(a)	4.44E-10	7.54E-07	(a)	4.44E-10
WNW	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10
NW	7.84E-07	4.0	4.88E-10	7.84E-07	4.0	4.88E-10	6.02E-07	(a)	3.27E-10
NNW	1.46E-06	2.0	1.47E-09	5.20E-07	5.0	3.04E-10	5.20E-07	(a)	3.04E-10

(a) 5-mile value used since there is no pathway located within the sector up to five miles.

(b) Controlling locations are discussed in Appendix A.

References: 1984 Land Use Census (letter ANPM-21221-JRM/LEB). NUS Corporation letters NUS-ANPP-1385 and NUS-ANPP-1386.

TABLE 4-18

PALO VERDE NUCLEAR GENERATING STATION DISPERSION

AND DEPOSITION PARAMETERS FOR LONG TERM RELEASES

AT THE NEAREST PATHWAY LOCATIONS CENTERED ON UNIT 3

DIRECTION	X/Q (Sec/m^3)	RESIDENCE(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	GARDEN(b) Dist. Miles	D/Q (m^{-2})	X/Q (Sec/m^3)	MILK(b) Dist. Miles	D/Q (m^{-2})
N	2.58E-06	1.8	2.47E-09	2.42E-06	1.9	2.22E-09	7.03E-07	(a)	3.48E-10
NNE	1.85E-06	1.7	2.97E-09	1.85E-06	1.7	2.97E-09	4.70E-07	(a)	4.04E-10
NE	1.66E-06	2.2	3.00E-09	1.48E-06	2.4	2.54E-09	5.77E-07	(a)	6.51E-10
ENE	8.75E-07	2.9	8.86E-10	8.75E-07	2.9	8.86E-10	3.86E-07	(a)	2.86E-10
E	8.90E-07	3.0	6.17E-10	4.06E-07	4.6	2.15E-10	4.25E-07	4.5	2.31E-10 goat
ESE	6.37E-07	3.7	2.84E-10	5.80E-07	4.0	2.46E-10	3.73E-07	(a)	1.37E-10
SE	5.84E-07	(a)	1.52E-10	5.84E-07	(a)	1.52E-10	5.84E-07	(a)	1.52E-10
SSE	1.36E-06	4.4	2.88E-10	1.09E-06	(a)	2.15E-10	1.09E-06	(a)	2.15E-10
S	2.65E-06	4.2	5.25E-10	2.25E-06	4.9	4.06E-10	2.31E-06	4.8	4.21E-10 cow
SSW	3.64E-06	3.1	9.82E-10	2.28E-06	(a)	4.53E-10	2.28E-06	(a)	4.53E-10
SW	3.19E-06	2.5	1.11E-09	1.58E-06	(a)	3.56E-10	1.58E-06	(a)	3.56E-10
WSW	2.12E-06	2.4	1.26E-09	8.55E-07	(a)	3.18E-10	8.55E-07	(a)	3.18E-10
W	7.54E-07	(a)	4.44E-10	7.54E-07	(a)	4.44E-10	7.54E-10	(a)	4.44E-10
WNW	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10	6.03E-07	(a)	3.25E-10
NW	6.83E-07	4.3	4.05E-10	6.82E-07	4.3	4.05E-10	6.02E-07	(a)	3.27E-10
NNW	1.34E-06	2.2	1.26E-09	5.16E-07	5.0	3.01E-10	5.20E-07	(a)	3.04E-10

(a) 5-mile value used since there is no pathway located within the sector up to five miles.

(b) Controlling locations are discussed in Appendix A.

References: 1984 Land Use Census (letter ANPM-21221-JRM/LEB). NUS Corporation letters NUS-ANPP-1385 and NUS-ANPP-1386.

4.4 Requirements: Liquid Effluents

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor unit, to areas at and beyond the SITE BOUNDARY (See Figure 6-4 and Figure 6-5) shall be limited:

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

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

Applicability: At all times.

Action:

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

4.4.1 Surveillance Requirements

Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

4.4.2 Implementation of the Requirements

This Requirement does not require implementation guidance. There are no offsite liquid effluent releases.

5.0 TOTAL DOSE AND DOSE TO PUBLIC ONSITE

5.1 Requirement: Total Dose

The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to direct radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

Applicability: At all times.

Action:

With the calculated doses from the release of radioactive materials in liquid and gaseous effluents exceeding twice the limits of Section 4.4a, 4.4b, 4.1a, 4.1b, 4.2a or 4.2b calculations shall be made including direct radiation contributions from the reactor units (including outside storage tanks, etc.) to determine whether the above limits of Section 5.1 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.2203(a)(4), shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report within 30 days is considered a timely request, and a variance is granted until staff action on the request is complete.

5.1.1 Surveillance Requirements

a. Cumulative dose contributions from the gaseous effluents shall be determined in accordance with the surveillance requirements of Section 4.4.1, 4.1.1 and 4.2.1 and in accordance with the methodology and parameters contained in Section 5.1.2.

b. Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in Section 5.1.2. This requirement is applicable only under conditions set forth in Section 5.1, Action.

5.1.2 Implementation of the Requirement

Since all other uranium fuel cycle sources are greater than 20 miles away, only the PVNGS site need be considered.

The total dose to any MEMBER OF THE PUBLIC will be determined based on a sum of the doses from all three units' releases and doses from direct radiation from PVNGS.

This dose evaluation is performed annually and submitted with the Annual Radioactive Effluent Release Report to assure compliance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation. NUREG-0543, Methods for Demonstrating LWR Compliance With the EPA Uranium Fuel Cycle Standard (40 CFR Part 190), February 1980, provides a discussion on compliance with 40 CFR Part 190 in relation to the Radiological Environmental Technical Specifications for sites of up to four nuclear power reactors. The NUREG concludes that as long as a nuclear plant site operates at a level below the 10 CFR Part 50, Appendix I reporting requirements, and there is no significant source of direct radiation from the site, no extra analysis is required to demonstrate compliance with 40 CFR Part 190. As a result, this dose evaluation will also be performed whenever calculated doses associated with effluent releases exceed twice the limits of Section 4.4a, 4.4b, 4.1a, 4.1b, 4.2a or 4.2b.

Dose Contribution from Liquid and Gaseous Effluents

The annual whole body dose accumulated by a MEMBER OF THE PUBLIC for the noble gases released in gaseous effluents is determined by using the following equation:

$$D_{WB} = (3.17E\text{-}08)\ \Sigma_i\ [(K_i)\ (X/Q)_{UNIT}\ (Q_i)] \qquad (5\text{-}1)$$

Where:

K_i = the whole body dose factor due to gamma emissions for each identified noble gas radionuclide i, in mrem/yr per μCi/m^3 from Table 3-3.

Q_i = the integrated release of radionuclide i, in μCi for the previous calendar year.

$(X/Q)_{UNIT}$ = the highest calculated annual average dispersion parameter, in sec/m^3, for a particular unit, at the controlling location, from Table 4-16, 4-17, or 4-18, or concurrent meteorological data if available.

=2.92E-06 from Unit 1
=2.19E-06 from Unit 2
=2.31E-06 from Unit 3

D_{WB} = the annual whole body dose in mrem to a MEMBER OF THE PUBLIC at the controlling location due to noble gases released in gaseous effluents.

3.17E-08 = the inverse of seconds in a year (yr/sec).

The annual dose to any organ accumulated by a MEMBER OF THE PUBLIC for iodine-131, iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days released in gaseous effluents is determined by using the following equation:

$$D_o = (3.17E\text{-}08)\ \Sigma_i\ [\Sigma_k (R_{ik} W_k)\ (Q_i)] \quad (5\text{-}2)$$

Where:

D_o = the total annual organ dose from gaseous effluents to a MEMBER OF THE PUBLIC, in mrem, at the controlling location.

Q_i = the integrated release of radionuclide i, in μCi, for the previous calendar year.

R_{ik} = the 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 age group are given in Tables 4-1 through 4-15.

W_K = the highest annual average dispersion or deposition parameter for the particular unit, used for estimating the total annual organ dose to a MEMBER OF THE PUBLIC at the controlling location for the particular unit.

= $(X/Q)_{UNIT}$, in sec/m^3 for the inhalation pathway and for all tritium calculations, for organ dose at the controlling location, from Table 4-16, 4-17, or 4-18, or concurrent meteorological data if available.

=2.92E-06 from Unit 1
=2.19E-06 from Unit 2
=2.31E-06 from Unit 3

= $(D/Q)_{UNIT}$, in m^{-2}, for the food and ground plane pathways, for organ dose at the controlling location, from Table 4-16, 4-17, or 4-18, or concurrent meteorological data if available.

=3.25E-09 from Unit 1
=3.88E-10 from Unit 2
=4.21E-10 from Unit 3

3.17E-08 = the inverse of seconds in a year (yr/sec).

Dose Due to Direct Radiation

The component of dose to a MEMBER OF THE PUBLIC due to direct radiation will be evaluated by first determining the direct radiation dose at the site boundary in each sector, and then extrapolating the site boundary dose to the controlling location by the inverse square law of distance.

Dose from Radioactive Liquid and Gaseous Effluents to MEMBERS OF THE PUBLIC due to their activities within the SITE BOUNDARY.

These activities have been determined to be limited to the vicinity of the Energy Information Center (EIC) located inside the SITE BOUNDARY. An assumption was made that no MEMBER OF THE PUBLIC would spend more than eight hours per year at this location. However this calculation has been historically performed assuming an occupancy factor of one (implying continuous occupancy over the entire year).

A X/Q, determined for the Energy Information Center, will be used for this assessment.

Equations 5-1 and 5-2 in Section 5.1.2 should be used for this assessment.

6.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

6.1 Requirement: REMP

The radiological environmental monitoring program shall be conducted as specified in Table 6-1, based on locations determined using data from the pre-operational monitoring period; and/or the operational monitoring period indicating a need to make changes in the program.

Applicability: At all times.

Action:

a. With the radiological environmental monitoring program not being conducted as specified in Table 6-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report, as required by Section 7.2, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table 6-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to A MEMBER OF THE PUBLIC is less than the calendar year limits of Section 4.4, 4.1 and 4.2. When more than one of the radionuclides in Table 6-2 are detected in the sampling medium, this report shall be submitted if:

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

When radionuclides other than those in Table 6-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose* to a MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of Section 4.4, 4.1 and 4.2. 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.

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 6-1, identify locations for obtaining replacement samples and add them to the Radiological Environmental Monitoring Program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program.

* The methodology and parameters used to estimate the potential annual dose to a MEMBER OF THE PUBLIC shall be indicated in this report.

6.1.1 Surveillance Requirements

a. The radiological environmental monitoring samples shall be collected pursuant to Table 6-1 from the specific locations given in Table 6-4 and Figure and Figure 6-2 and shall be analyzed pursuant to the requirements of Table 6-1, and the detection capabilities required by Table 6-3.

6.1.2 Implementation of the Requirements

The results of the radiological environmental monitoring program are intended to supplement the results of the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected based on the effluent measurements and modeling of the environmental exposure pathways. Thus the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures to individuals resulting from station operation.

This requirement is implemented by Nuclear Administrative and Technical Manual procedures.

TABLE 6-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency[a]	Type and Frequency of Analysis[d]
Airborne Radioiodine and particulates	Samples from 5 locations: 4 samples at or near the SITE BOUNDARIES (#14A, 15, 29, 40) including 3 different sectors of the highest calculated annual average ground level D/Q.* 1 sample (#40) from areas of special interest, which is from the vicinity of a community having the highest calculated annual average D/Q. 1 sample (#6A) from a control location 15-30 km (9-18 mi) distant and in the least prevalent wind direction.[e]	Continuous sampling collected weekly, or more frequently if required by dust loading.	Gross beta weekly[c], I-131 weekly; gamma isotopic analysis of composite (by location) quarterly.
Direct radiation[b]	Forty (40) routine monitoring stations (#5-40, #42, #44, #46, #50) either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: An inner ring of stations, one in each meteorological sector in the general area of the site boundary (16 locations); An outer ring of stations, one in each meteorological sector in the 6-8 km (4-5 mi) range from the site (16 locations); and The balance of the stations (8 locations) to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Quarterly	Gamma dose quarterly.
* D/Q refers to average annual relative ground deposition rate.			

TABLE 6-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

MAR 2016

Exposure Pathway and/or Sample	**Number of Representative Samples and Sample Locations**[a]	**Sampling and Collection Frequency**[a]	**Type and Frequency of Analysis**[d]
Waterborne			
Surface	85 acre Water storagereservoir (#60) 45 acre Water storage reservoir (#61) Evaporation pond #1 (#59) Evaporation pond #2 (#63) Evaporation pond #3 (#64)	Quarterly[h] grab sample	Tritium and gamma isotopic analysis quarterly.
Ground	2 onsite wells[f] (#57, #58)	Quarterly grab sample	Tritium and gamma isotopic analysis quarterly.
Drinking (well)	3 wells from surrounding residences (#46, #48, #49) that would be affected by its discharge.	Composite sample of weekly grab samples over 2-week period when I-131 analysis is performed, monthly composite of weekly grab samples otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year.[g] Composite for gross beta and gamma isotopic analyses monthly. Composite for tritium analysis quarterly.
Ingestion Milk	Samples from milking animals in 3 locations within 5 km (3 mi) distant having the highest dose potential. If there are none, 1 sample from milking animals in each of three areas between 5 and 8 km (3-5 mi) distant (#51, #54) where doses are calculated to be greater than 1 mrem per year.[g] One sample from milking animals at a control location 15 to 30 km (9-18 mi) distant (#53) and in the least prevalent wind direction.[e]	Semimonthly for animals on pasture; otherwise, monthly.	Gamma isotopic and I-131 analysis semimonthly when animals are on pasture or monthly at other times.

TABLE 6-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

MAR 2016

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency[a]	Type and Frequency of Analysis[d]
Food Products *	2 samples (#47, #51) of 3 types of broad leaf vegetation (as available) from locations identified per the criteria of Section 6.2b. of this manual.	Monthly during growing season.	Gamma isotopic analysis.
	1 control sample (#62) of 3 types of broad leaf vegetation (as available) grown 15 to 30 km (9-18 mi) distant in the least prevalent wind direction.[e]	Monthly during growing season.	Gamma isotopic analysis.

* When broad leaf vegetation samples are not available, reports from 4 existing supplemental airborne radioiodine sample locations will be substituted.

TABLE 6-1 (Continued)

TABLE NOTATION

a The number, media, frequency, and location of sampling may vary from site to site. It is recognized that, at times, it may not be possible or practical to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question. Actual locations (distance and direction) from the site shall be provided in Table 6-4 and Figure 6-1or Figure 6-2 in the ODCM. Refer to Regulatory Guide 4.1, “Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.”

b Regulatory Guide 4.13 provides guidance 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 purposes 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.

c Particulate sample filters shall be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air or water is greater than 10 times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

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

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

f Groundwater samples should be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

g The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

h Quarterly grab samples are not required from the onsite evaporation pond if the evaporation pond has not received any influent since the last sample was taken.

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TABLE 6-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fresh Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	20,000 *			
Mn-54	1,000			
Fe-59	400			
Co-58	1,000			
Co-60	300			
Zn-65	300			
Zr-Nb-95	400			
I-131	2 **	0.9	3	100
Cs-134	30	10	60	1,000
Cs-137	50	20	70	2,000
Ba-La-140	200		300	

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

** If no drinking water pathway exists, a reporting level of 20 pCi/l may be used.

TABLE 6-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL ANALYSIS [a]

Lower Limit of Detection (LLD)[b]				
Analysis	**Water (pCi/l)**	**Airborne Particulate or Gas (pCi/m^3)**	**Fresh Milk (pCi/l)**	**Food Products (pCi/kg, wet)**
Gross Beta	4	0.01		
H-3	2000*			
Mn-54	15			
Fe-59	30			
Co-58, -60	15			
Zn-65	30			
Zr-95	30			
Nb-95	15			
I-131	1**	0.07	1	60
Cs-134	15	0.05	15	60
Cs-137	18	0.06	18	80
Ba-140	60		60	
La-140	15		15	

NOTE: This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

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

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

Table 6-3 (Continued)

TABLE NOTATION

a Guidance for detection capabilities for thermoluminescent dosimeters used for environmental measurements is given in Regulatory Guide 4.13.

b Table 6-3 indicates acceptable detection capabilities for radioactive materials in environmental samples. These detection capabilities are tabulated in terms of the lower limits of detection (LLDs). The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) 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):

$$LLD = \frac{4.66 s_b}{E * V * 2.22 * Y * \exp(-\lambda \Delta t)}$$

Where:

LLD is the a priori lower limit of detection as defined above (as pCi per unit mass or volume),

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

E is the counting efficiency (as counts per disintegration),

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield (when applicable),

λ is the radioactive decay constant for the particular radionuclide, and

Δt for environmental samples is the elapsed time between sample collection (or end of the sample collection period) and time of counting.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry the background should 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 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 a measurement system and not as an 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, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

6.2 Requirement: Land Use Census

A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden* of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation.

Applicability: At all times.

Action:

a. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Section 4.2.1, identify the new location(s) in the next Annual Radioactive Effluent Release Report, pursuant to Section 7.1.

b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with Section 6.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may then be deleted from the monitoring program.

6.2.1 Surveillance Requirements

a. The land use census shall be conducted during the growing season annually using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to Section 7.2.

6.2.2 Implementation of the Requirements

The above Requirement is implemented by Nuclear Administrative and Technical Manual procedures.

***** Broad Leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 6-1 shall be followed, including analysis of control samples.

6.3 Requirement: Interlaboratory Comparison Program

Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that correspond to samples required by Table 6-1, as applicable.

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 pursuant to Section 7.2.

6.3.1 Surveillance Requirements

a. A summary of the results obtained as part of the above required Interlaboratory Comparison Program and in accordance with the methodology and parameters in this manual shall be included in the Annual Radiological Environmental Operating Report pursuant to Section 7.2.

6.3.2 Implementation of the Requirements

PVNGS laboratories or contract laboratories which perform analyses for the Radiological Environmental Monitoring Program (REMP) participate in an Interlaboratory Comparison Program. The participation includes all of the determinations (sample medium-radionuclide combinations) that are included in the monitoring program.

If deviation from specified limits is identified an investigation is made to determine the reason for the deviation and corrective actions are taken as necessary. The results of all analyses made under this program are included in the Annual Radiological Environmental Operating Report.

TABLE 6-4

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE COLLECTION LOCATIONS

SAMPLE SITE	SAMPLE TYPE	NOTE (d)	LOCATION DESIGNATION (a)	LOCATION DESCRIPTION (c)
1	TLD	SUP	E30	Goodyear
2	TLD	SUP	ENE24	Scott-Libby School
3	TLD	SUP	E21	Liberty School
4	TLD	SUP	E16	Buckeye
4	Air	SUP	E16	Same as TLD
5	TLD (b)	SP	ESE11	Palo Verde School
6	TLD (b)	Control	SSE31	APS Gila Bend substation
6A	Air (b)	Control	SSE13	Old US 80
7	TLD (b)	SP	SE7	Old US 80 and Arlington School Rd.
7A	Air	SUP	ESE3	Arlington School
8	TLD (b)	OR	SSE4	Southern Pacific Pipeline Rd.
9	TLD (b)	OR	S5	Southern Pacific Pipeline Rd.
10	TLD (b)	OR	SE5	355th Ave. and Elliot Rd.
11	TLD (b)	OR	ESE5	339th Ave. and Dobbins Rd.
12	TLD (b)	OR	E5	339th Ave. and Buckeye-Salome Rd.
13	TLD (b)	IR	N1	N site boundary
14	TLD (b)	IR	NNE2	NNE site boundary
14A	Air (b)		NNE2	371st Ave. and Buckeye-Salome Rd.
15	TLD (b)	IR	NE2	NE site boundary, WRF access road
15	Air (b)		NE2	Same as TLD
16	TLD (b)	IR	ENE2	ENE site boundary
17	TLD (b)	IR	E2	E site boundary
17A	Air	SUP	E3	351st Ave.
18	TLD (b)	IR	ESE2	ESE site boundary
19	TLD (b)	IR	SE2	SE site boundary
20	TLD (b)	IR	SSE2	SSE site boundary

TABLE 6-4

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE COLLECTION LOCATIONS

SAMPLE SITE	SAMPLE TYPE	NOTE (d)	LOCATION DESIGNATION (a)	LOCATION DESCRIPTION (c)
21	TLD (b)	IR	S3	S site boundary
21	Air	SUP	S3	Same as TLD
22	TLD (b)	IR	SSW3	SSW site boundary
23	TLD (b)	OR	W5	N of Elliot Rd
24	TLD (b)	OR	SW4	N of Elliot Rd.
25	TLD (b)	OR	WSW5	N of Elliot Rd.
26	TLD (b)	OR	SSW4	Duke Property
27	TLD (b)	IR	SW1	SW site boundary
28	TLD (b)	IR	WSW1	WSW site boundary
29	TLD (b)	IR	W1	W site boundary
29	Air (b)		W1	Same as TLD
30	TLD (b)	IR	WNW1	WNW site boundary
31	TLD (b)	IR	NW1	NW site boundary
32	TLD (b)	IR	NNW1	NNW site boundary
33	TLD (b)	OR	NW4	S of Buckeye Rd.
34	TLD (b)	OR	NNW5	395th Ave. and Van Buren St.
35	TLD (b)	SP	NNW8	Tonopah
35	Air	SUP	NNW8	Same as TLD
36	TLD (b)	OR	N5	Wintersburg Rd. and Van Buren St.
37	TLD (b)	OR	NNE5	363rd Ave. and Van Buren St.
38	TLD (b)	OR	NE5	355th Ave. and Buckeye Rd.
39	TLD (b)	OR	ENE5	343rd Ave. N of Broadway Rd.
40	TLD (b)	SP	N2	Wintersburg
40	Air (b)		N2	Same as TLD
41	TLD	SUP	ESE3	Arlington School
42	TLD (b)	SP	N8	Ruth Fisher School
43	TLD	SUP	NE5	Winters Well School

TABLE 6-4

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE COLLECTION LOCATIONS

SAMPLE SITE	SAMPLE TYPE	NOTE (d)	LOCATION DESIGNATION (a)	LOCATION DESCRIPTION (c)
44	TLD (b)	Control	ENE35	El Mirage
45	TLD	SUP Transit Control	ONSITE	Central lab, lead pig
46	TLD (b)	SP	ENE30	Litchfield Park School
46	Water (b)	WD	NNW8	Local residence
47	TLD	SUP	E35	Littleton School
47	Vegetation (b)		N3	Local residence
48	TLD	SUP	E24	Jackrabbit Trail
48	Water (b)	WD	SW1	Local residence
49	TLD	SUP	ENE11	Palo Verde Rd.
49	Water (b)	WD	N2	Local residence
50	TLD (b)	OR	WNW5	S of Buckeye-Salome Rd.
51	Milk (b)		ENE5	Local residence (goats)
51	Vegetation (b)		ENE5	Local residence
53	Milk (b)	Control	NE30	Local residence (goats)
54	Milk (b)		NNE4	Local residence (goats)
55	Water	WD SUP	SW3	Local residence
57	Ground Water (b)	WG	onsite	Well 27ddc
58	Ground Water (b)	WG	onsite	Well 34abb
59	Surface Water (b)	WS	onsite	Evaporation Pond #1
60	Surface Water (b)	WS	onsite	85 acre Water storage reservoir
61	Surface Water (b)	WS	onsite	45 acre Water storage reservoir
62	Vegetation (b)	Control	ENE26	Commercial produce company
63	Surface Water (b)	WS	onsite	Evaporation Pond #2
64	Surface Water (b)	WS	onsite	Evaporation Pond #3

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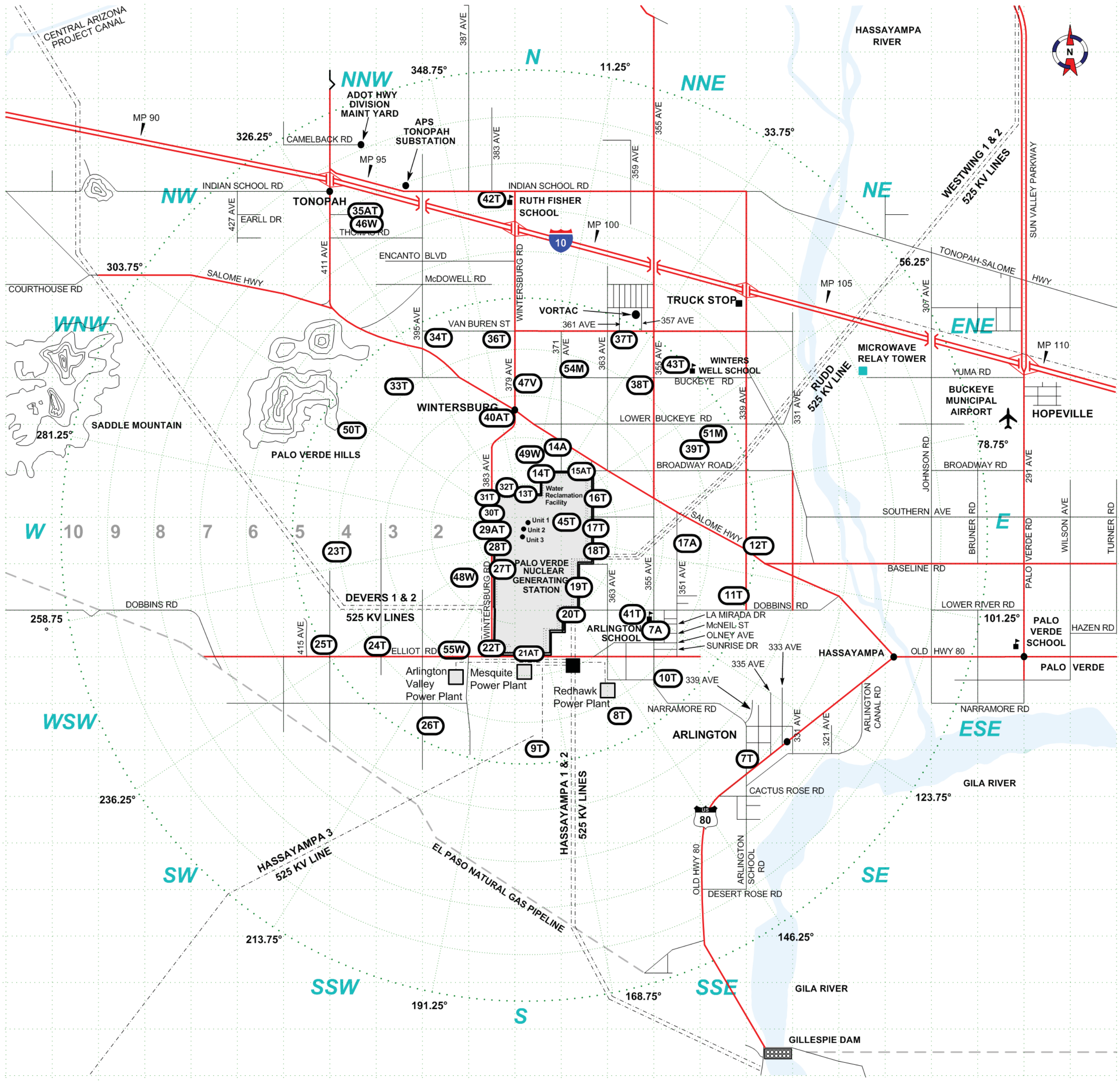
NOTES: (a) Distance and direction are relative to the Unit 2 containment, rounded to the nearest mile.
(b) These samples fulfill the requirements of the ODCM, Table 6-1.
(c) Refer to Figure 6-1 and Figure 6-2 for relative locations of sample sites.
(d) IR - inner ring
OR - outer ring
SP - school or population center
WS - waterborne surface
WG - waterborne ground
WD - waterborne drinking
SUP -designated supplemental sampling location



KEY TO MAP

Sample Site ①
A Air
V Vegetation
W Water
T TLD
M Milk

School
Airstrip

Figure 6-1
Radiological Environmental Monitoring Program Sample Sites
0 - 10 miles

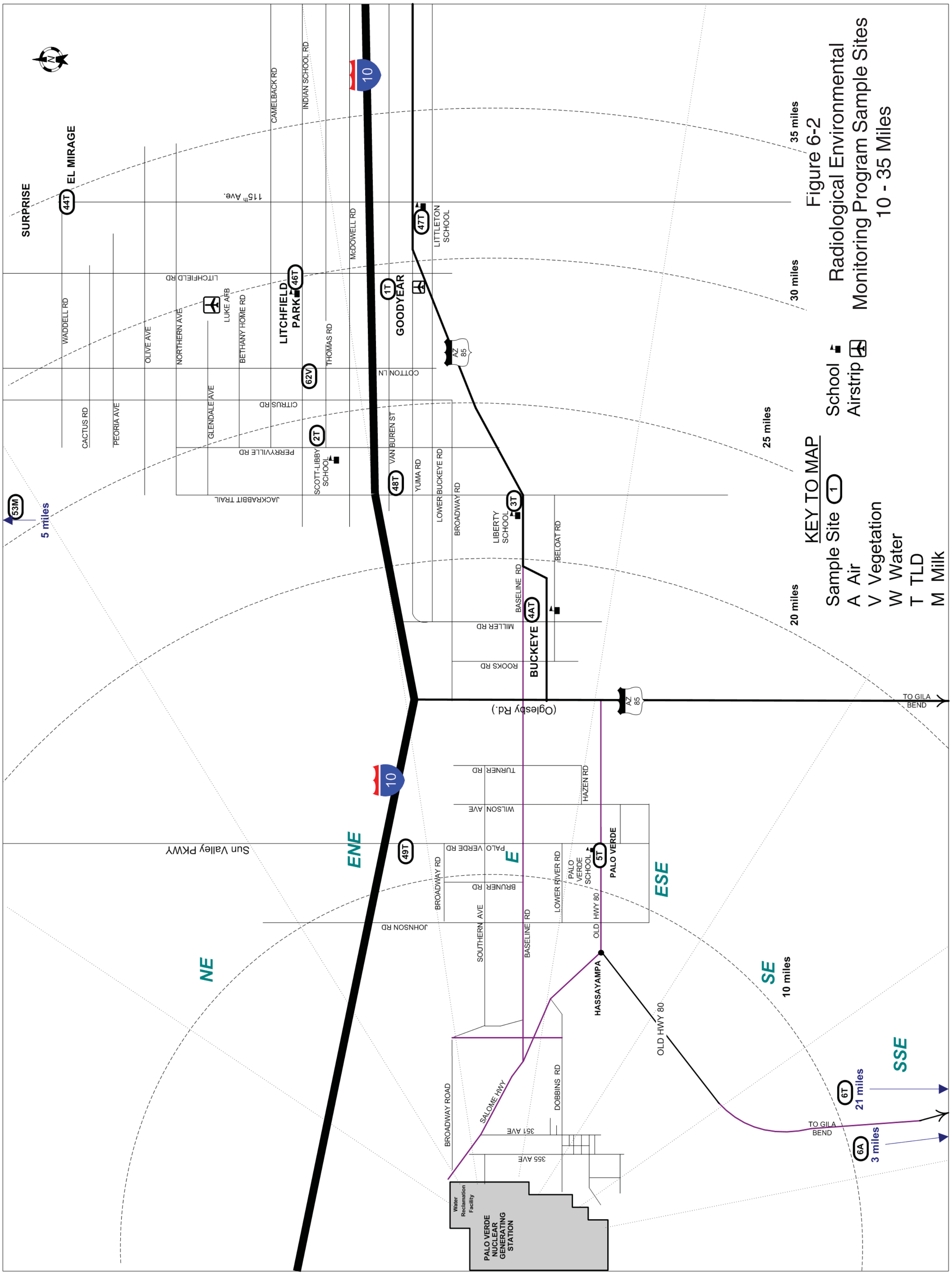


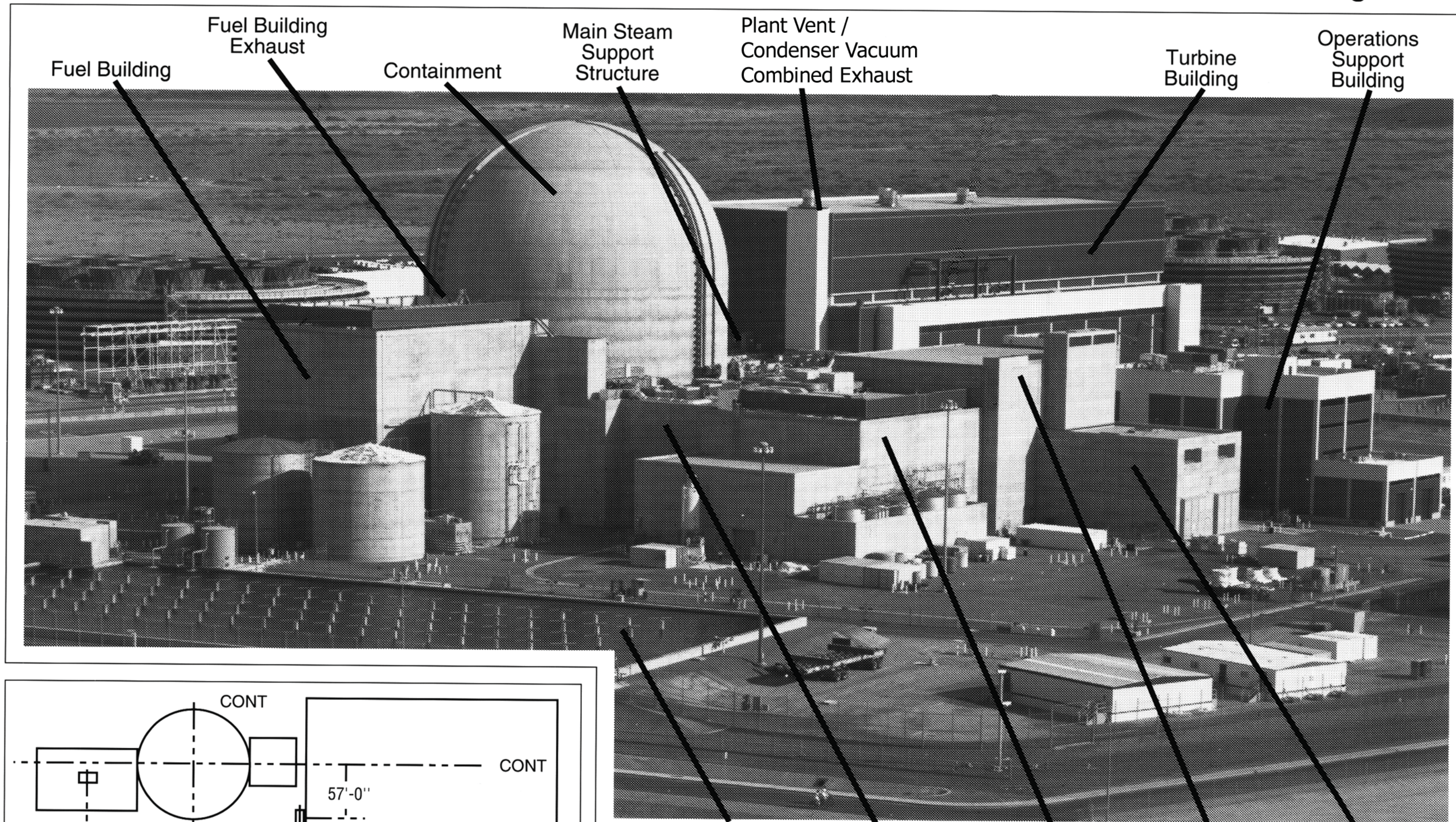
Figure 6-2
Radiological Environmental Monitoring Program Sample Sites
10 - 35 Miles

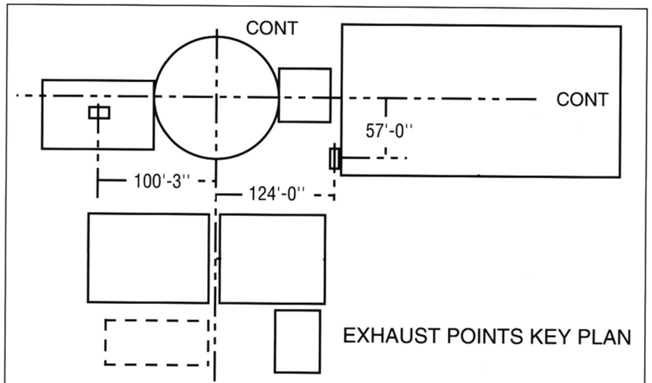
Figure 6-3
Radiological Environmental Monitoring Program
Sample Sites 35 - 75 Miles
DELETED

Figure 6-4
Site Exclusion Area Boundary
DELETED

Refer to UFSAR Figure 2.1-4

Palo Verde Nuclear Generating Station





Elevation of Exhaust Point Above Grade	
Plant Vent/Condenser Vacuum	**145'**
Fuel Building	**109'-9"**

Figure 6-5
Gaseous Effluent
Release Points

Figure 6-6
Low Population Zone
DELETED

Refer to UFSAR Figure 2.1-15

7.0 RADIOLOGICAL REPORTS

7.1 Requirement: Annual Radioactive Effluent Release Report *

Routine Annual Radioactive Effluent Release Reports covering the operation of the units during the previous calendar year shall be submitted in accordance with Technical Specification 5.6.3.

The Annual 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 Regulatory 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 Annual 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 on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), 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 6-4) 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 methodology and parameters in the ODCM.

The Annual 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 calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation. Acceptable methods for calculating the dose contributions are given Section 5.0 and Regulatory Guide 1.109 Rev. 1, October 1977.

The Annual Radioactive Effluent Release Report shall also include information required by the Technical Requirements Manual, Section 5.0.600.1.

* 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.

** In lieu of submission with the Annual Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

The Annual Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) 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. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),

e. Type of container (e.g., LSA, Type A, Type B, Large Quantity), and

f. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

The Annual Radioactive Effluent Release Reports shall include a list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

Changes to the ODCM shall be submitted in the form of a complete, legible copy as part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change in the ODCM was made. Changes made to the Process Control Program shall be submitted with the Annual Radioactive Effluent Release Report for the period of the report in which any change in the Process Control Program was made.

7.2 Requirement: Annual Radiological Environmental Operating Report *

Routine Annual Radiological Environmental Operating Reports covering the operation of the units during the previous calendar year shall be submitted by May 15 of each year in accordance with Technical Specification 5.6.2.

The Annual Radiological Environmental Operating Reports 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, with operational controls as appropriate, and with 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 6.2.

The Annual Radiological Environmental Operating Reports shall include the results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in Table 6-4 and Figure and Figure 6-2 as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual 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; at least two legible maps** covering all sampling locations keyed to a table giving distances and directions from the centerline of one reactor; the results of licensee participation in the Interlaboratory Comparison Program, required by Section 6.3; discussion of all deviations from the sampling schedule of Table 6-1; and discussion of all analyses in which the LLD required by Table 6-3 was not achievable.

* A single submittal may be made for a multiple unit station.

** One map shall cover stations near the SITE BOUNDARY; a second shall include the more distant stations.

APPENDIX A
DETERMINATION OF CONTROLLING LOCATION

The controlling location is the location of the MEMBER OF THE PUBLIC who receives the highest doses.

The determination of a controlling location for implementation of 10CFR50 for radioiodines and particulates is known to be a function of:

(1) Isotopic release rates

(2) Meteorology

(3) Exposure pathway

(4) Receptor's age

The incorporation of these parameters into Equation 5-2 results in the respective equations at the controlling location. The isotopic release rates are based upon the source terms calculated using the PVNGS Environmental Report, Operating License Stage, Table 3.5-12, without carbon.

All of the locations and exposure pathways, identified in the 1984 Land Use Census, have been evaluated. These include cow milk ingestion, goat milk ingestion, vegetable ingestion, inhalation, and ground plane exposure. An infant is assumed to be present at all milk pathway locations. A child is assumed to be present at all vegetable garden locations. The ground plane exposure pathway is only considered to be present where an infant is not present. Naturally, inhalation is present everywhere an individual is present.

For the determination of the controlling locations, the highest X/Q and D/Q values, based on the 9 year meteorological data base, for the vegetable garden, cow milk, and goat milk pathways, are selected for each unit. The receptor organ doses have been calculated at each of these locations. Based upon these calculations, it is determined that the controlling receptor pathway is a function of unit location. For Unit 1, the controlling receptor is a garden-child pathway; for releases from Unit 2 and Unit 3 the controlling receptor is a cow milk-infant pathway. These determinations are based upon Table 4-16, 4-17, or 4-18, which, in turn, is based upon the 1984 Land Use Census. Locations of the nearest residences, gardens and milk animals, as determined in the 1984 Land Use Census, are given in Table 4-16, 4-17, and 4-18.

APPENDIX B
BASES FOR REQUIREMENTS

B-2.1 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

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 and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, 64 of Appendix A to 10 CFR PART 50.

There are two separate radioactive gaseous effluent monitoring systems: the low range effluent monitors for normal plant radioactive gaseous effluents and the high range effluent monitors for post-accident plant radioactive gaseous effluents. The low range monitors operate at all times until the concentration of radioactivity in the effluent becomes too high during post-accident conditions. The high range monitors only operate when the concentration of radioactivity in the effluent is above the setpoint in the low range monitors.

B-3.1 GASEOUS EFFLUENT - DOSE RATE

This requirement provides reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either at or beyond the SITE BOUNDARY, in excess of the design objectives of Appendix I to 10 CFR part 50. This requirement is provided to ensure that gaseous effluents from all units on the site will be appropriately controlled. It provides operational flexibility for releasing gaseous effluents to satisfy the Section II.A and II.C design objectives of Appendix I to 10 CFR part 50. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrems/year to the total body or to less than or equal to 3000 mrems/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 mrems/year. This requirement does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

This requirement applies to the release of radioactive materials in gaseous effluents from all reactor units at the site.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLD). Detailed discussion of the LLD and other detection limits can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

B-3.2 SECONDARY SYSTEM LIQUID WASTE DISCHARGE TO ONSITE EVAPORATION PONDS - CONCENTRATION

This requirement is provided to ensure that the annual total effective dose equivalent to individual members of the public from the licensed operation does not exceed the requirements of 10 CFR Part 20, due to the accumulated activity in the evaporation ponds from the secondary system discharges.

Restricting the concentrations of the secondary liquid wastes discharged to the onsite evaporation ponds will restrict the quantity of radioactive material that can accumulate in the ponds. This, in turn, provides assurance that in the event of an uncontrolled release of the pond's contents to an UNRESTRICTED AREA, the resulting total effective dose equivalent to individual members of the public at the nearest exclusion area boundary will not exceed the requirements of 10 CFR Part 20.

This requirement applies to the secondary system liquid waste discharges of radioactive materials from all reactor units to the onsite evaporation ponds.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLD). Detailed discussion of the LLD and other detection limits can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

B-4.1 GASEOUS EFFLUENT - DOSE, Noble Gases

This requirement is provided to implement Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. This requirement 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 that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS 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 a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters 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 Regulatory 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 Regulatory 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. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This requirement applies to the release of radioactive materials in gaseous effluents from each reactor unit at the site.

B-4.2 GASEOUS EFFLUENT - DOSE - Iodine-131, Iodine-133, Tritium, and All Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days

This requirement is provided to implement the requirements of Sections II.C, III.A, IV.A of Appendix I, 10 CFR Part 50. This requirement is the guide 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 to UNRESTRICTED AREAS 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 a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory 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 Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases for 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 iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that 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.

This requirement applies to the release of radioactive materials in gaseous effluents from each reactor unit at the site.

B-4.3 GASEOUS RADWASTE TREATMENT

The OPERABILITY of the GASEOUS RADWASTE SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as reasonably achievable." This requirement implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

This requirement applies to the release of radioactive materials in gaseous effluents from each reactor unit at the site.

The minimum analysis frequency of 4/M (i.e., at least 4 times per month at intervals no greater than 9 days and a minimum of 48 times a year) is used for certain radioactive gaseous waste sampling in Table 3-1. This will eliminate taking double samples when quarterly and weekly samples are required at the same time.

B-4.4 SECONDARY SYSTEM LIQUID WASTE DISCHARGE TO ONSITE EVAPORATION PONDS - DOSE

This requirement is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. This requirement 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 to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141. The dose calculation methodology and parameters 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 a MEMBER OF THE PUBLIC 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 Regulatory 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 Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

This requirement 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.

B-5.1 TOTAL DOSE AND DOSE TO PUBLIC ONSITE

This requirement is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR 20.1301(d). The requirement specifies the preparation and submittal of a Special Report whenever the calculated doses due to releases of radioactivity and to radiation from uranium fuel cycle sources exceed 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. Even if a site was to contain up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor units (including outside storage tanks, etc.) are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 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 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, submittal of the Special Report within 30 days with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR Part 190.11 and 10 CFR Part 20.2203(a)(4), is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to other requirements for dose limitation of 10 CFR Part 20, as addressed in Section 3.2 and 3.1 of the ODCM. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle. Demonstration of compliance with the limits of 40 CFR Part 190 or with the design objectives of Appendix I to 10 CFR Part 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR 20.1301.

B-6.1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

The Radiological Environmental Monitoring Program required by this requirement provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring. The initially specified monitoring program will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLD). The LLDs required by Table 6-3 are considered optimum 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 an a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD and other detection limits can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

B-6.2 LAND USE CENSUS

This requirement is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from 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 50 m^2 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 Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 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/m^2.

B-6.3 INTERLABORATORY COMPARISON PROGRAM

The requirement for participation in an Interlaboratory Comparison Program is provided to ensure that 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 valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

APPENDIX C

DEFINITIONS

Note:

The following definitions were derived from the Palo Verde Nuclear Generating Station Technical Specifications. These selected definitions support those portions of the Technical Specifications which were transferred to the ODCM and have been incorporated into the Requirements sections of the ODCM.

Definitions:

The defined terms of this section appear in capitalized type and are applicable throughout the Requirements sections of this ODCM.

ACTION

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

CHANNEL CALIBRATION

See the Technical Specification definition.

CHANNEL CHECK

See the Technical Specification definition.

CHANNEL FUNCTIONAL TEST

See the Technical Specification definition.

DOSE EQUIVALENT I-131

See the Technical Specification definition.

FUNCTIONAL-FUNCTIONALITY

Functionality is an attribute of a structure, system, or component SSC(s) that is not controlled by the Technical Specifications (TSs). An SSC not controlled by Tss is functional or has functionality when it is capable of performing its function(s) as set forth in the current licensing basis (CLB). These CLB function(s) may include the capability to perform a necessary and related support function for an SSC(s) controlled by TSs.

MAR 2016

FREQUENCY NOTATION

The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table C-1.

GASEOUS RADWASTE SYSTEM

A GASEOUS RADWASTE SYSTEM shall be any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

DEFINITIONS (Continued)

MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational, or other purposes not associated with the plant.

OPERABLE-OPERABILITY

A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or 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).

MODE

See the Technical Specification definition.

PROCESS CONTROL PROGRAM

The PROCESS CONTROL PROGRAM shall contain the current formulas, sampling, analyses, test, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61, and 71, State regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

PURGE-PURGING

PURGE or PURGING shall be 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.

RATED THERMAL POWER

See the Technical Specification definition.

SITE BOUNDARY

The SITE BOUNDARY shall be that line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

SOLIDIFICATION

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).

DEFINITIONS (Continued)

SOURCE CHECK

A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

THERMAL POWER

THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

UNRESTRICTED AREA

An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY access to which is not controlled by the licensee for the purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.

VENTILATION EXHAUST TREATMENT SYSTEM

A VENTILATION EXHAUST TREATMENT SYSTEM shall be 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 charcoal adsorbers and/or 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. Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

VENTING

VENTING shall be 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 C-1

FREQUENCY NOTATION

MAR 2016

NOTATION	FREQUENCY*
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
4/M	At least 4 times per month at intervals no greater than 9 days and a minimum of 48 times per year.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
ANNUALLY	At least once per 365 days
R	At least once per 18 months.
P	Completed prior to each release.
S/U	Prior to reactor startup.
N.A.	Not Applicable.

*The specified Frequency for each Surveillance Requirement and Sampling Requirement is met if the Surveillance Requirement or Sampling Requirement 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.

MAR 2016

APPENDIX D
REFERENCES

1 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation."

2 Title 10, Code of Federal Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities."

3 Title 40, Code of Federal Regulations, Part 190, Environmental Radiation Protection Standards for Nuclear Power Operations."

4 Federal Register, Vol. 58, No. 245, Thursday, December 23, 1993, Notices, pages 68170-68179.

5 Regulatory 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.

6 Regulatory 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.

7 Regulatory 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.

8 Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," Revision 1, April 1975.

9 NUREG-0133, Preparation of Radiological Effluent Technical Specifications For Nuclear Power Plants, Oct. 1978.

10 NUREG 0841, "Final Environmental Statement Related to the Operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3", Section 5.9.1.4, February, 1982.

11 NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactor", Arpil 1991.

12 Environmental Report Operating License Stage, Palo Verde Nuclear Generating Station, December 1981.

13 PVNGS Updated Final Safety Analysis Report

14 Calculation 13-NC-ZY-252, "Annual Average Dose from Normal Operation Liquid Discharge from the Evaporation Pond", Rev 0.

15 Calculation 13-NC-ZY-253, "Annual Average Dose from Normal Operation Airborne Direct and Sky Shine from the Evaporation Pond", Rev 0.

16 Calculation 13-NC-ZY-254, "Radiation Dose Due to an Evaporation Pond Dike Failure During a Seismic Event", Rev. 0.

Appendix F

Correction to the 2013 and 2015 PVNGS

Annual Radiological Effluent Release Reports aps

A subsidiary of Pinnacle West Capital Corporation

Company Correspondence

ID #:	218-04128
DATE:	04/14/2017
TO:	File
Sta. #	
Ext. #	

FROM:	Joshua McDowell
Sta. #	7397
Ext. #	82-5482

McDowell, Joshua (Z08270)

Digitally signed by McDowell, Joshua (Z08270)
DN: cn=McDowell, Joshua (Z08270)
Reason: I am the author of this document
Date: 2017.04.14 03:52:25 -07'00'

SUBJECT: Correction to Annual Radioactive Effluent Release Reports for 2015 and 2013 Palo Verde Nuclear Generating Station – Units 1,2, and 3

REFERENCES:
1. PVNGS Annual Radioactive Effluent Release Report for 2015
2. PVNGS Annual Radioactive Effluent Release Report for 2016

Dear Sir or Madam:

In accordance with Palo Verde Nuclear Generating Station (PVNGS) Technical Specification (TS) 5.6.2, PVNGS submitted the Annual Radioactive Effluent Release Report (ARERR) for 2015 via Reference 1. It was discovered that a refueling purge permit had been revised after data was gathered for this report. This led to particulate activity not being accounted for in the annual report. The following 2015 ARERR tables were impacted and therefore revised in this submittal:

- 2 Batch Release Data
- 12 Unit 2 Gaseous Effluents – Summation of All Releases
- 15 Unit 2 Gaseous Effluents – Ground Level Releases – Batch – Fission Gases and Iodines
- 16 Unit 2 Gaseous Effluents - Ground Level Releases - Batch - Particulates
- 17 Unit 2 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines
- 18 Unit 2 Gaseous Effluents - Continuous and Batch - Particulates
- 30 Units 1, 2, and 3 Gaseous Effluents - Batch - Fission Gases and Iodines - Total By Quarter
- 31 Units 1, 2, and 3 Gaseous Effluents - Batch - Particulates - Total By Quarter
- 32 Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines - Total By Quarter
- 33 Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Particulates - Total By Quarter
- 36 Units 1, 2 and 3 Gaseous Effluents- Batch - Fission Gases and Iodine - Total By Unit
- 37 Units 1, 2 and 3 Gaseous Effluents- Batch - Particulates - Total By Unit
- 38 Units 1, 2 and 3 Gaseous Effluents- Continuous and Batch - Fission Gases and Iodine - Total By Unit
- 39 Units 1, 2 and 3 Gaseous Effluents - Continuous and Batch - Particulates - Total By Unit
- 43 Doses To Special Locations For 2014
- 44 Integrated Population Dose for 2014

- 45 Summary of Individual Doses for 2014

These deviations were documented through Corrective Action program document Condition Report (CR) 17-01056.

The Nuclear Regulatory Commission questioned a 2013 release of Xenon-133 as documented on the 2013 PVNGS ARERR. In response to this question, it was discovered that an overly conservative value had been applied to a release permit. This is documented through CR 17-05289.

The following 2013 ARERR tables were impacted and therefore revised in this submittal:

- 20 Unit 3 Gaseous Effluents - Summation Of All Releases
- 25 Unit 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines
- 27 Unit 3 Radiation Doses At And Beyond The Site Boundary
- 30 Units 1, 2, and 3 Gaseous Effluents - Batch - Fission Gases and Iodines - Total By Quarter
- 32 Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines - Total By Quarter
- 36 Units 1, 2 and 3 Gaseous Effluents- Batch - Fission Gases and Iodine - Total By Unit
- 38 Units 1, 2 and 3 Gaseous Effluents- Continuous and Batch - Fission Gases and Iodine - Total By Unit

Table 20:
Unit 3
Gaseous Effluents - Summation Of All Releases

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total For Year	Est. Total Error % (1)
A. Fission & activation gases							
1. Total release	Ci	5.83E-02	6.98E-02	2.05E-01	2.46E+01	2.49E+01	**3.54E+01**
2. Average release rate for period	µCi/sec	7.42E-03	8.88E-03	2.58E-02	3.09E+00	7.87E-01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
B. Iodine 131							
1. Total Iodine 131	Ci	0.00E+00	0.00E+00	0.00E+00	6.58E-06	6.58E-06	**3.32E+01**
2. Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	8.28E-07	2.08E-07	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
C. Particulates							
1. Particulates with half- lives > 8 days	Ci	1.51E-06	1.27E-06	2.72E-06	3.50E-04	3.56E-04	**3.43E+01**
2. Average release rate for period	µCi/sec	1.92E-07	1.61E-07	3.42E-07	4.40E-05	1.12E-05	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
4. Gross Alpha radioactivity	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**	
D. Tritium							
1. Total release	Ci	7.03E+01	1.35E+02	5.17E+02	2.13E+02	9.36E+02	**3.85E+01**
2. Average release rate for period	µCi/sec	8.94E+00	1.72E+01	6.50E+01	2.68E+01	2.96E+01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
(1) Estimated total error methodology is presented in Table 40.							
(2) See Table 27 for percent of ODCM Requirement limits.							

Table 25: Unit 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	5.21E-02	6.17E-02	1.84E-01	4.93E-01	7.90E-01
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	0.00E+00	0.00E+00	3.95E-08	0.00E+00	3.95E-08
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	Ci	6.25E-03	8.00E-03	2.15E-02	1.06E+00	1.10E+00
Xe-133m	Ci	0.00E+00	0.00E+00	3.41E-07	8.13E+00	8.13E+00
Xe-135	Ci	0.00E+00	5.03E-05	1.67E-06	1.49E+01	1.49E+01
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**5.83E-02**	**6.98E-02**	**2.05E-01**	**2.46E+01**	**2.49E+01**
2. Iodines						
I-131	Ci	0.00E+00	0.00E+00	0.00E+00	6.58E-06	6.58E-06
I-132	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**0.00E+00**	**0.00E+00**	**0.00E+00**	**6.58E-06**	**6.58E-06**

Table 27: Unit 3 Radiation Doses At And Beyond The Site Boundary						
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
Gamma Air Dose	mrad	1.37E-04	1.63E-04	4.84E-04	1.02E-02	1.10E-02
ODCM Req 4.1 Limit	mrad	5.00E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01
% ODCM Limit	%	**2.74E-03**	**3.26E-03**	**9.68E-03**	**2.04E-01**	**1.10E-01**
Beta Air Dose	mrad	5.01E-05	5.96E-05	1.76E-04	1.45E-02	1.48E-02
ODCM Req 4.1 Limit	mrad	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
% ODCM Limit	%	**5.01E-04**	**5.96E-04**	**1.76E-03**	**1.45E-01**	**7.40E-02**
Maximum Organ Dose (excluding skin)	mrem	2.52E-02	4.86E-02	1.85E-01	7.67E-02	3.36E-01
Age		Teen	Teen	Teen	Teen	Teen
Organ		Thyroid	4.86E-02	Thyroid	Lung	3.36E-01
ODCM Req. 4.2 Limit	mrem	7.50E+00	7.50E+00	7.50E+00	7.50E+00	1.50E+01
% ODCM Limit	%	**3.36E-01**	**6.48E-01**	**2.47E+00**	**1.02E+00**	**2.24E+00**

Calculations are based on parameters and methodologies of the ODCM using historical meteorology. Dose is calculated to a hypothetical individual. In contrast, Appendix C dose calculations are based on concurrent meteorology, a real individual, and only the actual pathways present.

Table 30: Units 1, 2, and 3 Gaseous Effluents - Batch - Fission Gases and Iodines - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	2.08E+00	3.33E-01	3.56E-01	6.22E-01	3.39E+00
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	3.20E-08	0.00E+00	3.95E-08	0.00E+00	7.15E-08
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	Ci	6.21E-01	3.57E-02	3.52E-02	1.09E+00	1.78E+00
Xe-133m	Ci	4.53E-07	0.00E+00	3.41E-07	8.13E+00	8.13E+00
Xe-135	Ci	1.29E-01	5.03E-05	1.67E-06	1.49E+01	1.51E+01
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**2.83E+00**	**3.68E-01**	**3.92E-01**	**2.48E+01**	**2.84E+01**
2. Iodines						
I-131	Ci	0.00E+00	9.92E-07	0.00E+00	0.00E+00	9.92E-07
I-132	Ci	0.00E+00	1.50E-05	0.00E+00	0.00E+00	1.50E-05
I-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**0.00E+00**	**1.60E-05**	**0.00E+00**	**0.00E+00**	**1.60E-05**

Table 32: Units 1, 2, and 3 Gaseous Effluents - Continuous and Batch - Fission Gases and Iodines - Total By Quarter						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	2.08E+00	3.33E-01	3.56E-01	6.22E-01	3.39E+00
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	3.20E-08	0.00E+00	3.95E-08	0.00E+00	7.15E-08
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	Ci	6.21E-01	3.57E-02	3.52E-02	1.09E+00	1.78E+00
Xe-133m	Ci	4.53E-07	0.00E+00	3.41E-07	8.13E+00	8.13E+00
Xe-135	Ci	1.29E-01	5.03E-05	1.67E-06	1.49E+01	1.51E+01
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**2.83E+00**	**3.68E-01**	**3.92E-01**	**2.48E+01**	**2.84E+01**
2. Iodines						
I-131	Ci	5.35E-06	5.61E-05	0.00E+00	6.58E-06	6.80E-05
I-132	Ci	1.39E-04	4.29E-04	0.00E+00	0.00E+00	5.68E-04
I-133	Ci	6.29E-06	0.00E+00	0.00E+00	0.00E+00	6.29E-06
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**1.51E-04**	**4.85E-04**	**0.00E+00**	**6.58E-06**	**6.42E-04**

Table 36: Units 1, 2 and 3 Gaseous Effluents- Batch - Fission Gases and Iodine - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
1. Fission gases					
Ar-41	Ci	2.07E+00	5.31E-01	7.90E-01	3.39E+00
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	3.20E-08	0.00E+00	3.95E-08	7.15E-08
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	Ci	6.09E-01	7.37E-02	1.10E+00	1.78E+00
Xe-133m	Ci	4.53E-07	0.00E+00	8.13E+00	8.13E+00
Xe-135	Ci	1.29E-01	0.00E+00	1.49E+01	1.51E+01
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**2.80E+00**	**6.05E-01**	**2.49E+01**	**2.84E+01**
2. Iodines					
I-131	Ci	9.92E-07	0.00E+00	0.00E+00	9.92E-07
I-132	Ci	1.50E-05	0.00E+00	0.00E+00	1.50E-05
I-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**1.60E-05**	**0.00E+00**	**0.00E+00**	**1.60E-05**

Table 38: Units 1, 2 and 3 Gaseous Effluents- Continuous and Batch - Fission Gases and Iodine - Total By Unit					
Nuclides Released	Unit	Unit 1	Unit 2	Unit 3	Total Units 1, 2 and 3
1. Fission gases					
Ar-41	Ci	2.07E+00	5.31E-01	7.90E-01	3.39E+00
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	3.20E-08	0.00E+00	3.95E-08	7.15E-08
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	Ci	6.09E-01	7.37E-02	1.10E+00	1.78E+00
Xe-133m	Ci	4.53E-07	0.00E+00	8.13E+00	8.13E+00
Xe-135	Ci	1.29E-01	0.00E+00	1.49E+01	1.51E+01
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**2.80E+00**	**6.05E-01**	**2.49E+01**	**2.84E+01**
2. Iodines					
I-131	Ci	6.14E-05	0.00E+00	6.58E-06	6.80E-05
I-132	Ci	5.68E-04	0.00E+00	0.00E+00	5.68E-04
I-133	Ci	6.29E-06	0.00E+00	0.00E+00	6.29E-06
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**6.36E-04**	**0.00E+00**	**6.58E-06**	**6.42E-04**

Table 1: Evaporation Pond Data					
Evaporation Pond 1(1A, 1B, 1C)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	3.22E+11	8.85E+11	8.85E+11	3.22E+11	
Tritium Concentration (uCi/cc)	4.85E-06	3.34E-06	3.65E-06	2.98E-06	
Tritium Curies	1.83E-01	1.16E+00	1.21E+00	3.52E-01	2.91E+00
Evaporation Pond 2 (2A and 2B)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	2.40E+11	7.97E+11	7.97E+11	2.90E+11	
Tritium Concentration (uCi/cc)	1.45E-06	1.46E-06	1.75E-06	1.12E-06	
Tritium curies	1.80E-01	4.91E-01	6.04E-01	1.45E-01	1.42E+00
Evaporation Pond 3 (3A and 3B)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Historical volume of water evaporated (ml)	2.22E+11	3.05E+11	3.05E+11	1.11E+11	
3B Tritium Concentration (uCi/cc)	1.65E-06	1.08E-06	1.24E-06	8.76E-07	
3B Tritium curies	1.81E-01	3.25E-01	3.73E-01	9.62E-02	9.76E-01
Dose (mRem)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Pond 1	7.61E-03	1.43E-02	1.50E-02	4.16E-03	4.12E-02
Pond 2	2.50E-03	6.81E-03	8.38E-03	2.01E-03	1.97E-02
Pond 3	2.51E-03	4.51E-03	5.18E-03	1.33E-03	1.35E-02
Total	6.71E-03	2.57E-02	2.86E-02	7.51E-03	7.44E-02

Table 2: Batch Release Data			
All times are in hours	Unit 1	Unit 2	Unit 3
January - June			
Number of batch releases	20	24	43
Total time period for batch releases	114.54	366.34	1275.06
Maximum time period for a batch release	**92.00**	**105.90**	**168.00**
Average time period for a batch release	5.73	15.26	29.65
Minimum time period for a batch release	0.53	0.51	0.10
July - December			
Number of batch releases	21	42	19
Total time period for batch releases	161.18	1501.48	198.17
Maximum time period for a batch release	**103.80**	**168.00**	**123.75**
Average time period for a batch release	7.68	35.75	10.43
Minimum time period for a batch release	0.52	0.18	0.50
January - December			
Number of batch releases	41	66	62
Total time period for batch releases	275.72	1867.82	1473.23
Maximum time period for a batch release	**103.80**	**168.00**	**168.00**
Average time period for a batch release	6.72	28.30	23.76
Minimum time period for a batch release	0.52	0.18	0.10

Table 12:
Unit 2
Gaseous Effluents - Summation Of All Releases

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total For Year	Est. Total Error % (1)
A. Fission & activation gases							
1. Total release	Ci	8.53E-02	9.98E-02	1.12E-01	9.63E+00	9.93E+00	**3.54E+01**
2. Average release rate for period	µCi/sec	1.10E-02	1.27E-02	1.41E-02	1.21E+00	3.15E-01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
B. Iodine 131							
1. Total Iodine 131	Ci	0.00E+00	0.00E+00	0.00E+00	2.38E-05	2.38E-05	**3.32E+01**
2. Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	2.99E-06	7.55E-07	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
C. Particulates							
1. Particulates with half- lives > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	8.97E-04	8.97E-04	**3.43E+01**
2. Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	1.13E-04	2.85E-05	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
4. Gross Alpha radioactivity	Ci	**< LLD**	**< LLD**	**< LLD**	**< LLD**	**< LLD**	
D. Tritium							
1. Total release	Ci	3.18E+02	1.04E+02	1.76E+02	3.22E+02	9.20E+02	**3.85E+01**
2. Average release rate for period	µCi/sec	4.09E+01	1.32E+01	2.21E+01	4.05E+01	2.92E+01	
3. Percent of ODCM Requirement limit	%	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	**NA (2)**	
(1) Estimated total error methodology is presented in Table 40.							
(2) See Table 19 for percent of ODCM Requirement limits.							

Table 15: Unit 2 Gaseous Effluents - Ground Level Releases - Batch - Fission Gases and Iodines						
Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year total
1. Fission gases						
Ar-41	Ci	7.29E-02	8.42E-02	9.39E-02	7.60E+00	7.86E+00
Kr-83m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-87	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	Ci	0.00E+00	0.00E+00	0.00E+00	9.77E-04	9.77E-04
Xe-133	Ci	1.24E-02	1.56E-02	1.79E-02	1.73E+00	1.77E+00
Xe-133m	Ci	0.00E+00	0.00E+00	0.00E+00	1.38E-03	1.38E-03
Xe-135	Ci	0.00E+00	0.00E+00	9.12E-05	0.00E+00	9.12E-05
Xe-135m	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	**8.53E-02**	**9.98E-02**	**1.12E-01**	**9.34E+00**	**9.63E+00**
2. Iodines						
I-131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	Ci	0.00E+00	0.00E+00	0.00E+00	7.30E-05	7.30E-05
I-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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