Exelon Generation

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Subject: Peach Bottom Atomic Power Station Units 1, 2 and 3

Independent Spent Fuel Storage Installation (ISFSI)
Facility Operation License DPR-12, DPR-44 and DPR-56
NRC Docket 50-171, 50-277 and 50-278 and ISFSI Docket 72-29

Annual Radioactive Effluent Release Report 60
January 1, 2017 through December 31, 2017

Enclosed is the Annual Radioactive Effluent Release Report 60, January 1, 2017 through December 31, 2017 for Peach Bottom Atomic Power Station, Units 1, 2 and 3.

This report is being submitted in compliance with 10 CFR 50.36a(2) and the Technical Specifications of Operating Licenses DPR-44 and DPR-56 and to fulfill the requirements of Offsite Dose Calculation Manual Specifications (ODCMS) 3.10.2. Additionally, this report is submitted to satisfy the annual effluent reporting requirements for the ISFSI required by the ODCM.

The ODCM was revised during the 2017 reporting period. There are no commitments contained in this letter.

If you have any questions or require additional information, please do not hesitate to contact Dr. Amber Donley at 717-456-3056.

Sincerely,

Matthew J. Herr, Plant Manager
Peach Bottom Atomic Power Station

MJH/SMO/GRS/ASD/asd

Enclosure (1)

cc: USNRC Region I, Regional Administrator (Daniel H. Dorman)
USNRC Senior Resident Inspector, PBAPS (Justin Heinly)
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CCN 18-28

PEACH BOTTOM ATOMIC POWER STATION
Unit Numbers 2 and 3
Docket Numbers 50-277 and 50-278
Unit Number 1
Docket Number 50-171
PBAPS Independent Spent Fuel Storage Installation
Docket Number 72-29

RADIOACTIVE EFFLUENT RELEASE REPORT

NO. 60

JANUARY 1, 2017 THROUGH DECEMBER 31, 2017

Submitted to
The United States Nuclear Regulatory Commission
Pursuant to
Facility Operating Licenses DPR-44 and DPR-56

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Technical Concurrence (for accuracy of information):

Siobhan O'Dwyer / Siobhan M. O'Dwyer 4-23-18

Manager, Site Chemistry and Radwaste Date

INTRODUCTION

In accordance with the Reporting Requirements of Technical Specification 5.6.3 applicable during the reporting period, January 1, 2017 through December 31, 2017, this report summarizes the Effluent Release Data for Peach Bottom Atomic Power Station (PBAPS) Units 2 and 3. The notations E+ and E- are used to denote positive and negative exponents to the base 10, respectively.

The release of radioactive materials during the reporting period was within the Offsite Dose Calculation Manual Specification (ODCMS) limits.

There were two (2) abnormal releases of liquid radioactive material. One release was from Residual Heat Removal (RHR) heat exchanger (beginning July of 2016) and the other is from groundwater tritium contamination ('tritium plume'). These releases were far below regulatory limits.

There were no abnormal releases of gaseous radioactive material during 2017.

The maximum calculated organ dose (bone) from iodines (I-131, I-133 and I-135), tritium (H-3), carbon-14 (C-14) and particulates to any individual due to all gaseous effluents was 5.90E-01 mrem, which was approximately 1.97E+00% of the annual limit. The maximum calculated air dose in the unrestricted area due to noble gas effluents was 2.21E-01 mrad (gamma) and 1.51E-01 mrad (beta), which was 1.11E+00% and 3.81E-01%, respectively, of the annual limits.

In 2017, there were no direct gaseous or liquid releases or discharges from Unit 1 to the environment. Previously drummed up tritiated water from Unit 1 was released through the Unit 2 and Unit 3 Liquid Radwaste 'B' Laundry Drain Tank system.

There were no gaseous or liquid radioactive releases from the Independent Spent Fuel Storage Installation, NRC Docket No. 72-29 (ISFSI).

There was a revision to RW-AA-100 "Process Control Program for Radioactive Waste" during the 2017 reporting period. This revision was editorial in nature.

There was a revision of the ODCM during the 2017 reporting period but not to Appendix A of the ODCM. More detail regarding the revision can be found in Attachment 1 and Appendix B of this report.

Exelon Nuclear common procedures, which provide consistent expectations and standards for Radioactive Effluents Controls Program (RECP), were used to generate this report. PBAPS site specific procedures used to assist with abnormal/unplanned releases were also used to generate this report. They are:

- CY-AA-170-000, Radioactive Effluent and Environmental Monitoring Program
- CY-AA-170-100, Radiological Environmental Monitoring Program
- CY-AA-170-200, Radioactive Effluent Controls Program
- CY-AA-170-300, Offsite Dose Calculation Manual Administration
- CY-AA-170-2000, Annual Radioactive Effluent Release Report
- CY-AA-170-2100, Estimated Errors of Effluent Measurement
- CY-AA-170-3100, Offsite Dose Calculation Manual Revisions
- CY-AA-170-2300, Determination of Carbon-14 in Gaseous Effluents
- CY-PB-170-202, RHR-HPSW Leak Rate Calculation
- CY-PB-170-2020, Radiological Abnormal Gaseous Release Assessment
- CY-PB-170-210, Gaseous Dose and Dose Rate Calculation

ATTACHMENT 1: SUPPLEMENTAL INFORMATION

Regulatory Limits

Table 1. Noble Gas Dose Rate and Dose Limits

Maximum Value	Units	Limit Classification	Specification
500	mrem/ yr	annual total body dose rate	ODCM Specification 3.8.C.1.a
3000	mrem/ yr	annual skin dose rate	ODCM Specification 3.8.C.1.a
10	mrad	gamma radiation air dose per quarter	ODCM Specification 3.8.C.2.a
20	mrad	beta radiation in air dose per quarter	ODCM Specification 3.8.C.2.b
20	mrad	gamma radiation in air dose per year	ODCM Specification 3.8.C.2.c
40	mrad	beta radiation in air dose per year	ODCM Specification 3.8.C.2.d

Table 2. Iodines, Tritium and Particulates (with half-lives >8 days) Dose Rate and Dose Limits

Maximum Value	Units	Limit Classification	Specification
1500	mrem/ yr	annual dose rate limit to any organ	ODCM Specification 3.8.C.1.b
15	mrem	annual dose limit to any organ per quarter	ODCM Specification 3.8.C.3.a
30	mrem	dose limit to any organ per year	ODCM Specification 3.8.C.3.b

Table 3. Liquid Effluent Activity Concentration and Dose Rate Limits

Maximum Value	Units	Limit Classification	Specification
≤ 10 times 10 CFR 20, Appendix B, Table 2, Column 2	µCi/mL	Activity Concentration in all liquid releases	ODCM Specification 3.8.B.1.a
2E-04	µCi/mL	total activity concentration for all dissolved and entrained noble gases	ODCM Specification 3.8.B.1.b
3.0	mrem	total body dose limit per quarter	ODCM Specification 3.8.B.2.a
10	mrem	total body dose limit per year	ODCM Specification 3.8.B.2.a
6.0	mrem	dose limit per quarter to any organ	ODCM Specification 3.8.B.2.b
20	mrem	dose limit per year to any organ	ODCM Specification 3.8.B.2.b

Maximum Permissible Concentrations

Gaseous dose rates, rather than effluent concentrations, are used to calculate permissible release rates for gaseous releases. The maximum permissible dose rates for gaseous releases are defined in ODCMS 3.8.C.1.a and 3.8.C.1.b.

The Effluent Concentrations Limits (ECL) specified in 10 CFR 20, Appendix B, Table 2, Column 2 multiplied by 10, for identified nuclides, are used to calculate permissible release rates and concentrations for liquid release per ODCMS 3.8.B.1.

The total activity concentration for all dissolved or entrained noble gases is limited to < 2E-04 µCi/mL (ODCMS 3.8.B.1.b).

Average Energy

The PBAPS ODCM limits the dose-equivalent rates due to the release of noble gases to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin. Therefore, the average beta and gamma energies of the radionuclide mixture in releases of fission and activation gases as described in Regulatory Guide 1.21, Revision 1, "Measuring, Evaluation, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," are not applicable to PBAPS.

Measures and Approximations of Total Radioactivity

Fission and Activation Gases

The method used for gamma isotopic analysis is the Canberra Genie™ System with a gas marinelli beaker. Grab samples are taken and analyzed weekly to determine the isotopic mixture of noble gas activity released for the week. Airborne effluent gaseous activity was continuously monitored and recorded in accordance with ODCMS Table 4.8.C.1. The data from the noble gas radiation monitor were analyzed to report noble gas effluent activities. When no activity was identified in the grab isotopic analysis, the entire release must be assumed to be the radionuclide with the most-limiting dose factors for the release pathway (i.e. krypton-88 (Kr-88) for all ground-level releases, Kr-88 for elevated gamma dose and Kr-87 for elevated beta dose; see ODCM IV.B and NUREG-0133[1]).

The activity released is listed as "unidentified" in the Attachment 2 Tables. If activity was found in the grab isotopic analysis, the isotopic mixture for the Noble Gas Monitor was determined from that isotopic mixture.

Iodines

The method used is the Canberra Genie™ System with a charcoal cartridge. Iodine activity was continuously sampled and analyzed in accordance with ODCMS Table 4.8.C.1.

Particulates

The method used is the Canberra Genie™ System with a particulate filter (47 mm diameter). Particulate activity was continuously sampled and analyzed in accordance with ODCM Table 4.8.C.1.

Composite particulate air samples were submitted to an offsite vendor laboratory for analyses of strontium-89 (Sr-89), Sr-90, nickel-63 (Ni-63) and gross alpha.

[1] NUREG 0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants: A Guidance Manual for Users of Standard Technical Specifications," October 1978.

Carbon-14

The amount of C-14 released was estimated using the guidance from the Electric Power Research Institute (EPRI) Technical Report 1021106, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents". The C-14 was released primarily through the Main Offgas Stack (9.70E+01%) with a small amount (3.00E+00%) through the Reactor Building Exhaust Vents. The C-14 in liquid effluents is not a significant dose pathway, as determined from studies. The resulting annual dose to the maximum conservative receptor is 5.90E-01 mrem, with the limiting receptor as the child bone.

Liquid Effluents

Gamma isotopic activity concentrations are determined on each batch of liquid effluent prior to release using the Canberra Genie™ System in accordance with ODCMS Table 4.8.B.1. The total activity of a released batch is determined by multiplying each nuclide's concentration by the total volume discharged.

Composite liquid radwaste samples are analyzed for tritium on-site and submitted to an offsite vendor laboratory for analyses of iron-55 (Fe-55), phosphorus-32 (P-32), Sr-89, Sr-90, Ni-63, and gross alpha.

Decommissioned Unit 1 Liquid Radioactive Waste Processing

There were no direct gaseous or liquid releases or discharges from Unit 1 to the environment during 2017. However, during the reporting period, a total of 532.7 gallons of water with low concentrations of H-3 were collected from Unit 1 and stored at Unit 2 and 3, for further processing. No gamma emitting nuclides were identified above detectable limits. Also during the reporting period, two separate releases of tritiated water, which originated from Unit 1, were processed through the Unit 2 and Unit 3 liquid radwaste system. A total of 804.7 gallons of tritiated water collected from Unit 1, between 2015 and 2017, were released. The first release of Unit 1 water contained 34 gallons of water collected in 2015, 238 gallons of water collected in 2016, and 103.7 gallons of water collected in 2017. The average H-3 concentration of the released water was 2.58E-03 µCi/mL, producing an estimated dose of 3.00E-08 mrem. The second release of Unit 1 water contained 429 gallons of water collected in 2017, with an average tritium concentration of 5.65E-04 µCi/mL which produced an estimated dose of 1.02E-08 mrem. The annual dose to the child total body and max organ (all organs but bone are equal) due to Unit 1 releases is 4.02E-8 mrem which is 4.02E-07% of the total body dose limit and 2.01E-7% of the maximum organ dose limit.

Estimate of Total Error Present

CY-AA-170-2100, "Estimated Errors of Effluent Measurements", provides the methodology to obtain an overall estimate of the error associated with radioactive effluents, which are listed in Attachment 2 of this report.

Batch Releases

Table 4. Quarterly Liquid Batch Release Statistics

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Number of Batch Releases	6	0	7	17
Total Time for Batch Releases (minutes)	4.25E+02	0	5.87E+02	9.61E+02
Maximum time period for batch release (minutes)	9.50E+01	0	1.30E+02	1.60E+02
Average time period for batch release (minutes)	6.60E+01	0	6.55E+01	6.35E+01
Minimum time period for batch release (minutes)	7.08E+01	0	8.39E+01	5.65E+01
Average Stream Flow (ft^3/s)[2,3]	1.60E+05	2.02E+05	6.37E+04	4.70E+04
Dilution volume (liters)	1.93E+09	0	2.67E+09	1.92E+10

Table 5. Quarterly Gaseous Batch Release Statistics

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Number of batch releases:	0	0	0	0
Total Time for batch releases (minutes)	0	0	0	0
Maximum time period for batch release (minutes)	0	0	0	0
Average time period for batch release (minutes)	0	0	0	0
Minimum time period for batch release (minutes)	0	0	0	0

Average Stream Flow

The river flow is not used for dose calculations. The actual flow rate of Circulation Water (the water that is circulated within the plant for cooling) is determined for each liquid effluent release because this Circulation Water provides dilution and therefore reduces the projected dose.

[2] Average Stream Flow is not used for dose calculation. Dec 2017 data unavailable, 4th quarter average only Oct and Nov

[3] USGS National Water Information System, Site Name: "Susquehanna River at Marietta, PA", Site Number: 01576000. Data accessed 27 February 2018.

Abnormal or Unplanned Releases

'Abnormal' releases are those releases that are not defined as 'normal' releases in the Licensee's ODCM. While attempts are made to ensure radioactivity is not released offsite without processing, monitoring of systems with a potential for release is continuously performed. Source terms used for dose calculations utilize direct sampling and the maximum concentrations of nuclides to ensure that the most conservative and bounding estimates are used. Methodologies calculate conservative dose utilizing conservative mathematical models to describe intake and exposure pathways. Therefore, reported doses for these abnormal releases are calculated conservatively.

Liquid Releases

Groundwater Tritium Plume

During 2017, during the sampling and analysis of the Radiological Ground Water Protection Program (RGPP), tritium was measured at several locations around the site. The ground water that has detectable tritium has been determined to flow into the Plant intake and eventually flow into the normal Discharge Canal. Details of this program can be found in the Peach Bottom Annual Radiological Environmental Operating Report (AREOR) as an appendix. No other nuclides were detected in monitoring wells.

Analysis of Release

It was assumed from the maximum flow rates measured[4] that ground water flowed to the discharge canal at a steady rate of 3.17E+02 gpm, carrying with it some of the tritium underneath the plant. The conservative maximum dose for the entire year from this continuous release is calculated to be 5.56E-05 mrem (to the whole-body) and 5.56E-05 mrem (to any organ, except bone[5] which is 0.00E+00 mrem)[6]. This dose contribution projection is well below the limit specified in the ODCM.

Heat Exchanger Leakage

In July of 2016, a small leak developed in the Unit 3 'C' Residual Heat Removal (RHR) Heat Exchanger, which is designed to circulate water to remove heat from the reactor unit when necessary. The dose model assumes that contaminated tours water leaks from the heat exchanger, regardless of operating pressure to ensure conservatism in calculated dose. As an additional precaution, installed radiation monitoring instrumentation can indicate an inadvertent release of radioactive material should the heat exchanger develop a large leak unexpectedly.

[4] "Estimated Mass Flux Of Tritiated Groundwater To The Conowingo Reservoir And Rock Run Creek, Peach Bottom Atomic Power Station, Delta, Pennsylvania", November 2012, Conestoga-Rovers & Associates.
[5] Tritium dose factor for bone is 0.00E+00; therefore no hypothetical dose is calculated.
[6] These doses are identical because the dose factors are identical for the same nuclide and pathway.

Analysis of Release

It was assumed that the torus water released to the discharge canal, during 2017, contributed a conservative maximum dose of 5.01E-05 mrem to the total body (receptor adult), and a conservative maximum organ dose of 1.17E-04 mrem to the adult GI-LLI, dose. This dose contribution is well below the limits specified in the ODCM.

Samples were analyzed for all the parameters of radioactive effluent releases. Composite liquid torus water samples were counted for tritium and submitted to an offsite vendor laboratory for analyses of Fe-55, P-32, Sr-89, Sr-90, Ni-63 and gross alpha. The dose contributions and isotope quantities from the releases were added to this Radioactive Effluent Release Report for the applicable reporting periods.

Gaseous Releases

There were no gaseous abnormal releases during 2017.

Changes to the ODCM

There was a revision the ODCM, but not the ODCM Specifications (Appendix A) during 2017. ODCM Revision 16 implemented changes to meteorological (MET) factors and the equation used to determine dose for the max receptor due to radioiodine, tritium, carbon-14, and particulates. The equation in ODCM Section IV.C. was updated to reflect the same equation definition in NUREG 0133. Some liquid dose factors were updated for radionuclides not commonly found in liquid radwaste. Additionally, the ODCM REMP portion was updated for some station coordinates or distances, a milk farm replaced a garden, and the number of required dosimeters at each location was changed. Revision 16 of the ODCM was implemented on 12/29/2017 to allow for sufficient time to implement the numerous procedure revisions needed to implement the new ODCM revision, but for the purposes of this report the doses reported are following ODCM Rev 15 methodology. There will be a more detailed discussion of the 2017 ARERR dose reported with ODCM Rev 16 methodology in Appendix B.

Minimum Detectable Concentrations

If a radionuclide was not detected, "<LLD" was reported as the activity. Samples were analyzed with techniques that achieved the required Lower Limits of Detection (LLD) as specified in ODCMS Table 4.8.B.1, "Radioactive Liquid Waste Sampling and Analysis" (for liquids) or ODCMS Table 4.8.C.1, "Radioactive Gaseous Waste Sampling and Analysis from Main Stack and Vent Stack" (for gases). In all cases, the LLD requirements were satisfied.

Violations

There were no effluent release violations for the 2017 reporting period.

Dose Assessment

Introduction

A dose assessment for PBAPS was conducted with the measured cumulative 2017 radioactive effluent source terms, provided in Attachment 2, "Effluent Summary," and the 2017 meteorological (MET) data. This dose assessment verifies that PBAPS continues to demonstrate compliance with the limits as well as the requirement of maintaining the doses "as low as is reasonably achievable" as stated in 10 CFR 50, Appendix I.[7]

Liquid Dose Assessment

Hydrologic Conditions and Receptor Locations of Interest

PBAPS is located on the Conowingo Pond formed in the Susquehanna River by the Conowingo Dam. For 2017, the annual average river flow[8] was measured as 4.73E+05 ft^3/s.

Of the three separate flow regimes that were used in the original Appendix I submittal, the most-limiting of them (<1.50E+04 ft^3/s) was used to calculate a dose assessment for this report because this would provide a bounding extreme for all PBAPS liquid effluents. Therefore, although the actual average stream flow for the year was more than double the limiting case, this report will provide an upper limit for the most-limiting dose.

The annual average dilution factor[9] at the Conowingo Intake is 5.40E+00 and the assumption for the reconcentration factor[9] is 1.16E+00. The PBAPS shorewidth factor[10] of 2.00E-01 was also used.

No invertebrate intake was examined because invertebrate ingestion pathways are not considered to be significant in the area close to PBAPS. The pathway factors for the various age groups, used to determine dose to the public from liquid effluents are shown in Table 6.

Table 6. Consumption and Usage Rate Assumptions

Pathway	Adult	Teenager	Child	Infant	Units
Eating Fish[10]	2.10E+01	1.60E+01	6.90E+00	0.00E+00	kg/ yr
Drinking Water[11]	7.30E+02	5.10E+02	5.10E+02	5.10E+02	L/ yr
Swimming[12]	2.80E+02	2.80E+02	0.00E+00	0.00E+00	h/ yr
Boating[12]	1.20E+02	1.20E+02	6.70E+01	0.00E+00	h/ yr
Shoreline Recreation[12]	3.25E+02	3.25E+02	1.40E+01	0.00E+00	h/ yr
Fishing from Conowingo Dam[12]	3.25E+02	3.25E+02	0.00E+00	0.00E+00	h/ yr

[7] 10 CFR 50 Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonable Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents".

[8] USGS National Water Information Service; Monitoring Site 01576000, Susquehanna River at Marietta, PA; http://waterdata.usgs.gov/nwis. Accessed 27 Feb 2018. Does not include Dec 2017 data.

[9] From original ODCM. [10] RG 1.109, Table A-2.

[11] All locations from RG 1.109, Section A-2. Chester Water Authority uses 10% of the RG 1.109 value because it is assumed to have 10% sourced from Conowingo Pond.

[12] PBAPS Environmental Report, Supplement No. 3, Page 19. Boating data is a ratio of Adult:Child rates from RG 1.109, Table A-2.

Liquid Effluent Dose Assessment Conclusion
For all permitted releases in 2017, the calculated total body dose was 6.12E-06 mrem and 7.00E-06 mrem to the limiting organ of adult liver.

Therefore, PBAPS liquid radioactive effluent controls continue to demonstrate compliance with 10 CFR 50, Appendix I objectives for the purposes of keeping doses to members of the public "as low as is reasonably achievable". These limiting or maximum calculated doses are a small fraction of the limits in Appendix I.

Gaseous Dose Assessment
The gaseous dose assessment calculates the conservative dose at the limiting receptor location, as defined in the ODCM and at locations from the land-use census, using the 2017 meteorology to demonstrate compliance with 10 CFR 50, Appendix I.

Tables 7 and 8 utilized the CY-PB-170-210 spreadsheet to calculate the doses for elevated and ground releases with the 2017 MET data and gaseous total activity released, including C-14. Table 7 utilized MET data from the locations with the highest X/Q from the Main Offgas Stack and the corresponding Reactor Building Exhaust Vents MET factors. Table 8 utilized MET data from the locations with the highest D/Q sectors from the Reactor Building Exhaust Vents and the corresponding Main Offgas Stack MET factors. The X/Q values are very similar to those used in the ODCM, and therefore the differences in noble gas dose is minimal. The larger discrepancies between Iodine, Particulates, Tritium (I/P/T) organ doses can be explained by the differences in pathways. Tables 7 and 8 assume that there is a milk pathway at each of the listed locations. The ODCM defines the milk pathway at 1500m SW and the D/Qs are more comparable (2017 vent: 2.24E-9 $1/m^2$ vs. ODCM vent: 1.58E-09 $1/m^2$) and therefore, the dose calculated by ODCM methodology is more conservative than the dose reported in Tables 7 and 8.

Table 7. Conservative Maximum Elevated Release Dose from 2017 Source Term and 2017 Meteorology

Distance (m)	Direction	2017 Highest MS X/Q (D/Q)	2017 Vent X/Q (D/Q)	Total Body Dose (mrem)	Skin Dose (mrem)	Gamma Air Dose (mrad)	Beta Air Dose (mrad)	I/P/T/C-14 Dose (mrem)	Limiting Receptor
4900	N	3.94E-08 (2.37E-10)	1.16E-07 (5.69E-10)	2.28E-02	2.97E-02	2.36E-02	1.61E-02	1.64E-01	Bone
3800	SW	3.14E-08 (1.80E-10)	1.39E-07 (5.34E-10)	2.72E-02	3.52E-02	2.82E-02	1.91E-02	1.36E-01	Bone

Table 8. Ground-Level Dose from 2017 Source Term and 2017 Meteorology

Distance (m)	Direction	2017 Highest Vent D/Q (X/Q)	2017 MS X/Q (D/Q)	Total Body Dose (mrem)	Skin Dose (mrem)	Gamma Air Dose (mrad)	Beta Air Dose (mrad)	I/P/T/C-14 Dose (mrem)	Limiting Receptor
1200	SSE	9.66E-09 (1.21E-06)	4.09E-09 (7.11E-10)	2.31E-01	3.00E-01	2.39E-01	1.62E-01	1.59E-01	Bone
900	NW	8.67E-09 (1.31E-06)	7.67E-09 (7.30E-10)	2.50E-01	3.25E-01	2.59E-01	1.75E-01	1.85E-01	Bone

Gaseous Radioactive Effluent Dose Assessment Conclusion

The conservative maximum dose was 5.90E-01 mrem with the maximum receptor as the child bone and this is due to the incorporation of carbon-14 in the calculation. Without C-14, the maximum dose is 3.09E-03 mrem to the infant thyroid. The noble gas limiting air doses were 2.21E-01 mrad (gamma) and 1.51E-01 mrad (beta). Noble gas plume conservative dose was 2.14E-01 mrem for the year to the total body and 2.79E-01 mrem for the year to the skin.

A dose assessment was performed for members of the public due to their activities inside the site boundary. The location where a member of the public would spend a significant amount of time inside the site boundary is the Vehicle checkpoint, approximately 1,900 feet N of the PBAPS Unit 2 and Unit 3 reactor building exhaust vents. Assuming continuous occupancy, the calculated total body and skin doses were 1.48E-01 mrem and 1.92E-01 mrem, respectively. The noble gas limiting air doses were 1.53E-01 mrad (gamma) and 1.03E-01 mrad (beta).

All doses are projected to be much less than the limits, as expected. Again, these dose models incorporate several factors of conservatism including a source term that, by procedure, will use the most dose-limiting noble gas nuclide when no fission gas can be identified by grab sample but activity is detected from the effluent radiation monitor. Exelon Nuclear uses a detailed C-14 dose projection from the Electric Power Research Institute, Technical Report 1021106. Details for the assumptions used in this calculation may be found there.[15]

Therefore, PBAPS gaseous radioactive effluent controls continue to demonstrate compliance with 10 CFR 50, Appendix I objectives for the purposes of keeping doses to members of the public "as low as is reasonably achievable". These limiting or maximum calculated doses are a small fraction of the limits in Appendix I.

[15] PBAPS uses specific Boiling Water Reactor assumptions because the fraction of C-14 that is in the CO_2 form will vary based on general plant design. This is important because the major dose pathway is through photosynthesis and, therefore, only the oxide form is relevant.

ATTACHMENT 2: EFFLUENT SUMMARY

Gaseous Effluents - Summation of All Releases

Period: January 1, 2017 through December 31, 2017 **Unit: Peach Bottom**

A. Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1. Total Release	Ci	1.50E+02	1.11E+02	6.77E+01	1.70E+02	4.00E+01
2. Average release For the Period	uCi/ s	1.93E+01	1.41E+01	8.52E+00	2.14E+01	
3. Gamma Air Dose	mrad	6.73E-02	4.97E-02	2.60E-02	7.90E-02	
4. Beta Air Dose	mrad	4.62E-02	3.41E-02	1.81E-02	5.40E-02	
5. Percent of ODCM limit						
Gamma Air Dose	%	6.73E-01	4.97E-01	2.60E-01	7.90E-01	
Beta Air Dose	%	2.31E-01	1.70E-01	9.04E-02	2.70E-01	

B. Iodines

1. Total I-131	Ci	4.71E-05	7.40E-05	8.50E-05	2.09E-04	1.90E+01
2. Average release For the Period	uCi/ s	6.06E-06	9.41E-06	1.07E-05	2.63E-05	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

C. Particulate

1. Particulates with T1/2 > 8 days	Ci	5.90E-05	8.48E-05	8.22E-05	2.22E-04	2.80E+01
2. Average release For the Period	uCi/ s	7.59E-06	1.08E-05	1.03E-05	2.79E-05	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

D. Tritium

1. Total Release	Ci	5.73E+00	1.35E+01	1.41E+01	3.24E+00	1.30E+01
2. Average release For the Period	uCi/ s	7.37E-01	1.71E+00	1.78E+00	4.07E-01	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

E. Gross Alpha

1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	4.00E+02
2. Average release For the Period	uCi/ s	<LLD	<LLD	<LLD	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

F. Carbon-14

1. Total Release	Ci	9.53E+00	9.53E+00	9.53E+00	9.53E+00
2. Average release For the Period	uCi/ s	1.23E+00	1.21E+00	1.20E+00	1.20E+00

G. Iodine-131, 133 and 135, Tritium, Carbon-14 & Particulate

1. Organ Dose*	mrem	1.48E-01	1.47E-01	1.47E-01	1.48E-01
2. Percent ODCM limit	%	9.83E-01	9.83E-01	9.83E-01	9.83E-01

*C-14 contributes most significantly; therefore, the quarterly dose to the child bone is reported

Gaseous Effluents Release Point: Elevated (Main Offgas Stack)

Period: January 1, 2017 through December 31, 2017 **Unit: Peach Bottom**

Nuclides Released		Continuous Mode				Batch Mode			
1. Fission Gases	**Unit**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	3.04E+00	9.55E+00	8.85E+00	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	4.26E+00	9.49E+00	3.40E+00	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	1.26E+00	1.43E+00	<LLD	1.83E+00	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Unidentified	Ci	2.50E+01	1.06E+01	1.03E+00	1.01E+01	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	2.63E+01	1.93E+01	2.01E+01	2.42E+01	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	3.57E-05	4.37E-05	5.88E-05	7.97E-05	<LLD	<LLD	<LLD	<LLD
I-133	Ci	9.66E-05	1.33E-04	1.58E-04	1.30E-04	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	2.24E-05	4.74E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	1.32E-04	1.99E-04	2.21E-04	2.10E-04	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	3.07E-05	3.11E-05	4.35E-05	3.55E-05	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	1.45E-07	7.56E-08	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	7.08E-06	6.55E-06	5.79E-06	7.00E-06	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	4.46E-06	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	7.59E-07	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	4.84E-07	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	1.09E-06	5.56E-06	1.58E-06	6.37E-05	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	1.19E-06	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	3.89E-05	4.32E-05	5.11E-05	1.13E-04	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3	Ci	8.18E-01	1.86E+00	2.55E+00	3.56E-01	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon-14									
C-14	Ci	9.24E+00	9.24E+00	9.24E+00	9.24E+00	<LLD	<LLD	<LLD	<LLD

Gaseous Effluents Release Point: Ground-Level (Units 2 and 3 Reactor Building Exhaust Vents and Abnormal Releases)

Period: January 1, 2017 through December 31, 2017 **Unit: Peach Bottom**

Nuclides Released		Continuous Mode				Batch Mode			
1. Fission Gases	**Unit**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Unidentified	Ci	1.24E+02	9.15E+01	4.77E+01	1.46E+02	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	1.24E+02	9.15E+01	4.77E+01	1.46E+02	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	1.15E-05	3.03E-05	2.63E-05	1.30E-04	<LLD	<LLD	<LLD	<LLD
I-133	Ci	1.12E-04	9.99E-05	2.21E-04	2.01E-04	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	1.24E-04	1.30E-04	2.48E-04	3.30E-04	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	7.17E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	3.46E-05	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	3.46E-06	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	2.02E-05	3.44E-05	3.11E-05	7.05E-05	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	5.64E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Total For Period	Ci	2.02E-05	4.16E-05	3.11E-05	1.09E-04	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3	Ci	4.91E+00	1.16E+01	1.16E+01	2.88E+00	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon-14									
C-14	Ci	2.86E-01	2.86E-01	2.86E-01	2.86E-01	<LLD	<LLD	<LLD	<LLD

Liquid Effluents - Summation of All Releases

Period: January 1, 2017 to December 31, 2017 **Unit: Peach Bottom**

A. Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1. Total Release (not including tritium, gases & alpha)	Ci	4.61E-04	2.14E-04	1.41E-03	2.05E-03	1.60E+01
2. Average diluted concentration for the Period	µCi/ mL	7.19E-13	3.21E-13	2.08E-12	3.03E-12	
3. Percent of applicable limit						
Total Body Dose	%	8.37E-04	3.20E-03	2.18E-03	6.32E-03	
Organ Dose	%	6.03E-04	2.44E-03	8.94E-04	2.80E-03	

B. Tritium						Est. Total Error %
1. Total Release	Ci	2.11E+00	9.99E-01	1.17E+00	2.59E+00	6.40E+00
2. Average diluted concentration for the Period	µCi/ mL	3.28E-09	1.50E-09	1.73E-09	3.83E-09	
3. Percent of applicable limit*	%	3.28E-05	1.50E-05	1.73E-05	3.83E-05	

*10x 10CFR20 Limit of 1.00E-03 µCi/ mL; ODCMS 3.8.B.1.a

C. Dissolved & Entrained Gases						Est. Total Error %
1. Total Release	Ci	<LLD	<LLD	<LLD	4.51E-06	2.80E+01
2. Average diluted concentration for the Period	µCi/ mL	<LLD	<LLD	<LLD	6.68E-15	
3. Percent of ODCM limit*	%	0.00E+00	0.00E+00	0.00E+00	3.34E-09	

*ODCMS 3.8.B.1.b Limit for all noble gases is 2.00E-04 µCi/ mL

D. Gross Alpha Activity						Est. Total Error %
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	2.30E+01

E. Volume of Waste Released (prior to dilution)	Liters	1.57E+08	1.57E+08	1.59E+08	1.59E+08

F. Volume of Dilution Water Used During Period	Liters	6.41E+11	6.68E+11	6.80E+11	6.75E+11

Liquid Effluents Release Points – Liquid Radwaste, RHR Leaks and Groundwater

Period: January 1, 2017 through December 31, 2017 **Unit: Peach Bottom**

Nuclides Released		Continuous Mode				Batch Mode			
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	7.40E-06	3.30E-06	<LLD	1.35E-06	7.03E-08	<LLD	<LLD	4.20E-07
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	1.20E-05	<LLD	<LLD	1.59E-04	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	3.40E-04	1.66E-04	1.28E-03	8.66E-04	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	2.79E-05	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	3.15E-05	1.49E-05	4.13E-05	1.03E-04	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	5.54E-05	2.14E-05	6.88E-05	2.51E-04	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	6.19E-04	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	5.93E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	5.78E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	7.96E-06	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	1.49E-05	4.38E-06	1.51E-05	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-124	Ci	<LLD	<LLD	<LLD	1.21E-05	<LLD	<LLD	<LLD	<LLD
Sb-125	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ni-63	Ci	<LLD	4.00E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
H-3	Ci	2.10E+00	9.99E-01	9.08E-01	2.26E+00	5.48E-03	<LLD	2.67E-01	3.27E-01
P-32	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	2.10E+00	9.99E-01	9.09E-01	2.26E+00	5.48E-03	0.00E+00	2.67E-01	3.27E-01
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.51E-06
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period (ex-tritium, gases and alpha)	Ci	4.61E-04	2.14E-04	1.41E-03	2.05E-03	7.03E-08	0.00E+00	0.00E+00	4.20E-07

ATTACHMENT 3: SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

Solid Waste Shipped

1.Type of Waste

	Units	2017	Est. error %
A: Spent Resin, Filters, Sludges, Evaporator Bottoms, etc	m^3	9.38E+01	
	Ci	2.49E+02	2.50E+01
B: Dry Compressible Waste, Contaminated Equipment, etc.	m^3	8.69E+02	
	Ci	2.39E+01	2.50E+01
C: Irradiated Components, Control Rods, etc.	m^3	1.78E-01	
	Ci	6.10E+00	2.50E+01
D: Other (Oil, SBLC)	m^3	1.41E+01	
	Ci	8.76E-04	2.50E+01

2.Estimate of Major Nuclide Composition (by type of waste)

a. Spent-Resin, Filters, Sludges, Evaporator Bottoms, etc.

Nuclide	Abundance % (no cutoff)	Activity (Ci)
H-3	2.30E-01	5.72E-01
C-14	1.10E+00	2.75E+00
Cl-36	6.14E-07	1.53E-06
Cr-51	2.17E+00	5.41E+00
Mn-54	3.04E+01	7.58E+01
Fe-55	1.56E-05	3.89E-05
Fe-59	6.39E-04	1.59E-03
C0-57	8.27E-03	2.06E-02
Co-58	5.26E+01	1.31E+02
Co-60	1.99E+00	4.95E+00
Ni-63	3.12E+00	7.77E+00
Zn-65	2.77E-04	6.90E-04
Sr-89	2.56E-02	6.38E-02
Sr-90	1.44E-06	3.59E-06
Zr-95	5.38E-05	1.34E-04
Nb-95	2.95E-03	7.34E-03
Tc-99	2.69E-09	6.70E-09
Ru-103	7.79E-02	1.94E-01
Ag-110m	3.06E-05	7.61E-05

Nuclide	Abundance % (no cutoff)	Activity (Ci)
Sn-113	2.62E-05	6.52E-05
Sb-124	2.62E-03	6.53E-03
Sb-125	2.30E-01	5.72E-01
I-131	2.93E-24	7.29E-24
Cs-134	2.34E-03	5.83E-03
Cs-137	8.03E+00	2.00E+01
Ba-140	9.52E-13	2.37E-12
La-140	1.06E-105	2.64E-105
Ce-141	3.35E-07	8.35E-07
Ce-144	1.70E-01	4.23E-01
Hf-175	8.84E-08	2.20E-07
Pu-238	1.59E-04	3.95E-04
Pu-239	5.34E-05	1.33E-04
Pu-241	1.63E-02	4.07E-02
Am-241	1.39E-04	3.46E-04
Cm-242	4.90E-06	1.22E-05
Cm-243	2.24E-05	5.59E-05
Cm-244	3.59E-04	8.95E-04

Analyses of 2017 resin samples showed higher H-3 activity than typically observed. The results were not the largest seen in PB history, but more significant than the previous five years. The original sample was reanalyzed and a confirmatory sample was analyzed and found to be statistically the same, therefore the H-3 scaling factors were adjusted for shipping of resin in 2017. These results were documented in IR 04000032 and the new scaling factors are accounted for in the table above. It is expected that resin shipped in the future will also utilize higher scaling factors.

b. Dry, Compressible Waste, Contaminated Equipment, etc.

Nuclide	Abundance % (no cutoff)	Activity (Ci)
H-3	6.45E-02	1.55E-02
C-14	1.15E-02	2.77E-03
Cr-51	8.78E-02	2.11E-02
Mn-54	2.00E+00	4.81E-01
Fe-55	3.84E+01	9.23E+00
Fe-59	6.20E-02	1.49E-02
Co-58	2.65E-02	6.36E-03
Co-60	5.37E+01	1.29E+01
Ni-63	2.19E+00	5.25E-01
Zn-65	1.36E+00	3.26E-01
Sr-89	7.08E-04	1.70E-04
Sr-90	3.42E-02	8.22E-03
Zr-95	3.00E-22	7.20E-23
Nb-94	8.62E-02	2.07E-02
Nb-95	1.77E-03	4.26E-04

Nuclide	Abundance % (no cutoff)	Activity (Ci)
Tc-99	2.87E-02	6.90E-03
Ag-110m	2.96E-02	7.11E-03
I-129	5.00E-03	1.20E-03
Cs-134	1.78E-04	4.27E-05
Cs-137	1.37E+00	3.30E-01
Ce-141	2.24E-11	5.37E-12
Ce-144	5.12E-01	1.23E-01
Pu-238	1.23E-05	2.95E-06
Pu-239	4.50E-04	1.08E-04
Pu-241	8.08E-03	1.94E-03
Am-241	2.10E-05	5.04E-06
Cm-242	7.53E-07	1.81E-07
Cm-243	2.59E-06	6.23E-07
Cm-244	3.20E-05	7.69E-06

c. Irradiated Components, Control Rods, etc.

Nuclide	Abundance % (no cutoff)	Activity (Ci)
H-3	2.82E-05	1.72E-06
C-14	1.01E-03	6.18E-05
Cr-51	1.18E-07	7.19E-09
Mn-54	8.91E-01	5.43E-02
Fe-55	4.59E+01	2.80E+00
Fe-59	6.25E-06	3.81E-07
Co-58	2.75E-03	1.68E-04
Co-60	4.96E+01	3.02E+00

Nuclide	Abundance % (no cutoff)	Activity (Ci)
Ni-59	6.78E-02	4.13E-03
Ni-63	3.52E+00	2.15E-01
Zn-65	1.63E-02	9.90E-04
Zr-95	4.31E-15	2.63E-16
Nb-94	5.46E-05	3.33E-06
Nb-95	9.05E-15	5.51E-16
Tc-99	8.57E-05	5.22E-06
Cs-137 D	8.72E-05	5.31E-06
Ce-144 D	4.03E-05	2.46E-06

d. Other: Oil

Nuclide	Abundance % (no cutoff)	Activity (Ci)
Co-60	2.29E+01	2.00E-04
Cs-137	1.31E+01	1.15E-04
Ce-144	6.40E+01	5.61E-04

3.Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
32	Hittman Transport Services	Energy Solution Services (CVRF) Bear Creek Operations
4	Hittman Transport Services	Energy Solution Services (GRF) Gallaher Road Operations
20	Hittman Transport Services	Energy Solutions LLC Clive Disposal Site- Containerized Waste Facility

Irradiated Fuel Shipments

No shipment of irradiated fuel was made during the reporting period of 2017.

Changes to Process Control Program (PCP)

There was a revision to RW-AA-100 during the 2017 reporting period. This revision was editorial in nature, with the only changes identifying the new nuclear plant within the Exelon Fleet and removing a decommissioned plant. There was no change to the overall program or the controls maintained by the program.

ATTACHMENT 4: RADIOLOGICAL IMPACT ON MAN

Radiological Impact on Man

Effluent	Applicable Organ	Estimated Dose	Age Group	Location		% of Applicable Limit	Limit	Unit
				Distance (meters)	Direction (toward)			
Noble Gas	Gamma - Air Dose	2.21E-01	All	1.10E+03	SSE	1.11E+00	2.00E+01	mrad
Noble Gas	Beta - Air Dose	1.51E-01	All	1.10E+03	SSE	3.78E-01	4.00E+01	mrad
Noble Gas	Total Body (gamma)	2.14E-01	All	1.10E+03	SSE	2.14E+00	1.00E+01	mrem
Noble Gas	Skin (Beta)	2.79E-01	All	1.10E+03	SSE	9.30E-01	3.00E+01	mrem
Gaseous Iodine, Particulate, Carbon-14 & Tritium	Bone	5.90E-01	Child	1.10E+03	SSE	1.97E+00	3.00E+01	mrem
Gaseous Iodine, Particulate & Tritium	Thyroid	3.09E-03	Infant	1.10E+03	SSE	1.03E-02	3.00E+01	mrem
Liquid	Total Body (gamma)	1.03E-04	Child	Site Boundary		1.71E-03	6.00E+00	mrem
Liquid	GI-LLI	1.67E-04	Adult			8.34E-04	2.00E+01	mrem
Direct Radiation	Total Body	0.00E+00	All	1.15E+03	SSE	0.00E+00	2.20E+01	mrem

40 CFR 190 Doses

Effluent	Applicable Organ	Estimated Dose	Age Group	Location		% of Applicable Limit	Limit	Unit
				Distance (meters)	Direction (toward)			
Total Dose	Total Body	2.14E-01	All	1.15E+03	SSE	8.56E-01	2.50E+01	mrem
Total Dose	Thyroid	3.09E-03	All	1.15E+03	SSE	4.12E-03	7.50E+01	mrem
Total Dose	Bone	5.90E-01	All	1.15E+03	SSE	2.36E+00	2.50E+01	mrem
Total Dose	Total Body	2.14E-01	All	1.15E+03	SSE	7.14E+00	3.00E+00	mrem
Total Dose	Bone	5.90E-01	All	1.15E+03	SSE	1.97E+01	3.00E+00	mrem
Total Dose	Thyroid	2.24E-01	All	1.15E+03	SSE	4.08E-01	5.50E+01	mrem

ATTACHMENT 5: METEOROLOGICAL DATA

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	0	0	0	0	4
NNE	0	2	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	5	3	0	0	0	0	8
E	4	13	1	0	0	0	18
ESE	0	6	0	0	0	0	6
SE	0	1	2	0	0	0	3
SSE	0	0	3	0	0	0	3
S	0	3	5	1	0	0	9
SSW	0	0	4	0	0	0	4
SW	0	0	2	0	0	0	2
WSW	0	1	1	0	1	0	3
W	0	0	0	2	0	0	2
WNW	0	0	1	3	0	0	4
NW	0	0	1	0	0	0	1
NNW	0	0	1	3	0	0	4
Variable	0	0	0	0	0	0	0
Total	10	33	21	9	1	0	74

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	1	0	0	0	3
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	3	2	0	0	0	0	5
E	4	3	0	0	0	0	7
ESE	0	2	0	0	0	0	2
SE	0	3	0	0	0	0	3
SSE	0	3	1	4	0	0	8
S	0	3	4	1	0	0	8
SSW	0	0	1	0	0	0	1
SW	0	0	5	1	0	0	6
WSW	0	1	4	2	0	0	7
W	0	3	9	11	2	0	25
WNW	0	0	13	12	0	0	25
NW	0	4	9	14	5	0	32
NNW	0	3	13	3	1	0	20
Variable	0	0	0	0	0	0	0
Total	7	31	60	48	8	0	154

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	1	0	0	0	2
NNE	1	1	0	0	0	0	2
NE	0	0	0	0	0	0	0
ENE	1	0	0	0	0	0	1
E	0	1	0	0	0	0	1
ESE	1	2	0	0	0	0	3
SE	1	2	2	0	0	0	5
SSE	0	3	3	0	0	0	6
S	0	3	4	1	0	0	8
SSW	0	3	0	1	0	0	4
SW	0	1	2	0	0	0	3
WSW	0	0	5	1	0	0	6
W	0	6	9	10	1	0	26
WNW	0	1	14	12	0	0	27
NW	0	4	11	9	1	0	25
NNW	0	6	17	3	1	0	27
Variable	0	0	0	0	0	0	0
Total	4	34	68	37	3	0	146

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	28	15	3	0	0	50
NNE	9	16	5	0	0	0	30
NE	18	41	1	0	0	0	60
ENE	23	12	0	0	0	0	35
E	28	21	0	0	0	0	49
ESE	10	16	0	0	0	0	26
SE	13	40	8	0	0	0	61
SSE	8	26	20	1	0	0	55
S	5	29	25	2	0	0	61
SSW	0	7	7	2	0	0	16
SW	2	17	7	2	0	0	28
WSW	4	18	19	7	0	0	48
W	7	36	52	37	3	0	135
WNW	12	52	70	39	0	0	173
NW	8	48	51	45	3	1	156
NNW	6	31	69	10	0	0	116
Variable	0	0	0	0	0	0	0
Total	157	438	349	148	6	1	1099

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	5	0	0	0	0	14
NNE	11	3	0	0	0	0	14
NE	23	3	0	0	0	0	26
ENE	24	6	0	0	0	0	30
E	40	5	0	0	0	0	45
ESE	40	5	0	0	0	0	45
SE	19	17	0	0	0	0	36
SSE	21	18	3	0	0	0	42
S	8	13	6	0	0	0	27
SSW	9	4	10	1	0	0	24
SW	10	27	2	1	0	0	40
WSW	11	35	16	0	0	0	62
W	4	37	9	0	0	0	50
WNW	6	17	2	0	0	0	25
NW	6	18	5	0	0	0	29
NNW	9	8	2	2	0	0	21
Variable	0	0	0	0	0	0	0
Total	250	221	55	4	0	0	530

Hours of calm in this stability class: 15
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	0	0	0	0	0	1
NNE	2	0	0	0	0	0	2
NE	7	0	0	0	0	0	7
ENE	3	0	0	0	0	0	3
E	12	1	0	0	0	0	13
ESE	10	0	0	0	0	0	10
SE	3	0	0	0	0	0	3
SSE	0	0	0	0	0	0	0
S	4	0	0	0	0	0	4
SSW	3	0	0	0	0	0	3
SW	3	0	0	0	0	0	3
WSW	6	9	0	0	0	0	15
W	2	1	0	0	0	0	3
WNW	5	1	0	0	0	0	6
NW	5	1	0	0	0	0	6
NNW	3	0	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	69	13	0	0	0	0	82

Hours of calm in this stability class: 11
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	0	0	0	0	0	4
NNE	0	0	0	0	0	0	0
NE	3	0	0	0	0	0	3
ENE	3	0	0	0	0	0	3
E	5	0	0	0	0	0	5
ESE	3	0	0	0	0	0	3
SE	3	0	0	0	0	0	3
SSE	1	0	0	0	0	0	1
S	0	0	0	0	0	0	0
SSW	1	1	1	0	0	0	3
SW	2	1	0	0	0	0	3
WSW	1	2	0	0	0	0	3
W	1	0	0	0	0	0	1
WNW	1	0	0	0	0	0	1
NW	0	0	0	0	0	0	0
NNW	1	0	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	29	4	1	0	0	0	34

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Extremely Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	1	0	0	0	0	1
E	0	1	0	0	0	0	1
ESE	0	0	3	1	0	0	4
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	2	3	1	0	0	6

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Moderately Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	1	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	1	3	1	0	0	5
SSE	0	0	0	0	0	0	0
S	0	0	0	1	0	0	1
SSW	0	0	0	1	0	0	1
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	2	3	3	0	0	8

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Slightly Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	0	0	0	0	1
NNE	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	1	0	0	0	0	1
ESE	0	2	1	0	0	0	3
SE	0	0	1	1	0	0	2
SSE	0	0	1	1	0	0	2
S	0	0	2	3	1	0	6
SSW	0	0	0	2	0	0	2
SW	0	0	0	1	0	0	1
WSW	0	0	1	0	0	1	2
W	0	0	0	0	4	3	7
WNW	0	0	0	2	5	3	10
NW	0	0	0	1	1	0	2
NNW	0	0	0	0	2	2	4
Variable	0	0	0	0	0	0	0
Total	0	5	6	11	13	9	44

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Neutral - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	9	31	23	6	3	73
NNE	0	1	13	12	4	0	30
NE	1	9	20	3	4	0	37
ENE	0	7	15	9	9	3	43
E	1	6	14	17	0	0	38
ESE	1	10	8	20	0	0	39
SE	1	14	35	12	0	0	62
SSE	1	9	23	12	2	1	48
S	1	8	31	30	7	0	77
SSW	1	8	21	27	9	1	67
SW	0	4	6	6	4	1	21
WSW	0	2	20	16	4	4	46
W	0	8	35	36	47	30	156
WNW	1	10	41	60	76	34	222
NW	1	14	43	65	59	31	213
NNW	0	14	53	59	11	10	147
Variable	0	0	0	0	0	0	0
Total	10	133	409	407	242	118	1319

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Slightly Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	8	9	2	0	0	21
NNE	1	5	5	1	0	0	12
NE	2	6	3	2	0	0	13
ENE	2	5	9	1	0	0	17
E	1	14	14	3	1	0	33
ESE	2	14	13	3	0	0	32
SE	3	23	21	2	0	0	49
SSE	2	29	20	3	0	0	54
S	6	23	42	22	4	1	98
SSW	1	9	16	8	7	0	41
SW	3	11	11	17	4	0	46
WSW	4	4	7	21	9	0	45
W	0	7	12	33	10	0	62
WNW	1	6	13	22	6	1	49
NW	3	3	7	40	1	0	54
NNW	0	10	14	7	0	0	31
Variable	0	0	0	0	0	0	0
Total	33	177	216	187	42	2	657

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Moderately Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	1	0	0	0	0	0	1
ENE	3	1	0	0	0	0	4
E	0	3	2	0	0	0	5
ESE	1	5	2	0	0	0	8
SE	3	2	3	0	0	0	8
SSE	0	3	0	0	0	0	3
S	1	9	4	0	0	0	14
SSW	0	9	10	1	0	0	20
SW	0	8	4	0	0	0	12
WSW	0	0	1	3	1	0	5
W	1	0	1	3	0	0	5
WNW	1	1	0	1	0	0	3
NW	0	2	2	0	0	0	4
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	11	43	29	8	1	0	92

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: January - March 2017
Stability Class - Extremely Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	2	2	0	0	0	4
SW	0	1	10	0	0	0	11
WSW	0	0	2	1	0	0	3
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	3	14	1	0	0	18

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 14

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	11	0	0	0	0	17
NNE	5	6	0	0	0	0	11
NE	10	5	0	0	0	0	15
ENE	12	1	0	0	0	0	13
E	19	7	0	0	0	0	26
ESE	4	32	0	0	0	0	36
SE	0	9	6	0	0	0	15
SSE	0	0	10	0	0	0	10
S	0	2	5	0	0	0	7
SSW	0	0	2	0	0	0	2
SW	0	0	2	0	0	0	2
WSW	0	1	0	2	0	0	3
W	1	0	5	2	0	0	8
WNW	0	0	6	1	0	0	7
NW	0	3	10	1	0	0	14
NNW	2	9	9	1	0	0	21
Variable	0	0	0	0	0	0	0
Total	59	86	55	7	0	0	207

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	5	7	0	0	0	0	12
NNE	2	2	0	0	0	0	4
NE	4	5	0	0	0	0	9
ENE	16	1	0	0	0	0	17
E	10	2	0	0	0	0	12
ESE	3	4	0	0	0	0	7
SE	0	11	6	0	0	0	17
SSE	0	2	15	3	0	0	20
S	0	7	9	1	0	0	17
SSW	0	0	6	1	0	0	7
SW	0	3	6	1	0	0	10
WSW	0	6	9	6	0	0	21
W	0	6	18	3	0	0	27
WNW	0	5	14	2	0	0	21
NW	1	6	9	5	0	0	21
NNW	2	11	6	0	0	0	19
Variable	0	0	0	0	0	0	0
Total	43	78	98	22	0	0	241

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	2	1	0	0	0	5
NNE	4	1	0	0	0	0	5
NE	4	0	0	0	0	0	4
ENE	3	1	0	0	0	0	4
E	4	0	0	0	0	0	4
ESE	1	0	1	0	0	0	2
SE	1	4	4	0	0	0	9
SSE	1	5	7	2	0	0	15
S	0	4	2	0	0	0	6
SSW	0	1	5	2	0	0	8
SW	1	0	4	0	0	0	5
WSW	1	4	7	3	0	0	15
W	0	8	6	1	0	0	15
WNW	0	6	9	2	0	0	17
NW	1	5	8	1	0	0	15
NNW	0	3	9	0	0	0	12
Variable	0	0	0	0	0	0	0
Total	23	44	63	11	0	0	141

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	18	27	5	0	0	0	50
NNE	19	14	0	0	0	0	33
NE	40	17	0	0	0	0	57
ENE	32	8	0	0	0	0	40
E	27	29	3	0	0	0	59
ESE	19	21	2	0	0	0	42
SE	7	46	35	0	0	0	88
SSE	6	37	13	4	0	0	60
S	4	28	32	1	0	0	65
SSW	10	14	9	0	0	0	33
SW	7	13	14	0	0	0	34
WSW	6	12	22	8	0	0	48
W	9	18	26	4	0	0	57
WNW	5	22	15	7	0	0	49
NW	4	17	21	5	0	0	47
NNW	8	26	14	0	0	0	48
Variable	0	0	0	0	0	0	0
Total	221	349	211	29	0	0	810

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	14	5	0	0	0	0	19
NNE	16	3	0	0	0	0	19
NE	10	0	0	0	0	0	10
ENE	13	4	0	0	0	0	17
E	20	3	0	0	0	0	23
ESE	14	3	0	0	0	0	17
SE	22	6	0	0	0	0	28
SSE	23	23	1	1	0	0	48
S	19	30	6	0	0	0	55
SSW	11	14	2	0	0	0	27
SW	21	24	5	0	0	0	50
WSW	15	37	3	0	0	0	55
W	15	37	6	0	0	0	58
WNW	21	29	0	0	0	0	50
NW	15	17	3	0	0	0	35
NNW	15	2	2	0	0	0	19
Variable	0	0	0	0	0	0	0
Total	264	237	28	1	0	0	530

Hours of calm in this stability class: 8
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	1	0	0	0	0	4
NNE	0	0	0	0	0	0	0
NE	1	0	0	0	0	0	1
ENE	2	0	0	0	0	0	2
E	10	0	0	0	0	0	10
ESE	16	0	0	0	0	0	16
SE	4	0	0	0	0	0	4
SSE	1	0	0	0	0	0	1
S	9	2	0	0	0	0	11
SSW	2	1	0	0	0	0	3
SW	17	4	0	0	0	0	21
WSW	20	18	0	0	0	0	38
W	15	11	0	0	0	0	26
WNW	7	5	0	0	0	0	12
NW	7	0	0	0	0	0	7
NNW	8	1	0	0	0	0	9
Variable	0	0	0	0	0	0	0
Total	122	43	0	0	0	0	165

Hours of calm in this stability class: 9
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	1	0	0	0	0	0	1
E	3	0	0	0	0	0	3
ESE	5	0	0	0	0	0	5
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	3	0	0	0	0	0	3
SSW	1	0	0	0	0	0	1
SW	12	8	0	0	0	0	20
WSW	4	8	0	0	0	0	12
W	5	4	0	0	0	0	9
WNW	4	0	0	0	0	0	4
NW	0	0	0	0	0	0	0
NNW	3	0	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	41	20	0	0	0	0	61

Hours of calm in this stability class: 8
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Extremely Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	2	0	0	0	0	2
ENE	0	4	0	0	0	0	4
E	0	2	1	1	0	0	4
ESE	0	3	1	0	0	0	4
SE	0	0	1	3	0	0	4
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	11	3	4	0	0	18

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Moderately Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	3	0	0	0	3
NNE	0	1	0	1	0	0	2
NE	0	2	2	0	0	0	4
ENE	2	2	2	1	0	0	7
E	0	2	1	0	0	0	3
ESE	0	1	2	0	0	0	3
SE	0	0	6	3	0	0	9
SSE	0	0	0	1	0	0	1
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	2	8	17	6	0	0	33

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Slightly Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	2	0	0	0	3
NNE	0	5	0	0	0	0	5
NE	0	3	1	0	0	0	4
ENE	1	1	0	1	0	0	3
E	1	2	2	0	0	0	5
ESE	0	11	2	0	0	0	13
SE	0	1	6	5	0	0	12
SSE	0	0	0	3	0	0	3
S	0	0	3	7	0	0	10
SSW	0	0	5	2	0	0	7
SW	0	0	0	1	0	0	1
WSW	0	0	1	0	0	1	2
W	0	0	1	1	1	1	4
WNW	0	0	2	5	0	1	8
NW	0	0	1	3	5	0	9
NNW	0	1	5	5	3	0	14
Variable	0	0	0	0	0	0	0
Total	2	25	31	33	9	3	103

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Neutral - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	9	16	13	0	0	39
NNE	4	9	12	10	0	0	35
NE	3	11	11	7	0	0	32
ENE	1	15	14	11	7	0	48
E	12	20	27	3	0	0	62
ESE	5	30	52	32	17	0	136
SE	3	14	48	34	10	0	109
SSE	5	19	37	34	0	0	95
S	1	7	26	25	13	0	72
SSW	1	6	31	36	6	0	80
SW	2	3	23	14	6	0	48
WSW	1	7	16	25	13	1	63
W	2	8	17	32	15	5	79
WNW	2	4	27	42	19	5	99
NW	0	7	20	39	29	7	102
NNW	3	14	37	20	5	0	79
Variable	0	0	0	0	0	0	0
Total	46	183	414	377	140	18	1178

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Slightly Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	6	9	0	0	0	17
NNE	2	2	10	0	0	0	14
NE	5	9	8	2	0	0	24
ENE	2	8	1	0	0	0	11
E	5	9	4	0	0	0	18
ESE	2	8	9	3	2	2	26
SE	1	14	7	0	1	0	23
SSE	1	21	9	6	0	0	37
S	4	9	26	11	2	0	52
SSW	3	11	44	36	5	0	99
SW	3	14	20	7	2	0	46
WSW	2	9	11	23	5	0	50
W	3	10	20	29	2	0	64
WNW	1	12	13	19	9	0	54
NW	1	4	10	33	2	0	50
NNW	1	6	18	10	4	0	39
Variable	0	0	0	0	0	0	0
Total	38	152	219	179	34	2	624

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Moderately Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	6	6	0	0	0	13
NNE	0	1	0	0	0	0	1
NE	0	3	2	0	0	0	5
ENE	2	0	1	0	0	0	3
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	1	1	0	0	0	0	2
SSE	0	1	5	0	0	0	6
S	0	5	7	0	0	0	12
SSW	1	8	7	1	0	0	17
SW	0	5	7	1	0	0	13
WSW	3	8	17	11	0	0	39
W	1	3	8	9	0	0	21
WNW	3	6	10	7	4	0	30
NW	2	4	6	4	2	0	18
NNW	1	2	7	1	0	0	11
Variable	0	0	0	0	0	0	0
Total	15	53	83	34	6	0	191

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: April - June 2017
Stability Class - Extremely Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	1	3	0	0	0	6
NNE	1	0	1	0	0	0	2
NE	0	1	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	2	0	0	0	0	2
SSW	0	3	0	0	0	0	3
SW	0	2	0	0	0	0	2
WSW	0	0	0	1	0	0	1
W	0	1	1	0	0	0	2
WNW	0	0	2	3	0	0	5
NW	1	2	1	1	0	0	5
NNW	0	1	3	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	4	13	11	5	0	0	33

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	10	17	0	0	0	0	27
NNE	12	15	0	0	0	0	27
NE	11	2	0	0	0	0	13
ENE	12	0	0	0	0	0	12
E	10	0	0	0	0	0	10
ESE	8	0	0	0	0	0	8
SE	2	11	2	0	0	0	15
SSE	1	6	3	0	0	0	10
S	1	3	5	0	0	0	9
SSW	0	0	1	0	0	0	1
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	2	0	0	0	0	0	2
NNW	3	9	2	0	0	0	14
Variable	0	0	0	0	0	0	0
Total	72	63	13	0	0	0	148

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	18	2	0	0	0	29
NNE	12	3	0	0	0	0	15
NE	11	0	0	0	0	0	11
ENE	6	1	0	0	0	0	7
E	3	0	0	0	0	0	3
ESE	1	0	0	0	0	0	1
SE	1	4	4	0	0	0	9
SSE	3	9	14	0	0	0	26
S	0	5	6	0	0	0	11
SSW	0	2	2	0	0	0	4
SW	0	0	8	0	0	0	8
WSW	0	0	0	0	0	0	0
W	0	4	2	0	0	0	6
WNW	1	5	3	0	0	0	9
NW	4	14	3	0	0	0	21
NNW	3	42	13	6	0	0	64
Variable	0	0	0	0	0	0	0
Total	54	107	57	6	0	0	224

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	8	1	0	0	0	11
NNE	5	2	0	0	0	0	7
NE	2	0	0	0	0	0	2
ENE	2	0	0	0	0	0	2
E	0	0	0	0	0	0	0
ESE	3	0	0	0	0	0	3
SE	0	2	0	0	0	0	2
SSE	1	3	2	0	0	0	6
S	0	1	2	0	0	0	3
SSW	2	3	0	0	0	0	5
SW	2	4	2	0	0	0	8
WSW	0	2	0	0	0	0	2
W	1	2	3	0	0	0	6
WNW	1	4	4	0	0	0	9
NW	1	9	1	0	0	0	11
NNW	2	23	6	1	0	0	32
Variable	0	0	0	0	0	0	0
Total	24	63	21	1	0	0	109

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	34	33	18	0	0	0	85
NNE	21	2	3	0	0	0	26
NE	19	0	0	0	0	0	19
ENE	21	0	0	0	0	0	21
E	17	0	0	0	0	0	17
ESE	7	1	0	0	0	0	8
SE	12	26	4	0	0	0	42
SSE	19	35	6	0	0	0	60
S	12	10	3	0	0	0	25
SSW	14	6	2	0	0	0	22
SW	4	10	16	0	0	0	30
WSW	9	12	10	0	0	0	31
W	13	18	8	0	0	0	39
WNW	17	21	4	0	0	0	42
NW	23	40	7	0	0	0	70
NNW	23	41	22	6	0	0	92
Variable	0	0	0	0	0	0	0
Total	265	255	103	6	0	0	629

Hours of calm in this stability class: 4
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	29	18	4	0	0	0	51
NNE	22	1	0	0	0	0	23
NE	9	1	0	0	0	0	10
ENE	10	0	0	0	0	0	10
E	9	0	0	0	0	0	9
ESE	16	2	0	0	0	0	18
SE	20	7	1	0	0	0	28
SSE	24	19	3	0	0	0	46
S	23	20	4	0	0	0	47
SSW	18	9	0	0	0	0	27
SW	31	23	0	0	0	0	54
WSW	38	24	0	0	0	0	62
W	37	37	1	0	0	0	75
WNW	27	34	0	0	0	0	61
NW	32	40	4	0	0	0	76
NNW	31	31	12	0	0	0	74
Variable	0	0	0	0	0	0	0
Total	376	266	29	0	0	0	671

Hours of calm in this stability class: 14
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	0	0	0	0	0	2
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	1	0	0	0	0	0	1
SSE	2	0	0	0	0	0	2
S	7	0	0	0	0	0	7
SSW	21	0	0	0	0	0	21
SW	32	7	0	0	0	0	39
WSW	47	38	0	0	0	0	85
W	35	16	0	0	0	0	51
WNW	22	10	0	0	0	0	32
NW	10	17	0	0	0	0	27
NNW	6	2	0	0	0	0	8
Variable	0	0	0	0	0	0	0
Total	185	90	0	0	0	0	275

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	1	0	0	0	0	0	1
SW	34	12	1	0	0	0	47
WSW	38	20	0	0	0	0	58
W	9	7	0	0	0	0	16
WNW	5	1	0	0	0	0	6
NW	1	0	0	0	0	0	1
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	88	40	1	0	0	0	129

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Extremely Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	1	0	0	0	1
ENE	0	1	1	0	0	0	2
E	0	3	1	0	0	0	4
ESE	0	2	2	1	0	0	5
SE	0	0	2	0	0	0	2
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	1	0	0	1
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	6	7	2	0	0	15

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Moderately Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	1	0	0	0	0	1
ENE	0	3	0	0	0	0	3
E	1	4	0	0	0	0	5
ESE	0	4	0	0	0	0	4
SE	0	3	4	0	0	0	7
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	1	15	4	0	0	0	20

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Slightly Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	1	0	0	0	3
NNE	1	1	4	2	0	0	8
NE	0	4	1	1	0	0	6
ENE	4	6	0	0	0	0	10
E	1	5	2	0	0	0	8
ESE	2	5	3	1	0	0	11
SE	0	3	1	0	0	0	4
SSE	0	0	2	0	0	0	2
S	0	0	0	0	0	0	0
SSW	0	0	3	2	0	0	5
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	1	0	0	0	0	1
NNW	0	1	1	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	8	28	18	6	0	0	60

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Neutral - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	12	30	40	23	5	0	110
NNE	9	14	35	19	2	0	79
NE	5	13	5	3	3	0	29
ENE	11	17	17	2	0	0	47
E	16	26	21	4	0	0	67
ESE	10	14	18	3	0	0	45
SE	9	11	5	1	0	0	26
SSE	3	13	31	7	0	0	54
S	3	24	31	15	1	0	74
SSW	1	13	17	10	0	0	41
SW	5	6	12	2	0	0	25
WSW	1	6	20	26	0	0	53
W	1	4	7	9	0	0	21
WNW	3	14	24	15	4	0	60
NW	3	18	10	3	1	0	35
NNW	3	53	87	25	16	0	184
Variable	0	0	0	0	0	0	0
Total	95	276	380	167	32	0	950

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Slightly Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	11	30	37	3	0	81
NNE	4	18	18	7	1	0	48
NE	5	16	8	4	2	0	35
ENE	7	15	11	4	0	0	37
E	12	36	13	2	0	0	63
ESE	6	27	9	6	0	0	48
SE	4	23	9	3	0	0	39
SSE	3	31	19	4	0	0	57
S	4	21	11	8	1	0	45
SSW	2	19	21	10	3	0	55
SW	3	9	16	7	0	0	35
WSW	2	15	20	7	0	0	44
W	5	15	24	19	0	0	63
WNW	2	7	10	12	1	0	32
NW	2	9	13	24	1	0	49
NNW	2	18	27	29	6	0	82
Variable	0	0	0	0	0	0	0
Total	63	290	259	183	18	0	813

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Moderately Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	12	26	5	0	0	45
NNE	2	4	9	2	0	0	17
NE	2	5	2	0	0	0	9
ENE	3	4	1	0	0	0	8
E	1	3	0	0	0	0	4
ESE	1	0	0	0	0	0	1
SE	0	0	0	0	0	0	0
SSE	2	2	0	0	0	0	4
S	2	10	0	0	0	0	12
SSW	6	8	3	0	0	0	17
SW	2	11	2	1	1	0	17
WSW	0	6	7	4	1	0	18
W	3	6	10	27	3	0	49
WNW	1	2	2	13	0	0	18
NW	1	4	4	7	0	0	16
NNW	4	9	22	6	0	0	41
Variable	0	0	0	0	0	0	0
Total	32	86	88	65	5	0	276

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: July - September 2017
Stability Class - Extremely Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	3	5	1	0	0	13
NNE	1	1	2	0	0	0	4
NE	1	1	0	0	0	0	2
ENE	0	0	0	0	0	0	0
E	1	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	1	0	0	0	0	0	1
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	2	0	0	0	0	0	2
SW	0	3	0	0	0	0	3
WSW	1	3	0	0	0	0	4
W	1	3	1	0	0	0	5
WNW	1	2	7	2	0	0	12
NW	2	3	3	0	0	0	8
NNW	3	3	9	0	0	0	15
Variable	0	0	0	0	0	0	0
Total	18	22	27	3	0	0	70

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Extremely Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	0	0	0	0	1
NNE	1	6	0	0	0	0	7
NE	4	1	0	0	0	0	5
ENE	8	0	0	0	0	0	8
E	8	0	0	0	0	0	8
ESE	3	4	0	0	0	0	7
SE	0	5	2	0	0	0	7
SSE	0	3	1	0	0	0	4
S	0	3	4	1	0	0	8
SSW	0	3	6	1	0	0	10
SW	0	0	0	0	0	0	0
WSW	0	1	0	0	0	0	1
W	0	1	0	0	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	1	0	0	0	0	1
NNW	0	3	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	24	32	13	2	0	0	71

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Moderately Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	5	1	1	0	0	8
NNE	4	12	0	0	0	0	16
NE	6	1	0	0	0	0	7
ENE	6	0	0	0	0	0	6
E	4	1	0	0	0	0	5
ESE	3	4	0	0	0	0	7
SE	0	3	0	0	0	0	3
SSE	2	5	2	1	0	0	10
S	0	3	9	0	0	0	12
SSW	0	7	8	0	0	0	15
SW	0	2	1	0	0	0	3
WSW	0	1	3	1	0	0	5
W	0	0	13	3	0	0	16
WNW	0	0	7	5	0	0	12
NW	0	1	7	2	0	0	10
NNW	0	2	17	4	0	0	23
Variable	0	0	0	0	0	0	0
Total	26	47	68	17	0	0	158

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Slightly Unstable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	2	0	0	0	0	5
NNE	4	2	0	0	0	0	6
NE	5	0	0	0	0	0	5
ENE	2	0	0	0	0	0	2
E	3	0	0	0	0	0	3
ESE	1	2	0	0	0	0	3
SE	0	3	1	0	0	0	4
SSE	0	4	0	0	0	0	4
S	0	5	2	0	0	0	7
SSW	0	2	4	0	0	0	6
SW	0	0	0	1	0	0	1
WSW	0	2	1	1	0	0	4
W	0	1	6	2	0	0	9
WNW	0	1	2	8	0	0	11
NW	0	2	5	0	0	0	7
NNW	1	6	19	5	0	0	31
Variable	0	0	0	0	0	0	0
Total	19	32	40	17	0	0	108

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Neutral - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	19	34	30	1	0	0	84
NNE	22	11	0	0	0	0	33
NE	17	0	0	0	0	0	17
ENE	10	0	0	0	0	0	10
E	15	0	0	0	0	0	15
ESE	11	6	0	0	0	0	17
SE	5	27	14	0	0	0	46
SSE	11	56	16	6	0	0	89
S	11	36	20	2	0	0	69
SSW	10	24	10	1	0	0	45
SW	4	12	8	1	0	0	25
WSW	7	8	10	0	0	0	25
W	12	14	29	11	0	0	66
WNW	11	34	34	20	0	0	99
NW	5	38	47	11	0	0	101
NNW	13	63	42	6	1	0	125
Variable	0	0	0	0	0	0	0
Total	183	363	260	59	1	0	866

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Slightly Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	25	14	0	0	0	0	39
NNE	25	6	0	0	0	0	31
NE	22	0	0	0	0	0	22
ENE	18	0	0	0	0	0	18
E	39	0	0	0	0	0	39
ESE	19	3	0	0	0	0	22
SE	23	18	0	0	0	0	41
SSE	23	33	0	0	0	0	56
S	31	24	5	0	0	0	60
SSW	25	16	1	2	0	0	44
SW	23	20	2	1	0	0	46
WSW	17	39	1	0	0	0	57
W	26	39	8	0	0	0	73
WNW	19	33	0	0	0	0	52
NW	28	32	1	0	0	0	61
NNW	16	29	0	0	0	0	45
Variable	0	0	0	0	0	0	0
Total	379	306	18	3	0	0	706

Hours of calm in this stability class: 10
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Moderately Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	1	0	0	0	0	5
NNE	1	0	0	0	0	0	1
NE	1	0	0	0	0	0	1
ENE	4	0	0	0	0	0	4
E	9	0	0	0	0	0	9
ESE	9	0	0	0	0	0	9
SE	7	2	0	0	0	0	9
SSE	2	0	0	0	0	0	2
S	5	0	0	0	0	0	5
SSW	4	3	0	0	0	0	7
SW	13	7	0	0	0	0	20
WSW	23	11	0	0	0	0	34
W	28	8	0	0	0	0	36
WNW	24	2	0	0	0	0	26
NW	11	0	0	0	0	0	11
NNW	7	2	0	0	0	0	9
Variable	0	0	0	0	0	0	0
Total	152	36	0	0	0	0	188

Hours of calm in this stability class: 6
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Extremely Stable - 150Ft-33Ft Delta-T (F)
Winds Measured at 33 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	1	0	0	0	0	2
NNE	1	0	0	0	0	0	1
NE	3	0	0	0	0	0	3
ENE	0	0	0	0	0	0	0
E	1	0	0	0	0	0	1
ESE	5	0	0	0	0	0	5
SE	0	0	0	0	0	0	0
SSE	1	0	0	0	0	0	1
S	2	0	0	0	0	0	2
SSW	0	0	0	0	0	0	0
SW	10	0	0	0	0	0	10
WSW	23	19	0	0	0	0	42
W	11	0	0	0	0	0	11
WNW	6	0	0	0	0	0	6
NW	3	0	0	0	0	0	3
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	69	20	0	0	0	0	89

Hours of calm in this stability class: 1
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Extremely Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	1	0	0	0	0	1
SE	0	0	1	1	0	0	2
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	1	1	1	0	0	3

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Moderately Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	1	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	0	0	0	0	1
SE	0	0	2	0	0	0	2
SSE	0	0	1	0	0	0	1
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	2	4	0	0	0	6

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Slightly Unstable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	1	3	0	0	0	0	4
E	1	1	0	0	0	0	2
ESE	0	5	0	0	0	0	5
SE	0	1	3	1	0	0	5
SSE	0	0	2	0	0	0	2
S	0	0	2	3	1	0	6
SSW	0	0	5	5	1	0	11
SW	0	0	2	0	0	0	2
WSW	0	0	0	0	0	0	0
W	0	0	0	1	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	2	11	14	10	2	0	39

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Neutral - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	5	19	33	31	3	0	91
NNE	3	26	9	6	0	0	44
NE	6	12	17	7	0	0	42
ENE	10	5	3	3	0	0	21
E	6	9	5	2	0	0	22
ESE	5	12	7	4	1	1	30
SE	5	14	24	11	12	0	66
SSE	2	10	33	10	5	1	61
S	1	15	33	25	1	2	77
SSW	1	7	28	18	7	0	61
SW	0	5	14	10	1	0	30
WSW	2	9	10	15	4	0	40
W	3	7	12	37	26	10	95
WNW	1	4	15	34	20	23	97
NW	4	8	41	75	30	8	166
NNW	4	13	57	30	11	3	118
Variable	0	0	0	0	0	0	0
Total	58	175	341	318	121	48	1061

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 36
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Slightly Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	5	36	8	0	0	52
NNE	1	14	9	0	0	0	24
NE	2	7	15	2	0	0	26
ENE	2	5	2	2	0	0	11
E	4	22	8	1	0	0	35
ESE	3	15	24	1	0	0	43
SE	4	19	24	12	0	0	59
SSE	6	22	21	24	0	0	73
S	1	19	37	29	3	0	89
SSW	4	8	28	12	2	1	55
SW	2	6	22	31	1	0	62
WSW	3	8	23	13	2	0	49
W	4	5	13	36	6	0	64
WNW	2	2	13	22	4	0	43
NW	3	9	16	33	3	0	64
NNW	5	13	16	8	0	0	42
Variable	0	0	0	0	0	0	0
Total	49	179	307	234	21	1	791

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 19
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Moderately Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	1	0	2	0	0	6
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	4	4	0	0	0	0	8
E	3	5	0	0	0	0	8
ESE	0	7	0	0	0	0	7
SE	4	4	1	0	0	0	9
SSE	0	1	3	3	0	0	7
S	3	1	9	1	0	0	14
SSW	4	7	7	1	0	0	19
SW	1	4	5	2	0	0	12
WSW	2	12	14	7	0	0	35
W	3	6	8	13	0	0	30
WNW	0	4	1	5	0	0	10
NW	1	2	2	0	0	0	5
NNW	0	4	3	0	0	0	7
Variable	0	0	0	0	0	0	0
Total	28	64	53	34	0	0	179

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

Peach Bottom Atomic Power Station

Period of Record: October – December 2017
Stability Class - Extremely Stable - 316Ft-33Ft Delta-T (F)
Winds Measured at 320 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	4	1	0	0	0	6
NNE	0	1	0	0	0	0	1
NE	1	0	0	0	0	0	1
ENE	2	1	0	0	0	0	3
E	2	1	1	0	0	0	4
ESE	1	2	0	0	0	0	3
SE	0	0	0	0	0	0	0
SSE	2	3	0	0	0	0	5
S	2	4	1	0	0	0	7
SSW	2	2	0	0	0	0	4
SW	2	0	0	0	0	0	2
WSW	3	1	0	3	0	0	7
W	1	1	2	2	0	0	6
WNW	3	4	1	0	0	0	8
NW	0	4	1	0	0	0	5
NNW	2	3	3	0	0	0	8
Variable	0	0	0	0	0	0	0
Total	24	31	10	5	0	0	70

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 4

APPENDIX A: ERRATA DATA SECTION

2016 Dose Assessment (Total Organ Dose)

Tables 7 and 8 utilized the CY-PB-170-210 spreadsheet to calculate the doses for elevated and ground releases with the 2016 MET data and gaseous total activity released, including C-14. An error was identified in the spreadsheet for calculating the dose to the Infant Bone and Liver, but not the Thyroid. Due to C-14 inclusion, the Bone is the max organ dose and therefore, Table 7 and 8 reported the incorrect dose to the Infant Bone. The calculations also used the wrong X/Q for the vent and stack for the calculation. This error was documented in IR # 04112670. Therefore, the dose reported in this Errata Data Section, includes the correct calculation and correct X/Q. As these dose values are applicable to the hypothetical maximum exposed individual, there is no change to the other doses reported in the 2016 ARERR (40 CFR 190). The calculation issue only applied to the doses calculated in Table 7 and 8. There were no errors identified in the noble gas dose calculations therefore, those values were not changed from that reported in the 2016 report.

Table 7. Conservative Maximum Elevated Release Dose from 2016 Source Term and 2016 Meteorology

Distance (m)	Direction	2016 Highest MS X/Q (D/Q)	2016 Vent X/Q (D/Q)	Total Body Dose (mrem)	Skin Dose (mrem)	Gamma Air Dose (mrad)	Beta Air Dose (mrad)	**I/P/T/C-14 Dose (mrem)**	Limiting Receptor
4900	N	4.42E-08 (3.10E-10)	1.14E-07 (5.99E-10)	2.57E-02	3.34E-02	2.65E-02	1.83E-02	**1.84E-01**	Bone
3800	SW	4.31E-08 (2.52E-10)	1.19E-07 (5.01E-10)	2.68E-02	3.48E-02	2.77E-02	1.90E-02	**1.80E-01**	Bone

Table 8. Ground-Level Dose from 2016 Source Term and 2016 Meteorology

Distance (m)	Direction	2016 Highest Vent D/Q (X/Q)	2016 MS X/Q (D/Q)	Total Body Dose (mrem)	Skin Dose (mrem)	Gamma Air Dose (mrad)	Beta Air Dose (mrad)	**I/P/T/C-14 Dose (mrem)**	Limiting Receptor
1200	SSE	1.00E-08 (1.11E-06)	5.46E-09 (6.31E-10)	2.42E-01	3.14E-01	2.51E-01	1.69E-01	**1.55E-01**	Bone
900	NW	6.64E-09 (1.15E-06)	3.60E-09 (5.08E-10)	2.51E-01	3.25E-01	2.60E-01	1.75E-01	**1.52E-01**	Bone

APPENDIX B: ODCM REVISION

ODCM Rev 16 Summary

The primary reason for the revision of the ODCM in 2017 was due to an error identified during the V&V of an effluent software, OpenEMS. A discrepancy between the software dose calculations and CY-PB-170-210 spreadsheet dose calculations was discovered (on the order of 2%). Further investigation determined that the definition of "R_i,"(dose factors) "W_s," and "W_v" did not align with NUREG 0133 (Section 5.3.1). The revision corrected the definitions of "Ws/Wv," ground and elevation dispersion/deposition factors. The corrected definitions are: "Ws/Wv " equals D/Q for the ingestion and ground-plane pathway and "Ws/Wv " equals X/Q for H-3, C-14, and the inhalation pathway. The alignment of the definition of "R_i" to NUREG 0133 will impact the dose calculations for radioiodine/particulate/tritium and carbon-14.

Also, the values for X/Q and D/Q for "W_s" (main stack dispersion and deposition meteorological factors) for the max receptor, 1500 m SW were updated because the last two 10-year averages have been significantly less than the ODCM values. The values for X/Q for "W_v" (reactor building exhaust vent dispersion meteorological factors) for the Max Receptor, 1500m SW was updated because the last two 10-year averages have been higher than the ODCM value. All updated values were taken from the 2005-2014 average.

Other changes included updating liquid dose factors or REMP station coordinates/locations and administrative errors. These changes do not affect the reported effluent dose for 2017. ODCM Rev 16 is attached after this summary section.

The doses recorded in the main body of this report were calculated using ODCM Rev 15 methodology and the 2017 source term since the ODCM was not implemented until 12/29/17, and 2017 Records followed Rev 15 methodology. However, since the ODCM was revised because of a calculation error, it was decided to present the updated doses from this report which were affected by ODCM Rev 16. The definition changes in Rev 16 affect the reported radioiodine/particulate/tritium and carbon-14 dose for the 2017 effluent report. The noble gas reported values are not impacted by ODCM Rev 16. The sections and page numbers of the 2017 ARERR impacted by ODCM Rev 16 are reported below. The updated doses are calculated with the 2017 source term and ODCM Rev 16 methodology.

2017 ARERR Dose Updated for ODCM Rev 16 Methodologies

Correction to page 4:
The maximum calculated organ dose (bone) from iodines (I-131, I-133 and I-135), tritium (H-3), carbon-14 (C-14) and particulates to any individual due to all gaseous effluents was **1.39E-01** mrem, which was approximately **4.64E-01%** of the annual limit.

Correction to page 9:
Carbon-14
The resulting annual dose to the maximum conservative receptor is **1.39E-01** mrem, with the limiting receptor as the child bone.

Correction to page 15:

Gaseous Radioactive Effluent Dose Assessment Conclusion

The conservative maximum dose was **1.39E-01** mrem with the maximum receptor as the child bone and this is due to the incorporation of carbon-14 in the calculation. Without C-14, the maximum dose is **3.12E-03** mrem to the infant thyroid.

The differences shown above are due to the change in X/Q between ODCM Rev 15 and Rev 16. While, the vent X/Q increased, the vent only contributes to 3.00E+00% of the C-14 activity and dose released; therefore, the smaller X/Q for the main stack dominates the C-14 dose.

Below is a more detailed table on the changes in dose to infant thyroid under ODCM Rev 16. The maximum dose is still to the bone when C-14 is included and due to the dependence of X/Q for C-14 dose, there is no impact to reported dose in Tables 7 and 8 on page 17. When C-14 is not included, the differences between ODCM Rev 15 and 16 can be seen. The same philosophy still applies when reviewing these reported doses: These locations, while having larger MET factors than the ODCM, the cow-milk-infant pathway does not exist at these locations and when the ODCM location MET factors are compared, the 2017 MET factors and thus the dose reported below are similar. The difference in methodology/definitions between Rev 15 and 16 are minor, since C-14 and H-3 are the dominant nuclides released, contributing the most dose, and those have always used the X/Q value to calculate dose.

Table B.1. Comparison of Infant Thyroid Dose Calculated for Locations Listed in Table 7 and 8 and the ODCM

Distance (m)	Direction	2017 Stack X/Q (D/Q)	2017 Vent X/Q (D/Q)	I/P/T Thyroid Dose (Rev 15) (mrem)	I/P/T Thyroid Dose (Rev 16) (mrem)
1500	SW	Rev 15 8.78E-08 (8.78E-10)	Rev 15 1.58E-07 (1.58E-09)	3.09E-03	3.11E-03
1500	SW	Rev 16 8.11E-09 (4.19E-10)	Rev 16 4.43E-07 (1.58E-09)	3.08E-03	3.12E-03
4900	N	4.09E-09 (7.11E-10)	1.21E-06 (9.66E-09)	1.14E-03	1.15E-03
3800	SW	3.14E-08 (1.80E-10)	1.39E-07 (5.34E-10)	1.08E-03	1.09E-03
1200	SSE	7.67E-09 (7.30E-10)	1.31E-06 (8.67E-09)	1.39E-02	1.40E-02
900	NW	8.67E-09 (1.31E-06)	7.67E-09 (7.30E-10)	1.30E-02	1.31E-02

Correction to page 17:
Carbon-14 quarterly dose and percentage corrected.

Gaseous Effluents - Summation of All Releases

Period: January 1, 2017 through December 31, 2017 **Unit: Peach Bottom**

A. Fission & Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1. Total Release	Ci	1.50E+02	1.11E+02	6.77E+01	1.70E+02	4.00E+01
2. Average release For the Period	uCi/ s	1.93E+01	1.41E+01	8.52E+00	2.14E+01	
3. Gamma Air Dose	mrad	6.73E-02	4.97E-02	2.60E-02	7.90E-02	
4. Beta Air Dose	mrad	4.62E-02	3.41E-02	1.81E-02	5.40E-02	
5. Percent of ODCM limit						
Gamma Air Dose	%	6.73E-01	4.97E-01	2.60E-01	7.90E-01	
Beta Air Dose	%	2.31E-01	1.70E-01	9.04E-02	2.70E-01	

B. Iodines

1. Total I-131	Ci	4.71E-05	7.40E-05	8.50E-05	2.09E-04	1.90E+01
2. Average release For the Period	uCi/ s	6.06E-06	9.41E-06	1.07E-05	2.63E-05	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

C. Particulate

1. Particulates with T1/2 > 8 days	Ci	5.90E-05	8.48E-05	8.22E-05	2.22E-04	2.80E+01
2. Average release For the Period	uCi/ s	7.59E-06	1.08E-05	1.03E-05	2.79E-05	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

D. Tritium

1. Total Release	Ci	5.73E+00	1.35E+01	1.41E+01	3.24E+00	1.30E+01
2. Average release For the Period	uCi/ s	7.37E-01	1.71E+00	1.78E+00	4.07E-01	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

E. Gross Alpha

1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	4.00E+02
2. Average release For the Period	uCi/ s	<LLD	<LLD	<LLD	<LLD	
3. Percent of ODCM limit	%	*	*	*	*	

* No ODCM defined Curie Limit, therefore a percentage of the limit cannot be calculated.

F. Carbon-14

1. Total Release	Ci	9.53E+00	9.53E+00	9.53E+00	9.53E+00
2. Average release For the Period	uCi/ s	1.23E+00	1.21E+00	1.20E+00	1.20E+00

G. Iodine-131, 133 and 135, Tritium, Carbon-14 & Particulate

1. Organ Dose*	mrem	**3.47E-02**	**3.47E-02**	**3.47E-02**	**3.47E-02**
2. Percent ODCM limit	%	**2.31E-01**	**2.31E-01**	**2.31E-01**	**2.31E-01**

*C-14 contributes most significantly; therefore, the quarterly dose to the child bone is reported

Correction to page 27:

Child bone, infant thyroid, and the corresponding percentage of the ODCM limit are corrected.

Radiological Impact on Man

Effluent	Applicable Organ	Estimated Dose	Age Group	Location		% of Applicable Limit	Limit	Unit
				Distance (meters)	Direction (toward)			
Noble Gas	Gamma - Air Dose	2.21E-01	All	1.10E+03	SSE	1.11E+00	2.00E+01	mrad
Noble Gas	Beta - Air Dose	1.51E-01	All	1.10E+03	SSE	3.87E-01	4.00E+01	mrad
Noble Gas	Total Body (gamma)	2.14E-01	All	1.10E+03	SSE	2.14E+00	1.00E+01	mrem
Noble Gas	Skin (Beta)	2.79E-01	All	1.10E+03	SSE	9.30E-01	3.00E+01	mrem
Gaseous Iodine, Particulate, Carbon-14 & Tritium	Bone	**1.39E-01**	Child	1.10E+03	SSE	**4.63E-01**	3.00E+01	mrem
Gaseous Iodine, Particulate & Tritium	Thyroid	**3.12E-03**	Infant	1.10E+03	SSE	**1.04E-02**	3.00E+01	mrem
Liquid	Total Body (gamma)	1.03E-04	Child	Site Boundary		1.71E-03	6.00E+00	mrem
Liquid	GI-LLI	1.67E-04	Adult			8.34E-04	2.00E+01	mrem
Direct Radiation	Total Body	0.00E+00	All	1.15E+03	SSE	0.00E+00	2.20E+01	mrem

40 CFR 190 Doses

Effluent	Applicable Organ	Estimated Dose	Age Group	Location		% of Applicable Limit	Limit	Unit
				Distance (meters)	Direction (toward)			
Total Dose	Total Body	2.14E-01	All	1.15E+03	SSE	8.56E-01	2.50E+01	mrem
Total Dose	Thyroid	**3.12E-03**	All	1.15E+03	SSE	**4.16E-03**	7.50E+01	mrem
Total Dose	Bone	**1.39E-01**	All	1.15E+03	SSE	**5.57E-01**	2.50E+01	mrem
Total Dose	Total Body	2.14E-01	All	1.15E+03	SSE	7.14E+00	3.00E+00	mrem
Total Dose	Bone	**1.39E-01**	All	1.15E+03	SSE	**4.63E-01**	3.00E+00	mrem
Total Dose	Thyroid	2.24E-01	All	1.15E+03	SSE	4.08E-01	5.50E+01	mrem

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Offsite Dose Calculation Manual
Revision 16

Peach Bottom Atomic Power Station
Units 2 and 3

Exelon Generation Company, LLC
Docket Nos. 50-277 & 50-278

PORC Approval: 12-21-17 / 17-30
PORC Chairman/ Date/ PORC Meeting#

Implemented:
Plant Manager

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Appendix A Radioactive Effluents Control Program

I. Purpose

The purpose of the Offsite Dose Calculation Manual is to establish methodologies and procedures for calculating doses to individuals in areas at and beyond the SITE BOUNDARY due to radioactive effluents from Peach Bottom Atomic Power Station. The results of these calculations are required to determine compliance with the requirements of Specification 5.5.4, "Radioactive Effluent Controls Program" of Appendix A to Operating Licenses DPR-44 and DPR-56, "Technical Specifications for Peach Bottom Atomic Power Station Units No. 2 and 3". The Radioactive Effluents Control Program is located in Appendix A of this Offsite Dose Calculation Manual and contains Offsite Dose Calculation Manual Specifications (ODCMS) and their associated Bases which implement the requirements of Technical Specification 5.5.4.

II. Setpoint Determination for Liquid & Gaseous Monitors

II.A Liquid Radwaste Activity Monitor Setpoint

A sketch of the Liquid Radwaste System is presented in Figure 4. Each tank of radioactive waste is sampled prior to release. A small liquid volume of this sample is analyzed for gross gamma activity in a NaI well counter. This NaI well counter activity is then converted to an equivalent liquid radwaste monitor reading.

CPS (R/W Monitor) = [Net CPM/ml (well) x Eff W/RW] + Background CPS

Where:

CPS (R/W Monitor)	=	liquid radwaste gross activity monitor reading in CPS
Net CPM/ml (well)	=	gross gamma activity for the radwaste sample tank [determined by the well counter]
Eff W/RW	=	conversion factor between well counter and liquid radwaste gross activity monitor [determined by calibrating both detectors with the same liquid radioactive source]
Background CPS	=	background reading of the liquid radwaste gross activity monitor in CPS

Exceeding the expected response would indicate that an incorrect sample had been obtained for that release and the release is automatically stopped.

The alarm and trip pot setpoints for the liquid radwaste activity monitor are determined from a calibration curve for the alarm pot and trip pot. The alarm pot setting includes a factor of 1.25 to allow for analysis error, pot setting error, instrument error and calibration error. The trip pot setting includes a factor of 1.35 to allow for analysis error, pot setting error, instrument error and calibration error.

II.B Liquid Radwaste Release Flowrate Setpoint Determination

The trip pot setpoint for the liquid radwaste release flowrate is determined by multiplying the liquid radwaste flowrate (from Section III.A) by 1.2 and using this value on the appropriate calibration curve for the discharge flow meter to be used. The Peach Bottom radwaste system has two flow monitors - high flow (5 to 300 gpm) and low flow (0.8 to 15 gpm). The factor of 1.2 allows for pot setting error and instrument error. The flow rate determination includes a margin of assurance which includes consideration of this error such that the instantaneous release limit of 10 CFR 20 is not exceeded.

II.C Setpoint Determination for Gaseous Radwaste

A sketch of the Offgas Radwaste Treatment System is presented in Figure 1. Sketches of the Ventilation Treatment Systems for Units 2 and 3 are presented in Figures 2 and 3 respectively. The high and high-high alarm setpoints for the main stack radiation monitor, Unit 2 roof vent radiation monitor and Unit 3 roof vent radiation monitor are determined as follows:

High Alarm - the high alarm setpoint is set at approximately 3 x background.

High-High Alarm - the high-high alarm setpoint is set at a release rate from this vent of approximately 30% of the instantaneous release limit as specified in ODCMS 3.8.C.1.a for the most restrictive case (skin or total body) on an unidentified basis. To determine these setpoints, solve the gaseous effluent dose rate equations in section IV.A of the ODCM to determine what main stack release rate and roof vent release rate will produce a dose rate of 150 mrem/yr to the total body (30% of the limit of 500 mrem/yr) and a dose rate of 900 mrem/yr to the skin (30% of the limit of 3000 mrem/yr) from each release point. Using the highest (most restrictive) release rate for each release point determine monitor response required to produce this release rate assuming a normal vent flow rate and pressure correction factor. Set the high-high alarm for approximately this monitor response.

II.D. Setpoint Determination for Gaseous Radwaste

Flow Monitors

The alarm setpoint for the main stack flow monitor is as follows:

Low Flow Alarm - 10,000 CFM. - This setting ensures that the main stack minimum dilution flow as specified in ODCMS 3.8.C.4.a is maintained.

The alarm setpoints for the roof vent flow monitors are as follows:

Low Flow Alarm - 1.5×10^5 cfm

High Flow Alarm - 5.4×10^5 cfm

III. Liquid Pathway Dose Calculations

III.A Liquid Radwaste Release Flow Rate Determination

Peach Bottom Atomic Power Station Units 2 and 3 have one common discharge point for liquid releases. The following calculation assures that the radwaste release limits are met.

The flow rate of liquid radwaste released from the site to areas at and beyond the SITE BOUNDARY shall be such that the concentration of radioactive material after dilution shall be limited to 10 times the concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than noble gases and 2E-4 μCi/ml total activity concentration for all noble gases as specified in ODCMS 3.8.B.1. This

methodology is consistent with the additional guidance the NRC provided to the industry during the implementation of the updated 10 CFR 20 which changed the criterion for controlling release rate based on Effective Concentration (EC) values in the updated 10 CFR 20 as opposed to the Maximum Permissible Concentration (MPC) values in the former 10 CFR 20.

Each tank of radioactive waste is sampled prior to release and is quantitatively analyzed for identifiable gamma emitters as specified in Table 4.8.B.1 of the ODCMS. While non-gamma emitters are not specifically addressed, the conservatisms inherent in the calculation of the maximum permissible release rate are more than adequate to account for them. From this gamma isotopic analysis the maximum permissible release flow rate is determined as follows:

Determine a Dilution Factor by:

$$\text{Dilution Factor} = \sum_i \frac{\mu Ci / ml_i}{10 \times ECL_i} \; 1$$

$\mu Ci / ml_i$ = the activity of each identified gamma emitter in $\mu Ci/ml$

ECL_i = The effluent concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than noble gases or 2×10^{-4} $\mu Ci/ml$ for noble gases.

Determine the Maximum Permissible Release Rate with this Dilution Factor by:

$$\text{Release Rate (gpm)} = \frac{A \times 2.0 \times 10^5}{B \times C \times \text{Dilution Factor}}$$

A = The number of circulating water pumps running which will provide dilution

2.0×10^5 = the flow rate in gpm for each circulating water pump running

B = margin of assurance which includes consideration of the maximum error in the activity setpoint, the maximum error in the flow setpoint, and possible loss of 5 out of the 6 possible circulating water pumps during a release. The value used for B is 10.0.

C = concentration gradient factor. The value used for C is 5.0 for discharge canal water levels less than 104' and 3.0 for canal water levels greater than 104'. This just adds another factor of conservatism.

III.B ODCMS 4.8.B.2.1

Dose contributions from liquid effluents released to areas at and beyond the SITE BOUNDARY shall be calculated using the equation below. This dose calculation uses those appropriate radionuclides listed in Table III.A.1. These radionuclides account for virtually 100 percent of the total body dose and organ dose from liquid effluents.

The dose for each age group and each organ should be calculated to determine the maximum total body dose and organ dose for each quarter and the year, as appropriate. Cumulative dose files for quarterly and yearly doses should be maintained separately and the maximum total body and organ dose reported in each case. **CM-1** NRC URI 88-33-01, T00353.

$$D_\tau = \sum_i \left[A_{i\tau} \sum_{\ell=1}^{m} \Delta t_\ell \, C_{i\ell} \, F_\ell \right]$$

where:

D_τ = The cumulative dose commitment to the total body or any organ, τ, from liquid effluents for the total

time period $\sum_{\ell=1}^{m} \Delta t_\ell$ 2, in mrem.

Δt_ℓ = The length of the ℓth time period over which $C_{i\ell}$ and F_ℓ are averaged for the liquid release, in hours.

$C_{i\ell}$ = The average concentration of radionuclide, i, in undiluted liquid effluent during time period Δt_ℓ from any liquid release, (determined by the effluent sampling analysis program, ODCMS Table 4.8.B.1), in μCi/ml.

$A_{i\tau}$ = The site related ingestion dose commitment factor to the total body or organ, τ, for each radionuclide listed in Table III.A.1, in mrem-ml per hr-μCi. See Site Specific Data.**

F_ℓ = The near field average dilution factor for $C_{i\ell}$ during any liquid effluent release. Defined as the ratio of the maximum undiluted liquid waste flow during release to the average flow through the discharge pathway.

III.C ODCMS 4.8.B.4.1

Projected dose contributions from liquid effluents shall be calculated using the methodology described in section III.B.

** See Note 1 in Bases

TABLE III.A.1

LIQUID EFFLUENT INGESTION DOSE FACTORS
(DECAY CORRECTED)
$A_{i\tau}$ DOSE FACTOR (MREM-ML PER HR-μCi)

	TOTAL BODY		
RADIONUCLIDE	ADULT	TEEN	CHILD
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	5.93E+04	6.49E+04	8.33E+04
CR-51	1.49E+00	1.53E+00	1.69E+00
MN-54	9.82E+02	1.00E+03	1.08E+03
FE-55	1.31E+02	1.40E+02	1.96E+02
FE-59	1.14E+03	1.17E+03	1.36E+03
CO-57	4.55E+01	4.71E+01	5.78E+01
CO-58	2.59E+02	2.62E+02	3.17E+02
CO-60	7.40E+02	7.48E+02	9.07E+02
NI-63	1.29E+03	1.34E+03	1.90E+03
ZN-65	3.87E+04	3.95E+04	4.16E+04
SR-89	8.83E+02	9.45E+02	1.48E+03
SR-90	1.88E+05	1.56E+05	1.72E+05
Y-91M	5.85E-13	6.14E-13	9.31E-13
Y-93	1.27E-03	1.34E-03	2.16E-03
NB-95	1.52E+02	1.56E+02	1.68E+02
NB-95M	no data	no data	no data
ZR-95	1.77E-01	1.72E-01	3.48E-01
ZR-97	1.56E-03	1.56E-03	3.43E-03
MO-99	2.91E+01	3.01E+01	5.53E+01
TC-99M	3.33E-02	3.33E-02	4.93E-02
RU-103	3.57E+00	3.60E+00	5.97E+00
RU-105	6.55E-03	6.72E-03	1.19E-02
AG-110M	2.13E+00	2.04E+00	4.23E+00
SN-113	no data	no data	no data
TE-129M	2.01E+03	2.17E+03	2.79E+03
TE-131M	4.57E+02	4.81E+02	5.74E+02
TE-132	1.40E+03	1.44E+03	1.65E+03
SB-124	2.27E+01	2.18E+01	5.15E+01
SB-125	8.79E+00	8.47E+00	2.01E+01
I-131	1.86E+02	1.79E+02	2.36E+02
I-133	1.97E+01	2.03E+01	3.20E+01
I-135	2.04E+00	2.06E+00	3.12E+00
CS-134	6.74E+05	3.88E+05	1.49E+05
CS-136	9.79E+04	9.15E+04	7.30E+04
CS-137	3.98E+05	2.20E+05	8.49E+04
CS-138	1.04E-11	1.09E-11	1.27E-11
BA-139	5.01E-07	5.17E-07	1.18E-06
BA-140	3.66E+01	3.62E+01	7.42E+01

LA-140	1.92E-02	1.97E-02	2.78E-02
LA-142	3.62E-08	3.70E-08	5.28E-08
CE-141	1.45E-02	1.46E-02	3.86E-02
CE-143	1.68E-03	1.69E-03	4.44E-03

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1
LIQUID EFFLUENT INGESTION DOSE FACTORS
(DECAY CORRECTED)

$A_{i\tau}$ DOSE FACTOR (MREM-ML PER HR-μCi)

	LIVER		
RADIONUCLIDE	ADULT	TEEN	CHILD
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	9.55E+04	1.04E+05	1.01E+05
CR-51	no data	no data	no data
MN-54	5.15E+03	5.06E+03	4.03E+03
FE-55	5.62E+02	6.01E+02	6.33E+02
FE-59	2.96E+03	3.02E+03	2.73E+03
CO-57	2.74E+01	2.81E+01	2.86E+01
CO-58	1.16E+02	1.14E+02	1.04E+02
CO-60	3.35E+02	3.32E+02	3.07E+02
NI-63	2.66E+03	2.80E+03	2.99E+03
ZN-65	8.55E+04	8.46E+04	6.69E+04
SR-89	no data	no data	no data
SR-90	no data	no data	no data
Y-91M	no data	no data	no data
Y-93	no data	no data	no data
NB-95	2.83E+02	2.84E+02	2.35E+02
NB-95M	no data	no data	no data
ZR-95	2.61E-01	2.50E-01	3.91E-01
ZR-97	3.40E-03	3.39E-03	5.82E-03
MO-99	1.53E+02	1.58E+02	2.23E+02
TC-99M	2.61E-03	2.57E-03	2.98E-03
RU-103	no data	no data	no data
RU-105	no data	no data	no data
AG-110M	3.58E+00	3.36E+00	5.30E+00
SN-113	no data	no data	no data
TE-129M	4.74E+03	5.09E+03	5.02E+03
TE-131M	5.48E+02	5.77E+02	5.40E+02
TE-132	1.48E+03	1.53E+03	1.36E+03
SB-124	1.08E+00	1.03E+00	1.91E+00
SB-125	4.13E+01	3.96E-01	7.39E-01
I-131	3.25E+02	3.32E+02	4.16E+02
I-133	6.48E+01	6.66E+01	8.45E+01
I-135	5.52E+00	5.55E+00	1.63E+00
CS-134	8.25E+05	8.36E+05	7.06E+05
CS-136	1.36E+05	1.36E+05	1.13E+05
CS-137	6.07E+05	6.32E+05	5.75E+05
CS-138	2.10E-11	2.18E-11	2.01E-11
BA-139	1.22E-08	1.25E-08	2.17E-08
BA-140	7.00E-01	6.90E-01	1.11E+00

LA-140	7.28E-02	7.40E-02	8.25E-02
LA-142	1.45E-07	1.49E-07	1.69E-07
CE-141	1.28E-01	1.27E-01	2.60E-01
CE-143	1.52E+01	1.51E+01	3.07E+01

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1

LIQUID EFFLUENT INGESTION DOSE FACTORS
(DECAY CORRECTED)
$A_{i\tau}$ DOSE FACTOR (MREM-ML PER HR-μCi)

	BONE		
RADIONUCLIDE	ADULT	TEEN	CHILD
H-3	no data	no data	no data
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	2.38E+05	2.58E+05	3.35E+05
CR-51	no data	no data	no data
MN-54	no data	no data	no data
FE-55	8.12E+02	8.47E+02	1.19E+03
FE-59	1.26E+03	1.30E+03	1.68E+03
CO-57	no data	no data	no data
CO-58	no data	no data	no data
CO-60	no data	no data	no data
NI-63	3.84E+04	3.97E+04	5.58E+04
ZN-65	2.69E+04	2.43E+04	2.51E+04
SR-89	3.08E+04	3.30E+04	5.19E+04
SR-90	7.67E+05	6.31E+05	6.78E+05
Y-91M	1.51E-11	1.61E-11	2.57E-11
Y-93	4.58E-02	4.90E-02	7.77E-02
NB-95	5.08E+02	5.12E+02	6.04E+02
NB-95M	no data	no data	no data
ZR-95	8.13E-01	7.94E-01	1.78E+00
ZR-97	1.69E-02	1.71E-02	4.03E-02
MO-99	no data	no data	no data
TC-99M	9.24E-04	9.22E-04	1.52E-03
RU-103	8.30E+00	8.43E+00	1.55E+01
RU-105	1.66E-02	1.73E-02	3.29E-02
AG-110M	3.87E+00	3.55E+00	7.84E+00
SN-113	no data	no data	no data
TE-129M	1.27E+04	1.37E+04	1.80E+04
TE-131M	1.12E+03	1.21E+03	1.56E+03
TE-132	2.29E+03	2.42E+03	3.07E+03
SB-124	5.72E+01	5.59E+01	1.47E+02
SB-125	3.69E+01	3.62E+01	9.59E+01
I-131	2.28E+02	2.38E+02	4.13E+02
I-133	3.72E+01	3.92E+01	6.84E+01
I-135	2.11E+00	2.16E+00	3.66E+00
CS-134	3.47E+05	3.55E+05	4.30E+05
CS-136	3.45E+04	3.46E+04	4.10E+04
CS-137	4.44E+05	4.75E+05	6.01E+05
CS-138	1.06E-11	1.14E-11	1.45E-11
BA-139	1.71E-05	1.77E-05	4.07E-05
BA-140	5.57E+02	5.63E+02	1.27E+03

LA-140	1.44E-01	1.51E-01	2.36E-01
LA-142	3.19E-07	3.35E-07	5.29E-07
CE-141	1.89E-01	1.90E-01	5.21E-01
CE-143	2.06E-02	2.07E-02	5.66E-02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1

LIQUID EFFLUENT INGESTION DOSE FACTORS
(DECAY CORRECTED)
A_{it} DOSE FACTOR (MREM-ML PER HR-μCi)

	KIDNEY		
RADIONUCLIDE	ADULT	TEEN	CHILD
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	no data	no data	no data
CR-51	3.28E-01	3.35E-01	2.57E-01
MN-54	1.53E+03	1.51E+03	1.13E+03
FE-55	no data	no data	no data
FE-59	no data	no data	no data
CO-57	no data	no data	no data
CO-58	no data	no data	no data
CO-60	no data	no data	no data
NI-63	no data	no data	no data
ZN-65	5.72E+04	5.41E+04	4.22E+04
SR-89	no data	no data	no data
SR-90	no data	no data	no data
Y-91M	no data	no data	no data
Y-93	no data	no data	no data
NB-95	2.79E+02	2.75E+02	2.21E+02
NB-95M	no data	no data	no data
ZR-95	4.09E-01	3.68E-01	5.60E-01
ZR-97	5.14E-03	5.14E-03	8.35E-03
MO-99	3.46E+02	3.61E+02	4.77E+02
TC-99M	3.96E-02	3.83E-02	4.33E-02
RU-103	3.17E+01	2.97E+01	3.91E+01
RU-105	2.14E-01	2.18E-01	2.89E-01
AG-110M	7.04E+00	6.40E+00	9.86E+00
SN-113	no data	no data	no data
TE-129M	5.31E+04	5.74E+04	5.29E+04
TE-131M	5.55E+03	6.01E+03	5.22E+03
TE-132	1.43E+04	1.47E+04	1.27E+04
SB-124	no data	no data	no data
SB-125	no data	no data	no data
I-131	5.57E+02	5.73E+02	6.82E+02
I-133	1.12E+02	1.16E+02	1.41E+02
I-135	8.86E+00	8.77E+00	1.01E+01
CS-134	2.67E+05	2.66E+05	2.19E+05
CS-136	7.57E+04	7.42E+04	6.00E+04
CS-137	2.06E+05	2.15E+05	1.87E+05
CS-138	1.54E-11	1.61E-11	1.41E-11
BA-139	1.14E-08	1.18E-08	1.90E-08
BA-140	2.38E-01	2.34E-01	3.62E-01

LA-140	no data	no data	no data
LA-142	no data	no data	no data
CE-141	5.94E-02	5.98E-02	1.14E-01
CE-143	6.70E-03	6.77E-03	1.29E-02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

TABLE III.A.1

LIQUID EFFLUENT INGESTION DOSE FACTORS
(DECAY CORRECTED)
A_{it} DOSE FACTOR (MREM-ML PER HR-μCi)

	GI-LLI		
RADIONUCLIDE	ADULT	TEEN	CHILD
H-3	2.13E+00	1.53E+00	2.70E+00
NA-24	1.65E+02	1.70E+02	1.98E+02
P-32	1.73E+05	1.41E+05	5.98E+04
CR-51	3.74E+02	2.57E+02	8.98E+01
MN-54	1.58E+04	1.04E+04	3.38E+03
FE-55	3.22E+02	2.60E+02	1.17E+02
FE-59	9.90E+03	7.15E+03	2.84E+03
CO-57	6.94E+02	5.24E+02	2.34E+02
CO-58	2.35E+03	1.56E+03	6.04E+02
CO-60	6.30E+03	4.33E+03	1.70E+03
NI-63	5.56E+02	4.46E+02	2.01E+02
ZN-65	5.38E+04	3.58E+04	1.18E+04
SR-89	4.94E+03	3.93E+03	2.01E+03
SR-90	2.22E+04	1.77E+04	9.13E+03
Y-91M	4.44E-11	7.58E-10	5.03E-08
Y-93	1.45E+03	1.50E+03	1.18E+03
NB-95	1.72E+06	1.21E+06	4.35E+05
NB-95M	no data	no data	no data
ZR-95	8.27E+02	5.78E+02	4.08E+02
ZR-97	1.06E+03	9.19E+02	8.81E+02
MO-99	3.54E+02	2.82E+02	1.85E+02
TC-99M	1.54E+00	1.69E+00	1.69E+00
RU-103	9.69E+02	7.04E+02	4.01E+02
RU-105	1.01E+01	1.40E+01	2.15E+01
AG-110M	1.46E+03	9.43E+02	6.30E+02
SN-113	no data	no data	no data
TE-129M	6.40E+04	5.15E+04	2.19E+04
TE-131M	5.44E+04	4.63E+04	2.19E+04
TE-132	7.02E+04	4.85E+04	1.37E+04
SB-124	1.62E+03	1.13E+03	9.19E+02
SB-125	4.07E+02	2.82E+02	2.29E+02
I-131	8.58E+01	6.57E+01	3.70E+01
I-133	5.82E+01	5.03E+01	3.40E+01
I-135	6.24E+00	6.16E+00	5.03E+00
CS-134	1.44E+04	1.04E+04	3.80E+03
CS-136	1.55E+04	1.09E+04	3.96E+03
CS-137	1.18E+04	9.00E+03	3.60E+03
CS-138	8.94E-17	9.90E-15	9.25E-12
BA-139	3.04E-05	1.58E-04	2.35E-03
BA-140	1.15E+03	8.69E+02	6.43E+02

LA-140	5.34E+03	4.25E+03	2.30E+03
LA-142	1.06E-03	4.52E-03	3.34E-02
CE-141	4.89E+02	3.63E+02	3.24E+02
CE-143	5.69E+02	4.54E+02	4.49E+02

NOTE: The listed dose factors are for radionuclides that may be detected in liquid effluents and have significant dose consequences. The factors are decayed for one day to account for the time between effluent release and ingestion of fish by the maximum exposed individual.

IV. Gaseous Pathway Dose Calculations

IV.A. ODCMS 4.8.C.1.1 and 4.8.C.1.2

The dose rate in areas at and beyond the SITE BOUNDARY due to radioactive materials released in gaseous effluents shall be determined by the expressions below:

IV.A.1 Noble Gases:

The dose rate from radioactive noble gas releases shall be determined by either of two methods. Method (a), the Gross Release Method, assumes that all noble gases released are the most limiting nuclide - Kr-88 for total body dose (vent and stack releases) and skin dose (vent releases) and Kr-87 for skin dose (stack releases). Method (b), the Isotopic Analysis Method, utilizes the results of noble gas analyses required by ODCMS 4.8.C.1.1.

a. Gross Release Method

$$D_{TB} = V\,\dot{Q}_{NS} + K\left(\overline{\chi/Q}\right)_V \dot{Q}_{NV}$$

$$D_S = \left[L_S\left(\overline{\chi/Q}\right)_S + 1.1B\right]\dot{Q}_{NS} + \left[L_V + 1.1M\right]\left(\overline{\chi/Q}\right)_V \dot{Q}_{NV}$$

where:

The location is the site boundary, 1100m SSE from the vents. This location results in the highest calculated dose to an individual from noble gas releases.

D_{TB} = total body dose rate, in mrem/yr.

D_S = skin dose rate, in mrem/yr.

V = 4.72×10^{-4} mrem/yr per μCi/sec; the constant for Kr-88 accounting for the gamma radiation from the elevated finite plume. This constant was developed using MARE program with plant specific inputs for PBAPS.

IV.A.1.a (Cont'd)

$\dot{Q}_{NS}$ = The gross release rate of noble gases from the stack determined by gross activity stack monitors averaged over one hour, in μCi/sec.

K = 1.47 X 10^4 mrem/yr per μCi/m^3; the total body dose factor due to gamma emissions for Kr-88 (Reg. Guide 1.109, Table B-1).

$\left(\overline{\chi/Q}\right)_V$ = 1.12 X 10^{-6} sec/m^3; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases.

$\dot{Q}_{NV}$ = The gross release rate of noble gases in gaseous effluents from vent releases determined by gross activity vent monitors averaged over one hour, in μCi/sec.

L_V = 2.37 x 10^3 mrem/yr per μCi/m^3; the skin dose factor due to beta emissions for Kr-88. (Reg. Guide 1.109, Table B-1).

L_S = 9.73 X 10^3 mrem/yr per μCi/m^3; the skin dose factor due to beta emissions for Kr-87. (Reg. Guide 1.109, Table B-1).

$\left(\overline{\chi/Q}\right)_S$ = 9.97 X 10^{-8} sec/m^3; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

B = 1.74 X 10^{-4} mrad/yr per μCi/sec; the constant for Kr-87 accounting for the gamma radiation from the elevated finite plume. This constant was developed using MARE program with plant specific inputs for PBAPS.

M = 1.52 X 10^4 mrad/yr per μCi/m^3; the air dose factor due to gamma emissions for Kr-88. (Reg. Guide 1.109, Table B-1).

1.1 = Unit conversion, converts air dose to skin dose, mrem/mrad.

IV.A.1. b. Isotopic Analysis Method

$$D_{TB} = \sum_i \left(V_i \dot{Q}_{iS} + K_i \left(\overline{\chi/Q}\right)_V \dot{Q}_{iV} \right)$$

$$D_S = \sum_i \left[\left(L_i \left(\overline{\chi/Q}\right)_S + 1.1 B_i \right) \dot{Q}_{iS} + \left(L_i + 1.1 M_i \right) \left(\overline{\chi/Q}\right)_V \dot{Q}_{iV} \right]$$

where:

The location is the site boundary, 1100m SSE from the vents. This location results in the highest calculated dose to an individual from noble gas releases.

D_{TB} = total body dose rate, in mrem/yr.

D_S = skin dose rate, in mrem/yr.

V_i = The constant for each identified noble gas radionuclide for the gamma radiation from the elevated finite plume. The constants were developed using the MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrem/yr per μCi/sec.

$\dot{Q}_{iS}$ = The release rate of noble gas radionuclide, i, in gaseous effluents from the stack determined by isotopic analysis averaged over one hour, in μCi/sec.

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrem/yr per $\mu Ci/m^3$.

$\left(\overline{\chi/Q}\right)_V$ = 1.12×10^{-6} sec/m^3; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases.

$\dot{Q}_{iV}$ = The release rate of noble gas radionuclide, i, in gaseous effluents from all vent releases determined by isotopic analysis averaged over one hour, in μCi/sec.

IV.A.1.b (Cont'd)

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrem/yr per $\mu Ci/m^3$.

$\left(\overline{\chi/Q}\right)_S$ = 9.97×10^{-8} sec/m^3; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

B_i = The constant for each identified noble gas radionuclide accounting for the gamma radiation from the elevated finite plume. The constants were developed using MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrad/yr per $\mu Ci/sec$.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per $\mu Ci/m^3$.

1.1 = Unit conversion, coverts air dose to skin dose, mrem/mrad.

TABLE IV.A.1 - Constants for Isotopic Analysis Method
(corrected for decay during transit)

Radionuclide	Plume-Air Dose Factor B_i (mrad/yr per μCi/sec)	Total Body Dose Factor K_i (mrem/yr per μCi/m^3)	Skin Dose Factor L_i (mrem/yr per μCi/m^3)	Gamma Air Dose Factor M_i (mrad/yr per μCi/m^3)	Beta Air Dose Factor N_i (mrad/yr per μCi/m^3)	Plume-Body Dose Factor V_i (mrem/yr per μCi/sec)
Kr-85m	4.02E-05	1.17E+03	1.46E+03	1.23E+03	1.97E+03	3.76E-05
Kr-87	1.74E-04	5.92E+03	9.73E+03	6.17E+03	1.03E+04	1.66E-04
Kr-88	4.90E-04	1.47E+04	2.37E+03	1.52E+04	2.93E+03	4.72E-04
Xe-133	1.19E-05	2.94E+02	3.06E+02	3.53E+02	1.05E+03	1.11E-05
Xe-133m	1.09E-05	2.51E+02	9.94E+02	3.27E+02	1.48E+03	1.01E-05
Xe-135	6.37E-05	1.81E+03	1.86E+03	1.92E+03	2.46E+03	5.95E-05
Xe-135m	6.61E-05	2.53E+03	5.76E+02	2.72E+03	5.99E+02	6.17E-05
Xe-138	1.52E-04	6.98E+03	3.26E+03	7.28E+03	3.75E+03	1.46E-04

The values K_i, L_i, M_i, and N_i are taken from Reg. Guide 1.109, Table B-1. The values B_i and V_i were developed using the MARE program with plant specific inputs for PBAPS.

IV.A.2 Iodine-131, iodine-133, tritium and radioactive materials in particulate form, other than noble gases, with half-lives greater than eight days:

The dose rate shall be determined for either of two critical organs and most restrictive age group. Child thyroid dose is limiting when iodine releases exceed 10 percent of the total release rates. The teenager lung dose is limiting when iodine is either not present or a small fraction of the total release.

When it is not clear which organ dose will be limiting, doses for both restrictive age group organs will be calculated and the limiting organ dose identified.

$$D = \sum_i P_i \left[W_S \dot{Q}_{iS} + W_V \dot{Q}_{iV} + W_V \dot{q}_{iV} \right]$$

where:
The location is the site boundary, 1100m SSE from the vents.

D = dose rate to the critical organ most restrictive age group, in mrem/yr.

P_i = The dose parameter for radionuclides other than noble gases for the inhalation pathway. The dose factors are based on the critical organ, and most restrictive age group. All values are from Reg. Guide 1.109 (Tables E-5, E-8, E-9 and E-10). Values are listed on Table IV.A.2, in mrem/yr per $\mu Ci/m^3$

W_S = 1.03×10^{-7} sec/m^3; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY from stack releases. (SSE boundary)

$\dot{Q}_{iS}$ = The release rate of radionuclides; i, in gaseous effluents from the stack determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in $\mu Ci/sec$.

W_V = 4.78×10^{-7} sec/m^3; the highest calculated annual average relative concentration for any area at or beyond the SITE BOUNDARY for all vent releases. (SSE boundary)

IV.A.2. (Cont'd)

$\dot{Q}_{iV}$ = The release rate of radionuclide, i,in gaseous effluents from all vent releases, determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in μCi/sec.

$\dot{q}_{iv}$ = The release rate of radionuclide, i, in gaseous effluents from the auxiliary boiler stack releases, determined by the oil sampling and analysis program (ODCM Specification Table 4.8.C.1) in μCi/sec as calculated below:

$$= \sum_{i} \frac{C_{iV} \times 3785 \times Z}{T}$$

where:

The location is the site boundary, 1100m SSE from the vents.

C_{iV} = activity concentration measured in oil for nuclide, i, in μCi/ml.

3785 = milliliters per gallon.

Z = gallons of oil consumed.

T = number of seconds used for release
Method (a) 60 second
Method (b) number of seconds used to burn oil for release.

TABLE IV.A.2
Pi CONSTANTS FOR CRITICAL ORGAN FOR THE MOST RESTRICTIVE AGE GROUP

(mrem/yr per μCi/m^3)

RADIONUCLIDE	INFANT THYROID DOSE FACTOR	INFANT LUNG DOSE FACTOR	CHILD THYROID DOSE FACTOR	TEENAGER LUNG DOSE FACTOR
H-3	6.47E+02	6.47E+02	1.13E+03	1.27E+03
C-14	5.31E+03	5.31E+03	6.73E+03	4.87E+03
NA-24	1.06E+04	1.06E+04	1.61E+04	1.38E+04
P-32	no data	no data	no data	no data
Cr-51	5.75E+01	1.28E+04	8.55+01	2.10E+04
MN-54	no data	1.00E+06	no data	1.98E+06
FE-55	no data	8.69E+04	no data	1.24E+05
MN-56	no data	1.25E+04	no data	1.52E+04
CO-58	no data	7.77E+05	no data	1.34E+06
FE-59	no data	1.02E+06	no data	1.53E+06
CO-60	no data	4.51E+06	no data	8.72E+06
NI-63	no data	2.09E+05	no data	3.07E+05
CU-64	no data	9.30E+03	no data	1.11E+04
NI-65	no data	8.12E+03	no data	9.36E+03
ZN-65	no data	6.47E+05	no data	1.24E+06
ZN-69	no data	1.47E+03	no data	1.58E+03
BR-83	no data	no data	no data	no data
BR-84	no data	no data	no data	no data
BR-85	no data	no data	no data	no data
RB-86	no data	no data	no data	no data
RB-88	no data	no data	no data	no data
RB-89	no data	no data	no data	no data
SR-89	no data	2.03E+06	no data	2.42E+06
SR-90	no data	1.12E+07	no data	1.65E+07
Y-90	no data	2.69E+05	no data	2.93E+05
SR-91	no data	5.26E+04	no data	6.07E+04
Y-91M	no data	2.79E+03	no data	3.20E+03
Y-91	no data	2.45E+06	no data	2.94E+06
SR-92	no data	2.38E+04	no data	2.74E+04
Y-92	no data	2.45E+04	no data	2.68E+04
Y-93	no data	7.64E+04	no data	8.32E+04
NB-95	no data	4.79E+05	no data	7.51E+05
ZR-95	no data	1.75E+06	no data	2.69E+06
ZR-97	no data	1.10E+05	no data	1.30E+05
MO-99	no data	1.35E+05	no data	1.54E+05
TC-99M	no data	8.11E+02	no data	1.15E+03
TC-101	no data	5.84E+02	no data	6.67E+02

RU-103	no data	5.52E+05	no data	7.83E+05
RU-105	no data	1.57E+04	no data	1.82E+04
RU-106	no data	1.16E+07	no data	1.61E+07
AG-110M	no data	3.67E+06	no data	6.75E+06
TE-125M	1.62E+03	4.47E+05	1.92E+03	5.36E+05
TE-127M	4.87E+03	1.31E+06	6.07E+03	1.66E+06
TE-127	1.85E+00	1.04E+04	1.96E+00	1.12E+04
TE-129M	5.47E+03	1.68E+06	6.33E+03	1.98E+06
TE-129	6.75E-02	3.00E+03	7.14E-02	3.30E+03
I-130	1.60E+06	no data	1.85E+06	no data
I-131	1.48E+07	no data	1.62E+07	no data
TE-131M	8.93E+01	1.99E+05	9.77E+01	2.38E+05
TE-131	1.58E-02	2.06E+03	1.70E-02	2.34E+03
I-132	1.69E+05	no data	1.94E+05	no data
TE-132	2.79E+02	3.40E+05	3.18E+02	4.49E+05
I-133	3.56E+06	no data	3.85E+06	0.00E+00
CS-134	no data	7.97E+04	0.00E+00	1.46E+05
I-134	4.45E+04	no data	5.07E+04	no data
I-135	6.96E+05	no data	7.92E+05	no data
CS-136	no data	1.18E+04	no data	1.78E+04
CS-137	no data	7.13E+04	no data	1.21E+05
CS-138	no data	6.54E+01	no data	7.87E+01
BA-139	no data	5.95E+03	no data	6.46E+03
BA-140	no data	1.60E+06	no data	2.03E+06
LA-140	no data	1.68E+05	no data	2.14E+05
BA-141	no data	2.97E+03	no data	3.29E+03
CE-141	no data	5.17E+05	no data	6.14E+05
BA-142	no data	1.55E+03	no data	1.91E+03
LA-142	no data	8.22E+03	no data	1.02E+04
CE-143	no data	1.16E+05	no data	1.30E+05
PR-143	no data	4.33E+05	no data	4.83E+05
CE-144	no data	9.84E+06	no data	1.34E+07
PR-144	no data	1.61E+03	no data	1.75E+03
ND-147	no data	3.22E+05	no data	3.72E+05
W-187	no data	3.96E+04	no data	4.74E+04
NP-239	no data	5.95E+04	no data	6.49E+04

IV.B. ODCMS 4.8.C.2.1

The air dose in areas at and beyond the SITE BOUNDARY due to noble gases released in gaseous effluents shall be determined by the expressions below.

The air dose shall be determined by either of two methods. Method (a), the Gross Release Method, assumes that all noble gases released are the most limiting nuclide - Kr-88 for gamma radiation and Kr-87 for beta radiation. Method (b), the Isotopic Analysis Method, utilizes the results of noble gas analyses required by ODCMS 4.8.C.1.1.

IV.B.1 for gamma radiation:

a. Gross Release Method

$$D_\gamma = 3.17 \times 10^{-8} \left[M \left(\overline{\chi/Q} \right)_V \tilde{Q}_V + B \tilde{Q}_S \right]$$

where:

The location is the SITE BOUNDARY 1100m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

D_γ = gamma air dose, in mrad.

3.17×10^{-8} = years per second.

M = 1.52×10^4 mrad/yr per $\mu Ci/m^3$; the air dose factor due to gamma emissions for Kr-88. (Reg. Guide 1.109, Table B-1)

$\left(\overline{\chi/Q} \right)_V$ = 1.12×10^{-6} sec/m^3; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_V$ = The gross release of noble gas radionuclides in gaseous effluents from all vents, determined by gross activity vent monitors, in μCi. Releases shall be cumulative over the calendar quarter or year as appropriate.

IV.B.1. a (Cont'd)

B = 4.90×10^{-4} mrad/year per μCi/sec; the constant for Kr-88 accounting for the gamma radiation from the elevated finite plume. The constant was developed using the MARE program with plant specific inputs for PBAPS.

$\tilde{Q}_S$ = The gross release of noble gas radionuclides in gaseous releases from the stack determined by gross activity stack monitor in μCi. Releases shall be cumulative over the calendar quarter or year as appropriate.

b. Isotopic Analysis Method

$$D_\gamma = 3.17 \times 10^{-8} \sum_i \left[M_i \left(\overline{\chi/Q}\right)_V \tilde{Q}_{iV} + B_i \tilde{Q}_{iS} \right]$$

where:

The location is the SITE BOUNDARY, 1100m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

D_γ = gamma air dose, in mrad.

3.17×10^{-8} = years per second.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per μCi/m^3.

$\left(\overline{\chi/Q}\right)_V$ = 1.12×10^{-6} sec/m^3; the highest calculated average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iV}$ = The release of noble gas radionuclides, i, in gaseous effluents from all vents as determined by isotopic analysis, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

B_i = The constant for each identified noble gas radionuclide accounting for the gamma radiation for the elevated finite plume. The constants were developed using the MARE program with plant specific inputs for PBAPS. Values are listed on Table IV.A.1, in mrad/yr per μCi/sec.

IV.B.1. b. (Cont'd)

$\tilde{Q}_{iS}$ = The release of noble gas radionuclides, i, in gaseous effluents from the stack determined by isotopic analysis, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

IV.B.2. for beta radiation:

a. Gross Release Method

$$D_\beta = 3.17 \times 10^{-8} N \left[\left(\overline{\chi/Q} \right)_V \tilde{Q}_V + \left(\overline{\chi/Q} \right)_S \tilde{Q}_S \right]$$

where:

The location is the SITE BOUNDARY 1100m SSE from the vents. This location results in the highest calculated gamma air dose from noble gas releases.

D_β = beta air dose, in mrad.

3.17×10^{-8} = years per second.

N = 1.03×10^4 mrad/yr per μCi/m^3; the air dose factor due to beta emissions for Kr-87. (Reg. Guide 1.109, Table B-1)

$\left(\overline{\chi/Q} \right)_V$ = 1.12×10^{-6} sec/m^3; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_V$ = The gross release of noble gas radionuclides in gaseous effluents from all vents determined by gross activity vent monitors, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

$\left(\overline{\chi/Q}\right)_S$ = 9.97×10^{-8} sec/m^3; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_S$ = The gross release of noble gas radionuclides in gaseous releases from the stack determined by gross activity stack monitors, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

IV.B.2. b. Isotopic Analysis Method

$$D_\beta = 3.17 \times 10^{-8} \sum_i N_i \left[\left(\overline{\chi/Q}\right)_V \tilde{Q}_{iV} + \left(\overline{\chi/Q}\right)_S \tilde{Q}_{iS} \right]$$

3.17×10^{-8} = years per second.

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide. Values are listed on Table IV.A.1, in mrad/yr per μCi/m^3.

$\left(\overline{\chi/Q}\right)_V$ = 1.12×10^{-6} sec/m^3; the highest calculated annual average relative concentration from vent releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iV}$ = The release of noble gas radionuclide, i, in gaseous effluents from all vents as determined by isotopic analysis, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

$\left(\overline{\chi/Q}\right)_S$ = 9.97×10^{-8} sec/m^3; the highest calculated annual average relative concentration from the stack releases for any area at or beyond the SITE BOUNDARY.

$\tilde{Q}_{iS}$ = The release of noble gas radionuclide, i, in gaseous effluents from the stack as determined by isotopic analysis, in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

IV.C ODCMS 4.8.C.3.1

The dose to an individual from iodine-131, iodine-133, tritium and radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to areas at and beyond the SITE BOUNDARY.

The dose shall be determined for the limiting organ. Infant thyroid doses are dominating any time that either iodine-131 release rates are more than two (2) percent of total release rates or iodine-133 exceeds 25 percent of total release rates. In these cases only iodine-131 and iodine-133 are potentially significant.

For cases where there is no detectable iodine releases, doses shall be determined for infant bone and liver. Both bone and liver doses are calculated because the controlling dose is dependent upon the presence of strontium.

When it is not clear whether thyroid, bone, or liver doses are controlling, all three shall be calculated and the limiting dose identified.

$$D = 3.17 \times 10^{-8} \sum_i F_e \, R_i \left[W_S \tilde{Q}_{iS} + W_V \tilde{Q}_{iV} + W_V \tilde{q}_{iV} \right]$$

where:

Location is the critical pathway dairy 1500m SW from vents.

D = limiting dose to the critical infant organ, from the milk, or inhalation, or ground plane pathways, in mrem.

3.17×10^{-8} = years per second.

F_e = Fraction that is elemental (0.5 for iodines and 1.0 for all other elements).

R_i = The dose factor for each identified radionuclide; i, in m^2 (mrem/yr) per μCi/sec except tritium, carbon-14, and inhalation pathway, which is in mrem/yr per μCi/m^3. The dose factors are for the critical individual organ for the most restrictive age group, infant. Table IV.C.1 list values for the ingestion pathway, Table IV.C.2 for the inhalation pathway, and Table IV.C.3 for the ground plane pathway. See Site Specific Data.**

IV.C (Continued)

W_S = 4.19×10^{-10} meters^{-2} $\left(\overline{D/Q}\right)$ for the ingestion and ground plane pathway for stack releases. Tritium, carbon-14, and the inhalation pathway use a (χ/Q) of 8.11×10^{-9} sec/m^3.

$\tilde{Q}_{iS}$ = The release of radionuclide, i, in gaseous effluents from the stack determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1), in μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

W_V = 1.58×10^{-9} meters^{-2} $\left(\overline{D/Q}\right)$ for the ingestion and ground plane pathway for vent releases. Tritium, carbon-14, and the inhalation pathway use a (χ/Q) of 4.43×10^{-7} sec/m^3.

** See Note 2 and 3 in Bases

$\tilde{Q}_{iV}$ = The release of radionuclide, i, in gaseous effluents from the vents determined by the effluent sampling and analysis program (ODCMS Table 4.8.C.1) in μCi. Release shall be cumulative over the calendar quarter or year, as appropriate.

$\tilde{q}_{iV}$ = The release of radionuclide, i, in gaseous effluents from the auxiliary boiler stack releases, determined by the oil sampling and analysis program (ODCMS Table 4.8.C.1) in μCi. Release shall be cumulative over the calendar quarter or year, as appropriate.

TABLE IV.C.1

Ri CONSTANTS INGESTION PATHWAY

(m^2 (mrem/yr) per μCi/sec)*

Radionuclide	Infant Bone	Infant Liver	Infant Thyroid	Infant Kidney	Infant Lung	Infant GI-LLI	Infant Skin	Infant T Body
H-3	no data	1.30E+03	1.30E+03	1.30E+03	1.30E+03	1.30E+03	no data	1.30E+03
C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	no data	6.89E+05
NA-24	4.48E+06	4.48E+06	4.48E+06	4.48E+06	4.48E+06	4.48E+06	no data	4.48E+06
P-32	4.74E+10	2.79E+09	no data	no data	no data	6.41E+08	no data	1.84E+09
CR-51	no data	no data	3.35E+04	7.32E+03	6.51E+04	1.50E+06	no data	5.13E+04
MN-54	no data	1.93E+07	no data	4.28E+06	no data	7.09E+06	no data	4.38E+06
FE-55	7.09E+07	4.58E+07	no data	no data	2.24E+07	5.81E+06	no data	1.22E+07
MN-56	no data	9.24E-03	no data	7.94E-03	no data	8.39E-01	no data	1.59E-03
CO-58	no data	9.57E+06	no data	no data	no data	2.39E+07	no data	2.39E+07
FE-59	7.92E+07	1.38E+08	no data	no data	4.09E+07	6.61E+07	no data	5.45E+07
CO-60	no data	4.69E+07	no data	no data	no data	1.12E+08	no data	1.11E+08
NI-63	1.88E+10	1.17E+09	no data	no data	no data	5.80E+07	no data	6.54E+08
CU-64	no data	5.42E+04	no data	9.17E+04	no data	1.11E+06	no data	2.51E+04
NI-65	1.03E+00	1.16E-01	no data	no data	no data	8.85E+00	no data	5.29E-02
ZN-65	2.69E+09	9.22E+09	no data	4.47E+09	no data	7.78E+09	no data	4.25E+09
ZN-69	3.09E+04	5.56E+04	no data	2.31E+04	no data	4.54E+06	no data	4.14E+03
BR-83	no data	no data	no data	no data	no data	no data	no data	1.20E-01
BR-84	no data	no data	no data	no data	no data	no data	no data	1.64E-23
BR-85	no data	no data	no data	no data	no data	no data	no data	no data
RB-86	no data	6.69E+09	no data	no data	no data	1.71E+08	no data	3.31E+09
RB-88	no data	5.60E-45	no data	no data	no data	5.45E-45	no data	3.07E-45
RB-89	no data	9.86E-53	no data	no data	no data	3.36E-53	no data	6.79E-53
SR-89	4.58E+09	no data	no data	no data	no data	9.42E+07	no data	1.31E+08
SR-90	6.55E+10	no data	no data	no data	no data	8.18E+08	no data	1.67E+10
Y-90	1.99E+02	no data	no data	no data	no data	2.74E+05	no data	5.33E+00
SR-91	7.94E+04	no data	no data	no data	no data	9.40E+04	no data	2.87E+03
Y-91M	1.66E-19	no data	no data	no data	no data	5.53E-16	no data	5.65E-21
Y-91	2.77E+04	no data	no data	no data	no data	1.98E+06	no data	7.37E+02
SR-92	1.36E+00	no data	no data	no data	no data	1.47E+01	no data	5.05E-02
Y-92	1.57E-04	no data	no data	no data	no data	3.01E+00	no data	4.43E-06
Y-93	6.31E-01	no data	no data	no data	no data	4.98E+03	no data	1.72E-02
NB-95	1.98E+05	8.16E+04	no data	5.85E+04	no data	6.89E+07	no data	4.72E+04
ZR-95	2.62E+03	6.40E+02	no data	6.89E+02	no data	3.19E+05	no data	4.54E+02
ZR-97	1.19E+00	2.04E-01	no data	2.05E-01	no data	1.30E+04	no data	9.31E-02
MO-99	no data	6.07E+07	no data	9.07E+07	no data	2.00E+07	no data	1.18E+07
TC-99M	8.04E+00	1.66E+01	no data	1.78E+02	8.67E+00	4.82E+03	no data	2.14E+02
TC-101	7.44E-60	9.38E-60	no data	1.11E-58	5.11E-60	1.59E-57	no data	9.28E-59
RU-103	2.97E+03	no data	no data	6.18E+03	no data	3.61E+04	no data	9.93E+02
RU-105	2.36E-03	no data	no data	1.73E-02	no data	9.38E-01	no data	7.94E-04
RU-106	9.54E+04	no data	no data	1.13E+05	no data	7.24E+05	no data	1.19E+04
AG-110M	1.87E+08	1.37E+08	no data	1.95E+08	no data	7.09E+09	no data	9.04E+07
SB-124	5.31E+07	7.81E+05	1.41E+05	no data	3.32E+07	1.64E+08	no data	1.64E+07
SB-125	5.23E+07	5.06E+05	6.55E+04	no data	3.03E+07	6.98E+07	no data	1.08E+07

TE-125M	5.68E+07	1.90E+07	1.91E+07	no data	no data	2.71E+07	no data	7.68E+06
TE-127M	1.82E+08	6.03E+07	5.26E+07	4.48E+08	no data	7.34E+07	no data	2.20E+07
TE-127	1.85E+03	6.19E+02	1.50E+03	4.51E+03	no data	3.88E+04	no data	3.97E+02
TE-129M	1.84E+08	6.32E+07	7.08E+07	4.61E+08	no data	1.10E+08	no data	2.84E+07
TE-129	7.99E-10	2.76E-10	6.70E-10	1.99E-09	no data	6.39E-08	no data	1.87E-10
I-130	1.04E+06	2.28E+06	2.56E+08	2.51E+06	no data	4.89E+05	no data	9.17E+05
I-131	7.97E+08	9.39E+08	3.08E+11	1.10E+09	no data	3.35E+07	no data	4.13E+08
TE-131M	9.87E+05	3.97E+05	8.05E+05	2.73E+06	no data	6.69E+06	no data	3.28E+05
TE-131	1.03E-32	3.79E-33	9.15E-33	2.62E-32	no data	4.14E-31	no data	2.88E-33
I-132	3.66E-01	7.43E-01	3.48E+01	8.29E-01	no data	6.02E-01	no data	2.65E-01
TE-132	6.17E+06	3.05E+06	4.51E+06	1.91E+07	no data	1.13E+07	no data	2.85E+06
I-133	1.06E+07	1.54E+07	2.81E+09	1.81E+07	no data	2.61E+06	no data	4.52E+06
CS-134	1.90E+10	3.54E+10	no data	9.11E+09	3.73E+09	9.61E+07	no data	3.57E+09
I-134	4.81E-12	9.86E-12	2.30E-10	1.10E-11	no data	1.02E-11	no data	3.51E-12
I-135	3.21E+04	6.39E+04	5.73E+06	7.12E+04	no data	2.31E+04	no data	2.33E+04
CS-136	5.80E+08	1.71E+09	no data	6.80E+08	1.39E+08	2.59E+07	no data	6.37E+08
CS-137	2.77E+10	3.24E+10	no data	8.71E+09	3.53E+09	1.01E+08	no data	2.30E+09
CS-138	2.58E-23	4.20E-23	no data	2.09E-23	3.27E-24	6.71E-23	no data	2.04E-23
BA-139	1.26E-07	8.32E-11	no data	5.00E-11	5.04E-11	7.95E-06	no data	3.63E-09
BA-140	7.09E+07	7.09E+04	no data	1.68E+04	4.35E+04	1.74E+07	no data	3.65E+06
LA-140	1.18E+01	4.67E+00	no data	no data	no data	5.49E+04	no data	1.20E+00
BA-141	1.41E-45	9.65E-49	no data	5.80E-49	5.87E-49	1.72E-44	no data	4.44E-47
CE-141	1.42E+04	8.69E+03	no data	2.68E+03	no data	4.49E+06	no data	1.02E+03
BA-142	7.43E-80	6.18E-83	no data	3.56E-83	3.74E-83	3.07E-79	no data	3.66E-81
LA-142	4.99E-11	1.83E-11	no data	no data	no data	3.11E-06	no data	4.39E-12
CE-143	1.16E+02	7.70E+04	no data	2.24E+01	no data	4.49E+05	no data	8.78E+00
PR-143	4.38E+02	1.64E+02	no data	6.09E+01	no data	2.31E+05	no data	2.17E+01
CE-144	1.14E+06	4.68E+05	no data	1.89E+05	no data	6.55E+07	no data	6.40E+04
PR-144	1.70E-53	6.59E-54	no data	2.39E-54	no data	3.07E-49	no data	8.58E-55
ND-147	2.58E+02	2.65E+02	no data	1.02E+02	no data	1.68E+05	no data	1.63E+01
W-187	1.79E+04	1.24E+04	no data	no data	no data	7.31E+05	no data	4.30E+03
NP-239	1.06E+01	9.51E-01	no data	1.90E+00	no data	2.75E+04	no data	5.37E-01
NP-237	5.33E+07	3.53E+06	no data	1.41E+07	no data	1.83E+06	no data	2.33E+06
NP-238	1.02E+02	2.56E+00	no data	5.58E+00	no data	3.42E+04	no data	1.57E+00

* Tritium and C-14 R_i values in units of mrem/yr per $\mu Ci/m^3$

TABLE IV.C.2
Ri CONSTANTS INHALATION PATHWAY
(mrem/yr per μCi/m³)

Radionuclide	Infant Bone	Infant Liver	Infant Thyroid	Infant Kidney	Infant Lung	Infant GI-LLI	Infant Skin	Infant T Body
H-3	no data	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	no data	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	no data	5.31E+03
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	no data	1.06E+04
P-32	2.03E+06	1.12E+05	no data	no data	no data	1.61E+04	no data	7.74E+04
CR-51	no data	no data	5.75E+01	1.32E+01	1.28E+04	3.57E+02	no data	8.95E+01
MN-54	no data	2.53E+04	no data	4.98E+03	1.00E+06	7.06E+03	no data	4.98E+03
FE-55	1.97E+04	1.18E+04	no data	no data	8.69E+04	1.10E+03	no data	3.33E+03
MN-56	no data	1.54E+00	no data	1.10E+00	1.25E+04	7.17E+04	no data	2.21E-01
CO-58	no data	1.22E+03	no data	no data	7.77E+05	1.11E+04	no data	1.82E+03
FE-59	1.36E+04	2.35E+04	no data	no data	1.02E+06	2.48E+04	no data	9.48E+03
CO-60	no data	8.02E+03	no data	no data	4.51E+06	3.19E+04	no data	1.18E+04
NI-63	3.39E+05	2.04E+04	no data	no data	2.09E+05	2.42E+03	no data	1.16E+04
CU-64	no data	1.88E+00	no data	3.98E+00	9.30E+03	1.50E+04	no data	7.74E-01
NI-65	2.39E+00	2.84E-01	no data	no data	8.12E+03	5.01E+04	no data	1.23E-01
ZN-65	1.93E+04	6.26E+04	no data	3.25E+04	6.47E+05	5.14E+04	no data	3.11E+04
ZN-69	5.39E-02	9.67E-02	no data	4.02E+02	1.47E+03	1.32E+04	no data	7.18E-03
BR-83	no data	no data	no data	no data	no data	no data	no data	3.81E+02
BR-84	no data	no data	no data	no data	no data	no data	no data	4.00E+02
BR-85	no data	no data	no data	no data	no data	no data	no data	2.04E+01
RB-86	no data	1.90E+05	no data	no data	no data	3.04E+03	no data	8.82E+04
RB-88	no data	5.57E+02	no data	no data	no data	3.39E+02	no data	2.87E+02
RB-89	no data	3.21E+02	no data	no data	no data	6.82E+01	no data	2.06E+02
SR-89	3.98E+05	no data	no data	no data	2.03E+06	6.40E+04	no data	1.14E+04
SR-90	4.09E+07	no data	no data	no data	1.12E+07	1.31E+05	no data	2.59E+06
Y-90	3.29E+03	no data	no data	no data	2.69E+05	1.04E+05	no data	8.82E+01
SR-91	9.56E+01	no data	no data	no data	5.26E+04	7.34E+04	no data	3.46E+00
Y-91M	4.07E-01	no data	no data	no data	2.79E+03	2.35E+03	no data	1.39E-02
Y-91	5.88E+05	no data	no data	no data	2.45E+06	7.03E+04	no data	1.57E+04
SR-92	1.05E+01	no data	no data	no data	2.38E+04	1.40E+05	no data	3.91E-01
Y-92	1.64E+01	no data	no data	no data	2.45E+04	1.27E+05	no data	4.61E-01
Y-93	1.50E+02	no data	no data	no data	7.64E+04	1.67E+05	no data	4.07E+00
NB-95	1.57E+04	6.43E+03	no data	4.72E+03	4.79E+05	1.27E+04	no data	3.78E+03
ZR-95	1.15E+05	2.79E+04	no data	3.11E+04	1.75E+06	2.17E+04	no data	2.03E+04
ZR-97	1.50E+02	2.56E+01	no data	2.59E+01	1.10E+05	1.40E+05	no data	1.17E+01
MO-99	no data	1.65E+02	no data	2.65E+02	1.35E+05	4.87E+04	no data	3.23E+01
TC-99M	1.40E-03	2.88E-03	no data	3.11E-02	8.11E+02	2.03E+03	no data	3.72E-02
TC-101	6.51E-05	8.23E-05	no data	9.79E-04	5.84E+02	8.44E+02	no data	8.12E-04
RU-103	2.02E+03	no data	no data	4.24E+03	5.52E+05	1.61E+04	no data	6.79E+02
RU-105	1.22E+00	no data	no data	8.99E-01	1.57E+04	4.84E+04	no data	4.10E-01
RU-106	8.68E+04	no data	no data	1.07E+05	1.16E+07	1.64E+05	no data	1.09E+04
AG-110M	9.98E+03	7.22E+03	no data	1.09E+04	3.67E+06	3.30E+04	no data	5.00E+03
TE-125M	4.76E+03	1.99E+03	1.62E+03	no data	4.47E+05	1.29E+04	no data	6.58E+02
TE-127M	1.67E+04	6.90E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04	no data	2.07E+03
TE-127	2.23E+00	9.53E-01	1.85E+00	4.86E+00	1.04E+04	2.44E+04	no data	4.89E-01
TE-129M	1.41E+04	6.09E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04	no data	2.23E+03
TE-129	7.88E-02	3.47E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04	no data	1.88E-02
I-130	6.36E+03	1.39E+04	1.60E+06	1.53E+04	no data	1.99E+03	no data	5.57E+03
I-131	3.79E+04	4.44E+04	1.48E+07	5.18E+04	no data	1.06E+03	no data	1.96E+04

TE-131M	1.07E+02	5.50E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05	no data	3.63E+01
TE-131	1.74E-02	8.22E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03	no data	5.00E-03
I-132	1.69E+03	3.54E+03	1.69E+05	3.95E+03	no data	1.90E+03	no data	1.26E+03
TE-132	3.72E+02	2.37E+02	2.79E+02	1.04E+03	3.40E+05	4.41E+04	no data	1.76E+02
I-133	1.32E+04	1.92E+04	3.56E+06	2.24E+04	no data	2.16E+03	no data	5.60E+03
CS-134	3.96E+05	7.03E+05	no data	1.90E+05	7.97E+04	1.33E+03	no data	7.45E+04
I-134	9.21E+02	1.88E+03	4.45E+04	2.09E+03	no data	1.29E+03	no data	6.65E+02
I-135	3.86E+03	7.60E+03	6.96E+05	8.47E+03	no data	1.83E+03	no data	2.77E+03
CS-136	4.83E+04	1.35E+05	no data	5.64E+04	1.18E+04	1.43E+03	no data	5.29E+04
CS-137	5.49E+05	6.12E+05	no data	1.72E+05	7.13E+04	1.33E+03	no data	4.55E+04
CS-138	5.05E+02	7.81E+02	no data	4.10E+02	6.54E+01	8.76E+02	no data	3.98E+02
BA-139	1.48E+00	9.84E-04	no data	5.92E-04	5.95E+03	5.10E+04	no data	4.30E-02
BA-140	5.60E+04	5.60E+01	no data	1.34E+01	1.60E+06	3.84E+04	no data	2.90E+03
LA-140	5.05E+02	2.00E+02	no data	no data	1.68E+05	8.48E+04	no data	5.15E+01
BA-141	1.57E-01	1.08E-04	no data	6.50E-05	2.97E+03	4.75E+03	no data	4.97E-03
CE-141	2.77E+04	1.67E+04	no data	5.25E+03	5.17E+05	2.16E+04	no data	1.99E+03
BA-142	3.98E-02	3.30E-05	no data	1.90E-05	1.55E+03	6.93E+02	no data	1.96E-03
LA-142	1.03E+00	3.77E-01	no data	no data	8.22E+03	5.95E+04	no data	9.04E-02
CE-143	2.93E+02	1.93E+02	no data	5.64E+01	1.16E+05	4.97E+04	no data	2.21E+01
PR-143	1.40E+04	5.24E+03	no data	1.97E+03	4.33E+05	3.72E+04	no data	6.99E+02
CE-144	3.19E+06	1.21E+06	no data	5.38E+05	9.84E+06	1.48E+05	no data	1.76E+05
PR-144	4.79E-02	1.85E-02	no data	6.72E-03	1.61E+03	4.28E+03	no data	2.41E-03
ND-147	7.94E+03	8.13E+03	no data	3.15E+03	3.22E+05	3.12E+04	no data	5.00E+02
W-187	1.30E+01	9.02E+00	no data	no data	3.96E+04	3.56E+04	no data	3.11E+00
NP-239	3.71E+02	3.32E+01	no data	6.62E+01	5.95E+04	2.49E+04	no data	1.88E+01
U-232	3.60E+08	no data	no data	3.36E+07	2.09E+09	6.10E+04	no data	2.98E+007
U-233	7.62E+07	no data	no data	1.53E+07	4.98E+08	5.64E+04	no data	5.36E+06
U-234	7.31E+07	no data	no data	1.50E+07	4.89E+08	5.53E+04	no data	5.25E+06
U-235	7.01E+07	no data	no data	1.41E+07	4.59E+08	7.03E+04	no data	4.93E+06
U-236	7.01E+07	no data	no data	1.44E+07	4.69E+08	5.19E+04	no data	5.04E+06
U-237	4.55E+02	no data	no data	1.13E+03	1.28E+05	1.83E+04	no data	1.21E+02
U-238	6.71E+07	no data	no data	1.32E+07	4.28E+08	4.96E+04	no data	4.61E+06
NP-237	4.03E+09	2.39E+09	no data	1.08E+09	4.89E+08	7.14E+04	no data	1.76E+08
NP-238	3.74E+03	8.47E+02	no data	2.06E+02	1.29E+05	3.61E+04	no data	5.82E+01
PU-238	3.77E+09	2.35E+09	no data	6.50E+08	1.26E+09	6.57E+04	no data	1.78E+08
PU-239	4.10E+09	2.46E+09	no data	6.93E+08	1.19E+09	5.99E+04	no data	1.88E+08
PU-240	4.10E+09	2.45E+09	no data	6.92E+08	1.19E+09	6.10E+04	no data	1.88E+08
PU-241	1.18E+08	2.59E+07	no data	1.61E+07	1.07E+06	1.26E+03	no data	4.35E+06
PU-242	3.81E+09	2.37E+09	no data	6.68E+08	1.14E+09	5.88E+04	no data	1.81E+08
PU-244	4.44E+09	2.72E+09	no data	7.64E+08	1.31E+09	8.76E+04	no data	2.07E+08
AM-241	4.41E+09	2.73E+09	no data	1.11E+09	5.68E+08	6.69E+04	no data	1.83E+08
AM-242M	4.55E+09	2.60E+09	no data	1.12E+09	2.30E+08	8.41E+04	no data	1.89E+08
AM-243	4.34E+09	2.63E+09	no data	1.08E+09	5.39E+08	7.84E+04	no data	1.78E+08
CM-242	1.79E+08	1.21E+08	no data	2.37E+07	4.16E+08	7.14E+04	no data	7.98E+06
CM-243	3.46E+09	2.13E+09	no data	5.47E+08	5.94E+08	7.03E+04	no data	1.48E+08
CM-244	2.90E+09	1.78E+09	no data	4.49E+08	5.71E+08	6.80E+04	no data	1.24E+08
CM-245	4.51E+09	2.74E+09	no data	7.32E+08	5.49E+08	6.34E+04	no data	1.90E+08
CM-246	4.48E+09	2.74E+09	no data	7.32E+08	5.59E+08	6.23E+04	no data	1.90E+08
CM-247	4.35E+09	2.70E+09	no data	7.21E+08	5.49E+08	8.19E+04	no data	1.86E+08
CM-248	3.61E+10	2.23E+10	no data	5.94E+09	4.52E+09	1.32E+06	no data	1.54E+09
CF-252	3.32E+09	no data	no data	no data	1.92E+09	2.59E+05	no data	1.41E+08

TABLE IV.C.3

Ri CONSTANTS GROUND PLANE PATHWAY

(m^2 (mrem/yr) per μCi/sec)

AG-110M	3.44E+09
AM-241	6.85E+08
AM-242M	9.61E+07
AM-243	5.03E+09
BA-139	1.06E+05
BA-140	2.05E+07
BA-141	4.18E+04
BA-142	4.49E+04
BR-83	4.87E+03
BR-84	2.03E+05
BR-85	no data
C-14	no data
CE-141	1.37E+07
CE-143	2.31E+06
CE-144	6.96E+07
CF-252	4.83E+10
CM-242	6.85E+05
CM-243	7.05E+09
CM-244	7.84E+06
CM-245	3.67E+09
CM-246	3.86E+06
CM-247	8.51E+09
CM-248	2.63E+10
CO-58	3.79E+08
CO-60	2.32E+10
CR-51	4.66E+06
CS-134	6.91E+09
CS-136	1.50E+08
CS-137	1.30E+10
CS-138	3.59E+05
CU-64	6.07E+05
FE-55	no data
FE-59	2.72E+08
H-3	no data
I-130	5.51E+06
I-131	1.73E+07
I-132	1.23E+06
I-133	2.45E+06
I-134	4.46E+05
I-135	2.52E+06
LA-140	1.92E+07
LA-142	7.60E+05
MN-54	1.38E+09
MN-56	9.04E+05
MO-99	3.99E+06

NA-24	1.19E+07
NB-95	1.37E+08
ND-147	8.40E+06
NI-63	no data
NI-65	2.97E+05
NP-237	5.42E+09
NP-238	4.53E+06
NP-239	1.71E+06
P-32	no data
PR-143	no data
PR-144	1.83E+03
PU-238	4.65E+06
PU-239	3.06E+06
PU-240	5.02E+06
PU-241	1.14E+07
PU-242	4.26E+06
PU-244	3.46E+09
RB-86	8.97E+06
RB-88	3.31E+04
RB-89	1.23E+05
RU-103	1.08E+08
RU-105	6.36E+05
RU-106	4.22E+08
SB-124	5.98E+08
SB-125	2.38E+09
SR-89	2.16E+04
SR-90	no data
SR-91	2.15E+06
SR-92	7.77E+05
TC-101	2.04E+04
TC-99M	1.84E+05
TE-125M	1.55E+06
TE-127	2.98E+03
TE-127M	9.17E+04
TE-129	2.62E+04
TE-129M	1.98E+07
TE-131	2.92E+04
TE-131M	8.03E+06
TE-132	4.23E+06
U-232	9.12E+06
U-233	8.90E+09
U-234	2.45E+06
U-235	1.24E+10
U-236	8.13E+04
U-237	5.16E+07
U-238	4.26E+08
W-187	2.36E+06
Y-90	4.49E+03
Y-91	1.07E+06
Y-91M	1.00E+05

Y-92	1.80E+05
Y-93	1.83E+05
ZN-65	7.46E+08
ZN-69	no data
ZR-95	2.45E+08
ZR-97	2.96E+06

IV.D ODCMS 4.8.C.5.1

The projected doses from releases of gaseous effluents to areas at and beyond the SITE BOUNDARY shall be calculated in accordance with the following sections of this manual:

a. gamma air dose - IV.B.1
b. beta air dose - IV.B.2
c. organ dose - IV.C

The projected dose calculation shall be based on expected release from plant operation. The normal release pathways result in the maximum releases from the plant. Any alternative release pathways result in lower releases and, therefore, lower doses.

IV.E Technical Requirements Manual Test Requirement (TR) 3.5.3

IV.E.1 The recombiner hydrogen analyzers currently used at Peach Bottom are Whittaker Electrochemical type. (Analyzers 4083A and 4083B on Unit 2. Analyzers 5083A and 5083B on Unit 3.)

IV.E.2 The calibration gas is in accordance with approved procedures.

IV.F ODCMS 4.8.C.7.1 and 4.8.C.7.2

IV.F.1 The dose rate in areas at and beyond the SITE BOUNDARY due to radioactive materials released in gaseous effluents from the incineration of waste oil from the auxiliary boilers shall be calculated by the equation in IV.A.2.

The dose rate from radioactive particulate release shall be determined by either of two methods. Method (a), total instantaneous release assumes that the total activity contained in the waste oil is released in the first minute of incineration. Method (b) uses the activity release over the entire time of incineration.

For normal operations, it is assumed that Method (a) will be used, since the total activity from the waste oil is expected to contribute an insignificant dose compared to the annual limits. However, in the event that the activity is significantly higher than administrative or regulatory limits, then Method (b) would be used because it is more accurate in calculating the dose rate.

Since the auxiliary boiler stacks are at approximately the same height as the reactor vents and discharge from the auxiliary boilers will also be heated, the use of the reactor vent D/Q value for the calculations is considered conservative.

IV.F.2 The dose to an individual from radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to areas at and beyond the SITE BOUNDARY from the incineration of contaminated waste oil from the auxiliary boiler stacks shall be calculated by the equation in IV.C.

V.A. ODCMS 4.8.D.1.1 and 4.8.D.1.2

V.A.1 ODCMS 4.8.D.1.1

The total gaseous and liquid cumulative dose contributions are limited by ODCMS 3.8.D.1 to 3.0 mrem for whole body and critical organ, and 55 mrem for the thyroid to preserve assumptions set forth in the 10CFR72.212 report for the TN-68 spent fuel casks that are stored on the Independent Spent Fuel Storage (ISFSI) pad. Exceeding these action levels does not necessarily result in the overall 40CFR190 or 10CFR72.104 requirements not being met. Further calculations are required to determine compliance.

Whole Body

The whole body dose contribution from liquid and gaseous effluents shall be determined by the following method:

$$D_{WB} = D_{\tau} + D_{\gamma}$$

where:

D_{WB} = whole body dose from liquid and gaseous effluents, in mrem.

D_{τ} = cumulative dose commitment to the total body from liquid effluents, in mrem (Determined by ODCM Section III.B).

D_{γ} = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

Critical organ(except thyroid)

The critical organ(except thyroid) dose contribution from liquid and gaseous effluents shall be determined by the following method:

$$D_{CO} = D_{\tau} + D_{\gamma} + D$$

where:

D_{CO} = critical organ(except thyroid) dose from liquid and gaseous effluents, in mrem.

D_{τ} = cumulative dose commitment to any organ from liquid effluents, in mrem (Determined by ODCM Section III.B).

D_{γ} = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

D = limiting dose to the critical organ(except thyroid), in mrem (Determined by ODCM Section IV.C).

Thyroid

The thyroid dose contribution from gaseous effluents shall be determined by the following method:

$$D_{Thy} = D_{\tau} + D_{\gamma} + D$$

where:

D_{Thy} = thyroid dose from gaseous effluents, in mrem.

D_{τ} = cumulative dose commitment to any organ from liquid effluents, in mrem (Determined by ODCM Section III.B).

D_{γ} = gamma air dose, in mrad (Determined by ODCM Section IV.B, with mrad equivalent to mrem).

D = limiting dose to the thyroid, in mrem (Determined by ODCM Section IV.C).

V.A.2 ODCMS 4.8.D.1.2

The cumulative dose from all sources(i.e. gas and liquid effluents and direct radiation) is calculated by summing the individual doses obtained in ODCMS 4.8.D.1.1 for whole body(D_{WB}), critical organ(D_{CO}) and thyroid(D_{Thy}) with the dosimeter net dose(mrem).

Whole Body

The cumulative whole body dose from liquid, gas and direct radiation shall be determined by the following method:

$$D_{WB}^{Total} = D_{WB} + D_{D}$$

where:

D_{WB}^{Total} = whole body dose equivalent from all sources, in mrem.

D_{WB} = whole body dose from liquid and gaseous effluents, in mrem.

D_{D} = Net dose from direct radiation, in mrem.

Critical Organ(except thyroid)

The cumulative critical organ(except thyroid) dose from liquid, gas and direct radiation shall be determined by the following method:

$$D_{CO}^{Total} = D_{CO} + D_{D}$$

where:

D_{CO}^{Total} = critical organ(except thyroid) dose equivalent from all sources, in mrem.

D_{CO} = critical organ(except thyroid) dose from liquid and gaseous effluents, in mrem.

D_{D} = Net dose from direct radiation, in mrem.

Thyroid

The cumulative thyroid dose from gas and direct radiation shall be determined by the following method:

$$D_{Thy}^{Total} = D_{Thy} + D_D$$

where:

D_{Thy}^{Total} = thyroid dose equivalent from all sources, in mrem.

D_{Thy} = thyroid dose from gaseous effluents, in mrem.

D_D = Net dose from direct radiation, in mrem.

The dose contribution is calculated at the discharge point for liquids and in the worst sector for gases. If necessary, the dose contribution from liquid and gas may be calculated for a real individual.

VI.A ODCMS 3.10.2.f

In accordance with ODCMS 3.10.2.f the Annual Radioactive Effluent Release Report shall include an assessment of radiation dose from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their acitivies inside the SITE BOUNDARY.

The location within the SITE BOUNDARY that is accessible to MEMBERS OF THE PUBLIC for activities unrelated to the operation of Peach Bottom Atomic Power Station is the Vehicle Checkpoint, located 1300 ft N from the vents.

Annual doses will be calculated in accordance with methodology described in ODCM IV.B and IV.C, assuming inhalation pathway, plume and ground shine doses are the dominate pathway. Continuous occupancy with current year MET data shall also be used. The maximum dose calculated will be reported in the Annual Radioactive Effluent Release Report.

VII.A ODCMS 4.8.E.1.1 and 4.8.E.1.2

The radiological environment monitoring samples shall be collected pursuant to Table VII.A.1 from the locations shown on Figures VII.A.1, VII.A.2, and VII.A.3, and shall be analyzed pursuant to the requirements of Table VII.A.1.

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
I. Direct Radiation				
Site Boundary	1L	1,100 feet NE of site	1 set of two (2)	Gamma Dose quarterly
	1A	1,500 feet SE of site	Dosimeters from each	
	2	4,700 feet SE of site	location at least	
	1I	2,900 feet SSE of site	quarterly	
	1C	4,700 feet SSE of site	Gamma dose quarterly	
	1J	4,000 feet S of site		
	1F	2,900 feet SSW of site		
	40	8,000 feet SW of site	Dosimeter sites were	
	1NN	2,700 feet WSW of site	chosen in accordance	
	1H	3,200 feet W of site	with Peach Bottom	
	1G	3,100 feet WNW of site	ODCMS Table 4.8.E.1	
	1B	2,500 feet NW of site	Item 1. Site Boundary	
	1E	3,000 feet NNW of site	stations all sectors	
	1K	4,700 feet SW of site	except several along	
Intermediate Distance	1P	2,200 feet ESE of site	Conowingo Pond. These sectors are monitored	
	15	19,300 feet N of site	by stations on the	
	22	12,500 feet NNE of site	east side of Conowingo	
	44	26,700 feet NE of site	Pond. The 5 mile	
	32	14,400 feet ENE of site	vicinity stations	
	45	18,500 feet ENE of site	cover all sectors.	
	14	10,300 feet E of site		
	17	21,500 feet ESE of site	The distant and	
	31A	24,100 feet SE of site	special interest	
	4K	45,900 feet SE of site	stations provide	
	23	5,500 feet SSE of site	information in	
	27	14,400 feet S of site	population centers and	
	48	26,500 feet SSW of site	control locations.	

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
	3A	19,300 feet SW of site		
	49	21,500 feet WSW of site		
	50	26,400 feet W of site		
	51	21,000 feet WNW of site		
	26	21,800 feet NW of site		
	6B	30,400 feet NW of site		
	42	21,600 feet NNW of site		
Distant and Special Interest	43	26,200 feet NNE of site		
	5	24,400 feet E of site		
	16	67,100 feet E of site		
	24	58,200 feet ESE of site		
	2B	3,900 feet SSE of site		
	46	23,800 feet SSE of site		
	47	22,700 feet S of site		
	18	52,200 feet W of site		
	19 C	124,000 feet WNW of site		
	1T	3,100 feet WNW of site		
II. Airborne				
Particulates	1Z	1,500 feet SE of site	Approximately 1 cfm continuous flow through glass fiber filter which is collected weekly.	Gross beta analysis on each weekly sample. Gamma spectrometry shall be done when gross beta exceeds ten times the yearly mean of control station value.
	1B	2,500 feet NW of site		
	1C	4,700 feet SSE of site		
	3A	19,300 feet SW of site		
	5H2 C	162,400 feet NE of site	These stations provide for coverage	

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
			of the highest annual average ground level D/Q near the site boundary, the community with the highest annual average D/Q and a control location.	Gross beta analysis done ≥24 hr after sampling to allow for Radon and Thoron daughter decay. Gamma Spec on quarterly composite by location.
Iodine	1Z 1B 1C 3A 5H2 C	1,500 feet SE of site 2,500 feet NW of site 4,700 feet SSE of site 19,300 feet SW of site 162,400 feet NE of site	A TEDA impregnated flow-through cartridge is connected to air sampler and is collected weekly at site filter change.	Iodine 131 weekly
III. Waterborne				
Surface	1LL C 1MM	1,200 feet ENE of site 5,500 feet SE of site	Sample collected from a continuous water sampler, monthly. In event	Gamma isotopic analysis monthly; H-3 on quarterly

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
			sampler is inoperable, grab samples will be collected each calendar day until sampler returned to service.	composite
Drinking	4L 6I C 13B	45,900 feet SE of site 30,500 feet NW of site 13,300 feet ESE of site	Sample collected from a continuous water sampler monthly. In event sampler is inoperable, weekly grab samples will be collected until sampler returned to service.	Gross beta and gamma isotopic monthly, H-3 on quarterly composite
Sediment	4J	7,400 feet SE of site	A sediment sample is taken down stream of discharge semi-annually.	Gamma isotopic analysis each sample
IV. Ingestion				
Milk	V C J R U X	32,600 feet W of site 5,100 feet W of site 4,900 feet SW of site 11,200 feet SSW of site 9,200 feet NW of site	Sample of fresh milk is collected from each farm biweekly when cows are on pasture	I-131 analyses on each sample Gamma isotopic analysis or Cs-134, Cs-137 by

TABLE VII.A-1

ODCM - Peach Bottom Atomic Power Station
Radiological Environmental Monitoring Program

Pathway	Station Code	Distance and Direction from PBAPS Vents	Collection Method and Discussion	Analyses
			(April through October), monthly at other times.	chemical separation quarterly
Fish	4	6,000-10,000 feet SE of site	Two species of recreationally important fish (predator and bottom feeder) sampled in season or semiannually if not seasonal.	Gamma isotopic analyses on edible portions.
	6 C	50,000-70,000 feet NNW of site		
Food Products	1C	4,700 feet SSE of site	Samples of three (3) different kinds of broad leaf vegetation monthly when available if milk sampling is not performed	Gamma isotopic and I-131 analysis
	55 C	51,900 feet NE of site		

C = Control Location

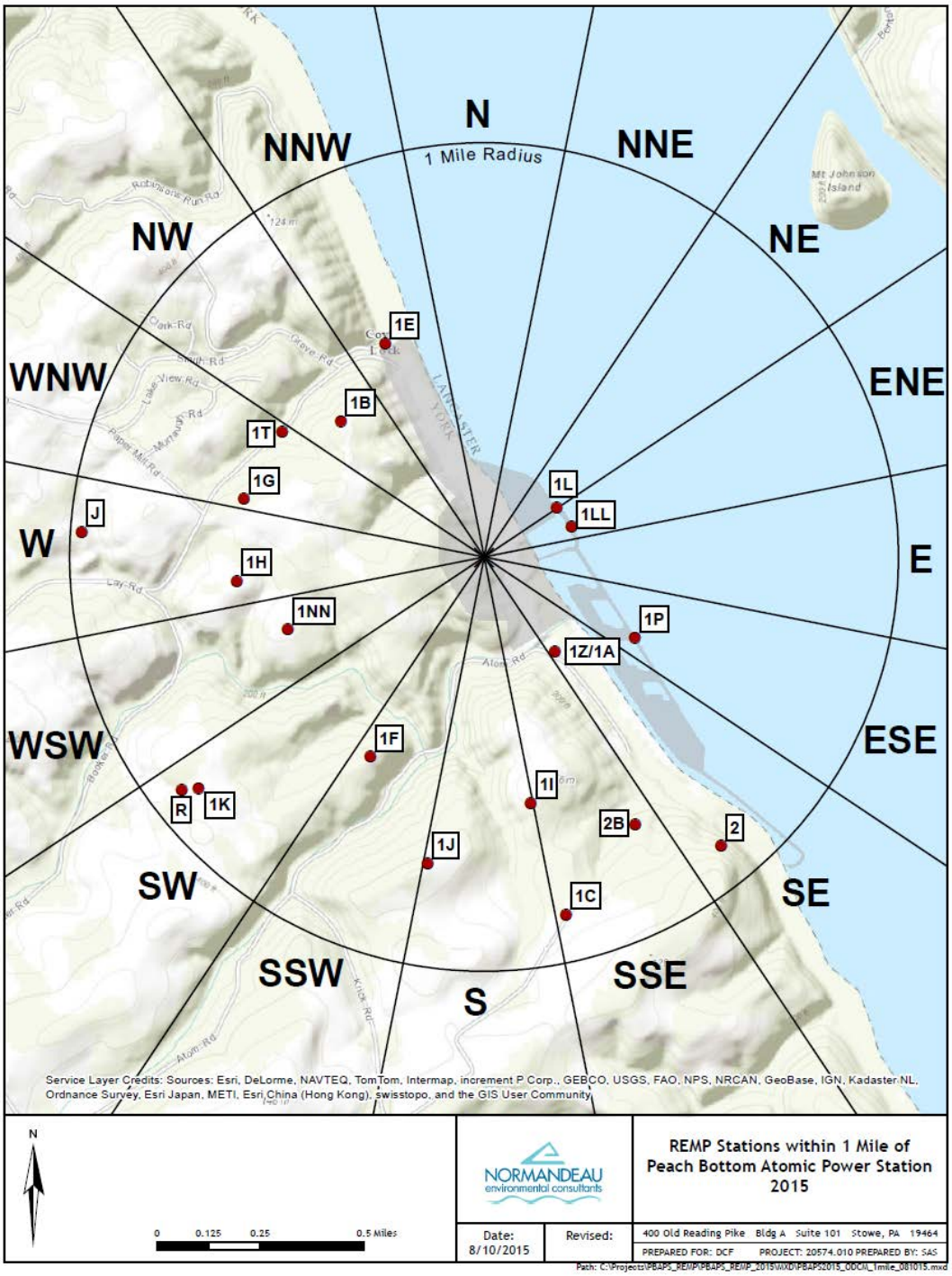

FIGURE VII.A.1
ENVIRONMENTAL SAMPLING STATIONS AT
SITE BOUNDARY AREA TO PEACH BOTTOM

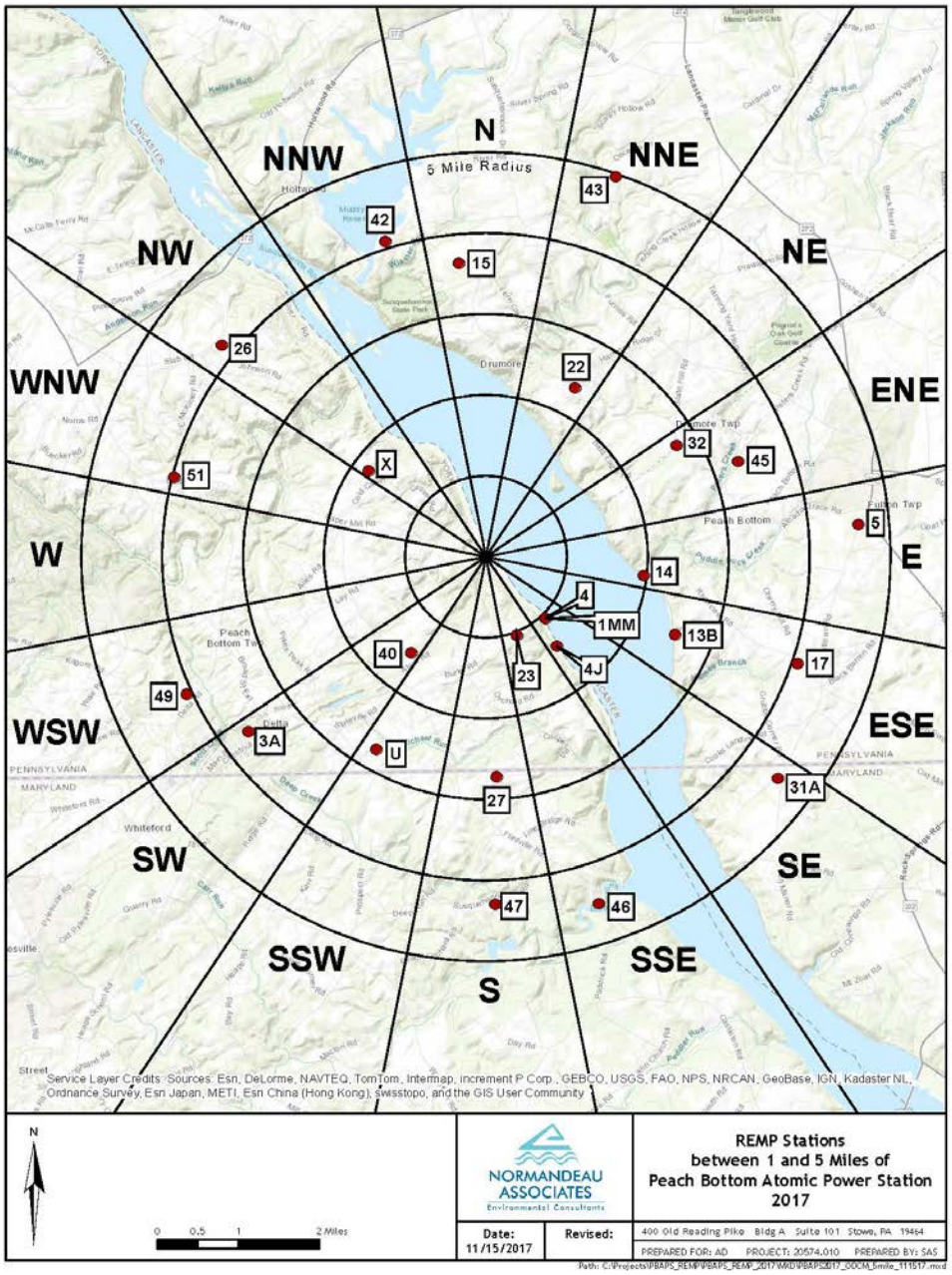

FIGURE VII.A.2
ENVIRONMENTAL SAMPLING STATIONS AT
INTERMEDIATE DISTANCES FROM PEACH BOTTOM SITE

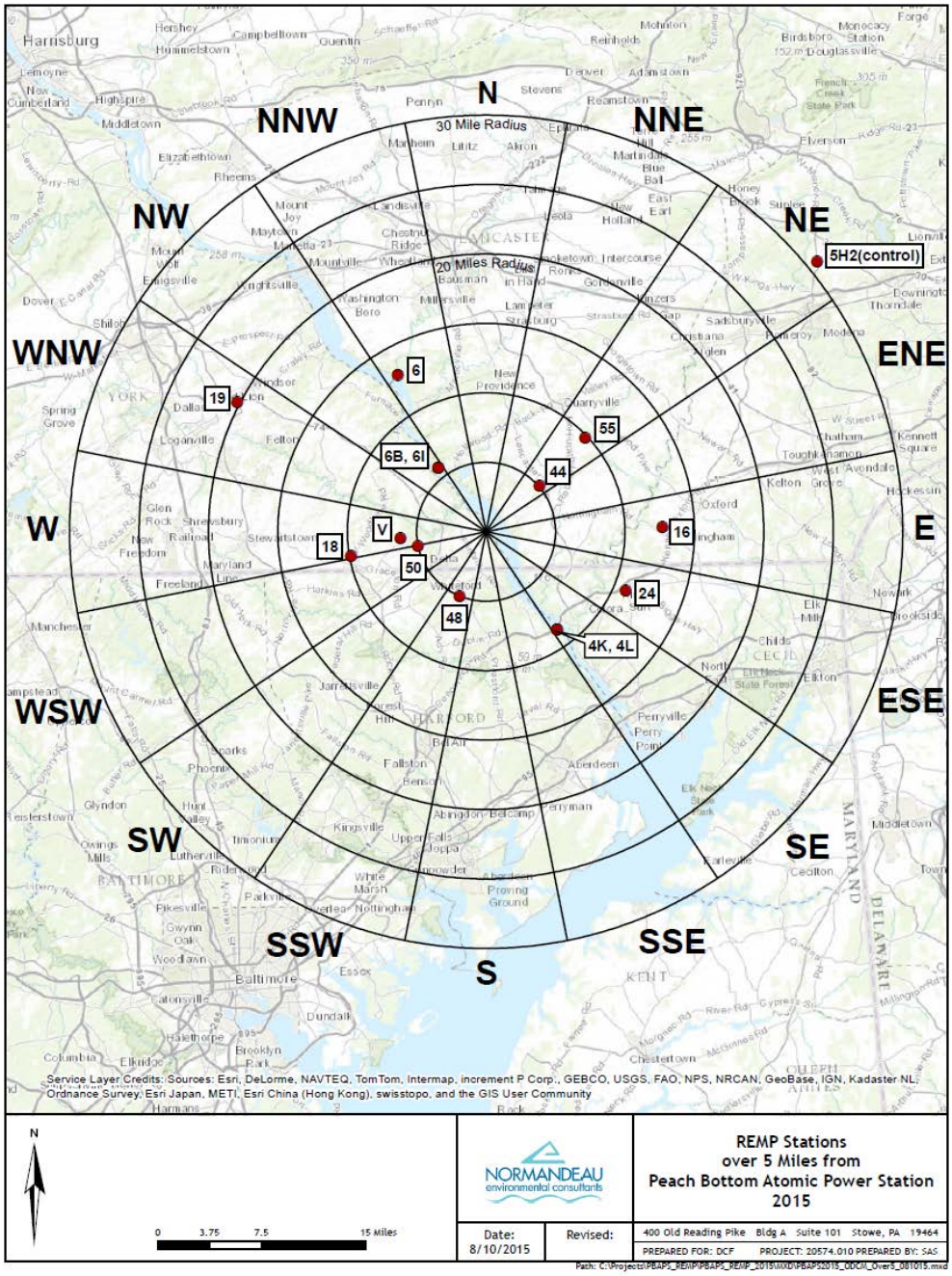

FIGURE VII.A.3
ENVIRONMENTAL SAMPLING STATIONS AT
REMOTE DISTANCES FROM PEACH BOTTOM SITE

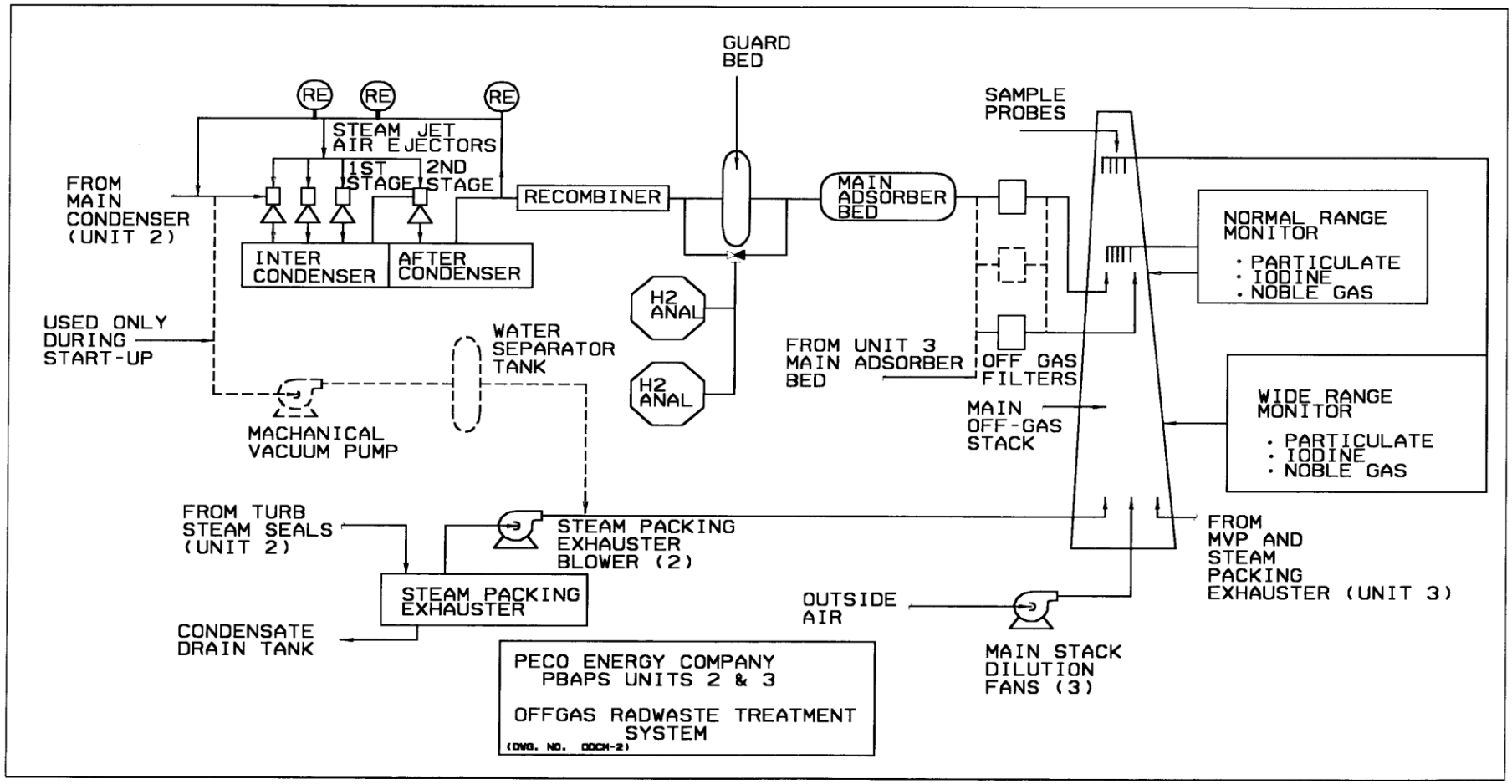
GUARD BED
RE
RE
RE
STEAM JET AIR EJECTORS
1ST STAGE
2ND STAGE
FROM MAIN CONDENSER (UNIT 2)
INTER CONDENSER
AFTER CONDENSER
RECOMBINER
MAIN ADSORBER BED
SAMPLE PROBES
NORMAL RANGE MONITOR
· PARTICULATE
· IODINE
· NOBLE GAS
H2 ANAL
H2 ANAL
USED ONLY DURING START-UP
WATER SEPARATOR TANK
MACHANICAL VACUUM PUMP
FROM UNIT 3 MAIN ADSORBER BED
OFF GAS FILTERS
MAIN OFF-GAS STACK
WIDE RANGE MONITOR
· PARTICULATE
· IODINE
· NOBLE GAS
FROM TURB STEAM SEALS (UNIT 2)
STEAM PACKING EXHAUSTER BLOWER (2)
FROM MVP AND STEAM PACKING EXHAUSTER (UNIT 3)
STEAM PACKING EXHAUSTER
CONDENSATE DRAIN TANK
OUTSIDE AIR
MAIN STACK DILUTION FANS (3)
PECO ENERGY COMPANY
PBAPS UNITS 2 & 3
OFFGAS RADWASTE TREATMENT SYSTEM
(DWG. NO. 00CM-2)

Figure 1

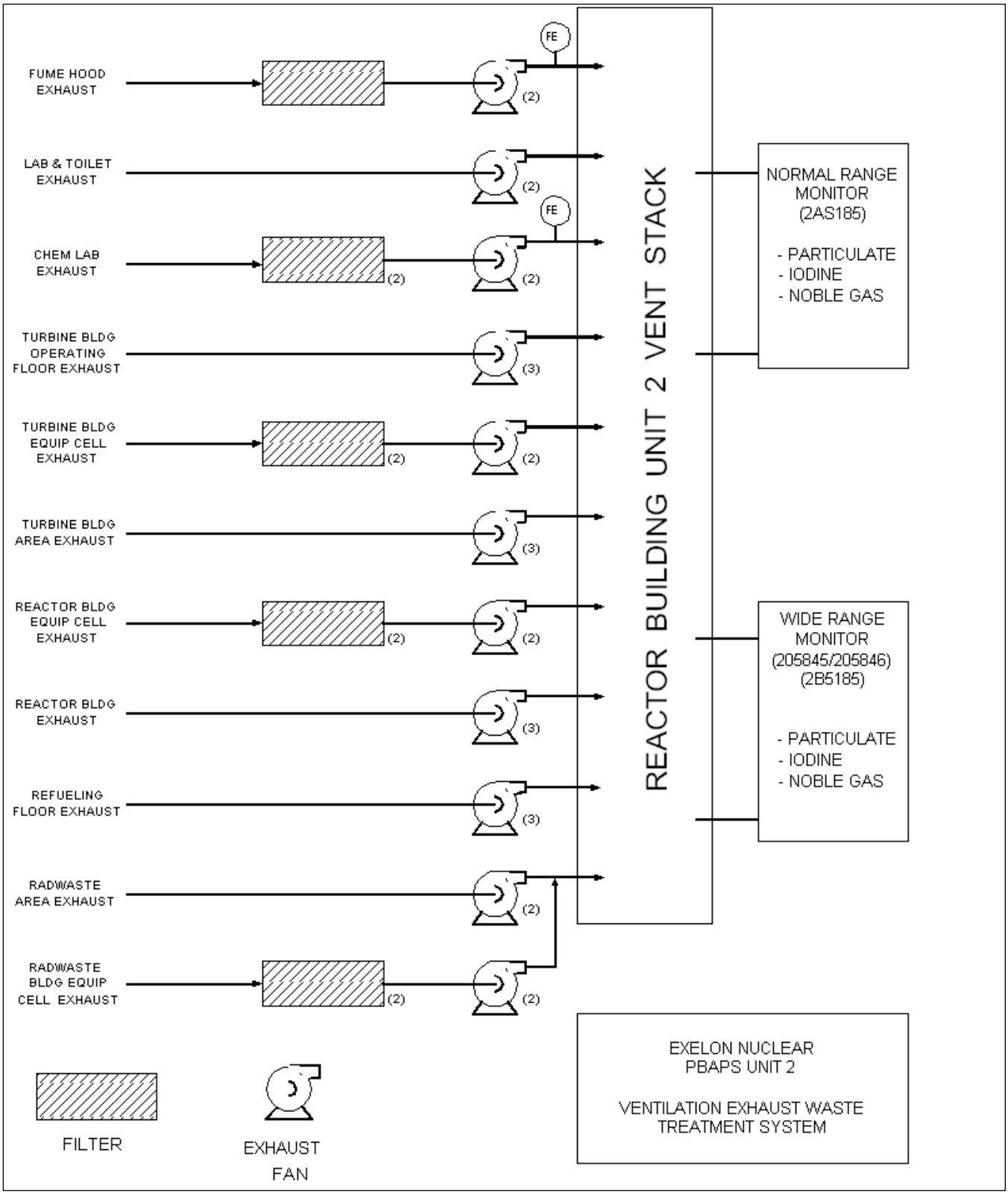
FUME HOOD EXHAUST
LAB & TOILET EXHAUST
CHEM LAB EXHAUST
TURBINE BLDG OPERATING FLOOR EXHAUST
TURBINE BLDG EQUIP CELL EXHAUST
TURBINE BLDG AREA EXHAUST
REACTOR BLDG EQUIP CELL EXHAUST
REACTOR BLDG EXHAUST
REFUELING FLOOR EXHAUST
RADWASTE AREA EXHAUST
RADWASTE BLDG EQUIP CELL EXHAUST
FE
(2)
(3)
REACTOR BUILDING UNIT 2 VENT STACK
NORMAL RANGE MONITOR (2AS185)
- PARTICULATE
- IODINE
- NOBLE GAS
WIDE RANGE MONITOR (205845/205846) (2B5185)
- PARTICULATE
- IODINE
- NOBLE GAS
EXELON NUCLEAR
PBAPS UNIT 2
VENTILATION EXHAUST WASTE TREATMENT SYSTEM
FILTER
EXHAUST FAN

Figure 2

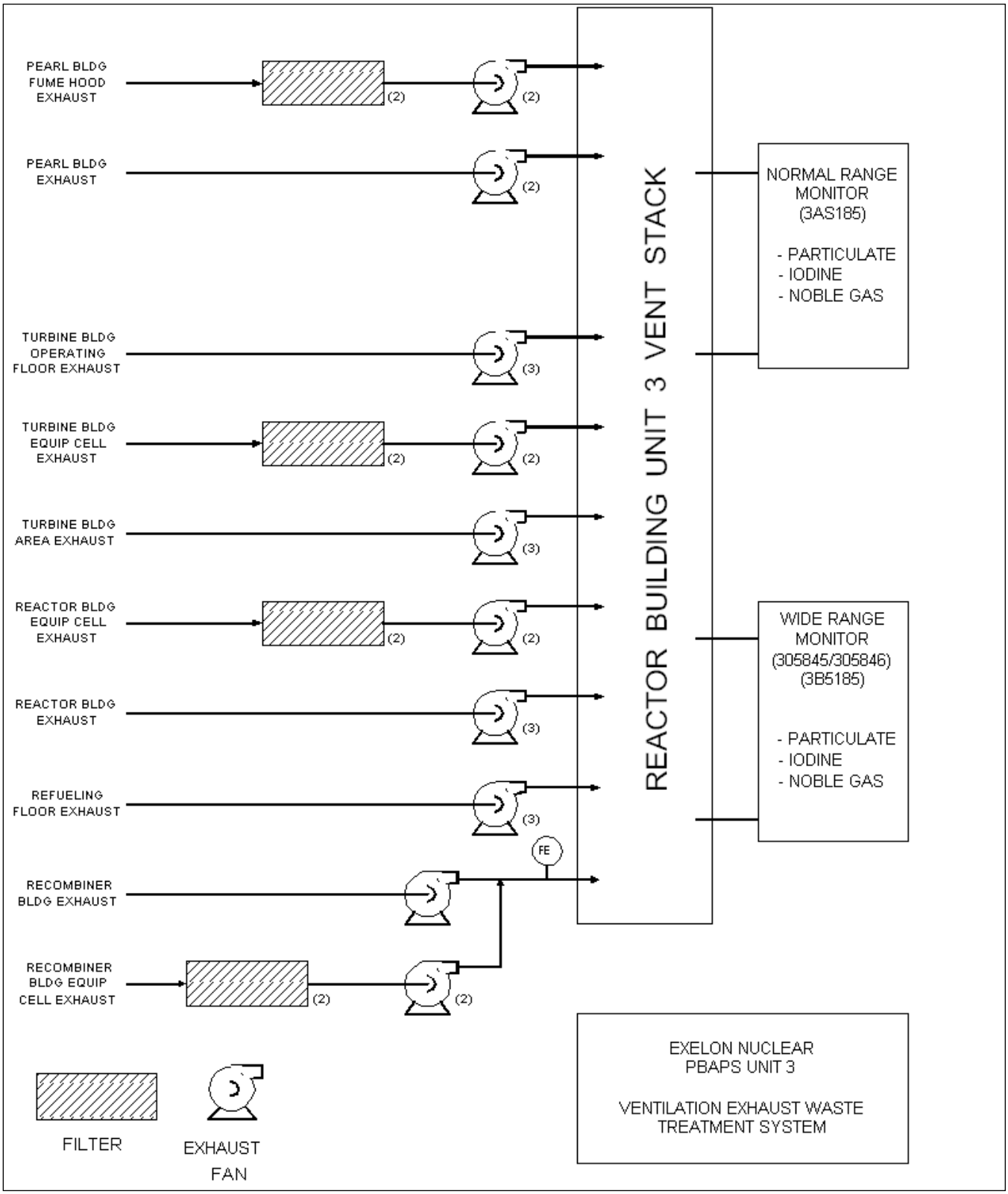
PEARL BLDG FUME HOOD EXHAUST
(2)
(2)
PEARL BLDG EXHAUST
(2)
TURBINE BLDG OPERATING FLOOR EXHAUST
(3)
TURBINE BLDG EQUIP CELL EXHAUST
(2)
(2)
TURBINE BLDG AREA EXHAUST
(3)
REACTOR BLDG EQUIP CELL EXHAUST
(2)
(2)
REACTOR BLDG EXHAUST
(3)
REFUELING FLOOR EXHAUST
(3)
FE
RECOMBINER BLDG EXHAUST
RECOMBINER BLDG EQUIP CELL EXHAUST
(2)
(2)
REACTOR BUILDING UNIT 3 VENT STACK
NORMAL RANGE MONITOR (3AS185)
- PARTICULATE
- IODINE
- NOBLE GAS
WIDE RANGE MONITOR (305845/305846) (3B5185)
- PARTICULATE
- IODINE
- NOBLE GAS
FILTER
EXHAUST FAN
EXELON NUCLEAR
PBAPS UNIT 3
VENTILATION EXHAUST WASTE TREATMENT SYSTEM

Figure 3

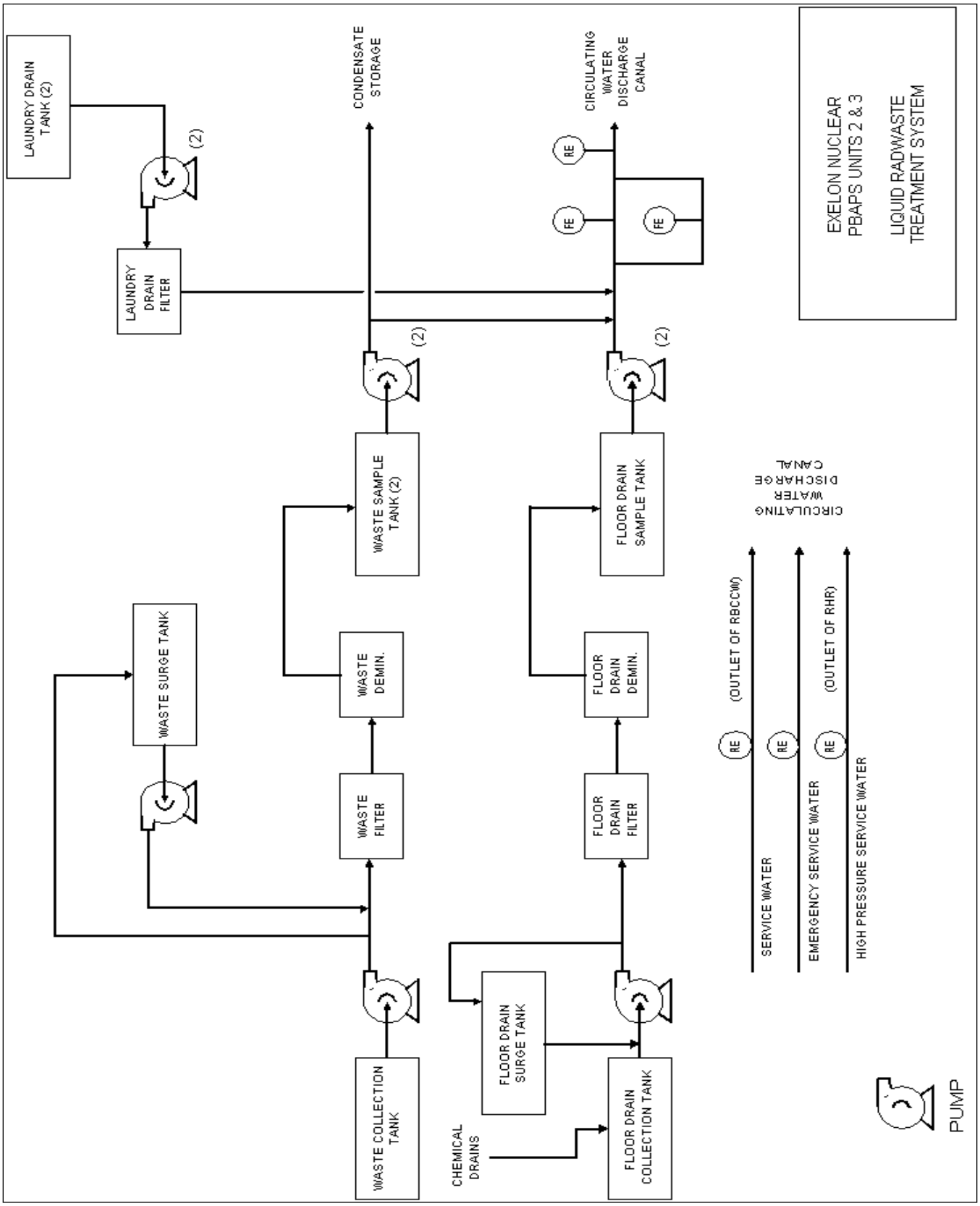
EXELON NUCLEAR
PBAPS UNITS 2 & 3
LIQUID RADWASTE
TREATMENT SYSTEM
LAUNDRY DRAIN TANK (2)
(2)
LAUNDRY DRAIN FILTER
CONDENSATE STORAGE
CIRCULATING WATER DISCHARGE CANAL
RE
FE
FE
FE
(2)
(2)
WASTE SAMPLE TANK (2)
FLOOR DRAIN SAMPLE TANK
WASTE SURGE TANK
WASTE DEMIN.
FLOOR DRAIN DEMIN.
WASTE FILTER
FLOOR DRAIN FILTER
CIRCULATING WATER DISCHARGE CANAL
(OUTLET OF RBCCW)
(OUTLET OF RHR)
RE
RE
RE
SERVICE WATER
EMERGENCY SERVICE WATER
HIGH PRESSURE SERVICE WATER
WASTE COLLECTION TANK
FLOOR DRAIN SURGE TANK
FLOOR DRAIN COLLECTION TANK
CHEMICAL DRAINS
PUMP

Figure 4

VIII. Bases

Liquid Effluent Release Flow Rate Determination

Non-gamma emitting radionuclides (H-3, Fe-55, Sr-89/90) are not detected by the effluent monitor and, therefore, are not directly included in the release flow rate determination. While tritium accounts for nearly all the activity released, it is not a significant contributor when determining the permissible flow rate. Examining releases over the years 2004 – 2006, the average diluted H-3 contribution to its limiting concentration in liquid effluents was 0.03%. This contribution is not expected to change significantly over time, since the concentration of H-3 in effluents can be expected to remain fairly consistent in effluent releases regardless of fuel conditions, activation product releases, and waste processing.

Based on relative abundances, other non-gamma emitting radionuclides only contributed up to nearly 3 % of the concentration limit. It is reasonable to assume that the abundances of these non-gamma will remain the same relative to other fission and/or activation products under varying conditions. Therefore, under conditions of elevated effluent radionuclide levels, the gamma-emitting radionuclides can be expected to be the main contributors to limiting conditions on liquid effluent concentrations. The maximum permissible release flow rate determination methodology presented in III.A offers an additional factor of conservatism of 30 to 50 which is more than adequate to account for the non-gamma emitting radionuclides.

Site Specific Data

NOTE 1

Liquid dose factors, $A_{i\tau}$, for section III.B were developed using the following site specific data. The liquid pathways involved are drinking water and fish.

$$A_{i\tau} = \left(U_w / D_w + U_F \, x BF_i\right) k_0 \, x DF_i \, x RC x e^{-24\lambda i}$$

U_w = liters per year; maximum age group usage of drinking water (Reg. Guide 1.109, Table E-5)

D_w = 5.4; average annual dilution at Conowingo intake

U_F = kg per year; maximum age group usage of fish (Reg. Guide 1.109, Table E-5)

BF_i = bioaccumulation factor for nuclide, i, in freshwater fish. Reg. Guide 1.109, Table A-1, except P-32 which uses a value of 3.0×10^3 pCi/kg per pCi/liter.

k_0 = 1.14×10^5 = (10^6 pCi/μCi x 10^3 ml/1)/ 8760 hr/yr) units conversion factor.

DF_i = dose conversion factor for nuclide, i, for the age group in total body or organ, as applicable. Reg. Guide 1.109, Table E-11, except P-32 bone which uses a value as indicated below.

3.0×10^{-5} mrem/pCi

RC = 1.16; reconcentration from PBAPS discharge back through PBAPS intake.

λ_i = decay constant for nuclide i, hr^{-1}

The data for D_W and RC were derived from data published in Peach Bottom Atomic Power Station Units 2 and 3 (Docket Nos. 50-277 and 50-278) Radioactive Effluent Dose Assessment, Enclosure A, September 30, 1976. All other data except P-32 BF and DF were used as given in Reg. Guide 1.109, Revision 1, October 1977. The P-32 BF and DF were used in accordance with information supplied in Branagan, E.F., Nichols, C.R., and Willis, C.A., "The Importance of P-32 in Nuclear Reactor Liquid Effluents", NRC, 6/82. The teen and child dose factors were derived by the ratio of the adult bone dose factors in Reg. Guide 1.109 and Branagan, et al.

NOTE 2

To develop constant R for the ingestion pathway in section IV.C, the following site specific data were used:

$$R_i^C\left(D/Q\right)=K'\frac{Q_F\left(U_{ap}\right)}{\lambda_i+\lambda_W}F_m(r)\left(DFL_i\right)\left[\frac{f_p f_s}{Y_p}+\frac{\left(1-f_p f_s\right)e^{-\lambda_i t_h}}{Y_s}\right]e^{-\lambda_i t_f}$$

where:

K' = 10^6 pCi/μCi; unit conversion factor

Q_F = 50 kg/day; cow's consumption rate

U_{ap} = 330 1/yr; yearly milk consumption by an infant

λ_i = radioactive decay constant for nuclide of interest, sec^{-1} (e.g. 9.97×10^{-7} sec^{-1} for I-131)

λ_W = 5.73×10^{-7} sec^{-1}; decay constant for removal of activity in leaf and plant surfaces

F_m = stable element transfer coefficient for nuclide of interest, day/liter (e.g. 6.0×10^{-3} day/liter for I-131)

r = fraction of deposited nuclide retained in cow's feed grass, 1.0 for radioiodine; 0.2 for particulates

DFL_i = ingestion dose factor in infant for nuclide of interest, mrem/pCi (e.g. 1.39×10^{-2} mrem/pCi for I-131)

f_p = 0.6; the fraction of the year the cow is on pasture (average of all farms)

f_s = 0.487; the fraction of cow feed that is pasture grass while the cow is on pasture (average of all farms)

Y_p = 0.7 kg/m^2; the agricultural productivity of pasture feed grass

Y_s = 2.0 kg/m^2; the agricultural productivity of stored feed

t_f = 1.73×10^5 sec (2 days); the transport time from pasture, to cow, to milk, to receptor

t_h = 7.78×10^6 sec (90 days); the transport time from pasture, to harvest, to cow, to milk, to receptor

NOTE 3

To develop constant R for tritium for the ingestion pathway in section IV.C, the following site specific data were used:

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. The following additional constants and formula are used:

$$R_{H-3}^{C}(\chi/Q) = K'K''F_m Q_F U_{ap}(DFL_i)[0.75(0.5/H)]$$

where:

K''' = 10^3 gm/kg; a constant of unit conversion

H = 14.61 gm/m^3; absolute humidity of the atmosphere

0.75 = the fraction of total feed that is water

0.5 = the ratio of the specific activity of the feed grass water to the atmospheric water

NOTE 4

To develop constant R for C-14 for the ingestion pathway in section IV.C, the following site specific data were used:

$$R_{C-14}^{Milk} = K' K''' \, p F_m Q_F U_{ap} DFL_{C-14} [0.11/0.16]$$

where:

p = the ratio of the total annual release time (for C-14 atmospheric releases) to the total annual time during photosynthesis occurs.

0.11 = the fraction of total plant mass that is natural carbon.

0.16 = the concentration of natural carbon in the atmosphere, in g/m^3.

The pathway is the grass-cow-milk ingestion pathway. These data were derived from data published in Peach Bottom Atomic Power Station Units 2 and 3 (Docket Nos. 50-277 and 50-278) Radioactive Effluent Dose Assessment, Enclosure A, September 30, 1976. All other data were used as given in Reg. Guide 1.109, Revision 1, October 1977.

ODCMS 4.8.B.2.1, Liquid Pathway Dose Calculations

The equations for calculating the doses due to the actual release rates of radioactive materials in liquid effluents were developed from 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 NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", October 1978.

ODCMS 4.8.C.1.1 and 4.8.C.1.2

Dose Rate Noble Gases

The equations for calculating the dose rate due to the actual release rates of radioactive noble gases in gaseous effluents were developed from 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, NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", August 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. The specified equations provide for determining the dose rates in areas at and beyond the SITE BOUNDARY based upon the historical average atmospheric conditions.

The dose rate due to noble gas release as calculated by the Gross Release Method is much more conservative than the dose calculated by the Isotopic Analysis Method. Assuming the release rates given in Radioactive Effluent Dose Assessment, September 30, 1976, the values calculated by the Gross Release Method for total body dose rate and skin dose rate are 6.0 times and 5.7 times, respectively, the values calculated by the Isotopic Analysis Method.

Dose Rate I-131, I-133, Tritium and Radioactive Material in Particulate Form.

The model Technical Specification LCO of NUREG-0133 for all radionuclides and radioactive materials in particulate form and radionuclides other than noble gases requires that the instantaneous dose rate be less than the equivalent of 1500 mrem per year.

The release data from 1994 to 1996 were evaluated and the critical organs were determined to be the child thyroid or teenager lung. The child thyroid dose rate is limiting when iodine releases exceed 10 percent of the total release rates. The teenager lung dose rate is limiting when iodine is either not present or a small fraction of the total release.

Because of good fuel performance the amount of I-131 released has decreased. The thyroid may not be the critical organ. When it is not clear which organ dose is limiting, doses for the child thyroid and teenage lung are calculated.

ODCMS 4.8.C.2.1

Dose Noble Gases

The equations for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents were developed from 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, NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", August 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. The specified equations provide for determining the air doses in areas at and beyond the SITE BOUNDARY based upon the historical average atmospheric conditions.

The dose due to noble gas releases as calculated by the Gross Release Method is much more conservative than the dose calculated by the Isotopic Analysis Method. Assuming the releases rates given in Radioactive Effluent Dose Assessment, September 30, 1976, the values calculated by the Gross Release Method for total body dose rate and skin dose rate are 4.3 times and 7.2 times, respectively, the values calculated by the Isotopic Analysis Method.

ODCMS 4.8.C.3.1

Dose, Iodine-131, Iodine-133, Tritium, and Radioactive Material in Particulate Form

The equation for calculating the doses due to the actual release of radioiodines, radioactive material in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days were developed using 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, NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", October 1978, and the atmospheric dispersion model presented in Information Requested in Enclosure 2 to Letter from George Lear to E. G. Bauer dated February 17, 1976, September 30, 1976. These equations provide for determining the actual doses based upon the historical average atmospheric conditions.

Compliance with the 10 CFR 50 limits for radioiodines, radioactive materials in particulate form and radionuclides other than noble gases with half lives greater than eight days is to be determined by calculating the infant thyroid, infant liver and infant bone dose. These organs were determined to be the critical organs based on the release data from 1994 to 1996.

Because of a decrease in the amount of I-131 released, the thyroid may not be the critical organ. The isotopic analysis method is used to calculate dose to the infant thyroid, infant liver and infant bone.